On the Mechanics of the Relationship between Energy Consumption, CO_2 Emissions, Openness and Economic Growth in the Selected Asian Countries

By

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"You have right to perform your prescribed duty, but you are not entitled to the fruits of action. Never consider yourself the cause of results of your activities, and never be attached to not to doing your duty". –(Shri-Bhagvad Gita, 2:47)

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Abstract

The increasing Greenhouse gas (GHGs) emissions has been, recently, a great topic of debate and discussions around the world. The major threat is the global warming and climate change. Countries are putting all their efforts to maximize the level of output. In doing so, a greater amount of energy is being consumed. Liberalization measures have been adopted by the developed and developing countries to get benefited from expansion of market size, inflow of low priced product, inflow of foreign capital, increase in productivity, and economic growth. It is found that among the GHGs CO2 emissions is the most responsible gas causing global warming. It has been estimated that there is more than 50 percent chance that, in the long-run atmospheric temperature would rise by 5^0C. There has been controversy on whether openness to trade or inflow of FDI increases the energy consumption and environmental degradation or it is otherwise.

In the thesis, we take these issues in the context of Asian countries and put effort to find the robust evidence by using several recently developed econometric approaches encompassing time series and panel data techniques. Specifically, we analyzed the Granger-causal relationship between energy consumption/production (and sub-components) and economic growth and trade; and CO2 emissions and economic growth and trade.

While analyzing stationarity of energy consumption /production among the Asian countries we must take into account structural breaks (in both time series and panel framework). While analyzing cointegration of energy consumption/production, we must take into account structural breaks (in both time series and panel framework). We must also analyze for the potential existence of hidden cointegration relationship. While validating the hypothesis related to energy-growth, energy-trade and trade-environmental degradation literature we must explore the potential existence of non-linear or asymmetric causality. Feedback hypothesis is supported for CO_2 emissions and Trade, ELEP-Coal and GDP and Trade, and EPC and GDP. Growth hypothesis is supported for Coal to GDP, ELEP to GDP and Trade, EPC to Trade. Conservation hypothesis is supported for Trade to oil, GDP and Trade to energy use. In the Asian countries we have contradictory results in significant energy saving effect of FDI. The results differ widely with the approach adopted for analysis and the level of the threshold used both in terms of significance and in terms of the sign of the coefficient. International technology transfer is happening only through IM. In Bangladesh, New Zealand, Philippines feedback hypothesis is supported between trade liberalization/openness leads to environmental degradation. In China, Indonesia, Japan, Pakistan, South Korea and Thailand, trade liberalization/openness leads to environmental degradation.

Keywords: Energy consumption, CO2 emissions, Openness, Economic Growth, Time series, Panel data, Structural breaks, Asymmetric causality, Hidden cointegration

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CHAPTER I
INTRODUCTION

The increasing threat caused by Global warming and climate change has generated renewed interest on the relationship between economic growth, energy consumption, and environmental pollutants. Though Global warming depends on worldwide Greenhouse Gas (GHG) emissions, its consequences differ among countries based on their social and natural characteristics. Stern et al. (2006) pointed out that if no action is taken to reduce emissions, the concentration of greenhouse gases in the atmosphere could double as early as 2035 from its pre-industrial level. This implies that in the short run, global average temperature may rise by over 2°C. In the longer term, there is greater than 50 percentage chance that the rise in temperature would exceed 5°C. Stern et al. (2006) emphasize that this radical change in temperature would affect all the countries. Among them, the earliest and the hardest hit would be the poorest and populous nations even though they contribute least to the GHG emissions. The worst impact of climate change could be substantially reduced by stabilizing the level of greenhouse gases in the atmosphere to a level between 450ppm and 550ppm Carbon Dioxide Equivalent (CO_2e) (Stern et al., 2006).

The Kyoto Protocol was signed in 1997 to overcome the possible occurrence of a worse climatic situation in future. The protocol considered CO_2 emissions as the main cause of global warming among GHGs and demanded a reduction in the GHG emissions by 5.2 percentage from the level of the 1990, during 2008-2012. Recent literature also indicates CO_2 emissions as the most important gaseous pollutant responsible for 58.8 percentage of the GHG emissions worldwide (Halicioglu, 2009). In the protocol and in various other meetings at the international level, deliberations stressed to replace the non-renewable energy consumption with the renewable energy consumption in order to reduce the CO_2 emissions and, thus, GHGs. With the increasing wave of globalization in general, and trade liberalization in particular, the threat of global warming and climate change has led to a resurgence of interest in testing the relationship between trade liberalization, economic growth, energy consumption and environmental pollution.

The race among developed and developing countries to achieve higher and higher growth at the cost of exploitation of existing natural resources started with the onset of industrial revolution and gained full momentum in the era of globalization that begin in 1990. This race of nations has resulted in increase of GHG emissions, particularly CO_2 emissions, which plays a major role in global warming and ozone depletion. During the 20th century, the average global surface temperature has increased by 0.6˚C, the snow-cover and ice extent has decreased by 10 percentage and the sea level rose by 10 to 20 centimeters (Conceiaco, 2003).

A great debate has sprouted between environmental and ecological economists and activists, and proponents of trade liberalization on the cost and benefits associated with trade liberalization. Neumayer (2000), for example, summarizes the following three criticisms of trade liberalization which leads to environmental degradation:

- Trade liberalization intensifies the existing high levels of environmental degradation,
- Countries will likely attract more foreign capital or Foreign Direct Investment (FDI) into "pollution havens" by lowering their environmental standards; and
- The dispute settlement system of the World Trade Organization (WTO) favours trade interests over environmental protection.

However, Heil and Selden (2001) argue that "the relationship between international trade and the environment is more complex than as described by the pollution haven hypothesis. Apart from differences in the regulatory intensity, international trade may affect pollution simply by altering the mix of goods and services that countries produce and consume as well as the technologies countries use to produce and consume them".

There is enough work, both theoretical and empirical, that has been devoted to analyze the relationship between CO_2 emissions/environmental pollution and economic growth[1] and energy consumption and economic growth either in the bi-variate or multivariate framework wherein policy implications have been drawn. Recent theoretical and empirical attempts to analyze the consequences of trade liberalization on environmental pollution can be seen in Grossman and Krueger (1993a) Shafik and Bandyopadhyay (1992), Chapman (1999), Eliste and Fredriksson (1998), Heil and Selden (2001), among others.

Neumayer (2000) argued that trade liberalization might harm the environment, if the environment is not optimally managed and "if externalities are not internalized, free trade can make the already-inefficient allocation of resources even more inefficient". The WTO (1997) also supports the argument of Neumayer (2000) by admitting that in order to realize the benefits of trade liberalization and to achieve sustainable trade-induced economic growth there is every need to adopt, at the outset, environmental policies at the national level as an increase in the trade flow has not only resulted in the environmental loses but also welfare losses (Markandya, 1994, pp. 10). Adding to that Neumayer (2000) mentioned that there are suggestions from both theoretical and empirical literature that even if resources are efficiently allocated and optimally utilized, increase in trade flow might harm the environment. This possibility can be explained as:

[1] Similarly, Ang (2008) argued that a persistent decline in environmental quality may generate negative externalities for the economy through reducing health human capital and, hence, productivity and so on GDP in the long-run. For example, Ferrer-i-Carbonell and Gowdy (2007), Di Tella and MacCulloch (2008), Van Praag and Baarsma (2005), Welsch (2002,2006), Rehdanz and Maddison (2008), Smyth et al. (2008) have suggested that environmental degradation, including air and noise pollution, has negative impact on life satisfaction and thus delivers negative impact on population.

Suppose there are two countries; one country specializes in the production of pollution-intensive goods and her trading partner in the production of non-polluting-intensive commodities and after an effort to liberalize trade between these countries, the second country will be able to import the pollution-intensive commodities of the first country which will reduce the emissions in second country but on the other side it will increase the emissions level in the first country. Here one may argue that in such a situation global emissions may not increase, as overall emissions will not get affected.

However, Copeland and Taylor (1994) in their two region model have shown that even if emissions decrease in one region (let us say North),global emissions increase just because emissions increase in the other region (let us say South) at a higher rate.[2], Neumayer (2000) mentioned that the negative worldwide environmental effects of trade liberalization might become worse "if one of the two conditions holds: first, pollution is not local but trans-boundary or global in nature and, second, the environment is not optimally managed."

Most of the studies in the area of energy and environmental economics have concentrated on the bivariate causality and studies based on multivariate causality have focused on non-renewable energy consumption in developed countries. Nevertheless, the work pertaining to the analysis of the relative performance of renewable and non-renewable energy sources is relatively scarce in developing countries. Therefore, this study is an attempt to extend the same into a bivariate framework for the selected Asian countries (incorporation of the countries will depend on the availability of the data for longest possible period i.e., 1965-2011). The study also proposes to employ new time series approaches that incorporate endogenously determined structural breaks and nonlinearity/asymmetry in the estimation, which has been excluded from

[2] The reader should note that this result represents a possibility but is not robust to changes in the specification of the model. More comprehensive models are ambiguous with respect to whether trade liberalization increases global pollution (see Copeland and Taylor, 1997).

the analysis of most of the existing studies. Within this framework, the experience of Asian countries follows in the next section.

1.1 Experience of Asian countries during study period

- Primary energy consumption (in Million tonnes oil equivalent) by Asia Pacific region was 437.7297 (11.62038% of the World) in 1965, which increased to 4573.8195 (38.10769% of the World) in 2010 whereas in the year of 1990 it was 1784.9321 (22.012540% of the World). This implies that during 1965-90, the primary energy consumption in Asia Pacific region has increased by 307.770%, whereas during 1990-2010, it has increased by 156.246% and overall percentage growth in the study period is 944.895.
- The CO_2 emissions (in Million tonnes carbon dioxide) in the Asia Pacific region was 1442.9448 (12.286% of the World) in 1965, which increased to 14535.713 (43.8371% of the World) in 2010 whereas in the year of 1990 it was 5621.4981 (24.859% of the World). This implies that during 1965-90, the CO_2 emissions of the Asia Pacific region has increased by 289.58511% whereas during 1990-2010, it has increased by 158.5736% and overall percentage growth in the study period is 907.36445.
- The Hydroelectricity consumption (in Million tonnes oil equivalent) in the Asia Pacific region was 34.41916 (16.4302% of the World) in 1965, which increased to 246.3685 (31.765% of the World) in 2010 whereas in the year of 1990 it was 90.107230 (18.426% of the World). This implies that during 1965-90, the Hydroelectricity consumption in the Asia Pacific region has increased by 161.79379% whereas during 1990-2010, it has increased by 173.41705% and overall percentage growth in the study period is 615.78887.

- The Coal consumption (in Million tonnes oil equivalent) in the Asia Pacific region was 234.59295 (16.4333% of the World) in 1965, which increased to 2384.73435 (67.06654% of the World) in 2010 whereas in the year of 1990 it was 825.2105804 (37.1663% of the World). This implies that during 1965-90, the Coal consumption in the Asia Pacific region has increased by 251.76272% whereas during 1990-2010 it has increased by 916.5413%.

1.2 Objectives of the study

In the proposed study, the focus is on the role of Renewable Energy Sources (RES) on economic growth of the Asian economies. In addition to that, the study attempts to analyze the relative performance of the consumption of RES over Non-Renewable Energy Sources (NRES). Thus keeping these views into consideration the proposed study will attempt to achieve the following two objectives:

1. To investigate the Granger-causal chain in the linear and non-linear framework between the consumption and production of RES and NRES, CO_2 emissions, openness and economic growth in the selected Asian countries in time series and panel framework.
2. To investigate whether FDI brings energy saving technologies via technology transfer in the selected Asian countries in the panel framework.

1.3 Methodology

The framework of the proposed study is as follows. Initially, to test for the stationary nature of the data series of the variables under consideration, allowances are made for the endogenous structural breaks by using Lee and Strazicich (2003, 2004) and Narayan and Poop (2010) proposed unit root tests. Then, new methodology for asymmetric cointegration is adopted, due to Richard (2012). Further, linear Granger-causality test is conducted to test the Granger-causal chain between the variables of interest with the approach due to Hacker and Hameti-J (2012), which extends the work of the Toda and Phillips (1993) and Toda and Yamamoto (1995). Further, to test for asymmetric causality, we use a symmetric causal approach proposed by Hameti-J (2012).

Further, in the panel framework, the linear Granger-causality (as there is no test developed to analyze nonlinear Granger-causality in the panel data to the best of our knowledge) is utilized after confirming the variables' order of integration and cointegration in the presence of structural breaks. Prior to the application of Granger-causality test, the study utilizes a battery of unit root and cointegration tests which incorporate structural breaks in the data for testing of stochastic property and cointegration property of the data. The battery of unit root and cointegration tests is used for robustness purpose. Specifically, we used heterogeneous panel causality test proposed by Dumitrescu and Hurlin (2012) and to test the stationary nature of the variables we used panel unit root tests that incorporates structural breaks such as Im et al. (2005) and Carrion-I-Silvestre et al. (2005) and tests that do not incorporate structural breaks such as Costantini and Lupi (2013), Demetrescu and Hanck (2012), Lupi (2011), and Hanck (2008).

1.4 Definition

In this study, ex-post measurable and objective definitions (like FDI and total trade) of Globalization have been used. This study examines the direction of causal-chain between the energy consumption and production sources (including RES and NRES), CO_2 emissions, openness (measured by total trade as a percentage of GDP) and economic growth (i.e., GDP per capita at constant prices).

1.5 Countries and period under study

In this study an elaborate attempt is made to review the empirical studies that focus on the analysis on the dynamics of the relationship between consumption of RES and NRES, economic growth and openness in the bivariate framework over the last two decades in the context of developed and developing countries. To analyze the Granger-causality between the variables, an empirical analysis has been carried out for a set of Asian countries for the period 1965-2010. Selection of the countries is based on the availability of data for the variables and study period we are interested in.

1.6 Expected contribution and scope of the study

The study is expected to contribute to the existing literature in numerous ways. For example, it seems to be the first of its kind by analyzing the relationship between the variables in the bivariate framework with advanced econometric approaches, which is rarely used in the studies conducted in Asian countries. The use of recently proposed structural breaks unit root and cointegration tests in case of time series and panel data is also a novel contribution of the study. Further, the use of asymmetric cointegration and Granger-causality test in identifying the lead-lag relationship between RES and NRES (particularly for coal and hydroelectricity), and economic growth and openness is also novel contribution and, hence, it is a value addition in the existing literature. In this study an attempt is made to find out whether FDI is able to contribute in energy saving technologies in Asian countries because there is great debate on whether or not

FDI enhances technological development of a country. From the policy point of view, the study may give a comprehensive picture that might help in guiding the policy makers of Asian countries while taking decisions related to growth, deregulation of energy sector development and adoption of policies pertaining to the development of renewable energy sectors. However, the study is limited by the availability of the data used for the countries under investigation. Policy implications and recommendations of the study are strictly limited to the set of Asian countries analyzed.

1.7 Disposition of the study

This study is organized into five chapters. Besides the current introductory chapter, wherein discussion about the selected research area followed by the Asian countries during 1965-2011, objectives, methodology, definition, and scope of the study is presented, there are other four chapters. In chapter two, a brief review of previous theoretical and empirical studies related to the topic will be presented. Chapter three discusses the objectives, data type, data source, methodology adopted for empirical analysis and construction of variables. Chapter four deals with the data analysis and empirical findings. Finally, conclusions, limitations and scope for the future study have been presented in chapter five.

CHAPTER II
LITERATURE REVIEW

This chapter provides a survey of the empirical literature on the causal relationship between energy consumption, CO_2 emissions, openness and economic growth and the theoretical underpinning on the influence of FDI inflows on energy use and related literature[3].The first section is devoted to literature on energy consumption, CO_2 emissions and economic growth, the second section is devoted to literature on energy consumption, openness and economic growth and the third section provides a theoretical way and a brief review of literature on the influence of FDI inflows on energy use.

There have been intensive studies on the relationship between economic growth, and environmental pollution, as well as economic growth and energy consumption. However, the empirical evidence remains controversial and ambiguous to date. We can group studies into four heads. The first is thus closely related to testing the validity of the Environmental Kuznets Curve (EKC) hypothesis. This hypothesis was first proposed and tested by Grossman and Krueger (1991). The EKC hypothesis states that as income increases, emissions increase as well until some threshold level of income is reached thereafter emissions begin to decline. The EKC hypothesis specifies emissions as a function of income, which presumes the existence of unidirectional causality which is running from income to emissions. However, it is conceivable that causation could run from emissions to income whereby emissions occur in the production process and, therefore, income increases. Recognizing this point, some studies have examined the direction of Granger causality between economic growth and environmental pollution (Coondoo and Dinda, 2002; Dinda and Coondoo, 2006; Akbostanci et al., 2009; Lee and Lee, 2009). However, a higher national income does not necessarily warrant greater efforts to contain

[3] The literature surveyed focuses exclusively on the energy consumption-growth nexus. The numerous studies pertaining to the dynamic estimation of energy demand is not covered in this survey. Every attempt was made to include all the published studies on the energy consumption-growth nexus. If a study has been overlooked, I extend my apologies to the authors.

the emissions of pollutants. More recently, Lee and Lee (2009) and Akbostanci et al. (2009) examine the time series dynamics between income and emissions to infer the direction of causality. The empirical results appear to be inconclusive.

A second set of studies examines the relationship between economic growth and energy consumption, since pollution emissions are primarily generated in the process of energy consumption by burning fossil fuels. Further, it is argued that economic development and output may be determined jointly, because higher economic development requires more energy consumption. Similarly, more efficient energy use needs a higher level of economic development. Therefore, the direction of causality may not be determined a priori. Following the seminal study by Kraft and Kraft (1978), an increasing number of studies have assessed the empirical evidence by employing Granger causality and cointegration models. Griffin and Gregory (1976), Berndt and Wood (1979), and Berndt (1980, 1990) have emphasized on the substitutability or complementarity between energy and the factors of production and the interplay with technical progress and productivity within a neoclassical theory of economic growth. Bergman (1988), Jorgenson and Wilcoxen (1993), Kemfert and Welsch (2000), and Smulders and de-Nooij (2003), among others, have explored the role of energy within a general equilibrium framework. The third set of studies has incorporated trade liberalization, either measured through total (merchandise) trade as a percentage of Gross Domestic Product (GDP) or Foreign Direct Investment (FDI) as a percentage of GDP in the economic growth-environmental pollutants nexus at the national and industrial firm level. A recent and emerging line of literature seems to analyze both nexuses in the same framework. This approach facilitates the examination of the dynamic relationship between economic growth, energy consumption and environmental pollutants altogether.

Recently, some studies have attempted to closely examine the financial development as another possible determinant of environmental performance, which we can put in the third category. For example, Frankel and Romer (1999) found that financial liberalization and development may attract FDI and higher degrees of R&D investments, which in turn can speed up economic growth and hence affect the dynamic of the environmental performance. Birdsall and Wheeler (1993) and Frankel and Romer (2002) indicated that financial development provides developing countries with the motive and opportunity to use new technology, help them with clean and environmentally friendly production, and consequently improve the global environment at large and enhance the sustainability of regional development. Additionally, Jensen (1996) and the World Bank (2000) have asserted that although financial development may enhance economic growth, it may result in more industrial pollution and environmental degradation. Tamazian et al. (2009) found that a higher degree of economic and financial development decreases environmental degradation. However, we will not focus on this set of studies in our literature as it is outside of the scope of this thesis.

More recently, few studies, which we can put into fourth group have analyzed the link between environmental pollution and FDI across a number of developing as well as developed countries. Few noteworthy studies in this area are Smarzynska and Wei (2001), Hoffmann et al. (2005), Mukhopadhyay (2006), Dean et al. (2009), Zarsky et al. (1999) etc.

2.1 The literature on energy consumption and economic growth

The relationship between energy consumption and economic growth and policy implications of the empirical findings has been extensively examined within the energy economics literature. Earlier work by Griffin and Gregory (1976), Berndt and Wood (1979), and Berndt (1980, 1990) emphasize the substitutability or complementarity between energy and the factors of production and the interplay with technical progress and productivity within a neoclassical theory of economic growth while Bergman (1988), Jorgenson and Wilcoxen (1993), Kemfert and Welsch (2000), and Smulders and de Nooij (2003), among others, explore the role of energy within a general equilibrium framework. On the other side of the spectrum, ecological economics questioned the role through which technical progress and the substitutability between energy and the factors of production affect the economic growth (Cleveland et al., 1984; Stern, 2004)[4]. While the work cited above has been important in understanding the role of energy in the economy, there has been growing literature on the causal relationship between energy consumption and economic growth utilizing a variety of time series econometric techniques. This line of inquiry stems, in part, from the earlier oil shocks of the 1970s to the more recent interest on energy prices and the impact of the Kyoto protocol agreement by a number of industrialized and developing countries to conserve energy and reduce greenhouse emissions. As against this backdrop, initially a brief review on the importance of renewable energy consumption and non-renewable energy consumption for economic growth is presented. Followed by a summary of the recent studies accomplished for testing the Granger-causal relationship between renewable energy consumption and non-renewable energy consumption and economic growth.

The path through which consumption of RES brings higher growth is uncertain, i.e., there is no unique way to say that this is the one way through which RES can boost economic growth. However, few attempts have been made to explain the plausible mechanism for such case. Domac et al. (2005) and Chien and Hu (2007) suggest that renewable energy might increase the macroeconomic efficiency and hence bring higher economic growth. This either might be due to

[4] These points are reiterated in Zachariadis (2007).

the expansion of business and new employment opportunities brought by renewable energy industries that resulted in economic growth or through the import substitution of energy, which has direct and indirect effects on increasing an economy's GDP and/or trade balance. Masui et al. (2006) pointed out some effective ways to address the issues related to the climate change, for example, adopting environmentally sustainable technologies, improving energy efficiency, forest conservation, reforestation, water conservation, or energy saving. The promotion of renewable energy sources is another well-accepted solution to the mitigation of CO_2 emissions. Krewitt et al. (2007) suggest that RES could provide as much as half of the world's energy needs by 2050 in a target-oriented scenario to prevent any dangerous anthropogenic interference with the climate system. Abulfotuh (2007) suggests that one possible solution to the environmental risks brought by the escalating demand for energy is to consider an immediate change in the composition of an energy resource portfolio. It is expected that RES have great potential to solve a major part of global energy sustainability. Hence, in this section we provide a brief review of the recent available literature in the field of renewable energy consumption and economic growth.

There are various studies analyzing the dynamics of the relationship between electricity consumption or energy consumption and economic growth either in the bivariate or multivariate framework. However, the literature in the field of disaggregated energy consumption that could show the relative performance of renewable energy consumption over non-renewable energy consumption is relatively less.

Yang (2000a) found bidirectional causality between aggregate energy consumption and GDP in Taiwan. However, at the disaggregation of energy sources, he found bidirectional causality between GDP and coal, GDP and electricity consumption and GDP and total energy consumption, but unidirectional causality running from GDP to oil consumption and from natural gas to GDP. Sari and Soytas (2004) found that waste had the largest initial impact, followed by oil, however; lignite, waste, oil, and hydropower explained the larger amount of GDP variation among energy sources within the 3-year horizon respectively. Wolde-Rufael (2004) found unidirectional Granger causality from coal, coke, electricity, and total energy consumption to real GDP, but no causality in any direction, between oil and real GDP. Domac et al. (2005) argue that bio-energy should help increase the economy’s macroeconomic efficiency through the creation of employment and other economic gains. Awerbuch and Sauter (2006) added that Renewable Energy Source (RES) had a positive effect on economic growth by reducing the negative effects of oil price volatility either by providing energy supply security or otherwise. Ewing et al. (2007) found that shocks arises due to Non-renewable Energy Consumption Source (NRECS) like coal and gas and that the oil had more impact on output variation than the shocks that arise due to consumption of RES. Chien and Hu (2008) have studied the effects of RES on GDP for 116 economies in 2003 through the Structural Equation Modeling (SEM) approach. They concluded that RES had a positive indirect effect on GDP through the increase in capital formation; however, RES did not show any improvement on the trade balance with no import substitution effect. Sari et al. (2008) by using Autoregressive Distributed Lag (ARDL) approach for the USA found that, in the long-run, industrial production and employment were the key determinants of fossil fuel, hydro, solar, waste and wind energy consumption, but did not have a significant impact on natural gas and wood energy consumption. Chang et al. (2009) by using Panel Threshold Regression (PTR) model for the Organization for Economic Co-operation and Development (OECD) countries over the period 1997-2006 asserted that there was no direct and simple relationship between GDP and the contribution of RES to the supply of energy. They concluded that the level of economic growth of a country influences the use of RES as a way to respond to oil price shocks. High-economic growth countries used RES to minimize the effects of adverse price shock, but low-economic growth countries were unable to do so. Therefore, the first countries exhibited a substitution effect towards RES to avoid the negative relationship between oil prices and GDP. Sadorsky (2009a) used a panel data model to estimate the impact of RES (which includes geothermal, wind and solar power, waste and wood) on economic growth and CO_2 emissions per capita and oil price for the G7 countries. The author found that, in the long run, real GDP per capita and CO_2 emissions per capita were the main drivers of the renewable energy consumption per capita. Oil prices had a smaller and negative effect on renewable energy consumption. In the short term, movements drove variations in renewable energy consumption back to the long-term equilibrium rather than short term shocks. Sadorsky (2009b) studied the relationship between RES (wind, solar and geothermal power, wood and wastes) and economic growth in a panel framework of 18 emerging economies for the period 1994-2003 and found that increase in real GDP had a positive and statistically significant effect on renewable energy consumption per capita. Payne (2009) provides a comparative causal analysis of the relationship between RES and NRES and real GDP for the USA over the period 1949-2006 and found no Granger causality between renewable and non-renewable energy consumption and real GDP. Apergis and Payne (2010a) attempted to study the relationship between RES and economic growth for 20 OECD countries over the period 1985-2005 within a framework of production function by incorporating capital formation and labour in the analysis and found a long-run equilibrium relationship between real GDP and RES.

Masui et al. (2006) pointed out some effective ways like adopting environmentally sustainable technologies, improving energy efficiency, forest conservation, reforestation, water conservation, or energy saving to address the issues related to climate change. They recommended that the promotion of renewable energy sources is another well-accepted solution to the mitigation of CO_2 emissions. Krewitt et al. (2007) suggest that RES could provide as much as half of the world's energy needs by 2050 in a target-oriented scenario to prevent any dangerous anthropogenic interference with the climate system. Abulfotuh (2007) suggests that one possible solution to the environmental risks brought by the escalating demand for energy is to consider an immediate change in the composition of an energy resource portfolio. It is expected that RES have great potential to solve a major part of global energy sustainability.

2.1.1 The causality literature on energy consumption-growth nexus

As one might expect, the empirical results on the energy consumption-growth nexus have yielded mixed results in terms of the postulated hypotheses[5]. The absence of any clear consensus on the relationship between energy consumption and growth can be attributed to the heterogeneity in climate conditions, varying energy consumption patterns, the structure and stages of economic development within a country, the alternative econometric methodologies employed, the presence of omitted variable bias along with the varying time horizons of the studies conducted (Yu and Choi, 1985; Ferguson et al., 2000; Toman and Jemelkova, 2003). Table-1.2 provides a chronological list of the literature examining the causal relationship between energy consumption and economic growth by country, methodology, variables included in the analysis, and empirical results. Please note in the discussion when a large

[5] Please refer to hypothesis section of this chapter to look into the hypothesis postulated for energy consumption growth literature.

number of studies are cited, the number of the specific studies from Table-1.2 will be referenced for the sake of brevity and readability.

2.1.2 Country coverage, variable selection, and model specification

A perusal of Table-1.2 reveals that the results vary a great deal across countries as well as across studies on a specific country. The majority of the studies have focussed on industrialized and developed countries, in part, due to the availability and reliability of the data. However, upon closer inspection, while a number of studies have investigated the energy consumption-growth relationship for industrialized, emerging market, and developing countries, studies pertaining to the transition economies of central Asia and eastern Europe have been limited. This omission in the literature may be attributed to the fact that many of these countries did not begin the transition to market-oriented economies until the early 1990s; hence, the availability of reliable time series data of sufficient frequency is quite limited.

Further examination of Table-1.2 displays the differences across models in variable selection, model specification, and methodology. A majority of the studies focused on the causal relationship between energy consumption/energy use and economic growth using aggregate energy consumption/energy use data (see 1, 3-5, 7-8, 11-12, 14-18, 20, 25, 34, 36, 39, 41, 47-48, 63, 68, 70-71, 76, 78, 80, 83-86, 88, 90-92, 95, 98-101, 104, 106, 108, 112, 117-118, 121, 123, and 125 in Table-1.2). However, given the use of aggregate energy consumption may mask the differential impact associated with various types of energy consumption as well as by end use and by sector, a number of studies examine the impact of various disaggregated measures of energy consumption/production such as electricity, coal, natural gas, oil, etc. as well as by sector (see 2-4, 6, 8-10, 13, 17-24, 26-33, 35, 37-38, 40-46, 48-62, 64-67, 69, 72-75, 77, 79, 81-82, 84, 87, 89, 93-94, 96-97, 99, 102-103, 105, 107, 109-111, 113, 114-116, 119-120, 122, 124, and 126-127 in Table-1.2). In addition, it is important to express energy consumption and economic activity measures in comparable terms.

Another feature of the model specification in a majority of the studies is the reliance on bivariate causality tests of energy-consumption measures and real output or employment (see 2-3, 10-11, 13, 17-20, 22-24, 26-32, 35, 37, 40-41, 45-46, 49, 53, 56, 58, 62, 64, 71, 74-75, 78, 83, 86-90, 92-94, 96-97, 102-104, 111-113, 116-117, 122, and 124-125 in Table-1.2). However, a common problem of a bivariate analysis is the possibility of omitted variable bias (Lütkepohl, 1982). Recognizing the omitted variable problem, several studies incorporate additional variables in the analysis, either by examining the relationship between energy-consumption measures and growth in the context of a production model framework by including measures of capital and/or labour (see 1, 4-6, 12, 14-16, 21, 25, 32, 34, 38-39, 43-44, 47-48, 50, 52, 54-55, 57, 61-63, 66, 70, 73, 76, 85, 91, 98, 100-101, 106, 109-110, 115, 118-120, and 127 in Table-1.2), through a demand model specification with the inclusion of the consumer or real energy prices (see 7-8, 15, 33-34, 59-60, 70, 73, 79, 81-82, 84, 95, 105, 108, 118, and 121 in Table-1.2), or the inclusion of a variety of other variables as in (see 7, 9, 33-34, 36, 39, 41-42, 47, 51, 55, 66-69, 72-73, 77, 79-81, 99, 105, 114, and 126-127 in Table-1.2)[6].

[6] In addition to incorporating measures of labour and capital in the production model, Soytas et al. (2007) and Soytas and Sari (2008) also include carbon dioxide emissions to examine the validity of the environmental Kuznets relationship.

2.1.3 Econometric approaches

2.1.3.1 Granger-Sims causality tests

In regards to the methodology employed to infer the causal relationship between energy consumption and growth, early studies relied upon Granger (1969) and Sims (1972) causality tests. In order to implement Granger-causality tests the respective time series should be stationary (Granger and Newbold, 1974). Recently, Toda and Yamamoto (1995) (TY) and Dolado and Lütkepohl (1996) (DL) developed a procedure which tests causality in non-stationary data, however, one must know the order of integration and the exact lag-length. For this reason, unit root tests are often conducted to discern whether the time series is stationary in level form (i.e., integrated of order zero, I(0)) or stationary after first-differencing (i.e., integrated of order one, I(1)). However, most of the studies have used unit root tests that do not take into account the existence of structural breaks. It is only recently that a few studies have used such test. The following studies employ either the Granger and/or Sims and/or Hsiao causality test and/or TY-DL test procedures to infer the causal relationship between energy-consumption measures and real Gross National Product (GNP), GDP, or employment either in level or first-difference form (see 6, 11, 18-19, 24-25, 29, 39, 42-47, 51, 54-56, 62-64, 66-67, 74, 76, 84, 86, 89-90, 94, 96, 99, 105, and 125 in Table-1.2)[7].

2.1.3.2 Engle-Granger/Johansen-Juselius cointegration and error-correction models

With the advances in time series econometrics, such techniques have been applied to investigate the relationship between energy consumption and growth. The technique that has emerged in a large number of studies is that of cointegration and the estimation of the corresponding error-

[7] While not explicitly testing for causality, a number of studies employ only forecast variance decompositions and/or impulse response functions to infer the impact of various energy-consumption measures on growth that are not elaborated in the present discussion.

correction model. Specifically, Engle and Granger (1987) extend the standard notion of Granger-causality to include the possibility that two time series may share a long-run common stochastic trend. Thus, the presence of cointegration and corresponding error-correction model allows the possibility of detecting causality in the short-run (lagged values of the time series) and/or the long-run (lagged value of the error term)[8].

Studies utilizing the Engle-Granger cointegration and error-correction model to infer the causal relationship between energy-consumption measures and economic growth include the following (see 2-4, 9, 13, 16-17, 37, 41, 92, and 103 in Table-1.2). However, the Johansen-Juselius cointegration and error-correction model has been more widely used as evident by the following studies (see 1, 5-8, 10, 12, 14-16, 20, 22-24, 26-31, 33-36, 38, 40, 48-49, 51-52, 57-58, 60, 62, 66, 70, 73, 75-77, 81-84, 87, 91, 93, 95-96, 99, 104, and 111 in Table-1.2)[9]. More recently, Hu and Lin (2008) and Lee and Chang (2007) provide evidence of a non-linear equilibrium relationship between energy consumption and economic growth using the threshold cointegration framework of Hansen and Seo (2002).

Likewise, Chiou-Wei et al. (2008) use the Baek and Brock (1992) test for non-linear Granger-causality while Huang et al. (2008) employ a threshold regression model to capture the non-linear relationship between energy consumption and economic growth. This line of research is particularly worthwhile given that the emphasis on the linear relationship between energy

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[8] In addition to the Engle and Granger (1987) cointegration procedure, the Johansen (1988) and Johansen and Juselius (1990) cointegration procedure allows one to test for the presence of cointegration in a multivariate setting without concerns for normalization as is the case for the Engle-Granger procedure. Note that in the case of the results pertaining to error-correction models reported in Table-1.2, no distinction is made between short- versus long-run causality or strong-form causality (both the short-run changes in the lagged variables and error-correction term are jointly significant) to conserve space. Also note the causal directions reported in Table-1.2 incorporate both short- and long-run causality. For example, if lagged changes in real GDP are significant in the equation for energy consumption and the error-correction term is significant in the equation for real GDP, while there is short-run causality from real GDP to energy consumption and long-run causality from energy consumption, both sources of causality taken together denote bidirectional causality between energy consumption and real GDP.

[9] Studies by Yu and Jin (1992), Hoa (1993), Lee and Chang (2007), and Hu and Lin (2008) simply test for the presence of cointegration without testing for causality within the context of an error-correction model are not reported in Table-1.2.

consumption and economic growth may not adequately capture the influence of energy consumption on economic growth once a specific threshold is reached. In other direction, Fallahi (2011) used Markov-switching (MS) VAR model and Kocaaslan (2013) used MS-VAR and Psaradakis et al. (2005) causality test to examine the direction of the causality between energy consumption and economic growth of the US.

To the best of our knowledge there are four studies which examined the direction of the causality between energy consumption and economic growth in the frequency domain framework. The Thoma (2004) was the first study to use such an approach for the US economy. Recently, Tiwari et al. (2012) used a more recent test developed by Croux and Reusens (2013) to examine the frequency domain causality for the USA. Bozokl and Yilanci (2013) used frequency domain causality test developed by Breitung and Candelon (2006) for the 20 OECD countries and Tiwari (2014) used frequency domain test developed by Lemmens et al. (2008) for the US economy.

2.1.3.3 ARDL bounds testing and Toda-Yamamoto long-run causality tests

While a majority of the studies cited have used the Engle-Granger and/or Johansen-Juselius cointegration procedures and corresponding error-correction models to infer the causal relationship between energy-consumption measures and economic growth, researchers have criticized such approaches due to the low power and size properties of small samples associated with conventional unit root and cointegration tests (Harris and Sollis, 2003). In response, more recent studies employ several methods that do not require the respective variables to be pre-tested for unit roots and cointegration: the autoregressive distributed lag (ARDL) model and bounds testing approach set forth by Pesaran and Shin (1999) and Pesaran et al. (2001) as well as the Toda and Yamamoto (1995) and Dolado and Lütkepohl (1996) tests of long-run causality. The appeal of these approaches is that hypothesis testing can be performed irrespective of whether the variables possess a unit root and the existence of cointegration among the variables. The ARDL bounds testing approach has been undertaken in the following studies (see 21, 32, 46, 50, 53, 59, 61, 63, 65, 68-69, 72, 74, 77, 79-80, 84, 86, 89, 94, 99, 105, 112, 116, and 119 in Table-1.2). The Toda-Yamamoto and Dolado-Lütkepohl approach have been used in the following studies (see 18-19, 25, 39, 43-44, 46-47, 54-56, 62-64, 74, 76, 84, 86, 89-90, 94, 96, and 99 in Table-1.2) and Narayan and Prasad (2008) used Bootstrapped Toda-Yamamoto Granger-causality (see 102 in Table-1.2).

2.1.3.4 Panel cointegration and error-correction models

As mentioned in the context of the ARDL, Toda-Yamamoto, and Dolado-Lütkepohl approaches, the consequence of the short data span, in many of the studies, on energy consumption and economic growth is the reduction in the power and size properties of conventional unit root and cointegration tests. Another approach that addresses these concerns is the panel cointegration tests advanced by Pedroni (1999, 2004) and Westerlund (2006). Panel unit root and cointegration tests provide additional power by combining the cross-section and time series data allowing for the heterogeneity across countries. Panel cointegration and corresponding error-correction models to infer the causal relationship between energy-consumption measures and economic growth are employed in the following studies (see 85, 88, 93, 95, 97-98, 100-101, 106-107, 109-110, 113-115, 117-118, 120-123, and 126-127 in Table-1.2)[10].

[10]Narayan and Smyth (2007a) also utilize the Westerlund (2006) panel cointegration test which allows for multiple structural breaks.

2.1.4 Summary of empirical results

With respect to the conclusions pertaining to the growth, conservation, neutrality, and feedback hypotheses the results are indeed mixed for a specific country as well as across countries. The USA (15) has the highest number of results reported, followed by, Turkey (11), Korea (10), China (9), India (8), Malaysia (8), Canada (6), Thailand (6), Indonesia (5), UK (5 and Taiwan (5) with no clear consensus in terms of the aforementioned hypotheses. In the case of 70 countries, comprising predominantly less-developed countries, there were at most three studies for each country[11]. When the results for specific countries were surveyed, about 18 percent of the results supported the neutrality hypothesis; 41 percent the feedback hypothesis; 26 percent the growth hypothesis; and about 14 percent the conservation hypothesis[12].

As for the limited number of panel data studies, the results also vary across regions. However, a majority of the existing panel data studies favour the growth hypothesis. Evidence supportive of the growth hypothesis is found by Lee (2005) for 18 developing countries; Chen et al. (2007) for 10 Asian countries; Mahadevan and Asafu-Adjaye (2007) for net energy importers of developing countries; Narayan and Smyth (2007a) for G7 countries; Apergis and Payne (2009) for 6 Central American countries; and Lee and Chang (2008) for 16 Middle Eastern and Asian countries. The conservation hypothesis is supported by Al-Iriani (2006) for 6 countries of the Gulf Cooperation Council; Mehrara (2007a) for 11 oil-exporting countries; and Huang et al. (2008) for middle and high-income countries, respectively. Huang et al. (2008) only support the neutrality hypothesis for low-income countries in the study. Finally, support for the feedback hypothesis is found by Mahadevan and Asafu-Adjaye (2007) for net energy exporters of

[11] Panel data studies were excluded from this discussion.

[12] Mixed results from some studies using disaggregated data were excluded in the calculation of the percentages. Only results that clearly provide conclusions with respect to one of the four hypotheses are reported. Also we excude here multi-country studies. Among the single country studies, the excluded studies are: 28, 43, 45, 50, 64, 68, 71, and 73.

developed and developing countries, net energy importers of developed countries, and all energy exporters and importers; Huang et al. (2008) for a panel of 82 countries; and Lee et al. (2008) for 22 Organization of Economic Cooperation and Development (OECD) countries.

2.1.5 Concluding remarks

Understanding the impact of energy consumption on economic growth is an important consideration in the formulation of both energy and environmental policies. This survey of the empirical literature on the causal relationship between energy consumption and economic growth has attempted to synthesize the results to date and provide avenues for future research. Firstly, as mentioned at the outset of this survey, there is no consensus with respect to a particular country or groups of countries considered energy-dependent or energy neutral. This lack of consensus can be attributed to the heterogeneity in climate conditions, varying energy consumption patterns, the structure and stages of economic development within a country, the alternative econometric approaches, and the presence of omitted variable bias along with the varying time horizons of the studies conducted. Future research in this area could benefit greatly by investigating the following areas:

1. Assuming the data is available and reliable, attempt to eliminate the omitted variable bias in the majority of the studies by examining the energy consumption-growth nexus within a production model and/or demand model framework (Payne, 2010);
2. Attempt to bridge the energy consumption-growth literature with the literature on the relationship between growth and emissions (i.e. Environmental Kuznets curve) by incorporating measures of greenhouse gas emissions in the analysis as recently undertaken by Soytas et al. (2007) and Soytas and Sari (2008);

Table 1.2: Summary of literature on relationship between energy consumption and economic growth

	Authors	Period and country	Methodology	Variables	Findings (country studied)
				Single-country studies	
1	Stern (2000)	USA (1948-1994)	JML	Divisia energy index; GDP; employment; capital	E → Y
2	Yang (2000a)	Taiwan (1954-1997)	EG	Energy consumption; coal; oil; natural gas electricity consumption; real GDP	E ↔ Y; CC ↔ Y; ELC ↔ Y; Y → OC; NGC → Y
3	Yang (2000b)	Taiwan (1954-1997)	EG	Coal consumption; real GNP	Y → CC
4	Aqeel and Butt (2001)	Pakistan (1955-1996)	EG	Energy consumption per capita; oil; gas; electricity consumption per capita; real GDP per capita; employment	Y → E; Y → OC; GC↮Y; ELC → Y; E → EMP
5	Chang et al. (2001)	Taiwan (1981:1-1997:11M)	JML; VDC; IRF	Energy consumption; industrial production; employment	E → IP
6	Ghosh (2002)	India (1950-1997)	JML, GC	Electricity supply; employment; real GDP	ES ← Y
7	Glasure (2002)	Korea (1961-1990)	JML; VDC	Energy consumption; real GDP; real government expenditure; real money supply; real oil prices; dummy variable oil price shocks	E ↔ Y
8	Hondroyiannis et al. (2002)	Greece (1960-1999)	JML	Total energy; residential; industrial consumption; Real GDP; consumer prices	E ↔ Y; IEC ↔ Y; REC → Y
9	Jumbe (2004)	Malawi (1970-1999)	EG	Electricity consumption; GDP; agricultural GDP	ELC ↔ Y
10	Shiu and Lam (2004)	China (1971-2000)	JML, VECM	Real GDP; electricity consumption	EC → Y
11	Altinay and Karagol (2004)	Turkey (1950-2000)	GC	Energy consumption; real GDP	E ↮Y
12	Ghali and El-Sakka (2004)	Canada (1961-1997)	JML; VDC	Energy use; real GDP; capital; employment	E ↔ Y
13	Morimoto and Hope (2004)	Sri Lanka (1960-1998)	EG	Electricity production; real GDP	ELP → Y
14	Oh and Lee (2004a)	Korea (1970-1999)	JML	Divisia energy index; real GDP; non-agricultural GDP; capital; labour	E ↔ Y
15	Oh and Lee (2004b)	Korea (1981:1-2000:4Q)	JML	Energy consumption; real GDP; capital; labour; real energy prices	Y ← E
16	Paul and Bhattacharya (2004)	India (1950-1996)	EG; JML	Energy consumption; real GDP; population; gross fixed capital formation	E ↔ Y
17	Thoma (2004)	USA (1973:1-2000:1M)	EG; frequency domain analysis; IRF; VDC	Total, commercial, industrial, other, and residential electricity usage; industrial production	IP → E; IP → CEC; IP → IEC; OEC ↮ IP; REC↮ IP
18	Wolde-Rufael (2004)	Shanghai (1952-1999)	TY	Total energy; coal; coke; electricity; oil consumption; real GDP	E → Y; COC → Y; ELC → Y; CC → Y; OC↮ Y
19	Altinay and Karagol (2005)	Turkey (1950-2000)	DL	Electricity consumption; Real GDP	ELC → Y
20	Lee and Chang (2005)	Taiwan (1954-2003)	JML; VECM	Energy consumption; coal; oil; gas; electricity consumption; Real GDP per capita	Y ↔ E; Y ↔ CC; OC → Y; GC → Y; ELC → Y
21	Narayan and Smyth (2005)	Australia (1966-1999)	ARDL, VECM	Electricity consumption per capita; real GDP per capita; manufacturing employment	Y → ELC; MEMP → ELC

22	Yoo (2005)	Korea (1970-2002)	JML, VECM	Real GDP; electricity consumption	ELC ↔ Y
23	Yoo and Jung (2005)	Korea (1977-2002)	JML	Nuclear energy consumption; real GDP	NEC → Y
24	Yoo and Kim (2006)	Indonesia (1971-2002)	JML, GC by Hsiao	Electricity production; electricity consumption; real GDP	Y → ELP; Y → ELC
25	Soytas and Sari (2006a)	China (1971-2002)	TY; VDC	Energy usage; real GDP; real gross fixed capital formation; labour force	E ↮ Y
26	Yoo (2006b)	Korea (1968-2002)	JML	Oil consumption; real GDP	OC ↔ Y
27	Yoo (2006a)	Korea (1968-2002)	JML	Coal consumption; real GDP	CC ↔ Y
28	Zou and Chau (2006)	China (1953-2002)	JML	Oil consumption; real GDP	(1953-2002) OC → Y; (1953-1984) OC ↔ Y; (1985-2002) OC ↔ Y
29	Yusof and Latif (2007)	Malaysia (1980-2006)	JML, GC	Real GDP; electricity consumption	EC ↮Y
30	Yaun et al. (2007)	China (1978-2004)	JML, VECM	Real GDP; electricity Consumption	EC → Y
31	Mozumder and Marathe (2007)	Bangladesh (1971-1999)	JML, VECM	Real GDP per capita; electricity consumption per capita	EC ← Y
32	Narayan and Singh (2007)	Fiji Islands (1971-2002)	ARDL, VECM	Real GDP; electricity consumption; labour	ELC → Y; ELC → L
33	Zachariadis and Pashourtidou (2007)	Cyprus (1960-2004)	JML, VECM, VARGFEVD	Real income per capita; electricity consumption; prices; weather	EC ↔ Y
34	Climent and Pardo (2007)	Spain (1984:1-2003:4Q)	JML	Energy consumption; real GDP Consumer prices; employment; oil production	E ↔ Y
35	Ho and Siu (2007)	Hong Kong (1966-2002)	JML	Electricity consumption; real GDP	ELC ↔ Y
36	Jobert and Karanfil (2007)	Turkey (1960-2003)	JML	Energy consumption; real GNP; industrial value added; energy consumption per capita; real GNP per capita; industrial value added per capita	E↮Y; E↮IVA
37	Lise and Montfort (2007)	Turkey (1970-2003)	EG	Primary energy consumption per capita; real GDP per capita	Y → PE
38	Soytas and Sari (2007)	Turkey (1968-2002)	JML; IRF; VDC	Industry electricity consumption; value added manufacturing; manufacturing employment; manufacturing real fixed investment	IELC → MVA
39	Soytas et al. (2007)	USA (1960-2000)	TY; VDC	Energy usage; real GDP; real gross fixed capital formation; real GDP; labour force; carbon dioxide emissions	E ↮Y
40	Yuan et al. (2007)	China (1978-2004)	JML; Hodrick-Prescott filter; VDC	Electricity consumption; real GDP	ELC → Y
41	Zamani (2007)	Iran (1967-2003)	EG	Total energy, gas, petroleum, consumption; industrial energy, electricity, gas, petroleum consumption; agricultural energy, electricity, petroleum consumption; real GDP; industrial value added; agricultural value added	Y → E; Y ↔ GC; Y ↔ PC; IVA → IEC; IVA → IGC; IVA → IELC; IVA → IPC; AVA ↔ AEC; AVA ↔ APC; AVA ↔ AELC
42	Abosedra et al. (2008)	Lebanon (1995:1-2005:12M)	GC; IRF	Electricity consumption growth; real import growth; temperature; relative humidity	ELC → IMP
43					

44	Payne and Taylor (2010)	USA (1957-2006)	TY	Nuclear energy consumption growth; real GDP growth; ratio of real gross fixed capital formation to real GDP; employment growth	NEC ↮ Y
45	Reynolds and Kolodziej (2008)	Former Soviet Union (1970-2003 and 1985-2002)	GC	Oil; coal; gas production; GDP	OP → Y; Y → CP; Y → GP
46	Tang (2008)	Malaysia (1972-2003)	ARDL, TY	Gross national product; electricity consumption	EC ↔ Y
47	Soytas and Sari (2008)	Turkey (1960-2000)	TY; VDC	Energy consumption; real GDP; real gross fixed capital formation; labour force; carbon dioxide emissions; dummy variable	E ↮Y
48	Yuan et al. (2008)	China (1963-2005)	JML; IRF	Total energy; coal; oil; electricity consumption; real GDP; capital; employment	E ↔ Y; CC ↔ Y; OC ↔ Y; ELC ↔ Y
49	Aktas and Yilmaz (2008)	Turkey (1970-2004)	JML, VECM	Gross national product; electricity consumption	EC ↔ Y
50	Sari et al. (2008)	USA (2001:1-2005:6M)	ARDL bounds Test	Coal; fossil fuel; hydroelectric; solar wind; natural gas; wood; waste energy consumption; industrial production, employment	CC → IP (+), EMP → IP (+); IP → FFC (+), EMP → FFC (-); IP → HEC (+), EMP → HEC (-); IP → NGC (+), EMP → NGC (+); IP → SEC (-), EMP → SEC (+); IP → WAEC (+), EMP → WAEC (-); IP → WEC (+), EMP → WEC (-)
51	Abosedra et al. (2009)	Lebanon (1995-2005)	JML; GC; VAR; GFEVD	Real GDP; electricity consumption; real imports; temperature; humidity	EC → Y
52	Odhiambo (2009a)	South Africa (1971-2006)	JML; VECM	Real GDP per capita; electricity consumption per capita; employment	EC ↔ Y
53	Odhiambo (2009b)	Tanzania (1971-2006)	ARDL, VECM	Real GDP per capita; electricity consumption per capita	EC → Y
54	Payne (2009)	USA (1949-2006)	TY	Renewable and non-renewable energy consumption; real GDP; real gross fixed capital formation; employment	RE ↮ Y; NRE↮Y
55	Lean and Smyth (2010a)	Malaysia (1971-2006)	TY	Real GDP; electricity consumption; exports; capital; labour	EC ↔ Y
56	Ciarreta and Zarraga (2010)	Spain (1971-2005)	TYDL	Real GDP; electricity consumption	EC ← Y
57	Lorde et al. (2010)	Barbados (1960-2004)	JML, VECM	Real GDP; electricity consumption; capital, labour; technology	EC ↔ Y
58	Acaravci (2010)	Turkey (1968-2005)	JML, VECM	Real GDP; electricity consumption	EC → Y
59	Chandran et al. (2010)	Malaysia (1971-2003)	ARDL, VECM	Electricity consumption; Real GDP; prices	EC → Y
60	Jamil and Ahmad (2010)	Pakistan (1960-2008)	JML, VECM, VARGFEVD	Industrial production; electricity consumption; Electricity Prices	EC ← Y
61	Ouédraogo (2010)	Burkina Faso (1968-2003)	ARDL, VECM	Real GDP; electricity consumption; capital formation	EC ↔ Y
62	Tiwari (2010)	India (1971-2006)	JML, GC- TYDL	Electricity consumption; employment	EC ↔ Y
63	Menyah and Wolde-Rufael (2010)	South Africa (1965–2006)	ARDL, TY	Per capita GDP; energy consumption; CO_2 emissions; capital; labour	CO_2→Y; E→Y; E→CO_2
64	Bowden and Payne (2010)	US (1949-2006)	TY	Renewable and Non-renewable energy consumption by sector; real gross domestic	Commercial and industrial REC ↮Y;

				product	Commercial and residential NERC ↔ Y; Residential REC and industrial NREC → Y
65	Shahbaz et al. (2011)	Portugal (1971-2009)	ARDL, GC-VECM	Electricity consumption; economic growth; employment	EC ↔ Y
66	Tiwari (2011a)	India (1971-2007)	JML, GC-VAR	Real GDP per capita; electricity consumption; CO_2 emissions; labour; capital	EC ↮Y
67	Tiwari (2011b)	India (1970-2007)	VAR, GC-DL	Primary energy consumption; CO_2 emissions; economic growth	EC ← Y
68	Jalil and Feridun (2011)	China (1953 – 2006)	ARDL	Per capita CO_2 emission; energy consumption; per capita real GDP; the ratio of liquid liabilities to GDP; trade ratio	FD → CO_2 (-); Y→CO_2; E→CO_2; TO→CO_2
69	Kouakou (2011)	Cote d'Ivoire (1971 to 2008)	ARDL, VECM	Electricity consumption per capita; GDP per capita; industry value added per capita	EC→Y; EC→IVA
70	Kaplan et al. (2011)	Turkey (1971-2006)	JML, VECM	Energy consumption; real GDP; real energy prices; capital; labour	EC ↔ Y
71	Fallahi (2011)	US (1960-2005)	Markov-switching vector autoregressive (MS-VAR)	Energy use; GDP	E ↔ Y (the first regime); E ↮Y (the second regime)
72	Kouakou (2011)	Cote d'Ivoire (1971-2008)	ARDL	GDP, industrial value added and electricity use	ELC ↔ Y; ELC →IVA
73	Bloch et al. (2012)	China (1977 to 2008 and 1965 to 2008 for the supply-side and demand-side analysis)	JML, VECM	For supply side: output, labor, capital and coal consumption, For demand side: income, coal price, carbon emissions and coal consumption.	Supply-side analysis: CC →Y Demand-side analysis: Y → CC CC ↔ CO_2 emissions.
74	Shahbaz and Feridun (2012)	Pakistan (1971- 2008)	ARDL, TY, VECM	Real GDP per capita; electricity consumption per capita in KWH.	Y → ELC
75	Tamba et al (2012)	Cameroon (1975–2008A)	JML; VECM	Diesel consumption; GDP	DC ↔ Y
76	Shahiduzzaman and Alam (2012)	Australia (1960–2009)	JML;TY approach	Real GDP; energy consumption; capital; labour	E ↔ Y
77	Alam et al. (2012)	Bangladesh (1972-2006)	JML;ARDL; VECM	Per capita real GDP; electricity consumption; CO_2 emissions	EC →Y
78	Kocaaslan (2013)	US (1968 and 2010)	Markov regime switching causality by Psaradakis et al. (2005)	Real GDP; total final energy consumption; total primary energy consumption	E ↔ Y
89	Tang and Tan (2013)	Malaysia (1970-2009)	ARDL; VECM	Electricity consumption; economic growth; energy prices; technology innovation (TIN)	TIN →Y; TIN →ECL; ELC ↔ Y
80	Ozturk and Acaravci (2013)	Turkey (1960–2007)	ARDL; VECM	Financial development; trade; economic growth; energy consumption; carbon emissions	EC ↮ Y
81	Polemis and Dagoumas (2013)	Greece (1970-211)	JML; VECM	Residential electricity consumption, GDP, Employment, Low voltage residential electricity price (deflated by the Consumer Price Index(2005) price of light fuel (deflated by the	ELC ↔ Y

				Consumer Price Index), heating and cooling degree days (HDD and CDD respectively).	
			Multi-Country Studies		
82	Asafu-Adjaye (2000)	India, Indonesia (1973-1995); Thailand, Philippines (1971-1995)	JML	Commercial energy usage per capita; real GDP; consumer prices	India, CEC →Y; Indonesia, CEC →Y; Thailand, CEC ↔Y; Philippines, CEC ↔Y
83	Soytas and Sari (2003)	Argentina (1950-1990); Canada, France, Germany, Japan, Turkey, UK, USA (1950-1992); Indonesia (1960-1992); Italy, Korea (1953-1991); Poland (1965-1994)	JML; VDC	Energy consumption; GDP per capita	Argentina, E ↔ Y; Canada, E↮Y; France, E → Y; Germany, E → Y; Indonesia, E ↮Y; Italy, Y→ E; Japan, E → Y; Korea, Y → E; Poland, E ↮ Y; Turkey, E ↔ Y; UK, E ↮Y; USA, E ↮Y
84	Fatai et al. (2004)	Australia, New Zealand, India, Indonesia, Thailand, Philippines (1960-1999)	GC; TY; ARDL; JML	Energy consumption; coal consumption; electricity consumption; oil consumption; natural gas consumption; industrial energy consumption; real GDP, consumer prices	Australia, JJ, Y → CC; GC ↮ Y, Y → ELC, IEC ↮Y, Y → E, TY Y → CC, GC ↮Y, Y → ELC, IEC – Y, Y → E, ARDL CC ↮Y, GC↮ Y, Y → ELC, IEC ↮Y, Y → E; New Zealand, JJ CC ↮Y, GC ↮Y, OC↮Y, IEC → Y, Y → E, TY CC↮Y, GC ↮Y, OC ↮ Y, Y → IEC, Y → E; India, JJ E → Y; Indonesia, JJ E → Y; Thailand, JJ E ↔Y; Philippines, E ↔ Y
85	Lee (2005)	South Korea, Singapore, Hungary, Argentina, Chile, Colombia, Mexico, Peru, Venezuela, Indonesia, Malaysia, Philippines, Thailand, India, Pakistan, Sri Lanka, Ghana, Kenya (1975-2001)	Pedroni panel cointegration	Energy usage; real GDP; real gross capital formation	Developing countries panel, E → Y
86	Wolde-Rufael (2005)	Algeria, Benin, Cameroon, Congo, DR, Congo, Rep., Egypt, Gabon, Ghana, Ivory Coast, Kenya, Morocco, Nigeria, Senegal, South Africa, Sudan, Togo, Tunisia, Zambia, Zimbabwe (1971-2001)	ARDL; TY	Energy use per capita; real GDP per capita	Algeria, Y → E(+); Benin, E↮ Y; Cameroon, E → Y(+) Congo DR, Y → E(+); Congo Rep, E↮Y; Egypt, Y → E(+) Gabon, E ↔ Y(+); Ghana, Y → E(+); Ivory Coast, Y → E(+) Kenya, E – Y; Morocco, E → Y(-); Nigeria, E →Y(-); Senegal, E↮Y; South Africa, E – Y; Sudan, E↮Y; Togo, E ↮ Y; Tunisia, E ↮Y; Zambia, E ↔ Y(-); Zimbabwe, E↮Y
87	Yoo (2006c)	Indonesia, Malaysia, Singapore, Thailand (1971-2002)	JML	Electricity consumption per capita; real GDP per capita	Indonesia, Y → ELC; Malaysia, ELC ↔ Y; Singapore, ELC ↔ Y; Thailand, Y → ELC
88	Al-Iriani (2006)	Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, UAE (1971-2002)	Pedroni panel cointegration	Energy consumption; real GDP	Gulf Cooperation Council countries panel, Y → E
89	Squalli and	Bahrain, Qatar, KSA, Singapore, Malaysia,	ARDL, TYMWT	Real GDP; electricity consumption	EC ↔ Y(Bahrain, Qatar and KSA); EC ↔

	Wilson (2006)	Kuwait, Oman, USA (1980-2003)			Y(Singapore and Malaysia); EC ← Y(Kuwait and Oman); EC↮Y (USA)
90	Lee (2006)	Belgium, France, Italy, Japan, The Netherlands, Sweden, Switzerland, UK, USA (1960-2001); Canada (1965-2001); Germany (1971-2001)	TY	Energy usage; real GDP per capita	Belgium, E → Y; Canada, E → Y; France, Y → E; Germany, E↮Y; Italy, Y → E; Japan, Y → E; The Netherlands, E → Y; Sweden, E ↮Y; Switzerland, E → Y; UK, E↮Y USA, E ↔ Y
91	Soytas and Sari (2006b)	Canada, Italy, Japan, UK, USA (1960-2004); France (1970-2002); Germany (1971-2002)	JML; VDC	Energy usage; real GDP per capita; labour force; real gross fixed capital formation	Canada, E ↔ Y; France, E → Y; Germany, E ↔ Y; Italy, E ↔ Y; Japan, E ↔ Y; UK, E ↔ Y; USA, E → Y
92	Francis et al. (2007)	Haiti, Jamaica, Trinidad and Tobago (1971-2002)	EG	Energy consumption per capita; real GDP per capita	Haiti, Y ↔ E; Jamaica, Y ↔ E; Trinidad and Tobago, Y ↔ E
93	Chen et al. (2007)	China, Hong Kong, Indonesia, India, Korea, Malaysia, Philippines, Singapore, Taiwan, Thailand (1971-2001)	JML; Pedroni panel cointegration	Electricity consumption; real GDP	China, ELC↮Y; Hong Kong, ELC ↔ Y; Indonesia, ELC → Y; India, Y → ELC; Korea, Y → ELC; Malaysia, Y → ELC Philippines, Y → ELC; Singapore, Y → ELC; Taiwan, ELC↮Y; Thailand, ELC ↮ Y; Ten country panel, ELC ↔ Y
94	Squalli (2007)	Indonesia, Nigeria, UAE, Venezuela, Algeria, Iraq, Kuwait, Libya, Iran, Qatar, Saudi Arabia (1980-2003)	ARDL, TYMWT	Real GDP per capita; electricity consumption per capita	EC → Y(Indonesia, Nigeria, UAE and Venezuela) EC ← Y(Algeria, Iraq, Kuwait and Libya) EC ↔ Y(Iran, Qatar, and Saudi Arabia)
95	Mahadevan and Asafu-Adjaye (2007)	Net energy exporters developed countries: Australia, Norway, UK (1971-2002) Net energy exporters developing countries: Argentina, Indonesia, Kuwait, Malaysia, Nigeria, Saudi Arabia, Venezuela (1971-2002) Net energy importers developed countries: Japan, Sweden, USA (1971-2002) Net energy importers developing countries: Ghana, India, Senegal, South Africa, South Korea, Singapore, Thailand (1971-2002)	Pedroni panel cointegration; JML	Energy usage per capita; real GDP per capita; consumer prices	Net energy exporters developed countries panel, E ↔ Y Australia E ↔ Y; Norway E ↔ Y; UK, E ↔ Y Net energy exporters developing countries panel E ↔ Y Argentina, E ↔ Y; Indonesia, E ↔ Y; Kuwait, E ↔ Y; Malaysia, E ↔ Y; Nigeria, E ↔ Y; Saudi Arabia, E ↔ Y Venezuela, E ↔ Y Net energy importers developed countries panel, E ↔ Y Japan, E ↔ Y; Sweden, E ↔ Y; USA, E ↔ Y Net energy importers developing countries panel, E → Y Ghana, E ↔ Y; India, E → Y; Senegal, E → Y; South Africa, E ↔ Y; South Korea, E → Y; Singapore, E ↔ Y; Thailand, E → Y All energy exporters panel, E ↔ Y All energy importers panel, E ↔ Y
96	Mehrara (2007b)	Iran, Kuwait, Saudi Arabia (1971-2002)	JML; TY	Commercial energy usage per capita; real GDP per capita	Iran, Y → CEC; Kuwait, Y → CEC; Saudi Arabia, CEC → Y

97	Mehrara (2007a)	Iran, Kuwait, Saudi Arabia, UAE, Bahrain, Oman, Algeria, Nigeria, Mexico, Venezuela, Ecuador (1971-2002)	Pedroni panel Cointegration	Commercial energy usage per capita; real GDP per capita	Oil-exporting countries panel, Y → CEC
98	Narayan and Smyth (2007a)	G7: Canada, France, Germany, Italy, Japan, UK, USA (1972-2002)	Pedroni panel Cointegration	Energy consumption per capita; real GDP per Capita; real gross fixed capital formation	E → Y
99	Zachariadis (2007)	Canada (1965-2004) France, Germany, Italy, Japan, UK (1960-2004); USA (1949-2004)	JML; ARDL; TY	Primary and final energy consumption: residential, industrial, commercial, and transport energy consumption; real GDP; real disposable income; real final consumption expenditures by households; value-added industries and services	Canada, JJ PE ↔ Y, Y → E, REC ↮Y, IEC ↔ Y, CEC ↔ Y, TEC ↮Y; ARDL PE ↔ Y, Y → E, Y → REC, Y → IEC, Y → CEC, Y → TEC; TY Y → PE, Y → E, Y → REC, IEC ↔ Y, CEC → Y, TEC↮Y France, JJ PE ↔ Y, E ↔ Y, REC ↔ Y, IEC↮Y, CEC → Y, TEC ↔ Y; ARDL PE → Y, E → Y, REC → Y, IEC↮Y, CEC↮Y, TEC ↔ Y; TY PE↮Y, E↮Y REC↮Y, IEC↮Y, CEC↮Y, TEC → Y Germany, JJ PE↮Y, E ↔ Y, Y → REC, IEC ↔ Y, CEC ↔ Y, TEC↮Y; ARDL Y → PE, Y → E, Y → REC, Y → IEC, CEC↔ Y, Y → TEC; TY PE↮Y, E↮Y, REC↮Y, Y → IEC, Y → CEC, TEC↮Y Italy, JJ PE ↔ Y, E ↔ Y, REC ↔ Y, IEC↮Y, CEC → Y, TEC ↔ Y; ARDL PE ↔ Y, E ↔ Y, REC ↔ Y, IEC↮Y, CEC → Y, TEC ↔ Y; TY PE↮Y, E↮Y, REC↮Y, IEC↮Y, Y → CEC, Y → TEC Japan, JJ PE ↔ Y, E ↔ Y, REC ↔ Y, IEC ↔ Y, CEC ↔ Y, TEC ↔ Y; ARDL PE ↔ Y, E ↔ Y, REC → Y, IEC → Y, CEC → Y, TEC ↔ Y; TY PE $ Y, E → Y, REC ↮Y, IEC → Y,CEC↮Y,TEC↮Y, UK, JJ Y → PE, Y → E, REC↮Y, IEC↮Y, Y → CEC, TEC↮Y; ARDL Y → PE, Y → E, REC↮Y, Y → IEC, Y → CEC, TEC → Y; TY Y → PE, Y → E, REC ↮Y, IEC↮Y, CEC ↮Y, TEC↮Y USA, JJ PE↮Y, REC↮Y, IEC↮Y, CEC → Y, Y → TEC; ARDL PE↮Y, E↮Y, REC↮Y, IEC↮Y, CEC → Y, Y → TEC; TY PE↮Y, E↮Y, REC↮Y, IEC↮Y, CEC → Y, Y → TEC.

100	Lee et al. (2008)	Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, The Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, UK, USA (1960-2001)	Pedroni panel Cointegration	Energy consumption per capita; real GDP per capita; Net capital stock per capita	OECD panel, $E \leftrightarrow Y$
101	Lee and Chang (2008)	China, Hong Kong, India, Indonesia, Iran, Japan, Jordan, South Korea, Malaysia, Pakistan, Philippines, Singapore, Sri Lanka, Syrian Arab Republic, Thailand, Turkey (1971-2002)	Pedroni panel Cointegration	Energy usage; real GDP; real gross fixed capital formation; labour force	Asian panel, $E \rightarrow Y$ APEC panel, $E \rightarrow Y$ ASEAN panel, $E \rightarrow Y$
102	Narayan and Prasad (2008)	Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland , Italy, Japan, Luxembourg, Spain, Sweden, Switzerland, Turkey, UK (1960-2002); Hungary, The Netherlands, New Zealand, Norway, Poland, Portugal (1965-2002); Korea, Mexico, Slovak Republic (1971-2002); USA (1970-2002)	Bootstrapped Granger causality (TYBSA)	Real GDP; Electricity consumption	$ELC \rightarrow Y$(Australia, Czech Rep. Italy, Portugal and Slovak Rep.); $ELC \nleftrightarrow Y$ (Austria, Belgium, Canada, Denmark, France, Germany, Greece, Ireland, Japan, Luxembourg, Mexico, New Zealand, Norway, Poland, Spain, Sweden, Switzerland, Turkey and USA) $EC \leftarrow Y$(Finland and Hungary) $EC \leftrightarrow Y$(Iceland, Korea and UK) $EC \leftarrow Y$(Netherlands)
103	Jinke et al. (2008)	China, India, Japan, South Africa, South Korea (1980-2005)	EG	Coal consumption; real GDP	China, $Y \rightarrow CC$; India, $CC \nleftrightarrow Y$; Japan, $Y \rightarrow CC$; South Africa, $CC \nleftrightarrow Y$; South Korea, $CC \nleftrightarrow Y$
104	Chiou-Wei et al. (2008)	Taiwan (1954-2006); Hong Kong, Singapore, Korea, Malaysia, Indonesia, Philippines, Thailand (1971-2003); USA (1960-2003)	JML; Baek and Brock non-linear Granger-causality	Energy consumption; real GDP	Taiwan, $E \rightarrow Y$; Hong Kong, $E \rightarrow Y$; Singapore, $Y \rightarrow E$ Korea, $E \nleftrightarrow Y$; Malaysia, $E \nleftrightarrow Y$; Indonesia, $E \leftrightarrow Y$; Philippines, $Y \rightarrow E$; Thailand, $E \nleftrightarrow Y$; USA, $E \nleftrightarrow Y$
105	Akinlo (2008)	11 sub-Saharan Africa (1980–2003): Cameroon, Cote D'Ivoire, Congo, Gambia, Ghana, Kenya, Nigeria, Senegal, Sudan, Togo, Zimbabwe	ARDL, VECM, VAR	Commercial energy use in kilograms of oil equivalent per capita; real GDP; consumer price index; government expenditure	$EC \leftrightarrow Y$(Gambia, Ghana and Senegal). $Y \rightarrow EC$ (Sudan and Zimbabwe). $EC \nleftrightarrow Y$ (Cameroon and Cote D'Ivoire). $Y \rightarrow EC$ (Congo). $EC \nleftrightarrow Y$ (Nigeria, Kenya and Togo).
106	Apergis and Payne (2009)	Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, Panama (1980-2004)	Pedroni panel cointegration	Energy consumption; real GDP; Real gross fixed capital formation; labour force	Central American panel, $E \rightarrow Y$
107	Narayan and Smyth (2009)	Six Middle Eastern countries (1974–2002): Iran, Israel, Kuwait, Oman, Saudi Arabia, and Syria.	The cointegration test of Westerlund (2006), Panel Granger causality	Electricity consumption; exports; gross domestic product	$EC \leftrightarrow Y$, $X \rightarrow Y$, $X \rightarrow EC$
108	Odhiambo (2010)	South Africa, Kenya and Congo (1972–2006)	ARDL	Per capita real GDP; total energy consumption per capita; CPI	South Africa and Kenya, $EC \rightarrow Y$; Congo(DRC), $Y \rightarrow EC$; South Africa and Kenya, $CPI \rightarrow Y$, $EC \rightarrow CPI$; Congo (DRC), $EC \rightarrow CPI$, $CPI \rightarrow Y$.
109	Apergis and Payne (2010a)	Twenty OECD countries (1985–2005): Australia, Austria, Belgium, Canada,	Pedroni (1999, 2004) proposed two	Real GDP; renewable energy consumption; real gross fixed capital formation; labour force	$REC \leftrightarrow Y$, $REC \rightarrow GFCF$, $REC \nleftrightarrow LF$

		Denmark, France, Germany, Iceland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, UK, US.	cointegration tests		
110	Apergis and Payne (2010b)	13 countries within Eurasia over the period (1992–2007): Armenia, Azerbaijan, Belarus, Estonia, Georgia, Kazakhstan, Kyrgyzstan, Latvia, Moldova, Russia, Tajikistan, Ukraine, and Uzbekistan.	The Pedroni (1999, 2004) heterogeneous panel cointegration test and panel vector error correction model.	Real GDP; real gross fixed capital formation; labour force; renewable energy consumption	REC $\leftrightarrow$ Y
111	Yoo and Kwak (2010)	Argentina, Brazil, Chile, Ecuador, Columbia, Peru, and Venezuela (1975-2006)	JML, VECM	Real GDP per capita; electricity consumption per capita	EC $\rightarrow$ Y(Argentina, Brazil, Chile and Ecuador), EC $\rightarrow$ Y(Columbia) EC $\not\leftrightarrow$ Y (Peru) EC $\leftrightarrow$ Y(Venezuela)
112	Ozturk and Acaravci (2010)	Hungary, Albania, Bulgaria, and Romania (1980–2006)	ARDL, GC- VECM	Energy consumption; economic growth	EC $\leftrightarrow$ Y (Hungary) EC $\not\leftrightarrow$ Y (Albania, Bulgaria, and Romania)
113	Narayan et al. (2010)	93 countries (1980–2006) Algeria, Angola, Argentina, Austria, Bahrain, Bangladesh, Barbados, Belgium, Bolivia, Brazil, Burkina Faso, Cambodia, Cameroon, Canada, Chile, China, Colombia, Costa Rica, Cote d'Ivoire, Cyprus, Denmark, Dominican Republic, DR Congo, Ecuador, Egypt, Ethiopia, Finland, France, Ghana, Greece, Guatemala, Hong Kong, Iceland, India, Indonesia, Iran, Iraq, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kenya, Kuwait, Luxembourg, Madagascar, Malawi, Malaysia, Mali, Malta, Mexico, Morocco, Mozambique , Myanmar, Netherlands , Niger, Nigeria, Norway, Oman, Pakistan, Peru, Philippines, Portuga, Qatar, Saudi Arabia, Senegal, Singapore, South Africa, South Korea, Spain, Sri Lanka, St. Lucia, Sudan, Sweden, Switzerland, Syria, Taiwan, Tanzania, Thailand, Trinidad & Tobago, Tunisia, Turkey, Uganda, UK, United Arab Emirates, Uruguay, US, Venezuela, Vietnam, Yemen, Zambia, Zimbabwe	Fully Modified Ordinary Least Squares (FMOLS) and Pedroni (2004) cointegration tests.	Total primary energy consumption, real GDP	Around 59% of the country's energy consumption has a statistically significant positive effect on real GDP in the long-run and in around 61% of the countries real GDP has a statistically significant positive effect on energy consumption in the long-run. Further, findings suggest that in about 40% of the countries, the relationship is either negative or statistically insignificant in the long-run
114	Hossain (2011)	Newly industrialized countries (NIC) (1971–2007): Brazil, China, India, Malaysia, Mexico, Philippines, South Africa, Thailand and Turkey.	The Johansen Fisher panel cointegration test	Carbon dioxide emissions; energy consumption; economic growth; trade openness; urbanization	Y $\rightarrow$ CO_2, TO $\rightarrow$ CO_2, Y $\rightarrow$ EC, TO $\rightarrow$ Y, URB $\rightarrow$ Y, TO $\rightarrow$ URB (but there is no evidence of long-run panel causal relationship among the variables).
115	Apergis and Payne (2011)	Six Central American countries over the period (1980–2006): Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, and Panama.	Pedroni cointegration tests	Real GDP; real gross fixed capital formation; labour force; renewable energy consumption.	REC $\leftrightarrow$ Y

116	Ozturk and Acaravci (2011)	11 Middle East and North Africa (MENA) countries (1971-2006)	ARDL	Electricity consumption; economic growth	Israel and Oman Y $\rightarrow$ ELC (short-run). Egypt and Saudi Arabia, ELC $\rightarrow$ Y (short-run and long run) Oman, ELC $\rightarrow$ Y (long run). For Iran, Morocco, and Syria any causal relationships within dynamic error-correction model can not be estimated.
117	Belke et al. (2011)	25 OECD countries from 1981 to 2007 (Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Slovakia, South Korea, Luxembourg, Mexico, the Netherlands, Portugal, Poland, Spain, Sweden, the United Kingdom, and US)	Dynamic ordinary least squares (DOLS) estimator proposed by Mark and Sul (2003)	Real GDP per capita; final energy consumption	E $\leftrightarrow$ Y
118	Eggoh et al (2011)	21 African countries (1970-2006) (Algeria, Cameroon , Congo Republic, Ivory Coast, Egypt, Gabon, Libya, Nigeria, South Africa and Sudan) and Net importing (Benin, Ethiopia, Ghana, Kenya, Morocco, Senegal, Tanzania, Togo, Tunisia, Zambia and Zimbabwe)	Pedroni (1999) and Westerlund (2006, 2007)	Economic growth; energy consumption; prices; labor; capital	E $\leftrightarrow$ Y
119	Tugcu et al. (2012)	G7 countries (1980-2009)	ARDL, Asymmetric causality	Renewable and non-renewable energy consumption; economic growth; labour; capital	REC $\leftrightarrow$ Y (for G7) in case of classical production function. Mixed results are found for each country when the production function is augmented.
120	Apergis and Payne (2012)	For 80 countries (1990–2007): Algeria, Argentina, Australia, Austria, Bangladesh, Belgium, Bolivia, Brazil, Bulgaria, Canada, Cameron, Chile, China, Comoros, Costa Rica, Denmark, Dominican Republic, Ecuador, Egypt, El Salvador, Ethiopia, Finland, France, Gabon, Germany, Ghana, Greece, Guatemala, Guinea, Honduras, Hungary, Iceland, India, Indonesia, Iran, Ireland, Italy, Japan, Jordan, Kenya, Korea, Luxembourg, Madagascar, Malawi, Malaysia, Mali, Mauritius, Mexico, Morocco, Mozambique, Netherlands, New Zealand, Nicaragua, Norway, Pakistan, Panama, Paraguay, Peru, Philippines, Poland, Portugal, Romania, Senegal, South Africa, Spain, Sri Lanka, Sudan, Swaziland, Sweden, Switzerland, Syria, Thailand, Tunisia, Turkey, Uganda, United Kingdom, United States, Uruguay, Venezuela, Zambia.	Pedroni (1999, 2004) heterogeneous panel cointegration test	Real GDP; renewable energy consumption; non-renewable energy consumption; real gross fixed capital formation; labour force	REC $\leftrightarrow$ Y, NREC $\leftrightarrow$ Y, REC $\leftrightarrow$ NREC
121	Kahsai et al. (2012)	40 Sub-Saharan African countries (1980-2007)	Pedroni's (1999) panel cointegration technique and Panel Granger causality	Gross domestic product per capita; CPI as a proxy for prices; energy consumption per capita.	E $\leftrightarrow$ Y, CPI $\rightarrow$ Y, REC $\not\leftrightarrow$ Y, CPI $\rightarrow$ Y (for the panel of 40 SSA countries as well as for the subset of low and middle income countries).

			tests.		CPI $\rightarrow$ E (for the panel of 40 SSA and low income countries).
122	Bildirici and Kayıkçı (2012)	11 CIS countries (1990–2009): Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Moldova, the Republic of Belarus, Russian Federation, Tajikistan, Ukraine and Uzbekistan.	Fully Modified Ordinary Least Squares (FMOLS) and Panel ARDL. Westerlund's (2006) and Pedroni (2004) cointegration tests.	Electricity consumption; economic growth	EC $\leftrightarrow$ Y, FMOLS and ARDL: EC $\rightarrow$ Y (-, for the second group of countries), EC $\rightarrow$ Y (+, for the first groups of countries).
123	Arouri et al (2012)	12 Middle East and North African Countries (MENA) (1981–2005): Algeria, Bahrain, Egypt, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, Saudi Arabia, Tunisia, and UAE.	The bootstrap panel cointegration test of Westerlund and Edgerton (2007). And panel error-correction model (PECM)	CO_2emission; energy consumption; per capita real GDP.	EC $\rightarrow$ CO_2 emissions (+). The causality from GDP to CO_2 emissions depends on the level of economic growth.
124	Fuinhas and Marques (2012)	Portugal, Italy, Greece, Spain and Turkey (PIGST), (1965-2009).	ARDL	GDP, primary energy consumption	PE $\leftrightarrow$ Y
125	Bozokl and Yilanci (2013)	20 OECD countries (Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Italy, Japan, Mexico, Netherlands, Norway, Portugal, Spain, Sweden, Turkey, UK, USA)	TYDL, Breitung and Candelon (2006).	GDP; energy consumption	First, in terms of causality running from GDP to energy consumption, there is a temporary relationship for Australia, Austria, Canada, Italy, Japan, Mexico, the Netherlands, Portugal, the UK, the USA, and a permanent relationship for Austria, Belgium, Denmark, Germany, Italy, Japan, the Netherlands, Norway, and the USA. Second, in terms of causality running from energy consumption to GDP, there is a temporary relationship for Austria, Denmark, Italy, the Nether-lands, Norway and Portugal, and a permanent relationship for Belgium, Finland, Greece, Italy, Japan, and Portugal.
126	Al-mulali and Sab (2013)	16 emerging countries (1980-2008): Brazil, Chile, China, Egypt, India, Indonesia, Jordan, Malaysia, Mauritius, Mexico, Morocco, Pakistan, Peru, Philippines, South Africa, and Thailand	FMOLS by Pedroni (2000) and VECM	Total primary energy consumption; CO_2 emission; economic development	PE $\leftrightarrow$ Y(+)
127	Al-mulali et al. (2014)	18 Latin American countries: Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Nicaragua, Panama, Paraguay, Peru, Uruguay and Venezuela. (1980-2010)	Panel Dynamic Ordinary Least Squares (DOLS) test, VECM	GDP; electricity consumption from renewable sources including hydroelectricity; electricity consumption from oil, gas and coal sources; total labor force; gross fixed capital formation; total trade of goods and services	Granger causality results revealed a bi-directional causal relationship between renewable electricity consumption and economic growth, total trade and economic growth, renewable electricity consumption and non-renewable energy consumption, and total labor force and gross fixed capital formation. In addition, a one way causal relationship was found from non-renewable energy consumption to economic growth, gross fixed capital formation to economic growth, total labor force to renewable electricity consumption, total trade to renewable electricity consumption, gross fixed capital formation to non-

					renewable electricity consumption and total labor force to non-renewable electricity consumption.

Notes: Definitions of notation: → or ←, ↔, and represent unidirectional causality, bidirectional causality, and no causality, respectively; abbreviations for measures of energy consumption defined as follows: E, total energy consumption, gross energy inputs, energy usage, or production; CC, coal consumption; COC, coke consumption; CP, coal production; ELC, electricity consumption; ELP, electricity production; FFC, fossil fuel consumption; HEC, hydroelectric consumption; GC, gas consumption; GP, gas production; LFC, liquid fuel consumption; NEC, nuclear consumption; NGC, natural gas consumption; OC, oil consumption; OP, oil production; PC, petroleum consumption; PE, primary energy consumption; SEC, solar energy consumption; SFC, solid fuel consumption; WAEC, waste energy consumption; WEC, wind energy consumption; REC, renewable energy consumption; NREC, non-renewable energy consumption; EC, electricity consumption. Abbreviations for measures of sector energy consumption: AEC, agricultural energy consumption; AELC, agricultural electricity consumption; APC, agricultural petroleum consumption; CEC, commercial energy consumption or usage; CREC, commercial renewable energy consumption; CNREC, commercial non-renewable energy consumption; IEC industrial energy consumption or usage; IELC, industrial electricity consumption; IGC, industrial gas consumption; IPC, industrial petroleum consumption; IREC, industrial renewable energy consumption; INREC, industrial non-renewable energy consumption; OEC, other energy consumption or usage; REC, residential energy consumption or usage; TEC, transportation energy consumption or usage; CEU, commercial electricity usage; IEU, industrial electricity usage; OEU, other sector electricity usage; REU, residential electricity usage; RREC, residential renewable energy consumption; RNREC, residential non-renewable energy consumption. Abbreviations for measures of output defined as follows: AVA, agricultural value added; IVA, industrial value added; MVA, manufacturing value added; IMP, imports; Y, real or nominal GDP or GNP; IP, industrial production; EMP, employment; NEMP, non-farm employment; MEMP, manufacturing employment; GFCF, Gross fixed capital formation, LF, labour force; FD, financial development; TO, trade openness; IVA, industry value added; DC, diesel consumption; X, exports; TIN, technology innovation. NA represents not applied. In methodology column EG, GC, VAR, GFEVD, JML, VECM, ARDL, PC, TYMWT and TYBSA means respectively Engle and Granger, Granger causality, Vector Autoregression Generalized Forecast Error Variance Decomposition, Johansen's Maximum Likelihood, Vector Error Correction Method, Autoregressive Distributed Lag Model to Cointegration, Panel Cointegration, Toda and Yamamoto (1995) M-Wald causality test and Toda and Yamamoto Bootstrapping causality analysis etc. Other time series methods employed: IFR, impulse response function; VDC, forecast error variance decomposition; spectral and frequency domain analysis; non-linear and bootstrapped Granger-causality; and dynamic panel estimation.

Source: Author's compilation

3. Analyze not only the aggregate energy consumption, but also the disaggregated measures of energy consumption to ascertain the differential impact of disaggregated measures of energy consumption and by sector on economic growth;
4. As a check on the robustness of the results employ several econometric approaches to test the causal relationship and in the case of multi-country analysis also examine the countries within a panel framework (Payne, 2010);
5. Differentiate countries according to energy consumption patterns and/or stages of economic development, grouping countries together with similar consumption patterns/level of development to examine similarities and differences;
6. In the panel data framework, an attempt is made to consider country and parameter specific heterogeneity in causality tests, which is ignored in the previous studies;
7. Examine the non-linear Granger-causal relationship as most of macroeconomic variables exhibit nonlinear adjustment path.

2.2 The literature on energy consumption, CO_2 emissions, openness and economic growth

In this section, literature review on the relationship between energy consumption, CO_2 emissions, openness and economic growth is briefly presented and then the hypotheses is formulated. Noteworthy studies linking the trade or openness with energy consumption and/or environmental degradation are Smarzynska and Wei (2001), Hoffmann et al. (2005), Mukhopadhyay (2006), Dean et al. (2009), Zarsky et al. (1999) etc.

Several alternative economic rationales supporting relationships between the FDI (where FDI is treated as a measure of openness) and CO_2 emissions and FDI and energy consumption have been proposed in the literature. According to the pollution haven hypothesis, weak environmental regulation in a host country may attract inward FDI by profit-driven companies eager to circumvent costly regulatory compliance in their home countries (Jensen, 1996; Hoffmann et al., 2005; Mukhopadhyay, 2006; Dean et al., 2009). Secondly, according to the pollution-halo hypothesis applying a universal environmental standard, multinationals engaging in FDI will tend to spread its greener technology to their counterparts in the host country (see, for example, Birdsall and Wheeler, 1993; Zarsky et al., 1999; Sandborke and Metha, 2002). This is also referred as a technique effect (Antweiler et al., 2001; Cole and Elliott, 2003; Grossman and Krueger, 1991). A scale effect would arise to the extent that the multinational FDI operations would significantly contribute to a host nation's industrial output and in turn the overall pollution level (see, for example, Zarsky et al., 1999; Jian and Rencheng, 2007). Finally, the composition effect is defined as a reduction in the share of pollution intensive goods in production. In general, the scale effect increases the level of pollution in empirical works; whereas composition effects occur when trade patterns are strongly influenced by factor intensities. Despite these clear theoretical arguments, empirical work designed to test these hypotheses has so far been unable to provide conclusive results (Smarzynska and Wei, 2001).

Trade entails the movement of goods produced in one country to another for either consumption or further processing. This implies that the production of these goods causes pollution and is related to consumption in another country. Wyckoff and Roop (1994) estimate that 13% of the total carbon emissions of the six largest OECD countries are embodied in their imports of manufactured goods. Environmental laws and regulations can be divided into two broad categories. The first represent policies that are domestically initiated and aimed at environmental protection and conservation. These measures generally affect exports indirectly. The second generally consists of environmental measures that are the outcomes of international agreements, conventions or arrangements (Asafu-Adjaye et al., 1997). Likewise, Siwar et al. (2008) states that trade can affect the environment in two ways: Firstly, trade and trade liberalization encourage industrial and manufacturing production, leading to increase in pollution. Secondly, industrialization and production lead to overuse of the environmental resources thus leading to environmental degradation.

Recent studies have attempted to combine the trade-growth-energy-CO_2 emissions nexus into a single, simultaneous multivariate model using the same framework. Ang (2007) and Soytas et al. (2007) initiated such an approach, which was then widely adopted by various other authors (Auffhammer and Carson, 2008; Halicioglu, 2009; Jalil and Mahmud, 2009; Jayanthakumaran et al., 2012). Studies which support the pro-environmental impact of trade openness include Lucas et al. (1992), Birdsall and Wheeler (1993), Frankel and Rose (2005) and Grether and de-Melo (2003). Other studies such as those by Suri and Chapman (1998), Cole et al. (2000) and Dean (2002) concludes that foreign trade is harmful to the environment. Whilst such studies have undoubtedly expanded our understanding of the environmental consequences of economic growth and foreign trade, they pay little attention to the causal relationship between foreign trade, income growth, and environmental quality. More specifically, these studies treat foreign trade and income as exogenous determinants of environmental quality/damage. This assumes a unidirectional causal relationship, in that, a change in the level of trade openness and income causes a consequent change in environmental quality, but the reverse does not hold true. Such a presumption neglects the possible endogeneity of foreign trade and income, which means that environmental quality and income may jointly be affected by foreign trade. Frankel and Rose (2005) address the issue of endogeneity between foreign trade, income and environmental quality in their analysis through the use of instrumental variable (IV) estimates.

Most other studies which focus on the environmental consequences of foreign trade employ Granger causality tests with little regard to the possible cointegrating relationship amongst the variables. If, indeed, the selected variables are cointegrated in a model, work by Miller and Russek (1990) suggests that the causality tests undertaken in these studies provide misleading results. Furthermore, Granger causality tests focus specifically on short-run dynamics rather than any underlying long-run relationships. Given that the environmental consequences of economic growth and foreign trade are essentially a long-run concept (Dinda and Coondoo, 2006), it is highly desirable to examine the true relationship amongst the variables using a cointegration approach.

Cole (2006) examined the relationship between trade liberalization and energy consumption. Cole (2006) used data from 32 countries and found that trade liberalization promotes economic growth which boosts energy demand. Moreover, trade liberalization stimulates capitalization which in results affects energy consumption. Jena and Grote (2008) investigated the impact of trade openness on energy consumption in the context of India. They noted that trade openness stimulates industrialization via scale effect, technique effect, composite effect and comparative advantages effect which affect energy consumption. Narayan and Smith (2009) examined the causal relationship between energy consumption and economic growth by incorporating exports as an indicator of trade openness in production function for a panel of six Middle Eastern countries namely Iran, Israel, Kuwait, Oman, Saudi Arabia and Syria. They applied panel unit root tests, panel cointegration and panel causality tests. Their analysis confirmed the presence of a cointegration relationship between variables. Furthermore, they reported that a short-run Granger causality exists running from energy consumption to real

GDP and from economic growth to exports, but neutral effect is found between exports and energy consumption.

Lean and Smyth (2010a) examined the causal relationship between aggregate output, electricity consumption, exports, labour and capital in a multivariate model for Malaysia by employing a modified version of the Granger causality test proposed by Toda and Yamamoto (1995) and Dolado and Lütkepohl (1996). They found evidence in support of bi-directional causality between aggregate output and electricity consumption and export led growth hypothesis in Malaysia. Lean and Smyth (2010b) used time series data from 1970-2008 to study the causal relationship between economic growth, electricity generation, exports and prices. They found evidence of uni-directional causality running from economic growth in electricity consumption.

Sami (2011) examined the relationship between exports, electricity consumption and real income per capita in Japan using time series data from 1960-2007. The study finds that there is a cointegrating relationship between electricity consumption, exports and economic growth and that in the long run, there is causality running from exports and real GDP per capita to electricity consumption. Sadorsky (2011) examined the causal relationship between total energy consumption and trade openness. The panel data was used to carry out group cointegration and Granger-causality approaches of 8 Middle Eastern countries, namely, Bahrain, Iran, Jordan, Oman, Qatar, Saudi Arabia, Syria and UAE. The empirical evidence reported that long run relationship exists between the variables. Sadorsky found that a 1 percentage increase in real per capita GDP increases per capita energy consumption by 0.62%. A 1% increase in real per capita exports increases per capita energy consumption by 0.11%, while 1% increase in real per capita imports increases per capita energy consumption by 0.04%. Panel Granger causality analysis revealed that exports Granger-cause energy consumption and the feedback are found between imports and energy consumption in the short run. Similarly, the bidirectional causality exists between GDP and energy consumption in the short run.

Table 2.2: Summary of literature on relationship between energy consumption and openness

Authors	Study Period	Methodology	Variables	Findings
Cole (2006)	32 developed and developing countries (1975–1995)	Fixed effects and random effect models	Total energy use, capital–labour ratio, per capita income, trade intensity (defined as the ratio of imports plus exports to GDP).	Focusing on scale, technique and composition effects, results suggest that trade will increase energy use.
Abosedra et al. (2008)	Lebanon (1995:1-2005:12M)	GC; IRF	Electricity consumption; real import; temperature; relative humidity	ELC → IMP
Narayan and Smyth (2009)	Six Middle Eastern countries (1974–2002): Iran, Israel, Kuwait, Oman, Saudi Arabia, and Syria	Westerlund (2006), Panel Granger causality	Electricity consumption; exports; gross domestic product	EC ↔ Y, X → Y , X → EC
Hossain (2011)	Newly industrialized countries (NIC) (1971–2007): Brazil, China, India, Malaysia, Mexico, Philippines, South Africa, Thailand and Turkey	The Johansen Fisher panel cointegration test, VECM	Carbon dioxide emissions; energy consumption; economic growth; trade openness; urbanization	Y → CO_2, TO → CO_2, Y → EC, TO → Y, URB → Y, TO → URB
Pao and Tsai (2011)	Brazil, India, and China (1980-2007) Russian Federation (1992e2007)	Panel cointegration	CO2 emissions, energy consumption, FDI (foreign direct investment) and GDP	CO2 ↔ FDI; Y → FDI; Y ↔ CO2; Y ↔ E; E→CO2
Kohler (2013)	South Africa (1960–2009)	ARDL, Johansen and Juselius's (1990) , VECM	CO2 emissions per capita, commercial energy use per capita, per capita real income, openness	E ↔ CO2 (+); T ↔ Y (+) ; T ↔ E (+)
Kanjilal and Ghosh (2013)	India (1971 to 2008)	ARDL , GH and HJ cointegration, VECM	Carbon emission, energy use, economic activity and trade openness	Negative sign of trade openness on CO2 emissions
Sadorsky (2013)	7 South American countries (1980-2007)	Panel cointegration tests and VECM	Output, capital, labor, energy, and exports (or imports)	E ↔ X; Y ↔ X ; Y ↔ M; E → M
Dedeoglu and Kaya (2013)	25 OECD countries	Canning and Pedroni (2008)	Energy use, exports, imports and GDP	E ↔ Y; E ↔ X; E ↔ M

Sadorsky (2012) uses panel cointegration regression techniques to examine the relationship between energy consumption, output and trade in a sample of 7 South American countries covering the period 1980 to 2007. His panel cointegration tests show a long-run relationship between 1) output, capital, labour, energy, and exports and 2) output, capital, labour, energy, and imports. Short-run dynamics show a bi-directional feedback relationship between energy consumption and exports, output and exports and output and imports. Further, he found evidence of a one way short-run relationship from energy consumption to imports, whereas in the long-run there is evidence of a causal relationship between trade (exports or imports) and energy consumption. Using the data from 52 developed and developing economies, Ghani (2012) explored the relationship between trade liberalization and energy demand. The results indicated that trade liberalization has an insignificant impact on energy consumption, but after a certain level of capital per labour, trade liberalization affects energy consumption. Kohler (2013) finds positive bidirectional causality between trade and income per capita and between trade and per capita energy use. However, it appears that trade liberalization in South Africa has not contributed to a long run growth in pollution-intensive activities nor higher emission levels.

2.3 The influence of FDI inflows on energy use

In this section, we first present the conceptual background for the hypothesis that FDI has an energy-reducing effect in the destination country. Then we give an overview of the empirical literature examining the evidence on energy-reducing technology transfer via FDI.

2.3.1 Theoretical background

In the literature on trade and the environment, it has become common to decompose the effects of economic activity and trade on pollution into a scale, a composition, and a technique effect. Grossman and Krueger (1993b), who examined data on concentrations of sulfur dioxide and suspended particulate matter, introduced this decomposition. It was later backed up with the formal theory by Antweiler et al. (2001) and further elaborated by Copeland and Taylor (2003). As argued by Cole (2006), the framework of the trade and environment literature is also applicable to energy use, since energy use is the principal cause of most air pollutants.

In our analysis, we adapt the concept developed by Antweiler et al. (2001) and examine how scale, composition, and technique effects influence total energy use. For simplicity, we split up total economic activity into two sectors with different energy intensities: industrial and non-industrial. Energy use in the non-industrial sector relative to its output value is defined by $e(A)$ with the properties $e(A) > 0$ and $e^{'}(A) < 0$, where A is a proxy for the average technology in use. We assume that the energy intensity in the industrial sector has been always μ times higher than $e(A)$. Measuring the total output by gross domestic product (GDP) and denoting the share of industrial value added in output by IND, total energy use can be written as

$$E = GDP \cdot (\mu \cdot IND + 1 - IND) \cdot e(A). \tag{2.1}$$

It follows from Equation (2.1) that the total energy use in a country can be decomposed into three factors: the scale of overall economic activity (GDP), the relative importance of energy-intensive sectors of economic activity (IND), and the energy intensity of technology in use $(e(A))$. In analogy to Antweiler et al. (2001), changes in these factors can be interpreted in the following way: The first term is obviously the scale effect and reflects the impact of increasing or decreasing economic activity on total energy use when holding constant the mix of sectors as well as the technology. The second term is the composition effect; holding scale and technology constant, and producing relatively more energy-intensive goods due to a sectoral shift leading to an increase in energy use. The last term captures the technique effect resulting from the implementation of a more energy-efficient technology A that reduces the input of energy into the production process. Having set out the fundamental factors affecting energy use, we can now identify the variables that influence these factors. In this context, we pay special attention to the effects of FDI inflows.

The scale effect can be directly measured by changes in the observable variable GDP. For constant returns to scale of production functions, an output increase leads to a proportional increase in energy inputs. This means that energy intensity, defined as energy use divided by GDP, remains constant.[13] FDI can influence the scale effect indirectly: since FDI inflows are assumed to stimulate economic growth and since expanded economic activity is related to higher energy use, the scale effect resulting from FDI inflows is positive, and its extent depends on the magnitude of the influence of FDI on GDP. Changes in the relative importance of the production of energy-intensive goods, i.e., the composition effect, are determined by changes in the sectoral structure of an economy. A typical empirical observation is that in the early stages of a country's economic development, economic activity shifts from the agricultural to the industrial sector. Since the latter is more energy intensive than the former, this implies a positive composition effect. Later in the development process, activity moves typically from the industry to the service sector or from the heavy to the lighter industry. This implies a negative composition effect at this stage, as the service sector and the light industry are less energy intensive (Stern, 2004). One reason for such a development pattern can be changes in the comparative advantage of an open economy in the world market. The comparative advantage can be influenced by variables like the capital-to-labour ratio, environmental regulations, or the share of skilled labour. FDI inflows contribute to the composition effect if they change the sectoral structure of an economy. In Equation (2.1), we measure sectoral shifts directly by changes in the share of industrial value added in GDP. This means that all the indirect influences on the sectoral structure, including the composition effect of FDI, are already captured by the inclusion of this variable.

[13] Note that this implication would not hold in the case of economies of scale, i.e., when an expansion of output needs a proportionally lower or higher increase in input quantities.

The technique effect covers the impact of employing new technologies or management practices on energy use. We hypothesize that novel technologies developed with a higher level of knowledge are more productive and hence more energy efficient than old technologies. In analogy to Arrow (1962), we propose that learning is a function of cumulated gross investment, which we denote by GI.[14] This means that accumulated knowledge increases with every new capital good being available. The hypothesis brought forward by Mielnik and Goldemberg (2002) is that imported investments via FDI in developing countries have a stronger energy-reducing effect than new domestic investments. This can be the case through technology transfer via FDI so that developing countries are able to 'leapfrog' over traditional technologies in use. In order to test this hypothesis, we explicitly consider the accumulated FDI inflows $GFDI$ as a determinant of energy intensity, which represents a source of accumulated knowledge that might differ from accumulated domestic investment in its strength. We further add the accumulated import value GIM and the accumulated foreign aid value $GAIL$ as further potential sources of technology transfer. All three variables are expressed as shares relative to overall cumulative gross investment GI, since the shares of foreign capital (embodied in FDI, imports, or aid) in total capital represent the relative importance of transferred knowledge in the economy (similar to Aitken and Harrison, 1999). A different driver of the energy-saving technique effect can be income per capita, which can be explained by a political economy mechanism: Since environmental quality is assumed to be a normal good, rising per-capita income leads to the higher public appreciation of a clean environment. The rising demand for environmental quality may then result in the adoption of stricter environmental regulations that

[14] Other variables that are typically used as a proxy for learning and technical progress are accumulated GDP or GDP per capita.

typically also provide incentives to reduce energy use.[15] Firms react to the regulation by the introduction of cleaner and more energy-efficient technologies. This effect, which is related to the so-called environmental Kuznets curve (EKC), is in the following referred to as income-induced technique effect. Summing up, we expect that the energy intensity of a country's technology, $e(A)$, depends negatively on accumulated gross investment, GI, and might be reduced further by the extent of the respective shares of accumulated FDI, imports and aid in accumulated investment. Furthermore, the income level per capita (YPC) might reduce energy intensity so that $e(A)$ is a function of

$$e(A) = f\left(G_I, \frac{G_{FDI}}{G_I}, \frac{G_{IM}}{G_I}, \frac{G_{AID}}{G_I}, YPC \right). \qquad (2.2)$$

With regard to FDI, it is also possible to establish an indirect link to the income-induced technique effect, namely, under the assumption that openness to trade and FDI enhances growth and hence per-capita income. Grossman and Krueger (1993b) emphasized especially this indirect effect when they analyzed the technique effect of trade liberalization. In the theoretical model by Antweiler et al. (2001), the income-induced technique effect is the only technique effect resulting from increasing openness.[16] While the literature on trade and the environment has mainly focused on the income-induced technique effect, the broader literature on technological change has recently expanded with numerous studies on technology transfer resulting from openness to trade and FDI (for an overview, see Keller, 2004). Technology transfer via FDI, which potentially also reduces energy use, can occur in two ways: first, directly via more efficient foreign firms operating in the host country and, second, indirectly

[15] This is obvious in the case of energy taxes but applies as well to other environmental policy measures like stricter regulations of pollutant emissions arising as a by-product from the use of fossil energy resources.
[16] In the empirical estimation of their model, Antweiler et al. (2001) provided a sensitivity test in which they explicitly allowed for a direct effect of FDI on SO_2 concentrations. However, they found no substantial relationship between the extent of FDI in an economy and the pollution level.

through technological spillovers from foreign firms to indigenous firms. For these mechanisms to be effective, we assume that the technology used by foreign investors is typically superior to the technology that is currently in place in developing countries. The direct effect implies that the foreign-owned firm, compared to a similar indigenous firm, uses less energy and hence contributes to the technique effect. Regarding the technological spillovers, the literature suggests three potential channels: demonstration effect, which stand for imitation and reverse engineering by local firms; labour turnover, which implies the transfer of knowledge of workers who change their employer; and vertical linkages, which involve that multinationals transfer technology to their suppliers or customers (Saggi, 2002). Additionally, higher exports and imports as well as FDI inflows are likely to lead to increased competition. Firms need to become more productive in order to stay competitive in the export market or to compete with imports and new foreign companies in the domestic market. For instance, Corcos et al. (2007) applied a theoretical model with heterogeneous firms and assumed that international trade increases aggregate productivity through a selection effect: the least productive firms leave the market under increased pressure from competition. One can expect that higher productivity also implies more efficient energy use in production.

Though we identified several indirect influences of FDI inflows on energy use through scale, composition, and technique effects, all the indirect effects are implicitly included in the variables GDP (scale effect), IND (composition effect), and YPC (income-induced technique effect). We therefore propose that any remaining direct influence of FDI can be attributed to technology transfer, and the main contribution of our analysis is to identify and quantify this influence empirically.

2.3.2 Empirical literature on energy-saving technology transfer via FDI

There is a large and growing empirical strand of literature on productivity improving technology transfer and spillovers through FDI. The evidence is mixed, but Keller (2004, p.771) notes in his survey paper that 'recent micro productivity studies tend to estimate positive, and in some cases also economically large spillovers associated with FDI'.[17] Among other studies, Tybout (2003) found evidence for efficiency improvements due to higher exposure to foreign competition as predicted by the New Trade Theory. However, he pointed out that it is not clear, according to the related literature, whether international activities cause the improved efficiency or vice versa. Furthermore, none of these empirical studies shed light on the effects of spillovers and productivity gains on energy efficiency. In the following, we focus specifically on energy-saving technology transfer via FDI. Peterson (2008) reviewed the existing evidence and remarked that although there may be a large potential for such technology transfer, there is a lack of knowledge about its empirical magnitude and its drivers, and the topic remains insufficiently researched. The hypothesis that foreign-owned companies use less energy than their indigenous counterparts in developing countries is confirmed by studies based on firm-level data. In their analysis of manufacturing plants in Cote D'Ivoire, Mexico, and Venezuela, Eskeland and Harrison (2003) found that foreign ownership is associated with less energy use. Fisher-Vanden et al. (2004), who found a negative impact of foreign ownership on the energy intensity of Chinese companies, have documented a similar result. These examples suggest that the more efficient technologies of foreign firms can indeed contribute to an energy-reducing technique effect via technology transfer. On an aggregate level, only very few studies link openness and FDI to energy-saving technology transfers. Cole (2006) used a variation of the

[17] Aitken and Harrison (1999), Javorcik (2004), and Javorcik and Spatareanu (2008) are prominent examples for examinations of spillovers to domestic firms via FDI.

model developed by Antweiler et al. (2001) to examine the impact of trade intensity (while not explicitly including FDI) on energy use in 32 developed and developing countries. His panel estimation yielded that the effect of liberalization is country specific and can be positive or negative, depending on whether the country is importing or exporting the energy-intensive good. Mielnik and Goldemberg (2002) carried out a simplified regression as a starting point for further research on the basis of previous evidence that developing and industrialized countries are converging to a common pattern of energy use (Mielnik and Goldemberg, 2000). Their results indicate that the quantity of FDI inflows has a negative influence on energy intensity. They used a sample of 20 developing countries[18] for the years 1987–1998, aggregating all countries to one time series, and estimated the regression:

$$EI_t = \beta_0 + \beta_1 \frac{FDI_t}{I_i} + \varepsilon_t. \tag{2.3}$$

The dependent variable EI_t is energy intensity in a year, t, i.e., the sum of total energy use in all 20 countries divided by their GDP, which is measured in purchasing-power parity. The explanatory variable $\frac{FDI_t}{I_i}$ represents inflows of FDI as a fraction of total gross investment in all countries; ε_t is the error term. We, in our study, first estimate a regression model by Mielnik and Goldemberg (2002) for Asian countries and compare results. However, before we estimate regression models, we first confirm the stationarity of the variables included as the result of this ordinary least squares (OLS) estimation relies critically on the stationarity assumption of the involved variables. If at least one variable is instead integrated, which implies non-stationarity; standard OLS regression analysis is not appropriate and can result in a spurious regression.

[18] The countries are in alphabetical order: Algeria, Brazil, Chile, PR China, Colombia, Costa Rica, Egypt, India, Indonesia, Malaysia, Mexico, Morocco, Nigeria, Pakistan, Peru, Philippines, Singapore, South Africa, Thailand, and Uruguay.

CHAPTER III
OBJECTIVES, DATA AND METHODOLOGY

The present chapter is organized into three sections. The first section deals with the objectives and hypotheses formulation of the study and the second section presents sources of the data and the type of data used in the study. Finally, the third section discusses the statistical methods and tools employed for the purpose of estimating and generation of results.

3.1 Objectives and hypotheses formulations

3.1.1 Objectives of the study

In the proposed study, the focus is on the role of RES on the economic growth of the Asian economies. In addition to that, the study attempts to analyze the relative performance of the consumption and production of RES over NRES. Thus keeping these views the proposed study will attempt to achieve the following two objectives:

1. To investigate the linear and non-linear Granger-causal chain between the consumption and production of RES and NRES, CO_2 emissions, openness and economic growth in the selected Asian countries in time series and panel framework;
2. To investigate whether FDI brings energy saving technologies via technology transfer in the selected Asian countries in panel framework.

3.1.2 Hypotheses formulations

In this section, we first present our hypotheses related to the first objective and thereafter for the second objective. For the first objective, the following set of three competing hypotheses[19]have been formulated based on review of literature.

[19] Note that here we have not discussed the hypotheses related to openness and growth literature because extensive research has been done in this area. However, much of the discussion on energy consumption and economic growth is drawn from an extensive survey of the literature, Squalli (2007, pp. 1193-4) which provides an excellent

As our framework is bivariate, we are interested in formulating and discussing the hypothesis and related policy implications between energy consumption/production and economic growth; openness and energy consumption; openness and CO_2 emissions.

The relationship between energy consumption and economic growth and corresponding policy implications have been set forth in a number of testable hypotheses by researchers. First, the "growth" hypothesis asserts that energy consumption plays an important role in economic growth both directly and as a complement to labour and capital in the production process. In the context of Granger-causality, the "growth" hypothesis is supported if an increase in energy consumption causes an increase in real Gross Domestic Product (GDP). The policy implications of the "growth" hypothesis suggest that energy conservation-oriented policies may have a detrimental impact on economic growth. Alternatively, if an increase in energy consumption has a negative impact on real GDP, a number of interpretations emerge. For example, the situation may be one in which a growing economy requires a decreasing amount of energy consumption as production shifts toward less energy intensive service sectors. Alternatively, the negative impact of energy consumption on real GDP may be attributed to either excessive energy consumption in unproductive sectors of the economy, capacity constraints, or an inefficient energy supply. Second, the "conservation" hypothesis implies that energy conservation policies such as the reduction in greenhouse emissions, efficiency improvement measures, and demand management policies designed to reduce energy consumption and waste may not adversely affect real GDP. The "conservation" hypothesis is supported if an increase in real GDP Granger-causes an increase in energy consumption. However, it is possible that a growing economy constrained by political, infrastructural, or mismanagement of resources could generate

description of the various hypotheses related to the relationship between energy consumption and economic growth.

inefficiencies and the reduction in the demand for goods and services, including energy consumption. If such is the case, an increase in real GDP may have a negative impact on energy consumption. Third, the “neutrality” hypothesis views energy consumption as a small component of real GDP and therefore energy consumption should not have a significant impact on economic growth. In this instance, energy conservation policies (as in the case of the “conservation” hypothesis) may not adversely affect real GDP. Support for the “neutrality” hypothesis is provided by the absence of Granger-causality between energy consumption and real GDP. Fourth, the “feedback” hypothesis suggests that energy consumption and real GDP are interdependent and may serve as complements to one another. In this case, increase (decrease) in energy consumption results in increase (decrease) in real GDP, and likewise, increase (decrease) in real GDP results in increase (decrease) in energy consumption. In this case, the “feedback” hypothesis is supported by evidence of bi-directional Granger-causality between energy consumption and real GDP. Thus, an energy policy oriented toward improvements in energy consumption efficiency may not adversely affect real GDP.

The second set of competing hypotheses concerns the Granger-causal relationship between trade and energy consumption/production. The policy implications are as follows: If Granger causality runs from energy consumption/production to trade, reducing energy consumption/production could impede attempts to develop a diversified (non-oil) trade specially export sector. On the other hand, if there is Granger causality running from trade to energy consumption/production or no Granger causality in either direction, energy conservation policies can be expected to have no adverse effect on openness. In other words, if energy plays its key role to flow exports or imports then any policies aiming at reducing energy consumption, such as energy conservation policies will negatively impact the flow of exports or imports and hence, reduce the benefit of trade openness. The bidirectional causal relationship between trade openness and energy consumption suggests in adopting energy expansion policies because energy consumption stimulates trade openness and as a result, trade openness affects energy consumption (Sadorsky, 2011). The energy conservation policies will not have an adverse effect on trade openness if causality is running from trade openness to energy consumption or neutral effect exists between trade openness and energy consumption (Sadorsky, 2011).

The third set of competing hypotheses concerns the relationship between emissions and openness or trade. The links between trade and the environment are multiple, complex and important. The trade and environment interface has typically been analyzed in the literature in two parts: first, the effect of trade policy on the environment; and second, the effect of environmental policy on trade. Under the first, the pertinent question has been whether trade liberalization leads to environmental degradation; and under the second, the pertinent question has been whether more stringent environmental policies have a detrimental (reducing) effect on trade. Putting it differently, one needs to validate whether trade liberalization Granger-cause environmental degradation or the Granger-causality runs otherwise. The effect of trade liberalization on the environment is subdivided into three categories (i) product effect, (ii) structural effect, and (iii) scale effect. (i) The product effect of trade is positive when trade liberalization expands the market for goods produced in an environmentally sound manner and/or environmental services like resource saving technology. Negative product effect results when goods directly harmful to the ecosystem are exchanged internationally. (ii) The structural effect of trade is the trade-induced change in the industrial composition and consumption, and depends on the pollution intensity of national output. The effect on the environment is positive if expanding export sectors are less polluting on average than contracting import competing sectors; and negative if the opposite holds. (iii) The scale effect of trade results from enhanced economic activity, including higher levels of production, resource extraction, and transportation. The impact on the environment is typically negative due to the greater pollutants emitted. In particular, the scale effect is accompanied by an increase in total production and income, and the latter can have a positive impact on the environment through the increased demand for better environmental quality (acting directly through the market, as well as through enhanced demand for environmental regulations from the voting population). The net environmental effect of trade liberalization is the sum of the product, structural, scale and income effects, and can be either positive or negative depending on the magnitudes of the component effects.

Apart from the environmental effects mentioned above, trade liberalization can also have regulatory effect, where existing environmental policies of a liberalizing economy are changed to facilitate trade. The regulatory effect of trade is likely to be positive since greater trade is associated with stronger domestic environmental policies (say harmonization of environmental standards[20], or increased enforcement of existing norms). The adverse environmental effect of trade noted under structural effect can take place only in the presence of market failures and regulatory failure. In the presence of an existing market failure, the environmental costs of production and consumption are not adequately reflected in the market prices, thus free trade can accentuate the adverse environmental effect (incorrect resource utilization of an economy) by expanding production in these sectors. Alternatively, regulatory failure can also be the source of the problem, when government policies aimed to encourage certain economic activities have

[20] The harmonization of environmental standards across countries for local pollutants is not supported on economic grounds, since the competitive effects are minor. Even on ecological grounds, it is not efficient to harmonize environmental standards across countries for local pollution problems, since the resource endowment, buffering capacity of the local ecosystem and preferences are likely to be different across countries. Harmonization of environmental standards is only relevant for trans-boundary or global pollution problems, and it has been widely recognized that international cooperation and good governance at the international level are necessary to protect global commons.

an adverse environmental impact, as in the case of subsidies for water or chemical inputs in agriculture that can lead to excessive extraction of ground water or overuse of chemical pesticides resulting in a drop in the water table and chemical runoff.

For the second objective, we hypotheses' that higher FDI does not bring energy saving technologies via technology transfer in the selected Asian countries.

3.2 Data type, study period and data source

The data sources used in this study are the online databases of World Development Indicators (WDI) of the World Bank, and the International Energy Agency (IEA). The study period is 1960-2010. However, it is likely to vary for different countries depending upon the availability of the data. A detailed summary of the period of each country for each variable is presented in Table 1.3.

3.3 Methodology

3.3.1 Methodology for time series analysis

3.3.1.1 Unit root/stationary analysis

To draw a reliable estimate, particularly in case of time series analysis, it is important to determine whether a series is stationary or not and if not, what is the degree of integration of a series. A series is said to be stationary if its mean and variance are constant over time and the value of the covariance between two time periods depend upon only on the distance or gap or lag between two time periods and not the actual time at which covariance is computed (for details refer Tiwari, 2011). If this is not the case, the series is said to be nonstationary. A series is said to have integrated of order "d", I (d), if it turns out to be stationary after differencing it “d” times. To verify whether a time series is stationary, the literature proposes several unit root tests such as DF (or augmented DF), PP (due to Perron, 1989, 1997), NP (due to Ng and Perron, 2001), DF-GLS, KPSS (for details refer Tiwari, 2011) etc. The null hypothesis for the first four tests is that the series has a unit root, whereas, for the fifth test the null hypothesis is that the series is stationary.

However, these traditional unit root tests are found to give misleading results (i.e., biased towards the non-rejection of null hypothesis when structural breaks/changes are present in the data series (Perron, 1989). Structural changes can take place because of economic crisis, technological shocks, changes in the economic factors’ preferences and behaviour accordingly, policy and regime changes, and organizational or institutional evolution. This is more likely to be the case if the time span is long. To overcome such a situation, Perron (1989) suggested a modification of unit root tests that allows for one break with a predetermined timing. Since then, several tests have been developed that can automatically take into account one or more than one structural breaks (see among others Banerjee et al., 1992; Zivot and Andrews, 1992; Perron, 1989; Bai and Perron, 1998, 2003). However, in our thesis, we have adopted two different tests of unit root, which have relatively high power properties in the presence of up to two structural breaks, namely- Lee and Strazicich (2003, 2004), and Narayan and Popp (2010), a recently developed test.[21]

[21] There are other unit root tests such as Zivot and Andrews (1992) which tests the null of non-stationary against a single-break stationary. However, the Zivot and Andrews (1992) and Lumsdaine and Papell (1997) ADF-type endogenous break unit root tests both have the limitation that the critical values are derived while assuming no break(s) under the null hypothesis. Nunes et al. (1997) showed that this assumption leads to size distortions in the presence of a unit root with structural breaks. As a result, when utilizing ADF-type endogenous break unit root tests, one might conclude that a time series is trend stationary, when in fact it is non-stationary with break(s), meaning that spurious rejections might occur. In contrast to the ADF-type tests, the LM unit root test is unaffected by breaks under the null hypothesis (Lee and Strazicich, 2003).

The Lee and Strazicich (2003, 2004)[22] test uses the Lagrange Multiplier (LM) test statistics, allows for two structural breaks, and has better size and sample properties. Now we will briefly discuss the Lee and Strazicich (2003, 2004) unit root test procedure. Let us consider the following data generating process (DGP):

$$y = \delta Z_t + e_{t,}\ e_t = \beta e_{t-1} + \varepsilon_t \tag{3.1}$$

where Z_t is a vector of exogenous variables, δ is a vector of parameters and ε_t is a white noise process, such that $\varepsilon_t \sim NIID(0, \sigma^2)$. First, let us consider the case when there is evidence of one structural break. The Crash model that allows shift in level only is described by $Z_t = [1, t, D_t]'$, and the break model that allows for changes in both level and trend is described as $Z_t = [1, t, D_t, DT_t]'$, where D_t and DT_t are two dummies defined as:

$D_t = 1, if\ t \geq T_B + 1$

$= 0$, *otherwise*

and

$DT_t = t - T_B, if\ t \geq T_B + 1$

$= 0$, *otherwise*

where T_B is the time of the break date.

Next, let us consider the framework that allows for two structural breaks. The crash model that considers two shifts in level only is described by $Z_t = [1, t, D_{1t}, D_{2t}]]'$, and the break model that allows for two changes in both level and trend is described as

[22] This section is largely based on Lee and Strazicich (2003, 2004).

Table 1.3: Summary of the study period

	PEC	CO_2 emissions	HYD	Coal	NG	NU	ELEP	ELEP-Coal	ELEP-HYDR	ELEP-NG	ELEP-NU	ELEP-Oil	ELEP-Rene	EPC	EU	GDPPC	Trade
Bangladesh	(1972-2010)		(1973-2010)	(1972-2010)	(1972-2010)		(1971-2009)		(1971-2009)	(1971-2009)		(1971-2009)	(1971-2009)	(1972-2009)	(1972-2009)	(1965-2010)	(1965-2010)
China	(1965-2010)	(1965-2010)	(1965-2010)	(1965-2010)	(1965-2010)		(1971-2009)	(1971-2009)	(1971-2009)	(1980-2009)		(1971-2009)	(1971-2009)	(1971-2009)	(1971-2009)	(1965-2010)	(1978-2010)
ChinaHKSAR	(1965-2010)	(1965-2010)					(1971-2009)	(1982-2009)				(1971-2009)		(1971-2009)	(1971-2009)	(1965-2010)	(1965-2010)
India	(1965-2010)	(1965-2010)	(1965-2010)	(1965-2010)	(1965-2010)	(1969-2010)	(1971-2009)	(1971-2009)	(1971-2009)	(1971-2009)	(1971-2009)	(1971-2009)	(1971-2009)	(1971-2009)	(1971-2009)	(1965-2010)	(1965-2010)
Indonesia	(1965-2010)	(1965-2010)	(1965-2010)	(1965-2010)	(1965-2010)		(1971-2009)		(1971-2009)	(1977-2009)		(1971-2009)	(1971-2009)	(1971-2009)	(1971-2009)	(1965-2010)	(1965-2010)
Japan	(1965-2010)	(1965-2010)	(1965-2010)	(1965-2010)	(1965-2010)	(1966-2010)	(1960-2010)	(1960-2010)	(1960-2010)	(1960-2010)	(1966-2010)	(1960-2010)	(1960-2010)	(1965-2010)	(1965-2010)	(1965-2010)	(1965-2010)
Malaysia	(1965-2010)	(1965-2010)	(1965-2010)		(1971-2010)		(1971-2009)		(1971-2009)	(1978-2009)		(1971-2009)	(1971-2009)	(1971-2009)	(1971-2009)	(1965-2010)	(1965-2010)
NewZealand	(1965-2010)	(1965-2010)	(1965-2010)	(1965-2010)	(1970-2010)		(1960-2010)	(1960-2010)	(1960-2010)	(1970-2010)		(1967-2010)	(1960-2010)	(1965-2010)	(1965-2010)	(1965-2010)	(1977-2010)
Pakistan	(1965-2010)	(1965-2010)	(1965-2010)	(1965-2010)	(1965-2010)		(1971-2009)	(1971-2009)	(1971-2009)	(1971-2009)	(1971-2009)	(1971-2009)	(1971-2009)	(1971-2009)	(1971-2009)	(1965-2010)	(1965-2010)
Philippines	(1965-2010)	(1965-2010)	(1965-2010)	(1975-2010)			(1971-2009)	(1971-2009)	(1973-2009)			(1971-2009)	(1973-2009)	(1971-2009)	(1971-2009)	(1965-2010)	(1965-2010)
Singapore	(1965-2010)	(1965-2010)										(1971-2010)		(1971-2010)	(1971-2010)	(1965-2010)	(1975-2010)
SouthKorea	(1965-2010)	(1965-2010)	(1965-2010)	(1965-2010)	(1986-2010)	(1978-2010)	(1971-2009)	(1971-2010)	(1971-2010)		(1976-2009)	(1971-2009)	(1971-2009)	(1971-2009)	(1971-2009)	(1965-2010)	(1965-2010)
Taiwan	(1965-2010)	(1965-2010)	(1965-2010)	(1965-2010)	(1965-2010)	(1978-2010)										(1965-2010)	
Thailand	(1965-2010)	(1965-2010)	(1965-2010)	(1966-2010)	(1981-2010)		(1971-2009)	(1971-2009)	(1971-2009)	(1981-2009)		(1971-2009)	(1971-2009)	(1971-2009)	(1971-2009)	(1965-2010)	(1965-2010)
Vietnam	(1965-2010)	(1965-2010)	(1965-2010)	(1965-2010)													

$Z_t = [1, t, D_{1t}, DT_{1t}, D_{2t}, DT_{2t}]'$, where D_{jt} and DT_{jt} for j = 1, 2 are appropriate dummies defined as above, viz.,

$$D_{jt} = 1, if\ t \geq T_{Bj} + 1$$

$$= 0, otherwise$$

and

$$DT_{tj} = t - T_{Bj}, if\ t \geq T_{Bj} + 1$$

$$= 0, otherwise$$

where T_{Bj} is the j[th] break date.

The main advantage of (Lee and Strazicich 2003, 2004) approach to unit root test is that it allows for breaks under the null (β = 1) and alternative (β < 1) in the DGP given in Equation (3.1). This method uses the following regression to obtain the LM unit root test statistics

$$\Delta y_t = \delta' \Delta Z_t + \phi \tilde{S}_{t-1} + \sum_{i=1}^{k} \gamma_i \Delta \tilde{S}_{t-j} + u_t \tag{3.2}$$

where $\tilde{S}_t = y_t - \tilde{\Psi}_t - Z_t\tilde{\delta}, t = 2,\ldots,T; \tilde{\delta}$ denotes the regression coefficient of Δy_t on ΔZ_t and $\tilde{\Psi}_t = y_t - Z_1\tilde{\delta}$, y_1 and Z_1 being first observations of y_t and Z_t respectively. The lagged term $\Delta \tilde{S}_{t-j}$ are included to correct for likely serial correlation in errors. Using the above equation, the null hypothesis of unit root test $(\phi = 0)$ is tested by the LM t-statistics. The location of the structural break or structural breaks is determined by selecting all possible breaks for the minimum t-statistic as follows:

$$\ln f\tilde{\tau}(\bar{\lambda}_i) = \ln_{\lambda} f\tilde{\tau}(\lambda), \text{where } \lambda = T_B / T.$$

The search is carried out over the trimming region $(0.15T, 0.85T)$, where T is sample size and T_B denotes date of structural break. We determined the breaks where the endogenous two-break LM t-test statistic is at a minimum. The critical values are tabulated in Lee and Strazicich (2003, 2004) for the two-break and one-break cases respectively.

Now we will briefly discuss the unit root test due to Narayan and Poop (2010). Suppose, we consider an unobserved components model to represent the DGP and the DGP of a time series y_t has two components, a deterministic component (d_t) and a stochastic component (u_t), as follows[23]:

$$y_t = d_t + u_t, \tag{3.3}$$

$$u_t = \rho u_{t-1} + \varepsilon_t, \tag{3.4}$$

$$\varepsilon_t = \Psi^*(L)e_t = A^*(L)^{-1}B(L)e_t, \tag{3.5}$$

e_t is a white noise process, such that $e_t \sim NIID(0,\sigma^2)$. By assuming that the roots of the lag polynomials $A^*(L)$ and $B(L)$, which are of order p and q, respectively, lie outside the unit circle NP (2010) considered two different specifications for trending data- one allows for two breaks in level (denoted as model 1 i.e., M1) and the other allows for two breaks in level as well as slope (denoted as model 2 i.e., M2). The specification of both models differs in terms of the definition of the deterministic component, d_t,:

$$d_t^{M1} = \alpha + \beta t + \Psi^*(L)(\theta_1 DU'_{1,t} + \theta_2 DU'_{2,t}), \tag{3.6}$$

$$d_t^{M2} = \alpha + \beta t + \Psi^*(L)(\theta_1 DU'_{1,t} + \theta_2 DU'_{2,t} + \gamma_1 DT'_{1,t} + \gamma_2 DT'_{2,t}), \tag{3.7}$$

with

[23] This section is largely based on Narayan and Poop's (2010) work. We are grateful to the authors for providing the codes for the analysis.

$$d_t^{M2} = \alpha + \beta t + \Psi^*(L)(\theta_1 DU_{1,t}^{'} + \theta_2 DU_{2,t}^{'} + \gamma_1 DT_{1,t}^{'} + \gamma_2 DT_{2,t}^{'}) \tag{3.8}$$

where, $T_{B,i}^{'}$, i = 1, 2, denote the true break dates, θ_i and γ_i, indicate the magnitude of the level and slope breaks, respectively. The inclusion of $\Psi^*(L)$ in Equations (3.6) and (3.7) enables breaks to occur slowly over time i.e., it assumes that the series responds to shocks to the trend function the way it reacts to shocks to the innovation process e_t (Vogelsang and Perron 1998). This process is known as the IO model and the IO-type test regressions to test for the unit root hypothesis for M1 and M2 can be derived by merging the structural model (3.3)–(3.7). The test regressions can be derived from the corresponding structural model in reduced form as follows:

$$y_t^{M1} = \rho y_{t-1} + \alpha_1 + \beta^* t + \theta_1 D(T_B^{'})_{1,t} + \theta_2 D(T_B^{'})_{2,t} +,$$

$$\delta_1 DU_{1,t-1}^{'} + \delta_2 DU_{2,t-1}^{'} + \sum_{j=1}^{k} \beta_j \Delta y_{t-j} + e_t \tag{3.9}$$

with $\alpha_1 = \Psi^*(1)^{-1}[(1-\rho)\alpha + \rho\beta] + \Psi^{*'}(1)^{-1}(1-\rho)\beta, \Psi^{*'}(1)^{-1}$ being the mean lag, $\beta^* = \Psi^*(1)^{-1}(1-\rho)\beta, \phi = \rho - 1, \delta_i = -\phi\theta_i$ and $D(T_B^{'})_{i,t} = 1(t = T_{B,i}^{'} + 1), i = 1,2$.

$$y_t^{M2} = \rho y_{t-1} + \alpha^* + \beta^* t + \kappa_1 D(T_B^{'})_{1,t} + \kappa_2 D(T_B^{'})_{2,t} + \delta_1^* DU_{1,t-1}^{'} +$$

$$\delta_2^* DU_{2,t-1}^{'} + \gamma_1^* DT_{1,t-1}^{'} + \gamma_2^* DT_{2,t-1}^{'} + \sum_{j=1}^{k} \beta_j \Delta y_{t-j} + e_t \tag{3.10}$$

where equation (3.9) and (3.10) are IO-type test regression for M1 and M2 respectively, $\kappa_i = (\theta_i + \gamma_i), \delta_i^* = (\gamma_i - \phi\theta_i), and\ \gamma_i^* = -\phi\gamma_i, i = 1,2.$

In order to test the unit root null hypothesis of ρ = 1 against the alternative hypothesis of ρ <1, we use the t-statistics of $\hat{\rho}$, denoted $t_{\hat{\rho}}$, in Equations (3.9) and (3.10). Since it is assumed that true break dates are unknown, $T_{B,i}^{'}$ in equations (3.9) and (3.10) has to be substituted by their estimates $\hat{T}_{B,i}$, i = 1, 2, in order to conduct the unit root test. The break dates can be selected simultaneously following a grid search procedure or a sequential procedure comparable to Kapetanios (2005). Narayan and Poop (2010) have preferred sequential procedure as it is far less computationally demanding, and therefore, we have also followed sequential procedure.

In this case, in the first step, search for a single break which we select according to the maximum absolute *t*-value of the break dummy coefficient θ_1 for M1 and κ_1 for M2. Thereafter, we impose the restriction $\theta_2 = \delta_2 = 0$ for M1 and $\kappa_2 = \delta = \gamma = 0$ for M2 and hence, we have:

$$T_{B,1}^{'} = \begin{cases} \arg\max_{T_{B,1}} \left| t_{\hat{\theta}_1}(T_{B,1}) \right|, \ for \ M1, \\ \arg\max_{T_{B,1}} \left| t_{\hat{\kappa}_1}(T_{B,1}) \right|, \ for \ M2 \end{cases} \tag{3.11}$$

So, in the first step, the test procedure reduces to the case described in (Popp, 2008). Imposing the first break $\hat{T}_{B,1}$ in the test regression, we estimate the second break date $\hat{T}_{B,2}$. Again we maximize the absolute *t*-value; this time θ_2 for M1 and κ_2 for M2. Hence, we have:

$$T_{B,2}^{'} = \begin{cases} \arg\max_{T_{B,2}} \left| t_{\hat{\theta}_2}(\hat{T}_{B,1}, T_{B,2}) \right|, \ for \ M1, \\ \arg\max_{T_{B,2}} \left| t_{\hat{\kappa}_2}(\hat{T}_{B,1}, T_{B,2} \right|, \ for \ M2 \end{cases} \tag{3.12}$$

3.3.1.2 Cointegration analysis in the time series

Economic theorists usually use the term cointegration to refer to an equality between desired and actual transactions, however, in Econometrics, it is used to refer the long-run relationship among nonstationary variables. Cointegration does not require that market forces generate the long-run relationship or by the behavioural rules of the individuals while in Engle-Granger's use of the term, the equilibrium relationship may be causal, behavioural, or simply a reduced form relationship among similarly trending variable (Enders, 2004, pp.322). The components of the vector X_t are said to cointegrated of order (d, b), which is denoted by $X_t \sim CI(d,b)$ if:

1. All components of X_t are integrated of order d[24].
2. There exist a cointegrating vector β such that the linear combination $\beta_1 X_{1t} + \beta_2 X_{2t} + \ldots + \beta_n X_{nt}$ is integrated of order (d-b), where $d \geq b \geq 0$, CI is a symbol of Cointegration, and vector of the coefficients, β, is known as cointegrating vector.

There are broadly two ways to carry out cointegration analysis. First, tests that are based on the residual approach, for example, Engle-Granger approach and second, that are based on Maximum Likelihood (ML) estimation of a VAR system, for example, Johansen-Juselius (1990) method (for details on both tests refer Tiwari, 2011). However, these tests were introduced based on the assumption that the cointegrating vector remained the same during the period of study. There are many reasons to expect that the long-run relationship between the underlying variables might change (shifts in the cointegrating vector can occur). Structural changes and asymmetry can take place because of economic crisis, technological shocks, changes in the economic factors' preferences and behaviour accordingly, policy and regime changes, and organizational or institutional evolution Gregory and Hansen (1996) show that these tests for cointegration have also low power in the presence of a regime shift that is not taken into account. Gregory and Hansen (1996) modify three residual based unit root tests that take into account one unknown regime shift. They suggest a procedure to choose the timing of a shift in the cointegrating vector based on the data. They furthermore provide new critical values for the ADF test for cointegration (as suggested by Engle and Granger 1987) and two tests known as Za and Zt (as suggested by Phillips, 1987). The Hatemi-J (2008a) builds on the Gregory and Hansen (1996) tests for cointegration in the presence of one shift and by extending their work to

[24] A series is integrated of order d if it must be differenced d times in order to become stationary.

allow for two regime shifts. The Hatemi-J (2008a) also provides new critical values for ADF, Za and Zt tests under these circumstances. Again, the timing of the breaks is not based on a priori information, but rather upon the underlying data. Therefore, in our study, we follow Hatemi-J (2008a) which incorporates structural changes and Granger and Yoon (2002) and Schorderet (2004), which incorporate for asymmetry with preferring Granger and Yoon (2002) as this test is found to be having a better model fit by Richard (2012), which demonstrates the small sample properties for both Granger and Yoon (2002) and Schorderet (2004). First, we discuss briefly a cointegration test due to Hatemi-J (2008a) and later focus on the asymmetric cointegration test due to Granger and Yoon (2002) and Schorderet (2004).

Hatemi-J (2008a) developed a model based on two regime shifts. To understand his model, let us define a regression equation of following type:

$$y_t = \alpha + \beta' x_t + u_t, \quad t = 1,2,\dots, n. \tag{3.13}$$

where y_t is the dependent variable; x_t is an m-dimensional vector of independent variables, α is the intercept term, β is a m-dimensional vector of slopes and t represents the time index. Equation (3.13) is the standard model that is usually applied to test for cointegration. According to Engle and Granger (1987), cointegration prevails if u_t is integrated of degree zero, $u_t \sim I(0)$, provided that $y_t \sim I(1)$ and $x_t \sim I(1)$.[25] Based on this idea to test for cointegration, the variables are tested for unit roots. If a unit root exists in each variable in the model represented by

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[25] For cointegration, higher orders of integration for y_t and x_t are also allowed as long as they are of the same order of integration, and the linear combination is integration of one less order than y_t and x_t. However, author developed test for y_t and x_t being at most integrated of degree one.

Equation (3.13), then the linear combination approximated by u_t is tested for one unit root. Three residual based test statistics, namely the augmented Dickey–Fuller (ADF) test (suggested by Engle and Granger, 1987), and the Z_a and Z_t tests (suggested by Phillips 1987) are commonly used to detect whether there is cointegration or not. However, Gregory and Hansen (1996) showed that these test statistics for cointegration are mis-specified if a structural shift has occurred during the period of study. They extended these test statistics to allow for one regime shift at an unknown time,[26] which is determined by the data. The Hatemi-J (2008a) generates new critical values by extending the tests for cointegration due to Gregory and Hansen (1996) to take into account the possibility of two structural shifts during the period of study. To account for the effect of two structural breaks on both the intercept and the slopes (two regime shifts), the authors generalized Equation (3.13) in the following form:

$$y_t = \alpha_0 + \alpha_1 D_{1t} + \alpha_2 D_{2t} + \beta_0' x_t + \beta_1' D_{1t} x_t + \beta_2' D_{2t} x_t + u_t \quad (3.14)$$

where D_{1t} and D_{2t} are dummy variables defined as:

$$D_{1t} = \begin{cases} 0 & if \quad t \le [n\tau_1] \\ 1 & if \quad t > [n\tau_1] \end{cases} \text{ and } D_{2t} = \begin{cases} 0 & if \quad t \le [n\tau_2] \\ 1 & if \quad t > [n\tau_2] \end{cases}$$

with the unknown parameters $\tau_1 \in (0, \ 1)$ and $\tau_2 \in (0, \ 1)$ signifying the relative timing of the regime change point and the bracket denotes the integer part.

To test the null hypothesis of no cointegration, the ADF test is calculated by the corresponding t-test for the slope of $\hat{u}_{t-1}$ in a regression of $\Delta\hat{u}_t$ on $\hat{u}_{t-1}$, $\Delta\hat{u}_{t-1}, \ldots, \Delta\hat{u}_{t-k}$, where $\hat{u}_t$ signifies the estimated error term from regression Equation (3.14). The Z_a and Z_t test

[26]By a regime shift it is meant that there is a change in both the intercept and the slope parameters.

statistics are based on the calculation of the bias-corrected first-order serial correlation coefficient estimate $\hat{\rho}^*$, defined as

$$\hat{\rho}^* = \frac{\sum_{t=1}^{n-1}\left(\hat{u}_t \hat{u}_{t+1} - \sum_{j=1}^{B} w(j/B)\hat{\gamma}(j)\right)}{\sum_{t=1}^{n-1}\hat{u}_t^2} \tag{3.15}$$

where $w(\cdot)$ is a function providing kernel weights meeting the standard conditions for spectral density estimators, B (itself a function of n) is the bandwidth number satisfying the conditions $B \to \infty$ and $B/n^5 = O(1)$ and $\hat{\gamma}(j)$ is an auto-covariance function. The auto-covariance function is defined by

$$\hat{\gamma}(j) = \frac{1}{n}\sum_{t=j+1}^{T}(\hat{u}_{t-j} - \hat{\rho}\hat{u}_{t-j-1})(\hat{u}_t - \hat{\rho}\hat{u}_{t-1}) \tag{3.16}$$

where $\hat{\rho}$ is the OLS estimate of the effect (without intercept) of $\hat{u}_{t-1}$ on $\hat{u}_t$. The Z_a and Z_t test statistics are defined as

$$Z_a = n(\hat{\rho}^* - 1) \tag{3.17}$$

and

$$Z_t = \frac{(\hat{\rho}^* - 1)}{\left(\hat{\gamma}(0) + 2\sum_{j=1}^{B} w(j/B)\hat{\gamma}(j)\right) / \sum_{1}^{n-2}(\hat{u}_t^2)} \tag{3.18}$$

where $\hat{\gamma}(0) + 2\sum_{j=1}^{B} w(j/B)\hat{\gamma}(j)$ is the long-run variance estimate of the residuals of a regression of $\hat{u}_t$ on $\hat{u}_{t-1}$.[27] These three test statistics have nonstandard distributions. It should be mentioned that the asymptotic distribution of the ADF test statistic is identical to the distribution of the Z_t statistic. Our applicable test statistics are the smallest values of these three tests across

[27] The estimation for the long-run variance utilizes an automatic bandwidth estimator and a pre-whitened quadratic spectral kernel with a first-order autoregression for the pre-whitening. For details, Gregory and Hansen (1996) refer us to Andrews (1991) and Andrews and Monahan (1992).

all values for τ_1 and τ_2, with $\tau_1 \in T_1 = (0.15, \quad 0.70)$ and $\tau_2 \in T_2 = (0.15 + \tau_1, \quad 0.85)$. The idea behind choosing the smallest value for each test statistic is that the smallest value represents the empirical evidence against the null hypothesis.[28] These test statistics are defined as

$$ADF^* = \inf_{(\tau_1,\tau_2)\in T} ADF(\tau_1,\tau_2) \tag{3.19}$$

$$Z_t^* = \inf_{(\tau_1,\tau_2)\in T} Z_t(\tau_1,\tau_2) \tag{3.20}$$

$$Z_a^* = \inf_{(\tau_1,\tau_2)\in T} Z_a(\tau_1,\tau_2) \tag{3.21}$$

where $T = (0.15\,n, \quad 0.85\,n)$. The idea to truncate the data by 15% on each side follows the footsteps of Gregory and Hansen (1996). Based on the same logic, we also let the distance between the two regimes shifts be at least 15%. The distribution of these test statistics can be expressed as functions of Brownian motions. However, since they are not given in closed forms, we generate the asymptotic critical values by simulation methods in a similar way as Gregory and Hansen (1996). The tests seem to have small size distortions and very good power properties.

Now we present a brief introduction about the Hidden cointegration approach. We adopted the Hidden cointegration technique developed by Granger and Yoon (2002) and Schorderet (2004)[29] and recently applied in Richard (2012) that demonstrates the small sample properties. This technique is particularly useful in examining asymmetry in cointegration between two variables. Let X_t and Y_t be two random walks given by

$$X_t = X_{t-1} + \zeta_t \tag{3.22}$$

$$Y_t = Y_{t-1} + \eta_t \tag{3.23}$$

[28] See also Gregory and Hansen (1996).
[29] We present a brief exposition of our approach since the details can be found in Granger and Yoon (2002) and Schorderet (2004). Here, our elaborations are based on Richard (2012).

where $\zeta_t \sim N(0,\sigma_\zeta^2)$ and $\eta_t \sim N(0,\sigma_\eta^2)$.

The hidden cointegration approach states that there is a threshold parameter, δ , such that[30]

$$\zeta_t^+ = \max(\zeta_t,\delta)\ \zeta_t^- = \min(\zeta_t,\delta) \text{ and } \zeta_t = \zeta_t^+ + \zeta_t^- - \delta) \quad (3.24)$$

$$\eta_t^+ = \max(\eta_t,\delta)\ \eta_t^- = \min(\eta_t,\delta) \text{ and } \eta_t = \eta_t^+ + \eta_t^- - \delta) \quad (3.25)$$

and that the following representations are true:

$$X_t = X_0 + \sum_j^t I(\Delta X_j > \delta)\Delta X_j + \sum_j^t I(\Delta X_j < \delta)\Delta X_j - \delta_t \quad (3.26)$$

$$Y_t = Y_0 + \sum_j^t I(\Delta Y_j > \delta)\Delta Y_j + \sum_j^t I(\Delta Y_j < \delta)\Delta Y_j - \delta_t \quad (3.27)$$

for all t= 1,2,…,T, and where X_0 and Y_0 are the initial values of the time series, Δ is the first-difference operator and δ_t is the trend term. $I(\cdot)$ is an indicator function that takes the value of 1 if the event in the brackets occurs and the value of zero otherwise. Equations (3.24) and (3.25) state that the error terms can be decomposed into their positive and negative components less the threshold value, while Equations (3.26) and (3.27) state that the time series can be decomposed into their initial values, their cumulative positive and negative components minus the trend terms. We must determine the threshold value before estimation can be done. Although a popular choice of zero could be adopted for the threshold (Granger and Yoon, 2002, p. 6), a more formal approach will be based on the criterion that maximizes the sum of the correlations between and $\{\Delta Y_t^-, \Delta X_t^-\}$, where $\Delta Y_t^+ \equiv I(\Delta Y_t > \delta)\Delta Y_t$ and $\Delta Y_t^- \equiv I(\Delta Y_t < \delta)\Delta Y$ and ditto for variable X_t (Granger and Yoon, 2002, p.25). Adopting a zero threshold value for

[30] Note that each variable may have a distinct threshold. The use of a common threshold here is for expository purpose only. In the data analysis, we shall relax this assumption.

HC naturally makes it a negative component to carry the notion of hydroelectricity conservation[31].

For real GDP per capita, setting δ to zero would capture the idea of booms and recessions or economic expansion and contraction. Thus, one can actually and directly answer the question of whether hydroelectricity conservation policies do harm the growth process. To choose a threshold value, Granger and Yoon (2002, p.7) suggest that sufficient variations around the chosen threshold must exist. In case $\delta \neq 0$, the cumulative sums of the positive and negative variations are given by

$$X_t^+ \equiv \sum_j^t I(\Delta X_j > \delta)\Delta X_j \; X_t^- \equiv \sum_j^t I(\Delta X_j < \delta)\Delta X_j \tag{3.28}$$

$$Y_t^+ \equiv \sum_j^t I(\Delta Y_j > \delta)\Delta Y_j \; Y_t^- \equiv \sum_j^t I(\Delta Y_j < \delta)\Delta Y_j \tag{3.29}$$

If, indeed, $\delta = 0$, Equations (3.28) and (3.29) respectively become

$$X_t^+ \equiv \sum_j^t I(\Delta X_j > 0)\Delta X_j \; X_t^- \equiv \sum_j^t I(\Delta X_j < 0)\Delta X_j \tag{3.30}$$

$$Y_t^+ \equiv \sum_j^t I(\Delta Y_j > 0)\Delta Y_j \; Y_t^- \equiv \sum_j^t I(\Delta Y_j < 0)\Delta Y_j \tag{3.31}$$

The hidden cointegration procedure requires that we first find the first difference of each of the time series, that is, compute $\Delta X_t \equiv X_t - X_{t-1}$ and $\Delta Y_t \equiv Y_t - Y_{t-1}$ and then apply formulae in Equations (3.30) and (3.31), or in Equations (3.28) and (3.29) in case $\delta \neq 0$, to these series to obtain their cumulative sums. Thus, $\{X_t^+\}_{t=1}^T$ (respectively $\{X_t^-\}_{t=1}^T$) and $\{Y_t^+\}_{t=1}^T$ (respectively

[31] In the subsequent analysis, we shall refer to the positive component of hydroelectricity consumption as hydroelectricity utilization and the negative component as hydroelectricity conservation. Likewise, we shall refer to the positive component of real GDP as economic expansion and the negative component as economic contraction.

$\{Y_t^-\}_{t=1}^T$) are the cumulative sums of the positive (respectively negative) components of shocks driving the levels of the original series at time t (Schorderet, 2004). We observe that X_t^+ and Y_t^+ (respectively X_t^- and Y_t^-) are integrated of order one and are monotonically increasing (respectively, decreasing). To establish the existence of nonlinear cointegration we may apply the Granger-Yoon (2002) hidden cointegration test procedure. Between X_t^+ and Y_t^+, for example, the Granger-Yoon (2002) specification is given by

$$X_t^+ = \alpha^+ + \beta^+ trd_t + \gamma^+ Y^+ + \upsilon_t \tag{3.32}$$

where we have added the time trend, trd_t. X_t^+ moreover, Y_t^+ are said to be asymmetrically cointegrated if there exists a vector $\theta' = (\alpha^+, \beta^+, \gamma^+)$ such that υ_t is stationary. For Equation (3.32), Granger and Yoon (2002) claim that the standard test procedure can be applied. In view of nonlinearity in the model, Schorderet (2004) points out that the standard test procedure applied to Equation (3.32) will be biased. To overcome this problem, he suggests adding ΔX_t^- to the left hand side of Equation (3.32) so that we have the following auxiliary model:

$$X_t^+ + \Delta X_t^- = \alpha^+ + \beta^+ trd_t + \gamma^+ Y^+ + \varepsilon_t \tag{3.33}$$

where asymmetric cointegration between X_t^+ and Y_t^+ is now preconditioned on the stationarity of ε_t. In what follows, we shall investigate both the Granger-Yoon (2002) and the Schorderet (2004) auxiliary hidden cointegration models for all the countries under study.

3.3.1.3 VAR bootstrap and asymmetric VAR causality

Now we will elaborate a bootstrap test for causality with endogenous lag length choice proposed by Hacker and Hatemi-J (2012). Hacker and Hatemi-J (2012) follow the approach of Hacker and Hatemi-J (2006), however, their work is different from that previous paper in a number of ways:

1. In Hacker and Hatemi-J (2006), the lag length was assumed to be known, whereas in the Hacker and Hatemi-J (2012) the lag length is assumed unknown and the one chosen for application is data driven, using minimization of an information criterion. Since the lag length in practice is typically unknown, Hacker and Hatemi-J (2012) considered that considering this in the simulations to be rather important. There is the possibility that more lags than the actual number may be chosen when the variables are integrated, and that may affect the usefulness of including augmentation lags when testing for Granger causality.
2. In Hacker and Hatemi-J (2012), power results are presented, whereas simulation results in power were entirely missing in the previous paper.
3. In Hacker and Hatemi-J (2012), smaller sample sizes are focused on – 20 and 40 observations. Hacker and Hatemi-J (2006) had simulation results for 40 and 100 observations.
4. In Hacker and Hatemi-J (2006) simulation results were missing for the situation in which no augmentation lags are used, for VAR(1) and VAR(2) models. Simulation results for this situation are presented in Hacker and Hatemi-J (2012), and Hacker and Hatemi-J (2012) find them interesting to investigate since it can affect the results of ignoring altogether the Toda and Yamamoto suggestion for augmented lags if indeed the

variables are integrated. In Hacker and Hatemi-J (2006) there were results presented for providing one augmentation lag when the variables were I(2), providing an example of what occurs with too-few augmentation lags, but we consider the situation of no augmentation lags important to present also.

5. Simulation results are presented in Hacker and Hatemi-J (2012), unlike in Hacker and Hatemi-J (2006), for the situation in which two augmentation lags are included when dealing with a VAR(1) model. Hacker and Hatemi-J (2012) considered this situation important to present since it allows further consideration of the effects of having too many augmentation lags if the variables are I(1) or I(0).

The Granger-causality testing procedure for Hacker and Hatemi-J (2012) test is explained as follows. Let's us consider the following vector autoregressive model of order k, VAR(k):

$$y_t = B_0 + B_1 y_{t-1} + \ldots + B_k y_{t-k} + u_t \qquad (3.34)$$

where y_t, B_0, and u_t are vectors with dimensions $n \times 1$ and $B_i, i \geq 1$ is a parameter matrix with $n \times n$ dimensions. The error vector, u_t, has a zero-expected value and it is assumed to be independent and identically distributed with a non-singular covariance matrix Ω that fulfils the $E|u_{it}|^{2+\lambda} < \infty$ condition for some $\lambda > 0$, with u_{it} being the *i*th element of u_t (this assumption is needed for appropriate testing conditions). There is non-Granger causality of the *r*th element of y_t on the *j*th element of y_t only if the subsequent statement is correct:

H_0: the element in B_i's row *j*, column *r* is zero for $i = 1, \ldots, k$. (3.35)

Toda and Yamamoto (1995) suggest that if one thinks that the variables in Equation (3.34) are integrated of order d, then a legitimate way to proceed is to estimate Equation (3.34) with *d* additional lags in the estimated VAR model (in addition to the k lags), and perform a Wald test with the null hypothesis constraints for no Granger causality applying on the Bi coefficient matrixes for only $i = 1,..., k$. Thus, the coefficient matrixes for the last d lags in the estimated VAR model would be unconstrained under the null hypothesis. We refer to the d additional lags as "augmentation lags" in this paper.

If the null hypothesis in a Wald test is true, then asymptotically the resulting Wald test statistic is χ^2 distributed with the number of restrictions under the null providing the number of degrees of freedom. In the case of Granger causality testing with only two variables in the VAR model, the degrees of freedom is equal to the lag order k, regardless of whether the Toda and Yamamoto augmentation lags are included, since the coefficient estimates for those additional lags are unconstrained under the null hypothesis.

Hacker and Hatemi-J (2012) adopted a new approach to determine the "optimal lag order". Hacker and Hatemi-J (2012) assume for their simulations and for their bootstrapping the optimal lag order is determined by estimating the VAR(k) model in equation (3.34) for $k = 0,..., K$, where K is the maximum lag length considered, and finding that k which minimizes the multivariate version of the Schwarz Bayesian criterion (SBC) rather resorting to some information-criterion minimization or some other data-driven technique. In brief, Hacker and Hatemi-J (2012) suggest that with reasonably small sample sizes, bootstrapping the two-stage process of researcher – first finding the optimal lag length and then finding a Wald statistic for testing Granger causality – can provide a decent distribution for considering the significance of a Wald statistic.

Now briefly we will discuss the type of bootstrapping approach adopted by Hacker and Hatemi-J (2012). The first stage of that bootstrapping process involves the estimation of equation (34) using the optimal lag order k (determined by the methodology discussed in the previous section) without imposing any restriction implied by the null hypothesis of non-causality. Then, we generate the simulated data, denoted by y_t^*, as the following:

$$y_t^* = \hat{B}_0 + \hat{B}_1 y_{t-1} + \ldots + \hat{B}_k y_{t-k} + \hat{u}_t^* \tag{3.36}$$

for the period $t = 1,\ldots, T$, where the circumflex above a parameter matrix represents the estimate of that parameter matrix in the first step, and $\hat{u}_t^*$ is a vector of bootstrapped error terms. The set of T bootstrapped error term vectors is found by drawing randomly with replacement from the vectors of modified residuals of the regression (defined below), with equal probability of drawing any of those vectors, and for each element in the error vector, subtracting the mean of the associated drawn modified residuals from each of those modified residuals (to make sure that the mean of the bootstrapped error term vectors is a zero vector).

The regression's modified residuals are the raw residuals modified via leverages to have constant variance (this modification can improve the bootstrapping under circumstances of Heteroskedasticity). Further notation helps clarify the leverage modification. Hacker and Hatemi-J (2012) define Y_{-p} to be $(y_{1-p,\ldots,}y_{T-p})$ and $Y_{i,-p}$ to be Y_{-p}'s ith row.

Thus, $Y_{i,-p}$ is defined as a row vector of y_{it}'s lag P values during the sample period $t = 1,\ldots, T$. Suppose also that $V = (Y'_{-1,\ldots,} Y'_{-k})$ and $V_i = (Y'_{i,-1,\ldots,} Y'_{i,-k})$ for $i = 1,\ldots, n$. For the equation that generates y_{1t}, the independent variable matrix is given by V_1; this equation has the null hypothesis restrictions of non-Granger causality. V provides the matrix of independent variables for the equation generating y_{2t}; this equation is not restricted by the null hypothesis of non-Granger causality and it includes the lag values of all variables in the VAR model. Now we are in the position to define the $T\times 1$ leverages vectors for y_{1t} and y_{2t} as the following:

$$l_1 = dig(V_1(V_1'V_1)^{-1}V_1'), \tag{3.37}$$

and:

$$l_2 = dig(V(V'V)^{-1}V'). \tag{3.38}$$

These leverages are used to modify the residuals in order to take into account the effect of ARCH. The modified residual for y_{it} is produced as:

$$\hat{u}_{it}^m = \frac{\hat{u}_{it}}{\sqrt{1-l_{it}}} \tag{3.39}$$

where the *t*th element of l_i is given by l_{it} and the raw residual from the regression with y_{it} as the dependent variable is given by $\hat{u}_{it}$.

The bootstrap simulation is repeated *M* times and each time a Wald statistic is produced using the previously determined optimal lag order for the original data and when implementing the Toda and Yamamoto (1995) methodology, an assumed order of integration. The resulting set of bootstrapped Wald statistics is referred to as the bootstrapped Wald distribution. Subsequently determined is the "bootstrap critical value" for the a-level of significance (c_{α}^{*}), which is the lower boundary of the top a quantile of the bootstrapped Wald-statistic distribution. If the calculated Wald statistic is higher than the bootstrap critical value c_{α}^{*} then the null hypothesis of non-causality is rejected based on bootstrapping at the a-level of significance.

Now we will discuss the asymmetric causality tests developed by Hatemi-J (2012). Reasons, which can create room for an asymmetric causal relationship between the variables, which are discussed in this chapter before. The asymmetric causality approach of Hatemi-J (2012) captures the asymmetry in the causal relationship by using the cumulative sums of positive and negative shocks. Further, a bootstrap simulation approach with leverage adjustment to generate critical values is suggested in Hatemi-J (2012) that is robust to non-normality and time-varying volatility. Now we will briefly elaborate the asymmetric causality tests.

Hatemi-J (2012) developed asymmetric causality tests taking idea from Granger and Yoon (2002) for integrated variables in a vector autoregressive (VAR) model. Hatemi-J (2012) argues that his test is asymmetric in the sense that it is developed on the idea that positive and negative shocks may have different causal impacts. Asymmetric causality tests developed by Hatemi-J (2012) can be explained as follows. Let us assume that in a VAR we have two integrated variables, x_{1t} and x_{2t}, defined as the following random walk processes[32] of which we are interested in investigating the causal relationship:

$$x_{1t} = x_{1t-1} + e_{1t} = x_{10} + \sum_{i=1}^{t} e_{1i}, \tag{3.40}$$

and

$$x_{2t} = x_{2t-1} + e_{2t} = x_{20} + \sum_{i=1}^{t} e_{2i}, \tag{3.41}$$

where $t = 1,2,\ldots T$, $x_{1,0}$ and $x_{2,0}$ are the constants that takes initial values, and e_{1i} and e_{2i} are the white noise errors terms. Hatemi-J (2012) defined positive and negative shocks as the following: $e_{1i}^{+} = \max(e_{1i},0)$, $e_{2i}^{+} = \max(e_{2i},0)$, $e_{1i}^{-} = \min(e_{1i},0)$, and $e_{2i}^{-} = \min(e_{2i},0)$, respectively. Therefore, one can express $e_{1i} = e_{1i}^{+} + e_{1i}^{-}$ and $e_{2i} = e_{2i}^{+} + e_{2i}^{-}$. This implies that

$$x_{1t} = x_{1t-1} + e_{1t} = x_{1,0} + \sum_{i=1}^{t} e_{1i}^{+} + \sum_{i=1}^{t} e_{1i}^{-},$$

and similarly,

[32] Asymmetric causality testing can also be implemented for stationary variables. In that case, positive or negative changes can be used instead of the cumulative sums.

$$x_{2t} = x_{2t-1} + e_{2t} = x_{2,0} + \sum_{i=1}^{t} e_{2i}^{+} + \sum_{i=1}^{t} e_{2i}^{-} .$$

Finally, in a cumulative form, the positive and negative shocks of each variable can be defined as

$x_{1t}^{+} = \sum_{i=1}^{t} e_{1i}^{+}, x_{1t}^{-} = \sum_{i=1}^{t} e_{1i}^{-}, x_{2t}^{+} = \sum_{i=1}^{t} e_{2i}^{+}$, and $x_{2t}^{-} = \sum_{i=1}^{t} e_{2i}^{-}$. It is important to mention that each positive as well as negative component has a permanent impact on the variables in question. Our objective is to test the causal relationship between these components. Let us discuss the case of testing for causal relationship between positive cumulative shocks.[33] Presuming that $x_t^{+} = (x_{1t}^{+}, x_{2t}^{+})$, for the following VAR model of order p, VAR(p), the test for causality can be implemented:

$$x_t^{+} = \alpha + A_1 x_{t-1}^{+} + \ldots + A_p x_{t-1}^{+} + \xi_t^{+}, \tag{3.42}$$

where x_t^{+}, α, and ξ_t^{+} respectively, is the 2 × 1 vector of the variables, of intercepts, and of error terms (corresponding to each of the variables representing the cumulative sum of positive shocks). The matrix A_r is a 2×2 matrix of parameters for lag order r (r = 1, . . .,p). To select appropriate lag order (p) we used information criteria suggested by Hatemi-J (2003) which is defined as follows[34]:

$$HJC = \ln\left(\left|\hat{\Omega}_j\right|\right) + j\left(\frac{n^2 \ln T + 2n^2 \ln(\ln T)}{2T}\right), \qquad j = 0,\ldots,p. \tag{3.43}$$

where $\left|\hat{\Omega}_j\right|$ denotes the determinant of the estimated variance–covariance matrix of the disturbance terms in the VAR model based on lag order j, n is the number of equations in the

[33]To conduct tests for causality between negative cumulative shocks, the vector $x_t^{-} = (x_{1t}^{-}, x_{2t}^{-})$ is used.

[34] We preferred to use this information criteria because Hatemi-J (2008b) have shown in the simulation experiments that this information criterion is robust to ARCH and it also performs well when the VAR model is used to forecast.

VAR model and T is the number of observations. Once appropriate lag order is determined we proceeded to test the null hypothesis that kth element of x_t^+ does not Granger-cause the ωth element of x_t^+.[35] Specifically the following hypothesis is tested:

H_0:the row ω, column k element in A_r equals zero for $r = 1, \ldots, p.$ (3.44)

A Wald test in a compact form can be also expressed. Let us make the following denotations[36]:

$X := (x_1^+, \ldots, x_T^+)$ $(n \times T)$ matrix,

$D := (\alpha, A_1, \ldots, A_p)$ $(n \times (1 + np))$ matrix,

$$Z_t := \begin{bmatrix} 1 \\ x_t^+ \\ x_{t-1}^+ \\ . \\ . \\ . \\ x_{t-p+1}^+ \end{bmatrix} \quad ((1 + np) \times 1) \text{ matrix, for } t = 1, \ldots, T,$$

where $Z := (Z_0, \ldots, Z_{T-1})$ $((1 + np) \times T)$ matrix, and $\delta := (\xi_1^+, \ldots \xi_T^+)$ $(n \times T)$ matrix. Hence, in compact form we can define the VAR(p)model as the following:

$$X = DZ + \delta \tag{3.45}$$

In such a case, the null hypothesis of non-Granger causality H_0: $C\beta = 0$, is tested by the following test method:

$$Wald = (C\beta)'[C((Z'Z)^{-1} \Theta S_U)C']^{-1}(C\beta), \tag{3.46}$$

[35] It should be mentioned that an additional unrestricted lag was included in the VAR model in order to take into account the effect of one unit root as suggested by Toda and Yamamoto (1995).
[36] Note that we assume the p initial values for each variable are available. For details on this assumption, see Lutkepohl (2005).

where β = vec(D) and vec indicates the column-stacking operator; Θ represents the Kronecker product, and C is a $p \times n(1 + np)$ indicator matrix with elements ones for restricted parameters and zeros for the rest of the parameters. S_U is the variance–covariance matrix of the unrestricted VAR model estimated as $S_U = \frac{\hat{\delta}_U^{'}\hat{\delta}_U}{T-q}$, where q is the number of parameters in each equation of the VAR model. If assumption of normality is satisfied, the Wald test statistic above has an asymptotic χ^2 distribution with the number of degrees of freedom equal to the number of restrictions to be tested (in this case equal to p). Further, to avoid the misleading results as our variable are non-normally distributed and also the plausible existence of autoregressive conditional Heteroskedasticity (ARCH) effects, we make use of the bootstrapping simulation technique. This approach is implemented as the following.

Firstly, the regression Equation (3.45) is estimated with restrictions implied by the null hypothesis of Granger non-causality imposed. Thereafter, data is bootstrapped, X_t^*, by using the estimated coefficients from the regression, the original data, and the bootstrapped residuals. That is, generate $X^* = \hat{D}Z + \delta^*$. The bootstrapped residuals (δ^*)are created by T random draws with replacement from the regression's modified residuals, each with equal probability of $1/T$. These bootstrapped residuals are mean-adjusted to make sure that the mean value of the residuals is zero in each bootstrap sample. This is achieved by subtracting the mean value of the resulting set of drawn modified residuals from each of the modified residuals in that particular set. The modified residuals are the regression's original residuals that are adjusted via *leverages* to have constant variance. The bootstrap simulations are repeated ten thousand times and each time the Wald test is estimated. In this way, the distribution of the test is generated. The bootstrap critical value at the α-level of significance (c_a^*) is obtained by taking the (α)th upper quantile of the distribution of the bootstrapped Wald test. The final step in the procedure is to calculate the Wald test using the original data and compared it to the bootstrap critical value. The null hypothesis of non-Granger causality is rejected at the αlevel of significance if the Wald test generated in the final step is greater than the bootstrap critical value (c_a^*). The bootstrap critical values are produced for three different significant significance levels i.e., one percentage, five percentage and 10 percentage.

3.3.2 Methodology for panel data analysis

3.3.2.1 Panel unit root tests

Breitung and Pesaran (2008) and Baltagi (2005) suggest that in the time-series Econometrics literature, the usual procedure to increase the power of unit root tests in light of shorter univariate time series data, is to use the panel data. The gain in power by switching from univariate unit root tests to panel unit root tests is well documented in the papers of Levin and Lin (1992) and Levin et al. (2002)., Surveys of panel unit root tests are given by Breitung and Pesaran (2005), Choi (2006), Banerjee (1999) and with a special focus on second generation panel unit root tests by Gutierrez (2006), Jang and Shin (2005) and Gengenbach et al. (2004), Hurlin (2010), Tiwari et al. (2012) among others. Therefore, for analysis, we used a battery of second generation panel unit root test.[37]

Panel unit root tests of the first generation assume independent units. However, if the panel features cross section dependence, these tests suffers from serious size distortions. In addition, these tests are more useful when co-movements are observed in the national business cycles of the countries in the same economic area (Hurlin, 2010). The implication of cross

[37] Interested reader is referred to Hurlin (2010), Tiwari et al. (2012) and references therein for further explanations on the first and second generation panel unit root tests.

section dependence is surveyed by several authors. Gengenbach et al. (2004) give a brief literature overview of simulation studies that assess the performance of panel unit root tests under the presence of cross correlation and cross section cointegration. Size distortions and power reductions of the Levin and Lin (1992) test due to cross section dependence were first reported by O'Connell (1998). Banerjee et al. (2005) demonstrate how panel unit root tests become oversized in the presence of long-run cross unit relationships. Hassler and Tarcolea (2005) conclude by investigating nominal long-term interest rates for 12 OECD countries, that ignoring or modelling cross-correlation in multi-country studies may heavily affect the outcome of non-stationarity panel analyses. By means of Monte Carlo simulations, Pesaran (2007) demonstrates that panel unit root tests that do not account for cross section dependence can be seriously biased if the degree of dependence is sufficiently large. PS show that OLS estimators provide little gain in precision compared with single equation OLS when cross section dependence is ignored in the panel regression.

Panel unit root tests are similar to unit root tests carried out on a single series. The panel unit root tests which assume independence across countries are based on the ADF model, and the ADF equation for panel data may be expressed as:

$$\Delta y_{it} = \rho_i y_{it-1} + \sum_{j=1}^{p} \delta_i \Delta y_{it-j} + x_{it}^{'} \beta + \varepsilon_{it} \qquad (3.47)$$

where y_{it} is the series of interest being $i = 1,..., N$ cross-section units over periods $t = 1,..., T$, x_{it} represents a column vector of exogenous variables, including any fixed effects or individual trends, ρ_i is the mean-reversion coefficient, p is the lag length of the autoregressive process and ε_{it} a idiosyncratic disturbance assumed to be a mutually independent. If $|\rho_i| < 1$, y_{it} is said to be weakly (trend-) stationary, and if $\rho_i = 1$, then y_{it} presents a unit root.

Two natural assumptions may be made about ρ_i the ADF model for panel data. First, one can assume that the persistence parameters are common across countries, so that $\rho_i = \rho$ for all i. Using this assumption, the Breitung (2000), Levin et al. (2002) approaches (both testing for a null hypothesis of a unit root against the alternative of no unit root), and the Hadri (2000) one (which tests the null hypothesis of no unit root against the alternative hypothesis of a unit root) can be applied. Second, one can allow ρ_i to be freely varying across units, allowing for individual unit root processes. This is the case of ADF and PP tests proposed by Maddala and Wu (1999) and Choi (2001) and IPS test proposed by Im et al. (2003).[38] The three of them test the null hypothesis of a unit root against the alternative hypothesis of some individuals without unit roots. In general, the possible deterministic components employed are fixed effects and individual trend. All the above panel unit root tests assume independence across countries. However, this assumption is restrictive, and if violated, it can lead to over-rejection of the null hypothesis (Bai and Ng, 2004). In this sense, the so-called second-generation tests that account for cross-section dependence should be used (see, for example, Bai and Ng, 2004; Moon and Perron, 2004; Breitung and Pesaran, 2008 for a survey). However, in our work, we have adopted the recently developed panel unit root tests which allow for cross-sectional dependence. We elaborate very shortly the testing procedure of second-generation panel unit root test

[38] Note that some tests for homogeneous panel data such as Levin et al. (2002) may be used if the panel is heterogeneous, since these tests remain consistent against heterogeneous alternatives as long as the fraction of stationary units converges to a positive constant.

employed.[39] These tests are based on Hansen (1995) approach, which suggested using stationary covariates in an otherwise standard Dickey-Fuller framework, in this way proposing his covariate augmented Dickey-Fuller test (CADF), rather than using panel data on a single variable. Indeed, Hansen (1995) and Caporale and Pittis (1999) showed that substantial power gains can be achieved using the CADF test, without incurring severe size distortions. Further, it is noteworthy to mention that these tests are based on a p-value combination tests independently proposed by Maddala and Wu (1999) and Choi (2001). These tests assume in the null hypothesis, 'all the series in the panel are I(1) against the alternate that at least one of the series is I(0)'. The tests are based on the idea that the p-values from N independent augmented Dickey-Fuller (ADF, Said and Dickey, 1984) tests can easily be combined in a test of the joint hypothesis concerning all $N > 1$ units. Both papers highlight that under the null the p-values p_i (i= 1,…,N) are independent $U_{(0,1)}$ variables so that $-2\log p_i \sim \chi^2(2)$. Therefore, for fixed N, as $T \to \infty$, under the null

$$P := -2\sum_{i=1}^{N} \log p_i \xrightarrow{d} \chi^2(2N). \tag{3.48}$$

Choi (2001) also considers different p-values combination tests. He suggests that the inverse normal combination test is based on the fact that under the null

$$Z := \frac{1}{\sqrt{N}} \sum_{i=1}^{N} \Phi^{-1}(p_i) \xrightarrow{d} N(0,1) \tag{3.49}$$

has the best overall performance, where convergence, as noted holds for fixed N and $T \to \infty$. The advantages of the p-value combination approach derive from its simplicity, the flexibility in specifying a different model for each panel unit, the ease in the use of unbalanced panels, the

[39] Among other we also used Breitung and Das (2005) proposed test.

possibility of using any unit root test, and the fact that the convergence results are proved using (fixed-N) T-asymptotic.

The assumption that the panel units are cross-sectionally independent, however, is very restrictive. For this reason, building upon Hartung (1999) framework, Demetrescu et al. (2006) propose a modified Choi's inverse-normal combination test that can be used even when the p values are not independent, given fixed N. Specifically, Hartung (1999) demonstrates that if the probits $\Phi^{-1}(p_i)$ are correlated with common correlation ∂, then under the null

$$Z_H := \frac{1}{\sqrt{N(1+\partial(N-1))}} \sum_{i=1}^{N} \Phi^{-1}(p_i) \sim N(0,1). \tag{3.50}$$

The actual modification proposed by Hartung (1999) and considered in Demetrescu et al. (2006) is slightly more complicated to allow for the fact that ∂, is unknown. A common practical implementation, used by Demetrescu et al. (2006) in their simulations, is[40]

$$\hat{Z}_H := \frac{\sum_{i=1}^{N} \Phi^{-1}(p_i)}{\left\{ N\left[1+\left(\hat{\partial}^* + 0.2\sqrt{\frac{2}{N+1}}(1-\hat{\partial}^*)\right)(N-1)\right]\right\}^{\frac{1}{2}}} \tag{3.51}$$

where $\hat{\partial}^*$ is a consistent estimator of ∂ such that $\hat{\partial}^* = \max\{-1/(N-1), \hat{\partial}\}$ with

$$\hat{\partial} = 1 - (N-1)^{-1} \sum_{i=1}^{N} \left(\Phi^{-1}(p_i) - N^{-1} \sum_{i=1}^{N} \Phi^{-1}(p_i) \right)^2 . \tag{3.52}$$

Hanck (2008) offers a very different viewpoint wherein he observes that panel unit root can be recast in terms of a multiple test problem. In his methodology the complete null hypothesis is: all the series are I(1), against the alternate that at least one series is I(0). As is well

[40] More general formulations can be applied which allow for unequal weights of the p values and better control of the significance levels. See Hartung (1999, p. 851).

known (see, for example, Shaffer, 1995), the complete null cannot be rejected simply on the basis that $\min(p_i) < \alpha (i = 1, \ldots, N)$ for a pre-specified level α, because such a procedure would result in a test having a size much larger than α. In fact, Simes (1986) shows that if a set of N hypotheses $H_{0,1}, \ldots, H_{0,N}$ are all true, and the associated test statistics are independent, then $\Pr(p_{(i)} > i\alpha / N) = 1 - \alpha$, where the $p_{(i)}$'s are the ordered p values such that $p_{(1)} \leq p_{(2)} \leq \ldots \leq p_{(N)}$. Furthermore, Sarkar and Chang (1997) show that Simes' equality is also held in the presence of positively dependent test statistics. Hanck (2008) thus suggests that the panel unit root null hypothesis can be tested simply by using the intersection test presented in Simes (1986). The test is very easy to compute: denote by $p_{(i)}$ the ordered sequence of the N p values of unit root test on each individual series. Given a pre-specified significance level α, the null is rejected if $p_{(i)} \leq i\alpha / N$ for any $i = 1, \ldots, N$.

The panel covariate Dickey-Fuller tests considered in Costantini and Lupi (2013) are extensions of the simple panel, based on the p-value combination methods outlined above, of the covariate augmented Dickey- Fuller (CADF) test advocated in Hansen (1995). On the other hand, Hansen (1995) proves that significant power gains in unit root test can be achieved if stationary covariates are included in the otherwise conventional ADF (1984) tests. The basic idea behind Hansen's test can be illustrated as follows: If we want to test for the presence of a unit root in y_t and a stationary covariate x_t exists that is linearly related to y_t, then adding x_t to the ADF regression for y_t increases the precision of the estimates and thus the power of the test. Prima facie, the idea may appear simple, but its application is far more complex than the standard procedure. For example, Hansen (1995) proved that the resulting unit root test statistic under the null, no longer follows the Dickey-Fuller distribution, instead follows a distribution according to a weighted sum of a Dickey-Fuller and a standard normal distribution, where the weights are functions of a nuisance parameter. To be more specific, consider

$$a(L)\Delta y_t = \delta y_{t-1} + v_t \tag{3.53}$$

$$v_t = b(L)(\Delta x_t - \mu_x) + e_t \tag{3.54}$$

where, $a(L) := (1 - a_1 L - a_2 L^2 - \ldots - a_p L^p)$ is a polynomial in the lag operator $L, \Delta x_t \sim I(0)$, $\mu_x := E(\Delta x), b(L) := (b_{q2} L^{-q_2} + \ldots + b_{q1} L^{-q_1})$ is a polynomial where both leads and lags are allowed. Furthermore, consider the long-run covariance matrix

$$\Omega := \sum_{k=-\infty}^{\infty} E\left[\begin{pmatrix} v_t \\ e_t \end{pmatrix} \begin{pmatrix} v_{t-k} & e_{t-k} \end{pmatrix}\right] = \begin{pmatrix} \omega_v^2 & \omega_{ve} \\ \omega_{ve} & \omega_e^2 \end{pmatrix} \tag{3.55}$$

Define the long-run squared correlation between v_t and e_t as

$$\rho^2 := \frac{\omega_{ve}^2}{\omega_v^2 \omega_e^2} \tag{3.56}$$

Here the test equation looks very similar to the ordinary ADF equation:

$$a(L)\Delta y_t = \delta y_{t-1} + b(L)\Delta x_{t-1} + e_t. \tag{3.57}$$

A constant and a trend models can be added in the CADF test similar to the simple ADF test. Subject to the fulfilment of some regularity conditions, Hansen (1995) shows that, under the null of unit root, the $t-$ratio for the coefficient in Equation (3.57) is such that

$$\hat{t}(\delta) \xrightarrow{\omega} \rho \frac{\int_0^1 W dW}{\left(\int_0^1 W^2\right)^{1/2}} + (1 - \rho^2)^{1/2} N(0,1) \tag{3.58}$$

where, W is a standard Wiener process, $N(0,1)$ a standard normal independent of W. When a model with a constant or with a constant and a linear trend is used, W is replaced by a demeaned or a detrended Wiener process, respectively (see Hansen, 1995, for details). Once the issue of computing the p values from Equation (3.58) is resolved, it becomes easy to apply p value combination methods to derive a panel CADF test. Costantini and Lupi (2013) picked up the idea from here and proposed a panel covariate augmented Dickey-Fuller test (they label pCADF) and also present a method to compute the asymptotic p values. The p value combination suggested by Costantini and Lupi (2013) follows Choi (2001) when no cross-dependence is detected and Demetrescu et al. (2006) in the presence of cross-dependence. Costantini and Lupi (2013) suggested using a stationary covariate for each variable and test the average of the first difference of the other series in the panel; as the alternate. Also, the difference of the first principal component among the series under investigation can be used as well (see Costantini and Lupi, 2013, for details). The latter procedure aims at extracting an underlying nonstationary common factor among the observed series, and uses its first differences as the stationary covariate. Of course, in this case, the panel CADF test refers explicitly to cross-dependent time series. In general, given that different stationary covariates can be selected for each series, and the method can be applied to panels comprised of independent units.

The use of Hansen's CADF test, instead of the conventional ADF test, ensures that the panel test has better power properties. Furthermore, in Costantini and Lupi (2013), contrary to Demetrescu et al. (2006), Hartung's procedure for cross-correlation correction is applied only when the p value of the cross-correlation test advocated by Pesaran (2004) is lower than a pre-specified threshold whose default value is set to 0.10.Therefore, in the present study, we applied a recent proposed test to the panel covariate augmented Dickey-Fuller test advocated in Costantini and Lupi (2013).[41] Further, extension to the CADF tests of the ADF-based test suggested in Hanck (2008)[42] proposed in Lupi (2011) are applied in this study. Given its relation to the Simes' procedure, the latter test is labelled as CADF. The null and alternative hypotheses of all these tests are same.

The panel unit root tests which incorporate structural breaks in DGP are used in the study. The first test used in the study is developed by Carrion-i-Silvestre et al's (2005) which is a modification of Hadri's (2000) stationarity test, which allows for multiple structural breaks through the incorporation of dummy variables in the deterministic specification of the model. Essentially, the Carrion-i-Silvestre et al. (2005) technique allows for two different types of multiple structural break effects. To see this, let us start with the following model:

$$y_{i,t} = \alpha_i + \sum_{k=1}^{m_i} \theta_{i,k} DU_{i,k,t} + \beta_i t + \sum_{k=1}^{m_i} \gamma_{i,k} DT^{*}_{i,k,t} + \varepsilon_{i,t} \tag{3.59}$$

here subscript $i = 1,\ldots, N$ individuals and $t = 1,\ldots, T$ time periods; the dummy variable $DT^{*}_{i,k,t} = t - T^{i}_{b,k}$ and 0 elsewhere; and $DU_{i,k,t} = 1$ for $t > T^{i}_{b,k}$ and 0 elsewhere, where $T^{i}_{b,k}$ denotes the *k*th date of the break for the *i*th individual and $k = 1,\ldots,m_i, m_i \geq 1$. Equation (3.59) includes: (a) individual structural break effects - shifts in the mean caused by the structural

[41]The three versions differ in the way the stationary covariate is selected. The rst (pCADF) consider the case where the correct stationary covariate (or a good proxy of it) is used. The second (pCADF.PC) assumes that the panel is balanced (it is transformed in a balanced panel in the case it is not) and utilises the differenced first principal component of the N series as the stationary covariate. The last (pCADF.DY) is again valid for a balanced panel and for each series takes the difference of the average of the other series as the stationary covariate.

[42] The four variants differ in the test they are based upon. The first (sADF) is based on the p values of standard ADF tests, as in Hanck (2008). The others (sCADF, sCADF.PC, and sCADF.DY) are based on the p values of CADF tests, with the stationary covariates selected as above, and are suggested here for the first time.

breaks, when $\beta_i = 0$; and (b) temporal structural break effects - shifts in the trend caused by the structural breaks when $\gamma_{i,k} \neq 0$.

Equation (3.59) contains three salient features. First, it allows structural breaks to have different effects on each individual time series, captured by $\theta_{i,k}$ and $\gamma_{i,k}$. Second, structural breaks are not restricted so they may occur at different locations, that is $T^i_{b,k} \neq T_{b,k}, \forall = \{1,\ldots,N\}$. Third, individuals are allowed to have different number of structural breaks $m_i \neq m_j, \forall_i = j, i, j = \{1,\ldots,T\}$. Carrioni-Silvestre et al. (2005) then use the Hadri (2000) procedure, which is constructed using a simple average of the univariate stationarity test in Kwiatkoeski et al. (1992) to test the null hypothesis of a stationary panel. The test statistic is of the form:

$$LM(\lambda) = N^{-1}\sum_{i=1}^{N}\left(\hat{\omega}_i^{-2}T^{-2}\sum_{t=1}^{T}\hat{S}_{i,t}^2\right) \tag{3.60}$$

where $\hat{S}_{i,t} = \sum_{j=1}^{t}\hat{\varepsilon}_{i,j}$ denotes the partial sum process that is obtained using the estimated OLS residuals from Equation (3.59), with $\hat{\omega}_i^2$ being a consistent estimate of the long-run variance of $\varepsilon_{i,j}$ which is obtained via the parametric method suggested by Shin and Snell (2006). It should be noted here that the panel test statistics can be computed for cases when the long-run variance is homogenous as well as heterogenous. Finally, λ denotes the dependence of the test on the dates of the break. For each individual i it is defined as:

$$\lambda_i = (\lambda_{i,1},\ldots,\lambda_{i,m_i})' = \left(T^i_{b,1}/T,\ldots,T^i_{b,m_i}/T\right)' \tag{3.61}$$

which indicates the relative positions of the dates of the breaks on the entire time period, T. To obtain the location and the number of breaks, Carrion-i-Silvestre et al. (2005) recommend using the Bai and Perron (1998) procedure, which computes the global minimisation of the sum of squared residuals (SSR). The $SSR(T^i_{b,1},\ldots,T^i_{b,m_i})$ is computed from Equation (3.59) as follows:

$$(\hat{T}^i_{b,1},\ldots,\hat{T}^i_{b,m_i}) = \arg\min_{T^i_{b,1},\ldots,T^i_{b,m_i}} SSR(T^i_{b,1},\ldots,T^i_{b,m_i}). \qquad (3.62)$$

Having obtained the dates for all possible $m_i \leq m^{\max}, i = \{1,\ldots,n\}$, we select the optimal number of breaks for each $i(m_i)$. On the procedure used to estimate the structural breaks, Carrion-i-Silvestre et al. (2005), following the work of Bai and Perron (2001) suggest that one should use the Bayesian information criterion when the model under the null hypothesis of panel stationarity includes trending regressors. However, if the model does not include trending regressors, they recommend estimating the breaks by using the modified Schwarz information criterion of Liu et al. (1997). The limiting distribution of $\eta_i(\lambda_i) = \hat{\omega}_i^2 T^{-2} \sum_{t=1}^{T} \hat{S}^2_{t=1}$ is used to construct the asymptotic distribution of Equation (3.60). Therefore, by defining $\bar{\xi} = N^{-1}\sum_{i=1}^{N}\xi_i$ and $\bar{\varsigma}^2 = N^{-1}\sum_{i=1}^{N}\xi_i^2$, where ξ_i and $\bar{\varsigma}^2$ are the individual mean and variance of $\eta_i(\lambda_i)$, respectively, the test statistic for the null hypothesis of a stationary panel with multiple breaks is:

$$Z(\lambda) = \frac{\sqrt{N}(LM(\lambda) - \bar{\xi})}{\bar{\varsigma}} \xrightarrow{d} N(0,1) \qquad (3.63)$$

Carrion-i-Silvestre et al. (2005, p.163) show that the limit distribution of $Z(\lambda)$ is standard normal; thus, no new set of critical values needs to be computed.

Im et al. (2005) develop another test adopted which incorporates structural breaks. The testing procedure of Im et al. (2005) test can be explained as follows. Let us consider the following equation:

$$Y_{it} = \gamma_i^{'} X_{it} + \varepsilon_{it},\ \varepsilon_{it} = \phi_i \varepsilon_{it-1} + e_{it} \tag{3.64}$$

For $t = 0,1,2,..., T; i = 1,2,..., N;$ where X_{it} is a vector of exogenous variables; γ_i is the corresponding parameter vector; ε_{it} is the error term of the process; and e_{it} is a zero-mean error term that allows for a heterogeneous variance structure across cross-section units but assumes no cross-correlations. The test for the unit root null is based on the parameter ϕ_i which allows for heterogeneous measures of persistence. When the data generating process follows Equation (3.64), the resulting critical values of the panel unit root test are invariant to γ_i. The condition is that Y_{it} allows for two structural breaks in levels (Model A), and D_{it} is a dummy variable that denotes a mean shift. Therefore, let X_{it} take the form of $(1, t, D_{1it}, D_{2it})'$, where t is a deterministic time trend, D_{1it} is a dummy variable that captures the first break and D_{2it} is a dummy variable that captures the second break respectively. From this, TB_i is the location at which the break occurs for country *i*, and then the dummy variable takes the form $D_{it} = 1$ if $t > T_{Bi}$, and 0 otherwise.

Another important feature of this model is that it allows for structural breaks under both the null and alternative hypotheses. To see this, suppose that $\phi_t = 1$ for all *i* so that

$$Y_{it} = \gamma_{1i} + \gamma_{2i} t + \gamma_{3i} D_{it} + \varepsilon_{it},\ \varepsilon_{it} = \varepsilon_{it-1} + e_{it} \tag{3.65}$$

Next, we can use the differencing transformation and solve this equation for ε_{it}, where we obtain

$$\Delta\varepsilon_{it} = Y_{it} - Y_{it-1} - \gamma_{2i} - \gamma_{3i}(D_{it} - D_{it-1})$$

(3.66)

Sequentially, we define $B_{it} = \Delta D_{it}$ and let $\Delta\varepsilon_{it} \equiv e_{it}$. In this case, Equation (3.66) can be re-written so that the model under the null becomes

$$Y_{it} = \gamma_{2i} + \gamma_{3i}B_{it} + Y_{it-1} + e_{it} \tag{3.67}$$

In order to obtain the panel LM unit root test statistics, we have to compute univariate LM unit root test statistics for each country first. The procedure is as follows:

$$\Delta Y_{it} = \gamma_i^{'}\Delta X_{it} + \varphi_i \widetilde{S}_{it-1} + u_{it} \tag{3.68}$$

Here, $\widetilde{S}_{it-1}$ is the detrended value of Y_{it-1}; and u_{it} is the stochastic distribution term in the model. Corrections for auto-correlated errors are accomplished via augmented terms $\Delta\widetilde{S}_{it-j}, j = 1,..., k$, in Equation (3.68), as with the ADF test. As provided by Im et al. (2005), the null and alternative hypotheses in the panel test are respectively given by $H_0 : \varphi_i = 0$ for all i – which means that the series of all countries contain a unit root – and when one or more countries reject the unit root, then $H_1 : \varphi_i < 0$. The unit root null hypothesis is described by $\varphi_i = 0$, and the LM test statistic for each time series is given by

$$\widetilde{\tau}_i = t - \text{statistic for the null hypothesis } \varphi_i = 0 \tag{3.69}$$

To endogenously determine the location of the two breaks, the minimum LM unit root test uses a grid search as follows:

$$LM_i^{\tau} = \inf_{\lambda_i} \widetilde{\tau}(\lambda_i) \tag{3.70}$$

There is a procedure repeated at each combination of break points, $\lambda = TB/T$. For Model A, the critical values are invariant to the break locations. This is an important characteristic (see Im et al., 2005). In this regard, it is not necessary to simulate different critical values for different estimated break points. More specifically, the asymptotic distribution of the LM test is free of the nuisance parameter, and the test does not exhibit spurious rejections even when a finite number of breaks exist under the null. Furthermore, since the unemployment rates hardly exhibit an upward or downward trend over time, Model A (level-shift) would be more appropriate for the main question of interest.

Synthetically, the panel LM test statistic is computed by averaging the optimal univariate LM unit root *t*-test statistics (LM_i^τ) estimated for each country, so that $\overline{LM}_{NT} = (1/N)\sum_{i=1}^{N} LM_i^\tau$.

A standardized panel LM unit root test statistic is then constructed by letting $E(L_T)$ and $V(L_T)$ respectively denote the expected value and variance of each country's *t*-test statistics under the null hypothesis, the values of which we can take from Table 1 of Im et al. (2005). The standardized LM panel unit root test statistic is then obtained as follows:

$$\Gamma_{LM} = \frac{\sqrt{N}[\overline{LM}_{NT} - E(LM_T)]}{\sqrt{V(LM_T)}} \tag{3.71}$$

The numerical values for $E(L_T)$ and $V(L_T)$ are obtained from Im et al. (2005). The asymptotic distribution is unaffected by the presence of structural breaks and is standard normal.

3.3.2.2 Cointegration analysis in panel data

There are several panel cointegration tests available in the literature. However, the most popular are Pedroni (1999, 2004) and Kao and Chiang (1998) which are residual based tests. These types of test in the literature are referred as the "First generation tests", as these tests follow the rather drastic option of imposing homogeneity, hence designing pooled tests, or assuming independence in the panel structure. To tackle with the situation, following the idea of

Johanson's (1988) based time series cointegration test, LLL (2001) proposed a trace test statistics in the panel data framework, which is derived from the average of individual likelihood ratio cointegration rank, trace test statistics from the panel individuals. In LLL (2001) test, the multivariate cointegration trace test of Johanson (1988) is engaged to investigate each individual cross-section system autonomously, in that way, allowing heterogeneity in each cross-sectional unit root for said panel. Recently, the most popular option has been the assumption of the existence of common factors in the variables or the cointegrating residuals (Banerjee and Carrion-i-Silvestre, 2006; Gengenbach et al., 2006; Westerlund, 2008). Though removing the dependence using principal components methods (Bai and Ng, 2004) allows use of standard tests for independent panels, unfortunately, none of these approaches have provided fully satisfactory solutions yet. Westerlund and Constantini (2009) rely upon the restrictive assumptions of weakly exogenous right-hand side variables and constant covariance across test statistics. Although the authors claim the test to be somehow robust to more general forms of dependence, on the basis of the reported simulations its size and power properties do not appear particularly appealing, especially for small sample sizes. As Gengenbach et al. (2006) explicitly admit, the need of large sample sizes is also a weakness of the common factor approach. Thus, although investigating the common factor structure of the data could be very important for its own sake, in many empirical applications the available information set may simply be not rich enough. A second problem of factor methods is the need to choose some form of structure of the factors. For instance, Banerjee and Carrion-i-Silvestre (2006) and Westerlund (2008) allow for common factors in the cointegrating residuals but not in the variables themselves. These are allowed by Bai and Carrion-i-Silvestre (2005) and Gengenbach et al. (2006), but at the cost of other restrictions: the former assumes homogeneous cointegrating vectors, and the latter that the matrix of factor loadings is full rank and block-diagonal. Hence, the empirically important case of a single source of non-stationarity is ruled out. For instance, in our case the national stochastic trends in energy consumption/production (and, if cointegration holds, GDP and trade) may be linked to a global stochastic trend. Completely different perspectives have been favoured by Chang and Nguyen (2012) on one hand, and Fachin (2007) and Westerlund and Edgerton (2007), on the other. Chang and Nguyen (2012), building upon Chang (2002), developed an instrumental variable (IV) test robust to general dependency among the errors of the equations of the different units. Cointegration across units is also admitted, but in this case some complications arise, the main one being that the instruments require an ordering of the units. The results and properties of the test should be invariant to the chosen ordering in large samples, but not necessarily so in small ones (see Chang and Song, 2009). Since cross-unit cointegration is a very likely feature of our dataset, we expect the IV test to not be fully suitable for our task.

Finally, Fachin (2007) and Westerlund and Edgerton (2007) developed two different bootstrap algorithms conditional on the cross-section linkages as present in the dataset at hand. In other terms, no attempt is made to model the dependence structure, which is simply reproduced in the pseudodata. More precisely, Fachin (2007) applied the Continuous-path block bootstrap (Paparoditis and Politis, 2001, 2003) separately to the right- and the left-hand side variables, hence generating unrelated pseudo series obeying the null hypothesis of no cointegration, while Westerlund and Edgerton (2007) developed a sieve bootstrap procedure. However, both tests have some weaknesses. The algorithm by Fachin (2007) destroys any relationship between not only long-run ones but also the modelled variables. Hence, the bootstrap pseudo data not only obeys the null hypothesis, (no long-run relationship) but also that of no short-run relationships.

On the other hand, the sieve bootstrap applied by Westerlund and Edgerton (2007) hinges upon the assumption of a linear structure of the cointegrating residuals.

Summing up, we need to improve on the available methods. To this end, a natural route is to extend to the analysis of cointegration the residual-based Stationary Bootstrap (RSB) test for unit roots developed by Parker et al. (2006), henceforth PPP, which does not require any assumptions on the form of time dependence of the residuals. The test by PPP is closely related to the block bootstrap panel unit root test shown by Palm et al. (2008) to be asymptotically valid; the key advantage of the Stationary Bootstrap over the block bootstrap is that the re-sampled pseudo-series series are stationary, hence the name (Politis and Romano, 1994). In both cases, the re-sampling involves chaining blocks of observations of the original series starting at random locations, with the difference that in the Stationary Bootstrap the length is also random, while in the block bootstrap it is fixed. In our paper, we have adopted such a test developed by Di-Iorio and Fachin (2014). However, this test does not adopt the structural break. To tackle this problem we used another test proposed by Di-Iorio and Fachin (2010). First, we will provide a brief introduction about panel cointegration test proposed by Di-Iorio and Fachin (2014) and then about the panel cointegration test proposed by Di-Iorio and Fachin (2010).

Di-Iorio and Fachin (2014) proposed a test of the "group mean" type (i.e., computed as a summary measure of the individual no cointegration statistics), with inference carried out, as mentioned above, through the bootstrap. We shall first describe the set-up, the computation of the individual two-step statistics, and the bootstrap algorithm.

Let us consider a standard set-up of an integrated bivariate process $z_{it} = (y_{it}, x_{it})'$, where $t = 1,..., T$ and $i = 1,..., N$ index, respectively, the time periods and the cross-section units, is assumed to be such that

$$x_{it} = x_{it-1} + u_{it}^x, \tag{3.72}$$

$$y_{it} = \beta_i x_{it} + u_{it}^y, \tag{3.73}$$

where $u_{it}^x \sim N(0, \sigma_{xi}^2)$ and u_{it}^y it is an error term whose properties determine the short- or long-run nature of the linear relationship between the two variables. When u_{it}^y is stationary (3.73) defines a level (cointegrating) relationship between the two variables with cointegrating coefficient β_i, while when u_{it}^y is I(1) the relation is best interpreted as the first difference, short-run equation, $\Delta y_{it} = \beta_i \Delta x_{it} + \Delta u_{it}^y$, in which case β_i, is the short-run elasticity of y_{it} to x_{it}. Recalling that the panel dimension will be brought into the discussion below, define for a given unit i

$$v_{it} := u_{it}^y - \rho_i u_{it-1}^y. \tag{3.74}$$

When $\rho_i = 1$ the residuals of (3.73) are I(1), so that y_{it} and x_{it} are not cointegrated. When $|\rho_i| < 1$ they are instead stationary, so that y_{it} and x_{it} are cointegrated. Note that, as strongly emphasised by PPP, we are not assuming an AR(1) structure for the cointegrating residuals. In other terms, equation (3.74) is not meant to be a model adequately capturing the memory of the u_{it}^y's, and thus the v_{it}'s are not assumed to be white noise. In fact, equation (3.74) has a purely instrumental purpose: defining a parameter, ρ_i, mapping the null hypothesis of interest of no cointegration. Since $\rho_i = 1$ implies no cointegration, the task of testing "*Hi0*: no cointegration in unit i" may be conveniently carried out by a test of $H_{i0} : \rho_i = 1$. A natural candidate is a generalisation of the Residual-Based Bootstrap test for unit roots by PPP. To this end we need to construct a pseudo-dataset $\{x_{it}^*, y_{it}^*\}$ obeying *Hi0* and reproducing the essential features of the originary data $\{x_{it}, y_{it}\}$.Since x_{it} is known to be I(1); broadly speaking, a natural way to obtain the pseudo series x_{it}^{*} is to resample the first differences Δx_{it} by some algorithm valid for weakly dependent series, obtain the pseudo-differences Δx_{it}^{*}, and finally cumulate them to obtain the x_{it}^{*}. Constructing y_{it}^{*} is a more delicate issue as we need to make sure that the pseudo data reproduces the relationship between y_{it} and x_{it}, which we thus need to estimate accurately with no prior knowledge of its nature (long-run or short-run). Direct estimation of (3.73) would work under cointegration but not in its absence, as in this case all estimators of β_i will stay random even in the limit, also leading to poor estimates of the residuals u_{it}^{y}. Essentially, we are trapped in a circular problem: to have a good estimate of (3.73) we need to know if cointegration holds or not, which we do only if we have a good estimate of (3.73). The way out from the puzzle is offered by Cochrane and Orcutt's (1949) iterated regression, first exploited by Hansen (1990) to develop a multi-step no cointegration test and recently proposed by Choi et al. (2008) and Wang and Rosa (2010).

The structure of a panel no cointegration test based on Hansen's multi-step procedure is the following:

Step 1: For a given unit i, estimate equations (3.73) and (3.74) by OLS, obtaining estimates $\hat{\beta}_i$ and $\hat{\rho}_i$.For the latter it holds that

$$\hat{\rho}_i = \rho_i + \begin{cases} o_p(1) & if \;\; \rho_i < 1(coin) \\ O_p(T^{-1}) & if \;\; \rho_i = 1(no-coin) \end{cases} \tag{3.75}$$

Then, quasi-difference the data using $\hat{\rho}_i$:

$$y_{it}^d = y_{it} - \hat{\rho}_i y_{it-1}$$

$$x_{it}^d = x_{it} - \hat{\rho}_i x_{it-1}$$

Step 2: Apply again OLS to the equation in the quasi-differences:

$$y_{it}^d = \beta_i^d x_{it}^d + u_{it}^d. \tag{3.76}$$

The two-step estimator $\hat{\beta}_i^d$ satisfies

$$\hat{\beta}_i^d = \beta_i + \begin{cases} O_p(T^{-1}) & if \quad \rho_i < 1(coin) \\ O_p(T^{-1/2}) & if \quad \rho_i = 1(no-coin) \end{cases} \tag{3.77}$$

(Hansen, 1990, theorem 1). The residuals estimated from (3.76) are:

$$\hat{\hat{u}}_{it}^d = y_{it}^d - \hat{\beta}_i^d x_{it}^d$$

$$= (y_{it} - \hat{\rho}_i y_{it-1}) - \hat{\beta}_i^d (x_{it} - \hat{\rho}_i x_{it-1}) \tag{3.78}$$

where the "double hat" notation for the residuals emphasises its dependence upon two estimates: the regression coefficient $\hat{\beta}_i^d$ and the AR(1) coefficient $\hat{\rho}_i$ used to compute the quasi-differences y_{it}^d and x_{it}^d. Since $\hat{\beta}_i^d$ and $\hat{\rho}_i$ respectively satisfy (3.77) and (3.75), $\hat{\hat{u}}_{it}^d$ it is stationary under both the null (no cointegration) and alternative hypothesis (cointegration). Similarly to Δx_{it}, it can then be re-sampled using any method valid for weakly dependent series, such as the Stationary Bootstrap.

Step 3: Define the residuals of the level equation (3.73) with the coefficient fixed at the estimate from the quasi-difference regression:

$$\tilde{u}_{it}^y = y_{it} - \hat{\beta}_i^d x_{it} \tag{3.79}$$

and estimate again the first-order auto-regression (3.74) on the $\tilde{u}_{it}^{y}$'s:

$$\tilde{u}_{it}^{y} = \tilde{\rho}_i \tilde{u}_{it-1}^{y} + \tilde{v}_{it} \tag{3.80}$$

obtaining a new estimate of the autoregressive coefficient, $\tilde{\rho}_i$. Thanks to the consistent estimation of the regression coefficient under the null hypothesis the AR(1) coefficient $\tilde{\rho}_i$ is such that the limiting distributions of the coefficient statistic, $T(\tilde{\rho}_i - 1)$, are identical to the Dickey-Fuller distribution (Hansen, 1990, theorem 2). Note that in the rest of the paper we shall assume no cointegration to be tested through the traditional studentised statistic, which we christen "Hansen-Engle-Granger": $HEG_i = (\tilde{\rho}_i - 1)/s_{\tilde{\rho}}$ where $s_{\tilde{\rho}}$ is the estimated standard error of $\tilde{\rho}_i$. A "group mean" panel no cointegration test is easily obtained carrying out a fourth step:

Step 4: Once obtained the individual AR coefficients $\tilde{\rho}_i$ (and the desired derived statistics, such as the HEGi) for all units, compute the desired panel (no) cointegration test as some summary statistic (G) of the N individual tests: $G = G(HEG_1, \ldots, HEG_N)$. As remarked in Step 3, the properties of the two-step residuals $\hat{\hat{u}}_{it}^{d}$ make bootstrap inference on G relatively easy. The details of the bootstrap procedure are the following[43]:

Algorithm 1: *RSB panel no cointegration test*

1. For all units $i = 1, \ldots, N$:

1.2 Estimate (3.73) by OLS, obtaining $\hat{u}_{it}^{y}$:

1.3 Estimate (3.74) by OLS, obtaining $\hat{\rho}_i$;

1.4 Quasi-difference the data using $\hat{\rho}_i : x_{it}^{d} = x_{it-1} - \hat{\rho}_i x_{it-1},\ y_{it}^{d} = y_{it-1} - \hat{\rho}_i y_{it-1}$;

[43] Note that, although for simplicity we consider here the case of a single right-hand side variable, the algorithm is trivially generalised to the case of multivariate models.

1.5 Estimate the equation in the quasi-differences, $y_{it}^d = \beta_i^d x_{it}^d + u_{it}^d$, obtaining the OLS coefficient estimate $\hat{\beta}_i^d$ and the residuals $\hat{u}_{it}^d$;

1.6 Compute the residuals $\tilde{u}_{it}^y = y_{it} - \hat{\beta}_i^d x_{it}$;

1.7 Estimate by OLS the AR(1) regression (3.80) on the residuals $\tilde{u}_{it}^y$, obtaining $\tilde{\rho}_i$ and the desired (no) cointegration test statistic. In the following we shall assume this to be the popular Engle-Granger statistic $HEG_i = (\tilde{\rho}_i - 1)/s_{\tilde{\rho}}$, where $s_{\tilde{\rho}}$ is the estimated standard error of the autoregressive coefficient;

2. Apply the Stationary Bootstrap to the $(T-1)\times 2N$ matrix $\vee = \left[\Delta X_1 \ldots \Delta X_N \quad \hat{U}_{y1}^d \ldots \hat{U}_{yN}^d\right]$, where $\Delta X_i = [\Delta x_{1i} \ldots \Delta x_{Ti}]'$,

$\Delta x_{it} = x_{it} - x_{it-1} - (T-1)^{-1}\sum_{s=2}^{T}(x_{is} - x_{is-1})$, and $\hat{U}_i^d = [\hat{u}_{1i}^d \ldots \hat{u}_{Ti}^d]'$

(note that if equation (3.73) does not include a constant the residuals must be centred on the mean also), obtaining a matrix of pseudo-values $\left[\Delta X_1^* \ldots \Delta X_N^* \quad \hat{U}_1^{d*} \ldots \hat{U}_N^{d*}\right]$. This is achieved through the following steps:

2.1 Generate $L_1, \ldots L_T$ i.i.d. from a geometric distribution with parameter θ_T;

2.2 For each $t \in [1, T-1]$ let $K_t = \inf\{k : L_1 + \ldots + L_k \geq t\}$ and $M_t = L_1 + \ldots + L_{K_t}$;

2.3 Independently from the above, generate $\varsigma_1 + \ldots + \varsigma_{K_T}$ i.i.d. from a uniform distribution on $\{2, \ldots, T\}$

2.4 For all $t \in [1, K_T]$ set $\left[\Delta x_{1t}^* \ldots \Delta x_{Nt}^* \quad u_{1t}^{d*} \ldots u_{Nt}^{d*}\right] = \left[\Delta x_{1\tau} \ldots \Delta x_{N\tau} \quad \hat{u}_{1\tau}^d \ldots \hat{u}_{N\tau}^d\right]$, where

$\tau = \left[(\varsigma K_t + (t - M_t)) \bmod (T-1)\right] + 2;$

3. Generate for each unit i the pseudo-differences of the right-hand side variable using $\hat{\beta}_i^d$ as population parameter: $\Delta y_{it}^* = \hat{\beta}_i^d \Delta x_{it}^* + u_{it}^{d*}$;

4. Cumulate the pseudo-differences Δx_{it}^* and Δy_{it}^* to obtain I(1) pseudo-levels x_{it}^* and $y_{it}^* = \hat{\beta}_i^d x_{it}^* + u_{it}^*$, where the residuals $u_{it}^* = \sum_{s=1}^{t} u_{is}^{d*}$ obey the null hypothesis of no cointegration;

5. Repeat steps 1.1-1.6 on the datasets $\{y_{it}^*, x_{it}^*\}, i=1,\ldots,N,$ obtaining the bootstrap counterparts of $\hat{\beta}_i^d, \tilde{u}_{it}^y, \tilde{v}_{it}, \tilde{\rho}_i$, namely $\beta_i^{d*}, \tilde{u}_{it}^*, \tilde{v}_{it}^*, \tilde{\rho}_i^*$ and the N no cointegration statistics $HEG_i^* = (\tilde{\rho}_i^* - 1) / s_{\tilde{\rho}^*}$, where $s_{\tilde{\rho}^*}$ is the estimated standard error of $\tilde{\rho}_i^*$;

6. Compute the summary statistics of the individual HEG_i statistics obtained from the original data, $G = G(HEG_1,\ldots,HEG_N)$, and from the bootstrap pseudo data, $G^* = G(HEG_1^*,\ldots,HEG_N^*)$;

7. Repeat steps 2-6 B times;

8. Assuming the rejection region of the test is the left-tail; obtain the bootstrap p-value as $p^* = prop(G^* < G)$. Reject the null hypothesis if $p^* < \alpha$, where α is the significance level of the test (alternatively, reject H0 if $G < c_\alpha^*$, where c_α^* is the $\alpha - 1$ level critical value obtained from the distribution of the G^*'s).

The authors have shown in the Appendix of the paper that under the assumption of independence across units, a test based on the mean of the individual statistics is asymptotically valid.

Dependent panels and tests based on order statistics are both of more difficult treatment. Since we are jointly re-sampling all units, intuition suggests that the dependence structure is automatically reproduced in the pseudo-data. This intuition is somehow supported by the formal proof of asymptotic validity of a block bootstrap panel unit root test provided by Palm et al. (2008) in a panel with common factors. However, many different dependence structures can be conceived, especially so in DGPs with more than one right-hand side variable. Since any proof of the asymptotic validity of the test will be necessarily conditional on the assumed dependence structure, a fully general proof is by definition not possible. Well-designed simulation studies may provide arguably more useful insights, especially considering the paramount importance for applied work of small sample performance.

Before proceeding further, some remarks are in order.

1. **Choice of summary statistic:** This aspect of the test, closely related with its null and alternative hypotheses, deserves a careful discussion. While there is wide agreement on the null hypothesis of panel tests, which is always H_0: “no cointegration in all units”, equivalent to $H_0 : HEG_i = 1 \forall i$ and $H_0 : \rho_i = 1 \forall i$, the alternative hypotheses is surrounded by some confusion in the literature. Even if this is seldom clearly stated (see for example, Pedroni, 2004; Chang and Song, 2009), in empirical panel studies allowing for heterogeneity the idea is to reject the null of no cointegration when the evidence in the opposite direction prevails, i.e. when the majority (or, briefly, most) of the units support cointegration. Concentrating for simplicity on the AR coefficient ρ_i, this implies that the alternative hypothesis of interest is H_1 :"$\rho_i < 1$ in the majority of the units". In other terms, we want H0 to be rejected when the mass of the distribution of the $\rho_i^{'}s$ is

significantly far from 1. This clearly suggest the median as summary statistic, so that $G = Median\,(\rho)$, where $\rho=[\rho_1..\rho_N]$. Asymptotic tests are instead typically based on the mean (i.e., $G = N^{-1}\sum_{i=1}^{N}\rho_i$), and will thus have power not only against the desired alternative hypothesis H_1:"$\rho_i < 1$ in the majority of the units" but also against the hypothesis H_1:"$\rho_i < 1$ in a small number of units", which is of very little or no interest at all. Actually, in some cases an empirically interesting hypothesis is the almost opposite case H_1:"$\rho_i < 1$ in all units". Since in this case all $\rho_i^{'}s$ should be significantly smaller than 1 in order to reject H0 the natural summary statistic is obviously $G = Max\,(\rho)$. While a max test is feasible using Chang and Nguyen's (2012) IV approach, to the best of our knowledge median tests have been considered only by Fachin (2007). In our simulation experiment we will evaluate median, mean and max tests.

2. **Block length:** An important, and still largely unsettled, aspect of block bootstrap methods is the choice of block length. In the case of the Stationary Bootstrap, the length is random and the choice to be made is on the parameter θ_T of the geometric distribution (step 2.1 of the algorithm), which determines the mean block length. To prove the asymptotic validity of the test PPP assume $\theta_T \to 0$ as $T \to \infty$, ; so that $\sqrt{T}\theta_T \to \infty$. In practice, in the finite samples used in simulation experiments, rules for the mean block length such as $0.10T$ used by Paparoditis and Politis (2001) or $1.75\sqrt[3]{N}$, used by Palm et al. (2008), seem to deliver good results. In our simulations we will thus use fixed mean

block lengths, leaving implementation of data-based methods, such as the Warp-Speed calibration of Palm et al. (2008), to future research.

Now we will discuss briefly second cointegration test employed in the study, which incorporates structural break in cointegration equation. Di-Iorio and Fachin (2010) developed this test. The estimation set-up of this test is explained below.

Let us consider, for simplicity, a standard bivariate panel cointegration set-up with the right-and left-hand side variables, denoted for generality by X and Y; observed over N units and T time periods, as usual indexed respectively by j and t. In the base case, dating back to Engle and Granger (1987), each unit X and Y are believed to be linked by a linear, but not necessarily cointegrating, relationship:

$$y_{jt} = \mu_{0j} + \beta_{0j} x_{jt} + \varepsilon_{jt} \tag{3.81}$$

Equation (3.81) may be generalised to allow for time-varying coefficients with a break in period

$$y_{jt} = \begin{cases} \mu_{0j} + \beta_{0j} x_{jt} + \varepsilon_{jt}, \ t \leq t_j^b \\ \mu_{1j} + \beta_{1j} x_{jt} + \varepsilon_{jt}, \ t > t_j^b \end{cases} \tag{3.82}$$

where we introduced a country index $i = 1,..., N$, and t_j^b is the break point for country j.

Summing up, with few exceptions, allowing for breaks seems necessary when testing for the existence a long-run relationship. Although the changes in the capital movement regulations help locating plausible breakpoints, these cannot be assumed as precisely known a priori. Rather, they should be considered as unknown parameters to be estimated endogenously. The classical reference for cointegration testing with breaks at unknown dates is Gregory and Hansen (1996), who proposed to compute a no-cointegration statistic (say, (t^b)) for all possible break points t^b and, assuming the rejection region is the left tail (as in the case of the popular ADF and Z tests), take the minimum:

$$\Theta = \underset{t^b \in [\delta T,(1-\delta)T]}{Min}(\theta(t_j^b))$$

The trimming factor is chosen to ensure computational stability with 0.15 or 0.20 as popular choices. Note that the break point is thus implicitly estimated as

$$\hat{t}^b = \underset{\hat{t}^b \in [\delta T,(1-\delta)T]}{Arg\min}(\theta(\hat{t}^b)). \quad (3.83)$$

which, though intuitively appealing (it is the break maximising the probability of rejection) is not necessarily the best choice. As we will see below, a natural alternative is a least square criterion.

A panel cointegration test allowing for breaks may be defined very simply by following Pedroni's (1999) group mean test approach as a summary statistic of the cointegration statistics wit break computed for the individual units[44]. This can either be taken as the standard Gregory and Hansen Min (ADF) tests, or the statistics corresponding to breakpoints estimated according to some other criterion. Westerlund and Edgerton (2008) suggest estimating the breakpoint based on the least squares criterion[45], which for stationary variables is consistent even under multiple breaks:

$$\hat{t}_j^b = \underset{t_j^b \in [\delta T,(1-\delta)T]}{Arg\min}(\sum_{t=1}^{T} \hat{\varepsilon}_{jt}^2(\hat{t}_j^b)). \quad (3.84)$$

where the notation $\hat{\varepsilon}_{jt}(t_j^b)$ for the residuals emphasizes their dependence on the breakpoint used in the estimation of Equation (3.82). For each unit the set of residuals $\{\hat{\varepsilon}_{jt}(\hat{t}_j^b)\}_{t=1}^{T}$ is by definition optimal in a least square sense, and can be used to compute a no-cointegration test with break

[44] For simplicity we will refer to a summary statistic of the individual cointegration tests as a "panel test", although in Pedroni's terminology this term is reserved for tests obtained imposing an homogeneity assumption.
[45] Using the standard abbreviation for residual sum of squares, below we will refer to this criterion as Argmin(RSS).

alternative to Min(ADFj). Now, consider a first order autoregressive equation for the optimal cointegrating residuals:

$$\hat{\varepsilon}_{jt}(\hat{t}_j^b) = \rho_{jt}\hat{\varepsilon}_{jt-1}(\hat{t}_j^b) + \nu_{jt}. \quad (3.85)$$

when H_0 : "no cointegration" holds $\rho_j = 1$; while under cointegration $|\rho_j| < 1$. The hypothesis of no cointegration is then equivalent to $H_0 : \rho_j = 1,$ and that of no panel cointegration as the same hypothesis for mean or median of this individual statistics. The latter arguably reflects more closely the usual definition of the panel null hypothesis as "no cointegration in the majority of the units" (for a detailed discussion of the relationship between summary statistic and alternative hypothesis, see Di-Iorio and Fachin, 2010). Two important remarks are in order here.

First, Equation (3.85) is not a model of the cointegrating residuals; its purpose is only to define a parameter expressing the null hypothesis of interest. Second, and most important, the $\nu_{jt}^{'}s$ are always stationary, either H_0 : holds or not. They can thus be re-sampled via any re-sampling scheme valid for weakly dependent units, such as the stationary bootstrap (Politis and Romano, 1994).

A bootstrap testing algorithm along the lines put forth in Parker et al. (2006) and already exploited in Di-Iorio and Fachin (2010) may then proceed as follows:

1. Estimate the breaking cointegrating model (3.82), with t_j^b given by (3.84), on the dataset $\{y_{jt}, x_{jt}\}, j=1,\ldots,N,$ obtaining for each unit j estimates of the coefficients $(\hat{\mu}_{rj}, \beta_{rj}, r=0,1)$ and of the optimal cointegrating residuals $\{\hat{\varepsilon}_{jt}(\hat{t}_j^b)\}$;
2. Compute the N individual no cointegration statistics $\hat{\theta}_j$ on the basis of the optimal cointegrating residuals $\{\hat{\varepsilon}_{jt}(\hat{t}_j^b)\}$;

3. Compute the summary statistics of interest, e.g. $\hat{\theta}_{mean} = N^{-1}\sum_{i=1}^{N}\hat{\theta}_i$,

$\hat{\theta}_{median} = median(\hat{\theta}_1 ... \hat{\theta}_N)$, according the alternative hypothesis of interest;

4. Compute $\hat{v}_{jt} = \hat{\varepsilon}_{jt}(\hat{t}_j^b) - \hat{\rho}_j \hat{\varepsilon}_{jt-1}(\hat{t}_j^b)$, where $\{\hat{\varepsilon}_{jt}\}$ are the optimal cointegrating residuals and $\hat{\rho}_{jt}$ is a consistent estimate (e.g., OLS) of ρ_j;

5. Resample the series $\{\hat{v}_{jt}\}$ via the stationary bootstrap:

- generate $L_1,...,\ L_T$ i.i.d. from a geometric distribution with parameter $\xi = 1(1+B)$, B = mean block size;

- for each $t \in [1, T-1]$ let $K_t = \inf\{k : L_1 + ... + L_T \geq t\}$ and $M_t = L_1 + ... + L_{K_t}$;

- generate $m_1,...,m_k$ i.i.d. from a uniform distribution on $\{2,...,T\}$;

- for all $t \in [1, K]$ set $v_t^* = \hat{v}_{[(m_{k_t} + (t - M_t)) \bmod (T-1)] + 2}$.

6. Cumulate $\{v_{jt}^*\}$ obtaining pseudo residuals $\{\varepsilon_{jt}^*\}$ obeying the null hypothesis of no cointegration:

$$\varepsilon_{jt}^* = \sum_{i=1}^{t} v_{jt}^*, \quad t = 1,...T \tag{3.86}$$

7. For each unit j construct the pseudo data under the null hypothesis of no cointegration and break in $\hat{t}_j^b$:

$$y_{jt}^* = \begin{cases} \hat{\mu}_{0j} + \hat{\beta}_{0j} x_{jt} + \varepsilon_{jt}^*, & t \leq \hat{t}_j^b \\ \hat{\mu}_{1j} + \hat{\beta}_{1j} x_{jt} + \varepsilon_{jt}^*, & t > \hat{t}_j^b \end{cases} \tag{3.87}$$

8. Using the datasets $\{y_{jt}^*, x_{jt}\}$ estimate for each unit j the breaking cointegrating model (3.82) for all possible breakpoints $\hat{t}_j^{b*}$, obtaining the corresponding sets of residuals

$\{\hat{\varepsilon}^*_{jt}(\hat{t}^{b*}_j)\}$;estimate the optimal breakpoints $\hat{t}^{b*}_j = Arg\min(\sum_{t=1}^{T}\hat{\varepsilon}^{*2}_{jt}(\hat{t}^{b*}_j))$ and the optimal cointegrating residuals $\{\hat{\varepsilon}^*_{jt}(\hat{t}^{b*}_j)\}$;

9. Compute the individual no cointegration statistics θ^*_{jt};

10. Compute the summary statistics $\theta^*_h(h = mean,\ median)$;

11. Repeat 5-11 B times;

12. Compute the boostrap significance level of the statistics: $p(\theta)^* = prop(\theta^*_h < \theta_h)$, $h =$ mean; median.

Considering that this is the generalisation of the test shown by Di-Iorio and Fachin (2010) to be asymptotically valid, and that our main interest is the empirical application in a small sample. Here we will report only the results obtained using the popular Augmented Dickey-Fuller test, which has the attractive feature of being closely related to the standard Gregory-Hansen Min(ADF) statistics.

3.3.2.3 Panel Granger-causality

Dumitrescu and Hurlin (2012) proposed a new simple test of Granger (1969) non-causality for heterogeneous panel data models. The major advantage of their test is that it allows us to take into account both dimensions of the heterogeneity present in this context: the heterogeneity of the causal relationships and the heterogeneity of the regression model used so as to test for Granger causality. The test statistic of this test is based on the individual Wald statistics of Granger non-causality averaged across the cross-section units. This statistic is shown to converge sequentially to a standard normal distribution and the Monte Carlo experiments show that the standardized panel statistics of this test have very good small sample properties, even in the presence of cross-sectional dependence. Now we will briefly elaborate this test and its development.

In terms of simple Granger-causality test, estimated for each individual, we say that variable x causes y if we are able to better predict y using all available information than in the case where the information set used does not include x (Granger, 1969). If x and y are observed on N individuals, gagging the presence of causality comes down to determining the optimal information set used to forecast y. Several solutions can be adopted. The most general one consists in testing the causality from variable x observed for the *i*th individual to the variable y observed for the *j*th individual, with $j=i$ or $j \neq i$. The second solution is more restrictive and derives directly from the time series analysis. It implies testing the causal relationship for a given individual. The cross-sectional information is then used only to improve the specification of the model and the power of tests as in Holtz-Eakin et al. (1988). The baseline idea is to assume that there exists a minimal statistical representation which is common to x and y at least in a subgroup of individuals. The authors developed test based on such a model. In this case, causality tests can be implemented and considered as a natural extension of the standard time series tests in the cross-sectional dimension. However, one of the main issues specific to panel data models refers to the specification of the heterogeneity between cross-section units. In this Granger causality context, the heterogeneity has two main dimensions. Dumitrescu and Hurlin (2012) hence distinguish between the heterogeneity of the regression model and that of the causal relationship from x to y. Indeed, the model considered may be different from an individual to another, whereas there is a causal relationship from x to y for all individuals. The simplest form of regression model heterogeneity takes the form of slope parameters' heterogeneity. More precisely, in a *p* order linear vector autoregressive model, we define four kinds of causal relationships. The first one, denoted Homogeneous Non Causality (HNC) hypothesis, implies that no individual causality relationship from x to y exists. The symmetric case is the Homogeneous Causality (HC) hypothesis, which occurs when N causality relationships exist, and when the individual predictors of y obtained conditionally on the past values of y and x are identical. The dynamics of y is then absolutely identical for all the individuals in the sample. The last two cases correspond to heterogeneous processes. Under the Heterogeneous Causality (HEC) hypothesis, we assume that N causality relationships exist, as in the HC case, but the dynamics of y is heterogeneous. Note, however, that the heterogeneity does not affect the causality result. Finally, under the Heterogeneous Non Causality (HENC) hypothesis, we assume that there is a causal relationship from x to y for a subgroup of individuals. Symmetrically, there is at least one and at most N-1 non causal relationships in the model. It is clear that in this case the heterogeneity deals with causality from x to y.

To sum up, under the HNC hypothesis, no individual causality from x to y occurs. On the contrary, in the HC and HEC cases, there is a causality relationship for each individual of the sample. To be more precise, in the HC case, the same regression model is valid (identical parameters' estimators) for all individuals, whereas this is not the case for the HEC hypothesis. Finally, under the HENC hypothesis, the causality relationship is heterogeneous since the variable x causes y only for a subgroup of N−N1 units.

In this context, Dumitrescu and Hurlin (2012) propose a simple test of the Homogeneous Non Causality (HNC) hypothesis. Under the null hypothesis, there is no causal relationship for any of the units of the panel against the alternative of HENC hypothesis. To put it differently, Dumitrescu and Hurlin (2012) do not test the HNC hypothesis against the HC hypothesis as Holtz-Eakin et al. (1988), which, as previously discussed, is a strong assumption. Indeed, we allow for two subgroups of cross-section units: the first one is characterized by causal relationships from x to y, but it does not necessarily rely on the same regression model, whereas there is no causal relationship from x to y in the case of the second subgroup. To build the test Dumitrescu and Hurlin (2012) considered a heterogeneous panel data model with fixed coefficients (in time). It follows that, both under the null and the alternative hypothesis, the unconstrained parameters may be different from one individual to another. The dynamics of the variables may be thus heterogeneous across the cross-section units, regardless of the existence (or not) of causal relationships. The framework of Dumitrescu and Hurlin (2012) hence relies on less strong assumptions than the ones in Holtz-Eakin et al. (1988), who assume the homogeneity of cross-section units, i.e. that the panel vector-autoregressive regression model is valid for all the individuals in the panel. Finally, the Dumitrescu and Hurlin (2012) adapt the Granger causality test-statistic to the case of unbalanced panels and/or different lag orders in the autoregressive process. Most importantly, Dumitrescu and Hurlin (2012) propose a block bootstrap procedure to correct the empirical critical values of panel Granger causality tests so as to account for cross-sectional dependence.

Some basic features of this test are as follows. Dumitrescu and Hurlin (2012) developed a test based on averaging standard individual Wald statistics of Granger non causality tests following the literature devoted to panel unit root tests in heterogeneous panels, and particularly Im et al. (2003). Under the assumption of cross-section independence (as used in first generation panel unit root tests), the authors provide different results. First, this statistic is shown to converge sequentially in distribution to a standard normal variate when the time dimension T tends to infinity, followed by the individual dimension N. Second, for a fixed T sample the semi-asymptotic distribution of the average statistic is characterized. In this case, individual

Wald statistics do not have a standard chi-squared distribution. However, under very general setting, it is shown that individual Wald statistics are independently distributed with finite second order moments. For a fixed T, the Lyapunov central limit theorem is sufficient to establish the distribution of the standardized average Wald statistic when N tends to infinity. The first two moments of this normal semi-asymptotic distribution correspond to the empirical mean of the corresponding theoretical moments of the individual Wald statistics. The issue is then to propose an evaluation of the first two moments of standard Wald statistics for small T samples. A first solution relies on Monte-Carlo or Bootstrap simulations. A second one consists in using an approximation of these moments based on the exact moments of the ratio of quadratic forms in normal variables derived from Magnus (1986) theorem for a fixed T sample, with T>5+2K. Given these approximations, Dumitrescu and Hurlin (2012) propose a second standardized average Wald statistic to test the HNC hypothesis in short T sample. Then, contrary to Kónya (2006), our testing procedure does not require bootstrap critical values generated by simulations. However, a block bootstrap simulation approach similar to theirs is adapted to our framework (group mean Wald-statistic) so as to take into account cross-sectional dependencies. The finite sample properties of test statistics are examined using Monte-Carlo methods. The simulation results clearly show that our panel based tests have very good properties even in samples with very small values of T and N. The size of standardized statistic based on the semi-asymptotic moments is reasonably close to the nominal size for all the values of T and N considered. Besides, the power of the panel test statistic substantially exceeds that of Granger non Causality tests based on single time series in all experiments and in particular for very small values of T, e.g. T=10, provided that there are at least a few cross-section units in the panel (e.g. N=5). Furthermore, approximated critical values are proposed for finite T and N samples, as well as a block-bootstrap procedure to compute empirical critical values when taking into account cross-section dependence. Now we will briefly discuss the estimation procedure of Dumitrescu and Hurlin (2012) proposed test of a non-causality in heterogeneous panel data models.

Let us denote by x and y, two stationary variables observed for N individuals on T periods. For each individual i=1,..,N, at time t=1,..,T, we consider the following linear model:

$$y_{i,t} = \alpha_i + \sum_{k=1}^{K} \gamma_i^{(k)} y_{i,t-1} + \sum_{k=1}^{K} \beta_i^{(k)} x_{i,t-k} + \varepsilon_{i,t} \tag{3.88}$$

with $K \in \mathrm{N}^*$ and $\beta_i = (\beta_i^{(1)}, \ldots, \beta_i^{(k)})'$. For simplicity, the individual effects α_i are supposed to be fixed in the time dimension. Initial conditions $(y_{i,-k}, \ldots, y_{i,0})$ and $(x_{i,-k}, \ldots, x_{i,0})$ of both individual processes $y_{i,t}$ and $x_{i,t}$ are given and observable. Now assume that lag orders K are identical for all cross-section units of the panel and the panel is balanced. Besides, allow the autoregressive parameters $\gamma_i^{(k)}$ and the regression coefficients slopes $\beta_i^{(k)}$ to differ across groups. However, contrary to Weinhold (1996) and Nair-Reichert and Weinhold (2001), parameters $\gamma_i^{(k)}$ and $\beta_i^{(k)}$ are constant in time. It is important to note that this model is not a random coefficient model as in Swamy (1970): it is a fixed coefficient model with fixed individual effects. In the sequel, we make the following assumptions.

This simple model with two variables constitutes the basic framework for studying Granger causality in a panel data context. If in a time series context, the standard causality tests consist in testing linear restrictions on the vectors β_i, in a panel data model one must be very careful to the issue of heterogeneity between individuals. The first source of heterogeneity is standard and comes from the presence of individual effects α_i. The second source, which is more crucial, is related to the heterogeneity of the parameters β_i. This kind of heterogeneity directly affects the paradigm of the representative agent and hence the conclusions with respect to causality relationships. It is well known that the estimates of autoregressive parameters β_i obtained under the wrong hypothesis, i.e. $\beta_i = \beta_j \forall (i, j)$, are biased (see Pesaran and Smith, 1995 for an $AR(1)$ process). Then, if we impose the homogeneity of coefficients β_i, the causality test-statistics can lead to fallacious inference. Intuitively, the estimate $\hat{\beta}$ obtained in an homogeneous model will converge to a value close to the average of the true coefficients β_i, and if this mean is itself close to zero, we risk to accept at wrong the hypothesis of no causality.

Beyond these statistical stakes, it is evident that a homogeneous specification of the relation between the variables x and y does not allow to interpret causality relations if at least one individual from the sample has an economic behaviour different from that of the others. For example, let us assume that there is a causality relation to a set of N countries, for which the vectors β_i are strictly identical. What conclusions can be drawn if we introduce into the sample a set of N_1 countries for which, in contrast, there is no relation of causality? Whatever the value of the ratio N / N_1 is, the test of the causality hypothesis is nonsensical.

Given these observations, we propose to test the Homogeneous Non Causality (*HNC*) hypothesis by taking into account both the heterogeneity of the regression model and that of the causal relation. Under the alternative we hence allow for a subgroup of individuals for which there is no causality relation and a subgroup of individuals for which the variable x Granger causes y. The null hypothesis of *HNC* is defined as:

$$H_0 : \beta_i = 0 \quad \forall i = 1, \ldots, N \tag{3.89}$$

with $\beta_i = (\beta_i^{(1)},...,\beta_i^{(k)})'$. Additionally, β_i may differ across groups under the alternative (model heterogeneity).We also allow for some, but not all, of the individual vectors β_i to be equal to 0 (non-causality assumption). We assume that under H_1, there are $N_1 < N$ individual processes with no causality from x to y. It follows that our test is not a test of non-causality assumption against causality from x to y for all the individuals, as in Holtz-Eakin et al. (1988). It is more general, since we can observe non causality for some units under the alternative:

$$H_1 : \beta_i = 0 \quad \forall i = 1,...,N_1$$
$$: \beta_i \neq 0 \quad \forall i = N_1+1, N_1+2,...,N$$

(3.90)

where N_1 is unknown but satisfies the condition $0 \leq N_1 / N < 1$. The ratio N_1 / N is necessarily inferior to one, since if $N_1 = N$ there is no causality for any of the individuals in the panel, which is equivalent to the HNC null hypothesis. Conversely, when $N_1 = 0$ there is causality for all the individuals in the sample. The structure of this test is similar to the unit root test in heterogeneous panels proposed by Im et al. (2003). In our context, if the null is accepted the variable x does not Granger cause the variable y for all the units of the panel. By contrast, if we assume that the *HNC* is rejected and $N_1 = 0$, we have seen that x Granger causes y for all the individuals of the panel: in this case we get a homogeneous result as far as causality is concerned. Indeed, the regression model considered may be not homogeneous, i.e., the estimators of the parameters differ across groups, but the causality relations are observed for all individuals. On the contrary, if $N_1 > 0$, the causality relationship is heterogeneous: the regression model and the causality relations are different from one individual in the sample to another. In this context, we propose to use the average of individual Wald statistics associated with the test of the non-causality hypothesis for units $i = 1,..., N$.

Definition: The average statistic $W_{N,T}^{Hnc}$ associated with the null Homogeneous Non Causality (HNC) hypothesis is defined as:

$$W_{N,T}^{Hnc} = \frac{1}{N}\sum_{i=1}^{N} W_{i,T}, \tag{3.91}$$

where $W_{i,T}$ denotes the individual Wald statistics for the ith cross-section unit corresponding to the individual test $H_0 : \beta_i = 0$. To obtain the general form of this statistic, we stack the observations for the T periods corresponding to the ith individual's characteristics into a T elements vector as:

$$\underset{(T,1)}{y_i^{(k)}} = \begin{bmatrix} y_{i,1-k} \\ . \\ . \\ y_{i,T-k} \end{bmatrix} \quad \underset{(T,1)}{x_i^{(k)}} = \begin{bmatrix} x_{i,1-k} \\ . \\ . \\ x_{i,T-k} \end{bmatrix} \quad \underset{(T,1)}{\varepsilon_i} = \begin{bmatrix} \varepsilon_{i,1} \\ . \\ . \\ \varepsilon_{i,T} \end{bmatrix}$$

and we define two (T, K) matrices:

$$Y_i = \left[y_i^{(1)} : y_i^{(2)} : ... : y_i^{(k)}\right] \text{and } X_i = \left[x_i^{(1)} : x_i^{(2)} : ... : x_i^{(k)}\right]$$

Let us also denote by Z_i the $(T, 2K+1)$ matrix $Z_i = [e: Y_i : X_i]$, where ϵ denotes a $(T,1)$ unit vector, and by $\theta_i = (\alpha_i \gamma_i' \beta_i')'$ the vector of parameters of the model. The test for the *HNC* hypothesis can now be expressed as $R\theta_i = 0$ where R is a $(K, 2K+1)$ matrix with $R = [0 : I_K]$. The Wald statistic $W_{i,T}$ corresponding to the individual test $H_0 : \beta_i = 0$ is defined for each $i = 1,..., N$ as:

$$W_{i,T} = \hat{\theta}_i^{'} R^{'} \left[\hat{\sigma}_i^2 R(Z_i^{'} Z_i)^{-1} R^{'}\right] R\hat{\theta}_i = \frac{\hat{\theta}_i^{'} R^{'} \left[R(Z_i^{'} Z_i)^{-1} R^{'}\right] R\hat{\theta}_i}{\hat{\varepsilon}_i^{'} \hat{\varepsilon}_i / (T - 2K - 1)}$$

where $\hat{\theta}_i$ is the estimate of parameter θ_i obtained under the alternative hypothesis, and $\hat{\sigma}_i^2$ is the estimate of the variance of the residuals. For a small T sample, the corresponding unbiased estimator takes the form of $\hat{\sigma}_i^2 = \hat{\varepsilon}_i^{'} \hat{\varepsilon}_i / (T - 2K - 1)$. It is well known that this Wald statistic can also be expressed as a ratio of quadratic forms in normal variables corresponding to the true population of residuals with:

$$W_{i,T} = (T - 2K - 1)\left(\frac{\tilde{\varepsilon}_i^{'} \Phi_i \tilde{\varepsilon}_i}{\tilde{\varepsilon}_i^{'} M_i \tilde{\varepsilon}_i}\right) \quad i = 1, \dots, N \tag{3.92}$$

where the $(T,1)$ vector $\tilde{\varepsilon}_i = \varepsilon_i / \sigma_{\varepsilon,i}$ is normally distributed according to $N(0, I_T)$ under Assumption A1[46]. The (T,T) matrices Φ_i and M_i are positive semi definite, symmetric and idempotent

$$\Phi_i = Z_i (Z_i^{'} Z_i)^{-1} R^{'} \left[R(Z_i^{'} Z_i)^{-1} R^{'}\right]^{-1} R(Z_i^{'} Z_i)^{-1} Z_i^{'} \tag{3.93}$$

where I_T is the identity matrix of size T. Notice that the matrix M_i corresponds to the standard projection matrix of the linear regression analysis.

Our objective now is to determine the distribution of the average statistic $W_{N,T}^{Hnc}$ under the null hypothesis of Homogeneous Non Causality. For that, we first consider the asymptotic case where T and N tend to infinity, and second we tackle the case where T is fixed. Therefore, under the null hypothesis of non causality, each individual Wald statistic converges to a chi-squared distribution with K degrees of freedom:

[46] Please refer to Dumitrescu and Hurlin (2012).

$$W_{i,T} \xrightarrow[T\to\infty]{d} \chi^2(K), \forall i=1,...,N. \tag{3.94}$$

In other words, when T tends to infinity, the individual statistics $\{W_{i,T}\}_{i=1}^{N}$ are identically distributed (i.i.d). Therefore, based on Lindberg–Levy central limit theorem authors' derived following test statistics:

$$Z_{N,T}^{Hnc} = \sqrt{\frac{N}{2K}}\left(W_{N,T}^{Hnc} - K\right) \xrightarrow[T,N\to\infty]{d} N(0,1) \tag{3.95}$$

with $W_{N,T}^{Hnc} = (1/N)\sum_{i=1}^{N} W_{i,T}$, where $T, N \to \infty$ denotes the fact that $T \to \infty$ first and then $N \to \infty$. For large N and T samples, if the realization of the standardized statistic $Z_{N,T}^{Hnc}$ is superior to the corresponding normal critical value for a given level of risk, the homogeneous non causality (HNC) hypothesis is rejected. This asymptotic result may be useful in some macro panels. However, it should be extended to the case where T and N simultaneously tend to infinity.

The case of fixed T samples and semi-asymptotic distributions: One should note that the individual Wald statistics $W_{i,T}$ are not necessarily identically distributed for small T since the matrices Φ_i and M_i are different from one individual to another. Besides, these statistics do not have a standard distribution as in the previous section. However, the condition which ensures the existence of second order moments is the same for all units. Indeed, the second order moments of $W_{i,T}$ exist when T>5+2K or equivalently T≥6+2K.

Under Assumption A2[47], if T>5+2K the individual statistics $W_{i,T}$ are independently but not identically distributed with finite second order moments $\forall i = 1,..., N$, and therefore, by

[47]Please refer to Dumitrescu and Hurlin (2012).

Lyapunov central limit theorem under the HNC null hypothesis, the average statistic $W_{N,T}^{Hnc}$ converges. Authors derived Z_N^{Hnc}, standardized statistic, by Lyapunov central limit theorem under the HNC null hypothesis as follows:

$$Z_N^{Hnc} = \frac{\sqrt{N}\left[W_{N,T}^{Hnc} - N^{-1}\sum_{i=1}^{N} E(W_{i,T})\right]}{\sqrt{N^{-1}\sum_{i=1}^{N} Var(W_{i,T})}} \xrightarrow[N\to\infty]{d} N(0,1) \tag{3.96}$$

with $W_{N,T}^{Hnc} = (1/N)\sum_{i=1}^{N} W_{i,T}$ where $E(W_{i,T})$ and $Var(W_{i,T})$ denote the mean and the variance of the statistic $W_{i,T}$ defined by Equation (3.92). The decision rule is the same as in the asymptotic case: if the realization of the standardized statistic Z_N^{Hnc} is superior to the corresponding normal critical value for a given level of risk, the homogeneous non causality (HNC) hypothesis is rejected. For large T, the moments used in Theorem 2 are expected to converge to $E(W_{i,T}) = K$ and $Var(W_{i,T}) = 2K$ since the individual statistics $W_{i,T}$ converge in distribution to a chi-squared distribution with K degrees of freedom. Then, the statistic Z_N^{Hnc} converges to $Z_{N,T}^{Hnc}$ and we find the conditions of Theorem 1. However, these values of the asymptotic moments can lead to poor test results when T is small. We should then evaluate the mean and the variance of the Wald statistic $W_{i,T}$, knowing that this statistic does not have a standard distribution for a fixed T sample. The issue is now to compute the standardized average statistic Z_N^{Hnc}. There are two main approaches to compute the first two moments of the individual Wald statistics $W_{i,T}$. On one hand, these moments can be computed via stochastic simulation (Monte Carlo or bootstrap) of the Wald under the null. In this case, for each cross section unit, it is necessary to estimate the parameters of the model (γ_i, σ_i and α_i) and the parameters β_i associated with the exogenous variables x_{it}. Then, the variable y_i is simulated under the null with i.i.d. normal residual ε_i with zero means and variance σ_i^2 (Monte Carlo) or with re-sampled historical residuals (bootstrap). At each simulation of the processes y_i and x_i the individual Wald statistic $W_{i,T}$ is computed. Finally, using the replications of $W_{i,T}$, we estimate the first two moments of the individual test-statistics for each cross-section unit. Denote by $\tilde{Z}_N^{MC}$ the corresponding standardized average statistic. It is obvious that this method can be time consuming, especially if we consider very large N panel sets. On the other hand, we propose here an approximation of $E(W_{i,T})$ and $Var(W_{i,T})$ based on the results of Magnus (1986). Let us consider the expression of the Wald statistic $W_{i,T}$ as a ratio of two quadratic forms in a standard normal vector under Assumption A1:

$$W_{i,T} = (T-2K-1)\left(\frac{\tilde{\varepsilon}_i^{'}\Phi_i\tilde{\varepsilon}_i}{\tilde{\varepsilon}_i^{'}M_i\tilde{\varepsilon}_i}\right) \quad i=1,\ldots, N \tag{3.97}$$

where the $(T,1)$ vector $\tilde{\varepsilon}_i = \varepsilon_i / \sigma_{\varepsilon,i}$ is normally distributed according to a $N(0, \mathrm{I}_T)$ and the matrices Φ_i and M_i are positive semi definite, symmetric and idempotent. For a given T sample, we denote by ϕ_i and m_i the realizations of the matrices Φ_i and M_i, respectively. We hence apply Magnus (1986) theorem to the quadratic forms in a standard normal vector defined as:

$$\tilde{W}_{i,T} = (T-2K-1)\left(\frac{\tilde{\varepsilon}_i^{'}\phi_i\tilde{\varepsilon}_i}{\tilde{\varepsilon}_i^{'}m_i\tilde{\varepsilon}_i}\right) \tag{3.98}$$

where the matrices ϕ_i and m_i are positive semi-definite. For a fixed T sample, where $T > 5 + 2K$ and given ϕ_i and m_i as the realizations of the matrices of Φ_i and M_i, respectively, the exact first two movements of the individual statistics $\widetilde{W}_{i,T}$, defined by Equation 3.98 for $i = 1,..., N,$ are respectively,

$$E(\widetilde{W}_{i,T}) = K \times \frac{(T-2K-1)}{(T-2K-3)} \tag{3.99}$$

and

$$Var(\widetilde{W}_{i,T}) = 2K \times \frac{(T-2K-1)^2 \times (T-K-3)}{(T-2K-3)^2 \times (T-2K-5)} \tag{3.100}$$

Given these approximations, the authors computed an approximated standardized statistic $\widetilde{Z}_N^{Hnc}$ for the average Wald statistic $W_{N,T}^{Hnc}$ of the HNC hypothesis

$$\widetilde{Z}_N^{Hnc} = \frac{\sqrt{N}\left[W_{N,T}^{Hnc} - E(\widetilde{W}_{i,T})\right]}{\sqrt{Var(\widetilde{W}_{i,T})}}. \tag{3.101}$$

For a large N sample, under the Homogeneous Non Causality (HNC) hypothesis, we assume that the statistic $\widetilde{Z}_N^{Hnc}$ follows the same distribution as the standardized average Wald statistic Z_N^{Hnc}. Further, the authors show that the standardised average statistics $\widetilde{Z}_N^{Hnc}$ converges in following distribution

$$\widetilde{Z}_N^{Hnc} = \sqrt{\frac{N}{2 \times K} \times \frac{(T-2K-5)}{(T-K-3)}} \times \left[\frac{(T-2K-3)}{(T-2K-1)} W_{N,T}^{Hnc} - K\right] \underset{N\to\infty}{\overset{d}{\to}} N(0,1) \tag{3.102}$$

with $W_{N,T}^{Hnc} = (1/N)\sum_{i=1}^{N} W_{i,T}$. Consequently, the testing procedure of the HNC hypothesis is very simple and works as follows: For each individual of the panel, we compute the standard Wald statistics $W_{i,T}$ associated with the individual hypothesis $H_0 : \beta_i = 0$ with $\beta_i \in \Re^K$. Given these N realizations, we obtain a realization of the average Wald statistic $W_{N,T}^{Hnc}$. We then compute the realization of the approximated standardized statistic $\widetilde{Z}_N^{Hnc}$ according to the Equation (3.102) or we compute the statistic $\widetilde{Z}_N^{MC}$ based on the Monte Carlo procedure previously described. For a large N sample, if the value of $\widetilde{Z}_N^{Hnc}$ (or $\widetilde{Z}_N^{MC}$) is superior to the corresponding normal critical value for a given level of risk, the homogeneous non causality (HNC) hypothesis is rejected.

To achieve our second objective we worked with two specifications. First specification is elated with linear panel data models wherein fixed effect and random effect models are estimated. Second approach is based on the nonlinear framework in the models which is achieved by utilising the PSTR model. Before we present the empirical models to be estimated, we give a brief introduction on how the empirical models are derived. We derive our empirical model for energy use from the theoretical framework presented in section 2.2 of Chapter 2. Hence, we need to add up the scale effect, the composition effect, and the technique effect.

In the case of constant returns to scale, the absolute size of an economy measured by GDP has no influence on energy intensity. We therefore leave the scale effect aside and analyze energy intensity EI as the dependent variable, i.e., total primary energy supply divided by GDP (as in Mielnik and Goldemberg, 2002; Cole, 2006), where GDP is measured in purchasing power parities. Furthermore using a multiplicative form for Equation (2.2), inserting it in (2.1), and taking logs, the energy intensity of developing country *i* at time *t* can be expressed as

$$\ln EI_{it} = \ln(\mu \cdot IND_{it} + 1 - IND_{it}) + a_1 \ln G_{I_{it}} + a_2 \ln\left(\frac{G_{FDI_{it}}}{G_{I_{it}}}\right)$$

$$+ a_3 \ln\left(\frac{G_{IM_{it}}}{G_{I_{it}}}\right) + a_4 \ln\left(\frac{G_{AID_{it}}}{G_{I_{it}}}\right) + a_5 \ln YPC_{it}. \qquad (3.103)$$

We are not able to include all the various influences on energy use, since many of them are determined on the micro level and the necessary micro data is not available for most developing countries. Examples are the detailed sectoral structure of the industry, local economic and environmental regulations, and energy prices. The way in which we will implicitly capture country or time specific effects in the estimation is to use panel data models with cross-section fixed effects or random effects and time fixed effects.

To make sure that the variables included in the estimating equations are stationary (otherwise results based on OLS model would not be reliable), we are approximating $\ln(\mu \cdot IND_{it} + 1 - IND_{it})$ in Equation (3.103) by $(\mu - 1) \cdot IND_{it}$ and taking first time differences which leads to

$$\Delta \ln EI_{it} = (\mu - 1) \cdot \Delta IND_{it} + (a_1 - a_2 - a_3 - a_4) \frac{I_{it}}{G_{I_{it}}}$$

$$+ a_2 \frac{FDI_{it}}{G_{FDI_{it}}} + a_3 \frac{IM_{it}}{G_{IM_{it}}} + a_4 \frac{AID_{it}}{G_{AID_{it}}} + a_5 \Delta \ln YPC_{it} \qquad (3.104)$$

Note that $\Delta\ln$ can also be expressed by relative changes; for instance, $I_{it} / G_{I_{it}}$ means gross investment flow in year t over cumulative gross investment up to year t. We now assume for reasons of data availability that accumulated flows of investment, FDI, imports, and aid are proportional to the GDP of the respective economy in year t, for example, $G_{FDI_{it}} = \sigma_2 Y_{it}$. Equation (3.104) then can be written as

$$\Delta \ln EI_{it} = (\mu - 1) \cdot \Delta IND_{it} + \frac{(a_1 - a_2 - a_3 - a_4)}{\sigma_1} \frac{I_{it}}{Y_{it}}$$

$$+\frac{a_2}{\sigma_2}\frac{FDI_{it}}{Y_{it}}+\frac{a_3}{\sigma_3}\frac{IM_{it}}{Y_{it}}+\frac{a_4}{\sigma_4}\frac{AID_{it}}{Y_{it}}+a_5\Delta\ln YPC_{it}. \qquad (3.105)$$

Writing the coefficients in a more comprehensive way and, for convenience, denoting the shares of investment, FDI, import, and aid flows in GDP by I_{it}, FDI_{it}, IM_{it}, and AID_{it} respectively, leads to our empirical model:

$$\Delta\ln EI_{it}=\overbrace{\beta_1\Delta IND_{it}}^{\substack{Composition\\effect}}+\overbrace{\beta_2 I_{it}}^{\substack{Vintage\\capital\\effect}}+\overbrace{\beta_3 FDI_{it}+\beta_4 IM_{it}+\beta_5 AID_{it}}^{\substack{Techonology\\transfer}}$$

$$+\overbrace{\beta_6\Delta\ln YPC_{it}}^{\substack{Income-induced\\technique\\effect}} \qquad (3.106)$$

Linking the model to the conceptual framework, the coefficients of FDI_{it}, IM_{it}, and AID_{it} encompass international technology transfer, while the coefficient of I_{it} also includes a domestic vintage capital effect that may contribute to a reduction of energy intensity. The composition effect is captured by IND_{it}, the change in the share of industrial value added in GDP. The income-induced technique effect, which the FDI may also bring about via rising incomes, is accounted for by the relative change in per-capita income $\ln YPC_{it}$. The scale effect is implicitly included since the study examines energy use relative to the size of the economy represented by GDP. The hypothesis of the proposed study is that the energy savings via FDI implies that β_3 is negative. The interpretation is straightforward: FDI inflows in a certain year decrease energy intensity in relative terms, whereas *ceteris paribus* energy intensity stays constant if there is no FDI inflow. The higher the FDI inflow intensity, the higher will be the relative reduction of energy intensity. This is consistent with the notion that FDI inflows continuously bring about technology transfer that can reduce energy intensity. The coefficients of imports and aid can be interpreted in the similar way.

Now we present the empirical models to be estimated. First, we present a simple final regression model which is used for estimation fixed and random effect models. The following is the final form of the model to be employed:

$$\Delta \ln EI_{it} = \alpha + \chi_i + \theta_t + \beta_1 \Delta IND_{it} + \beta_2 I_{it} + \beta_3 FDI_{it} + \beta_4 IM_{it} + \beta_5 AID_{it} + \beta_6 \Delta \ln YPC_{it} + \varepsilon_{it} \quad (3.107)$$

$$\Delta \ln E_{it} = \alpha + \chi_i + \theta_t + \beta_1 \Delta IND_{it} + \beta_2 I_{it} + \beta_3 FDI_{it} + \beta_4 IM_{it} + \beta_5 AID_{it} + \beta_6 \Delta \ln Y_{it} + \varepsilon_{it} \quad (3.108)$$

The definitions of all the variables are given below in Table-3.1. χ_i and Θ_t represents country and time specific fixed effects. The decision about the form of model to be used, whether random effect or fixed effect, will be based on Hausman specification test.

Now we will briefly discuss the PSTR approach developed by González et al. (2005)[48] which is also adopted to fulfil our second objective. This approach caters for the heterogeneity problem in a non-linear framework in panel data. A PSTR model is a fixed effect model with exogenous regressors. The model is therefore a panel model with coefficients that vary across individuals and over time. The PSTR model is the extension of a smooth transition regression (STR) modelling to panel data with heterogeneity across the panel members and over time (Chang and Chiang, 2011). It allows for heterogeneity in the regression coefficients by assuming that coefficients are continuous functions of an observable variable through a bounded

[48] Before we estimate fixed or random effect and PSTR models, stationarity of the variables has been tested through very popular panel unit root tests such as LLC test (Levin, Lin and Chu 2002), the IPS test (Im, Pesaran and Shin 2003) and the MW test (Maddala and Wu 1999). If in case for any variables we do not find evidence of stationarity in level form we tested it through panel unit root tests which incorporate structural breaks.

function of such variable, referred to as transition function and, fluctuates between extreme regimes (González et al., 2005). The fact that the transition variable is cross section-specific and time-varying implies that the regression coefficients for each of the cross-sections in the panel are changing over time. A simple PSTR model with two extreme regimes and a single transition function can be defined as:

$$y_{it} = \mu_i + \beta_0^{'} x_{it} + \beta_1^{'} x_{it} g(q_{it};\gamma, c) + \varepsilon_{it} \qquad (3.109)$$

where i=1,…,N, t=1,…,T, and N and T denote the cross-section and time-dimension of the panel respectively. The dependent variable y_{it} (dependent variable of equations 3.107 and 3.108) is a scalar, μ_i represents the fixed country effects, x_{it} is k-dimensional vector of time-varying exogenous variables (all independent variables of equations 3.107 and 3.108), q_{it} is the threshold variable (FDI in equations 3.107 and 3.108), c is the threshold parameter (FDI threshold) and, ε_{it} is the residual term.

The slope parameter γ denotes the smoothness of the transition from one regime to the other. As $\gamma \rightarrow \infty$, the transition function approaches an indicator function $I(q_{it} > c_j)$ that takes the value of 1 if $q_{it} > c_j$. As $\gamma \rightarrow \infty$, the transition function becomes a homogenous or linear panel regression model with fixed effects. Ibarra and Trupkin (2011) point out that if γ is sufficiently high, then the PSTR model reduces to a threshold model with two regimes as in Khan and Senhadji (2001). Therefore, in such a case, the direct effect of FDI on energy intensity will be given by $\beta_0^{'}$ for those countries with FDI less than or equal to c_j, and by $\beta_0^{'} + \beta_1^{'}$ for those countries where FDI exceeds c_j.

The transition function $g(q_{it};\gamma,c)$ is a continuous function of the observable variable q_{it} and is normalised to be bounded between 0 and 1; and these extreme values are associated with regression coefficients $\beta_0^{'}$ and $\beta_0^{'}+\beta_1^{'}$. In general, the value of $g(q_{it};\gamma,c)$ and thus the effects of FDI on energy intensity:

$$e_{it}=\frac{\Delta y_{it}}{\Delta x_{it}}=\beta_0^{'}+\beta_1^{'}g(q_{it};\gamma,c) \text{ for country } i \text{ at period } t. \tag{3.110}$$

We follow Granger and Terasvirta (1993), Terasvirta (1994), Jansen and Terasvirta (1996), and Gonzalez et al. (2005) and consider the following logistic transition function:

$$g(q_{it};\gamma,c)=\left[1+\exp\left(-\gamma\prod_{j=1}^{m}(q_{it}-c_j)\right)\right]^{-1} \tag{3.111}$$

where $c=(c_1,\ldots,c_m)'$ is an m-dimensional vector of location parameters, and $\gamma>0$ and $c_1\le c_2\le,\ldots,c_m$ are identification restrictions. The PSTR model can be generalised to allow for more than two different regimes as follows:

$$y_{it}=\mu_i+\beta_0^{'}x_{it}+\sum_{j=1}^{r}\beta_j^{'}x_{it}g_j(q_{it}^{j};\gamma_j,c_j)+\varepsilon_{it} \tag{3.112}$$

where the transition functions $g_j(q_{it}^{j};\gamma_j,c_j)$, $j=1,\ldots,r$ depend on the slope parameters γ_j and on location parameters c_j. If $r=1$r=1, $q_{it}^{j}=q_{it}$, and $\gamma_j\to\infty$ for all $j=1,\ldots,r$, the transition function becomes an indicator function, with I[A]=1 if event A occurs, and I[A]=0 otherwise; then the model in Equation (3.112) becomes a PTR model with $r+1$ regimes. Therefore this multi-level PSTR can be viewed as generalisation of the multiple regime PTR in Hansen (1999).

González et al. (2005) outlined a procedure for testing linearity against a PSTR model. This is deemed important since the PSTR is not identified if the data-generating process (DGP) is linear, therefore a linearity test is viewed to be necessary to avoid the estimation of unidentified models. The null hypothesis is: $H_0 : \beta_1 = 0$. However, the test is non-standard because under this null hypothesis, the PSTR model contains unidentified nuisance parameters (Hansen, 1996). Therefore, we adopt a possible solution developed by Luukkonen et al. (1988) and replace the transition function $g(q_{it};\gamma,c)$ by its first-order Taylor expansion around $\gamma = 0$ and test the linearity hypothesis as $H_0 : \gamma = 0$. After reparameterization, this leads to the following auxiliary regression:

$$y_{it} = \mu_i + \beta_0^{'*} x_{it} + \beta_1^{'*} x_{it} q_{it} + ... + \beta_m^{'*} x_{it} q_{it}^m + \varepsilon^*_{it} \tag{3.113}$$

where the parameter vectors $\beta_1^{'*},...,\beta_m^{'*}$ are multiples of γ and $\varepsilon_{it}^* = \varepsilon_{it} + R_m \beta_1^{'*} x_{it}$, where R_m is the remainder of the Taylor expansion. Therefore testing $H_0 : \gamma = 0$ in Equation (3.109) is equivalent to testing the $H_0^* : \beta_1^{'*} = ... = \beta_m^{'*} = 0$ in Equation (3.113). Then standard tests can be applied. We follow Colletaz and Hurlin (2006) and use Wald, Fischer and Likelihood ratio tests. The Wald LM test can be written as:

$$LM_W = \frac{NT(SSR_0 - SSR_1)}{SSR_0} \tag{3.114}$$

where K is the number of explanatory variables, SSR_0 is the panel sum of squared residuals under H0 (linear panel model with individual effects) and SSR_1 is the panel of sum of squared residuals under H1 (PSTR model with m regimes). The Fischer LM test can be written as:

$$LM_F = \frac{NT(SSR_0 - SSR_1)/mk}{SSR_0(TN - N - mk)} \tag{3.115}$$

with an approximate distribution of $F(mk, TN - N - mk)$. The likelihood ratio test can be written as:

$$LR = -2[\log(SSR_1) - \log(SSR_0)] \tag{3.116}$$

All these linearity tests are distributed $\chi^2(k)$ under the null hypothesis. According to Teräsvirta (1994) linearity tests also serve to determine the appropriate order of m of the logistic transition function in Equation (3.111) or equivalently the order of extreme regimes. We therefore test the null of no remaining non-linearity in the transition function. Consider an auxiliary regression Equation (3.113) with $r = 2$ or three regimes:

$$y_{it} = \mu_i + \beta_0^{'*} x_{it} + \beta_1^{'*} x_{it} g_1(q_{it}^1; \gamma_1, c_1) + \beta_2^{'*} x_{it} g_2(q_{it}^2; \gamma_2, c_2) + \varepsilon^*_{it} \tag{3.117}$$

The null hypothesis of no remaining heterogeneity in an estimated three-regime PSTR model can be formulated as $H_0 : \gamma_2 = 0$ in Equation (3.117). However, as already indicated, this test is non-standard because under this null hypothesis, the PSTR model contains unidentified nuisance parameters. Therefore, this identification problem is circumvented by replacing transition function, $g_2(q_{it}^2; \gamma_2, c_2)$ by the Taylor expansion around $\gamma_2 = 0$, resulting in the following auxiliary regression:

$$y_{it} = \mu_i + \beta_0^{'*} x_{it} + \beta_1^{'*} x_{it} g_1(q_{it}^1; \gamma_1, c_1) + \theta x_{it} q_{it} + \varepsilon^*_{it} \tag{3.118}$$

Using the auxiliary regression Equation (3.118) with $r = 2$, testing the null hypothesis of no remaining non-linearity is defined as $H_0 : \theta = 0$. Denote SSR_0 as the panel sum of squared residuals under H_0 (i.e. in a PSTR model with one transition function), and SSR_1 as the sum of squared residuals of the transformed Equation (3.118). Given a PSTR with r^* transition functions, the procedure is as follows; test $H_0 : r = r^*$ against $H_1 : r = r^* + 1$. If H_0 is not rejected, then the procedure ends. Otherwise, the null hypothesis $H_1 : r = r^* + 1$ is tested against $H_1 : r = r^* + 2$. The testing procedure continues until the first acceptance of the null hypothesis of no remaining heterogeneity. It should be kept in mind that at each step of the sequential procedure, the significance level must be reduced by a constant factor τ, such as $0 < \tau < 1$ in order to avoid excessively large models. As suggested by González et al. (2005), we assume $\tau < 0.5$.

Now we define all variables and their unit of measurement to be used to achieve our second objective. CO_2 emissions are measured by emission emanates from energy generation/production and consumption measured in metric tons per capita. Energy consumption is measured by electricity consumption (measured in kWh per capita). Openness is measured by either export as a percentage of GDP or total trade as a percentage of GDP or total merchandise trade as a percentage of GDP and FDI as percentage of GDP. Economic growth will be measured by GDP per capita growth at constant prices. In the proposed study, coal consumption and hydroelectricity consumption are considered as a proxy of non-renewable and renewable energy consumption because of their dominant nature in the total energy consumption and both variables are measured in per capita terms. For the first objective, definition of the variables as discussed above will be used while for the second objective, definition of the variables we present in Table 2.3 below following Hubler and Keller (2009).

Table: 2.3 Definition of variables

Variables	Definition	Unit
E	Total primary energy supply	Ktoe
EI	Energy intensity in PPP (total primary energy supply as a share of GDP in PPP)	Ktoe per (constant 2000) million US $ in PPP
IND	Share of industrial value added in GDP	(constant 2000) million US $
I	Gross fixed capital formation as a share of GDP	(constant 2000) million US $
FDI	Net inflow of FDI as a share of GDP	(constant 2000) million US $
IM	Imports as a share of GDP	(constant 2000) million US $
AID	Official Development assistance and official aid flows as a share of GDP	(constant 2000) million US $
Y	Total income (measured by GDP at PPP)	(constant 2000) million US $ in PPP
YPC	Per-capita income (measured by GDP at PPP)	(constant 2000) million US $ in PPP

CHAPTER IV
STATISTICAL ANALYSIS, EMPIRICAL RESULTS AND DISCUSSION

The present chapter is broadly organized into two sections; the first section deals with time series data analysis and the second section deals with panel data analysis. In the first section, we start with presenting the summary findings of the unit root test which incorporate structural breaks followed by the results of the bootstrap test for causality with endogenous lag length choice, results from cointegration test that incorporates structural breaks, asymmetric causality test results, results of unit root tests for asymmetric part of the variables and asymmetric cointegration. The second section starts with presenting the results obtained through panel unit root analysis using second-generation panel unit root tests followed by heterogeneous panel Granger-causality test, panel fixed and random effect models and lastly PSTR model.

4.1 Results of the unit root analysis with structural breaks

To test the stationary nature of the data we used two time series unit root tests, namely Lee-Strazicich and NP unit root tests. These unit root tests incorporate up to two endogenous structural breaks. We report all the unit root results for level data[49] in the Appendix-A. However, our conclusions on stationarity of variables are based on NP test, which has proven to be more powerful and less size distorted. We find from the unit root analysis that at least a model of NP test rejects the null hypothesis of a unit root for PEC in China, South Korea, and Thailand in the level data. However, for CO_2 emissions the results of the unit root analysis show that at least a model of NP test rejects the null hypothesis of a unit root for Pakistan and South Korea in the level data. In HYD, evidence of stationarity in the level form of the data is found in Bangladesh, Indonesia, Japan, New Zealand, Philippines, South Korea, Taiwan and Thailand. For Coal, we find evidence of stationarity in Bangladesh, Japan, South Korea and Thailand in

[49]We present results for only level data to save space. Our results of first difference data show that all variables for all countries are stationary.

the level data. The evidence of stationarity for GDPPC in the level form is found in Malaysia, New Zealand, and Singapore. For trade, in the level data, we find evidence of stationarity in Bangladesh, China, New Zealand, Singapore, and Thailand. The NGC shows the evidence of stationarity in the level form in India, Malaysia, New Zealand, Taiwan and Thailand whereas the NEC shows the stationarity only in Japan and Taiwan. In the level form of ELEP, we find evidence of stationarity only in New Zealand. In China, India, Pakistan, and Philippines, the level form of ELEP-Coal is found stationary whereas for ELEP-HYD, evidence of stationarity is found in Bangladesh, Indonesia, Japan, Malaysia, New Zealand, Philippines, South Korea and Thailand. We find evidence of stationarity for ELEP-NG in the level form in China, Indonesia, Malaysia, New Zealand and Pakistan. For ELEP-NU in the level form, evidence of stationarity is found only in Pakistan. For ELEP-Oil, evidence of stationarity in the level from is found in Bangladesh, Japan, Malaysia and New Zealand, whereas for ELEP-Rene, in the level form, evidence of stationarity is found in Bangladesh, Japan, Malaysia, New Zealand, South Korea and Thailand. For the level data of ELE-PEC, we find evidence of stationarity only in China, whereas for the level data of EU, stationarity is found in China, Indonesia, Malaysia, Singapore and South Korea.

Several important policy implications emerge from our empirical results obtained from the unit root tests with multiple structural breaks. First, if the energy consumption (or its any variants) is mean (or trend) reverting, then it follows that the series will return to its mean value (or trend path) and it might be possible to forecast future movements in the series based on past behaviours. Second, as Narayan and Smyth (2007b) reported other macroeconomic variables linked to the energy consumption or its variants via flow-on effects will not inherit that non-stationary condition and transmit it to major economic variables such as GDP. Third, for the future studies related to energy consumption (or its variants), structural breaks should be taken into account to obtain significant and reliable results. Regarding the structural breaks, we find the most of structural breaks have appeared in two episodes observed. First structural break in most of the series had occurred, which indicated the fall in oil prices from US$35 per barrel in 1980 to US$ 27 per barrel in 1986 that affected the world economic activity. The second structural break relates to the Asian financial crisis occurred in 1997, which affected economic activity and hence electricity demands in these countries. Fourth, it is related to the econometric modelling: In order to examine the long-run relationships, say between per capita energy consumption/production and per capita GDP, most of cointegration tests require variables to be characterized by a unit root. Similarly, in testing for causality, say between per capita energy consumption/production and per capita GDP, one needs to know the order of integration of the variables in order to correctly specify the model and avoid spurious results.

4.2 Results from the Granger-causality analysis

In the next step, we proceed to analyze the Granger-causality using the approach proposed by Hacker and Hatemi-J (2012). This method extends the Toda and Yamamoto (1995) approach by using a bootstrap test for causality with endogenous lag length choice. The results obtained using this approach are presented in Table-1.4-15.4. Table-1.4 presents results of Granger-causality analysis between CO_2 emissions and GDP, and CO_2 emissions and Trade. It is evident from Table-1.4 that the null hypothesis that CO_2 emissions does not Granger-cause GDP (denoted by $CO_2 \neq > GDP$) is rejected only in Thailand at least with a 10 % level of significance. This indicates that only for Thailand CO_2 emissions is the leading indicator of GDP and not for other Asian countries analyzed. Further evidence shows that GDP is a significant leading indicator for CO_2 emissions in Japan, Pakistan and South Korea as null hypothesis that GDP≠>CO_2 is rejected for these countries. The evidence of Granger-causality between CO_2 emissions and Trade shows that the null hypothesis that CO_2 emissions does not Granger-cause Trade is rejected for three countries (Bangladesh, China HKSAR and New Zealand) whereas the null hypothesis that Trade does not Granger-cause CO_2 emissions is rejected in China, Indonesia, Japan, New Zealand and Thailand. Therefore, for New Zealand we find evidence of the bidirectional causal relationship between CO_2 emissions and Trade.

Table 1.4: Granger-causality between CO_2 emissions and GDP; and CO_2 emissions and Trade

CO_2≠>GDP	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	GDP≠>CO_2	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
Bangladesh	0.012 [1]	7.895	4.325	2.958	Bangladesh	0.579	8.410	4.371	2.963
China	1.295 [2]	11.685	6.716	5.016	China	1.222 [2]	12.458	7.650	5.781
China HKSAR	1.554 [1]	7.495	4.213	2.925	China HKSAR	1.383 [1]	7.725	4.185	2.929
India	0.775 [1]	7.267	4.172	2.917	India	7.489 [1]	7.359	4.308	2.980
Indonesia	0.207 [1]	9.286	4.705	3.059	Indonesia	0.002 [1]	8.418	4.363	2.915
Japan	0.490 [1]	7.717	4.283	2.947	Japan	**4.849 [1]**	7.136	4.059	2.832
Malaysia	0.257 [1]	7.451	4.228	2.890	Malaysia	0.630 [1]	8.808	5.073	3.520
New Zealand	2.372 [1]	7.463	4.131	2.901	New Zealand	0.193 [1]	7.723	4.304	2.973
Pakistan	0.171 [1]	7.602	4.236	2.916	Pakistan	**3.032 [1]**	7.432	4.206	2.913
Philippines	4.497 [2]	11.413	7.146	5.231	Philippines	1.286 [2]	10.270	6.371	4.782
Singapore	0.239 [1]	7.242	4.133	2.923	Singapore	0.112 [1]	7.323	4.170	2.840
South Korea	2.339 [1]	8.346	4.449	3.108	South Korea	**7.412 [1]**	7.503	4.103	2.838
Taiwan	0.261 [1]	8.206	4.398	3.038	Taiwan	2.577 [1]	7.488	4.239	2.919
Thailand	**3.421 [1]**	8.186	4.578	3.182	Thailand	0.392 [1]	7.434	4.128	2.862
CO_2≠>Trade	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	Trade≠>CO_2	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
Bangladesh	**3.282 [1]**	7.645	4.230	2.898	Bangladesh	0.883 [1]	7.760	4.212	2.935
China	0.196 [2]	12.322	7.275	5.407	China	**10.185 [2]**	12.810	7.754	5.727
China HKSAR	**5.961 [1]**	7.650	4.218	2.855	China HKSAR	0.598 [1]	7.981	4.060	2.835
India	0.089 [1]	7.132	4.158	2.838	India	0.803 [1]	7.719	4.083	2.828
Indonesia	0.258 [1]	7.746	4.160	2.840	Indonesia	**8.561 [1]**	7.371	3.966	2.792
Japan	5.538 [1]	14.198	9.203	7.245	Japan	**12.410 [1]**	14.060	9.549	7.544
Malaysia	0.595 [1]	6.929	4.091	2.921	Malaysia	1.664 [1]	7.104	4.040	2.896
New Zealand	**11.22 [2]**	12.826	7.649	5.793	New Zealand	**2.112 [2]**	0.000	0.000	0.000
Pakistan	0.460 [1]	7.914	4.333	2.935	Pakistan	0.032 [1]	7.388	4.106	2.827
Philippines	2.311 [2]	7.274	4.031	2.914	Philippines	1.599 [2]	7.172	4.062	2.836
Singapore	0.221 [1]	7.992	4.316	2.996	Singapore	0.003 [1]	8.152	4.568	3.144
South Korea	0.374 [1]	8.346	4.239	2.859	South Korea	0.194 [1]	9.269	4.310	2.813
Thailand	1.672 [1]	7.569	4.133	2.799	Thailand	4.175 [1]	7.061	3.964	2.778

Table-2.4 presents results of Granger-causality analysis between Coal consumption and GDP, and Coal consumption and Trade. The results reported in Table-2.4 show that the null hypothesis that coal consumption does not Granger-cause GDP (denoted by Coal≠>GDP) is not rejected for any of the Asian country analyzed at least with a 10 % level of significance indicating that coal consumption is not the leading indicator of GDP for Asian countries analyzed. However, our evidence shows that GDP is a significant leading indicator of coal consumption in India, Pakistan, and the Philippines as null hypothesis that GDP≠>Coal is rejected for these countries. Further, evidence of Granger-causality between Coal consumption and Trade shows that the null hypothesis that Coal does not Granger-cause Trade is rejected for three countries (namely Bangladesh, New Zealand, and Thailand) whereas the null hypothesis that Trade does not Granger-cause Coal is rejected for China, Japan, and New Zealand. Hence, for New Zealand, in this case too, we find evidence of the bidirectional causal relationship between Coal consumption and Trade.

Table 2.4: Granger-causality between Coal consumption and GDP; Coal consumption and Trade

Coal≠>GDP	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	GDP≠>Coal	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
Bangladesh	0.135 [1]	7.876	4.205	2.894	Bangladesh	0.021 [1]	7.874	4.238	2.869
China	0.757 [2]	11.496	6.802	5.031	China	0.437 [2]	12.727	7.644	5.798
India	1.988 [2]	11.049	6.550	4.929	India	**16.075 [2]**	11.325	6.772	5.063
Indonesia	0.123 [1]	10.307	4.533	2.901	Indonesia	0.387 [1]	9.467	4.329	2.847
Japan	1.280 [1]	7.556	4.167	2.881	Japan	2.518 [1]	7.541	4.222	2.975
New Zealand	0.742 [1]	7.406	4.100	2.869	New Zealand	0.097 [1]	7.381	4.159	2.822
Pakistan	0.342 [2]	10.545	6.581	4.978	Pakistan	**24.489 [2]**	10.955	6.917	5.197
Philippines	0.827 [3]	14.640	9.160	7.037	Philippines	**18.229 [3]**	15.757	10.114	7.684
South Korea	1.078 [2]	10.913	6.653	5.143	South Korea	4.458 [2]	11.113	6.695	5.059
Taiwan	0.113 [1]	7.030	4.136	2.887	Taiwan	0.668 [1]	7.348	4.054	2.811
Thailand	4.171 **[2]**	11.397	6.797	5.065	Thailand	4.074 [1]	11.038	6.812	4.991
Coal≠>Trade	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	Trade≠>Coal	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
Bangladesh	**4.972 [1]**	7.605	4.233	2.920	Bangladesh	2.516 [1]	7.951	4.219	2.876
China	4.256 [3]	16.089	10.082	7.697	China	**15.321 [3]**	15.743	9.898	7.568
India	0.227 [1]	7.820	4.146	2.853	India	0.865 [1]	7.945	4.118	2.904
Indonesia	0.239 [1]	8.871	4.343	2.844	Indonesia	0.000 [1]	8.458	4.285	2.874
Japan	6.777 [3]	14.527	9.440	7.182	Japan	**8.952 [3]**	12.878	8.409	6.445
New Zealand	**3.537 [2]**	7.531	3.296	1.851	New Zealand	**2.993 [2]**	0.000	0.000	0.000
Pakistan	1.790 [3]	13.647	8.812	6.879	Pakistan	2.332 [3]	13.800	8.800	6.856
Philippines	0.090 [1]	8.427	4.615	3.146	Philippines	1.579 [1]	7.772	4.373	2.966
South Korea	0.031 [1]	8.031	4.143	2.893	South Korea	0.053 [1]	8.080	4.232	2.775
Thailand	8.634 [2]	15.279	7.251	5.027	Thailand	1.338 [1]	20.129	8.871	6.248

Table-3.4 presents results of Granger-causality analysis between Electricity Production (ELEP) and GDP, and ELEP and Trade. It is evident from Table-3.4 that the null hypothesis that ELEP does not Granger-cause GDP (denoted by ELEP≠>GDP) is rejected in India and South Korea among the Asian country analyzed at least with a 10 % level of significance. This indicates that ELEP is the leading indicator of GDP for these two countries among Asian countries analyzed. We also find that GDP is a significant leading indicator of ELEP in China, and Malaysia as null hypothesis that GDP≠>ELEP is rejected for these two countries. Further, evidence of Granger-causality between ELEP and Trade shows that the null hypothesis that

ELEP does not Granger-cause Trade is rejected for two countries (China and the Philippines) whereas the null hypothesis that Trade does not Granger-cause ELEP is rejected in China, Malaysia, New Zealand and Pakistan. Hence, for China, we find evidence of the bidirectional causal relationship between ELEP and Trade.

Table 3.4: Granger-causality between Electricity Production (ELEP) and GDP; and Electricity Production and Trade

ELEP≠>GDP	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	GDP≠> ELEP	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
Bangladesh	2.038 [2]	10.766	6.690	5.028	Bangladesh	0.541 [2]	12.925	7.661	5.527
China	9.171 [4]	18.596	12.239	9.818	China	**14.464 [4]**	19.835	12.456	9.773
China HKSAR	0.002 [1]	7.572	4.332	2.901	China HKSAR	3.304 [1]	8.040	4.246	2.987
India	**7.337 [2]**	10.832	6.557	4.946	India	0.525 [2]	10.502	6.430	4.768
Indonesia	0.089 [1]	12.167	4.798	2.935	Indonesia	0.000 [1]	12.127	5.006	2.907
Japan	0.000 [1]	8.886	5.125	3.527	Japan	0.345 [1]	7.734	4.153	2.863
Malaysia	0.379 [1]	8.071	4.160	2.870	Malaysia	**3.694 [1]**	7.350	4.179	2.920
New Zealand	0.219 [1]	7.235	4.086	2.921	New Zealand	2.292 [1]	6.952	3.912	2.810
Pakistan	0.021 [1]	8.077	4.417	3.068	Pakistan	0.101 **[1]**	8.269	4.413	3.067
Philippines	2.561 [2]	11.991	7.104	5.305	Philippines	1.675 [2]	11.165	6.692	5.070
South Korea	**4.100 [1]**	8.353	4.511	3.081	South Korea	1.432 [2]	7.930	4.203	2.911
Taiwan	0.113 [1]	7.030	4.136	2.887	Taiwan	0.668 [1]	7.348	4.054	2.811
Thailand	1.116 **[2]**	11.674	7.181	5.367	Thailand	3.104 [2]	12.124	7.293	5.433
ELEP≠>Trade	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	Trade≠> ELEP	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
Bangladesh	2.276 [1]	7.742	4.267	2.923	Bangladesh	1.012 [1]	7.817	4.236	2.882
China	**5.966 [2]**	13.593	7.287	5.113	China	**6.086 [2]**	13.053	7.374	5.224
China HKSAR	0.037 [1]	7.385	3.962	2.759	China HKSAR	0.004 [1]	8.509	4.673	3.171
India	0.482 [1]	7.756	4.261	2.906	India	0.365 [1]	7.246	3.993	2.845
Indonesia	0.007 [1]	9.065	4.545	2.885	Indonesia	0.031 [1]	8.698	4.452	2.900
Japan	4.939 [2]	11.302	7.015	5.286	Japan	3.140 [2]	10.412	6.392	4.883
Malaysia	1.563 [1]	8.070	4.338	2.949	Malaysia	**4.329 [1]**	7.146	4.002	2.835
New Zealand	0.732 [2]	0.000	0.000	0.000	New Zealand	**3.847 [2]**	0.000	0.000	0.000
Pakistan	1.532 [1]	7.501	4.065	2.788	Pakistan	**4.641 [1]**	7.724	4.341	2.970
Philippines	**5.364 [1]**	7.677	4.341	3.029	Philippines	0.099 [1]	7.142	4.065	2.829
South Korea	0.178 [1]	9.072	4.548	2.840	South Korea	0.136 [1]	10.423	4.651	2.903
Thailand	0.436 [2]	10.948	6.597	4.974	Thailand	2.496 [2]	12.910	7.828	5.832

Table-4.4 presents results of Granger-causality analysis between ELEP through Coal (denoted by ELEP-Coal) and GDP, and ELEP-Coal and Trade. It is evident from Table-4.4 that the null hypothesis that ELEP-Coal does not Granger-cause GDP (denoted by ELEP-Coal≠>GDP) and Trade does not Granger-cause ELEP-Coal (denoted by Trade≠>ELEP-Coal) is not rejected for any of the Asian country analyzed at least with a 10 % level of significance. This indicates that ELEP-Coal is not the leading indicator of GDP and Trade is not the leading indicator of ELEP-Coal for Asian countries analyzed. However, our evidence shows that GDP is a significant leading indicator of ELEP-Coal in China HKSAR and India as null hypothesis that GDP≠>ELEP-Coal is rejected for these two countries. Further, evidence of Granger-causality between ELEP-Coal and Trade shows that the null hypothesis that ELEP-Coal does not

Granger-cause Trade is rejected for two countries (New Zealand, and South Korea).

Table 4.4: Granger-causality between ELEP through Coal (ELEP-Coal) and GDP; and ELEP-Coal and Trade

ELEP-Coal≠>GDP	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	GDP≠>ELEP-Coal	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
China	3.515 [2]	11.662	6.865	5.097	China	1.772 [2]	12.875	7.359	5.494
China HKSAR	4.625 [3]	16.633	9.861	7.400	China HKSAR	**13.329 [3]**	17.019	10.368	7.915
India	3.526 [2]	11.059	6.644	4.940	India	**11.834 [2]**	10.640	6.526	4.856
Japan	3.273 [3]	10.954	6.729	5.039	Japan	2.889 [2]	11.387	7.002	5.216
New Zealand	0.674 [1]	7.272	4.020	2.719	New Zealand	0.382 [1]	7.399	4.076	2.819
Pakistan	1.070 [1]	7.606	4.208	2.900	Pakistan	1.249 **[1]**	7.541	4.173	2.955
Philippines	1.079 [2]	12.082	7.482	5.487	Philippines	3.356 [2]	10.982	6.541	4.884
South Korea	0.206 [1]	8.303	4.413	2.941	South Korea	0.374 [1]	8.540	4.321	2.911
Thailand	1.754 **[2]**	12.505	7.153	5.251	Thailand	1.250 [1]	12.261	7.514	5.517
ELEP-Coal≠>Trade	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	Trade≠>ELEP-Coal	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
China	0.239 [1]	8.031	4.419	2.946	China	0.110 [1]	7.868	4.417	2.921
China HKSAR	0.689 [1]	7.800	4.354	2.983	China HKSAR	0.179 [1]	7.851	4.338	3.028
India	1.257 [1]	7.254	4.137	2.820	India	1.894 [1]	7.694	4.399	3.010
Indonesia	0.000 [1]	7.890	4.376	3.003	Indonesia	2.112 [1]	8.960	4.627	3.155
Japan	1.630 [2]	13.358	8.285	6.169	Japan	0.966 [2]	11.474	7.195	5.477
New Zealand	**4.889 [3]**	0.000	0.000	0.000	New Zealand	0.276 [3]	0.000	0.000	0.000
Pakistan	0.053 [1]	7.683	4.281	2.910	Pakistan	1.214 **[1]**	7.854	4.157	2.840
Philippines	0.349 [1]	7.841	4.224	2.925	Philippines	0.030 [1]	7.725	4.510	3.066
South Korea	**4.594 [1]**	9.856	4.728	2.894	South Korea	0.101 [1]	10.281	4.648	2.885
Thailand	0.481 [1]	7.409	4.097	2.888	**Thailand**	0.595 [1]	8.080	4.682	3.165

Table 5.4: Granger-causality between ELEP through HYD (ELEP-HYD) and GDP; and ELEP-HYD and Trade

ELEP-HYD≠>GDP	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	GDP≠>ELEP-HYD	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
Bangladesh	**6.222 [2]**	11.915	7.210	5.310	Bangladesh	1.603 [2]	13.051	7.443	5.412
China	**4.676 [1]**	7.482	4.072	2.852	China	0.653 [1]	7.824	4.204	2.864
India	1.071 [1]	7.784	4.393	3.082	India	2.042 [1]	7.296	4.012	2.824
Indonesia	0.598 [1]	7.560	4.276	2.959	Indonesia	**4.068 [1]**	8.794	4.525	3.060
Japan	0.216 [1]	7.156	4.097	2.841	Japan	0.586 [1]	6.951	4.061	2.815
Malaysia	**4.129 [1]**	7.236	4.067	2.829	Malaysia	0.337 [1]	8.008	4.235	2.929
New Zealand	0.722 [1]	7.470	4.186	2.912	New Zealand	2.478 [1]	7.370	4.138	2.809
Pakistan	0.127 [2]	7.343	4.227	2.890	Pakistan	0.543 **[1]**	7.495	4.246	2.928
Philippines	0.337 [2]	11.648	7.033	5.248	Philippines	0.175 [2]	10.587	6.472	4.932
South Korea	0.083 [1]	7.248	4.167	2.854	South Korea	1.590 [1]	7.223	4.108	2.906
Thailand	**7.051 [2]**	11.880	7.230	5.466	Thailand	0.316 [2]	11.845	6.802	5.019
ELEP-HYD≠>Trade	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	Trade≠>ELEP-HYD	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
Bangladesh	**3.520 [1]**	7.626	4.250	2.940	Bangladesh	**3.173 [1]**	7.550	4.129	2.841
China	**5.815 [1]**	7.537	4.327	2.934	China	0.527 [1]	7.705	4.323	2.940
India	0.185 [1]	7.532	4.260	2.940	India	**8.692 [1]**	7.662	4.296	2.928
Indonesia	2.857 [2]	11.898	6.996	5.191	Indonesia	2.857 [1]	11.898	6.996	5.191
Japan	3.326 [2]	11.054	6.751	5.169	Japan	**6.697 [2]**	10.687	6.557	5.004
Malaysia	0.236 [1]	7.877	4.356	3.076	Malaysia	0.354 [1]	8.102	4.347	3.017
New Zealand	0.607 [2]	0.029	0.001	0.000	New Zealand	1.233 [2]	0.000	0.000	0.000
Pakistan	0.046 [1]	7.525	4.208	2.893	Pakistan	**3.274 [1]**	7.686	4.267	2.881
Philippines	1.587 [1]	7.456	4.155	2.932	Philippines	0.289 [1]	7.719	4.287	2.913
South Korea	0.155 [1]	7.157	3.997	2.799	South Korea	1.255 [1]	7.176	4.126	2.855
Thailand	1.323 [1]	7.494	4.272	3.009	Thailand	0.097 [1]	7.564	4.124	2.861

Table-5.4 presents results of Granger-causality analysis between ELEP through hydroelectricity (denoted as ELEP-HYD) and GDP, and ELEP-HYD and Trade. It is evident from Table-5.4 that the null hypothesis that ELEP-HYD does not Granger-cause GDP (denoted by ELEP-HYD≠>GDP) is rejected in Bangladesh, China, Malaysia and Thailand among the Asian countries analyzed at least with a 10 % level of significance. This indicates that ELEP-HYD is the leading indicator of GDP for these countries among the Asian countries analyzed. However, our evidence shows that GDP is a significant leading indicator of ELEP-HYD in Indonesia as null hypothesis that GDP≠>ELEP-HYD is rejected in this country. Further, evidence of Granger-causality between ELEP-HYD and Trade shows that the null hypothesis that ELEP-HYD does not Granger-cause Trade is rejected for two countries (Bangladesh and China) whereas the null hypothesis that Trade does not Granger-cause ELEP-HYD is rejected for Bangladesh, India, Japan and Pakistan. Hence, for Bangladesh, we find evidence of the bidirectional causal relationship between ELEP-HYD and Trade.

Table 6.4: Granger-causality between ELEP through Natural Gas (ELEP-NG) and GDP; and ELEP-NG and Trade

ELEP-NG≠>GDP	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	GDP≠>ELEP-NG	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
Bangladesh	**25.097 [3]**	13.674	8.760	6.787	Bangladesh	3.632 [3]	14.928	9.368	7.333
China	2.144 [1]	8.029	4.469	3.020	China	0.810 [1]	8.152	4.382	3.000
India	0.983 [1]	7.917	4.393	3.078	India	0.224 [1]	7.875	4.278	2.914
Indonesia	0.237 [1]	10.984	4.540	2.798	Indonesia	0.728 [1]	7.780	4.285	2.841
Japan	0.205 [1]	7.521	4.235	2.955	Japan	0.529 [1]	7.123	4.160	2.868
Malaysia	0.258 [1]	11.716	4.675	2.858	Malaysia	0.589 [1]	10.183	4.631	3.041
New Zealand	7.958 [4]	16.847	11.245	8.842	New Zealand	4.578 [1]	17.166	11.127	8.824
Pakistan	0.153 [2]	7.778	4.474	3.087	Pakistan	**4.979 [1]**	8.120	4.428	3.120
Thailand	1.948 **[2]**	14.385	8.274	5.870	Thailand	0.569 [1]	14.221	8.137	5.897
ELEP-NG≠>Trade	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	Trade≠>ELEP-NG	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
Bangladesh	0.126 [1]	7.726	4.168	2.850	Bangladesh	0.051 [1]	7.944	4.227	2.847
China	1.264 [2]	13.252	7.619	5.551	China	2.853 [3]	12.090	7.123	5.276
India	0.073 [1]	8.421	4.485	3.013	India	0.049 [1]	8.482	4.509	3.151
Indonesia	0.282 [1]	8.765	4.228	2.863	Indonesia	0.759 [1]	9.057	4.404	2.936
Japan	0.780 [3]	14.659	9.292	7.220	Japan	0.968 [3]	13.357	8.730	6.677
Malaysia	0.450 [1]	7.023	4.102	2.886	Malaysia	0.009 [1]	8.261	4.578	3.184
New Zealand	**3.629 [3]**	0.000	0.000	0.000	New Zealand	**3.563 [3]**	0.000	0.000	0.000
Pakistan	0.072 [1]	7.812	4.213	2.921	Pakistan	1.016 [1]	8.120	4.313	2.937
South Korea	0.309 [1]	7.707	4.411	3.062	South Korea	1.429 [1]	7.437	4.041	2.941
Thailand	0.004 [1]	8.037	4.363	3.053	Thailand	0.773 [1]	8.558	4.476	2.950

Table-6.4 presents results of Granger-causality analysis between ELEP through Natural Gas (denoted as ELEP-NG) and GDP, and ELEP-NG and Trade. It is evident from Table-6.4 that the null hypothesis that ELEP-NG does not Granger-cause GDP (denoted by ELEP-NG≠>GDP) is rejected in Bangladesh among the Asian countries analyzed at least with a 10 %

level of significance. This indicates that ELEP-NG is the leading indicator of GDP in Bangladesh among the Asian countries analyzed. However, our evidence shows that GDP is a significant leading indicator of ELEP-NG in Pakistanas null hypothesis that GDP≠>ELEP-NG is rejected in Pakistan. Further, we find a significant bidirectional causal relationship between ELEP-NG and Trade in New Zealand.

Table 7.4: Granger-Causality between ELEP through Nuclear energy (ELEP-NU) and GDP; and ELEP-NU and Trade

ELEP-NU≠>GDP	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	GDP≠>ELEP-NU	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
India	0.346 [1]	7.898	4.299	2.939	India	2.656 [1]	7.298	4.135	2.846
Japan	2.396 [4]	16.777	10.981	8.772	Japan	5.753 [1]	16.257	10.832	8.508
Pakistan	0.371 [1]	7.141	4.011	2.850	Pakistan	0.210 **[1]**	7.371	4.258	2.897
South Korea	0.736 [1]	9.521	4.244	2.769	South Korea	**5.873 [1]**	8.290	4.327	2.906
ELEP-NU≠>Trade	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	Trade≠>ELEP-NU	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
India	0.061 [1]	7.691	4.366	2.928	India	0.088 [1]	7.846	4.213	2.896
Japan	4.833 [4]	16.305	10.892	8.586	Japan	6.709 [4]	16.221	10.648	8.312
Pakistan	**3.798 [1]**	8.339	4.323	2.933	Pakistan	1.186 [1]	8.140	4.134	2.854
South Korea	0.974 [1]	10.628	4.499	2.791	South Korea	0.001 [1]	10.804	4.718	2.905

Table 8.4: Granger-causality between ELEP through Oil (ELEP-Oil) and GDP; and ELEP-Oil and Trade

ELEP-oil≠>GDP	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	GDP≠>ELEP-oil	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
Bangladesh	2.086 [2]	12.876	7.293	5.295	Bangladesh	0.363 [2]	12.866	7.299	5.116
China	0.040 [1]	7.618	4.097	2.840	China	0.152 [1]	7.581	4.137	2.846
China HKSAR	0.418 [1]	7.450	4.285	2.963	China HKSAR	0.349 [1]	7.351	4.010	2.860
India	1.648 [1]	7.793	4.054	2.853	India	1.175 [1]	8.315	4.285	2.892
Indonesia	0.165 [1]	8.363	4.293	2.851	Indonesia	2.078 [1]	9.129	4.387	2.869
Japan	0.240 [4]	7.549	4.190	2.889	Japan	1.947 [1]	7.406	4.103	2.839
Malaysia	1.233 [1]	8.298	4.241	2.903	Malaysia	0.181 [1]	8.249	4.417	2.923
New Zealand	0.511 [2]	11.030	6.821	5.041	New Zealand	0.049 [2]	11.034	6.708	5.097
Pakistan	0.032 [2]	11.342	6.976	5.331	Pakistan	**7.823 [1]**	11.110	6.791	5.081
Philippines	3.845 [2]	12.098	7.194	5.374	Philippines	2.507 [2]	10.787	6.801	4.937
Singapore	0.064 [2]	11.286	6.999	5.187	Singapore	**7.484 [2]**	12.190	7.518	5.544
South Korea	0.227 [1]	8.250	4.286	2.769	South Korea	**3.171 [1]**	8.877	4.308	2.840
Thailand	1.323 [2]	11.721	7.393	5.552	Thailand	0.607 [2]	12.061	7.454	5.525
ELEP- oil ≠>Trade	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	Trade≠>ELEP-oil	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
Bangladesh	0.026 [1]	8.006	4.349	2.996	Bangladesh	1.774 [1]	8.696	4.290	2.853
China	0.257 [1]	8.651	4.763	3.258	China	2.400 [1]	8.199	4.372	2.988
China HKSAR	0.040 [1]	7.353	4.260	3.078	China HKSAR	1.427 [1]	7.426	4.166	2.927
India	0.629 [1]	7.726	4.078	2.980	India	0.000 [1]	8.714	4.318	2.911
Indonesia	0.032 [1]	7.615	4.146	2.881	Indonesia	0.353 [1]	8.044	4.209	2.853
Japan	1.275 [2]	11.845	7.205	5.453	Japan	**8.510 [2]**	10.694	6.531	4.918
Malaysia	**6.983 [3]**	13.795	8.867	6.885	Malaysia	3.839 [3]	13.604	8.538	6.690
New Zealand	**2.763 [2]**	4.532	1.302	0.560	New Zealand	1.485 [2]	0.000	0.000	0.000
Pakistan	1.975 [1]	7.348	4.064	2.843	Pakistan	**5.732 [1]**	7.548	4.217	2.851
Philippines	**9.827 [1]**	7.662	4.285	2.936	Philippines	0.508 [1]	7.806	4.189	2.895
Singapore	0.221 [2]	11.669	6.908	5.223	Singapore	**8.218 [2]**	12.352	7.363	5.522
South Korea	0.000 [1]	7.639	4.235	2.806	South Korea	1.313 [1]	7.830	4.256	2.931
Thailand	0.743 [1]	7.467	4.280	2.969	Thailand	0.200 [1]	7.291	4.268	2.953

Table 9.4: Granger-causality between ELEP through Renewable (ELEP-Rene) and GDP; and ELEP-Rene and Trade

ELEP-Rene≠>GDP	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	GDP≠>ELEP-Rene	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
Bangladesh	6.222 [2]	11.915	7.210	5.310	Bangladesh	1.603 [2]	13.051	7.443	5.412
China	**4.651 [1]**	7.484	4.066	2.849	China	0.608 [1]	7.760	4.152	2.890
India	1.244 [1]	7.845	4.439	3.152	India	2.335 [1]	7.192	4.023	2.792
Indonesia	0.593 [1]	7.620	4.291	2.981	Indonesia	2.471 [1]	8.435	4.433	3.071
Japan	0.451 [4]	7.258	4.194	2.868	Japan	2.619 [1]	7.548	4.187	2.845
Malaysia	**4.129 [1]**	7.237	4.068	2.828	Malaysia	0.338 [1]	8.009	4.235	2.929
New Zealand	0.512 [1]	7.453	4.196	2.919	New Zealand	**3.002 [1]**	7.348	4.097	2.855
Pakistan	0.127 [1]	7.343	4.227	2.890	Pakistan	0.543 [1]	7.495	4.246	2.928
Philippines	0.795 [2]	18.595	7.396	4.924	Philippines	2.511 [2]	20.459	7.998	5.247
South Korea	0.234 [1]	7.254	4.138	2.835	South Korea	2.078 [1]	7.116	3.982	2.776
Thailand	0.674 [1]	8.434	4.296	2.870	Thailand	0.184 [1]	8.019	4.072	2.815
ELEP-Rene≠>Trade	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	Trade≠>ELEP-Rene	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
Bangladesh	**3.520 [1]**	7.626	4.250	2.940	Bangladesh	**3.173 [1]**	7.550	4.129	2.841
China	**5.272 [1]**	7.681	4.318	2.911	China	0.653 [1]	7.824	4.334	2.952
India	0.296 [1]	7.534	4.247	2.911	India	**8.559 [1]**	7.570	4.231	2.916
Indonesia	3.633 [2]	11.436	6.889	5.200	Indonesia	**6.728 [2]**	10.691	6.502	4.865
Japan	2.458 [2]	10.415	6.660	5.098	Japan	4.049 [2]	10.700	6.823	5.043
Malaysia	0.236 [1]	7.877	4.355	3.076	Malaysia	0.354 [1]	8.104	4.347	3.017
New Zealand	1.042 [2]	0.000	0.000	0.000	New Zealand	**5.130 [2]**	0.000	0.000	0.000
Pakistan	0.046 [1]	7.525	4.208	2.893	Pakistan	3.274 [2]	7.686	4.267	4.267
Philippines	0.089 [1]	7.952	4.479	3.057	Philippines	0.044 [1]	7.888	4.327	2.979
South Korea	0.130 [1]	7.207	4.090	2.791	South Korea	0.121 [1]	7.397	4.133	2.856
Thailand	1.281 [1]	7.476	4.319	2.919	Thailand	0.263 [1]	7.690	4.338	2.885

Table 10.4: Granger-causality between total Electricity consumption (EPC) and GDP; and EPC and Trade

EPC≠>GDP	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	GDP≠>EPC	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
Bangladesh	2.280 [1]	8.240	4.128	2.834	Bangladesh	**14.813 [1]**	9.423	4.783	3.227
China	3.010 [4]	18.255	11.987	9.608	China	5.942 [4]	18.654	12.320	9.503
China HKSAR	0.490 [1]	7.398	4.324	2.996	China HKSAR	2.664 [1]	8.417	4.669	3.283
India	**5.441 [2]**	10.818	6.820	5.042	India	2.064 [2]	11.031	6.713	5.057
Indonesia	0.640 [1]	11.300	4.910	2.955	Indonesia	0.035 [1]	12.181	5.023	2.967
Japan	0.026 [1]	8.339	4.292	2.930	Japan	0.005 [1]	7.735	4.281	2.961
Malaysia	**14.66 [2]**	11.351	6.815	5.238	Malaysia	**5.833 [2]**	11.817	7.207	5.398
New Zealand	0.147 [1]	7.560	4.252	2.866	New Zealand	1.587 [1]	7.547	4.110	2.950
Pakistan	1.526 [1]	8.341	4.653	3.221	Pakistan	0.617 [1]	7.881	4.500	3.157
Philippines	2.124 [2]	11.519	7.134	5.320	Philippines	1.755 [2]	13.237	8.051	6.049
Singapore	2.303 [1]	7.719	4.189	2.885	Singapore	0.312 [1]	9.741	5.209	3.607
South Korea	**4.322 [1]**	8.622	4.408	2.933	South Korea	2.222 [1]	9.762	4.600	2.927
Thailand	1.377 [2]	12.006	7.052	5.152	Thailand	3.783 [2]	13.601	8.155	5.878
EPC≠>Trade	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	Trade≠>EPC	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
Bangladesh	0.098 [1]	7.504	4.146	2.885	Bangladesh	0.000 [1]	8.131	4.515	3.050
China	0.352 [2]	12.118	7.468	5.503	China	**6.640 [2]**	13.114	8.165	5.991
China HKSAR	**4.393 [1]**	7.392	4.110	2.902	China HKSAR	0.925 [1]	8.006	4.344	3.039
India	0.974 [1]	7.671	4.242	2.937	India	0.577 [1]	7.380	4.105	2.913
Indonesia	0.071 [1]	8.872	4.345	2.876	Indonesia	0.007 [1]	8.930	4.394	2.879
Japan	4.440 [2]	11.465	6.866	5.108	Japan	**19.397 [2]**	11.140	6.939	5.110
Malaysia	**4.988 [1]**	7.701	4.288	2.936	Malaysia	2.011 [1]	7.249	4.193	2.821
New Zealand	0.469 [1]	7.681	4.299	2.940	New Zealand	0.969 [1]	9.038	4.846	3.432
Pakistan	2.313 [1]	7.471	4.025	2.834	Pakistan	**8.435 [1]**	7.653	4.204	2.912
Philippines	0.597 [1]	7.909	4.452	3.064	Philippines	0.414 [1]	7.624	4.160	2.963
Singapore	1.319 [1]	7.659	4.056	2.827	Singapore	**3.149 [1]**	8.236	4.396	3.043
South Korea	0.545 [2]	11.768	7.058	5.282	South Korea	4.716 [2]	11.180	6.727	5.101
Thailand	0.094 [2]	11.101	6.687	5.025	Thailand	3.190 [2]	12.861	8.026	5.912

Table-7.4 presents the results of Granger-causality analysis between ELEP through Nuclear energy (denoted as ELEP-NU) and GDP, and ELEP-NU and Trade. It is evident from Table-7.4 that the null hypotheses that ELEP-NU does not Granger-cause GDP (denoted by ELEP-NU≠>GDP) and Trade does not Granger-cause ELEP-NU are not rejected for any of the

Asian country analyzed at least with a 10 % level of significance. This indicates that ELEP-NU is not the leading indicator of GDP and Trade is not the leading indicator of ELEP-NU for the Asian countries analyzed. However, our evidence shows that GDP is a significant leading indicator of ELEP-NU in South Korea as null hypothesis that GDP≠>ELEP-NU is rejected in South Korea. Further, evidence of Granger-causality between ELEP-NU and Trade shows that the null hypothesis that ELEP-NU does not Granger-cause Trade is rejected just in Pakistan indicating that ELEP-NU is the leading indicator for Trade in Pakistan.

Table 11.4: Granger-causality between Energy Use (EU) and GDP; and EU and Trade

EU≠>GDP	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	GDP≠>EU	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
Bangladesh	0.001 [1]	8.002	4.412	2.978	Bangladesh	1.341 [1]	7.948	4.247	2.868
China	1.579 [2]	11.543	6.995	5.305	China	0.100 [2]	12.022	7.386	5.583
China HKSAR	0.764 [1]	7.622	4.222	2.927	China HKSAR	1.821 [1]	7.689	4.185	2.918
India	2.049 [1]	8.348	4.463	3.107	India	**5.702 [1]**	7.750	4.323	2.934
Indonesia	0.204 [1]	9.096	4.095	2.812	Indonesia	0.791 [1]	8.983	4.193	2.829
Japan	0.859 [1]	8.426	4.616	3.227	Japan	0.938 [1]	7.318	4.090	2.840
Malaysia	**5.678 [1]**	7.788	4.281	2.895	Malaysia	0.224 [1]	7.310	4.066	2.850
New Zealand	0.296 [1]	7.767	4.240	2.998	New Zealand	0.056 [1]	7.365	4.313	2.941
Pakistan	**4.314 [1]**	9.180	5.213	3.630	Pakistan	0.339 [1]	7.334	4.124	2.852
Philippines	**9.038 [3]**	14.060	9.069	6.994	Philippines	**13.637 [1]**	14.728	8.996	6.947
Singapore	0.388 [1]	7.546	4.071	2.905	Singapore	0.055 [1]	7.200	4.136	2.865
South Korea	3.462 [1]	11.292	5.880	3.987	South Korea	**3.198 [1]**	8.093	4.363	2.960
Thailand	1.130 [1]	8.626	4.710	3.205	Thailand	0.000 [1]	8.060	4.275	2.846
EU≠>Trade	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	Trade≠>EU	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
Bangladesh	0.348 [1]	7.442	4.230	2.846	Bangladesh	0.000 [1]	7.626	4.243	2.957
China	1.403 [2]	13.397	7.730	5.703	China	2.511 [2]	13.612	7.915	5.966
China HKSAR	1.381 [1]	7.730	4.184	2.926	China HKSAR	**3.960 [1]**	7.694	4.269	2.962
India	0.126 [1]	7.710	4.264	2.965	India	0.207 [1]	7.680	4.319	2.982
Indonesia	0.018 [1]	8.532	4.151	2.754	Indonesia	2.285 [1]	9.141	4.377	2.849
Japan	**16.88 [2]**	11.282	7.151	5.347	Japan	1.009 [2]	10.795	7.087	5.411
Malaysia	**8.262 [1]**	7.763	4.451	3.025	Malaysia	0.551 [1]	7.444	4.175	2.856
New Zealand	**90.43 [2]**	26.209	7.469	4.789	New Zealand	0.315 [2]	11.639	7.440	5.648
Pakistan	1.400 [1]	7.489	4.171	2.896	Pakistan	0.034 [1]	7.441	4.040	2.801
Philippines	0.591 [1]	7.566	4.198	2.828	Philippines	0.633 [1]	7.320	4.237	2.996
Singapore	0.100 [1]	8.454	4.459	3.032	Singapore	0.142 [1]	8.085	4.326	2.992
South Korea	0.107 [1]	8.868	4.197	2.858	South Korea	0.292 [1]	10.134	4.426	2.878
Thailand	11.41 [1]	7.792	4.268	2.960	Thailand	2.745 [1]	7.830	4.342	3.002

Table-8.4 presents results of Granger-causality analysis between ELEP through Oil (denoted as ELEP-Oil) and GDP, and ELEP-Oil and Trade. It is evident from Table-8.4 that the null hypothesis that ELEP-Oil does not Granger-cause GDP (denoted by ELEP-Oil≠>GDP) is not rejected for any of the Asian country analyzed at least with a 10 % level of significance. This indicates that ELEP-Oil is not the leading indicator of GDP for the Asian countries analyzed. However, our evidence shows that GDP is a significant leading indicator of ELEP-Oil in Pakistan, Singapore and South Korea as null hypothesis that GDP≠>ELEP-Oil is rejected for these countries. Further, evidence of Granger-causality between ELEP-Oil and Trade shows that the null hypothesis that ELEP-Oil does not Granger-cause Trade is rejected in Malaysia, New Zealand and Philippines, whereas the null hypothesis that Trade does not Granger-cause ELEP-Oil is rejected in Japan, Pakistan and Singapore.

Table 12.4: Granger-causality between Hydroelectricity consumption (HYD) and GDP; and HYD and Trade

HYD≠>GDP	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	GDP≠>HYD	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
Bangladesh	0.038 [1]	8.238	4.348	2.951	Bangladesh	0.731 [1]	7.601	4.215	2.912
China	0.560 [1]	7.621	4.162	2.847	China	2.839 [1]	7.698	4.324	2.977
India	1.184 [1]	7.557	4.118	2.934	India	2.079 [1]	7.014	4.080	2.781
Indonesia	1.218 [1]	10.476	4.566	2.940	Indonesia	1.624 [1]	8.575	4.157	2.766
Japan	0.009 [1]	7.154	3.991	2.795	Japan	0.003 [1]	7.206	4.080	2.868
Malaysia	**3.846 [1]**	7.898	4.200	2.927	Malaysia	0.000	7.797	4.260	2.915
New Zealand	0.212 [1]	7.529	4.182	2.893	New Zealand	**3.808 [1]**	7.303	4.076	2.868
Pakistan	0.226 [1]	7.393	4.078	2.805	Pakistan	0.307 [1]	7.707	4.165	2.921
Philippines	1.177 [2]	10.723	6.783	5.095	Philippines	2.035 [2]	10.726	6.794	5.094
South Korea	0.071 [1]	7.026	4.037	2.825	South Korea	0.327 [1]	7.136	4.095	2.848
Taiwan	0.796 [1]	7.088	4.095	2.872	Taiwan	0.235 [1]	7.182	4.039	2.811
Thailand	**6.070 [1]**	7.628	4.183	2.824	Thailand	0.223 [1]	7.455	3.997	2.731
HYD≠>Trade	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	Trade≠>HYD	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
Bangladesh	**3.535 [1]**	8.480	4.276	2.922	Bangladesh	2.006 [1]	7.970	4.345	2.976
China	**4.685 [1]**	7.425	4.246	2.894	China	0.484 [1]	8.015	4.234	2.950
India	0.088 [1]	7.548	4.140	2.900	India	**7.976 [1]**	7.242	4.111	2.833
Indonesia	0.051 [1]	8.423	4.270	2.835	Indonesia	**8.980 [1]**	8.657	4.533	2.930
Japan	1.578 [2]	10.887	6.796	5.224	Japan	**7.057 [2]**	10.056	6.689	4.996
Malaysia	0.110 [1]	8.286	4.593	2.994	Malaysia	0.159 [1]	8.063	4.443	3.053
New Zealand	1.222 [2]	0.539	0.026	0.005	New Zealand	1.298 [2]	0.000	0.000	0.000
Pakistan	0.415 [1]	7.220	4.187	2.858	Pakistan	0.370 [1]	7.497	4.126	2.921
Philippines	0.021 [1]	7.144	4.090	2.834	Philippines	0.020 [1]	7.919	4.306	2.971
South Korea	1.520 [1]	7.279	4.211	2.916	South Korea	1.349 [1]	7.530	4.164	2.911
Thailand	0.001 [1]	7.738	4.179	2.862	Thailand	0.363 [1]	7.566	4.157	2.911

Table 13.4: Granger-causality between Natural Gas consumption (NG) and GDP; and NG and Trade

NG≠>GDP	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	GDP≠>NG	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
Bangladesh	**13.884 [2]**	10.651	6.477	4.872	Bangladesh	**15.157 [2]**	11.133	6.859	5.100
China	3.429 [3]	14.204	9.123	7.122	China	7.122 [3]	14.392	9.551	7.399
India	**15.91 [1]**	11.391	6.792	4.912	India	0.568 [2]	10.105	6.296	4.747
Indonesia	0.463 [1]	9.609	4.655	2.956	Indonesia	0.201 [1]	9.535	4.481	2.907
Japan	0.191 [1]	7.517	4.155	2.888	Japan	**5.358 [1]**	7.817	4.235	2.923
Malaysia	1.226 [1]	7.864	4.320	2.929	Malaysia	1.614 [1]	7.559	4.180	2.847
New Zealand	**11.42 [4]**	17.236	11.221	8.757	New Zealand	3.140 [1]	17.182	11.110	8.653
Pakistan	0.067 [1]	7.384	4.153	2.946	Pakistan	**10.844 [1]**	8.607	4.873	3.336
Taiwan	0.394 [1]	7.646	4.353	3.003	Taiwan	0.019 [1]	7.635	4.235	2.890
NG≠>Trade	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	Trade≠>NG	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
Bangladesh	1.425 [1]	7.599	4.250	2.904	Bangladesh	2.498 [1]	8.058	4.349	2.920
China	0.145 [1]	8.125	4.383	2.979	China	0.190 [1]	7.828	4.289	2.895
India	**15.03 [2]**	10.872	6.609	4.953	India	1.478 [2]	11.253	6.899	5.146
Indonesia	0.079 [1]	8.010	4.216	2.857	Indonesia	0.004 [1]	8.550	4.184	2.801
Japan	2.988 [2]	12.181	7.457	5.568	Japan	0.866 [2]	11.464	6.982	5.220
Malaysia	**6.742 [2]**	13.045	8.072	5.950	Malaysia	1.178 [2]	13.570	7.392	5.341
New Zealand	1.425 [1]	2.694	0.488	0.161	New Zealand	**1.120 [2]**	0.000	0.000	0.000
Pakistan	0.000 [1]	7.397	4.111	2.902	Pakistan	0.700 [1]	7.171	4.096	2.800
South Korea	0.449 [1]	8.418	4.494	3.046	South Korea	0.855 [1]	7.653	4.113	2.844

Table 14.4: Granger-causality between Nuclear energy consumption (NU) and GDP; and NU and Trade

NU≠>GDP	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	GDP≠>NU	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
India	0.705 [1]	7.442	4.174	2.872	India	0.730 [1]	7.671	4.274	3.005
Japan	2.234 [4]	16.590	10.878	8.772	Japan	4.877 [4]	16.401	10.605	8.390
Taiwan	2.420 [1]	8.157	4.424	2.951	Taiwan	**9.815 [1]**	8.779	4.507	2.979
Thailand	0.687 [1]	7.614	4.138	2.918	Thailand	0.075 [1]	7.762	4.264	2.984
NU≠>Trade	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	Trade≠>NU	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
India	1.207 [1]	7.628	4.150	2.928	India	0.043 [1]	7.870	4.287	3.014
Japan	3.389 [4]	16.704	10.993	8.637	Japan	**9.038 [4]**	16.279	10.633	8.197
Thailand	1.220 [1]	8.149	4.252	2.854	Thailand	0.045 [1]	8.089	4.354	3.017

Table 15.4: Granger-Causality between Primary Energy Consumption (PEC) and GDP; and PEC and Trade

PEC≠>GDP	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	GDP≠>PEC	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
Bangladesh	0.626 [1]	7.616	4.275	2.924	Bangladesh	0.408 [1]	7.615	4.326	3.040
China	1.078 [2]	11.508	6.731	5.020	China	1.859 [2]	12.614	7.679	5.738
China HKSAR	1.005 [1]	7.956	4.252	2.883	China HKSAR	0.247 [1]	7.696	4.207	2.911
India	2.332 [1]	7.761	4.138	2.875	India	**3.093 [1]**	7.314	4.257	2.921
Indonesia	0.154 [1]	9.163	4.745	3.114	Indonesia	0.005 [1]	8.222	4.363	2.891
Japan	5.843 [4]	16.612	11.086	8.777	Japan	**11.680 [4]**	15.395	10.624	8.446
Malaysia	0.622 [1]	7.393	4.143	2.890	Malaysia	0.097 [1]	8.267	4.761	3.304
New Zealand	2.508 [1]	7.466	4.258	2.927	New Zealand	0.004 [1]	7.676	4.218	2.950
Pakistan	0.004 [1]	7.417	4.170	2.880	Pakistan	**4.853 [1]**	7.777	4.552	3.186
Philippines	3.761 [1]	11.292	7.179	5.328	Philippines	1.947 [1]	10.243	6.316	4.744
Singapore	0.201 [1]	7.271	4.137	2.911	Singapore	0.196 [1]	7.262	4.151	2.860
South Korea	1.924 [1]	7.858	4.382	3.031	South Korea	**3.950 [1]**	7.607	4.121	2.891
Taiwan	0.223 [1]	7.696	4.211	2.989	Taiwan	2.438 [1]	7.830	4.274	2.995
Thailand	**3.885 [1]**	7.864	4.587	3.187	Thailand	0.066 [1]	7.545	4.185	2.852
PEC≠>Trade	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	Trade≠>PEC	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
Bangladesh	**3.417 [1]**	7.670	4.109	2.902	Bangladesh	0.075 [1]	7.688	4.175	2.974
China	0.268 [2]	12.624	7.354	5.392	China	**7.164 [2]**	12.619	7.735	5.690
China HKSAR	**9.067 [1]**	7.558	4.302	2.970	China HKSAR	0.427 [1]	7.547	3.984	2.772
India	0.358 [1]	7.274	4.182	2.900	India	0.061 [1]	7.505	3.990	2.819
Indonesia	0.252 [1]	8.082	4.086	2.807	Indonesia	**3.987 [1]**	7.230	4.038	2.760
Japan	**15.15 [2]**	11.505	6.959	5.177	Japan	**10.209 [2]**	12.105	7.665	5.892
Malaysia	0.987 [1]	7.418	4.035	2.812	Malaysia	1.316 [1]	7.682	4.057	2.779
New Zealand	**0.663 [2]**	0.0000	0.0000	0.000	New Zealand	**0.410 [2]**	0.0000	0.000	0.000
Pakistan	0.187 [1]	7.616	4.346	2.983	Pakistan	0.089 [1]	7.509	4.070	2.839
Philippines	1.984 [1]	7.063	4.161	2.919	Philippines	1.704 [1]	7.357	4.055	2.820
Singapore	0.157 [1]	7.865	4.321	2.982	Singapore	0.000 [1]	8.209	4.568	3.146
South Korea	0.811 [1]	7.923	4.233	2.840	South Korea	0.143 [1]	9.155	4.476	2.899
Thailand	1.061 [1]	7.359	4.088	2.867	Thailand	3.039 [1]	7.289	4.091	2.872

Table-9.4 presents results of Granger-causality analysis between ELEP through Renewables (denoted as ELEP-Rene) and GDP, and ELEP-Rene and Trade. It is evident from Table-9.4 that the null hypothesis that ELEP-Rene does not Granger-cause GDP (denoted by ELEP-Rene≠>GDP) is rejected in China and Malaysia among the Asian countries analyzed at least with a 10 % level of significance. This indicates that ELEP-Rene is a leading indicator of GDP for these two countries among the Asian countries analyzed. However, our evidence shows that GDP is a significant leading indicator of ELEP-Rene in the New Zealand as null hypothesis that GDP≠>ELEP-Rene is rejected in New Zealand. Further, evidence of Granger-causality between ELEP-Rene and Trade show that the null hypothesis that ELEP-Rene does not Granger-cause Trade is rejected for two countries (namely Bangladesh and China) whereas the null hypothesis that Trade does not Granger-cause ELEP-Rene is rejected in Bangladesh, India, Indonesia and New Zealand. Hence, for Bangladesh, we find evidence of the bidirectional causal relationship between ELEP-Rene and Trade.

Table-10.4 presents results of Granger-causality analysis between total energy consumption (denoted by EPC) and GDP, and EPC and Trade. It is evident from Table-10.4 that the null hypothesis that EPC does not Granger-cause GDP (denoted by EPC≠>GDP) is rejected in India, Malaysia, and South Korea among the Asian country analyzed at least with a 10 % level of significance. This indicates that EPC is the leading indicator of GDP for these countries among the Asian countries analyzed. However, our evidence shows that GDP is a significant leading indicator of EPC in Bangladesh and Malaysia as null hypothesis that GDP≠>EPC is rejected for these two countries. Further, evidence of Granger-causality between EPC and Trade shows that the null hypothesis that EPC does not Granger-cause Trade is rejected in China HKSAR and Malaysia whereas the null hypothesis that Trade does not Granger-cause EPC is rejected in China, Japan, Pakistan and Singapore.

Table-11.4 presents results of Granger-causality analysis between Energy Use (EU) and GDP, and EU and Trade. It is evident from Table-11.4 that the null hypothesis that EU does not Granger-cause GDP (denoted by EU≠>GDP) is rejected in Malaysia, Pakistan and the Philippines among the Asian countries analyzed at least with a 10 % level of significance. This indicates that the EU is the leading indicator of GDP in Malaysia, Pakistan and Philippines among the Asian countries analyzed. However, our evidence shows that GDP is a significant leading indicator of EU in India, Philippines and South Korea as null hypothesis that GDP≠>EU is rejected for these countries. Further, evidence of Granger-causality between EU and Trade shows that the null hypothesis that EU does not Granger-cause Trade is rejected in Japan, Malaysia, New Zealand and Thailand whereas the null hypothesis that Trade does not Granger-cause EU is rejected only in China HKSAR.

Table-12.4 presents results of Granger-causality analysis between Hydroelectricity consumption (denoted by HYD) and GDP, and HYD and Trade. It is evident from Table-12.4 that the null hypothesis that HYD does not Granger-cause GDP (denoted by HYD≠>GDP) is rejected in Malaysia and Thailand among the Asian countries analyzed at least with a 10 % level of significance. This indicates that HYD is the leading indicator of GDP for these two countries among the Asian countries analyzed. However, our evidence shows that GDP is a significant leading indicator of HYD only in New Zealand as null hypothesis that GDP≠>HYD is rejected only in New Zealand. Further, evidence of Granger-causality between HYD and Trade shows that the null hypothesis that HYD does not Granger-cause Trade is rejected in Bangladesh and China, whereas, the null hypothesis that Trade does not Granger-cause HYD is rejected in India, Indonesia and Japan.

Table-13.4 presents the results of Granger-causality analysis between Natural Gas (denoted by NG) and GDP, NG and Trade. It is evident from Table-13.4 that the null hypothesis that NG does not Granger-cause GDP (denoted by NG≠>GDP) is rejected in Bangladesh, India and New Zealand among the Asian countries analyzed at least with a 10 % level of significance. This indicates that NG is the leading indicator of GDP for these three countries among the Asian countries analyzed. However, our evidence shows that GDP is a significant leading indicator of NG in Bangladesh, Japan and Pakistan as null hypothesis that GDP≠>NG is rejected for these countries. Further, evidence of Granger-causality between NG and Trade shows that the null hypothesis that NG does not Granger-cause Trade is rejected for two countries (India and Malaysia) whereas the null hypothesis that Trade does not Granger-cause NG is rejected only in New Zealand.

Table-14.4 presents the results of Granger-causality analysis between Nuclear Energy Consumption (denoted by NU) and GDP, and NU and Trade. It is evident from Table-14.4 that the null hypotheses that NU does not Granger-cause GDP (denoted by NU≠>GDP) and NU does not Granger-cause Trade (denoted by NU≠>Trade) are not rejected for any of the Asian country analyzed at least with a 10% level of significance. This indicates that NU is not the leading indicator of GDP and Trade for the Asian countries analyzed. However, our evidence shows that GDP is a significant leading indicator of NU in Taiwan as null hypothesis that GDP≠>NU is rejected in this country. Further, evidence of Granger-causality between NU and Trade shows that the null hypothesis that Trade does not Granger-cause NU is rejected only for Japan.

Table-15.4 presents results of Granger-causality analysis between PEC and GDP, and PEC and Trade. It is evident from Table-15.4 that the null hypothesis that PEC does not Granger-cause GDP (denoted by PEC≠>GDP) is rejected only in Thailand among the Asian countries analysed with a 10% level of significance. This indicates that PEC is the leading indicator of GDP in Thailand among the Asian countries analyzed. However, evidence shows that GDP is a significant leading indicator of PEC in India, Japan, Pakistan and South Korea as null hypothesis that GDP≠>PEC is rejected for these countries. Further, evidence of Granger-causality between PEC and Trade shows that the null hypothesis that PEC does not Granger-cause Trade is rejected in Bangladesh, China HKSAR, Japan and New Zealand, whereas, the null hypothesis that Trade does not Granger-cause PEC is rejected for China, Indonesia, Japan, New Zealand and Thailand. Hence, for Japan, and New Zealand we find evidence of the bidirectional causal relationship between PEC and Trade.

4.3 Results of the cointegration analysis with structural breaks

After establishing that variables are level non-stationary and first difference stationary i.e., they are I(1), we analyzed cointegration. Results of cointegration analysis are reported in Table-16.4-30.4. Table-16.4 presents the results of cointegration analysis between CO_2 emissions and GDP, and CO_2 emissions and Trade. In both the cases, we analyze cointegration first by using GDP or Trade as independent variable and CO_2 emissions as dependent variable, and second by using CO_2 emissions as independent variable and GDP or Trade as the dependent variable.

Table 16.4: Cointegration between CO_2 emissions and GDP; and CO_2 emissions and Trade

CO_2-GDP	ADF Test	Zt	Za	GDP-CO_2	ADF Test	Zt	Za
Bangladesh	-4.5095	-6.156**	-39.303	Bangladesh	-5.645	-5.699*	-36.609
China	-5.257	-4.976	-33.039	China	-5.620	-4.273	-27.840
China HKSAR	-5.426	-5.866*	-37.866	China HKSAR	-5.841*	-5.967*	-40.605
India	-5.674*	-6.446**	-44.209	India	-5.735*	-5.905*	-41.061
Indonesia	-6.240**	-6.311**	-42.753	Indonesia	-5.361	-5.409	-35.509
Japan	-4.878	-5.071	-34.258	Japan	-5.297	-5.357	-37.525
Philippines	-5.147	-4.514	-24.127	Philippines	-4.814	-3.345	-18.379
Taiwan	-6.473**	-6.546***	-45.007	Taiwan	-4.872	-4.571	-32.223
Thailand	-5.302	-5.862*	-39.878	Thailand	-5.394	-5.457	-37.225
CO_2-Trade	ADF Test	Zt	Za	Trade-CO_2	ADF Test	Zt	Za
China HKSAR	-5.611	-5.123	-33.859	China HKSAR	-5.754*	-5.826*	-39.112
India	-5.333	-4.789	-34.835	India	-5.109	-5.202	-37.371
Indonesia	-4.104	-3.804	-23.616	Indonesia	-5.338	-5.399	-36.296
Japan	-6.223**	-6.294**	-59.231*	Japan	-4.728	-5.483	-36.019
Malaysia	-5.915*	-4.207	-21.835	Malaysia	-4.730	-1.893	-24.485
Philippines	-4.855	-5.128	-34.434	Philippines	-6.680***	-6.756***	-46.268

Note: (a) Critical values for ADF tests and Zt test are: -6.503, -6.015, and -5.653 at 1%, 5% and 10% level of significance respectively; (b) Critical values for Za test are: -90.794, -76.003, and -52.232 at 1%, 5% and 10% level of significance respectively; and (c) ***, ** and * denotes significant at 1%, 5% and 10% level respectively. (d) Note of this table is applicable to Tables 17.4-30.4.

Table 17.4: Cointegration between Coal and GDP; and Coal and Trade

Coal-GDP	ADF Test	Zt	Za	GDP-Coal	ADF Test	Zt	Za
China	-5.378	-4.533	-30.131	China	-6.109**	-4.198	-27.478
India	-5.826*	-6.670***	-46.347	India	-5.876*	-6.078**	-41.071
Indonesia	-5.044	-4.686	-28.757	Indonesia			
Pakistan	-5.249	-5.336	-37.033	Pakistan	-5.791*	-4.763	-32.319
Philippines	-5.501	-6.341**	-38.211	Philippines			
Taiwan	-5.530	-4.372	-29.213	Taiwan	-5.948*	-5.185	-34.103
Coal-Trade	ADF Test	Zt	Za	Trade-Coal	ADF Test	Zt	Za
India	-5.766*	-4.595	-34.088	India	-5.659*	-5.457	-39.579
Indonesia	-4.813	-4.868	-31.467	Indonesia			
Pakistan	-4.296	-4.342	-26.772	Pakistan	-5.535	-5.835*	-40.023
Philippines	-6.009*	-6.096*	-38.542				

Results reported in Table-16.4 show that when CO_2 emissions is the dependent variable, cointegration between CO_2 emissions and GDP is significantly evident in Bangladesh, China HKSAR, India, Indonesia, Taiwan and Thailand as a null hypothesis of no cointegration is rejected by at least one of the three tests at the 10 % level of significance. However, when we replace the position of the variables, evidence to reject the null hypothesis of cointegration is found in Bangladesh, China HKSAR and India. Further, when cointegration is examined between CO_2 emissions and Trade keeping CO_2 emissions as the dependent variable, the null hypothesis of cointegration is rejected in Japan and Malaysia and when the position of the variable is replaced, significant evidence of cointegration is found in China HKSAR and Philippines.

In the next step, we report with Table-17.4, the results of cointegration analysis between Coal and GDP, and Coal and Trade. Results reported in Table-17.4 show that when Coal is the dependent variable cointegration between Coal and GDP is found in India and Philippines, and when dependent and independent variables are interchanged, evidence of rejection of the null hypothesis of cointegration is found in China, India, Pakistan and Taiwan. Further, when cointegration is examined between Coal and Trade keeping Coal as the dependent variable, we find that the null hypothesis is rejected in India and Philippines, and when we keep Trade as the dependent variable cointegration is found in India and Pakistan.

Further, we report the results of cointegration analysis between ELEP and GDP, and ELEP and Trade in Table-18.4. Evidence from Table-18.4 shows that when ELEP is the dependent variable cointegration between ELEP and GDP is found in Bangladesh, China, China HKSAR, India, Japan, Pakistan, Philippines, South Korea and Thailand as null hypothesis of no cointegration is rejected by at least one of the three test at the 10 % level of significance.

However, when GDP is the dependent variable and ELEP is the independent variable, we find evidence for the rejection of the null hypothesis of cointegration in Bangladesh, China, Philippines, South Korea and Thailand. Further, when cointegration is examined between ELEP and Trade keeping ELEP as the dependent variable we find that the hull hypothesis is rejected in China HKSAR, Japan and Malaysia and, when we keep Trade as dependent variable cointegration is found in China HKSAR, Indonesia and Malaysia.

Table 18.4: Cointegration between ELEP and GDP; and ELEP and Trade

ELEP-GDP	ADF Test	Zt	Za	GDP-ELEP	ADF Test	Zt	Za
Bangladesh	-6.613***	-9.008***	-44.646	Bangladesh	-5.816*	-10.009***	-51.281
China	-6.261**	-4.030	-23.245	China	-5.761*	-3.983	-24.021
China HKSAR	-5.884*	-5.934*	-36.534	China HKSAR	-5.528	-5.602	-34.784
India	-5.519	-7.275***	-39.824	India	-5.002	-5.217	-28.368
Indonesia	-4.956	-4.794	-28.381	Indonesia	-5.027	-5.030	-29.857
Japan	-5.743*	-5.087	-35.720	Japan	-4.889	-4.371	-29.097
Pakistan	-5.658*	-5.734*	-35.463	Pakistan	-5.241	-3.909	-24.908
Philippines	-5.712*	-5.788*	-36.218	Philippines	-6.521***	-5.694*	-35.774
South Korea	-5.849*	-5.675*	-35.140	South Korea	-5.636	-5.709*	-35.882
Thailand	-5.276	-5.857*	-31.970	Thailand	-5.685*	-5.877*	-34.497
ELEP-Trade	ADF Test	Zt	Za	Trade-ELEP	ADF Test	Zt	Za
China HKSAR	-4.719	-6.173**	-27.871	China HKSAR	-5.694*	-5.770*	-35.737
India	-5.457	-5.169	-32.212	India	-5.497	-4.842	-31.070
Indonesia	-5.082	-5.200	-21.619	Indonesia	-5.814*	-5.550	-33.855
Japan	-5.696*	-5.838*	-40.914	Japan	-5.276	-3.926	-53.334
Malaysia	-4.868	-5.910*	-34.967	Malaysia	-5.203	-5.619	-37.894
Pakistan	-4.002	-4.055	-24.136	Pakistan	-5.463	-6.586***	-35.352
Philippines	-5.251	-4.497	-22.871	Philippines	-5.124	-4.882	-30.949
South Korea	-4.548	-3.987	-24.428	South Korea	-5.109	-4.812	-40.204

Table 19.4: Cointegration between ELEP-Coal and GDP; and ELEP-Coal and Trade

ELEP-Coal-GDP	ADF Test	Zt	Za	GDP-ELEP-Coal	ADF Test	Zt	Za
China HKSAR	-12.787***	-7.14***	-38.770	China HKSAR	-27.962***	-4.490	-24.340
Japan	-5.369	-5.183	-36.252	Japan	-10.414***	-6.930***	-49.986
South Korea	-6.205**	-5.773*	-36.880	South Korea	-6.344**	-4.896	-30.867
Thailand	-6.090**	-5.608	-35.010	Thailand	-5.709*	-4.590	-27.835
ELEP-Coal-Trade	ADF Test	Zt	Za	Trade-ELEP-Coal	ADF Test	Zt	Za
China HKSAR	-10.871***	-6.68***	-34.034	China HKSAR	-9.683***	-5.450	-28.451
Japan	-5.004	-3.740	-29.603	Japan	-4.739	-4.049	-42.533
South Korea	-5.577	**-5.964***	**-38.170**	South Korea	-4.983	-4.742	-38.948

Table 20.4: Cointegration between ELEP-HYD and GDP; and ELEP-HYD and Trade

ELEP-HYD-GDP	ADF Test	Zt	Za	GDP-ELEP-HYD	ADF Test	Zt	Za
China	-5.529	-5.659*	-32.241	China	-5.108	-5.851*	-35.535
India	-5.346	-4.611	-29.080	India	-5.701*	4.100	-28.912
ELEP-HYD-Trade	ADF Test	Zt	Za	Trade-ELEP-HYD	ADF Test	Zt	Za
India	-5.520	-6.714***	-42.243	India	-6.654***	-6.743***	-42.503

Table-19.4 reports the results of cointegration analysis between ELEP-Coal and GDP, and ELEP-Coal and Trade. Evidence from Table-19.4 shows that when ELEP-Coal is dependent variable significant cointegration between ELEP-Coal and GDP is found in China HKSAR, South Korea and Thailand. However, when GDP is the dependent variable and ELEP-Coal is independent variable we find evidence for the rejection of the null hypothesis of cointegration in China HKSAR, Japan, South Korea and Thailand. Further, when cointegration is examined between ELEP-Coal and Trade keeping ELEP-Coal as dependent variable we find that the null hypothesis is rejected in China HKSAR and South Korea, and when we keep Trade as dependent variable cointegration is found only in China HKSAR.

Table 21.4: Cointegration between ELEP-NG and GDP; and ELEP-NG and Trade

ELEP-NG-GDP	ADF Test	Zt	Za	GDP-ELEP-NG	ADF Test	Zt	Za
Bangladesh	-5.781*	-8.235***	-48.254	Bangladesh	-5.568*	-9.201***	-51.550
India	-6.435**	-6.719***	-41.869	India	-5.826*	-5.436	-34.740
Japan	-5.588	-6.415**	-45.955	Japan	-6.282**	-5.245	-36.368
Thailand	-5.982*	-6.177**	-33.242	Thailand	-5.470	-4.476	-28.479
ELEP-NG-Trade	ADF Test	Zt	Za	Trade-ELEP-NG	ADF Test	Zt	Za
India	-5.090	-6.697***	-42.689	India	-4.711	-4.460	-28.067
Japan	-4.886	-5.740*	-39.833	Japan	-5.424	-3.226	-28.219

Table 22.4: Cointegration between ELEP-NU and GDP; and ELEP-NU and Trade

ELEP-NU-GDP	ADF Test	Zt	Za	GDP-ELEP-NU	ADF Test	Zt	Za
India	-6.455**	-5.791*	-31.301	India	-5.415	-4.099	-26.441
Japan	-5.814*	-5.764*	-33.277	Japan	-4.626	-6.256*	-32.843
South Korea	-7.894***	-9.817**	-56.414*	South Korea	-4.753	-5.119	-32.465
ELEP-NU-Trade	ADF Test	Zt	Za	Trade-ELEP-NU	ADF Test	Zt	Za
India	-5.360	-5.445	-28.650	India	-6.190**	-4.167	-24.742
Japan	-5.774*	-6.900***	-47.303	Japan	-6.402**	-2.858	-29.222
South Korea	-8.098***	-5.160	-31.407	South Korea	-5.539	-3.323	-41.282

Table 23.4: Cointegration between ELEP-Oil and GDP; and ELEP-Oil and Trade

ELEP-Oil-GDP	ADF Test	Zt	Za	GDP-ELEP-Oil	ADF Test	Zt	Za
China	-6.372**	-7.153***	-42.837	China	-4.037	-4.091	-23.854
China HKSAR	-5.043	-4.697	-28.593	China HKSAR	-4.804	-4.121	-23.770
India	-6.249**	-6.333**	-41.267	India	-6.441**	-4.103	-28.750
Indonesia	-5.214	-4.121	-26.280	Indonesia	-4.895	-3.939	-24.296
Pakistan	-7.497***	-4.931	-29.939	Pakistan	-5.261	-5.022	-31.197
Philippines	-5.031	-5.099	-31.896	Philippines	-3.912	-3.497	-20.720
South Korea	-5.873*	-5.950*	-38.186	South Korea	-5.641	-5.715*	-36.816
Thailand	-6.497**	-3.429	-24.797	Thailand	-5.777*	-4.894	-30.988
ELEP-Oil-Trade	ADF Test	Zt	Za	Trade-ELEP-Oil	ADF Test	Zt	Za
China HKSAR	-4.987	-4.827	-29.455	China HKSAR	-5.103	-4.967	-30.629
India	-6.520***	-6.607***	-42.346	India	-5.450	-5.523	-36.242
Indonesia	-4.743	-4.807	-29.807	Indonesia	-5.066	-5.134	-31.148
Pakistan	-5.019	-5.256	-33.096	Pakistan	-7.486***	-7.872***	-33.902
Philippines	-5.321	-5.392	-33.375	Philippines	-4.964	-4.864	-30.432
South Korea	-5.978*	-6.058**	-38.368	South Korea	-4.804	-4.869	-30.463

Results reported in Table-20.4 show that when cointegration is examined between ELEP-HYD and GDP keeping ELEP-HYD as the dependent variable we find that the null hypothesis is rejected in China, and when we keep GDP as dependent variable cointegration is found in

China and India. Further, when cointegration is examined between ELEP-HYD and Trade keeping either of the two as dependent variable we find that the hull hypothesis is rejected in India.

The results reported in Table-21.4 show that when ELEP-NG is the dependent variable cointegration between ELEP-NG and GDP is found in Bangladesh, India, Japan and Thailand, whereas, when GDP is dependent variable and ELEP-NG is independent variable we find evidence for the rejection of the null hypothesis of cointegration in Bangladesh, India and Japan. Further, when cointegration is examined between ELEP-NG and Trade keeping ELEP-NG as dependent variable we find that the null hypothesis is rejected in India and Japan and when we keep Trade as dependent variable cointegration is not found in any of the two countries analyzed.

Table 24.4: Cointegration between ELEP-Rene and GDP; and ELEP-Rene and Trade

ELEP-Rene-GDP	ADF Test	Zt	Za	GDP-ELEP-Rene	ADF Test	Zt	Za
China	-5.247	-5.658*	-32.294	China	-5.147	-5.866*	-35.653
India	-5.194	-4.795	-29.993	India	-5.553	-4.351	-29.439
Indonesia	-7.580***	-7.682***	-47.447	Indonesia	-5.784*	-4.922	-30.025
Pakistan	-5.705*	-5.154	-33.193	Pakistan	-5.740*	-4.051	-27.770
Philippines	-3.968	-4.425	-27.132	Philippines	-4.882	-4.518	-28.291
South Korea	-8.226***	-8.347***	-52.100	South Korea	-6.696***	-6.889***	-43.511
ELEP-Rene-Trade	ADF Test	Zt	Za	Trade-ELEP-Rene	ADF Test	Zt	Za
India	-5.983*	-6.835***	-43.045	India	-7.074***	-7.169***	-44.804
Indonesia	-5.940*	-5.456	-25.625	Indonesia	-5.443	-5.134	-31.054
Pakistan	-4.905	-4.851	-30.639	Pakistan	-5.254	-6.255**	-35.737
Philippines	-8.510***	-7.754***	-42.683	Philippines	-4.950	-4.941	-31.639
South Korea	-7.940***	-8.075***	-49.224	South Korea	-5.151	-5.220	-32.894

The results reported in Table-22.4 show that when ELEP-NU is the dependent variable cointegration between ELEP-NU and GDP is found in India, Japan, and South Korea, as the null hypothesis of no cointegration is rejected by at least one of the three tests at the 10 % level of significance. However, when GDP is dependent variable and ELEP-NU is independent variable, we find evidence for the rejection of the null hypothesis of cointegration in Japan. Further, when cointegration is examined between ELEP-NU and Trade keeping ELEP-NU as dependent variable, we find that the hull hypothesis is rejected in Japan and South Korea, and when we keep Trade as dependent variable cointegration is found in India and Japan.

The results reported in Table-23.4 show that when ELEP-Oil is the dependent variable cointegration between ELEP-Oil and GDP is found in China, India, Pakistan and South Korea as null hypothesis of no cointegration is rejected by at least one of the three tests at 10% level of significance. However, when GDP is dependent variable and ELEP-Oil is independent variable we find evidence for the rejection of the null hypothesis of cointegration in India and South Korea. Further, when cointegration is examined between ELEP-Oil and Trade keeping ELEP-Oil as the dependent variable, we find that the hull hypothesis is rejected in India, South Korea and Thailand, and when we keep Trade as dependent variable cointegration is found only in Pakistan.

The results reported in Table-24.4 show that when ELEP-Rene is dependent variable cointegration between ELEP-Rene and GDP is found in China, Indonesia, Pakistan and South Korea as a null hypothesis of no cointegration is rejected by at least one of the three tests at the 10 % level of significance. However, when GDP is the dependent variable and ELEP-Rene is independent variables we find evidence for the rejection of the null hypothesis of cointegration in China, Indonesia, Pakistan and South Korea. Further, when cointegration is examined between ELEP-Rene and Trade keeping ELEP-Rene as the dependent variable, we find that the null hypothesis is rejected in India, Indonesia, Philippines and South Korea, and when we keep Trade as dependent variable cointegration is found in India and Pakistan.

The results reported in Table-25.4 show that when EPC is the dependent variable cointegration between EPC and GDP is found in Bangladesh, China HKSAR, India, Pakistan, Philippines, South Korea and Thailand as null hypothesis of no cointegration is rejected by at least one of the three tests at the 10% level of significance. However, when GDP is the dependent variable and EPC is independent variable we find evidence for the rejection of the null hypothesis of cointegration in Bangladesh, India, South Korea and Thailand. Further, when cointegration is examined between EPC and Trade keeping EPC as the dependent variable, we find that the hull hypothesis is rejected in Japan, Malaysia and the Philippines, and when we keep Trade as dependent variable cointegration is found in China HKSAR, Indonesia and Pakistan.

The results reported in Table-26.4 show that when EU is the dependent variable cointegration between EU and GDP is found in Bangladesh, India, Pakistan, Philippines and Thailand as null hypothesis of no cointegration is rejected by at least one of the three tests at the 10 % level of significance. However, when GDP is the dependent variable and the EU is independent variable we find evidence for the rejection of the null hypothesis of cointegration in Bangladesh, India, Pakistan, Philippines and Thailand. Further, when cointegration is examined between EU and Trade keeping EU as dependent variable we find that the null hypothesis is rejected only in Philippines, and when we keep Trade as dependent variable cointegration is found in Pakistan and Philippines.

The results reported in Table-27.4 show that when HYD is the dependent variable cointegration between HYD and GDP is found only in Pakistan, and when GDP is dependent variable and HYD is independent variables we find evidence for the rejection of the null hypothesis of cointegration in China. Further, when cointegration is examined between HYD and Trade keeping HYD as dependent variable we find that the null hypothesis is rejected in India and Malaysia, and when we keep Trade as dependent variable cointegration is found only in Pakistan.

Table 25.4: Cointegration between EPC and GDP; and EPC and Trade

EPC-GDP	ADF Test	Zt	Za	GDP-EPC	ADF Test	Zt	Za
Bangladesh	-5.934*	-7.289***	-44.161	Bangladesh	-5.393	-5.920*	-37.776
China HKSAR	-6.953***	-7.046***	-41.015	China HKSAR	-5.386	-5.476	-30.799
India	-6.821***	-7.493***	-43.342	India	-6.291**	-6.375**	-38.292
Indonesia	-5.390	-5.134	-31.870	Indonesia	-5.287	-5.354	-30.794
Japan	-4.800	-5.284	-34.643	Japan	-5.072	-5.131	-33.434
Pakistan	-4.456	-5.886*	-36.673	Pakistan	-4.911	-3.798	-24.897
Philippines	-5.912*	-5.992*	-35.947	Philippines	-4.457	-4.277	-25.131
South Korea	-6.033**	-6.112**	-37.801	South Korea	-5.750*	-5.829*	-36.409
Thailand	-6.415**	-6.504***	-33.415	Thailand	-6.166**	-6.279**	-34.901
EPC-Trade	ADF Test	Zt	Za	Trade-EPC	ADF Test	Zt	Za
China HKSAR	-5.274	-5.049	-26.932	China HKSAR	-6.499**	-5.972*	-35.791
India	-5.453	-5.158	-32.638	India	-4.615	-4.677	-31.776
Indonesia	-4.883	-5.054	-21.318	Indonesia	-5.996*	-5.576	-34.302
Japan	-5.448	-6.808***	-41.237	Japan	-5.573	-5.637	-37.493
Malaysia	-5.278	-5.890**	-35.180	Malaysia	-5.373	-5.604	-37.171
Pakistan	-4.150	-4.206	-25.383	Pakistan	-5.982*	-6.868***	-38.849
Philippines	-6.473**	-5.541	-25.696	Philippines	-5.094	-4.382	-26.975
South Korea	-5.324	-5.354	-33.583	South Korea	-5.396	-4.469	-28.025

Table 26.4: Cointegration between EU and GDP; and EU and Trade

EU-GDP	ADF Test	Zt	Za	GDP-EU	ADF Test	Zt	Za
Bangladesh	-6.281**	-7.264***	-43.584	Bangladesh	-6.514***	-6.861***	-42.697
China HKSAR	-5.412	-5.039	-32.313	China HKSAR	-5.139	-4.874	-29.906
India	-6.219**	-7.391***	-47.747	India	-6.192**	-7.372***	-47.912
Japan	-4.876	-4.931	-32.516	Japan	-4.883	-4.084	-25.004
Pakistan	-6.306**	-6.413**	-40.449	Pakistan	-5.916*	-6.045**	-38.782
Philippines	-9.202***	-10.43***	-57.420*	Philippines	-8.493***	-8.553***	-52.504
Thailand	-6.079**	-6.160**	-38.619	Thailand	-4.715	-5.834*	-36.764
EU-Trade	ADF Test	Zt	Za	Trade-EU	ADF Test	Zt	Za
China HKSAR	-5.142	-4.777	-27.704	China HKSAR	-4.642	-4.642	-27.473
India	-5.594	-4.232	-32.612	India	-4.992	-4.758	-37.002
Japan	-5.401	-5.142	-30.970	Japan	-4.795	-3.653	-38.635
Pakistan	-4.377	-3.879	-24.086	Pakistan	-6.247**	-6.740***	-35.689
Philippines	-6.710***	-5.644	-33.664	Philippines	-5.710*	-5.786*	-37.002

Table 27.4: Cointegration between HYD and GDP; and HYD and Trade

HYD-GDP	ADF Test	Zt	Za	GDP-HYD	ADF Test	Zt	Za
China	-4.864	-5.526	-38.210	China	-6.559***	-6.145**	-42.289
India	-5.396	-4.844	-33.130	India	-6.202	-4.211	-30.161
Pakistan	-5.753*	-6.262**	-43.197	Pakistan	-5.367	-5.428	-38.948
HYD-Trade	ADF Test	Zt	Za	Trade-HYD	ADF Test	Zt	Za
India	-6.531***	-4.926	-29.408	India	-5.330	-5.444	-36.494
Malaysia	-5.948*	-5.954*	-32.965	Malaysia	-5.520	-4.600	-46.245
Pakistan	-5.344	-5.405	-36.062	Pakistan	-5.545	-5.743*	-39.287

The results reported in Table-28.4 show that when NG is the dependent variable cointegration between NG and GDP is found only in Bangladesh and Indonesia, and when GDP is the dependent variable and NG is independent variable we find evidence for the rejection of the null hypothesis of cointegration in China. Further, when cointegration is examined between NG and Trade keeping NG as the dependent variable we find that the null hypothesis is rejected in Indonesia and Japan, and when we keep Trade as dependent variable cointegration is found only in Japan and Pakistan.

The results reported in Table-29.4 show that when either NU or GDP is the dependent variable cointegration between NU and GDP is found in India and Thailand. Further, when cointegration is examined between NU and Trade keeping NU as the dependent variable we find that the null hypothesis is rejected in India, and when we keep Trade as dependent variable the null hypothesis of cointegration is not rejected in India.

Table 28.4: Cointegration between NG and GDP; and NG and Trade

NG-GDP	ADF Test	Zt	Za	GDP-NG	ADF Test	Zt	Za
Bangladesh	-5.407	-6.097**	-39.027	Bangladesh	-4.809	-5.437	-32.467
China	-5.356	-5.256	-33.238	China	-6.392**	-6.465**	-44.074
Indonesia	-4.297	-6.286**	-42.754	Indonesia	-4.509	-4.191	-25.742
Japan	-5.404	-4.038	-31.616	Japan	-5.357	-4.664	-32.615
Pakistan	-5.518	-5.580	-37.544	Pakistan	-5.046	-5.089	-34.155
NG-Trade	ADF Test	Zt	Za	Trade-NG	ADF Test	Zt	Za
Indonesia	-5.331	-6.478**	-44.109	Indonesia	-5.267	-5.326	-35.631
Japan	-5.930*	-5.991*	-43.053	Japan	-5.634	-5.691*	-39.191
Pakistan	-4.569	-4.255	-26.426	Pakistan	-6.185**	-5.670*	-38.810

Table 29.4: Cointegration between NU and GDP; and NU and Trade

NU-GDP	ADF Test	Zt	Za	GDP-NU	ADF Test	Zt	Za
India	-4.976	-5.704*	-37.337	India	-5.683*	-5.406	-35.488
Thailand	-6.810***	-7.645***	-41.199	Thailand	-5.927*	-5.922*	-34.467
NU-Trade	ADF Test	Zt	Za	Trade-NU	ADF Test	Zt	Za
India	-6.064**	-5.233	-34.553	India	-5.538	-5.060	-30.149

Table 30.4: Cointegration between PECand GDP; and PEC and Trade

PEC-GDP	ADF Test	Zt	Za	GDP-PEC	ADF Test	Zt	Za
Bangladesh	-4.723	-6.000*	-37.704	Bangladesh	-5.295	-5.846*	-36.716
China HKSAR	-5.660*	-5.496	-34.946	China HKSAR	-5.020	-5.381	-35.059
India	-4.985	-6.527***	-44.476	India	-5.742*	-6.117**	-42.626
Indonesia	-5.635	-6.429**	-43.952	Indonesia	-5.200	-5.474	-36.433
Pakistan	-5.326	-4.630	-29.908	Pakistan	-4.844	-4.463	-29.916
Philippines	-5.113	-4.488	-24.969	Philippines	-4.271	-3.157	-19.154
Taiwan	-6.489**	-6.562***	-45.346	Taiwan	-5.341	-4.331	-30.147
Thailand	-5.315	-5.932*	-40.405	Thailand	-5.373	-5.434	-36.533
PEC-Trade	ADF Test	Zt	Za	Trade-PEC	ADF Test	Zt	Za
China HKSAR	-4.663	-5.746*	-38.915	China HKSAR	-5.433	-5.706*	-37.874
India	-5.402	-4.917	-35.177	India	-4.938	-5.091	-36.279
Indonesia	-4.172	-4.079	-25.943	Indonesia	-5.440	-5.502	-37.071
Malaysia	-8.171***	-4.320	-20.624	Malaysia	-5.201	-1.989	-26.042
Pakistan	-3.867	-3.794	-23.417	Pakistan	-5.188	-5.647	-37.551
Philippines	-5.043	-4.996	-32.912	Philippines	-7.001***	-7.080***	-48.403

The results reported in Table-30.4 show that when PEC is the dependent variable cointegration between PEC and GDP is found in Bangladesh, China HKSAR, India, Indonesia, Taiwan and Thailand as null hypothesis of no cointegration is rejected by at least one of the three tests at the 10 % level of significance. However, when GDP is the dependent variable and PEC is independent variable we find evidence for the rejection of the null hypothesis of cointegration in Bangladesh and India. Further, when cointegration is examined between PEC and Trade keeping PEC as dependent variable we find that the hull hypothesis is rejected in China HKSAR and Malaysia, and when we keep Trade as dependent variable cointegration is found in China HKSAR and Philippines.

4.4 Results from the asymmetric Granger-causality analysis

We further proceed to analyze the asymmetric Granger-causality using the approach proposed by Hatemi-J (2012). This method extends the Toda and Yamamoto (1995) approach by testing the evidence of Granger-causality for positive and negative shocks. The results obtained using Hatemi-J (2012) approach is presented in Table-31.4-60.4.

Tables 31.4 and 32.4, respectively, present the results of asymmetric Granger-causality analysis between CO_2 emissions and GDP, and CO_2 emissions and Trade. It is evident from Table-31.4 that the null hypothesis that CO_2 emissions does not Granger-cause GDP is rejected in China for positive to negative shocks; in Japan for negative shocks and negative to positive shocks; in New Zealand for positive shocks and negative shocks with at least a 10 % level of significance. The null hypothesis that GDP does not Granger-cause CO_2 emissions is rejected in China for negative and positive to negative shocks; in India for positive shocks; in Japan for positive shocks, positive to negative and negative to positive shocks. The results reported in Table-32.4 show that the null hypothesis that CO_2 emissions does not Granger-cause Trade is rejected in China HKSAR for negative shocks and in Philippines for negative to positive shocks. The null hypothesis that Trade does not Granger-cause CO_2 emissions is rejected in Bangladesh, Pakistan, South Korea and Thailand for negative shocks; in Japan for positive shocks; in Philippines for negative and negative to positive shocks.

Table 31.4: Asymmetric Granger-causality between CO_2 emissions and GDP

H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
CO_2≠>GDP		China			GDP≠>CO_2		China		
$E^+ \neq> Y^+$	0.067 [1]	9.865	5.152	3.345	$Y^+ \neq> E^+$	0.749 [1]	10.120	4.624	3.155
$E^- \neq> Y^-$	0.781 [1]	8.086	4.235	3.014	$Y^- \neq> E^-$	**3.165 [1]**	10.029	4.919	3.150
$E^+ \neq> Y^-$	**18.367 [4]**	43.339	22.415	15.224	$Y^+ \neq> E^-$	**4.546 [1]**	8.165	4.377	2.894
$E^- \neq> Y^+$	0.104 [1]	8.782	4.615	3.169	$Y^- \neq> E^+$	3.882 [4]	54.228	25.947	18.036
		India					India		
$E^+ \neq> Y^+$	0.052 [1]	10.565	5.355	3.564	$Y^+ \neq> E^+$	**4.490 [1]**	8.983	4.769	3.249
$E^- \neq> Y^-$	0.000 [1]	46.752	7.255	3.523	$Y^- \neq> E^-$	0.105 [1]	17.487	5.828	2.962
$E^+ \neq> Y^-$	3.849 [3]	24.231	11.990	8.788	$Y^+ \neq> E^-$	2.106 [1]	9.292	4.737	3.258
$E^- \neq> Y^+$	0.087 [1]	9.554	4.533	3.165	$Y^- \neq> E^+$	7.656 [3]	24.089	11.065	7.863
		Japan					Japan		
$E^+ \neq> Y^+$	3.355 [1]	8.755	4.597	3.391	$Y^+ \neq> E^+$	**4.551 [1]**	8.286	4.275	3.191
$E^- \neq> Y^-$	**8.991 [1]**	16.807	6.494	3.911	$Y^- \neq> E^-$	0.000 [1]	9.759	4.341	2.977
$E^+ \neq> Y^-$	1.986 [1]	8.033	4.113	2.836	$Y^+ \neq> E^-$	**6.214 [4]**	34.115	17.139	11.632
$E^- \neq> Y^+$	**29.028 [4]**	30.027	15.246	11.247	$Y^- \neq> E^+$	**5.796 [1]**	13.972	4.879	3.127
		New Zealand					New Zealand		
$E^+ \neq> Y^+$	**4.083 [1]**	11.749	5.202	3.502	$Y^+ \neq> E^+$	0.650 [1]	7.288	4.726	3.095
$E^- \neq> Y^-$	**13.748 [3]**	30.416	14.910	10.550	$Y^- \neq> E^-$	1.153 [3]	19.830	11.233	8.783
$E^+ \neq> Y^-$	0.918 [1]	9.381	5.156	3.319	$Y^+ \neq> E^-$	0.553 [1]	9.154	4.537	3.030
$E^- \neq> Y^+$	0.041 [1]	11.013	5.125	3.443	$Y^- \neq> E^+$	0.091 [1]	8.715	5.288	3.484

Notes: (a) The max lag order considered is four. The optimal lag order is one for positive cases and it is two for the negative cases based on minimizing equation (4); (b) the symbol $A \neq> B$ means that A does not cause B; (c) BCV means critical value: (d) these notes are applicable up to Table-60.4.

Tables 33.4 and 34.4, respectively, present the results of asymmetric Granger-causality analysis between Coal and GDP, and Coal and Trade. It is evident from Table-33.4 that the null hypothesis that Coal does not Granger-cause GDP is rejected only in Pakistan for negative shocks and that GDP does not Granger-cause Coal is rejected in China for negative shocks; in India and Pakistan for positive shocks, negative shocks and for positive to negative shocks with at least a 10 % level of significance. The results reported in Table-34.4 show that the null hypothesis that Coal does not Granger-cause trade is rejected in Japan for negative to positive shocks, in Pakistan and Philippines for negative shocks, and that trade does not Granger-cause Coal is rejected in case of India for positive to negative shocks, in Pakistan for positive shocks with at least a 10% level of significance.

Table 32.4: Asymmetric Granger-causality between CO_2 emissions and Trade

H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
CO_2≠>Trade		Bangladesh			Trade≠>CO_2		Bangladesh		
$E^+ \neq> T^+$	5.711 [4]	330.340	71.614	38.627	$T^+ \neq> E^+$	0.939 [4]	268.294	64.060	33.965
$E^- \neq> T^-$	0.427 [1]	41.848	17.513	11.967	$T^- \neq> E^-$	**120.673[3]**	30.519	15.953	10.835
$E^+ \neq> T^-$	2.574 [1]	7.790	4.631	3.036	$T^+ \neq> E^-$	1.536 [3]	36.586	15.833	9.806
$E^- \neq> T^+$	8.186 [3]	44.987	17.890	11.425	$T^- \neq> E^+$	0.539 [1]	11.873	4.832	3.033
		China HKSAR					China HKSAR		
$E^+ \neq> T^+$	1.076 [1]	9.280	5.691	3.499	$T^+ \neq> E^+$	0.155 [1]	9.530	4.706	3.244
$E^- \neq> T^-$	**19.141 [1]**	15.487	5.482	3.163	$T^- \neq> E^-$	0.013 [1]	12.647	4.499	2.947
$E^+ \neq> T^-$	1.667 [1]	7.535	4.296	3.178	$T^+ \neq> E^-$	1.063 [1]	11.365	4.466	2.975
$E^- \neq> T^+$	0.640 [1]	10.525	4.637	2.865	$T^- \neq> E^+$	0.149 [1]	10.525	5.023	3.044
		Japan					Japan		
$E^+ \neq> T^+$	3.682 [2]	13.030	7.172	5.515	$T^+ \neq> E^+$	**11.646[2]**	16.002	8.585	6.198
$E^- \neq> T^-$	2.104[1]	11.964	5.365	2.915	$T^- \neq> E^-$	0.115[1]	10.510	4.819	3.247
$E^+ \neq> T^-$	0.037[1]	10.282	5.055	3.490	$T^+ \neq> E^-$	0.139[1]	7.714	3.782	2.588
$E^- \neq> T^+$	2.831[1]	10.366	5.000	3.389	$T^- \neq> E^+$	0.823[1]	14.908	7.101	4.229
		Pakistan					Pakistan		
$E^+ \neq> T^+$	1.313 [1]	7.628	4.663	3.331	$T^+ \neq> E^+$	1.155[1]	8.983	4.791	3.128
$E^- \neq> T^-$	1.430[1]	19.799	6.358	3.759	$T^- \neq> E^-$	**3.886[1]**	17.570	6.025	3.386
$E^+ \neq> T^-$	0.282[1]	10.484	4.499	3.141	$T^+ \neq> E^-$	0.594[1]	12.726	5.860	3.723
$E^- \neq> T^+$	0.505[1]	11.448	5.281	3.604	$T^- \neq> E^+$	0.016[1]	7.652	4.265	2.811
		Philippines					Philippines		
$E^+ \neq> T^+$	0.016 [1]	9.196	4.018	2.836	$T^+ \neq> E^+$	0.013[1]	8.462	4.535	3.059
$E^- \neq> T^-$	0.237[2]	10.006	4.932	3.506	$T^- \neq> E^-$	**26.492[1]**	11.211	4.595	2.900
$E^+ \neq> T^-$	6.191[4]	46.318	19.390	13.926	$T^+ \neq> E^-$	1.416[4]	31.694	15.253	11.030
$E^- \neq> T^+$	**22.502[4]**	39.060	17.032	12.518	$T^- \neq> E^+$	**16.622[4]**	32.097	15.096	10.976
		Singapore					Singapore		
$E^+ \neq> T^+$	1.693 [1]	9.584	5.224	3.418	$T^+ \neq> E^+$	0.015[1]	8.813	4.751	3.180
$E^- \neq> T^-$	32.095[4]	13969.2	441.23	157.2	$T^- \neq> E^-$	**298.809[4]**	34127.58	959.03	243.79
$E^+ \neq> T^-$	0.441[1]	10.259	4.971	3.326	$T^+ \neq> E^-$	0.824[1]	16.088	5.385	3.433
$E^- \neq> T^+$	0.573[1]	12.809	5.140	3.159	$T^- \neq> E^+$	0.089[1]	11.571	5.404	3.546
		Thailand					Thailand		
$E^+ \neq> T^+$	1.685 [1]	10.053	4.490	3.183	$T^+ \neq> E^+$	0.198[1]	9.018	4.980	3.077
$E^- \neq> T^-$	0.124 [3]	21.863	11.889	9.098	$T^- \neq> E^-$	**16.888[3]**	22.946	12.403	8.606
$E^+ \neq> T^-$	2.057 [1]	7.608	4.175	2.793	$T^+ \neq> E^-$	2.452[2]	14.987	8.664	6.144
$E^- \neq> T^+$	5.351 [2]	15.405	7.873	5.642	$T^- \neq> E^+$	0.418[1]	9.856	4.308	3.125

Table 33.4: Asymmetric Granger-causality between Coal and GDP

H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
Coal≠>GDP		China			GDP≠>Coal		China		
$E^+ \neq> Y^+$	2.742 [4]	40.993	20.494	13.750	$Y^+ \neq> E^+$	2.224 [4]	38.123	21.819	14.151
$E^- \neq> Y^-$	0.149 [1]	8.434	4.473	2.998	$Y^- \neq> E^-$	**7.119 [1]**	9.807	4.935	3.065
$E^+ \neq> Y^-$	8.862 [4]	49.346	19.795	14.566	$Y^+ \neq> E^-$	7.951 [4]	40.729	19.207	13.055
$E^- \neq> Y^+$	2.463 [4]	54.897	18.655	12.827	$Y^- \neq> E^+$	7.002 [4]	46.857	21.766	15.820
		India					India		
$E^+ \neq> Y^+$	0.510 [1]	8.683	5.361	3.204	$Y^+ \neq> E^+$	**6.609 [1]**	9.385	5.357	3.651
$E^- \neq> Y^-$	0.002 [1]	15.228	5.954	3.539	$Y^- \neq> E^-$	**8.534 [1]**	14.380	5.518	2.827
$E^+ \neq> Y^-$	0.105 [1]	10.225	4.785	3.180	$Y^+ \neq> E^-$	**3.378 [1]**	8.823	4.773	3.215
$E^- \neq> Y^+$	0.913 [1]	9.021	4.455	3.205	$Y^- \neq> E^+$	1.448 [1]	9.969	4.635	3.306
		Pakistan					Pakistan		
$E^+ \neq> Y^+$	1.625 [1]	8.075	4.151	2.681	$Y^+ \neq> E^+$	**3.555 [1]**	9.700	4.569	3.209
$E^- \neq> Y^-$	**670989[3]**	20.911	10.550	7.855	$Y^- \neq> E^-$	**12876 [3]**	27.962	13.795	9.311
$E^+ \neq> Y^-$	0.219 [2]	16.489	8.590	5.809	$Y^+ \neq> E^-$	**6.817 [2]**	17.971	9.375	6.561
$E^- \neq> Y^+$	3.402 [2]	14.073	8.243	5.487	$Y^- \neq> E^+$	2.013 [2]	13.742	7.453	5.291

Tables -35.4 and 36.4respectively present the results of asymmetric Granger-causality analysis between ELEP and GDP, and ELEP and Trade. It is evident from Table-33.4 that the null hypothesis that ELEP does not Granger-cause GDP is rejected only in Bangladesh for positive shocks, and in Philippines for negative shocks, and the null hypothesis that GDP does not Granger-cause ELEP is rejected in Bangladesh for negative to positive shocks; in Indonesia for positive shocks; in New Zealand for positive and negative to positive shocks; and in Philippines for negative and positive to negative shocks with at least 10% level of significance. The results reported in Table-36.4 show that the null hypothesis that ELEP does not Granger-cause Trade is rejected in case of Bangladesh for negative to positive shocks; in Philippines for negative shocks, and the null hypothesis that Trade does not Granger-cause ELEP is rejected in Bangladesh for negative shocks; and in Japan for negative and negative to positive shocks with at least a 10 % level of significance.

Table 34.4: Asymmetric Granger-causality between Coal and Trade

H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
Coal≠>Trade		India			Trade≠>Coal		India		
$E^+ \neq> T^+$	0.067 [1]	6.944	3.982	2.969	$T^+ \neq> E^+$	0.070 [1]	10.300	4.499	3.087
$E^- \neq> T^-$	3.110 [1]	11.033	5.083	3.279	$T^- \neq> E^-$	0.193 [1]	8.490	4.849	3.026
$E^+ \neq> T^-$	0.096 [1]	10.539	4.654	2.909	$T^+ \neq> E^-$	**5.564 [1]**	11.438	4.845	3.068
$E^- \neq> T^+$	0.004 [1]	14.203	5.151	3.131	$T^- \neq> E^+$	0.016 [1]	8.925	4.498	3.061
		Japan					Japan		
$E^+ \neq> T^+$	3.665 [3]	21.769	14.006	9.372	$T^+ \neq> E^+$	0.119 [3]	26.598	15.800	10.762
$E^- \neq> T^-$	0.165 [1]	14.479	4.523	2.970	$T^- \neq> E^-$	0.396 [1]	12.278	5.400	3.149
$E^+ \neq> T^-$	9.481 [4]	37.561	19.557	14.228	$T^+ \neq> E^-$	1.551 [2]	13.446	7.608	5.428
$E^- \neq> T^+$	**15.590 [2]**	15.309	8.719	5.974	$T^- \neq> E^+$	5.132 [4]	49.449	21.847	14.524
		Pakistan					Pakistan		
$E^+ \neq> T^+$	1.668 [3]	27.939	11.713	8.122	$T^+ \neq> E^+$	**55.75 [3]**	27.636	11.591	8.654
$E^- \neq> T^-$	**15.911 [3]**	20.871	12.107	8.466	$T^- \neq> E^-$	6.526 [3]	21.535	12.518	9.426
$E^+ \neq> T^-$	0.734 [1]	12.374	4.581	2.933	$T^+ \neq> E^-$	0.414 [1]	12.073	5.111	3.347
$E^- \neq> T^+$	0.524 [1]	11.900	5.326	3.060	$T^- \neq> E^+$	0.082 [1]	7.606	4.240	3.068
		Philippines					Philippines		
$E^+ \neq> T^+$	3.520 [4]	29628.9	647.88	165.58	$T^+ \neq> E^+$	31.56 [1]	13306.0	925.89	240.42
$E^- \neq> T^-$	**5.879 [1]**	18.023	5.667	3.180	$T^- \neq> E^-$	0.910 [1]	14.533	5.326	3.614
$E^+ \neq> T^-$	0.218 [3]	69.302	25.485	16.292	$T^+ \neq> E^-$	1.718 [1]	8.294	4.633	3.154
$E^- \neq> T^+$	0.055 [1]	18.107	5.081	3.262	$T^- \neq> E^+$	0.506 [3]	52.294	19.892	13.152

Tables 37.4 and 38.4 respectively present the results of asymmetric Granger-causality analysis between ELEP-Coal and GDP, and ELEP-Coal and Trade. It is evident from Table-37.4 that the null hypothesis that ELEP-Coal does not Granger-cause GDP is rejected only in Japan for negative shocks, and the null hypothesis that GDP does not Granger-cause ELEP-Coal is rejected in Japan and South Korea for positive to negative shocks; and in New Zealand for positive shocks with at least a 10 % level of significance. The results reported in Table-38.4

show that the null hypothesis that ELEP-Coal does not Granger-cause Trade is rejected in Pakistan for positive, negative and positive to negative shocks; and in South Korea and Thailand for negative to positive shocks, and that trade does not Granger-cause ELEP-Coal is rejected in Japan and Philippines for negative shocks; in Thailand for positive to negative shocks with at least a 10 % level of significance.

Table 35.4: Asymmetric Granger-causality between ELEP and GDP

H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
ELEP ≠>GDP		Bangladesh			GDP ≠>ELEP		Bangladesh		
$E^+ \neq> Y^+$	**139.56[4]**	238.671	50.306	27.020	$Y^+ \neq> E^+$	3.698 [4]	246.162	60.628	30.909
$E^- \neq> Y^-$	0.000 [1]	14.078	5.580	3.234	$Y^- \neq> E^-$	0.103 [1]	22.402	6.682	3.755
$E^+ \neq> Y^-$	0.750 [1]	9.182	4.454	2.923	$Y^+ \neq> E^-$	2.348 [4]	294.593	67.078	34.848
$E^- \neq> Y^+$	14.45[4]	365.323	81.380	36.478	$Y^- \neq> E^+$	**11.879 [1]**	13.043	5.878	3.583
		Indonesia					Indonesia		
$E^+ \neq> Y^+$	6.260 [4]	432.761	95.605	44.635	$Y^+ \neq> E^+$	**37.715 [4]**	293.183	81.258	30.673
$E^- \neq> Y^-$	0.000 [1]	33.892	5.883	3.099	$Y^- \neq> E^-$	0.000 [1]	34.810	6.146	3.598
$E^+ \neq> Y^-$	8.191 [4]	235.445	58.697	28.497	$Y^+ \neq> E^-$	0.551 [1]	10.360	4.929	3.235
$E^- \neq> Y^+$	0.887 [1]	12.740	5.805	3.503	$Y^- \neq> E^+$	22.242 [4]	630.221	93.620	44.329
		New Zealand					New Zealand		
$E^+ \neq> Y^+$	0.114 [1]	7.150	4.149	2.891	$Y^+ \neq> E^+$	**8.263 [1]**	8.795	4.628	3.077
$E^- \neq> Y^-$	0.106 [1]	14.411	5.773	3.575	$Y^- \neq> E^-$	0.301 [1]	10.898	4.733	2.978
$E^+ \neq> Y^-$	0.085 [1]	9.138	4.907	3.207	$Y^+ \neq> E^-$	0.009 [1]	9.644	4.240	3.062
$E^- \neq> Y^+$	0.406 [1]	12.050	5.253	3.304	$Y^- \neq> E^+$	**3.419 [1]**	8.063	4.525	3.150
		Philippines					Philippines		
$E^+ \neq> Y^+$	5.579 [4]	494.032	77.498	35.284	$Y^+ \neq> E^+$	1.114 [4]	345.240	72.025	37.105
$E^- \neq> Y^-$	**59487 [3]**	163.472	42.934	20.242	$Y^- \neq> E^-$	**764.252 [3]**	64.718	22.359	12.531
$E^+ \neq> Y^-$	4.603 [3]	36.224	17.573	11.878	$Y^+ \neq> E^-$	**116.020 [4]**	293.490	78.349	38.489
$E^- \neq> Y^+$	1.558 [4]	201.124	55.999	27.503	$Y^- \neq> E^+$	0.839 [3]	33.960	17.526	12.157

Table 36.4: Asymmetric Granger-causality between ELEP and Trade

H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
ELEP ≠>Trade		Bangladesh			Trade ≠>ELEP		Bangladesh		
$E^+ \neq> T^+$	6.845 [4]	241.440	80.446	40.850	$T^+ \neq> E^+$	2.430 [4]	350.088	45.151	24.205
$E^- \neq> T^-$	13.335 [4]	270.345	56.180	26.046	$T^- \neq> E^-$	**30.679 [4]**	265.870	64.796	29.115
$E^+ \neq> T^-$	5.908 [4]	532.965	87.262	47.222	$T^+ \neq> E^-$	4.058 [4]	233.744	58.138	28.910
$E^- \neq> T^+$	**238.624 [4]**	254.516	85.718	41.372	$T^- \neq> E^+$	9.699 [4]	203.674	50.871	30.684
		Japan					Japan		
$E^+ \neq> T^+$	2.473 [1]	9.101	4.462	2.842	$T^+ \neq> E^+$	3.130 [1]	10.668	5.245	3.618
$E^- \neq> T^-$	0.135 [1]	15.206	5.299	3.349	$T^- \neq> E^-$	**11.390 [1]**	25.513	7.467	3.429
$E^+ \neq> T^-$	1.614 [2]	12.240	6.727	5.007	$T^+ \neq> E^-$	0.560 [1]	8.647	4.557	2.976
$E^- \neq> T^+$	0.082 [1]	10.823	5.597	3.482	$T^- \neq> E^+$	**14.486 [1]**	17.159	8.392	6.159
		Philippines					Philippines		
$E^+ \neq> T^+$	3.786 [4]	329.539	68.412	32.223	$T^+ \neq> E^+$	11.597 [4]	462.020	85.244	34.957
$E^- \neq> T^-$	**93.797 [4]**	285.517	75.602	42.715	$T^- \neq> E^-$	3.029 [4]	270.485	63.232	35.245
$E^+ \neq> T^-$	9.984 [4]	485.131	65.402	32.970	$T^+ \neq> E^-$	0.944 [1]	13.189	5.802	3.386
$E^- \neq> T^+$	0.344 [1]	28.098	6.827	3.435	$T^- \neq> E^+$	26.459 [4]	394.904	93.126	38.318

Table 37.4: Asymmetric Granger-causality between ELEP-Coal and GDP

H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
ELEP-Coal ≠>GDP		Japan			GDP≠> ELEP-Coal		Japan		
$E^+ \neq> Y^+$	0.488 [1]	9.796	4.752	2.960	$Y^+ \neq> E^+$	2.646 [1]	7.153	4.246	3.023
$E^- \neq> Y^-$	**30.140 [4]**	22.563	12.843	9.207	$Y^- \neq> E^-$	14.21 [4]	91.234	38.135	23.207
$E^+ \neq> Y^-$	0.057 [1]	9.737	4.048	2.715	$Y^+ \neq> E^-$	**12.52 [3]**	22.725	12.994	8.703
$E^- \neq> Y^+$	7.039 [3]	19.604	11.198	8.009	$Y^- \neq> E^+$	0.200 [1]	9.316	4.392	3.107
		New Zealand					New Zealand		
$E^+ \neq> Y^+$	1.105 [1]	7.453	4.435	2.918	$Y^+ \neq> E^+$	**3.560 [1]**	8.984	4.818	3.308
$E^- \neq> Y^-$	0.335 [1]	9.014	4.123	2.868	$Y^- \neq> E^-$	0.233 [1]	7.755	3.920	2.943
$E^+ \neq> Y^-$	0.009 [1]	10.230	4.608	3.034	$Y^+ \neq> E^-$	1.668 [1]	9.583	4.704	3.032
$E^- \neq> Y^+$	0.010 [1]	10.565	4.607	3.305	$Y^- \neq> E^+$	0.003 [1]	9.680	4.882	2.988
		South Korea					South Korea		
$E^+ \neq> Y^+$	1.335 [2]	18.311	8.737	6.024	$Y^+ \neq> E^+$	3.871 [2]	21.413	11.308	7.306
$E^- \neq> Y^-$	3.246 [4]	102.347	31.486	17.541	$Y^- \neq> E^-$	14.36 [4]	174.017	34.861	19.638
$E^+ \neq> Y^-$	8.927 [4]	155.191	48.690	28.960	$Y^+ \neq> E^-$	**52.01 [4]**	112.274	39.322	21.374
$E^- \neq> Y^+$	1.042 [4]	91.922	30.534	19.009	$Y^- \neq> E^+$	11.14 [4]	153.728	33.505	19.033

Table 38.4: Asymmetric Granger-causality between ELEP-Coal and Trade

H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
ELEP-Coal≠> Trade		Japan			Trade≠> ELEP-Coal		Japan		
$E^+ \neq> T^+$	0.236 [1]	9.917	4.879	3.416	$T^+ \neq> E^+$	1.303 [1]	10.144	4.800	3.189
$E^- \neq> T^-$	1.283 [4]	23.971	15.109	10.507	$T^- \neq> E^-$	**22.094 [4]**	41.372	22.733	16.681
$E^+ \neq> T^-$	0.302 [1]	9.830	4.144	2.957	$T^+ \neq> E^-$	5.271 [3]	19.829	13.308	9.648
$E^- \neq> T^+$	4.308 [3]	19.370	11.225	8.086	$T^- \neq> E^+$	0.704 [1]	11.972	4.760	3.208
		Pakistan					Pakistan		
$E^+ \neq> T^+$	**770.598[4]**	544.27	95.743	48.715	$T^+ \neq> E^+$	0.079 [4]	135.350	52.446	22.863
$E^- \neq> T^-$	**22.782 [1]**	17.943	5.442	3.271	$T^- \neq> E^-$	0.130 [1]	11.069	5.412	3.642
$E^+ \neq> T^-$	**160.549 [4]**	585.21	82.530	41.652	$T^+ \neq> E^-$	23.883 [4]	211.629	57.651	31.367
$E^- \neq> T^+$	50.836 [4]	1213.2	116.50	51.288	$T^- \neq> E^+$	0.623 [4]	366.402	64.444	27.147
		Philippines					Philippines		
$E^+ \neq> T^+$	8.025 [4]	311.13	65.955	30.060	$T^+ \neq> E^+$	12.694 [4]	290.758	83.733	44.376
$E^- \neq> T^-$	0.874 [4]	248.15	54.943	22.955	$T^- \neq> E^-$	**1932.63[4]**	366.287	79.523	41.932
$E^+ \neq> T^-$	0.144 [1]	11.271	4.913	3.166	$T^+ \neq> E^-$	9.176 [3]	44.564	18.281	11.650
$E^- \neq> T^+$	8.106 [3]	33.100	15.197	10.164	$T^- \neq> E^+$	0.200 [1]	9.988	6.028	4.329
		South Korea					South Korea		
$E^+ \neq> T^+$	1.567 [2]	18.851	9.766	6.816	$T^+ \neq> E^+$	0.030 [2]	16.146	10.468	7.592
$E^- \neq> T^-$	0.007 [1]	11.343	5.383	3.678	$T^- \neq> E^-$	0.012 [1]	14.576	5.576	3.281
$E^+ \neq> T^-$	10.989 [4]	76.136	35.174	21.477	$T^+ \neq> E^-$	0.033 [1]	9.750	4.561	3.270
$E^- \neq> T^+$	**10.732 [1]**	10.425	5.218	3.537	$T^- \neq> E^+$	5.429 [4]	181.526	50.073	31.619
		Thailand					Thailand		
$E^+ \neq> T^+$	8.258 [4]	247.22	53.238	26.099	$T^+ \neq> E^+$	25.681 [4]	515.599	81.839	43.925
$E^- \neq> T^-$	0.261 [1]	11.510	5.634	3.333	$T^- \neq> E^-$	0.025 [1]	8.838	4.745	3.113
$E^+ \neq> T^-$	0.437 [1]	11.145	5.356	3.172	$T^+ \neq> E^-$	**76.057 [4]**	704.417	101.22	47.689
$E^- \neq> T^+$	230.59 [4]	659.37	84.616	39.636	$T^- \neq> E^+$	0.966 [1]	15.018	5.760	3.528

Tables 39.4 and 40.4respectively present the results of asymmetric Granger-causality analysis between ELEP-HYD and GDP, and ELEP-HYD and Trade. It is evident from Table-39.4 that the null hypothesis that ELEP-HYD does not Granger-cause GDP is rejected only in India for positive to negative shocks, and the null hypothesis that GDP does not Granger-cause ELEP-HYD is rejected in Bangladesh for negative to positive shocks; in India for positive to negative shocks; in Japan and New Zealand for negative shocks; in Malaysia for negative to

positive shocks; and in Pakistan and Philippines for negative to positive shocks and positive to negative shocks with at least 10% level of significance. The results reported in Table-40.4 show that the null hypothesis that ELEP-HYD does not Granger-cause Trade is rejected in India for negative and positive to negative shocks; in Indonesia for positive to negative shocks; in Japan for negative to positive shocks; in Philippines for positive shocks, and that Trade does not Granger-cause ELEP-HYD is rejected in Indonesia for negative and positive to negative shocks; in Japan for negative to positive shocks; in Malaysia and Thailand for negative shocks; in Pakistan for positive shocks with at least a 10% level of significance.

Table 39.4: Asymmetric Granger-causality between ELEP-HYD and GDP

H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
ELEP-HYD ≠>GDP		Bangladesh			GDP≠> ELEP-HYD		Bangladesh		
$E^{+} \neq> Y^{+}$	7.241 [4]	383.729	93.806	47.138	$Y^{+} \neq> E^{+}$	14.633 [4]	401.104	68.357	29.505
$E^{-} \neq> Y^{-}$	0.373 [1]	11.463	5.606	3.429	$Y^{-} \neq> E^{-}$	1.401 [1]	15.285	5.816	3.394
$E^{+} \neq> Y^{-}$	0.746 [1]	12.394	4.975	3.262	$Y^{+} \neq> E^{-}$	0.777 [1]	9.336	4.799	3.112
$E^{-} \neq> Y^{+}$	0.017 [1]	10.176	4.872	3.210	$Y^{-} \neq> E^{+}$	**3.932 [1]**	10.856	5.224	3.422
		India					India		
$E^{+} \neq> Y^{+}$	1.167 [2]	28.132	12.594	8.596	$Y^{+} \neq> E^{+}$	0.277 [2]	18.076	8.790	6.263
$E^{-} \neq> Y^{-}$	0.027 [1]	22.096	5.950	3.537	$Y^{-} \neq> E^{-}$	0.056 [1]	23.523	5.807	3.620
$E^{+} \neq> Y^{-}$	**3.695 [1]**	10.911	5.440	3.446	$Y^{+} \neq> E^{-}$	**192.625[4]**	268.689	56.945	32.731
$E^{-} \neq> Y^{+}$	13.238 [4]	329.621	62.553	29.559	$Y^{-} \neq> E^{+}$	2.614 [1]	14.844	5.727	3.576
		Japan					Japan		
$E^{+} \neq> Y^{+}$	0.005 [1]	9.402	4.404	3.041	$Y^{+} \neq> E^{+}$	0.692 [1]	7.753	4.064	2.901
$E^{-} \neq> Y^{-}$	0.389 [2]	14.569	7.474	5.667	$Y^{-} \neq> E^{-}$	**23.332 [2]**	19.878	9.395	6.477
$E^{+} \neq> Y^{-}$	0.024 [+1]	10.900	4.759	3.135	$Y^{+} \neq> E^{-}$	0.545 [1]	8.849	4.597	3.079
$E^{-} \neq> Y^{+}$	0.681 [1]	8.107	4.189	2.894	$Y^{-} \neq> E^{+}$	0.275 [1]	11.232	5.336	3.240
		Malaysia					Malaysia		
$E^{+} \neq> Y^{+}$	3.251 [4]	408.611	89.097	42.572	$Y^{+} \neq> E^{+}$	4.001 [4]	484.417	51.235	29.851
$E^{-} \neq> Y^{-}$	0.212 [1]	18.657	7.309	3.916	$Y^{-} \neq> E^{-}$	0.017 [1]	19.232	7.066	3.779
$E^{+} \neq> Y^{-}$	0.716 [2]	21.632	11.308	7.748	$Y^{+} \neq> E^{-}$	4.721 [4]	451.458	81.103	41.924
$E^{-} \neq> Y^{+}$	8.233 [4]	648.299	79.799	39.897	$Y^{-} \neq> E^{+}$	**10.100 [2]**	32.647	13.244	8.315
		New Zealand					New Zealand		
$E^{+} \neq> Y^{+}$	0.834 [1]	9.504	4.778	3.536	$Y^{+} \neq> E^{+}$	0.946 [1]	9.585	4.828	3.546
$E^{-} \neq> Y^{-}$	1.787 [1]	12.083	6.166	3.243	$Y^{-} \neq> E^{-}$	**3.126 [1]**	11.522	4.852	2.839
$E^{+} \neq> Y^{-}$	5.106 [4]	25.514	15.220	10.688	$Y^{+} \neq> E^{-}$	0.668 [1]	8.083	4.668	3.143
$E^{-} \neq> Y^{+}$	0.528 [1]	8.691	4.977	3.296	$Y^{-} \neq> E^{+}$	2.751 [4]	25.299	13.287	10.491
		Pakistan					Pakistan		
$E^{+} \neq> Y^{+}$	1.849 [2]	15.087	8.814	6.057	$Y^{+} \neq> E^{+}$	32.877 [4]	404.248	104.549	49.608
$E^{-} \neq> Y^{-}$	0.344 [1]	15.707	6.186	3.533	$Y^{-} \neq> E^{-}$	0.029 [1]	18.531	5.836	3.406
$E^{+} \neq> Y^{-}$	0.783 [4]	278.527	69.447	37.831	$Y^{+} \neq> E^{-}$	**11.183 [3]**	43.202	15.815	10.775
$E^{-} \neq> Y^{+}$	7.631 [3]	32.211	15.529	11.378	$Y^{-} \neq> E^{+}$	**39.926 [4]**	364.640	83.763	38.105
		Philippines					Philippines		
$E^{+} \neq> Y^{+}$	2.725 [4]	352.595	69.686	31.405	$Y^{+} \neq> E^{+}$	31.777 [4]	40.248	38.495	34.086
$E^{-} \neq> Y^{-}$	0.344 [1]	15.707	6.186	3.533	$Y^{-} \neq> E^{-}$	1.291 [1]	5.321	3.366	2.460
$E^{+} \neq> Y^{-}$	0.783 [4]	278.527	69.447	37.831	$Y^{+} \neq> E^{-}$	**11.122 [3]**	41.022	11.145	9.756
$E^{-} \neq> Y^{+}$	7.631 [3]	32.211	15.529	11.378	$Y^{-} \neq> E^{+}$	40.269 [4]	350.403	70.633	36.150

Table 40.4: Asymmetric Granger-causality between ELEP-HYD and Trade

H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
ELEP-HYD ≠>Trade		India			Trade≠> ELEP-HYD		India		
$E^+ \neq> T^+$	1.357 [2]	13.584	7.336	5.513	$T^+ \neq> E^+$	7.451 [2]	25.419	13.638	9.188
$E^- \neq> T^-$	**27.097 [3]**	63.721	22.853	13.412	$T^- \neq> E^-$	0.865 [3]	33.230	14.701	9.036
$E^+ \neq> T^-$	**54.279 [4]**	319.444	79.513	39.466	$T^+ \neq> E^-$	0.003 [1]	13.562	5.097	3.428
$E^- \neq> T^+$	0.175 [1]	17.448	7.189	4.001	$T^- \neq> E^+$	0.376 [4]	384.68	58.844	29.629
		Indonesia					Indonesia		
$E^+ \neq> T^+$	0.980 [1]	8.515	5.006	2.992	$T^+ \neq> E^+$	0.477 [1]	9.441	4.444	3.012
$E^- \neq> T^-$	0.636 [1]	10.124	4.936	3.143	$T^- \neq> E^-$	**18.528 [1]**	9.464	5.001	3.527
$E^+ \neq> T^-$	**38.475 [3]**	48.764	19.173	11.972	$T^+ \neq> E^-$	**45.055 [4]**	365.42	69.103	40.142
$E^- \neq> T^+$	0.770 [4]	359.249	81.129	35.563	$T^- \neq> E^+$	9.326 [3]	31.081	12.876	9.714
		Japan					Japan		
$E^+ \neq> T^+$	1.559 [1]	11.143	4.395	3.086	$T^+ \neq> E^+$	1.490 [1]	9.068	4.589	2.958
$E^- \neq> T^-$	0.005 [1]	9.659	4.113	2.929	$T^- \neq> E^-$	0.249 [1]	14.544	5.722	3.515
$E^+ \neq> T^-$	0.185 [1]	8.290	4.623	3.096	$T^+ \neq> E^-$	3.101 [4]	25.621	13.623	9.653
$E^- \neq> T^+$	**14.604 [4]**	29.226	16.495	11.953	$T^- \neq> E^+$	**8.549 [1]**	15.642	5.972	3.386
		Malaysia					Malaysia		
$E^+ \neq> T^+$	1.467 [1]	12.493	5.261	3.377	$T^+ \neq> E^+$	0.001 [1]	9.899	5.059	3.352
$E^- \neq> T^-$	8.716 [4]	629.154	80.325	37.452	$T^- \neq> E^-$	**76.469 [4]**	529.78	75.512	39.385
$E^+ \neq> T^-$	0.017 [1]	14.047	5.540	3.254	$T^+ \neq> E^-$	0.534 [4]	321.45	68.160	36.946
$E^- \neq> T^+$	2.352 [4]	339.155	64.805	32.932	$T^- \neq> E^+$	2.111 [1]	16.488	5.209	3.217
		Pakistan					Pakistan		
$E^+ \neq> T^+$	1.759 [1]	9.133	4.614	3.058	$T^+ \neq> E^+$	**9.941 [1]**	13.114	5.715	3.464
$E^- \neq> T^-$	25.348 [4]	532.838	64.448	35.513	$T^- \neq> E^-$	2.647 [1]	186.21	42.523	26.774
$E^+ \neq> T^-$	0.009 [2]	15.663	8.043	6.025	$T^+ \neq> E^-$	0.000 [1]	9.361	5.002	3.340
$E^- \neq> T^+$	0.011 [1]	10.971	5.250	3.212	$T^- \neq> E^+$	1.136 [2]	15.991	9.166	6.444
		Philippines					Philippines		
$E^+ \neq> T^+$	**26510.05[4]**	419.228	80.269	38.325	$T^+ \neq> E^+$	3.565 [4]	347.98	77.649	36.639
$E^- \neq> T^-$	0.051 [1]	13.759	5.527	3.294	$T^- \neq> E^-$	0.171 [1]	15.540	6.759	3.710
$E^+ \neq> T^-$	2.783 [4]	258.123	55.219	31.355	$T^+ \neq> E^-$	0.467 [1]	13.487	6.788	3.643
$E^- \neq> T^+$	0.314 [1]	10.975	5.056	2.937	$T^- \neq> E^+$	2.289 [4]	541.57	85.345	35.987
		Thailand					Thailand		
$E^+ \neq> T^+$	11.513 [4]	356.327	81.781	32.990	$T^+ \neq> E^+$	17.961 [4]	464.50	71.061	33.853
$E^- \neq> T^-$	5.691 [4]	329.154	56.978	32.111	$T^- \neq> E^-$	**40.266 [4]**	354.88	65.462	33.354
$E^+ \neq> T^-$	4.918 [4]	382.389	65.488	31.866	$T^+ \neq> E^-$	3.753 [4]	495.04	65.941	38.543
$E^- \neq> T^+$	13.090 [4]	541.646	70.998	37.009	$T^- \neq> E^+$	40.178 [4]	477.69	78.560	42.338

Table 41.4: Asymmetric Granger-causality between ELEP-NG and GDP

H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
ELEP-NG≠>GDP		Japan			GDP≠>ELEP-NG		Japan		
$E^+ \neq> Y^+$	0.032 [1]	8.358	4.798	3.360	$Y^+ \neq> E^+$	0.827 [1]	10.376	4.990	3.220
$E^- \neq> Y^-$	0.000 [1]	15.114	5.500	3.186	$Y^- \neq> E^-$	0.000 [1]	14.656	5.413	3.155
$E^+ \neq> Y^-$	0.076 [1]	7.817	4.384	2.795	$Y^+ \neq> E^-$	1.064 [1]	7.897	4.430	2.948
$E^- \neq> Y^+$	0.001 [1]	7.513	4.211	2.729	$Y^- \neq> E^+$	4.173 [1]	10.086	5.085	3.194

Table 42.4: Asymmetric Granger-causality between ELEP-NG and Trade

H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
ELEP-NG≠>Trade		India			Trade≠> ELEP-NG		India		
$E^+ \neq> T^+$	5.008 [2]	369.578	89.665	37.397	$T^+ \neq> E^+$	3.196 [4]	305.034	67.268	29.132
$E^- \neq> T^-$	**62.742 [4]**	389.365	89.477	40.666	$T^- \neq> E^-$	**107.588 [4]**	362.070	74.487	40.104
$E^+ \neq> T^-$	0.942 [4]	548.165	55.601	29.340	$T^+ \neq> E^-$	0.000 [1]	10.945	4.621	2.984
$E^- \neq> T^+$	0.097 [1]	14.409	6.035	3.588	$T^- \neq> E^+$	182.949 [4]	451.243	100.143	41.165

Tables 41.4 and 42.4 respectively present the results of asymmetric Granger-causality analysis between ELEP-NG and GDP, and ELEP-NG and Trade. It is evident from Table-41.4 that the null hypothesis that ELEP-NG does not Granger-cause GDP is not rejected, and that

GDP does not Granger-cause ELEP-NG is rejected in Japan for negative to positive shocks with at least at 10 % level of significance. The results reported in Table-42.4 show that the null hypothesis that ELEP-NG does not Granger-cause Trade and is rejected in India for negative shocks, and that Trade does not Granger-cause ELEP-NG is rejected in India for negative and negative to positive shocks with at least at 10 % level of significance.

Table 43.4: Asymmetric Granger-causality between ELEP-NU and GDP

H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
ELEP-NU≠> GDP		India			GDP≠>ELEP-NU		India		
$E^+ \neq> Y^+$	0.109 [2]	9.012	4.813	2.934	$Y^+ \neq> E^+$	1.591 [1]	13.917	5.359	3.535
$E^- \neq> Y^-$	7.060 [3]	39.564	20.093	12.461	$Y^- \neq> E^-$	7.949 [3]	34.102	15.293	10.767
$E^+ \neq> Y^-$	**102.818 [4]**	364.136	84.981	37.258	$Y^+ \neq> E^-$	**41.680 [4]**	276.161	74.592	33.431
$E^- \neq> Y^+$	19.838 [4]	487.353	87.981	35.767	$Y^- \neq> E^+$	0.358 [4]	363.733	44.235	24.057

Table 44.4: Asymmetric Granger-causality between ELEP-NU and Trade

H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
ELEP-NU≠>Trade		India			Trade≠>ELEP-NU		India		
$E^+ \neq> T^+$	**138.591 [4]**	459.546	75.070	37.090	$T^+ \neq> E^+$	3.279 [4]	223.411	63.611	32.821
$E^- \neq> T^-$	0.000 [1]	11.999	5.906	3.398	$T^- \neq> E^-$	0.019 [1]	19.307	5.773	3.156
$E^+ \neq> T^-$	0.000 [1]	12.487	5.255	3.317	$T^+ \neq> E^-$	**144.95[4]**	380.188	69.570	31.487
$E^- \neq> T^+$	**40.501 [4]**	591.763	79.699	33.760	$T^- \neq> E^+$	**35.14 [1]**	16.845	6.227	3.311
		Japan					Japan		
$E^+ \neq> T^+$	4.391 [4]	39.233	20.036	13.498	$T^+ \neq> E^+$	2.270 [4]	44.886	20.005	13.685
$E^- \neq> T^-$	**44.517 [3]**	33.400	15.905	11.425	$T^- \neq> E^-$	2.745 [3]	29.046	15.480	10.764
$E^+ \neq> T^-$	8.149 [4]	46.342	19.673	13.073	$T^+ \neq> E^-$	0.573 [1]	9.129	4.854	3.290
$E^- \neq> T^+$	0.283 [1]	12.782	5.404	3.338	$T^- \neq> E^+$	10.84 [4]	50.228	18.965	13.089
		Pakistan					Pakistan		
$E^+ \neq> T^+$	**64.055 [4]**	541.986	93.349	44.209	$T^+ \neq> E^+$	4.872 [4]	497.799	64.736	27.903
$E^- \neq> T^-$	0.665 [1]	15.021	5.076	3.226	$T^- \neq> E^-$	**15.02 [1]**	21.161	6.348	3.348
$E^+ \neq> T^-$	0.925 [2]	19.377	5.183	3.340	$T^+ \neq> E^-$	0.141 [1]	11.978	4.396	2.860
$E^- \neq> T^+$	17.567 [1]	16.885	5.556	3.169	$T^- \neq> E^+$	0.011 [1]	13.629	5.290	2.971

Table-43.4 and Table-44.4, present the results of asymmetric Granger-causality analysis between ELEP-NU and GDP, and ELEP-NU and Trade. It is evident from Table-43.4 that the null hypothesis that ELEP-NU does not Granger-cause GDP and that GDP does not Granger-cause ELEP-NU is rejected in India for positive to negative shocks with at least at 10 % level of significance. The results reported in Table-34.4 show that the null hypothesis that ELEP-NU does not Granger-cause Trade and is rejected in India and Pakistan for positive shocks, in Japan for negative shocks, and in India for negative to positive shocks; and that Trade does not Granger-cause ELEP-NU is rejected in India for negative to positive and positive to negative shocks and in Pakistan for negative shocks with at least at 10 % level of significance.

Table 45.4: Asymmetric Granger-causality between ELEP-Oil and GDP

H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
ELEP-Oil≠>GDP		Bangladesh			GDP≠>ELEP-Oil		Bangladesh		
$E^+ \neq> Y^+$	2.754 [4]	401.358	75.626	35.362	$Y^+ \neq> E^+$	3.192 [4]	383.378	59.199	32.896
$E^- \neq> Y^-$	0.183 [1]	11.295	5.669	3.182	$Y^- \neq> E^-$	0.573 [1]	12.979	5.571	3.758
$E^+ \neq> Y^-$	0.465 [1]	12.034	5.475	3.322	$Y^+ \neq> E^-$	6.816 [4]	401.638	68.502	34.494
$E^- \neq> Y^+$	0.479 [4]	332.540	59.403	31.216	$Y^- \neq> E^+$	**3.639 [1]**	13.227	5.937	3.500
		China HKSAR					China HKSAR		
$E^+ \neq> Y^+$	3.809 [3]	69.994	23.066	15.883	$Y^+ \neq> E^+$	0.160 [3]	30.458	16.041	10.188
$E^- \neq> Y^-$	6.827 [4]	357.424	71.882	31.710	$Y^- \neq> E^-$	28529 [4]	531.267	122.432	57.799
$E^+ \neq> Y^-$	0.580 [1]	15.807	5.395	3.479	$Y^+ \neq> E^-$	7.923 [3]	46.914	17.688	11.187
$E^- \neq> Y^+$	2.803 [3]	41.574	18.497	11.989	$Y^- \neq> E^+$	**5.266 [1]**	41.938	6.707	3.798
		India					India		
$E^+ \neq> Y^+$	2.951 [2]	22.059	11.718	8.052	$Y^+ \neq> E^+$	3.680 [2]	20.950	8.604	5.914
$E^- \neq> Y^-$	**29.036 [3]**	64.459	25.244	16.368	$Y^- \neq> E^-$	0.538 [3]	37.714	17.592	10.694
$E^+ \neq> Y^-$	1.639 [1]	14.017	5.997	3.728	$Y^+ \neq> E^-$	0.254 [1]	7.182	4.656	3.140
$E^- \neq> Y^+$	1.776 [1]	11.479	5.269	3.479	$Y^- \neq> E^+$	**3.931 [1]**	9.986	5.265	3.626
		New Zealand					New Zealand		
$E^+ \neq> Y^+$	**6.607 [1]**	7.788	4.280	2.911	$Y^+ \neq> E^+$	0.464 [1]	8.874	4.412	2.950
$E^- \neq> Y^-$	2.210 [1]	11.731	5.268	3.171	$Y^- \neq> E^-$	0.434 [1]	9.594	5.256	3.233
$E^+ \neq> Y^-$	0.151 [1]	9.454	4.545	3.049	$Y^+ \neq> E^-$	2.724 [2]	15.927	8.463	5.872
$E^- \neq> Y^+$	3.983 [2]	18.607	10.074	7.163	$Y^- \neq> E^+$	0.209 [1]	10.042	4.828	3.198
		Philippines					Philippines		
$E^+ \neq> Y^+$	3.577 [4]	310.362	61.708	28.883	$Y^+ \neq> E^+$	**78.111 [4]**	383.339	92.126	37.707
$E^- \neq> Y^-$	6.726 [4]	494.266	117.980	51.059	$Y^- \neq> E^-$	14.507 [4]	281.416	75.603	38.225
$E^+ \neq> Y^-$	**99.390 [4]**	585.806	118.626	50.045	$Y^+ \neq> E^-$	**530.251 [4]**	583.368	109.962	50.689
$E^- \neq> Y^+$	6.180 [1]	480.991	106.329	50.723	$Y^- \neq> E^+$	8.552 [4]	637.208	112.565	49.258
		South Korea					South Korea		
$E^+ \neq> Y^+$	1.168 [4]	398.150	55.239	30.147	$Y^+ \neq> E^+$	11.692 [4]	128.305	40.582	25.705
$E^- \neq> Y^-$	**23726 [4]**	190.640	60.399	32.321	$Y^- \neq> E^-$	0.000 [4]	263.016	94.008	43.874
$E^+ \neq> Y^-$	0.000 [1]	13.328	4.841	3.231	$Y^+ \neq> E^-$	**46.932 [4]**	85.897	32.964	21.338
$E^- \neq> Y^+$	3.474 [4]	102.202	35.252	20.510	$Y^- \neq> E^+$	0.164 [1]	27.763	6.111	3.479

Table-45.4 and Table-46.4, present the results of asymmetric Granger-causality analysis between ELEP-Oil and GDP, and ELEP-Oil and Trade. It is evident from Table-45.4 that the null hypothesis that ELEP-Oil does not Granger-cause GDP is rejected in India for negative shocks, in New Zealand for positive shocks, in South Korea for negative to positive shocks, and in Philippines for positive to negative shocks; and that GDP does not Granger-cause ELEP-Oil is rejected in Bangladesh, China HKSAR and India for negative to positive shocks, in Philippines for positive and positive to negative shocks; in South Korea for positive to negative shocks with at least 10% level of significance. The results reported in Table-46.4 show that the null hypothesis that ELEP-Oil does not Granger-cause Trade is rejected in Pakistan for positive shocks and in Thailand for negative to positive shocks; and that Trade does not Granger-cause

ELEP-Oil is rejected in China HKSAR for negative to positive shocks, in India for negative shocks, in Japan for positive and negative shocks, and in Pakistan for negative to positive shocks with at least 10% level of significance.

Table 46.4: Asymmetric Granger-causality between ELEP-Oil and Trade

H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
ELEP-Oil≠>Trade		China HKSAR			Trade ≠>ELEP-Oil		China HKSAR		
$E^+ \neq> T^+$	5.549 [4]	740.724	106.145	53.484	$T^+ \neq> E^+$	8.502 [4]	430.576	83.688	34.313
$E^- \neq> T^-$	1.426 [3]	29.461	15.657	10.668	$T^- \neq> E^-$	0.322 [3]	34.756	17.949	11.753
$E^+ \neq> T^-$	0.061 [4]	457.812	91.784	41.855	$T^+ \neq> E^-$	7.255 [4]	611.072	89.919	43.113
$E^- \neq> T^+$	2.622 [4]	537.848	93.193	46.866	$T^- \neq> E^+$	**59666 [4]**	371.505	70.801	31.169
		India					India		
$E^+ \neq> T^+$	0.004 [1]	9.907	5.641	3.289	$T^+ \neq> E^+$	3.780 [1]	10.140	5.554	3.734
$E^- \neq> T^-$	1.633 [3]	23.875	12.223	8.423	$T^- \neq> E^-$	**33.323 [3]**	58.795	25.319	14.955
$E^+ \neq> T^-$	0.253 [1]	9.838	5.419	3.395	$T^+ \neq> E^-$	4.595 [3]	32.657	16.104	10.733
$E^- \neq> T^+$	8.983 [3]	44.377	22.820	14.145	$T^- \neq> E^+$	0.162 [1]	14.485	6.938	4.611
		Japan					Japan		
$E^+ \neq> T^+$	2.616 [1]	7.755	4.217	3.038	$T^+ \neq> E^+$	**5.585 [1]**	10.491	4.716	3.398
$E^- \neq> T^-$	0.285 [1]	16.784	5.077	2.903	$T^- \neq> E^-$	**7.920 [1]**	16.359	6.681	3.580
$E^+ \neq> T^-$	0.508 [1]	10.283	4.271	2.790	$T^+ \neq> E^-$	1.048 [1]	8.551	4.371	3.051
$E^- \neq> T^+$	0.181 [1]	9.376	4.700	3.138	$T^- \neq> E^+$	3.364 [1]	11.106	5.480	3.602
		Pakistan					Pakistan		
$E^+ \neq> T^+$	**145.422 [4]**	494.468	80.487	42.848	$T^+ \neq> E^+$	0.520 [4]	347.700	53.155	26.048
$E^- \neq> T^-$	0.082 [1]	10.620	5.222	3.207	$T^- \neq> E^-$	1.534 [1]	18.687	6.903	4.077
$E^+ \neq> T^-$	0.087 [1]	9.761	4.712	2.983	$T^+ \neq> E^-$	48.278 [4]	487.163	117.979	66.289
$E^- \neq> T^+$	7.249 [4]	392.428	56.166	27.484	$T^- \neq> E^+$	**21.605 [1]**	10.673	4.905	3.343
		Thailand					Thailand		
$E^+ \neq> T^+$	11.077 [4]	427.124	72.334	33.702	$T^+ \neq> E^+$	28.486 [4]	603.359	93.355	38.607
$E^- \neq> T^-$	0.669 [2]	21.874	9.953	6.411	$T^- \neq> E^-$	0.383 [2]	17.147	9.244	6.372
$E^+ \neq> T^-$	0.390 [4]	260.302	65.145	32.572	$T^+ \neq> E^-$	0.336 [4]	257.313	70.726	36.862
$E^- \neq> T^+$	50.554 [4]	343.720	82.268	36.317	$T^- \neq> E^+$	10.061 [4]	567.479	62.762	33.638

Table-47.4 and Table-48.4, present the results of asymmetric Granger-causality analysis between ELEP-Rene and GDP, and ELEP-Rene and Trade. It is evident from Table-47.4 that the null hypothesis that ELEP-Rene does not Granger-cause GDP is rejected in India, Indonesia and South Korea for positive to negative shocks; and that GDP does not Granger-cause ELEP-Rene is rejected in Bangladesh and Malaysia for negative to positive shocks, in India and Philippines for positive to negative shocks, in Japan for negative shocks with at least at 10% level of significance. The results reported in Table-48 show that the null hypothesis that ELEP-Rene does not Granger-cause Trade is rejected in India for negative, and positive to negative shocks, in Indonesia for positive to negative shocks, in Japan for positive shocks, in Pakistan for negative shocks, in Philippines and South Korea for negative to positive shocks; and that Trade does not Granger-cause ELEP-Rene is rejected in Indonesia, Malaysia and Thailand for negative shocks and in Pakistan for positive shocks with at least at 10% level of significance.

Table 47.4: Asymmetric Granger-causality between ELEP-Rene and GDP

H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
ELEP-Rene≠>GDP	Bangladesh				GDP≠>ELEP-Rene	Bangladesh			
$E^{+} \neq> Y^{+}$	7.241 [4]	383.729	93.806	47.138	$Y^{+} \neq> E^{+}$	14.63 [4]	401.104	68.357	29.505
$E^{-} \neq> Y^{-}$	0.373 [1]	11.463	5.606	3.429	$Y^{-} \neq> E^{-}$	1.401 [1]	15.285	5.816	3.394
$E^{+} \neq> Y^{-}$	0.746 [1]	12.394	4.975	3.262	$Y^{+} \neq> E^{-}$	0.777 [1]	9.336	4.799	3.112
$E^{-} \neq> Y^{+}$	0.017 [1]	10.176	4.872	3.210	$Y^{-} \neq> E^{+}$	**3.932 [1]**	10.856	5.224	3.422
	India					India			
$E^{+} \neq> Y^{+}$	1.168 [2]	28.126	12.595	8.598	$Y^{+} \neq> E^{+}$	0.277 [2]	18.070	8.788	6.264
$E^{-} \neq> Y^{-}$	0.027 [1]	22.097	5.949	3.537	$Y^{-} \neq> E^{-}$	0.056 [1]	23.514	5.806	3.621
$E^{+} \neq> Y^{-}$	**3.697 [1]**	10.907	5.440	3.447	$Y^{+} \neq> E^{-}$	**192.85 [4]**	268.388	56.864	32.740
$E^{-} \neq> Y^{+}$	13.243 [4]	328.332	62.599	29.574	$Y^{-} \neq> E^{+}$	2.612 [1]	14.843	5.726	3.575
	Indonesia					Indonesia			
$E^{+} \neq> Y^{+}$	4.825 [4]	289.400	77.185	34.817	$Y^{+} \neq> E^{+}$	8.161 [4]	779.333	87.388	43.319
$E^{-} \neq> Y^{-}$	2.074 [4]	394.537	107.387	48.652	$Y^{-} \neq> E^{-}$	1.014 [4]	765.877	112.18	49.515
$E^{+} \neq> Y^{-}$	**5.784 [1]**	14.028	4.780	3.198	$Y^{+} \neq> E^{-}$	4.176 [4]	392.262	63.089	31.124
$E^{-} \neq> Y^{+}$	27.601 [4]	339.078	87.266	42.716	$Y^{-} \neq> E^{+}$	1.083 [1]	9.448	4.997	3.622
	Japan					Japan			
$E^{+} \neq> Y^{+}$	0.012 [1]	9.079	4.409	2.957	$Y^{+} \neq> E^{+}$	0.673 [1]	7.989	4.054	2.893
$E^{-} \neq> Y^{-}$	0.520 [2]	11.942	7.993	5.581	$Y^{-} \neq> E^{-}$	**25.96 [2]**	27.728	9.757	6.466
$E^{+} \neq> Y^{-}$	0.029 [1]	10.121	4.445	3.051	$Y^{+} \neq> E^{-}$	0.590 [1]	8.163	4.248	3.092
$E^{-} \neq> Y^{+}$	0.510 [1]	8.576	4.404	2.980	$Y^{-} \neq> E^{+}$	0.377 [1]	10.259	5.342	3.285
	Malaysia					Malaysia			
$E^{+} \neq> Y^{+}$	3.251 [4]	408.611	89.097	42.572	$Y^{+} \neq> E^{+}$	4.001 [4]	484.417	51.235	29.851
$E^{-} \neq> Y^{-}$	0.212 [1]	18.657	7.309	3.916	$Y^{-} \neq> E^{-}$	0.017 [1]	19.232	7.066	3.779
$E^{+} \neq> Y^{-}$	0.716 [2]	21.632	11.308	7.748	$Y^{+} \neq> E^{-}$	4.721 [4]	451.458	81.103	41.924
$E^{-} \neq> Y^{+}$	8.233 [4]	648.299	79.799	39.897	$Y^{-} \neq> E^{+}$	**10.10 [2]**	32.647	13.244	8.315
	Philippines					Philippines			
$E^{+} \neq> Y^{+}$	20.976 [4]	334.625	100.824	46.739	$Y^{+} \neq> E^{+}$	1.328 [4]	183.913	47.325	26.567
$E^{-} \neq> Y^{-}$	1.000 [2]	19.710	9.334	6.682	$Y^{-} \neq> E^{-}$	0.101 [2]	18.773	8.222	5.487
$E^{+} \neq> Y^{-}$	0.402 [4]	379.260	58.133	29.013	$Y^{+} \neq> E^{-}$	**21.88 [3]**	37.717	15.073	10.583
$E^{-} \neq> Y^{+}$	1.294 [3]	45.564	17.124	12.386	$Y^{-} \neq> E^{+}$	5.229 [4]	479.020	126.86	57.329
	South Korea					South Korea			
$E^{+} \neq> Y^{+}$	2.803 [3]	30.441	16.193	9.935	$Y^{+} \neq> E^{+}$	8.357 [3]	31.802	15.810	10.875
$E^{-} \neq> Y^{-}$	0.011 [1]	14.832	5.221	3.364	$Y^{-} \neq> E^{-}$	0.039 [1]	15.076	5.645	3.290
$E^{+} \neq> Y^{-}$	**31.981 [1]**	92.758	31.560	20.073	$Y^{+} \neq> E^{-}$	0.364 [1]	11.247	5.021	3.408
$E^{-} \neq> Y^{+}$	1.284 [1]	8.913	5.223	3.559	$Y^{-} \neq> E^{+}$	5.602 [4]	71.079	28.063	18.021

Table-49.4 and Table-50.4, present the results of asymmetric Granger-causality analysis between EPC and GDP, and EPC and Trade. It is evident from Table-49.4 that the null hypothesis that EPC does not Granger-cause GDP is rejected only in Bangladesh for positive and in Japan for negative to positive shocks; and that GDP does not Granger-cause EPC is rejected in Bangladesh and Philippines for negative shocks, in Japan for positive to negative shocks, and in New Zealand for positive and positive to negative shocks with at least a 10% level of significance. The results reported in Table-50.4 show that the null hypothesis that EPC does not Granger-cause Trade is rejected in Bangladesh for positive to negative and negative to positive shocks, in Japan for positive shocks, in Pakistan for negative shocks, in Philippines positive to negative shocks; and the that Trade does not Granger-cause EPC is rejected in Japan and Philippines for negative and negative to positive shocks, in Pakistan for positive and positive to negative shocks with at least at 10% level of significance.

Table 48.4: Asymmetric Granger-causality between ELEP-Rene and Trade

H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
ELEP-Rene≠> Trade		India			Trade ≠> ELEP-Rene		India		
$E^{+} \neq> T^{+}$	1.358 [2]	13.582	7.333	5.513	$T^{+} \neq> E^{+}$	7.447 [2]	25.403	13.698	**9.211**
$E^{-} \neq> T^{-}$	**27.091[3]**	63.730	22.831	13.410	$T^{-} \neq> E^{-}$	0.864 [3]	33.233	14.694	**9.036**
$E^{+} \neq> T^{-}$	**54.281 [4]**	318.38	79.549	39.472	$T^{+} \neq> E^{-}$	0.003 [1]	13.561	5.096	**3.428**
$E^{-} \neq> T^{+}$	0.175 [1]	17.446	7.189	4.001	$T^{-} \neq> E^{+}$	0.376 [4]	384.43	58.816	**29.638**
		Indonesia					Indonesia		
$E^{+} \neq> T^{+}$	0.978 [1]	9.714	4.809	2.938	$T^{+} \neq> E^{+}$	0.320 [1]	8.493	4.250	3.000
$E^{-} \neq> T^{-}$	0.457 [1]	11.652	5.466	3.600	$T^{-} \neq> E^{-}$	**3.627 [1]**	10.660	5.030	3.525
$E^{+} \neq> T^{-}$	**35.965 [3]**	36.477	17.461	12.209	$T^{+} \neq> E^{-}$	9.056 [4]	222.39	61.143	31.148
$E^{-} \neq> T^{+}$	0.878 [4]	424.38	89.099	37.767	$T^{-} \neq> E^{+}$	6.787 [3]	31.247	14.460	9.865
		Japan					Japan		
$E^{+} \neq> T^{+}$	**7.683 [1]**	20.412	6.963	4.416	$T^{+} \neq> E^{+}$	0.424 [1]	11.859	5.929	3.674
$E^{-} \neq> T^{-}$	0.006 [1]	10.398	5.052	3.095	$T^{-} \neq> E^{-}$	0.024 [1]	26.162	7.506	3.684
$E^{+} \neq> T^{-}$	22.676 [4]	592.52	95.237	42.717	$T^{+} \neq> E^{-}$	14.580[4]	245.33	68.125	29.415
$E^{-} \neq> T^{+}$	10.523 [4]	582.49	85.852	40.502	$T^{-} \neq> E^{+}$	19.713[4]	557.80	144.08	72.804
		Malaysia					Malaysia		
$E^{+} \neq> T^{+}$	1.467 [1]	12.493	5.261	3.377	$T^{+} \neq> E^{+}$	0.001 [1]	9.899	5.059	3.352
$E^{-} \neq> T^{-}$	8.716 [4]	629.15	80.325	37.452	$T^{-} \neq> E^{-}$	**76.469[4]**	529.78	75.512	39.385
$E^{+} \neq> T^{-}$	0.017 [1]	14.047	5.540	3.254	$T^{+} \neq> E^{-}$	0.534 [4]	321.45	68.160	36.946
$E^{-} \neq> T^{+}$	2.352 [4]	339.16	64.805	32.932	$T^{-} \neq> E^{+}$	2.111 [1]	16.488	5.209	3.217
		Pakistan					Pakistan		
$E^{+} \neq> T^{+}$	1.759 [1]	9.133	4.614	3.058	$T^{+} \neq> E^{+}$	**9.941 [1]**	13.114	5.715	3.464
$E^{-} \neq> T^{-}$	**25.348 [4]**	532.84	64.448	35.513	$T^{-} \neq> E^{-}$	2.647 [4]	186.21	42.523	26.774
$E^{+} \neq> T^{-}$	0.009 [2]	15.663	8.043	6.025	$T^{+} \neq> E^{-}$	0.000 [1]	9.361	5.002	3.340
$E^{-} \neq> T^{+}$	0.011 [1]	10.971	5.250	3.212	$T^{-} \neq> E^{+}$	1.136 [2]	15.991	9.166	6.444
		Philippines					Philippines		
$E^{+} \neq> T^{+}$	0.164 [1]	12.027	6.445	3.923	$T^{+} \neq> E^{+}$	0.272 [1]	12.957	6.478	3.956
$E^{-} \neq> T^{-}$	3.550 [2]	25.921	10.149	6.739	$T^{-} \neq> E^{-}$	0.375 [2]	21.450	10.686	6.965
$E^{+} \neq> T^{-}$	1.093 [1]	12.539	5.239	3.472	$T^{+} \neq> E^{-}$	3.769 [4]	10615	699.01	202.37
$E^{-} \neq> T^{+}$	**2383.20 [4]**	10159	873.25	230.72	$T^{-} \neq> E^{+}$	1.557 [1]	13.848	6.313	4.183
		South Korea					South Korea		
$E^{+} \neq> T^{+}$	0.986 [2]	16.625	9.726	7.017	$T^{+} \neq> E^{+}$	1.472 [2]	19.395	8.866	6.851
$E^{-} \neq> T^{-}$	4.865 [3]	32.712	15.542	9.865	$T^{-} \neq> E^{-}$	3.830 [3]	39.042	16.689	10.760
$E^{+} \neq> T^{-}$	0.215 [2]	15.624	8.738	5.986	$T^{+} \neq> E^{-}$	15.247[4]	753.05	90.566	41.388
$E^{-} \neq> T^{+}$	**61.104 [4]**	562.02	68.571	37.271	$T^{-} \neq> E^{+}$	0.758 [2]	19.373	10.092	6.747
		Thailand					Thailand		
$E^{+} \neq> T^{+}$	11.513 [4]	356.33	81.781	32.990	$T^{+} \neq> E^{+}$	17.961[4]	464.50	71.061	33.853
$E^{-} \neq> T^{-}$	5.691 [4]	329.15	56.978	32.111	$T^{-} \neq> E^{-}$	**40.266[4]**	354.88	65.462	33.354
$E^{+} \neq> T^{-}$	4.918 [4]	382.39	65.488	31.866	$T^{+} \neq> E^{-}$	3.753 [4]	495.04	65.941	38.543
$E^{-} \neq> T^{+}$	13.090 [4]	541.65	70.998	37.009	$T^{-} \neq> E^{+}$	40.178[4]	477.69	78.560	42.338

Table 49.4: Asymmetric Granger-causality between EPC and GDP

H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
EPC≠>GDP		Bangladesh			GDP ≠> EPC		Bangladesh		
$E^+ \neq> Y^+$	**10.123 [2]**	16.164	9.027	6.579	$Y^+ \neq> E^+$	4.746 [2]	17.826	9.380	6.534
$E^- \neq> Y^-$	0.060 [1]	28.149	6.805	3.573	$Y^- \neq> E^-$	**7.187 [1]**	14.712	5.949	3.917
$E^+ \neq> Y^-$	0.599 [1]	8.392	4.744	3.316	$Y^+ \neq> E^-$	2.854 [4]	374.74	62.684	32.904
$E^- \neq> Y^+$	7.962 [4]	440.109	62.311	31.937	$Y^- \neq> E^+$	0.004 [1]	9.307	4.525	3.248
		Japan					Japan		
$E^+ \neq> Y^+$	0.194 [1]	8.352	5.537	3.583	$Y^+ \neq> E^+$	0.693 [1]	10.226	5.118	3.317
$E^- \neq> Y^-$	0.024 [1]	25.494	6.823	3.530	$Y^- \neq> E^-$	0.000 [1]	21.310	5.639	3.116
$E^+ \neq> Y^-$	0.826 [1]	7.874	4.570	3.190	$Y^+ \neq> E^-$	**22.150 [4]**	37.919	19.412	13.424
$E^- \neq> Y^+$	**17.085 [4]**	47.252	23.444	14.400	$Y^- \neq> E^+$	0.210 [1]	8.685	4.484	3.057
		New Zealand					New Zealand		
$E^+ \neq> Y^+$	1.057 [3]	19.395	11.157	8.228	$Y^+ \neq> E^+$	**45.770 [3]**	21.816	13.377	10.077
$E^- \neq> Y^-$	1.272 [4]	2.993	1.341	0.817	$Y^- \neq> E^-$	0.029 [4]	54.553	27.108	17.103
$E^+ \neq> Y^-$	1.840 [4]	41.788	21.020	15.177	$Y^+ \neq> E^-$	**3.811 [1]**	8.498	4.643	3.285
$E^- \neq> Y^+$	1.212 [1]	11.721	5.857	3.523	$Y^- \neq> E^+$	5.268 [4]	54.565	23.141	14.830
		Philippines					Philippines		
$E^+ \neq> Y^+$	24.401 [4]	762.365	87.792	43.770	$Y^+ \neq> E^+$	2.288 [4]	737.69	122.99	50.679
$E^- \neq> Y^-$	1.400 [4]	505.265	77.201	43.866	$Y^- \neq> E^-$	**1928.75 [4]**	966.43	134.48	55.921
$E^+ \neq> Y^-$	1.731 [3]	44.979	20.709	12.551	$Y^+ \neq> E^-$	2.309 [2]	17.929	10.834	7.663
$E^- \neq> Y^+$	1.502 [2]	17.273	10.668	6.800	$Y^- \neq> E^+$	0.630 [3]	46.740	22.705	15.700

Table 50.4: Asymmetric Granger-causality between EPC and Trade

H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
EPC≠>Trade		Bangladesh			Trade≠>EPC		Bangladesh		
$E^+ \neq> T^+$	1.495 [4]	590.548	68.980	38.509	$T^+ \neq> E^+$	4.647 [4]	551.72	64.572	29.934
$E^- \neq> T^-$	17.675 [4]	407.424	63.650	30.925	$T^- \neq> E^-$	22.96 [4]	229.71	69.542	38.492
$E^+ \neq> T^-$	**113.487 [4]**	229.162	59.521	30.270	$T^+ \neq> E^-$	1.795 [4]	244.79	51.667	28.506
$E^- \neq> T^+$	**80.426 [4]**	268.026	74.543	33.791	$T^- \neq> E^+$	4.661 [4]	299.19	59.845	32.999
		Japan					Japan		
$E^+ \neq> T^+$	**18.986 [4]**	41.001	19.685	14.060	$T^+ \neq> E^+$	15.09 [4]	45.699	23.211	15.669
$E^- \neq> T^-$	0.006 [1]	12.493	4.8510	2.974	$T^- \neq> E^-$	**7.057 [1]**	13.434	6.085	3.266
$E^+ \neq> T^-$	2.961 [1]	8.497	4.251	3.179	$T^+ \neq> E^-$	0.234 [1]	8.835	4.767	3.110
$E^- \neq> T^+$	0.396 [1]	10.153	4.436	3.241	$T^- \neq> E^+$	**3.334 [1]**	6.896	4.153	2.989
		Pakistan					Pakistan		
$E^+ \neq> T^+$	5.074 [3]	36.323	16.512	11.832	$T^+ \neq> E^+$	**17.53 [3]**	42.237	17.728	11.744
$E^- \neq> T^-$	**77.757 [4]**	680.201	111.39	44.280	$T^- \neq> E^-$	1.380 [4]	193.94	53.231	30.832
$E^+ \neq> T^-$	0.252 [4]	218.244	59.218	33.527	$T^+ \neq> E^-$	**30.33 [4]**	309.07	49.273	26.085
$E^- \neq> T^+$	24.334 [4]	473.161	76.880	33.861	$T^- \neq> E^+$	7.322 [4]	402.97	90.190	44.023
		Philippines					Philippines		
$E^+ \neq> T^+$	1.597 [3]	32.068	16.748	10.986	$T^+ \neq> E^+$	4.950 [3]	44.572	17.395	12.328
$E^- \neq> T^-$	1.898 [4]	188.497	48.453	25.191	$T^- \neq> E^-$	**35.52 [4]**	295.03	73.473	32.876
$E^+ \neq> T^-$	**156.632 [4]**	298.824	77.823	36.630	$T^+ \neq> E^-$	0.146 [1]	11.823	5.072	3.129
$E^- \neq> T^+$	1.084 [1]	16.887	6.497	3.614	$T^- \neq> E^+$	176.2 [4]	995.09	99.308	50.231

Table-51.4 and Table-52.4, resent the results of asymmetric Granger-causality analysis between EU and GDP, and EU and Trade. It is evident from Table-51.4 that the null hypothesis that EU does not Granger-cause GDP is rejected only in China HKSAR and Malaysia for positive, in Japan for negative and negative to positive, and in New Zealand for positive and negative shocks; and that GDP does not Granger-cause EU is rejected in China and Japan for negative to positive shocks and in Philippines for positive to negative shocks with at least a 10%

level of significance. The results reported in Table-52.4 show that the null hypothesis that EU does not Granger-cause Trade is rejected in China HKSAR and Thailand for negative shocks, in Philippines for negative to positive shocks; and that Trade does not Granger-cause EU is rejected in China HKSAR, Indonesia, Malaysia and Philippines for negative shocks, in India for positive to negative shocks, and in Pakistan for negative to positive shocks with at least at 10% level of significance.

Table 51.4: Asymmetric Granger-causality between EU and GDP

H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
EU≠>GDP		China			GDP≠>EU		China		
$E^+ \neq> Y^+$	0.588 [2]	16.097	9.067	5.813	$Y^+ \neq> E^+$	0.063 [2]	25.380	12.813	8.792
$E^- \neq> Y^-$	0.000 [1]	25.671	6.359	3.398	$Y^- \neq> E^-$	0.000 [1]	19.532	6.602	3.698
$E^+ \neq> Y^-$	1.751 [1]	8.129	4.805	3.415	$Y^+ \neq> E^-$	7.293 [4]	372.39	75.585	35.249
$E^- \neq> Y^+$	8.099 [4]	443.43	82.619	47.367	$Y^- \neq> E^+$	**7.027 [1]**	8.301	4.431	3.331
		China HKSAR					China HKSAR		
$E^+ \neq> Y^+$	**214.95 [4]**	746.57	92.972	37.229	$Y^+ \neq> E^+$	5.123 [4]	266.51	64.449	35.086
$E^- \neq> Y^-$	18.916 [4]	1643.6	168.24	71.613	$Y^- \neq> E^-$	0.001 [4]	258.33	55.858	29.370
$E^+ \neq> Y^-$	1.548 [1]	7.851	4.553	3.163	$Y^+ \neq> E^-$	0.002 [1]	8.451	4.768	3.275
$E^- \neq> Y^+$	0.102 [1]	9.312	5.154	3.462	$Y^- \neq> E^+$	1.112 [1]	10.086	4.887	2.957
		Japan					Japan		
$E^+ \neq> Y^+$	2.389 [3]	21.227	10.839	7.839	$Y^+ \neq> E^+$	0.099 [3]	21.609	10.153	7.822
$E^- \neq> Y^-$	**45.052 [3]**	39.196	19.331	10.585	$Y^- \neq> E^-$	0.000 [3]	27.739	12.852	9.108
$E^+ \neq> Y^-$	2.300 [1]	7.030	4.086	2.758	$Y^+ \neq> E^-$	2.101 [3]	20.376	11.840	8.609
$E^- \neq> Y^+$	**9.335 [3]**	20.856	10.828	8.262	$Y^- \neq> E^+$	**4.103 [1]**	8.962	4.478	3.124
		Malaysia					Malaysia		
$E^+ \neq> Y^+$	**14.154 [3]**	46.424	18.400	12.932	$Y^+ \neq> E^+$	4.124 [3]	35.923	14.843	9.569
$E^- \neq> Y^-$	1.609 [3]	34.412	15.229	11.753	$Y^- \neq> E^-$	4.647 [3]	47.544	20.687	13.529
$E^+ \neq> Y^-$	0.054 [1]	12.294	5.337	2.879	$Y^+ \neq> E^-$	0.310 [2]	15.154	8.857	6.076
$E^- \neq> Y^+$	0.454 [2]	21.283	9.012	6.394	$Y^- \neq> E^+$	0.154 [1]	11.041	5.089	3.597
		New Zealand					New Zealand		
$E^+ \neq> Y^+$	**6.451 [1]**	9.857	4.921	3.481	$Y^+ \neq> E^+$	1.688 [1]	8.131	4.203	2.937
$E^- \neq> Y^-$	**5.989 [1]**	14.582	5.077	3.270	$Y^- \neq> E^-$	0.713 [1]	7.781	5.154	3.236
$E^+ \neq> Y^-$	2.052 [1]	9.416	5.100	3.214	$Y^+ \neq> E^-$	1.841 [1]	8.471	4.500	2.933
$E^- \neq> Y^+$	0.581 [1]	8.574	4.422	3.237	$Y^- \neq> E^+$	1.706 [1]	8.681	4.974	3.347
		Philippines					Philippines		
$E^+ \neq> Y^+$	4.204 [4]	700.19	82.365	38.985	$Y^+ \neq> E^+$	6.628 [4]	481.33	109.32	51.303
$E^- \neq> Y^-$	34.622 [4]	349.08	107.68	58.598	$Y^- \neq> E^-$	10.96 [4]	732.59	105.04	51.677
$E^+ \neq> Y^-$	14.010 [4]	212.76	65.514	34.319	$Y^+ \neq> E^-$	**366.3 [4]**	628.15	82.975	35.880
$E^- \neq> Y^+$	2.994 [4]	343.87	92.705	38.785	$Y^- \neq> E^+$	10.58 [4]	429.28	80.292	36.026

Table-53.4 and Table-54.4, present the results of asymmetric Granger-causality analysis between HYD and GDP, and HYD and Trade. It is evident from Table-53.4 that the null hypothesis that HYD does not Granger-cause GDP is rejected in China for negative shocks, in Indonesia for positive and positive to negative shocks, and in Japan and South Korea for positive shocks; and that GDP does not Granger-cause HYD is rejected in India for negative to positive shocks, and in Japan for negative to positive shocks. The results reported in Table-54.4 show that the null hypothesis that HYD does not Granger-cause Trade is rejected in Bangladesh and South Korea for positive shocks, in Indonesia for negative to positive shocks, and in Thailand for positive and negative to positive shocks; and that Trade does not Granger-cause HYD is rejected in India for positive and negative shocks, in Japan for negative shocks, and in New Zealand for positive to negative shocks, and in Thailand for negative to positive shocks.

Table 52.4: Asymmetric Granger-causality between EU and Trade

H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
EU≠>Trade		China HKSAR			Trade≠>EU		China HKSAR		
$E^+ \neq> T^+$	0.043 [1]	8.672	4.866	3.291	$T^+ \neq> E^+$	1.268 [1]	9.985	5.047	3.490
$E^- \neq> T^-$	**307259 [4]**	391.58	81.216	33.836	$T^- \neq> E^-$	**42854 [4]**	647.08	77.685	33.070
$E^+ \neq> T^-$	1.944 [4]	378.99	80.397	37.896	$T^+ \neq> E^-$	18.939 [4]	334.01	87.524	44.114
$E^- \neq> T^+$	6.631 [4]	313.26	59.518	30.865	$T^- \neq> E^+$	5.561 [4]	146.78	48.472	25.283
		India					India		
$E^+ \neq> T^+$	1.818 [4]	441.88	78.097	37.922	$T^+ \neq> E^+$	16.924 [4]	329.55	67.581	31.962
$E^- \neq> T^-$	0.075 [1]	28.422	6.163	3.384	$T^- \neq> E^-$	0.068 [1]	22.869	5.253	2.981
$E^+ \neq> T^-$	1.622 [1]	9.454	4.653	3.323	$T^+ \neq> E^-$	**1113.35 [4]**	493.64	72.036	33.508
$E^- \neq> T^+$	3.582 [4]	287.46	63.580	30.706	$T^- \neq> E^+$	0.664 [1]	8.469	4.785	3.597
		Indonesia					Indonesia		
$E^+ \neq> T^+$	17.145 [4]	470.31	83.909	38.653	$T^+ \neq> E^+$	30.452 [4]	346.09	83.522	43.393
$E^- \neq> T^-$	9.775 [4]	305.49	59.014	29.274	$T^- \neq> E^-$	**919.294 [4]**	351.59	75.710	36.696
$E^+ \neq> T^-$	0.229 [1]	10.413	4.905	3.519	$T^+ \neq> E^-$	0.167 [4]	373.56	72.779	33.340
$E^- \neq> T^+$	0.086 [4]	5.119	1.494	0.688	$T^- \neq> E^+$	1.702 [1]	11.826	5.712	3.983
		Malaysia					Malaysia		
$E^+ \neq> T^+$	4.814 [4]	690.87	78.852	40.617	$T^+ \neq> E^+$	30.350 [4]	674.36	81.659	39.627
$E^- \neq> T^-$	0.630 [2]	17.046	8.630	6.159	$T^- \neq> E^-$	**7.332 [2]**	17.690	8.452	5.611
$E^+ \neq> T^-$	18.832 [4]	216.51	70.753	31.587	$T^+ \neq> E^-$	7.644 [3]	38.932	16.401	10.239
$E^- \neq> T^+$	6.611 [3]	53.346	16.256	11.341	$T^- \neq> E^+$	10.314 [4]	233.95	87.292	32.316
		Pakistan					Pakistan		
$E^+ \neq> T^+$	0.052 [1]	15.140	5.674	3.952	$T^+ \neq> E^+$	0.144 [1]	12.828	5.497	3.430
$E^- \neq> T^-$	0.001 [1]	13.442	5.776	3.774	$T^- \neq> E^-$	0.007 [1]	13.305	6.417	3.632
$E^+ \neq> T^-$	0.007 [1]	11.110	5.260	3.283	$T^+ \neq> E^-$	0.000 [1]	22.268	5.908	3.362
$E^- \neq> T^+$	0.004 [1]	13.376	6.248	3.959	$T^- \neq> E^+$	**4.947 [1]**	14.133	6.022	3.756
		Philippines					Philippines		
$E^+ \neq> T^+$	7.494 [4]	522.99	65.497	30.434	$T^+ \neq> E^+$	10.166 [4]	471.60	99.949	41.278
$E^- \neq> T^-$	31.183 [4]	363.23	88.411	38.029	$T^- \neq> E^-$	**395.877 [4]**	417.27	60.257	24.490
$E^+ \neq> T^-$	16.233 [4]	380.59	64.878	31.776	$T^+ \neq> E^-$	1.287 [4]	312.83	63.339	31.176
$E^- \neq> T^+$	**50.353 [4]**	596.28	116.23	49.050	$T^- \neq> E^+$	7.967 [4]	500.64	84.408	39.346
		Thailand					Thailand		
$E^+ \neq> T^+$	7.675 [4]	407.96	86.243	38.827	$T^+ \neq> E^+$	6.868 [4]	290.17	68.131	33.932
$E^- \neq> T^-$	**73.340 [3]**	62.610	19.341	12.700	$T^- \neq> E^-$	6.270 [3]	41.971	16.726	10.588
$E^+ \neq> T^-$	7.454 [3]	34.492	14.397	9.678	$T^+ \neq> E^-$	1.749 [4]	367.96	56.532	27.386
$E^- \neq> T^+$	18.966 [4]	854.45	91.334	43.738	$T^- \neq> E^+$	1.978 [3]	38.390	16.050	12.069

Table-55.4 and Table-56.4, present the results of asymmetric Granger-causality analysis between NG and GDP, and NG and Trade. It is evident from Table-55.4 that the null hypothesis that NG does not Granger-cause GDP is rejected in China for positive to negative shocks, in India for positive, negative and positive to negative shocks, and New Zealand and Pakistan for negative shocks; and that GDP does not Granger-cause NG is rejected in China and Pakistan for positive shocks, in New Zealand for negative and positive to negative shocks and in Taiwan for negative to positive shocks. The results reported in Table-56.4 show that the null hypothesis that NG does not Granger-cause Trade is rejected in India for positive and negative to positive shocks; and that Trade does not Granger-cause NG is not rejected for any of the case with at least at 10 % level of significance.

Table 53.4: Asymmetric Granger-causality between HYD and GDP

H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
HYD≠>GDP		China			GDP≠>HYD		China		
$E^+ \neq> Y^+$	0.456 [1]	8.954	4.721	3.019	$Y^+ \neq> E^+$	0.554 [1]	9.107	4.570	3.059
$E^- \neq> Y^-$	**39.375 [2]**	22.87	8.958	5.750	$Y^- \neq> E^-$	0.022 [2]	13.134	8.128	5.497
$E^+ \neq> Y^-$	0.610 [1]	8.052	4.144	2.791	$Y^+ \neq> E^-$	0.157 [1]	8.790	5.053	3.380
$E^- \neq> Y^+$	0.139 [1]	8.453	4.614	3.011	$Y^- \neq> E^+$	1.263 [1]	8.481	4.126	2.930
		India					India		
$E^+ \neq> Y^+$	2.928 [2]	14.86	7.482	5.654	$Y^+ \neq> E^+$	3.379 [2]	16.920	8.052	5.420
$E^- \neq> Y^-$	0.100 [1]	19.62	5.587	3.105	$Y^- \neq> E^-$	0.205 [1]	12.107	5.670	3.395
$E^+ \neq> Y^-$	0.464 [1]	10.68	4.874	3.102	$Y^+ \neq> E^-$	1.785 [1]	8.526	4.829	3.147
$E^- \neq> Y^+$	0.090 [1]	9.465	5.081	3.161	$Y^- \neq> E^+$	**11.892[1]**	13.560	5.270	3.390
		Indonesia					Indonesia		
$E^+ \neq> Y^+$	**8.855 [2]**	14.99	7.805	5.854	$Y^+ \neq> E^+$	0.997 [2]	14.222	7.675	5.499
$E^- \neq> Y^-$	0.664 [1]	10.12	5.124	3.267	$Y^- \neq> E^-$	0.021 [1]	14.341	4.723	2.976
$E^+ \neq> Y^-$	**4.883 [1]**	12.32	5.295	3.429	$Y^+ \neq> E^-$	0.915 [1]	9.997	4.351	3.082
$E^- \neq> Y^+$	0.100 [1]	8.443	4.042	2.642	$Y^- \neq> E^+$	0.009 [1]	12.158	4.954	2.974
		Japan					Japan		
$E^+ \neq> Y^+$	**3.508 [3]**	8.830	4.469	2.872	$Y^+ \neq> E^+$	0.302 [1]	8.556	4.369	3.119
$E^- \neq> Y^-$	0.452 [1]	15.37	4.566	2.832	$Y^- \neq> E^-$	**3.686 [1]**	15.128	5.159	3.317
$E^+ \neq> Y^-$	0.000 [1]	11.82	5.211	3.146	$Y^+ \neq> E^-$	2.134 [1]	7.470	4.280	3.216
$E^- \neq> Y^+$	2.886 [1]	8.193	4.931	3.077	$Y^- \neq> E^+$	0.389 [1]	9.879	4.866	3.144
		South Korea					South Korea		
$E^+ \neq> Y^+$	**4.067 [1]**	8.658	4.570	2.950	$Y^+ \neq> E^+$	0.021 [1]	8.570	4.495	2.976
$E^- \neq> Y^-$	0.071 [1]	12.65	5.641	3.355	$Y^- \neq> E^-$	0.067 [1]	22.042	6.974	3.957
$E^+ \neq> Y^-$	0.012 [1]	8.160	4.332	3.028	$Y^+ \neq> E^-$	1.047 [1]	9.163	4.551	3.320
$E^- \neq> Y^+$	2.302 [1]	7.873	4.473	3.081	$Y^- \neq> E^+$	0.896 [1]	11.201	5.265	3.167

Table-57.4 and Table-58.4, present the results of asymmetric Granger-causality analysis between NU and GDP, and NU and Trade. It is evident from Table-57.4 that the null hypothesis that NU does not Granger-cause GDP is not rejected and that GDP does not Granger-cause NU is rejected in India for positive and negative shocks with at least a 10 % level of significance. The results reported in Table-58.4 show that the null hypothesis that NU does not Granger-cause Trade is rejected in India for positive shocks and in Japan for negative shocks; and that Trade does not Granger-cause NU is rejected in India for positive to negative shocks and negative to positive shocks with at least a 10 % level of significance.

Table 54.4: Asymmetric Granger-causality between HYD and Trade

H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
HYD≠>Trade		Bangladesh			Trade≠>HYD		Bangladesh		
$E^{+} \neq> T^{+}$	**44.347 [4]**	413.30	68.216	39.263	$T^{+} \neq> E^{+}$	4.547 [4]	243.35	51.817	27.484
$E^{-} \neq> T^{-}$	0.015 [1]	18.560	6.197	3.656	$T^{-} \neq> E^{-}$	0.070 [1]	14.839	5.509	3.235
$E^{+} \neq> T^{-}$	2.281 [4]	524.86	75.467	38.926	$T^{+} \neq> E^{-}$	0.202 [1]	10.437	4.642	3.119
$E^{-} \neq> T^{+}$	0.000 [1]	10.145	5.274	3.256	$T^{-} \neq> E^{+}$	0.956 [4]	212.1	71.407	32.099
		India					India		
$E^{+} \neq> T^{+}$	0.620 [1]	8.258	4.346	2.808	$T^{+} \neq> E^{+}$	**8.224 [1]**	9.936	4.870	3.116
$E^{-} \neq> T^{-}$	0.487 [2]	13.950	7.723	5.185	$T^{-} \neq> E^{-}$	**98.344 [2]**	14.625	9.407	6.678
$E^{+} \neq> T^{-}$	0.077 [1]	9.882	4.727	2.808	$T^{+} \neq> E^{-}$	0.001 [1]	10.794	4.994	3.176
$E^{-} \neq> T^{+}$	0.152 [1]	16.191	5.135	3.136	$T^{-} \neq> E^{+}$	0.010 [1]	11.851	5.336	3.228
		Indonesia					Indonesia		
$E^{+} \neq> T^{+}$	0.727 [1]	9.063	5.015	3.331	$T^{+} \neq> E^{+}$	0.109 [1]	11.334	5.319	3.470
$E^{-} \neq> T^{-}$	0.060 [1]	7.869	4.365	3.083	$T^{-} \neq> E^{-}$	0.097 [1]	9.008	4.204	2.864
$E^{+} \neq> T^{-}$	7.267 [4]	31.892	19.462	14.224	$T^{+} \neq> E^{-}$	4.479 [4]	39.884	17.864	12.246
$E^{-} \neq> T^{+}$	**37.315 [4]**	41.198	21.581	14.107	$T^{-} \neq> E^{+}$	6.476 [4]	38.524	20.888	15.076
		Japan					Japan		
$E^{+} \neq> T^{+}$	1.405 [1]	10.886	5.144	3.122	$T^{+} \neq> E^{+}$	0.123 [1]	8.917	4.884	3.059
$E^{-} \neq> T^{-}$	0.013 [1]	11.587	5.038	3.262	$T^{-} \neq> E^{-}$	**3.560 [1]**	11.100	4.846	3.123
$E^{+} \neq> T^{-}$	0.250 [1]	7.459	4.353	3.255	$T^{+} \neq> E^{-}$	0.009 [1]	8.835	4.117	3.024
$E^{-} \neq> T^{+}$	0.312 [1]	10.382	5.243	3.143	$T^{-} \neq> E^{+}$	3.319 [1]	11.562	5.256	3.623
		New Zealand					New Zealand		
$E^{+} \neq> T^{+}$	3.392 [4]	44.853	22.042	14.338	$T^{+} \neq> E^{+}$	9.212 [4]	46.243	21.412	14.271
$E^{-} \neq> T^{-}$	4.315 [4]	42.240	18.793	13.658	$T^{-} \neq> E^{-}$	0.004 [4]	49.000	20.019	12.227
$E^{+} \neq> T^{-}$	4.794 [4]	35.780	18.858	12.989	$T^{+} \neq> E^{-}$	**38.388 [4]**	47.695	22.482	15.578
$E^{-} \neq> T^{+}$	5.396 [4]	35.834	19.522	13.365	$T^{-} \neq> E^{+}$	0.015 [4]	39.237	18.801	12.714
		South Korea					South Korea		
$E^{+} \neq> T^{+}$	**4.751 [1]**	8.008	4.688	3.219	$T^{+} \neq> E^{+}$	0.999 [1]	8.395	4.365	3.102
$E^{-} \neq> T^{-}$	1.765 [4]	107.91	32.812	19.965	$T^{-} \neq> E^{-}$	3.231 [4]	70.709	30.542	18.595
$E^{+} \neq> T^{-}$	7.361 [4]	34.498	19.943	12.887	$T^{+} \neq> E^{-}$	0.112 [1]	7.940	4.189	2.914
$E^{-} \neq> T^{+}$	1.546 [1]	10.029	4.885	3.298	$T^{-} \neq> E^{+}$	6.130 [4]	40.387	21.158	14.226
		Thailand					Thailand		
$E^{+} \neq> T^{+}$	**18.760 [4]**	47.443	24.356	18.378	$T^{+} \neq> E^{+}$	3.157 [4]	33.604	17.616	12.965
$E^{-} \neq> T^{-}$	6.734 [4]	39.348	20.800	13.638	$T^{-} \neq> E^{-}$	7.799 [4]	35.614	16.883	11.867
$E^{+} \neq> T^{-}$	11.120 [4]	42.803	21.937	15.121	$T^{+} \neq> E^{-}$	0.258 [1]	9.689	5.023	3.042
$E^{-} \neq> T^{+}$	7.130 [1]	11.402	5.331	3.567	$T^{-} \neq> E^{+}$	20.235 [4]	41.528	20.706	**15.220**

Table-59.4 and Table-60.4, present the results of asymmetric Granger-causality analysis between PEC and GDP, and PEC and Trade. It is evident from Table-59.4 that the null hypothesis that PEC does not Granger-cause GDP is rejected in India for negative shocks, in Japan for negative and negative to positive shocks, and in New Zealand for positive and negative shocks; and that GDP does not Granger-cause PEC is rejected in China for positive to negative shocks, and in Japan and New Zealand for positive shocks with at least at 10 % level of significance. The results reported in Table-60.4 show that the null hypothesis that PEC does not Granger-cause Trade is rejected in China HKSAR for negative shocks, in India and Philippines for negative to positive shocks; and that Trade does not Granger-cause PEC is rejected in

Philippines for negative shocks and negative to positive shocks and in Singapore for negative shocks with at least at 10 % level of significance.

Table 55.4: Asymmetric Granger-causality between NG and GDP

H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
NG≠>GDP		China			GDP≠>NG		China		
$E^+ \neq> Y^+$	3.051 [3]	19.155	11.337	8.590	$Y^+ \neq> E^+$	**25.693 [3]**	22.282	11.099	8.500
$E^- \neq> Y^-$	0.507 [1]	8.993	4.657	2.807	$Y^- \neq> E^-$	0.482 [1]	8.065	4.092	2.835
$E^+ \neq> Y^-$	**15.625 [4]**	30.852	19.080	13.742	$Y^+ \neq> E^-$	2.519 [2]	17.112	9.536	7.035
$E^- \neq> Y^+$	0.521 [2]	13.225	7.354	5.153	$Y^- \neq> E^+$	10.448 [4]	47.486	22.683	15.029
		India					India		
$E^+ \neq> Y^+$	**5.556 [1]**	9.384	4.689	3.204	$Y^+ \neq> E^+$	0.034 [1]	8.247	4.036	2.891
$E^- \neq> Y^-$	**70.337 [2]**	41.187	11.795	6.926	$Y^- \neq> E^-$	1.880 [2]	36.004	13.463	8.781
$E^+ \neq> Y^-$	**9.760 [2]**	15.285	8.339	6.101	$Y^+ \neq> E^-$	0.885 [1]	9.089	4.510	3.265
$E^- \neq> Y^+$	0.392 [1]	10.665	4.223	2.938	$Y^- \neq> E^+$	0.666 [2]	15.969	8.181	5.572
		New Zealand					New Zealand		
$E^+ \neq> Y^+$	9.621 [4]	97.485	32.481	19.491	$Y^+ \neq> E^+$	15.645 [4]	146.72	53.606	30.552
$E^- \neq> Y^-$	**103.516 [4]**	102.925	31.207	20.855	$Y^- \neq> E^-$	**300.859 [4]**	112.04	31.677	18.804
$E^+ \neq> Y^-$	13.125 [4]	84.679	35.329	22.367	$Y^+ \neq> E^-$	**19.968 [3]**	44.459	18.075	12.128
$E^- \neq> Y^+$	1.367 [3]	41.983	16.141	10.194	$Y^- \neq> E^+$	1.548 [4]	83.564	35.212	22.277
		Pakistan					Pakistan		
$E^+ \neq> Y^+$	0.047 [1]	9.336	5.125	3.123	$Y^+ \neq> E^+$	**11.774 [1]**	9.992	5.560	4.016
$E^- \neq> Y^-$	**205.774 [2]**	28.710	10.806	6.832	$Y^- \neq> E^-$	0.612 [2]	21.741	9.135	6.745
$E^+ \neq> Y^-$	0.042 [1]	10.790	5.448	3.700	$Y^+ \neq> E^-$	0.499 [2]	19.408	8.657	6.085
$E^- \neq> Y^+$	**7.575 [2]**	17.280	7.928	5.600	$Y^- \neq> E^+$	0.842 [1]	8.758	4.810	3.196
		Taiwan					Taiwan		
$E^+ \neq> Y^+$	0.586 [1]	7.760	4.561	3.172	$Y^+ \neq> E^+$	0.006 [1]	10.075	4.164	2.970
$E^- \neq> Y^-$	0.000 [1]	11.573	5.920	3.520	$Y^- \neq> E^-$	0.000 [1]	9.738	4.714	2.732
$E^+ \neq> Y^-$	6.233 [4]	25.386	14.026	10.977	$Y^+ \neq> E^-$	0.007 [1]	7.809	4.392	2.981
$E^- \neq> Y^+$	0.000 [1]	8.861	4.708	3.384	$Y^- \neq> E^+$	115.190 [4]	46.079	20.239	14.653

Table 56.4: Asymmetric Granger-causality between NG and Trade

H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
NG≠>Trade		India			Trade≠>NG		India		
$E^+ \neq> T^+$	**3.977 [1]**	10.218	4.513	3.083	$T^+ \neq> E^+$	0.317 [1]	10.908	5.431	3.271
$E^- \neq> T^-$	0.000 [1]	14.307	4.395	3.144	$T^- \neq> E^-$	0.490 [1]	9.649	4.832	3.182
$E^+ \neq> T^-$	0.693 [2]	11.409	7.187	5.291	$T^+ \neq> E^-$	0.521 [1]	9.142	3.999	2.783
$E^- \neq> T^+$	10.777 [1]	15.453	5.978	3.715	$T^- \neq> E^+$	4.521 [2]	13.156	8.515	5.755

Table 57.4: Asymmetric Granger-causality between NU and GDP

H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
NU≠>GDP		India			GDP≠>NU		India		
$E^+ \neq> Y^+$	0.044 [2]	13.243	7.550	5.530	$Y^+ \neq> E^+$	**6.717 [2]**	15.330	8.121	5.839
$E^- \neq> Y^-$	0.482 [3]	24.155	12.259	8.464	$Y^- \neq> E^-$	**47.56 [3]**	31.840	13.965	8.977
$E^+ \neq> Y^-$	7.710 [4]	95.831	24.163	16.146	$Y^+ \neq> E^-$	3.605 [3]	21.867	12.230	8.724
$E^- \neq> Y^+$	10.125 [3]	28.129	14.346	10.259	$Y^- \neq> E^+$	2.004 [4]	69.784	27.923	14.869

Table 58.4: Asymmetric Granger-causality between NU and Trade

H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
NU≠>Trade		India			Trade≠>NU		India		
$E^{+} \neq> T^{+}$	**31.416 [4]**	80.222	24.403	16.011	$T^{+} \neq> E^{+}$	4.915 [4]	55.547	23.730	14.246
$E^{-} \neq> T^{-}$	0.015 [1]	10.469	5.539	3.035	$T^{-} \neq> E^{-}$	0.194 [1]	12.868	5.742	3.830
$E^{+} \neq> T^{-}$	0.452 [3]	27.534	14.430	9.851	$T^{+} \neq> E^{-}$	**9.279 [2]**	14.525	8.522	6.158
$E^{-} \neq> T^{+}$	3.335 [2]	15.849	6.878	5.291	$T^{-} \neq> E^{+}$	**21.74 [3]**	26.026	14.005	9.776
		Japan					Japan		
$E^{+} \neq> T^{+}$	5.004 [4]	45.183	20.107	12.590	$T^{+} \neq> E^{+}$	7.679 [4]	52.133	19.633	14.173
$E^{-} \neq> T^{-}$	**44.517 [3]**	33.400	15.905	11.425	$T^{-} \neq> E^{-}$	2.745 [3]	29.046	15.480	10.764
$E^{+} \neq> T^{-}$	2.437 [4]	46.764	22.682	14.507	$T^{+} \neq> E^{-}$	0.573 [1]	9.129	4.854	3.290
$E^{-} \neq> T^{+}$	0.283 [1]	12.782	5.404	3.338	$T^{-} \neq> E^{+}$	4.686 [4]	34.722	19.797	13.969

Table 59.4: Asymmetric Granger-causality between PEC and GDP

H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
PEC≠>GDP		China			GDP≠>PEC		China		
$E^{+} \neq> Y^{+}$	0.076 [1]	9.901	5.089	3.220	$Y^{+} \neq> E^{+}$	0.742 [1]	10.177	4.453	3.077
$E^{-} \neq> Y^{-}$	0.788 [1]	8.172	4.290	3.045	$Y^{-} \neq> E^{-}$	2.671 [1]	10.292	4.859	3.165
$E^{+} \neq> Y^{-}$	12.997 [4]	47.806	21.659	15.307	$Y^{+} \neq> E^{-}$	**4.625 [1]**	8.133	4.375	2.898
$E^{-} \neq> Y^{+}$	0.102 [1]	8.688	4.515	3.148	$Y^{-} \neq> E^{+}$	2.746 [4]	45.875	23.209	16.488
		India					India		
$E^{+} \neq> Y^{+}$	0.141 [1]	9.125	5.018	3.670	$Y^{+} \neq> E^{+}$	1.637 [1]	8.898	4.478	3.166
$E^{-} \neq> Y^{-}$	**256.949 [4]**	39.960	19.161	12.031	$Y^{-} \neq> E^{-}$	1.949 [4]	55.462	22.207	13.650
$E^{+} \neq> Y^{-}$	8.832 [3]	18.130	11.023	8.357	$Y^{+} \neq> E^{-}$	1.859 [1]	9.401	4.773	3.096
$E^{-} \neq> Y^{+}$	0.123 [1]	8.797	4.236	3.116	$Y^{-} \neq> E^{+}$	1.582 [3]	21.303	11.323	8.588
		Japan					Japan		
$E^{+} \neq> Y^{+}$	2.154 [1]	9.390	5.155	3.610	$Y^{+} \neq> E^{+}$	**4.517 [1]**	7.590	4.733	3.305
$E^{-} \neq> Y^{-}$	**12.202 [1]**	24.807	6.907	3.992	$Y^{-} \neq> E^{-}$	0.000 [1]	10.244	4.394	2.996
$E^{+} \neq> Y^{-}$	2.160 [1]	6.850	3.990	3.006	$Y^{+} \neq> E^{-}$	7.444 [4]	36.104	17.948	11.827
$E^{-} \neq> Y^{+}$	**33.583 [4]**	29.755	15.782	11.573	$Y^{-} \neq> E^{+}$	2.955 [1]	8.924	4.825	3.150
		New Zealand					New Zealand		
$E^{+} \neq> Y^{+}$	**4.237 [1]**	7.948	4.849	3.196	$Y^{+} \neq> E^{+}$	**3.288 [1]**	9.422	4.619	3.219
$E^{-} \neq> Y^{-}$	**9.399 [1]**	19.495	5.207	2.904	$Y^{-} \neq> E^{-}$	0.293 [1]	11.594	4.714	3.244
$E^{+} \neq> Y^{-}$	1.281 [1]	11.524	5.069	3.036	$Y^{+} \neq> E^{-}$	0.236 [1]	9.277	4.426	3.054
$E^{-} \neq> Y^{+}$	0.149 [1]	12.575	5.173	3.318	$Y^{-} \neq> E^{+}$	0.889 [1]	10.597	5.560	3.341

Table 60.4: Asymmetric Granger-causality between PEC and Trade

H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%	H0:	Test Value	BCV at 1%	BCV at 5%	BCV at 10%
PEC≠>Trade		China HKSAR			Trade≠>PEC		China HKSAR		
$E^{+} \neq> T^{+}$	0.964 [1]	9.190	5.243	3.173	$T^{+} \neq> E^{+}$	0.129 [1]	9.510	4.895	3.302
$E^{-} \neq> T^{-}$	**19.14 [1]**	15.487	5.482	3.163	$T^{-} \neq> E^{-}$	0.013 [1]	12.647	4.499	2.947
$E^{+} \neq> T^{-}$	2.073 [1]	7.394	4.520	2.947	$T^{+} \neq> E^{-}$	1.063 [1]	11.365	4.466	2.975
$E^{-} \neq> T^{+}$	0.640 [1]	10.525	4.637	2.865	$T^{-} \neq> E^{+}$	0.576 [1]	10.235	5.166	3.116
		India					India		
$E^{+} \neq> T^{+}$	1.191 [1]	8.353	4.324	3.017	$T^{+} \neq> E^{+}$	0.121 [1]	11.137	5.290	3.416
$E^{-} \neq> T^{-}$	1.776 [1]	13.827	4.787	2.902	$T^{-} \neq> E^{-}$	0.001 [1]	8.829	4.129	2.750
$E^{+} \neq> T^{-}$	3.092 [3]	22.035	11.517	8.737	$T^{+} \neq> E^{-}$	0.565 [4]	39.706	17.582	12.070
$E^{-} \neq> T^{+}$	**21.51 [4]**	40.747	16.325	12.315	$T^{-} \neq> E^{+}$	5.929 [3]	22.723	11.308	8.486
		Philippines					Philippines		
$E^{+} \neq> T^{+}$	0.018 [1]	8.671	4.420	2.880	$T^{+} \neq> E^{+}$	0.001 [1]	8.224	4.443	3.182
$E^{-} \neq> T^{-}$	0.359 [1]	10.065	4.871	3.304	$T^{-} \neq> E^{-}$	**24.52 [1]**	11.059	4.680	2.954
$E^{+} \neq> T^{-}$	1.850 [4]	40.244	19.817	13.774	$T^{+} \neq> E^{-}$	0.833 [4]	28.034	14.527	10.653
$E^{-} \neq> T^{+}$	**18.16 [4]**	36.003	17.834	12.244	$T^{-} \neq> E^{+}$	**14.16 [4]**	30.416	16.042	11.110
		Singapore					Singapore		
$E^{+} \neq> T^{+}$	4.076 [3]	38.344	19.677	12.669	$T^{+} \neq> E^{+}$	1.280 [3]	51.590	19.038	13.330
$E^{-} \neq> T^{-}$	31.78 [4]	11373	777.15	176.64	$T^{-} \neq> E^{-}$	**583.49 [4]**	13582.60	801.73	176.23
$E^{+} \neq> T^{-}$	0.367 [1]	11.791	5.106	3.304	$T^{+} \neq> E^{-}$	4.450 [4]	26554.23	1062.7	244.06
$E^{-} \neq> T^{+}$	6.352 [4]	9306.2	524.22	139.33	$T^{-} \neq> E^{+}$	0.146 [1]	11.833	5.428	3.520

4.5 Results from the hidden cointegration approach

In the final step of our time series analysis, we utilized hidden cointegration approach in order to capture the observed asymmetry in the TY asymmetric causality test. We first consider the popular choice of zero for the threshold and apply formulae in Equations (3.30) and (3.31). The figures-1B and 2B displayed in the Appendix-B[50] show the cumulated positive and negative components for HYD electricity consumption and real GDP, respectively, at zero threshold value. These figures show that the cumulated positive components are monotonically increasing while the cumulated negative components are monotonically decreasing over time, suggesting that there are sufficient variations of both the positive and negative shocks around the threshold value of zero. This follows from the fact that the case of $\eta_j = \eta_i^+$ or $\eta_j = 0$ (respectively $\zeta_j = \zeta_i^+$ or $\zeta_j = 0$) is excluded for all $j \in K$ as recommended by Granger and Yoon (2002, p.7). Thus, the popular choice of zero for the threshold is apparently supported by the data of HYD electricity consumption and real GDP for all the countries under study. This also holds good for all other cases analysed. The criterion that determines the threshold value based on the maximized sum of correlations between $\{\Delta G_t^+, \Delta E_t^+\}$ and $\{\Delta G_t^-, \Delta E_t^-\}$ corroborates our choice of zero. We do not impose a common threshold on G_t and E_t. Rather, we search for the threshold over $\delta_G \in [-0.2, 0.2]$ for G_t and over $\delta_E \in [-0.2, 0.2]$ for E_t with an increment of 0.001 in each case. The tables from 61.4 to 75.4 report the results of threshold values. The table-61.4 reports the results of threshold values for GDP and CO_2 emissions, and Trade and CO_2 emissions.

In the column 2 of Table-61.4, we find that the threshold values of C_t (CO_2 emissions)

[50]Please note that in Appendix-B we give plots of only once case of the total cases analysed just to save space. Results are available upon demand.

for all countries are approximately zero except South Korea. In column 3, the threshold values of G_t (GDP) for all countries are approximately zero. Similar results hold for column 7 which presents the threshold values for T_t (Trade). However, column-6, which presents the threshold values of C_t, for the countries, namely, China, India, and South Korea, the threshold values are not approximately zero. However, by setting the threshold value of zero for the countries where evidence shows that it is not approximately zero, we find that the sum of correlations marginally decreases. Hence, setting the threshold value equal to zero is still admissible for these countries.

Table 61.4: Threshold table- Estimated threshold values for real GDP, CO_2 emissions, and Trade

GDP and CO_2 emissions				Trade and CO_2 emissions			
Country	δ_C	δ_G	Maximum sum of correlation	Country	δ_C	δ_T	Maximum sum of correlation
Bangladesh	-0.001	0	0.788562	Bangladesh	-0.001	-0.006	0.75642
China	-0.017	-0.031	1.262098	China	**0.151**	0	0.848144
China HKSAR	-0.004	-0.003	1.098531	China HKSAR	-0.004	-0.005	0.976936
India	-0.012	-0.006	0.722105	India	**0.103**	-0.003	0.251094
Indonesia	-0.008	-0.005	1.246981	Indonesia	-0.027	-0.003	0.576807
Japan	-0.001	0	1.027499	Japan	-0.001	-0.2	0.906303
Malaysia	-0.003	-0.015	1.410827	Malaysia	-0.003	-0.037	0.90573
New Zealand	-0.001	-0.003	1.203364	New Zealand	-0.08	-0.2	1.037585
Pakistan	-0.002	0	1.281507	Pakistan	-0.002	-0.005	1.005978
Philippines	-0.004	-0.002	1.239341	Philippines	-0.004	-0.006	1.004513
Singapore	-0.002	-0.007	0.914034	Singapore	-0.002	-0.002	0.954523
South Korea	**-0.103**	-0.03	**1.187151**	South Korea	**-0.103**	0.009	0.524287
Taiwan	-0.001	-0.007	1.443737				
Thailand	-0.01	-0.024	1.169308	Thailand	-0.01	-0.001	1.089981

Table-62.4 reports the results of threshold values for GDP and Coal consumption, and Trade and Coal consumption. The results reported for the threshold values in Table-62.4 show that threshold values of G_t (see column-3) and C_t (Coal consumption) (see column-2) for all countries are approximately zero. Similar results are also observed for threshold values of C_t (see column-6) and T_t (see column-7) with exception of two countries. In case of China, for C_t, the threshold value is 0.16 and in case of Japan, for T_t the threshold value is -0.2. However, by setting the threshold value of zero for these two countries we find that the sum of correlations marginally decreases. Hence, we moved ahead for further analysis with the zero threshold value in this case too.

Table 62.4: Threshold table- Estimated threshold values for real GDP, Coal, and Trade

GDP and coal				Trade and Coal			
Country	δ_C	δ_G	Maximum sum of correlation	Country	δ_C	δ_T	Maximum sum of correlation
Bangladesh	-0.054	-0.003	1.036059	Bangladesh	-0.04	-0.006	0.909226
China	-0.007	-0.031	1.300339	China	**0.164**	0	0.785125
India	-0.002	-0.006	0.880845	India	-0.002	-0.004	0.553852
Indonesia	-0.007	0.014	0.618827	Indonesia	-0.007	-0.003	0.448388
Japan	0	0	0.937624	Japan	0	**-0.2**	0.661303
New Zealand	-0.013	-0.003	1.06035	New Zealand	-0.013	0.009	0.793112
Pakistan	-0.006	0	1.11773	Pakistan	-0.006	-0.005	0.891704
Philippines	-0.002	-0.002	0.46251	Philippines	-0.029	-0.006	0.532409
South Korea	-0.004	-0.03	0.733784	South Korea	-0.004	0.003	0.082399
Taiwan	-0.005	-0.007	0.925163	Taiwan			
Thailand	-0.014	-0.024	0.918983	Thailand	-0.014	-0.019	1.149783

Table 63.4: Threshold table- Estimated threshold values for real GDP, ELEP, and Trade

GDP and ELEP				Trade and ELEP			
Country	δ_E	δ_G	Maximum sum of correlation	Country	δ_E	δ_T	Maximum sum of correlation
Bangladesh	-0.02	-0.056	1.15906	Bangladesh	-0.2	-0.006	-0.07477
China	**0.151**	-0.031	0.948779	China	**0.151**	0	0.981502
China HKSAR	-0.012	**0.14**	0.777887	China HKSAR	-0.024	-0.005	0.880724
India	-0.2	-0.006	0.633168	India	0.025	**0.187**	0.404712
Indonesia	**-0.159**	-0.005	0.842138	Indonesia	0.034	0.099	0.441127
Japan	-0.002	0	1.286981	Japan	-0.002	0.023	0.873221
Malaysia	-0.001	-0.015	1.199657	Malaysia	-0.001	-0.008	1.035969
New Zealand	-0.006	0.001	0.958664	New Zealand	-0.008	-0.2	0.563154
Pakistan	-0.027	0	1.157903	Pakistan	-0.027	-0.006	1.110214
Philippines	-0.003	-0.002	1.035988	Philippines	**-0.2**	-0.006	0.389676
South Korea	-0.027	-0.03	1.391193	South Korea	-0.027	0.009	0.777206
Thailand	0	-0.024	1.306763	Thailand	0	-0.013	0.956792

Table-63.4 reports the results of threshold values for G_t and ELEP (E_t), and T_t and E_t. In column 2 of Table-63.4, we find that the threshold value of E_t for all the countries are approximately zero except China and Indonesia. In column 3, the threshold values of G_t for all countries are approximately zero except China HKSAR. Similarly, for E_t in column 6, the threshold values are approximately zero for all countries except China and Philippines, and for T_t, in column-7, the threshold values are approximately zero except for India. However, setting the threshold value of zero for these countries have considerably reduced the sum of correlations and, therefore, we continue our further estimation with the zero threshold value.

Table-64.4 reports the results of the threshold values for GDP and ELEP-Coal, and Trade and ELEP-Coal. In columns 2, 3 and 7 of Table-64.4, we find that the threshold values of C_t (ELEP-Coal), G_t, and T_t for all the countries are approximately zero. However, in column 6 we find that, except China and Pakistan, for all countries the threshold values are approximately zero. Here, for China we do not find that setting of zero threshold values reduces the maximum sum of correlation, but still in order to compare our results we continue with the zero value of threshold.

Table 64.4: Threshold table- Estimated threshold values for real GDP, ELEP-Coal, and Trade

GDP and ELEP-Coal				Trade and ELEP-Coal			
Country	δ_C	δ_G	Maximum sum of correlation	Country	δ_C	δ_T	Maximum sum of correlation
China	0	-0.031	1.284043	China	**0.176**	0	0.779267
ChinaHKSAR	-0.097	-0.002	0.730901	ChinaHKSAR	-0.016	-0.005	1.02886
India	-0.019	-0.006	0.801219	India	-0.019	0.005	0.584171
Japan	-0.007	0	0.699603	Indonesia	0.038	-0.003	0.647252
New Zealand	-0.028	0.001	1.279619	Japan	-0.001	-0.003	0.437229
Pakistan	0.08	0	0.497417	New Zealand	-0.028	0.011	0.861934
Philippines	-0.059	0.006	0.521075	Pakistan	**-0.117**	-0.006	0.726053
South Korea	-0.2	-0.03	0.411115	Philippines	-0.059	0.009	0.324499
Thailand	0.016	-0.024	0.976375	South Korea	0.01	0.019	0.499232
				Thailand	0.016	-0.013	0.561067

Table-65.4 reports the results of the threshold values for GDP and ELEP-HYD, and Trade and ELEP-HYD. The columns 2, 3, 6 and 7 show that for all variables and all countries, the threshold values are approximately zero. Table-66.4 reports the results of threshold values for GDP and ELEP-NG, and Trade and ELEP-NG. In column 2 of Table-66.4, we find that the threshold value of E_t (ELEP-NG) for Bangladesh, Indonesia and Thailand are not approximately zero. In column 3, the threshold values of G_t for Bangladesh, China and Japan are not approximately zero. Similarly, column 7 which presents threshold values for the T_t shows that the threshold value is not approximately zero only for Thailand, and column-6 which presents threshold values for E_t shows that the threshold value is not approximately zero only for Indonesia. Though we find that the maximum sum of correlations for Bangladesh does not decrease, we still continue with zero threshold value for the purpose of comparison.

Table-67.4 reports the results of the threshold values for GDP and ELEP-NU, and Trade and ELEP-NU. The columns 2, 3, 6 and 7 show that for all variables and all countries the threshold values are approximately zero, with the exception of Pakistan in column 2. Table-68.4 reports the results of the threshold values for GDP (G_t) and ELEP-Oil (E_t), and Trade (T_t) and ELEP-Oil. The columns 2, 3 and 6 of Table-68.4 show that the threshold values of all countries for E_t and GDP are approximately zero, with the exception of New Zealand (in columns 2 and 6). The results for the threshold values reported in column-7 show that for China HKSAR and India the threshold values for T_t are not approximately zero. However, in this case, the use of zero threshold values marginally reduces the sum of correlations.

Table 65.4: Threshold table- Estimated threshold values for real GDP, ELEP-HYD, and Trade

GDP and ELEP-HYD				Trade and ELEP-HYD			
Country	δ_E	δ_G	Maximum sum of correlation	Country	δ_E	δ_T	Maximum sum of correlation
Bangladesh	-0.006	0	0.540127	Bangladesh	-0.2	-0.006	0.326857
China	-0.012	-0.031	0.815642	China	-0.012	0	0.787976
India	-0.01	-0.006	1.246912	India	-0.01	0.002	0.746256
Indonesia	-0.012	-0.2	0.438181	Indonesia	-0.064	-0.003	0.811931
Japan	-0.019	0	0.702087	Japan	-0.016	-0.003	0.773268
Malaysia	0	-0.015	0.837118	Malaysia	0	-0.008	1.09043
New Zealand	-0.004	-0.003	0.89029	New Zealand	-0.004	-0.025	0.962423
Pakistan	-0.002	0	1.116134	Pakistan	-0.002	0.003	1.261852
Philippines	-0.2	-0.002	0.391332	Philippines	-0.2	-0.006	0.386279
South Korea	-0.028	-0.03	0.473997	South Korea	-0.028	0.056	0.551576
Thailand	-0.001	-0.024	0.868396	Thailand	0.005	-0.02	0.811226

Table 66.4: Threshold table- Estimated threshold values for real GDP, ELEP-NG, and Trade

GDP and ELEP-NG				Trade and ELEP-NG			
Country	δ_E	δ_G	Maximum sum of correlation	Country	δ_E	δ_T	Maximum sum of correlation
Bangladesh	**-0.126**	**-0.159**	1.100419	Bangladesh	0.035	-0.024	0.213346
China	-0.05	**-0.2**	0.873922	China	-0.05	0	0.914538
India	-0.054	0.013	0.943793	India	-0.054	0.012	0.760608
Indonesia	**-0.18**	-0.005	0.458935	Indonesia	**-0.2**	-0.049	0.592853
Japan	-0.001	**0.118**	0.439073	Japan	-0.001	-0.003	0.415278
Malaysia	-0.013	-0.017	0.679152	Malaysia	-0.013	-0.008	0.522781
New Zealand	-0.009	-0.003	0.691304	New Zealand	0.024	0.061	0.543421
Pakistan	-0.02	0	0.891838	Pakistan	-0.02	-0.006	0.904863
Thailand	**-0.2**	-0.024	0.468839	South Korea	0.018	-0.081	0.873914
				Thailand	-0.039	**-0.16**	0.312091

Table 67.4: Threshold table- Estimated threshold values for real GDP, ELEP-NU, and Trade

GDP and ELEP-NU				Trade and ELEP-NU			
Country	δ_E	δ_G	Maximum sum of correlation	Country	δ_E	δ_T	Maximum sum of correlation
India	-0.004	0.011	1.00737	India	0.038	-0.004	0.686339
Japan	-0.004	0	0.604356	Japan	0.024	0.049	0.541465
Pakistan	**-0.157**	0	0.396907	Pakistan	0.012	-0.006	0.214749
South Korea	0.02	-0.03	0.669431	South Korea	0.009	0.039	0.434529

Table 68.4: Threshold table- Estmated threshold values for real GDP, ELEP-Oil, and Trade

GDP and ELEP-Oil				Trade and ELEP-Oil			
Country	δ_E	δ_G	Maximum sum of correlation	Country	δ_E	δ_T	Maximum sum of correlation
Bangladesh	-0.043	0	0.910809	Bangladesh	-0.043	0.008	0.706044
China	-0.024	0.013	0.254529	China	-0.024	0	1.336416
ChinaHKSAR	-0.033	0.012	0.639819	ChinaHKSAR	-0.013	**0.128**	0.672852
India	-0.019	-0.006	0.225164	India	-0.003	**-0.2**	0.64014
Indonesia	-0.022	-0.005	0.902654	Indonesia	0.056	-0.003	0.656602
Japan	-0.007	0	1.197877	Japan	0.004	0.02	1.007131
Malaysia	-0.014	-0.015	1.076048	Malaysia	-0.014	0.004	0.693185
New Zealand	**-0.2**	-0.003	0.432885	New Zealand	**-0.2**	0	0.216708
Pakistan	-0.03	0	0.648285	Pakistan	-0.03	0.003	0.215294
Philippines	-0.005	-0.002	1.090887	Philippines	-0.051	-0.006	0.981498
Singapore	-0.033	-0.007	1.542623	Singapore	-0.067	-0.002	1.176011
South Korea	-0.009	-0.03	0.868628	South Korea	-0.009	0.009	0.650679
Thailand	-0.011	-0.024	1.32248	Thailand	-0.011	-0.013	1.242416

Table 69.4: Threshold table- Estimated threshold values for real GDP, ELEP-Rene, and Trade

GDP and ELEP-Rene				Trade and ELEP-Rene			
Country	δ_E	δ_G	Maximum sum of correlation	Country	δ_E	δ_T	Maximum sum of correlation
Bangladesh	-0.006	0	0.540127	Bangladesh	-0.027	-0.006	0.0759
China	-0.012	-0.031	0.828245	China	-0.012	0	0.820619
India	-0.009	-0.006	1.275946	India	-0.009	0.002	0.702627
Indonesia	-0.013	-0.005	0.547615	Indonesia	-0.016	-0.003	0.781797
Japan	-0.001	0	0.629698	Japan	-0.002	-0.003	0.746157
Malaysia	0	-0.015	0.836975	Malaysia	0	-0.008	1.09036
New Zealand	-0.013	-0.003	0.963059	New Zealand	0	-0.025	0.854806
Pakistan	-0.002	0	1.116134	Pakistan	-0.002	0.003	1.261852
Philippines	-0.015	-0.002	0.763711	Philippines	-0.015	-0.006	0.889115
South Korea	-0.008	-0.03	0.387118	South Korea	-0.008	0.056	0.466897
Thailand	-0.028	-0.024	0.846233	Thailand	-0.028	-0.02	0.768058

Table 70.4: Threshold table- Estimated threshold values for real GDP, EPC, and Trade

GDP and EPC				Trade and EPC			
Country	δ_E	δ_G	Maximum sum of correlation	Country	δ_E	δ_T	Maximum sum of correlation
Bangladesh	-0.016	0	1.017199	Bangladesh	**-0.2**	-0.006	-0.08606
China	-0.008	-0.031	1.244886	China	**0.152**	0	0.973984
China HKSAR	**0.183**	0	0.936497	China HKSAR	**-0.2**	-0.005	0.456681
India	-0.001	-0.006	1.17601	India	**-0.2**	0.002	0.3859
Indonesia	0	-0.005	0.914564	Indonesia	**-0.156**	0.099	0.390475
Japan	-0.2	0	0.299441	Japan	0	-0.003	1.076207
Malaysia	-0.007	-0.015	1.140357	Malaysia	-0.007	-0.008	0.903046
New Zealand	-0.2	-0.003	0.415283	New Zealand	-0.001	0	0.810349
Pakistan	-0.008	0.004	1.397472	Pakistan	-0.008	-0.006	1.095189
Philippines	-0.003	-0.002	1.219311	Philippines	-0.003	0.017	0.821626
Singapore	0	-0.007	1.730623	Singapore	0	-0.002	1.125815
South Korea	-0.047	-0.03	1.425519	South Korea	-0.047	0	0.996355
Thailand	-0.001	-0.024	1.304327	Thailand	-0.001	-0.013	1.049618

Table-69.4 reports the results of threshold values for GDP and ELEP-Rene, and Trade and ELEP-Rene. The columns 2, 3, 6 and 7 show that for all variables and all countries the threshold values are approximately zero. Table-70.4 reports the results of threshold values for GDP (G_t) and EPC (E_t), and Trade (T_t) and EPC (E_t). In columns 2, 3 and 7 of Table 70.4, we find that the threshold value of E_t for all countries is approximately zero, except China

HKSAR in column 2. However, in column 6 we find that in Bangladesh, China, China HKSAR, India and Indonesia, the threshold values of E_t are not approximately zero. However, the maximum sum of correlation of all countries decreases if the threshold values are set equal to zero. Thus, we keep zero threshold level in our further analysis.

Table 71.4: Threshold table- Estimated threshold values for real GDP, EU, and Trade

GDP and EU				Trade and EU			
Country	δ_E	δ_G	Maximum sum of correlation	Country	δ_E	δ_T	Maximum sum of correlation
Bangladesh	-0.002	0	1.033966	Bangladesh	-0.002	0.008	0.878417
China	-0.007	-0.031	1.005917	China	0.004	0	1.098993
China HKSAR	-0.004	-0.2	0.348646	China HKSAR	-0.004	-0.021	0.59578
India	0.074	-0.006	0.864082	India	0.074	-0.004	0.429571
Indonesia	-0.003	-0.005	1.040945	Indonesia	0.006	0.17	0.219474
Japan	0	0	1.183022	Japan	0	**-0.2**	0.882546
Malaysia	-0.002	-0.015	1.531748	Malaysia	-0.002	-0.008	1.182372
New Zealand	-0.002	-0.003	1.20466	New Zealand	-0.005	0.061	0.329526
Pakistan	-0.001	0	1.276228	Pakistan	-0.001	-0.015	0.829569
Philippines	-0.001	-0.002	1.087572	Philippines	0.005	0.017	1.237531
Singapore	0	-0.007	1.224191	Singapore	0	-0.002	0.683009
South Korea	-0.033	-0.03	1.308059	South Korea	-0.033	0.009	0.617572
Thailand	-0.005	-0.024	1.314189	Thailand	-0.005	-0.013	1.019311

Table-71.4 reports the results of threshold values for GDP and EU, and Trade and EU. The columns 2, 3, 6 and 7 show that for all variables and all countries, the threshold values are approximately zero, with the exception of Japan in column 7. Table-72.4 reports the results of threshold values for GDP and HYD, and Trade and HYD. The columns 2, 3, 6 and 7 show that for all variables and all countries, the threshold values are approximately zero, with the exception of Bangladesh and Indonesia in column 2.

Table-73.4 reports the results of threshold values for GDP and NG, and Trade and NG. The columns 2, 3, 6 and 7 show that for all variables and all countries, the threshold values are approximately zero, with the only exception of Bangladesh in columns 2 and 6. Table-74.4 reports the results of threshold values for GDP and NU, and Trade and NU. The columns 2, 3, 6 and 7 show that for all variables and all countries, the threshold values are approximately zero, with the only exception of Japan in column 2.

Table 72.4: Threshold table- Estimated threshold values for real GDP, HYD, and Trade

GDP and HYD				Trade and HYD			
Country	δ_E	δ_G	Maximum sum of correlation	Country	δ_E	δ_T	Maximum sum of correlation
Bangladesh	-0.006	**-0.2**	0.246193	Bangladesh	-0.027	-0.024	0.418814
China	-0.013	-0.031	1.094786	China	-0.013	0	0.832621
India	-0.016	-0.006	1.238761	India	-0.016	0.002	0.851152
Indonesia	-0.001	**-0.2**	0.233852	Indonesia	-0.088	-0.003	0.529688
Japan	0.003	0	0.826313	Japan	0	-0.003	0.399129
Malaysia	-0.01	-0.015	0.780379	Malaysia	-0.014	-0.028	0.708268
New Zealand	-0.007	-0.003	0.963459	New Zealand	-0.007	-0.025	1.002331
Pakistan	-0.016	-0.001	0.729014	Pakistan	-0.016	-0.005	0.912417
Philippines	-0.003	-0.002	0.5696	Philippines	-0.003	-0.006	0.977193
South Korea	-0.023	-0.03	0.643775	South Korea	-0.026	-0.2	0.690167
Taiwan	-0.001	-0.021	0.711198	Thailand	-0.002	-0.02	0.879903
Thailand	-0.002	-0.024	0.874257				

Table 73.4: Threshold table- Estimated threshold values for real GDP, NG, and Trade

GDP and NG				Trade and NG			
Country	δ_E	δ_G	Maximum sum of correlation	Country	δ_E	δ_T	Maximum sum of correlation
Bangladesh	**-0.2**	0	0.50413	Bangladesh	**-0.2**	-0.006	-0.04161
China	0	-0.031	1.089884	China	0	0	1.047744
India	-0.002	-0.006	0.478999	India	-0.002	-0.003	0.438473
Indonesia	-0.001	-0.005	0.501106	Indonesia	-0.051	-0.003	0.184913
Japan	0.001	0	0.725296	Japan	-0.069	-0.2	0.756872
Malaysia	0.01	-0.017	0.882616	Malaysia	-0.002	0.098	0.438289
New Zealand	-0.034	-0.003	0.729061	New Zealand	-0.05	0.061	0.432533
Pakistan	-0.002	0	1.095493	Pakistan	-0.002	-0.005	0.662595
Taiwan	0.012	-0.007	0.956825	South Korea	-0.032	-0.081	0.873621

Table 74.4: Threshold table- Estimated threshold values for real GDP, NU, and Trade

GDP and NU				Trade and NU			
Country	δ_E	δ_G	Maximum sum of correlation	Country	δ_E	δ_T	Maximum sum of correlation
India	-0.01	0.011	1.072552	India	-0.01	-0.003	0.719722
Japan	**-0.2**	0	0.442545	Japan	-0.019	0.049	0.580802
Taiwan	0.001	-0.021	0.848056	Thailand	-0.081	-0.08	0.722671
Thailand	-0.081	0.01	0.822223				

Table 75.4: Threshold table- Estimated threshold values for real GDP, PEC, and Trade

GDP and PEC				Trade and PEC			
Country	δ_E	δ_G	Maximum sum of correlation	Country	δ_E	δ_T	Maximum sum of correlation
Bangladesh	0	0	0.4064	Bangladesh	0	-0.031	0.487749
China	-0.015	-0.031	1.268791	China	**0.154**	0	0.859358
ChinaHKSAR	-0.004	-0.003	1.066545	ChinaHKSAR	-0.004	-0.005	0.944385
India	-0.003	-0.006	0.815994	India	**0.103**	-0.003	0.229707
Indonesia	0	-0.005	1.102931	Indonesia	-0.047	-0.003	0.466452
Japan	**0.146**	0	1.063672	Japan	-0.002	**-0.2**	0.917069
Malaysia	0	-0.015	1.364521	Malaysia	0	**-0.11**	0.861306
New Zealand	-0.001	-0.003	0.785806	New Zealand	-0.001	-0.025	0.978936
Pakistan	-0.004	0	1.368448	Pakistan	-0.004	-0.005	1.059631
Philippines	-0.004	-0.002	1.297956	Philippines	-0.004	-0.006	1.068287
Singapore	-0.002	-0.007	0.914629	Singapore	-0.002	-0.002	0.96482
South Korea	-0.08	-0.03	1.208338	South Korea	-0.08	0.009	0.566369
Taiwan	-0.024	-0.007	1.504976	Thailand	-0.053	-0.001	0.938814
Thailand	-0.053	-0.024	1.096834				

Table-75.4 reports the results of threshold values for GDP (G_t) and PEC_t, and Trade and PEC_t. In column 2 of Table 75.4, we find that the threshold value of PEC_t for all the countries are approximately zero, with the only exception of Japan. In column 3, the threshold values of G_t for all countries are approximately zero. In column 7, we find that the threshold values are not approximately zero for only Japan and Malaysia. Similarly, in column 6, we find that the threshold values are not approximately zero for only China and India.

Thus, our whole findings from the threshold estimation analysis show that for most of the countries and in almost all combinations of the variables, the choice of zero threshold value is admissible. However, there are some exceptional cases, where, empirically zero threshold values are not found; the use of zero thresholds is found to reduce the maximum sum of correlation. Therefore, we proceeded with zero threshold value in our further analysis. Another reason to use zero thresholds is to compare results in those countries where we do not find that the maximum sum of correlations is reduced due to its use.

In estimating our model, we first determine the optimal lag length to be used in the unit root tests. In each case, we select the optimal lag length based on the Modified Akaike Information Criterion (MAIC). We next determine the order of integration of each of the derived cumulated components. The Appendix-C presents the unit root results of the derived cumulated components for each pair of the variable. Table-1C presents the unit root results for the level as well as first difference data for GDP and CO_2 emissions. Table-2C presents unit root results for level as well as first difference data for Trade and CO_2 emissions. Table-1C shows that GDP and CO_2 emissions are level non-stationary for all countries and for both positive and negative components, except for China, which is level stationary for negative components of both variables, and Japan, which is level stationary for a negative component of GDP. The unit root results on the first difference data show that for all countries, both components of both variables are stationary as a null hypothesis of unit root is rejected by at least one of three tests utilized in the present context, with the only exception of Japan for positive components of both variables.

It is evident from the results reported in Table-2C that the Trade and CO_2 emissions are level non-stationary for all countries, and for both positive and negative components, except in China for both components of CO_2 emissions, in Pakistan for a positive component of Trade, and in Singapore for both components of the trade. First difference results show that in all countries for both components of both variable data is stationary as a null hypothesis of unit root is rejected by at least one of three tests utilized in the present context except in Bangladesh, New Zealand and South Korea for negative components of Trade, and in Japan for a positive component of CO_2 emissions.

Table-3C reports the results of unit root analysis for level and first difference data for GDP and Coal. We find from the results that both components of all series are level non-stationary and first difference stationary with two exceptions in each case. For the level data, G^- and $Coal^+$ are stationary in China. However, for the first difference data, DG^+ in Japan, and $DCoal^+$ in Taiwan are nonstationary variables.

Table-4C reports the results of unit root analysis for level and first difference data for Trade and Coal. From Table-4C, we find that both components of all series are level nonstationary and first difference stationary with some exceptions in each case. For the level data, $Coal^+$ in China, $Coal^-$ in New Zealand, and T^+ in Pakistan are stationary. However, in the first difference data, DT^- and $DCoal^-$ in New Zealand, and DT^- in South Korea are nonstationary variables.

Table-5C reports the results of unit root analysis for level and first difference data for GDP and ELEP. We find that both components of all series are level nonstationary and first difference stationary with some exceptions in each case. With the level data, in Japan G^+ and G^-, in Malaysia E^-, and in Philippines E^+ are stationary. However, in the first difference data, in Japan DG^+ and DE^+, in Malaysia and Pakistan DE^+, and in Thailand DG^+ are nonstationary.

Table-6C reports the results of unit root analysis for level and first difference data for Trade and ELEP. The cases where level data is stationary are: China for E^+; Indonesia, Japan and Thailand for T^-; and New Zealand for T^+ and E^-. Moreover, in all the other cases, level data is non-stationary. The cases where first difference data are non-stationary are Malaysia and Pakistan for DE^+, New Zealand for DT^- and DE^+, and South Korea for DT^-. In all the other cases, the first difference data is stationary. Table-7C reports the results of unit root analysis for level and first difference data for GDP and ELEP-Coal. The evidence of stationarity in the level form of the data is found in China and New Zealand for ELEP-Coal$^+$; in India for both components of ELEP-Coal; and in Japan for ELEP-Coal$^-$, and for all the other cases we find that data is non-stationary. Further, we find evidence that first difference data are non-stationary only in Thailand for DG^+, and data were stationary for the remaining cases.

Table-8C reports the results of unit root analysis for level and first difference data for Trade and ELEP-Coal. The evidence of stationarity cases, for level data, are found in China for both components of Trade, and E^+; in India and Japan for T^- and E^+; and in Thailand for T^- and in all other cases data is level non-stationary. Further, for first difference data we do not find evidence of stationarity only in New Zealand and South Korea for DT^-, and is evident in all other cases.

Table-9C reports the results of unit root analysis for level and first difference data for GDP and ELEP-HYD. The evidence of stationarity in the level form of the data is found only in India and Japan for E^+, and in all other cases, we find that data is non-stationary. Further, in case of first differenced data, we find the evidence of non-stationary only in Japan and Thailand for DG^{+}, the data were found to be stationary for remaining cases.

Table-10C reports the results of unit root analysis for level and first difference data for Trade and ELEP-HYD. The evidence of stationarity cases, for level data, was found in Bangladesh, Indonesia and Thailand for T^{-}; in India and Japan for T^{-} and E^{+}; and in New Zealand for E^{+}, and for all other cases data is level non-stationary. Further, in first difference we do not find evidence of stationarity only in New Zealand and South Korea for DT^{-}, and is evident in all other cases.

Table-11C reports the results of unit root analysis for level and first difference data for GDP and ELEP-NG. The evidence of stationarity in the level form of the data is found only in India and Pakistan for E^{-}; in Japan for G^{-}; and in New Zealand and Thailand for G^{+}, and for all other cases, we find that data is non-stationary. Further, in case of first differenced data we find the evidence of non-stationary only in Japan and Thailand for DG^{+}, and data were found to be stationary.

Table-12C reports the results of unit root analysis for level and first difference data for Trade and ELEP-NG. The evidence of stationarity cases for level data, are found in Bangladesh, Indonesia, Japan and Thailand for T^{-}; in India for T^{-} and E^{-}; in New Zealand and Pakistan for E^{-}; South Korea for T^{+} and E^{-} , and for all other cases data is level non-stationary. Further, in the first difference form we do not find evidence of stationarity in Bangladesh and New Zealand for DT^{-}, and in South Korea for DT^{-} and DT^{+}, and is evident in all other cases.

Table-13C reports the results of unit root analysis for level and first difference data for GDP and ELEP-NU. The evidence of stationarity, in the level form of the data, is found only in Japan for G^{-}, and that data is non-stationary for all other cases. Further, in case of first differenced data we find the evidence of non-stationary only in Japan and South Korea for DG^+, and data were found to be stationary for the remaining cases.

Table-14C reports the results of unit root analysis for level and first difference data for Trade and ELEP-NU. The evidence of stationarity, for level data, is found only in India and Japan for T^-, and data are level non-stationary for all other cases. Further, in the first difference data we do not find evidence of stationarity only in South Korea for DT^-, and is evident in all other cases.

Table-15C reports the results of unit root analysis for level and first difference data for GDP and ELEP-Oil. The evidence of stationarity in the level form of the data is found only in China for E^- and in Thailand for E^+ and E^-, and for all other cases, we find that the data is non-stationary. Further, in case of first differenced data, we find the evidence of non-stationary only in Japan and Thailand for DG^+, and data were found to be stationary for remaining cases.

Table-16C reports the results of unit root analysis for level and first difference data for Trade and ELEP-Oil. The evidence of stationarity cases, for level data, are found in Bangladesh, Indonesia and Japan for T^-; in China for E^+ and E^-; and in Singapore for T^+ and T^-; and in Thailand for T^-, E^+ and E^-, and for all other cases data is level non-stationary. Further, in the first difference data we do not find evidence of stationarity in China HKSAR for DT^+; in New Zealand and South Korea for DT^-, and is evident in all other cases.

Table-17C reports the results of unit root analysis for level and first difference data for GDP and ELEP-Rene. The evidence of stationarity in the level form of the data is found only in China and Philippines for E^-; in India for E^+; in Japan for G^- and E^-, and in all other cases we find that data is non-stationary. Further, in case of first differenced data we find the evidence of non-stationary only in Japan and Thailand for DG^+, and data were found to be stationary for remaining cases.

Table-18C reports the results of unit root analysis for level and first difference data for trade and ELEP-Rene. The evidence of stationarity, for level data, is found in Bangladesh, Indonesia and Thailand for T^-; in India for T^- and E^+; in New Zealand for E^+; and the Philippines and Japan for E^-, and data is level non-stationary for all other cases. Further, in the first difference data we do not find evidence of stationarity in Bangladesh, New Zealand, and South Korea for DT^-, and it is evident in all other cases.

Table-19C reports the results of unit root analysis for level and first difference data for GDP and ELEP-EPC. The evidence of stationarity in the level form of the data is found only in Bangladesh and Philippines for E^+; in China and Singapore for E^-; and in Japan for G^-, and for all other cases the data was found to be nonstationary. Further, in case of first differenced data we find evidence of non-stationary only in in Japan, South Korea and Thailand for DG^+; Malaysia for DE^+, and data were found to be stationary for remaining cases.

Table-20C reports the results of unit root analysis for level and first difference data for Trade and ELEP-EPC. The evidence of stationarity cases, for level data, are found in Bangladesh, China and Philippines for E^+; in India, Indonesia and Thailand for T^-; in Japan and New Zealand for T^- and E^-; and in Singapore for T^+, T^- and E^-, and for all other cases the data is level non-stationary. Further, in the first difference data we do not find evidence of stationarity in Bangladesh for DT^-; Malaysia and New Zealand for DE^+, and found to be evident in all other cases.

Table-21C reports the results of unit root analysis for level and first difference data for GDP and EU. The evidence of stationarity in the level form of the data is found in China

HKSAR and Pakistan for EU^+; in China for EU^-; in Japan for G^-, and for all other cases we find that data is non-stationary. Further, in case of first differenced data we find the evidence of non-stationary in Japan and Thailand for DG^+, and data were found to be stationary for the remaining cases.

Table-22C reports the results of unit root analysis for level and first difference data for Trade and EU. The evidence of stationarity, for level data, is found in China for EU^-; in China HKSAR and Pakistan for EU^+; in India, Indonesia, and Thailand for T^-; and in Singapore for T^+ and T^-, and for all other cases data is level non-stationary. Further, in the first difference form in Bangladesh, New Zealand, and South Korea for DT^- and in the China HKSAR for DT^+, we do not find evidence of stationarity and for all other cases it is evident.

Table-23C reports the results of unit root analysis for level and first difference data for GDP and NG. The evidence of stationarity in the level form of the data is found only in China and Japan for G^-; and in New Zealand for G^+ and E^- and for all other cases, we find that data is non-stationary. Further, in case of first differenced data only in Japan for DG^+, we find the evidence of non-stationary and for remaining cases; data were found stationary.

Table-24C report results of unit root analysis for level and first difference data for Trade and NG. The evidence of stationarity, for level data, is found in China for E^+ and E^-; in Pakistan for T^+; and in South Korea for T^+ and E^-, and for all other cases data is level non-stationary. Further, in the first difference data in Bangladesh and New Zealand DT^-; in China DE^+ and DE^-; and in South Korea for DT^+ and DT^-, we do not find evidence of stationarity and for all other cases it is evident.

Table-25C report results of unit root analysis for level and first difference data for GDP and NU. The evidence of stationarity in the level form of the data is found only in Japan for G^-

and in Thailand for G^+ and E^- and for all other cases, we find that data is non-stationary. Further, in case of first differenced data only in Japan and Thailand for DG^+, we find the evidence of non-stationary and for remaining cases; data were found to be stationary.

Table-26C report results of unit root analysis for level and first difference data for Trade and NU. The evidence of stationarity cases, for level data, is found in India, Japan and Thailand for T^- and for all other cases data is level non-stationary. In the first difference data for all cases, evidence of stationarity is evident.

Table-27C report results of unit root analysis for level and first difference data for GDP and PEC. The evidence of stationarity in the level form of the data is found only in China for G^- and PEC^-; and in Japan for G^- and for all other cases, we find that data is non-stationary. Further, in case of first differenced data in Indonesia, Japan, and Singapore for DG^+, we find the evidence of non-stationary and for remaining cases; data were found to be stationary.

Table-28C report results of unit root analysis for level and first difference data for Trade and PEC. The evidence of stationarity, for level data, is found in Pakistan for T^+; and in Singapore for T^+ and T^-, and for all other cases data are level non-stationary. Further, in the first difference data in Bangladesh, New Zealand, and South Korea for DT^-, we do not find evidence of stationarity and for all other cases it is evident.

Table-29C report results of unit root analysis for level and first difference data for GDP and HYD. The evidence of stationarity in the level form of the data is found in China for G^-; in India for HYD^+; in Japan for G^-, HYD^+, and HYD^-; in Malaysia and New Zealand for HYD^+; in the Philippines for HYD^-; and in Taiwan for HYD^+ and HYD^- and for all other cases we find that data is non-stationary. Further, in case of first differenced data only in Indonesia and Japan for DG^{+}, we find the evidence of non-stationary and for remaining cases; data were found to be stationary.

Table-30C report results of unit root analysis for level and first difference data for Trade and HYD. The evidence of stationarity cases, for level data, are found in India, Malaysia and New Zealand for HYD^{+}; in Japan for HYD^{+} and HYD^{-}; in Pakistan for T^{-}; and in the Philippines for HYD^{-} and for all other cases data is level non-stationary. Further, in the first difference data for New Zealand and South Korea DT^{-}, we do not find evidence of stationarity and for all other cases it is evident.

Hence, the research and policy implications of our study are that researchers should consider the asymmetries observed in the data in terms of positive and negative shocks. With the inclusion of asymmetry, as observed in the data, for the cases where evidence of stationary is found, one can provide reliable forecast which will be helpful in future policy making related to energy generation and energy consumption.

After examining the cases of stationarity and non-stationarity in the data, we moved to examine the cointegration for the cases where we had evidence that level data is non-stationary and stationary at first difference. To examine the cointegration between the test variables we used two approaches; Granger-Yoon (2002) and the Schorderet (2004) approach. *To do this, we normalize each cointegration relation to the less integrated cumulative component (Ng and Perron, 1997; Maddala and Kim, 1999, p. 157)*. However, in the present elaboration we will present results derived from the former approach only and the results from the later case are presented in the Appendix-D.

Table 76.4: Granger and Yoon's cointegration approach for CO_2, GDP, and Trade

Country	Combination of variables in co-integration space								Combination of variables in co-integration space							
Bangladesh	CO_2 and GDP								CO_2 and trade							
	G+,C+	G+,C-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-	T+,C+	T+,C-	T-,C+	T-,C-	C+,T+	C+,T-	C-,T+	C-,T-
DFG		-3.45			-2.98	-3.77								-3.68		
PP					-19.82	-27.96								-29.38		
MZ						-3.06								-3.29		
China																
	G+,C+	G+,C-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-	T+,C+	T+,C-	T-,C+	T-,C-	C+,T+	C+,T-	C-,T+	C-,T-
DFG		-3.76	-2.95			-4.03		-3.71								
PP		-21.68				-32.58		-28.49						-19.52		
MZ		-3.03				-3.93								-3.01		
China HKSAR																
	G+,C+	G+,C-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-	T+,C+	T+,C-	T-,C+	T-,C-	C+,T+	C+,T-	C-,T+	C-,T-
DFG					-2.96											
PP		-18.42			-17.44											
MZ																
India																
	G+,C+	G+,C-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-	T+,C+	T+,C-	T-,C+	T-,C-	C+,T+	C+,T-	C-,T+	C-,T-
DFG												-3.11				-3.25
PP												-17.8				-23.63
MZ																-3.04
Japan																
	G+,C+	G+,C-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-	T+,C+	T+,C-	T-,C+	T-,C-	C+,T+	C+,T-	C-,T+	C-,T-
DFG																
PP												-205				
MZ												-9.61				
Malaysia																
	G+,C+	G+,C-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-	T+,C+	T+,C-	T-,C+	T-,C-	C+,T+	C+,T-	C-,T+	C-,T-
DFG																
PP							-18.61	-23.25		-34.6						
MZ								-3.06		-3.41						
New Zealand																
	G+,C+	G+,C-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-	T+,C+	T+,C-	T-,C+	T-,C-	C+,T+	C+,T-	C-,T+	C-,T-
DFG									-2.97				-2.93			
PP									-18.54	-167.9			-18.19			
MZ										-8.64						
Pakistan																
	G+,C+	G+,C-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-	T+,C+	T+,C-	T-,C+	T-,C-	C+,T+	C+,T-	C-,T+	C-,T-
DFG									-3.3		-2.93	-4.78				-4.61
PP									-21.82		-18.0	-41.2				-37.87
MZ									-2.99			-4.08				-3.93
Singapore																
	G+,C+	G+,C-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-	T+,C+	T+,C-	T-,C+	T-,C-	C+,T+	C+,T-	C-,T+	C-,T-
DFG									-3.94		-3.89					
PP									-29.57	-20.18	-29.5	-18.0				
MZ									-3.59		-3.59					
South Korea																
	G+,C+	G+,C-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-	T+,C+	T+,C-	T-,C+	T-,C-	C+,T+	C+,T-	C-,T+	C-,T-
DFG										-3.2						
PP																
MZ																

Table-76.4 presents cointegration results between CO_2 emissions and GDP, and CO_2 emissions and Trade for all possible pairs. The results obtained from cointegration analysis between CO_2 emissions and GDP show that Bangladesh has evidence of cointegration for three combinations [(G^+, C^-), (C^+, G^+) and (C^+, G^-)]; China has evidence of cointegration for four pairs[(G^+, C^-), (G^-, C^+), (C^+, G^-) and (C^-, G^-)];China HKSAR has evidence of cointegration for two cases [(G^+, C^-) and (G^+, C^+)]. Only two instances of cointegration are found for Malaysia [(C^-, G^+) and (C^-, G^-)], whereas, for rest of the countries analysed, no evidence of cointegration is found. The results obtained from the cointegration analysis between CO_2 emissions and Trade show the evidence of one cointegration relationship (C^+,T^-) in Bangladesh and China, two cointegration relationships (C^-,T^- and T^-,C^-) in India, one cointegration relationship (C^-,T^-) in Japan, and one cointegration relationship (C^+,T^-) in Malaysia. We find three cointegration relationships (T^+,C^+; T^+,C^-; and C^+,T^+) for New Zealand, whereas, Pakistan shows four cointegration relations (T^+,C^-; T^-,C^+; T^-,C^- and C^-,T^-). Singapore also exhibits four cointegration relationships in all cases when T is dependent and C is explanatory variable. South Korea shows only one cointegration relationship between T^+ and C^-.

Table-77.4 presents cointegration results between Coal and GDP, and Coal and Trade for all possible pairs. Bangladesh shows three and two instances of hidden cointegration between Coal and GDP, and Coal and Trade respectively, whereas, India shows two instances of cointegration between Coal and GDP, and no instance of hidden cointegration between Coal and Trade. Indonesia and Thailand show no instance of cointegration between Coal consumption and GDP, and two instances of hidden cointegration between Coal and Trade; whereas, Japan shows evidence of one hidden cointegration relation between Coal and GDP, and one between Coal and Trade. New Zealand shows two hidden cointegration relations between Coal and GDP, and one instance of hidden cointegration between Coal and Trade. Interestingly, Pakistan shows two hidden cointegration relations between Coal and GDP, and four hidden cointegration relations between Coal and Trade. Philippines shows three hidden cointegration relations between Coal and GDP, and one hidden cointegration relationship between Coal and Trade.

South Korea shows one hidden cointegration relation between Coal and GDP, and two hidden cointegration relations between Coal and Trade.

Table 77.5: Granger and Yoon's cointegration approach for Coal, GDP, and Trade

Country	Combination of variables in co-integration space								Combination of variables in co-integration space							
China																
	G+,C+	G+,C-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-	T+,C+	T+,C-	T-,C+	T-,C-	C+,T+	C+,T-	C-,T+	C-,T-
DFG		-3.39			-3.25	-3.86										-3.34
PP		-17.93			-22.26	-30.94								-18.23		
MZ					-3.26	-3.83								-2.93		
India																
	G+,C+	G+,C-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-	T+,C+	T+,C-	T-,C+	T-,C-	C+,T+	C+,T-	C-,T+	C-,T-
DFG							-3.49	-2.92								
PP							-24.07									
MZ							-3.04									
Indonesia																
	G+,C+	G+,C-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-	T+,C+	T+,C-	T-,C+	T-,C-	C+,T+	C+,T-	C-,T+	C-,T-
DFG												-3.05	-2.94			
PP												-19.3				
MZ																
Japan																
	G+,C+	G+,C-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-	T+,C+	T+,C-	T-,C+	T-,C-	C+,T+	C+,T-	C-,T+	C-,T-
DFG																
PP		-18.37														
MZ												6.32				
New Zealand																
	G+,C+	G+,C-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-	T+,C+	T+,C-	T-,C+	T-,C-	C+,T+	C+,T-	C-,T+	C-,T-
DFG																
PP							-21.87	-23.82								
MZ								-3		7.6						
Pakistan																
	G+,C+	G+,C-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-	T+,C+	T+,C-	T-,C+	T-,C-	C+,T+	C+,T-	C-,T+	C-,T-
DFG		-4.12				-3.48			-2.94			-4.43				-3.48
PP		-31.46				-23.68			-17.93		-18.04	-36.4				-23.43
MZ		-3.82				-3.34						-3.91				-3.13
Philippines																
	G+,C+	G+,C-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-	T+,C+	T+,C-	T-,C+	T-,C-	C+,T+	C+,T-	C-,T+	C-,T-
DFG		-2.97				-3.05						-3.21				
PP				-33.6								-21.2				
MZ				-3.96								-2.94				
South Korea																
	G+,C+	G+,C-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-	T+,C+	T+,C-	T-,C+	T-,C-	C+,T+	C+,T-	C-,T+	C-,T-
DFG							-3.19									-3.06
PP																
MZ										4.61						
Thailand																
	G+,C+	G+,C-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-	T+,C+	T+,C-	T-,C+	T-,C-	C+,T+	C+,T-	C-,T+	C-,T-
DFG												-3.49				-3.13
PP												-28.3				-23.9
MZ												-3.06				

Table 78.4: Granger and Yoon's cointegration ELEP, GDP and Trade

Country	Combination of variables in co-integration space								Combination of variables in co-integration space							
Bangladesh																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG												-3.1				
PP																
MZ																
China HKSAR																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP		-18					-17.3									
MZ																
India																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP										-25.7						
MZ																
Indonesia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG												-2.9				
PP												-18				
MZ																
Japan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3						-3.77						
PP		-18		-20												-31.2
MZ																-3.63
Malaysia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP							-19.2								-22.3	
MZ																
New Zealand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3.2					-3.26			-3.14					-3.01	
PP		-20					-22.7					-54667			-20.1	
MZ		-3					-3.07			3.94		-523				
Pakistan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG									-3.04		-3.18					
PP									-18.5		-19.82					
MZ							-5.01	-4.38			-2.93					-4.39
Philippines																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3.9				-3.8								
PP				-29				-28								
MZ				-3.4				-3.2								
South Korea																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG										-3.08						
PP						-33				-50.3						
MZ						-3.8				-4.19		-8.03				
Thailand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-2.9				-3.1								
PP				-23				-26				-18				
MZ																

Table-78.4 presents cointegration results between ELEP and GDP, and ELEP and Trade for all possible pairs. The Bangladesh, India and Indonesia show one hidden cointegration relation between ELEP and Trade, and the absence of hidden cointegration relation between

ELEP and GDP. In China, no evidence of a hidden cointegration relation is found between GDP and ELEP, and ELEP and Trade, whereas, China HKSAR and Philippines show two hidden cointegration relations between ELEP and GDP, and absence of hidden cointegration relation between ELEP and Trade. Malaysia shows one hidden cointegration relation between GDP and ELEP, and ELEP and Trade, whereas, Japan shows two hidden cointegration relations. New Zealand and Pakistan show two hidden cointegration relations between ELEP and GDP, and three instances of hidden cointegration between ELEP and Trade. South Korea shows one hidden cointegration relation between ELEP and GDP, and two hidden cointegration relations between ELEP and Trade, whereas, Thailand shows two hidden cointegration relations between ELEP and GDP, and one hidden cointegration relation between ELEP and Trade.

Table-79.4 presents cointegration results between ELEP-Coal and GDP, and ELEP-Coal and Trade for all possible pairs. Thailand shows evidence of one hidden cointegration relation between ELEP-Coal and GDP, and ELEP-Coal and Trade; whereas, Pakistan shows absence of the hidden cointegration relationship between ELEP-Coal and GDP, and ELEP-Coal and Trade. China HKSAR, India, New Zealand and the Philippines show evidence of two hidden cointegration relations between ELEP-Coal and GDP, whereas, South Korea shows the absence of any hidden cointegration relationship between ELEP-Coal and GDP. China, Indonesia and Japan show evidence of five hidden cointegration relations between ELEP-Coal and GDP. China HKSAR shows absence of hidden cointegration relationship between ELEP-Coal and Trade, whereas, Philippines shows evidence of one hidden cointegration relationship between ELEP-Coal and Trade. China and South Korea show evidence of two hidden cointegration relations between ELEP-Coal and Trade; Japan shows evidence of five hidden cointegration relations; India, Indonesia, and New Zealand show evidence of four hidden cointegration relations.

Table 79.4: Granger and Yoon's cointegration ELEP-Coal, GDP and Trade

Country	Combination of variables in co-integration space										Combination of variables in co-integration space					
China																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG					-3.61	-4.22							-3.22	-3.28		
PP			-62.7		-25.27	-31.36	-200.2						-18.44	-19.65		
MZ			-5.42	15700	-3.46	-3.83	-9.93							-2.99		
China HKSAR																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG			-3.19	-3.85												
PP			-19.8	-20.13												
MZ																
India																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG							-3.04	-3.48	-2.97						-3.07	
PP										-24.4		-20.4				
MZ																
Indonesia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3.36				-3.49	-3.08					-2.95				-2.95
PP		-32.27		-17.8		-21.96	-19.07	-90.5	-28.31			-17.7				-17.8
MZ		-3.62				-3.17	-3.03	-6.71	-3.61		3.41+E11					
Japan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3.36				-3.49	-3.08			-3.17		-2.99		-3.15		
PP		-32.27		-17.8		-21.96	-19.07	-90.5						-18.39		
MZ		-3.62				-3.17	-3.03	-6.71				5.74		-2.95		
New Zealand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG					-3.09	-3.56							-3.07	-3.24		
PP					-20.2	-25.6				-32.3		-577	-20.9	-22.62		
MZ						-3.07				-3.03		-53.6				
Philippines																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3.32				-3.07				-3.04				
PP				-21.73				-19.7				-19.7				
MZ				-3.19												
South Korea																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP										-83.6		-27.4				
MZ										-5.72						
Thailand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3.17								-3.06						
PP		-19.9								-24.6						
MZ		-2.97								-3.15						

Table-80.4 presents cointegration results between ELEP-HYD and GDP, and ELEP-HYD and Trade for all possible pairs. Bangladesh and the Philippines do not have any hidden cointegration relation between ELEP-HYD and GDP, and ELEP-HYD and Trade; South Korea has two hidden cointegration relations between ELEP-HYD and GDP, and ELEP-HYD and Trade. Indonesia, Malaysia and New Zealand show evidence of two hidden cointegration relations between ELEP-HYD and GDP; China shows three; India shows four; and Japan shows five hidden cointegration relations. Thailand shows absence of the hidden cointegration relationship between ELEP-HYD and GDP. With regards to the hidden cointegration relationships between ELEP-HYD and Trade, China, India and South Korea show two hidden cointegration relations; Indonesia shows one; Thailand shows three; Japan and New Zealand show four hidden cointegration relations.

Table 80.4: Granger and Yoon's cointegration ELEP-HYD, GDP and Trade

Country	Combination of variables in co-integration space								Combination of variables in co-integration space							
China																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3.1				-3.8				-3.2				-3.54
PP							-29.4	-28				-22				-25.3
MZ							-3.59	-3.4				-2.9				-3.07
India																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3	-3.02	-3.1		-3.7					-3.04			
PP				-20		-18		-25				-31				
MZ								-3.1				-3.3				
Indonesia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP				-18				-18				-17				
MZ																
Japan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG						-3.2	-3.53							-3.12		
PP		-19		-19	-17.6	-23	-26.2			-806			-19.3	-21.7		
MZ							-3.08			-19.8		5.14				
Malaysia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3.2				-3								
PP				-20				-18								
MZ																
New Zealand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3		-3.2									-3	-3.08		
PP		-18		-21								18.2	-19.8	-19.8		
MZ				-3.1						4.97		29.3				
South Korea																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG	-3.53				-3.91											
PP	-26				-30.5					-96.7		-1002				
MZ	-3.05				-3.23					-6.11		-224				
Thailand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG										-2.95		-3.6				
PP										-20.6		-31				-34.4
MZ												-3.7				-3.93

Table-81.4 presents cointegration results between ELEP-NG and GDP, and ELEP-NG and Trade for all possible pairs. Indonesia, Malaysia, Pakistan and South Korea show absence of hidden cointegration relation between ELEP-NG and GDP. Bangladesh, China, and Thailand show one hidden cointegration relation between ELEP-NG and GDP, whereas, India, Japan, and New Zealand show two hidden cointegration relations between ELEP-NG and GDP. China shows absence of hidden cointegration relation between ELEP-NG and Trade, whereas, India shows evidence of one hidden cointegration relation between ELEP-NG and Trade. Bangladesh and Japan show two hidden cointegration relations between ELEP-NG and Trade, whereas, Malaysia, Pakistan and South Korea show three hidden cointegration relations between ELEP-NG and Trade. India and Thailand show four hidden cointegration relations between ELEP-NG and Trade.

Table-82.4 presents cointegration results between ELEP-NU and GDP, and ELEP-NU and Trade for all possible pairs. Japan and Pakistan show two hidden cointegration relations between ELEP-NU and GDP. South Korea shows the absence hidden cointegration relationship between ELEP-NU and GDP. India shows four hidden cointegration relation between ELEP-NU and GDP. India and Japan show two hidden cointegration relations between ELEP-NU and Trade, while Pakistan shows absence of hidden cointegration relation; and South Korea shows three hidden cointegration relations.

Table-83.4 presents cointegration results between ELEP-Oil and GDP, and ELEP-Oil and Trade for all possible pairs. China HKSAR, Indonesia and New Zealand show absence of hidden cointegration relations between ELEP-Oil and GDP, and also between ELEP-Oil and Trade. Bangladesh, Pakistan and South Korea show absence of hidden cointegration relation between ELEP-Oil and GDP, and the presence of one cointegration relation between ELEP-Oil and Trade. Malaysia and the Philippines show evidence of one hidden cointegration relation between ELEP-Oil and GDP, and between ELEP-Oil and Trade. Japan shows evidence of one hidden cointegration relation between ELEP-Oil and GDP, and two hidden cointegration relations between ELEP-Oil and Trade. India shows evidence of two hidden cointegration relations between ELEP-Oil and GDP, and three hidden cointegration relations between ELEP-Oil and Trade, whereas, Thailand shows the inverse case. China shows evidence of four hidden cointegration relations between ELEP-Oil and GDP, and between ELEP-Oil and Trade, whereas, Singapore shows evidence of eight hidden cointegration relations between ELEP-Oil nd GDP, and four hidden cointegration relationships between ELEP-Oil and Trade.

Table-84.4 presents cointegration results between ELEP-Rene and GDP, and ELEP-Rene and Trade for all possible pairs. Malaysia, Pakistan, Philippines and South Korea show two hidden cointegration relations between ELEP-Rene and GDP. India, Indonesia, New Zealand and Thailand show three hidden cointegration relations between ELEP-Rene and GDP. Bangladesh, China and Japan show evidence of four hidden cointegration relations between ELEP-Rene and GDP. Bangladesh, Indonesia, Malaysia and Pakistan show absence of hidden cointegration relation between ELEP-Rene and Trade, while, China, India, Philippines, South Korea and Thailand show evidence of two hidden cointegration relations between ELEP-Rene and Trade. Japan shows three and New Zealand shows four hidden cointegration relations between ELEP-Rene and Trade.

Table-85.4 presents cointegration results between EPC and GDP, and EPC and Trade for all possible pairs. China and Malaysia show evidence of two hidden cointegration relations between EPC and GDP, and absence of hidden cointegration relation between EPC and Trade, whereas, the evidence is exactly the opposite for India, Japan and South Korea. Pakistan shows absence of hidden cointegration relation between EPC and GDP, and EPC and Trade. Indonesia shows absence of hidden cointegration relation between EPC and GDP, but the presence of one hidden cointegration between EPC and Trade. China HKSAR and Philippines show evidence of three hidden cointegration relations between EPC and GDP, and absence of hidden cointegration relation between EPC and Trade, while it is the opposite for New Zealand. Bangladesh shows four hidden cointegration relations between EPC and GDP, and one hidden cointegration relation between EPC and Trade. Thailand shows one hidden cointegration relationship between the EPC and Trade, but two hidden cointegration relations between EPC and GDP. Interestingly, Singapore shows five hidden cointegration relations between EPC and GDP, but four hidden cointegration relations between EPC and Trade.

Table-86.4 presents cointegration results between EU and GDP, and EU and Trade for all possible pairs. Bangladesh shows absence of hidden cointegration, but India shows the existence of two hidden cointegration relations between both EU and GDP, and EU and Trade. Indonesia, Japan, New Zealand, Philippines and Thailand show absence of hidden cointegration; Singapore and Malaysia show the existence of two hidden cointegration relations; Pakistan shows existence of one hidden cointegration relation; China shows existence of three hidden cointegration relations; and China HKSAR shows existence of four hidden cointegration relations between EU and GDP. With regards to the cointegration relationship between the EU and Trade, Malaysia shows intone; Indonesia, Pakistan and Philippines shows existence of one hidden cointegration relation; China, China HKSAR, and Japan show the existence of two hidden cointegration relations; New Zealand shows three; Singapore and Thailand show existence of four hidden cointegration relations.

Table 81.4: Granger and Yoon's cointegration ELEP-NG, GDP and Trade

Country	Combination of variables in co-integration space								Combination of variables in co-integration space							
Bangladesh																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG								-5.27				-5.46				-6.08
PP												-40.71				-57.87
MZ												-3.94				-4.76
China																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG	-4.14															
PP	-30.98															
MZ	-3.83															
India																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG							-3.32	-3.3							-3.24	-3.37
PP										-23.76		-21.48				
MZ																
Indonesia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG															-3.23	
PP																
MZ																
Japan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG										-3.31						
PP		-18.7		-20.3												
MZ										4.66		4.29				
Malaysia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG											-2.98				-2.96	
PP										-22.24	-22.94				-18.19	
MZ											-3.03					
New Zealand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG			-2.98					-3.01							-3.73	-3.57
PP			-17.72					-17.48		-51.5		19.41			-19.21	-18.01
MZ										-4.3		149.91				
Pakistan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG											-2.96					
PP											-17.5			-17.65	-21.39	
MZ															-2.97	
South Korea																
									T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG									-3.31							-3.06
PP																-18.1
MZ												4.5				
Thailand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG											-4.19	-2.98			-3.82	
PP							-19.13			-19.9	-32.93	-22.58			-27.05	
MZ											-3.7				-3.31	

Table 82.4: Granger and Yoon's cointegration ELEP-NU, GDP and Trade

Country	Combination of variables in co-integration space								Combination of variables in co-integration space							
India																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG					-3.39		-3.04	-3.66					-3.07			
PP				-17.6	-20.3		-19.82	-25.74				-25.32				
MZ								-3.25								
Japan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP				-32.2												
MZ				-3.71						-6.55		-5.29				
Pakistan																

	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP						-18.84										
MZ																
South Korea																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP										-55.2					-17.77	
MZ										-4.47		-6.8				

Table 83.4: Granger and Yoon's cointegration ELEP-Oil, GDP and Trade

Country	Combination of variables in co-integration space								Combination of variables in co-integration space							
Bangladesh																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG										-2.98						
PP																
MZ																
China																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG	-2.95	-3.4											-2.96	-3.39		
PP		-20					-26.7	-34					-18	-21.8	-80.2	-60.3
MZ							-3.3	-3.7							-6.06	-5.18
India																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG			-3.03				-3.8									
PP			-22.1				-56.8			-23.8		-18			-19.1	
MZ			-3.16				-4.63									
Japan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG										-3.14		-3				
PP		-17														
MZ										5.65						
Malaysia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3.1										-2.92		
PP				-19										-17.5		
MZ																
Pakistan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG												-2.9				
PP																
MZ																
Philippines																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3								-3.5				
PP				-19								-26				
MZ				-3								-3				
Singapore																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG			-3.12	-3.1	-3.41	-3.1	-3.74	-3.6	-3.89		-3.88					
PP	-17.7	-18	-20.2	-27	-24.7	-19	-26.1	-28	-29	-21.9	-29.44	-20				
MZ				-3.4	-3.44	-3	-3.56	-3.7	-3.56		-3.57					
South Korea																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP																
MZ												-2.99				
Thailand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG					-3.31	-3							-3.11			
PP					-20.1	-18		-20					-19.3		-18.8	
MZ					-2.92								-2.98			

Table-87.4 presents cointegration results between HYD and GDP, and HYD and Trade for all possible pairs. Bangladesh and Thailand show absence of hidden cointegration relation between HYD and GDP, and HYD and Trade. Indonesia and Pakistan shows absence of hidden cointegration relationship between HYD and GDP; India and South Korea show presence of one hidden cointegration relation; Malaysia and Philippines show the existence of two hidden cointegration relations; China, New Zealand and Thailand show existence of three hidden cointegration relations; and Japan shows the existence of six hidden cointegration relations. With regard to the hidden cointegration relationships between HYD and Trade, China, Indonesia and Malaysia show existence of one hidden cointegration relation; Philippines shows the presence of two hidden cointegration relations; Pakistan and South Korea show existence of three hidden cointegration relations; India and New Zealand show the existence of four; and Japan shows the existence of five hidden cointegration relations.

Table 84.4: Granger and Yoon's cointegration ELEP-Rene, GDP and Trade

Country	Combination of variables in co-integration space								Combination of variables in co-integration space							
Bangladesh																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG					-3.1	-3.2										
PP					-22	-25	-23.2	-18								
MZ																
China																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3.5												-3.11
PP		-182		-199			-44.9	-36				-18				-20.8
MZ		-9.2		-9.7			-3.61									
India																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3.2			-3.72	-4.3				-3	-2.93			
PP				-28			-30.9	-37				-31				
MZ								-3				-3.3				
Indonesia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP				-20			-20.9	-30								
MZ																
Japan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG					-4.31	-4.7								-2.94		
PP					-46.7	-50	-37	-29		-273				-20.5		
MZ					-3.02	-3.2				-11.3		3.41				
Malaysia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3.3												
PP				-23			-17.4									
MZ																
New Zealand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3		-3.5				-2.9					-3.53	-3.08		
PP		-19		-25				-22		-46824		-19	-25.1	-20.9		
MZ				-3.1						-153		-39.4				
Pakistan																

	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3.2												
PP		-56		-23												
MZ		-4.4														
Philippines																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG							-3.99	-4.3							-3.08	-3.5
PP							-33.3	-38								-22.1
MZ																
South Korea																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG	-3.21															
PP	-23.7				-37.9					-735		-56				
MZ										-18.9		-4.3				
Thailand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG												-3.4				
PP					-21	-21		-19		-18.6		-29				
MZ												-3.5				

Table 85.4: Granger and Yoon's cointegration EPC, GDP and Trade

Country	Combination of variables in co-integration space								Combination of variables in co-integration space							
Bangladesh																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3	-3.23	-3.2		-3						-3.29		
PP																
MZ																
China																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG							-3.97									
PP																
MZ				2.7E+13												
China HKSAR																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3					-3.26	-3.1								
PP		-19					-19.2									
MZ																
India																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP										-27.9		-24				
MZ										-3.04						
Indonesia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG												-2.9				
PP												-18				
MZ																
Japan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP										-24					-20.7	
MZ										-2.93						
Malaysia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG	-3.12															
PP	-19.6			-18												
MZ																
New Zealand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP										-23.5		-678			-27.9	
MZ												-18			-3.42	
Philippines																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3.7				-3.3								
PP				-25		-19		-21								
MZ				-3.2												

Singapore																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3.1							-3.83		-3.95					
PP	-81.5	-20			-39.3		-46.9	-43	-28.1	-20.1	-28.83				-71.8	
MZ	-6.27	-3			-4.35		-4.52	-4.3	-3.5		-3.55				-5.56	
South Korea																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG										-3.59						
PP										-26.1				-19		
MZ										-3.37						
Thailand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3.7				-3.9								
PP				-33				-35				-18				
MZ				-2.9				-3								

Table 86.4: Granger and Yoon's cointegration EU, GDP and Trade

Country	Combination of variables in co-integration space								Combination of variables in co-integration space							
China																
	G+,E+	G+,E-	G-,E-	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG							-3.09	-3.1							-3.25	-3.36
PP						-18	-19.6	-21							-18.4	-18.8
MZ							-2.98	-3.1								
China HKSAR																
	G+,E+	G+,E-	G-,E-	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3.6	-3.75	-3.2		-3.4					-3.84	-3.72		
PP				-27	-28.3	-23		-23					-29.9	-28.8		
MZ				-3.3	-3.56	-3.2		-3.1					-3.67	-3.6		
India																
	G+,E+	G+,E-	G-,E-	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3.5				-4.2								
PP				-29				-36		-18		-23				
MZ								-3.1								
Indonesia																
	G+,E+	G+,E-	G-,E-	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP												-17				
MZ																
Japan																
	G+,E+	G+,E-	G-,E-	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP																
MZ										8.61		2.92				
Malaysia																
	G+,E+	G+,E-	G-,E-	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG					-3.67											
PP	-17.5				-26.9											
MZ					-3.08											
New Zealand																
	G+,E+	G+,E-	G-,E-	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG										-3.17					-3.07	
PP												17.5			-18.5	
MZ										7.68		9.76				
Pakistan																
	G+,E+	G+,E-	G-,E-	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG						-3.1					-2.93					
PP						-18										
MZ																
Philippines																
	G+,E+	G+,E-	G-,E-	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP										-17.5						
MZ																
Singapore																
	G+,E+	G+,E-	G-,E-	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-4				-3.9	-4.14	-3.72	-3.89					
PP				-38				-30	-32.1	-40	-29.42	-23				

MZ				-3.9				-3.5	-3.75	-3.79	-3.57					
South Korea																
	G+,E+	G+,E-	G-,E-	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-4.3				-4.2		-3.35						
PP				-39				-37								
MZ				-3.2				-3.1				-7.86				
Thailand																
	G+,E+	G+,E-	G-,E-	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG									-3.2	-3.85		-3.5				-3.17
PP									-19.1	-32.2		-25				-20.6
MZ										-3.68		-3.1				

Table 87.4: Granger and Yoon's cointegration HYD, GDP and Trade

Country	Combination of variables in co-integration space								Combination of variables in co-integration space							
China																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3			-3.16	-4.1								-3.01
PP				-19				-33								-19.9
MZ								-3.3								
India																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG						-3.1				-2.98		-3.1		-3.38		-3.14
PP						-17								-22.4		-21.1
MZ														-3.18		-3.02
Indonesia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP													-19.5			
MZ																
Japan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG						-3.7	-3.07	-2.9		-2.99			-3.21	-2.93	-3.41	
PP		-24		-17	-17.3	-26	-20.5	-19					-24.8	-19	-24.8	-18.6
MZ		-3										4.99				
Malaysia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3.7				-3.2								
PP				-27				-21		-60.2						
MZ				-3.3				-3		-4.74						
New Zealand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3	-3.35	-3.4							-3.15	-3.14		
PP					-23.9	-25						18	-19.3	-18.7		
MZ					-2.96	-3.1				5.69		28.1				
Pakistan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG											-3.13			-3.13		
PP									-17.8		-19.86			-19.7		
MZ																
Philippines																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP							-17.3	-18							-18.8	-18
MZ																
South Korea																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG					-3.57											
PP					-23.4					-52.4		18.8		-17.4		
MZ					-2.93					-4.08		11.1				
Taiwan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-								
DFG					-3.2	-4.1										
PP		-21			-22.6	-35										
MZ						-3.3										

Table-88.4 presents cointegration results between NG and GDP, and NG and Trade for all possible pairs. India, Indonesia, South Korea and Taiwan show absence of hidden cointegration relations between NG and GDP; Bangladesh, China, Malaysia and Pakistan show existence of one hidden cointegration relation; Japan shows the existence of two; and New Zealand shows existence of three hidden cointegration relations. Regarding the hidden cointegration relationship between HYD and Trade, Bangladesh and Malaysia show absence of hidden cointegration relation; India and Indonesia show existence of one hidden cointegration relation; Japan and New Zealand show the presence of two hidden cointegration relations; China and South Korea show presence of three hidden cointegration relations; Pakistan shows evidence for six hidden cointegration relations.

Table 88.4: Granger and Yoon's cointegration NG, GDP and Trade

Country	Combination of variables in co-integration space								Combination of variables in co-integration space							
Bangladesh																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3.64														
PP																
MZ																
China																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3.52													-2.94	-3.2
PP		-19.4										-36.19				
MZ												-4.22				
India																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG									-2.93							
PP									-17.57							
MZ																
Indonesia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG										-2.97						
PP										-17.62						
MZ																
Japan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3												
PP		-17.5		-19.49								-406.6				
MZ				-2.94						6.5		-13.99				
Malaysia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3.29												
PP				-23.03												
MZ																
New Zealand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG	-3.06		-2.96				-2.93									
PP	-18.76		-17.52				-17.31					18.29				
MZ	-2.93									6.4		13.79				
Pakistan																

	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3.27								-3.04	-2.96			-3.31		
PP		-20.2							-17.78	-18.27	-18.1	-20.74		-23.22		-28.9
MZ		-3.11												-3.17		-3.37
South Korea																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG									-3.26							
PP										-841						
MZ										-20.26		4.77				

Table 89.4: Granger and Yoon's cointegration NU, GDP and Trade

Country	Combination of variables in co-integration space								Combination of variables in co-integration space							
India																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG							-2.95									
PP					-17.56					-20.63		-19.48				
MZ																
Japan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3.14				-2.99								
PP				-29.5				-17.52								
MZ				-3.44						-6.56		-3.02				
Thailand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG												-3.22			-4.4	
PP										-20.46	-25.48	-19.84			-36.44	
MZ															-3.21	

Table-89.4 presents cointegration results between NU and GDP, and NU and Trade for all possible pairs. India and Japan show two hidden cointegration relations between NU and GDP, and NU and Trade. Thailand shows three hidden cointegration relationships between NU and Trade, and absence of the hidden cointegration relationship between NU and GDP.

Table 90.4: Granger and Yoon's cointegration PEC, GDP and Trade

Country	Combination of variables in co-integration space								Combination of variables in co-integration space							
Bangladesh																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-4.27				-3.61								-3.1		
PP		-21.13				-24.14								-21.37		
MZ																
China																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3.71				-3.86		-3.74								
PP		-21.44				-30.87		-28.82						-18.69		
MZ		-3.01				-3.83		-2.92						-2.92		
India																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG												-3.49				-3.47
PP												-22.71				-27.05
MZ												-3.03				-3.24
Japan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP												-1002				
MZ										-8.63		-22.14				
Malaysia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP								-106.4		-19.08						
MZ								-7.09				-4.57				

Pakistan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG									-3.32		-2.92	-3.75				-3.86
PP									-21.79		-17.9	-27.87				-28.52
MZ									-3			-3.27				-3.33
Singapore																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG									-3.95		-3.89					
PP									-29.65	-20.16	-29.5	-17.98				
MZ									-3.59		-3.59					
South Korea																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG										-3.29						
PP																
MZ												-4.99				
Thailand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP				-22				-24.1								
MZ																

Table-90.4 presents cointegration results between PEC and GDP, and PEC and Trade for all possible pairs. Bangladesh shows two hidden cointegration relations between PEC and GDP, and one hidden cointegration relation between PEC and Trade, whereas, Malaysia shows the opposite. India, Japan and South Korea show two hidden cointegration relations between PEC and Trade, and absence of the hidden cointegration relationship between PEC and GDP, while Thailand shows the opposite. China shows evidence of three hidden cointegration relations between PEC and GDP, and one hidden cointegration relationship between PEC and Trade. Pakistan and Singapore show absence of the hidden cointegration relationship between PEC and GDP, but existence of four hidden cointegration relationships between PEC and Trade.

4.6 Results from the panel data analysis: unit root, cointegration and Granger-causality

To further achieve our first objective for panel data, we moved ahead with testing unit root for series under investigation. However, as we have different sample period for most of the series, we adopted two approaches in order to work with balanced data set. First, we tried to maximize the time period and removed from our analysis the countries that did not have observations starting from 1960. Thus, in the first approach our study period is 1960-2009/20010. Second, we tried to include maximum possible countries in our analysis thus reducing the time period. However, in this case there is no fixed study period as it varies with the variables under investigation. These two approaches are adopted to look for any difference in the results, which may arise due to changes in sample structure and thus to ensure the robustness of results. However, in case of ambiguity in results within a sample, we relied on test 3 and test 9. Test 3 is proposed in 2012 and has proven to be the most powerful test in the presence of cross-sectional dependence. Test 9 incorporates up to five structural breaks in the data and provides us the test results for both cases when the sample is homogenous and when it is heterogeneous. The results of panel unit root analysis are presented in Appendix-F from Table-1F to -14F. In each case to ensure that the results are robust, we used nine recently developed panel unit root tests. In almost all cases, most of panel unit root tests give similar results. Table-1F, which reports panel unit root results for two samples for CO_2 emissions and GDP, and CO_2 emissions and Trade, shows that the null hypothesis of unit root is not rejected by most of the tests used, and panel unit root test by Carrion-I-Silvestre et al. (2005) rejects the null of stationarity for both samples in both variables. Thus, we conclude that variables are stationary here. Similar to Table-1F, the Table-2F which reports panel unit root results for two samples for Coal and GDP, and Coal and Trade, shows that variables are non-stationary in level form. All other tables also provide the same evidence and based on that, we conclude that all variables under consideration are nonstationary in the level form. Further, to test the order of integration of the variables, we tested unit root for first difference data and found that all variables are stationary. After determining that all the variables under investigation are integrated of order one, i.e., I (1), we moved to test for cointegration. We have used two tests to test the presence of cointegration; one without a structural break (proposed by DI-Iorio and Fachin, 2014) and the other with structural breaks (proposed by DI-Iorio and Fachin, 2010). Results of panel cointegration are reported in Table-91.4.

Table 91.4: Testing cointegration in panel data models

C: X-Y	Di-Iorio and Fachin (2014)			Di-Iorio and Fachin (2010)			C: Y-X	Di-Iorio and Fachin (2014)			Di-Iorio and Fachin (2010)		
	Mean	Median	Max	Mean	Median	Max		Mean	Median	Max	Mean	Median	Max
CO_2-	-0.379	-0.285	1.996	-3.16	-3.08	-1.82	CO_2-	0.9302	0.871	4.528	-3.94	**-4.04**	-2.12
GDPPC1_1	(0.657)	(0.656)	(0.893)	(0.799)	(0.810)	(0.664)	GDPPC1_1	(0.775)	(0.811)	(0.880)	(0.105)	**(0.077)**	(0.61)
CO_2-	0.739	0.593	2.559	-3.02	-2.99	-1.66	CO_2-	-0.963	**-0.996**	1.8301	-3.50	-3.59	-2.19
GDPPC1_2	(0.865)	(0.815)	(0.692)	(0.906)	(0.899)	(0.731)	GDPPC1_2	(0.122)	**(0.0338)**	(0.791)	(0.551)	(0.393)	(0.44)
CO_2-	**-0.510**	**-0.955**	0.759	-3.79	**-4.03**	-1.37	CO_2-	0.895	2.3011	4.305	-3.43	-3.53	-1.83
Trade1_1	**(0.0604)**	**(0.002)**	(0.202)	(0.201)	**(0.085)**	(0.916)	Trade1_1	(0.959)	(0.998)	(0.964)	(0.731)	(0.588)	(0.71)
CO_2-	**-0.789**	-0.308	**0.284**	-3.79	**-4.03**	-1.37	CO_2-	**-1.099**	-0.263	**0.225**	**-4.78**	**-4.35**	-2.98
Trade1_2	**(0.099)**	(0.372)	**(0.021)**	(0.201)	**(0.085)**	(0.916)	Trade1_2	**(0.0274)**	(0.459)	**(0.022)**	**(0.000)**	**(0.021)**	(0.07)
Coal-	1.401	1.376	2.853	-3.27	-3.16	-2.48	Coal-	0.152	0.460	1.163	-3.88	-3.33	-2.31
GDPPC1_1	(0.916)	(0.935)	(0.783)	(0.747)	(0.793)	(0.240)	GDPPC1_1	(0.9400)	(0.992)	(0.868)	(0.314)	(0.864)	(0.52)
Coal-	1.001	1.160	1.999	-3.33	-2.95	-2.56	Coal-	-0.190	-0.162	2.828	-3.45	-2.95	-2.12
GDPPC1_2	(0.748)	(0.904)	(0.258)	(0.444)	(0.825)	(0.101)	GDPPC1_2	(0.642)	(0.6212)	(0.942)	(0.845)	(0.981)	(0.68)
Coal-	-0.597	**-1.162**	0.806	-3.21	-2.98	-1.90	Coal-	0.775	1.593	2.838	-2.87	-2.51	-0.80
Trade1_1	(0.542)	**(0.0014)**	(0.3198	(0.504)	(0.666)	(0.612)	Trade1_1	(0.9842)	(0.999)	(0.958)	(0.776)	(0.943)	(0.92)
Coal-	-0.313	-0.289	1.449	-3.47	-3.22	-2.27	Coal-	0.532	0.233	4.047	-3.40	-3.99	-2.09
Trade1_2	(0.122)	(0.111)	(0.5698	(0.509)	(0.724)	(0.628)	Trade1_2	(0.991)	(0.951)	(0.977)	(0.785)	(0.171)	(0.59)
ELEP-	-0.183	-0.139	1.548	-3.76	-3.66	-2.21	ELEP-	1.605	0.638	5.791	-3.42	-3.48	-1.99
GDPPC1_1	(0.189)	(0.245)	(0.9416	(0.244)	(0.307)	(0.562)	GDPPC1_1	(0.938)	(0.5974)	(0.899)	(0.310)	(0.280)	(0.48)
ELEP-	-0.098	0.227	0.957	-3.11	-3.21	-1.27	ELEP-	3.489	3.345	9.322	-3.79	-3.69	-2.87
Trade1_1	(0.255)	(0.764)	(0.194)	(0.958)	(0.860)	(0.953)	Trade1_1	(0.998)	(0.999)	(0.986)	(0.435)	(0.530)	(0.19)
ELEP_Coal-	2.972	1.698	10.99	-3.98	-3.84	-2.19	ELEP_Coal-	0.4739	0.709	1.621	-3.67	-3.50	-2.69
GDPPC1_1	(1.000)	(0.997)	(1.000)	(0.133)	(0.249)	(0.740)	GDPPC1_1	(0.792)	(0.971)	(0.496)	(0.330)	(0.525)	(0.13)
ELEP_Coal-	3.0746	1.0813	18.23	-3.54	-3.72	-2.03	ELEP_Coal-	0.411	0.397	0.593	-3.59	-3.76	-2.12
GDPPC1_2	(0.999)	(0.919)	(1.000)	(0.734)	(0.538)	(0.757)	GDPPC1_2	(0.888)	(0.912)	(0.091)	(0.361)	(0.232)	(0.52)
ELEP_Coal-	-0.075	-0.058	0.987	-3.48	-3.54	-2.37	ELEP_Coal-	1.669	1.947	3.418	**-3.70**	**-3.84**	-1.96
Trade1_1	(0.269)	(0.268)	(0.292)	(0.234)	(0.193)	(0.315)	Trade1_1	(0.988)	(0.997)	(0.966)	**(0.089)**	**(0.063)**	(0.39)
ELEP_Coal-	0.712	0.762	1.928	-4.13	-3.80	-3.44	ELEP_Coal-	0.846	1.095	1.988	-3.18	-3.15	-2.66
Trade1_2	(0.946)	(0.980)	(0.649)	(0.146)	(0.430)	(0.092)	Trade1_2	(0.963)	(0.989)	(0.816)	(0.783)	(0.730)	(0.16)
ELEP_Hyd-	2.972	1.698	10.99	-3.98	-3.84	-2.19	ELEP_Hyd-	0.474	0.709	1.621	-3.67	-3.50	-2.69
GDPPC1_1	(1.000)	(0.997)	(1.000)	(0.133)	(0.249)	(0.740)	GDPPC1_1	(0.792)	(0.971)	(0.496)	(0.330)	(0.525)	(0.13)
ELEP_Hyd-	3.075	1.081	18.227	-3.54	-3.72	-2.03	ELEP_Hyd-	0.411	0.3969	**0.593**	-3.59	-3.76	-2.12
GDPPC1_2	(0.999)	(0.919)	(1.000)	(0.734)	(0.538)	(0.757)	GDPPC1_2	(0.888)	(0.912)	**(0.091)**	(0.361)	(0.232)	(0.52)
ELEP_Hyd-	-0.075	-0.058	0.987	-3.48	-3.54	-2.37	ELEP_Hyd-	1.669	1.947	3.418	**-3.70**	**-3.84**	-1.96
Trade1_1	(0.239)	(0.268)	(0.292)	(0.234)	(0.193)	(0.315)	Trade1_1	(0.988)	(0.997)	(0.966)	**(0.089)**	**(0.063)**	(0.39)
ELEP_Hyd-	0.712	0.762	1.928	-4.13	-3.80	**-3.44**	ELEP_Hyd-	0.846	1.095	1.988	-3.18	-3.15	-2.66
Trade1_2	(0.946)	(0.980)	(0.649)	(0.146)	(0.430)	**(0.092)**	Trade1_2	(0.963)	(0.989)	(0.816)	(0.783)	(0.730)	(0.16)
ELEP_NG-	2.100	1.508	6.620	-3.29	-3.58	-2.16	ELEP_NG-	1.077	1.003	2.035	**-3.74**	**-3.91**	-1.51
GDPPC1_1	(0.9834)	(0.956)	(0.987)	(0.770)	(0.447)	(0.754)	GDPPC 1_1	(0.986)	(0.989)	(0.917)	**(0.094)**	**(0.080)**	(0.72)
ELEP_NG-	1.684	1.567	5.864	-3.29	-3.58	-2.16	ELEP_NG-	0.726	0.670	1.417	-2.89	-3.13	-1.74
GDPPC 1_2	(0.996)	(0.989)	(0.989)	(0.770)	(0.447)	(0.754)	GDPPC 1_2	(0.943)	(0.919)	(0.490)	(0.913)	(0.710)	(0.65)
ELEP_NG-	0.603	0.662	2.299	-3.36	-3.29	-2.26	ELEP_NG-	2.745	2.966	3.386	-3.31	-3.42	-2.16
Trade1_1	(0.878)	(0.896)	(0.945)	(0.443)	(0.498)	(0.619)	Trade1_1	(0.999)	(1.000)	(0.981)	(0.361)	(0.195)	(0.19)
ELEP_NG-	0.066	-0.045	1.039	-3.61	-3.65	-2.97	ELEP_NG-	1.369	1.519	2.803	-3.84	-3.87	-2.85
Trade1_2	(0.621)	(0.524)	(0.244)	(0.505)	(0.493)	(0.339)	Trade1_2	(0.978)	(0.997)	(0.835)	(0.150)	(0.156)	(0.10)
ELEP_NU-	0.116	-0.612	2.911	-4.07	-3.87	**-3.47**	ELEP_NU-	-0.273	**-0.446**	0.582	-4.14	-3.98	-2.74
GDPPC1_1	(0.176)	(0.031)	(0.915)	(0.046)	(0.109)	**(0.024)**	GDPPC1_1	(0.154)	**(0.077)**	(0.214)	(0.103)	(0.152)	(0.28)
ELEP_NU-	0.866	0.790	3.44	-3.17	-3.06	-2.75	ELEP_NU-	0.689	0.582	1.476	-3.22	-3.30	-2.85
Trade1_1	(0.867)	(0.829)	(0.964)	(0.546)	(0.647)	(0.244)	Trade1_1	(0.859)	(0.831)	(0.839)	(0.726)	(0.645)	(0.35)
ELEP_Oil-	2.8357	1.873	8.9422	**-4.96**	**-4.67**	-2.61	ELEP_Oil-	**-0.849**	-0.119	**0.368**	-3.37	-3.35	-2.82
GDPPC1_1	(0.999)	(0.988)	(0.999)	**(0.000)**	**(0.002)**	(0.272)	GDPPC1_1	**(0.0112)**	(0.536)	**(0.099)**	(0.499)	(0.492)	(0.04)
ELEP_Oil-	0.9091	0.828	4.648	-3.16	-2.85	-1.82	ELEP_Oil-	0.3403	0.252	2.742	-3.57	-3.52	-2.31
Trade1_1	(0.979)	(0.961)	(0.995)	(0.589)	(0.838)	(0.379)	Trade1_1	(0.944)	(0.951)	(0.838)	(0.291)	(0.364)	(0.40)
ELEP_Oil-	1.126	1.192	4.399	**-3.96**	-3.86	-2.41	ELEP_Oil-	**-0.4806**	-0.2033	2.279	-3.89	-3.50	-2.03
Trade1_2	(0.983)	(0.989)	(0.976)	**(0.064)**	(0.130)	(0.207)	Trade1_2	**(0.0312)**	(0.4046)	(0.818)	(0.187)	(0.588)	(0.68)
ELEP_Rene-	0.564	1.151	3.038	-3.55	-3.51	-2.31	ELEP_Rene-	0.6361	0.588	2.7555	-3.49	-3.35	-2.00
GDPPC1_1	(0.911)	(0.977)	(0.915)	(0.289)	(0.322)	(0.222)	GDPPC1_1	(0.984)	(0.983)	(0.962)	(0.526)	(0.679)	(0.75)
ELEP_Rene-	-0.4351	-0.435	2.0233	**-4.20**	**-3.98**	-2.38	ELEP_Rene-	1.249	1.008	3.466	-3.68	**-4.09**	-1.43
Trade1_1	(0.590)	(0.348)	(0.869)	**(0.006)**	**(0.056)**	(0.245)	Trade1_1	(0.981)	(0.966)	(0.982)	(0.246)	**(0.063)**	(0.68)
ELEP_Rene-	0.178	-0.427	3.338	**-4.05**	-3.90	**-3.61**	ELEP_Rene-	1.3967	1.0276	6.206	-3.50	-3.59	-2.54
Trade1_2	(0.928)	(0.285)	(0.956)	**(0.050)**	(0.169)	**(0.001)**	Trade1_2	(1.000)	(1.000)	(0.999)	(0.620)	(0.457)	(0.26)
ELEP_PE-	0.625	0.599	2.998	**-4.11**	**-3.90**	-2.75	ELEP_PE-	-0.359	-0.129	0.881	-3.64	-3.67	-2.41
GDPPC1_1	(0.812)	(0.835)	(0.858)	**(0.031)**	**(0.098)**	(0.101)	GDPPC1_1	(0.552)	(0.747)	(0.235)	(0.123)	(0.132)	(0.16)
ELEP_PE-	**-0.7181**	**-0.854**	1.066	-3.27	-3.05	-2.14	ELEP_PE-	1.3108	1.296	5.328	-3.62	-3.61	-2.53
Trade1_1	**(0.021)**	**(0.004)**	(0.441)	(0.898)	(0.952)	(0.562)	Trade1_1	(0.931)	(0.970)	(0.924)	(0.599)	(0.546)	(0.42)

ELEP_PE-	-0.2827	-0.259	0.895	-2.99	-2.91	-1.89	ELEP_PE-	2.126	1.584	11.196	**-4.01**	-3.96	-2.46
Trade1_2	(0.269)	(0.313)	(0.196)	(0.776)	(0.774)	(0.373)	Trade1_2	(0.998)	(0.999)	(0.994)	**(0.062)**	(0.110)	(0.27)
EnergyUse-	0.7208	0.575	4.455	-3.84	-3.93	-2.58	EnergyUse-	-0.194	-0.207	1.634	-3.38	-3.07	-2.08
GDPPC1_1	(0.902)	(0.842)	(0.943)	(0.36)	(0.276)	(0.310)	GDPPC1_1	(0.162)	(0.165)	(0.559)	(0.782)	(0.947)	(0.49)
EnergyUse-	-0.4404	-0.448	1.647	-3.35	-3.30	-1.39	EnergyUse-	2.1207	1.228	5.435	-3.43	-3.40	-2.09
Trade1_1	(0.185)	(0.151)	(0.808)	(0.673)	(0.675)	(0.875)	Trade1_1	(0.999)	(0.988)	(0.994)	(0.688)	(0.672)	(0.43)
EnergyUse-	0.2264	-0.217	2.384	**-4.00**	-3.69	**-2.93**	EnergyUse-	1.4033	0.7311	5.077	-3.56	-3.56	-1.70
Trade1_2	(0.784)	(0.241)	(0.782)	**(0.079)**	(0.380)	**(0.082)**	Trade1_2	(0.999)	(0.964)	(0.983)	(0.789)	(0.735)	(0.91)
Hydro-	2.5668	2.6053	5.073	**-5.02**	**-4.88**	**-3.59**	Hydro-	**-2.1845**	**-1.436**	**-0.119**	**-4.51**	**-4.65**	-1.94
GDPPC1_1	(0.996)	(0.999)	(0.984)	**(0.000)**	**(0.000)**	**(0.006)**	GDPPC1_1	**(0.000)**	**(0.000)**	**(0.001)**	**(0.004)**	**(0.004)**	(0.79)
Hydro-	2.8816	1.646	8.818	-3.44	-3.37	-2.54	Hydro-	**-0.649**	**-0.683**	1.249	-3.13	-3.22	-2.09
GDPPC1_2	(0.993)	(0.956)	(0.994)	(0.325)	(0.396)	(0.103)	GDPPC1_2	**(0.053)**	**(0.0244)**	(0.777)	(0.860)	(0.726)	(0.42)
Hydro-	0.273	0.342	1.657	**-4.13**	**-4.50**	**-2.79**	Hydro-	**-1.174**	-0.981	1.297	-3.79	-3.81	-2.25
Trade1_1	(0.705)	(0.747)	(0.758)	**(0.009)**	**(0.001)**	**(0.083)**	Trade1_1	**(0.065)**	(0.125)	(0.814)	(0.275)	(0.279)	(0.35)
Hydro-	-0.292	-0.381	1.917	-3.80	-3.67	**-2.89**	Hydro-	**-1.1963**	**-1.238**	1.119	-3.08	-3.16	-1.58
Trade1_2	(0.307)	(0.277)	(0.6512	(0.121)	(0.238)	**(0.089)**	Trade1_2	**(0.009)**	**(0.008)**	(0.647)	(0.734)	(0.591)	(0.69)
NUC-	2.9510	2.500	5.899	-3.85	-3.85	-2.69	NUC-	**-0.8654**	**-0.9472**	**-0.463**	-3.72	-2.94	-2.89
GDPPC1_1	(0.992)	(0.991)	(0.987)	(0.232)	(0.256)	(0.384)	GDPPC1_1	**(0.0758)**	**(0.0404)**	**(0.021)**	(0.204)	(0.622)	(0.25)
NUC-	2.8246	2.664	3.648	-3.74	-3.74	-2.90	NUC-	**-1.3540**	**-1.370**	1.9524	-3.46	-3.27	-2.81
Trade1_2	(0.996)	(0.993)	(0.968)	(0.209)	(0.209)	(0.243)	Trade1_2	**(0.055)**	**(0.049)**	(0.998)	(0.490)	(0.562)	(0.44)
NGC-	3.7993	2.3582	9.0694	-3.41	-3.39	-2.57	NGC-	**-1.5920**	**-0.988**	**-0.539**	-3.47	-3.09	-2.17
GDPPC1_1	(0.999)	(0.997)	(0.997)	(0.513)	(0.510)	(0.297)	GDPPC1_1	**(0.0122)**	**(0.086)**	**(0.002)**	(0.694)	(0.943)	(0.45)
NGC-	0.8659	1.196	1.865	-3.32	-3.23	-2.25	NGC-	**-0.7455**	**-1.216**	0.6355	-3.33	-2.95	-1.52
GDPPC1_2	(0.846)	(0.970)	(0.454)	(0.761)	(0.799)	(0.716)	GDPPC1_2	**(0.080)**	**(0.003)**	(0.204)	(0.768)	(0.958)	(0.81)
NGC-	-0.0023	-0.039	1.372	-3.62	-3.18	-2.49	NGC-	0.4488	1.267	2.154	-3.25	-3.25	-0.77
Trade1_1	(0.458)	(0.438)	(0.762)	(0.275)	(0.600)	(0.469)	Trade1_1	(0.961)	(0.998)	(0.943)	(0.850)	(0.799)	(0.94)
NGC-	-0.5361	-0.472	1.844	-3.21	-3.27	-2.23	NGC-	0.9869	1.189	4.408	-3.18	-3.41	-1.75
Trade1_2	(0.105)	(0.110)	(0.6136	(0.729)	(0.660)	(0.742)	Trade1_2	(0.997)	(0.998)	(0.967)	(0.929)	(0.647)	(0.91)
PEC-	1.4161	1.633	4.645	-3.41	-3.22	-1.78	PEC-	**-0.8860**	-0.635	1.649	-3.56	-3.26	-0.66
GDPPC1_1	(0.767)	(0.933)	(0.709)	(0.455)	(0.651)	(0.553)	GDPPC1_1	**(0.0556)**	(0.118)	(0.848)	(0.334)	(0.697)	(0.98)
PEC-	0.9603	0.7008	4.646	-2.93	-2.88	-1.64	PEC-	-0.5870	-0.6931	1.197	-3.23	-3.06	-2.16
GDPPC1_2	(0.863)	(0.757)	(0.885)	(0.882)	(0.887)	(0.606)	GDPPC1_2	(0.2214)	(0.100)	(0.615)	(0.788)	(0.867)	(0.39)
PEC-	**-0.5188**	**-0.875**	0.802	**-3.52**	-3.32	-1.92	PEC-	-0.113	1.559	3.824	-3.04	-3.18	-2.34
Trade1_1	**(0.0234)**	**(0.001)**	(0.1814	**(0.056)**	(0.147)	(0.246)	Trade1_1	(0.669)	(0.999)	(0.973)	(0.836)	(0.646)	(0.11)
PEC-	-0.2862	-0.197	1.458	-3.86	-4.26	-1.43	PEC-	0.5923	1.553	3.217	-3.51	-3.69	-1.88
Trade1_2	(0.157)	(0.237)	(0.468)	(0.115)	(0.017)	(0.910)	Trade1_2	(0.968)	(0.999)	(0.877)	(0.801)	(0.603)	(0.71)

The results reported in Table-91.4 show that when we test for cointegration between CO_2 emissions and GDP by making GDP as dependent variable and CO_2 emissions as explanatory variable, we do not find evidence of cointegration in both samples analyzed. However, when we make GDP as independent and CO_2 emissions as dependent variable, we find that Median test of DI-Iorio and Fachin (2010) in the sample 1, and Median test of DI-Iorio and Fachin (2014) in the sample 2 provide evidence of cointegration indicating that CO_2 emissions having long-run effect on GDP. In the next step, we examined the cointegration between CO_2 emissions and Trade. First, we kept Trade as the dependent variable and CO_2 emissions as independent variable and found that in both the samples at least one of the three tests of DI-Iorio and Fachin (2014) and DI-Iorio and Fachin (2010) rejects the null of no cointegration indicating that CO_2 emissions has long-run influence on Trade. However, when we reverse the order of variables we found that, in sample 1, the null hypothesis of no cointegration is not rejected; whereas, in sample 2 it is. This indicates that as sample 2 includes more countries at the cost of time period, the evident results may be either due to the inclusion of the new country or reduction of the time period. The true reason is, however, unknown.. In addition, we analyzed the long-run relationship between Coal consumption and GDP and found that there is no evidence of cointegration between Coal and GDP as in both samples null hypothesis of cointegration is not rejected when either of the two variables were kept as dependent. However, we find one instance of cointegration for sample 1 when cointegration is examined between Coal and Trade. This indicates that Coal consumption has long run effect on Trade. Further, we find that in sample 1, Trade has long run effect on ELEP-Coal. No significant evidence of long-run relationship is found between ELEP and GDP, and ELEP and Trade in both samples. Also, no significant evidence of long-run relationship is found between ELEP-Coal and GDP and vice-versa. Regarding ELEP-HYD and GDP, we find a long-run relationship (in sample 2) and that GDP has long-run effect on ELEP-HYD. This is a good sign as Asian economies are putting efforts to generate more electricity through a renewable energy sources. Regarding the long-run relationship between Trade and ELEP-HYD, we find evidence that in sample 1, Trade is influencing ELEP-HYD in the long-run and vice-versa in sample 2. Thus, we can say that, Trade and ELEP-HYD are re-enforcing each other. As we observed results from a long-run relationship between GDP and ELEP-HYD, we find similar evidence for the long-run relationship between ELEP-NG. Regarding the long-run relationship between Trade and ELEP-NG, we do not find any significant evidence for cointegration in both samples. We find significant evidence for cointegration between ELEP-NU and GDP when either of the variables is treated as dependent, indicating that both variables are having a long-run significant influence on each other. We find significant evidence for cointegration between ELEP-Oil and GDP when either of the variables is kept as dependent, indicating that both are having a long-run significant influence on each other. Regarding the relationship between ELEP-Oil and Trade, for sample-2, we find significant evidence of cointegration between both variables when either of the two variables is kept as the dependent variable. There is no evidence for significant cointegration between ELEP-Rene and GDP, and strong evidence of cointegration is found between ELEP-Rene and Trade, which shows that ELEP-Rene is having a long-run influence on Trade. Further, evidence shows that ELEP-PE has significant long-run effect on GDP and we cannot conclude regarding the direction of long-run relationship between ELEP-PE and Trade, as in sample-1, ELEP-PE has shown to be having significant long-run influence on Trade, whereas, in sample-2, the reverse was found. No long-run relationship between GDP and EU was found, but we find that in sample-2, EU has long run impact on Trade. It is found that consumption of HYD and GDP have significant long run relation where both are determining each other in sample-1. However, sample-2 shows that GDP affects in the long-run overall consumption of HYD. Regarding the long-run relationship between consumption of HYD and Trade we find that both variables have significant influence on each other in the long-run. We find that both GDP and Trade have long-run effect on NU and that GDP has a long-run influence on NG. We do not find any significant evidence on the long-run relationship between Trade and NG. Finally, yet importantly, we find that in sample-1, GDP has a long-run effect on the PEC and PEC has long-run effect on Trade.

In our final attempt to achieve our first objective, we tested the Granger-causality between the variables under investigation. Hence, we applied a more powerful and robust test of Granger-causality in heterogeneous panel data. Even if Asian countries are assumed to have some similarities, they possess heterogeneity in several aspects. Thus, a test that is unable to take into account this heterogeneity may not be a reliable tool and the results obtained may therefore be biased. Here, we report the results of two test statistics, namely Z^{bar} and $Z^{bar\text{-}tild}$ and each test is analyzed with three different lag-lengths (Lags=1, 2, and 3) in order to make sure that the derived results are robust with inclusion of different lag lengths. It is important to mention that Z^{bar} test statistic is for large T whereas $Z^{bar\text{-}tild}$ test statistic is for fixed T or small T for our sample. Thus, our conclusion is based upon $Z^{bar\text{-}tild}$ test statistic.

We report results of Granger-causality in heterogeneous panel data in Table-92.4. We find strong evidence of rejection of the null hypothesis of HNC from GDP to CO_2 emissions in sample-1 and reverse holds good for sample 2. However, in both samples the null of HNC is rejected in favour of HENC for Trade and CO_2 emissions indicating significant evidence of bi-directional causal relationship. Both samples of Coal and GDP show the evidence of significant unidirectional causality running from Coal to GDP, and bidirectional causality between Coal and Trade with strong evidence on unidirectional Granger-causality running from Trade to Coal. The Trade does not Granger-cause ELEP and GDP. However, ELEP Granger-causes both GDP and Trade, but this direction of causality is very much sensitive to choice of lag length and hence, results are not robust. Thus, we conclude that there is evidence of significant unidirectional causality from ELEP to GDP and Trade. The evidence of significant bidirectional Granger-causality is found between ELEP-Coal and GDP, and ELEP-Coal and Trade. The ELEP-HYD is found to Granger-cause GDP in sample-1 but this evidence is not robust to the choice of lags, whereas, the evidence to Granger-causality running from GDP to ELEP-HYD is sensitive to the choice of samples as well as lag-length. Further, we also find that ELEP-HYD Granger-causes Trade, but, this evidence varies with changes in the lag-length. In case of ELEP-NG, we find the evidence of significant bidirectional causality in sample-1, which is insensitive to the choice of lag-length, but, no evidence of significant Granger-causality is found in the sample-2. We have an evidence of Granger-causality running from ELEP-NG to Trade in sample-1, but, it is quite sensitive to changes in the lag-length and in sample-2, we do not find any evidence of significant causality. There is no evidence of significant Granger-causality between ELEP-NU and Trade, and an evidence of unidirectional Granger-causality is found between ELEP-NU and GDP, where Granger-causality is running from GDP to ELEP-NU, but it's sensitive to lag-length. We find robust evidence of significant Granger-causality running from Trade to Oil but not vice-versa. No evidence of significant Granger-causality is found between Oil and GDP. We also do not find any evidence of significant Granger-causality between ELEP-Rene and GDP, and between ELEP-Rene and Trade. However, we find a strong evidence of significant unidirectional Granger-causality running from both GDP and Trade to EU. The evidence of significant bidirectional causal relationship is found between EPC and GDP, and the significant unidirectional causal relationship between the EPC and Trade. A strong evidence for a unidirectional causal relationship is found between the Trade and EU where causality is running from Trade to EU. We also find that GDP Granger-causes EU significantly, but, this evidence is affected by the choice of lag-length. No evidence of Granger-causality is found between HYD and GDP, but unidirectional Granger-causality is found between HYD and Trade, which is running from HYD to Trade, but, this evidence is sensitive to the lag-length choice. Interestingly, in sample-1, the bidirectional causal relationship between NG and GDP is found, and in sample-2 a unidirectional causal relationship is found where causality is running from NG to GDP. The contrary results are also observed when Granger-causality is tested between NG and Trade. In sample-1, Trade Granger-causes NG, whereas, in the sample-2 no evidence of significant Granger-causality from any of direction is found.

Regarding NU and Trade, no evidence of significant Granger-causality from any direction is found, but, we do find evidence of significant Granger-causality running from NU to GDP which is, however, sensitive to lag-length choice. The results of Granger-causality analysis between PEC and Trade show evidence of significant unidirectional causal relationship, which is running from Trade to PEC. In sample-1, we find that PEC Granger-cause GDP, whereas, in sample-2 the reverse causality holds.

Table 92.4: Testing Granger Causality in Heterogeneous Panel Data Models

H0: X-Y	Zbar statistic (p-values)			Zbar tild statistic-standardized for fixed T value (p-values)			H0: X-Y	Zbar statistic (p-values)			Zbar tild statistic-standardized for fixed T value (p-values)		
	Lag=1	Lag=2	Lag=3	Lag=1	Lag=2	Lag=3		Lag=1	Lag=2	Lag=3	Lag=1	Lag=2	Lag=3
CO_2-	1.4965	**1.8696**	**3.1419**	1.2552	0.6715	0.7094	GDPPC1-	1.4438	**5.2011**	**7.0835**	1.2069	**2.1727**	1.8716
GDPPC1	(0.135)	**(0.0615**	**(0.002)**	(0.209)	(0.5019	(0.4781)	CO_2	(0.149)	**(0.000)**	**(0.000)**	(0.227)	**(0.028)**	(0.061)
CO_2-	1.6054	**6.3349**	**7.0468**	1.3747	**2.7123**	**1.8972**	Trade1-	**3.1407**	**7.0265**	**7.2142**	**2.7824**	**3.0240**	1.9466
Trade1	(0.108)	**(0.0000**	**(0.000)**	(0.169)	**(0.007)**	**(0.0578)**	CO_2	**(0.002)**	**(0.000)**	**(0.000)**	**(0.005)**	**(0.003)**	(0.052)
CO_2-	**2.6041**	**4.2609**	**5.9943**	**2.2001**	**1.6635**	1.4454	GDPPC2-	-0.093	**1.7228**	**3.7877**	-0.228	0.5460	0.8134
GDPPC2	**(0.009)**	**(0.0000**	**(0.000)**	**(0.028)**	**(0.096)**	(0.1484)	CO_2	(0.926)	**(0.089)**	**(0.000)**	(0.819)	(0.585)	(0.416)
CO_2-	**3.8087**	**6.5491**	**11.095**	**3.1846**	**2.5519**	**2.7404**	Trade2-	**2.3024**	**4.2188**	**20.274**	**1.8594**	1.5562	5.2702
Trade2	**(0.000)**	**(0.000)**	**(0.000)**	**(0.001)**	**(0.011)**	**(0.0061)**	CO_2	**(0.021)**	**(0.000)**	**(0.000)**	**(0.063)**	(0.119)	(0.000)
Coal-	**5.5098**	**8.1548**	**11.312**	**4.9546**	**3.5324**	**3.1550**	GDPPC1-	0.6974	0.0090	-0.2000	0.5422	0.1463	-0.2395
GDPPC1	**(0.000)**	**(0.0000**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.0016)**	Coal	(0.486)	(0.993)	(0.842)	(0.588)	(0.884)	(0.811)
Coal-	-0.1924	1.3332	**3.5568**	-0.256	0.4846	0.9013	Coal-	**2.0403**	**5.0502**	**3.5920**	**1.7913**	**2.1596**	0.9117
Trade1	(0.847)	(0.1825	**(0.000)**	(0.798)	(0.628)	(0.3674)	Trade1	**(0.041)**	**(0.000)**	**(0.000)**	**(0.073)**	**(0.031)**	(0.362)
Coal-	**6.5852**	**7.9886**	**17.537**	**5.7280**	**3.2648**	**4.6742**	GDPPC2-	-0.104	**-2.42**	-0.0668	-0.232	-1.257	-0.2828
GDPPC2	**(0.000)**	**(0.0000**	**(0.000)**	**(0.000)**	**(0.001)**	**(0.0000)**	Coal	(0.918)	**(0.016)**	(0.947)	(0.817)	(0.209)	(0.777)
Coal-	1.0444	**3.2235**	**7.2439**	0.7731	1.1612	**1.7180**	Coal-	0.5687	1.3377	**10.423**	0.3546	0.3554	2.5942
Trade2	(0.296)	**(0.0013**	**(0.000)**	(0.439)	(0.246)	**(0.0858)**	Trade2	(0.569)	(0.181)	**(0.000)**	(0.723)	(0.722)	(0.009)
ELEP-	**9.1493**	**13.3644**	**16.119**	**8.1034**	**5.6877**	**4.3657**	GDPPC1-	**2.2008**	**1.7522**	**4.2119**	**1.8477**	0.5747	0.9550
GDP1	**(0.000)**	**(0.0000**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.0000)**	ELEP1	**(0.028)**	**(0.079)**	**(0.000)**	**(0.065)**	(0.565)	(0.339)
ELEP-	0.4896	**4.9710**	**10.589**	0.3188	**2.0091**	**2.8034**	Trade1-	-0.393	-1.350	2.9751	-0.476	-0.774	0.6226
Trade1	(0.6244	**(0.0000**	**(0.000)**	(0.749)	**(0.045)**	**(0.0051)**	ELEP1	(0.695)	(0.177)	(0.003)	(0.634)	(0.439)	(0.533)
ELEP_Coal-	-0.7030	**5.1237**	**8.1963**	-0.742	**2.0953**	**2.1424**	GDPPC1-	0.2247	**3.0983**	**6.7257**	0.0932	1.2035	1.7212
GDPPC1	(0.4820	**(0.0000**	**(0.000)**	(0.458)	**(0.036)**	**(0.0322)**	ELEP_Coal1	(0.822)	**(0.002)**	**(0.000)**	(0.926)	(0.229)	(0.085)
ELEP_Coal-	-0.5882	-1.471	**-1.967**	-0.624	-0.787	-0.7411	Trade1-	**3.6268**	**3.8789**	**2.7899**	**3.1707**	1.5687	0.6213
Trade1	(0.5564	(0.141)	**(0.049)**	(0.533)	(0.431)	(0.4586)	ELEP_Coal1	**(0.000)**	**(0.000)**	**(0.005)**	**(0.001)**	(0.117)	(0.534)
ELEP_Coal-	**2.0366**	**4.7493**	**18.092**	1.5760	**1.7060**	**4.4169**	GDPPC2-	-0.389	-0.633	**10.239**	-0.496	-0.507	2.3604
GDPPC2	**(0.0417**	**(0.000)**	**(0.000)**	(0.115)	**(0.088)**	**(0.0000)**	ELEP_Coal1	(0.699)	(0.527)	**(0.000)**	(0.620)	(0.612)	(0.018)
ELEP_Coal-	0.3331	2.4889	**10.218**	0.1199	0.7766	**2.3549**	Trade2-	-0.387	**2.1893**	**8.0646**	-0.496	0.6534	1.7911
Trade2	(0.739)	(0.013)	**(0.000)**	(0.905)	(0.437)	**(0.0185)**	ELEP_Coal1	(0.699)	**(0.029)**	**(0.000)**	(0.620)	(0.514)	(0.073)
ELEP_Hyd-	-0.703	**5.1237**	**8.1963**	-0.742	**2.0953**	**2.1424**	GDPPC1-	0.2247	**3.0983**	**6.7257**	0.0932	1.2035	1.7212
GDPPC1	(0.482)	**(0.000)**	**(0.000)**	(0.458)	**(0.036)**	**(0.0322)**	ELEP_Hyd1	(0.822)	**(0.002)**	**(0.000)**	(0.926)	(0.227)	(0.085)
ELEP_Hyd-	-0.588	-1.471	**-1.967**	-0.624	-0.787	-0.7411	ELEP_Hyd1-	**3.6268**	**3.8789**	**2.7899**	**3.1707**	1.5687	0.6213
Trade1	(0.556)	(0.141)	**(0.049)**	(0.533)	(0.431)	(0.4586)	Trade1	**(0.000)**	**(0.000)**	**(0.005)**	**(0.002)**	(0.117)	(0.534)
ELEP_Hyd-	**2.0366**	**4.7493**	**18.092**	1.5760	**1.7060**	**4.4169**	GDP2-	-0.387	-0.633	**10.239**	-0.496	-0.507	2.3604
GDPPC2	**(0.042)**	**(0.000)**	**(0.000)**	(0.115)	**(0.088)**	**(0.0000)**	ELEP _Hyd1	(0.699)	(0.527)	**(0.000)**	(0.620)	(0.612)	(0.018)
ELEP_Hyd-	0.3331	**2.4889**	**10.218**	0.1199	0.7766	**2.3549**	Trade2-	0.5523	2.1893	**8.0646**	0.3072	0.6534	1.7911
Trade2	(0.739)	**(0.013)**	**(0.000)**	(0.905)	(0.437)	**(0.0185)**	ELEP_Hyd1	(0.581)	(0.027)	**(0.000)**	(0.759)	(0.514)	(0.073)
ELEP_NG-	**2.4831**	**5.8959**	**8.7165**	**2.1492**	**2.4690**	**2.3344**	GDPPC1-	1.1781	**25.182**	**22.863**	0.9743	**10.961**	6.3863
GDP1	**(0.013)**	**(0.000)**	**(0.000)**	**(0.032)**	**(0.014)**	**(0.0196)**	ELEP_NG1	(0.239)	**(0.000)**	**(0.000)**	(0.329)	**(0.000)**	(0.000)
ELEP_NG-	-1.278	**5.8744**	**4.3527**	-1.228	**2.4729**	1.1016	Trade1-	-0.757	0.1841	1.3155	-0.759	-0.033	0.2316
Trade1	(0.201)	**(0.000)**	**(0.000)**	(0.219)	**(0.013)**	(0.2706)	ELEP_NG1	(0.449)	(0.854)	(0.188)	(0.448)	(0.974)	(0.817)
ELEP_NG-	-0.347	**2.2239**	**1.8058**	-0.457	0.6857	0.1711	GDP2-	0.6102	**2.2008**	0.1943	0.3664	0.6761	-0.2561
GDP2	(0.729)	**(0.026)**	**(0.071)**	(0.648)	(0.493)	(0.8641)	ELEP_NG1	(0.542)	**(0.028)**	(0.846)	(0.714)	(0.499)	(0.798)
ELEP_NG-	-0.721	**2.8575**	**2.5048**	-0.779	0.9486	0.3564	Trade2-	-0.584	**3.0059**	1.3509	-0.661	1.0101	0.0505
Trade2	(0.471)	**(0.004)**	**(0.012)**	(0.436)	(0.343)	(0.7215)	ELEP_NG1	(0.559)	**(0.003)**	(0.177)	(0.509)	(0.312)	(0.959)
ELEP_NU-	0.4818	0.3917	**5.4405**	0.3365	0.0361	1.3410	GDP1-	-0.117	-0.888	**5.0172**	-0.192	-0.514	1.2234
GDP1	(0.629)	(0.695)	**(0.000)**	(0.737)	(0.971)	(0.1799)	ELEP_NU1	(0.907)	(0.374)	**(0.000)**	(0.847)	(0.607)	(0.221)
ELEP_NU-	0.3176	1.0831	**4.5323**	0.1914	0.3333	1.0887	Trade1-	0.5088	-0.133	-0.1787	0.3604	-0.189	-0.2197
Trade1	(0.751)	(0.279)	**(0.000)**	(0.848)	(0.739)	(0.2763)	ELEP_NU1	(0.611)	(0.894)	(0.858)	(0.719)	(0.849)	(0.826)
ELEP_Oil1-	0.0032	0.6556	-0.335	-0.136	0.0838	-0.3577	GDP1-	-0.125	**2.8760**	**5.3929**	-0.252	1.0615	1.2830
GDP1	(0.998)	(0.521)	(0.738)	(0.892)	(0.933)	(0.7206)	ELEP_Oil1	(0.900)	**(0.004)**	**(0.000)**	(0.801)	(0.289)	(0.199)

ELEP_Oil1-	1.1499	-0.072	**2.1886**	0.9133	-0.212	0.3974	Trade1-	1.1585	**2.0737**	**1.6676**	0.9210	0.7334	0.2481
Trade1	(0.2505	(0.942)	**(0.029)**	(0.361)	(0.833)	(0.6911)	ELEP_Oil1	(0.247)	**(0.038)**	**(0.095)**	(0.357)	(0.463)	(0.804)
ELEP_Oil1-	0.5525	0.8529	**8.8045**	0.3120	0.1070	**2.0771**	Trade2-	1.2200	**6.2575**	**8.2407**	0.8963	**2.4015**	1.9230
Trade2	(0.5806	(0.394)	**(0.000)**	(0.755)	(0.915)	**(0.0378)**	ELEP_Oil1	(0.223)	**(0.000)**	**(0.000)**	(0.370)	**(0.016)**	(0.055)
ELEP_Rene-	0.6194	**3.2835**	**2.8853**	0.4296	1.2573	0.5857	GDP1-	0.4918	-1.067	-0.1990	0.3148	-0.658	-0.2977
GDP1	(0.5357	**(0.001)**	**(0.004)**	(0.668)	(0.209)	(0.5581)	ELEP_Rene1	(0.623)	(0.286)	(0.842)	(0.753)	(0.511)	(0.766)
ELEP_Rene-	**2.5786**	**2.2273**	**3.8200**	**2.2058**	0.8103	0.8764	Trade1-	-1.480	-0.487	-1.3891	-1.448	-0.385	-0.6156
Trade1	**(0.0099**	**(0.026)**	**(0.000)**	**(0.027)**	(0.418)	(0.3808)	ELEP_Rene1	(0.139)	(0.626)	(0.165)	(0.148)	(0.700)	(0.538)
ELEP_Rene-	1.4317	0.8446	**2.7386**	1.0955	0.1239	0.4457	Trade2-	0.0103	2.2226	0.3129	-0.149	0.7089	-0.2172
Trade2	(0.1522	(0.398)	**(0.006)**	(0.273)	(0.901)	(0.6558)	ELEP_Rene1	(0.992)	(0.026)	(0.754)	(0.882)	(0.478)	(0.828)
EPC1-	**3.0482**	**6.3934**	**13.316**	**2.6106**	**2.6183**	**3.5628**	GDP1- EPC1	**2.6699**	**8.0255**	**10.553**	**2.2700**	**3.3369**	2.7712
GDP1	**(0.0023**	**(0.000)**	**(0.000)**	**(0.009)**	**(0.009)**	**(0.0004)**		**(0.008)**	**(0.000)**	**(0.000)**	**(0.023)**	**(0.001)**	(0.006)
EPC1-	0.8212	1.0035	**4.3648**	0.6236	0.2714	1.0325	Trade1- EPC1	-0.648	-0.002	0.8386	-0.699	-0.171	0.0224
Trade1	(0.4115	(0.316)	**(0.000)**	(0.533)	(0.786)	(0.3018)		(0.517)	(0.998)	(0.402)	(0.484)	(0.869)	(0.982)
EPC1-	**4.1505**	**8.3702**	**16.717**	**3.4619**	**3.2985**	**4.2395**	Trade2-	0.8495	1.2017	**10.920**	0.5720	0.2551	2.6554
Trade2	**(0.0000**	**(0.000)**	**(0.000)**	**(0.001)**	**(0.001)**	**(0.0000)**	ElectricPC1	(0.396)	(0.229)	**(0.000)**	(0.567)	(0.799)	(0.008)
EnergyUse1-	1.1382	**2.2548**	**3.9361**	0.8856	0.7880	0.8657	GDPPC1-	0.8495	1.2017	**10.920**	0.5720	0.2551	2.6554
GDP1	(0.255)	**(0.024)**	**(0.000)**	(0.376)	(0.431)	(0.3866)	EnergyUse1	(0.396)	(0.229)	**(0.000)**	(0.567)	(0.799)	(0.008)
EnergyUse1-	0.9145	0.8008	**2.4541**	0.7013	0.1729	0.4734	Trade1-	**4.6498**	**4.6088**	**7.1086**	**4.0642**	**1.8497**	1.8066
Trade1	(0.3605	(0.423)	**(0.0141**	(0.483)	(0.8627	(0.6359)	EnergyUse1	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.064)**	(0.071)
EnergyUse1-	1.5621	1.3550	**6.9541**	1.1959	0.3201	1.5714	Trade2-	**3.4030**	**9.3795**	**27.188**	**2.8075**	**3.7270**	7.1011
Trade2	(0.1183	(0.175)	**(0.0000**	(0.232)	(0.749)	(0.1161)	EnergyUse1	**(0.001)**	**(0.000)**	**(0.000)**	**(0.005)**	**(0.000)**	(0.000)
Hydro1-	0.1296	1.1991	**-1.912**	0.0113	0.3830	-0.7635	GDPPC1-	0.4909	0.9927	**2.7524**	0.3426	0.2900	0.6119
GDPPC1	(0.897)	(0.231)	**(0.056)**	(0.991)	(0.702)	(0.4452)	Hydro1	(0.624)	(0.321)	**(0.006)**	(0.732)	(0.772)	(0.541)
Hydro1-	0.1296	1.1991	-1.912	0.0113	0.3830	-0.7635	Trade1-	0.4909	0.9927	**2.7524**	0.3426	0.2900	0.6119
Trade1	(0.897)	(0.231)	(0.056)	(0.991)	(0.702)	(0.4452)	Hydro1	(0.624)	(0.321)	**(0.006)**	(0.732)	(0.772)	(0.541)
Hydro2-	-0.088	-0.849	-1.300	-0.216	-0.575	-0.6294	GDPPC2-	0.8428	0.6513	**2.8924**	0.6189	0.0830	0.5651
GDPPC2	(0.930)	(0.395)	(0.194)	(0.829)	(0.565)	(0.5291)	Hydro1	(0.399)	(0.515)	**(0.004)**	(0.536)	(0.934)	(0.572)
Hydro2-	**2.5485**	**3.2858**	**5.6459**	**1.9962**	1.0783	1.1239	Trade2-	1.2932	**2.9400**	1.5797	0.9232	0.9361	0.0591
Trade2	**(0.011)**	**(0.001)**	**(0.000)**	**(0.046)**	(0.281)	(0.2611)	Hydro1	(0.196)	**(0.003)**	(0.114)	(0.356)	(0.349)	(0.953)
NG1-	**2.8107**	**4.2843**	**6.9012**	**2.4977**	**1.8144**	**1.8874**	GDPPC1-	1.2946	**9.6284**	**13.005**	1.1076	**4.2226**	3.6872
GDPPC1	**(0.005)**	**(0.000)**	**(0.000)**	**(0.001)**	**(0.069)**	**(0.0591)**	NG1	(0.196)	**(0.000)**	**(0.000)**	(0.268)	**(0.000)**	(0.000)
NG1-	-1.219	**-2.228**	**-2.016**	-1.182	-1.099	-0.7148	Trade1-	**2.1826**	**5.8058**	**5.2151**	**1.9363**	**2.5214**	1.4173
Trade1	(0.223)	**(0.026)**	**(0.044)**	(0.237)	(0.272)	(0.4748)	NG1	**(0.029)**	**(0.000)**	**(0.000)**	**(0.053)**	**(0.012)**	(0.156)
NG1-	0.4742	**4.8925**	**9.6673**	0.1897	1.6346	**2.0102**	GDPPC2-	-0.368	**3.2198**	**5.5672**	-0.513	0.9697	0.9854
GDPPC2	(0.635)	**(0.000)**	**(0.000)**	(0.849)	(0.102)	**(0.0444)**	NG2	(0.713)	**(0.001)**	**(0.000)**	(0.608)	(0.332)	(0.324)
NG2-	0.1039	**-2.767**	**5.9476**	-0.119	-1.409	1.0805	Trade2-	-0.429	-0.611	**4.5260**	-0.564	-0.553	0.7252
Trade2	(0.917)	**(0.006)**	**(0.000)**	(0.905)	(0.159)	(0.2799)	NG2	(0.668)	(0.541)	**(0.000)**	(0.573)	(0.580)	(0.468)
NUC1-	**2.1560**	**3.0269**	**3.5849**	**1.8045**	1.1566	0.8119	GDPPC1-	-0.264	0.1854	**1.8819**	-0.324	-0.058	0.3425
GDPPC1	**(0.031)**	**(0.003)**	**(0.000)**	**(0.071)**	(0.247)	(0.4168)	NUC1	(0.792)	(0.853)	**(0.059)**	(0.746)	(0.954)	(0.732)
NUC1-	-0.075	**1.8873**	**5.5454**	-0.145	0.6880	1.3758	Trade1-	-0.176	-1.779	-0.270	-0.234	-0.879	-0.2270
Trade1	(0.941)	**(0.059)**	**(0.000)**	(0.884)	(0.491)	(0.1689)	NUC1	(0.876)	(0.075)	(0.787)	(0.815)	(0.379)	(0.820)
PEC1-	-0.498	**2.8169**	**3.3533**	-0.574	1.0983	0.7717	GDPPC1-	-0.003	**7.3978**	**9.0737**	-0.119	**3.1626**	2.4584
GDPPC1	(0.618)	**(0.005)**	**(0.001)**	(0.566)	(0.272)	(0.4403)	PEC1	(0.998)	**(0.000)**	**(0.000)**	(0.905)	**(0.002)**	(0.014)
PEC1-	-0.418	0.3054	**3.6107**	-0.481	-0.008	0.8841	Trade1-	**5.9738**	**9.6067**	**9.4179**	**5.3799**	**4.1867**	2.5963
Trade1	(0.676)	(0.760)	**(0.000)**	(0.630)	(0.996)	(0.3767)	PEC1	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	(0.009)
PEC2-	0.2502	**13.382**	**11.043**	0.0809	**5.6799**	**2.8914**	GDPPC2-	-0.722	**4.1620**	**5.3356**	-0.794	1.6200	1.2567
GDPPC2	(0.802)	**(0.000)**	**(0.000)**	(0.936)	**(0.000)**	**(0.0038)**	PEC2	(0.470)	**(0.000)**	**(0.000)**	(0.427)	(0.105)	(0.209)
PEC2-	**1.6528**	**2.9881**	**5.2806**	1.2879	1.0303	1.1379	Trade2-	**1.9164**	**3.5994**	**11.416**	1.5198	1.2915	2.8288
Trade2	**(0.098)**	**(0.003)**	**(0.000)**	(0.198)	(0.303)	(0.2552)	PEC2	**(0.055)**	**(0.000)**	**(0.000)**	(0.128)	(0.196)	(0.005)

Note: (1) H_0: The null is the Homogenous non Causality (HNC) hypothesis from X to Y and H_1: There is a causality relationship from X to Y for at least one cross section unit or a subgroup of individuals (i.e., Heterogeneous non causality (HENC) hypothesis). (2) Bold are significant test statistics at least with 10% significance level.

4.7 The estimating equations for the second objective and results

Since there is considerable heterogeneity in the development of energy intensities among Asian countries, we allow for unobserved effects in the estimation. To check the need for country specific effects, we carry out F-tests on poolability. Note that country specific effects in the difference equation imply country specific time trends in the equation in levels. The tests reject the null hypothesis that fixed effects are redundant in all cases. We then carry out Hausman tests for choosing between fixed and random effects, which show that random effects are consistent only in specification-A given below.[51] For each specification, we have used several models such as country specific fixed effects, country specific random effects, time specific fixed effects, time specific random effects, country and time specific fixed effects, and country and time specific random effects. In addition, for each alternative case we choose a model based on Hausman test. It is worthy to mention that, in principle, changes in the relative price of energy should be considered as they have an effect on the technology and the relative employment of input factors. Unfortunately, we were not able to obtain energy prices over the sample period for most of the developing countries. Nevertheless, it is possible to include worldwide changes in the energy prices indirectly via time-specific fixed effects. These effects are furthermore able to capture any other time specific influence that affects all countries in the sample in a similar way. In our parsimonious specification-A, we follow Mielnik and Goldemberg (2002) and explain the energy intensity by the variable FDI_{it}/I_{it}, i.e., FDI relative to total investment:

$$\text{A: } \Delta \ln EI_{it} = \alpha + \chi_i + \theta_t + \beta_1 \frac{FDI_{it}}{I_{it}} + \varepsilon_{it}$$

where α is the overall constant, χ_i are country-specific effects, and θ_t are period-specific effects. The error terms are denoted by ε_{it}. As in Mielnik and Goldemberg (2002), we do not include further control variables in this specification. This estimation, however, will suffer from an omitted variable bias if other determinants of energy intensity are partially correlated with FDI and not captured by the country or time specific effects. Therefore, we turn to specification-B

[51] The Hausman test examines the null hypothesis of inexistence of correlation between unobservable individual effects and the independent variables, against the alternative hypothesis of existence of correlation. If the null hypothesis is not rejected we can conclude that correlation is not relevant and therefore a panel model of random effects being the most correct way of carrying out the analysis. On the contrary, if the null hypothesis is rejected we can conclude that correlation is relevant and therefore a panel model of fixed effects being the most appropriate way to carrying out analysis.

that directly follows from Equation 3.106 and additionally includes a constant plus country-and time-specific effects. For the exact definition of the variables, see Table 3.1.

B: $\Delta \ln EI_{it} = \alpha + \chi_i + \theta_t + \beta_1 \Delta IND_{it} + \beta_2 I_{it} + \beta_3 FDI_{it} + \beta_4 IM_{it} + \beta_5 AID_{it} + \beta_6 \Delta \ln YPC_{it} + \varepsilon_{it}$

Throughout specification-B, we apply all models used in the specification-A, and the choice of final model is based on the *F*-test and the Hausman test. The pairwise correlations between explanatory variables are low so that multicollinearity should not be a problem.[52] The highest correlation of FDI with another variable is found regarding Aid with -0.32 (see Table 93.4 below for full correlation results). To be on the safer side, we always complement each regression by first omitting Aid and then omitting FDI. In these additional regressions, we find no significantly different results, hence we present the full spectrum of variables.

Table 93.4: Correlation statistics

	AID	DIND	DLNE	DLNEI	DLNY	DLNYPC	FDI	FDII	I	IM
AID	1									
DIND	-0.0057	1								
DLNE	-0.0083	0.174316	1							
DLNEI	0.10491	-0.02492	0.77316	1						
DLNY	0.04580	0.217095	0.021027	-0.40425	1					
DLNYPC	0.00902	0.178466	-0.05821	-0.05679	-0.1447	1				
FDI	-0.3261	0.103183	0.05901	-0.08685	0.02192	0.20865	1			
FDII	-0.2885	0.084105	-0.01643	-0.05725	-0.0551	0.28625	0.911391	1		
I	-0.4096	0.046639	0.140938	-0.10466	0.13941	-0.03644	0.189124	-0.043	1	
IM	-0.3283	0.0096	0.003216	0.040312	-0.052	-0.072268	0.4857	0.4083	0.3706	1

Table 94.4: Descriptive statistics

	DLNEI	DLNE	FDII	FDI	I	IM	DIND	AID	DLNY	DLNYPC
Mean	-0.012726	0.0429	15.643	1.5372	0.1002	0.1273	0.0983	0.00615	6.11E-06	0.395885
Median	-0.017838	0.0383	10.271	0.8731	0.0899	0.0960	0.0765	0.00350	0.00134	0.226849
Maximum	0.253116	0.3137	89.399	8.7629	0.2373	0.4245	3.1137	0.05855	0.02392	70.03043
Minimum	-0.242779	-0.1884	-42.05	-2.758	0.0423	0.0171	-4.116	-0.00286	-0.06114	-35.76377
Std. Dev.	0.055871	0.0507	17.451	1.734	0.0431	0.0942	1.0586	0.00938	0.010424	10.50897
Skewness	0.845079	0.7245	1.0812	1.331	0.9596	1.2825	-0.347	3.08373	-2.38296	0.800303
Kurtosis	6.838990	8.5590	4.9851	4.865	3.3253	4.1791	4.5558	13.4838	14.33233	11.35863
Jarque-Bera	191.3400	358.99	93.701	114.92	41.206	86.670	31.559	1608.93	1643.602	787.6607
(Probability)	(0.0000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.00000)	(0.0000)	(0.00000)

Descriptive statistics of the variables are presented in Table-94.4. The Jarque-Bera test statistic results show that all variables are non-normally distributed and Kurtosis statistics show

[52]The time series plots of the variables in the panel data set are presented in Appendix-E.

that all variables show positive excess Kurtosis indicating that the variables under consideration distribution has fatter tails than normal i.e., they are platykurtic.

It is, furthermore, noteworthy that due to the estimation in first differences, the regression is not able to capture those technological spillovers that occur only with a time-lag after the FDI inflow has been recorded. Knowledge transferred from abroad is likely to diffuse further within the country with a time delay. We also notice that GDP is part of the dependent variable and several explanatory variables. This is appropriate as long as the resulting intensity variables develop independently of GDP over time. If GDP fluctuates in the short-run while energy supply, FDI, imports, Aid, investment share, and the industry share adjust sluggishly, we can possibly detect a resulting correlation between energy intensity and the regressors, since they are all influenced by GDP fluctuations. Especially, if energy intensity is strongly affected by short-term GDP fluctuations, the effect of income, measured by GDP per capita, on energy intensity might be caused by the design of the variables.[53] In order to remedy the potential problems, we employ specification-B2, where we replace the values of all explanatory variables by their one-period lagged counterparts (B1 is the variant without time lags). This means that FDI inflows affect energy intensity in the year after the actual inflow.[54]

In the alternative specification, i.e., specification-C, we use total primary energy supply, *E*, as the dependent variable and replace Income Per Capita (*YPC*) by total GDP (denoted as *Y*) as an explanatory variable. In this case, GDP captures both the income-induced technique effect

[53]According to the Durbin–Wu–Hausman endogeneity test, we find that GDP per capita is endogenous. We therefore use a two-stage least squares (TSLS) estimation as a robustness check for specification B1 and employ GDP per capita lagged for one period as an instrument for current GDP per capita. Testing for the presence of a weak instrument by running a reduced form regression finds no indication of a weak instrument. The Sargan test for overidentification does not suggest including GDP per capita lagged for two periods as an additional instrument.
[54]Note that an inflow of FDI typically takes place at one specific point in time during the year. If the inflow is recorded at the end of the year it is reasonable that the effect on energy intensity takes place only in the following year. Furthermore, a lag of one year takes delayed spillovers at least partially into account.

and the scale effect without imposing the restriction of constant returns to scale.[55] An advantage compared with model-B is that GDP is no longer part of the dependent variable, therefore reducing distortions caused by short-term GDP fluctuations.

C: $\Delta \ln E_{it} = \alpha + \chi_i + \theta_t + \beta_1 \Delta IND_{it} + \beta_2 I_{it} + \beta_3 FDI_{it} + \beta_4 IM_{it} + \beta_5 AID_{it} + \beta_6 \Delta \ln Y_{it} + \varepsilon_{it}$

Nevertheless, there is still the possibility of an endogeneity bias, since the change in energy use might itself affect GDP or even FDI. Therefore, we again employ a second specification, i.e., specification-C2, where we replace the values of all explanatory variables by their one-year lagged counterparts, while C1 is without time lags.

4.7.1 The estimating equations for the second objective and results

The results referring to the specifications-A, -B, and -C are reported in Tables 95.4-99.4. For all the three specifications, we employ eight models. Model-1 is simply the polled OLS regression, Model-2 takes into account cross-country fixed effects, Model-3 takes into account cross-country fixed effects with country specific weights, Model-4 takes into account cross-country random effect, Model-5 takes into account period-specific fixed effect, Model-6 takes into account period-specific fixed effects with period weights, Model-7 takes into account period-specific random effect, and Model-8 takes into account cross-country and period-specific fixed or random effects depending upon the results of Hausman test.

[55] Note that including total income as well as per-capita income simultaneously would lead to a multicollinearity problem.

Table 95.4: Regression results for Model A

Panel data Models: Dependent variable DLNEI (Method of estimation POLS)								
Independent variables	Model 1 Pooling	Model 2 Fixed (CS)	Model 3 Fixed (CSW)	Model 4 Random (CS)	Model 5 Fixed (TS)	Model 6 Fixed (TSW)	Model 7 Random (TS)	Model 8 Random (Two-way)
FDII	-0.000172 [-0.866649]	-0.000350 [-1.454419]	-0.000421a [-2.704001]	-0.000282 [-1.261996]	-2.80E-05 [-0.131410]	-0.000128 [-0.851206]	-0.000117 [-0.587152]	-0.000217 [-0.947326]
C	-0.010050b [-2.167165]	-0.007279 [-1.449626]	-0.006169c [-1.898439]	-0.008343 [-1.162687]	-0.012290a [-2.618773]	-0.010726a [-3.275659]	-0.010904b [-2.019088]	-0.009342 [-1.192087]
Model summary								
Adjusted R-squared	-0.000958	0.064675	0.156613	0.002284	0.077722	0.077953	-0.002529	-0.000395
F-statistic	0.751081 (0.386936)	2.997597 (0.002060)	6.364522 (0.0000)	1.595243 (0.207715)	1.755542 (0.012649)	1.757977 (0.012464)	0.344209 (0.557921)	0.897427 (0.344356)
Tests of pool-ability (F-test)	2.8107 (0.005365)							
Cross-section random / SD (Rho)				0.015944/0.080				0.016230/0.0826
Period random							0.015707/0.079	0.016489/0.0853
Idiosyncratic random / SD (Rho)				0.054034/0.919			0.053656/0.921	0.051503/0.8321
Fixed Effects F-Tests (CS)		$F_{(8,251)}$ =3.2718***						
Fixed Effects F-Tests (TS)					$F_{(28,231)}$= 1.789128**			
Fixed effect F-test (CS and TS)								
Hausman test (Cross-section random)				0.576309 (0.4478)				0.410781 (0.5216)
Hausman test (Period random)							1.404795 (0.2359)	1.024813 (0.3114)
Hausman test (Cross-section and period random)								0.102258 (0.7491)
Cross-sections included	9	9	9	9	9	9	9	9
Total panel observations	261	261	261	261	261	261	261	261

Note: (1) ***, **, and *denote significance at 1, 5 and 10 % level of significance. (2) OLS, EF, RE, CS, PS, SD denotes ordinary least square, fixed-effect, random effect, cross-section, period specific, and standard deviation respectively. @ denotes White cross-section or White period standard errors & covariance (d.f. corrected).

Source: Author's calculation

From Table-95.4, it is evident that the F test is insignificant at even at a 10 % level of significance for pooled OLS model i.e., Model-1. Therefore, we discard this model and estimate model with country specific fixed effects, and find that now F-test is significant along with the F-tests for country specific fixed effects. Next, to decide between fixed and random effect models, we run country specific random effect model and calculate Hausman test and find that the null hypothesis of Hausman test is not rejected (see Model-4) indicating that the country specific random effect model is an appropriate way to carry out our analysis. Similarly, we tested a model for fixed period effect and random period effect and found that the null hypothesis of Hausman test is not rejected which indicated that we estimate a model with two-way random effect. However, when we estimate a model with two way-random effects, we find that the model is not a good fit as the *F*-test for model fit is not significant. Therefore, from specification-A, we could not draw any solid conclusion. The possible cause might be the problem of omitted variables bias, which we rectified in the specification-B and present results in Table-96.4.

The *F*-test for all coefficients jointly being zero is not rejected for polled OLS case (Model-1), country-specific random effect (Model-4) and period specific random effect (Model-7) in the specification-B1, but, the null hypothesis is rejected in all other cases. Further, the reported (adjusted) R^2 values are low even in all those models, which reject the *F*-test for all coefficients jointly being zero. One reason for the low explanatory power is that we estimate the equation in the first difference. The examination of the residuals' distributions reveals a very high Jarque–Bera statistics stemming from high kurtosis values in all cases. Since, this finding has rejected the normal distribution assumption of the residuals, the reported significance levels should be interpreted with some caution. We could not remedy this problem by redefining the estimation model, changing the sample size, or eliminating outliers. The Hausman test rejects the null hypothesis in the case of country-specific fixed effect indicating that the fixed effect model is preferred (see Model-4), but, the Hausman test does not reject the null hypothesis for period specific random effect indicating that the random effect model is appropriate for country-specific random effects (see Model-7) but *F*-test for model significance is insignificant. Hence, we draw our conclusions based on country-specific fixed effect model. Both Model-2 and Model-3 show that I and IM have negative and significant impact, and Model-3 (which is more parsimonious) indicates the negative and significant impact of DLNYPC. The hypothesis that new capital investment brings about energy saving technical progress is therefore accepted because I shows negative and significant impact. We also accept the hypothesis that both the income-induced technique effect and the scale effect are reducing energy intensity as GDP is significant with a negative sign. The hypothesis that imported energy also helps in reducing energy intensity is accepted as the coefficient of IM is significant and with a negative sign. Surprisingly, Aid inflows and FDI inflows are now showing significant impact on energy intensity indicating that these variables still do not play significant role in determining the energy intensity.

The F-test for all coefficients jointly being zero is rejected in all cases in this specification i.e., in specification-B2. Further, the reported (adjusted) R^2 values (see Table-97.4) are low in all these models in this case too. Since, the Hausman test rejects the null hypothesis in both cases, i.e., when country-specific random effect (see Model-4) and period specific random effects (see Model-7) are employed, it indicates two-way fixed effect model is the preferred model. Results of two-way fixed effects are reported in Model-8 which shows very interesting findings. The effect of DIND, FDI, and I is positive and significant (contrary to the findings of specification-B1), whereas, the impact of IM is negative and significant (which corroborates with the findings of specification-B1). Given that specification-B2 is more parsimonious theoretically, we take these findings for drawing our conclusions. Hence, the hypothesis that new capital investment brings about energy saving technical progress is challenged. It is, on the other hand, possible that the investment variable absorbs part of the composition effect. Since, energy-intensive sectors are typically also capital intensive, a strong increase in investment may reflect an expansion of the energy intensive sectors and could therefore lead to an increase in energy intensity. This view is supported by the fact that our existing measures of the composition effect, namely, the share of industrial value added in GDP, is rather crude and cannot capture all sectoral changes in the economy. Interestingly, FDI inflow increases the energy intensity indicating that higher FDI inflow does not bring the energy saving technologies, but, old and obsolete technologies. Further, insignificant coefficient of GDP also indicates that both the income-induced technique effect and the scale effect are reducing energy intensity.

The *F*-test for all coefficients jointly being zero is rejected in all cases (except case of polled OLS model, i.e., Model-1) in this specification i.e., in specification-C1 (see Table-98.4). Further, the reported (adjusted) R^2 values are low in all models and in this case too. Since, the Hausman test rejects the null hypothesis in both cases, i.e., when country-specific random effect (see Model-4) and period specific random effects (see Model-7) are employed. This indicates two-way fixed effect model is the preferred model in this specification, i.e., C1, as opposed to specification-B1. Results of the two-way fixed effects are reported in Model-8, which corroborates to the findings of specification-B2 (results reported in Table-97.4), except that in the specification-C1, FDI now becomes insignificant. Results reported in specification-C2 (in Table-99.4) is very much similar to the results reported in specification-C1 (in Table-98.4). Hence, both specifications of the model-C show that the effect of DIND and I is positive and significant, and the impact of IM is negative and significant. These results are confirmed by specification-B2. Hence, for DIND, I and IM, we have robust findings. However, for FDI we do not have robust findings, but, the coefficient of FDI in each model is positive which indicates that FDI does not bring energy saving technologies but the obsolete and old techniques. In the specification-B2, where changes in total energy intensity are examined, the coefficient of lagged

Table 96.4: Regression results for Model B (Type 1: without lag)

Panel data Models: Dependent variable DLNEI (Method of estimation POLS)								
Independent variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
	Pooling	Fixed (CS)	Fixed (CSW)	Random (CS)	Fixed (TS)	Fixed (TSW)	Random (TS)	Fixed (Two-way)
DIND	-0.000482 [-0.143798]	-0.001112 [-0.338266]	0.001765 [0.681760]	-0.000482 [-0.150511]	0.001484 [0.414478]	0.000667 [0.259901]	0.000119 [0.035598]	8.83E-08 [2.52E-05]
I	-0.143515 [-1.568305]	-0.410444b [-2.318873]	-0.308012c [-1.710534]	-0.143515 [-1.641523]	-0.104087 [-1.109599]	-0.099600 [-1.596755]	-0.129484 [-1.439392]	-0.116611 [-0.573072]
FDI	-0.003530 [-1.448774]	6.00E-05 [0.020245]	-0.001637 [-0.677048]	-0.003530 [-1.516411]	-0.001739 [-0.709288]	-0.001750 [-1.041140]	-0.002947 [-1.236814]	0.000922 [0.286395]
IM	0.092447b [2.037614]	-0.247547a [-2.948967]	-0.201863b [-2.066852]	0.092447b [2.132742]	0.088012c [1.954167]	0.036691 [1.284439]	0.090707b [2.055256]	-0.321076a [-2.902359]
AID	0.442663 [1.050293]	-0.319075 [-0.533507]	-0.131746 [-0.383825]	0.442663 [1.099326]	0.402364 [0.915519]	0.644924c [1.846183]	0.435480 [1.046332]	0.362860 [0.481702]
DLNYPC	-0.000137 [-0.394229]	-0.000374 [-1.097331]	-0.000505c [-1.797800]	-0.000137 [-0.412634]	-0.000283 [-0.785983]	-5.91E-05 [-0.230927]	-0.000187 [-0.544206]	-0.000486 [-1.369622]
C	-0.007196 [-0.635968]	0.062240a [2.872220]	0.04735b [2.366177]	-0.007196 [-0.665659]	-0.013225 [-1.165018]	-0.008612 [-1.079041]	-0.009293 [-0.820895]	0.036598 [1.533908]
Model summary								
Adjusted R-squared	0.013357	0.099409	0.149235	0.013357	0.083893	0.108196	0.009869	0.168956
F-statistic	1.584366 (0.152034)	3.042077 (0.000236)	4.245129 (0.00001)	1.584366 (0.207715)	1.697587 (0.013014)	1.924190 (0.002742)	1.430268 (0.20335)	2.253723 (0.000085)
Cross-section random / SD (Rho)				0.000000/0.000000				
Period random							0.013278/ 0.0580	
Idiosyncratic random / SD (Rho)				0.053062/1.0000			0.053517/ 0.9420	
Fixed Effects F-Tests (CS)		$F_{(8,245)}$ =4.0218***						$F_{(8,217)}$ =3.8788***
Fixed Effects F-Tests (TS)					$F_{(28,225)}$= 1.695709**			$F_{(28,217)}$ =1.7323**
Fixed effect F-test (CS and TS)								$F_{(36,217)}$ =2.3158***
Hausman test (Cross-section random)				30.435074 (0.0000)				0.410781 (0.5216)
Hausman test (Period random)							8.932462 (0.1774)	1.024813 (0.3114)
Hausman test (Cross-section and period random)								0.102258 (0.7491)

Note: (1) ***, **, and *denote significance at 1, 5 and 10 % level of significance. (2) OLS, EF, RE, CS, PS, SD denotes ordinary least square, fixed-effect, random effect, cross-section, period specific, and standard deviation respectively. @ denotes White cross-section or White period standard errors & covariance (d.f. corrected).

Source: Author's calculation

FDI inflows is positive and highly significant. According to the estimate, an increase of one percentage point in FDI intensity raises energy intensity supply by about 0.6 per cent. This finding is likely to stem from the scale effect. FDI inflows in the previous year induce increasing economic activity in the current year, which results in higher energy use. All other regressions do not confirm any significant effect of FDI on total energy use. Using our theoretical background, the results imply that it is not possible to identify a robust energy-reducing effect of technology transfer via FDI in this macro panel. The insignificant effect of Aid shows that energy-intensity reduction by Aid inflows is not in line with the expectations that industrialized donor countries promote energy-saving technologies in Asian countries.

Table 97.4: Regression results for Model B (Type 2: with lagged value)

Panel data Models: Dependent variable DLNEI (Method of estimation POLS)								
Independent variables	Model 1 Pooling	Model 2 Fixed (CS)	Model 3 Fixed (CSW)	Model 4 Random (CS)	Model 5 Fixed (TS)	Model 6 Fixed (TSW)	Model 7 Random (TS)	Model 8 Fixed (Two-way)
DIND	0.006438b [2.014903]	0.005465c [1.720946]	0.003793 [1.539015]	0.006438b [2.074362]	0.009073b [2.695112]	0.008515a [3.193483]	0.006438b [2.086477]	0.007459b [2.199256]
I	0.214814b [2.512325]	0.130594 [0.752189]	0.393284b [2.231184]	0.214814b [2.586462]	0.233222b [2.660798]	0.215449a [3.417832]	0.214814b [2.601568]	0.430488b [2.114285]
FDI	0.003583c [1.666538]	0.002924 [1.123119]	0.001197 [0.541535]	0.003583c [1.715716]	0.006099b [2.796485]	0.004877a [3.084572]	0.003583c [1.725737]	0.006057b [2.074720]
IM	-0.055172 [-1.317924]	-0.322838a [-4.167610]	-0.197893b [-2.279215]	-0.055172 [-1.35682]	-0.056889 [-1.35923]	-0.056499 [-2.044304]	-0.055172 [-1.364740]	-0.306838a [-2.927541]
AID	0.473134 [1.233156]	0.010846 [0.019181]	0.453923 [1.358410]	0.473134 [1.269546]	0.229279 [0.574892]	0.429363 [1.155920]	0.473134 [1.276961]	0.007988 [0.011119]
DLNYPC	0.247521 [0.785967]	0.361912 [1.147166]	0.045063 [0.139647]	0.247521 [0.809160]	0.300229 [0.831029]	0.230673 [0.732805]	0.247521 [0.813886]	0.302009 [0.810610]
C	0.019305c [1.841326]	0.065703b [3.127572]	0.023686 [1.227372]	0.019305 [1.895662]	0.014943 [1.421004]	0.017386b [2.144917]	0.019305c [1.906734]	0.028498 [1.186001]
Model summary								
Adjusted R-squared	0.038803	0.093116	0.063185	0.038803	0.103617	0.157265	0.038803	0.132451
F-statistic	2.682064 (0.015394)	2.833515 (0.000602)	2.204397 (0.00831)	2.682064 (0.01539)	1.875718 (0.004343)	2.413727 (0.00009)	2.682064 (0.01539)	1.930931 (0.001494)
Cross-section random / SD (Rho)				0.000000/ 0.000000				
Period random							0.000000/ 0.0000	
Idiosyncratic random / SD (Rho)				0.048539/ 1.0000			0.048257/ 1.0000	
Fixed Effects F-Tests (CS)		$F_{(8,236)}$ =2.82663**						$F_{(8,209)}$ =1.9015*
Fixed Effects F-Tests (TS)					$F_{(27,217)}$= 1.653**	$F_{(27,217)}$=1.882406**		$F_{(27,209)}$ =1.3963
Fixed effect F-test (CS/TS)								$F_{(35,209)}$ =1.753**
Hausman test (Cross-section random)				20.96747 (0.0009)				
Hausman test (Period random)							24.46639 (0.0004)	
Hausman test (Cross-section and period random)								

Note: (1) ***, **, and *denote significance at 1, 5 and 10 % level of significance. (2) OLS, EF, RE, CS, PS, SD denotes ordinary least square, fixed-effect, random effect, cross-section, period specific, and standard deviation respectively. @ denotes White cross-section or White period standard errors & covariance (d.f. corrected).

Source: Author's calculation

On the contrary, the investment share of GDP, labelled as I, is significantly positive in all specifications. The increase in Gross investment of 1 per cent of GDP, increases the energy intensity or total primary energy supply by about more than 40 per cent. The hypothesis that new capital investment brings about energy saving technical progress is, therefore, challenged.

Table 98.4: Regression results for Model C (Type 1: without lagged value)

Panel data Models: Dependent variable DLNE (Method of estimation POLS)								
Independent variables	Model 1 Pooling	Model 2 Fixed (CS)	Model 3 Fixed (CSW)	Model 4 Random (CS)	Model 5 Fixed (TS)	Model 6 Fixed (TSW)	Model 7 Random (TS)	Model 8 Fixed (Two-way)
DIND	0.007841b [2.585752]	0.006934b [2.275605]	0.006895b [2.966891]	0.007801b [2.618690]	0.008180b [2.475690]	0.007701a [2.902387]	0.007841b [2.634698]	0.006627b [1.978149]
I	0.220300b [2.636336]	0.222160 [1.304877]	0.458754b [2.718364]	0.221653b [2.655878]	0.237542b [2.728332]	0.219794a [3.581380]	0.220300b [2.686239]	0.497823b [2.491074]
FDI	0.002157 [1.022781]	0.000892 [0.347422]	-0.000905 [-0.422840]	0.002131 [1.021386]	0.004704b [2.160682]	0.004528b [2.867254]	0.002157 [1.042141]	0.004293 [1.478763]
IM	-0.046528 [-1.155506]	-0.271921a [-3.560586]	-0.171134b [-2.012529]	-0.048887 [-1.217829]	-0.050555 [-1.235437]	-0.050921c [-1.910129]	-0.046528 [-1.177379]	-0.247196b [-2.355570]
AID	0.357185 [0.941038]	-0.083803 [-0.151418]	0.322484 [1.040047]	0.352052 [0.933002]	0.146671 [0.364162]	0.339239 [0.932169]	0.357185 [0.958850]	-0.176526 [-0.247802]
DLNY	-0.252497 [-0.814493]	-0.167617 [-0.531257]	-0.418593 [-1.318251]	-0.251628 [-0.826684]	-0.386531 [-1.074915]	-0.304546 [-1.064865]	-0.252497 [-0.829911]	-0.427934 [-1.142073]
C	0.020617 [2.010501]	0.053924b [2.605631]	0.017646 [0.954101]	0.020857b [2.036056]	0.016769 [1.601878]	0.017723c [2.255363]	0.020617b [2.048558]	0.018576 [0.782339]
Model summary								
Adjusted R-squared	0.034779	0.070443	0.072116	0.033906	0.070309	0.134411	0.034779	0.093174
F-statistic	2.555411 (0.20236)	2.401952 (0.00367)	2.437835 (0.00316)	2.514975 (0.02211)	1.576091 (0.02831)	2.182888 (0.00041)	2.555411 (0.02024)	1.633611 (0.013206)
Cross-section random / SD (Rho)				0.002043/ 0.0017				
Period random							0.000000/ 0.0000	
Idiosyncratic random / SD (Rho)				0.048865/ 0.9983			0.048868/ 1.0000	
Fixed Effects F-Tests (CS)		$F_{(8,245)}$ =2.213**						$F_{(8,217)}$ =1.70917*
Fixed Effects F-Tests (TS)					$F_{(28,225)}$= 1.34531			$F_{(28,217)}$ =1.2193
Fixed effect F-test (CS/TS)								$F_{(36,217)}$ =1.4526**
Hausman test (Cross-section random)				15.34129 (0.0178)				
Hausman test (Period random)							18.489415 (0.0051)	
Hausman test (Cross-section and period random)								
Note: (1) ***, **, and *denote significance at 1, 5 and 10 % level of significance. (2) OLS, EF, RE, CS, PS, SD denotes ordinary least square, fixed-effect, random effect, cross-section, period specific, and standard deviation respectively. @ denotes White cross-section or White period standard errors & covariance (d.f. corrected).								
Source: Author's calculation								

It is on the other hand that the investment variable absorbs part of the composition effect. Since, energy-intensive sectors are typically also capital intensive, a strong increase in investment may reflect an expansion of the energy intensive sectors and could therefore lead to an increase in energy intensity. Further, the composition effect has a positive effect on energy intensity and total energy supply. In other words, for the share of industrial value added in GDP, we always find a positive and significant sign, which indicates that the sectoral change between

Table 99.4: Regression results for Model C (Type 2: with lagged value)

Panel data Models: Dependent variable DLNE (Method of estimation POLS)								
Independent variables	Model 1 Pooling	Model 2 Fixed (CS)	Model 3 Fixed (CSW)	Model 4 Random (CS)	Model 5 Fixed (TS)	Model 6 Fixed (TSW)	Model 7 Random (TS)	Model 8 Fixed (Two-way)
DIND	0.007841b [2.585752]	0.006934b [2.275605]	0.006895b [2.966891]	0.007801b [2.618690]	0.008180b [2.475690]	0.007701a [2.902387]	0.007841b [2.634698]	0.006627b [1.978149]
I	0.220300b [2.636336]	0.222160 [1.304877]	0.458754b [2.718364]	0.221653b [2.655878]	0.237542b [2.728332]	0.219794a [3.581380]	0.220300b [2.686239]	0.497823b [2.491074]
FDI	0.002157 [1.022781]	0.000892 [0.347422]	-0.000905 [-0.422840]	0.002131 [1.021386]	0.004704b [2.160682]	0.004528b [2.867254]	0.002157 [1.042141]	0.004293 [1.478763]
IM	-0.046528 [-1.155506]	-0.271921a [-3.560586]	-0.171134b [-2.012529]	-0.048887 [-1.217829]	-0.050555 [-1.235437]	-0.050921c [-1.910129]	-0.046528 [-1.177379]	-0.247196b [-2.355570]
AID	0.357185 [0.941038]	-0.083803 [-0.151418]	0.322484 [1.040047]	0.352052 [0.933002]	0.146671 [0.364162]	0.339239 [0.932169]	0.357185 [0.958850]	-0.176526 [-0.247802]
DLNY	-0.252497 [-0.814493]	-0.167617 [-0.531257]	-0.418593 [-1.318251]	-0.251628 [-0.826684]	-0.386531 [-1.074915]	-0.304546 [-1.064865]	-0.252497 [-0.829911]	-0.427934 [-1.142073]
C	0.020617 [2.010501]	0.053924b [2.605631]	0.017646 [0.954101]	0.020857b [2.036056]	0.016769 [1.601878]	0.017723c [2.255363]	0.020617b [2.048558]	0.018576 [0.782339]
Model summary								
Adjusted R-squared	0.034779	0.070443	0.072116	0.033906	0.070309	0.134411	0.034779	0.093174
F-statistic	2.555411 (0.20236)	2.401952 (0.00367)	2.437835 (0.00316)	2.514975 (0.02211)	1.576091 (0.0283)	2.182888 (0.00041)	2.555411 (0.02024)	1.633611 (0.01321)
Cross-section random / SD (Rho)				0.002043/ 0.0017				
Period random							0.000000/ 0.0000	
Idiosyncratic random / SD (Rho)				0.048865/ 0.9983			0.048868/ 1.0000	
Fixed Effects F-Tests (CS)		$F_{(8,245)}$ =2.213**						$F_{(8,217)}$ =1.7092*
Fixed Effects F-Tests (TS)					$F_{(28,225)}$= 1.34531			$F_{(28,217)}$ =1.2194
Fixed effect F-test (CS/TS)								$F_{(36,217)}$ =1.453**
Hausman test (Cross-section random)				15.3413 (0.0178)				
Hausman test (Period random)							18.4894 (0.0051)	
Hausman test (Cross-section and period random)								

Note: (1) ***, **, and *denote significance at 1, 5 and 10 % level of significance. (2) OLS, EF, RE, CS, PS, SD denotes ordinary least square, fixed-effect, random effect, cross-section, period specific, and standard deviation respectively. @ denotes White cross-section or White period standard errors & covariance (d.f. corrected).

Source: Author's calculation

the industrial sector on the one hand and agriculture or services on the other hand, has almost the same importance as the sectoral changes within the industrial sector. To be specific, our existing measure of the composition effect, namely, the share of industrial value added in GDP, is a suitable measure and can capture all sectoral changes in the economy. The insignificant impact of changes in GDP per-capita (income-induced technique effect) or GDP (scale effect) may be due to short-term fluctuations in GDP or GDP per-capita, where energy intensity is defined as energy supply over GDP, typically moves in the opposite direction to that of GDP, and if a longer-term influence really existed, we would find a significant result in all specifications, but this is not found to be the case. Thus, we conclude that the income-induced technique effect and the scale effect show an indeterminate effect on energy intensity or total energy saving. Finally, yet importantly, the hypothesis that imported energy is also helping in reducing energy intensity is also accepted, as the coefficient of IM is significant with a negative sign.

4.7.2 The Empirical results of PSTR models

Before we proceed to analyze the PSTR model, we test the stationarity of the variables and the results are presented below in Table-100.4. Panel unit root tests were also conducted for both specifications. The panel unit root tests employed are the Im et al. (2003) and the Levin, Lin and Chu (2002) (LLC). The LLC test assumes parameter homogeneity, meaning, it suffers from heterogeneity bias as opposed to the IPS, which allows for individual unit root processes and thus heterogeneous parameters. Therefore, IPS is the preferred test. However, LLC unit root test results confirm IPS test results, with exception to the FDII variable, where the IPS statistic indicates that the panel is stationary, and the LLC test finds the panel non-stationary.

Table 100.4: Panel unit root results

Panel unit root tests	DLNE	DLNEI	DIND	DLNY	DLNYPC SIC: 0 to 5	I	FDII SIC: 0 to 6	FDI SIC: 0 to 6	IM SIC: 0 to 3	AID SIC: 0 to 2
Levin, Lin and Chu t*-stat	-8.1511 (0.0000)	-8.85676 (0.0000)	-9.1416 (0.0000)	-9.1775 (0.0000)	-4.81311 (0.0000)	0.27151 (0.6070)	0.04082 (0.5163)	2.63363 (0.9958)	-0.33687 (0.3681)	-7.05042 (0.0000)
Breitung t-stat	-3.4812 (0.0002)	-7.42484 (0.0000)	-3.7131 (0.0001)	-6.5285 (0.0001)	-3.14150 (0.0001)	0.21253 (0.5842)	3.88738 (0.9999)	5.34719 (1.0000)	0.79946 (0.7880)	-0.81286 (0.2081)
Im, Pesaran and Shin W-stat	-8.445 (0.0000)	-8.89414 (0.0000)	-9.4946 (0.0000)	-8.6198 (0.0000)	-9.76915 (0.0000)	0.50945 (0.6948)	-2.2648 (0.0118)	-0.24052 (0.4050)	-0.55629 (0.2890)	-4.89515 (0.0000)
ADF - Fisher Chi-square	94.5971 (0.0000)	98.5951 (0.0000)	105.224 (0.0000)	94.7636 (0.0000)	116.726 (0.0000)	11.9269 (0.8510)	38.4844 (0.0033)	33.9695 (0.0127)	26.2639 (0.0939)	62.2979 (0.0000)
PP - Fisher Chi-square	93.8667 (0.0000)	117.536 (0.0000)	103.732 (0.0000)	95.2212 (0.0000)	600.176 (0.0000)	9.48057 (0.9475)	27.0129 (0.0788)	19.9329 (0.3366)	24.2905 (0.1457)	61.0123 (0.0000)

Note: Individual effects, individual linear trends; Automatic lag length selection based on SIC: 0 to 1 for rest of variables where it is not defined; Newey-West automatic bandwidth selection and Bartlett kernel. ** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

The results reported in Table-100.4 show that all variables included in the models are stationary, except, FDII, FDI and IM. Further, to test the robustness of results for these variables, we utilized two panel unit root tests that incorporate structural breaks and found that variables are stationary. Therefore, we proceed to estimate our PSTR model first by testing for the presence of linearity, and then for no remaining non-linearity and present the results in Table-101.4 and Table-102.4, respectively. The linearity tests result show that the null hypothesis that the model is linear is rejected for all three tests for both models, implying that the relationship between energy and FDI inflow in the Asian countries is indeed nonlinear.

Table 101.4: Linearity test

	Model 1		**Model 2**	
Test	Statistics	P-value	Statistics	P-value
Lagrange multiplies-Wald Tests (LM):	33.270	0.001	36.394	0.006
Lagrange multiplies-Fisher Tests (LMF):	2.923	0.001	2.107	0.006
Likelihood ratio-LRT Tests (LRT):	35.600	0.000	39.208	0.000
H0: Linear Model H1: PSTR model with at least one Threshold Variable (r=1)				

Table-102 presents the results of tests for no remaining non-linearity after assuming a two-regime model. The results indicate that the null hypothesis cannot be rejected, implying that the model has only one threshold or two regimes. This implies that in the Asian countries, there is only one threshold level of energy consumption, which separates the low FDI inflow regime and high FDI inflow regime.

Table 102.4: Testing the number of regimes-tests of no remaining non-linearity

	Model 1		Model 2	
Test	Statistics	P-value	Statistics	P-value
Lagrange multiplies-Wald Tests (LM):	16.796	0.157	11.244	0.884
Lagrange multiplies-Fisher Tests (LMF):	1.306	0.216	0.555	0.928
Likelihood ratio-LRT Tests (LRT):	17.363	0.136	11.495	0.872
H0: PSTR with r = 1 against H1: PSTR with at least r = 2				

We present results in Table-103.4 for the estimated model parameters. In line with expectations, the threshold level is found to be a single-digit figure of 1.106% for the Asian countries for Model-2. The fact that the estimated threshold level is at single-digit may be attributable to the notion that Asian countries, as being classified under non-industrialized, low income, or developing countries, share similar economic characteristics and pursue similar macroeconomic policies as other developing regions around the world, hence the economic conditions may be similar. In particular, many developed and developing countries across the world have all adopted policies to promote FDI inflow and reduce energy consumption. Hence, some macroeconomic conditions in the Asian countries are similar to the conditions transpiring in developing countries elsewhere.

Table-103.4 present the results obtained from estimation of two models. The results obtained from the Model-1 show that in both the regimes there is some difference. In the first regime, i.e., low FDI inflow regime, ∆IND, IM and AID has a negative and significant impact on EI, and FDI has a positive impact on EI. However, in the second regime ∆IND, and AID show positive and significant impact on EI while FDI shows negative and significant impact. Hence, from the results of Model-1 some interesting findings emerge, such as: (a) in low FDI inflow regime impact of ∆IND, IM and AID is negative, whereas FDI and EI show positive impact; (b) in high FDI inflow regime ∆IND, and AID show positive impact, and FDI show negative impact. Thus, the variable that shows positive impact of EI in the low FDI inflow regime has negative and significant impact of EI in high FDI inflow regime and vice-versa. The coefficient for the threshold variable (FDI) is positive in the first regime, and negative in the second regime, and statistically significant in the low and high FDI inflow regime, indicating that the effect of FDI inflow on *EI* is statistically significant when the FDI inflow is below or above the threshold level of 0.209%. The IND and AID have a negative and significant impact on EI in low FDI inflow regimes, indicating that higher levels of investment and AID assistance do not necessarily lead to higher energy intensity. To make these investment effective and productive, governments should put efforts to promote FDI inflow and once this is done, one can realize the positive impact of these investments. Another interesting fact it that in order to realize significant positive impact of IM on EI, the governments of Asian countries need to put some extra effort on developing sound import policies together with attracting high FDI inflow.

Table 103.4: PSTR model estimation

Variable	Model 1: Dependent variable- ΔlnEI B0	B1	Model 2: Dependent variable- ΔlnE B0	B1
ΔIND	-0.0297***	0.0308*	0.0046	-0.0188***
	[-1.9333]	[1.6722]	[0.5351]	[-2.2563]
I	0.0031	-0.0056	0.0096	-0.0063
	[0.1716]	[-0.2398]	[1.4802]	[-0.6948]
FDI	1.1257***	-1.9705***	-0.3106	0.9444***
	[2.9393]	[-3.4709]	[-1.1464]	[3.4633]
IM	-0.3665**	0.0089	-0.5411***	0.2203**
	[-1.7045]	[0.0356]	[-4.2565]	[1.8173]
AID	-10.1567**	10.4791*	0.5042	-3.2580
	[-1.7143]	[1.6880]	[1.2107]	[-1.2689]
ΔlnYPC/ΔlnY	-0.0015	0.0017	-1.8074***	2.3455***
	[-0.8573]	[0.6686]	[-2.4776]	[2.9163]
Transition parameters				
Threshold (c)	0.2095		1.1061	
Slope (gama)	3.5438		1.2925	
Standard Errors of Estimated Parameters Corrected of Heteroskedasticity (per column for each transition function				

The results obtained from the Model-2 show that in both regimes there is some difference. In the first regime, i.e., low FDI inflow regime, IM and GDP have a negative and significant impact on E. However, in the second regime, only ΔIND shows the negative and significant impact on E, and FDI, IM and GDP have a positive and significant impact on *E*. The coefficient for the threshold variable (FDI) is positive in the first regime (but not significant), and negative and statistically significant in the second regime, indicating that the effect of FDI inflow on E is statistically significant when the FDI inflow is above the threshold level of 1.106%. The IND has a negative and significant impact on E in the high FDI inflow regimes, indicating that higher levels of investment do not necessarily lead to higher energy intensity, given that FDI inflow is above the threshold level of 1.106%. Further, IM and GDP have a negative and significant impact on E in the low FDI inflow regimes, indicating that higher levels of imports and GDP do not necessarily lead to higher energy intensity. Interestingly, IM and GDP have a positive and significant impact on E in the high FDI inflow regimes, indicating that higher levels of imports and GDP may lead to higher energy intensity if *the* FDI *inflow* is above the threshold level of 1.106%. Hence, our findings show that the impact of FDI and other variables highly depends upon the level of the threshold of FDI inflow. However, whatever may be the threshold level for FDI inflow, in low FDI inflow regime, IM shows negative impact, and in the high FDI inflow regime IM shows positive impact on energy intensity.

Finally, we also estimated a PSTR model with total technology transfer (hereafter TT, which is defined as the sum of AID, FDI and IM) and the results show that in the low TT regime, income induced and scale effect is significant with the expected sign but not in the high TT regime. Negative and significant impact of TT is found in high TT regime in both specifications. Please refer to Appendix -F for all results related to this analysis.

CHAPTER V
CONCLUSIONS, POLICY RECOMMENDATIONS AND LIMITATIONS

The present chapter is organized into four sections. The first section deals with the conclusions drawn from the empirical analysis carried out in the study. We also discuss here the policy recommendation and give suggestions. The second section presents the limitations of the study, and finally the future scope of the study has been discussed.

5.1 Conclusions and policy implications

From the unit root analysis of the level data, we find that: (1) in Bangladesh, HYD, Trade, ELEP-HYD, ELEP-Oil and ELEP-Rene are the stationary variables; (2) in China, PEC, Trade, ELEP-Coal, ELEP-NG, ELEP-PEC and EU are the stationary variables; (3) in China HKSAR, no stationary variable is found; (4) in India, NG and ELEP-Coal are found to be the stationary variables; (5) in Indonesia, HYD, ELEP-HYD, ELEP-NG and EU are the stationary variables; (6) in Japan, HYD, NEC, ELEP-HYD, ELEP-Oil and ELEP-Rene are the stationary variables; (7) in Malaysia, GDP, NG, ELEP-HYD, ELEP-NG, ELEP-Oil, ELEP-Rene and EU are the stationary variables; (8) in New Zealand, HYD, GDP, Trade, NG, ELEP, ELEP-HYD, ELEP-NG, ELEP-Oil and ELEP-Rene are the stationary variables; (9) in Pakistan, HYD, ELEP-Coal and ELEP-HYD are the stationary variables; (10) in Philippines, HYD, ELEP-Coal and ELEP-HYD are the stationary variables; (11) in Singapore, GDP, Trade and EU are the stationary variables; (12) in South Korea, PEC, CO_2emissions, HYD, ELEP-HYD, ELEP-Rene and EU are the stationary variables; (13) in Taiwan, NGC and NEC are the stationary variables and; (14) in Thailand, PEC, HYD, Trade, NGC, ELEP-HYD and ELEP-Rene are the stationary variables.

From the unit root analysis of the decomposed level data, we find that:[56] (1) in Bangladesh, Trade and ELEP-EPC are the stationary variables; (2) in China, CO_2 emissions,

[56]Note that here we say stationarity is present in a variables when at least a decomposed component of the said variable is stationary.

GDP, Coal, Trade, ELEP, ELEP-Coal, ELEP-Oil, ELEP-EPC, ELEP-Rene, EU, NG, and PEC are the stationary variables; (3) in China HKSAR, EU is the stationary variable; (4) in India, Trade, ELEP-Coal, ELEP-HYD, ELEP-NG, ELEP-Rene and HYD are the stationary variables; (5) in Indonesia, Trade is the only stationary variable; (6) in Japan, GDP, Trade, ELEP-Coal, ELEP-HYD, ELEP-Rene, ELEP-EPC and HYD are the stationary variables; (7) in Malaysia, ELEP and ELEP-HYD are the stationary variables; (8) in New Zealand, Coal, Trade, ELEP, ELEP-Coal, ELEP-HYD, ELEP-NG, ELEP-Rene, ELEP-EPC, NG and HYD are the stationary variables; (9) in Pakistan, Trade, ELEP-NG and EU are the stationary variables; (10) in Philippines, ELEP, ELEP-Rene, ELEP-EPC and HYD are the stationary variables; (11) in Singapore, Trade and EPC are the stationary variables; (12) in South Korea, Trade, ELEP-NG and NG are the stationary variables; (13) in Taiwan, HYD is the only stationary variable and; (14) in Thailand, Trade, ELEP-NG, ELEP-Oil and NU are the stationary variables.

From the above unit root results, the following (research/policy) implications can be drawn. First, if in any country, any of the energy consumption/production variable is mean (or trend) reverting, then it follows that the series will return to its mean value (or trend path) and it might be possible to forecast future movements in the series based on past behaviours. Second, for future studies related to energy consumption/production (or its variants), structural breaks should be taken into account to obtain reliable results. Third, in order to examine the long - run relationship or Granger-causality, say between per capita energy consumption/production and per capita GDP, the obtained results can be taken for granted. Fourth, for the cases where we find at least one component of the decomposed series as stationary, the observed asymmetry in their estimation procedure has to be taken into account while forecasting that series. Fifth, the observed asymmetry should also be taken into account while studying the long-run relationship.

Further, to draw conclusion from the Granger-causality analysis between economic growth and energy components and CO_2 emissions, we summarize the results and present in Table-1.5. In terms of the hypotheses formulated (in Chapter III) on the relationship between energy consumption/production and economic growth, columns 3 and 5 present all those cases where the growth hypothesis is supported, and columns 4 and 6 present the cases where conservation hypothesis is supported. The word "None" reported in Table-1.5 denotes the cases where neutrality hypothesis is supported. Similarly, the presence of common countries in the columns 3 and 4, and column 5 and 6 in Table-1.5 indicates the evidence of bi-directional causal relationship for such countries. To be precise, the evidence of bidirectional causal relationship among the countries is shown with the bold letters. For example, in columns 3 and 4, for NG we find evidence of bidirectional causality only in case of Bangladesh (shown by bold letters), however, if we look at columns 5 and 6, we find evidence of bidirectional causality for China, New Zealand and Pakistan. Overall, our results of columns 5 and 6 (asymmetric causality) indicate that the policymakers of Asian countries have to carefully consider the inherent asymmetric nature of the data while formulating the policies related to energy consumption/production and economic growth. The countries which show evidence of a bidirectional causal relation for some of the energy variants suffer from the policy dilemma in formulating appropriate energy and/economic growth related policy.

Table 1.5: Summary results of Granger-causality analysis between energy variants and growth

No.	Variables (Z)	**Results for level data** From Z to Y	From Y to Z	**Results for decomposed data** From Z to Y	From Y to Z
1	PEC	Thailand	**India**, Japan, Pakistan, and South Korea	**India(1)**, **Japan(2), and New Zealand(2)**	China(1), **Japan(1), and New Zealand(1)**
2	CO_2 emissions	Thailand	**Japan**, Pakistan, and South Korea	**China(1)**, **Japan(2)**, and New Zealand (2)	**China(2)**, India(1), and **Japan(3)**
3	HYD	Malaysia, and Thailand	New Zealand	China(1), Indonesia(2), **Japan(1)**, and South Korea (1)	India(1), and **Japan (1)**
4	Coal	None	India, **Pakistan**, and Philippines	**Pakistan (1)**	China (1), India(3), and **Pakistan (3)**
5	NG	**Bangladesh**, India, and **New Zealand**	**Bangladesh**, Japan and **Pakistan**	**China (1)**, India(3), **New Zealand(1)**, **and Pakistan(2)**	**China(1), New Zealand(2), Pakistan(1)** and Taiwan(1)
6	NU	None	Taiwan	None	India(2)
7	ELEP	India, and South Korea	China, and Malaysia	**Bangladesh (1), and Philippines (1)**	**Bangladesh(1)**, Indonesia(1), New Zealand (1), **and Philippines (2)**
8	ELEP-Coal	None	China, and India	**Japan (1)**	**Japan (1)**, New Zealand (1), and South Korea (1)
9	ELEP-HYD	**Bangladesh**, China, **Malaysia**, and Thailand	Indonesia	**India (1)**	**Bangladesh(1)**, **India(1)**, Japan(1), **Malaysia(1)**, New Zealand(1), Pakistan (2), and Philippines (2)
10	ELEP-NG	Bangladesh	Pakistan	None	Japan (1)
11	ELEP-NU	None	South Korea	**India(1)**	**India(1)**
12	ELEP-Oil	None	Pakistan, Singapore, and **South Korea**	**India(1),** New Zealand(1), **Philippines (1), and South Korea (1)**	Bangladesh(1), China HKSAR(1), **India(1)**, **Philippines(2), and South Korea(1)**
13	ELEP-Rene	China, and **Malaysia**	New Zealand	**India(1)**, Indonesia(1), and South Korea(1)	Bangladesh (1), **India(1)**, Japan(1), **Malaysia(1)**, and Philippines (1)
14	EPC	India, **Malaysia**, and South Korea	**Bangladesh**, and **Malaysia**	**Bangladesh(1), and Japan(1)**	**Bangladesh (1), Japan(1)**, New Zealand(2), and Philippines (1)
15	Energy use	Malaysia, Pakistan, and **Philippines**	India, **Philippines**, and South Korea	China HKSAR(1), **Japan(2)**, Malaysia(1), and New Zealand(2)	China (1), **Japan(1)**, and **Philippines(1)**

Note: In the parenthesis numbers 1,2,…4 denotes the number of significant asymmetric Granger-causal relationships found in the associated country. Bold are the countries which confirms either the Growth or conservation hypothesis in both cases i.e., when causality is tested between energy variants and GDP (Y).

Similarly, to draw conclusion from the Granger-causality analysis between energy variants and Trade, we summarize the results and present them in Table-2.5. In terms of the hypothesis formulated (in Chapter III) for the relationship between energy consumption/production and Trade, columns 3 and 5 present all those cases where growth hypothesis is supported, and columns 4 and 6 present results of all those cases where conservation hypothesis is supported. The word "None" reported in Table-2.5 denotes the cases where neutrality hypothesis is supported. Similarly, the presence of common countries in the columns 3 and 4, and column 5 and 6 in Table-2.5 indicates evidence of bi-directional causal relationship for such countries. To be precise, the evidence of bidirectional causal relationship among the countries is shown with the bold letters. For example, in columns 3 and 4, for PEC, we find evidence of bidirectional causality only in case of Japan and New Zealand, however, if we look at columns 5 and 6, we find evidence of bidirectional causality in Philippines. Overall, our results of columns 5 and 6 (asymmetric causality) indicate that the policymakers of Asian countries have to carefully consider the inherent asymmetric nature of the data while formulating the policies related to energy consumption/generation and to openness. Therefore the policy implication is that where the growth hypothesis is supported, reducing energy consumption/production could impede attempts to develop a diversified (non-oil) trade, especially in the export sector. On the other hand, the cases where evidence of Granger-causality running from Trade to energy consumption/production or no Granger causality in either direction (countries in the columns 4 and 6, ignoring the countries with bold letters as they show evidence of bidirectional causal relationship) is found, energy conservation policies can be expected to have no adverse effect on openness. Thus, countries may formulate their energy and external sector policies which demand less energy provided they do not hamper the economic growth, such as Japan, for PEC. To be very precise, in columns 3 and 4 of Tables-1.5 and -2.5, the bold values are the cases where growth and conservation hypothesis, respectively, is supported when we do not take into account the asymmetry. On the other hand, the columns 5 and 6 reported the cases where the asymmetry is taken into account.

In terms of country specific cointegration analysis and Granger-causality findings, we report and summarize the results in Tables 3.5 and 3.6, respectively. The results reported in Table-3.5 have the long run policy implications with respect a particular variable concerned where we observe at least a cointegration relation.

Table 2.5: Summary results of Granger-causality analysis energy variants and trade

		Results for original data		Results for decomposed data	
No.	Variables (Z)	From Z to T	From T to Z	From Z to T	From T to Z
1	PEC	Bangladesh, China HKSAR, **Japan, and New Zealand**	China, Indonesia, **Japan, New Zealand**, and Thailand	China HKSAR(1), India(1), and **Philippines (1)**	**Philippines(2)**, and Singapore(1)
2	HYD	**Bangladesh**, and China	India, **Indonesia**, and Japan.	Bangladesh(1), **Indonesia(1)**, South Korea(1) and **Thailand(2)**	India(2), Japan(1), New Zealand(1), and **Thailand(1)**
3	Coal	Bangladesh, **New Zealand**, and Thailand	China, **Japan, and New Zealand**	**Japan(1), Pakistan(1)**, and Philippines(1)	India(1), and **Pakistan(1)**
4	NG	India, and Malaysia	New Zealand	India(2)	None
5	NU	None	**Japan**	**India(1), and Japan(1)**	**India(2)**
6	ELEP	**China**, and Philippines	**China**, Malaysia, New Zealand, and **Pakistan**	**Bangladesh(1)**, and Philippines(1) **Pakistan(1)**	**Bangladesh(1)** and Japan(2)
7	ELEP-Coal	New Zealand, and South Korea	None	Pakistan(3), South Korea(1), and **Thailand(1)**	Japan(1), Philippines(1), and **Thailand(1)**
8	ELEP-HYD	**Bangladesh** and China	**Bangladesh, India, Japan** and Pakistan	**India(2), Indonesia(1), Japan(1)**, and Philippines(1)	**Indonesia(2), Japan(1),** Malaysia(1), Pakistan(1), and Thailand(1)
9	ELEP-NG	**New Zealand**	**New Zealand**	**India(1)**	**India(2)**
10	ELEP-NU	**Pakistan**	None	**India(2),** Japan(1), and **Pakistan(1)**	**India(2), and Pakistan(1)**
11	ELEP-Oil	Malaysia, New Zealand, and Philippines	Japan, **Pakistan**, and Singapore.	**Pakistan(1),** and Thailand(1)	China HKSAR(1), India(1),Japan(2), and **Pakistan(1)**
12	ELEP-Rene	**Bangladesh**, and China	**Bangladesh**, **India, Indonesia**, and New Zealand	**India(2), Indonesia(1),** Japan(1), **Pakistan(1),** Philippines(1), and South Korea(1)	**Indonesia(1)**, Malaysia(1), **Pakistan(1)**, and Thailand(1)
13	EPC	China HKSAR, and Malaysia	China, **Japan**, **Pakistan,** and Singapore	Bangladesh(2), **Japan(1), Pakistan(1), and Philippines(1)**	**Japan(2)**, **Pakistan(2), and Philippines(2)**
14	Energy use	Japan, **Malaysia,** New Zealand and **Thailand**	**China HKSAR.**	**China HKSAR(1), Philippines(1)**, **and Thailand(1)**	**China HKSAR(1)**, India(1), Indonesia(1), **Malaysia(1)**, Pakistan(1) and **Philippines(1)**

Note: In the parenthesis numbers 1,2,…4 denotes the number of significant asymmetric Granger-causal relationships found in the associated country. Bold are the countries which confirms either the Growth or conservation hypothesis in both cases i.e., when causality is tested between energy variants and Trade (T).

Regarding the relationship between Trade and CO_2 emissions, we find that in Bangladesh, China HKSAR and New Zealand, CO_2 emissions Granger-causes Trade; and in China, Indonesia, Japan, New Zealand and Thailand, Trade Granger-causes CO_2 emission, when we do not take into account the asymmetry. However, when the asymmetry is taken into account, in China HKSAR and Philippines, the CO_2 emissions Granger-causes Trade, while, in Bangladesh, Japan, Pakistan, Philippines, South Korea and Thailand, the Trade Granger-causes CO_2 emissions. Thus, New Zealand and Philippines are the two countries which face policy dilemma while formulating appropriate external and energy policy. In Bangladesh, China, Indonesia, Japan, New Zealand, Pakistan, Philippines, South Korea and Thailand, trade liberalization/openness leads to environmental degradation. Therefore, in these countries the policy makers have to be very careful in order to minimize the detrimental effect of Trade liberalization on the environment. Further, in Bangladesh, China HKSAR, New Zealand and Philippines, we find that more stringent environmental policy has a detrimental (reducing) effect on Trade. Thus, these countries have to formulate strict environmental policies in order to reduce the environment's detrimental (reducing) effect on Trade.

Further, we find evidence of cointegration for all most all the countries and for many variables, indicating that energy consumption/production is related to growth and openness in the long-run. We also observed evidence of a number of hidden cointegration relations among the Asian countries, which indicates that researchers should explore the possibility of such a hidden cointegration relation before concluding the absence of cointegration and then make policy recommendations.

Now we briefly explain the summary of findings about our panel data analysis. The results from the panel data analysis show that:

(i) The CO_2 emissions have the long-run effect on GDP not vice-versa;

(ii) The electricity production through nuclear energy, oil, and primary energy has a positive effect on GDP;

(iii) The electricity production through renewable energy sources has the long-run effect on Trade;

(iv) The GDP has long run effect on Hydroelectricity consumption;

(v) The Hydroelectricity consumption and Trade have long-run effect on each other;

(vi) Trade and GDP have long-run effect on the nuclear energy consumption and;

(vii) The GDP and natural gas consumption have long-run effect on each other.

The policy implications of the above findings can be summarized as: The Asian countries have to formulate the long run environmental policies in order to reduce the degree of the harmful effect of GHGs, and policies should be made to not curb the ELEP-NU, ELEP-Oil and ELEP-PE; the energy conservation policies specially designed for HYD may not adversely affect the GDP and; the consumption of nuclear energy should be promoted to boost the economic growth and promote liberalization.

Finally, regarding the Granger-causal relationship in the Asian countries in the panel data set we find that:

(i) There is robust evidence for bidirectional Granger-causal relationship between CO_2 emissions and Trade, between ELEP-Coal and GDP and Trade, and between EPC and GDP. The policy implication is that while formulating policies related to the variables we find a bi-directional causal relationship and the policy makers have to be very careful because if the policy is defined to affect one variable, it will surely affect another variable too.

(ii) There is robust evidence for unidirectional Granger-causality running from Coal to GDP, from ELEP to GDP and Trade, from Trade to oil, from GDP and Trade to energy use, and from the EPC to Trade. The policy implication is that the policy made should not curb the Coal consumption and ELEP as they promote growth, and ELEP and EPC promote trade too.

Finally, yet importantly, our results obtained to achieve second objective show that, in general, in the Asian countries, there are contradictory results in significant energy saving effect of FDI. The results differ widely with the approach adopted for analysis and the level of the threshold used both in terms of significance and in terms of the sign of the coefficient. However, in all our specifications, we find that in the low FDI regime, IM shows negative effect and in the high FDI regime, IM shows positive impact on energy intensity. This indicates that, international technology transfer is happening only through IM. The effect of domestic vintage capital is positive in low threshold regime and negative in the high threshold regime, but in both regimes, it is insignificant. This indicates that government policies related to boosting the domestic investment are not enough, hence, more efforts are needed. Another interesting evidence is the insignificant income induced technique effect and the significant scale effect. However, in the low threshold level of FDI the scale effect carries a negative sign (as theoretically expected) and both carry a positive sign in higher threshold level of FDI. These findings offer a number of areas that could further be explored with some more robust econometric technique, such as, evaluating the effects in the time varying parameter model.

5.2 Limitations of the study

The present study has been limited by:

- The use of small sample data: In the present work, we have also included some countries which have had relatively less observations which might have resulted in some bias in the results.
- Undeveloped techniques which can rectify the bias that arises due to small sample: Our results are valid provided that they are unbiased. Basically, for panel data estimation we do not have sound empirical approaches available which can take into account the bias that arises due to small sample data.

Table-3.5: Summary results of cointegration analysis-A country wise overlook

	Bangladesh	China	China HKSAR	India	Indonesia	Japan	Malaysia	New Zealand	Pakistan	Philippines	Singapore	South Korea	Taiwan	Thailand	Vietnam
CO_2 & GDP	Yes	No	Yes	Yes	Yes	No	NA	NA	NA	No	NA	NA	Yes	Yes	NA
CO_2 & Trade	NA	NA	Yes	No	No	Yes	Yes	NA	NA	Yes	NA	NA	NA	NA	NA
Coal & GDP	NA	Yes	NA	Yes	No	NA	NA	NA	Yes	Yes	NA	NA	Yes	NA	NA
Coal & Trade	NA	NA	NA	Yes	No	NA	NA	NA	Yes	Yes	NA	NA	NA	NA	NA
HYD & GDP	NA	Yes	NA	No	NA	NA	NA	NA	Yes	NA	NA	NA	NA	NA	NA
HYD & Trade	NA	NA	NA	Yes	NA	NA	Yes	NA	Yes	NA	NA	NA	NA	NA	NA
NG &GDP	Yes	Yes	NA	NA	Yes	No	NA	NA	No	NA	NA	NA	NA	NA	NA
NG & Trade	NA	NA	NA	NA	NA	Yes	NA	NA	NA	NA	NA	NA	NA	NA	NA
NU & GDP	NA	NA	NA	Yes	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NU & Trade	NA	NA	NA	Yes	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ELEP & GDP	Yes	Yes	Yes	Yes	Yes	Yes	NA	NA	Yes	Yes	NA	Yes	NA	Yes	NA
ELEP & Trade	NA	NA	Yes	No	Yes	Yes	Yes	NA	Yes	No	NA	No	NA	NA	NA
ELEP-Coal & GDP	NA	NA	Yes	NA	NA	Yes	NA	NA	NA	NA	NA	Yes	NA	Yes	NA
ELEP-Coal & Trade	NA	NA	Yes	NA	NA	No	NA	NA	NA	NA	NA	Yes	NA	Yes	NA
ELEP-HYD & GDP	NA	Yes	NA	Yes	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ELEP-HYD & Trade	NA	NA	NA	Yes	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ELEP-NG & GDP	Yes	NA	NA	Yes	NA	Yes	NA	NA	NA	NA	NA	NA	NA	Yes	NA
ELEP-NG & Trade	NA	NA	NA	Yes	NA	Yes	NA	NA	NA	NA	NA	NA	NA	NA	NA
ELEP-NU & GDP	NA	NA	NA	Yes	NA	Yes	NA	NA	NA	NA	NA	Yes	NA	NA	NA
ELEP-NU & Trade	NA	NA	NA	Yes	NA	Yes	NA	NA	NA	NA	NA	Yes	NA	NA	NA
ELEP-Oil & GDP	NA	Yes	No	Yes	No	NA	NA	NA	Yes	No	NA	Yes	NA	Yes	NA
ELEP-Oil & Trade	NA	NA	No	Yes	No	NA	NA	NA	Yes	No	NA	Yes	NA	NA	NA
ELEP-Rene & GDP	NA	Yes	NA	No	Yes	NA	NA	NA	Yes	No	NA	Yes	NA	NA	NA
ELEP-Rene & Trade	NA	NA	NA	Yes	Yes	NA	NA	NA	Yes	Yes	NA	Yes	NA	NA	NA
EPC & GDP	Yes	NA	Yes	Yes	No	No	NA	NA	Yes	Yes	NA	Yes	NA	Yes	NA
EPC & Trade	NA	NA	Yes	No	Yes	Yes	Yes	NA	Yes	Yes	NA	No	NA	NA	NA
EU & GDP	Yes	NA	No	Yes	NA	No	NA	NA	Yes	Yes	NA	NA	NA	Yes	NA
EU & Trade	NA	NA	No	No	NA	No	NA	NA	Yes	Yes	NA	NA	NA	NA	NA
PEC & GDP	Yes	NA	Yes	Yes	Yes	NA	NA	NA	No	No	NA	NA	Yes	Yes	NA
PEC & Trade	NA	NA	Yes	No	No	NA	Yes	NA	No	Yes	NA	NA	NA	NA	NA

Note: NA denotes analysis is not applicable either due to data unavailability or due to either of the two variables was stationary.

Table-4.5: Summary results of Granger-causality analysis-A country wise overlook

Variables	Bangladesh	China	China HKSAR	India	Indonesia	Japan	Malaysia	New Zealand	Pakistan	Philippines	Singapore	South Korea	Taiwan	Thailand	Vietnam
CO_2 & GDP		↔				↔		→	←			←		→	
CO_2 & Trade															
Energy consumption and variants'															
Coal & GDP		←		←					↔	←					
Coal & Trade	→			←		↔		↔	↔	←				→	
HYD & GDP		→		←	→	↔	→	←				→		→	
HYD & Trade	→	→		←	↔	←		←				→		↔	
NG &GDP	↔	↔		→		←		↔	↔				←		
NG & Trade				→			→	←							
NU & GDP				←									←		
NU & Trade				↔		↔									
EU & GDP		←	→	←		↔	→	→	→	↔		←			
EU & Trade			↔	←	←	→	↔	→	←	↔				↔	
PEC & GDP		←		↔		↔		↔	←			←		→	
PEC & Trade	→	←	→	→	←	↔		↔		↔	←			←	
EPC & GDP	↔			→		↔	↔	←		←		→			
EPC & Trade	→	←	→			↔	→		↔	↔	←				
Energy production and variants'															
ELEP & GDP	↔	←		→	←		←	←		↔		→			
ELEP & Trade	↔	↔				←	←	←	↔	→					
ELEP-Coal & GDP		←		←		↔		←				←			
ELEP-Coal & Trade						←		→	→	←		→		↔	
ELEP-HYD & GDP	↔	→		↔	←	←	↔	←	←	←				→	
ELEP-HYD & Trade	↔	→		↔	↔	↔	←		←	→				←	
ELEP-NG & GDP	→					←			←						
ELEP-NG & Trade				↔				↔							
ELEP-NU & GDP				↔								←			
ELEP-NU & Trade				↔		→			↔						
ELEP-Oil & GDP	←		←	↔				→	←	↔	←	↔			
ELEP-Oil & Trade			←	←		←	→	→	↔	→	←			→	
ELEP-Rene & GDP	←	→		↔	→	←	↔	←		←		→			
ELEP-Rene & Trade	↔	→		↔	↔	→	←	←	↔	→		→	←		

Note: → or ←, and ↔ represent unidirectional causality, and bidirectional causality , respectively, and blank cells denotes no causality or the cases where causality tests are not applied.

- Undeveloped appropriate technique that can be used to estimate asymmetric vector error correction: As discussed before, there might be several reasons that cause asymmetry in the data structure, however, there are quite a few approaches available to take into account such a problem when the sample data is small.

5.3 Scope for future research

The present study has analyzed the (asymmetric) Granger-causality and estimated (hidden) long-run relationship between energy (and its variations) and GDP, and Trade in a set of Asian countries. However, the same study can be extended in the following directions:

- We can analyze the study of the World level data set, provided the data is available.
- The study can be extended to analyze the Granger-causality between the energy consumption and output growth at the sector level, such as, Grange-causality between energy consumption by agriculture sector and output growth of this sector etc.
- A bootstrapping approach for obtaining the critical values can be developed to overcome some estimation problems such as small sample size, nonlinear nature of data etc., while analyzing the long-run hidden cointegration between energy consumption and economic growth or Trade.
- Another possible extension in the direction of development in the methodology can be the development of a procedure to examine the hidden cointegration in panel data, to take into account the asymmetry observed in the time series framework for different variables and in different countries. In addition, one can focus effort to develop a procedure for examining the hidden cointegration or asymmetric causality in the multivariate framework in the time series and panel data structure. In order to

have very robust results, one can think of extending it in the direction of adopting the appropriate lag-length which is determined endogenously in the panel structure.

- One can also use the rolling window approach for TY Granger-causality in order to see how the effects of variables have been changing over different periods. This may offer some more insights as we can compare the period of policy changes with the dynamic effect of Granger-causality which has evolved over those different periods.
- Attempts can be made to further explore and analyze which of the effects of trade liberalization on the environment (product effect, structural effect, or scale effect) dominates for each of the Asian countries to formulate and design appropriate environment and Trade policies.

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Appendices

Appendix A: Unit root with structural breaks

Table 1A: Lee-Strazicich and NP unit root tests for PEC variable

Country	Lee-Strazicich's LM unit Root Test								NP results							
	Model type: Crash				Model type: trend break				Model type: M1				Model type: M2			
	T_{B1}	T_{B2}	k	Test statistics	T_{B1}	T_{B2}	K	Test statistics	T_{B1}	T_{B2}	k	Test statistics	T_{B1}	T_{B2}	k	Test statistics
Bangladesh	1979	1986	0	2.5611	1980	1994	3	-6.1782[a]	1983	1994	0	-5.057	1983	1989	4	-0.1973
China	1981	2004	1	-2.5748	1974	1999	1	-8.2197[a]	1974	1976	1	-2.7305	1975	1999	2	-6.6808[a]
China HKSAR	1975	2004	0	0.7561	1973	1990	0	-3.7304	1974	1987	2	-3.1124	1975	2000	4	2.1986
India	1996	2000	0	-2.9995	1986	2000	0	-6.8317[a]	1980	2000	3	-3.2476	1981	1989	3	-2.426
Indonesia	1974	1985	4	-1.6845	1975	1989	2	-3.7672	1974	1976	0	-1.2839	1975	1978	1	-0.2053
Japan	1977	1983	3	-1.2879	1978	1992	3	-3.3421	1974	1983	0	-1.0758	1977	1983	2	-0.0092
Malaysia	1973	1988	4	-1.6165	1975	1987	0	-3.3861	1978	1999	4	-1.9812	1978	1999	4	-0.7927
New Zealand	1973	1994	4	-3.1063	1978	1994	4	-6.8090[a]	1985	1989	0	-2.4575	1981	1985	3	-2.2411
Pakistan	1975	2000	4	-1.8328	1975	1989	4	-4.7434[b]	1975	1977	4	-2.5121	1975	2000	4	-0.5262
Philippines	1976	1986	3	-2.2726	1979	1992	3	-3.5404	1983	1986	0	-2.6174	1980	1986	1	-2.321
Singapore	1975	1998	1	-1.6595	1994	2004	1	-3.1618	1975	1998	5	-2.4141	1988	1998	5	-2.1874
South Korea	1977	1985	4	0.6628	1973	1997	4	-4.9668[b]	1979	1997	1	0.2469	1980	1997	0	-5.470[b]
Taiwan	1973	1983	3	-1.6973	1973	1993	3	-4.5721	1975	1980	0	-3.3757	1975	1982	0	0.5118
Thailand	1974	1982	2	-0.609	1978	1997	4	-4.5556	1983	1986	3	-4.168[c]	1974	1986	3	-1.985

Table 2A: LeeStrazicich and NP unit root tests for CO2 variable

Country	Lee-Strazicich's LM unit Root Test								NP results							
	Model type Crash				Model type trend break				Model type M1				Model type M2			
	T_{B1}	T_{B2}	k	Test statistics	T_{B1}	T_{B2}	k	Test statistics	T_{B1}	T_{B2}	k	Test statistics	T_{B1}	T_{B2}	k	Test statistics
Bangladesh	1979	1998	0	-2.9677	1981	1984	0	-4.8567	1990	1994	4	-0.0291	1990	1998	0	-4.53
China	1974	2003	1	-3.411	1974	1999	1	-7.1699	1974	1976	2	-1.759	1974	1978	4	-1.673
China HKSAR	1993	2004	0	-1.8283	1994	2001	0	-3.8736	1993	2000	0	-1.094	1993	2000	0	-3.427
India	1984	1988	0	-2.9331	1977	1996	0	-4.7432	1989	2000	0	-2.313	1988	2000	0	-4.336
Indonesia	1985	1997	2	-2.1455	1981	1997	4	-3.4624	1974	1976	0	-1.404	1976	1997	0	-4.651
Japan	1976	1983	3	-1.2852	1979	1993	4	-3.8907	1974	1981	0	-2.3797	1983	1997	0	-3.867
Malaysia	1973	1998	1	-2.0478	1981	2000	1	-4.443	1998	1999	0	0.8922	1986	1997	0	-2.297
New Zealand	1989	2006	0	-2.5978	1978	2001	0	-4.8883	1977	1981	0	-0.9485	1981	1992	3	1.76
Pakistan	1975	1980	1	-1.8689	1976	1991	1	-5.2233	1976	2000	4	0.6638	1976	1993	3	-5.985[a]
Philippines	1975	1982	2	-2.2572	1982	1991	2	-3.9311	1983	1991	0	-2.989	1986	1991	1	-2.2069
Singapore	1984	1994	4	-3.8346	1978	1994	4	-3.7201	1979	1995	4	-2.375	1979	1995	1	-2.0653
South Korea	2000	2005	0	0.1749	1978	1997	4	-4.5678	1981	1997	0	-0.7102	1981	1997	0	-4.854[c]
Taiwan	1975	1982	2	-2.71	1973	1999	3	-4.9215	1975	1980	0	-0.997	1975	1982	1	1.0157
Thailand	1974	1998	1	-1.7697	1979	1993	4	-4.874	1986	1997	0	-2.297	1986	1997	0	-3.4759

Table 3A: Lee-Strazicich and NP unit root tests for HYD variable

Country	Lee-Strazicich's LM unit Root Test								NP results							
	Model type Crash				Model type trend break				Model type M1				Model type M2			
	T_{B1}	T_{B2}	k	Test statistics	T_{B1}	T_{B2}	k	Test statistics	T_{B1}	T_{B2}	K	Test statistics	T_{B1}	T_{B2}	k	Test statistics
Bangladesh	1984	1992	0	-6.0285	1993	1998	2	-7.6968	1985	1994	2	-4.7662b	1985	1942	2	-5.137c
China	1990	2003	3	-5.0777	1983	2003	3	-6.5832	1977	2000	0	-1.7068	1990	1995	3	-4.2004
India	1974	1995	0	-1.9577	1975	1997	3	-5.0601	1974	1981	1	-3.2968	1981	1995	0	-3.0737
Indonesia	1985	1991	0	-3.3696	1981	1987	0	-5.6744	1975	1985	0	-4.4318c	1982	1985	0	-5.228b
Japan	1980	2003	0	-5.7204	1975	2003	0	-6.5944	1983	1993	0	-5.3106a	1983	1993	0	-5.8332b
Malaysia	1983	1996	0	-2.6482	1974	1983	1	-4.7668	1983	1996	0	-3.3657	1983	1998	0	-2.8861
New Zealand	1996	2000	0	-3.0846	1974	1995	2	-6.0901	1998	2000	3	-2.1033	1976	1991	2	-6.1141a
Pakistan	1977	1996	0	-2.2087	1985	1997	4	-5.3507	1996	1999	3	-0.1902	1996	2000	0	-2.8144
Philippines	1991	1997	0	-5.1876	1990	2004	4	-8.0137	1983	1991	0	-5.1402b	1982	1991	0	-7.7671a
South Korea	1993	2004	0	-4.2838	1989	1997	0	-6.3253	1990	1993	3	-0.4113	1993	2000	0	-5.2618c
Taiwan	1973	1998	0	-6.193	1983	2000	4	-7.3874	1974	1984	0	-5.4058a	1979	2000	0	-5.7328b
Thailand	1976	1981	0	-5.6712	1976	1982	0	-6.2202	1979	1998	0	-6.1683a	1979	1998	0	-6.3932a

Table 4A: Lee-Strazicich and NP unit root tests for Coal variable

Country	Lee-Strazicich's LM unit Root Test								NP results							
	Model type Crash				Model type trend break				Model type M1				Model type M2			
	T_{B1}	T_{B2}	k	Test statistics	T_{B1}	T_{B2}	k	Test statistics	T_{B1}	T_{B2}	K	Test statistics	T_{B1}	T_{B2}	k	Test statistics
Bangladesh	1989	1999	0	-5.8552	1993	1998	0	-6.4081	1982	1997	0	-5.7697a	1989	1997	3	-5.136c
China	1974	2003	1	-4.0092	1992	2002	1	-6.8534	1974	1976	1	-3.682	1974	1978	4	-2.196
India	1986	2003	0	-2.2289	1974	1997	0	-3.4163	1977	1989	0	-1.3035	1977	1989	0	-1.2282
Indonesia	1975	1985	0	-1.0233	1983	1995	4	-5.4503	1978	1984	0	-4.083	1978	1984	0	-3.892
Japan	1974	1978	0	-3.9373	1974	1979	0	-4.16	1974	1977	1	-4.7783b	1977	1980	2	-2.549
New Zealand	2000	2005	0	-2.1507	1983	2001	3	-6.3277	1984	2000	3	-4.1027	1984	1987	3	-3.7416
Pakistan	1979	2006	1	-2.3003	1980	1994	3	-4.8294	1975	1996	3	-3.8876	1980	1996	3	-3.498
Philippines	1982	1991	0	-1.8877	1985	1999	3	-6.5337	1982	1985	3	-2.601	1982	1985	3	-2.6195
South Korea	1975	1981	3	-3.2169	1978	1995	4	-5.0504	1978	1983	4	-4.4693c	1988	1995	0	-4.2907
Taiwan	1983	1991	3	-1.9635	1981	1994	3	-4.9167	1978	1982	0	-3.2592	1980	1983	0	0.4016
Thailand	1981	1987	3	-1.9422	1977	1992	0	-4.4673	1978	1982	2	-4.963b	1978	1982	2	-4.6923

Table 5A: Lee-Strazicich and NP unit root tests for GDPPC variable

Country	Lee-Strazicich's LM unit Root Test								NP results							
	Model type Crash				Model type trend break				Model type M1				Model type M2			
	T_{B1}	T_{B2}	k	Test statistics	T_{B1}	T_{B2}	k	Test statistics	T_{B1}	T_{B2}	k	Test statistics	T_{B1}	T_{B2}	k	Test statistics
Bangladesh	1971	1979	4	-1.9554	1970	1995	0	-4.4987	1975	1991	4	3.7398	1975	1992	4	-0.2066
China	1968	1978	1	-0.326	1968	1977	1	-5.7884	1975	1988	2	-1.4719	1975	1983	1	-3.8997
China HKSAR	1977	1985	3	-0.971	1984	1997	1	-4.5711	1975	1997	0	-2.4344	1984	1997	2	-2.9627
India	2002	2006	0	-1.0319	1971	1995	0	-4.0364	1974	1978	0	0.77198	1974	1978	0	0.4482
Indonesia	1982	1998	1	-2.3128	1977	1997	4	-4.5065	1981	1997	0	-3.4027	1981	1997	0	-3.1082
Japan	1974	1993	1	-0.6617	1972	1989	1	-5.2383	1978	1997	0	-1.1882	1989	1997	0	-3.951
Malaysia	1996	2000	0	-2.228	1983	1994	3	-4.3657	1984	1997	0	-0.9247	1984	1997	0	-5.7138[b]
New Zealand	1968	1974	1	-3.0559	1975	1998	3	-5.4524	1974	1998	3	-4.1038	1974	1998	3	-6.2291[a]
Pakistan	1969	1978	1	-1.8475	1971	1996	0	-2.6066	1992	1996	0	-2.7268	1979	1996	0	-3.9748
Philippines	1981	1997	1	-1.943	1982	1992	3	-5.2016	1983	1985	4	-2.0681	1983	1990	0	-3.7616
Singapore	1969	1997	1	-3.0733	1970	1997	1	-4.088	1997	2000	2	-3.0619	1984	1997	1	-5.0277[c]
South Korea	1982	1986	0	-1.886	1986	1993	0	-3.4799	1979	1997	0	0.1692	1979	1997	0	-3.1838
Taiwan	1977	2000	0	-1.4429	1970	1994	3	-5.4687	1986	2000	4	-1.4326	1986	2000	4	-1.505
Thailand	1972	1998	1	-3.4172	1987	1996	4	-6.4262	1987	1997	0	-3.6117	1987	1997	3	-2.7552

Table 6A: Lee-Strazicich and NP unit root tests for Trade variable

Country	Lee-Strazicich's LM unit Root Test								NP results							
	Model type Crash				Model type trend break				Model type M1				Model type M2			
	T_{B1}	T_{B2}	k	Test statistics	T_{B1}	T_{B2}	k	Test statistics	T_{B1}	T_{B2}	K	Test statistics	T_{B1}	T_{B2}	k	Test statistics
Bangladesh	1970	1976	1	-3.1711	1971	1978	3	-6.3352	1976	1994	0	-3.1972	1975	1994	5	-6.0513[a]
China	1988	1996	4	-2.7568	1986	2000	4	-4.9557	1985	1994	4	-3.3691	1985	1996	4	-5.0311[c]
China HKSAR	1971	1976	0	-0.7672	1980	1992	0	-3.0383	1987	1991	3	-3.592	1975	1986	0	-3.0148
India	1994	2004	0	-2.586	1986	2005	1	-6.0734	1983	1994	0	-2.6563	1978	1994	0	-2.207
Indonesia	1987	2004	4	-3.6638	1974	1986	4	-5.0099	1987	1998	4	-3.3698	1990	1998	0	-3.5631
Japan	1969	1973	1	-2.4974	1981	2005	1	-6.427	1975	1984	1	-0.9926	1974	2001	1	1.3015
Malaysia	1974	2001	1	-2.164	1980	2004	1	-5.8618	1991	1995	0	2.46324	1974	1991	0	2.548
New Zealand	2004	2008	0	-1.5251	1990	2007	0	-14.946	1991	2001	0	-5.8856[a]	1987	1991	5	4.4049
Pakistan	1971	2002	0	-4.4203	1973	2002	1	-4.863	1978	1980	0	-4.0421	1978	1991	1	-4.057
Philippines	1986	1993	0	-1.59	1972	1994	0	-3.3173	1979	1997	0	-0.283	1979	1997	0	-2.697
Singapore	1989	1999	2	-4.4774	1986	1999	2	-5.3614	1993	1999	5	-6.315[a]	1993	1999	5	-5.416[b]
South Korea	1972	1977	0	-2.5071	1978	2005	1	-6.6991	1985	1993	0	1.0746	1985	2000	0	1.1702
Thailand	1974	1987	0	-2.445	1968	1987	0	-4.6722	1987	1999	2	-4.7205[b]	1987	1999	0	-4.41

Table 7A: Lee-Strazicich and NP unit root tests for NGC

Country	Lee-Strazicich's LM unit Root Test								NP results							
	Model type Crash				Model type trend break				Model type M1				Model type M2			
	T_{B1}	T_{B2}	k	Test statistics	T_{B1}	T_{B2}	k	Test statistics	T_{B1}	T_{B2}	K	Test statistics	T_{B1}	T_{B2}	k	Test statistics
Bangladesh	1990	1999	1	0.1805	1985	1997	0	-4.4798	1989	1999	2	1.1341	1989	1999	0	-2.6939
China	1982	2004	3	-3.4109	1979	1997	3	-5.7503	1979	1982	1	-1.3022	1982	1999	0	1.2482
India	1985	2000	0	-1.7764	1981	1991	0	-4.0805	1975	1979	5	-6.1420[a]	1979	1985	0	-4.022
Indonesia	1976	2003	0	-1.3499	1980	1995	3	-6.4084	1974	1977	4	-1.7791	1975	1982	4	-0.5249
Japan	1976	1985	4	-2.3636	1976	1987	0	-4.3286	1980	1983	5	0.2394	1980	1983	2	-4.6071
Malaysia	2003	2006	0	0.5481	1984	1999	2	-5.1739	1982	1999	4	-5.6926[a]	1982	1999	4	-4.4185
New Zealand	1977	1990	4	-1.6637	1982	1996	1	-5.7192	1983	1998	3	-7.4379[a]	1979	1981	0	-1.7421
Pakistan	1991	1996	1	-3.2938	1984	2001	1	-4.9388	1979	1991	0	-2.6352	1982	1992	1	-3.6271
South Korea	1993	2008	0	1.5194	1992	1998	0	-2.4854	1995	1997	0	-1.7911	1997	2002	0	-5.0829
Taiwan	1974	1985	4	-2.6025	1975	1989	0	-3.5045	1980	1989	0	-5.8185[a]	1980	1989	2	-6.512[a]
Thailand	1991	1995	3	-1.304	1987	1997	0	-3.8177	1988	1996	0	-2.6874	1993	2002	3	-7.6633[a]

Table 8A: Lee-Strazicich and NP unit root tests for NU

Country	Lee-Strazicich's LM unit Root Test								NP results							
	Model type Crash				Model type trend break				Model type M1				Model type M2			
	T_{B1}	T_{B2}	k	Test statistics	T_{B1}	T_{B2}	k	Test statistics	T_{B1}	T_{B2}	K	Test statistics	T_{B1}	T_{B2}	k	Test statistics
India	1990	2003	0	-3.2122	1991	2001	0	-4.0392	1988	1993	0	-3.4952	1988	1994	3	-3.4176
Japan	1980	1984	4	-0.769	1979	2001	4	-4.0734	1974	1976	3	-5.219[b]	1975	1978	3	-3.1077
South Korea	1990	1994	3	-3.2095	1991	2004	4	-14.661	1985	1994	4	-3.8377	1985	1988	1	-0.0973
Taiwan	1989	1995	4	-1.7442	1984	1990	0	-5.9973	1985	1987	4	-3.3076	1985	2000	1	-7.3107[a]

Table 9A: Lee-Strazicich and NP unit root tests for ELEP

Country	Lee-Strazicich's LM unit Root Test								NP results							
	Model type Crash				Model type trend break				Model type M1				Model type M2			
	T_{B1}	T_{B2}	k	Test statistics	T_{B1}	T_{B2}	k	Test statistics	T_{B1}	T_{B2}	K	Test statistics	T_{B1}	T_{B2}	k	Test statistics
Bangladesh	1992	1996	0	-2.1054	1987	1997	0	-3.7492	1979	1992	0	-3.3294	1979	1992	0	-2.553
China	1974	1997	0	-2.0905	1973	1999	4	-48.642	1980	1997	3	-3.5099	1978	1997	1	-4.2396
China HKSAR	1994	1998	1	-2.2577	1992	2000	3	-6.9643	1993	1999	4	1.4391	1993	1998	0	-1.7849
India	1995	2005	0	-2.0974	1973	1999	4	-45.266	1978	1983	0	-2.0397	1980	1995	3	-3.2456
Indonesia	1984	1997	0	-2.1567	1973	1991	4	-20.585	1979	1985	2	-0.8722	1978	1985	3	-0.0048
Japan	1979	1985	0	-1.9824	1963	1982	4	-6.1903	1973	1979	0	0.23512	1973	1986	4	-1.9599
Malaysia	1988	2005	0	-2.0716	1973	2000	4	-28.954	1990	1997	3	-2.442	1992	1997	3	-3.635
New Zealand	1978	1991	0	-1.9856	1963	1982	4	-6.3384	1971	1974	4	-0.9322	1974	1991	3	-6.7015[a]
Pakistan	1992	1998	0	-2.1071	1973	1993	4	-40.463	1992	1995	3	1.7124	1991	1995	1	-4.4767
Philippines	1985	1990	0	-2.0408	1973	1993	4	-49.206	1985	1993	0	-2.0486	1985	1993	0	-3.5019
South Korea	1990	1997	0	-2.0744	1973	1999	4	-64.491	1997	1999	1	-0.7904	1997	2000	1	-3.1779
Thailand	1997	2001	0	-2.0474	1973	1997	5	-29.586	1986	1997	1	-0.9921	1986	1997	1	-2.2928

Table 10A: Lee-Strazicich and NP unit root tests for ELEP-Coal

Country	Lee-Strazicich's LM unit Root Test								NP results							
	Model type Crash				Model type trend break				Model type M1				Model type M2			
	T_{B1}	T_{B2}	k	Test statistics	T_{B1}	T_{B2}	k	Test statistics	T_{B1}	T_{B2}	K	Test statistics	T_{B1}	T_{B2}	k	Test statistics
China	1979	1997	0	-2.123	1973	1978	4	-31.569	1979	1997	3	-6.1061[a]	1978	1997	4	-5.5802[b]
China HKSAR	1988	1990	3	-1.2019	1977	1986	3	-5.652	1993	1996	1	-2.5905	1993	1997	3	-3.595
India	1989	1997	0	-2.113	1973	1990	4	-28.979	1981	1983	4	-4.3617[c]	1978	1989	0	-4.2739
Japan	1966	1985	0	-2.0234	1963	1975	4	-6.2185	1970	1977	4	-3.2632	1971	1997	4	-0.9124
New Zealand	1978	1985	0	-2.1706	1963	1995	0	-6.1523	1978	1991	0	-2.6221	1978	1991	3	-3.6242
Pakistan	1981	1986	0	-2.4196	1974	1994	0	-5.3493	1981	1994	0	-8.5994[a]	1981	1994	0	-11.028[a]
Philippines	1989	1993	0	-2.3357	1974	1983	0	-5.2201	1981	1995	3	-4.6839[b]	1981	1995	3	-4.2685
South Korea	1986	1990	0	-2.222	1973	1982	4	-8.3355	1983	1992	4	-3.3103	1980	1992	4	-3.2685
Thailand	1992	1997	0	-2.1494	1973	1990	4	-11.692	1978	1984	0	-2.2867	1978	1984	0	-2.203

Table 11A: Lee-Strazicich and NP unit root tests for ELEP-HYD

Country	Lee-Strazicich's LM unit Root Test								NP results							
	Model type Crash				Model type trend break				Model type M1				Model type M2			
	T_{B1}	T_{B2}	k	Test statistics	T_{B1}	T_{B2}	k	Test statistics	T_{B1}	T_{B2}	K	Test statistics	T_{B1}	T_{B2}	k	Test statistics
Bangladesh	1984	1992	0	-3.313	1986	1992	0	-5.1802	1985	1994	0	-5.8965[a]	1985	1994	2	-5.3998[b]
China	1990	2003	0	-2.9098	1990	2000	4	-6.3566	1990	1995	3	-3.3878	1990	1998	3	-3.924
India	1994	2003	0	-3.0312	1993	1996	2	-4.3479	1987	2001	0	-3.1416	1986	2001	0	-2.9878
Indonesia	1982	1985	0	-3.868	1984	1990	0	-6.4016	1985	1996	0	-3.8747	1985	1996	0	-5.6618[b]
Japan	1991	2006	0	-5.4265	1977	2005	0	-6.8306	1972	1993	0	-5.0212[b]	1972	1993	0	-6.125[a]
Malaysia	1979	1983	0	-2.5865	1979	1984	1	-6.5976	1983	1998	0	-2.5575	1983	1988	1	-5.515[b]
New Zealand	1996	2000	0	-1.2211	1974	1995	2	-6.9757	1970	1978	1	-3.4634	1986	1991	2	-6.556[a]
Pakistan	1995	1998	0	-2.819	1991	2001	0	-4.221	1995	1998	0	-2.8366	1980	2001	2	1.5987
Philippines	1990	1997	0	-3.5475	1989	1993	0	-5.7847	1983	1998	0	-2.9197	1990	1997	0	-5.859[b]
South Korea	1984	1993	0	-3.8964	1986	1997	0	-6.6317	1984	1993	0	-4.208[c]	1990	1993	0	-4.227
Thailand	1981	1996	0	-5.4916	1978	1984	3	-10.049	1979	1985	3	-6.328[a]	1979	1985	3	-6.0868[a]

Table 12A: Lee-Strazicich and NP unit root tests for ELEP-NG

Country	Lee-Strazicich's LM unit Root Test								NP results							
	Model type Crash				Model type trend break				Model type M1				Model type M2			
	T_{B1}	T_{B2}	k	Test statistics	T_{B1}	T_{B2}	k	Test statistics	T_{B1}	T_{B2}	K	Test statistics	T_{B1}	T_{B2}	k	Test statistics
Bangladesh	1981	1996	0	-1.489	1987	1997	0	-4.0086	1981	1986	0	-3.1259	1986	1992	0	-3.881
China	1995	1997	0	-2.4984	1981	1992	0	-4.3412	1995	1998	4	-4.4634[c]	1987	1996	0	-2.357
India	1985	1988	0	-2.0176	1980	1997	0	-4.7338	1981	1988	3	-4.1247	1981	1988	3	-3.5184
Indonesia	1977	1992	4	-3.8054	1979	1990	2	-8.7428	1986	1992	4	-7.472[a]	1983	1992	4	-6.085[a]
Japan	1994	1999	4	-0.4844	1973	1985	4	-6.6874	1972	1980	2	-0.093	1980	1986	4	-4.3321
Malaysia	1979	1983	2	-5.7611	1980	1989	2	-5.2882	1984	1990	0	-4.4963[c]	1984	1990	0	-3.7973
New Zealand	1977	1981	4	-0.7239	1979	1983	1	-8.8629	1979	1984	3	-0.3274	1978	1994	1	-7.0299[a]
Pakistan	2003	2006	0	-2.0332	1988	2001	3	-7.4176	1982	1986	3	-4.1713[c]	1984	1993	3	-3.8492
Thailand	1977	1995	0	0.3922	1978	1990	2	-6.5487	1989	1996	4	-1.9989	1987	1990	0	-0.3208

Table 13A: Lee-Strazicich and NP unit root tests for ELEP-NU

Country	Lee-Strazicich's LM unit Root Test								NP results							
	Model type Crash				Model type trend break				Model type M1				Model type M2			
	T_{B1}	T_{B2}	k	Test statistics	T_{B1}	T_{B2}	k	Test statistics	T_{B1}	T_{B2}	K	Test statistics	T_{B1}	T_{B2}	k	Test statistics
India	1993	2006	0	-3.3951	1993	2002	0	-4.4576	1981	1994	1	-3.005	1982	1999	0	-3.5246
Japan	1985	1986	4	-0.7196	1983	2005	4	-4.9633	1974	1977	3	-2.7874	1974	1977	3	-2.391
Pakistan	1978	1998	0	-4.8304	1978	1981	0	-6.2184	1979	1988	0	-8.2207[a]	1980	1989	0	-0.2592
South Korea	1978	1988	3	0.7569	1977	1989	1	-4.6585	1982	1986	4	-0.3715	1982	1985	0	-0.4373

Table 14A: Lee-Strazicich and NP unit root tests for ELEP-Oil

Country	Lee-Strazicich's LM unit Root Test								NP results							
	Model type Crash				Model type trend break				Model type M1				Model type M2			
	T_{B1}	T_{B2}	k	Test statistics	T_{B1}	T_{B2}	k	Test statistics	T_{B1}	T_{B2}	K	Test statistics	T_{B1}	T_{B2}	k	Test statistics
Bangladesh	1989	1996	0	-3.2115	1988	1995	4	-8.6012	1989	1991	0	-3.3081	1985	1990	0	-7.6216[a]
China	1993	2004	1	-1.0239	1978	2001	1	-4.1196	1992	1994	1	-1.1061	1980	1993	3	-2.2601
China HKSAR	1986	1993	2	-2.7208	1985	1993	3	-6.5632	1988	1993	3	-1.3013	1990	1993	0	-2.2772
India	1995	1998	0	-3.3357	1993	1998	0	-4.5027	1978	1995	2	-3.444	1995	2000	4	-0.6966
Indonesia	1978	1993	0	-2.0171	1981	1997	1	-3.9935	1993	1996	3	-2.4944	1984	1993	1	-4.2543
Japan	1976	1986	3	-0.7003	1973	2001	0	-4.9112	1973	1989	0	-0.7463	1973	1988	0	-5.5651[b]
Malaysia	1985	2002	1	-3.2618	1979	1998	1	-6.7968	1998	2001	3	-6.0189[a]	1984	1998	2	-7.395[a]
New Zealand	1987	1998	1	-3.4959	1986	1996	3	-4.5396	1991	1997	0	-5.3472[a]	1991	1997	0	-5.9011[b]
Pakistan	1980	2002	1	-3.8382	1981	2000	1	-5.8957	1979	1981	4	-0.29	1979	2001	4	-4.7804
Philippines	1986	2005	3	-4.1558	1984	1998	0	-4.6841	1986	1998	0	-1.9994	1986	1998	0	-3.2974
Singapore	1978	1993	1	-2.5914	1992	2001	3	-5.9653	1993	2001	4	-1.5512	1992	2001	3	-3.953
South Korea	1985	1990	0	-2.3929	1985	1991	0	-4.0745	1986	1997	0	-2.689	1986	1999	1	0.2189
Thailand	1989	2000	1	-2.9513	1983	1992	2	-7.0996	1985	2000	3	1.2978	1984	2001	2	-3.6307

Table 15A: Lee-Strazicich and NP unit root tests for ELEP-Rene

Country	Lee-Strazicich's LM unit Root Test								NP results							
	Model type Crash				Model type trend break				Model type M1				Model type M2			
	T_{B1}	T_{B2}	k	Test statistics	T_{B1}	T_{B2}	k	Test statistics	T_{B1}	T_{B2}	K	Test statistics	T_{B1}	T_{B2}	k	Test statistics
Bangladesh	1984	1992	0	-3.313	1986	1992	0	-5.1802	1985	1994	0	-5.8965[a]	1985	1994	2	-5.3998[b]
China	1990	2003	0	-2.8536	1989	2002	3	-6.154	1990	1995	3	-3.0611	1990	1995	3	-3.6068
India	1994	2004	0	-3.0672	1993	1996	2	-4.2543	1987	2001	0	-3.111	1986	2001	0	-3.3153
Indonesia	1982	1985	0	-3.618	1983	1987	0	-5.6758	1985	1996	0	-3.4484	1985	1996	0	-4.6687
Japan	1991	2006	0	-5.9197	1977	1984	0	-6.5148	1972	1996	0	-5.0996[b]	1972	1993	0	-6.1828[a]
Malaysia	1979	1983	0	-2.5864	1979	1984	1	-6.5994	1983	1998	0	-2.5573	1983	1988	1	-5.5152[b]
New Zealand	1996	2000	0	-0.9896	1975	1995	2	-5.8076	1974	1998	5	-3.554	1975	1998	5	-5.5075[b]
Pakistan	1995	1998	0	-2.819	1991	2001	0	-4.221	1995	1998	0	-2.8366	1980	2001	2	1.5987
Philippines	1985	1989	4	-3.3456	1986	1996	0	-5.5621	1986	1998	0	-3.4529	1986	1998	4	-3.2479
South Korea	1984	1990	0	-5.0205	1986	1997	0	-6.7517	1986	1993	0	-4.5606[b]	1990	1993	0	-5.4040[b]
Thailand	1989	1995	0	-5.2054	1978	1986	3	-8.0055	1979	1991	5	-4.697[b]	1979	1995	0	-6.0904[a]

Table 16A: Lee-Strazicich and NP unit root tests for EPC

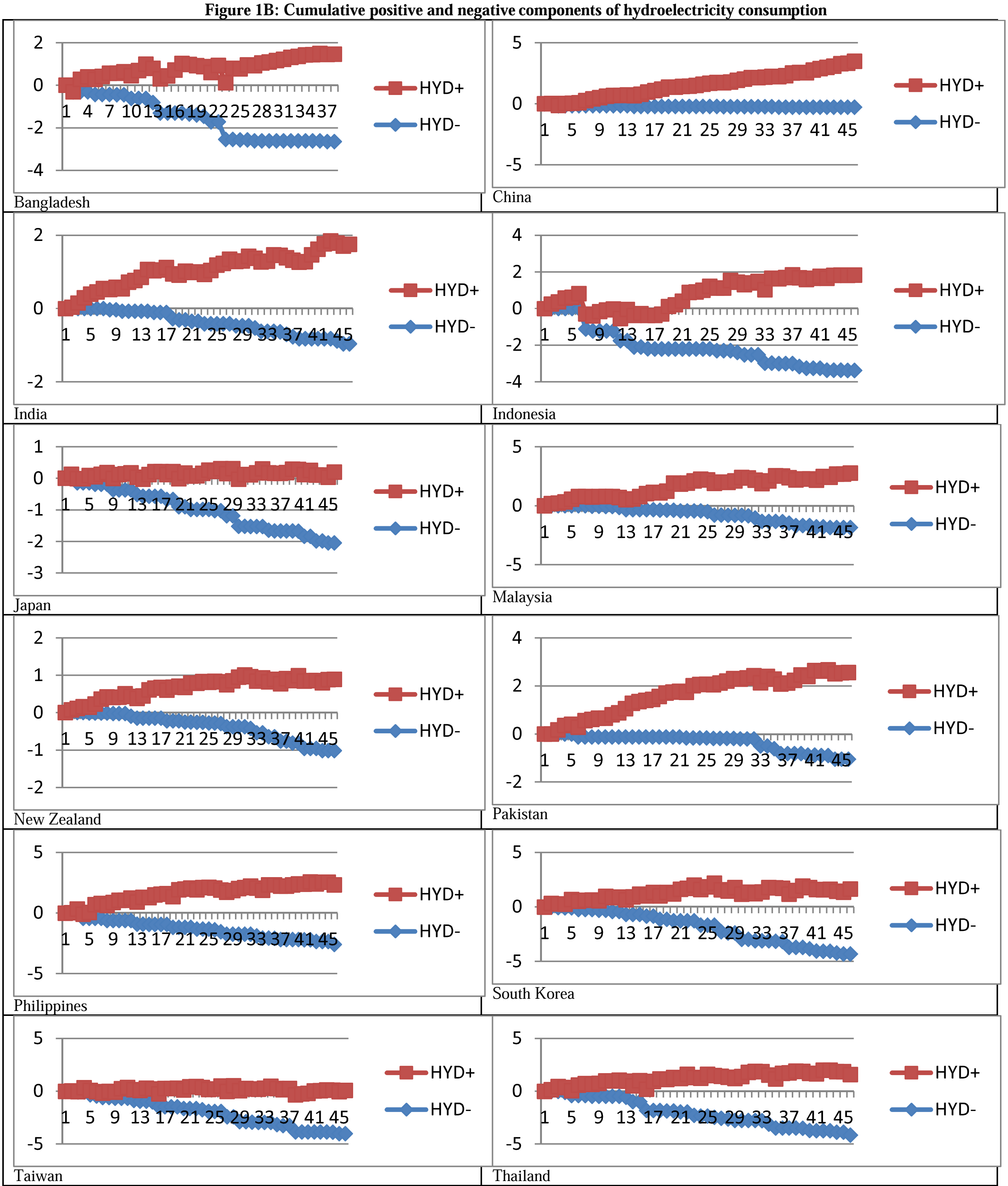
Country	Lee-Strazicich's LM unit Root Test								NP results							
	Model type Crash				Model type trend break				Model type M1				Model type M2			
	T_{B1}	T_{B2}	k	Test statistics	T_{B1}	T_{B2}	k	Test statistics	T_{B1}	T_{B2}	K	Test statistics	T_{B1}	T_{B2}	k	Test statistics
Bangladesh	1988	1995	0	-3.5052	1978	1996	0	-3.9516	1979	1990	0	-3.4947	1980	1991	0	-2.0295
China	1981	2002	2	-3.4284	1980	1996	3	-6.4479	1980	1988	3	-3.7481	1978	1997	4	-4.9923[c]
China HKSAR	1989	1998	1	-2.0295	1986	2000	0	-5.0225	1986	1988	0	-1.1997	1986	1989	0	-3.4025
India	1978	1985	3	-2.3625	1985	1997	1	-3.3439	1978	1995	0	-2.2005	1980	1995	0	-3.9903
Indonesia	1980	1997	3	-2.6363	1978	1995	1	-9.732	1979	1982	2	-0.0032	1978	1987	0	-3.5976
Japan	1997	2001	4	-2.5774	1974	2008	4	-131.62	1973	1986	4	-1.811	1973	1986	4	-1.2803
Malaysia	1979	2001	3	-4.4894	1985	1996	3	-5.4363	1979	1998	3	-0.8829	1993	1998	3	-3.9827
New Zealand	1974	1991	1	-1.2256	1974	1987	1	-5.3677	1973	1982	0	-1.2982	1973	1981	2	-2.6676
Pakistan	1979	1993	1	-1.9854	1983	1989	4	-4.5	1978	1997	0	-0.7111	1979	1995	1	-3.2464
Philippines	1985	1992	0	-2.1918	1979	1994	0	-3.7442	1980	1985	0	-1.8861	1985	1993	0	-2.998
Singapore	1978	2000	1	-0.5011	1983	2000	1	-3.5038	1980	1986	4	1.0989	1986	1996	4	-0.3769
South Korea	1997	2002	1	-1.3856	1981	2000	1	-4.5849	1997	2000	1	-1.1361	1997	2000	1	-3.6686
Thailand	1998	2001	1	-3.2021	1982	1992	1	-6.6502	1996	1999	1	-0.4566	1996	2000	1	-1.985

Table 17A: Lee-Strazicich and NP unit root tests for EU

Country	Lee-Strazicich's LM unit Root Test								NP results							
	Model type Crash				Model type trend break				Model type M1				Model type M2			
	T_{B1}	T_{B2}	k	Test statistics	T_{B1}	T_{B2}	k	Test statistics	T_{B1}	T_{B2}	K	Test statistics	T_{B1}	T_{B2}	k	Test statistics
Bangladesh	1985	2004	0	-2.8554	1981	2000	0	-5.1965	1986	1990	4	1.2418	1986	1994	0	-4.0505
China	1990	2003	1	-2.708	1999	2004	2	-5.8656	1990	2001	1	-3.2157	1994	2000	2	-5.8449[b]
China HKSAR	1985	2001	0	-3.3891	1992	2000	1	-5.7567	1997	1999	0	-1.7475	1996	2000	1	-2.913
India	1982	1998	2	-2.2028	1979	2000	0	-4.8933	1992	2000	0	-0.929	1978	2001	1	-2.6827
Indonesia	1989	1992	0	-3.4381	1988	1994	0	-5.2438	1989	1994	0	-5.2583[b]	1989	1997	5	-6.097[a]
Japan	1979	2001	0	-1.7527	1981	2009	3	-86.693	1974	1987	4	-2.258	1974	1983	0	-1.2539
Malaysia	1978	1990	0	-3.7516	1978	1990	0	-6.0408	1978	1991	0	-4.6752[b]	1979	1991	0	-5.2449[b]
New Zealand	1981	1997	4	-3.3719	1987	2001	4	-5.4883	1977	1981	4	-2.1376	1977	1985	4	-1.884
Pakistan	1986	1991	0	-2.642	1987	2001	0	-3.6656	1986	1991	3	-3.945	1986	1997	0	-2.9967
Philippines	1986	1990	3	-2.1899	1984	1998	0	-5.3058	1983	2000	0	-1.0986	1983	2000	0	-3.9595
Singapore	2002	2006	0	-1.8954	1987	1993	0	-5.234	1981	1994	0	3.04206	1989	1992	0	-5.6102[b]
South Korea	1980	1999	2	-2.0687	1981	1995	0	-4.2228	1980	1997	0	-0.0293	1989	1987	3	-5.795[b]
Thailand	1984	1998	1	-2.3671	1981	1993	3	-5.2489	1983	1997	0	1.8678	1988	1997	3	-3.3308

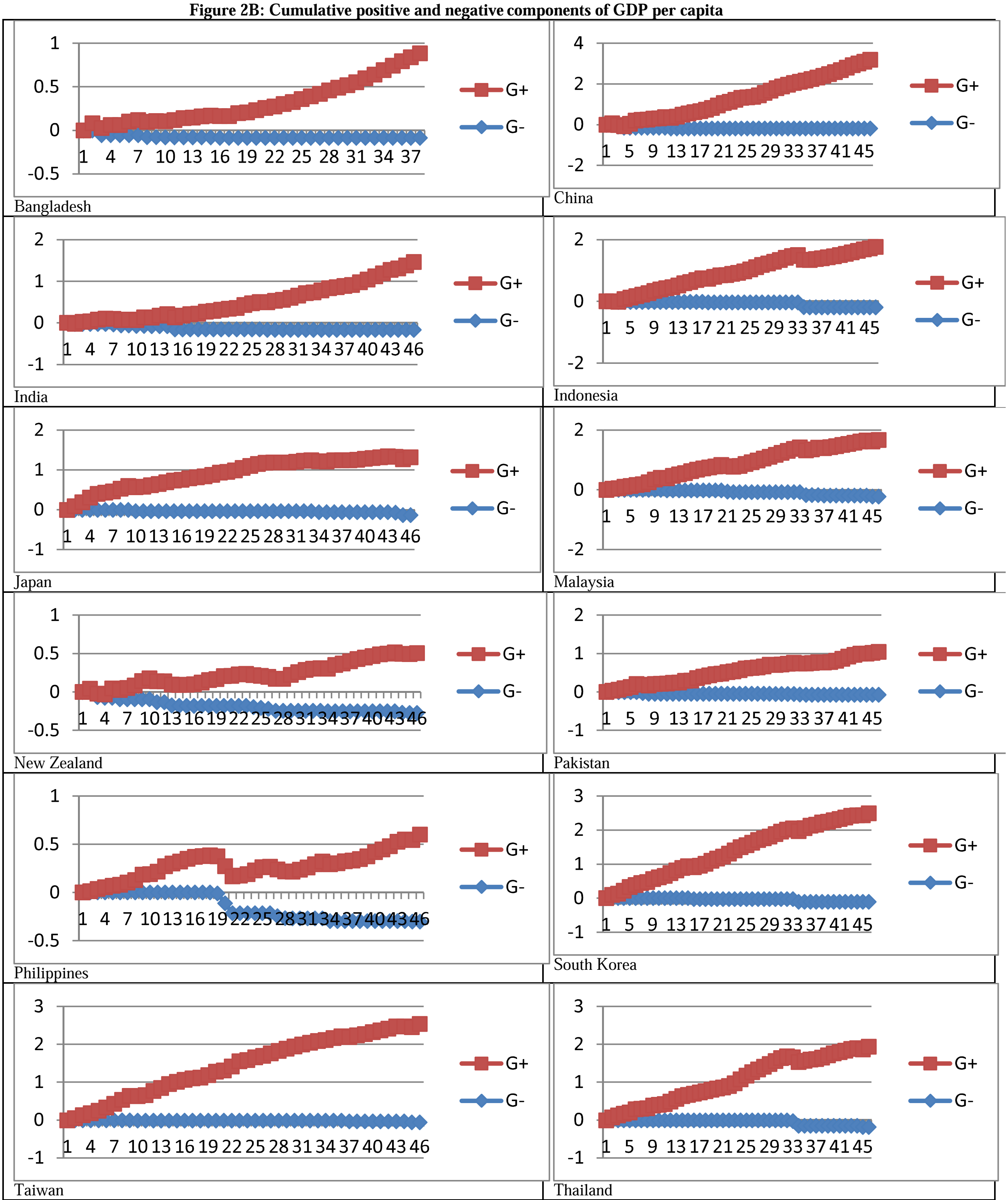
Appendix B: Cumulative positive and negative components of HYD and GDP

Figure 1B: Cumulative positive and negative components of hydroelectricity consumption



Note: HYD+ and HYD- denote cumulative positive and negative components respectively for hydroelectricity consumption.

Figure 2B: Cumulative positive and negative components of GDP per capita



Note: G+ and G- denote cumulative positive and negative components respectively for GDP per capita.

Appendix C: Tables for unit root analysis for hidden cointegration part

Table 1C: Unit Root for the level and first difference data (for GDP and CO_2)

Bangladesh					Bangladesh				
	G+	G-	C+	C-		DG+	DG-	DC+	DC-
DFG	-0.17	0	-2.05	-2.38	DFG	0	0	**-5.26**	**-4.94**
PP	-0.84	-1.96	-12.83	-12.13	PP	**-19.14**	**-33**	**-42.48**	**-46.04**
MZ	-0.32	-0.1	-1.92	-2.22	MZ	-1.28	-2.08	**-3.11**	**-3.43**
China					China				
	G+	G-	C+	C-		DG+	DG-	DC+	DC-
DFG	0	**-2.68**	-2.58	**-2.63**	DFG	**-4.97**	**-5.38**	**-4.19**	0
PP	-2.45	-10	-12.93	-9.8	PP	**-42.46**	**-49.66**	**-32.14**	**-26.46**
MZ	-0.69	-1.94	-2.48	-1.81	MZ	**-3.96**	**-4.49**	**-3.68**	-0.43
China HKSAR					China HKSAR				
	G+	G-	C+	C-		DG+	DG-	DC+	DC-
DFG	-1.14	-1.88	-1.98	-1.47	DFG	0	**-5**	0	**-2.92**
PP	-3.33	-8.43	-9.23	-5.19	PP	**-21.28**	**-51.79**	**-44.1**	**-889.84**
MZ	-1.11	-1.85	-1.78	-1.37	MZ	-1.88	**-3.52**	**-3.64**	**-20.72**
India					India				
	G+	G-	C+	C-		DG+	DG-	DC+	DC-
DFG	0.23	-0.99	-1.83	-2.14	DFG	**-4.46**	**-5.35**	0	**-5.16**
PP	-0.36	-3.2	-9.27	-8.53	PP	**-46.24**	**-52.02**	**-25.23**	**-51.24**
MZ	0.12	-0.97	-1.77	-1.82	MZ	**-3.06**	**-3.51**	-1.45	**-3.6**
Indonesia					Indonesia				
	G+	G-	C+	C-		DG+	DG-	DC+	DC-
DFG	-2.16	-1.87	-0.92	-1.65	DFG	0	**-4.9**	0	0
PP	-8.03	-7.22	-2.33	-7.71	PP	**-13.64**	**-47.84**	**-23.23**	**-37.11**
MZ	-1.93	-1.81	-0.87	-1.67	MZ	-1.84	**-3.54**	-1.87	**-2.83**
Japan					Japan				
	G+	G-	C+	C-		DG+	DG-	DC+	DC-
DFG	-1.46	-2.12	-1.74	-1.98	DFG	0	**-4.04**	0	0
PP	-5.79	**-16.95**	-6.43	-9.18	PP	-10.25	**-56.09**	-10.01	**-52.03**
MZ	-1.34	-2.48	-1.45	-1.97	MZ	-1.49	**-4.16**	-1.11	**-3.72**
Malaysia					Malaysia				
	G+	G-	C+	C-		DG+	DG-	DC+	DC-
DFG	-2.15	-1.98	-0.46	0	DFG	0	0	-0.6	**-5.5**
PP	-10.69	-8.34	-2.15	-6.18	PP	**-22.03**	**-71.06**	**-15.45**	**-65.57**
MZ	-2.18	-1.85	-0.61	-1.21	MZ	-2.31	**-4.77**	-0.39	**-5.19**
New Zealand					New Zealand				
	G+	G-	C+	C-		DG+	DG-	DC+	DC-
DFG	-2.22	-1.79	-1.35	-2.05	DFG	**-4.14**	0	-0.34	**-3.29**
PP	-10.52	-5.1	-6.26	-12.41	PP	**-36.16**	**-42.18**	**-29.53**	**-29.51**
MZ	-2.17	-1.26	-1.33	-2.32	MZ	**-3.04**	**-2.94**	-0.35	**-2.94**
Pakistan					Pakistan				
	G+	G-	C+	C-		DG+	DG-	DC+	DC-
DFG	-1.99	-2.61	-1.44	-1.95	DFG	**-3.75**	0	0	**-4.41**
PP	-7.97	-12.94	-5.76	-7.2	PP	**-33.66**	**-47.75**	**-19.01**	**-36.87**
MZ	-1.9	-2.45	-1.54	-1.74	MZ	**-2.87**	**-4.29**	-2.04	**-3.68**
Philippines					Philippines				
	G+	G-	C+	C-		DG+	DG-	DC+	DC-
DFG	-1.64	0	-1.31	-1.68	DFG	0	0	0	-1.87
PP	-7.79	-5.42	-4.46	-6.14	PP	**-20.36**	**-40.76**	**-332.96**	**-38.33**
MZ	-1.84	-1.55	-1.09	-1.7	MZ	-2.29	**-4.16**	**-12.53**	**-3.33**
Singapore					Singapore				
	G+	G-	C+	C-		DG+	DG-	DC+	DC-
DFG	0	-0.83	-2.15	-1.46	DFG	0	0	0	0
PP	-2.06	-3.03	-9.78	-3.95	PP	**-12.67**	**-66.03**	**-41.27**	**-35.78**
MZ	-0.47	-0.8	-2	-1.21	MZ	-1.67	**-4.61**	**-3.12**	-1.91
South Korea					South Korea				
	G+	G-	C+	C-		DG+	DG-	DC+	DC-
DFG	-0.85	-2.26	-0.43	-1.78	DFG	0	**-5.02**	**-3.05**	**-4.95**
PP	-3.81	-10.26	-1.95	-6.5	PP	**-14.71**	**-49.84**	**-24.97**	**-49**
MZ	-0.95	-2.13	-0.39	-1.7	MZ	-1.14	**-3.55**	**-2.24**	**-3.52**
Taiwan					Taiwan				
	G+	G-	C+	C-		DG+	DG-	DC+	DC-
DFG	-1.04	-1.27	-0.71	-2.12	DFG	0	-4.94	0	**-4.96**
PP	-3.02	-6.13	-1.96	-9.46	PP	**-21.13**	**-57.65**	**-26.65**	**-47.65**
MZ	-0.88	-1.33	-0.51	-2.08	MZ	-2.3	**-3.83**	-2.3	**-3.68**
Thailand					Thailand				
	G+	G-	C+	C-		DG+	DG-	DC+	DC-
DFG	0	-1.72	-1.27	-2.33	DFG	0	**-4.78**	-2.44	**-4.94**

PP	-5.94	-6.43	-6.45	-10.76	PP	**-16.24**	**-44.55**	**-15.32**	**-48.19**
MZ	-1.63	-1.66	-1.41	-2.19	MZ	-2.29	**-3.67**	-1.68	**-3.57**

Notes: DF-GLS: The GLS-detrended Augmented Dickey-Fuller test; PP: The Phillips-Perron test (Zα); MZτ: The modified Phillips-Perron test (MZα). For the GLS detrended series with a drift and linear trend in the GLS, the 1%, 5% and 10% critical values for the DF-GLS and the MZτ statistics are -3.42, -2.91and -2.62 respectively while the 1%, 5% and 10% critical values for the PP statistic are -23.8, -17.3 and -14.2 respectively. The optimal lag length has been chosen by minimizing the modified Akaike information criterion (MAIC). Bold values are significant at least at 10% critical values.

Table 2C: Unit Root for the level and first difference data (for Trade and CO_2)

Bangladesh					Bangladesh				
	T+	T-	C+	C-		DT+	DT-	DC+	DC-
DFG	-2.37	-1.59	-2.05	-2.38	DFG	**-3.3**	0	**-5.26**	**-4.94**
PP	-11.55	-7.77	-12.83	-12.13	PP	**-31.41**	-13.89	**-42.48**	**-46.04**
MZ	-2.19	-1.41	-1.92	-2.22	MZ	-2.3	-1.03	**-3.11**	**-3.43**
China					China				
	T+	T-	C+	C-		DT+	DT-	DC+	DC-
DFG	-1.57	0	-2.32	0	DFG	0	**-4.67**	**-3.45**	**-4.57**
PP	-3.27	-1.24	**-19.26**	**-17.93**	PP	**-30.79**	**-39.22**	**-23.61**	**-38.81**
MZ	-1.16	-0.46	-2.96	-2.74	MZ	**-3.16**	**-3.66**	**-3.21**	**-3.15**
China HKSAR					China HKSAR				
	T+	T-	C+	C-		DT+	DT-	DC+	DC-
DFG	-1.8	-1.44	-1.98	-1.47	DFG	0	-1.17	0	-2.92
PP	-6.26	-3.99	-9.23	-5.19	PP	**-19.63**	**-34.36**	**-44.1**	**-889.84**
MZ	-1.73	-1.34	-1.78	-1.37	MZ	-2.19	-1.67	**-3.64**	**-20.72**
India					India				
	T+	T-	C+	C-		DT+	DT-	DC+	DC-
DFG	-1.65	-2.52	-1.83	-2.14	DFG	0	**-3.81**	0	**-5.16**
PP	-4.43	-9.09	-9.27	-8.53	PP	**-40.69**	**-34.94**	**-25.23**	**-51.24**
MZ	-1.36	-1.95	-1.77	-1.82	MZ	**-2.72**	**-3.26**	-1.45	**-3.6**
Indonesia					Indonesia				
	T+	T-	C+	C-		DT+	DT-	DC+	DC-
DFG	-1.33	-2.27	-0.92	-1.65	DFG	-1.36	0	0	0
PP	-4	-10.11	-2.33	-7.71	PP	**-46.58**	**-63.14**	**-23.23**	**-37.11**
MZ	-1.33	-2.05	-0.87	-1.67	MZ	**-3.78**	**-4.21**	-1.87	**-2.83**
Japan					Japan				
	T+	T-	C+	C-		DT+	DT-	DC+	DC-
DFG	-1.95	0	-1.74	-1.98	DFG	**-4.78**	**-1.68**	0	0
PP	-7.08	15.94	-6.43	-9.18	PP	**-44.96**	**-135.65**	-10.01	**-52.03**
MZ	-1.76	6.46	-1.45	-1.97	MZ	**-3.7**	**-7.7**	-1.11	**-3.72**
Malaysia					Malaysia				
	T+	T-	C+	C-		DT+	DT-	DC+	DC-
DFG	0	-2.19	-0.46	0	DFG	0	-1.69	-0.6	**-5.5**
PP	-5.48	9.57	-2.15	-6.18	PP	**-17.79**	**-892.44**	**-15.45**	**-65.57**
MZ	-1.45	2.82	-0.61	-1.21	MZ	-1.55	**-20.86**	-0.39	**-5.19**
New Zealand					New Zealand				
	T+	T-	C+	C-		DT+	DT-	DC+	DC-
DFG	-0.84	7.04	0	-1.79	DFG	0	15.53	**-2.8**	**-2.89**
PP	-2.68	18.48	-4.12	-12.68	PP	**-23.68**	19.42	**-26.19**	**-16.61**
MZ	-0.8	15.9	-1.13	-2.11	MZ	-0.95	57266.64	-1.51	-1.96
Pakistan					Pakistan				
	T+	T-	C+	C-		DT+	DT-	DC+	DC-
DFG	**-2.93**	-1.87	-1.44	-1.95	DFG	**-5.49**	**-5.15**	0	**-4.41**
PP	**-18.07**	-7.36	-5.76	-7.2	PP	**-55.55**	**-48.87**	**-19.01**	**-36.87**
MZ	**-2.71**	-1.75	-1.54	-1.74	MZ	**-3.77**	**-3.91**	-2.04	**-3.68**
Philippines					Philippines				
	T+	T-	C+	C-		DT+	DT-	DC+	DC-
DFG	-1.8	-2.47	-1.31	-1.68	DFG	**-3.51**	0	0	-1.87
PP	-6.44	**-13.53**	-4.46	-6.14	PP	**-27.33**	**-52.97**	**-332.96**	**-38.33**
MZ	-1.69	-2.38	-1.09	-1.7	MZ	**-2.9**	**-3.7**	**-12.53**	**-3.33**
Singapore					Singapore				
	T+	T-	C+	C-		DT+	DT-	DC+	DC-
DFG	**-3.89**	-2.43	-1.88	-1.63	DFG	**-3.77**	0	0	0
PP	**-29.47**	**-16.76**	-6.2	-5.54	PP	**-31.16**	**-59.33**	**-28.48**	**-42.34**
MZ	**-3.59**	-2.5	-1.67	-1.54	MZ	**-2.87**	**-4.28**	-1.88	**-3.11**
South Korea					South Korea				
	T+	T-	C+	C-		DT+	DT-	DC+	DC-
DFG	-1.19	-2.31	-0.43	-1.78	DFG	0	-2.21	**-3.05**	**-4.95**
PP	-5.33	18.37	-1.95	-6.5	PP	**-20.04**	9.13	**-24.97**	**-49**
MZ	-1.23	9.57	-0.39	-1.7	MZ	-2	2.44	-2.24	**-3.52**
Taiwan					Taiwan				
	T+	T-	C+	C-		DT+	DT-	DC+	DC-
DFG					DFG				

PP					PP				
MZ					MZ				
Thailand					Thailand				
	T+	T-	C+	C-		DT+	DT-	DC+	DC-
DFG	-2.17	-2.38	-1.27	-2.33	DFG	**-4.5**	**-5.5**	**-2.44**	**-4.94**
PP	-8.11	-11.17	-6.45	-10.76	PP	**-38.05**	**-63.32**	**-15.32**	**-48.19**
MZ	-1.96	-2.24	-1.41	-2.19	MZ	**-3.33**	**-4.41**	-1.68	**-3.57**
Notes: See Table 1C									

Table 3C: Unit Root for the level and first difference data (for GDP and Coal)

Bangladesh					Bangladesh				
	G+	G-	Coal+	Coal-		DG+	DG-	DCoal+	DCoal-
DFG	-0.17	0	-1.74	-1.77	DFG	0	0	0	0
PP	-0.84	-1.96	-5.43	-7.44	PP	**-19.14**	**-33**	**-21.4**	**-77.8**
MZ	-0.32	-0.1	-1.5	-1.69	MZ	-1.28	-2.08	-1.2	**-5.06**
China					China				
	G+	G-	Coal+	Coal-		DG+	DG-	DCoal+	DCoal-
DFG	0	**-2.68**	**-2.81**	0	DFG	**-4.97**	**-5.38**	**-4.23**	0
PP	-2.45	-10	**-15.5**	-2.47	PP	**-42.46**	**-49.66**	**-33.4**	**-24.06**
MZ	-0.69	-1.94	**-2.73**	0.13	MZ	**-3.96**	**-4.49**	**-3.71**	-0.53
India					India				
	G+	G-	Coal+	Coal-		DG+	DG-	DCoal+	DCoal-
DFG	0.23	-0.99	-1.65	-1.64	DFG	**-4.46**	**-5.35**	0	**-5.67**
PP	-0.36	-3.2	-9.08	-6.21	PP	**-46.24**	**-52.02**	**-22.52**	**-57.54**
MZ	0.12	-0.97	-1.73	-1.46	MZ	**-3.06**	**-3.51**	-1.62	**-3.84**
Indonesia					Indonesia				
	G+	G-	Coal+	Coal-		DG+	DG-	DCoal+	DCoal-
DFG	-2.16	-1.87	-2.16	0	DFG	0	**-4.9**	**-3.87**	0
PP	-8.03	-7.22	-8.88	-1.81	PP	**-13.64**	**-47.84**	**-33.03**	**-21.03**
MZ	-1.93	-1.81	-2.02	-0.37	MZ	-1.84	**-3.54**	**-3.07**	-0.98
Japan					Japan				
	G+	G-	Coal+	Coal-		DG+	DG-	DCoal+	DCoal-
DFG	-1.46	-2.12	0	-1.6	DFG	0	**-4.04**	0	0
PP	-5.79	-16.95	-10.07	-4.71	PP	-10.25	**-56.09**	**-17.71**	**-27.84**
MZ	-1.34	-2.48	-2.06	-1.47	MZ	-1.49	**-4.16**	-1.53	-1.51
New Zealand					New Zealand				
	G+	G-	Coal+	Coal-		DG+	DG-	DCoal+	DCoal-
DFG	-2.22	-1.79	-1.17	-1.88	DFG	**-4.14**	0	-4.39	-2.07
PP	-10.52	-5.1	-3.87	-23.81	PP	**-36.16**	**-42.18**	**-49.94**	**-13.95**
MZ	-2.17	-1.26	-1.05	-2.99	MZ	**-3.04**	**-2.94**	**-2.86**	-0.95
Pakistan					Pakistan				
	G+	G-	Coal+	Coal-		DG+	DG-	DCoal+	DCoal-
DFG	-1.99	-2.61	-2.43	-1.41	DFG	**-3.75**	0	0	0
PP	-7.97	-12.94	-12.04	-5.11	PP	**-33.66**	**-47.75**	**-16.1**	**-18.51**
MZ	-1.9	-2.45	-2.39	-1.37	MZ	**-2.87**	**-4.29**	-2.41	-2.46
Philippines					Philippines				
	G+	G-	Coal+	Coal-		DG+	DG-	DCoal+	DCoal-
DFG	-1.36	-2.17	-1.86	-1.2	DFG	0	**-4.57**	0	0
PP	-6.84	-11.07	-6.86	-3.42	PP	**-31.71**	**-36.81**	**-15.59**	**-28.35**
MZ	-1.62	-2.26	-1.6	-1.15	MZ	**-3.35**	**-3.96**	-0.97	-1.83
South Korea					South Korea				
	G+	G-	Coal+	Coal-		DG+	DG-	DCoal+	DCoal-
DFG	-0.85	-2.26	-1.75	-2.84	DFG	0	**-5.02**	0	0
PP	-3.81	-10.26	-6.36	-13.15	PP	**-14.71**	**-49.84**	**-27.02**	**-19.72**
MZ	-0.95	-2.13	-1.72	-2.33	MZ	-1.14	**-3.55**	-1.97	-1.99
Taiwan					Taiwan				
	G+	G-	Coal+	Coal-		DG+	DG-	DCoal+	DCoal-
DFG	-1.04	-1.27	-1.56	-1.23	DFG	0	**-4.94**	-1.72	-0.38
PP	-3.02	-6.13	-5.86	-2.55	PP	**-21.13**	**-57.65**	-10.2	**-19.41**
MZ	-0.88	-1.33	-1.58	-0.89	MZ	-2.3	**-3.83**	-1.4	-0.51
Thailand					Thailand				
	G+	G-	Coal+	Coal-		DG+	DG-	DCoal+	DCoal-
DFG	0	-1.74	-1.03	-1.86	DFG	0	**-4.73**	0	**-5.35**
PP	-5.43	-6.55	-3.01	-7.83	PP	**-18.08**	**-43.61**	**-22.7**	**-53.17**
MZ	-1.56	-1.68	-1.02	-1.8	MZ	-2.55	**-3.63**	-1.64	**-3.67**
Notes: See Table 1C									

Table 4C: Unit Root for the level and first difference data (for Coal and Trade)

Bangladesh					Bangladesh				
	T+	T-	Coal+	Coal-		DT+	DT-	DCoal+	DCoal-
DFG	-2.37	-1.59	-1.74	-1.77	DFG	**-3.3**	0	0	0
PP	-11.55	-7.77	-5.43	-7.44	PP	**-31.41**	**-13.89**	**-21.4**	**-77.8**
MZ	-2.19	-1.41	-1.5	-1.69	MZ	-2.3	-1.03	-1.2	**-5.06**
China					China				
	T+	T-	Coal+	Coal-		DT+	DT-	DCoal+	DCoal-
DFG	-1.57	0	-2.41	0	DFG	0	**-4.67**	**-3.28**	**-4.57**
PP	-3.27	-1.24	**-18.54**	-2.39	PP	**-30.79**	**-39.22**	**-21.17**	**-38.81**
MZ	-1.16	-0.46	**-2.95**	0.59	MZ	**-3.16**	**-3.66**	**-3.02**	**-3.15**
India					India				
	T+	T-	Coal+	Coal-		DT+	DT-	DCoal+	DCoal-
DFG	-1.65	-2.52	-1.65	-1.64	DFG	0	**-3.81**	0	**-5.67**
PP	-4.43	-9.09	-9.08	-6.21	PP	**-40.69**	**-34.94**	**-22.52**	**-57.54**
MZ	-1.36	-1.95	-1.73	-1.46	MZ	**-2.72**	**-3.26**	-1.62	**-3.84**
Indonesia					Indonesia				
	T+	T-	Coal+	Coal-		DT+	DT-	DCoal+	DCoal-
DFG	-1.33	-2.27	-2.16	0	DFG	-1.36	0	**-3.87**	0
PP	-4	-10.11	-8.88	-1.81	PP	**-46.58**	**-63.14**	**-33.03**	**-21.03**
MZ	-1.33	-2.05	-2.02	-0.37	MZ	**-3.78**	**-4.21**	**-3.07**	-0.98
Japan					Japan				
	T+	T-	Coal+	Coal-		DT+	DT-	DCoal+	DCoal-
DFG	-1.95	0	0	-1.6	DFG	**-4.78**	-1.68	0	0
PP	-7.08	15.94	-10.07	-4.71	PP	**-44.96**	**-135.65**	**-17.71**	**-27.84**
MZ	-1.76	6.46	-2.06	-1.47	MZ	**-3.7**	**-7.7**	-1.53	-1.51
New Zealand					New Zealand				
	T+	T-	Coal+	Coal-		DT+	DT-	DCoal+	DCoal-
DFG	-0.84	7.04	-1.63	-1.64	DFG	0	15.53	**-3.74**	0
PP	-2.68	18.48	-6.49	**-18.66**	PP	**-23.68**	19.42	**-37.25**	-11.55
MZ	-0.8	15.9	-1.56	-2.68	MZ	-0.95	57266.64	-2.4	-0.93
Pakistan					Pakistan				
	T+	T-	Coal+	Coal-		DT+	DT-	DCoal+	DCoal-
DFG	**-2.93**	-1.87	-2.43	-1.41	DFG	**-5.49**	**-5.15**	0	0
PP	**-18.07**	-7.36	-12.04	-5.11	PP	**-55.55**	**-48.87**	**-16.1**	**-18.51**
MZ	**-2.71**	-1.75	-2.39	-1.37	MZ	**-3.77**	**-3.91**	-2.41	-2.46
Philippines					Philippines				
	T+	T-	Coal+	Coal-		DT+	DT-	DCoal+	DCoal-
DFG	-1.99	-2.29	-1.86	-1.2	DFG	**-3.39**	0	0	0
PP	-8.26	-11.99	-6.86	-3.42	PP	**-24.36**	**-48**	**-15.59**	**-28.35**
MZ	-1.92	-2.19	-1.6	-1.15	MZ	**-2.68**	**-3.61**	-0.97	-1.83
South Korea					South Korea				
	T+	T-	Coal+	Coal-		DT+	DT-	DCoal+	DCoal-
DFG	-1.19	-2.31	-1.75	-2.84	DFG	0	-2.21	0	0
PP	-5.33	18.37	-6.36	-13.15	PP	**-20.04**	9.13	**-27.02**	**-19.72**
MZ	-1.23	9.57	-1.72	-2.33	MZ	-2	2.44	-1.97	-1.99
Thailand					Thailand				
	T+	T-	Coal+	Coal-		DT+	DT-	DCoal+	DCoal-
DFG	-2.09	-2.45	-1.03	-1.86	DFG	0	0	0	**-5.35**
PP	-7.92	-12.67	-3.01	-7.83	PP	**-23.92**	**-20.08**	**-22.7**	**-53.17**
MZ	-1.92	-2.39	-1.02	-1.8	MZ	-2.05	-1.36	-1.64	**-3.67**

Notes: See Table 1C

Table 5C: Unit Root for the level and first difference data (for GDP and ELEP)

Bangladesh					Bangladesh				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-0.08	0	-2.39	-1.7	DFG	0	**-13.7**	0	**-4.61**
PP	-0.76	-4.09	-7.27	-6.19	PP	**-18.6**	**-28.8**	**-21.78**	**-41.99**
MZ	-0.25	0.22	-1.71	-1.61	MZ	-1.2	-1.18	-1.16	**-3.26**
China					China				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	0	-2.01	-1.94		DFG	0	0	**-3.07**	
PP	-8.32	-7.02	-8.84		PP	**-34.8**	**-79.5**	**-23.83**	
MZ	-1.65	-1.63	-1.94		MZ	**-3.72**	**-5.39**	-2.47	
China HKSAR					China HKSAR				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.25	-1.87	-0.41	-1.88	DFG	0	**-4.27**	**-3**	**-4.67**
PP	-4.41	-8.24	-2.3	-7.07	PP	**-20.6**	**-39.6**	**-21.89**	**-42.96**
MZ	-1.16	-1.82	-0.64	-1.76	MZ	-1.69	**-3.01**	-2.44	**-3.3**
India					India				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-0.16	0	-0.85		DFG	**-4.08**	0	-2.54	

PP	-1.68	-5.18	-2.42		PP	**-39.5**	**-84.2**	**-18.71**	
MZ	-0.22	-1.26	-0.89		MZ	**-2.73**	**-5.44**	-2.12	
Indonesia					Indonesia				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.95	-1.94	-0.79	0	DFG	**-3.24**	**-4.52**	0	**-4.76**
PP	-8.97	-7.56	-2.87	-8.64	PP	**-21.6**	**-40.8**	**-15.94**	**-43.56**
MZ	-1.99	-1.83	-0.84	-1.87	MZ	**-2.73**	**-3.27**	-1.75	**-3.32**
Japan					Japan				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.12	-2.14	-0.67	-1.93	DFG	-2.25	**-4.24**	0	**-5.16**
PP	**-3.84**	**-17.82**	-2.88	**-15.08**	PP	-10.9	**-62.5**	-7.84	**-53.2**
MZ	-1.04	-2.51	-0.78	-2.31	MZ	-1.63	**-4.41**	-0.54	**-4.29**
Malaysia					Malaysia				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.79	-2.29	-1.12	-1.82	DFG	0	**-5.85**	-1.7	-1.95
PP	-10.5	-11.09	-5.91	**-16.85**	PP	**-14.6**	**-56.5**	-11.23	**-72.83**
MZ	-2.03	-2.15	-1.4	-2.35	MZ	-1.29	**-4.23**	-1.53	**-4.99**
New Zealand					New Zealand				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-2.07	-1.44	-0.82	-2.35	DFG	**-4.09**	**-4.51**	**-3.16**	**-5.19**
PP	-8.1	-4.64	-3.01	-12.43	PP	**-36.5**	**-45.6**	**-21.78**	**-58.89**
MZ	-1.88	-1.36	-0.8	-2.23	MZ	**-3.27**	**-3.24**	**-2.63**	**-3.84**
Pakistan					Pakistan				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.88	-2.29	-0.8	0	DFG	**-3.23**	0	0	0
PP	-6.74	-5.69	-1.88	5.42	PP	**-25**	**-25**	-11.01	**-16.61**
MZ	-1.8	-1.43	-0.65	4.5	MZ	**-2.53**	-1.27	-1.11	-2.03
Philippines					Philippines				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	0	-2.38	-2.56	-1.47	DFG	**-3.97**	**-4.6**	**-4.96**	**-6.61**
PP	-7.2	-13.05	**-16.19**	-5.31	PP	**-31.1**	**-37.9**	**-41.44**	**-40.62**
MZ	-1.77	-2.48	-2.39	-1.48	MZ	**-3.42**	**-4.03**	**-3.5**	**-3.07**
South Korea					South Korea				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.12	-2.37	-1.11	-1.89	DFG	0	**-4.68**	0	**-4.61**
PP	-3.66	-11.45	-5.6	-7.15	PP	**-14.5**	**-43.4**	**-14.58**	**-42.62**
MZ	-1.06	-2.25	-1.15	-1.78	MZ	-1.78	**-3.32**	-1.75	**-3.29**
Thailand					Thailand				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	0	-1.81	-0.76	-1.86	DFG	0	**-4.38**	**-2.63**	**-4.56**
PP	-3.58	-7.27	-10.02	-6.98	PP	-11.8	**-37.5**	**-14.55**	**-41.67**
MZ	-1.15	-1.77	-1.92	-1.75	MZ	-2.02	**-3.39**	-2.04	**-3.26**
Notes: See Table 1C									

Table 6C: Unit Root for the level and first difference data (for ELEP and Trade)

Bangladesh					Bangladesh				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-2.24	**-2.71**	-2.39	-1.7	DFG	**-3.5**	0	0	**-4.61**
PP	-11.18	-8.48	-7.27	-6.19	PP	**-34.84**	**-13.22**	**-21.78**	**-41.99**
MZ	-2.14	-1.71	-1.71	-1.61	MZ	-2.38	-0.97	-1.16	**-3.26**
China					China				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.78	0	**-3.41**		DFG	0	**-3.92**	**-2.99**	
PP	-3.65	-3.11	-24.04		PP	**-21.12**	**-31.96**	**-16.48**	
MZ	-1.27	-1.08	-3.35		MZ	**-2.33**	**-3.23**	**-2.33**	
China HKSAR					China HKSAR				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.48	-1.57	-0.41	-1.88	DFG	0	**-3.17**	**-3**	**-4.67**
PP	-6.55	-5.3	-2.3	-7.07	PP	**-12.82**	**-27.41**	**-21.89**	**-42.96**
MZ	-1.64	-1.28	-0.64	-1.76	MZ	-1.63	-1.7	-2.44	**-3.3**
India					India				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.08	-2.59	-0.85		DFG	**-4.54**	-2.57	-2.54	
PP	-3.41	-20.48	-2.42		PP	**-42.95**	**-17.74**	**-18.71**	
MZ	-1.01	-2.63	-0.89		MZ	**-3.11**	-1.22	-2.12	
Indonesia					Indonesia				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.2	**-2.7**	-0.79	0	DFG	**-4.13**	0	0	**-4.76**
PP	-3.03	**-15.16**	-2.87	-8.64	PP	**-35.33**	**-45.52**	**-15.94**	**-43.56**
MZ	-1.15	-2.48	-0.84	-1.87	MZ	**-2.83**	**-3.44**	-1.75	**-3.32**
Japan					Japan				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-

DFG	-1.63	**-2.74**	-0.67	-1.93	DFG	**-4.82**	-1.67	0	**-5.16**
PP	-5.6	15.86	-2.88	**-15.08**	PP	**-47.28**	**-195.83**	**-7.84**	**-53.2**
MZ	-1.57	5.71	-0.78	-2.31	MZ	**-3.72**	**-9.42**	-0.54	**-4.29**
Malaysia					Malaysia				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	0	-1.64	-1.12	-1.82	DFG	0	**-4.36**	-1.7	-1.95
PP	-5.69	-7.89	-5.91	**-16.85**	PP	**-16.22**	**-32.82**	-11.23	**-72.83**
MZ	-1.41	-1.54	-1.4	-2.35	MZ	-1.38	-2.48	-1.53	**-4.99**
New Zealand					New Zealand				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-0.84	7.04	-1.32	**-2.69**	DFG	0	15.53	0	**-4.27**
PP	**-2.68**	18.48	-4.2	**-14.62**	PP	**-23.68**	19.42	-10.75	**-39.95**
MZ	-0.8	15.9	-1.18	-2.47	MZ	-0.95	57266.64	-0.52	**-3.18**
Pakistan					Pakistan				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-2.54	-2.55	-0.8	0	DFG	**-4.52**	**-6.34**	0	0
PP	-13.64	-11.71	-1.88	5.42	PP	**-41.87**	**-26.92**	-11.01	**-16.61**
MZ	-2.39	-1.91	-0.65	4.5	MZ	**-3.24**	-2.37	-1.11	-2.03
Philippines					Philippines				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-2.13	-2.17			DFG	**-3.35**	0		
PP	-9.58	-11.53			PP	**-24.91**	**-54.5**		
MZ	-2.09	-2.11			MZ	**-2.75**	**-3.88**		
South Korea					South Korea				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	0	-2.39	-1.11	-1.89	DFG	-0.04	-2.21	0	**-4.61**
PP	-7.33	17.12	-5.6	-7.15	PP	**-56.34**	7.95	**-14.58**	**-42.62**
MZ	-1.72	8.84	-1.15	-1.78	MZ	**-4.6**	2.23	-1.75	**-3.29**
Thailand					Thailand				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-2.13	**-2.76**	-0.76	-1.86	DFG	**-3.91**	**-3.6**	**-2.63**	**-4.56**
PP	-8.93	**-16.32**	-10.02	-6.98	PP	**-31.47**	**-33.03**	**-14.55**	**-41.67**
MZ	-1.98	-2.61	-1.92	-1.75	MZ	**-2.93**	**-2.82**	-2.04	**-3.26**

Notes: See Table 1C

Table 7C: Unit Root for the level and first difference data (for GDP and ELEP-Coal)

China					China				
	G+	G-	E +	E -		DG+	DG-	DE+	DE-
DFG	0	-2.01	**-2.8**	-1.88	DFG	0	0	0	0
PP	-8.32	-7.02	**-15.94**	-5.78	PP	**-34.81**	**-79.49**	**-59.86**	**-22.52**
MZ	-1.65	-1.63	-2.59	-1.43	MZ	**-3.72**	**-5.39**	**-5.03**	-0.28
China HKSAR					China HKSAR				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-2.11	-2.13	-0.82	-1.56	DFG	**-3.65**	**-3.68**	**-7.41**	0
PP	-7.83	-9.53	-6.48	-4.83	PP	**-26.41**	**-29.45**	**-15.61**	**-19.26**
MZ	-1.78	-1.95	-0.44	-1.39	MZ	**-2.92**	-2.6	-0.93	-1.57
India					India				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-0.16	0	0	0	DFG	**-4.08**	0	-2.16	**-4.91**
PP	-1.68	-5.18	**-14.14**	**-305.88**	PP	**-39.49**	**-84.16**	**-20.98**	**-45.24**
MZ	-0.22	-1.26	-2.53	-12.29	MZ	**-2.73**	**-5.44**	-1.64	**-3.39**
Japan					Japan				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.12	-2.14	-2.56	0	DFG	-2.25	**-4.24**	**-4.97**	-2.44
PP	-3.84	**-17.82**	-14.42	**-101.19**	PP	**-10.91**	**-62.53**	**-45.4**	**-13.56**
MZ	-1.04	-2.51	-2.48	**-7.09**	MZ	-1.63	**-4.41**	**-4.07**	-2.21
New Zealand					New Zealand				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-2.07	-1.44	-3.13	-1.85	DFG	**-4.09**	**-4.51**	**-5.77**	**-4.53**
PP	-8.1	-4.64	**-20.34**	-5.75	PP	**-36.48**	**-45.56**	**-64.17**	**-49.92**
MZ	-1.88	-1.36	**-2.81**	-1.54	MZ	**-3.27**	**-3.24**	**-3.73**	**-3.11**
Pakistan					Pakistan				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.88	-2.29	-1.85	-1.45	DFG	**-3.23**	0	0	-0.75
PP	-6.74	-5.69	-8.52	-4.66	PP	**-25**	**-25.03**	**-50.8**	**-933.99**
MZ	-1.8	-1.43	-1.82	-1.34	MZ	-2.53	-1.27	**-3.64**	**-21.31**
Philippines					Philippines				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	0	-2.38	-1.23	-1.75	DFG	**-3.97**	**-4.6**	0	-0.57
PP	-7.2	-13.05	-3.89	-7.71	PP	**-31.08**	**-37.9**	**-30.23**	**-329.86**
MZ	-1.77	-2.48	-1.14	-1.72	MZ	**-3.42**	**-4.03**	**-2.86**	**-12.36**
South Korea					South Korea				

	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.12	-2.37	-1.58	0	DFG	0	**-4.68**	**-5.18**	**-5.61**
PP	-3.66	-11.45	-6.41	-2.18	PP	**-14.47**	**-43.39**	**-46.09**	**-52.66**
MZ	-1.06	-2.25	-1.53	-0.42	MZ	-1.78	**-3.32**	**-4**	**-3.72**
Thailand					Thailand				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	0	-1.81	-1.21	-2.12	DFG	0	**-4.38**	0	0
PP	-3.58	-7.27	-3.48	-10.15	PP	-11.8	**-37.5**	**-15.66**	**-123.15**
MZ	-1.15	-1.77	-1.13	-1.94	MZ	-2.02	**-3.39**	-0.33	**-7.28**
Notes: See Table 1C									

Table 8C: Unit Root for the level and first difference data (for Trade and ELEP-Coal)

China					China				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.78	0	**-3.28**		DFG	0	**-3.92**	0	
PP	**-3.65**	**-3.11**	**-19.62**		PP	**-21.12**	**-31.96**	**-20.74**	
MZ	-1.27	-1.08	-2.99		MZ	-2.33	**-3.23**	**-2.86**	
China HKSAR					China HKSAR				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.25	-1.53	-0.82	-1.56	DFG	**-3.08**	-2.1	**-7.41**	0
PP	-5.67	-7.19	-6.48	-4.83	PP	**-20.05**	-10.21	**-15.61**	**-19.26**
MZ	-1.4	-0.72	-0.44	-1.39	MZ	-2.47	-0.47	-0.93	-1.57
India					India				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.08	-2.59	0	0	DFG	**-4.54**	-2.57	-2.16	**-4.91**
PP	-3.41	**-20.48**	**-14.14**	**-305.88**	PP	**-42.95**	**-17.74**	**-20.98**	**-45.24**
MZ	-1.01	-2.63	-2.53	-12.29	MZ	**-3.11**	-1.22	-1.64	**-3.39**
Indonesia					Indonesia				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.49	-2.3	-1.41	-2.3	DFG	**-3.69**	**-3.84**	-1.57	**-3.6**
PP	-10.87	-11.22	-10.3	-11.25	PP	**-29.43**	**-29.54**	**-16.14**	**-28.71**
MZ	-2.07	-2.14	0.36	-2.18	MZ	-2.51	**-2.7**	-0.23	**-2.68**
Japan					Japan				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.63	**-2.74**	-2.56	0	DFG	**-4.82**	-1.67	**-4.97**	-2.44
PP	-5.6	15.86	**-14.42**	**-101.19**	PP	**-47.28**	**-195.83**	**-45.4**	**-13.56**
MZ	-1.57	5.71	-2.48	**-7.09**	MZ	**-3.72**	**-9.42**	**-4.07**	-2.21
New Zealand					New Zealand				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-0.84	7.04	-3.04	-1.88	DFG	0	15.53	**-4.11**	0
PP	-2.68	18.48	-20.74	-7.6	PP	**-23.68**	19.42	**-40.53**	**-29.63**
MZ	-0.8	15.9	-2.55	-1.66	MZ	-0.95	57266.64	-2.48	-2.42
Pakistan					Pakistan				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-2.54	-2.55	-1.85	-1.45	DFG	**-4.52**	**-6.34**	0	-0.75
PP	-13.64	-11.71	-8.52	-4.66	PP	**-41.87**	**-26.92**	**-50.8**	**-933.99**
MZ	-2.39	-1.91	-1.82	-1.34	MZ	**-3.24**	-2.37	**-3.64**	**-21.31**
Philippines					Philippines				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.75	-2.11	-1.23	-1.75	DFG	**-3.19**	0	0	-0.57
PP	-8.82	-11.77	-3.89	-7.71	PP	**-23.14**	**-38.93**	**-30.23**	**-329.86**
MZ	-1.92	-2.05	-1.14	-1.72	MZ	**-2.67**	**-2.92**	**-2.86**	**-12.36**
South Korea					South Korea				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	0	-2.39	-1.58	0	DFG	-0.04	-2.21	**-5.18**	**-5.61**
PP	-7.33	17.12	-6.41	-2.18	PP	**-56.34**	7.95	**-46.09**	**-52.66**
MZ	-1.72	8.84	-1.53	-0.42	MZ	**-4.6**	2.23	**-4**	**-3.72**
Thailand					Thailand				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-2.13	**-2.76**	-1.21	-2.12	DFG	**-3.91**	**-3.6**	0	0
PP	-8.93	**-16.32**	-3.48	-10.15	PP	**-31.47**	**-33.03**	**-15.66**	**-123.15**
MZ	-1.98	-2.61	-1.13	-1.94	MZ	**-2.93**	**-2.82**	-0.33	**-7.28**
Notes: See Table 1C									

Table 9C: Unit Root for the level and first difference data (for GDP and ELEP-HYD)

Bangladesh					Bangladesh				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-0.08	0	-2.26	-1.67	DFG	0	**-13.66**	**-4.13**	**-4.1**
PP	-0.76	-4.09	-8.84	-7.1	PP	**-18.63**	**-28.8**	**-41.85**	**-37.81**
MZ	-0.25	0.22	-1.58	-1.68	MZ	-1.2	-1.18	-2.52	**-2.86**
China					China				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	0	-2.01	0	-2.6	DFG	0	0	0	0
PP	-8.32	-7.02	-13.69	-13.81	PP	**-34.81**	**-79.49**	**-52.49**	**-23.24**
MZ	-1.65	-1.63	-2.41	-2.41	MZ	**-3.72**	**-5.39**	**-4.23**	-0.61
India					India				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-0.16	0	**-3.07**	-1.83	DFG	**-4.08**	0	**-3.93**	**-4.64**
PP	-1.68	-5.18	**-17.75**	-6.64	PP	**-39.49**	**-84.16**	**-34.51**	**-43.94**
MZ	-0.22	-1.26	**-2.81**	-1.57	MZ	**-2.73**	**-5.44**	**-2.9**	**-3.13**
Indonesia					Indonesia				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.95	-1.94	-1.4	-2.01	DFG	**-3.24**	**-4.52**	0	0
PP	-8.97	-7.56	-5.31	-6.58	PP	**-21.62**	**-40.81**	**-32.28**	**-116.11**
MZ	-1.99	-1.83	-1.34	-1.67	MZ	**-2.73**	**-3.27**	-1.95	**-6.68**
Japan					Japan				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.12	-2.14	-2.6	-2.33	DFG	-2.25	**-4.24**	**-6.36**	**-5.25**
PP	-3.84	**-17.82**	**-17.68**	-12.22	PP	-10.91	**-62.53**	**-70.93**	**-61.6**
MZ	-1.04	-2.51	-2.26	-2.15	MZ	-1.63	**-4.41**	**-3.53**	**-3.23**
Malaysia					Malaysia				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.79	-2.29	-2.16	0	DFG	0	**-5.85**	**-4.82**	**-5.55**
PP	-10.5	-11.09	-10.43	-6.25	PP	**-14.62**	**-56.46**	**-42.41**	**-51.81**
MZ	-2.03	-2.15	-2.15	-1.65	MZ	-1.29	**-4.23**	**-3.71**	**-4.4**
New Zealand					New Zealand				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-2.07	-1.44	-1.32	-0.77	DFG	**-4.09**	**-4.51**	**-5.66**	**-5.17**
PP	-8.1	-4.64	-4.11	-1.82	PP	**-36.48**	**-45.56**	**-60.61**	**-62.4**
MZ	-1.88	-1.36	-1.05	-0.59	MZ	**-3.27**	**-3.24**	**-3.8**	**-3.2**
Pakistan					Pakistan				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.88	-2.29	-1.67	-1.24	DFG	**-3.23**	0	**-4.2**	**-2.19**
PP	-6.74	-5.69	-5.09	-3.93	PP	**-25**	**-25.03**	**-38.89**	**-34.96**
MZ	-1.8	-1.43	-1.32	-1.19	MZ	-2.53	-1.27	**-2.79**	**-2.79**
Philippines					Philippines				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	0	-2.38			DFG	**-3.97**	**-4.6**		
PP	-7.2	-13.05			PP	**-31.08**	**-37.9**		
MZ	-1.77	-2.48			MZ	**-3.42**	**-4.03**		
South Korea					South Korea				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.12	-2.37	-1.05	-1.78	DFG	0	**-4.68**	0	0
PP	-3.66	-11.45	-3.89	-7.2	PP	**-14.47**	**-43.39**	**-31.86**	**-52.33**
MZ	-1.06	-2.25	-1.1	-1.65	MZ	-1.78	**-3.32**	-0.62	**-3.21**
Thailand					Thailand				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	0	-1.81	-1.87	-1.95	DFG	0	**-4.38**	**-4.77**	**-4.01**
PP	-3.58	-7.27	-7.67	-9.01	PP	-11.8	**-37.5**	**-43.9**	**-38.09**
MZ	-1.15	-1.77	-1.68	-1.9	MZ	-2.02	**-3.39**	**-3.22**	**-2.76**

Notes: See Table 1C

Table 10C: Unit Root for the level and first difference data (for ELEP-HYD and Trade)

Bangladesh					Bangladesh				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-2.18	**-2.68**			DFG	**-3.48**	0		
PP	-11.16	-8.38			PP	**-34.82**	**-13.38**		
MZ	-2.1	-1.71			MZ	-2.39	**-1**		
China					China				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.78	0	-1.92	-1.71	DFG	0	**-3.92**	0	-0.96
PP	-3.65	-3.11	-9.2	-5.48	PP	**-21.12**	**-31.96**	**-27.25**	**-22.46**
MZ	-1.27	-1.08	-1.94	-1.44	MZ	-2.33	-3.23	-2.46	-0.68
India					India				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-

DFG	-1.08	-2.59	**-3.07**	-1.83	DFG	**-4.54**	-2.57	**-3.93**	**-4.64**
PP	-3.41	**-20.48**	**-17.75**	-6.64	PP	**-42.95**	**-17.74**	**-34.51**	**-43.94**
MZ	-1.01	**-2.63**	-2.81	-1.57	MZ	**-3.11**	-1.22	**-2.9**	**-3.13**
Indonesia					Indonesia				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.2	**-2.7**	-1.4	-2.01	DFG	**-4.13**	0	0	0
PP	-3.03	**-15.16**	-5.31	-6.58	PP	**-35.33**	**-45.52**	**-32.28**	**-116.11**
MZ	-1.15	-2.48	-1.34	-1.67	MZ	**-2.83**	**-3.44**	-1.95	**-6.68**
Japan					Japan				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.63	**-2.74**	-2.6	-2.33	DFG	**-4.82**	-1.67	**-6.36**	**-5.25**
PP	-5.6	15.86	**-17.68**	-12.22	PP	**-47.28**	**-195.83**	**-70.93**	**-61.6**
MZ	-1.57	5.71	-2.26	-2.15	MZ	**-3.72**	**-9.42**	**-3.53**	**-3.23**
Malaysia					Malaysia				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	0	-1.64	-2.16	0	DFG	0	**-4.36**	**-4.82**	**-5.55**
PP	-5.69	-7.89	-10.43	-6.25	PP	**-16.22**	**-32.82**	**-42.41**	**-51.81**
MZ	-1.41	-1.54	-2.15	-1.65	MZ	-1.38	**-2.48**	**-3.71**	**-4.4**
New Zealand					New Zealand				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-0.84	7.04	**-2.96**	-1.27	DFG	0	15.53	**-4.51**	0
PP	-2.68	18.48	**-19.19**	-3.38	PP	**-23.68**	19.42	**-41.27**	**-196.89**
MZ	-0.8	15.9	-2.48	-1.03	MZ	-0.95	57266.64	**-2.72**	**-9.11**
Pakistan					Pakistan				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-2.54	-2.55	-1.67	-1.24	DFG	**-4.52**	**-6.34**	**-4.2**	**-2.19**
PP	**-13.64**	-11.71	-5.09	-3.93	PP	**-41.87**	**-26.92**	**-38.89**	**-34.96**
MZ	-2.39	-1.91	-1.32	-1.19	MZ	**-3.24**	-2.37	**-2.79**	**-2.79**
Philippines					Philippines				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.75	-2.11			DFG	**-3.19**	0		
PP	-8.82	-11.77			PP	**-23.14**	**-38.93**		
MZ	-1.92	-2.05			MZ	**-2.67**	**-2.92**		
South Korea					South Korea				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	0	-2.39	-1.05	-1.78	DFG	-0.04	-2.21	0	0
PP	-7.33	17.12	-3.89	-7.2	PP	**-56.34**	7.95	**-31.86**	**-52.33**
MZ	-1.72	8.84	-1.1	-1.65	MZ	**-4.6**	2.23	-0.62	**-3.21**
Thailand					Thailand				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-2.13	**-2.76**	-1.87	-1.95	DFG	**-3.91**	**-3.6**	**-4.77**	**-4.01**
PP	-8.93	**-16.32**	-7.67	-9.01	PP	**-31.47**	**-33.03**	**-43.9**	**-38.09**
MZ	-1.98	-2.61	-1.68	-1.9	MZ	**-2.93**	**-2.82**	**-3.22**	**-2.76**

Notes: See Table 1C

Table 11C: Unit Root for the level and first difference data (for GDP and ELEP-NG)

Bangladesh					Bangladesh				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-0.08	0	-1.45	-2.2	DFG	0	**-13.66**	-1.29	**-4.81**
PP	-0.76	-4.09	-3.32	-7.78	PP	**-18.63**	**-28.8**	**-22.21**	**-44.07**
MZ	-0.25	0.22	-1.06	-1.69	MZ	-1.2	-1.18	-1.26	**-3.35**
China					China				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-4.35		-1.89	-2.11	DFG	**-3.8**		**-3.88**	0
PP	-33.96		-9.68	-10.59	PP	**-25.67**		**-33.82**	**-32.99**
MZ	-4.01		-1.79	-2.07	MZ	**-3.29**		-2.5	**-3.05**
India					India				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-0.16	0	-1.7	**-3.3**	DFG	**-4.08**	0	**-4**	0
PP	-1.68	-5.18	-6.56	**-17.02**	PP	**-39.49**	**-84.16**	**-24.89**	**-33.25**
MZ	-0.22	-1.26	-1.69	-2.46	MZ	**-2.73**	**-5.44**	-2.02	-1.98
Indonesia					Indonesia				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.84	-2.05	-1.09	-0.62	DFG	**-2.78**	**-4.14**	**-3.49**	**-5.37**
PP	-7.85	-8.46	-6.25	-3.9	PP	**-17.12**	**-34.51**	**-29.58**	**-46.17**
MZ	-1.9	-1.93	-0.91	-0.63	MZ	-2.19	**-3.01**	-1.35	**-3.47**
Japan					Japan				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.12	-2.14	-1.09	-2.28	DFG	-2.25	**-4.24**	0	0
PP	-3.84	**-17.82**	-2.24	-9.82	PP	-10.91	**-62.53**	**-18.54**	**-59.19**
MZ	-1.04	-2.51	-0.64	-2.08	MZ	-1.63	**-4.41**	-0.87	**-4.23**
Malaysia					Malaysia				

	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.85	-2.56	-1.07	-1.78	DFG	-1.55	0	**-3.32**	0
PP	-11.06	-13.4	-3.2	-6.67	PP	**-17.46**	**-46.77**	**-24.92**	**-39.9**
MZ	-2.24	-2.38	-0.97	-1.73	MZ	-2.17	**-3.86**	-2.44	**-3.41**
New Zealand					New Zealand				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	**-2.85**	-1.75	0	-2.35	DFG	**-3.49**	**-3.22**	**-5.91**	**-5.75**
PP	**-16.34**	-5.94	-3.79	-10.04	PP	**-25.01**	**-29.64**	**-43.59**	**-55.07**
MZ	**-2.81**	-1.58	-0.76	-2.01	MZ	**-2.96**	**-2.34**	**-3.65**	**-3.87**
Pakistan					Pakistan				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.88	-2.29	-2.5	-1.79	DFG	**-3.23**	**0**	**0**	**-3.44**
PP	-6.74	-5.69	-13.93	**-14.39**	PP	**-25**	**-25.03**	**-55.42**	**-27.6**
MZ	-1.8	-1.43	-2.38	-2.31	MZ	**-2.53**	**-1.27**	**-4.27**	**-2.79**
Thailand					Thailand				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-2.04	-2.23	-0.11	-1.42	DFG	0	**-3.75**		**-4.42**
PP	**-28.79**	-9.79	-5.9	-4.52	PP	-7.27	**-27.96**		**-35.33**
MZ	**-3.72**	-2.09	-0.09	-1.3	MZ	-1.5	**-2.94**		**-3.01**

Notes: See Table 1C

Table 12C: Unit Root for the level and first difference data (for Trade and ELEP-NG)

Bangladesh					Bangladesh				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-2.24	**-2.71**	-1.45	-2.2	DFG	**-3.5**	0	-1.29	**-4.81**
PP	-11.18	-8.48	-3.32	-7.78	PP	**-34.84**	-13.22	**-22.21**	**-44.07**
MZ	-2.14	-1.71	-1.06	-1.69	MZ	-2.38	-0.97	-1.26	**-3.35**
China					China				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.85	0	-1.89	-2.11	DFG	0	**-4.34**	**-3.88**	0
PP	-5.41	-3.06	-9.68	-10.59	PP	**-17.56**	**-37.79**	**-33.82**	**-32.99**
MZ	-1.52	-0.92	-1.79	-2.07	MZ	-2.28	**-3.65**	-2.5	**-3.05**
India					India				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.08	-2.59	-1.7	**-3.3**	DFG	**-4.54**	-2.57	**-4**	0
PP	-3.41	**-20.48**	-6.56	**-17.02**	PP	**-42.95**	**-17.74**	**-24.89**	**-33.25**
MZ	-1.01	**-2.63**	-1.69	-2.46	MZ	**-3.11**	-1.22	-2.02	-1.98
Indonesia					Indonesia				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.35	**-2.7**	-1.09	-0.62	DFG	**-4.07**	-2.46	**-3.49**	**-5.37**
PP	-3.57	**-15.12**	-6.25	-3.9	PP	**-36.69**	**-40.39**	**-29.58**	**-46.17**
MZ	-1.04	-2.52	-0.91	-0.63	MZ	**-2.81**	**-3.28**	-1.35	**-3.47**
Japan					Japan				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.63	**-2.74**	-1.09	-2.28	DFG	**-4.82**	-1.67	0	0
PP	-5.6	15.86	-2.24	-9.82	PP	**-47.28**	**-195.83**	**-18.54**	**-59.19**
MZ	-1.57	5.71	-0.64	-2.08	MZ	**-3.72**	**-9.42**	-0.87	**-4.23**
Malaysia					Malaysia				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	0	-1.28	-1.07	-1.78	DFG	0	**-2.97**	-3.32	0
PP	-4.83	-9.63	-3.2	-6.67	PP	**-17.31**	**-24.95**	**-24.92**	**-39.9**
MZ	-1.27	-1.66	-0.97	-1.73	MZ	-1.97	-2.2	-2.44	**-3.41**
New Zealand					New Zealand				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-0.84	7.04	-2.59	**-3.56**	DFG	0	15.53	**-4.07**	**-5.21**
PP	-2.68	18.48	-12.86	**-17.93**	PP	**-23.68**	19.42	**-34.32**	**-46.04**
MZ	-0.8	15.9	-2.27	-2.51	MZ	-0.95	57266.64	**-2.82**	**-3.59**
Pakistan					Pakistan				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-2.54	-2.55	-2.5	-1.79	DFG	**-4.52**	**-6.34**	0	**-3.44**
PP	-13.64	-11.71	-13.93	**-14.39**	PP	**-41.87**	**-26.92**	**-55.42**	**-27.6**
MZ	-2.39	-1.91	-2.38	-2.31	MZ	**-3.24**	-2.37	**-4.27**	**-2.79**
South Korea					South Korea				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	**-2.86**	-2.36	-2.36	-3.1	DFG	0	-2.28	0	**-3.82**
PP	-13.9	12.62	-11.64	**-19.21**	PP	-12.09	8.52	**-16.29**	**-31.48**
MZ	-2.45	6.54	-0.16	-2.77	MZ	-1.27	3.29	-0.23	**-2.84**
Thailand					Thailand				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.74	**-2.62**	-0.11	-1.42	DFG	**-3.7**	**-3.59**		**-4.42**
PP	-7.01	**-18.24**	-5.9	-4.52	PP	**-24.43**	**-25.21**		**-35.33**
MZ	-1.65	-2.38	-0.09	-1.3	MZ	**-2.73**	-2.07		**-3.01**

Notes: See Table 1C

Table 13C: Unit Root for the level and first difference data (for GDP and ELEP-NU)

India					India				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-0.16	0	-2.44	-1.97	DFG	**-4.08**	0	0	**-5.22**
PP	-1.68	-5.18	-10.26	-8.19	PP	**-39.49**	**-84.16**	**-53.49**	**-50.31**
MZ	-0.22	-1.26	-1.82	-1.82	MZ	**-2.73**	**-5.44**	**-3.67**	**-3.43**
Japan					Japan				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.39	-2.1	0	-1.15	DFG	0	**-3.99**	**-4.02**	0
PP	-5.48	**-16.52**	-4.81	-4.06	PP	-10.1	**-54.78**	**-35.83**	**-27.91**
MZ	-1.28	-2.45	-1.25	-1.14	MZ	-1.29	**-4.11**	**-2.86**	-2.14
Pakistan					Pakistan				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.88	-2.29	-2.4	-1.81	DFG	**-3.23**	0	**-4.87**	**-4.15**
PP	-6.74	-5.69	-12.01	-7.18	PP	**-25**	**-25.03**	**-44.58**	**-34.85**
MZ	-1.8	-1.43	-2.24	-1.77	MZ	-2.53	-1.27	**-3.4**	**-3.15**
South Korea					South Korea				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.02	-2.25	-0.03	-2.32	DFG	0	**-4.34**	**-15.27**	**-4.35**
PP	-3.96	-10.64	-4.23	-8.4	PP	-10.4	**-37.23**	**-22.77**	**-37.39**
MZ	-1.15	-2.16	0.22	-1.82	MZ	-0.87	**-3.08**	-0.85	**-3.04**
Notes: See Table 1C									

Table 14C: Unit Root for the level and first difference data (for Trade and ELEP-NU)

India					India				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.08	-2.59	-2.44	-1.97	DFG	**-4.54**	-2.57	0	**-5.22**
PP	-3.41	**-20.48**	-10.26	-8.19	PP	**-42.95**	**-17.74**	**-53.49**	**-50.31**
MZ	-1.01	**-2.63**	-1.82	-1.82	MZ	**-3.11**	-1.22	**-3.67**	**-3.43**
Japan					Japan				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-2.02	**-3.11**	0	-1.15	DFG	**-4.76**	-1.68	**-4.02**	0
PP	-7.44	15.89	-4.81	-4.06	PP	**-44.42**	**-133.9**	**-35.83**	**-27.91**
MZ	-1.79	6.72	-1.25	-1.14	MZ	**-3.68**	**-7.64**	**-2.86**	-2.14
Pakistan					Pakistan				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-2.54	-2.55	-2.4	-1.81	DFG	**-4.52**	**-6.34**	**-4.87**	**-4.15**
PP	-13.64	-11.71	-12.01	-7.18	PP	**-41.87**	**-26.92**	**-44.58**	**-34.85**
MZ	-2.39	-1.91	-2.24	-1.77	MZ	**-3.24**	-2.37	**-3.4**	**-3.15**
South Korea					South Korea				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-2.33	-2.44	-0.03	-2.32	DFG	0	-2.2	**-15.27**	**-4.35**
PP	-6.33	15.6	-4.23	-8.4	PP	**-70.76**	6.35	**-22.77**	**-37.39**
MZ	-1.7	8.17	0.22	-1.82	MZ	**-5.41**	1.94	-0.85	**-3.04**
Notes: See Table 1C									

Table 15C: Unit Root for the level and first difference data (for GDP and ELEP-Oil)

Bangladesh					Bangladesh				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-0.08	0	-1.78	-1.72	DFG	0	**-13.66**	**-4.07**	**-3.4**
PP	-0.76	-4.09	-6.96	-7.18	PP	**-18.63**	**-28.8**	**-34.86**	**-24.32**
MZ	-0.25	0.22	-1.75	-1.79	MZ	-1.2	-1.18	**-3.05**	**-2.86**
China					China				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	0	-2.01	-1.15	-1.22	DFG	0	0	**-5.71**	-2.23
PP	-8.32	-7.02	-5.87	**-33.66**	PP	**-34.81**	**-79.49**	**-26.42**	**-15.37**
MZ	-1.65	-1.63	-1.11	**-3.64**	MZ	**-3.72**	**-5.39**	-2.51	-2.07
China HKSAR					China HKSAR				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.25	-1.87	-1.69	-1.69	DFG	0	**-4.27**	-2.59	0
PP	-4.41	-8.24	-6.12	-5.87	PP	**-20.61**	**-39.62**	**-24.57**	**-25.68**
MZ	-1.16	-1.82	-1.67	-1.56	MZ	-1.69	**-3.01**	-1.89	-2.29
India					India				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-0.16	0	-2.06	-1.6	DFG	**-4.08**	**0**	**0**	**-2.77**
PP	-1.68	-5.18	-7.56	-7.09	PP	**-39.49**	**-84.16**	**-32.18**	**-20.37**
MZ	-0.22	-1.26	-1.85	-0.74	MZ	**-2.73**	**-5.44**	-2.22	-1.3
Indonesia					Indonesia				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.95	-1.94	-1.53	-2.36	DFG	**-3.24**	**-4.52**	**-3.89**	**-4.58**

PP	-8.97	-7.56	-6.49	-11.47	PP	**-21.62**	**-40.81**	**-31.39**	**-40.15**
MZ	-1.99	-1.83	-1.56	-2.29	MZ	**-2.73**	**-3.27**	**-2.9**	**-3.58**
Japan					Japan				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.12	-2.14	-0.96	-0.91	DFG	-2.25	**-4.24**	0	0
PP	-3.84	-17.82	-3.03	-2.55	PP	-10.91	**-62.53**	**-17.83**	**-45.62**
MZ	-1.04	-2.51	-0.91	-0.69	MZ	-1.63	**-4.41**	-1.94	-1.94
Malaysia					Malaysia				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.79	-2.29	-2.02	-1.09	DFG	0	**-5.85**	**-4.92**	0
PP	-10.5	-11.09	-8.67	-3.24	PP	**-14.62**	**-56.46**	**-42.66**	**-25.72**
MZ	-2.03	-2.15	-1.99	-1	MZ	-1.29	**-4.23**	**-3.79**	-2.39
New Zealand					New Zealand				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-2.58	-1.47			DFG	**-3.88**	0		
PP	-10.89	-4.96			PP	**-32.71**	**-41.23**		
MZ	-2.22	-1.38			MZ	**-3**	**-3.07**		
Pakistan					Pakistan				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.88	-2.29	-1.97	-1.83	DFG	**-3.23**	0	0	**-3.46**
PP	-6.74	-5.69	-7.83	-5.92	PP	**-25**	**-25.03**	**-42.37**	**-26.28**
MZ	-1.8	-1.43	-1.86	-1.58	MZ	-2.53	-1.27	**-4.35**	**-2.76**
Philippines					Philippines				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	0	-2.38	-2.27	-1.36	DFG	**-3.97**	**-4.6**	0	0
PP	-7.2	-13.05	-9.81	-4.62	PP	**-31.08**	**-37.9**	**-42.77**	**-30.75**
MZ	-1.77	-2.48	-2.07	-1.29	MZ	**-3.42**	**-4.03**	**-3.13**	**-2.7**
Singapore					Singapore				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.37	-0.82	-0.46	-1.79	DFG	0	0	0	**-3.26**
PP	-10.01	-4.36	-4.74	-9.74	PP	**-23.17**	**-36.16**	**-18.16**	**-21.62**
MZ	-1.75	-0.99	-0.97	-2	MZ	-2.25	**-2.94**	-1.94	**-3**
South Korea					South Korea				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.12	-2.37	-2.28	-2.38	DFG	0	**-4.68**	**-4.15**	**-4.09**
PP	-3.66	-11.45	-11.53	-11.42	PP	**-14.47**	**-43.39**	**-36.52**	**-36.07**
MZ	-1.06	-2.25	-2.25	-2.2	MZ	-1.78	**-3.32**	**-3.1**	**-3.06**
Thailand					Thailand				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	0	-1.81	**-2.83**	-1.43	DFG	0	**-4.38**	**-3.89**	**-3.38**
PP	-3.58	-7.27	**-16.91**	**-15.57**	PP	-11.8	**-37.5**	**-29.51**	**-26.83**
MZ	-1.15	-1.77	**-2.8**	-2.37	MZ	-2.02	**-3.39**	**-3.06**	**-2.92**
Notes: See Table 1C									

Table 16C: Unit Root for the level and first difference data (for Trade and ELEP-Oil)

Bangladesh					Bangladesh				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-2.24	**-2.71**	-1.78	-1.72	DFG	**-3.5**	0	**-4.07**	**-3.4**
PP	-11.18	-8.48	-6.96	-7.18	PP	**-34.84**	-13.22	**-34.86**	**-24.32**
MZ	-2.14	-1.71	-1.75	-1.79	MZ	-2.38	-0.97	**-3.05**	**-2.86**
China					China				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.78	0	**-2.89**	-1.54	DFG	0	**-3.92**	**-4.39**	-2.01
PP	-3.65	-3.11	-11.74	**-46.75**	PP	**-21.12**	**-31.96**	**-26.65**	-12.4
MZ	-1.27	-1.08	-2.26	**-4.47**	MZ	-2.33	**-3.23**	-2.58	-1.88
China HKSAR					China HKSAR				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.48	-1.57	-1.69	-1.69	DFG	0	**-3.17**	-2.59	0
PP	-6.55	-5.3	-6.12	-5.87	PP	-12.82	**-27.41**	**-24.57**	**-25.68**
MZ	-1.64	-1.28	-1.67	-1.56	MZ	-1.63	-1.7	-1.89	-2.29
India					India				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.08	-2.59	-2.06	-1.6	DFG	**-4.54**	-2.57	0	**-2.77**
PP	-3.41	-20.48	-7.56	-7.09	PP	**-42.95**	**-17.74**	**-32.18**	**-20.37**
MZ	-1.01	-2.63	-1.85	-0.74	MZ	**-3.11**	-1.22	-2.22	-1.3
Indonesia					Indonesia				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.2	**-2.7**	-1.53	-2.36	DFG	**-4.13**	0	**-3.89**	**-4.58**
PP	-3.03	**-15.16**	-6.49	-11.47	PP	**-35.33**	**-45.52**	**-31.39**	**-40.15**
MZ	-1.15	-2.48	-1.56	-2.29	MZ	**-2.83**	**-3.44**	**-2.9**	**-3.58**
Japan					Japan				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-

DFG	-1.63	**-2.74**	-0.96	-0.91	DFG	**-4.82**	-1.67	0	0
PP	-5.6	15.86	-3.03	-2.55	PP	**-47.28**	**-195.83**	**-17.83**	**-45.62**
MZ	-1.57	5.71	-0.91	-0.69	MZ	**-3.72**	**-9.42**	-1.94	-1.94
Malaysia					Malaysia				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	0	-1.64	-2.02	-1.09	DFG	0	**-4.36**	**-4.92**	0
PP	-5.69	-7.89	-8.67	-3.24	PP	**-16.22**	**-32.82**	**-42.66**	**-25.72**
MZ	-1.41	-1.54	-1.99	-1	MZ	-1.38	-2.48	**-3.79**	-2.39
New Zealand					New Zealand				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-0.84	7.04			DFG	0	15.53		
PP	-2.68	18.48			PP	**-23.68**	19.42		
MZ	-0.8	15.9			MZ	-0.95	57266.64		
Pakistan					Pakistan				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-2.54	-2.55	-1.97	-1.83	DFG	**-4.52**	**-6.34**	0	**-3.46**
PP	-13.64	-11.71	-7.83	-5.92	PP	**-41.87**	**-26.92**	**-42.37**	**-26.28**
MZ	-2.39	-1.91	-1.86	-1.58	MZ	**-3.24**	**-2.37**	**-4.35**	**-2.76**
Philippines					Philippines				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.75	-2.11	-2.27	-1.36	DFG	**-3.19**	0	0	0
PP	-8.82	-11.77	-9.81	-4.62	PP	**-23.14**	**-38.93**	**-42.77**	**-30.75**
MZ	-1.92	-2.05	-2.07	-1.29	MZ	**-2.67**	**-2.92**	**-3.13**	**-2.7**
Singapore					Singapore				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	**-3.9**	-2.41	-0.95	-1.92	DFG	**-3.75**	0	**-2.8**	**-3.13**
PP	**-29.5**	**-19.04**	-7.81	-10.12	PP	**-30.51**	**-17.64**	**-15.46**	**-20.15**
MZ	**-3.58**	-2.49	-1.57	-2.07	MZ	-2.8	-1.2	-1.99	**-2.88**
South Korea					South Korea				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	0	-2.39	-2.28	-2.38	DFG	-0.04	-2.21	**-4.15**	**-4.09**
PP	-7.33	17.12	-11.53	-11.42	PP	**-56.34**	7.95	**-36.52**	**-36.07**
MZ	-1.72	8.84	-2.25	-2.2	MZ	**-4.6**	2.23	**-3.1**	**-3.06**
Thailand					Thailand				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-2.13	**-2.76**	**-2.83**	-1.43	DFG	**-3.91**	**-3.6**	**-3.89**	**-3.38**
PP	-8.93	**-16.32**	**-16.91**	**-15.57**	PP	**-31.47**	**-33.03**	**-29.51**	**-26.83**
MZ	-1.98	**-2.61**	**-2.8**	-2.37	MZ	**-2.93**	**-2.82**	**-3.06**	**-2.92**

Notes: See Table 1C

Table 17C: Unit Root for the level and first difference data (for ELEP-Rene and GDP)

Bangladesh					Bangladesh				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-0.08	0	-2.26	-1.67	DFG	0	**-13.66**	**-4.13**	**-4.1**
PP	-0.76	-4.09	-8.84	-7.1	PP	**-18.63**	**-28.8**	**-41.85**	**-37.81**
MZ	-0.25	0.22	-1.58	-1.68	MZ	-1.2	-1.18	-2.52	**-2.86**
China					China				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	0	-2.01	-2.31	**-2.64**	DFG	0	0	0	0
PP	-8.32	-7.02	-13.68	**-14.33**	PP	**-34.81**	**-79.49**	**-51.79**	**-23.86**
MZ	-1.65	-1.63	-2.38	-2.45	MZ	**-3.72**	**-5.39**	**-4.2**	-0.77
India					India				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-0.16	0	**-2.95**	-2.13	DFG	**-4.08**	0	**-3.87**	**-4.66**
PP	-1.68	-5.18	**-16.76**	-8.41	PP	**-39.49**	**-84.16**	**-33.94**	**-45.09**
MZ	-0.22	-1.26	**-2.74**	-1.85	MZ	**-2.73**	**-5.44**	**-2.87**	**-3.04**
Indonesia					Indonesia				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.95	-1.94	-1.32	-2.32	DFG	**-3.24**	**-4.52**	0	0
PP	-8.97	-7.56	-4.56	-9.28	PP	**-21.62**	**-40.81**	**-31.04**	**-4348.61**
MZ	-1.99	-1.83	-1.24	-1.95	MZ	**-2.73**	**-3.27**	-1.78	**-46.49**
Japan					Japan				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.12	-2.14	-2.09	**-2.69**	DFG	-2.25	**-4.24**	0	**-5.33**
PP	-3.84	**-17.82**	-13.94	**-15.69**	PP	-10.91	**-62.53**	**-75.16**	**-60.95**
MZ	-1.04	-2.51	-1.87	-2.48	MZ	-1.63	**-4.41**	**-3.82**	**-3.35**
Malaysia					Malaysia				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.79	-2.29	-2.16	0	DFG	0	**-5.85**	**-4.82**	**-5.55**
PP	-10.5	-11.09	-10.43	-6.25	PP	**-14.62**	**-56.46**	**-42.41**	**-51.8**
MZ	-2.03	-2.15	-2.15	-1.65	MZ	-1.29	**-4.23**	**-3.71**	**-4.4**
New Zealand					New Zealand				

	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-2.07	-1.44	-1.46	-1.01	DFG	**-4.09**	**-4.51**	**-5.27**	**-4.64**
PP	-8.1	-4.64	-4.37	-2.49	PP	**-36.48**	**-45.56**	**-55.82**	**-54.77**
MZ	-1.88	-1.36	-1.14	-0.85	MZ	**-3.27**	**-3.24**	**-3.61**	**-3.02**
Pakistan					Pakistan				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.88	-2.29	-1.67	-1.24	DFG	**-3.23**	0	**-4.2**	-2.19
PP	-6.74	-5.69	-5.09	-3.93	PP	**-25**	**-25.03**	**-38.89**	**-34.96**
MZ	-1.8	-1.43	-1.32	-1.19	MZ	-2.53	-1.27	**-2.79**	**-2.79**
Philippines					Philippines				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	0	-2.31	-1.05	**-3.08**	DFG	0	**-4.54**	**-2.86**	**-4.66**
PP	-6.58	-12.49	-3.51	**-16.46**	PP	**-34.56**	**-36.71**	**-23.31**	**-42.32**
MZ	-1.68	-2.42	-0.99	-2.57	MZ	**-3.83**	**-3.96**	-2.15	**-3.17**
South Korea					South Korea				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.12	-2.37	-1.11	-1.42	DFG	0	**-4.68**	-0.53	-1.94
PP	-3.66	-11.45	-3.97	-5.4	PP	**-14.47**	**-43.39**	**-34.16**	**-32.39**
MZ	-1.06	-2.25	-1.15	-1.38	MZ	-1.78	**-3.32**	-0.41	-1.34
Thailand					Thailand				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	0	-1.81	-1.89	-1.2	DFG	0	**-4.38**	**-4.66**	**-3.83**
PP	-3.58	-7.27	-7.78	-4.24	PP	-11.8	**-37.5**	**-41.77**	**-37.62**
MZ	-1.15	-1.77	-1.72	-1.18	MZ	-2.02	**-3.39**	**-3.25**	-2.59
Notes: See Table 1C									

Table 18C: Unit Root for the level and first difference data (for Trade and ELEP-Rene)

Bangladesh					Bangladesh				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-2.24	**-2.71**	-2.26	-1.67	DFG	**-3.5**	0	**-4.13**	**-4.1**
PP	-11.18	-8.48	-8.84	-7.1	PP	**-34.84**	-13.22	**-41.85**	**-37.81**
MZ	-2.14	-1.71	-1.58	-1.68	MZ	-2.38	-0.97	-2.52	**-2.86**
China					China				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.78	0	-1.82	-1.68	DFG	0	**-3.92**	0	0
PP	-3.65	-3.11	-8.91	-5.32	PP	**-21.12**	**-31.96**	**-27**	**-30.71**
MZ	-1.27	-1.08	-1.88	-1.43	MZ	-2.33	**-3.23**	-2.46	-2.16
India					India				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.08	-2.59	**-2.95**	-2.13	DFG	**-4.54**	-2.57	**-3.87**	**-4.66**
PP	-3.41	**-20.48**	**-16.76**	-8.41	PP	**-42.95**	**-17.74**	**-33.94**	**-45.09**
MZ	-1.01	**-2.63**	**-2.74**	-1.85	MZ	**-3.11**	-1.22	**-2.87**	**-3.04**
Indonesia					Indonesia				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.2	**-2.7**	-1.32	-2.32	DFG	**-4.13**	0	0	0
PP	-3.03	**-15.16**	-4.56	-9.28	PP	**-35.33**	**-45.52**	**-31.04**	**-4348.61**
MZ	-1.15	-2.48	-1.24	-1.95	MZ	**-2.83**	**-3.44**	-1.78	**-46.49**
Japan					Japan				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.63	-2.74	-2.09	**-2.69**	DFG	**-4.82**	-1.67	0	**-5.33**
PP	-5.6	15.86	-13.94	**-15.69**	PP	**-47.28**	**-195.83**	**-75.16**	**-60.95**
MZ	-1.57	5.71	-1.87	-2.48	MZ	**-3.72**	**-9.42**	**-3.82**	**-3.35**
Malaysia					Malaysia				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	0	-1.64	-2.16	0	DFG	0	**-4.36**	**-4.82**	**-5.55**
PP	-5.69	-7.89	-10.43	-6.25	PP	**-16.22**	**-32.82**	**-42.41**	**-51.8**
MZ	-1.41	-1.54	-2.15	-1.65	MZ	-1.38	-2.48	**-3.71**	**-4.4**
New Zealand					New Zealand				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-0.84	7.04	**-3.07**	-1.31	DFG	0	15.53	**-4.73**	0
PP	-2.68	18.48	**-20.59**	-3.44	PP	**-23.68**	19.42	**-43.63**	**-40.58**
MZ	-0.8	15.9	-2.55	-1.11	MZ	-0.95	57266.64	**-2.8**	-2.56
Pakistan					Pakistan				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-2.54	-2.55	-1.67	-1.24	DFG	**-4.52**	**-6.34**	**-4.2**	-2.19
PP	-13.64	-11.71	-5.09	-3.93	PP	**-41.87**	**-26.92**	**-38.89**	**-34.96**
MZ	-2.39	-1.91	-1.32	-1.19	MZ	**-3.24**	-2.37	**-2.79**	**-2.79**
Philippines					Philippines				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.65	-2.22	-1.05	**-3.08**	DFG	**-3.21**	0	**-2.86**	**-4.66**
PP	-8.74	-12.12	-3.51	**-16.46**	PP	**-22.34**	**-37.51**	**-23.31**	**-42.32**
MZ	-1.88	-2.12	-0.99	-2.57	MZ	**-2.62**	**-2.89**	-2.15	**-3.17**

South Korea					South Korea				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	0	-2.39	-1.11	-1.42	DFG	-0.04	-2.21	-0.53	-1.94
PP	-7.33	17.12	-3.97	-5.4	PP	**-56.34**	7.95	**-34.16**	**-32.39**
MZ	-1.72	8.84	-1.15	-1.38	MZ	**-4.6**	2.23	-0.41	-1.34
Thailand					Thailand				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-2.13	**-2.76**	-1.89	-1.2	DFG	**-3.91**	**-3.6**	**-4.66**	**-3.83**
PP	-8.93	**-16.32**	-7.78	-4.24	PP	**-31.47**	**-33.03**	**-41.77**	**-37.62**
MZ	-1.98	-2.61	-1.72	-1.18	MZ	**-2.93**	**-2.82**	**-3.25**	-2.59
Notes: See Table 1C									

Table 19C: Unit Root for the level and first difference data (for GDP and EPC)

Bangladesh					Bangladesh				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-0.19	-0.42	**-3.25**	-1.79	DFG	0	0	**-5.59**	**-4.39**
PP	-0.92	-2	**-15.51**	-6.72	PP	**-18.7**	**-32.9**	**-102.64**	**-36.72**
MZ	-0.35	-0.1	-2.23	-1.69	MZ	-1.26	-2.13	**-6.31**	**-3.36**
China					China				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	0	-2.01	-1.45	0	DFG	0	0	**-3.11**	**-4.86**
PP	-8.32	-7.02	-6.15	**-147.92**	PP	**-34.81**	**-79.49**	**-24.24**	**-44.63**
MZ	-1.65	-1.63	-1.49	**-8.52**	MZ	**-3.72**	**-5.39**	-2.53	**-3.37**
China HKSAR					China HKSAR				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.25	-1.87	-0.79	**-2.89**	DFG	0	**-4.27**	0	**-4.97**
PP	-4.41	-8.24	-2.27	**-15.06**	PP	**-20.61**	**-39.62**	**-11.45**	**-46.03**
MZ	-1.16	-1.82	-0.73	-2.44	MZ	-1.69	**-3.01**	-1.08	**-3.42**
India					India				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-0.16	0	-1.57	-1.73	DFG	**-4.08**	0	**-3.01**	**-4.64**
PP	-1.68	-5.18	-5.75	-6.18	PP	**-39.49**	**-84.16**	**-20.84**	**-42.32**
MZ	-0.22	-1.26	-1.64	-1.6	MZ	**-2.73**	**-5.44**	-2.49	**-3.28**
Indonesia					Indonesia				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.95	-1.94	-0.8	0	DFG	**-3.24**	**-4.52**	0	0
PP	-8.97	-7.56	-3.04	-8.42	PP	**-21.62**	**-40.81**	**-17.11**	**-21.61**
MZ	-1.99	-1.83	-0.91	-1.83	MZ	**-2.73**	**-3.27**	-2.02	0.04
Japan					Japan				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.46	-2.12			DFG	0	**-4.04**		
PP	-5.79	**-16.95**			PP	-10.25	**-56.09**		
MZ	-1.34	-2.48			MZ	-1.49	**-4.16**		
Malaysia					Malaysia				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.79	-2.29	-1.42	-1.27	DFG	0	**-5.85**	0	**-4.4**
PP	-10.5	-11.09	-7.79	-6.18	PP	**-14.62**	**-56.46**	-10.84	**-52.51**
MZ	-2.03	-2.15	-1.71	-1.3	MZ	-1.29	**-4.23**	-1.51	**-3.7**
New Zealand					New Zealand				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-2.22	-1.79			DFG	**-4.14**	**0**		
PP	-10.52	-5.1			PP	**-36.16**	**-42.18**		
MZ	-2.17	-1.26			MZ	**-3.04**	**-2.94**		
Pakistan					Pakistan				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.88	-2.29	-1.15	-2.09	DFG	**-3.23**	0	0	**-4.45**
PP	-6.74	-5.69	-2.83	-12.3	PP	**-25**	**-25.03**	**-17.57**	**-47.76**
MZ	-1.8	-1.43	-0.98	-2.13	MZ	-2.53	-1.27	-1.72	**-3.57**
Philippines					Philippines				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	0	-2.38	**-2.72**	-1.01	DFG	**-3.97**	**-4.6**	0	**-4.47**
PP	-7.2	-13.05	**-16.68**	-2.91	PP	**-31.08**	**-37.9**	**-29.44**	**-42.61**
MZ	-1.77	-2.48	-2.58	-0.99	MZ	**-3.42**	**-4.03**	**-2.68**	**-2.95**
Singapore					Singapore				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.37	-0.82	-0.21	-1.58	DFG	0	0	0	-1.98
PP	-10.01	-4.36	-3.38	**-212.01**	PP	**-23.17**	**-36.16**	**-19.62**	**-18.25**
MZ	-1.75	-0.99	-0.61	**-9.99**	MZ	-2.25	**-2.94**	-1.74	-2.43
South Korea					South Korea				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-0.86	-2.35	-0.75	-1.86	DFG	0	**-4.63**	0	**-4.57**
PP	-4.24	-11.22	-7.16	-6.98	PP	-13.55	**-42.51**	**-14.54**	**-41.82**

MZ	-1.1	-2.22	-1.35	-1.75	MZ	-1.5	**-3.28**	-1.51	**-3.26**
Thailand					Thailand				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	0	-1.81	-1.03	-1.82	DFG	0	**-4.38**	**-2.88**	**-4.58**
PP	-3.58	-7.27	-11.05	-6.84	PP	-11.8	**-37.5**	**-15.71**	**-41.48**
MZ	-1.15	-1.77	-2.05	-1.72	MZ	-2.02	**-3.39**	-2.18	**-3.29**
Notes: See Table 1C									

Table 20C: Unit Root for the level and first difference data (for Trade and EPC)

Bangladesh					Bangladesh				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-2.4	-1.59	**-3.25**	-1.79	DFG	**-3.31**	0	**-5.59**	**-4.39**
PP	-11.49	-7.96	**-15.51**	-6.72	PP	**-31.44**	-13.77	**-102.64**	**-36.72**
MZ	-2.21	-1.4	-2.23	-1.69	MZ	-2.29	-1	**-6.31**	**-3.36**
China					China				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.78	0	**-2.62**		DFG	0	**-3.92**	**-2.97**	
PP	-3.65	-3.11	**-15.87**		PP	**-21.12**	**-31.96**	**-17.26**	
MZ	-1.27	-1.08	**-2.64**		MZ	-2.33	**-3.23**	-2.43	
China HKSAR					China HKSAR				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.71	-1.57			DFG	0	**-3.97**		
PP	-6.45	-5.38			PP	**-14.83**	**-42.52**		
MZ	-1.69	-1.32			MZ	-1.84	**-2.8**		
India					India				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.08	-2.59	-1.57	-1.73	DFG	**-4.54**	-2.57	**-3.01**	**-4.64**
PP	-3.41	**-20.48**	-5.75	-6.18	PP	**-42.95**	**-17.74**	**-20.84**	**-42.32**
MZ	-1.01	**-2.63**	-1.64	-1.6	MZ	**-3.11**	-1.22	-2.49	**-3.28**
Indonesia					Indonesia				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.2	**-2.7**	-0.8	0	DFG	**-4.13**	0	0	0
PP	-3.03	**-15.16**	-3.04	-8.42	PP	**-35.33**	**-45.52**	**-17.11**	**-21.61**
MZ	-1.15	-2.48	-0.91	-1.83	MZ	**-2.83**	**-3.44**	-2.02	0.04
Japan					Japan				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.9	**-2.74**	-1.07	-1.79	DFG	**-4.84**	**-2.86**	**-3.22**	**-2.68**
PP	-6.6	**-23.01**	-5.93	**-16.88**	PP	**-45.28**	**-22.59**	**-19.41**	**-27.52**
MZ	-1.71	**-2.89**	-1.3	-2.49	MZ	**-3.7**	-1.85	-2.51	-2.54
Malaysia					Malaysia				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	0	-1.64	-1.42	-1.27	DFG	0	**-4.36**	0	**-4.4**
PP	-5.69	-7.89	-7.79	-6.18	PP	**-16.22**	**-32.82**	-10.84	**-52.51**
MZ	-1.41	-1.54	-1.71	-1.3	MZ	-1.38	-2.48	-1.51	**-3.7**
New Zealand					New Zealand				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.02	-1.38	-1.19	-2.3	DFG	1.89	0	0	**-3.45**
PP	-3.31	**-40.86**	-3.36	**-26.18**	PP	**-21.7**	**-18.86**	-11.04	**-28.04**
MZ	-0.96	**-3.94**	-1	**-3.33**	MZ	1.09	-2.26	-0.86	**-3.14**
Pakistan					Pakistan				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-2.54	-2.55	-1.15	-2.09	DFG	**-4.52**	**-6.34**	0	**-4.45**
PP	-13.64	-11.71	-2.83	-12.3	PP	**-41.87**	**-26.92**	**-17.57**	**-47.76**
MZ	-2.39	-1.91	-0.98	-2.13	MZ	**-3.24**	-2.37	-1.72	**-3.57**
Philippines					Philippines				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.75	-2.11	-2.72	-1.01	DFG	**-3.19**	0	0	**-4.47**
PP	-8.82	-11.77	**-16.68**	-2.91	PP	**-23.14**	**-38.93**	**-29.44**	**-42.61**
MZ	-1.92	-2.05	-2.58	-0.99	MZ	**-2.67**	**-2.92**	**-2.68**	**-2.95**
Singapore					Singapore				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	**-3.9**	-2.41	-0.71	-1.65	DFG	**-3.75**	0	0	-2
PP	**-29.5**	**-19.04**	-6.24	**-232.83**	PP	**-30.51**	**-17.64**	**-17.07**	**-18.07**
MZ	**-3.58**	-2.49	-1.26	-10.51	MZ	**-2.8**	-1.2	-1.9	**-2.45**
South Korea					South Korea				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	0	-2.21	-0.75	-1.86	DFG	0	**-4.49**	0	**-4.57**
PP	-6.48	-12.06	-7.16	-6.98	PP	**-70.51**	**-42.5**	**-14.54**	**-41.82**
MZ	-1.62	-2.07	-1.35	-1.75	MZ	**-5.3**	**-3.18**	-1.51	**-3.26**
Thailand					Thailand				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-2.13	**-2.76**	-1.03	-1.82	DFG	**-3.91**	**-3.6**	**-2.88**	**-4.58**

PP	-8.93	**-16.32**	-11.05	-6.84	PP	**-31.47**	**-33.03**	**-15.71**	**-41.48**
MZ	-1.98	-2.61	-2.05	-1.72	MZ	**-2.93**	**-2.82**	-2.18	**-3.29**
Notes: See Table 1C									

Table 21C: Unit Root for the level and first difference data (for EU and GDP)

Bangladesh					Bangladesh				
	G+	G-	EU+	EU-		DG+	DG-	DEU+	DEU-
DFG	-0.19	-0.42	-1.21	-1.28	DFG	0	0	**-5.58**	0
PP	-0.92	-2	-2.69	-4.39	PP	**-18.7**	**-32.9**	**-43.69**	**-27.8**
MZ	-0.35	-0.1	-0.79	-1.28	MZ	-1.26	-2.13	**-2.79**	-1.54
China					China				
	G+	G-	EU+	EU-		DG+	DG-	DEU+	DEU-
DFG	0	-2.01	-1.69	**-3.15**	DFG	0	0	**-2.97**	**-4.26**
PP	-8.32	-7.02	-12.24	**-20.65**	PP	**-34.81**	**-79.49**	**-18.76**	**-35**
MZ	-1.65	-1.63	-2.24	**-3.07**	MZ	**-3.72**	**-5.39**	-2.6	**-3.42**
China HKSAR					China HKSAR				
	G+	G-	EU+	EU-		DG+	DG-	DEU+	DEU-
DFG	-1.25	-1.87	**-3.76**	-1.47	DFG	0	**-4.27**	**-4.96**	0
PP	-4.41	-8.24	**-29.11**	-4.75	PP	**-20.61**	**-39.62**	**-43.5**	**-75.41**
MZ	-1.16	-1.82	**-3.62**	-1.38	MZ	-1.69	**-3.01**	**-3.9**	**-4.93**
India					India				
	G+	G-	EU+	EU-		DG+	DG-	DEU+	DEU-
DFG	-0.16	0	-0.54	0	DFG	**-4.08**	0	-1.86	**-4.68**
PP	-1.68	-5.18	-5.25	-7.88	PP	**-39.49**	**-84.16**	**-19.51**	**-42.7**
MZ	-0.22	-1.26	-0.81	-1.82	MZ	**-2.73**	**-5.44**	-1.05	**-3.29**
Indonesia					Indonesia				
	G+	G-	EU+	EU-		DG+	DG-	DEU+	DEU-
DFG	-1.95	-1.94	-1.75	-1.43	DFG	**-3.24**	**-4.52**	0	0
PP	-8.97	-7.56	-7.12	-4.4	PP	**-21.62**	**-40.81**	**-46.68**	**-42.14**
MZ	-1.99	-1.83	-1.73	-1.29	MZ	**-2.73**	**-3.27**	**-3.65**	**-2.97**
Japan					Japan				
	G+	G-	EU+	EU-		DG+	DG-	DEU+	DEU-
DFG	-1.46	-2.12	-1.65	-2.24	DFG	0	**-4.04**	0	0
PP	-5.79	**-16.95**	-6.13	-11.27	PP	-10.25	**-56.09**	**-7.47**	**-100.27**
MZ	-1.34	-2.48	-1.38	-2.26	MZ	-1.49	**-4.16**	-0.16	**-6.58**
Malaysia					Malaysia				
	G+	G-	EU+	EU-		DG+	DG-	DEU+	DEU-
DFG	-1.79	-2.29	-2.43	-1.62	DFG	0	**-5.85**	0	**-3.89**
PP	-10.5	-11.09	-13.2	-9.43	PP	**-14.62**	**-56.46**	**-43**	**-38.34**
MZ	-2.03	-2.15	-2.2	-1.77	MZ	-1.29	**-4.23**	**-2.91**	**-3.23**
New Zealand					New Zealand				
	G+	G-	EU+	EU-		DG+	DG-	DEU+	DEU-
DFG	-2.22	-1.79	-0.66	-1.95	DFG	**-4.14**	0	0	**-4.96**
PP	-10.52	-5.1	-1.54	-6.81	PP	**-36.16**	**-42.18**	**-31.86**	**-47.98**
MZ	-2.17	-1.26	-0.49	-1.72	MZ	**-3.04**	**-2.94**	-1.99	**-3.55**
Pakistan					Pakistan				
	G+	G-	EU+	EU-		DG+	DG-	DEU+	DEU-
DFG	-1.88	-2.29	-2.64	-1.63	DFG	**-3.23**	0	**-4.47**	0
PP	-6.74	-5.69	**-14.23**	-10.1	PP	**-25**	**-25.03**	**-38.94**	**-23.51**
MZ	-1.8	-1.43	-2.49	-1.82	MZ	-2.53	-1.27	**-3.33**	-0.04
Philippines					Philippines				
	G+	G-	EU+	EU-		DG+	DG-	DEU+	DEU-
DFG	0	-2.38	-1.19	-1.99	DFG	**-3.97**	**-4.6**	0	**-4.3**
PP	-7.2	-13.05	-2.94	-9.03	PP	**-31.08**	**-37.9**	**-34.16**	**-41.53**
MZ	-1.77	-2.48	-0.68	-1.88	MZ	**-3.42**	**-4.03**	-1.64	**-2.82**
Singapore					Singapore				
	G+	G-	EU+	EU-		DG+	DG-	DEU+	DEU-
DFG	-1.37	-0.82	-2.01	-0.73	DFG	0	0	0	0
PP	-10.01	-4.36	-8.85	-2.1	PP	**-23.17**	**-36.16**	**-28.08**	**-35.2**
MZ	-1.75	-0.99	-1.92	-0.68	MZ	-2.25	**-2.94**	-2.04	-1.79
South Korea					South Korea				
	G+	G-	EU+	EU-		DG+	DG-	DEU+	DEU-
DFG	-1.12	-2.37	0	-2.32	DFG	0	**-4.68**	0	**-4.67**
PP	-3.66	-11.45	-4.71	-10.9	PP	**-14.47**	**-43.39**	**-16.5**	**-43.36**
MZ	-1.06	-2.25	-1.22	-2.19	MZ	-1.78	**-3.32**	-1.4	**-3.32**
Thailand					Thailand				
	G+	G-	EU+	EU-		DG+	DG-	DEU+	DEU-
DFG	0	-1.81	-1.81	-2.41	DFG	0	**-4.38**	0	**-4.24**
PP	-3.58	-7.27	-8.42	-12	PP	-11.8	**-37.5**	**-15.03**	**-38.2**
MZ	-1.15	-1.77	-1.97	-2.32	MZ	-2.02	**-3.39**	-2.23	**-3.07**
Notes: See Table 1C									

Table 22C: Unit Root for the level and first difference data (for Trade and EU)

Bangladesh					Bangladesh				
	T+	T-	EU+	EU-		DT+	DT-	DEU+	DEU-
DFG	-2.4	-1.59	-1.21	-1.28	DFG	**-3.31**	0	**-5.58**	0
PP	-11.49	-7.96	-2.69	-4.39	PP	**-31.44**	-13.77	**-43.69**	**-27.8**
MZ	-2.21	-1.4	-0.79	-1.28	MZ	-2.29	-1	**-2.79**	-1.54
China					China				
	T+	T-	EU+	EU-		DT+	DT-	DEU+	DEU-
DFG	-1.78	0	-1.84	**-3.25**	DFG	0	**-3.92**	**-2.84**	**-4.27**
PP	-3.65	-3.11	-15.95	**-18.42**	PP	**-21.12**	**-31.96**	**-16.54**	**-32.63**
MZ	-1.27	-1.08	-2.59	**-2.8**	MZ	-2.33	**-3.23**	-2.59	**-3.29**
China HKSAR					China HKSAR				
	T+	T-	EU+	EU-		DT+	DT-	DEU+	DEU-
DFG	-1.48	-1.57	**-3.76**	-1.47	DFG	0	**-3.17**	**-4.96**	0
PP	-6.55	-5.3	**-29.11**	-4.75	PP	-12.82	**-27.41**	**-43.5**	**-75.41**
MZ	-1.64	-1.28	**-3.62**	-1.38	MZ	-1.63	-1.7	**-3.9**	**-4.93**
India					India				
	T+	T-	EU+	EU-		DT+	DT-	DEU+	DEU-
DFG	-1.08	-2.59	-0.54	0	DFG	**-4.54**	-2.57	-1.86	**-4.68**
PP	-3.41	**-20.48**	-5.25	-7.88	PP	**-42.95**	**-17.74**	**-19.51**	**-42.7**
MZ	-1.01	**-2.63**	-0.81	-1.82	MZ	**-3.11**	-1.22	-1.05	**-3.29**
Indonesia					Indonesia				
	T+	T-	EU+	EU-		DT+	DT-	DEU+	DEU-
DFG	-1.2	**-2.7**	-1.75	-1.43	DFG	**-4.13**	0	0	0
PP	-3.03	**-15.16**	-7.12	-4.4	PP	**-35.33**	**-45.52**	**-46.68**	**-42.14**
MZ	-1.15	-2.48	-1.73	-1.29	MZ	**-2.83**	**-3.44**	**-3.65**	**-2.97**
Japan					Japan				
	T+	T-	EU+	EU-		DT+	DT-	DEU+	DEU-
DFG	-1.95	0	-1.65	-2.24	DFG	**-4.78**	-1.68	0	0
PP	-7.08	15.94	-6.13	-11.27	PP	**-44.96**	**-135.65**	**-7.47**	**-100.27**
MZ	-1.76	6.46	-1.38	-2.26	MZ	**-3.7**	**-7.7**	-0.16	**-6.58**
Malaysia					Malaysia				
	T+	T-	EU+	EU-		DT+	DT-	DEU+	DEU-
DFG	0	-1.64	-2.43	-1.62	DFG	0	**-4.36**	0	**-3.89**
PP	-5.69	-7.89	-13.2	-9.43	PP	**-16.22**	**-32.82**	**-43**	**-38.34**
MZ	-1.41	-1.54	-2.2	-1.77	MZ	-1.38	-2.48	**-2.91**	**-3.23**
New Zealand					New Zealand				
	T+	T-	EU+	EU-		DT+	DT-	DEU+	DEU-
DFG	-0.84	7.04	-1.37	-2.16	DFG	0	15.53	0	**-3.5**
PP	-2.68	18.48	-3.76	-9.9	PP	**-23.68**	19.42	**-15.82**	**-25.58**
MZ	-0.8	15.9	-1.21	-2.03	MZ	-0.95	57266.64	-1.51	-2.56
Pakistan					Pakistan				
	T+	T-	EU+	EU-		DT+	DT-	DEU+	DEU-
DFG	-2.54	-2.55	**-2.64**	-1.63	DFG	**-4.52**	**-6.34**	**-4.47**	0
PP	-13.64	-11.71	**-14.23**	-10.1	PP	**-41.87**	**-26.92**	**-38.94**	**-23.51**
MZ	-2.39	-1.91	-2.49	-1.82	MZ	**-3.24**	-2.37	**-3.33**	-0.04
Philippines					Philippines				
	T+	T-	EU+	EU-		DT+	DT-	DEU+	DEU-
DFG	-1.75	-2.11	-1.19	-1.99	DFG	**-3.19**	0	0	**-4.3**
PP	-8.82	-11.77	-2.94	-9.03	PP	**-23.14**	**-38.93**	**-34.16**	**-41.53**
MZ	-1.92	-2.05	-0.68	-1.88	MZ	**-2.67**	**-2.92**	-1.64	**-2.82**
Singapore					Singapore				
	T+	T-	EU+	EU-		DT+	DT-	DEU+	DEU-
DFG	**-3.9**	-2.41	-1.76	-0.88	DFG	**-3.75**	0	0	0
PP	**-29.5**	**-19.04**	-7.43	-2.52	PP	**-30.51**	**-17.64**	**-24.04**	**-374.58**
MZ	**-3.58**	-2.49	-1.76	-0.77	MZ	**-2.8**	-1.2	-1.83	**-13.19**
South Korea					South Korea				
	T+	T-	EU+	EU-		DT+	DT-	DEU+	DEU-
DFG	0	-2.39	0	-2.32	DFG	-0.04	-2.21	0	**-4.67**
PP	-7.33	17.12	-4.71	-10.9	PP	**-56.34**	7.95	**-16.5**	**-43.36**
MZ	-1.72	8.84	-1.22	-2.19	MZ	**-4.6**	2.23	-1.4	**-3.32**
Thailand					Thailand				
	T+	T-	EU+	EU-		DT+	DT-	DEU+	DEU-
DFG	-2.13	**-2.76**	-1.81	-2.41	DFG	**-3.91**	**-3.6**	0	**-4.24**
PP	-8.93	**-16.32**	-8.42	-12	PP	**-31.47**	**-33.03**	**-15.03**	**-38.2**
MZ	-1.98	-2.61	-1.97	-2.32	MZ	**-2.93**	**-2.82**	-2.23	**-3.07**

Notes: See Table 1C

Table 23C: Unit Root for the level and first difference data (for GDP and NG)

Bangladesh					Bangladesh				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-0.17	0	-0.37		DFG	0	0	**-4.88**	
PP	-0.84	-1.96	-1.99		PP	**-19.14**	**-33**	**-35.29**	
MZ	-0.32	-0.1	-0.4		MZ	-1.28	-2.08	-2.53	
China					China				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	0	**-2.68**	-1.77	0	DFG	**-4.97**	**-5.38**	0	**-3.15**
PP	-2.45	-10	-7.25	-5.18	PP	**-42.46**	**-49.66**	**-6.75**	**-35.42**
MZ	-0.69	-1.94	-1.81	-1.48	MZ	**-3.96**	**-4.49**	-1.47	**-3.76**
India					India				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	0.23	-0.99	-0.91	-1.73	DFG	**-4.46**	**-5.35**	**-3.59**	**-6.89**
PP	-0.36	-3.2	-2.1	-6.79	PP	**-46.24**	**-52.02**	**-30.44**	**-46.19**
MZ	0.12	-0.97	-0.8	-1.72	MZ	**-3.06**	**-3.51**	**-2.86**	**-3.35**
Indonesia					Indonesia				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-2.16	-1.87	-0.91	-2.01	DFG	0	**-4.9**	**-3.58**	0
PP	-8.03	-7.22	-1.91	-7.92	PP	**-13.64**	**-47.84**	**-35.92**	**-354.01**
MZ	-1.93	-1.81	-0.67	-1.87	MZ	-1.84	**-3.54**	-2.51	**-12.85**
Japan					Japan				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.46	-2.12	-0.99	-0.26	DFG	0	**-4.04**	**-4**	0
PP	-5.79	**-16.95**	-2.09	-1.21	PP	-10.25	**-56.09**	**-31.35**	**-296.76**
MZ	-1.34	-2.48	-0.75	-0.27	MZ	-1.49	**-4.16**	**-3.24**	**-11.51**
Malaysia					Malaysia				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.98	-2.33	-1.29	-1.43	DFG	0	0	**-3.48**	**-4.5**
PP	-9.61	-11.2	-4.73	-4.3	PP	**-15.39**	**-63.41**	**-27.31**	**-44.96**
MZ	-1.98	-2.18	-1.16	-1.25	MZ	-1.54	**-4.54**	**-2.77**	**-2.98**
New Zealand					New Zealand				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	**-2.85**	-1.75	-1.24	**-2.81**	DFG	**-3.49**	**-3.22**	**-5.04**	**-4.45**
PP	**-16.34**	-5.94	-3.82	**-15.92**	PP	**-25.01**	**-29.64**	**-44.28**	**-37.52**
MZ	**-2.81**	-1.58	-0.99	**-2.75**	MZ	**-2.96**	-2.34	**-3.96**	**-3.63**
Pakistan					Pakistan				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.99	-2.61	-2.17	-1.93	DFG	**-3.75**	0	**-4.23**	**-5.12**
PP	-7.97	-12.94	-11.33	-7.69	PP	**-33.66**	**-47.75**	**-35.44**	**-50.19**
MZ	-1.9	-2.45	-2.08	-1.75	MZ	**-2.87**	**-4.29**	**-3.37**	**-3.62**
Taiwan					Taiwan				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.04	-1.27	-2.01	-1.48	DFG	0	**-4.94**	0	0
PP	-3.02	-6.13	-7.21	-5.4	PP	**-21.13**	**-57.65**	**-22.62**	**-15.16**
MZ	-0.88	-1.33	-1.74	-1.56	MZ	-2.3	**-3.83**	-1.87	-1.85
Notes: See Table 1C									

Table 24C: Unit Root for the level and first difference data (for Trade and NG)

Bangladesh					Bangladesh				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-2.37	-1.59	-0.37		DFG	**-3.3**	0	**-4.88**	
PP	-11.55	-7.77	-1.99		PP	**-31.41**	-13.89	**-35.29**	
MZ	-2.19	-1.41	-0.4		MZ	**-2.3**	-1.03	-2.53	
China					China				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.57	0	-0.74	**-3.09**	DFG	0	**-4.67**	0	0
PP	-3.27	-1.24	**-20.8**	-11.61	PP	**-30.79**	**-39.22**	-10.33	-5.29
MZ	-1.16	-0.46	**-3**	-2.15	MZ	**-3.16**	**-3.66**	-1.29	0.18
India					India				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.65	-2.52	-0.91	-1.73	DFG	0	**-3.81**	**-3.59**	**-6.89**
PP	-4.43	-9.09	-2.1	-6.79	PP	**-40.69**	**-34.94**	**-30.44**	**-46.19**
MZ	-1.36	-1.95	-0.8	-1.72	MZ	**-2.72**	**-3.26**	**-2.86**	**-3.35**
Indonesia					Indonesia				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.33	-2.27	-0.91	-2.01	DFG	-1.36	0	**-3.58**	0
PP	-4	-10.11	-1.91	-7.92	PP	**-46.58**	**-63.14**	**-35.92**	**-354.01**
MZ	-1.33	-2.05	-0.67	-1.87	MZ	**-3.78**	**-4.21**	-2.51	**-12.85**
Japan					Japan				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.95	0	-0.99	-0.26	DFG	**-4.78**	-1.68	**-4**	0

PP	-7.08	15.94	-2.09	-1.21	PP	**-44.96**	**-135.65**	**-31.35**	**-296.76**
MZ	-1.76	6.46	-0.75	-0.27	MZ	**-3.7**	**-7.7**	**-3.24**	**-11.51**
Malaysia					Malaysia				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	0	-2.03	-1.29	-1.43	DFG	0	-1.72	**-3.48**	**-4.5**
PP	-4.99	10.95	-4.73	-4.3	PP	**-16.08**	**-498.68**	**-27.31**	**-44.96**
MZ	-1.29	3.41	-1.16	-1.25	MZ	-1.38	**-15.45**	**-2.77**	**-2.98**
New Zealand					New Zealand				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-0.84	7.04	-1.65	-2.57	DFG	0	15.53	0	**-4.17**
PP	-2.68	18.48	-4.76	-12.52	PP	**-23.68**	19.42	**-23.37**	**-32.72**
MZ	-0.8	15.9	-1.34	-2.39	MZ	-0.95	57266.64	**-2.67**	**-3.38**
Pakistan					Pakistan				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	**-2.93**	-1.87	-2.17	-1.93	DFG	**-5.49**	**-5.15**	**-4.23**	**-5.12**
PP	**-18.07**	-7.36	-11.33	-7.69	PP	**-55.55**	**-48.87**	**-35.44**	**-50.19**
MZ	**-2.71**	-1.75	-2.08	-1.75	MZ	**-3.77**	**-3.91**	**-3.37**	**-3.62**
South Korea					South Korea				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	**-2.86**	-2.36	-1.01	**-2.95**	DFG	0	-2.28	**-16.12**	**-3.87**
PP	-13.9	12.62	-9.67	**-18.13**	PP	-12.09	8.52	**-17.65**	**-31.85**
MZ	-2.45	6.54	0.27	**-2.69**	MZ	-1.27	3.29	-0.54	**-2.84**

Notes: See Table 1C

Table 25C: Unit Root for the level and first difference data (for GDP and NU)

India					India				
	G+	G-	NU+	NU-		DG+	DG-	DNU+	DNU-
DFG	-0.29	-1.14	-1.44	-2.19	DFG	**-4.45**	0	0	**-5.4**
PP	-1.85	-3.77	-7.4	-9.27	PP	**-44.02**	**-67.25**	**-82.7**	**-53.18**
MZ	-0.31	-1.08	-1.44	-1.84	MZ	**-2.94**	**-4.61**	**-5.11**	**-3.49**
Japan					Japan				
	G+	G-	NU+	NU-		DG+	DG-	DNU+	DNU-
DFG	-1.39	-2.1	0	-2.08	DFG	0	**-3.99**	**-4.3**	0
PP	-5.48	**-16.52**	-2.82	-9.75	PP	-10.1	**-54.78**	**-37.32**	**-41.09**
MZ	-1.28	-2.45	-0.73	-2.03	MZ	-1.29	**-4.11**	**-2.83**	**-2.87**
Taiwan					Taiwan				
	G+	G-	NU+	NU-		DG+	DG-	DNU+	DNU-
DFG	-1.12	-1.43	-1.2	**-2.64**	DFG	0	**-4.41**	0	**-4.34**
PP	-3.24	-6.49	-4.68	-9.57	PP	**-14.68**	**-44.55**	**-14.74**	**-36.83**
MZ	-1.06	-1.41	-1.22	-1.88	MZ	-1.19	**-3.37**	-1.74	**-3.02**
Thailand					Thailand				
	G+	G-	NU+	NU-		DG+	DG-	DNU+	DNU-
DFG	-2.49	-2.13	0	-1.68	DFG	0	**-4.03**	0	**-3.66**
PP	**-14.37**	-8.86	-2.84	-7.32	PP	-8.54	**-32.09**	**-17.87**	**-29.11**
MZ	**-2.62**	-1.99	0.24	-1.73	MZ	-1.77	**-3.12**	-0.65	**-2.7**

Notes: See Table 1C

Table 26C: Unit Root for the level and first difference data (for Trade and NU)

India					India				
	T+	T-	NU+	NU-		DT+	DT-	DNU+	DNU-
DFG	-1.53	**-2.68**	-1.44	-2.19	DFG	**-3.02**	**-3.59**	0	**-5.4**
PP	-4.17	**-20.23**	-7.4	-9.27	PP	**-37.23**	**-45.3**	**-82.7**	**-53.18**
MZ	-1.33	**-2.77**	-1.44	-1.84	MZ	**-2.83**	**-3.17**	**-5.11**	**-3.49**
Japan					Japan				
	T+	T-	NU+	NU-		DT+	DT-	DNU+	DNU-
DFG	-2.02	**-3.11**	0	-2.08	DFG	**-4.76**	-1.68	**-4.3**	0
PP	-7.44	15.89	-2.82	-9.75	PP	**-44.42**	**-133.9**	**-37.32**	**-41.09**
MZ	-1.79	6.72	-0.73	-2.03	MZ	**-3.68**	**-7.64**	**-2.83**	**-2.87**
Thailand					Thailand				
	T+	T-	NU+	NU-		DT+	DT-	DNU+	DNU-
DFG	-2.06	**-2.73**	0	-1.68	DFG	**-3.61**	**-4.33**	0	**-3.66**
PP	-9.03	**-15.72**	-2.84	-7.32	PP	**-26.22**	**-44.96**	**-17.87**	**-29.11**
MZ	-2.01	-2.48	0.24	-1.73	MZ	**-2.68**	**-3.5**	-0.65	**-2.7**

Notes: See Table 1C

Table 27C: Unit Root for the level and first difference data (for GDP and PEC)

Bangladesh					Bangladesh				
	G+	G-	PEC+	PEC-		DG+	DG-	DPEC+	DPEC-
DFG	-0.17	0	-1.3	-1.86	DFG	0	0	**-5.31**	**-4.57**
PP	-0.84	-1.96	-7.09	-6.98	PP	**-19.14**	**-33**	**-39.94**	**-41.82**
MZ	-0.32	-0.1	-1.24	-1.75	MZ	-1.28	-2.08	**-2.86**	**-3.26**
China					China				
	G+	G-	PEC+	PEC-		DG+	DG-	DPEC+	DPEC-
DFG	0	**-2.68**	-2.52	**-2.64**	DFG	**-4.97**	**-5.38**	**-4**	**-5.3**
PP	-2.45	-10	-12.57	-9.83	PP	**-42.46**	**-49.66**	**-29.57**	**-52.9**
MZ	-0.69	-1.94	-2.44	-1.82	MZ	**-3.96**	**-4.49**	**-3.54**	**-3.66**
China HKSAR					China HKSAR				
	G+	G-	PEC+	PEC-		DG+	DG-	DPEC+	DPEC-
DFG	-1.14	-1.88	-2.16	-1.8	DFG	0	**-5**	0	0
PP	-3.33	-8.43	-9.7	-8.47	PP	**-21.28**	**-51.79**	**-40.28**	**-81.96**
MZ	-1.11	-1.85	-1.83	-1.75	MZ	-1.88	**-3.52**	**-3.23**	**-5.13**
India					India				
	G+	G-	PEC+	PEC-		DG+	DG-	DPEC+	DPEC-
DFG	0.23	-0.99	-2.21	-1.93	DFG	**-4.46**	**-5.35**	0	**-5.18**
PP	-0.36	-3.2	-12.84	-6.71	PP	**-46.24**	**-52.02**	**-28.06**	**-51.5**
MZ	0.12	-0.97	-2.17	-1.58	MZ	**-3.06**	**-3.51**	-2.09	**-3.61**
Indonesia					Indonesia				
	G+	G-	PEC+	PEC-		DG+	DG-	DPEC+	DPEC-
DFG	-2.16	-1.87	-0.76	-1.8	DFG	0	**-4.9**	0	0
PP	-8.03	-7.22	-1.81	-7.63	PP	-13.64	**-47.84**	**-25.39**	**-53.82**
MZ	-1.93	-1.81	-0.71	-1.73	MZ	-1.84	**-3.54**	-2.05	**-3.76**
Japan					Japan				
	G+	G-	PEC+	PEC-		DG+	DG-	DPEC+	DPEC-
DFG	-1.46	-2.12	-1.72	-2.11	DFG	0	**-4.04**	0	**-3.19**
PP	-5.79	**-16.95**	-7.02	-10.8	PP	-10.25	**-56.09**	**-5.01**	**-35.61**
MZ	-1.34	-2.48	-1.53	-2.15	MZ	-1.49	**-4.16**	0.02	**-2.91**
Malaysia					Malaysia				
	G+	G-	PEC+	PEC-		DG+	DG-	DPEC+	DPEC-
DFG	-2.15	-1.98	-0.28	0	DFG	0	0	0	0
PP	-10.69	-8.34	-1.3	2.17	PP	**-22.03**	**-71.06**	**-17.37**	**-12372.2**
MZ	-2.18	-1.85	-0.39	0.83	MZ	-2.31	**-4.77**	-0.54	**-78.62**
New Zealand					New Zealand				
	G+	G-	PEC+	PEC-		DG+	DG-	DPEC+	DPEC-
DFG	-2.22	-1.79	-0.65	0	DFG	**-4.14**	0	0	**-3.75**
PP	-10.52	-5.1	-2.61	-11.28	PP	**-36.16**	**-42.18**	**-28.15**	**-44.44**
MZ	-2.17	-1.26	-0.64	-2.17	MZ	**-3.04**	**-2.94**	-1.5	-2.42
Pakistan					Pakistan				
	G+	G-	PEC+	PEC-		DG+	DG-	DPEC+	DPEC-
DFG	-1.99	-2.61	-1.57	-2	DFG	**-3.75**	0	0	0
PP	-7.97	-12.94	-7.09	-7.5	PP	**-33.66**	**-47.75**	**-24.25**	**-58.89**
MZ	-1.9	-2.45	-1.68	-1.79	MZ	**-2.87**	**-4.29**	-2.61	**-4.67**
Philippines					Philippines				
	G+	G-	PEC+	PEC-		DG+	DG-	DPEC+	DPEC-
DFG	-1.64	0	-1.12	-1.48	DFG	0	0	**-2.8**	0
PP	-7.79	-5.42	-4.14	-5.03	PP	**-20.36**	**-40.76**	**-25.2**	**-30.59**
MZ	-1.84	-1.55	-1	-1.52	MZ	-2.29	**-4.16**	-2.18	**-2.86**
Singapore					Singapore				
	G+	G-	PEC+	PEC-		DG+	DG-	DPEC+	DPEC-
DFG	0	-0.83	-2.16	-1.44	DFG	0	0	0	0
PP	-2.06	-3.03	-9.84	-3.9	PP	-12.67	**-66.03**	**-49.58**	**-35.7**
MZ	-0.47	-0.8	-2.01	-1.19	MZ	-1.67	**-4.61**	**-3.72**	-1.91
South Korea					South Korea				
	G+	G-	PEC+	PEC-		DG+	DG-	DPEC+	DPEC-
DFG	-0.85	-2.26	-0.44	-1.78	DFG	0	**-5.02**	**-2.86**	**-4.95**
PP	-3.81	-10.26	-2.34	-6.5	PP	**-14.71**	**-49.84**	**-21.16**	**-49**
MZ	-0.95	-2.13	-0.49	-1.7	MZ	-1.14	**-3.55**	-2.15	**-3.52**
Taiwan					Taiwan				
	G+	G-	PEC+	PEC-		DG+	DG-	DPEC+	DPEC-
DFG	-1.04	-1.27	-0.54	-2.32	DFG	0	**-4.94**	**-3.26**	**-4.9**
PP	-3.02	-6.13	-1.32	-13.1	PP	**-21.13**	**-57.65**	**-28.91**	**-46.31**
MZ	-0.88	-1.33	-0.3	-2.37	MZ	-2.3	**-3.83**	-2.52	**-3.75**
Thailand					Thailand				
	G+	G-	PEC+	PEC-		DG+	DG-	DPEC+	DPEC-
DFG	0	-1.72	-1.33	-1.78	DFG	0	**-4.78**	0	**-4.95**
PP	-5.94	-6.43	-6.91	-6.5	PP	**-16.24**	**-44.55**	**-14.22**	**-49**
MZ	-1.63	-1.66	-1.5	-1.7	MZ	-2.29	**-3.67**	-1.67	**-3.52**

Notes: See Table 1C

Table 28C: Unit Root for the level and first difference data (for Trade and PEC)

Bangladesh					Bangladesh				
	T+	T-	PEC+	PEC-		DT+	DT-	DPEC+	DPEC-
DFG	-2.37	-1.59	-1.3	-1.86	DFG	**-3.3**	0	**-5.31**	**-4.57**
PP	-11.55	-7.77	-7.09	-6.98	PP	**-31.41**	-13.89	**-39.94**	**-41.82**
MZ	-2.19	-1.41	-1.24	-1.75	MZ	-2.3	-1.03	**-2.86**	**-3.26**
China					China				
	T+	T-	PEC+	PEC-		DT+	DT-	DPEC+	DPEC-
DFG	-1.57	0	-2.04	0	DFG	0	**-4.67**	**-3.34**	**-4.57**
PP	-3.27	-1.24	-18.27	-2.39	PP	**-30.79**	**-39.22**	**-22.63**	**-38.81**
MZ	-1.16	-0.46	-2.84	0.59	MZ	**-3.16**	**-3.66**	**-3.13**	**-3.15**
China HKSAR					China HKSAR				
	T+	T-	PEC+	PEC-		DT+	DT-	DPEC+	DPEC-
DFG	-1.8	-1.44	-2.16	-1.8	DFG	0	-1.17	0	0
PP	-6.26	-3.99	-9.7	-8.47	PP	**-19.63**	**-34.36**	**-40.28**	**-81.96**
MZ	-1.73	-1.34	-1.83	-1.75	MZ	-2.19	-1.67	**-3.23**	**-5.13**
India					India				
	T+	T-	PEC+	PEC-		DT+	DT-	DPEC+	DPEC-
DFG	-1.65	-2.52	-2.21	-1.93	DFG	0	**-3.81**	0	**-5.18**
PP	-4.43	-9.09	-12.84	-6.71	PP	**-40.69**	**-34.94**	**-28.06**	**-51.5**
MZ	-1.36	-1.95	-2.17	-1.58	MZ	**-2.72**	**-3.26**	-2.09	**-3.61**
Indonesia					Indonesia				
	T+	T-	PEC+	PEC-		DT+	DT-	DPEC+	DPEC-
DFG	-1.33	-2.27	-0.76	-1.8	DFG	-1.36	0	0	0
PP	-4	-10.11	-1.81	-7.63	PP	**-46.58**	**-63.14**	**-25.39**	**-53.82**
MZ	-1.33	-2.05	-0.71	-1.73	MZ	**-3.78**	**-4.21**	-2.05	**-3.76**
Japan					Japan				
	T+	T-	PEC+	PEC-		DT+	DT-	DPEC+	DPEC-
DFG	-1.95	0	-1.72	-2.11	DFG	**-4.78**	-1.68	0	**-3.19**
PP	-7.08	15.94	-7.02	-10.8	PP	**-44.96**	**-135.65**	**-5.01**	**-35.61**
MZ	-1.76	6.46	-1.53	-2.15	MZ	**-3.7**	**-7.7**	0.02	**-2.91**
Malaysia					Malaysia				
	T+	T-	PEC+	PEC-		DT+	DT-	DPEC+	DPEC-
DFG	0	-2.19	-0.28	0	DFG	0	-1.69	0	0
PP	-5.48	9.57	-1.3	2.17	PP	**-17.79**	**-892.44**	**-17.37**	**-12372.2**
MZ	-1.45	2.82	-0.39	0.83	MZ	-1.55	**-20.86**	-0.54	**-78.62**
New Zealand					New Zealand				
	T+	T-	PEC+	PEC-		DT+	DT-	DPEC+	DPEC-
DFG	-0.84	7.04	-0.62	0	DFG	0	15.53	0	**-4.04**
PP	-2.68	18.48	-1.38	-12.92	PP	**-23.68**	19.42	**-21.12**	**-28.47**
MZ	-0.8	15.9	-0.53	-2.42	MZ	-0.95	57266.64	-0.76	-1.46
Pakistan					Pakistan				
	T+	T-	PEC+	PEC-		DT+	DT-	DPEC+	DPEC-
DFG	**-2.93**	-1.87	-1.57	-2	DFG	**-5.49**	**-5.15**	0	0
PP	**-18.07**	-7.36	-7.09	-7.5	PP	**-55.55**	**-48.87**	**-24.25**	**-58.89**
MZ	**-2.71**	-1.75	-1.68	-1.79	MZ	**-3.77**	**-3.91**	-2.61	**-4.67**
Philippines					Philippines				
	T+	T-	PEC+	PEC-		DT+	DT-	DPEC+	DPEC-
DFG	-1.8	-2.47	-1.12	-1.48	DFG	**-3.51**	0	**-2.8**	0
PP	-6.44	-13.53	-4.14	-5.03	PP	**-27.33**	**-52.97**	**-25.2**	**-30.59**
MZ	-1.69	-2.38	-1	-1.52	MZ	**-2.9**	**-3.7**	-2.18	**-2.86**
Singapore					Singapore				
	T+	T-	PEC+	PEC-		DT+	DT-	DPEC+	DPEC-
DFG	**-3.89**	-2.43	-1.91	-1.64	DFG	**-3.77**	0	0	-1.08
PP	**-29.47**	**-16.76**	-6.27	-5.64	PP	**-31.16**	**-59.33**	**-30.49**	**-44.95**
MZ	**-3.59**	-2.5	-1.68	-1.56	MZ	**-2.87**	**-4.28**	-2.1	**-3.32**
South Korea					South Korea				
	T+	T-	PEC+	PEC-		DT+	DT-	DPEC+	DPEC-
DFG	-1.19	-2.31	-0.44	-1.78	DFG	0	-2.21	**-2.86**	**-4.95**
PP	-5.33	18.37	-2.34	-6.5	PP	**-20.04**	9.13	**-21.16**	**-49**
MZ	-1.23	9.57	-0.49	-1.7	MZ	-2	2.44	-2.15	**-3.52**
Thailand					Thailand				
	T+	T-	PEC+	PEC-		DT+	DT-	DPEC+	DPEC-
DFG	-2.17	-2.38	-1.33	-1.78	DFG	**-4.5**	**-5.5**	0	**-4.95**
PP	-8.11	-11.17	-6.91	-6.5	PP	**-38.05**	**-63.32**	**-14.22**	**-49**
MZ	-1.96	-2.24	-1.5	-1.7	MZ	**-3.33**	**-4.41**	-1.67	**-3.52**

Notes: See Table 1C

Table 29C: Unit Root for the level and first difference data (for GDP and PEC)

Bangladesh					Bangladesh				
	G+	G-	HYD+	HYD-		DG+	DG-	DHYD+	DHYD-
DFG	-0.44	0	-2.15	-1.56	DFG	0	-1.97	**-4.55**	**-4.09**
PP	0.01	-3.02	-10.42	-6.1	PP	**-24.7**	**-24.68**	**-42.26**	**-36.51**
MZ	0.05	-0.21	-1.83	-1.53	MZ	-1.24	-0.37	**-2.96**	**-2.73**
China					China				
	G+	G-	HYD+	HYD-		DG+	DG-	DHYD+	DHYD-
DFG	0	**-2.68**	-2.28	**-2.77**	DFG	**-4.97**	**-5.38**	0	**-5.51**
PP	-2.45	-10	-13.68	-11.38	PP	**-42.46**	**-49.66**	**-34.1**	**-55.38**
MZ	-0.69	-1.94	-2.33	-1.98	MZ	**-3.96**	**-4.49**	**-2.81**	**-3.76**
India					India				
	G+	G-	HYD+	HYD-		DG+	DG-	DHYD+	DHYD-
DFG	0.23	-0.99	**-2.67**	0	DFG	**-4.46**	**-5.35**	**-4.53**	**-5.72**
PP	-0.36	-3.2	-12.67	-8.16	PP	**-46.24**	**-52.02**	**-41.79**	**-57.47**
MZ	0.12	-0.97	-2.36	-1.77	MZ	**-3.06**	**-3.51**	**-3.47**	**-4.28**
Indonesia					Indonesia				
	G+	G-	HYD+	HYD-		DG+	DG-	DHYD+	DHYD-
DFG	-2.16	-1.87	-1.63	-1.76	DFG	0	**-4.9**	0	0
PP	-8.03	-7.22	-8.25	-6.15	PP	-13.64	**-47.84**	**-45.64**	**-27.08**
MZ	-1.93	-1.81	-1.58	-1.56	MZ	-1.84	**-3.54**	-2.48	-0.83
Japan					Japan				
	G+	G-	HYD+	HYD-		DG+	DG-	DHYD+	DHYD-
DFG	-1.46	-2.12	**-2.68**	**-2.9**	DFG	0	**-4.04**	-0.79	**-4.81**
PP	-5.79	**-16.95**	**-16.98**	**-18.63**	PP	-10.25	**-56.09**	**-41.87**	**-54.69**
MZ	-1.34	-2.48	-2.35	-2.58	MZ	-1.49	**-4.16**	-1.11	**-2.87**
Malaysia					Malaysia				
	G+	G-	HYD+	HYD-		DG+	DG-	DHYD+	DHYD-
DFG	-2.15	-1.98	**-2.78**	-1.84	DFG	0	0	0	**-5.6**
PP	-10.69	-8.34	**-15.5**	-6.71	PP	**-22.03**	**-71.06**	**-44.64**	**-55.22**
MZ	-2.18	-1.85	**-2.64**	-1.7	MZ	-2.31	**-4.77**	**-3.37**	**-4.41**
New Zealand					New Zealand				
	G+	G-	HYD+	HYD-		DG+	DG-	DHYD+	DHYD-
DFG	-2.22	-1.79	**-2.92**	-0.88	DFG	**-4.14**	0	**-5.14**	0
PP	-10.52	-5.1	**-18.76**	-2.16	PP	**-36.16**	**-42.18**	**-52.68**	**-99.41**
MZ	-2.17	-1.26	**-2.65**	-0.72	MZ	**-3.04**	**-2.94**	**-3.4**	**-5.53**
Pakistan					Pakistan				
	G+	G-	HYD+	HYD-		DG+	DG-	DHYD+	DHYD-
DFG	-1.99	-2.61	-2.09	-0.99	DFG	**-3.75**	0	**-5.34**	-2.57
PP	-7.97	-12.94	-8.22	-2.64	PP	**-33.66**	**-47.75**	**-53.53**	**-35.83**
MZ	-1.9	-2.45	-1.66	-0.95	MZ	**-2.87**	**-4.29**	**-3.51**	-2.21
Philippines					Philippines				
	G+	G-	HYD+	HYD-		DG+	DG-	DHYD+	DHYD-
DFG	-1.64	0	-1.38	0	DFG	0	0	**-6.19**	**-4.59**
PP	-7.79	-5.42	-3.86	**-18.91**	PP	**-20.36**	**-40.76**	**-63.93**	**-25.36**
MZ	-1.84	-1.55	-0.97	-2.49	MZ	-2.29	**-4.16**	**-3.96**	0.92
South Korea					South Korea				
	G+	G-	HYD+	HYD-		DG+	DG-	DHYD+	DHYD-
DFG	-0.85	-2.26	-2.21	-1.6	DFG	0	**-5.02**	0	0
PP	-3.81	-10.26	-12.1	-5.23	PP	**-14.71**	**-49.84**	**-35.23**	**-45.95**
MZ	-0.95	-2.13	-2.09	-1.41	MZ	-1.14	**-3.55**	-0.7	-2.19
Taiwan					Taiwan				
	G+	G-	HYD+	HYD-		DG+	DG-	DHYD+	DHYD-
DFG	-1.04	-1.27	-2.38	**-2.66**	DFG	0	**-4.94**	**-5.41**	**-5.11**
PP	-3.02	-6.13	**-14.49**	**-15.52**	PP	**-21.13**	**-57.65**	**-59.05**	**-54.06**
MZ	-0.88	-1.33	-2.22	-2.44	MZ	-2.3	**-3.83**	**-3.29**	**-3.26**
Thailand					Thailand				
	G+	G-	HYD+	HYD-		DG+	DG-	DHYD+	DHYD-
DFG	0	-1.72	-1.79	-2.57	DFG	0	**-4.78**	**-5.42**	**-4.26**
PP	-5.94	-6.43	-8.71	-13.77	PP	**-16.24**	**-44.55**	**-56.37**	**-42.47**
MZ	-1.63	-1.66	-1.7	-2.45	MZ	-2.29	**-3.67**	**-3.61**	**-2.97**

Notes: See Table 1C

Table 30C: Unit Root for the level and first difference data (for Trade and PEC)

Bangladesh					Bangladesh				
	T+	T-	HYD+	HYD-		DT+	DT-	DHYD+	DHYD-
DFG	-2.37	-1.1	-2.15	-1.56	DFG	**-3.37**	0	**-4.55**	**-4.09**
PP	-10.6	-6.44	-10.42	-6.1	PP	**-31.68**	**-28.5**	**-42.26**	**-36.51**
MZ	-2.05	-0.98	-1.83	-1.53	MZ	-2.31	-1.15	**-2.96**	**-2.73**
China					China				
	T+	T-	HYD+	HYD-		DT+	DT-	DHYD+	DHYD-
DFG	-1.57	0	-1.58	-1.78	DFG	0	**-4.67**	0	**-0.56**
PP	-3.27	-1.24	-7.14	-6.1	PP	**-30.79**	**-39.22**	**-24.35**	**-458.6**
MZ	-1.16	-0.46	-1.64	-1.53	MZ	**-3.16**	**-3.66**	-2.21	**-14.78**
India					India				
	T+	T-	HYD+	HYD-		DT+	DT-	DHYD+	DHYD-
DFG	-1.65	-2.52	**-2.67**	0	DFG	0	**-3.81**	**-4.53**	**-5.72**
PP	-4.43	-9.09	-12.67	-8.16	PP	**-40.69**	**-34.94**	**-41.79**	**-57.47**
MZ	-1.36	-1.95	-2.36	-1.77	MZ	**-2.72**	**-3.26**	**-3.47**	**-4.28**
Indonesia					Indonesia				
	T+	T-	HYD+	HYD-		DT+	DT-	DHYD+	DHYD-
DFG	-1.33	-2.27	-1.63	-1.76	DFG	-1.36	0	0	0
PP	-4	-10.11	-8.25	-6.15	PP	**-46.58**	**-63.14**	**-45.64**	**-27.08**
MZ	-1.33	-2.05	-1.58	-1.56	MZ	**-3.78**	**-4.21**	-2.48	-0.83
Japan					Japan				
	T+	T-	HYD+	HYD-		DT+	DT-	DHYD+	DHYD-
DFG	-1.95	0	**-2.68**	**-2.9**	DFG	**-4.78**	-1.68	-0.79	**-4.81**
PP	-7.08	15.94	**-16.98**	**-18.63**	PP	**-44.96**	**-135.65**	**-41.87**	**-54.69**
MZ	-1.76	6.46	-2.35	-2.58	MZ	**-3.7**	**-7.7**	-1.11	**-2.87**
Malaysia					Malaysia				
	T+	T-	HYD+	HYD-		DT+	DT-	DHYD+	DHYD-
DFG	0	-2.19	**-2.78**	-1.84	DFG	0	-1.69	0	**-5.6**
PP	-5.48	9.57	**-15.5**	-6.71	PP	**-17.79**	**-892.44**	**-44.64**	**-55.22**
MZ	-1.45	2.82	**-2.64**	-1.7	MZ	-1.55	**-20.86**	**-3.37**	**-4.41**
New Zealand					New Zealand				
	T+	T-	HYD+	HYD-		DT+	DT-	DHYD+	DHYD-
DFG	-0.84	7.04	**-3.04**	-1.23	DFG	0	15.53	**-4.22**	0
PP	-2.68	18.48	-18.06	-3.17	PP	**-23.68**	19.42	**-39.27**	**-72.65**
MZ	-0.8	15.9	-2.49	-0.99	MZ	-0.95	57266.6	**-2.7**	**-4.57**
Pakistan					Pakistan				
	T+	T-	HYD+	HYD-		DT+	DT-	DHYD+	DHYD-
DFG	**-2.93**	-1.87	-2.09	-0.99	DFG	**-5.49**	**-5.15**	**-5.34**	-2.57
PP	**-18.07**	-7.36	-8.22	-2.64	PP	**-55.55**	**-48.87**	**-53.53**	**-35.83**
MZ	**-2.71**	-1.75	-1.66	-0.95	MZ	**-3.77**	**-3.91**	**-3.51**	-2.21
Philippines					Philippines				
	T+	T-	HYD+	HYD-		DT+	DT-	DHYD+	DHYD-
DFG	-1.8	-2.47	-1.38	0	DFG	**-3.51**	0	**-6.19**	**-4.59**
PP	-6.44	-13.53	-3.86	**-18.91**	PP	**-27.33**	**-52.97**	**-63.93**	**-25.36**
MZ	-1.69	-2.38	-0.97	-2.49	MZ	**-2.9**	**-3.7**	**-3.96**	0.92
South Korea					South Korea				
	T+	T-	HYD+	HYD-		DT+	DT-	DHYD+	DHYD-
DFG	-1.19	-2.31	-2.21	-1.6	DFG	0	-2.21	0	0
PP	-5.33	18.37	-12.1	-5.23	PP	**-20.04**	9.13	**-35.23**	**-45.95**
MZ	-1.23	9.57	-2.09	-1.41	MZ	-2	2.44	-0.7	-2.19
Thailand					Thailand				
	T+	T-	HYD+	HYD-		DT+	DT-	DHYD+	DHYD-
DFG	-2.17	-2.38	-1.79	-2.57	DFG	**-4.5**	**-5.5**	**-5.42**	**-4.26**
PP	-8.11	-11.17	-8.71	-13.77	PP	**-38.05**	**-63.32**	**-56.37**	**-42.47**
MZ	-1.96	-2.24	-1.7	-2.45	MZ	**-3.33**	**-4.41**	**-3.61**	**-2.97**

Notes: Refer to Table 1C.

Appendix D: Tables for cointegration analysis: Schorderet's cointegration test

Table 1D: Cointegration between CO2 emissions and GDP and Trade

Bangladesh																
	G+,C+	G+,C-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-	T+,C+	T+,C-	T-,C+	T-,C-	C+,T+	C+,T-	C-,T+	C-,T-
DFG					-3.09	-3.9	-5.1	-5						-3.68		
PP					-20.9	-30	-41.7	-41						-29.4		
MZ						-3.2	-3.06	-3						-3.29		
China																
	G+,C+	G+,C-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-	T+,C+	T+,C-	T-,C+	T-,C-	C+,T+	C+,T-	C-,T+	C-,T-
DFG		-5.6		-4.7	-3.12	-3.9	-5.46	-4.8								
PP		-39		-39	-20.5	-30	-47.9	-40						-19.5		
MZ		-3.8		-3.7	-3.13	-3.8	-4.42	-4.1						-3.01		
China HKSAR																
	G+,C+	G+,C-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-	T+,C+	T+,C-	T-,C+	T-,C-	C+,T+	C+,T-	C-,T+	C-,T-
DFG						-3.7										
PP		-35		-29	-19.3		-27	-22								
MZ																
India																
	G+,C+	G+,C-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-	T+,C+	T+,C-	T-,C+	T-,C-	C+,T+	C+,T-	C-,T+	C-,T-
DFG								-4.2				-3.1				-3.25
PP							-28.2	-41				-18				-23.6
MZ								-3.1								-3.04
Indonesia																
	G+,C+	G+,C-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-	T+,C+	T+,C-	T-,C+	T-,C-	C+,T+	C+,T-	C-,T+	C-,T-
DFG	-3.15						-3.19	-3.2								
PP	-20.8						-32.6	-31								
MZ																
Japan																
	G+,C+	G+,C-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-	T+,C+	T+,C-	T-,C+	T-,C-	C+,T+	C+,T-	C-,T+	C-,T-
DFG																
PP												-205				
MZ										8.64		-9.6				
Malaysia																
	G+,C+	G+,C-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-	T+,C+	T+,C-	T-,C+	T-,C-	C+,T+	C+,T-	C-,T+	C-,T-
DFG								-3.9								
PP								-33		-34.6						
MZ								-2.9		-3.41		4.4				
New Zealand																
	G+,C+	G+,C-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-	T+,C+	T+,C-	T-,C+	T-,C-	C+,T+	C+,T-	C-,T+	C-,T-
DFG		-3.3		-3.2					-2.97				-2.93			
PP							-20.3	-20	-18.5	-168			-18.2			
MZ										-8.64						
Pakistan																
	G+,C+	G+,C-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-	T+,C+	T+,C-	T-,C+	T-,C-	C+,T+	C+,T-	C-,T+	C-,T-
DFG									-3.3		-2.93	-4.8				-4.61
PP									-21.8		-18.03	-41				-37.9
MZ									-2.99			-4.1				-3.93
Philippines																
	G+,C+	G+,C-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-	T+,C+	T+,C-	T-,C+	T-,C-	C+,T+	C+,T-	C-,T+	C-,T-
DFG																
PP																
MZ																
Singapore																
	G+,C+	G+,C-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-	T+,C+	T+,C-	T-,C+	T-,C-	C+,T+	C+,T-	C-,T+	C-,T-
DFG									-3.94		-3.89					
PP							-18.3		-29.6	-20.2	-29.53	-18				
MZ									-3.59		-3.59					
South Korea																
	G+,C+	G+,C-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-	T+,C+	T+,C-	T-,C+	T-,C-	C+,T+	C+,T-	C-,T+	C-,T-
DFG										-3.2						
PP		-24						-23								
MZ												4.99				
Taiwan																
	G+,C+	G+,C-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-	T+,C+	T+,C-	T-,C+	T-,C-	C+,T+	C+,T-	C-,T+	C-,T-
DFG							-2.99	-3								
PP		-25		-20			-23.5	-23								
MZ																

Thailand								
	G+,C+	G+,C-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-
DFG								-2.9
PP							-17.6	-19
MZ								

Table 2D: Cointegration between Coal, GDP and Trade

Bangladesh																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG								-3	-3.66		-3.61					-3
PP		-18				-20	-20	-22	-17.8							-21.6
MZ																
China																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-5.1		-5	-3.23	-3.8	-5.4	-4.9							-3.52	-3.37
PP		-32		-42	-21.8	-29	-47.3	-41							-24	-22.2
MZ		-3.4		-3.9	-3.22	-3.7	-4.35	-4.1							-3.11	-3.07
India																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3.3			-4.03	-3.5		-3.49		-3.8			-3.86	-3.12
PP				-29			-37.6	-31				-20			-35.4	-26.7
MZ							-3								-2.96	
Indonesia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG							-3.07	-3.2				-3.1	-3.09		-3.2	-3.56
PP								-18				-23	-18.1		-17.8	-23.5
MZ																
Japan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-4.5			-3.74	-3.5							-3.41	-3.39		
PP		-30			-30.2	-26			-113	-76.1	-141.6	-35	-25.1	-25		
MZ		-3.4			-3.28	-3.2			-7.07	-5.5	-8.01	-3.2	-3.08	-3.11		
New Zealand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3.6				-4							-3.04			
PP		-22				-32			-85.9	-37004			-20.9	-19.7		
MZ						-3.3			-5.97	-136						
Pakistan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG						-3.2			-2.98			-4.4				-3.15
PP		-94		-23		-18			-44.6		-35.7	-36				-20.2
MZ		-6.2							-3.44			-3.6				
Philippines																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG	-2.92		-3.17	-4.9		-3.3						-3.6			-3.58	
PP	-18.2		-21	-29		-18	-52.1	-433				-26			-26.5	-29.1
MZ			-3.01	-3.6			-4.63	-15							-2.93	-3.13
South Korea																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP							-32.9	-26	-636	-24.9	-63.25	-27			-27.1	-30.9
MZ									-17.6		-5.04					
Taiwan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,C+							
DFG																
PP		-20		-31												
MZ				-3.1												
Thailand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP							-37.8	-40							-33	-31
MZ																

Table 3D: Cointegration between ELEP, GDP and Trade

Bangladesh																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG									-3.03		-4.06	-3.1				
PP							-23.4	-29	-19.7		-30.17				-21.6	-25.5
MZ											-3.35					
China																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG							-3.17	-3								-3.07

PP		-41					-24.6	-23								
MZ		-3.9														
China HKSAR																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG							-2.94									-2.94
PP		-22		-29	-19.2		-18.2									-18.1
MZ																
India																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG							-2.92	-3.3		-3.37						
PP		-18					-22.4	-27		-28.5					-21.6	
MZ																
Indonesia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG	-2.93						-6.14	-6.1								-6.21
PP	-18.4						-37.6	-38	-19.2	-19.9		-19			-20	-38
MZ							-3.06	-3.1								-3.06
Japan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP									-128	-66.2						
MZ									-7.66	-5.11						
Malaysia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3														
PP	-21.7	-20		-18					-17.7							
MZ																
New Zealand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3.4	-2.99				-3.19	-2.9								
PP		-24	-17.9				-22.4	-20	-328	-97.4	-176.6					-20.2
MZ		-3							-12.5	-6.37	-8.95					
Pakistan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3.1					-3.24	-3.3	-4.5		-4.48				-3.52	-3.78
PP		-22		-20			-22	-23	-27	-17.8	-26.87	-18			-24.6	-26.3
MZ																-3.01
Philippines																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG			-3.6	-3.6			-4.31	-4.9								
PP			-24.6	-25			-34	-41								
MZ			-3.3	-3.2			-3.11	-3.4								
South Korea																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG									-3.21							
PP								-20	-299	-95.2	-8472	-58				
MZ									-11.9	-6.29	-65	-4.5				
Thailand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG								-3.4		-4.61		-4.5				
PP								-20		-36.7		-37				
MZ										-3.3		-3.3				

Table 4D: Cointegration between ELEP-Coal, GDP and Trade

China																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3.5	-3.29	-3.9							-3.22	-3.28		
PP		-57	-50.7	-137	-21.2	-28	-105	-105					-18.4	-19.7	-19.6	-26.6
MZ		-4.9	-4.86	-7.9	-3.1	-3.6	-6.72	-6.8						-2.99		-3.32
China HKSAR																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG			-3.53				-3.93					-3.1			-3.09	-2.98
PP		-30	-25.4	-41			-18.6	-18		-20		-25				-17.9
MZ		-3.1		-3.7												
India																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG								-3.3	-3.13	-3.43		-3.3				
PP		-18					-26.8	-35	-19.9	-29.9		-28			-26.8	-28.5
MZ																

Indonesia									T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DF G									-3.58							
PP									-26.9		-21.11	-19			-22.5	
MZ																
Japan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DF G						-3.2									-2.93	
PP		-19				-20			-79.2	-55.4	-135.9	-62			-17.4	
MZ						-3			-5.82	-4.55	-7.79	-4.9				
New Zealand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DF G		-2.9		-3.1	-3.48	-3.8		-3.7						-3.35		
PP		-19		-20	-30.4	-35	-17.6	-33			-168.7	-30	-33	-30	-17.8	-18.3
MZ						-2.9					-8.73		-3			
Pakistan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DF G				-3.5					-4.67		-4.39	-3				
PP		-25		-26			-23.8	-23	-29.2	-17.9	-26.44	-19	-18.4			
MZ																
Philippines																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DF G	-3.2		-3.85	-3.4												-4.57
PP	-18.7	-17	-27.9	-22			-58	-37							-26.2	-22.6
MZ			-3.55	-3.2			-4.53	-3.2								
South Korea																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DF G							-3.91	-3.8							-3.38	-3.57
PP				-21			-29.8	-28	-3935	-106	-2082	-47			-23.5	-25
MZ							-3.08	-3	-44.2	-6.63	-32.11	-3.9				
Thailand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DF G		-3.5						-5.5		-4.49		-4.7				-5.28
PP		-23					-18.5	-51		-36.7		-38			-19.3	-47.9
MZ		-3.2						-3.9		-3.23		-3.4				-3.83
M Z		-4.9	-4.86	-7.9	-3.1	-3.6	-6.72	-6.8								

Table 5D: Cointegration between ELEP-HYD, GDP and Trade

Bangladesh																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG					-3.1	-3.2										
PP					-22	-25	-23.2	-18								
MZ																
China																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3.3		-3.8				-3.6				-3.8				
PP		-211		-248			-47.5	-36				-28			-34.2	-31.7
MZ		-10		-11			-3.75									
India																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3.6	-2.97	-3	-3.72	-4.2		-3.33		-3.5	-3.01		-3.56	-2.93
PP				-32	-17.5	-19	-30.7	-36		-28.2		-29	-18.4	-17.8	-27.8	-20.8
MZ								-3								
Indonesia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3.2												
PP				-21				-25		-18.9		-18	-21.9		-22	
MZ																
Japan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG					-4.37	-4.5							-4.52	-4.52		
PP					-48.5	-49	-60.2	-23	-50.4	-29	-59.76	-62	-50.1	-49.5	-27.4	-23.1
MZ					-2.98	-3	-3.69		-4.52		-4.94	-4.9	-3.05	-3.04		

Malaysia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3.3						-3.88		-3.4				
PP				-23			-17.4			-30.2		-25			-17.7	
MZ										-3.19						
New Zealand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3.2		-3.5									-3.93	-3.61		
PP	-18.4	-22		-26				-21	-21.6	-652	-22.51	-3959	-35.7	-32.9		
MZ				-3.1						-17.8		-44				
Pakistan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3.2					-3.97		-4.49	-2.9				
PP		-56		-23					-25.2		-26.85	-19			-18	
MZ		-4.4														
Philippines																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP																
MZ																
South Korea																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP	-51.8				-40.3				-8274	-34.6	-7409	-40	-20.7			
MZ	-4.6								-64.2	-2.93	-60.78	-3.4				
Thailand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG						-3.1				-4.52		-4.7		-3.16		
PP					-21.8	-23	-20.1	-31		-39.2		-38	-18	-26.7	-20.2	-28
MZ										-3.16		-3.4				

Table 6D: Cointegration between ELEP-NG, GDP and Trade

Bangladesh																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG	-3.26			-3.3					-3.34		-3.31	-5.9				
PP							-34.7	-33	-22.5		-19.67	-43			-96.5	-59.3
MZ									-2.93			-3.9			-6.1	-4.36
China																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG	-4.14	-3.5		-3.9			-4.65								-2.99	-2.93
PP	-31	-22		-28			-39.6								-21.7	-21.6
MZ	-3.83	-3		-3.4			-2.94									
India																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG										-3.38		-3.4				
PP							-26.4	-95		-28.2		-28			-28.9	-34.7
MZ								-6.1								-2.99
Indonesia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG							-3.02	-3					-2.97		-3.42	-3.06
PP									-23		-20.18		-24.7		-17.6	
MZ																
Japan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP							-19.6	-21	-119	-64	-71.66	-65			-21.7	-20.8
MZ									-7.38	-4.99	-5.5	-5				
Malaysia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3					-3.42	-3.4							-3.39	-3.37
PP		-18					-26.2	-26		-6218					-25.9	-25.6
MZ										-55.7						
New Zealand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3.1		-3.2			-5.2	-5.6							-5.04	-4.8
PP		-20		-20			-32.6	-38	-1287	-105	-53.18	-686			-40.1	-38.2
MZ							-3.36	-3.7	-25.2	-6.66	-4.42	-18			-3.28	-3.18
Pakistan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3					-4.7		-4.49			-3.05		
PP		-19		-21					-28.3	-17.8	-26.76	-19		-20.8	-19.6	

MZ																
South Korea																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG															-8.41	-11.6
PP										-902					-21.5	
MZ										-21	3.04					
Thailand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG			-3.73							-4.31	-3.37	-5				
PP			-28.2				-29			-33.9	-23.65	-43			-278	-23.2
MZ			-3.32							-3.11		-3.7			-11.3	

Table 7D: Cointegration between ELEP-NU, GDP and Trade

India																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3.6	-3.78	-2.9				-3.38		-3.4	-3.5		-3.9	
PP				-29	-30.4	-20	-29.1	-30		-28.8		-29	-24.7		-38.7	-22.1
MZ																
Japan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG							-4.31	-3.9							-3.67	-3.78
PP							-40.3	-33	-268	-83.5	-162.5	-109			-31.6	-31.8
MZ							-2.99		-11.3	-5.85	-8.67	-6.9				
Pakistan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3.2		-3.3	-3.49	-3.5			-4.49		-4.48		-3.05			
PP		-23		-24	-26.5	-27		-20	-25.7		-26.88	-18	-21	-18.2		
MZ					-2.98	-3										
South Korea																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG							-15.3	-15								-13.9
PP		-21					-21.6	-21	-46.8	-111	-6286	-222			-26.5	-21.4
MZ									-4.02	-74.4	-55.96	-10				

Table 8D: Cointegration between ELEP-Oil, GDP and Trade

Bangladesh																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E	E+,T+	E+,T-	E-,T+	E-,T-
DFG									-3.28	-3.05	-3.28					
PP									-22.2		-22.3					
MZ																
China																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E	E+,T+	E+,T-	E-,T+	E-,T-
DFG	-2.93	-3.7			-2.93											
PP		-441		-136	-19.3									-18		
MZ		-15		-7.9												
China HKSAR																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP		-18		-19								-28	-19.2	-18.8		
MZ																
India																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E	E+,T+	E+,T-	E-,T+	E-,T-
DFG										-3.31		-3.3				
PP							-28	-19		-27.2		-26			-23.8	-17.7
MZ																
Indonesia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E	E+,T+	E+,T-	E-,T+	E-,T-
DFG								-3								
PP							-19.7	-20		-18.8		-20				
MZ																
Japan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP									-83.4	-58.7	-39.6	-46				
MZ									-6.01	-4.72	-3.81	-4.1				
Malaysia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E	E+,T+	E+,T-	E-,T+	E-,T-
DFG										-4.98				-3.59		
PP		-18		-20						-44.9			-22.7	-27.4		
MZ										-3.72						
New Zealand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E	E+,T+	E+,T-	E-,T+	E-,T-

DFG																
PP																
MZ																
Pakistan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3.3		-3.9					-4.53	-3.01	-4.15	-2.9				
PP		-24		-34					-26.8	-19.1	-25.8	-19				
MZ																
Philippines																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E	E+,T+	E+,T-	E-,T+	E-,T-
DFG			-3.18									-4				
PP			-19.3		-19	-19						-33	-19.2	-18.4		
MZ			-2.96									-3.3				
Singapore																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E	E+,T+	E+,T-	E-,T+	E-,T-
DFG	-3.21		-3.24		-3.12	-3	-3.6	-3.7	-3.41	-3.32	-3.3	-3.2				
PP	-22	-27	-25.6	-26	-19	-18	-27.7	-29	-26.2	-25.9	-26.3	-25				
MZ	-3.07	-3	-3.2		-2.97		-3.68	-3.7	-3.23		-3.18					
South Korea																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E	E+,T+	E+,T-	E-,T+	E-,T-
DFG					-3.13									-3.13		
PP					-20.3				-566	-148	-2532	-76	-17.9	-19.8		
MZ									-16.5	-7.96	-35.4	-5.4				
Thailand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E	E+,T+	E+,T-	E-,T+	E-,T-
DFG					-3.34					-4.86		-4.6	-3.05			
PP					-23.6					-40.2		-36	-19.4			
MZ										-3.47		-3.3				

Table 9D: Cointegration between ELEP-Rene, GDP and Trade

Bangladesh																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG					-3.1	-3.2			-3.4	-3.04	-3.26		-3.05	-3.35		
PP					-22	-25	-23.2	-18	-22.6		-21.68		-22.3	-28		-17.8
MZ																
China																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3.5								-3.4				
PP		-182		-199			-44.9	-36				-23			-33.1	-30.5
MZ		-9.2		-9.7			-3.61									
India																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3.2			-3.72	-4.3		-3.32		-3.5			-3.62	-3.38
PP				-28			-30.9	-37		-28.1		-30			-29.2	-26.4
MZ								-3								
Indonesia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP				-20			-20.9	-30		-18.9		-18			-30.4	-20.1
MZ																
Japan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG					-4.31	-4.7							-4.3	-4.56		
PP					-46.7	-50	-37	-29	-34	-31	-77.16	-50	-47	-49.1	-30.1	-28.9
MZ					-3.02	-3.2			-3.6	-3.03	-5.75	-4.2	-3.03	-3.15		
Malaysia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3.3						-3.88		-3.4				
PP				-23			-17.4			-30.2		-25			-17.7	
MZ										-3.19						
New Zealand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3		-3.5				-2.9					-4.15	-3.56		
PP	-18.1	-19		-25				-22		-26.1		-1416	-37.6	-32.7		
MZ				-3.1								-26				
Pakistan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3.2					-3.97		-4.49	-2.9				
PP		-56		-23					-25.2		-26.85	-19			-18	
MZ		-4.4														
Philippines																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-

DFG	-3.24						-3.99	-4.3				-3.1			-3.53	-3.68
PP	-20.1						-33.3	-38				-22			-29.4	-31.3
MZ	-3.02															
South Korea																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG	-3.71															
PP	-29.9				-37.9				-4644	-37.8	-2923	-34	-26.3	-17.6		
MZ	-3.11								-48.1	-3.21	-38.1					
Thailand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG										-4.47		-4.7		-2.93		
PP					-21	-21		-19		-38.9		-38	-20.5	-24.6		
MZ										-3.12		-3.4				

Table 10D: Cointegration between EPC, GDP and Trade

Bangladesh																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG					-3.45	-3.3			-3.38		-4.26		-3.38			
PP				-22	-19	-18	-42.6	-24			-21.86		-19.9	-18.2	-20.2	-104
MZ							-3.34									-6.56
China																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG							-3.19	-3.1								-3
PP		-84		-179			-25	-24							-17.5	
MZ		-6		-9.2												
China HKSAR																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP		-21					-23.4									
MZ																
India																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3.9			-3.14	-3.4		-3.4		-3.5			-3.15	-3.07
PP				-39			-22.2	-25		-28.6		-29			-22.2	-21.6
MZ																
Indonesia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG	-3.04						-6.49	-6.5		-2.94						-6.54
PP	-19.8						-60.4	-60	-18.9	-20.5		-19			-53.5	-61.1
MZ							-4.55	-4.6							-4.11	-4.58
Japan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG										-3.28		-4				-3.09
PP										-24.9		-33			-18.5	-20.1
MZ												-3.2				
Malaysia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP	-25.8			-18												
MZ																
New Zealand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP										-22.2						
MZ																
Pakistan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3.1		-3			-4.55	-4.7	-4.37		-4.24				-4.35	-4.34
PP		-22		-21			-40.9	-44	-26.4	-18	-26				-37.1	-36.6
MZ							-3.68	-3.9							-3.48	-3.47
Philippines																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG	-2.95		-3.73	-4.2								-2.9				
PP	-18.4		-25.1	-33				-23				-19				
MZ			-3.28	-3.5												
Singapore																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG	-3.99								-3.35	-3.32	-3.57	-3.5				
PP	-31.8	-43			-39.3		-24.6	-20	-24.9	-26.4	-25.29	-28				
MZ	-3.62	-3.9			-4.35				-3.13		-3.18					
South Korea																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-

DFG		-3.1														
PP		-20								-32.2		-22		-17.9		
MZ										-2.94						
Thailand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG								-3.9		-4.68		-4.5				
PP				-22				-22		-37.1		-37				
MZ										-3.34		-3.3				

Table 11D: Cointegration between EU, GDP and Trade

Bangladesh																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3.3			-3.12				-3.88		-3.7					
PP		-24			-17.6		-29.6		-20.8							
MZ																
China																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG							-2.93	-3							-3.24	-2.99
PP		-118		-117			-18.4	-18							-21.2	-18.1
MZ		-7.3		-7.3												
China HKSAR																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG					-4.05	-3.6							-4.02	-3.97		
PP		-17		-22	-32.6	-28	-42.2	-21					-32.4	-31.7		-19.3
MZ					-3.34	-3	-4.03						-3.35	-3.31		
India																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-4.3						-3.32		-3.4				
PP		-22		-41			-19.6	-23		-26.9		-29			-27.3	-19.6
MZ																
Indonesia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3.2				-5		-3.09	-3.82	-3				
PP				-19			-25	-46		-23.2	-30.04	-22			-1203	-18.6
MZ								-3.5			-3.08				-24.3	
Japan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP									-365	-92.2	-154.4					
MZ									-13.3	-6.25	-8.44					
Malaysia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG					-3.61											
PP					-28	-17	-23.6	-41					-18.4		-22.8	-19.5
MZ					-2.93											
New Zealand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-4.2		-3.1											-3.39	
PP		-29					-17.8	-19	-2367	-173	-4646	-308			-24.2	
MZ		-3							-344	-8.79	-48.08	-12				
Pakistan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3		-3.1		-3.1	-3.93	-4.1	-4.41		-4.53					-3.88
PP		-21		-21	-19.4	-20	-38.9	-40	-26.7	-17.6	-27.3	-18			-55	-36.2
MZ							-3.41	-3.5							-4.52	-3.33
Philippines																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG	-3.14									-3.18						
PP	-17.8									-21.1				-18.7	-18.4	-19.6
MZ																
Singapore																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG							-3.12	-3.9	-3.73	-3.76	-3.36	-3.4				
PP			-20.8	-25		-18	-19.8	-29	-31.4	-31.2	-26.87	-27	-17.6	-17.6		
MZ								-3.1	-3.53		-3.23					
South Korea																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG								-3.9								
PP				-22				-34	-642	-92.8	-2927	-50				
MZ								-3	-17.7	-6.06	-38.11	-4.1				
Thailand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-

DFG							-3.41	-3.4		-5.47		-4.8			-3.37	-3.31
PP							-24	-23	-18.9	-48.7		-39			-22.9	-22.4
MZ							-2.92			-3.85		-3.4				

Table 12D: Cointegration between NG, GDP and Trade

Bangladesh																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG							-4.98	-5	-4						-4.98	-5.55
PP		-23					-37	-36	-18.1						-34.8	-38.6
MZ																
China																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP		-18														
MZ																
India																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3.1							-3.74		-3.04	-3.5				
PP		-25		-24					-28				-17.7		-30.8	
MZ									-3.08							
Indonesia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG	-3.08						-3.64	-3.7							-3.52	-3.6
PP	-20.5						-38	-39		-18.3					-36.7	-37.6
MZ																
Japan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG							-4.77	-4								-4
PP							-42.7	-32	-202	-81.3	-23.85	-22			-20.6	-31.6
MZ							-3.73	-3.2	-9.74	-5.73						-3.23
Malaysia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG							-3.33	-3.3							-3.09	-3.26
PP		-18		-22			-26.1	-26	-41.4	-45.6	-63.24	-54			-23.5	-25.4
MZ									-3.92	-4.09	-5.02	-4.5				
New Zealand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3.2					-4.33	-4.2							-4.01	-3.37
PP		-21					-34.3	-33	-47.1	-680	-532.4	-585			-30	-22.7
MZ							-3.72	-3.6	-4.18	-18.2	-16	-17			-3.37	
Pakistan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG							-4.07	-3.7		-3.16	-3.05	-4		-3.24	-3.91	-4.01
PP		-110		-29			-32.8	-29	-33.8	-20.1	-36.58	-36		-22	-30.1	-33.1
MZ		-7					-3.25	-3				-3.2		-3.04	-3.13	-3.19
South Korea																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG															-8.99	-15.7
PP										-9302					-21.7	-18.3
MZ										-216						
Taiwan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-								
DFG																
PP		-22		-22												
MZ																

Table 13D: Cointegration between NU, GDP and Trade

India																
	G+,E+	G+,E-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG					-3.09	-3.9	-5.1	-5		-3.39		-3.5				
PP					-20.9	-30	-41.7	-41		-27.9		-28	-17.8		-28.6	-26.9
MZ						-3.2	-3.06	-3								
Japan																
	G+,E+	G+,E-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-4.7	-3.12	-3.9	-5.46	-4.8							-4.47	-4.58
PP				-39	-20.5	-30	-47.9	-40	-285	-83.5	-126.1	-132			-39.5	-40.2
MZ				-3.7	-3.13	-3.8	-4.42	-4.1	-11.7	-5.85	-7.51	-7.6				
Taiwan																
	G+,E+	G+,E-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-								
DFG						-3.7										
PP		-25		-29	-19.3		-27	-22								

MZ																
Thailand																
	G+,E+	G+,E-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-	T+,E+	T+,E-	T-,E+	T+,E-	E+,T+	E+,T-	T+,E-	E-,T-
DFG								-4.2		-4.75		-5.7			-5.86	-3.93
PP							-28.2	-41		-37	-23.35	-46			-22.7	
MZ								-3.1		-3.32		-3.7				

Table 14D: Cointegration between PEC, GDP and Trade

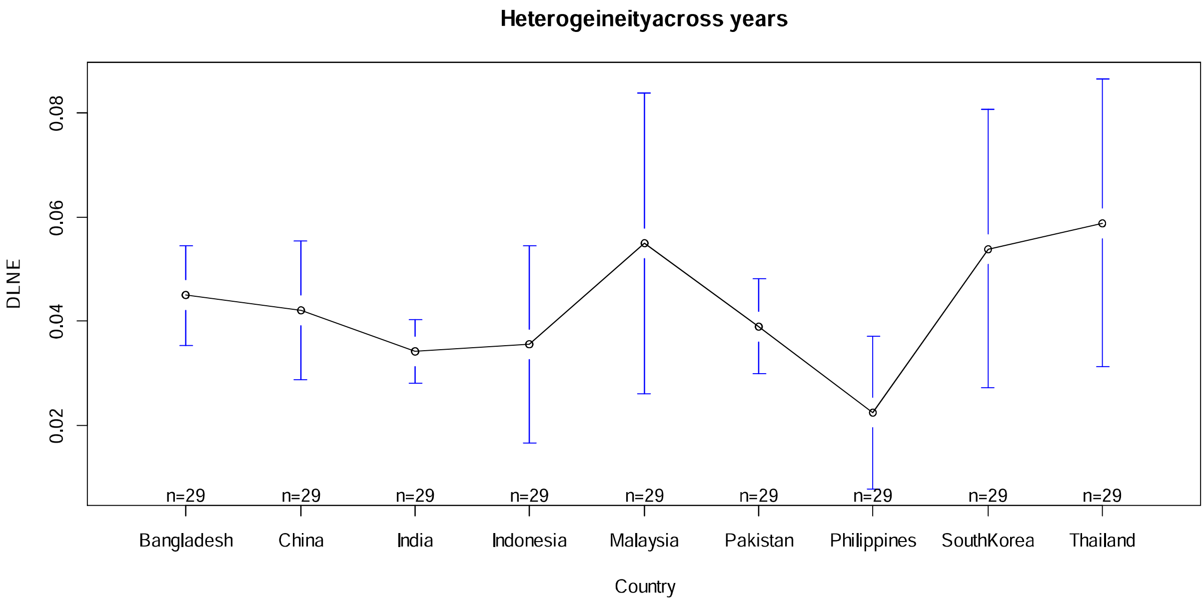
Bangladesh																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-2.9		-3.6	-5.3	-5	-3.87	-3.01	-3.85			-3.1	-5.32	-5.55
PP		-23		-18		-24	-40.1	-39		-19.5				-21.4	-39.8	-41.2
MZ																-2.92
China																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-5.7		-4.7	-2.95	-3.7	-5.28	-4.6							-3.59	-3.5
PP		-40		-39	-18.7	-28	-45.4	-37							-25.5	-24.4
MZ		-3.8		-3.7	-2.99	-3.6	-4.28	-3.9							-3.26	-3.23
China HKSAR																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG							-3.03									
PP		-37		-24			-27.4	-27							-20.2	-22.6
MZ																
India																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP				-19			-37.2	-37				-29			-41.5	-44.1
MZ															-3.05	-3.28
Indonesia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG	-3.24						-3.65	-3.8								-3.97
PP	-22.1						-38.8	-40							-37.9	-42.9
MZ																
Japan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP									-286	-87.6	-32.0					
MZ									-11.7	-6.07	-3.36					
Malaysia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG								-4.2								
PP		-18						-37	-35.7	-44.8						
MZ								-3	-3.67	-4.01		3.78				
New Zealand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3.5														
PP		-20					-20.1	-25	-78.7	-54.7	-1481	-280			-22.3	-19.5
MZ									-5.63	-4.45	-27.0	-11				
Pakistan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG								-4.6				-4.2				
PP		-23		-25			-20.8	-42	-38.8		-33.7	-37			-20.8	-33.9
MZ								-3.6	-3.03			-3.2				-3.35
Philippines																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG										-3.1		-3.3				
PP										-19.7		-22				
MZ																
Singapore																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG									-3.68	-3.38	-3.56	-3.3				
PP							-18.5		-27.2	-27.7	-26.2	-27			-19.8	-20.4
MZ									-3.31		-3.25					
South Korea																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG								-3.3								
PP		-21						-25	-779	-44.3	-502.	-25				
MZ									-19.6	-3.76	-15.6					
Taiwan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-								
DFG							-3.22	-3.2								
PP		-27		-18			-27.8	-27								

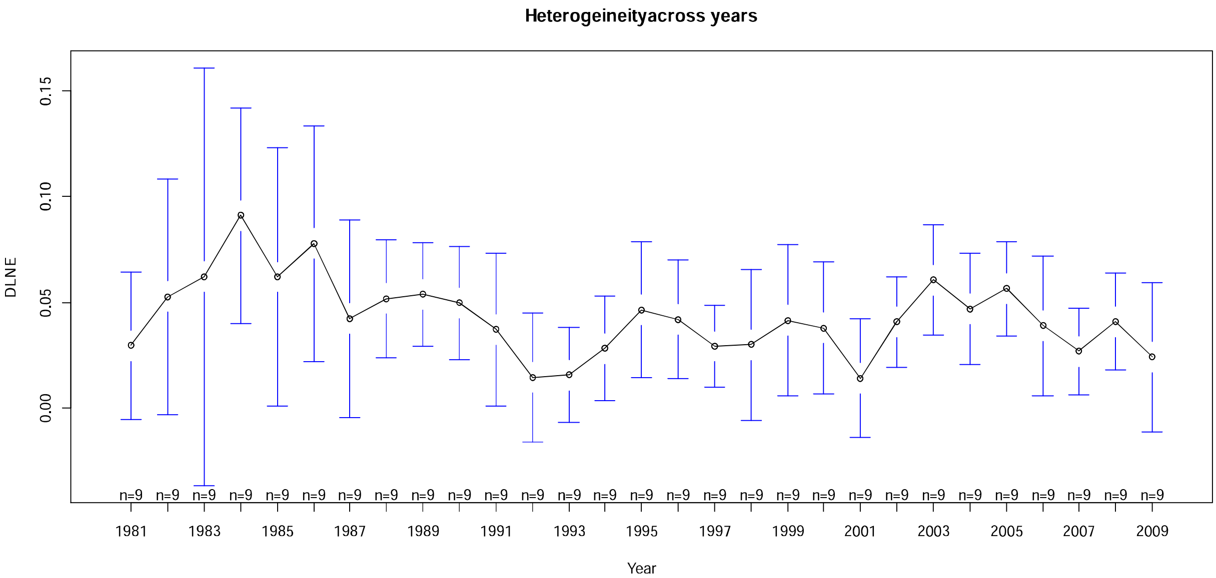
MZ																
Thailand																
	G+,E+	G+,E-	G+,E+	G+,E+	E+,G+	E+,G-	E-,G+	G+,E+	T+,E+	T+,E-	T-,E+	T-,E+	E+,T+	E+,T-	T-,E+	E-,T-
DFG																
PP				-27								-23				
MZ				-3												

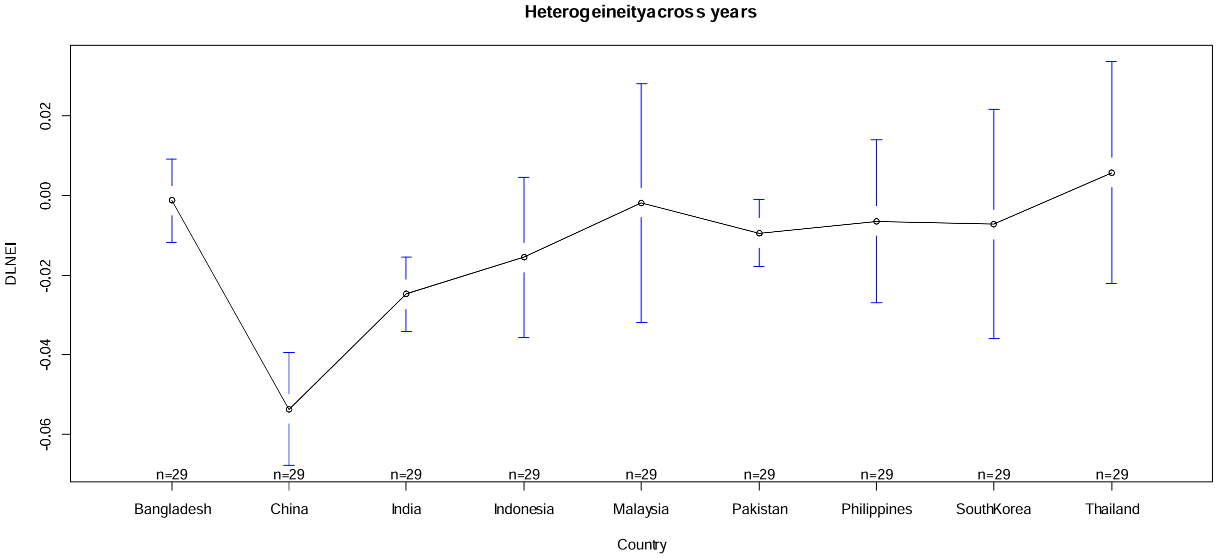
Table 15D: Cointegration between HYD, GDP and Trade

Bangladesh																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3.5		-3.7	-3.38				-3.5		-3.98		-3.25	-3.25		
PP					-24.7	-21	-19.8						-23.8	-23.1		
MZ																
China																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-5.2								-3.1				
PP				-42			-114	-54				-20			-29.8	-26.7
MZ				-3.9			-6.57	-3.7								
India																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG										-3.85		-3.8		-3.66		
PP					-22.4	-32	-23.6	-23		-20.7		-20	-18.7	-26.2	-19	-41.8
MZ					-3.12	-3.7								-3.32		-3.96
Indonesia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG													-4.61			
PP					-25.9	-23			-19.5			-18	-45.4	-22.7		
MZ													-3.43			
Japan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG							-3.85	-3.4					-4.26		-3.92	-3.36
PP					-44.4	-53	-38.5	-34	-111	-63.6	-77.52	-78	-48.9	-44.4	-39.7	-34
MZ						-3.2			-7	-4.9	-5.68	-5.6				
Malaysia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3.7									-3.41	-3.38		
PP				-29		-17		-25	-78.8	-35.6	-81.05	-54	-22.8	-22.8		
MZ				-3.1					-5.78	-3.33	-5.84	-4.5	-3.11	-3.08		
New Zealand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3		-4	-3.73	-3.7		-3.2					-3.92	-3.51		
PP	-17.5			-27	-34.9	-34		-25		-993	-19.66	-9838.2	-34	-30.3		
MZ				-2.9						-22.1		-70				
Pakistan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3.6		-3.6					-4.36	-3.09						
PP		-28		-28					-35	-19.9	-44.33			-23.1		
MZ											-3.47					
Philippines																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG										-3.08						
PP							-170	-139		-19.3		-18			-426	-92.6
MZ							-8.17	-7.2							-14	-5.34
South Korea																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG					-4.83											
PP				-21	-45.6	-29			-514	-25.7	-123.6	-22	-41.4	-32		
MZ					-3.39				-15.8		-7.31		-3			
Taiwan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-								
DFG					-4.15	-4.8	-3.32	-3.2								
PP		-20		-22	-42.8	-52	-31.8	-29								
MZ						-3.1										
Thailand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG						-3.1										
PP					-19.8	-25	-26.8	-29		-18.7			-19.7	-23	-27	-27.3
MZ																

Appendix E: Plots of the variables for second objective



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Thailand
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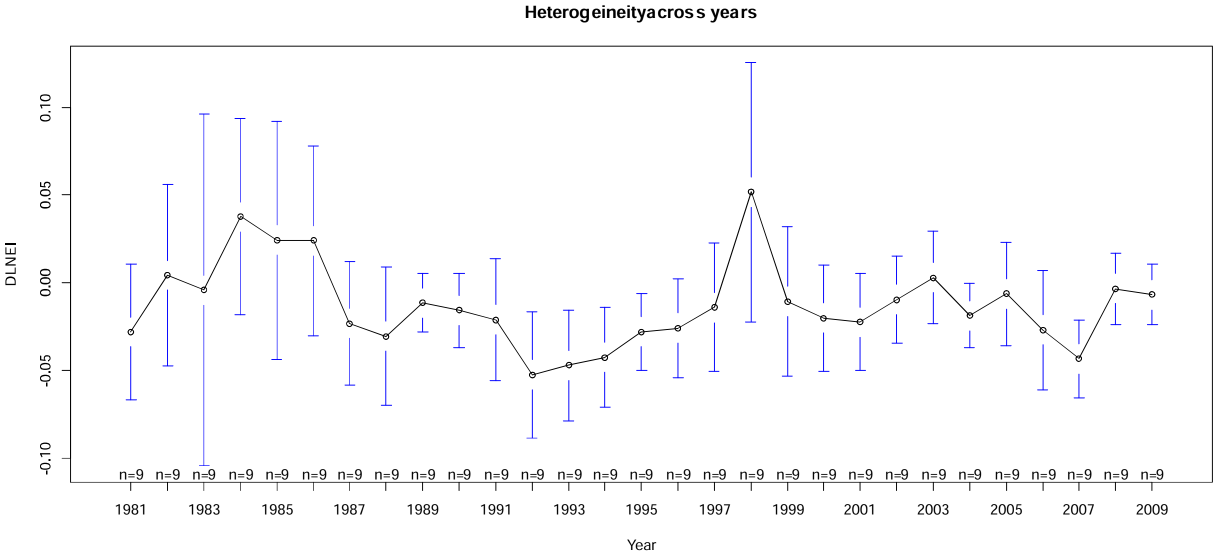
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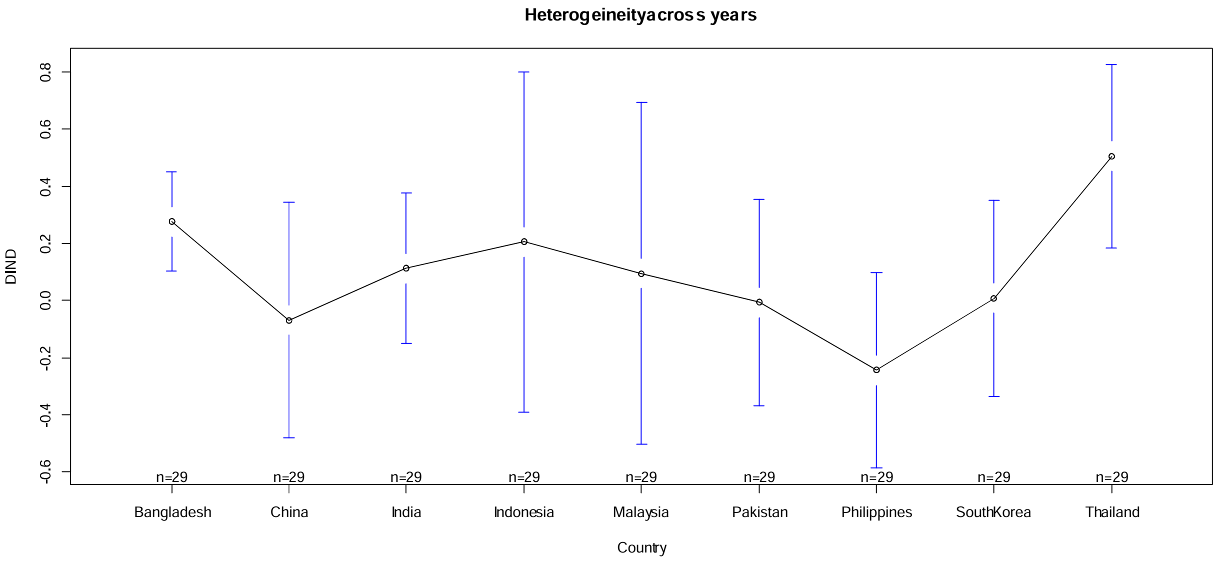
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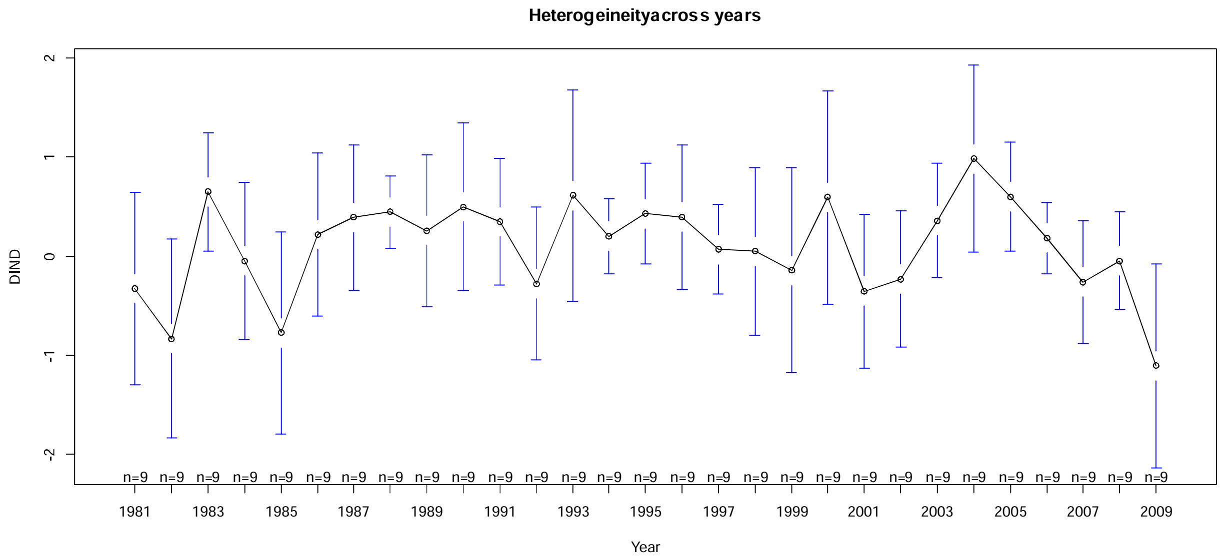
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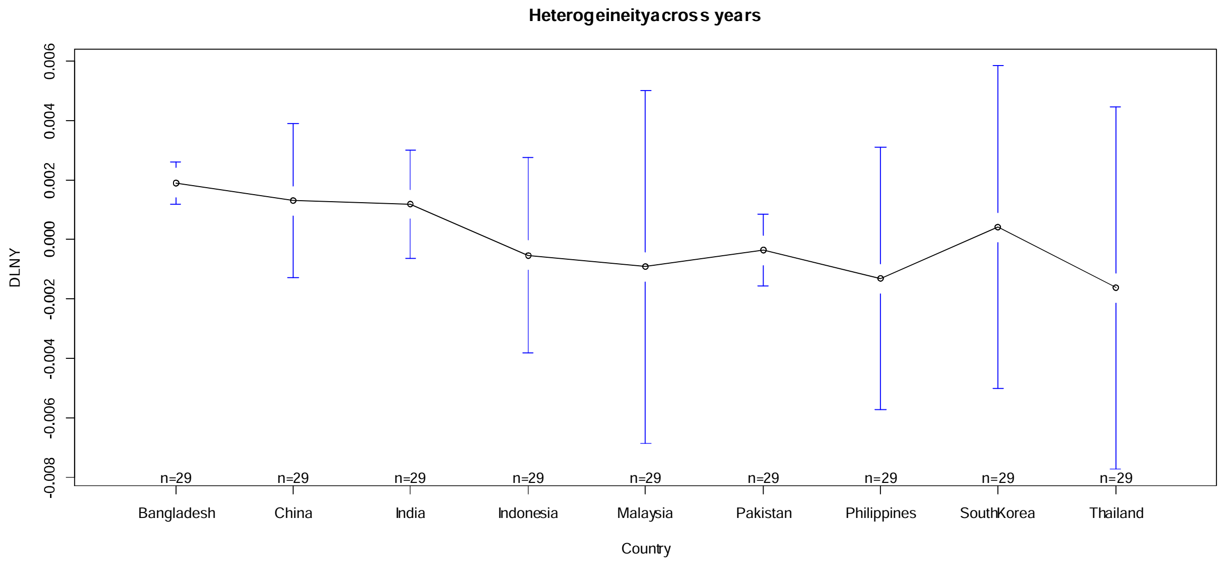
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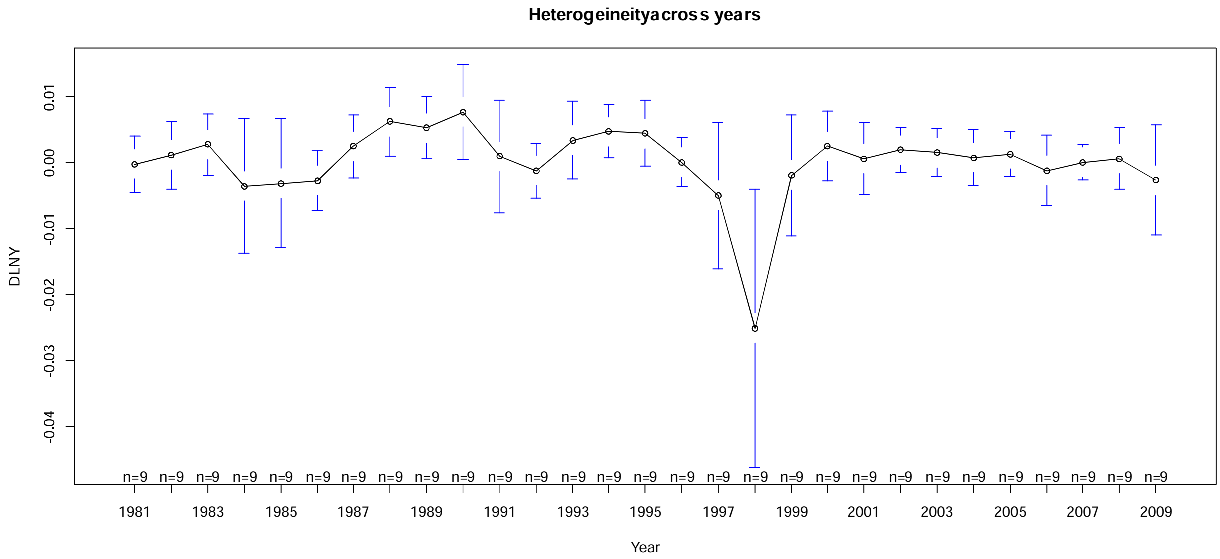
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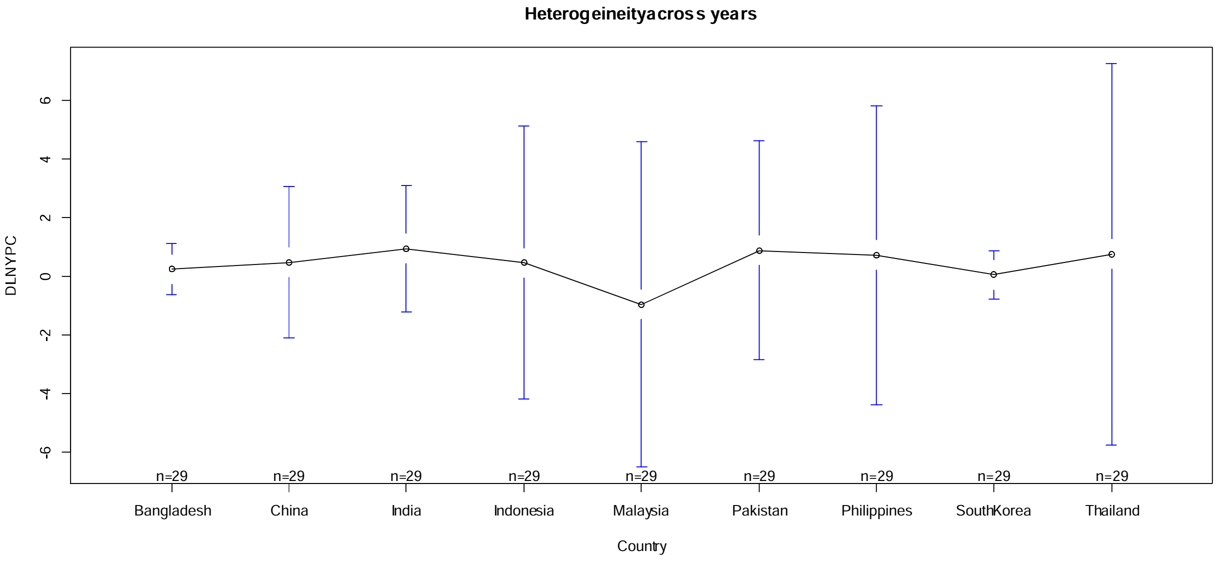
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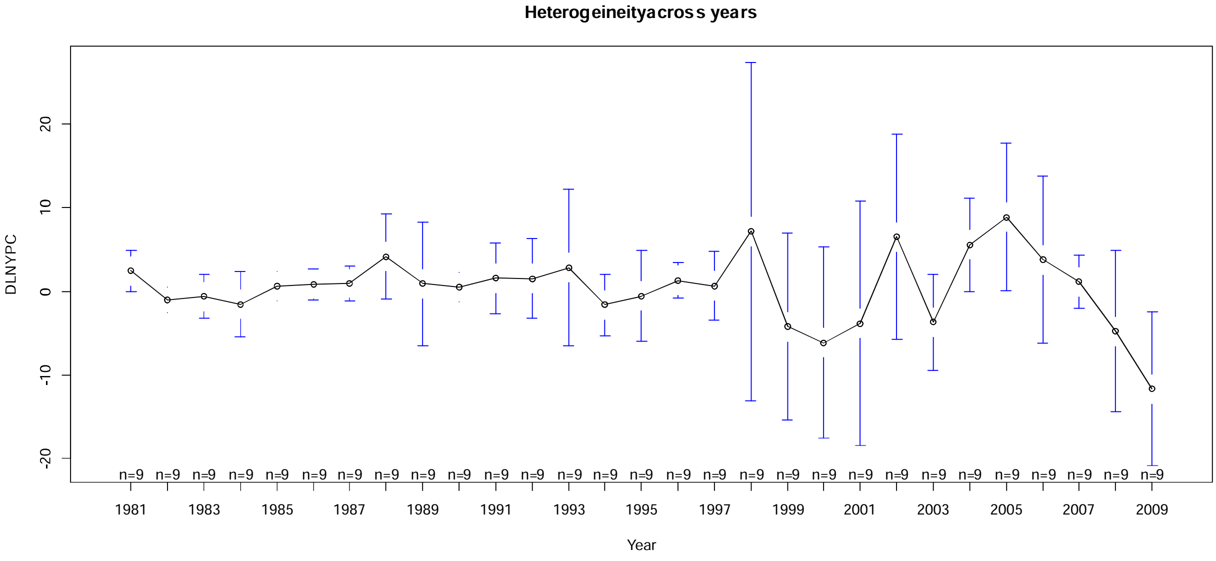
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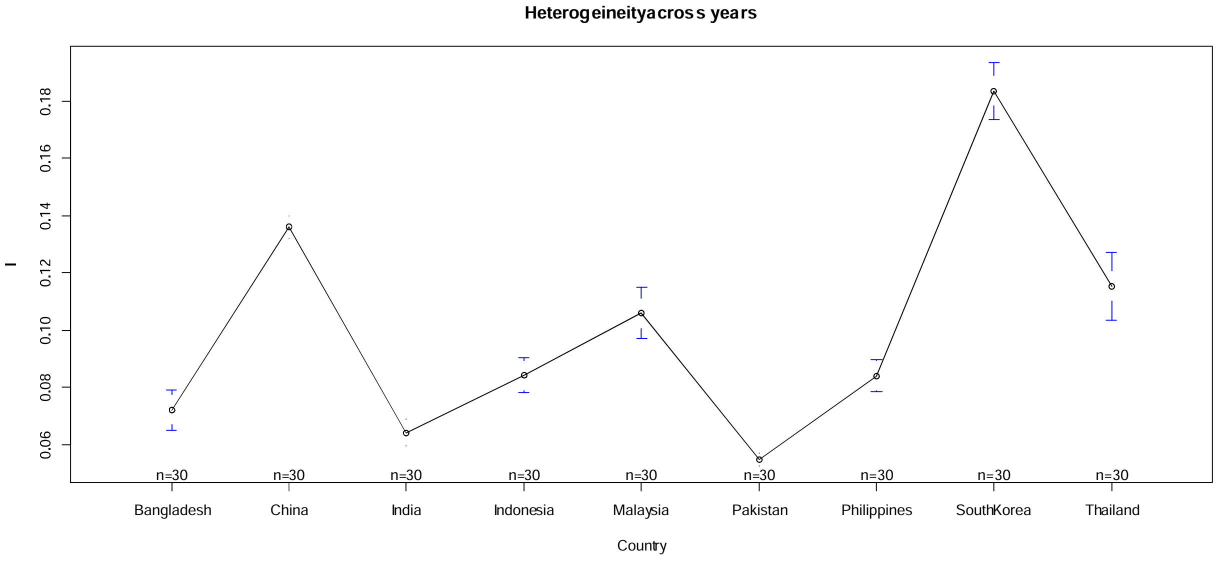
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SouthKorea
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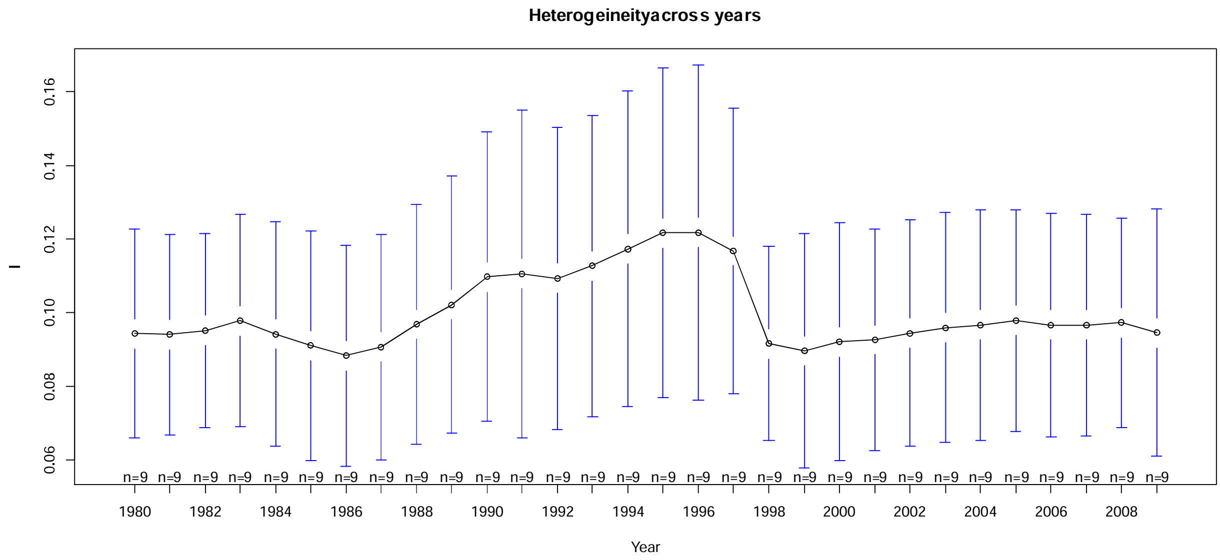
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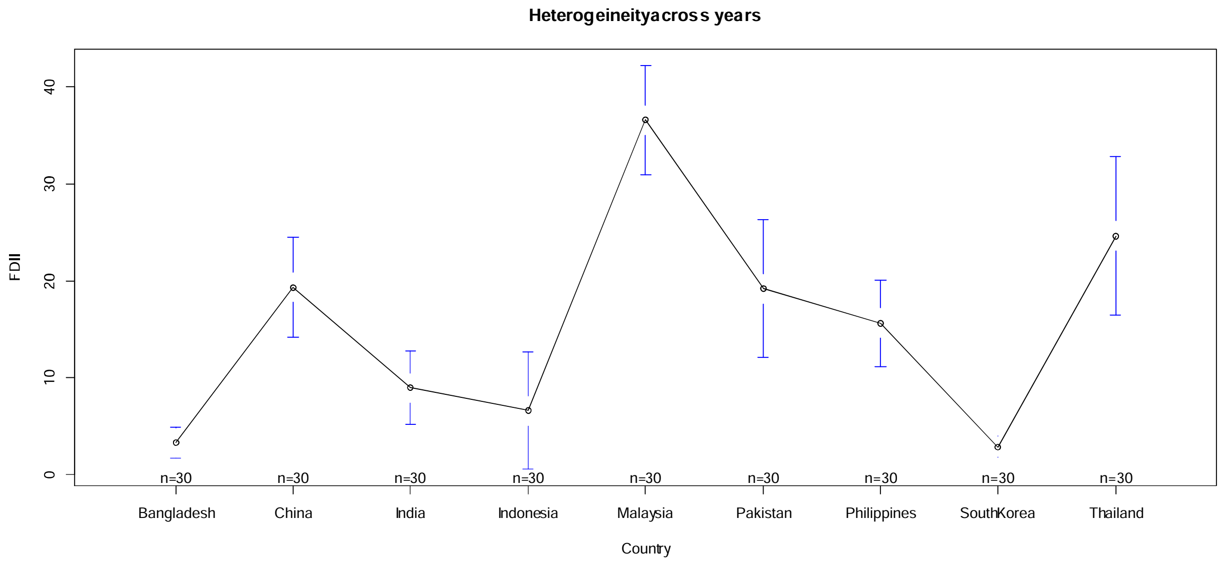
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
Year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20
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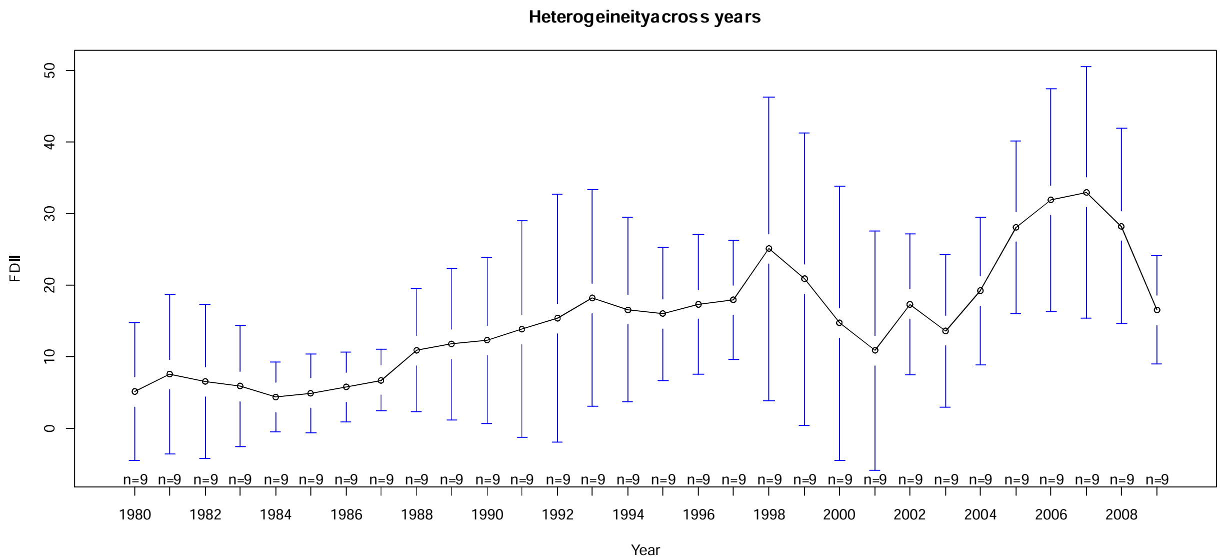
China
India
Indonesia
Malaysia
Pakistan
Philippines
SouthKorea
Thailand
Country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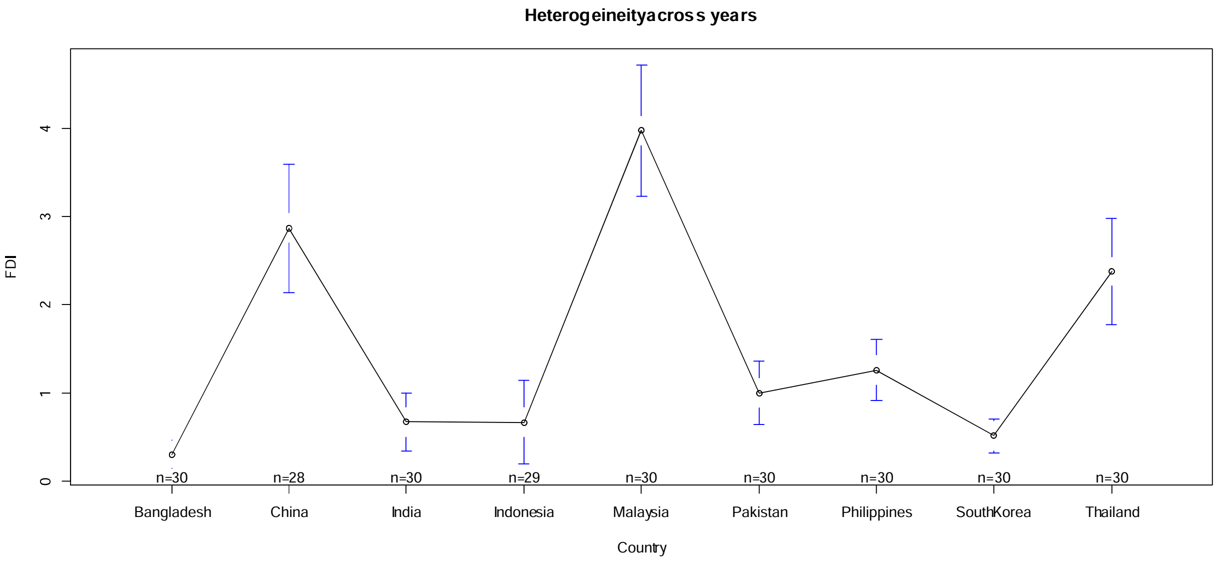
2004
2006
2008
Year



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Philippines
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Thailand
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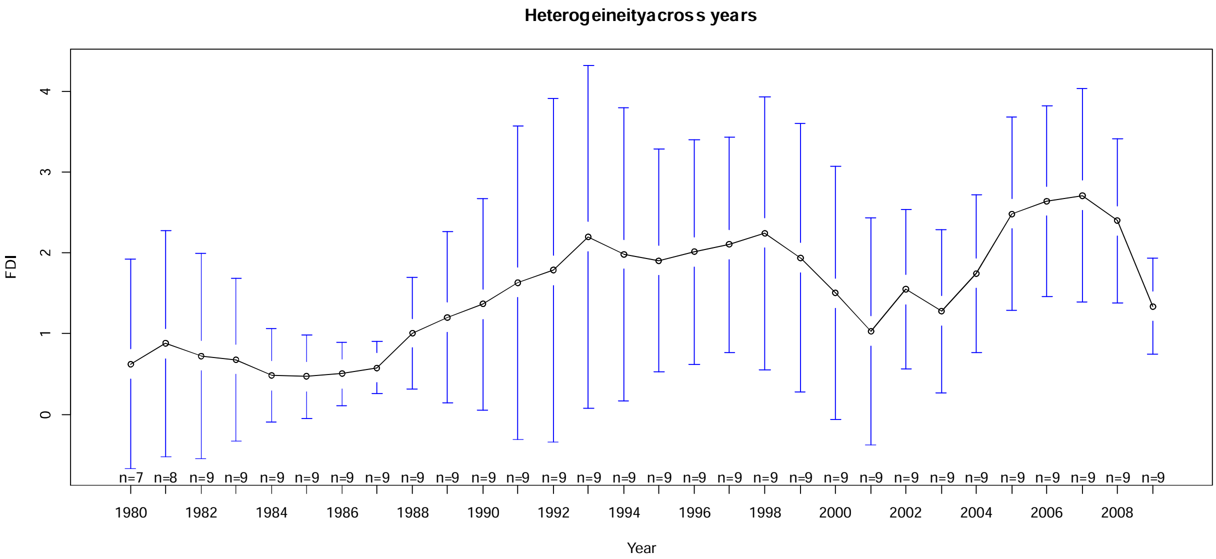

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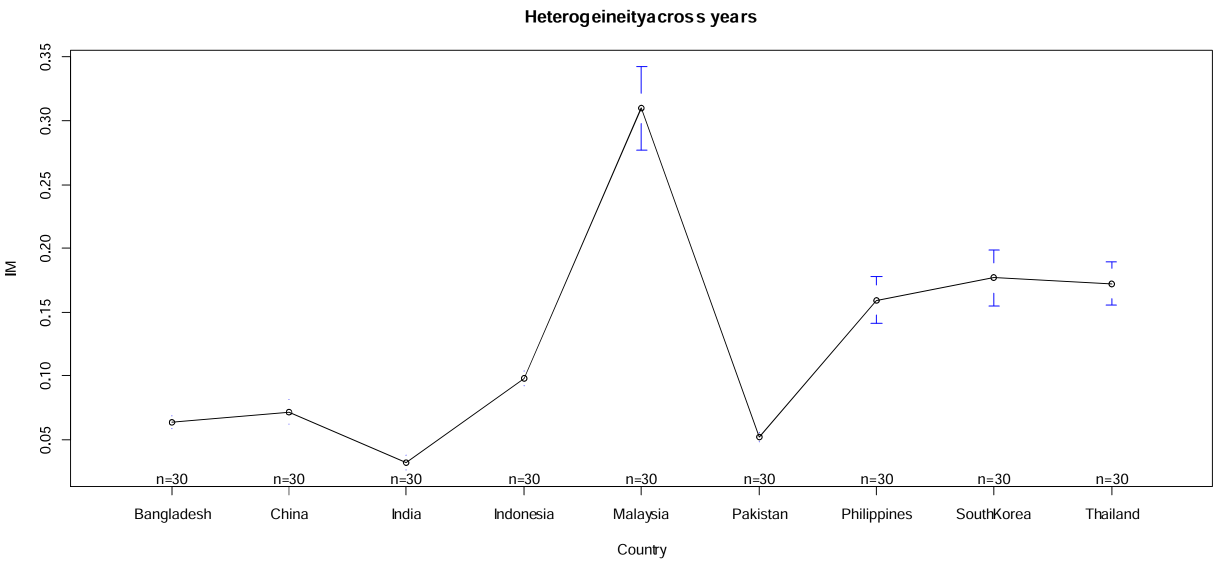
Year



Heterogeineityacross years
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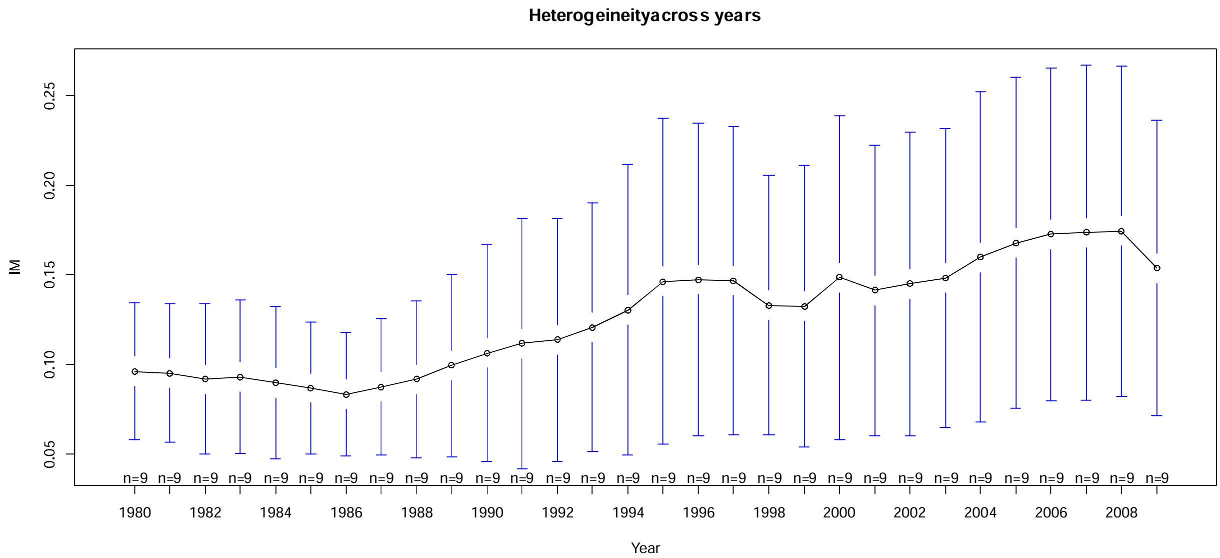
n=30
n=30
n=30
n=30
n=30
n=30
n=30
n=30
Bangladesh
China
India
Indonesia
Malaysia
Pakistan
Philippines
SouthKorea
Thailand
Country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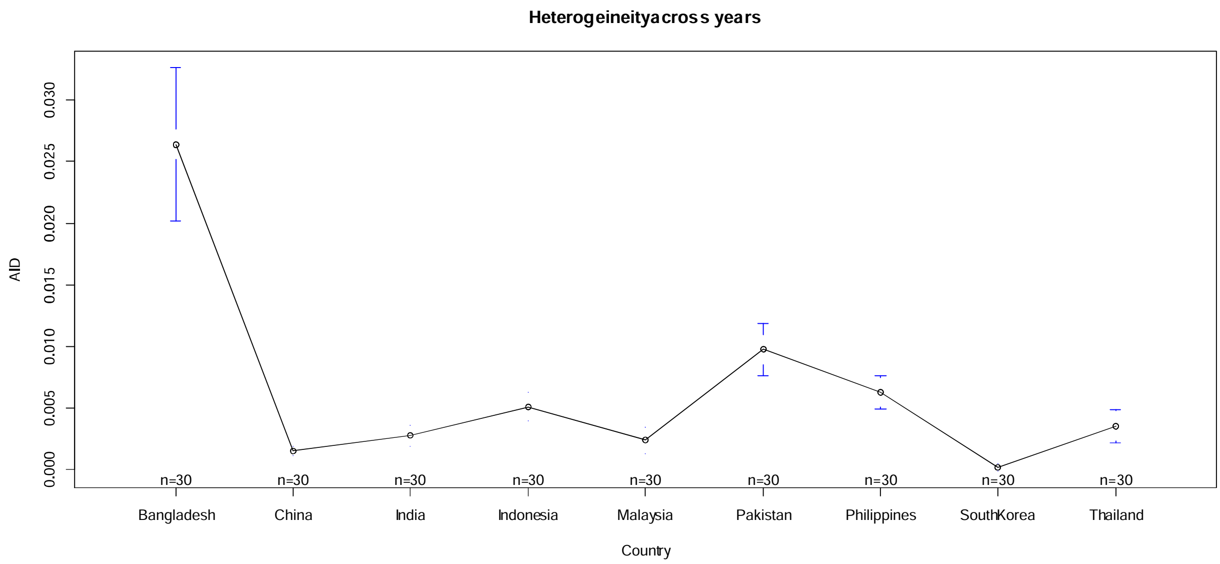
2004
2006
2008
Year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0.015
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India
Indonesia
Malaysia
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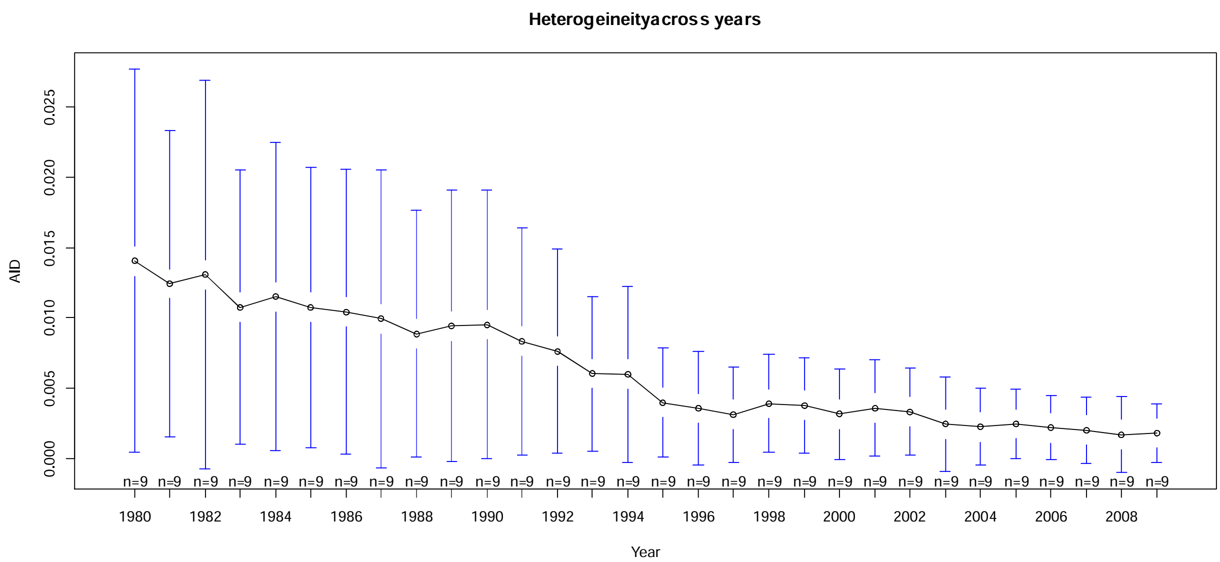
Philippines
SouthKorea
Thailand
Country


Heterogeineityacross years
AID
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0.005
0.010
0.015
0.020
0.025
n=9
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
Year

Appendix F: Reesults of panel unit root analysis

Table 1F: Panel unit root test for CO2 emissions, GDP and Trade

Tests without structural breaks: Trend model								
	Sample 1		Sample 2		Sample 1		Sample 2	
	CO2 emissions	GDP	CO2 emissions	GDP	CO2 emissions	Trade	CO2 emissions	Trade
Test statistic	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)
1	2.003665 (0.977447)	2.6093984 (0.9954649)	3.2041745 (0.9993227)	3.4312450 (0.9996996)	2.2590664 (0.9880604)	0.7843857 (0.7835931)	2.8804958 (0.9980147)	3.4312450 (0.9996996)
2	1.9448058 (0.9741008)	2.5327453 (0.9943413)	3.057493 (0.998884)	3.2741687 (0.9994701)	2.3812651 (0.9913734)	0.8268151 (0.7958291)	2.7958790 (0.9974121)	3.2741687 (0.9994701)
3	-0.7883222 (0.2152541)	2.6006612 (0.9953478)	-1.87586380 (0.03033699)	1.0681781 (0.8572799)	-1.0938124 (0.1370186)	0.4644529 (0.6788384)	-1.1201210 (0.1313311)	1.0681781 (0.8572799)
4	1.1297862 (0.8707169)	0.83206268 (0.79731322)	0.98589204 (0.83790695)	0.64130919 (0.739339)	0.72502817 (0.76578262)	5.3846367 (0.99999996)	1.0933085 (0.86287081)	4.3138034 (0.99999198)
	Decision on H_0		Decision on H_0		Decision on H_0		Decision on H_0	
	1 % 5 % 10 %	1 % 5 % 10 %	1 % 5 % 10 %	1 % 5 % 10 %	1 % 5 % 10 %	1 % 5 % 10 %	1 % 5 % 10 %	1 % 5 % 10 %
5	T T T	T T T	T T T	T T T	T T T	T T T	T T T	T T T
6	T T T	T T T	T T T	T T T	T T T	T T T	T T T	T T T
7	F F F	T T T	F F F	T T T	F F F	F F F	F F F	T T T
Tests with structural breaks								
8.1	-7.930	-10.013	-9.827	-11.758	-6.195	-8.968	-8.655	-15.408
8.2	-21.085	-26.099	-22.529	-22.746	-13.566	-17.017	-20.208	-30.600
9.1	11.516418 (0.000000)	16.167050 (0.000000)	10.819794 (0.000000)	16.861547 (0.000000)	10.193004 (0.000000)	6.5175545 (0.000000)	12.994693 (0.000000)	4.9283431 (0.000000)
9.2	21.490893 (0.000000)	17.559926 (0.000000)	21.827551 (0.000000)	27.940188 (0.000000)	18.293214 (0.000000)	9.9368502 (0.000000)	18.449121 (0.000000)	11.132796 (0.000000)

Note: (1) Panel-ADF test: This test is of Costantini and Lupi (2012) based on Choi (2001) when no cross-dependence is detected.
(2) Panel-ADF test (pADF test): This test is of Costantini and Lupi (2012) based on Demetrescu et al. (2006) in the presence of cross-dependence. Cross-dependence has been detected through a cross-dependence test (Pesaran 2004) and Hartung's correction has been used in the combination of the p values as suggested in Demetrescu et al. (2006).
(3) Panel-CADF test (pCADF_PC): It is the Panel Covariate Augmented DF test. This is proposed by Costantini and Lupi (2012). pCADF.PC assumes that the panel is balanced and utilises the differenced first principal component of the N series as the stationary covariate. In the present case we used max.lag.y = 5, max.lag.X = 5.
(4) The J. Breitung and S. Das (2005) test.
(4) Sims ADF-based test: It is the ADF-based test in the original form proposed by Hanck (2008).
(5) SimespCADF- test: This is an ADF-based test proposed by Lupi (2011) advancing over Hanck (2008) for the stationary covariate case.
(6) SimespCADF_PC- test: This is an ADF-based test proposed by Lupi (2011) advancing over Hanck (2008) and that utilises the differenced first principal component of the N series as the stationary covariate.
(7) TRUE indicate that the test does not reject the null and FALSE shows that the null is rejected.
(8) is the Im et al. (2005) test where (8.1) is two breaks test in constant and (8.2) is two break tests in constant and trend
(9) Carrion-i-Silvestre et al. (2005) unit root test where (9.1) is the [Homo] version of test and (9.2) is the [Hetro] version of the test
(10) In each case lag selection is based on AIC and we fixed maximum lag 5.
(11) The 5% critical value for the minimum LM unit root test with two breaks is −3.842. The 5% critical value for the panel LM unit root test (with or without breaks) is −1.645. ** denotes significance at the 5% level. The specifications include an intercept and time trend.

Source: Author's calculation through R Development Core Team (2011) software

Table 2F: Panel unit root test for Coal, GDP and Trade

Tests without structural breaks: Trend model								
	Sample 1		Sample 2		Sample 1		Sample 2	
	Coal	GDP	Coal	GDP	Coal	Trade	Coal	Trade
Test statistic	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)
1	-1.52321463 (0.06385251)	2.6199901 (0.9956034)	-1.30197703 (0.0964621)	-0.4590863 (0.3230861)	-0.5268232 (0.2991582)	3.8741152 (0.9999465)	-4.207447e+00 (1.291361e-05)	2.3481961 (0.9905677)
2	-1.52321463 (0.06385251)	2.761712 (0.997125)	-1.49450614 (0.067521)	-0.5269735 (0.2991060)	-0.5268232 (0.2991582)	3.905743 (0.999953)	-4.333180e+00 (7.348532e-06)	2.4183686 (0.9922049)
3	-1.0880865 (0.1382785)	2.0483978 (0.9797395)	-0.3806211 (0.3517422)	-0.1281804 (0.4490031)	-2.10916731 (0.0174650)	0.9579732 (0.8309619)	-7.381880e+00 (7.803469e-14)	-4.166427e+00 (1.547051e-05)
4	1.1297862 (0.87071685)	0.83206268 (0.7973132)	0.98589204 (0.837906)	0.64130919 (0.739339)	0.72502817 (0.7657826)	5.3846367 (0.999999)	1.0933085 (0.86287081)	4.3138034 (0.99999198)
	Decision on H_0		Decision on H_0		Decision on H_0		Decision on H_0	
	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%
5	T T F	T T T	T F F	T F F	T F F	T T T	F F F	T T T
6	T T F	T T T	T F F	T F F	T F F	T T T	F F F	T T T
7	T F F	T T T	F F F	F F F	F F F	T T T	F F F	F F F
Tests with structural breaks								
8.1	-9.309	-9.366	-12.104	-10.862	-6.163	-7.394	-13.330	-12.831
8.2	-17.553	-17.162	-23.530	-20.065	-13.134	-14.196	-22.118	-27.679
9	24.484947 (0.000000)	15.933075 (0.000000)	17.533316 (0.000000)	9.8508604 (0.000000)	25.880024 (0.000000)	3.7800332 (0.000000)	7.7751134 (0.000000)	7.7778750 (0.000000)
10	25.466309 (0.000000)	16.817237 (0.000000)	15.415284 (0.000000)	36.920568 (0.000000)	24.475954 (0.000000)	8.3451216 (0.000000)	10.024209 (0.000000)	10.780452 (0.000000)
Note: Refer to Table 1.								
Source: Author's calculation through R Development Core Team (2011) software								

Table 3F: Panel unit root test for ELEP-Coal, GDP and Trade

Tests without structural breaks: Trend model								
	Sample 1		Sample 2		Sample 1		Sample 2	
	Coal	GDP	Coal	GDP	Coal	Trade	Coal	Trade
Test statistic	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)
1	-0.2075525 (0.4177892)	2.9214687 (0.9982581)	0.7553035 (0.7749665)	0.9478565 (0.8283987)	-0.1371810 (0.4454439)	-0.3422028 (0.3660992)	-0.1371810 (0.4454439)	-0.1371810 (0.4454439)
2	-0.2075525 (0.4177892)	3.1590627 (0.9992086)	0.4354274 (0.6683739)	1.0867999 (0.8614374)	-0.1061476 (0.4577326)	-0.3607134 (0.3591569)	-0.1061476 (0.4577326)	-0.1061476 (0.4577326)
3	-3.12381717 (0.0008926)	0.8563523 (0.8040985)	-1.74366482 (0.04060878)	-1.63285660 (0.051249)	-5.373918e+00 (3.852193e-08)	-4.55268e+00 (2.64834e-06)	-5.373918e+00 (3.852193e-08)	-5.373918e+00 (3.852193e-08)
4	-0.30877 (0.37877)	1.40169 (0.9195)	0.181562 (0.57203)	0.71012 (0.7611)	-0.412203 (0.34009)	1.188056 (0.88259)	0.181562 (0.57203)	2.2510277 (0.987808)
	Decision on H_0		Decision on H_0		Decision on H_0		Decision on H_0	
	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%
5	T T T	T T T	T T T	T T T	T T T	T T T	T T T	T T T
6	T T T	T T T	T T T	T T T	T T T	T T T	T T T	T T T
7	F F F	T T T	T T T	T F F	F F F	T F F	F F F	F F F
Tests with structural breaks								
8.1	-8.364	-9.699	-10.806	-11.910	-7.845	-7.728	-10.806	-10.392
8.2	-16.336	-19.013	-19.023	-19.718	-14.738	-13.861	-19.023	-18.104
9	9.6042730 (0.000000)	9.1349739 (0.000000)	25.023236 (0.000000)	18.912211 (0.000000)	8.2450742 (0.000000)	7.9237065 (0.000000)	25.023236 (0.000000)	1.1182401 (0.1317322)
10	10.701295 (0.000000)	22.566124 (0.000000)	50.191473 (0.000000)	82.460876 (0.000000)	9.4877253 (0.000000)	6.6489110 (0.000000)	50.191473 (0.000000)	16.490883 (0.000000)
Note: Refer to Table 1.								
Source: Author's calculation through R Development Core Team (2011) software								

Table 4F: Panel unit root test for ELEP, GDP and Trade

Tests without structural breaks: Trend model				
	Sample 1		Sample 2	
	ELEP	GDP	ELEP	Trade
Test statistic	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)
1	4.6798434 (0.9999986)	3.6674860 (0.9998775)	4.4443142 (0.9999956)	0.751636 (0.773865)
2	4.6261145 (0.9999981)	3.6253799 (0.9998557)	4.5771262 (0.9999976)	0.7740976 (0.7805635)
3	-0.8920557 (0.1861815)	0.7478286 (0.7727182)	-1.29928000 (0.0969239)	-1.44501978 (0.0742262)
4	0.72502817 (0.76578262)	5.3846367 (0.9999999)	1.0933085 (0.8628708)	4.3138034 (0.999992)
	Decision on H_0		Decision on H_0	
	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%
5	T T T	T T T	T T T	T T T
6	T T T	T T T	T T T	T T T
7	F F F	T T T	F F F	T T T
Tests with structural breaks				
8.1	-9.318	-10.468	-6.415	-9.783
8.2	-19.170	-22.139	-16.385	-18.595
9	3.9988668 (0.000000)	16.215543 (0.000000)	4.6222492 (0.000000)	10.771997 (0.000000)
10	18.146747 (0.000000)	33.731510 (0.000000)	16.980246 (0.000000)	15.81091 (0.000000)
Note: Refer to Table 1.				
Source: Author's calculation through R Development Core Team (2011) software				

Table 5F: Panel unit root test for ELEP-HYD, GDP and trade

Tests without structural breaks: Trend model								
	Sample 1		Sample 2		Sample 1		Sample 2	
	ELEP-HYD	GDP	ELEP-HYD	GDP	ELEP-HYD	Trade	ELEP-HYD	Trade
Test statistic	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)
1	-0.2075525 (0.4177892)	2.9214687 (0.9982581)	0.7553035 (0.7749665)	0.9478565 (0.8283987)	-0.1371810 (0.4454439)	-0.3422028 (0.3660992)	-0.1371810 (0.4454439)	-0.3422028 (0.3660992)
2	-0.2075525 (0.4177892)	3.1590627 (0.9992086)	0.4354274 (0.6683739)	1.0867999 (0.8614374)	-0.1061476 (0.4577326)	-0.3607134 (0.3591569)	-0.1061476 (0.4577326)	-0.3607134 (0.3591569)
3	-3.12381717 (0.0008926)	0.8563523 (0.8040985)	-1.74366482 (0.04060878)	-1.63285660 (0.05124958)	-5.373918e+00 (0.000000)	-4.55268e+00 ((0.000026)	-5.373918e+00 (3.852193e-08)	-4.552678e+00 (2.648364e-06)
4	0.72502817 (0.76578262)	5.3846367 (0.999999)	1.0933085 (0.86287081)	4.3138034 (0.99999198)	1.1297862 (0.87071685)	0.83206268 (0.79731322)	0.98589204 (0.83790695)	0.64130919 (0.73933909)
	Decision on H_0		Decision on H_0		Decision on H_0		Decision on H_0	
	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%
5	T T T	T T T	T T T	T T T	T T T	T T T	T T T	T T T
6	T T T	T T T	T T T	T T T	T T T	T T T	T T T	T T T
7	F F F	T T T	T T T	T F F	F F F	T T F	F F F	T F F
Tests with structural breaks								
8.1	-8.364	-9.699	-10.806	-11.910	-7.845	-7.728	-10.806	-10.392
8.2	-16.336	-19.013	-19.023	-19.718	-14.738	-13.861	-19.023	-18.104
9	9.6042730 (0.000000)	9.1349739 (0.000000)	25.023236 (0.000000)	18.912211 (0.000000)	8.2450742 (0.000000)	7.9237065 (0.000000)	25.023236 (0.000000)	1.1182401 (0.131732)
10	10.701295 (0.000000)	22.566124 (0.000000)	50.191473 (0.000000)	82.460876 (0.000000)	9.4877253 (0.000000)	6.6489110 (0.000000)	50.191473 (0.000000)	16.490883 (0.000000)
Note: Refer to Table 1.								
Source: Author's calculation through R Development Core Team (2011) software								

Table 6F: Panel unit root test for ELEP-NG, GDP and trade

Tests without structural breaks: Trend model								
	Sample 1		Sample 2		Sample 1		Sample 2	
	ELEP-NG	GDP	ELEP-NG	GDP	ELEP-NG	Trade	ELEP-NG	Trade
Test statistic	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)
1	-2.332593926 (0.00983473)	3.6842935 (0.9998853)	-2.326929756 (0.0099845)	-1.43375830 (0.07582062)	-0.5967491 (0.2753374)	-1.43375830 (0.07582062)	-0.5967491 (0.2753374)	-0.2855766 (0.3876012)
2	-2.332593926 (0.00983473)	4.3813881 (0.9999941)	-2.326929756 (0.0099845)	-1.77400062 (0.03803152)	-0.5967491 (0.2753374)	-1.77400062 (0.03803152)	-0.5967491 (0.2753374)	-0.3010241 (0.3816980)
3	-3.04659424 (0.00115725)	1.5582690 (0.9404153)	-2.665593399 (0.0038426)	-1.86771631 (0.03090081)	1.9059815 (0.9716737)	-1.86771631 (0.03090081)	1.9059815 (0.9716737)	-4.216418e+00 (1.241065e-05)
4	0.72502817 (0.76578262)	5.3846367 (0.99999996)	1.0933085 (0.86287081)	4.3138034 (0.99999198)	0.72502817 (0.76578262)	5.3846367 (0.99999996)	1.0933085 (0.86287081)	4.3138034 (0.99999198)
	Decision on H_0		Decision on H_0		Decision on H_0		Decision on H_0	
	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%
5	F F F	T T T	F F F	T F F	F F F	T F F	F F F	T T T
6	F F F	T T T	F F F	T F F	F F F	T F F	F F F	T T T
7	T F F	T T F	F F F	T F F	F F F	F F F	F F F	F F F
Tests with structural breaks								
8.1	-10.841	-6.821	-12.435	-11.549	-8.197	-7.979	-12.435	-10.720
8.2	-20.667	-13.620	-24.660	-20.784	-14.444	-13.157	-24.660	-18.467
9	9.8714566 (0.000000)	12.793234 (0.000000)	2.5731414 (0.005039)	8.4555908 (0.000000)	6.6818056 (0.000000)	4.6832810 (0.000000)	2.5731414 (0.0050390)	2.1469712 (0.015897)
10	8.2253843 (0.000000)	16.390424 (0.000000)	25.640318 (0.000000)	44.619996 (0.000000)	9.9494494 (0.000000)	5.6094064 (0.000000)	25.640318 (0.000000)	20.449219 (0.000000)

Note: Refer to Table 1.

Source: Author's calculation through R Development Core Team (2011) software

Results for ELEP-NU are not available

Table 7F: Panel unit root test for ELEP-Oil, GDP and trade

Tests without structural breaks: Trend model						
	Sample 1		Sample 1		Sample 2	
	ELEP-Oil	GDP	ELEP-Oil	Trade	ELEP-Oil	Trade
Test statistic	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)
1	-0.2271610 (0.4101493)	3.9740211 (0.9999647)	-0.1064313 (0.4576201)	0.751636 (0.773865)	0.04377673 (0.5174588)	1.0265953 (0.8476945)
2	-0.2271610 (0.4101493)	3.8572813 (0.9999427)	-0.1064313 (0.4576201)	0.7740976 (0.7805635)	0.04377673 (0.5174588)	0.9964383 (0.8404814)
3	-0.7433421 (0.2286373)	1.4602650 (0.9278914)	-0.8328239 (0.2024720)	-1.44501978 (0.0742262)	-0.4709679 (0.3188318)	-2.83834998 (0.0022674)
4	0.72502817 (0.7657826)	5.3846367 (0.9999999)	1.0933085 (0.8628708)	4.3138034 (0.999992)	1.1297862 (0.8707168)	0.83206268 (0.7973132)
	Decision on H_0		Decision on H_0		Decision on H_0	
	1 % 5 % 10 %	1 % 5 % 10 %	1 % 5 % 10 %	1 % 5 % 10 %	1 % 5 % 10 %	1 % 5 % 10 %
5	F F F	T T T	T T T	T T T	T F F	T T T
6	F F F	T T T	T T T	T T T	T F F	T T T
7	F F F	T T T	F F F	T T F	T T T	F F F
Tests with structural breaks						
8.1	-21.415	-10.979	-9.749	-9.783	-14.518	-12.593
8.2	-40.038	-23.088	-21.185	-18.595	-25.731	-19.476
9	2.3072317 (0.010520952)	16.302261 (0.000000)	9.5692584 (0.000000)	10.771997 (0.000000)	3.6675298 (0.000122453)	9.6921869 (0.000000)
10	5.5666134 (0.000000)	29.918476 (0.000000)	13.511349 (0.000000)	15.810917 (0.000000)	3.9186686 (0.000000)	19.363656 (0.000000)
Note: Refer to Table 1.						
Source: Author's calculation through R Development Core Team (2011) software						

Table 8F: Panel unit root test for ELEP-Rene, GDP and trade

Tests without structural breaks: Trend model						
	Sample 1		Sample 1		Sample 2	
	ELEP-Rene	GDP	ELEP-Rene	Trade	ELEP-Rene	Trade
Test statistic	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)
1	-2.604211687 (0.0046042)	3.7154521 (0.9998986)	-4.710180e+00 (1.237493e-06)	0.8818201 (0.8110630)	-0.5967491 (0.2753374)	-1.43375830 (0.0758206)
2	-2.604211687 (0.0046042)	3.7457848 (0.9999101)	-4.710180e+00 (1.237493e-06)	0.8890192 (0.8130036)	-0.5967491 (0.2753374)	-1.77400062 (0.0380315)
3	-4.027018e+00 (2.824432e-05)	0.9335737 (0.8247381)	-8.059078e+00 (3.843597e-16)	-2.43648271 (0.0074154)	1.9059815 (0.9716737)	-1.86771631 (0.0309008)
4	0.72502817 (0.76578262)	5.3846367 (0.9999999)	0.72502817 (0.76578262)	5.3846367 (0.9999999)	0.72502817 (0.7657826)	5.3846367 (0.9999999)
	Decision on H_0		Decision on H_0		Decision on H_0	
	1 % 5 % 10 %	1 % 5 % 10 %	1 % 5 % 10%	1 % 5 % 10 %	1 % 5 % 10 %	1 % 5 % 10 %
5	T F F	F F T	T T T	T T F	F F F	T T T
6	T F F	F F T	T T T	T T F	F F F	T T T
7	F F F	F F F	F F F	T T F	F F F	F F F
Tests with structural breaks						
8.1	-16.092	-9.879	-14.286	-10.000	-14.873	-10.795
8.2	-23.065	-21.509	-20.633	-17.794	-21.517	-16.965
9	3.4875717 (0.00024371)	12.754871 (0.000000)	3.3911228 (0.0003480)	10.321838 (0.000000)	7.1691155 (0.000000)	9.2993682 (0.000000)
10	5.1673486 (0.000000)	30.557404 (0.000000)	5.7568242 (0.000000)	15.897826 (0.000000)	7.2693513 (0.000000)	19.753111 (0.000000)
Note: Refer to Table 1.						
Source: Author's calculation through R Development Core Team (2011) software						

Table 9F: Panel unit root test for EPC, GDP and Trade

Tests without structural breaks: Trend model						
	Sample 1		Sample 1		Sample 2	
	EPC	GDP	EPC	Trade	EPC	Trade
Test statistic	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)
1	4.8693585 (0.9999994)	3.9740211 (0.9999647)	3.4602270 (0.9997301)	0.751636 (0.773865)	4.2136103 (0.9999874)	1.0265953 (0.8476945)
2	4.7263175 (0.9999989)	3.8572813 (0.9999427)	3.5636309 (0.9998171)	0.7740976 (0.7805635)	4.0898323 (0.9999784)	0.9964383 (0.8404814)
3	-0.4857097 (0.3135865)	1.4602650 (0.9278914)	-0.8678934 (0.1927263)	-1.44501978 (0.0742262)	-3.33407092 (0.0004279)	-2.838349981 (0.00226737)
4	0.72502817 (0.7657826)	5.3846367 (0.9999999)	1.0933085 (0.8628708)	4.3138034 (0.9999919)	1.1297862 (0.8707169)	0.83206268 (0.79731322)
	Decision on H_0		Decision on H_0		Decision on H_0	
	1 % 5 % 10 %	1 % 5 % 10 %	1 % 5 % 10 %	1 % 5 % 10 %	1 % 5 % 10 %	1 % 5 % 10%
5	T T F	T T T	T T F	T T T	T T T	T T T
6	T T F	T T T	T T F	T T T	T T T	T T T
7	F F F	T T T	F F F	T T F	F F F	F F F
Tests with structural breaks						
8.1	-8.445	-10.979	-7.368	-9.783	-9.783	-12.593
8.2	-18.495	-23.088	-16.514	-18.595	-23.399	-19.476
9	16.284520 (0.000000)	16.302261 (0.000000)	16.037647 (0.000000)	10.771997 (0.000000)	11.288108 (0.000000)	9.6921869 (0.000000)
10	28.099745 (0.000000)	29.918476 (0.000000)	27.048579 (0.000000)	15.810917 (0.000000)	24.542174 (0.000000)	19.363656 (0.000000)
Note: Refer to Table 1.						
Source: Author's calculation through R Development Core Team (2011) software						

Table 10F: Panel unit root test for EU, GDP and Trade

Tests without structural breaks: Trend model						
	Sample 1		Sample 1		Sample 2	
	EU	GDP	EU	Trade	EU	Trade
Test statistic	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)
1	3.2088738 (0.9993337)	3.6674860 (0.9998775)	2.5607956 (0.9947784)	0.751636 (0.773865)	2.2114797 (0.9864987)	1.0265953 (0.8476945)
2	3.1720330 (0.9992431)	3.6253799 (0.9998557)	2.6373213 (0.9958218)	0.7740976 (0.7805635)	1.5989744 (0.9450869)	0.9964383 (0.8404814)
3	1.4923104 (0.9321911)	0.7478286 (0.7727182)	-0.5419553 (0.2939246)	-1.44501978 (0.0742262)	2.0109018 (0.9778321)	-2.838349981 (0.00226737)
4	0.72502817 (0.76578262)	5.3846367 (0.9999999)	1.0933085 (0.8628708)	4.3138034 (0.9999919)	0.72502817 (0.76578262)	5.3846367 (0.99999996)
	Decision on H_0		Decision on H_0		Decision on H_0	
	1 % 5 % 10 %	1 % 5 % 10 %	1 % 5 % 10 %	1 % 5 % 10 %	1 % 5 % 10 %	1 % 5 % 10%
5	T T T	T T T	T T T	T T T	T T T	T T T
6	T T T	T T T	T T T	T T T	T T T	T T T
7	T F F	T T T	T F F	T T F	T F F	F F F
Tests with structural breaks						
8.1	-9.163	-10.979	-6.645	-9.783	-10.887	-12.593
8.2	-20.727	-23.088	-18.174	-18.595	-22.493	-19.476
9	4.2800727 (0.000000)	16.302261 (0.000000)	1.5778493 (0.05730011 2)	10.771997 (0.000000)	11.422225 (0.000000)	9.6921869 (0.000000)
10	17.428986 (0.000000)	29.918476 (0.000000)	6.8385978 (0.000000)	15.810917 (0.000000)	21.096360 (0.000000)	19.363656 (0.000000)
Note: Refer to Table 1.						
Source: Author's calculation through R Development Core Team (2011) software						

Table 11F: Panel unit root test for HYD, GDP and Trade

Tests without structural breaks: Trend model								
	Sample 1		Sample 1		Sample 1		Sample 2	
	HYD	GDP	HYD	GDP	HYD	Trade	HYD	Trade
Test statistic	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)
1	-3.3619081 (0.000387)	-2.27983e+01 (0.000000)	-3.675549470 (0.0001186)	1.1847603 (0.8819439)	-2.940662048 (0.0016375)	3.2813792 (0.9994835)	-3.56627678 (0.000181)	2.3018015 (0.9893268)
2	-3.3893545 (0.000350)	-2.34791e+01 (0.000000)	-3.675549470 (0.0001186)	1.2811133 (0.8999231)	-2.940662048 (0.0016375)	3.3081682 (0.9995305)	-3.56627678 (0.0001810)	2.3205933 (0.9898456)
3	-2.7896592 (0.0026387)	-1.16017e+01 (0.000000)	-3.25156090 (0.00057389)	0.8942425 (0.8144039)	-3.783898e+00 (7.719571e-05)	0.7550306 (0.7748847)	-3.4414394 (0.0002893)	-1.61940072 (0.0526805)
4	0.72502817 (0.765782)	5.3846367 (0.99999996)	1.0933085 (0.86287081)	4.3138034 (0.9999919)	1.1297862 (0.87071685)	0.83206268 (0.7973132)	0.98589204 (0.837907)	0.64130919 (0.7393391)
	Decision on H_0		Decision on H_0		Decision on H_0		Decision on H_0	
	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%
5	F F F	F T T	F T T	T T F	T T F	T T T	T F F	T T T
6	F F F	F T T	F T T	T T F	T T F	T T T	T F F	T T T
7	T F F	F T F	F T T	T F F	T F F	T T T	F F F	T F F
Tests with structural breaks								
8.1	-16.279	-9.706	-15.940	-9.201	-13.595	-8.454	-14.185	-15.540
8.2	-23.246	-19.133	-24.099	-20.074	-18.594	-16.130	-21.739	-33.716
9	4.9965920 (0.000000)	15.063926 (0.000000)	3.2462016 (0.000585)	3.2462016 (0.000585)	4.1907404 (0.000000)	5.6322608 (0.000000)	3.7203319 (0.000000)	2.6348043 (0.004209)
10	4.9566229 (0.000000)	16.538323 (0.000000)	5.3643268 (0.000000)	5.3643268 (0.000000)	3.4399713 (0.0002909)	9.4787774 (0.000000)	9.0596369 (0.000000)	10.847236 (0.000000)

Note: Refer to Table 1.

Source: Author's calculation through R Development Core Team (2011) software

Table 12F: Panel unit root test for NG, GDP and Trade

Tests without structural breaks: Trend model								
	Sample 1		Sample 1		Sample 1		Sample 2	
	NG	GDP	NG	GDP	NG	Trade	NG	Trade
Test statistic	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)
1	0.1627351 (0.5646365)	2.6218944 (0.9956279)	0.8462045 (0.8012807)	-1.37733652 (0.0842041)	0.3504123 (0.6369854)	-0.3246932 (0.3727066)	0.3504123 (0.6369854)	-0.3246932 (0.3727066)
2	0.1627351 (0.5646365)	3.0096055 (0.9986921)	0.8462045 (0.8012807)	-1.70418950 (0.04413)	0.3504123 (0.6369854)	-0.3273440 (0.3717039)	0.3504123 (0.6369854)	-0.3273440 (0.3717039)
3	-0.5865348 (0.2787581)	2.8999252 (0.9981337)	-1.67650446 (0.0468197)	-1.68197891 (0.04629)	-3.3146912 (0.0004587)	-1.2071422 (0.1136887)	-3.3146912 (0.000458)	-1.2071422 (0.1136887)
4	0.72502817 (0.76578262)	5.3846367 (0.999999)	1.0933085 (0.8628708)	4.3138034 (0.999992)	0.72502817 (0.7657826)	5.3846367 (0.9999999)	1.0933085 (0.86287)	4.3138034 (0.999992)
	Decision on H_0		Decision on H_0		Decision on H_0		Decision on H_0	
	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%
5	T T T	T T T	T T T	F F F	T T T	T T T	T T T	T T T
6	T T T	T T T	T T T	F F F	T T T	T T T	T T T	T T T
7	T T T	T T T	F F F	F F F	T F F	F F F	T F F	F F F
Tests with structural breaks								
8.1	-7.736	-7.377	-12.382	-11.387	-5.445	-7.183	-12.382	-17.267
8.2	-14.268	-13.347	-22.108	-25.516	-10.418	-11.596	-22.108	-38.724
9	7.0913423 (0.000000)	15.092552 (0.000000)	36.791238 (0.000000)	7.4089417 (0.000000)	4.2024216 (0.000000)	2.1618740 (0.015314)	36.791238 (0.000000)	1.6055662 (0.054184)
10	18.604927 (0.000000)	13.131981 (0.000000)	42.524261 (0.000000)	70.466996 (0.000000)	15.332619 (0.000000)	7.6143953 (0.000000)	42.524261 (0.000000)	23.240522 (0.000000)

Note: Refer to Table 1.

Source: Author's calculation through R Development Core Team (2011) software

Table 13F: Panel unit root test for NU, GDP and Trade

Tests without structural breaks: Trend model				
	Sample 1		Sample 1	
	NU	GDP	NU	Trade
Test statistic	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)
1	-2.956686946 (0.001554818)	1.8815978 (0.9700547)	-0.7774041 (0.2184602)	1.8815978 (0.9700547)
2	-2.956686946 (0.001554818)	2.328116 (0.990047)	-0.7774041 (0.2184602)	2.328116 (0.990047)
3	-3.6950370723 (0.0001099274)	1.1479284 (0.8745009)	-0.6550401 (0.2562210)	1.1479284 (0.8745009)
4	0.72502817 (0.76578262)	5.3846367 (0.99999996)	1.0933085 (0.86287081)	4.3138034 (0.9999919)
	Decision on H_0		Decision on H_0	
	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%
5	F F F	T T T	T T T	T T T
6	F F F	T T T	T T T	T T T
7	F F F	T T T	T T T	T T T
Tests with structural breaks				
8.1	-9.872	-4.846	-11.087	-7.746
8.2	-17.101	-10.715	-17.147	-23.423
9	2.5814069 (0.004919926)	12.439257 (0.000000)	2.5806017 (0.004931416)	3.5992618 (0.000159)
10	13.369664 (0.000000)	28.391590 (0.000000)	15.598060 (0.000000)	7.7111661 (0.000000)
Note: Refer to Table 1.				
Source: Author's calculation through R Development Core Team (2011) software				

Table 14F: Panel unit root test for PEC, GDP and Trade

Tests without structural breaks: Trend model								
	Sample 1		Sample 1		Sample 1		Sample 2	
	PEC	GDP	PEC	GDP	PEC	Trade	PEC	Trade
Test statistic	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)
1	1.6677089 (0.9523132)	2.6093984 (0.9954649)	1.8992817 (0.9712363)	0.7843857 (0.7835931)	1.8207099 (0.9656745)	3.4312450 (0.9996996)	2.1226550 (0.9831086)	3.4379496 (0.99971)
2	1.6187187 (0.9472461)	2.5327453 (0.9943413)	2.0020187 (0.9773586)	0.8268151 (0.7958291)	1.7373610 (0.9588383)	3.2741687 (0.9994701)	2.0603004 (0.9803151)	3.3369572 (0.99958)
3	-2.18803517 (0.01433352)	2.6006612 (0.9953478)	-2.29638827 (0.010827)	0.4644529 (0.6788384)	-1.47561037 (0.0700242)	1.0681781 (0.8572799)	-0.5108229 (0.3047375)	0.4497653 (0.67356)
4	1.1297862 (0.87071685)	0.83206268 (0.7973132)	0.98589204 (0.83791)	0.64130919 (0.739339)	0.72502817 (0.7657826)	5.3846367 (0.999999)	1.0933085 (0.862870)	4.3138034 (0.999992)
	Decision on H_0		Decision on H_0		Decision on H_0		Decision on H_0	
	1 % 5 % 10 %	1 % 5 % 10 %	1 % 5 % 10 %	1 % 5 % 10 %	1 % 5 % 10 %	1 % 5 % 10 %	1 % 5 % 10 %	1 % 5 % 10 %
5	T T T	T T T	T T F	T F F	T F F	T T T	T T T	T T T
6	T T T	T T T	T T F	T F F	T F F	T T T	T T T	T T T
7	T F F	T T T	T T F	F F F	F F F	T T T	F F F	F F F
Tests with structural breaks								
8.1	-8.135	-10.013	-9.640	-11.758	-6.393	-8.968	-8.924	-15.408
8.2	-20.364	-20.437	-23.463	-22.746	-15.332	-17.017	-19.006	-30.600
9	12.541323 (0.000000)	16.167050 (0.000000)	28.226813 (0.000000)	16.861547 (0.000000)	18.271076 (0.000000)	6.5175545 (0.000000)	16.710151 (0.000000)	4.928343 (0.0000)
10	17.550787 (0.000000)	17.559926 (0.000000)	29.829585 (0.000000)	27.940188 (0.000000)	22.388596 (0.000000)	9.9368502 (0.000000)	26.573514 (0.000000)	11.1328 (0.0000)
Note: Refer to Table 1.								
Source: Author's calculation through R Development Core Team (2011) software								

Table 15F: Linearity test

	Model 1		Model 2	
Test	Statistics	P-value	Statistics	P-value
Lagrange multiplies-Wald Tests (LM):	26.503	0.009	27.165	0.007
Lagrange multiplies-Fisher Tests (LMF):	2.260	0.010	2.323	0.008
Likelihood ratio-LRT Tests (LRT):	27.947	0.000	28.686	0.000
H0: Linear Model H1: PSTR model with at least one Threshold Variable (r=1)				

Table 16F: Testing the number of regimes-tests of no remaining non-linearity

	Model 1		Model 2	
Test	Statistics	P-value	Statistics	P-value
Lagrange multiplies-Wald Tests (LM):	-0.000	1.000	3.473	0.482
Lagrange multiplies-Fisher Tests (LMF):	-0.000	1.000	0.809	0.520
Likelihood ratio-LRT Tests (LRT):	-0.000	1.000	3.496	0.478
H0: PSTR with r = 1 against H1: PSTR with at least r = 2				

Table 17F: PSTR model estimation

	Model 1: Dependent variable- ∆lnEI		Model 2: Dependent variable- ∆lnE	
Variable	B0	B1	B0	B1
∆IND	0.0099 [0.9171]	-0.0198 [-0.9160]	0.0111 ** [2.4909]	-0.0068[-1.0161]
I	-1.7069*** [-3.9764]	3.4139*** [3.9726]	-0.0185 [-0.1009]	0.4069***[3.6035]
∆lnYPC/∆lnY	-0.0017*[-1.7017]	0.0035* [1.7023]	-1.3075**[-2.5429]	2.0779***[3.7256]
TT	0.0178***[3.4274]	-0.0356*** [-3.4269]	0.0076[1.1391]	-0.0170** [-2.3577]
Transition parameters				
Threshold (c)	0.1345		1.9264	
Slope (gama)	3.3404e-07		2.6425e+03	
Standard Errors of Estimated Parameters Corrected of Heteroskedasticity (per column for each transition function				

Appendix G: List of publication in peer reviewed journals

(1) Aviral Kumar Tiwari. The asymmetric causality analysis between energy consumption and income in the United States. ***Renewable & Sustainable Energy Reviews***, 36(C) (2014): 362-369. (DOI: 10.1016/j.rser.2014.04.066**),** *Elsevier-* Publications*; Impact Factor:-* **5.627**.

(2) Muhammad Shahbaz, Aviral Kumar Tiwari, Farooq Ahmed Jam, and Ilhan Ozturk. Are fluctuations in coal consumption per capita temporary? Evidence from developed and developing economies. ***Renewable & Sustainable Energy Reviews***, 33 (2014): 96-101. (DOI: 10.1016/j.rser.2014.01.086) *Elsevier-* Publications*; Impact Factor:-* **5.627**.

(3) Aviral Kumar Tiwari, Muhammad Shahbaz and Qazi Muhammad Adnan Hye. The Environmental Kuzents Curve and the role of coal consumption in India: Cointegration and causality analysis in an open economy. ***Renewable & Sustainable Energy Reviews*****,** 18 (2013): 519-527. (DOI:10.1016/j.rser.2012.10.031) *Elsevier-* Publications*; Impact Factor:-* **5.627**.

(4) Aviral Kumar Tiwari, Ilhan Ozturk and M. Aruna. Tourism, energy consumption and climate change in OECD countries**.** ***International Journal of Energy Economics and Policy***, 3(3) (2013)**:** 247-261.

(5) Muhammad Shahbaz, Aviral Kumar Tiwari, and Ilhan Ozturk. Are fluctuations in electricity consumption per-capita transitory? Evidence from developed and developing economies. ***Renewable & Sustainable Energy Reviews***, 28 (2013): 551-554. (DOI: 10.1016/j.rser.2013.08.007) *Elsevier-* Publications*; Impact Factor:-* **5.627**.

(6) Muhammad Shahbaz, Aviral Kumar Tiwari and Muhammad Nasir. The effects of financial development, economic growth, coal consumption and trade openness on CO_2 emissions in South Africa. ***Energy Policy*****,** 61 (2013): 1452-1459.

(DOI: 10.1016/j.enpol.2013.07.006) *Elsevier-* Publications*; Impact Factor:-* ***2*.743**.

(7) Muhammad Shahbaz, Qazi Muhammad Adnan Hye, Aviral Kumar Tiwari and Nuno Carlos Leitão. Economic growth, energy consumption, financial development, international trade and CO_2 Emissions in Indonesia. ***Renewable & Sustainable Energy Reviews****,* 25 (2013): 109-121. (DOI: 10.1016/j.rser.2013.04.009) *Elsevier-* Publications*; Impact Factor:-* **5.627**.

(8) Aviral Kumar Tiwari. On the dynamics of energy consumption, CO_2 emissions and economic growth: Evidence from India. ***Indian Economic Review***, 47(1) (2012*)*: 57-87.

(9) Muhammad Shahbaz, Mihai Mutascu and Aviral Kumar Tiwari. Revisiting the relationship between electricity consumption, capital and economic growth: Cointegration and causality analysis in Romania. ***The Romanian Journal of Economic Forecasting****,* 15(3) (2012): 97-120. The Institute for Economic Forecasting-Publications; *Impact Factor:-* **0.60**.

(10) Aviral Kumar Tiwari. A structural var analysis of renewable energy consumption, real gdp and CO_2 emissions: Evidence from India. ***Economics Bulletin***, 31(2) (2011): 1793-1806.

(11) Aviral Kumar Tiwari. Happiness and environmental degradation: What determines happiness? ***Economics Bulletin***, 31(4) (2011): 3192-3210.

(12) Aviral Kumar Tiwari. Comparative performance of renewable and nonrenewable energy source on economic growth and CO_2 emissions of Europe and Eurasian countries: A PVAR approach. ***Economics Bulletin****,* 31(3) (2011): 2356-2372.

(13) Aviral Kumar Tiwari and M. Aruna. Primary energy, income, foreign direct investment (FDI), and human capital in India: A multivariate analysis. ***Energy Studies Review,*** (Accepted/In Press).

(14) Aviral Kumar Tiwari. Long term trends in non-renewable resource commodity prices: Fresh evidence in the presence of structural breaks. ***International Journal of Global Energy Issues (IJGEI)***, (revised draft submitted).

(15) Aviral Kumar Tiwari, Olaolu R. Olayeni and Nicholas Apergis. Renewable energy production and economic growth in sub-Saharan Africa: A hidden cointegration analysis. ***Applied Energy,*** (communicated).

(16) Aviral Kumar Tiwari, M. Aruna, Duc Khuong Nguyen, An asymmetric cointegration analysis of hydroelectricity consumption and economic growth: the case of Asian countries, ***Applied Economics,*** (communicated).

Appendix H: Conference attended/participated

(1) 94th IEA Annual Conference, 27-29 December, 2011, Bharati Vidyapeeth Deemed University, Pune, India.

(2) 3rd International Conference on Applied Econometrics (ICAE-111), 16-17 December, 2011, IBS Hyderabad, Hyderabad, India.

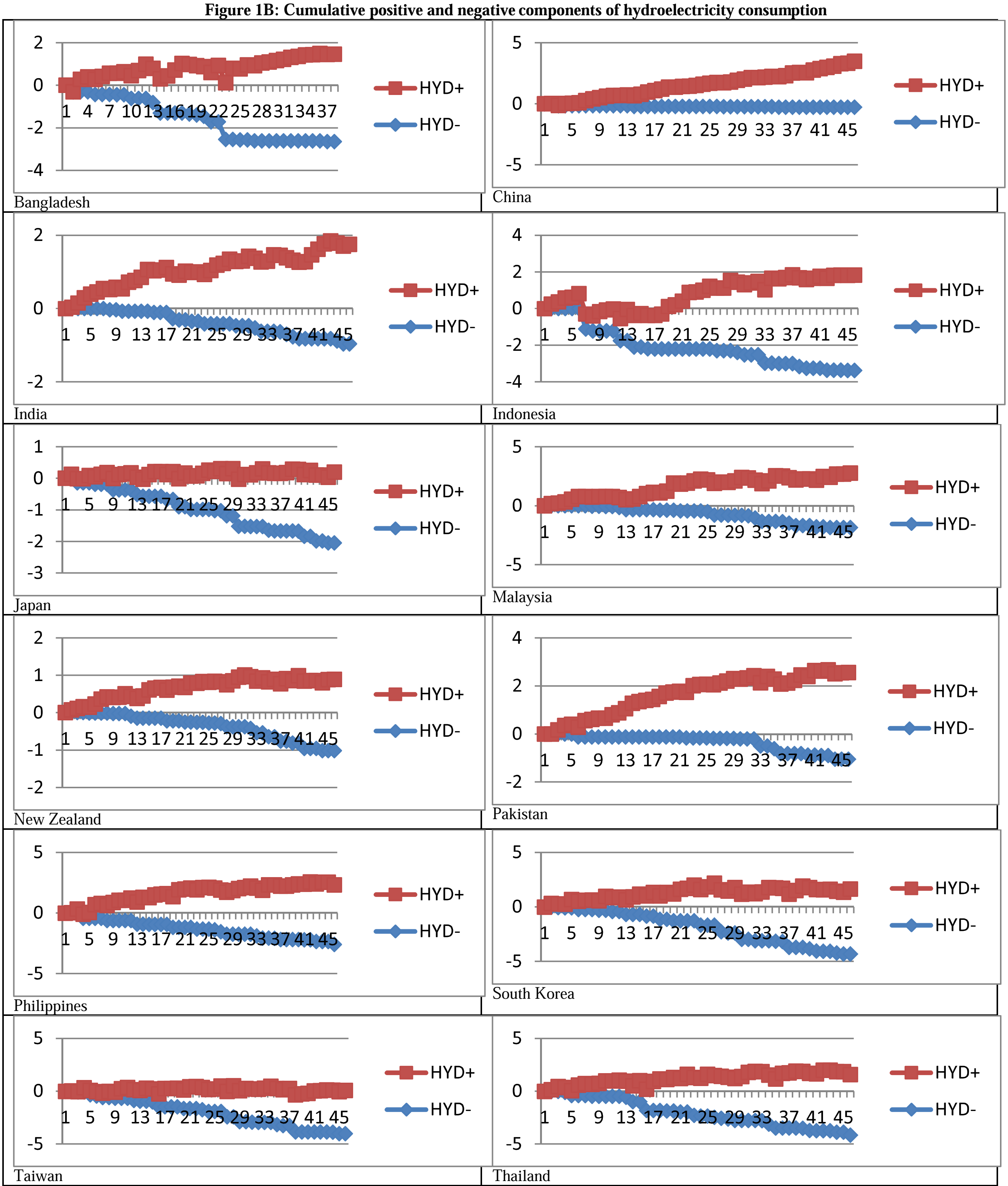
(3) 6th Doctoral Thesis Conference, 26-27 April, 2013, IBS Hyderabad, Hyderabad, India.

Appendix I: Publications in conference proceeding/conference issue of the journal

(1) Aviral Kumar Tiwari, Bharti Pandey and A. P. Tiwari. 2011. Market Reforms in Energy Sector: Evidence from a Panel Data Based Cointegration Analysis of BRICS Countries. ***The Indian Economic Journal***, Special Issue: 191-205.

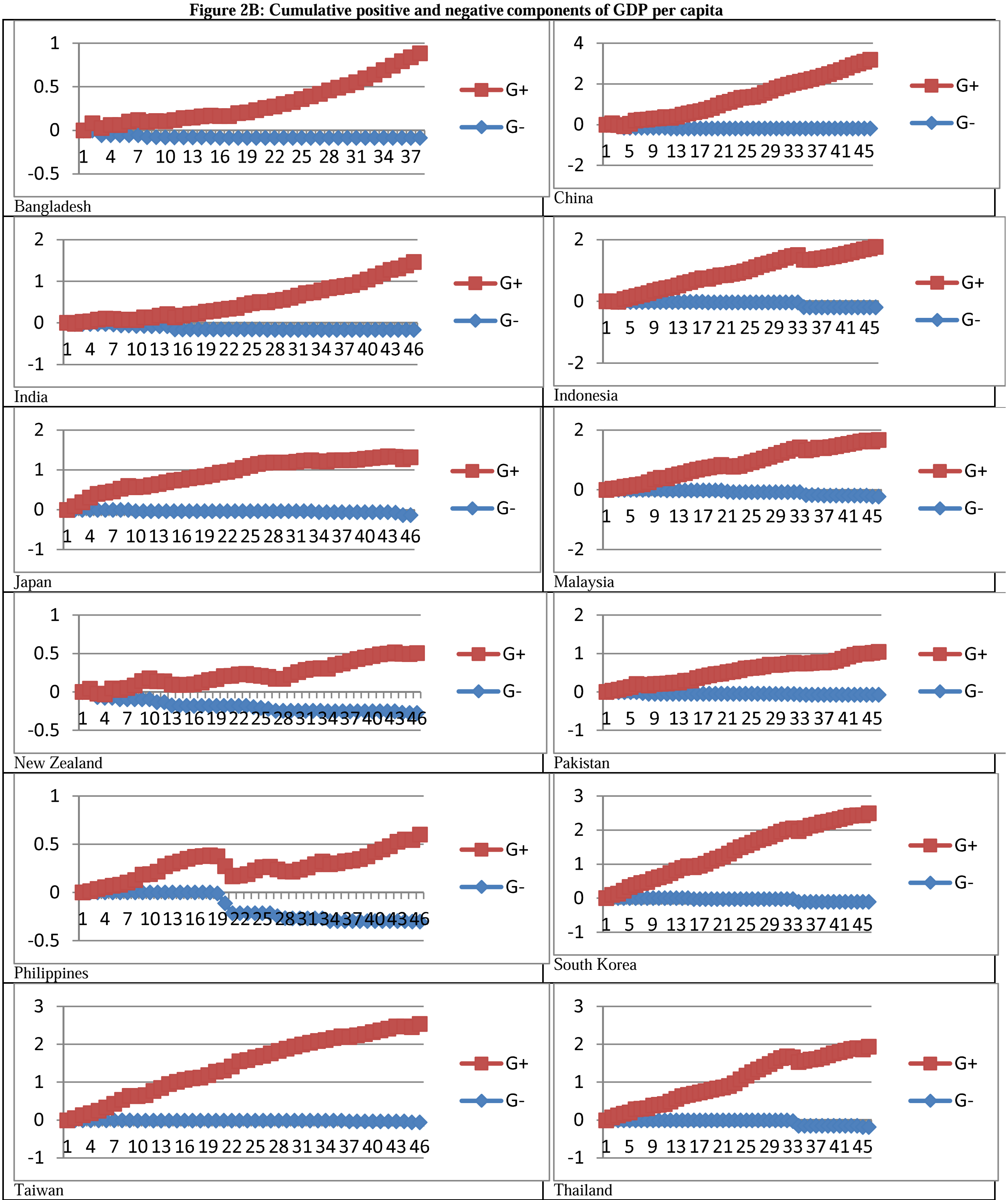
Appendix B: Cumulative positive and negative components of HYD and GDP

Figure 1B: Cumulative positive and negative components of hydroelectricity consumption



Note: HYD+ and HYD- denote cumulative positive and negative components respectively for hydroelectricity consumption.

Figure 2B: Cumulative positive and negative components of GDP per capita



Note: G+ and G- denote cumulative positive and negative components respectively for GDP per capita.

Appendix C: Tables for unit root analysis for hidden cointegration part

Table 1C: Unit Root for the level and first difference data (for GDP and CO_2)

Bangladesh					Bangladesh				
	G+	G-	C+	C-		DG+	DG-	DC+	DC-
DFG	-0.17	0	-2.05	-2.38	DFG	0	0	**-5.26**	**-4.94**
PP	-0.84	-1.96	-12.83	-12.13	PP	**-19.14**	**-33**	**-42.48**	**-46.04**
MZ	-0.32	-0.1	-1.92	-2.22	MZ	-1.28	-2.08	**-3.11**	**-3.43**
China					China				
	G+	G-	C+	C-		DG+	DG-	DC+	DC-
DFG	0	**-2.68**	-2.58	**-2.63**	DFG	**-4.97**	**-5.38**	**-4.19**	0
PP	-2.45	-10	-12.93	-9.8	PP	**-42.46**	**-49.66**	**-32.14**	**-26.46**
MZ	-0.69	-1.94	-2.48	-1.81	MZ	**-3.96**	**-4.49**	**-3.68**	-0.43
China HKSAR					China HKSAR				
	G+	G-	C+	C-		DG+	DG-	DC+	DC-
DFG	-1.14	-1.88	-1.98	-1.47	DFG	0	**-5**	0	**-2.92**
PP	-3.33	-8.43	-9.23	-5.19	PP	**-21.28**	**-51.79**	**-44.1**	**-889.84**
MZ	-1.11	-1.85	-1.78	-1.37	MZ	-1.88	**-3.52**	**-3.64**	**-20.72**
India					India				
	G+	G-	C+	C-		DG+	DG-	DC+	DC-
DFG	0.23	-0.99	-1.83	-2.14	DFG	**-4.46**	**-5.35**	0	**-5.16**
PP	-0.36	-3.2	-9.27	-8.53	PP	**-46.24**	**-52.02**	**-25.23**	**-51.24**
MZ	0.12	-0.97	-1.77	-1.82	MZ	**-3.06**	**-3.51**	-1.45	**-3.6**
Indonesia					Indonesia				
	G+	G-	C+	C-		DG+	DG-	DC+	DC-
DFG	-2.16	-1.87	-0.92	-1.65	DFG	0	**-4.9**	0	0
PP	-8.03	-7.22	-2.33	-7.71	PP	**-13.64**	**-47.84**	**-23.23**	**-37.11**
MZ	-1.93	-1.81	-0.87	-1.67	MZ	-1.84	**-3.54**	-1.87	**-2.83**
Japan					Japan				
	G+	G-	C+	C-		DG+	DG-	DC+	DC-
DFG	-1.46	-2.12	-1.74	-1.98	DFG	0	**-4.04**	0	0
PP	-5.79	**-16.95**	-6.43	-9.18	PP	-10.25	**-56.09**	-10.01	**-52.03**
MZ	-1.34	-2.48	-1.45	-1.97	MZ	-1.49	**-4.16**	-1.11	**-3.72**
Malaysia					Malaysia				
	G+	G-	C+	C-		DG+	DG-	DC+	DC-
DFG	-2.15	-1.98	-0.46	0	DFG	0	0	-0.6	**-5.5**
PP	-10.69	-8.34	-2.15	-6.18	PP	**-22.03**	**-71.06**	**-15.45**	**-65.57**
MZ	-2.18	-1.85	-0.61	-1.21	MZ	-2.31	**-4.77**	-0.39	**-5.19**
New Zealand					New Zealand				
	G+	G-	C+	C-		DG+	DG-	DC+	DC-
DFG	-2.22	-1.79	-1.35	-2.05	DFG	**-4.14**	0	-0.34	**-3.29**
PP	-10.52	-5.1	-6.26	-12.41	PP	**-36.16**	**-42.18**	**-29.53**	**-29.51**
MZ	-2.17	-1.26	-1.33	-2.32	MZ	**-3.04**	**-2.94**	-0.35	**-2.94**
Pakistan					Pakistan				
	G+	G-	C+	C-		DG+	DG-	DC+	DC-
DFG	-1.99	-2.61	-1.44	-1.95	DFG	**-3.75**	0	0	**-4.41**
PP	-7.97	-12.94	-5.76	-7.2	PP	**-33.66**	**-47.75**	**-19.01**	**-36.87**
MZ	-1.9	-2.45	-1.54	-1.74	MZ	**-2.87**	**-4.29**	-2.04	**-3.68**
Philippines					Philippines				
	G+	G-	C+	C-		DG+	DG-	DC+	DC-
DFG	-1.64	0	-1.31	-1.68	DFG	0	0	0	-1.87
PP	-7.79	-5.42	-4.46	-6.14	PP	**-20.36**	**-40.76**	**-332.96**	**-38.33**
MZ	-1.84	-1.55	-1.09	-1.7	MZ	-2.29	**-4.16**	**-12.53**	**-3.33**
Singapore					Singapore				
	G+	G-	C+	C-		DG+	DG-	DC+	DC-
DFG	0	-0.83	-2.15	-1.46	DFG	0	0	0	0
PP	-2.06	-3.03	-9.78	-3.95	PP	**-12.67**	**-66.03**	**-41.27**	**-35.78**
MZ	-0.47	-0.8	-2	-1.21	MZ	-1.67	**-4.61**	**-3.12**	-1.91
South Korea					South Korea				
	G+	G-	C+	C-		DG+	DG-	DC+	DC-
DFG	-0.85	-2.26	-0.43	-1.78	DFG	0	**-5.02**	**-3.05**	**-4.95**
PP	-3.81	-10.26	-1.95	-6.5	PP	**-14.71**	**-49.84**	**-24.97**	**-49**
MZ	-0.95	-2.13	-0.39	-1.7	MZ	-1.14	**-3.55**	**-2.24**	**-3.52**
Taiwan					Taiwan				
	G+	G-	C+	C-		DG+	DG-	DC+	DC-
DFG	-1.04	-1.27	-0.71	-2.12	DFG	0	-4.94	0	**-4.96**
PP	-3.02	-6.13	-1.96	-9.46	PP	**-21.13**	**-57.65**	**-26.65**	**-47.65**
MZ	-0.88	-1.33	-0.51	-2.08	MZ	-2.3	**-3.83**	-2.3	**-3.68**
Thailand					Thailand				
	G+	G-	C+	C-		DG+	DG-	DC+	DC-
DFG	0	-1.72	-1.27	-2.33	DFG	0	**-4.78**	-2.44	**-4.94**

PP	-5.94	-6.43	-6.45	-10.76	PP	**-16.24**	**-44.55**	**-15.32**	**-48.19**
MZ	-1.63	-1.66	-1.41	-2.19	MZ	-2.29	**-3.67**	-1.68	**-3.57**

Notes: DF-GLS: The GLS-detrended Augmented Dickey-Fuller test; PP: The Phillips-Perron test (Zα); MZτ: The modified Phillips-Perron test (MZα). For the GLS detrended series with a drift and linear trend in the GLS, the 1%, 5% and 10% critical values for the DF-GLS and the MZτ statistics are -3.42, -2.91and -2.62 respectively while the 1%, 5% and 10% critical values for the PP statistic are -23.8, -17.3 and -14.2 respectively. The optimal lag length has been chosen by minimizing the modified Akaike information criterion (MAIC). Bold values are significant at least at 10% critical values.

Table 2C: Unit Root for the level and first difference data (for Trade and CO_2)

Bangladesh					Bangladesh				
	T+	T-	C+	C-		DT+	DT-	DC+	DC-
DFG	-2.37	-1.59	-2.05	-2.38	DFG	**-3.3**	0	**-5.26**	**-4.94**
PP	-11.55	-7.77	-12.83	-12.13	PP	**-31.41**	-13.89	**-42.48**	**-46.04**
MZ	-2.19	-1.41	-1.92	-2.22	MZ	-2.3	-1.03	**-3.11**	**-3.43**
China					China				
	T+	T-	C+	C-		DT+	DT-	DC+	DC-
DFG	-1.57	0	-2.32	0	DFG	0	**-4.67**	**-3.45**	**-4.57**
PP	-3.27	-1.24	**-19.26**	**-17.93**	PP	**-30.79**	**-39.22**	**-23.61**	**-38.81**
MZ	-1.16	-0.46	-2.96	-2.74	MZ	**-3.16**	**-3.66**	**-3.21**	**-3.15**
China HKSAR					China HKSAR				
	T+	T-	C+	C-		DT+	DT-	DC+	DC-
DFG	-1.8	-1.44	-1.98	-1.47	DFG	0	-1.17	0	-2.92
PP	-6.26	-3.99	-9.23	-5.19	PP	**-19.63**	**-34.36**	**-44.1**	**-889.84**
MZ	-1.73	-1.34	-1.78	-1.37	MZ	-2.19	-1.67	**-3.64**	**-20.72**
India					India				
	T+	T-	C+	C-		DT+	DT-	DC+	DC-
DFG	-1.65	-2.52	-1.83	-2.14	DFG	0	**-3.81**	0	**-5.16**
PP	-4.43	-9.09	-9.27	-8.53	PP	**-40.69**	**-34.94**	**-25.23**	**-51.24**
MZ	-1.36	-1.95	-1.77	-1.82	MZ	**-2.72**	**-3.26**	-1.45	**-3.6**
Indonesia					Indonesia				
	T+	T-	C+	C-		DT+	DT-	DC+	DC-
DFG	-1.33	-2.27	-0.92	-1.65	DFG	-1.36	0	0	0
PP	-4	-10.11	-2.33	-7.71	PP	**-46.58**	**-63.14**	**-23.23**	**-37.11**
MZ	-1.33	-2.05	-0.87	-1.67	MZ	**-3.78**	**-4.21**	-1.87	**-2.83**
Japan					Japan				
	T+	T-	C+	C-		DT+	DT-	DC+	DC-
DFG	-1.95	0	-1.74	-1.98	DFG	**-4.78**	**-1.68**	0	0
PP	-7.08	15.94	-6.43	-9.18	PP	**-44.96**	**-135.65**	-10.01	**-52.03**
MZ	-1.76	6.46	-1.45	-1.97	MZ	**-3.7**	**-7.7**	-1.11	**-3.72**
Malaysia					Malaysia				
	T+	T-	C+	C-		DT+	DT-	DC+	DC-
DFG	0	-2.19	-0.46	0	DFG	0	-1.69	-0.6	**-5.5**
PP	-5.48	9.57	-2.15	-6.18	PP	**-17.79**	**-892.44**	**-15.45**	**-65.57**
MZ	-1.45	2.82	-0.61	-1.21	MZ	-1.55	**-20.86**	-0.39	**-5.19**
New Zealand					New Zealand				
	T+	T-	C+	C-		DT+	DT-	DC+	DC-
DFG	-0.84	7.04	0	-1.79	DFG	0	15.53	**-2.8**	**-2.89**
PP	-2.68	18.48	-4.12	-12.68	PP	**-23.68**	19.42	**-26.19**	**-16.61**
MZ	-0.8	15.9	-1.13	-2.11	MZ	-0.95	57266.64	-1.51	-1.96
Pakistan					Pakistan				
	T+	T-	C+	C-		DT+	DT-	DC+	DC-
DFG	**-2.93**	-1.87	-1.44	-1.95	DFG	**-5.49**	**-5.15**	0	**-4.41**
PP	**-18.07**	-7.36	-5.76	-7.2	PP	**-55.55**	**-48.87**	**-19.01**	**-36.87**
MZ	**-2.71**	-1.75	-1.54	-1.74	MZ	**-3.77**	**-3.91**	-2.04	**-3.68**
Philippines					Philippines				
	T+	T-	C+	C-		DT+	DT-	DC+	DC-
DFG	-1.8	-2.47	-1.31	-1.68	DFG	**-3.51**	0	0	-1.87
PP	-6.44	**-13.53**	-4.46	-6.14	PP	**-27.33**	**-52.97**	**-332.96**	**-38.33**
MZ	-1.69	-2.38	-1.09	-1.7	MZ	**-2.9**	**-3.7**	**-12.53**	**-3.33**
Singapore					Singapore				
	T+	T-	C+	C-		DT+	DT-	DC+	DC-
DFG	**-3.89**	-2.43	-1.88	-1.63	DFG	**-3.77**	0	0	0
PP	**-29.47**	**-16.76**	-6.2	-5.54	PP	**-31.16**	**-59.33**	**-28.48**	**-42.34**
MZ	**-3.59**	-2.5	-1.67	-1.54	MZ	**-2.87**	**-4.28**	-1.88	**-3.11**
South Korea					South Korea				
	T+	T-	C+	C-		DT+	DT-	DC+	DC-
DFG	-1.19	-2.31	-0.43	-1.78	DFG	0	-2.21	**-3.05**	**-4.95**
PP	-5.33	18.37	-1.95	-6.5	PP	**-20.04**	9.13	**-24.97**	**-49**
MZ	-1.23	9.57	-0.39	-1.7	MZ	-2	2.44	-2.24	**-3.52**
Taiwan					Taiwan				
	T+	T-	C+	C-		DT+	DT-	DC+	DC-
DFG					DFG				

PP					PP				
MZ					MZ				
Thailand					Thailand				
	T+	T-	C+	C-		DT+	DT-	DC+	DC-
DFG	-2.17	-2.38	-1.27	-2.33	DFG	**-4.5**	**-5.5**	**-2.44**	**-4.94**
PP	-8.11	-11.17	-6.45	-10.76	PP	**-38.05**	**-63.32**	**-15.32**	**-48.19**
MZ	-1.96	-2.24	-1.41	-2.19	MZ	**-3.33**	**-4.41**	-1.68	**-3.57**
Notes: See Table 1C									

Table 3C: Unit Root for the level and first difference data (for GDP and Coal)

Bangladesh					Bangladesh				
	G+	G-	Coal+	Coal-		DG+	DG-	DCoal+	DCoal-
DFG	-0.17	0	-1.74	-1.77	DFG	0	0	0	0
PP	-0.84	-1.96	-5.43	-7.44	PP	**-19.14**	**-33**	**-21.4**	**-77.8**
MZ	-0.32	-0.1	-1.5	-1.69	MZ	-1.28	-2.08	-1.2	**-5.06**
China					China				
	G+	G-	Coal+	Coal-		DG+	DG-	DCoal+	DCoal-
DFG	0	**-2.68**	**-2.81**	0	DFG	**-4.97**	**-5.38**	**-4.23**	0
PP	-2.45	-10	**-15.5**	-2.47	PP	**-42.46**	**-49.66**	**-33.4**	**-24.06**
MZ	-0.69	-1.94	**-2.73**	0.13	MZ	**-3.96**	**-4.49**	**-3.71**	-0.53
India					India				
	G+	G-	Coal+	Coal-		DG+	DG-	DCoal+	DCoal-
DFG	0.23	-0.99	-1.65	-1.64	DFG	**-4.46**	**-5.35**	0	**-5.67**
PP	-0.36	-3.2	-9.08	-6.21	PP	**-46.24**	**-52.02**	**-22.52**	**-57.54**
MZ	0.12	-0.97	-1.73	-1.46	MZ	**-3.06**	**-3.51**	-1.62	**-3.84**
Indonesia					Indonesia				
	G+	G-	Coal+	Coal-		DG+	DG-	DCoal+	DCoal-
DFG	-2.16	-1.87	-2.16	0	DFG	0	**-4.9**	**-3.87**	0
PP	-8.03	-7.22	-8.88	-1.81	PP	**-13.64**	**-47.84**	**-33.03**	**-21.03**
MZ	-1.93	-1.81	-2.02	-0.37	MZ	-1.84	**-3.54**	**-3.07**	-0.98
Japan					Japan				
	G+	G-	Coal+	Coal-		DG+	DG-	DCoal+	DCoal-
DFG	-1.46	-2.12	0	-1.6	DFG	0	**-4.04**	0	0
PP	-5.79	-16.95	-10.07	-4.71	PP	-10.25	**-56.09**	**-17.71**	**-27.84**
MZ	-1.34	-2.48	-2.06	-1.47	MZ	-1.49	**-4.16**	-1.53	-1.51
New Zealand					New Zealand				
	G+	G-	Coal+	Coal-		DG+	DG-	DCoal+	DCoal-
DFG	-2.22	-1.79	-1.17	-1.88	DFG	**-4.14**	0	-4.39	-2.07
PP	-10.52	-5.1	-3.87	-23.81	PP	**-36.16**	**-42.18**	**-49.94**	**-13.95**
MZ	-2.17	-1.26	-1.05	-2.99	MZ	**-3.04**	**-2.94**	**-2.86**	-0.95
Pakistan					Pakistan				
	G+	G-	Coal+	Coal-		DG+	DG-	DCoal+	DCoal-
DFG	-1.99	-2.61	-2.43	-1.41	DFG	**-3.75**	0	0	0
PP	-7.97	-12.94	-12.04	-5.11	PP	**-33.66**	**-47.75**	**-16.1**	**-18.51**
MZ	-1.9	-2.45	-2.39	-1.37	MZ	**-2.87**	**-4.29**	-2.41	-2.46
Philippines					Philippines				
	G+	G-	Coal+	Coal-		DG+	DG-	DCoal+	DCoal-
DFG	-1.36	-2.17	-1.86	-1.2	DFG	0	**-4.57**	0	0
PP	-6.84	-11.07	-6.86	-3.42	PP	**-31.71**	**-36.81**	**-15.59**	**-28.35**
MZ	-1.62	-2.26	-1.6	-1.15	MZ	**-3.35**	**-3.96**	-0.97	-1.83
South Korea					South Korea				
	G+	G-	Coal+	Coal-		DG+	DG-	DCoal+	DCoal-
DFG	-0.85	-2.26	-1.75	-2.84	DFG	0	**-5.02**	0	0
PP	-3.81	-10.26	-6.36	-13.15	PP	**-14.71**	**-49.84**	**-27.02**	**-19.72**
MZ	-0.95	-2.13	-1.72	-2.33	MZ	-1.14	**-3.55**	-1.97	-1.99
Taiwan					Taiwan				
	G+	G-	Coal+	Coal-		DG+	DG-	DCoal+	DCoal-
DFG	-1.04	-1.27	-1.56	-1.23	DFG	0	**-4.94**	-1.72	-0.38
PP	-3.02	-6.13	-5.86	-2.55	PP	**-21.13**	**-57.65**	-10.2	**-19.41**
MZ	-0.88	-1.33	-1.58	-0.89	MZ	-2.3	**-3.83**	-1.4	-0.51
Thailand					Thailand				
	G+	G-	Coal+	Coal-		DG+	DG-	DCoal+	DCoal-
DFG	0	-1.74	-1.03	-1.86	DFG	0	**-4.73**	0	**-5.35**
PP	-5.43	-6.55	-3.01	-7.83	PP	**-18.08**	**-43.61**	**-22.7**	**-53.17**
MZ	-1.56	-1.68	-1.02	-1.8	MZ	-2.55	**-3.63**	-1.64	**-3.67**
Notes: See Table 1C									

Table 4C: Unit Root for the level and first difference data (for Coal and Trade)

Bangladesh					Bangladesh				
	T+	T-	Coal+	Coal-		DT+	DT-	DCoal+	DCoal-
DFG	-2.37	-1.59	-1.74	-1.77	DFG	**-3.3**	0	0	0
PP	-11.55	-7.77	-5.43	-7.44	PP	**-31.41**	**-13.89**	**-21.4**	**-77.8**
MZ	-2.19	-1.41	-1.5	-1.69	MZ	-2.3	-1.03	-1.2	**-5.06**
China					China				
	T+	T-	Coal+	Coal-		DT+	DT-	DCoal+	DCoal-
DFG	-1.57	0	-2.41	0	DFG	0	**-4.67**	**-3.28**	**-4.57**
PP	-3.27	-1.24	**-18.54**	-2.39	PP	**-30.79**	**-39.22**	**-21.17**	**-38.81**
MZ	-1.16	-0.46	**-2.95**	0.59	MZ	**-3.16**	**-3.66**	**-3.02**	**-3.15**
India					India				
	T+	T-	Coal+	Coal-		DT+	DT-	DCoal+	DCoal-
DFG	-1.65	-2.52	-1.65	-1.64	DFG	0	**-3.81**	0	**-5.67**
PP	-4.43	-9.09	-9.08	-6.21	PP	**-40.69**	**-34.94**	**-22.52**	**-57.54**
MZ	-1.36	-1.95	-1.73	-1.46	MZ	**-2.72**	**-3.26**	-1.62	**-3.84**
Indonesia					Indonesia				
	T+	T-	Coal+	Coal-		DT+	DT-	DCoal+	DCoal-
DFG	-1.33	-2.27	-2.16	0	DFG	-1.36	0	**-3.87**	0
PP	-4	-10.11	-8.88	-1.81	PP	**-46.58**	**-63.14**	**-33.03**	**-21.03**
MZ	-1.33	-2.05	-2.02	-0.37	MZ	**-3.78**	**-4.21**	**-3.07**	-0.98
Japan					Japan				
	T+	T-	Coal+	Coal-		DT+	DT-	DCoal+	DCoal-
DFG	-1.95	0	0	-1.6	DFG	**-4.78**	-1.68	0	0
PP	-7.08	15.94	-10.07	-4.71	PP	**-44.96**	**-135.65**	**-17.71**	**-27.84**
MZ	-1.76	6.46	-2.06	-1.47	MZ	**-3.7**	**-7.7**	-1.53	-1.51
New Zealand					New Zealand				
	T+	T-	Coal+	Coal-		DT+	DT-	DCoal+	DCoal-
DFG	-0.84	7.04	-1.63	-1.64	DFG	0	15.53	**-3.74**	0
PP	-2.68	18.48	-6.49	**-18.66**	PP	**-23.68**	19.42	**-37.25**	-11.55
MZ	-0.8	15.9	-1.56	-2.68	MZ	-0.95	57266.64	-2.4	-0.93
Pakistan					Pakistan				
	T+	T-	Coal+	Coal-		DT+	DT-	DCoal+	DCoal-
DFG	**-2.93**	-1.87	-2.43	-1.41	DFG	**-5.49**	**-5.15**	0	0
PP	**-18.07**	-7.36	-12.04	-5.11	PP	**-55.55**	**-48.87**	**-16.1**	**-18.51**
MZ	**-2.71**	-1.75	-2.39	-1.37	MZ	**-3.77**	**-3.91**	-2.41	-2.46
Philippines					Philippines				
	T+	T-	Coal+	Coal-		DT+	DT-	DCoal+	DCoal-
DFG	-1.99	-2.29	-1.86	-1.2	DFG	**-3.39**	0	0	0
PP	-8.26	-11.99	-6.86	-3.42	PP	**-24.36**	**-48**	**-15.59**	**-28.35**
MZ	-1.92	-2.19	-1.6	-1.15	MZ	**-2.68**	**-3.61**	-0.97	-1.83
South Korea					South Korea				
	T+	T-	Coal+	Coal-		DT+	DT-	DCoal+	DCoal-
DFG	-1.19	-2.31	-1.75	-2.84	DFG	0	-2.21	0	0
PP	-5.33	18.37	-6.36	-13.15	PP	**-20.04**	9.13	**-27.02**	**-19.72**
MZ	-1.23	9.57	-1.72	-2.33	MZ	-2	2.44	-1.97	-1.99
Thailand					Thailand				
	T+	T-	Coal+	Coal-		DT+	DT-	DCoal+	DCoal-
DFG	-2.09	-2.45	-1.03	-1.86	DFG	0	0	0	**-5.35**
PP	-7.92	-12.67	-3.01	-7.83	PP	**-23.92**	**-20.08**	**-22.7**	**-53.17**
MZ	-1.92	-2.39	-1.02	-1.8	MZ	-2.05	-1.36	-1.64	**-3.67**

Notes: See Table 1C

Table 5C: Unit Root for the level and first difference data (for GDP and ELEP)

Bangladesh					Bangladesh				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-0.08	0	-2.39	-1.7	DFG	0	**-13.7**	0	**-4.61**
PP	-0.76	-4.09	-7.27	-6.19	PP	**-18.6**	**-28.8**	**-21.78**	**-41.99**
MZ	-0.25	0.22	-1.71	-1.61	MZ	-1.2	-1.18	-1.16	**-3.26**
China					China				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	0	-2.01	-1.94		DFG	0	0	**-3.07**	
PP	-8.32	-7.02	-8.84		PP	**-34.8**	**-79.5**	**-23.83**	
MZ	-1.65	-1.63	-1.94		MZ	**-3.72**	**-5.39**	-2.47	
China HKSAR					China HKSAR				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.25	-1.87	-0.41	-1.88	DFG	0	**-4.27**	**-3**	**-4.67**
PP	-4.41	-8.24	-2.3	-7.07	PP	**-20.6**	**-39.6**	**-21.89**	**-42.96**
MZ	-1.16	-1.82	-0.64	-1.76	MZ	-1.69	**-3.01**	-2.44	**-3.3**
India					India				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-0.16	0	-0.85		DFG	**-4.08**	0	-2.54	

PP	-1.68	-5.18	-2.42		PP	**-39.5**	**-84.2**	**-18.71**	
MZ	-0.22	-1.26	-0.89		MZ	**-2.73**	**-5.44**	-2.12	
Indonesia					Indonesia				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.95	-1.94	-0.79	0	DFG	**-3.24**	**-4.52**	0	**-4.76**
PP	-8.97	-7.56	-2.87	-8.64	PP	**-21.6**	**-40.8**	**-15.94**	**-43.56**
MZ	-1.99	-1.83	-0.84	-1.87	MZ	**-2.73**	**-3.27**	-1.75	**-3.32**
Japan					Japan				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.12	-2.14	-0.67	-1.93	DFG	-2.25	**-4.24**	0	**-5.16**
PP	**-3.84**	**-17.82**	-2.88	**-15.08**	PP	-10.9	**-62.5**	-7.84	**-53.2**
MZ	-1.04	-2.51	-0.78	-2.31	MZ	-1.63	**-4.41**	-0.54	**-4.29**
Malaysia					Malaysia				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.79	-2.29	-1.12	-1.82	DFG	0	**-5.85**	-1.7	-1.95
PP	-10.5	-11.09	-5.91	**-16.85**	PP	**-14.6**	**-56.5**	-11.23	**-72.83**
MZ	-2.03	-2.15	-1.4	-2.35	MZ	-1.29	**-4.23**	-1.53	**-4.99**
New Zealand					New Zealand				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-2.07	-1.44	-0.82	-2.35	DFG	**-4.09**	**-4.51**	**-3.16**	**-5.19**
PP	-8.1	-4.64	-3.01	-12.43	PP	**-36.5**	**-45.6**	**-21.78**	**-58.89**
MZ	-1.88	-1.36	-0.8	-2.23	MZ	**-3.27**	**-3.24**	**-2.63**	**-3.84**
Pakistan					Pakistan				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.88	-2.29	-0.8	0	DFG	**-3.23**	0	0	0
PP	-6.74	-5.69	-1.88	5.42	PP	**-25**	**-25**	-11.01	**-16.61**
MZ	-1.8	-1.43	-0.65	4.5	MZ	**-2.53**	-1.27	-1.11	-2.03
Philippines					Philippines				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	0	-2.38	-2.56	-1.47	DFG	**-3.97**	**-4.6**	**-4.96**	**-6.61**
PP	-7.2	-13.05	**-16.19**	-5.31	PP	**-31.1**	**-37.9**	**-41.44**	**-40.62**
MZ	-1.77	-2.48	-2.39	-1.48	MZ	**-3.42**	**-4.03**	**-3.5**	**-3.07**
South Korea					South Korea				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.12	-2.37	-1.11	-1.89	DFG	0	**-4.68**	0	**-4.61**
PP	-3.66	-11.45	-5.6	-7.15	PP	**-14.5**	**-43.4**	**-14.58**	**-42.62**
MZ	-1.06	-2.25	-1.15	-1.78	MZ	-1.78	**-3.32**	-1.75	**-3.29**
Thailand					Thailand				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	0	-1.81	-0.76	-1.86	DFG	0	**-4.38**	**-2.63**	**-4.56**
PP	-3.58	-7.27	-10.02	-6.98	PP	-11.8	**-37.5**	**-14.55**	**-41.67**
MZ	-1.15	-1.77	-1.92	-1.75	MZ	-2.02	**-3.39**	-2.04	**-3.26**

Notes: See Table 1C

Table 6C: Unit Root for the level and first difference data (for ELEP and Trade)

Bangladesh					Bangladesh				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-2.24	**-2.71**	-2.39	-1.7	DFG	**-3.5**	0	0	**-4.61**
PP	-11.18	-8.48	-7.27	-6.19	PP	**-34.84**	**-13.22**	**-21.78**	**-41.99**
MZ	-2.14	-1.71	-1.71	-1.61	MZ	-2.38	-0.97	-1.16	**-3.26**
China					China				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.78	0	**-3.41**		DFG	0	**-3.92**	**-2.99**	
PP	-3.65	-3.11	-24.04		PP	**-21.12**	**-31.96**	**-16.48**	
MZ	-1.27	-1.08	-3.35		MZ	**-2.33**	**-3.23**	**-2.33**	
China HKSAR					China HKSAR				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.48	-1.57	-0.41	-1.88	DFG	0	**-3.17**	**-3**	**-4.67**
PP	-6.55	-5.3	-2.3	-7.07	PP	**-12.82**	**-27.41**	**-21.89**	**-42.96**
MZ	-1.64	-1.28	-0.64	-1.76	MZ	-1.63	-1.7	-2.44	**-3.3**
India					India				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.08	-2.59	-0.85		DFG	**-4.54**	-2.57	-2.54	
PP	-3.41	-20.48	-2.42		PP	**-42.95**	**-17.74**	**-18.71**	
MZ	-1.01	-2.63	-0.89		MZ	**-3.11**	-1.22	-2.12	
Indonesia					Indonesia				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.2	**-2.7**	-0.79	0	DFG	**-4.13**	0	0	**-4.76**
PP	-3.03	**-15.16**	-2.87	-8.64	PP	**-35.33**	**-45.52**	**-15.94**	**-43.56**
MZ	-1.15	-2.48	-0.84	-1.87	MZ	**-2.83**	**-3.44**	-1.75	**-3.32**
Japan					Japan				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-

DFG	-1.63	**-2.74**	-0.67	-1.93	DFG	**-4.82**	-1.67	0	**-5.16**
PP	-5.6	15.86	-2.88	**-15.08**	PP	**-47.28**	**-195.83**	**-7.84**	**-53.2**
MZ	-1.57	5.71	-0.78	-2.31	MZ	**-3.72**	**-9.42**	-0.54	**-4.29**
Malaysia					Malaysia				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	0	-1.64	-1.12	-1.82	DFG	0	**-4.36**	-1.7	-1.95
PP	-5.69	-7.89	-5.91	**-16.85**	PP	**-16.22**	**-32.82**	-11.23	**-72.83**
MZ	-1.41	-1.54	-1.4	-2.35	MZ	-1.38	-2.48	-1.53	**-4.99**
New Zealand					New Zealand				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-0.84	7.04	-1.32	**-2.69**	DFG	0	15.53	0	**-4.27**
PP	**-2.68**	18.48	-4.2	**-14.62**	PP	**-23.68**	19.42	-10.75	**-39.95**
MZ	-0.8	15.9	-1.18	-2.47	MZ	-0.95	57266.64	-0.52	**-3.18**
Pakistan					Pakistan				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-2.54	-2.55	-0.8	0	DFG	**-4.52**	**-6.34**	0	0
PP	-13.64	-11.71	-1.88	5.42	PP	**-41.87**	**-26.92**	-11.01	**-16.61**
MZ	-2.39	-1.91	-0.65	4.5	MZ	**-3.24**	-2.37	-1.11	-2.03
Philippines					Philippines				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-2.13	-2.17			DFG	**-3.35**	0		
PP	-9.58	-11.53			PP	**-24.91**	**-54.5**		
MZ	-2.09	-2.11			MZ	**-2.75**	**-3.88**		
South Korea					South Korea				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	0	-2.39	-1.11	-1.89	DFG	-0.04	-2.21	0	**-4.61**
PP	-7.33	17.12	-5.6	-7.15	PP	**-56.34**	7.95	**-14.58**	**-42.62**
MZ	-1.72	8.84	-1.15	-1.78	MZ	**-4.6**	2.23	-1.75	**-3.29**
Thailand					Thailand				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-2.13	**-2.76**	-0.76	-1.86	DFG	**-3.91**	**-3.6**	**-2.63**	**-4.56**
PP	-8.93	**-16.32**	-10.02	-6.98	PP	**-31.47**	**-33.03**	**-14.55**	**-41.67**
MZ	-1.98	-2.61	-1.92	-1.75	MZ	**-2.93**	**-2.82**	-2.04	**-3.26**
Notes: See Table 1C									

Table 7C: Unit Root for the level and first difference data (for GDP and ELEP-Coal)

China					China				
	G+	G-	E +	E -		DG+	DG-	DE+	DE-
DFG	0	-2.01	**-2.8**	-1.88	DFG	0	0	0	0
PP	-8.32	-7.02	**-15.94**	-5.78	PP	**-34.81**	**-79.49**	**-59.86**	**-22.52**
MZ	-1.65	-1.63	-2.59	-1.43	MZ	**-3.72**	**-5.39**	**-5.03**	-0.28
China HKSAR					China HKSAR				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-2.11	-2.13	-0.82	-1.56	DFG	**-3.65**	**-3.68**	**-7.41**	0
PP	-7.83	-9.53	-6.48	-4.83	PP	**-26.41**	**-29.45**	**-15.61**	**-19.26**
MZ	-1.78	-1.95	-0.44	-1.39	MZ	**-2.92**	-2.6	-0.93	-1.57
India					India				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-0.16	0	0	0	DFG	**-4.08**	0	-2.16	**-4.91**
PP	-1.68	-5.18	**-14.14**	**-305.88**	PP	**-39.49**	**-84.16**	**-20.98**	**-45.24**
MZ	-0.22	-1.26	-2.53	-12.29	MZ	**-2.73**	**-5.44**	-1.64	**-3.39**
Japan					Japan				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.12	-2.14	-2.56	0	DFG	-2.25	**-4.24**	**-4.97**	-2.44
PP	-3.84	**-17.82**	-14.42	**-101.19**	PP	**-10.91**	**-62.53**	**-45.4**	**-13.56**
MZ	-1.04	-2.51	-2.48	**-7.09**	MZ	-1.63	**-4.41**	**-4.07**	-2.21
New Zealand					New Zealand				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-2.07	-1.44	-3.13	-1.85	DFG	**-4.09**	**-4.51**	**-5.77**	**-4.53**
PP	-8.1	-4.64	**-20.34**	-5.75	PP	**-36.48**	**-45.56**	**-64.17**	**-49.92**
MZ	-1.88	-1.36	**-2.81**	-1.54	MZ	**-3.27**	**-3.24**	**-3.73**	**-3.11**
Pakistan					Pakistan				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.88	-2.29	-1.85	-1.45	DFG	**-3.23**	0	0	-0.75
PP	-6.74	-5.69	-8.52	-4.66	PP	**-25**	**-25.03**	**-50.8**	**-933.99**
MZ	-1.8	-1.43	-1.82	-1.34	MZ	-2.53	-1.27	**-3.64**	**-21.31**
Philippines					Philippines				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	0	-2.38	-1.23	-1.75	DFG	**-3.97**	**-4.6**	0	-0.57
PP	-7.2	-13.05	-3.89	-7.71	PP	**-31.08**	**-37.9**	**-30.23**	**-329.86**
MZ	-1.77	-2.48	-1.14	-1.72	MZ	**-3.42**	**-4.03**	**-2.86**	**-12.36**
South Korea					South Korea				

	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.12	-2.37	-1.58	0	DFG	0	**-4.68**	**-5.18**	**-5.61**
PP	-3.66	-11.45	-6.41	-2.18	PP	**-14.47**	**-43.39**	**-46.09**	**-52.66**
MZ	-1.06	-2.25	-1.53	-0.42	MZ	-1.78	**-3.32**	**-4**	**-3.72**
Thailand					Thailand				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	0	-1.81	-1.21	-2.12	DFG	0	**-4.38**	0	0
PP	-3.58	-7.27	-3.48	-10.15	PP	-11.8	**-37.5**	**-15.66**	**-123.15**
MZ	-1.15	-1.77	-1.13	-1.94	MZ	-2.02	**-3.39**	-0.33	**-7.28**
Notes: See Table 1C									

Table 8C: Unit Root for the level and first difference data (for Trade and ELEP-Coal)

China					China				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.78	0	**-3.28**		DFG	0	**-3.92**	0	
PP	**-3.65**	**-3.11**	**-19.62**		PP	**-21.12**	**-31.96**	**-20.74**	
MZ	-1.27	-1.08	-2.99		MZ	-2.33	**-3.23**	**-2.86**	
China HKSAR					China HKSAR				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.25	-1.53	-0.82	-1.56	DFG	**-3.08**	-2.1	**-7.41**	0
PP	-5.67	-7.19	-6.48	-4.83	PP	**-20.05**	-10.21	**-15.61**	**-19.26**
MZ	-1.4	-0.72	-0.44	-1.39	MZ	-2.47	-0.47	-0.93	-1.57
India					India				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.08	-2.59	0	0	DFG	**-4.54**	-2.57	-2.16	**-4.91**
PP	-3.41	**-20.48**	**-14.14**	**-305.88**	PP	**-42.95**	**-17.74**	**-20.98**	**-45.24**
MZ	-1.01	-2.63	-2.53	-12.29	MZ	**-3.11**	-1.22	-1.64	**-3.39**
Indonesia					Indonesia				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.49	-2.3	-1.41	-2.3	DFG	**-3.69**	**-3.84**	-1.57	**-3.6**
PP	-10.87	-11.22	-10.3	-11.25	PP	**-29.43**	**-29.54**	**-16.14**	**-28.71**
MZ	-2.07	-2.14	0.36	-2.18	MZ	-2.51	**-2.7**	-0.23	**-2.68**
Japan					Japan				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.63	**-2.74**	-2.56	0	DFG	**-4.82**	-1.67	**-4.97**	-2.44
PP	-5.6	15.86	**-14.42**	**-101.19**	PP	**-47.28**	**-195.83**	**-45.4**	**-13.56**
MZ	-1.57	5.71	-2.48	**-7.09**	MZ	**-3.72**	**-9.42**	**-4.07**	-2.21
New Zealand					New Zealand				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-0.84	7.04	-3.04	-1.88	DFG	0	15.53	**-4.11**	0
PP	-2.68	18.48	-20.74	-7.6	PP	**-23.68**	19.42	**-40.53**	**-29.63**
MZ	-0.8	15.9	-2.55	-1.66	MZ	-0.95	57266.64	-2.48	-2.42
Pakistan					Pakistan				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-2.54	-2.55	-1.85	-1.45	DFG	**-4.52**	**-6.34**	0	-0.75
PP	-13.64	-11.71	-8.52	-4.66	PP	**-41.87**	**-26.92**	**-50.8**	**-933.99**
MZ	-2.39	-1.91	-1.82	-1.34	MZ	**-3.24**	-2.37	**-3.64**	**-21.31**
Philippines					Philippines				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.75	-2.11	-1.23	-1.75	DFG	**-3.19**	0	0	-0.57
PP	-8.82	-11.77	-3.89	-7.71	PP	**-23.14**	**-38.93**	**-30.23**	**-329.86**
MZ	-1.92	-2.05	-1.14	-1.72	MZ	**-2.67**	**-2.92**	**-2.86**	**-12.36**
South Korea					South Korea				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	0	-2.39	-1.58	0	DFG	-0.04	-2.21	**-5.18**	**-5.61**
PP	-7.33	17.12	-6.41	-2.18	PP	**-56.34**	7.95	**-46.09**	**-52.66**
MZ	-1.72	8.84	-1.53	-0.42	MZ	**-4.6**	2.23	**-4**	**-3.72**
Thailand					Thailand				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-2.13	**-2.76**	-1.21	-2.12	DFG	**-3.91**	**-3.6**	0	0
PP	-8.93	**-16.32**	-3.48	-10.15	PP	**-31.47**	**-33.03**	**-15.66**	**-123.15**
MZ	-1.98	-2.61	-1.13	-1.94	MZ	**-2.93**	**-2.82**	-0.33	**-7.28**
Notes: See Table 1C									

Table 9C: Unit Root for the level and first difference data (for GDP and ELEP-HYD)

Bangladesh					Bangladesh				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-0.08	0	-2.26	-1.67	DFG	0	**-13.66**	**-4.13**	**-4.1**
PP	-0.76	-4.09	-8.84	-7.1	PP	**-18.63**	**-28.8**	**-41.85**	**-37.81**
MZ	-0.25	0.22	-1.58	-1.68	MZ	-1.2	-1.18	-2.52	**-2.86**
China					China				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	0	-2.01	0	-2.6	DFG	0	0	0	0
PP	-8.32	-7.02	-13.69	-13.81	PP	**-34.81**	**-79.49**	**-52.49**	**-23.24**
MZ	-1.65	-1.63	-2.41	-2.41	MZ	**-3.72**	**-5.39**	**-4.23**	-0.61
India					India				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-0.16	0	**-3.07**	-1.83	DFG	**-4.08**	0	**-3.93**	**-4.64**
PP	-1.68	-5.18	**-17.75**	-6.64	PP	**-39.49**	**-84.16**	**-34.51**	**-43.94**
MZ	-0.22	-1.26	**-2.81**	-1.57	MZ	**-2.73**	**-5.44**	**-2.9**	**-3.13**
Indonesia					Indonesia				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.95	-1.94	-1.4	-2.01	DFG	**-3.24**	**-4.52**	0	0
PP	-8.97	-7.56	-5.31	-6.58	PP	**-21.62**	**-40.81**	**-32.28**	**-116.11**
MZ	-1.99	-1.83	-1.34	-1.67	MZ	**-2.73**	**-3.27**	-1.95	**-6.68**
Japan					Japan				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.12	-2.14	-2.6	-2.33	DFG	-2.25	**-4.24**	**-6.36**	**-5.25**
PP	-3.84	**-17.82**	**-17.68**	-12.22	PP	-10.91	**-62.53**	**-70.93**	**-61.6**
MZ	-1.04	-2.51	-2.26	-2.15	MZ	-1.63	**-4.41**	**-3.53**	**-3.23**
Malaysia					Malaysia				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.79	-2.29	-2.16	0	DFG	0	**-5.85**	**-4.82**	**-5.55**
PP	-10.5	-11.09	-10.43	-6.25	PP	**-14.62**	**-56.46**	**-42.41**	**-51.81**
MZ	-2.03	-2.15	-2.15	-1.65	MZ	-1.29	**-4.23**	**-3.71**	**-4.4**
New Zealand					New Zealand				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-2.07	-1.44	-1.32	-0.77	DFG	**-4.09**	**-4.51**	**-5.66**	**-5.17**
PP	-8.1	-4.64	-4.11	-1.82	PP	**-36.48**	**-45.56**	**-60.61**	**-62.4**
MZ	-1.88	-1.36	-1.05	-0.59	MZ	**-3.27**	**-3.24**	**-3.8**	**-3.2**
Pakistan					Pakistan				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.88	-2.29	-1.67	-1.24	DFG	**-3.23**	0	**-4.2**	**-2.19**
PP	-6.74	-5.69	-5.09	-3.93	PP	**-25**	**-25.03**	**-38.89**	**-34.96**
MZ	-1.8	-1.43	-1.32	-1.19	MZ	-2.53	-1.27	**-2.79**	**-2.79**
Philippines					Philippines				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	0	-2.38			DFG	**-3.97**	**-4.6**		
PP	-7.2	-13.05			PP	**-31.08**	**-37.9**		
MZ	-1.77	-2.48			MZ	**-3.42**	**-4.03**		
South Korea					South Korea				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.12	-2.37	-1.05	-1.78	DFG	0	**-4.68**	0	0
PP	-3.66	-11.45	-3.89	-7.2	PP	**-14.47**	**-43.39**	**-31.86**	**-52.33**
MZ	-1.06	-2.25	-1.1	-1.65	MZ	-1.78	**-3.32**	-0.62	**-3.21**
Thailand					Thailand				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	0	-1.81	-1.87	-1.95	DFG	0	**-4.38**	**-4.77**	**-4.01**
PP	-3.58	-7.27	-7.67	-9.01	PP	-11.8	**-37.5**	**-43.9**	**-38.09**
MZ	-1.15	-1.77	-1.68	-1.9	MZ	-2.02	**-3.39**	**-3.22**	**-2.76**

Notes: See Table 1C

Table 10C: Unit Root for the level and first difference data (for ELEP-HYD and Trade)

Bangladesh					Bangladesh				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-2.18	**-2.68**			DFG	**-3.48**	0		
PP	-11.16	-8.38			PP	**-34.82**	**-13.38**		
MZ	-2.1	-1.71			MZ	-2.39	**-1**		
China					China				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.78	0	-1.92	-1.71	DFG	0	**-3.92**	0	-0.96
PP	-3.65	-3.11	-9.2	-5.48	PP	**-21.12**	**-31.96**	**-27.25**	**-22.46**
MZ	-1.27	-1.08	-1.94	-1.44	MZ	-2.33	-3.23	-2.46	-0.68
India					India				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-

DFG	-1.08	-2.59	**-3.07**	-1.83	DFG	**-4.54**	-2.57	**-3.93**	**-4.64**
PP	-3.41	**-20.48**	**-17.75**	-6.64	PP	**-42.95**	**-17.74**	**-34.51**	**-43.94**
MZ	-1.01	**-2.63**	-2.81	-1.57	MZ	**-3.11**	-1.22	**-2.9**	**-3.13**
Indonesia					Indonesia				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.2	**-2.7**	-1.4	-2.01	DFG	**-4.13**	0	0	0
PP	-3.03	**-15.16**	-5.31	-6.58	PP	**-35.33**	**-45.52**	**-32.28**	**-116.11**
MZ	-1.15	-2.48	-1.34	-1.67	MZ	**-2.83**	**-3.44**	-1.95	**-6.68**
Japan					Japan				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.63	**-2.74**	-2.6	-2.33	DFG	**-4.82**	-1.67	**-6.36**	**-5.25**
PP	-5.6	15.86	**-17.68**	-12.22	PP	**-47.28**	**-195.83**	**-70.93**	**-61.6**
MZ	-1.57	5.71	-2.26	-2.15	MZ	**-3.72**	**-9.42**	**-3.53**	**-3.23**
Malaysia					Malaysia				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	0	-1.64	-2.16	0	DFG	0	**-4.36**	**-4.82**	**-5.55**
PP	-5.69	-7.89	-10.43	-6.25	PP	**-16.22**	**-32.82**	**-42.41**	**-51.81**
MZ	-1.41	-1.54	-2.15	-1.65	MZ	-1.38	**-2.48**	**-3.71**	**-4.4**
New Zealand					New Zealand				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-0.84	7.04	**-2.96**	-1.27	DFG	0	15.53	**-4.51**	0
PP	-2.68	18.48	**-19.19**	-3.38	PP	**-23.68**	19.42	**-41.27**	**-196.89**
MZ	-0.8	15.9	-2.48	-1.03	MZ	-0.95	57266.64	**-2.72**	**-9.11**
Pakistan					Pakistan				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-2.54	-2.55	-1.67	-1.24	DFG	**-4.52**	**-6.34**	**-4.2**	**-2.19**
PP	**-13.64**	-11.71	-5.09	-3.93	PP	**-41.87**	**-26.92**	**-38.89**	**-34.96**
MZ	-2.39	-1.91	-1.32	-1.19	MZ	**-3.24**	-2.37	**-2.79**	**-2.79**
Philippines					Philippines				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.75	-2.11			DFG	**-3.19**	0		
PP	-8.82	-11.77			PP	**-23.14**	**-38.93**		
MZ	-1.92	-2.05			MZ	**-2.67**	**-2.92**		
South Korea					South Korea				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	0	-2.39	-1.05	-1.78	DFG	-0.04	-2.21	0	0
PP	-7.33	17.12	-3.89	-7.2	PP	**-56.34**	7.95	**-31.86**	**-52.33**
MZ	-1.72	8.84	-1.1	-1.65	MZ	**-4.6**	2.23	-0.62	**-3.21**
Thailand					Thailand				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-2.13	**-2.76**	-1.87	-1.95	DFG	**-3.91**	**-3.6**	**-4.77**	**-4.01**
PP	-8.93	**-16.32**	-7.67	-9.01	PP	**-31.47**	**-33.03**	**-43.9**	**-38.09**
MZ	-1.98	-2.61	-1.68	-1.9	MZ	**-2.93**	**-2.82**	**-3.22**	**-2.76**
Notes: See Table 1C									

Table 11C: Unit Root for the level and first difference data (for GDP and ELEP-NG)

Bangladesh					Bangladesh				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-0.08	0	-1.45	-2.2	DFG	0	**-13.66**	-1.29	**-4.81**
PP	-0.76	-4.09	-3.32	-7.78	PP	**-18.63**	**-28.8**	**-22.21**	**-44.07**
MZ	-0.25	0.22	-1.06	-1.69	MZ	-1.2	-1.18	-1.26	**-3.35**
China					China				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-4.35		-1.89	-2.11	DFG	**-3.8**		**-3.88**	0
PP	-33.96		-9.68	-10.59	PP	**-25.67**		**-33.82**	**-32.99**
MZ	-4.01		-1.79	-2.07	MZ	**-3.29**		-2.5	**-3.05**
India					India				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-0.16	0	-1.7	**-3.3**	DFG	**-4.08**	0	**-4**	0
PP	-1.68	-5.18	-6.56	**-17.02**	PP	**-39.49**	**-84.16**	**-24.89**	**-33.25**
MZ	-0.22	-1.26	-1.69	-2.46	MZ	**-2.73**	**-5.44**	-2.02	-1.98
Indonesia					Indonesia				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.84	-2.05	-1.09	-0.62	DFG	**-2.78**	**-4.14**	**-3.49**	**-5.37**
PP	-7.85	-8.46	-6.25	-3.9	PP	**-17.12**	**-34.51**	**-29.58**	**-46.17**
MZ	-1.9	-1.93	-0.91	-0.63	MZ	-2.19	**-3.01**	-1.35	**-3.47**
Japan					Japan				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.12	-2.14	-1.09	-2.28	DFG	-2.25	**-4.24**	0	0
PP	-3.84	**-17.82**	-2.24	-9.82	PP	-10.91	**-62.53**	**-18.54**	**-59.19**
MZ	-1.04	-2.51	-0.64	-2.08	MZ	-1.63	**-4.41**	-0.87	**-4.23**
Malaysia					Malaysia				

	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.85	-2.56	-1.07	-1.78	DFG	-1.55	0	**-3.32**	0
PP	-11.06	-13.4	-3.2	-6.67	PP	**-17.46**	**-46.77**	**-24.92**	**-39.9**
MZ	-2.24	-2.38	-0.97	-1.73	MZ	-2.17	**-3.86**	-2.44	**-3.41**
New Zealand					New Zealand				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	**-2.85**	-1.75	0	-2.35	DFG	**-3.49**	**-3.22**	**-5.91**	**-5.75**
PP	**-16.34**	-5.94	-3.79	-10.04	PP	**-25.01**	**-29.64**	**-43.59**	**-55.07**
MZ	**-2.81**	-1.58	-0.76	-2.01	MZ	**-2.96**	**-2.34**	**-3.65**	**-3.87**
Pakistan					Pakistan				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.88	-2.29	-2.5	-1.79	DFG	**-3.23**	**0**	**0**	**-3.44**
PP	-6.74	-5.69	-13.93	**-14.39**	PP	**-25**	**-25.03**	**-55.42**	**-27.6**
MZ	-1.8	-1.43	-2.38	-2.31	MZ	**-2.53**	**-1.27**	**-4.27**	**-2.79**
Thailand					Thailand				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-2.04	-2.23	-0.11	-1.42	DFG	0	**-3.75**		**-4.42**
PP	**-28.79**	-9.79	-5.9	-4.52	PP	-7.27	**-27.96**		**-35.33**
MZ	**-3.72**	-2.09	-0.09	-1.3	MZ	-1.5	**-2.94**		**-3.01**
Notes: See Table 1C									

Table 12C: Unit Root for the level and first difference data (for Trade and ELEP-NG)

Bangladesh					Bangladesh				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-2.24	**-2.71**	-1.45	-2.2	DFG	**-3.5**	0	-1.29	**-4.81**
PP	-11.18	-8.48	-3.32	-7.78	PP	**-34.84**	-13.22	**-22.21**	**-44.07**
MZ	-2.14	-1.71	-1.06	-1.69	MZ	-2.38	-0.97	-1.26	**-3.35**
China					China				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.85	0	-1.89	-2.11	DFG	0	**-4.34**	**-3.88**	0
PP	-5.41	-3.06	-9.68	-10.59	PP	**-17.56**	**-37.79**	**-33.82**	**-32.99**
MZ	-1.52	-0.92	-1.79	-2.07	MZ	-2.28	**-3.65**	-2.5	**-3.05**
India					India				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.08	-2.59	-1.7	**-3.3**	DFG	**-4.54**	-2.57	**-4**	0
PP	-3.41	**-20.48**	-6.56	**-17.02**	PP	**-42.95**	**-17.74**	**-24.89**	**-33.25**
MZ	-1.01	**-2.63**	-1.69	-2.46	MZ	**-3.11**	-1.22	-2.02	-1.98
Indonesia					Indonesia				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.35	**-2.7**	-1.09	-0.62	DFG	**-4.07**	-2.46	**-3.49**	**-5.37**
PP	-3.57	**-15.12**	-6.25	-3.9	PP	**-36.69**	**-40.39**	**-29.58**	**-46.17**
MZ	-1.04	-2.52	-0.91	-0.63	MZ	**-2.81**	**-3.28**	-1.35	**-3.47**
Japan					Japan				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.63	**-2.74**	-1.09	-2.28	DFG	**-4.82**	-1.67	0	0
PP	-5.6	15.86	-2.24	-9.82	PP	**-47.28**	**-195.83**	**-18.54**	**-59.19**
MZ	-1.57	5.71	-0.64	-2.08	MZ	**-3.72**	**-9.42**	-0.87	**-4.23**
Malaysia					Malaysia				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	0	-1.28	-1.07	-1.78	DFG	0	**-2.97**	-3.32	0
PP	-4.83	-9.63	-3.2	-6.67	PP	**-17.31**	**-24.95**	**-24.92**	**-39.9**
MZ	-1.27	-1.66	-0.97	-1.73	MZ	-1.97	-2.2	-2.44	**-3.41**
New Zealand					New Zealand				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-0.84	7.04	-2.59	**-3.56**	DFG	0	15.53	**-4.07**	**-5.21**
PP	-2.68	18.48	-12.86	**-17.93**	PP	**-23.68**	19.42	**-34.32**	**-46.04**
MZ	-0.8	15.9	-2.27	-2.51	MZ	-0.95	57266.64	**-2.82**	**-3.59**
Pakistan					Pakistan				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-2.54	-2.55	-2.5	-1.79	DFG	**-4.52**	**-6.34**	0	**-3.44**
PP	-13.64	-11.71	-13.93	**-14.39**	PP	**-41.87**	**-26.92**	**-55.42**	**-27.6**
MZ	-2.39	-1.91	-2.38	-2.31	MZ	**-3.24**	-2.37	**-4.27**	**-2.79**
South Korea					South Korea				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	**-2.86**	-2.36	-2.36	-3.1	DFG	0	-2.28	0	**-3.82**
PP	-13.9	12.62	-11.64	**-19.21**	PP	-12.09	8.52	**-16.29**	**-31.48**
MZ	-2.45	6.54	-0.16	-2.77	MZ	-1.27	3.29	-0.23	**-2.84**
Thailand					Thailand				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.74	**-2.62**	-0.11	-1.42	DFG	**-3.7**	**-3.59**		**-4.42**
PP	-7.01	**-18.24**	-5.9	-4.52	PP	**-24.43**	**-25.21**		**-35.33**
MZ	-1.65	-2.38	-0.09	-1.3	MZ	**-2.73**	-2.07		**-3.01**

Notes: See Table 1C

Table 13C: Unit Root for the level and first difference data (for GDP and ELEP-NU)

India					India				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-0.16	0	-2.44	-1.97	DFG	**-4.08**	0	0	**-5.22**
PP	-1.68	-5.18	-10.26	-8.19	PP	**-39.49**	**-84.16**	**-53.49**	**-50.31**
MZ	-0.22	-1.26	-1.82	-1.82	MZ	**-2.73**	**-5.44**	**-3.67**	**-3.43**
Japan					Japan				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.39	-2.1	0	-1.15	DFG	0	**-3.99**	**-4.02**	0
PP	-5.48	**-16.52**	-4.81	-4.06	PP	-10.1	**-54.78**	**-35.83**	**-27.91**
MZ	-1.28	-2.45	-1.25	-1.14	MZ	-1.29	**-4.11**	**-2.86**	-2.14
Pakistan					Pakistan				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.88	-2.29	-2.4	-1.81	DFG	**-3.23**	0	**-4.87**	**-4.15**
PP	-6.74	-5.69	-12.01	-7.18	PP	**-25**	**-25.03**	**-44.58**	**-34.85**
MZ	-1.8	-1.43	-2.24	-1.77	MZ	-2.53	-1.27	**-3.4**	**-3.15**
South Korea					South Korea				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.02	-2.25	-0.03	-2.32	DFG	0	**-4.34**	**-15.27**	**-4.35**
PP	-3.96	-10.64	-4.23	-8.4	PP	-10.4	**-37.23**	**-22.77**	**-37.39**
MZ	-1.15	-2.16	0.22	-1.82	MZ	-0.87	**-3.08**	-0.85	**-3.04**

Notes: See Table 1C

Table 14C: Unit Root for the level and first difference data (for Trade and ELEP-NU)

India					India				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.08	-2.59	-2.44	-1.97	DFG	**-4.54**	-2.57	0	**-5.22**
PP	-3.41	**-20.48**	-10.26	-8.19	PP	**-42.95**	**-17.74**	**-53.49**	**-50.31**
MZ	-1.01	**-2.63**	-1.82	-1.82	MZ	**-3.11**	-1.22	**-3.67**	**-3.43**
Japan					Japan				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-2.02	**-3.11**	0	-1.15	DFG	**-4.76**	-1.68	**-4.02**	0
PP	-7.44	15.89	-4.81	-4.06	PP	**-44.42**	**-133.9**	**-35.83**	**-27.91**
MZ	-1.79	6.72	-1.25	-1.14	MZ	**-3.68**	**-7.64**	**-2.86**	-2.14
Pakistan					Pakistan				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-2.54	-2.55	-2.4	-1.81	DFG	**-4.52**	**-6.34**	**-4.87**	**-4.15**
PP	-13.64	-11.71	-12.01	-7.18	PP	**-41.87**	**-26.92**	**-44.58**	**-34.85**
MZ	-2.39	-1.91	-2.24	-1.77	MZ	**-3.24**	-2.37	**-3.4**	**-3.15**
South Korea					South Korea				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-2.33	-2.44	-0.03	-2.32	DFG	0	-2.2	**-15.27**	**-4.35**
PP	-6.33	15.6	-4.23	-8.4	PP	**-70.76**	6.35	**-22.77**	**-37.39**
MZ	-1.7	8.17	0.22	-1.82	MZ	**-5.41**	1.94	-0.85	**-3.04**

Notes: See Table 1C

Table 15C: Unit Root for the level and first difference data (for GDP and ELEP-Oil)

Bangladesh					Bangladesh				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-0.08	0	-1.78	-1.72	DFG	0	**-13.66**	**-4.07**	**-3.4**
PP	-0.76	-4.09	-6.96	-7.18	PP	**-18.63**	**-28.8**	**-34.86**	**-24.32**
MZ	-0.25	0.22	-1.75	-1.79	MZ	-1.2	-1.18	**-3.05**	**-2.86**
China					China				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	0	-2.01	-1.15	-1.22	DFG	0	0	**-5.71**	-2.23
PP	-8.32	-7.02	-5.87	**-33.66**	PP	**-34.81**	**-79.49**	**-26.42**	**-15.37**
MZ	-1.65	-1.63	-1.11	**-3.64**	MZ	**-3.72**	**-5.39**	-2.51	-2.07
China HKSAR					China HKSAR				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.25	-1.87	-1.69	-1.69	DFG	0	**-4.27**	-2.59	0
PP	-4.41	-8.24	-6.12	-5.87	PP	**-20.61**	**-39.62**	**-24.57**	**-25.68**
MZ	-1.16	-1.82	-1.67	-1.56	MZ	-1.69	**-3.01**	-1.89	-2.29
India					India				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-0.16	0	-2.06	-1.6	DFG	**-4.08**	**0**	**0**	**-2.77**
PP	-1.68	-5.18	-7.56	-7.09	PP	**-39.49**	**-84.16**	**-32.18**	**-20.37**
MZ	-0.22	-1.26	-1.85	-0.74	MZ	**-2.73**	**-5.44**	-2.22	-1.3
Indonesia					Indonesia				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.95	-1.94	-1.53	-2.36	DFG	**-3.24**	**-4.52**	**-3.89**	**-4.58**

PP	-8.97	-7.56	-6.49	-11.47	PP	**-21.62**	**-40.81**	**-31.39**	**-40.15**
MZ	-1.99	-1.83	-1.56	-2.29	MZ	**-2.73**	**-3.27**	**-2.9**	**-3.58**
Japan					Japan				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.12	-2.14	-0.96	-0.91	DFG	-2.25	**-4.24**	0	0
PP	-3.84	-17.82	-3.03	-2.55	PP	-10.91	**-62.53**	**-17.83**	**-45.62**
MZ	-1.04	-2.51	-0.91	-0.69	MZ	-1.63	**-4.41**	-1.94	-1.94
Malaysia					Malaysia				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.79	-2.29	-2.02	-1.09	DFG	0	**-5.85**	**-4.92**	0
PP	-10.5	-11.09	-8.67	-3.24	PP	**-14.62**	**-56.46**	**-42.66**	**-25.72**
MZ	-2.03	-2.15	-1.99	-1	MZ	-1.29	**-4.23**	**-3.79**	-2.39
New Zealand					New Zealand				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-2.58	-1.47			DFG	**-3.88**	0		
PP	-10.89	-4.96			PP	**-32.71**	**-41.23**		
MZ	-2.22	-1.38			MZ	**-3**	**-3.07**		
Pakistan					Pakistan				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.88	-2.29	-1.97	-1.83	DFG	**-3.23**	0	0	**-3.46**
PP	-6.74	-5.69	-7.83	-5.92	PP	**-25**	**-25.03**	**-42.37**	**-26.28**
MZ	-1.8	-1.43	-1.86	-1.58	MZ	-2.53	-1.27	**-4.35**	**-2.76**
Philippines					Philippines				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	0	-2.38	-2.27	-1.36	DFG	**-3.97**	**-4.6**	0	0
PP	-7.2	-13.05	-9.81	-4.62	PP	**-31.08**	**-37.9**	**-42.77**	**-30.75**
MZ	-1.77	-2.48	-2.07	-1.29	MZ	**-3.42**	**-4.03**	**-3.13**	**-2.7**
Singapore					Singapore				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.37	-0.82	-0.46	-1.79	DFG	0	0	0	**-3.26**
PP	-10.01	-4.36	-4.74	-9.74	PP	**-23.17**	**-36.16**	**-18.16**	**-21.62**
MZ	-1.75	-0.99	-0.97	-2	MZ	-2.25	**-2.94**	-1.94	**-3**
South Korea					South Korea				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.12	-2.37	-2.28	-2.38	DFG	0	**-4.68**	**-4.15**	**-4.09**
PP	-3.66	-11.45	-11.53	-11.42	PP	**-14.47**	**-43.39**	**-36.52**	**-36.07**
MZ	-1.06	-2.25	-2.25	-2.2	MZ	-1.78	**-3.32**	**-3.1**	**-3.06**
Thailand					Thailand				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	0	-1.81	**-2.83**	-1.43	DFG	0	**-4.38**	**-3.89**	**-3.38**
PP	-3.58	-7.27	**-16.91**	**-15.57**	PP	-11.8	**-37.5**	**-29.51**	**-26.83**
MZ	-1.15	-1.77	**-2.8**	-2.37	MZ	-2.02	**-3.39**	**-3.06**	**-2.92**
Notes: See Table 1C									

Table 16C: Unit Root for the level and first difference data (for Trade and ELEP-Oil)

Bangladesh					Bangladesh				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-2.24	**-2.71**	-1.78	-1.72	DFG	**-3.5**	0	**-4.07**	**-3.4**
PP	-11.18	-8.48	-6.96	-7.18	PP	**-34.84**	-13.22	**-34.86**	**-24.32**
MZ	-2.14	-1.71	-1.75	-1.79	MZ	-2.38	-0.97	**-3.05**	**-2.86**
China					China				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.78	0	**-2.89**	-1.54	DFG	0	**-3.92**	**-4.39**	-2.01
PP	-3.65	-3.11	-11.74	**-46.75**	PP	**-21.12**	**-31.96**	**-26.65**	-12.4
MZ	-1.27	-1.08	-2.26	**-4.47**	MZ	-2.33	**-3.23**	-2.58	-1.88
China HKSAR					China HKSAR				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.48	-1.57	-1.69	-1.69	DFG	0	**-3.17**	-2.59	0
PP	-6.55	-5.3	-6.12	-5.87	PP	-12.82	**-27.41**	**-24.57**	**-25.68**
MZ	-1.64	-1.28	-1.67	-1.56	MZ	-1.63	-1.7	-1.89	-2.29
India					India				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.08	-2.59	-2.06	-1.6	DFG	**-4.54**	-2.57	0	**-2.77**
PP	-3.41	-20.48	-7.56	-7.09	PP	**-42.95**	**-17.74**	**-32.18**	**-20.37**
MZ	-1.01	-2.63	-1.85	-0.74	MZ	**-3.11**	-1.22	-2.22	-1.3
Indonesia					Indonesia				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.2	**-2.7**	-1.53	-2.36	DFG	**-4.13**	0	**-3.89**	**-4.58**
PP	-3.03	**-15.16**	-6.49	-11.47	PP	**-35.33**	**-45.52**	**-31.39**	**-40.15**
MZ	-1.15	-2.48	-1.56	-2.29	MZ	**-2.83**	**-3.44**	**-2.9**	**-3.58**
Japan					Japan				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-

DFG	-1.63	**-2.74**	-0.96	-0.91	DFG	**-4.82**	-1.67	0	0
PP	-5.6	15.86	-3.03	-2.55	PP	**-47.28**	**-195.83**	**-17.83**	**-45.62**
MZ	-1.57	5.71	-0.91	-0.69	MZ	**-3.72**	**-9.42**	-1.94	-1.94
Malaysia					Malaysia				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	0	-1.64	-2.02	-1.09	DFG	0	**-4.36**	**-4.92**	0
PP	-5.69	-7.89	-8.67	-3.24	PP	**-16.22**	**-32.82**	**-42.66**	**-25.72**
MZ	-1.41	-1.54	-1.99	-1	MZ	-1.38	-2.48	**-3.79**	-2.39
New Zealand					New Zealand				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-0.84	7.04			DFG	0	15.53		
PP	-2.68	18.48			PP	**-23.68**	19.42		
MZ	-0.8	15.9			MZ	-0.95	57266.64		
Pakistan					Pakistan				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-2.54	-2.55	-1.97	-1.83	DFG	**-4.52**	**-6.34**	0	**-3.46**
PP	-13.64	-11.71	-7.83	-5.92	PP	**-41.87**	**-26.92**	**-42.37**	**-26.28**
MZ	-2.39	-1.91	-1.86	-1.58	MZ	**-3.24**	**-2.37**	**-4.35**	**-2.76**
Philippines					Philippines				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.75	-2.11	-2.27	-1.36	DFG	**-3.19**	0	0	0
PP	-8.82	-11.77	-9.81	-4.62	PP	**-23.14**	**-38.93**	**-42.77**	**-30.75**
MZ	-1.92	-2.05	-2.07	-1.29	MZ	**-2.67**	**-2.92**	**-3.13**	**-2.7**
Singapore					Singapore				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	**-3.9**	-2.41	-0.95	-1.92	DFG	**-3.75**	0	**-2.8**	**-3.13**
PP	**-29.5**	**-19.04**	-7.81	-10.12	PP	**-30.51**	**-17.64**	**-15.46**	**-20.15**
MZ	**-3.58**	-2.49	-1.57	-2.07	MZ	-2.8	-1.2	-1.99	**-2.88**
South Korea					South Korea				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	0	-2.39	-2.28	-2.38	DFG	-0.04	-2.21	**-4.15**	**-4.09**
PP	-7.33	17.12	-11.53	-11.42	PP	**-56.34**	7.95	**-36.52**	**-36.07**
MZ	-1.72	8.84	-2.25	-2.2	MZ	**-4.6**	2.23	**-3.1**	**-3.06**
Thailand					Thailand				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-2.13	**-2.76**	**-2.83**	-1.43	DFG	**-3.91**	**-3.6**	**-3.89**	**-3.38**
PP	-8.93	**-16.32**	**-16.91**	**-15.57**	PP	**-31.47**	**-33.03**	**-29.51**	**-26.83**
MZ	-1.98	**-2.61**	**-2.8**	-2.37	MZ	**-2.93**	**-2.82**	**-3.06**	**-2.92**
Notes: See Table 1C									

Table 17C: Unit Root for the level and first difference data (for ELEP-Rene and GDP)

Bangladesh					Bangladesh				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-0.08	0	-2.26	-1.67	DFG	0	**-13.66**	**-4.13**	**-4.1**
PP	-0.76	-4.09	-8.84	-7.1	PP	**-18.63**	**-28.8**	**-41.85**	**-37.81**
MZ	-0.25	0.22	-1.58	-1.68	MZ	-1.2	-1.18	-2.52	**-2.86**
China					China				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	0	-2.01	-2.31	**-2.64**	DFG	0	0	0	0
PP	-8.32	-7.02	-13.68	**-14.33**	PP	**-34.81**	**-79.49**	**-51.79**	**-23.86**
MZ	-1.65	-1.63	-2.38	-2.45	MZ	**-3.72**	**-5.39**	**-4.2**	-0.77
India					India				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-0.16	0	**-2.95**	-2.13	DFG	**-4.08**	0	**-3.87**	**-4.66**
PP	-1.68	-5.18	**-16.76**	-8.41	PP	**-39.49**	**-84.16**	**-33.94**	**-45.09**
MZ	-0.22	-1.26	**-2.74**	-1.85	MZ	**-2.73**	**-5.44**	**-2.87**	**-3.04**
Indonesia					Indonesia				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.95	-1.94	-1.32	-2.32	DFG	**-3.24**	**-4.52**	0	0
PP	-8.97	-7.56	-4.56	-9.28	PP	**-21.62**	**-40.81**	**-31.04**	**-4348.61**
MZ	-1.99	-1.83	-1.24	-1.95	MZ	**-2.73**	**-3.27**	-1.78	**-46.49**
Japan					Japan				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.12	-2.14	-2.09	**-2.69**	DFG	-2.25	**-4.24**	0	**-5.33**
PP	-3.84	**-17.82**	-13.94	**-15.69**	PP	-10.91	**-62.53**	**-75.16**	**-60.95**
MZ	-1.04	-2.51	-1.87	-2.48	MZ	-1.63	**-4.41**	**-3.82**	**-3.35**
Malaysia					Malaysia				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.79	-2.29	-2.16	0	DFG	0	**-5.85**	**-4.82**	**-5.55**
PP	-10.5	-11.09	-10.43	-6.25	PP	**-14.62**	**-56.46**	**-42.41**	**-51.8**
MZ	-2.03	-2.15	-2.15	-1.65	MZ	-1.29	**-4.23**	**-3.71**	**-4.4**
New Zealand					New Zealand				

	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-2.07	-1.44	-1.46	-1.01	DFG	**-4.09**	**-4.51**	**-5.27**	**-4.64**
PP	-8.1	-4.64	-4.37	-2.49	PP	**-36.48**	**-45.56**	**-55.82**	**-54.77**
MZ	-1.88	-1.36	-1.14	-0.85	MZ	**-3.27**	**-3.24**	**-3.61**	**-3.02**
Pakistan					Pakistan				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.88	-2.29	-1.67	-1.24	DFG	**-3.23**	0	**-4.2**	-2.19
PP	-6.74	-5.69	-5.09	-3.93	PP	**-25**	**-25.03**	**-38.89**	**-34.96**
MZ	-1.8	-1.43	-1.32	-1.19	MZ	-2.53	-1.27	**-2.79**	**-2.79**
Philippines					Philippines				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	0	-2.31	-1.05	**-3.08**	DFG	0	**-4.54**	**-2.86**	**-4.66**
PP	-6.58	-12.49	-3.51	**-16.46**	PP	**-34.56**	**-36.71**	**-23.31**	**-42.32**
MZ	-1.68	-2.42	-0.99	-2.57	MZ	**-3.83**	**-3.96**	-2.15	**-3.17**
South Korea					South Korea				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.12	-2.37	-1.11	-1.42	DFG	0	**-4.68**	-0.53	-1.94
PP	-3.66	-11.45	-3.97	-5.4	PP	**-14.47**	**-43.39**	**-34.16**	**-32.39**
MZ	-1.06	-2.25	-1.15	-1.38	MZ	-1.78	**-3.32**	-0.41	-1.34
Thailand					Thailand				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	0	-1.81	-1.89	-1.2	DFG	0	**-4.38**	**-4.66**	**-3.83**
PP	-3.58	-7.27	-7.78	-4.24	PP	-11.8	**-37.5**	**-41.77**	**-37.62**
MZ	-1.15	-1.77	-1.72	-1.18	MZ	-2.02	**-3.39**	**-3.25**	-2.59

Notes: See Table 1C

Table 18C: Unit Root for the level and first difference data (for Trade and ELEP-Rene)

Bangladesh					Bangladesh				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-2.24	**-2.71**	-2.26	-1.67	DFG	**-3.5**	0	**-4.13**	**-4.1**
PP	-11.18	-8.48	-8.84	-7.1	PP	**-34.84**	-13.22	**-41.85**	**-37.81**
MZ	-2.14	-1.71	-1.58	-1.68	MZ	-2.38	-0.97	-2.52	**-2.86**
China					China				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.78	0	-1.82	-1.68	DFG	0	**-3.92**	0	0
PP	-3.65	-3.11	-8.91	-5.32	PP	**-21.12**	**-31.96**	**-27**	**-30.71**
MZ	-1.27	-1.08	-1.88	-1.43	MZ	-2.33	**-3.23**	-2.46	-2.16
India					India				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.08	-2.59	**-2.95**	-2.13	DFG	**-4.54**	-2.57	**-3.87**	**-4.66**
PP	-3.41	**-20.48**	**-16.76**	-8.41	PP	**-42.95**	**-17.74**	**-33.94**	**-45.09**
MZ	-1.01	**-2.63**	**-2.74**	-1.85	MZ	**-3.11**	-1.22	**-2.87**	**-3.04**
Indonesia					Indonesia				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.2	**-2.7**	-1.32	-2.32	DFG	**-4.13**	0	0	0
PP	-3.03	**-15.16**	-4.56	-9.28	PP	**-35.33**	**-45.52**	**-31.04**	**-4348.61**
MZ	-1.15	-2.48	-1.24	-1.95	MZ	**-2.83**	**-3.44**	-1.78	**-46.49**
Japan					Japan				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.63	-2.74	-2.09	**-2.69**	DFG	**-4.82**	-1.67	0	**-5.33**
PP	-5.6	15.86	-13.94	**-15.69**	PP	**-47.28**	**-195.83**	**-75.16**	**-60.95**
MZ	-1.57	5.71	-1.87	-2.48	MZ	**-3.72**	**-9.42**	**-3.82**	**-3.35**
Malaysia					Malaysia				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	0	-1.64	-2.16	0	DFG	0	**-4.36**	**-4.82**	**-5.55**
PP	-5.69	-7.89	-10.43	-6.25	PP	**-16.22**	**-32.82**	**-42.41**	**-51.8**
MZ	-1.41	-1.54	-2.15	-1.65	MZ	-1.38	-2.48	**-3.71**	**-4.4**
New Zealand					New Zealand				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-0.84	7.04	**-3.07**	-1.31	DFG	0	15.53	**-4.73**	0
PP	-2.68	18.48	**-20.59**	-3.44	PP	**-23.68**	19.42	**-43.63**	**-40.58**
MZ	-0.8	15.9	-2.55	-1.11	MZ	-0.95	57266.64	**-2.8**	-2.56
Pakistan					Pakistan				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-2.54	-2.55	-1.67	-1.24	DFG	**-4.52**	**-6.34**	**-4.2**	-2.19
PP	-13.64	-11.71	-5.09	-3.93	PP	**-41.87**	**-26.92**	**-38.89**	**-34.96**
MZ	-2.39	-1.91	-1.32	-1.19	MZ	**-3.24**	-2.37	**-2.79**	**-2.79**
Philippines					Philippines				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.65	-2.22	-1.05	**-3.08**	DFG	**-3.21**	0	**-2.86**	**-4.66**
PP	-8.74	-12.12	-3.51	**-16.46**	PP	**-22.34**	**-37.51**	**-23.31**	**-42.32**
MZ	-1.88	-2.12	-0.99	-2.57	MZ	**-2.62**	**-2.89**	-2.15	**-3.17**

South Korea					South Korea				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	0	-2.39	-1.11	-1.42	DFG	-0.04	-2.21	-0.53	-1.94
PP	-7.33	17.12	-3.97	-5.4	PP	**-56.34**	7.95	**-34.16**	**-32.39**
MZ	-1.72	8.84	-1.15	-1.38	MZ	**-4.6**	2.23	-0.41	-1.34
Thailand					Thailand				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-2.13	**-2.76**	-1.89	-1.2	DFG	**-3.91**	**-3.6**	**-4.66**	**-3.83**
PP	-8.93	**-16.32**	-7.78	-4.24	PP	**-31.47**	**-33.03**	**-41.77**	**-37.62**
MZ	-1.98	-2.61	-1.72	-1.18	MZ	**-2.93**	**-2.82**	**-3.25**	-2.59
Notes: See Table 1C									

Table 19C: Unit Root for the level and first difference data (for GDP and EPC)

Bangladesh					Bangladesh				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-0.19	-0.42	**-3.25**	-1.79	DFG	0	0	**-5.59**	**-4.39**
PP	-0.92	-2	**-15.51**	-6.72	PP	**-18.7**	**-32.9**	**-102.64**	**-36.72**
MZ	-0.35	-0.1	-2.23	-1.69	MZ	-1.26	-2.13	**-6.31**	**-3.36**
China					China				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	0	-2.01	-1.45	0	DFG	0	0	**-3.11**	**-4.86**
PP	-8.32	-7.02	-6.15	**-147.92**	PP	**-34.81**	**-79.49**	**-24.24**	**-44.63**
MZ	-1.65	-1.63	-1.49	**-8.52**	MZ	**-3.72**	**-5.39**	-2.53	**-3.37**
China HKSAR					China HKSAR				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.25	-1.87	-0.79	**-2.89**	DFG	0	**-4.27**	0	**-4.97**
PP	-4.41	-8.24	-2.27	**-15.06**	PP	**-20.61**	**-39.62**	**-11.45**	**-46.03**
MZ	-1.16	-1.82	-0.73	-2.44	MZ	-1.69	**-3.01**	-1.08	**-3.42**
India					India				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-0.16	0	-1.57	-1.73	DFG	**-4.08**	0	**-3.01**	**-4.64**
PP	-1.68	-5.18	-5.75	-6.18	PP	**-39.49**	**-84.16**	**-20.84**	**-42.32**
MZ	-0.22	-1.26	-1.64	-1.6	MZ	**-2.73**	**-5.44**	-2.49	**-3.28**
Indonesia					Indonesia				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.95	-1.94	-0.8	0	DFG	**-3.24**	**-4.52**	0	0
PP	-8.97	-7.56	-3.04	-8.42	PP	**-21.62**	**-40.81**	**-17.11**	**-21.61**
MZ	-1.99	-1.83	-0.91	-1.83	MZ	**-2.73**	**-3.27**	-2.02	0.04
Japan					Japan				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.46	-2.12			DFG	0	**-4.04**		
PP	-5.79	**-16.95**			PP	-10.25	**-56.09**		
MZ	-1.34	-2.48			MZ	-1.49	**-4.16**		
Malaysia					Malaysia				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.79	-2.29	-1.42	-1.27	DFG	0	**-5.85**	0	**-4.4**
PP	-10.5	-11.09	-7.79	-6.18	PP	**-14.62**	**-56.46**	-10.84	**-52.51**
MZ	-2.03	-2.15	-1.71	-1.3	MZ	-1.29	**-4.23**	-1.51	**-3.7**
New Zealand					New Zealand				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-2.22	-1.79			DFG	**-4.14**	**0**		
PP	-10.52	-5.1			PP	**-36.16**	**-42.18**		
MZ	-2.17	-1.26			MZ	**-3.04**	**-2.94**		
Pakistan					Pakistan				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.88	-2.29	-1.15	-2.09	DFG	**-3.23**	0	0	**-4.45**
PP	-6.74	-5.69	-2.83	-12.3	PP	**-25**	**-25.03**	**-17.57**	**-47.76**
MZ	-1.8	-1.43	-0.98	-2.13	MZ	-2.53	-1.27	-1.72	**-3.57**
Philippines					Philippines				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	0	-2.38	**-2.72**	-1.01	DFG	**-3.97**	**-4.6**	0	**-4.47**
PP	-7.2	-13.05	**-16.68**	-2.91	PP	**-31.08**	**-37.9**	**-29.44**	**-42.61**
MZ	-1.77	-2.48	-2.58	-0.99	MZ	**-3.42**	**-4.03**	**-2.68**	**-2.95**
Singapore					Singapore				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.37	-0.82	-0.21	-1.58	DFG	0	0	0	-1.98
PP	-10.01	-4.36	-3.38	**-212.01**	PP	**-23.17**	**-36.16**	**-19.62**	**-18.25**
MZ	-1.75	-0.99	-0.61	**-9.99**	MZ	-2.25	**-2.94**	-1.74	-2.43
South Korea					South Korea				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-0.86	-2.35	-0.75	-1.86	DFG	0	**-4.63**	0	**-4.57**
PP	-4.24	-11.22	-7.16	-6.98	PP	-13.55	**-42.51**	**-14.54**	**-41.82**

MZ	-1.1	-2.22	-1.35	-1.75	MZ	-1.5	**-3.28**	-1.51	**-3.26**
Thailand					Thailand				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	0	-1.81	-1.03	-1.82	DFG	0	**-4.38**	**-2.88**	**-4.58**
PP	-3.58	-7.27	-11.05	-6.84	PP	-11.8	**-37.5**	**-15.71**	**-41.48**
MZ	-1.15	-1.77	-2.05	-1.72	MZ	-2.02	**-3.39**	-2.18	**-3.29**
Notes: See Table 1C									

Table 20C: Unit Root for the level and first difference data (for Trade and EPC)

Bangladesh					Bangladesh				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-2.4	-1.59	**-3.25**	-1.79	DFG	**-3.31**	0	**-5.59**	**-4.39**
PP	-11.49	-7.96	**-15.51**	-6.72	PP	**-31.44**	-13.77	**-102.64**	**-36.72**
MZ	-2.21	-1.4	-2.23	-1.69	MZ	-2.29	-1	**-6.31**	**-3.36**
China					China				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.78	0	**-2.62**		DFG	0	**-3.92**	**-2.97**	
PP	-3.65	-3.11	**-15.87**		PP	**-21.12**	**-31.96**	**-17.26**	
MZ	-1.27	-1.08	**-2.64**		MZ	-2.33	**-3.23**	-2.43	
China HKSAR					China HKSAR				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.71	-1.57			DFG	0	**-3.97**		
PP	-6.45	-5.38			PP	**-14.83**	**-42.52**		
MZ	-1.69	-1.32			MZ	-1.84	**-2.8**		
India					India				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.08	-2.59	-1.57	-1.73	DFG	**-4.54**	-2.57	**-3.01**	**-4.64**
PP	-3.41	**-20.48**	-5.75	-6.18	PP	**-42.95**	**-17.74**	**-20.84**	**-42.32**
MZ	-1.01	**-2.63**	-1.64	-1.6	MZ	**-3.11**	-1.22	-2.49	**-3.28**
Indonesia					Indonesia				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.2	**-2.7**	-0.8	0	DFG	**-4.13**	0	0	0
PP	-3.03	**-15.16**	-3.04	-8.42	PP	**-35.33**	**-45.52**	**-17.11**	**-21.61**
MZ	-1.15	-2.48	-0.91	-1.83	MZ	**-2.83**	**-3.44**	-2.02	0.04
Japan					Japan				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.9	**-2.74**	-1.07	-1.79	DFG	**-4.84**	**-2.86**	**-3.22**	**-2.68**
PP	-6.6	**-23.01**	-5.93	**-16.88**	PP	**-45.28**	**-22.59**	**-19.41**	**-27.52**
MZ	-1.71	**-2.89**	-1.3	-2.49	MZ	**-3.7**	-1.85	-2.51	-2.54
Malaysia					Malaysia				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	0	-1.64	-1.42	-1.27	DFG	0	**-4.36**	0	**-4.4**
PP	-5.69	-7.89	-7.79	-6.18	PP	**-16.22**	**-32.82**	-10.84	**-52.51**
MZ	-1.41	-1.54	-1.71	-1.3	MZ	-1.38	-2.48	-1.51	**-3.7**
New Zealand					New Zealand				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.02	-1.38	-1.19	-2.3	DFG	1.89	0	0	**-3.45**
PP	-3.31	**-40.86**	-3.36	**-26.18**	PP	**-21.7**	**-18.86**	-11.04	**-28.04**
MZ	-0.96	**-3.94**	-1	**-3.33**	MZ	1.09	-2.26	-0.86	**-3.14**
Pakistan					Pakistan				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-2.54	-2.55	-1.15	-2.09	DFG	**-4.52**	**-6.34**	0	**-4.45**
PP	-13.64	-11.71	-2.83	-12.3	PP	**-41.87**	**-26.92**	**-17.57**	**-47.76**
MZ	-2.39	-1.91	-0.98	-2.13	MZ	**-3.24**	-2.37	-1.72	**-3.57**
Philippines					Philippines				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.75	-2.11	-2.72	-1.01	DFG	**-3.19**	0	0	**-4.47**
PP	-8.82	-11.77	**-16.68**	-2.91	PP	**-23.14**	**-38.93**	**-29.44**	**-42.61**
MZ	-1.92	-2.05	-2.58	-0.99	MZ	**-2.67**	**-2.92**	**-2.68**	**-2.95**
Singapore					Singapore				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	**-3.9**	-2.41	-0.71	-1.65	DFG	**-3.75**	0	0	-2
PP	**-29.5**	**-19.04**	-6.24	**-232.83**	PP	**-30.51**	**-17.64**	**-17.07**	**-18.07**
MZ	**-3.58**	-2.49	-1.26	-10.51	MZ	**-2.8**	-1.2	-1.9	**-2.45**
South Korea					South Korea				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	0	-2.21	-0.75	-1.86	DFG	0	**-4.49**	0	**-4.57**
PP	-6.48	-12.06	-7.16	-6.98	PP	**-70.51**	**-42.5**	**-14.54**	**-41.82**
MZ	-1.62	-2.07	-1.35	-1.75	MZ	**-5.3**	**-3.18**	-1.51	**-3.26**
Thailand					Thailand				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-2.13	**-2.76**	-1.03	-1.82	DFG	**-3.91**	**-3.6**	**-2.88**	**-4.58**

PP	-8.93	**-16.32**	-11.05	-6.84	PP	**-31.47**	**-33.03**	**-15.71**	**-41.48**
MZ	-1.98	-2.61	-2.05	-1.72	MZ	**-2.93**	**-2.82**	-2.18	**-3.29**
Notes: See Table 1C									

Table 21C: Unit Root for the level and first difference data (for EU and GDP)

Bangladesh					Bangladesh				
	G+	G-	EU+	EU-		DG+	DG-	DEU+	DEU-
DFG	-0.19	-0.42	-1.21	-1.28	DFG	0	0	**-5.58**	0
PP	-0.92	-2	-2.69	-4.39	PP	**-18.7**	**-32.9**	**-43.69**	**-27.8**
MZ	-0.35	-0.1	-0.79	-1.28	MZ	-1.26	-2.13	**-2.79**	-1.54
China					China				
	G+	G-	EU+	EU-		DG+	DG-	DEU+	DEU-
DFG	0	-2.01	-1.69	**-3.15**	DFG	0	0	**-2.97**	**-4.26**
PP	-8.32	-7.02	-12.24	**-20.65**	PP	**-34.81**	**-79.49**	**-18.76**	**-35**
MZ	-1.65	-1.63	-2.24	**-3.07**	MZ	**-3.72**	**-5.39**	-2.6	**-3.42**
China HKSAR					China HKSAR				
	G+	G-	EU+	EU-		DG+	DG-	DEU+	DEU-
DFG	-1.25	-1.87	**-3.76**	-1.47	DFG	0	**-4.27**	**-4.96**	0
PP	-4.41	-8.24	**-29.11**	-4.75	PP	**-20.61**	**-39.62**	**-43.5**	**-75.41**
MZ	-1.16	-1.82	**-3.62**	-1.38	MZ	-1.69	**-3.01**	**-3.9**	**-4.93**
India					India				
	G+	G-	EU+	EU-		DG+	DG-	DEU+	DEU-
DFG	-0.16	0	-0.54	0	DFG	**-4.08**	0	-1.86	**-4.68**
PP	-1.68	-5.18	-5.25	-7.88	PP	**-39.49**	**-84.16**	**-19.51**	**-42.7**
MZ	-0.22	-1.26	-0.81	-1.82	MZ	**-2.73**	**-5.44**	-1.05	**-3.29**
Indonesia					Indonesia				
	G+	G-	EU+	EU-		DG+	DG-	DEU+	DEU-
DFG	-1.95	-1.94	-1.75	-1.43	DFG	**-3.24**	**-4.52**	0	0
PP	-8.97	-7.56	-7.12	-4.4	PP	**-21.62**	**-40.81**	**-46.68**	**-42.14**
MZ	-1.99	-1.83	-1.73	-1.29	MZ	**-2.73**	**-3.27**	**-3.65**	**-2.97**
Japan					Japan				
	G+	G-	EU+	EU-		DG+	DG-	DEU+	DEU-
DFG	-1.46	-2.12	-1.65	-2.24	DFG	0	**-4.04**	0	0
PP	-5.79	**-16.95**	-6.13	-11.27	PP	-10.25	**-56.09**	**-7.47**	**-100.27**
MZ	-1.34	-2.48	-1.38	-2.26	MZ	-1.49	**-4.16**	-0.16	**-6.58**
Malaysia					Malaysia				
	G+	G-	EU+	EU-		DG+	DG-	DEU+	DEU-
DFG	-1.79	-2.29	-2.43	-1.62	DFG	0	**-5.85**	0	**-3.89**
PP	-10.5	-11.09	-13.2	-9.43	PP	**-14.62**	**-56.46**	**-43**	**-38.34**
MZ	-2.03	-2.15	-2.2	-1.77	MZ	-1.29	**-4.23**	**-2.91**	**-3.23**
New Zealand					New Zealand				
	G+	G-	EU+	EU-		DG+	DG-	DEU+	DEU-
DFG	-2.22	-1.79	-0.66	-1.95	DFG	**-4.14**	0	0	**-4.96**
PP	-10.52	-5.1	-1.54	-6.81	PP	**-36.16**	**-42.18**	**-31.86**	**-47.98**
MZ	-2.17	-1.26	-0.49	-1.72	MZ	**-3.04**	**-2.94**	-1.99	**-3.55**
Pakistan					Pakistan				
	G+	G-	EU+	EU-		DG+	DG-	DEU+	DEU-
DFG	-1.88	-2.29	-2.64	-1.63	DFG	**-3.23**	0	**-4.47**	0
PP	-6.74	-5.69	**-14.23**	-10.1	PP	**-25**	**-25.03**	**-38.94**	**-23.51**
MZ	-1.8	-1.43	-2.49	-1.82	MZ	-2.53	-1.27	**-3.33**	-0.04
Philippines					Philippines				
	G+	G-	EU+	EU-		DG+	DG-	DEU+	DEU-
DFG	0	-2.38	-1.19	-1.99	DFG	**-3.97**	**-4.6**	0	**-4.3**
PP	-7.2	-13.05	-2.94	-9.03	PP	**-31.08**	**-37.9**	**-34.16**	**-41.53**
MZ	-1.77	-2.48	-0.68	-1.88	MZ	**-3.42**	**-4.03**	-1.64	**-2.82**
Singapore					Singapore				
	G+	G-	EU+	EU-		DG+	DG-	DEU+	DEU-
DFG	-1.37	-0.82	-2.01	-0.73	DFG	0	0	0	0
PP	-10.01	-4.36	-8.85	-2.1	PP	**-23.17**	**-36.16**	**-28.08**	**-35.2**
MZ	-1.75	-0.99	-1.92	-0.68	MZ	-2.25	**-2.94**	-2.04	-1.79
South Korea					South Korea				
	G+	G-	EU+	EU-		DG+	DG-	DEU+	DEU-
DFG	-1.12	-2.37	0	-2.32	DFG	0	**-4.68**	0	**-4.67**
PP	-3.66	-11.45	-4.71	-10.9	PP	**-14.47**	**-43.39**	**-16.5**	**-43.36**
MZ	-1.06	-2.25	-1.22	-2.19	MZ	-1.78	**-3.32**	-1.4	**-3.32**
Thailand					Thailand				
	G+	G-	EU+	EU-		DG+	DG-	DEU+	DEU-
DFG	0	-1.81	-1.81	-2.41	DFG	0	**-4.38**	0	**-4.24**
PP	-3.58	-7.27	-8.42	-12	PP	-11.8	**-37.5**	**-15.03**	**-38.2**
MZ	-1.15	-1.77	-1.97	-2.32	MZ	-2.02	**-3.39**	-2.23	**-3.07**
Notes: See Table 1C									

Table 22C: Unit Root for the level and first difference data (for Trade and EU)

Bangladesh					Bangladesh				
	T+	T-	EU+	EU-		DT+	DT-	DEU+	DEU-
DFG	-2.4	-1.59	-1.21	-1.28	DFG	**-3.31**	0	**-5.58**	0
PP	-11.49	-7.96	-2.69	-4.39	PP	**-31.44**	-13.77	**-43.69**	**-27.8**
MZ	-2.21	-1.4	-0.79	-1.28	MZ	-2.29	-1	**-2.79**	-1.54
China					China				
	T+	T-	EU+	EU-		DT+	DT-	DEU+	DEU-
DFG	-1.78	0	-1.84	**-3.25**	DFG	0	**-3.92**	**-2.84**	**-4.27**
PP	-3.65	-3.11	-15.95	**-18.42**	PP	**-21.12**	**-31.96**	**-16.54**	**-32.63**
MZ	-1.27	-1.08	-2.59	**-2.8**	MZ	-2.33	**-3.23**	-2.59	**-3.29**
China HKSAR					China HKSAR				
	T+	T-	EU+	EU-		DT+	DT-	DEU+	DEU-
DFG	-1.48	-1.57	**-3.76**	-1.47	DFG	0	**-3.17**	**-4.96**	0
PP	-6.55	-5.3	**-29.11**	-4.75	PP	-12.82	**-27.41**	**-43.5**	**-75.41**
MZ	-1.64	-1.28	**-3.62**	-1.38	MZ	-1.63	-1.7	**-3.9**	**-4.93**
India					India				
	T+	T-	EU+	EU-		DT+	DT-	DEU+	DEU-
DFG	-1.08	-2.59	-0.54	0	DFG	**-4.54**	-2.57	-1.86	**-4.68**
PP	-3.41	**-20.48**	-5.25	-7.88	PP	**-42.95**	**-17.74**	**-19.51**	**-42.7**
MZ	-1.01	**-2.63**	-0.81	-1.82	MZ	**-3.11**	-1.22	-1.05	**-3.29**
Indonesia					Indonesia				
	T+	T-	EU+	EU-		DT+	DT-	DEU+	DEU-
DFG	-1.2	**-2.7**	-1.75	-1.43	DFG	**-4.13**	0	0	0
PP	-3.03	**-15.16**	-7.12	-4.4	PP	**-35.33**	**-45.52**	**-46.68**	**-42.14**
MZ	-1.15	-2.48	-1.73	-1.29	MZ	**-2.83**	**-3.44**	**-3.65**	**-2.97**
Japan					Japan				
	T+	T-	EU+	EU-		DT+	DT-	DEU+	DEU-
DFG	-1.95	0	-1.65	-2.24	DFG	**-4.78**	-1.68	0	0
PP	-7.08	15.94	-6.13	-11.27	PP	**-44.96**	**-135.65**	**-7.47**	**-100.27**
MZ	-1.76	6.46	-1.38	-2.26	MZ	**-3.7**	**-7.7**	-0.16	**-6.58**
Malaysia					Malaysia				
	T+	T-	EU+	EU-		DT+	DT-	DEU+	DEU-
DFG	0	-1.64	-2.43	-1.62	DFG	0	**-4.36**	0	**-3.89**
PP	-5.69	-7.89	-13.2	-9.43	PP	**-16.22**	**-32.82**	**-43**	**-38.34**
MZ	-1.41	-1.54	-2.2	-1.77	MZ	-1.38	-2.48	**-2.91**	**-3.23**
New Zealand					New Zealand				
	T+	T-	EU+	EU-		DT+	DT-	DEU+	DEU-
DFG	-0.84	7.04	-1.37	-2.16	DFG	0	15.53	0	**-3.5**
PP	-2.68	18.48	-3.76	-9.9	PP	**-23.68**	19.42	**-15.82**	**-25.58**
MZ	-0.8	15.9	-1.21	-2.03	MZ	-0.95	57266.64	-1.51	-2.56
Pakistan					Pakistan				
	T+	T-	EU+	EU-		DT+	DT-	DEU+	DEU-
DFG	-2.54	-2.55	**-2.64**	-1.63	DFG	**-4.52**	**-6.34**	**-4.47**	0
PP	-13.64	-11.71	**-14.23**	-10.1	PP	**-41.87**	**-26.92**	**-38.94**	**-23.51**
MZ	-2.39	-1.91	-2.49	-1.82	MZ	**-3.24**	-2.37	**-3.33**	-0.04
Philippines					Philippines				
	T+	T-	EU+	EU-		DT+	DT-	DEU+	DEU-
DFG	-1.75	-2.11	-1.19	-1.99	DFG	**-3.19**	0	0	**-4.3**
PP	-8.82	-11.77	-2.94	-9.03	PP	**-23.14**	**-38.93**	**-34.16**	**-41.53**
MZ	-1.92	-2.05	-0.68	-1.88	MZ	**-2.67**	**-2.92**	-1.64	**-2.82**
Singapore					Singapore				
	T+	T-	EU+	EU-		DT+	DT-	DEU+	DEU-
DFG	**-3.9**	-2.41	-1.76	-0.88	DFG	**-3.75**	0	0	0
PP	**-29.5**	**-19.04**	-7.43	-2.52	PP	**-30.51**	**-17.64**	**-24.04**	**-374.58**
MZ	**-3.58**	-2.49	-1.76	-0.77	MZ	**-2.8**	-1.2	-1.83	**-13.19**
South Korea					South Korea				
	T+	T-	EU+	EU-		DT+	DT-	DEU+	DEU-
DFG	0	-2.39	0	-2.32	DFG	-0.04	-2.21	0	**-4.67**
PP	-7.33	17.12	-4.71	-10.9	PP	**-56.34**	7.95	**-16.5**	**-43.36**
MZ	-1.72	8.84	-1.22	-2.19	MZ	**-4.6**	2.23	-1.4	**-3.32**
Thailand					Thailand				
	T+	T-	EU+	EU-		DT+	DT-	DEU+	DEU-
DFG	-2.13	**-2.76**	-1.81	-2.41	DFG	**-3.91**	**-3.6**	0	**-4.24**
PP	-8.93	**-16.32**	-8.42	-12	PP	**-31.47**	**-33.03**	**-15.03**	**-38.2**
MZ	-1.98	-2.61	-1.97	-2.32	MZ	**-2.93**	**-2.82**	-2.23	**-3.07**

Notes: See Table 1C

Table 23C: Unit Root for the level and first difference data (for GDP and NG)

Bangladesh					Bangladesh				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-0.17	0	-0.37		DFG	0	0	**-4.88**	
PP	-0.84	-1.96	-1.99		PP	**-19.14**	**-33**	**-35.29**	
MZ	-0.32	-0.1	-0.4		MZ	-1.28	-2.08	-2.53	
China					China				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	0	**-2.68**	-1.77	0	DFG	**-4.97**	**-5.38**	0	**-3.15**
PP	-2.45	-10	-7.25	-5.18	PP	**-42.46**	**-49.66**	**-6.75**	**-35.42**
MZ	-0.69	-1.94	-1.81	-1.48	MZ	**-3.96**	**-4.49**	-1.47	**-3.76**
India					India				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	0.23	-0.99	-0.91	-1.73	DFG	**-4.46**	**-5.35**	**-3.59**	**-6.89**
PP	-0.36	-3.2	-2.1	-6.79	PP	**-46.24**	**-52.02**	**-30.44**	**-46.19**
MZ	0.12	-0.97	-0.8	-1.72	MZ	**-3.06**	**-3.51**	**-2.86**	**-3.35**
Indonesia					Indonesia				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-2.16	-1.87	-0.91	-2.01	DFG	0	**-4.9**	**-3.58**	0
PP	-8.03	-7.22	-1.91	-7.92	PP	**-13.64**	**-47.84**	**-35.92**	**-354.01**
MZ	-1.93	-1.81	-0.67	-1.87	MZ	-1.84	**-3.54**	-2.51	**-12.85**
Japan					Japan				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.46	-2.12	-0.99	-0.26	DFG	0	**-4.04**	**-4**	0
PP	-5.79	**-16.95**	-2.09	-1.21	PP	-10.25	**-56.09**	**-31.35**	**-296.76**
MZ	-1.34	-2.48	-0.75	-0.27	MZ	-1.49	**-4.16**	**-3.24**	**-11.51**
Malaysia					Malaysia				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.98	-2.33	-1.29	-1.43	DFG	0	0	**-3.48**	**-4.5**
PP	-9.61	-11.2	-4.73	-4.3	PP	**-15.39**	**-63.41**	**-27.31**	**-44.96**
MZ	-1.98	-2.18	-1.16	-1.25	MZ	-1.54	**-4.54**	**-2.77**	**-2.98**
New Zealand					New Zealand				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	**-2.85**	-1.75	-1.24	**-2.81**	DFG	**-3.49**	**-3.22**	**-5.04**	**-4.45**
PP	**-16.34**	-5.94	-3.82	**-15.92**	PP	**-25.01**	**-29.64**	**-44.28**	**-37.52**
MZ	**-2.81**	-1.58	-0.99	**-2.75**	MZ	**-2.96**	-2.34	**-3.96**	**-3.63**
Pakistan					Pakistan				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.99	-2.61	-2.17	-1.93	DFG	**-3.75**	0	**-4.23**	**-5.12**
PP	-7.97	-12.94	-11.33	-7.69	PP	**-33.66**	**-47.75**	**-35.44**	**-50.19**
MZ	-1.9	-2.45	-2.08	-1.75	MZ	**-2.87**	**-4.29**	**-3.37**	**-3.62**
Taiwan					Taiwan				
	G+	G-	E+	E-		DG+	DG-	DE+	DE-
DFG	-1.04	-1.27	-2.01	-1.48	DFG	0	**-4.94**	0	0
PP	-3.02	-6.13	-7.21	-5.4	PP	**-21.13**	**-57.65**	**-22.62**	**-15.16**
MZ	-0.88	-1.33	-1.74	-1.56	MZ	-2.3	**-3.83**	-1.87	-1.85
Notes: See Table 1C									

Table 24C: Unit Root for the level and first difference data (for Trade and NG)

Bangladesh					Bangladesh				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-2.37	-1.59	-0.37		DFG	**-3.3**	0	**-4.88**	
PP	-11.55	-7.77	-1.99		PP	**-31.41**	-13.89	**-35.29**	
MZ	-2.19	-1.41	-0.4		MZ	**-2.3**	-1.03	-2.53	
China					China				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.57	0	-0.74	**-3.09**	DFG	0	**-4.67**	0	0
PP	-3.27	-1.24	**-20.8**	-11.61	PP	**-30.79**	**-39.22**	-10.33	-5.29
MZ	-1.16	-0.46	**-3**	-2.15	MZ	**-3.16**	**-3.66**	-1.29	0.18
India					India				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.65	-2.52	-0.91	-1.73	DFG	0	**-3.81**	**-3.59**	**-6.89**
PP	-4.43	-9.09	-2.1	-6.79	PP	**-40.69**	**-34.94**	**-30.44**	**-46.19**
MZ	-1.36	-1.95	-0.8	-1.72	MZ	**-2.72**	**-3.26**	**-2.86**	**-3.35**
Indonesia					Indonesia				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.33	-2.27	-0.91	-2.01	DFG	-1.36	0	**-3.58**	0
PP	-4	-10.11	-1.91	-7.92	PP	**-46.58**	**-63.14**	**-35.92**	**-354.01**
MZ	-1.33	-2.05	-0.67	-1.87	MZ	**-3.78**	**-4.21**	-2.51	**-12.85**
Japan					Japan				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-1.95	0	-0.99	-0.26	DFG	**-4.78**	-1.68	**-4**	0

PP	-7.08	15.94	-2.09	-1.21	PP	**-44.96**	**-135.65**	**-31.35**	**-296.76**
MZ	-1.76	6.46	-0.75	-0.27	MZ	**-3.7**	**-7.7**	**-3.24**	**-11.51**
Malaysia					Malaysia				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	0	-2.03	-1.29	-1.43	DFG	0	-1.72	**-3.48**	**-4.5**
PP	-4.99	10.95	-4.73	-4.3	PP	**-16.08**	**-498.68**	**-27.31**	**-44.96**
MZ	-1.29	3.41	-1.16	-1.25	MZ	-1.38	**-15.45**	**-2.77**	**-2.98**
New Zealand					New Zealand				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	-0.84	7.04	-1.65	-2.57	DFG	0	15.53	0	**-4.17**
PP	-2.68	18.48	-4.76	-12.52	PP	**-23.68**	19.42	**-23.37**	**-32.72**
MZ	-0.8	15.9	-1.34	-2.39	MZ	-0.95	57266.64	**-2.67**	**-3.38**
Pakistan					Pakistan				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	**-2.93**	-1.87	-2.17	-1.93	DFG	**-5.49**	**-5.15**	**-4.23**	**-5.12**
PP	**-18.07**	-7.36	-11.33	-7.69	PP	**-55.55**	**-48.87**	**-35.44**	**-50.19**
MZ	**-2.71**	-1.75	-2.08	-1.75	MZ	**-3.77**	**-3.91**	**-3.37**	**-3.62**
South Korea					South Korea				
	T+	T-	E+	E-		DT+	DT-	DE+	DE-
DFG	**-2.86**	-2.36	-1.01	**-2.95**	DFG	0	-2.28	**-16.12**	**-3.87**
PP	-13.9	12.62	-9.67	**-18.13**	PP	-12.09	8.52	**-17.65**	**-31.85**
MZ	-2.45	6.54	0.27	**-2.69**	MZ	-1.27	3.29	-0.54	**-2.84**
Notes: See Table 1C									

Table 25C: Unit Root for the level and first difference data (for GDP and NU)

India					India				
	G+	G-	NU+	NU-		DG+	DG-	DNU+	DNU-
DFG	-0.29	-1.14	-1.44	-2.19	DFG	**-4.45**	0	0	**-5.4**
PP	-1.85	-3.77	-7.4	-9.27	PP	**-44.02**	**-67.25**	**-82.7**	**-53.18**
MZ	-0.31	-1.08	-1.44	-1.84	MZ	**-2.94**	**-4.61**	**-5.11**	**-3.49**
Japan					Japan				
	G+	G-	NU+	NU-		DG+	DG-	DNU+	DNU-
DFG	-1.39	-2.1	0	-2.08	DFG	0	**-3.99**	**-4.3**	0
PP	-5.48	**-16.52**	-2.82	-9.75	PP	-10.1	**-54.78**	**-37.32**	**-41.09**
MZ	-1.28	-2.45	-0.73	-2.03	MZ	-1.29	**-4.11**	**-2.83**	**-2.87**
Taiwan					Taiwan				
	G+	G-	NU+	NU-		DG+	DG-	DNU+	DNU-
DFG	-1.12	-1.43	-1.2	**-2.64**	DFG	0	**-4.41**	0	**-4.34**
PP	-3.24	-6.49	-4.68	-9.57	PP	**-14.68**	**-44.55**	**-14.74**	**-36.83**
MZ	-1.06	-1.41	-1.22	-1.88	MZ	-1.19	**-3.37**	-1.74	**-3.02**
Thailand					Thailand				
	G+	G-	NU+	NU-		DG+	DG-	DNU+	DNU-
DFG	-2.49	-2.13	0	-1.68	DFG	0	**-4.03**	0	**-3.66**
PP	**-14.37**	-8.86	-2.84	-7.32	PP	-8.54	**-32.09**	**-17.87**	**-29.11**
MZ	**-2.62**	-1.99	0.24	-1.73	MZ	-1.77	**-3.12**	-0.65	**-2.7**
Notes: See Table 1C									

Table 26C: Unit Root for the level and first difference data (for Trade and NU)

India					India				
	T+	T-	NU+	NU-		DT+	DT-	DNU+	DNU-
DFG	-1.53	**-2.68**	-1.44	-2.19	DFG	**-3.02**	**-3.59**	0	**-5.4**
PP	-4.17	**-20.23**	-7.4	-9.27	PP	**-37.23**	**-45.3**	**-82.7**	**-53.18**
MZ	-1.33	**-2.77**	-1.44	-1.84	MZ	**-2.83**	**-3.17**	**-5.11**	**-3.49**
Japan					Japan				
	T+	T-	NU+	NU-		DT+	DT-	DNU+	DNU-
DFG	-2.02	**-3.11**	0	-2.08	DFG	**-4.76**	-1.68	**-4.3**	0
PP	-7.44	15.89	-2.82	-9.75	PP	**-44.42**	**-133.9**	**-37.32**	**-41.09**
MZ	-1.79	6.72	-0.73	-2.03	MZ	**-3.68**	**-7.64**	**-2.83**	**-2.87**
Thailand					Thailand				
	T+	T-	NU+	NU-		DT+	DT-	DNU+	DNU-
DFG	-2.06	**-2.73**	0	-1.68	DFG	**-3.61**	**-4.33**	0	**-3.66**
PP	-9.03	**-15.72**	-2.84	-7.32	PP	**-26.22**	**-44.96**	**-17.87**	**-29.11**
MZ	-2.01	-2.48	0.24	-1.73	MZ	**-2.68**	**-3.5**	-0.65	**-2.7**
Notes: See Table 1C									

Table 27C: Unit Root for the level and first difference data (for GDP and PEC)

Bangladesh					Bangladesh				
	G+	G-	PEC+	PEC-		DG+	DG-	DPEC+	DPEC-
DFG	-0.17	0	-1.3	-1.86	DFG	0	0	**-5.31**	**-4.57**
PP	-0.84	-1.96	-7.09	-6.98	PP	**-19.14**	**-33**	**-39.94**	**-41.82**
MZ	-0.32	-0.1	-1.24	-1.75	MZ	-1.28	-2.08	**-2.86**	**-3.26**
China					China				
	G+	G-	PEC+	PEC-		DG+	DG-	DPEC+	DPEC-
DFG	0	**-2.68**	-2.52	**-2.64**	DFG	**-4.97**	**-5.38**	**-4**	**-5.3**
PP	-2.45	-10	-12.57	-9.83	PP	**-42.46**	**-49.66**	**-29.57**	**-52.9**
MZ	-0.69	-1.94	-2.44	-1.82	MZ	**-3.96**	**-4.49**	**-3.54**	**-3.66**
China HKSAR					China HKSAR				
	G+	G-	PEC+	PEC-		DG+	DG-	DPEC+	DPEC-
DFG	-1.14	-1.88	-2.16	-1.8	DFG	0	**-5**	0	0
PP	-3.33	-8.43	-9.7	-8.47	PP	**-21.28**	**-51.79**	**-40.28**	**-81.96**
MZ	-1.11	-1.85	-1.83	-1.75	MZ	-1.88	**-3.52**	**-3.23**	**-5.13**
India					India				
	G+	G-	PEC+	PEC-		DG+	DG-	DPEC+	DPEC-
DFG	0.23	-0.99	-2.21	-1.93	DFG	**-4.46**	**-5.35**	0	**-5.18**
PP	-0.36	-3.2	-12.84	-6.71	PP	**-46.24**	**-52.02**	**-28.06**	**-51.5**
MZ	0.12	-0.97	-2.17	-1.58	MZ	**-3.06**	**-3.51**	-2.09	**-3.61**
Indonesia					Indonesia				
	G+	G-	PEC+	PEC-		DG+	DG-	DPEC+	DPEC-
DFG	-2.16	-1.87	-0.76	-1.8	DFG	0	**-4.9**	0	0
PP	-8.03	-7.22	-1.81	-7.63	PP	-13.64	**-47.84**	**-25.39**	**-53.82**
MZ	-1.93	-1.81	-0.71	-1.73	MZ	-1.84	**-3.54**	-2.05	**-3.76**
Japan					Japan				
	G+	G-	PEC+	PEC-		DG+	DG-	DPEC+	DPEC-
DFG	-1.46	-2.12	-1.72	-2.11	DFG	0	**-4.04**	0	**-3.19**
PP	-5.79	**-16.95**	-7.02	-10.8	PP	-10.25	**-56.09**	**-5.01**	**-35.61**
MZ	-1.34	-2.48	-1.53	-2.15	MZ	-1.49	**-4.16**	0.02	**-2.91**
Malaysia					Malaysia				
	G+	G-	PEC+	PEC-		DG+	DG-	DPEC+	DPEC-
DFG	-2.15	-1.98	-0.28	0	DFG	0	0	0	0
PP	-10.69	-8.34	-1.3	2.17	PP	**-22.03**	**-71.06**	**-17.37**	**-12372.2**
MZ	-2.18	-1.85	-0.39	0.83	MZ	-2.31	**-4.77**	-0.54	**-78.62**
New Zealand					New Zealand				
	G+	G-	PEC+	PEC-		DG+	DG-	DPEC+	DPEC-
DFG	-2.22	-1.79	-0.65	0	DFG	**-4.14**	0	0	**-3.75**
PP	-10.52	-5.1	-2.61	-11.28	PP	**-36.16**	**-42.18**	**-28.15**	**-44.44**
MZ	-2.17	-1.26	-0.64	-2.17	MZ	**-3.04**	**-2.94**	-1.5	-2.42
Pakistan					Pakistan				
	G+	G-	PEC+	PEC-		DG+	DG-	DPEC+	DPEC-
DFG	-1.99	-2.61	-1.57	-2	DFG	**-3.75**	0	0	0
PP	-7.97	-12.94	-7.09	-7.5	PP	**-33.66**	**-47.75**	**-24.25**	**-58.89**
MZ	-1.9	-2.45	-1.68	-1.79	MZ	**-2.87**	**-4.29**	-2.61	**-4.67**
Philippines					Philippines				
	G+	G-	PEC+	PEC-		DG+	DG-	DPEC+	DPEC-
DFG	-1.64	0	-1.12	-1.48	DFG	0	0	**-2.8**	0
PP	-7.79	-5.42	-4.14	-5.03	PP	**-20.36**	**-40.76**	**-25.2**	**-30.59**
MZ	-1.84	-1.55	-1	-1.52	MZ	-2.29	**-4.16**	-2.18	**-2.86**
Singapore					Singapore				
	G+	G-	PEC+	PEC-		DG+	DG-	DPEC+	DPEC-
DFG	0	-0.83	-2.16	-1.44	DFG	0	0	0	0
PP	-2.06	-3.03	-9.84	-3.9	PP	-12.67	**-66.03**	**-49.58**	**-35.7**
MZ	-0.47	-0.8	-2.01	-1.19	MZ	-1.67	**-4.61**	**-3.72**	-1.91
South Korea					South Korea				
	G+	G-	PEC+	PEC-		DG+	DG-	DPEC+	DPEC-
DFG	-0.85	-2.26	-0.44	-1.78	DFG	0	**-5.02**	**-2.86**	**-4.95**
PP	-3.81	-10.26	-2.34	-6.5	PP	**-14.71**	**-49.84**	**-21.16**	**-49**
MZ	-0.95	-2.13	-0.49	-1.7	MZ	-1.14	**-3.55**	-2.15	**-3.52**
Taiwan					Taiwan				
	G+	G-	PEC+	PEC-		DG+	DG-	DPEC+	DPEC-
DFG	-1.04	-1.27	-0.54	-2.32	DFG	0	**-4.94**	**-3.26**	**-4.9**
PP	-3.02	-6.13	-1.32	-13.1	PP	**-21.13**	**-57.65**	**-28.91**	**-46.31**
MZ	-0.88	-1.33	-0.3	-2.37	MZ	-2.3	**-3.83**	-2.52	**-3.75**
Thailand					Thailand				
	G+	G-	PEC+	PEC-		DG+	DG-	DPEC+	DPEC-
DFG	0	-1.72	-1.33	-1.78	DFG	0	**-4.78**	0	**-4.95**
PP	-5.94	-6.43	-6.91	-6.5	PP	**-16.24**	**-44.55**	**-14.22**	**-49**
MZ	-1.63	-1.66	-1.5	-1.7	MZ	-2.29	**-3.67**	-1.67	**-3.52**

Notes: See Table 1C

Table 28C: Unit Root for the level and first difference data (for Trade and PEC)

Bangladesh					Bangladesh				
	T+	T-	PEC+	PEC-		DT+	DT-	DPEC+	DPEC-
DFG	-2.37	-1.59	-1.3	-1.86	DFG	**-3.3**	0	**-5.31**	**-4.57**
PP	-11.55	-7.77	-7.09	-6.98	PP	**-31.41**	-13.89	**-39.94**	**-41.82**
MZ	-2.19	-1.41	-1.24	-1.75	MZ	-2.3	-1.03	**-2.86**	**-3.26**
China					China				
	T+	T-	PEC+	PEC-		DT+	DT-	DPEC+	DPEC-
DFG	-1.57	0	-2.04	0	DFG	0	**-4.67**	**-3.34**	**-4.57**
PP	-3.27	-1.24	-18.27	-2.39	PP	**-30.79**	**-39.22**	**-22.63**	**-38.81**
MZ	-1.16	-0.46	-2.84	0.59	MZ	**-3.16**	**-3.66**	**-3.13**	**-3.15**
China HKSAR					China HKSAR				
	T+	T-	PEC+	PEC-		DT+	DT-	DPEC+	DPEC-
DFG	-1.8	-1.44	-2.16	-1.8	DFG	0	-1.17	0	0
PP	-6.26	-3.99	-9.7	-8.47	PP	**-19.63**	**-34.36**	**-40.28**	**-81.96**
MZ	-1.73	-1.34	-1.83	-1.75	MZ	-2.19	-1.67	**-3.23**	**-5.13**
India					India				
	T+	T-	PEC+	PEC-		DT+	DT-	DPEC+	DPEC-
DFG	-1.65	-2.52	-2.21	-1.93	DFG	0	**-3.81**	0	**-5.18**
PP	-4.43	-9.09	-12.84	-6.71	PP	**-40.69**	**-34.94**	**-28.06**	**-51.5**
MZ	-1.36	-1.95	-2.17	-1.58	MZ	**-2.72**	**-3.26**	-2.09	**-3.61**
Indonesia					Indonesia				
	T+	T-	PEC+	PEC-		DT+	DT-	DPEC+	DPEC-
DFG	-1.33	-2.27	-0.76	-1.8	DFG	-1.36	0	0	0
PP	-4	-10.11	-1.81	-7.63	PP	**-46.58**	**-63.14**	**-25.39**	**-53.82**
MZ	-1.33	-2.05	-0.71	-1.73	MZ	**-3.78**	**-4.21**	-2.05	**-3.76**
Japan					Japan				
	T+	T-	PEC+	PEC-		DT+	DT-	DPEC+	DPEC-
DFG	-1.95	0	-1.72	-2.11	DFG	**-4.78**	-1.68	0	**-3.19**
PP	-7.08	15.94	-7.02	-10.8	PP	**-44.96**	**-135.65**	**-5.01**	**-35.61**
MZ	-1.76	6.46	-1.53	-2.15	MZ	**-3.7**	**-7.7**	0.02	**-2.91**
Malaysia					Malaysia				
	T+	T-	PEC+	PEC-		DT+	DT-	DPEC+	DPEC-
DFG	0	-2.19	-0.28	0	DFG	0	-1.69	0	0
PP	-5.48	9.57	-1.3	2.17	PP	**-17.79**	**-892.44**	**-17.37**	**-12372.2**
MZ	-1.45	2.82	-0.39	0.83	MZ	-1.55	**-20.86**	-0.54	**-78.62**
New Zealand					New Zealand				
	T+	T-	PEC+	PEC-		DT+	DT-	DPEC+	DPEC-
DFG	-0.84	7.04	-0.62	0	DFG	0	15.53	0	**-4.04**
PP	-2.68	18.48	-1.38	-12.92	PP	**-23.68**	19.42	**-21.12**	**-28.47**
MZ	-0.8	15.9	-0.53	-2.42	MZ	-0.95	57266.64	-0.76	-1.46
Pakistan					Pakistan				
	T+	T-	PEC+	PEC-		DT+	DT-	DPEC+	DPEC-
DFG	**-2.93**	-1.87	-1.57	-2	DFG	**-5.49**	**-5.15**	0	0
PP	**-18.07**	-7.36	-7.09	-7.5	PP	**-55.55**	**-48.87**	**-24.25**	**-58.89**
MZ	**-2.71**	-1.75	-1.68	-1.79	MZ	**-3.77**	**-3.91**	-2.61	**-4.67**
Philippines					Philippines				
	T+	T-	PEC+	PEC-		DT+	DT-	DPEC+	DPEC-
DFG	-1.8	-2.47	-1.12	-1.48	DFG	**-3.51**	0	**-2.8**	0
PP	-6.44	-13.53	-4.14	-5.03	PP	**-27.33**	**-52.97**	**-25.2**	**-30.59**
MZ	-1.69	-2.38	-1	-1.52	MZ	**-2.9**	**-3.7**	-2.18	**-2.86**
Singapore					Singapore				
	T+	T-	PEC+	PEC-		DT+	DT-	DPEC+	DPEC-
DFG	**-3.89**	-2.43	-1.91	-1.64	DFG	**-3.77**	0	0	-1.08
PP	**-29.47**	**-16.76**	-6.27	-5.64	PP	**-31.16**	**-59.33**	**-30.49**	**-44.95**
MZ	**-3.59**	-2.5	-1.68	-1.56	MZ	**-2.87**	**-4.28**	-2.1	**-3.32**
South Korea					South Korea				
	T+	T-	PEC+	PEC-		DT+	DT-	DPEC+	DPEC-
DFG	-1.19	-2.31	-0.44	-1.78	DFG	0	-2.21	**-2.86**	**-4.95**
PP	-5.33	18.37	-2.34	-6.5	PP	**-20.04**	9.13	**-21.16**	**-49**
MZ	-1.23	9.57	-0.49	-1.7	MZ	-2	2.44	-2.15	**-3.52**
Thailand					Thailand				
	T+	T-	PEC+	PEC-		DT+	DT-	DPEC+	DPEC-
DFG	-2.17	-2.38	-1.33	-1.78	DFG	**-4.5**	**-5.5**	0	**-4.95**
PP	-8.11	-11.17	-6.91	-6.5	PP	**-38.05**	**-63.32**	**-14.22**	**-49**
MZ	-1.96	-2.24	-1.5	-1.7	MZ	**-3.33**	**-4.41**	-1.67	**-3.52**
Notes: See Table 1C									

Table 29C: Unit Root for the level and first difference data (for GDP and PEC)

Bangladesh					Bangladesh				
	G+	G-	HYD+	HYD-		DG+	DG-	DHYD+	DHYD-
DFG	-0.44	0	-2.15	-1.56	DFG	0	-1.97	**-4.55**	**-4.09**
PP	0.01	-3.02	-10.42	-6.1	PP	**-24.7**	**-24.68**	**-42.26**	**-36.51**
MZ	0.05	-0.21	-1.83	-1.53	MZ	-1.24	-0.37	**-2.96**	**-2.73**
China					China				
	G+	G-	HYD+	HYD-		DG+	DG-	DHYD+	DHYD-
DFG	0	**-2.68**	-2.28	**-2.77**	DFG	**-4.97**	**-5.38**	0	**-5.51**
PP	-2.45	-10	-13.68	-11.38	PP	**-42.46**	**-49.66**	**-34.1**	**-55.38**
MZ	-0.69	-1.94	-2.33	-1.98	MZ	**-3.96**	**-4.49**	**-2.81**	**-3.76**
India					India				
	G+	G-	HYD+	HYD-		DG+	DG-	DHYD+	DHYD-
DFG	0.23	-0.99	**-2.67**	0	DFG	**-4.46**	**-5.35**	**-4.53**	**-5.72**
PP	-0.36	-3.2	-12.67	-8.16	PP	**-46.24**	**-52.02**	**-41.79**	**-57.47**
MZ	0.12	-0.97	-2.36	-1.77	MZ	**-3.06**	**-3.51**	**-3.47**	**-4.28**
Indonesia					Indonesia				
	G+	G-	HYD+	HYD-		DG+	DG-	DHYD+	DHYD-
DFG	-2.16	-1.87	-1.63	-1.76	DFG	0	**-4.9**	0	0
PP	-8.03	-7.22	-8.25	-6.15	PP	-13.64	**-47.84**	**-45.64**	**-27.08**
MZ	-1.93	-1.81	-1.58	-1.56	MZ	-1.84	**-3.54**	-2.48	-0.83
Japan					Japan				
	G+	G-	HYD+	HYD-		DG+	DG-	DHYD+	DHYD-
DFG	-1.46	-2.12	**-2.68**	**-2.9**	DFG	0	**-4.04**	-0.79	**-4.81**
PP	-5.79	**-16.95**	**-16.98**	**-18.63**	PP	-10.25	**-56.09**	**-41.87**	**-54.69**
MZ	-1.34	-2.48	-2.35	-2.58	MZ	-1.49	**-4.16**	-1.11	**-2.87**
Malaysia					Malaysia				
	G+	G-	HYD+	HYD-		DG+	DG-	DHYD+	DHYD-
DFG	-2.15	-1.98	**-2.78**	-1.84	DFG	0	0	0	**-5.6**
PP	-10.69	-8.34	**-15.5**	-6.71	PP	**-22.03**	**-71.06**	**-44.64**	**-55.22**
MZ	-2.18	-1.85	**-2.64**	-1.7	MZ	-2.31	**-4.77**	**-3.37**	**-4.41**
New Zealand					New Zealand				
	G+	G-	HYD+	HYD-		DG+	DG-	DHYD+	DHYD-
DFG	-2.22	-1.79	**-2.92**	-0.88	DFG	**-4.14**	0	**-5.14**	0
PP	-10.52	-5.1	**-18.76**	-2.16	PP	**-36.16**	**-42.18**	**-52.68**	**-99.41**
MZ	-2.17	-1.26	**-2.65**	-0.72	MZ	**-3.04**	**-2.94**	**-3.4**	**-5.53**
Pakistan					Pakistan				
	G+	G-	HYD+	HYD-		DG+	DG-	DHYD+	DHYD-
DFG	-1.99	-2.61	-2.09	-0.99	DFG	**-3.75**	0	**-5.34**	-2.57
PP	-7.97	-12.94	-8.22	-2.64	PP	**-33.66**	**-47.75**	**-53.53**	**-35.83**
MZ	-1.9	-2.45	-1.66	-0.95	MZ	**-2.87**	**-4.29**	**-3.51**	-2.21
Philippines					Philippines				
	G+	G-	HYD+	HYD-		DG+	DG-	DHYD+	DHYD-
DFG	-1.64	0	-1.38	0	DFG	0	0	**-6.19**	**-4.59**
PP	-7.79	-5.42	-3.86	**-18.91**	PP	**-20.36**	**-40.76**	**-63.93**	**-25.36**
MZ	-1.84	-1.55	-0.97	-2.49	MZ	-2.29	**-4.16**	**-3.96**	0.92
South Korea					South Korea				
	G+	G-	HYD+	HYD-		DG+	DG-	DHYD+	DHYD-
DFG	-0.85	-2.26	-2.21	-1.6	DFG	0	**-5.02**	0	0
PP	-3.81	-10.26	-12.1	-5.23	PP	**-14.71**	**-49.84**	**-35.23**	**-45.95**
MZ	-0.95	-2.13	-2.09	-1.41	MZ	-1.14	**-3.55**	-0.7	-2.19
Taiwan					Taiwan				
	G+	G-	HYD+	HYD-		DG+	DG-	DHYD+	DHYD-
DFG	-1.04	-1.27	-2.38	**-2.66**	DFG	0	**-4.94**	**-5.41**	**-5.11**
PP	-3.02	-6.13	**-14.49**	**-15.52**	PP	**-21.13**	**-57.65**	**-59.05**	**-54.06**
MZ	-0.88	-1.33	-2.22	-2.44	MZ	-2.3	**-3.83**	**-3.29**	**-3.26**
Thailand					Thailand				
	G+	G-	HYD+	HYD-		DG+	DG-	DHYD+	DHYD-
DFG	0	-1.72	-1.79	-2.57	DFG	0	**-4.78**	**-5.42**	**-4.26**
PP	-5.94	-6.43	-8.71	-13.77	PP	**-16.24**	**-44.55**	**-56.37**	**-42.47**
MZ	-1.63	-1.66	-1.7	-2.45	MZ	-2.29	**-3.67**	**-3.61**	**-2.97**

Notes: See Table 1C

Table 30C: Unit Root for the level and first difference data (for Trade and PEC)

Bangladesh					Bangladesh				
	T+	T-	HYD+	HYD-		DT+	DT-	DHYD+	DHYD-
DFG	-2.37	-1.1	-2.15	-1.56	DFG	**-3.37**	0	**-4.55**	**-4.09**
PP	-10.6	-6.44	-10.42	-6.1	PP	**-31.68**	**-28.5**	**-42.26**	**-36.51**
MZ	-2.05	-0.98	-1.83	-1.53	MZ	-2.31	-1.15	**-2.96**	**-2.73**
China					China				
	T+	T-	HYD+	HYD-		DT+	DT-	DHYD+	DHYD-
DFG	-1.57	0	-1.58	-1.78	DFG	0	**-4.67**	0	**-0.56**
PP	-3.27	-1.24	-7.14	-6.1	PP	**-30.79**	**-39.22**	**-24.35**	**-458.6**
MZ	-1.16	-0.46	-1.64	-1.53	MZ	**-3.16**	**-3.66**	-2.21	**-14.78**
India					India				
	T+	T-	HYD+	HYD-		DT+	DT-	DHYD+	DHYD-
DFG	-1.65	-2.52	**-2.67**	0	DFG	0	**-3.81**	**-4.53**	**-5.72**
PP	-4.43	-9.09	-12.67	-8.16	PP	**-40.69**	**-34.94**	**-41.79**	**-57.47**
MZ	-1.36	-1.95	-2.36	-1.77	MZ	**-2.72**	**-3.26**	**-3.47**	**-4.28**
Indonesia					Indonesia				
	T+	T-	HYD+	HYD-		DT+	DT-	DHYD+	DHYD-
DFG	-1.33	-2.27	-1.63	-1.76	DFG	-1.36	0	0	0
PP	-4	-10.11	-8.25	-6.15	PP	**-46.58**	**-63.14**	**-45.64**	**-27.08**
MZ	-1.33	-2.05	-1.58	-1.56	MZ	**-3.78**	**-4.21**	-2.48	-0.83
Japan					Japan				
	T+	T-	HYD+	HYD-		DT+	DT-	DHYD+	DHYD-
DFG	-1.95	0	**-2.68**	**-2.9**	DFG	**-4.78**	-1.68	-0.79	**-4.81**
PP	-7.08	15.94	**-16.98**	**-18.63**	PP	**-44.96**	**-135.65**	**-41.87**	**-54.69**
MZ	-1.76	6.46	-2.35	-2.58	MZ	**-3.7**	**-7.7**	-1.11	**-2.87**
Malaysia					Malaysia				
	T+	T-	HYD+	HYD-		DT+	DT-	DHYD+	DHYD-
DFG	0	-2.19	**-2.78**	-1.84	DFG	0	-1.69	0	**-5.6**
PP	-5.48	9.57	**-15.5**	-6.71	PP	**-17.79**	**-892.44**	**-44.64**	**-55.22**
MZ	-1.45	2.82	**-2.64**	-1.7	MZ	-1.55	**-20.86**	**-3.37**	**-4.41**
New Zealand					New Zealand				
	T+	T-	HYD+	HYD-		DT+	DT-	DHYD+	DHYD-
DFG	-0.84	7.04	**-3.04**	-1.23	DFG	0	15.53	**-4.22**	0
PP	-2.68	18.48	-18.06	-3.17	PP	**-23.68**	19.42	**-39.27**	**-72.65**
MZ	-0.8	15.9	-2.49	-0.99	MZ	-0.95	57266.6	**-2.7**	**-4.57**
Pakistan					Pakistan				
	T+	T-	HYD+	HYD-		DT+	DT-	DHYD+	DHYD-
DFG	**-2.93**	-1.87	-2.09	-0.99	DFG	**-5.49**	**-5.15**	**-5.34**	-2.57
PP	**-18.07**	-7.36	-8.22	-2.64	PP	**-55.55**	**-48.87**	**-53.53**	**-35.83**
MZ	**-2.71**	-1.75	-1.66	-0.95	MZ	**-3.77**	**-3.91**	**-3.51**	-2.21
Philippines					Philippines				
	T+	T-	HYD+	HYD-		DT+	DT-	DHYD+	DHYD-
DFG	-1.8	-2.47	-1.38	0	DFG	**-3.51**	0	**-6.19**	**-4.59**
PP	-6.44	-13.53	-3.86	**-18.91**	PP	**-27.33**	**-52.97**	**-63.93**	**-25.36**
MZ	-1.69	-2.38	-0.97	-2.49	MZ	**-2.9**	**-3.7**	**-3.96**	0.92
South Korea					South Korea				
	T+	T-	HYD+	HYD-		DT+	DT-	DHYD+	DHYD-
DFG	-1.19	-2.31	-2.21	-1.6	DFG	0	-2.21	0	0
PP	-5.33	18.37	-12.1	-5.23	PP	**-20.04**	9.13	**-35.23**	**-45.95**
MZ	-1.23	9.57	-2.09	-1.41	MZ	-2	2.44	-0.7	-2.19
Thailand					Thailand				
	T+	T-	HYD+	HYD-		DT+	DT-	DHYD+	DHYD-
DFG	-2.17	-2.38	-1.79	-2.57	DFG	**-4.5**	**-5.5**	**-5.42**	**-4.26**
PP	-8.11	-11.17	-8.71	-13.77	PP	**-38.05**	**-63.32**	**-56.37**	**-42.47**
MZ	-1.96	-2.24	-1.7	-2.45	MZ	**-3.33**	**-4.41**	**-3.61**	**-2.97**

Notes: Refer to Table 1C.

Appendix D: Tables for cointegration analysis: Schorderet's cointegration test

Table 1D: Cointegration between CO2 emissions and GDP and Trade

Bangladesh																
	G+,C+	G+,C-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-	T+,C+	T+,C-	T-,C+	T-,C-	C+,T+	C+,T-	C-,T+	C-,T-
DFG					-3.09	-3.9	-5.1	-5						-3.68		
PP					-20.9	-30	-41.7	-41						-29.4		
MZ						-3.2	-3.06	-3						-3.29		
China																
	G+,C+	G+,C-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-	T+,C+	T+,C-	T-,C+	T-,C-	C+,T+	C+,T-	C-,T+	C-,T-
DFG		-5.6		-4.7	-3.12	-3.9	-5.46	-4.8								
PP		-39		-39	-20.5	-30	-47.9	-40						-19.5		
MZ		-3.8		-3.7	-3.13	-3.8	-4.42	-4.1						-3.01		
China HKSAR																
	G+,C+	G+,C-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-	T+,C+	T+,C-	T-,C+	T-,C-	C+,T+	C+,T-	C-,T+	C-,T-
DFG						-3.7										
PP		-35		-29	-19.3		-27	-22								
MZ																
India																
	G+,C+	G+,C-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-	T+,C+	T+,C-	T-,C+	T-,C-	C+,T+	C+,T-	C-,T+	C-,T-
DFG								-4.2				-3.1				-3.25
PP							-28.2	-41				-18				-23.6
MZ								-3.1								-3.04
Indonesia																
	G+,C+	G+,C-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-	T+,C+	T+,C-	T-,C+	T-,C-	C+,T+	C+,T-	C-,T+	C-,T-
DFG	-3.15						-3.19	-3.2								
PP	-20.8						-32.6	-31								
MZ																
Japan																
	G+,C+	G+,C-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-	T+,C+	T+,C-	T-,C+	T-,C-	C+,T+	C+,T-	C-,T+	C-,T-
DFG																
PP												-205				
MZ										8.64		-9.6				
Malaysia																
	G+,C+	G+,C-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-	T+,C+	T+,C-	T-,C+	T-,C-	C+,T+	C+,T-	C-,T+	C-,T-
DFG								-3.9								
PP								-33		-34.6						
MZ								-2.9		-3.41		4.4				
New Zealand																
	G+,C+	G+,C-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-	T+,C+	T+,C-	T-,C+	T-,C-	C+,T+	C+,T-	C-,T+	C-,T-
DFG		-3.3		-3.2					-2.97				-2.93			
PP							-20.3	-20	-18.5	-168			-18.2			
MZ										-8.64						
Pakistan																
	G+,C+	G+,C-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-	T+,C+	T+,C-	T-,C+	T-,C-	C+,T+	C+,T-	C-,T+	C-,T-
DFG									-3.3		-2.93	-4.8				-4.61
PP									-21.8		-18.03	-41				-37.9
MZ									-2.99			-4.1				-3.93
Philippines																
	G+,C+	G+,C-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-	T+,C+	T+,C-	T-,C+	T-,C-	C+,T+	C+,T-	C-,T+	C-,T-
DFG																
PP																
MZ																
Singapore																
	G+,C+	G+,C-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-	T+,C+	T+,C-	T-,C+	T-,C-	C+,T+	C+,T-	C-,T+	C-,T-
DFG									-3.94		-3.89					
PP							-18.3		-29.6	-20.2	-29.53	-18				
MZ									-3.59		-3.59					
South Korea																
	G+,C+	G+,C-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-	T+,C+	T+,C-	T-,C+	T-,C-	C+,T+	C+,T-	C-,T+	C-,T-
DFG										-3.2						
PP		-24						-23								
MZ												4.99				
Taiwan																
	G+,C+	G+,C-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-	T+,C+	T+,C-	T-,C+	T-,C-	C+,T+	C+,T-	C-,T+	C-,T-
DFG							-2.99	-3								
PP		-25		-20			-23.5	-23								
MZ																

Thailand								
	G+,C+	G+,C-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-
DFG								-2.9
PP							-17.6	-19
MZ								

Table 2D: Cointegration between Coal, GDP and Trade

Bangladesh																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG								-3	-3.66		-3.61					-3
PP		-18				-20	-20	-22	-17.8							-21.6
MZ																
China																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-5.1		-5	-3.23	-3.8	-5.4	-4.9							-3.52	-3.37
PP		-32		-42	-21.8	-29	-47.3	-41							-24	-22.2
MZ		-3.4		-3.9	-3.22	-3.7	-4.35	-4.1							-3.11	-3.07
India																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3.3			-4.03	-3.5		-3.49		-3.8			-3.86	-3.12
PP				-29			-37.6	-31				-20			-35.4	-26.7
MZ							-3								-2.96	
Indonesia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG							-3.07	-3.2				-3.1	-3.09		-3.2	-3.56
PP								-18				-23	-18.1		-17.8	-23.5
MZ																
Japan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-4.5			-3.74	-3.5							-3.41	-3.39		
PP		-30			-30.2	-26			-113	-76.1	-141.6	-35	-25.1	-25		
MZ		-3.4			-3.28	-3.2			-7.07	-5.5	-8.01	-3.2	-3.08	-3.11		
New Zealand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3.6				-4							-3.04			
PP		-22				-32			-85.9	-37004			-20.9	-19.7		
MZ						-3.3			-5.97	-136						
Pakistan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG						-3.2			-2.98			-4.4				-3.15
PP		-94		-23		-18			-44.6		-35.7	-36				-20.2
MZ		-6.2							-3.44			-3.6				
Philippines																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG	-2.92		-3.17	-4.9		-3.3						-3.6			-3.58	
PP	-18.2		-21	-29		-18	-52.1	-433				-26			-26.5	-29.1
MZ			-3.01	-3.6			-4.63	-15							-2.93	-3.13
South Korea																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP							-32.9	-26	-636	-24.9	-63.25	-27			-27.1	-30.9
MZ									-17.6		-5.04					
Taiwan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,C+							
DFG																
PP		-20		-31												
MZ				-3.1												
Thailand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP							-37.8	-40							-33	-31
MZ																

Table 3D: Cointegration between ELEP, GDP and Trade

Bangladesh																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG									-3.03		-4.06	-3.1				
PP							-23.4	-29	-19.7		-30.17				-21.6	-25.5
MZ											-3.35					
China																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG							-3.17	-3								-3.07

PP		-41					-24.6	-23								
MZ		-3.9														
China HKSAR																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG							-2.94									-2.94
PP		-22		-29	-19.2		-18.2									-18.1
MZ																
India																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG							-2.92	-3.3		-3.37						
PP		-18					-22.4	-27		-28.5					-21.6	
MZ																
Indonesia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG	-2.93						-6.14	-6.1								-6.21
PP	-18.4						-37.6	-38	-19.2	-19.9		-19			-20	-38
MZ							-3.06	-3.1								-3.06
Japan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP									-128	-66.2						
MZ									-7.66	-5.11						
Malaysia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3														
PP	-21.7	-20		-18					-17.7							
MZ																
New Zealand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3.4	-2.99				-3.19	-2.9								
PP		-24	-17.9				-22.4	-20	-328	-97.4	-176.6					-20.2
MZ		-3							-12.5	-6.37	-8.95					
Pakistan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3.1					-3.24	-3.3	-4.5		-4.48				-3.52	-3.78
PP		-22		-20			-22	-23	-27	-17.8	-26.87	-18			-24.6	-26.3
MZ																-3.01
Philippines																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG			-3.6	-3.6			-4.31	-4.9								
PP			-24.6	-25			-34	-41								
MZ			-3.3	-3.2			-3.11	-3.4								
South Korea																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG									-3.21							
PP								-20	-299	-95.2	-8472	-58				
MZ									-11.9	-6.29	-65	-4.5				
Thailand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG								-3.4		-4.61		-4.5				
PP								-20		-36.7		-37				
MZ										-3.3		-3.3				

Table 4D: Cointegration between ELEP-Coal, GDP and Trade

China																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3.5	-3.29	-3.9							-3.22	-3.28		
PP		-57	-50.7	-137	-21.2	-28	-105	-105					-18.4	-19.7	-19.6	-26.6
MZ		-4.9	-4.86	-7.9	-3.1	-3.6	-6.72	-6.8						-2.99		-3.32
China HKSAR																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG			-3.53				-3.93					-3.1			-3.09	-2.98
PP		-30	-25.4	-41			-18.6	-18		-20		-25				-17.9
MZ		-3.1		-3.7												
India																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG								-3.3	-3.13	-3.43		-3.3				
PP		-18					-26.8	-35	-19.9	-29.9		-28			-26.8	-28.5
MZ																

Indonesia									T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG									-3.58							
PP									-26.9		-21.11	-19			-22.5	
MZ																
Japan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG						-3.2									-2.93	
PP		-19				-20			-79.2	-55.4	-135.9	-62			-17.4	
MZ						-3			-5.82	-4.55	-7.79	-4.9				
New Zealand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-2.9		-3.1	-3.48	-3.8		-3.7						-3.35		
PP		-19		-20	-30.4	-35	-17.6	-33			-168.7	-30	-33	-30	-17.8	-18.3
MZ						-2.9					-8.73		-3			
Pakistan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3.5					-4.67		-4.39	-3				
PP		-25		-26			-23.8	-23	-29.2	-17.9	-26.44	-19	-18.4			
MZ																
Philippines																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG	-3.2		-3.85	-3.4												-4.57
PP	-18.7	-17	-27.9	-22			-58	-37							-26.2	-22.6
MZ			-3.55	-3.2			-4.53	-3.2								
South Korea																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG							-3.91	-3.8							-3.38	-3.57
PP				-21			-29.8	-28	-3935	-106	-2082	-47			-23.5	-25
MZ							-3.08	-3	-44.2	-6.63	-32.11	-3.9				
Thailand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3.5						-5.5		-4.49		-4.7				-5.28
PP		-23					-18.5	-51		-36.7		-38			-19.3	-47.9
MZ		-3.2						-3.9		-3.23		-3.4				-3.83
MZ		-4.9	-4.86	-7.9	-3.1	-3.6	-6.72	-6.8								

Table 5D: Cointegration between ELEP-HYD, GDP and Trade

Bangladesh																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG					-3.1	-3.2										
PP					-22	-25	-23.2	-18								
MZ																
China																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3.3		-3.8				-3.6				-3.8				
PP		-211		-248			-47.5	-36				-28			-34.2	-31.7
MZ		-10		-11			-3.75									
India																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3.6	-2.97	-3	-3.72	-4.2		-3.33		-3.5	-3.01		-3.56	-2.93
PP				-32	-17.5	-19	-30.7	-36		-28.2		-29	-18.4	-17.8	-27.8	-20.8
MZ								-3								
Indonesia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3.2												
PP				-21				-25		-18.9		-18	-21.9		-22	
MZ																
Japan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG					-4.37	-4.5							-4.52	-4.52		
PP					-48.5	-49	-60.2	-23	-50.4	-29	-59.76	-62	-50.1	-49.5	-27.4	-23.1
MZ					-2.98	-3	-3.69		-4.52		-4.94	-4.9	-3.05	-3.04		

	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
Malaysia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3.3						-3.88		-3.4				
PP				-23			-17.4			-30.2		-25			-17.7	
MZ										-3.19						
New Zealand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3.2		-3.5									-3.93	-3.61		
PP	-18.4	-22		-26				-21	-21.6	-652	-22.51	-3959	-35.7	-32.9		
MZ				-3.1						-17.8		-44				
Pakistan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3.2					-3.97		-4.49	-2.9				
PP		-56		-23					-25.2		-26.85	-19			-18	
MZ		-4.4														
Philippines																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP																
MZ																
South Korea																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP	-51.8				-40.3				-8274	-34.6	-7409	-40	-20.7			
MZ	-4.6								-64.2	-2.93	-60.78	-3.4				
Thailand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG						-3.1				-4.52		-4.7		-3.16		
PP					-21.8	-23	-20.1	-31		-39.2		-38	-18	-26.7	-20.2	-28
MZ										-3.16		-3.4				

Table 6D: Cointegration between ELEP-NG, GDP and Trade

	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
Bangladesh																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG	-3.26			-3.3					-3.34		-3.31	-5.9				
PP							-34.7	-33	-22.5		-19.67	-43			-96.5	-59.3
MZ									-2.93			-3.9			-6.1	-4.36
China																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG	-4.14	-3.5		-3.9			-4.65								-2.99	-2.93
PP	-31	-22		-28			-39.6								-21.7	-21.6
MZ	-3.83	-3		-3.4			-2.94									
India																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG										-3.38		-3.4				
PP							-26.4	-95		-28.2		-28			-28.9	-34.7
MZ								-6.1								-2.99
Indonesia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG							-3.02	-3					-2.97		-3.42	-3.06
PP									-23		-20.18		-24.7		-17.6	
MZ																
Japan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP							-19.6	-21	-119	-64	-71.66	-65			-21.7	-20.8
MZ									-7.38	-4.99	-5.5	-5				
Malaysia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3					-3.42	-3.4							-3.39	-3.37
PP		-18					-26.2	-26		-6218					-25.9	-25.6
MZ										-55.7						
New Zealand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3.1		-3.2			-5.2	-5.6							-5.04	-4.8
PP		-20		-20			-32.6	-38	-1287	-105	-53.18	-686			-40.1	-38.2
MZ							-3.36	-3.7	-25.2	-6.66	-4.42	-18			-3.28	-3.18
Pakistan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3					-4.7		-4.49			-3.05		
PP		-19		-21					-28.3	-17.8	-26.76	-19		-20.8	-19.6	

	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
MZ																
South Korea																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG															-8.41	-11.6
PP										-902					-21.5	
MZ										-21	3.04					
Thailand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG			-3.73							-4.31	-3.37	-5				
PP			-28.2				-29			-33.9	-23.65	-43			-278	-23.2
MZ			-3.32							-3.11		-3.7			-11.3	

Table 7D: Cointegration between ELEP-NU, GDP and Trade

India																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3.6	-3.78	-2.9				-3.38		-3.4	-3.5		-3.9	
PP				-29	-30.4	-20	-29.1	-30		-28.8		-29	-24.7		-38.7	-22.1
MZ																
Japan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG							-4.31	-3.9							-3.67	-3.78
PP							-40.3	-33	-268	-83.5	-162.5	-109			-31.6	-31.8
MZ							-2.99		-11.3	-5.85	-8.67	-6.9				
Pakistan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3.2		-3.3	-3.49	-3.5			-4.49		-4.48		-3.05			
PP		-23		-24	-26.5	-27		-20	-25.7		-26.88	-18	-21	-18.2		
MZ					-2.98	-3										
South Korea																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG							-15.3	-15								-13.9
PP		-21					-21.6	-21	-46.8	-111	-6286	-222			-26.5	-21.4
MZ									-4.02	-74.4	-55.96	-10				

Table 8D: Cointegration between ELEP-Oil, GDP and Trade

Bangladesh																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG									-3.28	-3.05	-3.28					
PP									-22.2		-22.3					
MZ																
China																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG	-2.93	-3.7			-2.93											
PP		-441		-136	-19.3									-18		
MZ		-15		-7.9												
China HKSAR																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP		-18		-19								-28	-19.2	-18.8		
MZ																
India																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG										-3.31		-3.3				
PP							-28	-19		-27.2		-26			-23.8	-17.7
MZ																
Indonesia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG								-3								
PP							-19.7	-20		-18.8		-20				
MZ																
Japan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP									-83.4	-58.7	-39.6	-46				
MZ									-6.01	-4.72	-3.81	-4.1				
Malaysia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG										-4.98				-3.59		
PP		-18		-20						-44.9			-22.7	-27.4		
MZ										-3.72						
New Zealand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-

DFG																
PP																
MZ																
Pakistan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3.3		-3.9					-4.53	-3.01	-4.15	-2.9				
PP		-24		-34					-26.8	-19.1	-25.8	-19				
MZ																
Philippines																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E	E+,T+	E+,T-	E-,T+	E-,T-
DFG			-3.18									-4				
PP			-19.3		-19	-19						-33	-19.2	-18.4		
MZ			-2.96									-3.3				
Singapore																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E	E+,T+	E+,T-	E-,T+	E-,T-
DFG	-3.21		-3.24		-3.12	-3	-3.6	-3.7	-3.41	-3.32	-3.3	-3.2				
PP	-22	-27	-25.6	-26	-19	-18	-27.7	-29	-26.2	-25.9	-26.3	-25				
MZ	-3.07	-3	-3.2		-2.97		-3.68	-3.7	-3.23		-3.18					
South Korea																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E	E+,T+	E+,T-	E-,T+	E-,T-
DFG					-3.13									-3.13		
PP					-20.3				-566	-148	-2532	-76	-17.9	-19.8		
MZ									-16.5	-7.96	-35.4	-5.4				
Thailand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E	E+,T+	E+,T-	E-,T+	E-,T-
DFG					-3.34					-4.86		-4.6	-3.05			
PP					-23.6					-40.2		-36	-19.4			
MZ										-3.47		-3.3				

Table 9D: Cointegration between ELEP-Rene, GDP and Trade

Bangladesh																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG					-3.1	-3.2			-3.4	-3.04	-3.26		-3.05	-3.35		
PP					-22	-25	-23.2	-18	-22.6		-21.68		-22.3	-28		-17.8
MZ																
China																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3.5								-3.4				
PP		-182		-199			-44.9	-36				-23			-33.1	-30.5
MZ		-9.2		-9.7			-3.61									
India																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3.2			-3.72	-4.3		-3.32		-3.5			-3.62	-3.38
PP				-28			-30.9	-37		-28.1		-30			-29.2	-26.4
MZ								-3								
Indonesia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP				-20			-20.9	-30		-18.9		-18			-30.4	-20.1
MZ																
Japan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG					-4.31	-4.7							-4.3	-4.56		
PP					-46.7	-50	-37	-29	-34	-31	-77.16	-50	-47	-49.1	-30.1	-28.9
MZ					-3.02	-3.2			-3.6	-3.03	-5.75	-4.2	-3.03	-3.15		
Malaysia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3.3						-3.88		-3.4				
PP				-23			-17.4			-30.2		-25			-17.7	
MZ										-3.19						
New Zealand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3		-3.5				-2.9					-4.15	-3.56		
PP	-18.1	-19		-25				-22		-26.1		-1416	-37.6	-32.7		
MZ				-3.1								-26				
Pakistan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3.2					-3.97		-4.49	-2.9				
PP		-56		-23					-25.2		-26.85	-19			-18	
MZ		-4.4														
Philippines																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-

DFG	-3.24						-3.99	-4.3				-3.1			-3.53	-3.68
PP	-20.1						-33.3	-38				-22			-29.4	-31.3
MZ	-3.02															
South Korea																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG	-3.71															
PP	-29.9				-37.9				-4644	-37.8	-2923	-34	-26.3	-17.6		
MZ	-3.11								-48.1	-3.21	-38.1					
Thailand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG										-4.47		-4.7		-2.93		
PP					-21	-21		-19		-38.9		-38	-20.5	-24.6		
MZ										-3.12		-3.4				

Table 10D: Cointegration between EPC, GDP and Trade

Bangladesh																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG					-3.45	-3.3			-3.38		-4.26		-3.38			
PP				-22	-19	-18	-42.6	-24			-21.86		-19.9	-18.2	-20.2	-104
MZ							-3.34									-6.56
China																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG							-3.19	-3.1								-3
PP		-84		-179			-25	-24							-17.5	
MZ		-6		-9.2												
China HKSAR																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP		-21					-23.4									
MZ																
India																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3.9			-3.14	-3.4		-3.4		-3.5			-3.15	-3.07
PP				-39			-22.2	-25		-28.6		-29			-22.2	-21.6
MZ																
Indonesia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG	-3.04						-6.49	-6.5		-2.94						-6.54
PP	-19.8						-60.4	-60	-18.9	-20.5		-19			-53.5	-61.1
MZ							-4.55	-4.6							-4.11	-4.58
Japan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG										-3.28		-4				-3.09
PP										-24.9		-33			-18.5	-20.1
MZ												-3.2				
Malaysia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP	-25.8			-18												
MZ																
New Zealand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP										-22.2						
MZ																
Pakistan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3.1		-3			-4.55	-4.7	-4.37		-4.24				-4.35	-4.34
PP		-22		-21			-40.9	-44	-26.4	-18	-26				-37.1	-36.6
MZ							-3.68	-3.9							-3.48	-3.47
Philippines																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG	-2.95		-3.73	-4.2								-2.9				
PP	-18.4		-25.1	-33				-23				-19				
MZ			-3.28	-3.5												
Singapore																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG	-3.99								-3.35	-3.32	-3.57	-3.5				
PP	-31.8	-43			-39.3		-24.6	-20	-24.9	-26.4	-25.29	-28				
MZ	-3.62	-3.9			-4.35				-3.13		-3.18					
South Korea																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-

DFG		-3.1														
PP		-20								-32.2		-22		-17.9		
MZ										-2.94						
Thailand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG								-3.9		-4.68		-4.5				
PP				-22				-22		-37.1		-37				
MZ										-3.34		-3.3				

Table 11D: Cointegration between EU, GDP and Trade

Bangladesh																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3.3			-3.12				-3.88		-3.7					
PP		-24			-17.6		-29.6		-20.8							
MZ																
China																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG							-2.93	-3							-3.24	-2.99
PP		-118		-117			-18.4	-18							-21.2	-18.1
MZ		-7.3		-7.3												
China HKSAR																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG					-4.05	-3.6							-4.02	-3.97		
PP		-17		-22	-32.6	-28	-42.2	-21					-32.4	-31.7		-19.3
MZ					-3.34	-3	-4.03						-3.35	-3.31		
India																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-4.3						-3.32		-3.4				
PP		-22		-41			-19.6	-23		-26.9		-29			-27.3	-19.6
MZ																
Indonesia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3.2				-5		-3.09	-3.82	-3				
PP				-19			-25	-46		-23.2	-30.04	-22			-1203	-18.6
MZ								-3.5			-3.08				-24.3	
Japan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP									-365	-92.2	-154.4					
MZ									-13.3	-6.25	-8.44					
Malaysia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG					-3.61											
PP					-28	-17	-23.6	-41					-18.4		-22.8	-19.5
MZ					-2.93											
New Zealand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-4.2		-3.1											-3.39	
PP		-29					-17.8	-19	-2367	-173	-4646	-308			-24.2	
MZ		-3							-344	-8.79	-48.08	-12				
Pakistan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3		-3.1		-3.1	-3.93	-4.1	-4.41		-4.53					-3.88
PP		-21		-21	-19.4	-20	-38.9	-40	-26.7	-17.6	-27.3	-18			-55	-36.2
MZ							-3.41	-3.5							-4.52	-3.33
Philippines																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG	-3.14									-3.18						
PP	-17.8									-21.1				-18.7	-18.4	-19.6
MZ																
Singapore																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG							-3.12	-3.9	-3.73	-3.76	-3.36	-3.4				
PP			-20.8	-25		-18	-19.8	-29	-31.4	-31.2	-26.87	-27	-17.6	-17.6		
MZ								-3.1	-3.53		-3.23					
South Korea																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG								-3.9								
PP				-22				-34	-642	-92.8	-2927	-50				
MZ								-3	-17.7	-6.06	-38.11	-4.1				
Thailand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-

DFG							-3.41	-3.4		-5.47		-4.8			-3.37	-3.31
PP							-24	-23	-18.9	-48.7		-39			-22.9	-22.4
MZ							-2.92			-3.85		-3.4				

Table 12D: Cointegration between NG, GDP and Trade

Bangladesh																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG							-4.98	-5	-4						-4.98	-5.55
PP		-23					-37	-36	-18.1						-34.8	-38.6
MZ																
China																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP		-18														
MZ																
India																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3.1							-3.74		-3.04	-3.5				
PP		-25		-24					-28				-17.7		-30.8	
MZ									-3.08							
Indonesia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG	-3.08						-3.64	-3.7							-3.52	-3.6
PP	-20.5						-38	-39		-18.3					-36.7	-37.6
MZ																
Japan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG							-4.77	-4								-4
PP							-42.7	-32	-202	-81.3	-23.85	-22			-20.6	-31.6
MZ							-3.73	-3.2	-9.74	-5.73						-3.23
Malaysia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG							-3.33	-3.3							-3.09	-3.26
PP		-18		-22			-26.1	-26	-41.4	-45.6	-63.24	-54			-23.5	-25.4
MZ									-3.92	-4.09	-5.02	-4.5				
New Zealand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3.2					-4.33	-4.2							-4.01	-3.37
PP		-21					-34.3	-33	-47.1	-680	-532.4	-585			-30	-22.7
MZ							-3.72	-3.6	-4.18	-18.2	-16	-17			-3.37	
Pakistan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG							-4.07	-3.7		-3.16	-3.05	-4		-3.24	-3.91	-4.01
PP		-110		-29			-32.8	-29	-33.8	-20.1	-36.58	-36		-22	-30.1	-33.1
MZ		-7					-3.25	-3				-3.2		-3.04	-3.13	-3.19
South Korea																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG															-8.99	-15.7
PP										-9302					-21.7	-18.3
MZ										-216						
Taiwan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-								
DFG																
PP		-22		-22												
MZ																

Table 13D: Cointegration between NU, GDP and Trade

India																
	G+,E+	G+,E-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG					-3.09	-3.9	-5.1	-5		-3.39		-3.5				
PP					-20.9	-30	-41.7	-41		-27.9		-28	-17.8		-28.6	-26.9
MZ						-3.2	-3.06	-3								
Japan																
	G+,E+	G+,E-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-4.7	-3.12	-3.9	-5.46	-4.8							-4.47	-4.58
PP				-39	-20.5	-30	-47.9	-40	-285	-83.5	-126.1	-132			-39.5	-40.2
MZ				-3.7	-3.13	-3.8	-4.42	-4.1	-11.7	-5.85	-7.51	-7.6				
Taiwan																
	G+,E+	G+,E-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-								
DFG						-3.7										
PP		-25		-29	-19.3		-27	-22								

MZ																
Thailand																
	G+,E+	G+,E-	G-,C+	G-,C-	C+,G+	C+,G-	C-,G+	C-,G-	T+,E+	T+,E-	T-,E+	T+,E-	E+,T+	E+,T-	T+,E-	E-,T-
DFG								-4.2		-4.75		-5.7			-5.86	-3.93
PP							-28.2	-41		-37	-23.35	-46			-22.7	
MZ								-3.1		-3.32		-3.7				

Table 14D: Cointegration between PEC, GDP and Trade

Bangladesh																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-2.9		-3.6	-5.3	-5	-3.87	-3.01	-3.85			-3.1	-5.32	-5.55
PP		-23		-18		-24	-40.1	-39		-19.5				-21.4	-39.8	-41.2
MZ																-2.92
China																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-5.7		-4.7	-2.95	-3.7	-5.28	-4.6							-3.59	-3.5
PP		-40		-39	-18.7	-28	-45.4	-37							-25.5	-24.4
MZ		-3.8		-3.7	-2.99	-3.6	-4.28	-3.9							-3.26	-3.23
China HKSAR																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG							-3.03									
PP		-37		-24			-27.4	-27							-20.2	-22.6
MZ																
India																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP				-19			-37.2	-37				-29			-41.5	-44.1
MZ															-3.05	-3.28
Indonesia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG	-3.24						-3.65	-3.8								-3.97
PP	-22.1						-38.8	-40							-37.9	-42.9
MZ																
Japan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG																
PP									-286	-87.6	-32.0					
MZ									-11.7	-6.07	-3.36					
Malaysia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG								-4.2								
PP		-18						-37	-35.7	-44.8						
MZ								-3	-3.67	-4.01		3.78				
New Zealand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3.5														
PP		-20					-20.1	-25	-78.7	-54.7	-1481	-280			-22.3	-19.5
MZ									-5.63	-4.45	-27.0	-11				
Pakistan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG								-4.6				-4.2				
PP		-23		-25			-20.8	-42	-38.8		-33.7	-37			-20.8	-33.9
MZ								-3.6	-3.03			-3.2				-3.35
Philippines																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG										-3.1		-3.3				
PP										-19.7		-22				
MZ																
Singapore																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG									-3.68	-3.38	-3.56	-3.3				
PP							-18.5		-27.2	-27.7	-26.2	-27			-19.8	-20.4
MZ									-3.31		-3.25					
South Korea																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG								-3.3								
PP		-21						-25	-779	-44.3	-502.	-25				
MZ									-19.6	-3.76	-15.6					
Taiwan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-								
DFG							-3.22	-3.2								
PP		-27		-18			-27.8	-27								

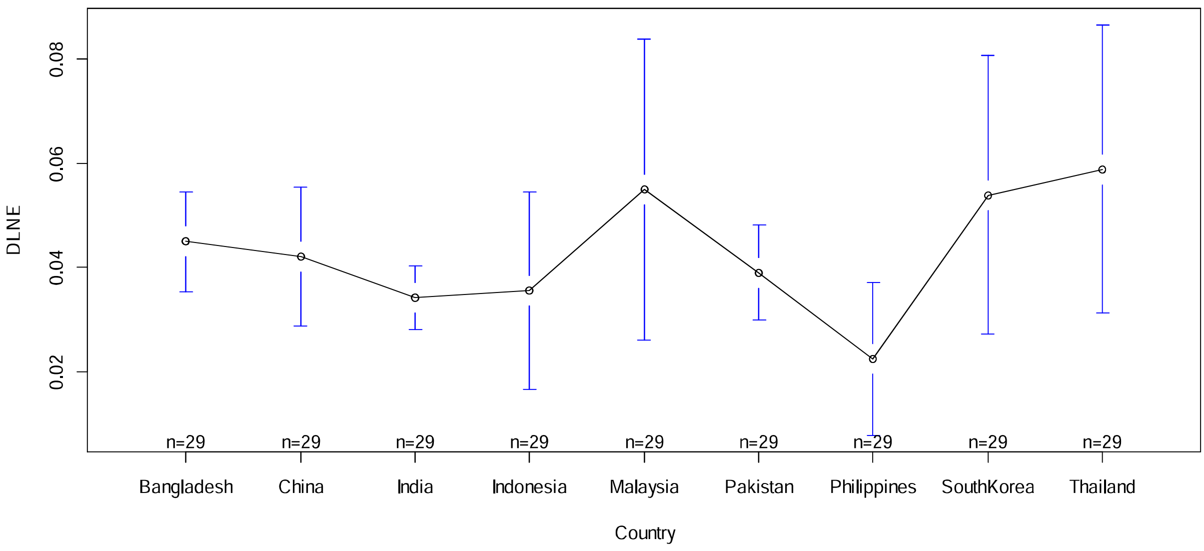
MZ																
Thailand																
	G+,E+	G+,E-	G+,E+	G+,E+	E+,G+	E+,G-	E-,G+	G+,E+	T+,E+	T+,E-	T-,E+	T-,E+	E+,T+	E+,T-	T-,E+	E-,T-
DFG																
PP				-27								-23				
MZ				-3												

Table 15D: Cointegration between HYD, GDP and Trade

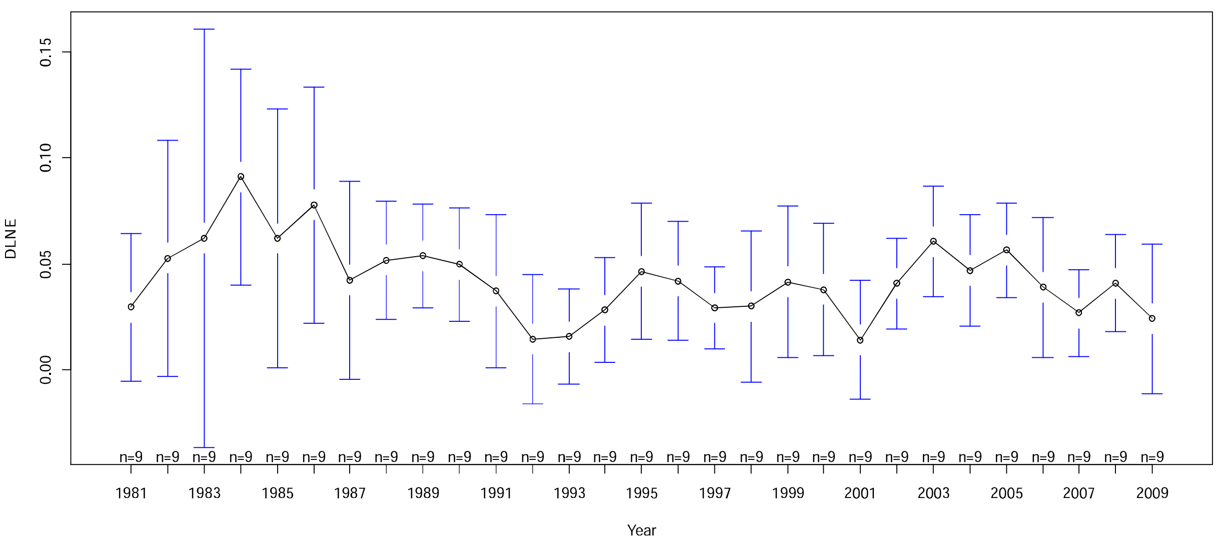
Bangladesh																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3.5		-3.7	-3.38				-3.5		-3.98		-3.25	-3.25		
PP					-24.7	-21	-19.8						-23.8	-23.1		
MZ																
China																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-5.2								-3.1				
PP				-42			-114	-54				-20			-29.8	-26.7
MZ				-3.9			-6.57	-3.7								
India																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG										-3.85		-3.8		-3.66		
PP					-22.4	-32	-23.6	-23		-20.7		-20	-18.7	-26.2	-19	-41.8
MZ					-3.12	-3.7								-3.32		-3.96
Indonesia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG													-4.61			
PP					-25.9	-23			-19.5			-18	-45.4	-22.7		
MZ													-3.43			
Japan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG							-3.85	-3.4					-4.26		-3.92	-3.36
PP					-44.4	-53	-38.5	-34	-111	-63.6	-77.52	-78	-48.9	-44.4	-39.7	-34
MZ						-3.2			-7	-4.9	-5.68	-5.6				
Malaysia																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG				-3.7									-3.41	-3.38		
PP				-29		-17		-25	-78.8	-35.6	-81.05	-54	-22.8	-22.8		
MZ				-3.1					-5.78	-3.33	-5.84	-4.5	-3.11	-3.08		
New Zealand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3		-4	-3.73	-3.7		-3.2					-3.92	-3.51		
PP	-17.5			-27	-34.9	-34		-25		-993	-19.66	-9838.2	-34	-30.3		
MZ				-2.9						-22.1		-70				
Pakistan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG		-3.6		-3.6					-4.36	-3.09						
PP		-28		-28					-35	-19.9	-44.33			-23.1		
MZ											-3.47					
Philippines																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG										-3.08						
PP							-170	-139		-19.3		-18			-426	-92.6
MZ							-8.17	-7.2							-14	-5.34
South Korea																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG					-4.83											
PP				-21	-45.6	-29			-514	-25.7	-123.6	-22	-41.4	-32		
MZ					-3.39				-15.8		-7.31		-3			
Taiwan																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-								
DFG					-4.15	-4.8	-3.32	-3.2								
PP		-20		-22	-42.8	-52	-31.8	-29								
MZ						-3.1										
Thailand																
	G+,E+	G+,E-	G-,E+	G-,E-	E+,G+	E+,G-	E-,G+	E-,G-	T+,E+	T+,E-	T-,E+	T-,E-	E+,T+	E+,T-	E-,T+	E-,T-
DFG						-3.1										
PP					-19.8	-25	-26.8	-29		-18.7			-19.7	-23	-27	-27.3
MZ																

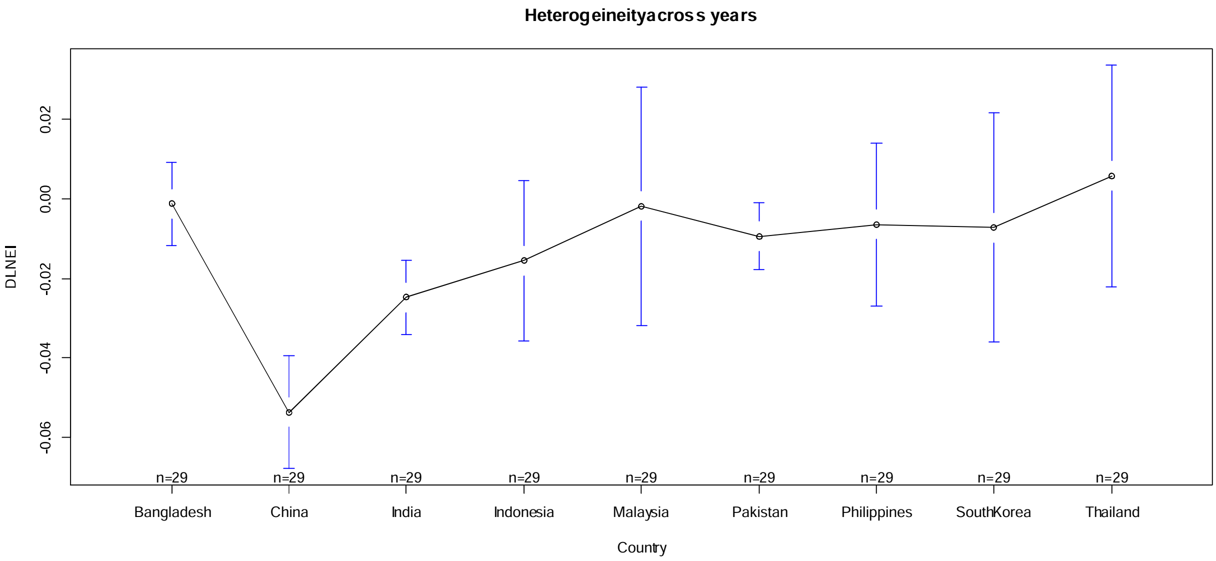
Appendix E: Plots of the variables for second objective

Heterogeineityacross years



Heterogeineityacross years




Heterogeineityacross years
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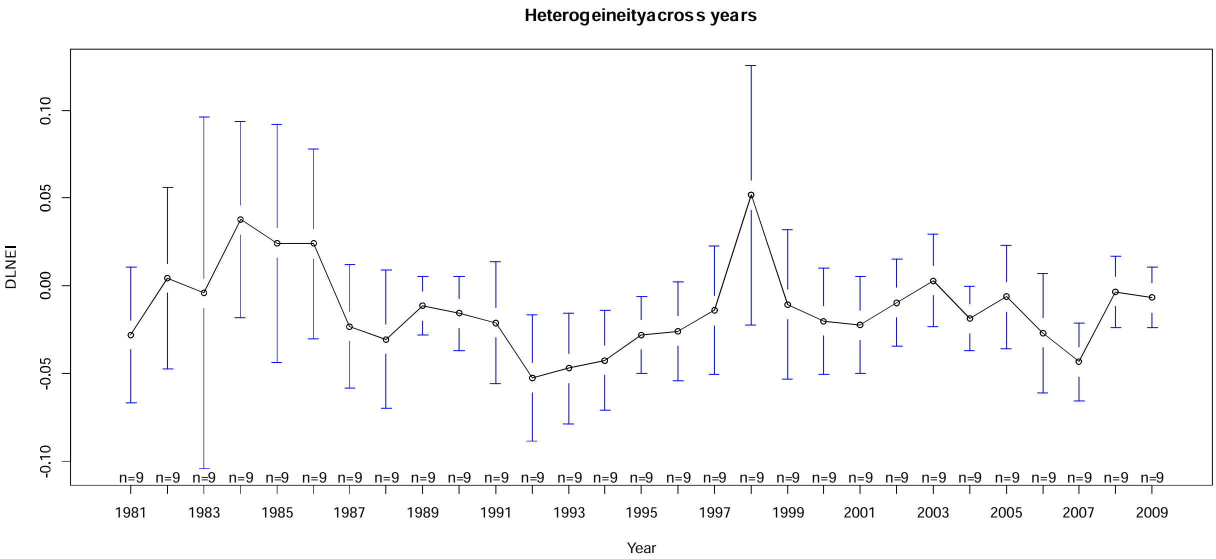
-0.02
-0.04
-0.06
n=29
Bangladesh
China
India
Indonesia
Malaysia
Pakistan
Philippines
SouthKorea
Thailand
Country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-0.10
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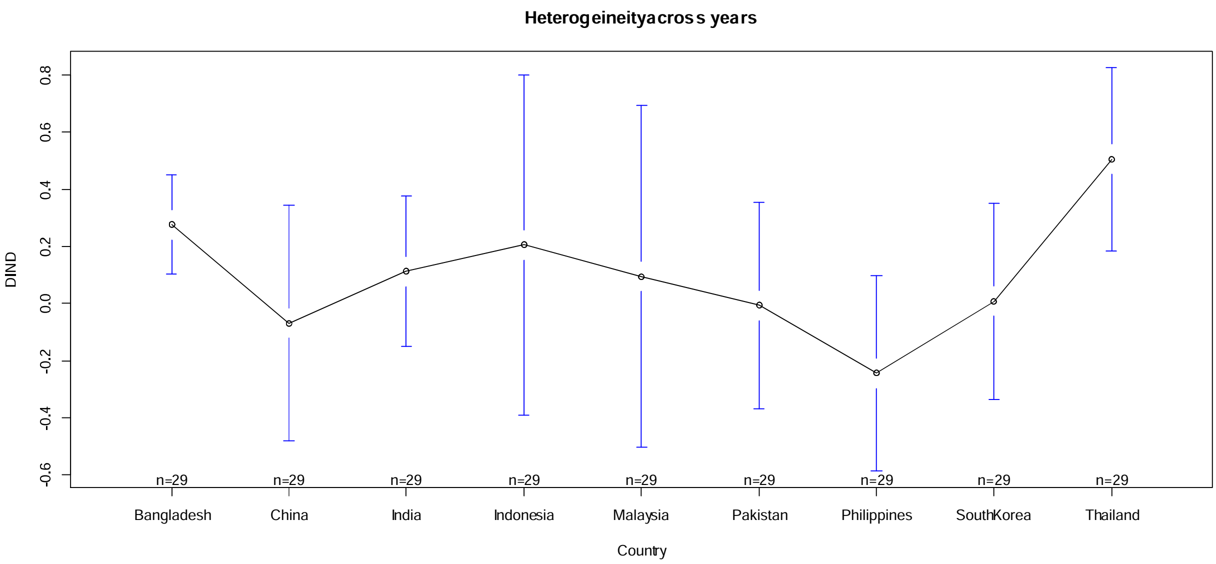
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
Year


Heterogeineityacross years
DIND
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0.4
0.2
0.0
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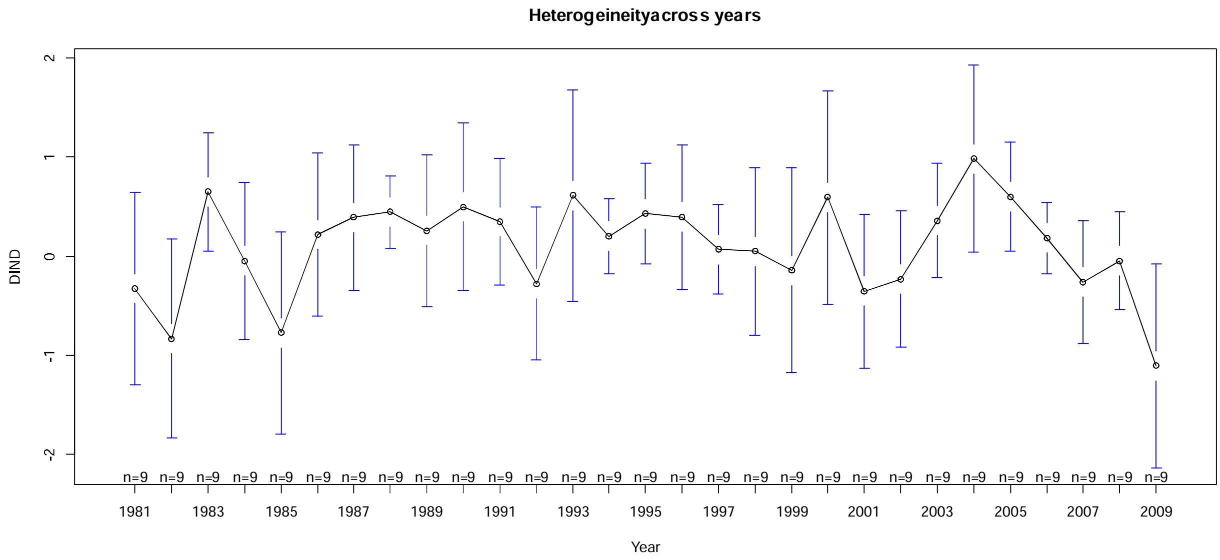
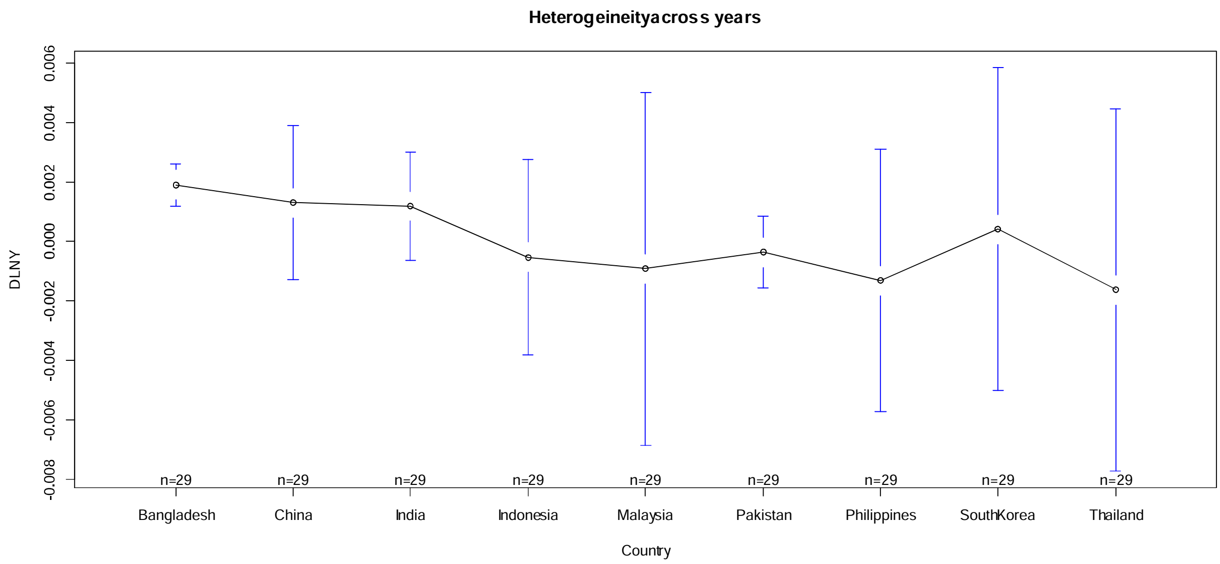
Bangladesh
China
India
Indonesia
Malaysia
Pakistan
Philippines
SouthKorea
Thailand
Country


Heterogeineityacross years
DIND
Year


Heterogeineityacross years
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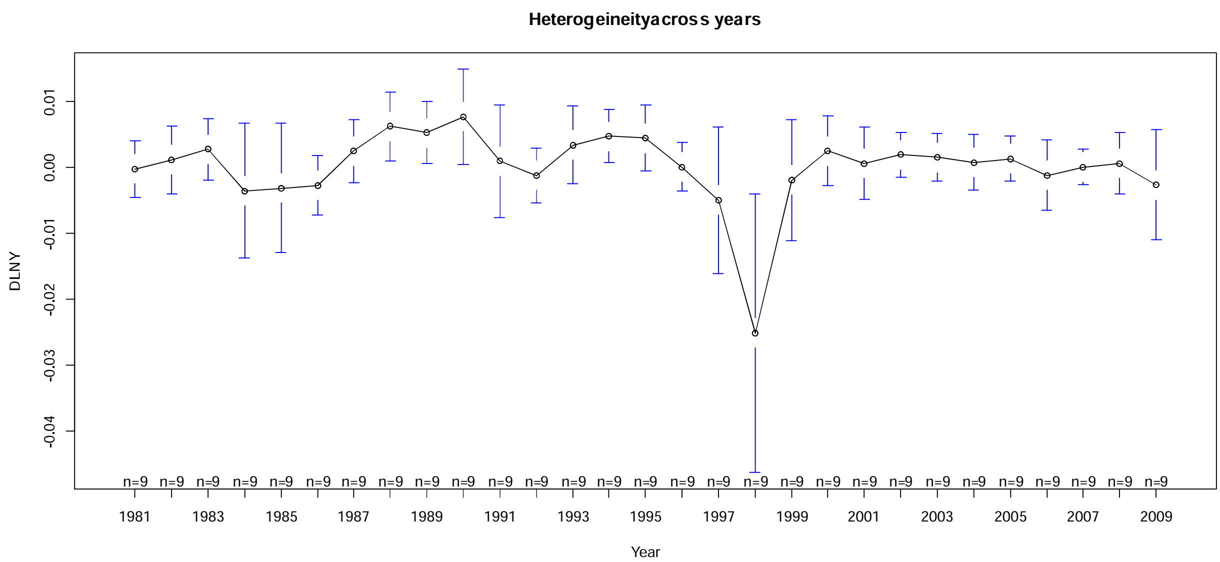
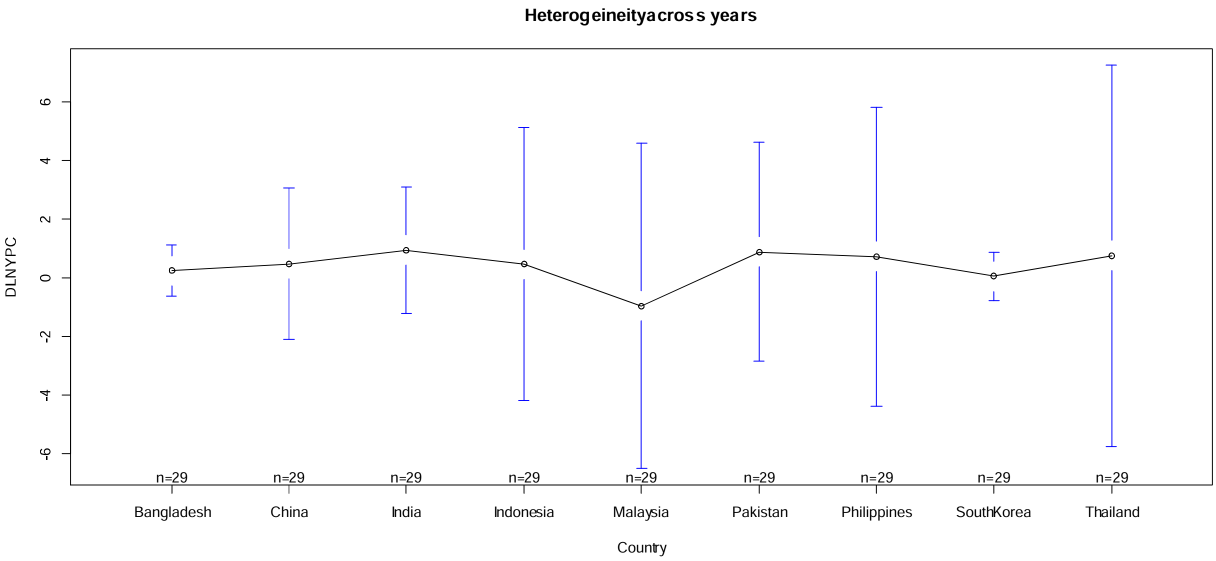
Bangladesh
China
India
Indonesia
Malaysia
Pakistan
Philippines
SouthKorea
Thailand
Country


Heterogeineityacross years
DLNY
Year


Heterogeineityacross years
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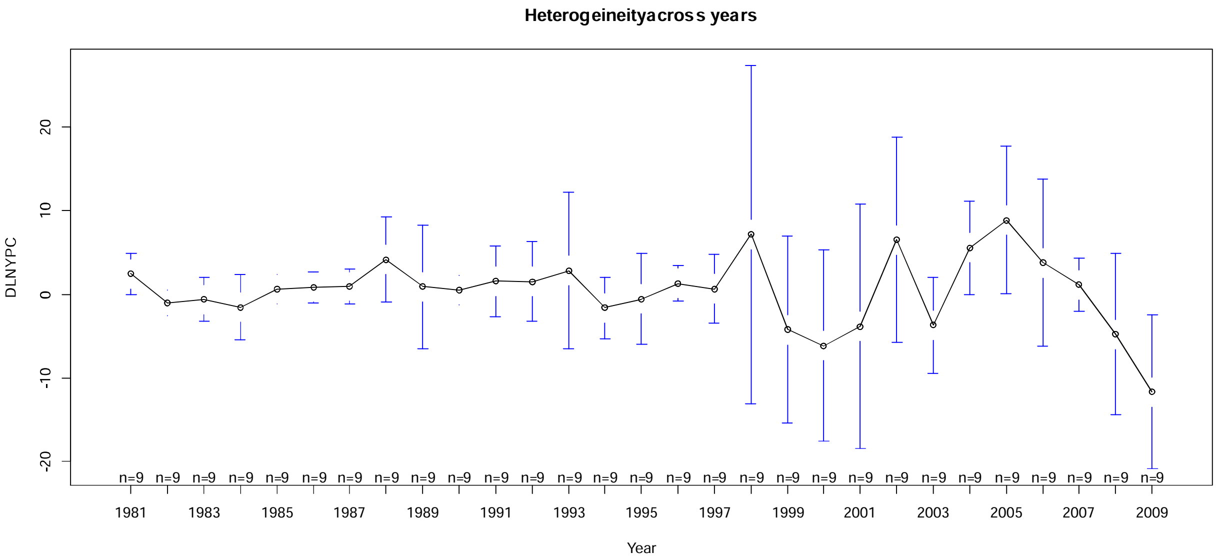
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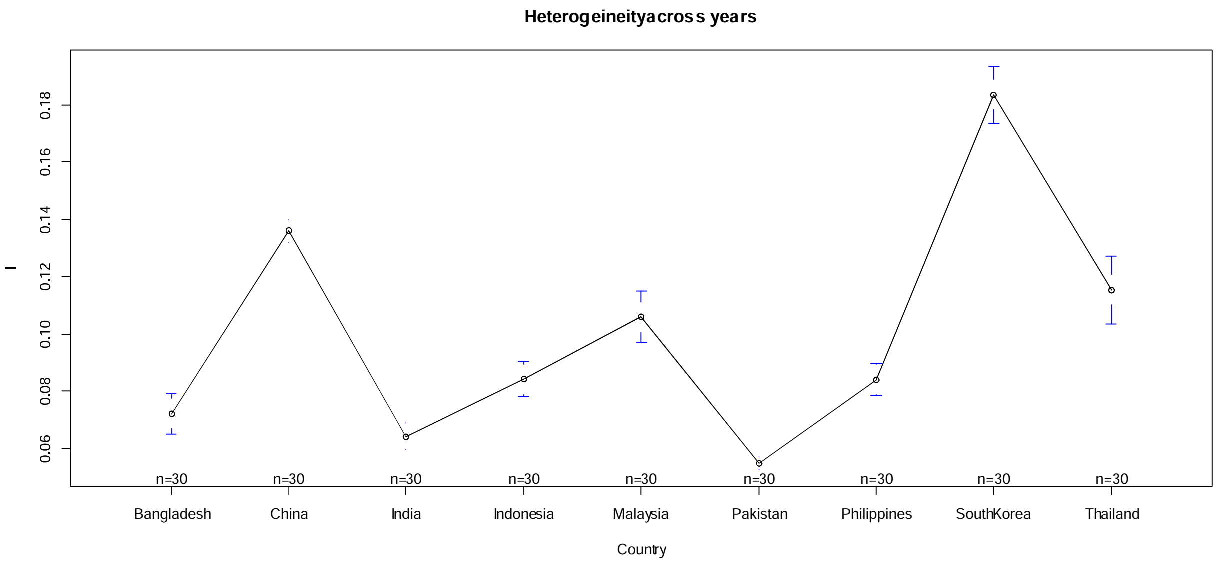
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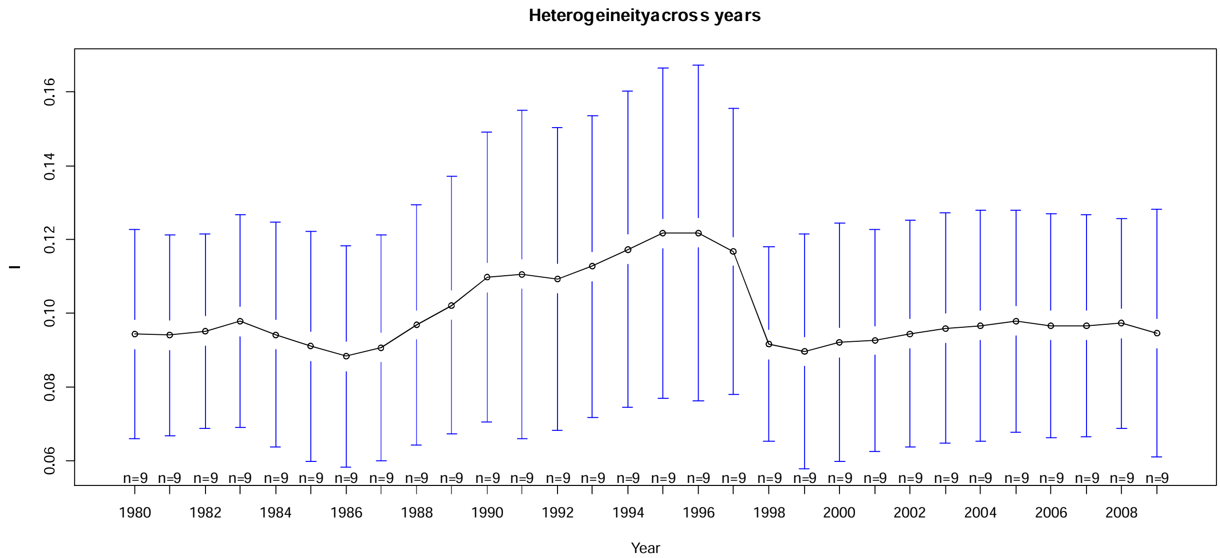
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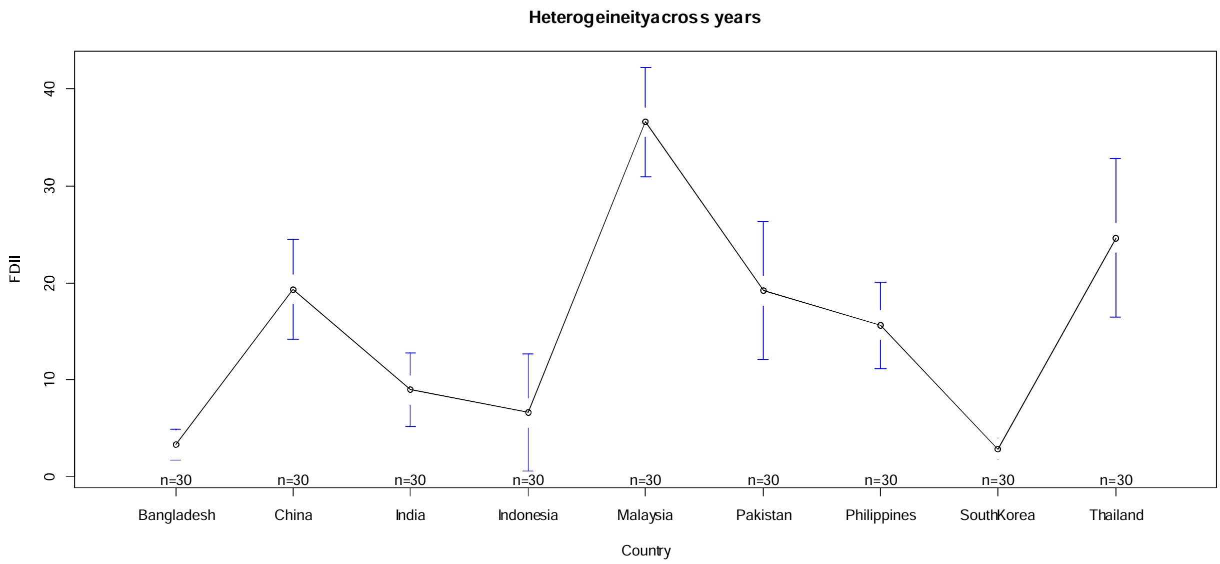
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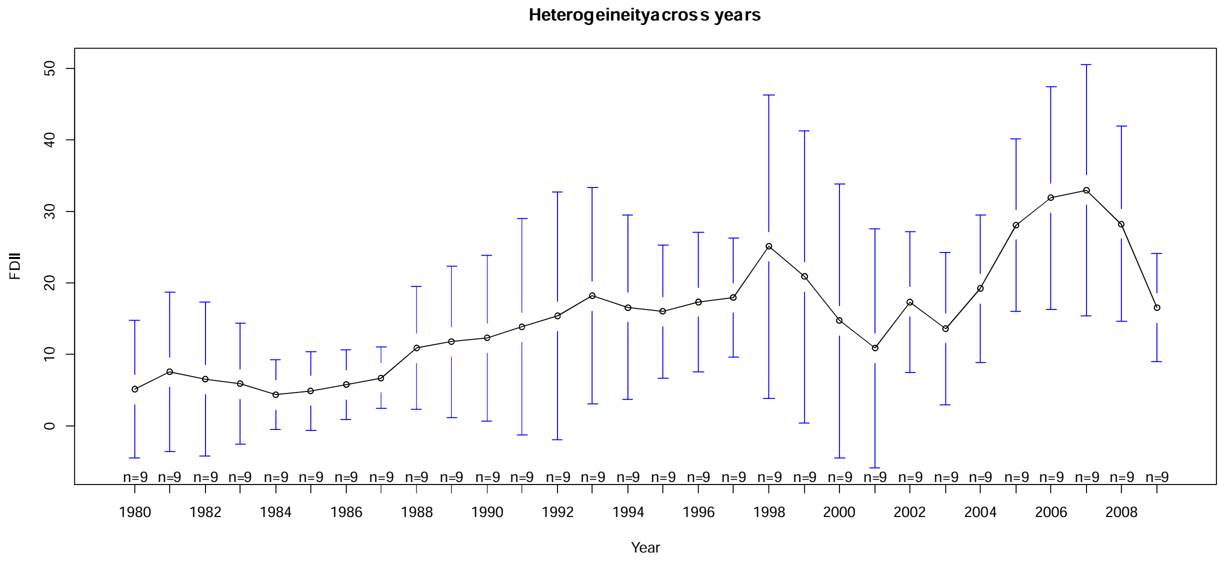
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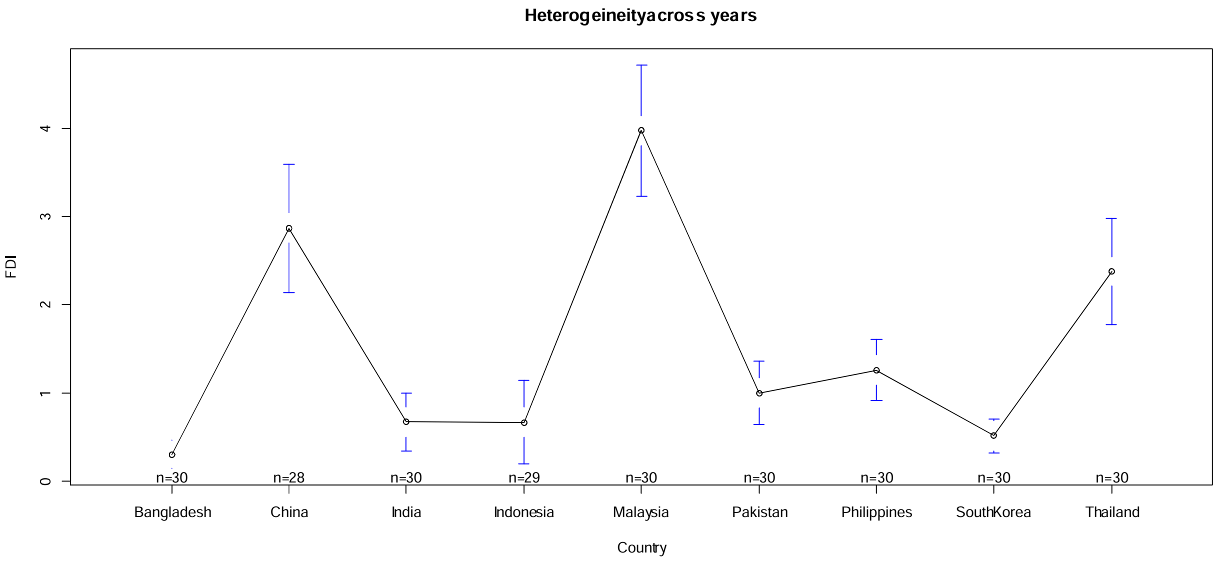
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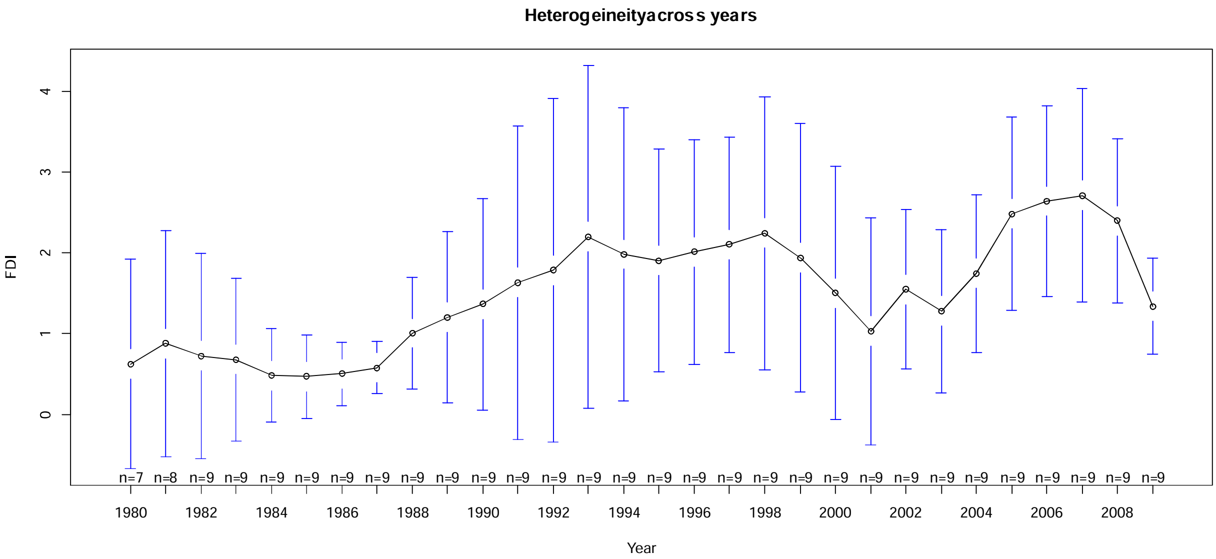
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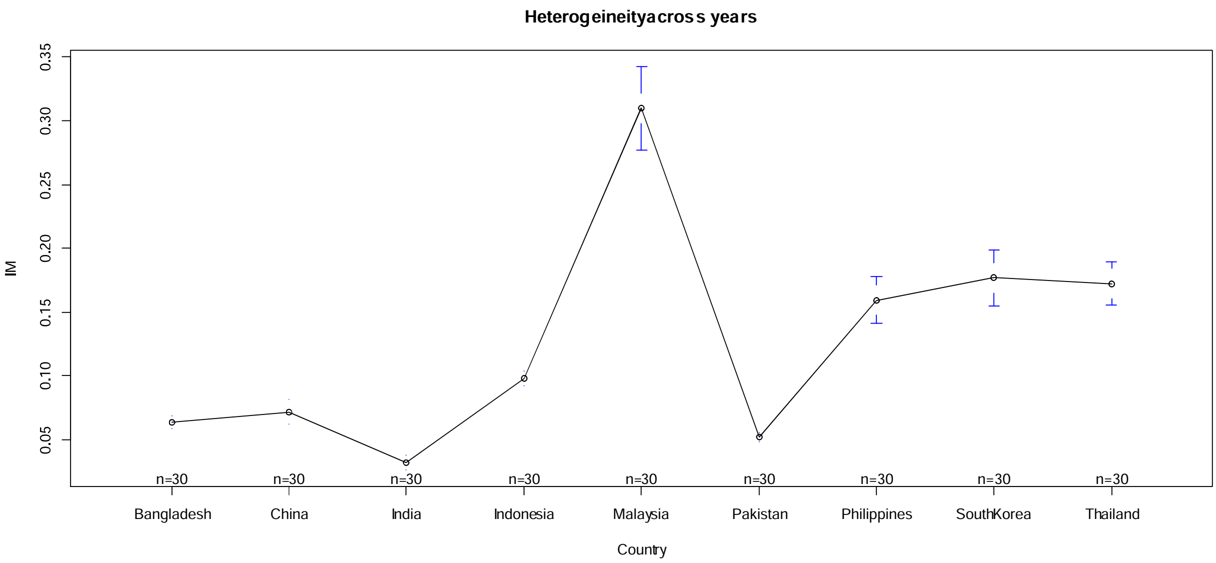
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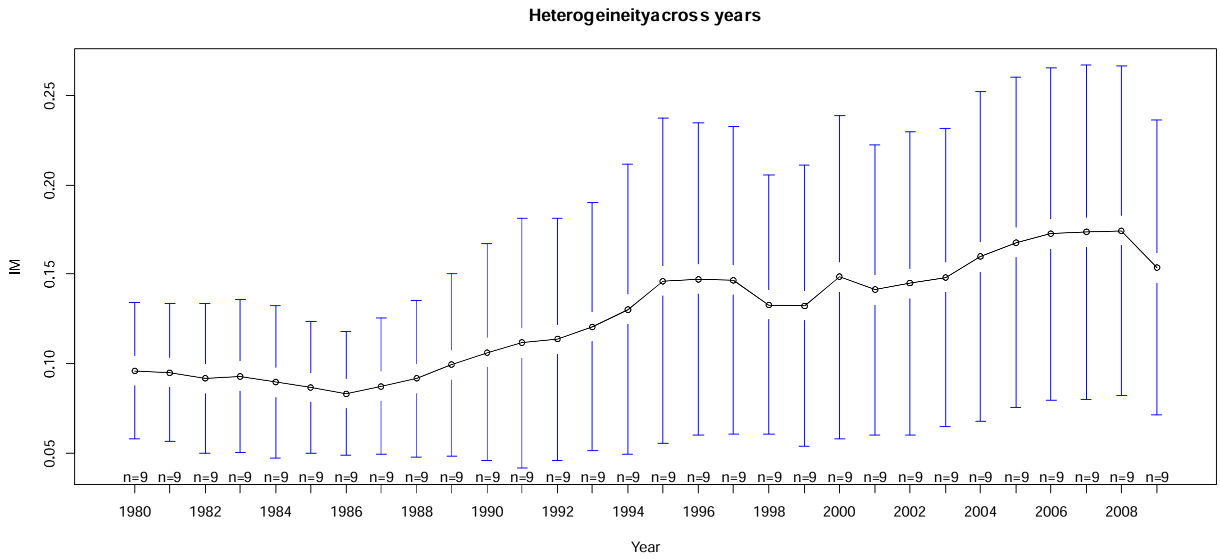
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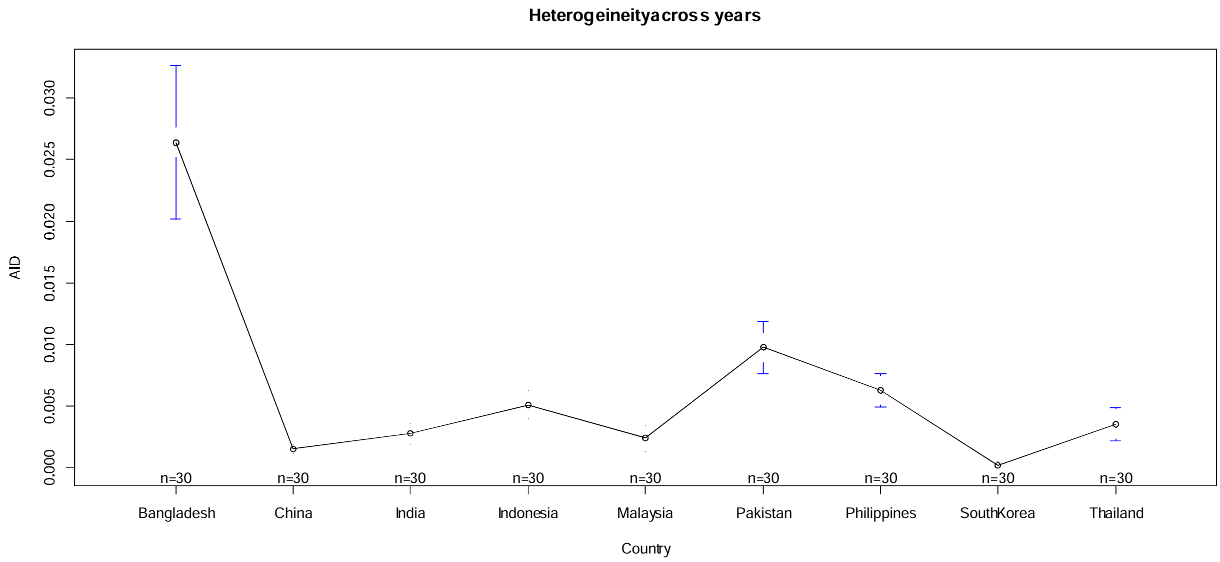
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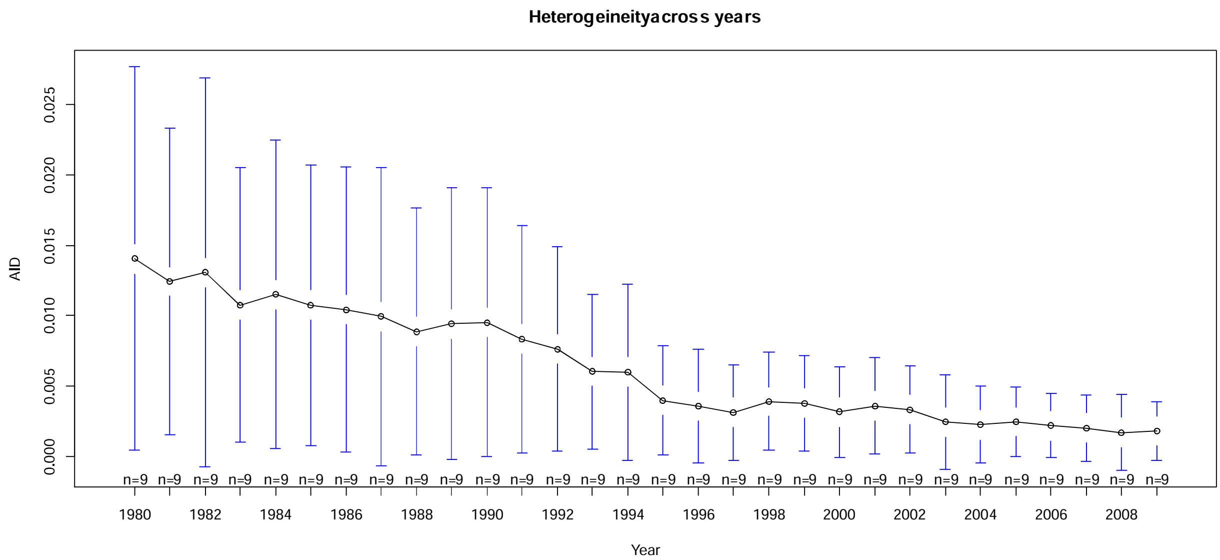
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1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008
Year

Appendix F: Reesults of panel unit root analysis

Table 1F: Panel unit root test for CO2 emissions, GDP and Trade

Tests without structural breaks: Trend model								
	Sample 1		Sample 2		Sample 1		Sample 2	
	CO_2 emissions	GDP	CO_2 emissions	GDP	CO_2 emissions	Trade	CO_2 emissions	Trade
Test statistic	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)
1	2.003665 (0.977447)	2.6093984 (0.9954649)	3.2041745 (0.9993227)	3.4312450 (0.9996996)	2.2590664 (0.9880604)	0.7843857 (0.7835931)	2.8804958 (0.9980147)	3.4312450 (0.9996996)
2	1.9448058 (0.9741008)	2.5327453 (0.9943413)	3.057493 (0.998884)	3.2741687 (0.9994701)	2.3812651 (0.9913734)	0.8268151 (0.7958291)	2.7958790 (0.9974121)	3.2741687 (0.9994701)
3	-0.7883222 (0.2152541)	2.6006612 (0.9953478)	-1.87586380 (0.03033699)	1.0681781 (0.8572799)	-1.0938124 (0.1370186)	0.4644529 (0.6788384)	-1.1201210 (0.1313311)	1.0681781 (0.8572799)
4	1.1297862 (0.8707169)	0.83206268 (0.79731322)	0.98589204 (0.83790695)	0.64130919 (0.739339)	0.72502817 (0.76578262)	5.3846367 (0.99999996)	1.0933085 (0.86287081)	4.3138034 (0.99999198)
	Decision on H_0		Decision on H_0		Decision on H_0		Decision on H_0	
	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%
5	T T T	T T T	T T T	T T T	T T T	T T T	T T T	T T T
6	T T T	T T T	T T T	T T T	T T T	T T T	T T T	T T T
7	F F F	T T T	F F F	T T T	F F F	F F F	F F F	T T T
Tests with structural breaks								
8.1	-7.930	-10.013	-9.827	-11.758	-6.195	-8.968	-8.655	-15.408
8.2	-21.085	-26.099	-22.529	-22.746	-13.566	-17.017	-20.208	-30.600
9.1	11.516418 (0.000000)	16.167050 (0.000000)	10.819794 (0.000000)	16.861547 (0.000000)	10.193004 (0.000000)	6.5175545 (0.000000)	12.994693 (0.000000)	4.9283431 (0.000000)
9.2	21.490893 (0.000000)	17.559926 (0.000000)	21.827551 (0.000000)	27.940188 (0.000000)	18.293214 (0.000000)	9.9368502 (0.000000)	18.449121 (0.000000)	11.132796 (0.000000)

Note: (1) Panel-ADF test: This test is of Costantini and Lupi (2012) based on Choi (2001) when no cross-dependence is detected.
(2) Panel-ADF test (pADF test): This test is of Costantini and Lupi (2012) based on Demetrescu et al. (2006) in the presence of cross-dependence. Cross-dependence has been detected through a cross-dependence test (Pesaran 2004) and Hartung's correction has been used in the combination of the p values as suggested in Demetrescu et al. (2006).
(3) Panel-CADF test (pCADF_PC): It is the Panel Covariate Augmented DF test. This is proposed by Costantini and Lupi (2012). pCADF.PC assumes that the panel is balanced and utilises the differenced first principal component of the N series as the stationary covariate. In the present case we used max.lag.y = 5, max.lag.X = 5.
(4) The J. Breitung and S. Das (2005) test.
(4) Sims ADF-based test: It is the ADF-based test in the original form proposed by Hanck (2008).
(5) SimespCADF- test: This is an ADF-based test proposed by Lupi (2011) advancing over Hanck (2008) for the stationary covariate case.
(6) SimespCADF_PC- test: This is an ADF-based test proposed by Lupi (2011) advancing over Hanck (2008) and that utilises the differenced first principal component of the N series as the stationary covariate.
(7) TRUE indicate that the test does not reject the null and FALSE shows that the null is rejected.
(8) is the Im et al. (2005) test where (8.1) is two breaks test in constant and (8.2) is two break tests in constant and trend
(9) Carrion-i-Silvestre et al. (2005) unit root test where (9.1) is the [Homo] version of test and (9.2) is the [Hetro] version of the test
(10) In each case lag selection is based on AIC and we fixed maximum lag 5.
(11) The 5% critical value for the minimum LM unit root test with two breaks is −3.842. The 5% critical value for the panel LM unit root test (with or without breaks) is −1.645. ∗∗ denotes significance at the 5% level. The specifications include an intercept and time trend.

Source: Author's calculation through R Development Core Team (2011) software

Table 2F: Panel unit root test for Coal, GDP and Trade

Tests without structural breaks: Trend model								
	Sample 1		Sample 2		Sample 1		Sample 2	
	Coal	GDP	Coal	GDP	Coal	Trade	Coal	Trade
Test statistic	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)
1	-1.52321463 (0.06385251)	2.6199901 (0.9956034)	-1.30197703 (0.0964621)	-0.4590863 (0.3230861)	-0.5268232 (0.2991582)	3.8741152 (0.9999465)	-4.207447e+00 (1.291361e-05)	2.3481961 (0.9905677)
2	-1.52321463 (0.06385251)	2.761712 (0.997125)	-1.49450614 (0.067521)	-0.5269735 (0.2991060)	-0.5268232 (0.2991582)	3.905743 (0.999953)	-4.333180e+00 (7.348532e-06)	2.4183686 (0.9922049)
3	-1.0880865 (0.1382785)	2.0483978 (0.9797395)	-0.3806211 (0.3517422)	-0.1281804 (0.4490031)	-2.10916731 (0.0174650)	0.9579732 (0.8309619)	-7.381880e+00 (7.803469e-14)	-4.166427e+00 (1.547051e-05)
4	1.1297862 (0.87071685)	0.83206268 (0.7973132)	0.98589204 (0.837906)	0.64130919 (0.739339)	0.72502817 (0.7657826)	5.3846367 (0.999999)	1.0933085 (0.86287081)	4.3138034 (0.99999198)
	Decision on H_0		Decision on H_0		Decision on H_0		Decision on H_0	
	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%
5	T T F	T T T	T F F	T F F	T F F	T T T	F F F	T T T
6	T T F	T T T	T F F	T F F	T F F	T T T	F F F	T T T
7	T F F	T T T	F F F	F F F	F F F	T T T	F F F	F F F
Tests with structural breaks								
8.1	-9.309	-9.366	-12.104	-10.862	-6.163	-7.394	-13.330	-12.831
8.2	-17.553	-17.162	-23.530	-20.065	-13.134	-14.196	-22.118	-27.679
9	24.484947 (0.000000)	15.933075 (0.000000)	17.533316 (0.000000)	9.8508604 (0.000000)	25.880024 (0.000000)	3.7800332 (0.000000)	7.7751134 (0.000000)	7.7778750 (0.000000)
10	25.466309 (0.000000)	16.817237 (0.000000)	15.415284 (0.000000)	36.920568 (0.000000)	24.475954 (0.000000)	8.3451216 (0.000000)	10.024209 (0.000000)	10.780452 (0.000000)
Note: Refer to Table 1.								
Source: Author's calculation through R Development Core Team (2011) software								

Table 3F: Panel unit root test for ELEP-Coal, GDP and Trade

Tests without structural breaks: Trend model								
	Sample 1		Sample 2		Sample 1		Sample 2	
	Coal	GDP	Coal	GDP	Coal	Trade	Coal	Trade
Test statistic	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)
1	-0.2075525 (0.4177892)	2.9214687 (0.9982581)	0.7553035 (0.7749665)	0.9478565 (0.8283987)	-0.1371810 (0.4454439)	-0.3422028 (0.3660992)	-0.1371810 (0.4454439)	-0.1371810 (0.4454439)
2	-0.2075525 (0.4177892)	3.1590627 (0.9992086)	0.4354274 (0.6683739)	1.0867999 (0.8614374)	-0.1061476 (0.4577326)	-0.3607134 (0.3591569)	-0.1061476 (0.4577326)	-0.1061476 (0.4577326)
3	-3.12381717 (0.0008926)	0.8563523 (0.8040985)	-1.74366482 (0.04060878)	-1.63285660 (0.051249)	-5.373918e+00 (3.852193e-08)	-4.55268e+00 (2.64834e-06)	-5.373918e+00 (3.852193e-08)	-5.373918e+00 (3.852193e-08)
4	-0.30877 (0.37877)	1.40169 (0.9195)	0.181562 (0.57203)	0.71012 (0.7611)	-0.412203 (0.34009)	1.188056 (0.88259)	0.181562 (0.57203)	2.2510277 (0.987808)
	Decision on H_0		Decision on H_0		Decision on H_0		Decision on H_0	
	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%
5	T T T	T T T	T T T	T T T	T T T	T T T	T T T	T T T
6	T T T	T T T	T T T	T T T	T T T	T T T	T T T	T T T
7	F F F	T T T	T T T	T F F	F F F	T F F	F F F	F F F
Tests with structural breaks								
8.1	-8.364	-9.699	-10.806	-11.910	-7.845	-7.728	-10.806	-10.392
8.2	-16.336	-19.013	-19.023	-19.718	-14.738	-13.861	-19.023	-18.104
9	9.6042730 (0.000000)	9.1349739 (0.000000)	25.023236 (0.000000)	18.912211 (0.000000)	8.2450742 (0.000000)	7.9237065 (0.000000)	25.023236 (0.000000)	1.1182401 (0.1317322)
10	10.701295 (0.000000)	22.566124 (0.000000)	50.191473 (0.000000)	82.460876 (0.000000)	9.4877253 (0.000000)	6.6489110 (0.000000)	50.191473 (0.000000)	16.490883 (0.000000)
Note: Refer to Table 1.								
Source: Author's calculation through R Development Core Team (2011) software								

Table 4F: Panel unit root test for ELEP, GDP and Trade

Tests without structural breaks: Trend model				
	Sample 1		Sample 2	
	ELEP	GDP	ELEP	Trade
Test statistic	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)
1	4.6798434 (0.9999986)	3.6674860 (0.9998775)	4.4443142 (0.9999956)	0.751636 (0.773865)
2	4.6261145 (0.9999981)	3.6253799 (0.9998557)	4.5771262 (0.9999976)	0.7740976 (0.7805635)
3	-0.8920557 (0.1861815)	0.7478286 (0.7727182)	-1.29928000 (0.0969239)	-1.44501978 (0.0742262)
4	0.72502817 (0.76578262)	5.3846367 (0.9999999)	1.0933085 (0.8628708)	4.3138034 (0.999992)
	Decision on H_0		Decision on H_0	
	1 % 5 % 10 %	1 % 5 % 10 %	1 % 5 % 10 %	1 % 5 % 10 %
5	T T T	T T T	T T T	T T T
6	T T T	T T T	T T T	T T T
7	F F F	T T T	F F F	T T T
Tests with structural breaks				
8.1	-9.318	-10.468	-6.415	-9.783
8.2	-19.170	-22.139	-16.385	-18.595
9	3.9988668 (0.000000)	16.215543 (0.000000)	4.6222492 (0.000000)	10.771997 (0.000000)
10	18.146747 (0.000000)	33.731510 (0.000000)	16.980246 (0.000000)	15.81091 (0.000000)
Note: Refer to Table 1.				
Source: Author's calculation through R Development Core Team (2011) software				

Table 5F: Panel unit root test for ELEP-HYD, GDP and trade

Tests without structural breaks: Trend model								
	Sample 1		Sample 2		Sample 1		Sample 2	
	ELEP-HYD	GDP	ELEP-HYD	GDP	ELEP-HYD	Trade	ELEP-HYD	Trade
Test statistic	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)
1	-0.2075525 (0.4177892)	2.9214687 (0.9982581)	0.7553035 (0.7749665)	0.9478565 (0.8283987)	-0.1371810 (0.4454439)	-0.3422028 (0.3660992)	-0.1371810 (0.4454439)	-0.3422028 (0.3660992)
2	-0.2075525 (0.4177892)	3.1590627 (0.9992086)	0.4354274 (0.6683739)	1.0867999 (0.8614374)	-0.1061476 (0.4577326)	-0.3607134 (0.3591569)	-0.1061476 (0.4577326)	-0.3607134 (0.3591569)
3	-3.12381717 (0.0008926)	0.8563523 (0.8040985)	-1.74366482 (0.04060878)	-1.63285660 (0.05124958)	-5.373918e+00 (0.000000)	-4.55268e+00 ((0.000026)	-5.373918e+00 (3.852193e-08)	-4.552678e+00 (2.648364e-06)
4	0.72502817 (0.76578262)	5.3846367 (0.999999)	1.0933085 (0.86287081)	4.3138034 (0.99999198)	1.1297862 (0.87071685)	0.83206268 (0.79731322)	0.98589204 (0.83790695)	0.64130919 (0.73933909)
	Decision on H_0		Decision on H_0		Decision on H_0		Decision on H_0	
	1 % 5 % 10 %	1 % 5 % 10 %	1 % 5 % 10 %	1 % 5 % 10 %	1 % 5 % 10%	1 % 5 % 10 %	1 % 5 % 10%	1 % 5 % 10%
5	T T T	T T T	T T T	T T T	T T T	T T T	T T T	T T T
6	T T T	T T T	T T T	T T T	T T T	T T T	T T T	T T T
7	F F F	T T T	T T T	T F F	F F F	T T F	F F F	T F F
Tests with structural breaks								
8.1	-8.364	-9.699	-10.806	-11.910	-7.845	-7.728	-10.806	-10.392
8.2	-16.336	-19.013	-19.023	-19.718	-14.738	-13.861	-19.023	-18.104
9	9.6042730 (0.000000)	9.1349739 (0.000000)	25.023236 (0.000000)	18.912211 (0.000000)	8.2450742 (0.000000)	7.9237065 (0.000000)	25.023236 (0.000000)	1.1182401 (0.131732)
10	10.701295 (0.000000)	22.566124 (0.000000)	50.191473 (0.000000)	82.460876 (0.000000)	9.4877253 (0.000000)	6.6489110 (0.000000)	50.191473 (0.000000)	16.490883 (0.000000)
Note: Refer to Table 1.								
Source: Author's calculation through R Development Core Team (2011) software								

Table 6F: Panel unit root test for ELEP-NG, GDP and trade

Tests without structural breaks: Trend model								
	Sample 1		Sample 2		Sample 1		Sample 2	
	ELEP-NG	GDP	ELEP-NG	GDP	ELEP-NG	Trade	ELEP-NG	Trade
Test statistic	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)
1	-2.332593926 (0.00983473)	3.6842935 (0.9998853)	-2.326929756 (0.0099845)	-1.43375830 (0.07582062)	-0.5967491 (0.2753374)	-1.43375830 (0.07582062)	-0.5967491 (0.2753374)	-0.2855766 (0.3876012)
2	-2.332593926 (0.00983473)	4.3813881 (0.9999941)	-2.326929756 (0.0099845)	-1.77400062 (0.03803152)	-0.5967491 (0.2753374)	-1.77400062 (0.03803152)	-0.5967491 (0.2753374)	-0.3010241 (0.3816980)
3	-3.04659424 (0.00115725)	1.5582690 (0.9404153)	-2.665593399 (0.0038426)	-1.86771631 (0.03090081)	1.9059815 (0.9716737)	-1.86771631 (0.03090081)	1.9059815 (0.9716737)	-4.216418e+00 (1.241065e-05)
4	0.72502817 (0.76578262)	5.3846367 (0.99999996)	1.0933085 (0.86287081)	4.3138034 (0.99999198)	0.72502817 (0.76578262)	5.3846367 (0.99999996)	1.0933085 (0.86287081)	4.3138034 (0.99999198)
	Decision on H_0		Decision on H_0		Decision on H_0		Decision on H_0	
	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%
5	F F F	T T T	F F F	T F F	F F F	T F F	F F F	T T T
6	F F F	T T T	F F F	T F F	F F F	T F F	F F F	T T T
7	T F F	T T F	F F F	T F F	F F F	F F F	F F F	F F F
Tests with structural breaks								
8.1	-10.841	-6.821	-12.435	-11.549	-8.197	-7.979	-12.435	-10.720
8.2	-20.667	-13.620	-24.660	-20.784	-14.444	-13.157	-24.660	-18.467
9	9.8714566 (0.000000)	12.793234 (0.000000)	2.5731414 (0.005039)	8.4555908 (0.000000)	6.6818056 (0.000000)	4.6832810 (0.000000)	2.5731414 (0.0050390)	2.1469712 (0.015897)
10	8.2253843 (0.000000)	16.390424 (0.000000)	25.640318 (0.000000)	44.619996 (0.000000)	9.9494494 (0.000000)	5.6094064 (0.000000)	25.640318 (0.000000)	20.449219 (0.000000)

Note: Refer to Table 1.

Source: Author's calculation through R Development Core Team (2011) software

Results for ELEP-NU are not available

Table 7F: Panel unit root test for ELEP-Oil, GDP and trade

Tests without structural breaks: Trend model						
	Sample 1		Sample 1		Sample 2	
	ELEP-Oil	GDP	ELEP-Oil	Trade	ELEP-Oil	Trade
Test statistic	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)
1	-0.2271610 (0.4101493)	3.9740211 (0.9999647)	-0.1064313 (0.4576201)	0.751636 (0.773865)	0.04377673 (0.5174588)	1.0265953 (0.8476945)
2	-0.2271610 (0.4101493)	3.8572813 (0.9999427)	-0.1064313 (0.4576201)	0.7740976 (0.7805635)	0.04377673 (0.5174588)	0.9964383 (0.8404814)
3	-0.7433421 (0.2286373)	1.4602650 (0.9278914)	-0.8328239 (0.2024720)	-1.44501978 (0.0742262)	-0.4709679 (0.3188318)	-2.83834998 (0.0022674)
4	0.72502817 (0.7657826)	5.3846367 (0.9999999)	1.0933085 (0.8628708)	4.3138034 (0.999992)	1.1297862 (0.8707168)	0.83206268 (0.7973132)
	Decision on H_0		Decision on H_0		Decision on H_0	
	1 % 5 % 10 %	1 % 5 % 10 %	1 % 5 % 10 %	1 % 5 % 10 %	1 % 5 % 10 %	1 % 5 % 10 %
5	F F F	T T T	T T T	T T T	T F F	T T T
6	F F F	T T T	T T T	T T T	T F F	T T T
7	F F F	T T T	F F F	T T F	T T T	F F F
Tests with structural breaks						
8.1	-21.415	-10.979	-9.749	-9.783	-14.518	-12.593
8.2	-40.038	-23.088	-21.185	-18.595	-25.731	-19.476
9	2.3072317 (0.0105209 52)	16.302261 (0.000000)	9.5692584 (0.000000)	10.771997 (0.000000)	3.6675298 (0.00012245 3)	9.6921869 (0.000000)
10	5.5666134 (0.000000)	29.918476 (0.000000)	13.511349 (0.000000)	15.810917 (0.000000)	3.9186686 (0.000000)	19.363656 (0.000000)
Note: Refer to Table 1.						
Source: Author's calculation through R Development Core Team (2011) software						

Table 8F: Panel unit root test for ELEP-Rene, GDP and trade

Tests without structural breaks: Trend model						
	Sample 1		Sample 1		Sample 2	
	ELEP-Rene	GDP	ELEP-Rene	Trade	ELEP-Rene	Trade
Test statistic	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)
1	-2.604211687 (0.0046042)	3.7154521 (0.9998986)	-4.710180e+00 (1.237493e-06)	0.8818201 (0.8110630)	-0.5967491 (0.2753374)	-1.43375830 (0.0758206)
2	-2.604211687 (0.0046042)	3.7457848 (0.9999101)	-4.710180e+00 (1.237493e-06)	0.8890192 (0.8130036)	-0.5967491 (0.2753374)	-1.77400062 (0.0380315)
3	-4.027018e+00 (2.824432e-05)	0.9335737 (0.8247381)	-8.059078e+00 (3.843597e-16)	-2.43648271 (0.0074154)	1.9059815 (0.9716737)	-1.86771631 (0.0309008)
4	0.72502817 (0.76578262)	5.3846367 (0.9999999)	0.72502817 (0.76578262)	5.3846367 (0.9999999)	0.72502817 (0.7657826)	5.3846367 (0.9999999)
	Decision on H_0		Decision on H_0		Decision on H_0	
	1 % 5 % 10 %	1 % 5 % 10 %	1 % 5 % 10%	1 % 5 % 10 %	1 % 5 % 10 %	1 % 5 % 10 %
5	T F F	F F T	T T T	T T F	F F F	T T T
6	T F F	F F T	T T T	T T F	F F F	T T T
7	F F F	F F F	F F F	T T F	F F F	F F F
Tests with structural breaks						
8.1	-16.092	-9.879	-14.286	-10.000	-14.873	-10.795
8.2	-23.065	-21.509	-20.633	-17.794	-21.517	-16.965
9	3.4875717 (0.00024371)	12.754871 (0.000000)	3.3911228 (0.0003480)	10.321838 (0.000000)	7.1691155 (0.000000)	9.2993682 (0.000000)
10	5.1673486 (0.000000)	30.557404 (0.000000)	5.7568242 (0.000000)	15.897826 (0.000000)	7.2693513 (0.000000)	19.753111 (0.000000)
Note: Refer to Table 1.						
Source: Author's calculation through R Development Core Team (2011) software						

Table 9F: Panel unit root test for EPC, GDP and Trade

Tests without structural breaks: Trend model						
	Sample 1		Sample 1		Sample 2	
	EPC	GDP	EPC	Trade	EPC	Trade
Test statistic	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)
1	4.8693585 (0.9999994)	3.9740211 (0.9999647)	3.4602270 (0.9997301)	0.751636 (0.773865)	4.2136103 (0.9999874)	1.0265953 (0.8476945)
2	4.7263175 (0.9999989)	3.8572813 (0.9999427)	3.5636309 (0.9998171)	0.7740976 (0.7805635)	4.0898323 (0.9999784)	0.9964383 (0.8404814)
3	-0.4857097 (0.3135865)	1.4602650 (0.9278914)	-0.8678934 (0.1927263)	-1.44501978 (0.0742262)	-3.33407092 (0.0004279)	-2.838349981 (0.00226737)
4	0.72502817 (0.7657826)	5.3846367 (0.9999999)	1.0933085 (0.8628708)	4.3138034 (0.9999919)	1.1297862 (0.8707169)	0.83206268 (0.79731322)
	Decision on H_0		Decision on H_0		Decision on H_0	
	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%
5	T T F	T T T	T T F	T T T	T T T	T T T
6	T T F	T T T	T T F	T T T	T T T	T T T
7	F F F	T T T	F F F	T T F	F F F	F F F
Tests with structural breaks						
8.1	-8.445	-10.979	-7.368	-9.783	-9.783	-12.593
8.2	-18.495	-23.088	-16.514	-18.595	-23.399	-19.476
9	16.284520 (0.000000)	16.302261 (0.000000)	16.037647 (0.000000)	10.771997 (0.000000)	11.288108 (0.000000)	9.6921869 (0.000000)
10	28.099745 (0.000000)	29.918476 (0.000000)	27.048579 (0.000000)	15.810917 (0.000000)	24.542174 (0.000000)	19.363656 (0.000000)
Note: Refer to Table 1.						
Source: Author's calculation through R Development Core Team (2011) software						

Table 10F: Panel unit root test for EU, GDP and Trade

Tests without structural breaks: Trend model						
	Sample 1		Sample 1		Sample 2	
	EU	GDP	EU	Trade	EU	Trade
Test statistic	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)
1	3.2088738 (0.9993337)	3.6674860 (0.9998775)	2.5607956 (0.9947784)	0.751636 (0.773865)	2.2114797 (0.9864987)	1.0265953 (0.8476945)
2	3.1720330 (0.9992431)	3.6253799 (0.9998557)	2.6373213 (0.9958218)	0.7740976 (0.7805635)	1.5989744 (0.9450869)	0.9964383 (0.8404814)
3	1.4923104 (0.9321911)	0.7478286 (0.7727182)	-0.5419553 (0.2939246)	-1.44501978 (0.0742262)	2.0109018 (0.9778321)	-2.838349981 (0.00226737)
4	0.72502817 (0.76578262)	5.3846367 (0.9999999)	1.0933085 (0.8628708)	4.3138034 (0.9999919)	0.72502817 (0.76578262)	5.3846367 (0.99999996)
	Decision on H_0		Decision on H_0		Decision on H_0	
	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%
5	T T T	T T T	T T T	T T T	T T T	T T T
6	T T T	T T T	T T T	T T T	T T T	T T T
7	T F F	T T T	T F F	T T F	T F F	F F F
Tests with structural breaks						
8.1	-9.163	-10.979	-6.645	-9.783	-10.887	-12.593
8.2	-20.727	-23.088	-18.174	-18.595	-22.493	-19.476
9	4.2800727 (0.000000)	16.302261 (0.000000)	1.5778493 (0.057300112)	10.771997 (0.000000)	11.422225 (0.000000)	9.6921869 (0.000000)
10	17.428986 (0.000000)	29.918476 (0.000000)	6.8385978 (0.000000)	15.810917 (0.000000)	21.096360 (0.000000)	19.363656 (0.000000)
Note: Refer to Table 1.						
Source: Author's calculation through R Development Core Team (2011) software						

Table 11F: Panel unit root test for HYD, GDP and Trade

Tests without structural breaks: Trend model								
	Sample 1		Sample 1		Sample 1		Sample 2	
	HYD	GDP	HYD	GDP	HYD	Trade	HYD	Trade
Test statistic	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)
1	-3.3619081 (0.000387)	-2.27983e+01 (0.000000)	-3.675549470 (0.0001186)	1.1847603 (0.8819439)	-2.940662048 (0.0016375)	3.2813792 (0.9994835)	-3.56627678 (0.000181)	2.3018015 (0.9893268)
2	-3.3893545 (0.000350)	-2.34791e+01 (0.000000)	-3.675549470 (0.0001186)	1.2811133 (0.8999231)	-2.940662048 (0.0016375)	3.3081682 (0.9995305)	-3.56627678 (0.0001810)	2.3205933 (0.9898456)
3	-2.7896592 (0.0026387)	-1.16017e+01 (0.000000)	-3.25156090 (0.00057389)	0.8942425 (0.8144039)	-3.783898e+00 (7.719571e-05)	0.7550306 (0.7748847)	-3.4414394 (0.0002893)	-1.61940072 (0.0526805)
4	0.72502817 (0.765782)	5.3846367 (0.99999996)	1.0933085 (0.86287081)	4.3138034 (0.9999919)	1.1297862 (0.87071685)	0.83206268 (0.7973132)	0.98589204 (0.837907)	0.64130919 (0.7393391)
	Decision on H_0		Decision on H_0		Decision on H_0		Decision on H_0	
	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%
5	F F F	F T T	F T T	T T F	T T F	T T T	T F F	T T T
6	F F F	F T T	F T T	T T F	T T F	T T T	T F F	T T T
7	T F F	F T F	F T T	T F F	T F F	T T T	F F F	T F F
Tests with structural breaks								
8.1	-16.279	-9.706	-15.940	-9.201	-13.595	-8.454	-14.185	-15.540
8.2	-23.246	-19.133	-24.099	-20.074	-18.594	-16.130	-21.739	-33.716
9	4.9965920 (0.000000)	15.063926 (0.000000)	3.2462016 (0.000585)	3.2462016 (0.000585)	4.1907404 (0.000000)	5.6322608 (0.000000)	3.7203319 (0.000000)	2.6348043 (0.004209)
10	4.9566229 (0.000000)	16.538323 (0.000000)	5.3643268 (0.000000)	5.3643268 (0.000000)	3.4399713 (0.0002909)	9.4787774 (0.000000)	9.0596369 (0.000000)	10.847236 (0.000000)
Note: Refer to Table 1.								
Source: Author's calculation through R Development Core Team (2011) software								

Table 12F: Panel unit root test for NG, GDP and Trade

Tests without structural breaks: Trend model								
	Sample 1		Sample 1		Sample 1		Sample 2	
	NG	GDP	NG	GDP	NG	Trade	NG	Trade
Test statistic	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)
1	0.1627351 (0.5646365)	2.6218944 (0.9956279)	0.8462045 (0.8012807)	-1.37733652 (0.0842041)	0.3504123 (0.6369854)	-0.3246932 (0.3727066)	0.3504123 (0.6369854)	-0.3246932 (0.3727066)
2	0.1627351 (0.5646365)	3.0096055 (0.9986921)	0.8462045 (0.8012807)	-1.70418950 (0.04413)	0.3504123 (0.6369854)	-0.3273440 (0.3717039)	0.3504123 (0.6369854)	-0.3273440 (0.3717039)
3	-0.5865348 (0.2787581)	2.8999252 (0.9981337)	-1.67650446 (0.0468197)	-1.68197891 (0.04629)	-3.3146912 (0.0004587)	-1.2071422 (0.1136887)	-3.3146912 (0.000458)	-1.2071422 (0.1136887)
4	0.72502817 (0.76578262)	5.3846367 (0.999999)	1.0933085 (0.8628708)	4.3138034 (0.999992)	0.72502817 (0.7657826)	5.3846367 (0.9999999)	1.0933085 (0.86287)	4.3138034 (0.999992)
	Decision on H_0		Decision on H_0		Decision on H_0		Decision on H_0	
	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%
5	T T T	T T T	T T T	F F F	T T T	T T T	T T T	T T T
6	T T T	T T T	T T T	F F F	T T T	T T T	T T T	T T T
7	T T T	T T T	F F F	F F F	T F F	F F F	T F F	F F F
Tests with structural breaks								
8.1	-7.736	-7.377	-12.382	-11.387	-5.445	-7.183	-12.382	-17.267
8.2	-14.268	-13.347	-22.108	-25.516	-10.418	-11.596	-22.108	-38.724
9	7.0913423 (0.000000)	15.092552 (0.000000)	36.791238 (0.000000)	7.4089417 (0.000000)	4.2024216 (0.000000)	2.1618740 (0.015314)	36.791238 (0.000000)	1.6055662 (0.054184)
10	18.604927 (0.000000)	13.131981 (0.000000)	42.524261 (0.000000)	70.466996 (0.000000)	15.332619 (0.000000)	7.6143953 (0.000000)	42.524261 (0.000000)	23.240522 (0.000000)
Note: Refer to Table 1.								
Source: Author's calculation through R Development Core Team (2011) software								

Table 13F: Panel unit root test for NU, GDP and Trade

Tests without structural breaks: Trend model				
	Sample 1		Sample 1	
	NU	GDP	NU	Trade
Test statistic	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)
1	-2.956686946 (0.001554818)	1.8815978 (0.9700547)	-0.7774041 (0.2184602)	1.8815978 (0.9700547)
2	-2.956686946 (0.001554818)	2.328116 (0.990047)	-0.7774041 (0.2184602)	2.328116 (0.990047)
3	-3.6950370723 (0.0001099274)	1.1479284 (0.8745009)	-0.6550401 (0.2562210)	1.1479284 (0.8745009)
4	0.72502817 (0.76578262)	5.3846367 (0.99999996)	1.0933085 (0.86287081)	4.3138034 (0.9999919)
	Decision on H_0		Decision on H_0	
	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%
5	F F F	T T T	T T T	T T T
6	F F F	T T T	T T T	T T T
7	F F F	T T T	T T T	T T T
Tests with structural breaks				
8.1	-9.872	-4.846	-11.087	-7.746
8.2	-17.101	-10.715	-17.147	-23.423
9	2.5814069 (0.004919926)	12.439257 (0.000000)	2.5806017 (0.004931416)	3.5992618 (0.000159)
10	13.369664 (0.000000)	28.391590 (0.000000)	15.598060 (0.000000)	7.7111661 (0.000000)
Note: Refer to Table 1.				
Source: Author's calculation through R Development Core Team (2011) software				

Table 14F: Panel unit root test for PEC, GDP and Trade

Tests without structural breaks: Trend model								
	Sample 1		Sample 1		Sample 1		Sample 2	
	PEC	GDP	PEC	GDP	PEC	Trade	PEC	Trade
Test statistic	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)	Test statistic (p-value)
1	1.6677089 (0.9523132)	2.6093984 (0.9954649)	1.8992817 (0.9712363)	0.7843857 (0.7835931)	1.8207099 (0.9656745)	3.4312450 (0.9996996)	2.1226550 (0.9831086)	3.4379496 (0.99971)
2	1.6187187 (0.9472461)	2.5327453 (0.9943413)	2.0020187 (0.9773586)	0.8268151 (0.7958291)	1.7373610 (0.9588383)	3.2741687 (0.9994701)	2.0603004 (0.9803151)	3.3369572 (0.99958)
3	-2.18803517 (0.01433352)	2.6006612 (0.9953478)	-2.29638827 (0.010827)	0.4644529 (0.6788384)	-1.47561037 (0.0700242)	1.0681781 (0.8572799)	-0.5108229 (0.3047375)	0.4497653 (0.67356)
4	1.1297862 (0.87071685)	0.83206268 (0.7973132)	0.98589204 (0.83791)	0.64130919 (0.739339)	0.72502817 (0.7657826)	5.3846367 (0.999999)	1.0933085 (0.862870)	4.3138034 (0.999992)
	Decision on H_0		Decision on H_0		Decision on H_0		Decision on H_0	
	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%	1% 5% 10%
5	T T T	T T T	T T F	T F F	T F F	T T T	T T T	T T T
6	T T T	T T T	T T F	T F F	T F F	T T T	T T T	T T T
7	T F F	T T T	T T F	F F F	F F F	T T T	F F F	F F F
Tests with structural breaks								
8.1	-8.135	-10.013	-9.640	-11.758	-6.393	-8.968	-8.924	-15.408
8.2	-20.364	-20.437	-23.463	-22.746	-15.332	-17.017	-19.006	-30.600
9	12.541323 (0.000000)	16.167050 (0.000000)	28.226813 (0.000000)	16.861547 (0.000000)	18.271076 (0.000000)	6.5175545 (0.000000)	16.710151 (0.000000)	4.928343 (0.0000)
10	17.550787 (0.000000)	17.559926 (0.000000)	29.829585 (0.000000)	27.940188 (0.000000)	22.388596 (0.000000)	9.9368502 (0.000000)	26.573514 (0.000000)	11.1328 (0.0000)
Note: Refer to Table 1.								
Source: Author's calculation through R Development Core Team (2011) software								

Table 15F: Linearity test

	Model 1		Model 2	
Test	Statistics	P-value	Statistics	P-value
Lagrange multiplies-Wald Tests (LM):	26.503	0.009	27.165	0.007
Lagrange multiplies-Fisher Tests (LMF):	2.260	0.010	2.323	0.008
Likelihood ratio-LRT Tests (LRT):	27.947	0.000	28.686	0.000
H0: Linear Model H1: PSTR model with at least one Threshold Variable (r=1)				

Table 16F: Testing the number of regimes-tests of no remaining non-linearity

	Model 1		**Model 2**	
Test	Statistics	P-value	Statistics	P-value
Lagrange multiplies-Wald Tests (LM):	-0.000	1.000	3.473	0.482
Lagrange multiplies-Fisher Tests (LMF):	-0.000	1.000	0.809	0.520
Likelihood ratio-LRT Tests (LRT):	-0.000	1.000	3.496	0.478
H0: PSTR with r = 1 against H1: PSTR with at least r = 2				

Table 17F: PSTR model estimation

	Model 1: Dependent variable- ΔlnEI		Model 2: Dependent variable- ΔlnE	
Variable	B0	B1	B0	B1
ΔIND	0.0099 [0.9171]	-0.0198 [-0.9160]	0.0111 ** [2.4909]	-0.0068[-1.0161]
I	-1.7069*** [-3.9764]	3.4139*** [3.9726]	-0.0185 [-0.1009]	0.4069***[3.6035]
ΔlnYPC/ΔlnY	-0.0017*[-1.7017]	0.0035* [1.7023]	-1.3075**[-2.5429]	2.0779***[3.7256]
TT	0.0178***[3.4274]	-0.0356*** [-3.4269]	0.0076[1.1391]	-0.0170** [-2.3577]
Transition parameters				
Threshold (c)	0.1345		1.9264	
Slope (gama)	3.3404e-07		2.6425e+03	
Standard Errors of Estimated Parameters Corrected of Heteroskedasticity (per column for each transition function				

Appendix G: List of publication in peer reviewed journals

(1) Aviral Kumar Tiwari. The asymmetric causality analysis between energy consumption and income in the United States. ***Renewable & Sustainable Energy Reviews***, 36(C) (2014): 362-369. (DOI: 10.1016/j.rser.2014.04.066), *Elsevier-* Publications*; Impact Factor:-* **5.627**.

(2) Muhammad Shahbaz, Aviral Kumar Tiwari, Farooq Ahmed Jam, and Ilhan Ozturk. Are fluctuations in coal consumption per capita temporary? Evidence from developed and developing economies. ***Renewable & Sustainable Energy Reviews***, 33 (2014): 96-101. (DOI: 10.1016/j.rser.2014.01.086) *Elsevier-* Publications*; Impact Factor:-* **5.627**.

(3) Aviral Kumar Tiwari, Muhammad Shahbaz and Qazi Muhammad Adnan Hye. The Environmental Kuzents Curve and the role of coal consumption in India: Cointegration and causality analysis in an open economy. ***Renewable & Sustainable Energy Reviews***, 18 (2013): 519-527. (DOI:10.1016/j.rser.2012.10.031) *Elsevier-* Publications*; Impact Factor:-* **5.627**.

(4) Aviral Kumar Tiwari, Ilhan Ozturk and M. Aruna. Tourism, energy consumption and climate change in OECD countries. ***International Journal of Energy Economics and Policy***, 3(3) (2013): 247-261.

(5) Muhammad Shahbaz, Aviral Kumar Tiwari, and Ilhan Ozturk. Are fluctuations in electricity consumption per-capita transitory? Evidence from developed and developing economies. ***Renewable & Sustainable Energy Reviews***, 28 (2013): 551-554. (DOI: 10.1016/j.rser.2013.08.007) *Elsevier-* Publications*; Impact Factor:-* **5.627**.

(6) Muhammad Shahbaz, Aviral Kumar Tiwari and Muhammad Nasir. The effects of financial development, economic growth, coal consumption and trade openness on CO_2 emissions in South Africa. ***Energy Policy***, 61 (2013): 1452-1459.

(DOI: 10.1016/j.enpol.2013.07.006) *Elsevier-* Publications; *Impact Factor:- 2*.**743**.

(7) Muhammad Shahbaz, Qazi Muhammad Adnan Hye, Aviral Kumar Tiwari and Nuno Carlos Leitão. Economic growth, energy consumption, financial development, international trade and CO_2 Emissions in Indonesia. ***Renewable & Sustainable Energy Reviews***, 25 (2013): 109-121. (DOI: 10.1016/j.rser.2013.04.009) *Elsevier-* Publications; *Impact Factor:-* **5.627**.

(8) Aviral Kumar Tiwari. On the dynamics of energy consumption, CO_2 emissions and economic growth: Evidence from India. ***Indian Economic Review***, 47(1) (2012): 57-87.

(9) Muhammad Shahbaz, Mihai Mutascu and Aviral Kumar Tiwari. Revisiting the relationship between electricity consumption, capital and economic growth: Cointegration and causality analysis in Romania. ***The Romanian Journal of Economic Forecasting***, 15(3) (2012): 97-120. The Institute for Economic Forecasting-Publications; *Impact Factor:-* **0.60**.

(10) Aviral Kumar Tiwari. A structural var analysis of renewable energy consumption, real gdp and CO_2 emissions: Evidence from India. ***Economics Bulletin***, 31(2) (2011): 1793-1806.

(11) Aviral Kumar Tiwari. Happiness and environmental degradation: What determines happiness? ***Economics Bulletin***, 31(4) (2011): 3192-3210.

(12) Aviral Kumar Tiwari. Comparative performance of renewable and nonrenewable energy source on economic growth and CO_2 emissions of Europe and Eurasian countries: A PVAR approach. ***Economics Bulletin***, 31(3) (2011): 2356-2372.

(13) Aviral Kumar Tiwari and M. Aruna. Primary energy, income, foreign direct investment (FDI), and human capital in India: A multivariate analysis. ***Energy Studies Review,*** (Accepted/In Press).

(14) Aviral Kumar Tiwari. Long term trends in non-renewable resource commodity prices: Fresh evidence in the presence of structural breaks**. *International Journal of Global Energy Issues (IJGEI)*,** (revised draft submitted).

(15) Aviral Kumar Tiwari, Olaolu R. Olayeni and Nicholas Apergis. Renewable energy production and economic growth in sub-Saharan Africa: A hidden cointegration analysis. ***Applied Energy,*** (communicated).

(16) Aviral Kumar Tiwari, M. Aruna, Duc Khuong Nguyen, An asymmetric cointegration analysis of hydroelectricity consumption and economic growth: the case of Asian countries, ***Applied Economics,*** (communicated).

Appendix H: Conference attended/participated

(1) 94th IEA Annual Conference, 27-29 December, 2011, Bharati Vidyapeeth Deemed University, Pune, India.

(2) 3rd International Conference on Applied Econometrics (ICAE-111), 16-17 December, 2011, IBS Hyderabad, Hyderabad, India.

(3) 6th Doctoral Thesis Conference, 26-27 April, 2013, IBS Hyderabad, Hyderabad, India.

Appendix I: Publications in conference proceeding/conference issue of the journal

(1) Aviral Kumar Tiwari, Bharti Pandey and A. P. Tiwari. 2011. Market Reforms in Energy Sector: Evidence from a Panel Data Based Cointegration Analysis of BRICS Countries. ***The Indian Economic Journal***, Special Issue: 191-205.

Dedicated to My Parents

The ICFAI University, Tripura

CERTIFICATE

This is to certify that the Thesis titled "**On the Mechanics of the Relationship between Energy Consumption, CO_2 Emissions, Openness and Economic Growth in the Selected Asian Countries**" **s**ubmitted by **Aviral Kumar Tiwari** ID No. **08AT02290015** for the award of Ph.D. Degree of the ICFAI University, embodies original work done by him/her under my supervision.

Date:

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Signature of the Supervisor in full

Name in Capital letters ______________________________________

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Final Recommendation of Panel of Ph.D. Examiners

Title of the Ph.D. Thesis ____

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Name of the Candidate____________________________________ Id No.____________________

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1. Excellent ☐
2. Good ☐
3. Unacceptable ☐

Name and Signature of all examiners:

1.

2.

3.

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