



Panel Data Analysis of Public Expenditures on Education, Health, Social Security and Welfare, and Economic Growth: Lessons from Asia Countries

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Lessons from Asia Countries**

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Table of Contents

Acknowledgement.....	i
Table of Contents	ii
List of Figures and Tables	iv
Executive Summary	vi
CHAPTER 1.....	1
INTRODUCTION.....	1
1.1: Background of the Study.....	1
1.2: Objectives of the Study	3
1.3: Organizational Structure.....	4
CHAPTER 2.....	5
RESEARCH METHODOLOGY	5
2.1. Recent Developed Panel Unit Root Tests.....	5
2.2. Recent Developed Panel Cointegration Tests.....	8
2.3. Estimation Methods of Short-run and Long-run Income Elasticity	11
CHAPTER 3.....	14
DATA DESCRIPTION.....	14
3.1. Data on Education Expenditures	14
3.2. Data on Health Expenditures.....	16
3.3. Data on Social Security and Welfare Expenditures	17
3.4. Data on Economic Growth (GDP)	19
CHAPTER 4.....	22
PANEL ANALYSIS ON EDUCATION EXPENDITURES AND GDP	22
4.1. Literature Review on Education.....	22
4.2. Results of Panel Unit Root Tests for EE and GDP	27
4.2.1 ADF Unit Root Tests for EE and GDP	27
4.2.2 Several Panel Unit Tests for EE and GDP	31
4.3 Results of Panel Cointegration Tests for EE and GDP.....	34
4.3.1 Country by Country Johansen Cointegration Tests for EE	34
4.3.2 Several Panel Cointegration Tests for EE and GDP	36
4.4. Analysis on Short-run and Long-run for EE and GDP	39
CHAPTER 5.....	44
PANEL ANALYSIS ON HEALTH EXPENDITURES AND GDP	44
5.1. Literature Review on Health	44

5.1.1 Supported Results on the Existences of Unit Root and Cointegration	46
5.1.2 Rejected Results on the Existences of Unit Root and Cointegration.....	48
5.1.3 Mixed Results on the Existences of Unit Root and Cointegration	49
5.2. Results of Panel Unit Root Tests for HE	50
5.2.1 ADF Unit Root Tests for HE and GDP.....	50
5.2.2 Several Panel Unit root Tests.....	53
5.2 Results of Panel Cointegration Tests for HE	56
5.3.1 Country by Country Johansen Cointegration Tests for HE	56
5.3.2 Several Panel Cointegration Tests for HE and GDP	58
5.4. Analysis on Short-run and Long-run for HE and GDP	61
CHAPTER 6.....	65
PANEL ANALYSIS ON SOCIAL SECURITY AND WELFARE EXPENDITURES AND GDP ..	65
6.1. Literature Review on Social Security and Welfare.....	66
6.2. Results of Panel Unit Root Tests	69
6.2.1 ADF Unit Root Tests	69
6.2.2 Several Panel Unit Tests for SSW	71
6.3. Results of Panel Cointegration Tests for SSW and GDP.....	74
6.3.1 Country by Country Johansen Cointegration Tests for SSW.....	74
6.3.2 Several Panel Cointegration Tests for SSW and GDP	76
6.4. Analysis on Short-run and Long-run for SSW	80
CHAPTER 7.....	84
CONCLUSIONS.....	84
7.1: Research Findings and Policy Implication.....	84
7.2: Remarks for Further Development.....	85
References:.....	86
Appendix.....	96

List of Figures and Tables

Figures

Figure 1: Real Education Expenditure per capita in Asia Countries, 1973-2012.....	16
Figure 2: Real Health Expenditure per capita in Asia Countries, 1973-2012	17
Figure 3: Real Social Security and welfare Expenditure per capita in Asia Countries, 1973-2012..	19
Figure 4: Real GDP per capita in Asia Countries, 1973-2012.....	20

Tables

Table 4 - 1: Unit root test for EE at level	29
Table 4 - 2: Unit root test for GDP at level	29
Table 4 - 3: Unit root test for EE at first difference.....	30
Table 4 - 4: Unit root test for GDP at first difference.....	30
Table 4 - 5: Panel Unit Root Testing for EE in case of “No Trend”	32
Table 4 - 6: Panel Unit Root Testing in case of “With Trend”	32
Table 4 - 7: Panel Unit Root test for EE.....	33
Table 4 - 8: Panel Unit Root Test for GDP.....	33
Table 4 - 9: Johansen tests for EE, without trend.....	35
Table 4 - 10: Johansen tests for EE, with trend.....	35
Table 4 - 11: Summary results of panel cointegration tests for EE and GDP, “No Trend”	37
Table 4 - 12: Summary results of panel cointegration tests for EE and GDP, “With Trend”	38
Table 4 - 13: Error Correction Model (ECM) results for EE, “No Trend”	40
Table 4 - 14: Long-run GDP elasticity, for EE.....	41
Table 4 - 15: Results of Granger Causality Tests for EE and GDP	42
Table 5- 1: Unit root test for HE, at level.....	51
Table 5- 2: Unit root test for GDP, at level.....	51
Table 5- 3: Unit root test for HE, at first difference	52
Table 5- 4: Unit root test for GDP at first different	52
Table 5- 5: Panel unit root test for HE in case of no trend	53
Table 5- 6: Panel unit root test for HE in case of with trend	54
Table 5- 7: Result of Panel Unit Root test for HE without trend	55
Table 5- 8: Result of Panel Unit Root test for HE.....	55
Table 5- 9: Johansen tests for HE in case of without trend	56
Table 5- 10: Johansen tests for HE in case of with trend	57
Table 5- 11: Summary results of panel cointegration tests for HE and GDP (No trend)	59
Table 5- 12: Summary results of panel cointegration tests for HE and GDP, “With Trend”	60
Table 5- 13: Error Correction Model (ECM) results for HE 1975-2006, “No Trend”	62
Table 5- 14: Long-run income elasticity, 1975-2006	63
Table 5- 15: Results of Granger Causality tests	63
Table 6 - 1: Estimated lag orders and country by country ADF t-statistics for SSW at level.	69
Table 6 - 2: Estimated lag orders and country by country ADF t-statistics for GDP at level.....	69
Table 6 - 3: Unit root test for SSW at first difference.	70
Table 6 - 4: Unit root test for GDP at first difference.....	70

Table 6 - 5: Panel Unit Root Testing for SSW in case of “No Trend”	72
Table 6 - 6: Panel Unit Root Testing for SSW in case of “With Trend”.....	72
Table 6 - 7: Result of Panel Unit Root test for SSW no time trend model.....	73
Table 6 - 8: Result of Panel Unit Root Test for SSW with time trend model.....	73
Table 6 - 9: Johansen tests for SSW (No trend), 1973-2012	75
Table 6 - 10: Johansen tests for SSW (with trend), 1973-2012	75
Table 6 - 11: Summary results of panel unit root and cointegration tests, “No Trend”.....	78
Table 6 - 12: Summary results of panel unit root and cointegration tests, “With Trend”.....	79
Table 6 - 13: Error Correction Model (ECM) results 1973-2008, “No Trend”	81
Table 6 - 14: Long-run GDP elasticity, 1973-2012	82
Table 6 - 15: Results of Granger Causality Tests	83

Executive Summary

The relationship between public expenditures and economic growth has received much attention by economists for several decades, especially Wagner's Law vs. Keynesian's Approach, both at the aggregated and disaggregated levels. But they have reached different results considerably by data sets (from country to country and from period to period) and econometric techniques. To us, the disaggregated analysis is very valuable from the policy perspective. The results for the growth effects of public expenditures by individual sectors of an economy give rise to information that is particularly useful for the government, which are resource constrained and where the allocation of limited public resources between sectors is a critical issue. In this regard, the main interest of this study is to re-examine the relationship between economic growth and public expenditures at the disaggregated level.

This study attempts to re-examine the relationship between public expenditures and economic growth by focusing on three sectors: education, health, and social security and welfare. Specifically, research on social security and welfare and growth is still very scarce. The analysis aims: (1) to find the link between each public expenditure and economic development by employing the cointegration techniques; (2) to investigate the short-run and long-run income elasticity against each public expenditure of each country; and (3) to find the causality and directions of each public expenditure and economic growth.

The study has two significances and uniqueness. Firstly, existing studies have intensively used time series/cross-section data which may yield unreliable results. There are also no serious efforts to examine the two-way link between public expenditures and GDP, especially for the panel unit root and panel cointegration properties. This study prefers to apply several panel unit root and cointegration tests recently developed because no single test is likely to be definitive. Secondly, most studies on the link between public expenditures and GDP have been analyzed using data from OECD, but little is known for other regions. The data employed in this study cover 11 Asian countries namely Bangladesh, Hong Kong, Japan, Korea, Malaysia, Nepal, Philippines, Singapore, Sri Lanka, Taiwan and Thailand. It covers the period from 1973 to 2012.

On the study of the link between EE and GDP, the findings from several panel unit root and cointegration tests show that the two series are non-stationary and cointegrated for both with and

without time trend in the regressions. Whether education is a necessity good or a luxury good, this study shows that it remains controversial. Moreover, the tests suggest that bidirectional causality does exist.

On the study of the link between HE and GDP, the findings from several panel unit root and cointegration tests are very conclusive both without and with a time trend, and they suggest the presences of unit-roots and cointegration in the link between HE and GDP. Whether health care is a necessity good or a luxury good, this study shows that it remains controversial. Moreover, the causality tests suggest that only uni-directional causality (GDP cause HE) does exist.

On the study of the relationship between SSW and GDP, the findings from several panel unit root and cointegration tests suggest that the two series are non-stationary and cointegrated. The presence of a time trend variable seems to affect the results of both panel unit roots and cointegration. Whether SSW is a necessity good or a luxury good, this study shows that it remains controversial. Moreover, the tests suggest that bidirectional causality does exist.

Therefore, researchers studying public expenditures, especially on education, health, social security and welfare need to be concerned about the presence of unit roots and cointegration in the data. They also need to pay attention on the causes and directions and the short-run and long-run effects of each public expenditure on economic development.

JEL classification: C13, C22, C23, I18, I22, I28, I38, O23, O47, O53

Keywords: Public Expenditures, Education, Health, Social Security, Social Welfare, Dynamic Panel, Unit Roots, Cointegration, Causality, Short-run, Long-run, Economic Growth, Economic Development, Asia.

CHAPTER 1

INTRODUCTION

1.1: Background of the Study

The size of public expenditures and its effect on long-run economic growth, and vice versa, has been an interest research topic for several decades. The literature, essentially of an empirical nature, has proceeded at two levels. One set of studies has explored the principal link between government expenditures and economic growth at the aggregated level. The other set of studies has been investigated the relationship between public expenditures and economic development at the disaggregated level.

At the aggregated level, the central question has been light on the phenomena of causes and directions. Since Wagner argued that economic growth is the fundamental determinant of public sector growth, the so-called Wagner's Law (1883), one side of studies has examined this hypothesis, either in the form of standard regression (e.g. Ganti and Kolluri, 1979; and Georgakopoulos and Loizides, 1994) or in the form of error-correction regression (e.g. Kolluri et al. 2000). But they have reached different results considerably by data sets (from country to country and from period to period) and econometric techniques. The other side of studies has assessed whether the government spending can accelerate economic growth following to the thought of the Keynesian's Law (1936). Here again, empirical working either in standard regression forms (e.g. Landau, 1983) or error-correction regressions (e.g. Ghali, 1998) have found diverse results.

Singh and Sahni (1984) were among the initial studies to examine the causal link between public expenditures and national income. Subsequently, their work has generated many other studies, the results of which range the full continuum from no causality to bidirectional causality between these two variables. Ram (1986, 1987) suggested that differences in the

nature of underlying data, the test procedure and the period studied may explain the diversity in results. Ahsan et al. (1992) added various other factors in their study and suggested that failure to account for omitted variables can give rise to a misleading causal ordering among the variables. Recently, various other studies have used the cointegration test results to either validate or invalidate Wagner's Law. Examples of those studies include Hondroyianis and Papapetrou (1995), Bohl (1996), Bagdigen and Cetintas (2003), Loizides and Vamvoukas (2005), and Rehman et al. (2010).

Along similar lines with the analysis mentioned above, a number of studies have examined this issue by using public expenditures at the disaggregated level. The composition of public expenditure is very complicated. It may be disaggregated by function (expenditures on general public services, defense, education, health, social security and welfare, housing and community amenities, economic services (e.g. agriculture, industry, electricity-gas-water, transport and communications) and others); by capital expenditure and recurrent expenditure; by financing variables (e.g. budget surplus/deficit and tax revenue); and so on. Examples of existing studies in this area include Landau (1986), Devarajan *et al.*, (1996), Chletsos and Kollias (1997), Miller and Russek (1997), Biswa et al. (1999), Bose et al. (2007), Liu et al. (2008), Saad and Kalakech (2009), Alam et al. (2010) and Nurudeen and Usman (2010). Considering the association between public expenditures by function or sector and economic growth, some studies have found that such association is significant and positive for particular sectors. The same association has been reported to be significant and negative in other studies for certain sectors. Yet other works have found this association to be insignificant for some sectors. The variation in results is even much more than the studies using public expenditures at the aggregated level.

To us, the disaggregated analysis is very valuable from the policy perspective. The results for the growth effects of public expenditures by individual sectors of an economy give rise to information that is particularly useful for the government, which are resource constrained

and where the allocation of limited public resources between sectors is a critical issue. In this regard, the main interest of this study is to re-examine the relationship between economic growth and public expenditures at the disaggregated level including three important sectors: education, health, and social security and welfare in Asian countries by using recent developed panel data analysis.

1.2: Objectives of the Study

The relationship between public expenditures and economic growth has received much attention by economists for several decades, especially Wagner's Law vs. Keynesian's Approach. As a consequence of this debate, there exists an extensive empirical literature with the objective of testing the validity of each hypothesis mentioned above. However, it appears that there is a lack of consensus across studies. The objective of this study, therefore, is to revisit this topic again by using recently developed panel data techniques and new data set from Asian countries.

This study attempts to re-examine the relationship between public expenditures and economic growth at the disaggregated level by focusing on three sectors: education, health, and social security and welfare. Specifically, research on social security and welfare and growth is still very scarce. The analysis aims: (1) to find the link between each public expenditure and economic development by employing the cointegration techniques; (2) to investigate the short-run and long-run income elasticity against each public expenditure of each country; and (3) to find the causality and directions of each public expenditure and economic growth.

The study has two significances and uniqueness. Firstly, existing studies have intensively used time series/cross-section data which may yield unreliable results. There are also no serious efforts to examine the two-way link between expenditures on education, health, social security and welfare and GDP, especially for the panel unit root and panel cointegration properties. Since the data sets used in the previous studies are mainly based on OECD countries which nearly identical, any differences in test results are not likely to be due to differences in the

data generating process. This study is preferable to apply several panel unit root and cointegration tests recently developed because no single test is likely to be definitive. Secondly, little is known for other regions including Asia. The data employed in this study cover 11 Asia countries namely Bangladesh, Hong Kong, Japan, Korea, Malaysia, Nepal, Philippines, Singapore, Sri Lanka, Taiwan and Thailand. It covers the period from 1973 to 2012.

1.3: Organizational Structure

The remaining of the study begins from Chapter 2 with a review of research methodology. It presents the recent development of panel unit root and panel cointegration tests. Chapter 3 provides the descriptions of data on public expenditures of Asia countries that are used in this study. From chapter 4 to chapter 6, three original empirical works are presented. Chapter 4 shows the panel data analysis of expenditures on education and economic growth. Chapter 5 considers expenditures on health and GDP. Chapter 6 focuses on the relationship between expenditures on social security and welfare and GDP. In each original chapter, related literature reviews and regression results are presented and discussed. The final Chapter 7 summarizes the research findings and remarks for further development of the study.

CHAPTER 2

RESEARCH METHODOLOGY

2.1. Recent Developed Panel Unit Root Tests

Problems regarding unit roots are well known and testing for unit roots in time series studies is now common practice, such as Augmented Dicky-Fuller (ADF) test (1979, 1981)¹.

Consider a simple model:

$$y_t = \mu + \beta t + \gamma y_{t-1} + \varepsilon_t, \varepsilon_t \approx N(0, \sigma^2)$$

Augmented Dicky-Fuller (ADF) test is an extension form which will accommodate some of correlation. The advantage is that it can accommodate higher-order autoregressive process in ε_t .

$$y_t = \mu + \beta t + \gamma y_{t-1} + \gamma_1 \Delta y_{t-1} + \cdots + \gamma_p \Delta y_{t-p} + \varepsilon_t$$

where μ is a constant, β the coefficient on a time trend and p the lag order of the autoregressive process. Imposing the constraints $\alpha = 0$ and $\beta = 0$ corresponds to modeling a random walk and using the constraint $\beta = 0$ corresponds to modeling a random walk with a drift.

The unit root test is then carried out under the null hypothesis $\gamma = 0$ against the alternative hypothesis of $\gamma < 1$. Once a value for the test statistic is $DF_\tau = \frac{\hat{\gamma} - 1}{SE(\hat{\gamma})}$ and it can be

compared to the relevant critical value table for the test.

Testing for unit roots in panel data is, however, more recent. Panel unit root tests offer a number of advantages by combining time series and cross-section data. It is by now a

¹ Example of other common unit root tests in time series include Phillips-Perron (1988), Kwiatkowski et al. (1992), Ng and Perron (1995), and Elliott et al. (1996).

generally accepted argument that the commonly used unit root tests like ADF and PP tests lack power in distinguishing the unit root null from stationary alternatives, and that using panel data unit root tests is one way of increasing the power of unit root tests based on a single time series. Banerjee (1999) and Baltagi and Kao (2000) provide a survey of development in nonstationary panels including the earlier manuscripts of the methods employed in this paper². The characteristics of these methods are as following:

(a) Levin, Lin and Chu (2002) tests

Levin, Lin and Chu (LLC) have further developed the test proposed by Levin and Lin (1992). Considering the model

$$y_{it} = \rho_i y_{it-1} + z'_{it} \gamma_i + u_{it} \quad (1)$$

where z_{it} is the deterministic component and u_{it} is a stationary process. z_{it} could be zero, one, the fixed effects, μ_i , or fixed effect as well as a time trend, t . The LLC tests assume that u_{it} are $iid(0, \sigma_u^2)$ and $\rho_i = \rho$ for all i (homogeneous across i). Testing the null hypothesis is that $H_0 : \rho = 1$ against the alternative hypothesis $H_1 : \rho < 1$. The corresponding t -statistic, under the null hypothesis is given by

$$t_\rho = \frac{(\hat{\rho} - 1) \sqrt{\sum_{i=1}^N \sum_{t=1}^T \tilde{y}_{i,t-1}^2}}{s_e}, \quad \text{where } s_e^2 = \frac{1}{NT} \sum_{i=1}^N \sum_{t=1}^T \tilde{u}_{it}^2$$

Along the similar line, Breitung (2000) also assumes common unit root process. Interestingly, he proposed the nonparametric approach which asymptotically does not depend on parameters involved by the short-run dynamics of the process. The simulations suggested that the variance ratio test has favorable small sample properties.

(b) Im, Pesaran and Shin (2003) tests

² A number of alternative panel unit root tests have been developed in recent years. Uncovered tests in this paper include Harris and Tzavalis (1999), Phillips and Sul (2003), Bai and Ng (2004), and Moon and Perron (2004).

Im, Pesaran and Shin (IPS) allow for a heterogeneous coefficient of y_{it-1} and proposed an alternative testing procedure based on averaging individual unit root test statistic. IPS suggested an average of the ADF tests when u_{it} is serially correlated with different serial correlation properties across cross-sectional units, i.e. $u_{it} = \sum_{j=1}^{\rho_i} \phi_{ij} u_{it-j} + z'_{it} \gamma_i + \varepsilon_{it}$. Substituting this to (1), we get:

$$y_{it} = \delta_i y_{it-1} + \sum_{j=1}^{k_i} \theta_{ij} \Delta y_{it-j} + z'_{it} \gamma_i + \varepsilon_{it} \quad (2)$$

The null hypothesis is that $H_0: \delta_i = 1$ for all i against the alternative hypothesis $H_1: \delta_i < 1$ for at least one i . The IPS t -bar statistic is based on the average of the individual ADF statistics as $\bar{t} = \frac{1}{N} \sum_{i=1}^N t_{\delta_i}$, where t_{δ_i} is the individual t -statistic of testing the null hypothesis.

(c) Combining P-values Tests

Maddala and Wu (1999) and Choi (2001) proposed two Fisher type tests (ADF and PP) as $P = -2 \sum_{i=1}^N \ln p_i$ (3)

which combining the p -values from unit root tests for each cross-section i to test for unit root in panel data. P is distributed as χ^2 with $2N$ degrees of freedom as $T_i \rightarrow \infty$ for all N . It is argued that the Fisher test has the advantage over the IPS test in that it does not require a balanced panel. Also, the Fisher test can use different lag lengths in the individual ADF regressions and can be applied to any other unit root tests. The disadvantage is that the p -values have to be derived by Monte Carlo simulations.

$$\text{Choi (2001) proposed a } Z \text{ test as } Z = \frac{\frac{1}{\sqrt{N}} \sum_{i=1}^N (-2 \ln p_i - 2)}{2}.$$

(d) Residual Based LM Test

Hadri (2000) proposed a residual based Lagrange Multiplier (LM) test for the null that the time series for each are stationary around a deterministic trend against the alternative of a unit root in panel data. Considering the following model

$$y_{it} = z'_{it}\gamma + r_{it} + \varepsilon_{it} \quad (4)$$

where $e_{it} = \sum_{j=1}^t u_{ij} + \varepsilon_{it}$. Let $\bar{e}_{ij}$ be the residuals from the regression and $\bar{\sigma}_e^2$ be the estimate of the error variance. Also, let S_{it} be the partial sum process of the residuals, $S_{it} = \sum_{j=1}^t \bar{e}_{ij}$ and then

$$\text{the LM statistic is } LM = \frac{\frac{1}{N} \sum_{i=1}^N \frac{1}{T^2} \sum_{t=1}^T S_{it}^2}{\bar{\sigma}_e^2}.$$

2.2. Recent Developed Panel Cointegration Tests

As well as problems regarding unit roots, the use of cointegration techniques in time series studies to test for the presence of long-run relationships among integrated variables is now common practice, such as Johansen test (1988, 1991)³.

Johansen test is based on VAR approach. The advantage of this test is that it permits more than one cointegrating relationship, which is more applicable than some tests allowing only one cointegrating relationship. To carry out the test, we first formulate the VAR:

$$y_t = \Gamma_1 y_{t-1} + \Gamma_2 y_{t-2} + \dots + \Gamma_p y_{t-p} + \varepsilon_t$$

There are two types Johansen test, either with trace or with eigenvalue, and the inferences might be a little bit different.

$$\text{Trace Test} = -T \sum_{i=r+1}^M \ln \left[1 - (r_i^*)^2 \right], \text{ where } r \text{ is the cross correlation matrix.}$$

We then refer this statistic to the chi-squared distribution with $M - r$ degrees of freedom to test

³ Example of other common cointegration tests in time series include Engle and Granger (1987) and Johansen and Juselius (1990).

the null hypothesis of no cointegration.

Testing for cointegration in panel data, on the other hand, has received much attention recently. Most approaches are taking no cointegration as the null hypothesis⁴. The approach within this category is almost exclusively based on the residual-based tests⁵. The most influential theoretical contributions are, perhaps, Pedroni (1999, 2004) including his earlier works since 1995. Together with Pedroni tests, we present newly developed error correction-based cointegration tests for panel data by Westerlund (2007).

(a) Pedroni (1999, 2004)

Following the introduction of the residual-based panel cointegration tests in 1995, Pedroni (1999, 2004) extended his panel cointegration testing procedure that allow is for heterogeneous slopes coefficients across cross-sections. Considering a general case,

$$y_{i,t} = \alpha_i + \delta_i t + \beta_{1i} x_{1i,t} + \beta_{2i} x_{2i,t} + \dots + \beta_{Mi} x_{Mi,t} + e_{i,t}$$

where T refers to the number of observations over time, N refers to the number of individual members in the panel, and M refers to the number of regression variables. The model is allowed to include intercept and deterministic time trends.

The author derived the asymptotic distributions and explores the small sample performances of seven statistics: the panel v-test, panel rho-test, panel PP-test, panel ADF test, group rho-test, group PP-test, and group ADF test. In the null hypothesis, the residuals are nonstationary. In the alternative hypothesis, the residuals are stationary. For the first four tests, it is assumed that the residuals of the alternative hypothesis have common autoregressive coefficients γ_i referred to as the within-dimension based statistics or the so called panel

⁴ The studies consist of taking panel cointegration as the null hypothesis, for instance, include McCoskey and Kao (1998) and Westerlund (2005a).

⁵ Examples of the residual-based panel cointegration tests include McCoskey and Kao (1998), Kao (1999), and Westerlund (2005b). See also Larsson, Lyhagen, Lotgren (2001) and Groen and Kleibergen (2003) for a likelihood-based framework.

statistics; For the remaining three tests, it is assumed that the residuals of the alternative hypothesis have individual autoregressive coefficients γ_i referred to as the between-dimension based statistics or group mean statistics. For the panel statistics the test for the null of no cointegration is implemented as a residual-based test of the null hypothesis $H_0 : \gamma_i = 1$ vs. $H_1 : \gamma_i = \gamma < 1$ for all i . By contrast, for the group mean statistics the test for the null of no cointegration is implemented as a residual-based test of the null hypothesis $H_0 : \gamma_i = 1$ vs. $H_1 : \gamma_i < 1$ for all i .

(b) Kao (1999)

Kao (1999) studied residual-based tests for cointegration regression in panel data. DF and ADF tests are applied to test null of no cointegration. Asymptotic distributions of the tests are derived and Monte Carlo experiments are conducted to evaluate finite sample properties of the tests. The Kao (1999) test is known as the special case of Pedroni (1999) which cointegrating vectors are assumed to be homogeneous.

(c) Maddala and Wu (1999)

Maddala and Wu (1999) proposed a simple test of unit root with panel data in their paper. The procedure to test panel cointegration is simple, no need for a separate theory for each type of test. The disadvantage point is the correlation among the test statistics for the different cross-section units that require the bootstrap method to get critical values for the chi-squared test. Unlike Pedroni and Kao tests that either all the relationships are cointegrated or all are not, the proposed tests allow for some relationships to be cointegrated and others not. Maddala and Wu tests are known as the Johansen Fisher type.

(d) Westerlund (2007)

Westerlund (2007) proposed new error correction-based cointegration tests for panel

data, which do not impose any common factor restriction. The author argued that the tests are more powerful than the residual-based tests. Considering the basic model setup,

$$\begin{aligned} y_{it} &= \phi_{1i} + \phi_{2i}t + z_{it}, \\ x_{it} &= x_{it-1} + v_{it}, \end{aligned}$$

where $t = 1, 2, \dots, T$ and $i = 1, 2, \dots, N$ index the time-series and cross-sectional units, respectively. The conditional error correction model for y_{it} is

$$\alpha_i(L)\Delta y_{it} = \delta_{1i} + \delta_{2i}t + \alpha_i(y_{it-1} - \beta_i'x_{it-1}) + \gamma_i(L)'v_{it} + e_{it},$$

where $\gamma_i(L) = \sum_{j=0}^{p_i} \gamma_{ij}L^j$ is K -dimensional polynomials in the lag operator L . The

above equation represents the typical deterministic elements including a constant and a linear time trend.

If $\alpha_i < 0$, then there is error correction, which implies that y_{it} and x_{it} are cointegrated, whereas if $\alpha_i = 0$, the error correction will be absent and there is no cointegration. The author proposed four panel statistics that are based on this idea. Two of the statistics are based on pooling the information regarding the error correction along the cross-sectional dimension of the panel or the so-called panel statistics. The second pair does not exploit this information which referred to as group mean statistics. The former two tests are designed to test the alternative hypothesis that the panel is cointegrated as a whole ($H_0 : \alpha_i = 0$ vs. $H_1^p : \alpha_i = \alpha < 0$), while in the latter two test the alternative is that there is at least one individual that is cointegrated ($H_0 : \alpha_i = 0$ vs. $H_1^g : \alpha_i < 0$).

2.3. Estimation Methods of Short-run and Long-run Income Elasticity

In this subsection, the estimation methods of short-run and long-run income elasticities and together with the method of testing causality will be briefly reviewed.

① Error Correction Model

The cointegrating regression so far considers only the long-run property of the model, and does not deal with the short-run dynamics explicitly. The short-run dynamics can be integrated with long-run equilibrium by using Error Correction Model (ECM).

We define the error correction term by $\xi_t = y_t - \beta x_t$, where β is a cointegrating coefficient. In fact, ξ_t is the error from a regression of y_t on x_t . Then an ECM is simply defined as

$$\Delta y_t = \alpha \xi_{t-1} + \gamma \Delta x_t + \mu_t$$

where μ is i.i.d. The ECM equation simply says that Δy_t can be explained by the lagged ξ_{t-1} and Δx_t . Notice that ξ_{t-1} can be thought of as an equilibrium error (or disequilibrium term) occurred in the previous period. If it is non-zero, the model is out of equilibrium and vice versa.

All the variables in the ECM are stationary, and therefore, the ECM has no spurious regression problem. α and γ are called short-run parameters.

② The long-run Income Elasticity

$$\text{Consider the model } LE_t = \beta_1 + \beta_2 LE_{t-1} + \beta_3 LY_t + \beta_4 LY_{t-1},$$

Where LE is expenditure for a good represented in log form. LY is income represented in log form as well. Long-run income elasticity θ is calculated as

$$\theta = \frac{\hat{\beta}_3 + \hat{\beta}_4}{1 - \hat{\beta}_2}$$

③ Granger Causality

Causality in the sense defined by Granger (1969) is inferred when lagged values of a variable, say x_t , have explanatory power in a regression of a variable y_t on lagged values of y_t and x_t . Here these two variables are assumed to be stationary time series with zero means. The simple causal model is

$$x_t = \sum_{j=1}^m a_j x_{t-j} + \sum_{j=1}^m b_j y_{t-j} + \varepsilon_t$$

$$y_t = \sum_{j=1}^m c_j x_{t-j} + \sum_{j=1}^m d_j y_{t-j} + \eta_t$$

where ε_t, η_t are taken to be two uncorrelated white-noises series. The definition of causality give in above implies that y_t is causing x_t provided some b_j is not zero. Similarly, x_t is causing y_t if some c_j is not zero. If both of these events occur, there is said to be a feedback relationship between x_t and y_t . The VAR can be used to test the hypothesis. Tests of the restrictions can be based on simple F tests in the single equations of the VAR model.

Table 2.1: The development of Panel Unit root

Panel Unit Root test	First Generation	Homogenous	Breitung(2000) Hadri(2000) LLC(2000)
		Heterogeneous	Madala and Wu (1999) Choi(2001) IPS(2003)
	Second Generation		O'Connell(1998) Breitung and Das(2005) Moon and Perron(2004) Bai and Ng(2004) Pesaran(2003)

CHAPTER 3

DATA DESCRIPTION

In this chapter, the data description of public expenditures on education, health and social security and welfare will be presented from sections 3.1 to 3.3. In the last section 3.4, data on economic growth will be illustrated. The data set totally consists of 11 Asia countries covering the period of 1973-2012. Data are benefited mainly from sources of ADB (1985, 1999 and 2013 Key Indicators). The starting data set was the list of 48 Asia and the Pacific countries stated in ADB. However, data especially for public expenditures on education, health and social security and welfare are not available for 26 countries. For example, China provides data of public expenditures on education and health mixed for certain of period. Another 8 countries including Brunei, Cambodia, Kiribati, Kyrgyz, Mongolia, Maldives, Tonga and Vanuatu are also excluded due to insufficient samples (short term and/or discontinuity).

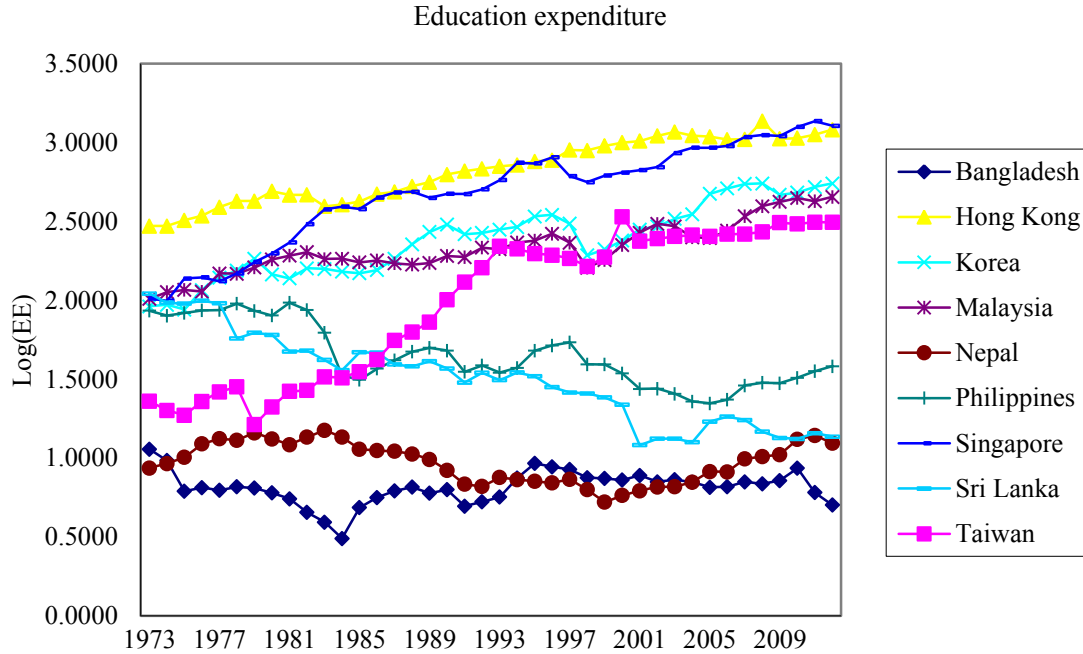
Finally we generate data from Bangladesh, Hong Kong, Japan, Korea, Malaysia, Nepal, Philippines, Singapore, Sri Lanka, Taiwan and Thailand. The panel data set has been selected so as to produce the longest and largest observations for each public expenditure data. All Education Expenditure (EE), Health care Expenditure (HE), Social Security and Welfare (SSW) and Gross Domestic Product (GDP) variables are measured in per capita U.S. dollar terms at constant prices of year 2000 and transformed in natural logarithms. The details of each component will be illustrated as below.

3.1. Data on Education Expenditures

We generate data on education expenditures for 9 countries including Bangladesh, Hong Kong, Korea, Malaysia, Nepal, Philippines, Singapore, Sri Lanka covering the period of 1973 and 2012. The panel data set has a total of $9 \times 40 = 360$ observations.

The characteristics of education expenditures during the study period are shown in Figure 1. The samples can be broadly divided into three groups. First group is three industrialized countries including Japan, Hong Kong, Singapore. These countries have shown a sharp and continuous increasing trend over the past few decades. Japan is highest annual expenditure on education in this area. But it is in the lower group among OECD countries. It is of interest to investigate whether the investment in this sector induces their economic growths or inversely the economic growth leads to the increase in education investment, or they are bi-directionary. Second group is Korea, Malaysia and Sri Lanka. There is a lot of changing. Several ups and downs, especially for the Korea they have stayed almost at the same position during 1973 and 2008. The last group includes Philippines and Sri Lanka. The education spending in Philippines showed a sharp decline trend in early 1980s. Since then, it fluctuated from times to times. The current EE is just about the same level of 1985. The spending in Sri Lanka has shown a steady decline over the period of the study. Its spending now is roughly one-half of the level at the early 1970.

Figure 1: Real Education Expenditure per capita in Asia Countries, 1973-2012



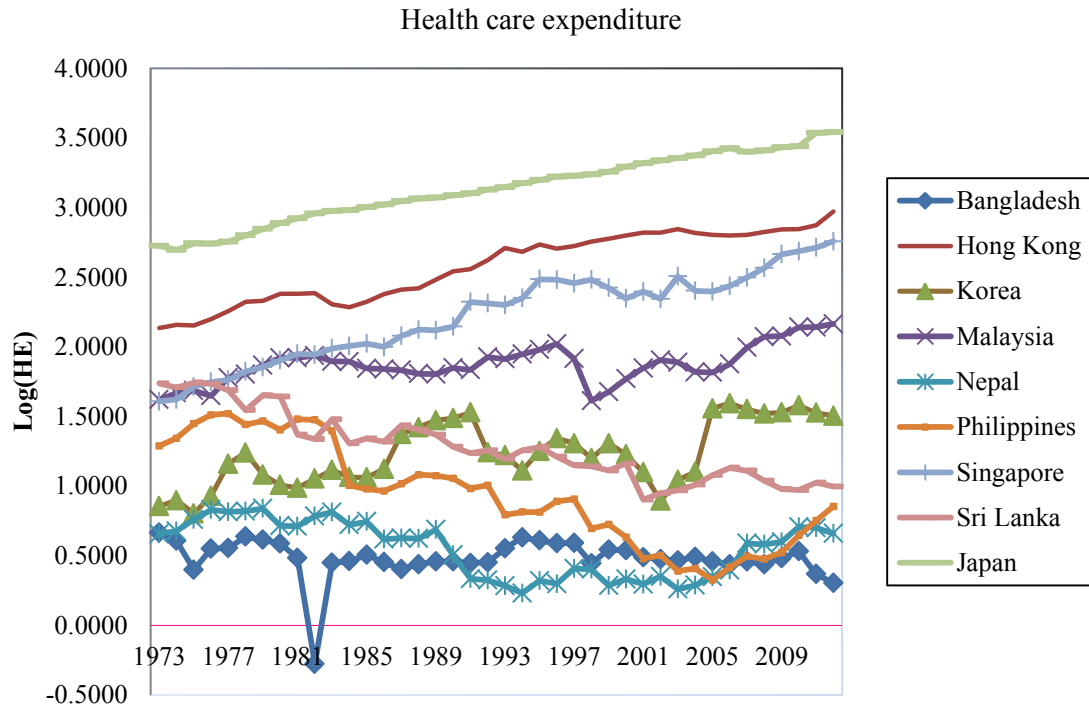
3.2. Data on Health Expenditures

We generate data on health expenditures for 9 countries including Bangladesh, Hong Kong, Japan, Malaysia, Nepal, Philippines, Singapore and Sri Lanka covering the period of 1973 and 2012. The panel data set has a total of $9 \times 40 = 360$ observations.

The characteristics of HE during the study period are shown in Figure 1. The samples can be broadly divided into three groups. First group is three members of high income. Japan has experienced strong increases in health spending. Not only Japan but also Singapore and Hong Kong have experienced strong increases in health spending. Hong Kong has indicated upward trends for HE, except for a small decrease during 1983-1985. Singapore has recorded significant jump up to 1995 and maintained at the same level for a past decade. Second group is three countries of Malaysia and Korea and Sri Lanka. Malaysia has shown upward trends up to 1996, but this has turned to big decreases due to the impacts of Asian Financial Crisis (AFC) occurred in 1997. HE, then, has recovered back closed to the level of 1996. On the other hand, Korea has changed up and down over time. And, third group is three developing countries of

Bangladesh, Nepal and Philippines. With several small ups and downs, HE in these countries has shown the downward trends. The changes in HE for Bangladesh and Nepal are relatively small as compared with Philippines. The largest drops of HE can be observed in the Bangladesh case during the AFC.

Figure 2: Real Health Expenditure per capita in Asia Countries, 1973-2012



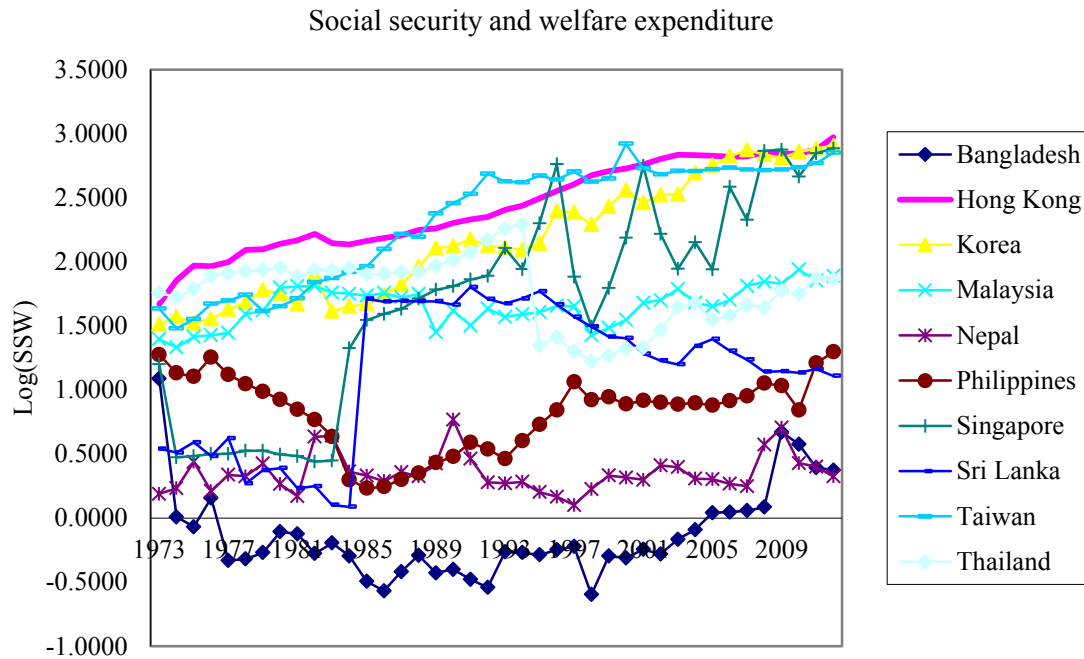
3.3. Data on Social Security and Welfare Expenditures

We generate data of expenditures on SSW for 10 countries including Bangladesh, Hong Kong, Korea, Malaysia, Nepal, Philippines, Singapore, Sri Lanka, Taiwan, and Thailand covering the period of 1973 and 2012. The panel data set has a total of $10 \times 40 = 400$ observations.

The characteristics of SSW during the study period are shown in Figure 2. The samples show that Japan, Hong Kong and Singapore share a same trend of steady growth in SSW spending and the scale of the spending has increased nearly double over the period of 1973-2012. However, Taiwan and Korea changed up and down over time. Second group is Singapore

and Sri Lanka. Sri Lanka's SSW fluctuated sharply during 1985-1986. Since then, it was maintained stably up to 1995. It has turned to decline again until the present. Likewise, Singapore declined in 1973 and was stable for 6 years, and then in 1983 sharply up and increasing until 1995 and then up and down until present. Not only Singapore but Sri Lanka also had strong increasing in 1984 but it is barely decreasing until now. Nepal had small up and down in this series. Next, the spending for the case of Philippines has shown a U-shape bottom down at 1984. It had gradually declined from 1973 to 1984 and then inversely increased from 1984 to 2008. Bangladesh's SSW declined significantly from 1973 to 1974. Other big turning points occurred during the years of 1986, 1992 and 1998. Since 2000s, it has gradually increased, but yet far from the highest level recorded in 1973. Only one country had along deficit Social Security and Welfare Expenditure for long time and just increasing over zero in 2005. Lastly, Thailand is another country that experienced a big drop over 1994-1995. Except for this point of time, the SSW spending has shown an increasing trend.

Figure 3: Real Social Security and welfare Expenditure per capita in Asia Countries, 1973-2012

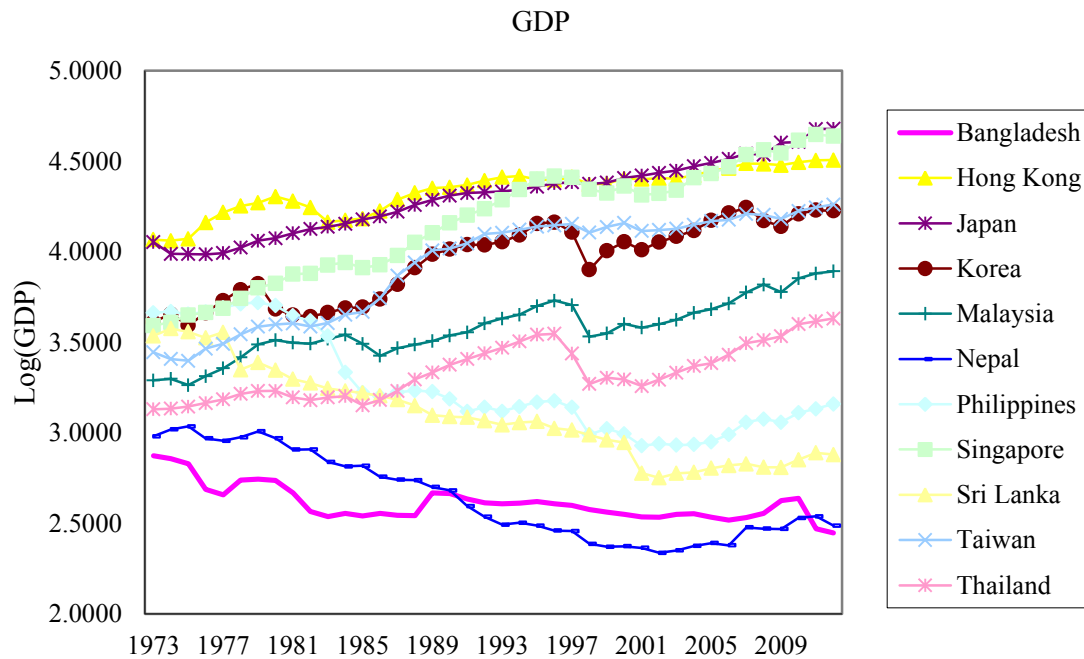


3.4. Data on Economic Growth (GDP)

In this section, data on economic growth of all 11 Asia countries including, Bangladesh, Hong Kong, Japan, Korea, Malaysia, Nepal, Philippines, Singapore, Sri Lanka, Taiwan and Thailand covering the period of 1973 and 2012 are presented in figure 4.

The samples can be broadly divided into two big groups. There are upward group and downward group. First group is three members of high income level. Hong Kong has barely changed in GDP during the last four decades. Likewise, Japan has also experienced strong increases in GDP over the time. And Japan is the top class of GDP. On the other hand, Singapore is the large growth compared with Japan and Hong Kong. In 1973, GDP was only 3.6 but in the 2012 was 4.6 the same level by Japan.

Figure 4: Real GDP per capita in Asia Countries, 1973-2012



Second group is four newly industrialized countries of Taiwan, Korea, Malaysia, and Thailand. Four countries have the same trend for forty decade. They are drop from 1997 to 1999 because of Asian crisis. Thailand was given the big affect of this problem. But Taiwan experienced a small decrease during this period. Looking at the figure, Korea had big change two periods. The first was 1981 and second was 1998. For Malaysia the GDP also has shown upward trends up to 1996, but this has turned to decrease due to the impacts of AFC occurred in 1997. GDP, then, has shown a steady growth up to the present. Taiwan has experienced a steady growth as same as Korea. The movement of Taiwan's GDP is strongly similar with Korea and now at almost the same level. Thailand, on the other hand, has figured the similar path as Malaysia with a certain lower scale. It has growth fast during the mid 1980s to mid 1990s and since the early 2000s.

And, third group is four developing countries of Philippines, Sri Lanka, Bangladesh, and Nepal. With several small ups and downs, GDP in these countries has shown the downward trends. The changes in GDP for Bangladesh and Nepal are relatively small as compared with

Philippines and Sri Lanka. The largest drops of GDP can be observed in the case of Sri Lanka during the AFC.

Table 3 – 1: Asia Countries for economic growth Data

	Countries
1	Bangladesh
2	Hong Kong
3	Japan
4	Korea
5	Malaysia
6	Nepal
7	Philippines
8	Singapore
9	Sri Lanka
10	Taiwan
11	Thailand

CHAPTER 4

PANEL ANALYSIS ON EDUCATION EXPENDITURES AND GDP

Chapter 4 provides the 1st original empirical study of this dissertation regarding to panel analysis on education expenditures (EE) and GDP. The existing literature on the role of education on economic growth usually employs standard sources of growth equations based on a dynamic Cobb-Douglas aggregate production function, which can be extended to include human capital as a determinant of the economy's growth rate. Or, they may directly investigate the causality between EE and economic development. Does education really promote economic growth? Previous empirical evidence tends to use time-series/cross-countries technique to examine the relationship between EE and GDP. The findings generally suggested that EE and GDP are cointegrated, but the causality among the two variables is not conclusive.

In this chapter, we aim to analyze this question using panel data technique. It utilizes data from 9 Asia countries for the period of 1973-2012. In brief, the results of six panel unit root tests generally indicate that the two series of EE and GDP are non-stationary for both with and without time trend in the regressions. This study applies panel cointegration testing from the residual-based approach, the maximum likelihood approach, and the error correction approach. In short the results indicate that the two series are cointegrated for both with and without time trend in the regressions. Therefore, researchers studying national education expenditures need to be concerned about the presence of unit roots and cointegration in the data. Whether education is a necessity good or a luxury good, this study shows that it remains controversial. Moreover, the tests suggest that bidirectional causality does exist.

4.1. Literature Review on Education

The existing literature on the role of education on economic growth usually employs

standard sources of economic growth equations based on Cobb-Douglas aggregate production function, which can easily be extended to include human capital as a determinant of the growth rate. Or, they may directly investigate the causality between EE and economic development.

One strand of models includes those by Barro (1991), Barro and Lee (1993, 2000), and Baumol (1986), which argue that human capital plays an important role as a facilitating factor on the international transfer of technology from innovating countries to imitating ones, helping them to catch-up with the developed countries. Also, Mankiw, Romer, and Weil (1992) showed an extended Solow-type growth model, when solved for the steady-state per capita income level, ends up in an equation that includes physical and human capital as the basic growth determinants. Alternatively, on the endogenous growth side of models, human capital accumulation has been recognized as one of the most significant engines of economic growth. Romer (1990) developed a growth model assuming that the creation of new ideas/designs is a direct function of the human capital. Thus, investment in human capital by improving research and development entails a growth. Persistent accumulation of knowledge by human beings promotes the productivity of labor and is the driving force of economic growth, either with intentional efforts (Lucas, 1988) or with learning by doing (Azariades and Drazen, 1990). Indeed, investment in human capital is generally proxied by education variables.

Other researchers found either weak or no evidence that education or education expenditures enhance economic growth. Benhabib and Spiegel (1994) found weak evidence of a relationship between changes in educational attainment of the labor force and economic growth. Devarajan et al (1996) found negative correlations between the share of education expenditures in government budget and economic growth in most of their estimates. Blis and Klenow (2000) find causation from schooling to economic growth is too weak to produce the correlation coefficients obtained by Barro (1991). They instead found reverse causality from economic growth to schooling.

Most of the studies mentioned above use cross-section analysis. While cross-section

analysis is informative of the correlation that can be established from the data, it is less useful in establishing a causal link from education or education expenditure to economic growth. Accordingly, the objective of the study in this chapter is to analyze the relationships (cointegration, and short-run and long-run) between education expenditures and growth in Asia countries using panel data analysis. Only previous works that apply similar approaches to this study will be reviewed below. Most works we found used time-series analysis rather than panel analysis, except for few studies, e.g. Bentzen and Smith (2006). The findings generally suggested that EE and GDP are cointegrated, but the causality among the two variables is not conclusive.

(1) Meulemeester and Rochat (1995) shed light on the relationship between higher education and economic growth by applying econometric tools of cointegration and causality tests in 6 countries namely Australia, France, Italy, Japan, Sweden and United Kingdom. The studied period varied from country to country. The results showed a significant causality from national higher educational effort to economic growth for 4 countries: France, Japan, Sweden and United Kingdom. However, such a causality link could not be found for Australia and Italy;

(2) Asteriou & Agiomirgianakis (2001) examined the relationship between human capital and GDP per capita in Greece, covering data from 1960 to 1994. Proxies of human capital were measured by enrollment rates in primary, secondary and higher education, and public expenditures in education over total expenditures (private spending is excluded). ADF tests showed that all variables have unit roots in their levels but are stationary in first differences. Johansen cointegration tests using the trace tests indicated that there is one cointegrating vector between educational expenditures and GDP. Error Correction Model (ECM) tests resulted that the hypothesis's that the growth rate of educational expenditures does not cause the growth rate of GDP is rejected, but not vice-versa.

(3) Musila & Belassi (2004) investigated the relationship between government education expenditure per worker and economic growth in Uganda over the period of 1965-

1999. ADF and PP tests showed that the null hypothesis of a unit root cannot be rejected for all level variables, but rejected for all first difference variables. Johansen cointegration tests performed with a linear trend suggested two cointegrating vectors both the trace and maximum eigenvalue tests. The estimates of ECM tests indicated that an increase in the education expenditure has a positive and significant impact on economic growth. Moreover, they used a year dummy to capture structural shifts from the policies of the military regime before 1980, which showed a negative and significant repressed economic growth.

(4) Bentzen & Smith (2006) analyzed the impact of public R&D expenditures on private sector output in Denmark, Iceland, Finland, Norway and Sweden covering the data from 1975 to 1995. ADF and PP tests resulted that except for one case of Danish public R&D expenditure according to PP test, all variables are non-stationary. The first difference of the variables turned out to be stationary. Whereas Engle-Granger tests showed that only Denmark and Sweden have cointegration relationship, Johansen tests indicated that Denmark, Sweden and Finland have cointegration relationship. Pedroni panel tests found that the results are mixed, but the strongest evidence in favor of cointegration (only according to the ADF-type parametric statistics) is found for a subsample consisting of Denmark, Finland and Iceland.

(5) Francis & Iyare (2006) analyzed the causal relationship between expenditure on education per capita and GNI per capita in Barbados, Jamaica, and Trinidad-Tobago over the period of 1964-1998. ADF tests for both with and without trend did overwhelmingly support the presence of unit roots in levels in all the series for all countries. The series in first difference are stationary. Engle-Granger cointegration tests showed that education and GNI are cointegrated for all countries with a time trend. The results of ECM tests indicated a mixed set of outcomes. Education causes development in Jamaica in the short run, but there is no evidence for Barbados, and Trinidad-Tobago.

(6) Islam et al. (2007) examined relationship between expenditure on education and growth in Bangladesh over the period from 1976 to 2003. Using ADF tests for both with and

without a time trend, the presence of a unit root could not be rejected for both levels and first difference of all variable. The nonstationary is rejected at second difference. Using Johansen-Juselius cointegration tests for with and without trend, the hypothesis of no cointegration is rejected. Both trace and eigenvalue tests generated same results. Granger causality tests showed that the null hypotheses cannot be rejected, which implies that bidirectional long-run causality between expenditure on education and GDP does exist.

(7) Aka and Dumont (2008) examined the causal relationships between human capital (including education and health) and economic growth for the USA using time series approach for the period of 1929-1997. They found cointegration between the variables under study. The EC-VAR investigations showed bidirectional causality between Education and Health. Causality also existed from Education to Economic growth. On the other hand, causality was found between Health and Economic growth and not the reverse.

(8) Liu et al. (2008) investigated the relationship between the USA five federal expenditures including national defense, human resources, physical resources, net interest payment and others and GDP over the period of 1947-2002. It is worth noting that in their study, health and social security also be added to education spending to compound the human resources. They applied Granger causality tests and found that there is unidirectional causality for GDP and human resources expenditures. The increase in human resources expenditure does cause GDP growth, but not vice versa.

(9) Pradhan (2009) examined the causality between government expenditure on education and GDP in India during 1951-2001. The results of ADF tests indicated that education expenditures are integrated of order one, both without and with trend. Applying Johansen-Juselius cointegration tests, both series are cointegrated for both eigenvalue and trace statistics, which means there is a long run relationship between them. ECM tests showed that there is presence of unidirectional causality from economic growth to education, but there is no reverse causality.

(10) Saad and Kalakech (2009) investigated the growth effects of government expenditure in Lebanon over the period of 1962-2007, with particular sectors including defense, education, health and agriculture. The results of ADF and PP unit root testing reported that EE is not stationary at level, but becomes stationary at first difference. Johansen test indicated that there is one cointegration relationship both by the trace statistics and maximum eigenvalue statistic. Their findings revealed that EE has a positive effect on growth in the long-run and negative impact in the short-run (ECM model).

(11) Alam et al. (2010) examined the long-run relationship between public expenditures including education, health, and social security and welfare and economic growth in 10 Asian developing countries. ADF tests clearly failed to reject the non-stationarity hypothesis for the levels of EE, whereas it was rejected for the first difference. Panel unit root test (IPS test) showed EE is integrated of order one both without and with time trend. Moreover, Johansen and Juselius (1990) tests suggested the long-run relationship among variables for both the trace statistics and maximum eigen-value statistics. For panel cointegration test, it implied that a strong long-run relationship exists between the variables.

4.2. Results of Panel Unit Root Tests for EE and GDP

4.2.1 ADF Unit Root Tests for EE and GDP

Table 4.1, Table 4.2, table 4.3 and Table 4.4 present the country by country unit root tests based on the popular ADF regressions (with a maximum lag of 9 periods) for two cases of no time trends and with time trends, by using level and first difference respectively. With respect to the level models, on the basis of no time trends, the ADF unit root hypothesis for both EE and GDP can be rejected only for Bangladesh at the 5% level. For the regressions with time trends, the ADF unit root hypothesis for both EE and GDP cannot be rejected except for only one country, Hong Kong at the 5% level. In sum, unit roots are not detected only for two out of 36 cases for the level variables. Two variables are non stationary at level like other study.

Using the first difference models, EE still have unit root in two countries, Bangladesh and Nepal by no trend. In case of with time trend EE have unit root in Bangladesh and Nepal too. Other countries are stationary. For GDP they show that GDP for without trend in two countries cannot reject the null hypothesis (Nepal and Taiwan) and with trend are non-stationary in four countries, namely Hong Kong, Nepal and Taiwan. And with individual time trends appear to be stationary at least at the 5% level in four cases.

Thus, most of the country by country test results suggest that unit root hypotheses cannot be rejected for most level variables, but rejected for most first difference variables. Similar to the majority of the previous studies mentioned above, the presence of time trending variables do not give conflicting results for a particular concern in the case of Asia countries.

Table 4 - 1: Unit root test for EE at level

<u>Level</u>	EE				No trend	With trend
	Lag	No trend	Lag	With trend		
Bangladesh	9	-3.050*	9	-2.248	No unit root	unit root
Hong Kong	0	-1.235	0	-2.365	unit root	unit root
Korea	1	-1.368	1	-3.379	unit root	unit root
Malaysia	1	-0.997	1	-3.079	unit root	unit root
Nepal	9	-2.833	9	-1.862	unit root	unit root
Philippines	7	-2.002	7	-2.437	unit root	unit root
Singapore	0	-1.875	1	-1.859	unit root	unit root
Sri Lanka	0	-1.470	0	-2.961	unit root	unit root
Taiwan	0	-0.814	0	-1.480	unit root	unit root

Note: *and ** represent 5% and 1% levels of significance

Table 4 - 2: Unit root test for GDP at level

<u>At level</u>	GDP				No trend	With trend
	Lag	No trend	Lag	With trend		
Bangladesh	0	-2.516	0	-2.955	unit root	unit root
Hong Kong	1	-2.262	1	-4.002*	unit root	No unit root
Korea	0	-1.114	0	-2.218	unit root	unit root
Malaysia	0	-0.677	0	-2.077	unit root	unit root
Nepal	7	-2.901	7	-0.836	unit root	unit root
Philippines	1	-1.673	1	-1.047	unit root	unit root
Singapore	1	-1.217	1	-2.004	unit root	unit root
Sri Lanka	1	-2.210	1	-0.854	unit root	unit root
Taiwan	7	-1.660	7	-1.950	unit root	unit root

Note: *and ** represent 5% and 1% levels of significance

Table 4 - 3: Unit root test for EE at first difference

First Difference	EE				No trend	With trend
	Lag	No trend	Lag	With trend		
Bangladesh	9	-2.202	9	-2.084	unit root	unit root
Hong Kong	6	-3.600*	6	-3.488*	no unit root	no unit root
Korea	0	-4.844**	0	-4.789**	no unit root	no unit root
Malaysia	0	-4.948**	2	-4.881**	no unit root	no unit root
Nepal	7	-1.529	7	-1.847	unit root	unit root
Philippines	0	-4.389**	0	-4.389**	no unit root	no unit root
Singapore	0	-5.286**	0	-5.579**	no unit root	no unit root
Sri Lanka	0	-6.857**	0	-6.838**	no unit root	no unit root
Taiwan	0	-6.396**	0	-6.375**	no unit root	no unit root

Note: *and ** represent 5% and 1% levels of significance

Table 4 - 4: Unit root test for GDP at first difference

First difference	GDP				No trend	With trend
	Lag	No trend	Lag	With trend		
Bangladesh	1	-5.391**	1	-5.504**	no unit root	no unit root
Hong Kong	8	-2.995*	8	-3.009	no unit root	unit root
Korea	8	-3.341*	8	-3.455***	no unit root	no unit root
Malaysia	8	-3.359*	8	-3.299***	no unit root	unit root
Nepal	2	-2.125	2	-2.589	unit root	unit root
Philippines	0	-3.789*	0	-4.034*	no unit root	no unit root
Singapore	0	-4.399**	0	-4.427**	no unit root	no unit root
Sri Lanka	0	-6.982**	0	-7.551**	no unit root	no unit root
Taiwan	6	-1.332	6	-1.676	unit root	unit root

Note: *, ** and***represent 5%, 1% and 10%levels of significance

4.2.2 Several Panel Unit Tests for EE and GDP

This study performs five different types of panel unit root test as described in Chapter 2 Section 2.1. The selection of lags is based on Newey-West bandwidth using Bartlett kernel. As shown in Table 4.5 and Table 4.6 the LLC, Breitung, IPS, ADF Fisher, and Hadri tests are presented. Firstly, LLC and Breitung tests assume the null of common unit root.

For EE, the LLC tests can reject the null hypothesis for without time trend in the regressions. But with time trend we cannot reject the null hypothesis. For this variable using LLC result is inconclusive. This method also gives the different result for GDP without trend is non-stationary but including time trend they can reject the null hypothesis. However, for Breitung tests the null hypothesis of Breitung test is that all panels are non stationary. It cannot reject the null hypothesis without time trend and with time trend included in the regression.

For GDP, on the other hand, LLC tests show that the null hypothesis could be rejected without trending variable, but not for with time trend included. Breitung tests show that they both are non-stationary with and without time trend included.

Secondly, IPS and ADF Fisher tests assume the null of individual unit root. For EE, with time trending variable excluded, all IPS, and ADF Fisher test cannot reject the null hypothesis of having a unit root, but with time trending variable included IPS test can reject the null hypothesis at 5% significant level, while ADF Fisher test cannot reject the null hypothesis at level. No matter time trending variable is included or excluded, the test results for GDP cannot reject the null hypothesis for both IPS and ADF tests.

Table 4 - 5: Panel Unit Root Testing for EE in case of “No Trend”

Study	EE	<i>p</i> -value	GDP	<i>p</i> -value
Null: common unit root				
Levin, Lin & Chu t-stat	-2.8748**	0.0020	-3.5069**	0.0002
Breitung t-stat	3.2061	0.9993	4.4299	1.0000
Null: individual unit root				
Im, Pesaran and Shin W-stat	0.2861	0.6126	0.5827	0.7199
ADF - Fisher Chi-square	13.7492	0.7453	13.0007	0.8774
Null: no common unit root				
Hadri Z-stat	65.1050**	0.0000	68.9903**	0.0000

Note: *and ** represent 5% and 1% levels of significance

Table 4 - 6: Panel Unit Root Testing in case of “With Trend”

Study	EE	<i>p</i> -value	GDP	<i>p</i> -value
Null: common unit root				
Levin, Lin & Chu t-stat	-1.2488	0.1059	-0.6702	0.2514
Breitung t-stat	-0.8866	0.1876	1.0388	0.8506
Null: individual unit root				
Im, Pesaran and Shin W-stat	-1.9866*	0.0235	0.3228	0.6266
ADF - Fisher Chi-square	15.6326	0.6182	8.7536	0.9856
Null: no common unit root				
Hadri Z-stat	24.2983**	0.0000	32.7049**	0.0000

Note: *and ** represent 5% and 1% levels of significance

And finally, Hadri tests assume the null of no common unit root. The null hypothesis could be rejected in all cases for EE and GDP. In the case of the limited country by country sample size in this study ($9 \times 40 = 360$), Hadri tests are probably the most appropriated because they apply a residual based Lagrange Multiplier test and do not require a number of samples for calculating lags like in the other test methods.

Thus, most panel tests are very conclusive (17 out of 20) and give a clear rejection of the non stationary hypothesis for both EE and GDP, no matter a time trend is included or excluded. Taken together with country by country ADF tests, the results clearly indicate that EE

and GDP series can be characterized as $I(1)$ processes. Since the previous studies mentioned above did not apply panel techniques, the results we found here can contribute new findings for the literature. And, these results then motivate further analysis of the existence of long run cointegrating linkages between EE and GDP in the sample of Asia countries. In Table 4.7 and Table 4.8 it can be concluded that all most methods with trend and without trend EE have unit root. Not only EE but also GDP are non-stationary in most cases. Table summarizes the unit roots test for the panel series and show that Panel is non stationary at level i.e. the acceptance of the null hypothesis of unit root.

Table 4 - 7: Panel Unit Root test for EE

Test method	<i>Null hypothesis</i>	Result/No trend	Result/ trend
Levin, Lin & Chu t-stat	<i>Unit root</i>	stationary	Non stationary
Breitung t-stat	<i>Unit root</i>	Non stationary	Non stationary
Im, Pesaran and Shin W-stat	<i>Unit root</i>	Non stationary	stationary
ADF - Fisher Chi-square	<i>Unit root</i>	Non stationary	Non stationary
Hadri Z-stat	<i>No Unit root</i>	Non stationary	Non stationary

Table 4 - 8: Panel Unit Root Test for GDP

Test method	<i>Null hypothesis</i>	Result/No trend	Result/ trend
Levin, Lin & Chu t-stat	<i>Unit root</i>	Non stationary	stationary
Breitung t-stat	<i>Unit root</i>	Non stationary	Non stationary
Im, Pesaran and Shin W-stat	<i>Unit root</i>	Non stationary	Non stationary
ADF - Fisher Chi-square	<i>Unit root</i>	Non stationary	Non stationary
Hadri Z-stat	<i>No Unit root</i>	Non stationary	Non stationary

4.3 Results of Panel Cointegration Tests for EE and GDP

4.3.1 Country by Country Johansen Cointegration Tests for EE

We start by presenting the country by country cointegration tests based on the Johansen tests for the cases of intercept and linear time trend included as in Table 4.9 and Table 4.10. The null hypothesis is no long-run relationship between EE and GDP. There are two test statistics in Johansen cointegration testing, namely Trace- statistics and maximum Eigenvalue statistic.

On the basis of trace statistics, in case of no time trend, the Johansen null hypothesis of no cointegration among EE and GDP cannot be rejected for most countries. In case of with no time trend, the Johansen null hypothesis test can be rejected for two countries for Bangladesh at 5% and for Singapore at 10% significant level. Using maximum Eigenvalue statistic, in case of time trend, the Johansen null hypothesis cannot be rejected for two countries (Bangladesh and Singapore at 10% significant level). However, in case of without time trend also, the Johansen null hypothesis cannot be rejected 2 out of 9 countries at least at the 10% level. These results imply that trace statistics seem to have a high power than maximum Eigenvalue statistics, and time trend variable seems to play an important role in our case study.

Table 4 - 9: Johansen tests for EE, without trend

No Trend	Rank =0				Rank ≤ 1	
	Trace statistics	p-value	Max-Eigen value statistic	p-value	Trace/Max-Eigen value	p-value
Bangladesh	17.97303*	0.0207	13.88950***	0.0572	4.083531*	0.0433
Hong Kong	20.37830	0.2074	16.79730	0.1144	3.581001	0.8015
Korea	15.45733	0.5367	9.819512	0.6381	5.637815	0.5076
Japan	13.44474	0.7030	8.857071	0.7391	4.587673	0.6562
Malaysia	20.29133	0.2115	13.06652	0.3227	7.224809	0.3216
Nepal	17.20728	0.3996	14.65497	0.2130	2.552310	0.9249
Philippines	15.85555	0.5042	8.473560	0.7772	7.381988	0.3063
Singapore	24.98647***	0.0641	19.37568***	0.0502	5.610786	0.5112
Sri Lanka	19.15731	0.2716	14.03864	0.2516	5.118667	0.5794

Note: *, ** and***represent 5%, 1% and 10%levels of significance

Table 4 - 10: Johansen tests for EE, with trend

With Trend	Rank =0				Rank ≤ 1	
	Trace statistics	p-value	Max-Eigen value statistic	p-value	Trace/Max-Eigen value	p-value
Bangladesh	25.04712***	0.0631	14.73048	0.1278	10.31664	0.1135
Hong Kong	20.37830	0.2074	16.79730	0.1144	3.581001	0.8015
Korea	15.45733	0.5367	9.819512	0.6381	5.637815	0.5076
Japan	13.44474	0.7030	8.857071	0.7391	4.587673	0.6562
Malaysia	20.29133	0.2115	13.06652	0.3227	7.224809	0.3216
Nepal	17.20728	0.3996	14.65497	0.2130	2.552310	0.9249
Philippines	15.85555	0.5042	8.473560	0.7772	7.381988	0.3063
Singapore	24.98647***	0.0641	19.37568***	0.0502	5.610786	0.5112
Sri Lanka	19.15731	0.2716	14.03864	0.2516	5.118667	0.5794

Note: *, ** and***represent 5%, 1% and 10%levels of significance

4.3.2 Several Panel Cointegration Tests for EE and GDP

Moreover, the results of panel cointegration tests from four methods are presented in Table 4.11 and Table 4.12 for the case of no time trend and for the case of with time trend. Pedroni (1999, 2004), Kao (1999) tests are derived from a residual-based approach, while Maddala and Wu (1999) tests are derived from Johansen Fisher Type maximum likelihood approach, and finally, Westerlund (2007) tests are derived from error correction model.

First, Pedroni tests for the assumption of no trend show that no cointegration hypothesis is rejected in six out of the seven tests (except for only group rho-stat) at the least 10% significant levels. When weighted statistics are applied, the result of rejection reduces to four tests, and all shows that the null hypothesis is rejected. In case of with trending, Pedroni tests show that the null hypothesis is cannot reject in two out of the seven tests at the 10% significant level. When weighted statistics are applied, the result of rejection increases to three out of the four tests. Overall, the cointegrating relationship between EE and GDP exists for both no trend and with trend, which mean there is a long run relationship exists within the variables.

Next, the Kao (1999) test, the special case of Pedroni (1999) which cointegrating vectors are assumed to be homogeneous, shows that EE and GDP are cointegrated. The test can reject the null hypothesis of cointegration even at the 1% significant level.

The Johansen Fisher type proposed by Maddala and Wu (1999) reaches to the results that the two series are cointegrated by the trace statistics of 37.86 and the maximum Eigenvalue statistic of 28.88 least at the 5% significant level, under the assumption of no trend in the model. When time trend is included, however, the tests suggest that the relationship between EE and GDP by both the - trace statistics and the maximum Eigenvalue statistic cannot reject the null hypothesis which means there is no long run relationship between two variables.

Finally, Westerlund tests find that the null hypothesis of no cointegration is highly rejected in all four tests at the 1% significant level, both without and with trend included

Table 4 - 11: Summary results of panel cointegration tests for EE and GDP, “No Trend”

	Cointegration testing				
Study	Test	Statistic	<i>p</i> -value	Weighted Stat	<i>p</i> -value
Pedroni (1999, 2004)	Panel v-stat	1.985210	0.0236	1.759257	0.0393
	Panel rho-stat	-2.331604	0.0099	-2.302612	0.0107
	Panel PP-stat	-2.243072	0.0124	-2.171145	0.0150
	Panel ADF-stat	-2.748518	0.0030	-2.679213	0.0037
	Group rho-stat	-0.902869	0.1833		
	Group PP-stat	-1.600432	0.0548		
	Group ADF-stat	-2.299871	0.0107		
Kao (1999)	ADF t-Stat	-2.640013	0.0041		
Maddala & Wu (1999)	Trace test, Rank=0	37.86	0.0040		
	Trace test, Rank=1	40.73	0.0017		
(Johansen Fisher Type)	Max-eigen test, Rank=0	28.88	0.0499		
	Max-eigen test, Rank=1	40.73	0.0017		
				Bootstrap Stat	<i>p</i> -value
Westerlund (2007)	Panel statistics P_τ	-8.241	0.000	-8.241	0.000
	Panel statistics P_α	-12.846	0.000	-12.846	0.000
	Group statistics G_τ	-2.954	0.000	-2.954	0.000
	Group statistics G_α	-12.542	0.002	-12.542	0.002

Note: *, ** and***represent 5%, 1% and 10%levels of significance

Table 4 - 12: Summary results of panel cointegration tests for EE and GDP, “With Trend”

	Cointegration testing				
Study	Test	Statistic	<i>p</i> -value	Weighted Stat	<i>p</i> -value
Pedroni	Panel v-stat	0.458582	0.3233	0.464373	0.3212
	Panel rho-stat	-1.480352	0.0694	-1.351008	0.0883
	Panel PP-stat	-2.353949	0.0093	-2.189577	0.0143
	Panel ADF-stat	-2.972466	0.0015	-2.814677	0.0024
	Group rho-stat	0.024847	0.5099		
	Group PP-stat	-1.502940	0.0664		
	Group ADF-stat	-2.550323	0.0054		
Maddala & Wu (1999) (Johansen Fisher Type)	Trace test, Rank=0	21.94	0.2348		
	Trace test, Rank=1	11.25	0.8834		
	Max-eigen test, Rank=0	22.51	0.2101		
	Max-eigen test, Rank=1	11.25	0.8834		
				Bootstrap Stat	<i>p</i> -value
Westerlund	Panel statistics P_τ	-9.2640	0.000	-9.2640	0.000
	Panel statistics P_α	-16.977	0.000	-16.977	0.000
	Group statistics G_τ	-3.3710	0.000	-3.3710	0.000
	Group statistics G_α	-16.154	0.027	-16.154	0.027

Note: *, ** and***represent 5%, 1% and 10%levels of significance

respectively. The Westerlund tests, using 100 bootstrap replications, also reject the null hypothesis in all four tests for case of no trend. This method strong rejects the null hypothesis of no cointegration. Its gives strong evidence that two variables have a long run relationship. In our case study, Westerlund tests seem to have the highest power relative to Pedroni, Kao, and Maddala and Wu tests. Together, the majority of performed tests indicate that there is a cointegrating relationship between EE and GDP for the Asia data. And, they show that the inclusion of a time trend variable can affect the estimation results in this case study.

4.4. Analysis on Short-run and Long-run for EE and GDP

Next, we are interested in investigation of short-run and long-run relationship between EE and GDP. Short-run dynamics can be integrated with long-run equilibrium by using Error Correction Model (ECM). The results of ECM tests are presented in Table 4. 13. The tests show that short-run income elasticity in most series appears to be largely lower than one meaning that education spending is a necessity good. In fact, many tests indicate significant negative income elasticity (Giffen goods). This finding deserves for further investigations whenever data is available to include more control variables such as relative price, proportion of population age (e.g. under 15 or 24), private expenditures on education and/or structural break in the model. Nevertheless, some series show that the results are statistically insignificant. Only In the case of Bangladesh, short-run income elasticity is greatly over one meaning that education is a luxury good.

Next step, in table 4.14 we attempt to test the long-run income elasticity in the case of Asia over the period 1973-2012. Since the existing studies on this topic tend to pay attention on the long-run relationship between education and economic growth, its direction of causality rather than to concern on the scale of the elasticity, it is not easy to compare the results of this study with others. Nevertheless, we find that the elasticity of education spending against income is significantly greater than one for Hong Kong, Korea, Sri Lanka and Taiwan. Education is a necessary good in Bangladesh, Malaysia, Nepal, Philippines and Singapore.

Table 4 - 13: Error Correction Model (ECM) results for EE, “No Trend”

	Bangladesh	Hong Kong	Korea	Malaysia	Nepal	Philippines	Singapore	Sri Lanka	Taiwan
ΔEE	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000
ΔGDP	3.718233	-1.981699	-0.818436	-1.031461	-0.764236	-0.555726	-0.977345	-0.363992	-1.612433
	(1.49662)	(0.17475)	(0.16885)	(0.07931)	(0.11952)	(0.08160)	(0.10414)	(0.27109)	(0.06683)
Constant	-10.49629	5.778711	0.842749	1.359008	1.038329	0.162673	1.386325	-0.361374	4.356825
R^2	0.161432	0.216752	0.185327	0.102849	0.135288	0.323477	0.182383	0.182383	0.350006
F-statistic	1.193558	1.715754	1.410417	0.710764	0.970020	2.964502	1.383010	1.383010	3.338544
Schwarz Criteria	-5.047784	-7.610380	-5.435067	-5.997735	-6.610520	-5.540787	-5.541734	-5.541734	-5.557579

Note: *, ** and***represent 5%, 1% and 10%levels of significance

Table 4 - 14: Long-run GDP elasticity, for EE

	Income elasticity	t-test	p-value
Bangladesh	0.411808	2.474966	0.0179
Hong Kong	1.481864	16.96376	0.0000
Korea	1.032659	20.81979	0.0000
Malaysia	0.978208	18.90435	0.0000
Nepal	0.382011	5.984371	0.0000
Philippines	0.675289	16.19543	0.0000
Singapore	0.977364	23.05720	0.0000
Sri Lanka	1.118014	30.35120	0.0000
Taiwan	1.560453	26.83081	0.0000

Table 4 - 15: Results of Granger Causality Tests for EE and GDP

	Null Hypothesis	F-statistics	p-value
Bangladesh	ΔGDP growth does not Granger Cause ΔEE growth	2.46765	0.1003
	ΔEE growth does not Granger Cause ΔGDP growth	0.16060	0.8523
Hong Kong	$\Delta GDP \rightarrow \Delta EE$ growth	3.10754*	0.0580
	$\Delta EE \rightarrow \Delta GDP$ growth	3.54184*	0.0404
Korea	$\Delta GDP \rightarrow \Delta EE$ growth	0.79436	0.4603
	$\Delta EE \rightarrow \Delta GDP$ growth	0.18266	0.8339
Malaysia	$\Delta GDP \rightarrow \Delta EE$ growth	0.60231	0.5535
	$\Delta EE \rightarrow \Delta GDP$ growth	1.95473	0.1577
Nepal	$\Delta GDP \rightarrow \Delta EE$ growth	0.82300	0.4475
	$\Delta EE \rightarrow \Delta GDP$ growth	0.72542	0.4917
Philippines	$\Delta GDP \rightarrow \Delta EE$ growth	3.30189*	0.0493
	$\Delta EE \rightarrow \Delta GDP$ growth	2.18631	0.1283
Singapore	$\Delta GDP \rightarrow \Delta EE$ growth	0.54999	0.5822
	$\Delta EE \rightarrow \Delta GDP$ growth	1.54066	0.2293
Sri Lanka	$\Delta GDP \rightarrow \Delta EE$ growth	1.83674	0.1753
	$\Delta EE \rightarrow \Delta GDP$ growth	0.82064	0.4489
Taiwan	$\Delta GDP \rightarrow \Delta EE$ growth	5.86747*	0.0066
	$\Delta EE \rightarrow \Delta GDP$ growth	0.01081	0.9893

Note: *, ** and *** represent 5%, 1% and 10% levels of significance

In addition, the causality between EE and GDP is examined as presented in Table 4.15. Using Granger causality tests, the null hypothesis of D-(GDP) does not cause D-(EE) can be rejected for three countries, Hong Kong, Philippines and Taiwan. Only Hong Kong has bidirectional causality. For

Philippine and Taiwan, the result shows that unidirectional causality of GDP and EE does exist. This result clearly suggests that bidirectional causality does exist. This finding lends a support to the majority of previous studies that expenditures on education can play an important role for economic growth.

CHAPTER 5

PANEL ANALYSIS ON HEALTH EXPENDITURES AND GDP

Chapter 5 provides the 2nd original empirical study of this dissertation regarding to panel analysis on health expenditures (HE) and GDP. Many recent studies have tested the hypotheses of unit root and cointegration in HE and GDP by relatively similar approaches and techniques. They examined data mainly from OECD countries, but reached different conclusions. This study utilizes data from 11 Asia countries for the period of 1973-2012. In brief, along with the popular ADF unit root tests, the results of six panel unit root tests clearly indicate that the two series of HE and GDP are non-stationary for both with and without time trend in the regressions. Together with the typical applied Johansen cointegration tests, this study applies panel cointegration testing from the residual-based approach, the maximum likelihood approach, and the error correction approach. The results indicate that the two series are obviously cointegrated for both with and without time trend in the regressions. Therefore, researchers studying national health expenditure need to be concerned about the presence of unit roots and cointegration in the data. Whether health care is a necessity good or a luxury good, this study shows that it remains controversial. Moreover, the causality tests suggest that only uni-directional causality (GDP cause HE) does exist.

5.1. Literature Review on Health

In pioneering works, Newhouse (1977) and others analyzed health expenditure per capita on GDP in OECD countries by using cross-section data. In his seminal article, Newhouse (1977) provided a comparison of health expenditures across 13 developed nations. Using a simple regression of per capita medical expenditures against per capita GDP, differences in the level of national incomes are able to explain 92 per cent of the variance in per capita health outlays. Furthermore, most estimates of the income

elasticity of health care spending obtained have exceeded unity, health care has been deemed a luxury good, rather than a necessity good.

Culyer (1990) reviewed the success and failures of the reform process of European nations battling rising health care requirements, and concluded that given the strength of the relationship between HE and income, growing expenditures are consequently beyond the reach of policy. Hitiris and Posnett (1992) used a sample of 560 cross sectional and time series observations from the OECD to test the determinants of health care spending. Their results reaffirmed that the vast majority of expenditures on health are caused by income discrepancies. The impact of demographic variables was quite limited under all their model specifications, if even found to be significant.

Following the publication of annual health care statistics by OECD (1990), analysts have attempted to address this research topic by using time series and panel data. As some of those studies to be reviewed in the next section, it can be said that the majority of studies tend to use a simple regression of HE and GDP, while some studies attempts to control for a variety of both ‘background’ and ‘institutional’ influences, including demography (such as proportion of ageing population, life expectancy and infant mortality rate), relative price for medical inputs, and fiscal constraints (such as public and private provider arrangements). Generally, it is found that demography is a secondary factor in the overall increase of HE. The key factor is technology and rising relative prices for medical inputs, combined with the intensity of medical care at older ages.

In sum, over the past few decades, research interest has shifted from finding the determinants of HE and checking whether health care were a luxury good to the necessity of solve issues of unit root and cointegration between HE and GDP. Most findings on the unit root and cointegration tests of HE and GDP have been derived from OECD data, but little is known for other regions. For example, Gbesemete and Gerdtham (1992) used a cross section sample of 13 African nations in 1984. They found that per capita GNP was the most significant factor in explaining HE. Jaunky and Khadaroo (2008) examines the

income elasticity of HE for 28 African countries over 1991-2000, considering both aggregate, and public-private health expenditures. HE is found to be a luxury for public sector, but is a necessity for private sector. Thus, in this section 5.1, we review the major related literature and summarize them into three sub-groups by the nature of the results and the published years.

5.1.1 Supported Results on the Existences of Unit Root and Cointegration

(1) Hansen and King (1996) performed country by country unit root tests without and with time trend included, using a complete data set for 20 of the 24 OECD member nations covering the period 1960 to 1987. They criticized the econometric methods used in many previous studies. The paper suggested that standard time series models where HE is a function of real per capita GDP and a selection of non-income variables (the proportion of the population under the age of 15 and over the age of 65, the proportion of HE that is publicly funded and the relative price of health care) may be misspecified. They could generally not reject the null hypothesis for either HE or GDP. Moreover, their country-specific tests rarely rejected the hypothesis of no cointegration.

(2) Blomqvist and Carter (1997) reviewed methodological problems that arise from issues in the data. They re-examined the view widely held that the income elasticity of HE exceeds one that has been based on international cross-section data, or on pooled cross-sections and time series. The paper used annual time series spanning the years 1960 to 1991 for the 20 OECD countries on total HE in purchasing power parity (PPP) terms, GDP per capita in PPP terms, the percentage of the population aged 65 and over. They reached the same results with the above study that HE and GDP appear to be non-stationary and cointegrated. The null hypothesis of unit root test was rejected for few countries for HE and GDP, and the panel unit root test concluded that all of the variables are $I(1)$ around a linear trend. They rejected the null hypothesis of no cointegration at 5% level for every country, and the pooling cointegrated series tests indicated a strong evidence that the two variables are cointegrated.

(3) Gerdtham and Lothgren (2000) examined stationarity and cointegration of HE and GDP for a

sample of 21 OECD countries using data for the period 1960-1997. They showed that the unit root hypothesis for both HE and GDP with time trend can only be rejected for few countries in a panel setting (only two countries for HE and three countries for GDP). The panel unit root test was even more conclusive and gave a clear rejection of the trend stationary. The null hypothesis of no cointegration cannot be rejected for any country at the 5% level and the panel test result was in line with the country-by-country results and was clearly insignificant. The cointegration test results indicated that HE and GDP are cointegrated.

(4) Bhat and Jain (2004) applied time series cointegration analysis of private health care expenditures with structural breaks in India over 1960-2003. The three tests indicated that there is a unit root in the data. Eagle-Granger tests and Johansen tests indicated that the two series are not cointegrated, but when considering structural breaks, the results turn out that to find evidence of cointegration. The findings suggested that income elasticity of private health expenditure is larger than one.

(5) Bilgel (2004) investigated the determinants of Canadian real per capita provincial total, private and government health expenditures for the period of 1975-2002. The unit root tests showed that, in most of the series, the null hypothesis cannot be rejected. Using panel unit root tests showed that the null hypothesis of either level or trend stationary can be rejected for all the series. The results showed that income, federal transfers, the share of senior population and life expectancy at birth have positive significant long-run effects on total HE, but the relative price of health care appeared to be insignificant. The evidence supported that health appears to be a luxury for few provinces, but from a national perspective, health is a necessity.

(6) Dritsakis (2005) investigated the relationship between HE and GDP for 15 members of European Union by unbalanced data during 1960-1998 and added the relative price of health care in the model. The results of unit root tests were robust regardless the lag length and suggested that most series are integrated of order one or two. While Eagle-Granger tests conducted with and with the inclusion of a

time trend indicated that there is a significant cointegration relationship among 4 out of 15 members of EU, the Johansen cointegration test found more strong evidence that cointegration vectors equal to one for 10 members and equal to 2 for 5 members. Moreover, the long-run elasticities of GDP exceed unity, meaning that health care is a luxury good.

(7) Tosetti and Moscone (2007) investigated the long-run economic relationship between HE and income in the US at a state level, using data over the period 1980-2004. HE is non-stationary including an intercept, as well as adding an intercept and a linear trend in the regression. They concluded that health spending and income are cointegrated. The results suggested that health care is a necessity rather than a luxury.

(8) Wang and Rettenmaier (2007) examined nonstationarity and cointegration of health care expenditures and gross state products (GSP) by utilizing a panel data set of 50 US states. Both the individual state-based method and the recent panel data method are applied. Allowing for structural breaks in the test, they found that HE and GSP are both nonstationary. The evidence also suggested that the two series form a cointegrating relationship. The income elasticities of health spending vary over states and became smaller in the 1990s.

(9) Westerlund (2007) employed five types of panel unit root tests that produce eight estimations. The paper found that the HE appears to be non-stationary in 6 out of 8 cases of panel unit root tests, and GDP appear to be non-stationary in 7 out of 8 cases. Furthermore, the author proposed new tests (error correction-based) for panel cointegration and concluded that all four tests of HE and GDP are cointegrated at the 5% significant level.

5.1.2 Rejected Results on the Existences of Unit Root and Cointegration

In opposite to above previous studies' results, (10) McCoskey and Selden (1998) revisited the study of Hansen and King (1996) by employing the same data set from OECD countries. They presented

unit root test results for time series with different tests and showed that they are able to reject the unit root hypothesis for both series HE and GDP, except for only one country in each case. The panel unit root tests confirmed rejection of the presence of unit roots in the data for both series. However, Hansen and King (1996) are concerned their results because they did not account for a time trend in the tests.

(11) Jell, Lee, Tieslau and Strazicich (2003) re-examined the stationarity of HE and GDP in a panel setting by utilizing data from 20 OECD countries over the period from 1960 to 1997. Unlike many previous studies, they allowed structural breaks in their panel unit root tests by applying panel LM unit root tests that allows for heterogeneous level shifts. Their results supported that HE and GDP are stationary around one or two breaks.

(12) Carrion-i-Silvestre (2005) analyzed the stationarity of the real per capita HE and real per capita GDP for a sample of OECD countries, allowing for the presence of multiple structural breaks. One novelty of the paper was that it permits the presence of structural breaks that affect both the level and the slope of the time series. After the cross-section dependence is accounted for, they have found that these variables can be characterized as stationary processes evolving around a broken trend.

5.1.3 Mixed Results on the Existences of Unit Root and Cointegration

On the other hand, some studies found mixed results, (13) Roberts (1999) suggested that previous research on the determinants of health care spending is characterized by three serious shortcomings: a lack of attention to dynamics, a failure to deal with heterogeneity and a neglect of sensitivity testing. The paper cope with these problems by using data from 20 OECD countries over the period 1960-1993 and considered the percentage of publicly funded HE, the percentage of the population aged over 65, and the relative price of health care in the model. She found no evidence to reject the null hypothesis of a unit root for any variable and country with a time trend, but only about half of the countries in case of without a time trend. The results of cointegration were, however, not conclusive. Long-run and short-run elasticity estimates were found to be sensitive to both model specification and sample composition.

(14) Okunade and Karakus (2001) studied the determinants of HE considering GDP and the relative price of health care from 19 OECD countries over the period 1960-1997. They presented that OECD countries do not all have the same order of integration across all the variables, regardless of the lag length 1, 2 or 3. With respect to panel unit root test results without and with time trend included, they found that panel data reject the unit root hypothesis for HE but not for GDP. Four countries indicated a significant cointegration relationship in the no time-trend model, while five countries do so in a model with the time-trend. The long-run GDP elasticity of HE estimate suggested that health care is a national luxury.

(15) Dreger and Reimers (2005) examined the link between HE and GDP for 21 OECD countries over the period 1975-2001, and considered medical progress (life expectancy and infant mortality) in the model. They detected a unit root for HE (4 out of 4 methods, but inconclusive results for GDP by different methods of panel tests (2 out of 4 methods). Most of the panel cointegration tests pointed out the existence of a long run relationship between HE and GDP. The income elasticity is not different from unity, implying that health care is not a luxury good.

5.2. Results of Panel Unit Root Tests for HE

5.2.1 ADF Unit Root Tests for HE and GDP

Table 5.1, table 5.2, table 5.3 and table 5.4 present the country by country unit root tests based on the popular ADF regressions (with a maximum lag of 9 periods) for two cases of no time trends and with time trends, by using level and first difference respectively. With respect to the level models, on the basis of no time trends, the ADF unit root - Hypothesis for HE can be rejected only for Bangladesh at the 5% level, and the tests for GDP cannot be rejected for all countries.

Table 5- 1: Unit root test for HE, at level

<u>Level</u>	Health Expenditure				No trend	With trend
	Lag	No trend	Lag	With trend		
Bangladesh	0	-4.987**	0	-4.933**	no unit root	no unit root
Hong Kong	0	-0.794	0	-1.768	unit root	unit root
Korea	9	-1.224	9	-2.172	unit root	unit root
Japan	5	-1.984	5	-3.810*	unit root	No unit root
Malaysia	1	-2.023	1	-2.665	unit root	unit root
Nepal	0	-1.198	0	-0.891	unit root	unit root
Philippines	0	-1.095	0	-1.058	unit root	unit root
Singapore	0	-0.951	0	-2.374	unit root	unit root
Sri Lanka	0	-1.601	0	-3.250	unit root	unit root

Note: *, ** and***represent 5%, 1% and 10%levels of significance

Table 5- 2: Unit root test for GDP, at level

<u>At level</u>	GDP				No trend	With trend
	Lag	No trend	Lag	With trend		
Bangladesh	0	-2.516	0	-2.955	unit root	unit root
Hong Kong	1	-2.262	1	-4.002*	unit root	No unit root
Korea	0	-1.114	0	-2.218	unit root	unit root
Malaysia	0	-0.677	0	-2.077	unit root	unit root
Nepal	7	-2.901	7	-0.836	unit root	unit root
Philippines	1	-1.673	1	-1.047	unit root	unit root
Singapore	1	-1.217	1	-2.004	unit root	unit root
Sri Lanka	1	-2.210	1	-0.854	unit root	unit root
Taiwan	7	-1.660	7	-1.950	unit root	unit root
Japan	9	0.586	9	-2.657	unit root	unit root
Thailand	3	-1.294	3	-3.050	unit root	unit root

Note: *, ** and***represent 5%, 1% and 10%levels of significance

Table 5- 3: Unit root test for HE, at first difference

<u>First Difference</u>	Health Expenditure					
	Lag	No trend	Lag	With trend	No trend	With trend
Bangladesh	0	-8.947**	0	-8.820**	no unit root	no unit root
Hong Kong	0	-4.694**	0	-4.589**	no unit root	no unit root
Korea	2	-4.943**	2	-4.873**	no unit root	no unit root
Japan	4	-3.254*	2	-3.714*	no unit root	no unit root
Malaysia	0	-4.928**	0	-4.868**	no unit root	no unit root
Nepal	0	-5.756**	0	-5.794**	no unit root	no unit root
Philippines	0	-5.193**	0	-5.228**	no unit root	no unit root
Singapore	8	-2.290	8	-2.174	unit root	unit root
Sri Lanka	0	-7.505**	0	-7.479**	no unit root	no unit root

Note: *, ** and *** represent 5%, 1% and 10% levels of significance

Table 5- 4: Unit root test for GDP at first different

<u>At first different</u>	GDP					
	Lag	No trend	Lag	With trend	No trend	With trend
Bangladesh	1	-5.391*	1	-5.504*	no unit root	no unit root
Hong Kong	8	-2.995*	8	-3.009	no unit root	unit root
Korea	8	-3.341*	8	-3.455*	no unit root	no unit root
Malaysia	8	-3.359*	8	-3.299*	no unit root	no unit root
Nepal	2	-2.125	2	-2.589	unit root	unit root
Philippines	0	-3.789*	0	-4.034*	no unit root	no unit root
Singapore	0	-4.399*	0	-4.427*	no unit root	no unit root
Sri Lanka	0	-6.982*	0	-7.551*	no unit root	no unit root
Taiwan	6	-1.332*	6	-1.676	no unit root	unit root
Japan	1	-4.318*	1	-4.110*	no unit root	no unit root
Thailand	0	-3.898*	0	-3.861*	no unit root	no unit root

Note: *and ** represent 5% and 1% levels of significance

For the regressions without time trends, the ADF unit root hypothesis for HE can be rejected for

Bangladesh at the 5% level and none any country for GDP. And For the regressions with time trends, the ADF unit root hypothesis for HE also can be rejected for Bangladesh at the 5% level, and for GDP can be rejected only for Hong Kong at the 1% level of significant. In sum, unit roots are not detected only for 3 out of 38 cases for the level variables.

The first difference models have shown that most HE and GDP for both without and with individual time trends appear to be stationary. For HE series, unit roots are still detected for Singapore both in cases of no and with trend. For GDP series, nonstationary is detected for Nepal and Taiwan both in cases of without and with trend. And Hong Kong still has unit root in case of time trend include. But all these series appear to be stationary for the second difference variables.

Thus, the majority of the country by country test results suggest that unit root hypotheses can be rejected for either HE or GDP at the first difference. Unlike some studies in OECD, for instance [Hansen and King (1996) vs. McCoskey and Selden (1998)] and Roberts (1999), the presence of time trending variables do not give conflicting results for a particular concern in the case of Asia countries.

5.2.2 Several Panel Unit root Tests

Table 5- 5: Panel unit root test for HE in case of no trend

Study	HE	<i>p</i> -value	GDP	<i>p</i> -value
Null: common unit root				
Levin, Lin & Chu t-stat	-1.6434***	0.0501	-3.5069**	0.0002
Breitung t-stat	4.3863	1.0000	4.4299	1.0000
Null: individual unit root				
Im, Pesaran and Shin W-stat	-0.5540	0.2898	0.5827	0.7199
ADF - Fisher Chi-square	29.2590*	0.0453	13.0007	0.8774
Null: no common unit root				
Hadri Z-stat	58.1117	0.0000	68.9903	0.0000

Note: *and ** and ***represent 5% and 1% and 10% levels of significance

Table 5- 6: Panel unit root test for HE in case of with trend

Study	HE	<i>p</i> -value	GDP	<i>p</i> -value
Null: common unit root				
Levin, Lin & Chu t-stat	-0.6504	0.2577	-0.6702	0.2514
Breitung t-stat	-1.1971	0.1156	1.0388	0.8506
Null: individual unit root				
Im, Pesaran and Shin W-stat	-0.8696	0.1923	0.3228	0.6266
ADF - Fisher Chi-square	29.6311*	0.0412	8.7536	0.9856
Null: no common unit root				
Hadri Z-stat	17.5671	0.0000	32.7049	0.0000

Note: *and ** and ***represent 5% and 1% and 10% levels of significance

This study also performs five different types of panel unit root test as described in Chapter 2. The selection of lags is based on Newey-West bandwidth using Bartlett kernel. As shown in Table 5.5, Table 5.6, Table 5.7 and Table 5.8, the LLC, Breitung, IPS, ADF Fisher, and Hadri tests are presented.

Firstly, LLC tests show that the null hypothesis could be rejected without trending variable, but cannot rejected with time trend variable for both HE and GDP.

Secondly, Breitung tests assume the null of common unit root; Breitung test can not reject stationary for both cases of with and without time trend for two series of HE and GDP.

IPS tests assume the null of individual unit root. Not Only IPS shows that health expenditure is stationary for both no time trend and with time trend, but also Hadri test.

For ADF - Fisher tests show that health expenditure and GDP are stationary for both no time trend and with time trend. No matter time trending variable is included or excluded, the test results can not reject the null hypothesis for the two series.

And finally, Hadri tests assume the null of no common unit root. The null hypothesis could be rejected in all cases for HE and GDP. In the case of the limited country by country sample size in this

study ($9 \times 40 = 360$), Hadri tests are probably the most appropriated because they apply a residual based Lagrange Multiplier test and do not require a number of samples for calculating lags like in the other test methods.

Thus, most panel tests are very conclusive and give a clear rejection of the stationary hypothesis for both HE and GDP, no matter a time trend is included or excluded. Taken together with country by country ADF tests, the results clearly indicate that HE and GDP series can be characterized as $I(1)$ processes. These results are in accordance with the findings by Hansen and King (1996), Blomqvist and Carter (1997), Roberts (1999), Gerdtham and Lothgren (2000), Bilgel (2004), Dritsakis (2005), Tosetti and Moscone (2007), Wang and Rettenmaier (2007), and Westerlund (2007), but in contrast to McCoskey and Selden (1998), Jell et al. (2003), and Carrion-i-Silvestre (2005). These results then motivate further analysis of the existence of long run cointegrating linkages between HE and GDP in the sample of Asia countries.

Table 5- 7: Result of Panel Unit Root test for HE without trend

Test method	Null hypothesis	Result/No trend	Result/ trend
Levin, Lin & Chu t-stat	Unit root	Non stationary	stationary
Breitung t-stat	Unit root	Non stationary	Non stationary
Im, Pesaran and Shin W-stat	Unit root	Non stationary	Non stationary
ADF - Fisher Chi-square	Unit root	stationary	Non stationary
Hadri Z-stat	No Unit root	Non stationary	Non stationary

Table 5- 8: Result of Panel Unit Root test for HE

Test method	Null hypothesis	Result/No trend	Result/ trend
Levin, Lin & Chu t-stat	Unit root	Non stationary	Non stationary

Breitung t-stat	Unit root	Non stationary	Non stationary
Im, Pesaran and Shin W-stat	Unit root	Non stationary	Non stationary
ADF - Fisher Chi-square	Unit root	stationary	Non stationary
Hadri Z-stat	No Unit root	Non stationary	Non stationary

5.3 Results of Panel Cointegration Tests for HE

5.3.1 Country by Country Johansen Cointegration Tests for HE

Similar to the previous section, we start by presenting the country by country cointegration tests based on the Johansen tests for the cases of intercept and linear time trend included as in Table 5.9 and Table 5.10. The null hypothesis is no long-run relationship between HE and GDP. There are two test statistics in Johansen cointegration testing, namely trace statistics and maximum Eigenvalue statistic.

Using trace statistics, In case of no time trend, the Johansen null hypothesis of no cointegration among HE and GDP can be rejected only for Bangladesh, Hong Kong and Singapore. However, In case of time trend, the Johansen null hypothesis test can be rejected for two countries (Bangladesh and Singapore).

Not only trace statistics, In case of no time trend, the Johansen null hypothesis of no cointegration among HE and GDP can be rejected only for Bangladesh, Hong Kong and Singapore, but also Maximum Eigenvalue-statistic. However, In case of time trend, the Johansen null hypothesis test can be rejected only 1 out of 9 countries at least at the 5% level by using Maximum Eigenvalue-statistic.

These results imply that trace statistics seem to have a high power than maximum Eigenvalue statistics in our case study. For rank smaller than one for only without time trend can be rejected for Bangladesh, Philippine and Sri Lanka. And two countries for time trend model.

Table 5- 9: Johansen tests for HE in case of without trend

No Trend	Rank =0				Rank ≤ 1	
	Trace statistics	p-value	Max-Eigen value statistic	p-value	Trace/Max-Eigen value	p-value
Bangladesh	24.53441**	0.0017	16.31504*	0.0234	8.219368**	0.0041
Hong Kong	14.98966	0.0595	14.36853*	0.0481	0.621129	0.4306
Korea	9.565722	0.3156	8.450102	0.3348	1.115619	0.2909
Japan	6.179300	0.6743	5.930777	0.6221	0.248523	0.6181
Malaysia	9.234044	0.3442	8.493583	0.3307	0.740461	0.3895
Nepal	8.889669	0.3757	6.857371	0.5061	0.052077	0.1540
Philippines	12.60293	0.1302	8.158253	0.3628	4.444675*	0.0350
Singapore	20.63443**	0.0077	19.06622**	0.0081	1.568208	0.2105
Sri Lanka	17.63940	0.0234	12.61589***	0.0896	5.023510*	0.0250

Note: *and ** and ***represent 5% and 1% and 10% levels of significance

Table 5- 10: Johansen tests for HE in case of with trend

With Trend	Rank =0				Rank ≤ 1	
	Trace statistics	p-value	Max-Eigen value statistic	p-value	Trace/Max-Eigen value	p-value
Bangladesh	28.94505*	0.0201	16.43092	0.1278	12.51413***	0.0501
Hong Kong	20.37830	0.2074	16.79730	0.1144	3.581001	0.8015
Korea	15.45733	0.5367	9.819512	0.6381	5.637815	0.5076
Japan	13.44474	0.7030	8.857071	0.7391	4.587673	0.6562
Malaysia	20.29133	0.2115	13.06652	0.3227	7.224809	0.3216
Nepal	17.20728	0.3996	14.65497	0.2130	2.552310	0.9249
Philippines	15.85555	0.5042	8.473560	0.7772	7.381988	0.3063
Singapore	24.98647***	0.0641	19.37568***	0.0502	5.610786	0.5112
Sri Lanka	19.15731	0.2716	14.03864	0.2516	5.118667	0.5794

Note: *and ** and ***represent 5% and 1% and 10% levels of significance

5.3.2 Several Panel Cointegration Tests for HE and GDP

The results of panel cointegration tests from four methods are presented in Table 5.11 for the case of no time trend and Table 5.12 for the case of with time trend. Pedroni (1999, 2004), Kao (1999) tests are derived from a residual-based approach, while Maddala and Wu (1999) tests are derived from Johansen Fisher Type maximum likelihood approach, and final test is Westerlund (2007).

First, Pedroni tests for the assumption of no trend show that no cointegration hypothesis is rejected in six out of the seven tests (except for only Panel v-stat) at the 1% significant level. In case of with trending, Pedroni tests show that the null hypothesis is rejected in six tests at the 1% significant level too. Thus, the cointegrating relationship between HE and GDP exists for both no trend and with trend.

Second, The Kao (1999) test, the special case of Pedroni (1999) which cointegrating vectors are assumed to be homogeneous, also shows that HE and GDP are cointegrated. The test rejects the null hypothesis of no cointegration with trend by the statistic of -2.172262 at the 5% significant level.

Third, The Johansen Fisher type proposed by Maddala and Wu (1999) reaches to the same results by the trace statistics of 46.94 and the maximum Eigenvalue statistic of 36.79 at the 1% significant level, under the assumption of no trend in the model. When time trend is included, cannot be reject the cointegrating relationship between GDP and HE.

Finally, Westerlund tests, using 100 bootstrap replications, find that the null hypothesis of no cointegration is rejected in all four tests at the 1% significant level, both without and with trend included respectively. In our case study, Westerlund tests seem to have a higher power relative to Pedroni, Kao, and Maddala and Wu tests. Together, the test methods performed tests show a very conclusive finding to indicate that there is a cointegrating relationship between HE and GDP for the Asia data.

Table 5- 11: Summary results of panel cointegration tests for HE and GDP (No trend)

	Cointegration testing				
Study	Test	Statistic	<i>p</i> -value	Weighted Stat	<i>p</i> -value
Pedroni (1999, 2004)	Panel v-stat	0.239418	0.4054	-0.682840	0.7526
	Panel rho-stat	-5.073209	0.0000	-7.685661	0.0000
	Panel PP-stat	-4.617294	0.0000	-6.520601	0.0000
	Panel ADF-stat	-4.579908	0.0000	-6.703849	0.0000
	Group rho-stat	-3.447605	0.0003		
	Group PP-stat	-3.745838	0.0001		
	Group ADF-stat	-3.594473	0.0002		
Kao (1999)	ADF t-Stat	-2.172262	0.0149		
Maddala & Wu (1999) (Johansen Fisher Type)	Trace test, Rank=0	46.94	0.0002		
	Trace test, Rank=1	38.91	0.0029		
	Max-eigen test, Rank=0	36.79	0.0056		
	Max-eigen test, Rank=1	38.91	0.0029		
				Bootstrap Stat	<i>p</i> -value
Westerlund (2007)	Panel statistics P_{τ}	0.0029	0.000	-8.446	0.000
	Panel statistics P_{α}	-15.705	0.000	-15.705	0.000
	Group statistics G_{τ}	-2.839	0.000	-2.839	0.000
	Group statistics G_{α}	-20.592	0.000	-20.592	0.000

Note: *, ** and***represent 5%, 1% and 10%levels of significance

Table 5- 12: Summary results of panel cointegration tests for HE and GDP, “With Trend”

	Cointegration testing				
Study	Test	Statistic	p -value	Weighted Stat	p -value
Pedroni	Panel v-stat	-1.581594	0.9431	-2.633829	0.9958
	Panel rho-stat	-4.311168	0.0000	-6.904003	0.0000
	Panel PP-stat	-5.469062	0.0000	-7.916690	0.0000
	Panel ADF-stat	-5.591911	0.0000	-8.229206	0.0000
	Group rho-stat	-2.233440	0.0128		
	Group PP-stat	-4.153337	0.0000		
	Group ADF-stat	-4.383990	0.0000		
Maddala & Wu (1999) (Johansen Fisher Type)	Trace test, Rank=0	27.32	0.0731		
	Trace test, Rank=1	15.85	0.6027		
	Max-eigen test, Rank=0	24.56	0.1376		
	Max-eigen test, Rank=1	15.85	0.6027		
				Bootstrap Stat	p -value
Westerlund	Panel statistics P_{τ}	-10.418	0.000	-10.418	0.000
	Panel statistics P_{α}	-22.034	0.000	-22.034	0.000
	Group statistics G_{τ}	-3.443	0.000	-3.443	0.000
	Group statistics G_{α}	-28.588	0.000	-28.588	0.000

Note: *, ** and***represent 5%, 1% and 10%levels of significance

5.4. Analysis on Short-run and Long-run for HE and GDP

We are interested in investigation of short-run relationship between HE and GDP. Short-run dynamics can be integrated with long-run equilibrium by using Error Correction Model (ECM). The tests show that short-run income elasticity in most series appears to be largely lower than one, meaning that health spending is a necessity good. In fact, many tests indicate negative income elasticity (Giffen goods). This finding deserves for further investigations whenever data is available to include more control variables such as relative price, proportion of population age (e.g. less than 15 or over 65), medical progress and/or structural break. The results obtained for each country are presented in table 5.11. According to ECM, the error correction coefficient is meaningful and negative for all countries; thus, a long term relationship exists between the health expenditures and economic growth in the aforementioned countries

Next, we attempt to test the long-run income elasticity in the case of Asia over the period 1973-2012. Since Newhouse (1977) argued that health spending is a luxury good in OECD countries in the long-run, Okudane and Karakus (2001) reconfirmed this result by using OECD countries but different period. Dritsakis (2005) reached the same results using EU member countries data. In opposite, Dreger and - Reimer (2005) found that health expenditure is a necessity good using the similar OECD countries data with Okudane and Karakus (2001). Bilgel (2004) and Tosetti and Moscone (2007) reached the results that health spending appear to be a necessity in Canada and US, respectively.

Table 5- 13: Error Correction Model (ECM) results for HE 1975-2006, “No Trend”

	Bangladesh	Hong Kong	Korea	Japan	Malaysia	Nepal	Philippines	Singapore	Sri Lanka
Δ HE	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000
Δ GDP	-1.297409 (0.38846)	-2.391652 (0.16716)	-0.601054 (0.19670)	-1.591268 (0.34170)	-0.602816 (0.16493)	-1.007107 (0.14028)	-1.234948 (0.17109)	-0.957908 (0.02286)	-0.993607 (0.05985)
Trend									
Constant	2.903992	7.806814	1.130279	3.131006	0.280603	2.105091	3.076161	1.766725	1.792331
R ²	0.347105	0.228258	0.274498	0.062646	0.197993	0.051346	0.205556	0.500547	0.217858
Adjusted R ²	0.241800	0.103783	0.157481	-0.088540	0.068638	-0.101663	0.077420	0.419990	0.091706
F-statistic	3.296169	1.833770	2.345805	0.414363	1.530610	0.335574	1.604205	6.213579	1.726950
Schwarz	-3.271752	-7.748715	-3.265347	-8.301727	-5.504690	-5.225160	-4.748417	-6.371008	-4.794869
Criteria									

Note: * and ** represent 5% and 1% levels of significance. Standard errors in parentheses.

Table 5- 14: Long-run income elasticity, 1975-2006

	Income elasticity	t-test	p-value
Bangladesh	0.587578	2.543621	0.0152
Hong Kong	1.878687	18.21339	0.0000
Korea	0.796591	0.116877	0.0000
Japan	0.793018	17.38522	0.0000
Malaysia	0.705368	0.076941	0.0000
Nepal	0.701226	8.976645	0.0000
Philippines	1.295645	17.51512	0.0000
Singapore	0.983047	39.29072	0.0000
Sri Lanka	0.965892	23.77546	0.0000

* denotes significance at 5% level, ** at 1% level.

Table 5- 15: Results of Granger Causality tests

	Null Hypothesis	F-statistics	p-value
Bangladesh	ΔGDP growth does not Granger Cause ΔHE growth	0.80008	0.4578
	ΔHE growth does not Granger Cause ΔGDP growth	0.39903	0.6742
Hong Kong	$\Delta GDP \nrightarrow \Delta HE$ growth	4.65055	0.0166
	$\Delta HE \nrightarrow \Delta GDP$ growth	2.55758	0.0928
Korea	$\Delta GDP \nrightarrow \Delta HE$ growth	0.87647	0.4257
	$\Delta HE \nrightarrow \Delta GDP$ growth	0.83107	0.4445
Japan	$\Delta GDP \nrightarrow \Delta HE$ growth	0.13391	0.8751
	$\Delta HE \nrightarrow \Delta GDP$ growth	0.57519	0.5681
Malaysia	$\Delta GDP \nrightarrow \Delta HE$ growth	1.22933	0.3055
	$\Delta HE \nrightarrow \Delta GDP$ growth	0.77206	0.4702
Nepal	$\Delta GDP \nrightarrow \Delta HE$ growth	1.33857	0.2761
	$\Delta HE \nrightarrow \Delta GDP$ growth	0.41721	0.6623
Philippines	$\Delta GDP \nrightarrow \Delta HE$ growth	3.10125	0.0583
	$\Delta HE \nrightarrow \Delta GDP$ growth	1.03170	0.3676
Singapore	$\Delta GDP \nrightarrow \Delta HE$ growth	14.1175	4.E-05
	$\Delta HE \nrightarrow \Delta GDP$ growth	1.25982	0.2970

Sri Lanka	$\Delta\text{GDP} \rightarrow \Delta\text{HE}$ growth	3.56736	0.0396
	$\Delta\text{HE} \rightarrow \Delta\text{GDP}$ growth	0.04490	0.9562

* denotes significance at 5% level, ** at 1% level.

Although some tests of this study as shown in table 5.14 are statistically significant, the results show that income elasticity varies largely from country to country. The long-run income elasticities in Hong Kong and Philippines are found to be greater than one. This means health care is a luxury good. By contrast, the long-run income elasticities in Bangladesh, Korea, Japan, Malaysia, Nepal, Singapore and Sri Lanka are lower than one implying health care is a necessity good. The literature on whether health care expenditure is a necessity or luxury good including our study, yet, remains controversial. According to this result, the long run coefficients are positive and meaningful.

In addition, the causality between HE and GDP is examined as presented in Table 5.15. Using Granger causality tests, the null hypothesis of $D(\text{GDP})$ does not cause $D(\text{HE})$ is rejected in series of Hong Kong, Singapore and Sri Lanka. The reverse causality cannot be rejected in all series. The result suggests that only three countries uni-directional causality does exist.

CHAPTER 6

PANEL ANALYSIS ON SOCIAL SECURITY AND WELFARE EXPENDITURES AND GDP

Chapter 6 provides the 3rd original empirical study of this dissertation regarding to panel analysis on social security and welfare expenditures (SSW) and GDP. The relationship between SSW and growth is admittedly so complicated. The effect of SSW on growth is still an open question both theoretically and empirically. Some researchers argued that if SSW expenditures induce earlier retirement, it may positively affect savings, and therefore growth. Some scholars argued that too much SSW will oppress folk savings, and that is unfavorable to accumulate capital and disadvantageous economic development. Existing studies have heavily used time series and cross-country data. Moreover, there are also no serious efforts to examine the two-way link between SSW and GDP, especially for the panel unit root and panel cointegration properties.

In this chapter, we aim to analyze this question using panel data technique. It utilizes data from 10 Asia countries for the period of 1973-2012. In brief, the results of six panel unit root tests generally indicate that the two series of SSW and GDP are non-stationary. This study applies panel cointegration testing from the residual-based approach, the maximum likelihood approach, and the error correction approach. The results indicate that the two series are cointegrated. The presence of a time trend variable seems to affect the results of both panel unit roots and cointegration. Therefore, researchers studying national SSW expenditures need to be concerned about the presence of unit roots and cointegration in the data. Whether SSW is a necessity good or a luxury good, this study shows that it remains controversial. Moreover, the tests suggest that unidirectional causality does exist.

6.1. Literature Review on Social Security and Welfare

What is the relationship between SSW and growth? We may review it through theoretical and empirical aspects. Theoretically, since Feldstein (1974) argued that SSW by the government has an effect on macroeconomic variables such as private savings, the recent works on SSW have considered more factors. Some models predict a positive effect of redistributive expenditures on growth, e.g. Sala-i-Martin (1992) emphasized that pensions will induce earlier retirement. Zhang (1995) argued that unfunded SSW has the positive impact of a long-run growth through reducing fertility and advancing human capital investment not affecting the savings rate. Mulligan (1997) noted that SSW may enhance growth since parents accumulate altruism for children as an alternative to working and paying social security tax. Bellettini and Ceroni (1999) and Sanchez-Losada (2000) argued that SSW system with benefits indexed to wages provides taxpayers with incentives to support growth-oriented policies, which increase the future productivity of labor and long-run growth. Moreover, Zhang and Zhang (2004) pointed out that the interactions among fertility, investment in human capital, growth, and SSW are complicated in general. All these discussions are constrained by the fact that SSW is an independent variable.

Empirically, Perotti (1996) found a positive coefficient of SSW expenditures on growth in cross-country regressions. Cuyvers and Rayp (1998) reported that SSW expenditures have a positive significance for growth in East Asian newly industrializing countries under the incomplete market model. Bellettini and Ceroni (2000) investigated the relationship between SSW expenditures and growth based on 61 countries data. They suggested that whenever a statistically significant association among the two variables exists, it has a positive sign. The positive coefficient appeared to be larger in relatively underdeveloped SSW systems. The results indicated that such influence takes place through the channel of human capital formation. In addition, the similar evidences are also offered by Zhang and Zhang (2004).

However, Huntington (1968) argued that periods of rapid growth may increase socio-political

instability in the absence of a flawless SSW system. It will trigger a deep social conflict that may harm economic activities. Darby (1979) and Ehrlich and Zhong (1998) found that too much expenditures on SSW will oppress folk savings and that is unfavorable to accumulate capital and disadvantageous economic development. Maruo (1987) considered the impact of demographic aging in Japan on the SSW system and on economic growth. She argued that as the cost of SSW increases significantly in the earlier stage of ageing, the disposable income and private consumption of the present labor force generation tend to increase at a lower growth rate than that of the GNP. Some researchers have also asserted that SSW expenditures have a negative effect on savings and concluded that empirical evidence does not support the presumption that private savings are displaced by SSW (e.g. Aaron, 1982; Alesina and Rodrick, 1994).

Previous studies mentioned above have relatively used time series data which may yield unreliable results due to short time spans of typical data sets. There are also no serious efforts to examine the two-way link between SSW and GDP, especially for the panel unit root and panel cointegration properties. Few existing studies we found can be summarized as below.

(1) Lee and Chang (2006a) examined the long-run co-movement and causal relationship between SSW and GDP in 12 Asian countries from 1972 to 2000. Data included Australia, Bahrain, Iran, Israel, Korea, Kuwait, Malaysia, Singapore, Sri Lanka, Syrian, Thailand and Turkey. Several panel unit root tests (LLC, IPS and Hadri) indicated that no matter if there is a time effect or not, all variables are the $I(1)$ process. The Pedroni cointegration tests showed strong evidence of the existence of a long-run equilibrium cointegrating relationship between SSW and GDP. The panel-based error correction model (Westerlund) also suggested that there are long-run linkages between SSW and growth. Moreover, the Granger causality test presented bidirectional causality results.

(2) Lee and Chang (2006b) investigated the long-run co-movement and the causal relationship between SSW and GDP, employing data on 25 OECD countries from 1980 to 2001. Similar to Asian case, the cointegration tests indicated strong existence of a long-run cointegrating link between SSW and GDP

in OECD case, after allowing for a heterogeneous country effect. The results of panel-based error correction model showed that SSW and GDP lack short-run causality, but reveal the existence of long-run bidirectional causality.

(3) Liu et al. (2008) investigated the relationship between the USA five federal expenditures including national defense, human resources, physical resources, net interest payment and others and GDP over the period of 1947-2002. It is worth noting that in their study, education and health also be added to SSW spending to compound the human resources. They applied Granger causality tests and found that there is unidirectional causality for GDP and human resources expenditures. The increase in human resources expenditure does cause GDP growth, but not vice versa.

(4) Alam et al. (2010) examined the long-run relationship between public expenditures including education, health, and social security and welfare and economic growth in 10 Asian developing countries. Both for with and without trend terms, ADF tests clearly failed to reject the non-stationarity hypothesis for the levels of SSW, whereas it was rejected for the first difference. Panel unit root test (IPS test) showed SSW is integrated of order one both without and with time trend. Moreover, Johansen and Juselius (1990) tests suggested the long-run relationship among variables for both the trace statistics and maximum eigen-value statistics. For panel cointegration test, it implied that a strong long-run relationship exists between the variables.

(5) Clemente et al. (2010) examined the sensitivity of government social spendings and GDP relationship using data on 18 OECD countries from 1980 to 1999, depending on the welfare system in place (4 patterns). The ADF tests reported that all social spending variables are $I(1)$ in a model with time trend. IPS panel unit root test reported the same result. They concluded that there exists a long-run relationship between social expenditures and GDP for the group of countries considered, although the changes of parameters in the models are made.

6.2. Results of Panel Unit Root Tests

6.2.1 ADF Unit Root Tests

Table 6 - 1: Estimated lag orders and country by country ADF t-statistics for SSW at level.

<u>Level</u>	SSW				No trend	With trend
	Lag	No trend	Lag	With trend		
Bangladesh	0	-4.032**	0	-5.145*	no unit root	no unit root
Hong Kong	4	-0.008	4	-3.785*	unit root	no unit root
Korea	0	-0.452	4	-3.398***	unit root	no unit root
Malaysia	7	-1.537	0	-1.904	unit root	unit root
Nepal	1	-4.346**	1	-4.271**	no unit root	no unit root
Philippines	0	-1.262	0	-1.490	unit root	unit root
Singapore	0	-0.953	0	-3.753*	unit root	no unit root
Sri Lanka	0	-1.775	0	-1.666	unit root	unit root
Taiwan	5	-1.412	5	-1.670	unit root	unit root
Thailand	0	-1.939	0	-2.060	unit root	unit root

Note: *and ** and ***represent 5% and 1% and 10% levels of significance

Table 6 - 2: Estimated lag orders and country by country ADF t-statistics for GDP at level.

<u>Level</u>	GDP				No trend	With trend
	Lag	No trend	Lag	With trend		
Bangladesh	0	-2.516	0	-2.955	unit root	unit root
Hong Kong	1	-2.262	1	-4.002*	unit root	no unit root
Korea	0	-1.114	0	-2.218	unit root	unit root
Malaysia	0	-0.677	0	-2.077	unit root	unit root
Nepal	7	-2.901	7	-0.836	unit root	unit root
Philippines	1	-1.673	1	-1.047	unit root	unit root
Singapore	1	-1.217	1	-2.004	unit root	unit root
Sri Lanka	1	-2.210	1	-0.854	unit root	unit root
Taiwan	7	-1.660	7	-1.950	unit root	unit root
Japan	9	0.586	9	-2.657	unit root	unit root
Thailand	3	-1.294	3	-3.050	unit root	unit root

Note: *represent 5% levels of significance

Table 6 - 3: Unit root test for SSW at first difference.

<u>First Difference</u>	SSW				No trend	With trend
	Lag	No trend	Lag	With trend		
Bangladesh	5	-2.625	5	-4.143*	unit root	no unit root
Hong Kong	0	-5.594**	0	-5.184**	no unit root	no unit root
Korea	5	-3.833**	5	-4.025*	no unit root	no unit root
Malaysia	2	-3.853**	2	-3.798*	no unit root	no unit root
Nepal	1	-6.838**	1	-6.732**	no unit root	no unit root
Philippines	0	-5.277**	0	-5.715**	no unit root	no unit root
Singapore	4	-3.259*	4	-3.200	no unit root	unit root
Sri Lanka	0	-6.335**	0	-6.332**	no unit root	no unit root
Taiwan	4	-1.611	4	-1.814	unit root	no unit root
Thailand	0	-6.302**	0	-6.215**	no unit root	no unit root

Note: *and ** and ***represent 5% and 1% and 10% levels of significance

Table 6 - 4: Unit root test for GDP at first difference.

<u>At first different</u>	GDP				No trend	With trend
	Lag	No trend	Lag	With trend		
Bangladesh	1	-5.391**	1	-5.504**	no unit root	no unit root
Hong Kong	8	-2.995*	8	-3.009	no unit root	unit root
Korea	8	-3.341*	8	-3.455***	no unit root	no unit root
Malaysia	8	-3.359*	8	-3.299***	no unit root	unit root
Nepal	2	-2.125	2	-2.589	unit root	unit root
Philippines	0	-3.789*	0	-4.034*	no unit root	no unit root
Singapore	0	-4.399**	0	-4.427**	no unit root	no unit root
Sri Lanka	0	-6.982**	0	-7.551**	no unit root	no unit root
Taiwan	6	-1.332	6	-1.676	unit root	unit root
Japan	1	-4.318**	1	-4.110*	no unit root	no unit root
Thailand	0	-3.898**	0	-3.861*	no unit root	no unit root

Note: *and ** and ***represent 5% and 1% and 10% levels of significance

Table 6.1, Table 6.2, Table 6.3 and Table 6.4 present the country by country unit root tests based

on the popular ADF regressions (with a maximum lag of 9 periods) for two cases of no time trends and with time trends, by using level and first difference respectively. With respect to the level models, on the basis of no time trends, the ADF unit root hypothesis for SSW cannot be rejected only for two countries (Bangladesh and Nepal), and the tests for GDP cannot be rejected for any country at the 5% level show in table 6.1 and table 6.2 for without time trend.

For the regressions with time trends, the ADF unit root hypothesis for SSW cannot be rejected for five countries too at the 5% level Bangladesh and Nepal. In sum, unit roots are not detected only for 7 out of 42 cases for the level variables. Using the first difference models, they show that 33 out of 42 SSW and GDP for both without and with individual time trends appear to be stationary at least at the 5% level.

Thus, most of the country by country test results suggest that unit root hypotheses cannot be rejected for most level variables, but rejected for the first difference variables. Similar to the majority of the previous studies mentioned above, the presence of time trending variables do not give conflicting results for a particular concern in the case of Asia countries.

6.2.2 Several Panel Unit Tests for SSW

The five different types of panel unit root test as described in Chapter 2 Section 2.1. The selection of lags is based on Newey-West bandwidth using Bartlett kernel. As shown in Table 6.5 Table 6.6, Table 6.7, and Table 6.8, the LLC, Breitung, IPS, ADF Fisher, and Hadri tests are presented.

Firstly, LLC and Breitung tests assume the null of common unit root. For SSW, the LLC tests cannot reject the null hypothesis in the cases of with and without time trend in the regression. Moreover, Breitung tests cannot reject the null hypothesis with time trend included and not included in the regression. For GDP, not similarly to SSW, LLC tests show that the null hypothesis could be rejected without trending variable, but not for with time trend included. Breitung test is clearly insignificant without time trend and also cannot reject with time trend included too.

Secondly, IPS and ADF Fisher tests assume the null of individual unit root. For SSW, no matter

time trending variable is included or excluded, the results of IPS and ADF Fisher tests cannot reject the null hypothesis of having a unit root. For GDP, on the other hand, the results of IPS and ADF Fisher tests suggest that the null hypothesis of the presence of unit root cannot be rejected both for without and with time trend variable in the regressions.

Table 6 - 5: Panel Unit Root Testing for SSW in case of “No Trend”

Study	SSW	<i>p</i> -value	GDP	<i>p</i> -value
Null: common unit root				
Levin, Lin & Chu t-stat	-0.4910	0.3117	-3.5069**	0.0002
Breitung t-stat	2.3778	0.9913	4.4299	1.0000
Null: individual unit root				
Im, Pesaran and Shin W-stat	-0.2738	0.3921	0.5827	0.7199
ADF - Fisher Chi-square	26.8733	0.1389	13.0007	0.8774
Null: no common unit root				
Hadri Z-stat	52.9302**	0.0000	68.9903**	0.0000

Note: *and ** and ***represent 5% and 1% and 10% levels of significance

Table 6 - 6: Panel Unit Root Testing for SSW in case of “With Trend”

Study	SSW	<i>p</i> -value	GDP	<i>p</i> -value
Null: common unit root				
Levin, Lin & Chu t-stat	-0.1325	0.4473	-0.6702	0.2514
Breitung t-stat	-0.7572	0.2245	1.0388	0.8506
Null: individual unit root				
Im, Pesaran and Shin W-stat	-0.5118	0.3044	0.3228	0.6266
ADF - Fisher Chi-square	26.4041	0.1529	8.7536	0.9856
Null: no common unit root				
Hadri Z-stat	31.3120**	0.0000	32.7049**	0.0000

Note: *and ** and ***represent 5% and 1% and 10% levels of significance

Hadri tests assume the null of no common unit root. The null hypothesis could be strong rejected in all cases both for SSW and GDP. In the case of the limited country by country sample size in this study

($10 \times 36 = 360$), Hadri tests are probably the most appropriated because they apply a residual based Lagrange Multiplier test and do not require a number of samples for calculating lags like in the other test methods.

Thus, the majority of panel unit root tests suggest the null hypothesis is accepted in the data. Taken together with country by country ADF tests, the results indicate that SSW and GDP series can be characterized as $I(1)$ processes. Since the existing studies applying panel techniques are still scarce, the results we found here can contribute new findings for the literature. And, these results then motivate further analysis of the existence of long run cointegrating linkages between SSW and GDP in the sample of Asia countries.

Table 6 - 7: Result of Panel Unit Root test for SSW no time trend model

Test method	Null hypothesis	Result/No trend	Result/ trend
Levin, Lin & Chu t-stat	Unit root	Non stationary	stationary
Breitung t-stat	Unit root	Non stationary	Non stationary
Im, Pesaran and Shin W-stat	Unit root	Non stationary	Non stationary
ADF - Fisher Chi-square	Unit root	Non stationary	Non stationary
Hadri Z-stat	No Unit root	Non stationary	Non stationary

Table 6 - 8: Result of Panel Unit Root Test for SSW with time trend model

Test method	Null hypothesis	Result/No trend	Result/ trend
Levin, Lin & Chu t-stat	Unit root	Non stationary	Non stationary
Breitung t-stat	Unit root	Non stationary	Non stationary
Im, Pesaran and Shin W-stat	Unit root	Non stationary	Non stationary
ADF - Fisher Chi-square	Unit root	Non stationary	Non stationary
Hadri Z-stat	No Unit root	Non stationary	Non stationary

6.3. Results of Panel Cointegration Tests for SSW and GDP

6.3.1 Country by Country Johansen Cointegration Tests for SSW

Similar to chapter four and chapter five, we start by presenting the country by country cointegration tests based on the Johansen tests for the cases of intercept and linear time- trend included as in Table 6.7. The null hypothesis is no long-run relationship between SSW and GDP. There are two test statistics in Johansen cointegration testing, namely trace statistics and maximum Eigen-value statistic-trend included as in Table 6.8.

Based on statistics, in case of no time trend, the Johansen null hypothesis of no cointegration among SSW and GDP cannot be rejected for six countries. There is Nepal and Taiwan can reject at 5% significant. Hong Kong and Singapore can reject at 10% significant level. In case of with time trend, the Johansen null hypothesis test also can be rejected for two countries (Nepal and Thailand).

Using maximum Eigen value statistic, in case of no time trend, the Johansen null hypothesis cannot be rejected for six countries (Bangladesh, Korea, Malaysia, Philippines, Sri Lanka and Thailand). However, in case of with time trend, the Johansen null hypothesis can be rejected 2 out of 10 countries (Nepal and Thailand) at least at the 5% level. These results imply that trace statistics seem to have a high power than maximum Eigenvalue statistics, and time trend variable seems to play an important role in our case study.

Table 6 - 9: Johansen tests for SSW (No trend), 1973-2012

No Trend	Rank =0				Rank ≤ 1	
	Trace statistics	p-value	Max-Eigen value statistic	p-value	Trace/Max-Eigen value	p-value
Bangladesh	12.12161	0.1512	11.72002	0.1216	0.401585	0.5263
Hong Kong	13.94422***	0.0845	13.55335***	0.0645	0.390869	0.5318
Korea	6.086055	0.6853	6.013584	0.6115	0.072471	0.7878
Malaysia	5.480201	0.7559	4.871221	0.7580	0.608980	0.4352
Nepal	19.77949*	0.0106	16.90943*	0.0187	2.870066***	0.0902
Philippines	10.37323	0.2531	7.555943	0.4256	2.817283***	0.0933
Singapore	14.32484***	0.0744	13.13297***	0.0749	1.191873	0.2750
Sri Lanka	9.634969	0.3099	3.772030	0.0521	5.862938	0.6309
Taiwan	18.94486*	0.0145	14.92468*	0.0393	4.020179*	0.0450
Thailand	10.32138	0.2568	8.302367	0.3488	2.019018	0.1553

Note: *and ** and ***represent 5% and 1% and 10% levels of significance

Table 6 - 10: Johansen tests for SSW (with trend), 1973-2012

With Trend	Rank =0				Rank ≤ 1	
	Trace statistics	p-value	Max-Eigen value statistic	p-value	Trace/Max-Eigen value	p-value
Bangladesh	22.09012	0.1377	12.90821	0.3355	9.181913	0.1695
Hong Kong	22.03784	0.1395	16.93410	0.1097	5.103732	0.5815
Korea	17.36244	0.3884	11.82048	0.4320	5.541964	0.5205
Malaysia	12.32788	0.7888	7.566118	0.8585	4.761762	0.6308
Nepal	24.05159***	0.0828	20.89359*	0.0300	3.158001***	0.0828
Philippines	11.80305	0.8254	7.688790	0.8484	4.114257	0.7255
Singapore	17.96180	0.3465	13.15070	0.3160	4.811095	0.6237
Sri Lanka	12.20202	0.7979	6.419842	0.9358	5.782180	0.4884

Taiwan	19.87760	0.2322	15.71120	0.1580	4.166409	0.7179
Thailand	29.07070*	0.0193	21.39698*	0.0252	7.673727	0.2795

Note: *and ** and ***represent 5% and 1% and 10% levels of significance

6.3.2 Several Panel Cointegration Tests for SSW and GDP

The results of panel cointegration tests from four methods are presented in Table 6.11 for the case of no time trend and Table 6.12 for the case of with time trend. Pedroni (1999, 2004), Kao (1999) tests are derived from a residual-based approach, while Maddala and Wu (1999) tests are derived from Johansen Fisher Type maximum likelihood approach, and finally, Westerlund (2007) tests are derived from error correction model.

Pedroni tests for the assumption of no trend show that no cointegration hypothesis is rejected in all tests at least at the 1% significant level. When weighted statistics are applied, the result of rejection reduces to six out of the seven tests (except for only panel v-stat). In case of with trending, Pedroni tests show that the null hypothesis is rejected all seven tests at the 1% significant level. When weighted statistics are applied, the same result is also observed. Overall, the cointegrating relationship between SSW and GDP exists for both no trend and with trend, but it seems Pedroni tests have a relatively low power to reject the null hypothesis of no cointegration when a time trend is included.

Kao (1999) test, the special case of Pedroni (1999) which cointegrating vectors are assumed to be homogeneous, shows that SSW and GDP are not cointegrated. The test cannot reject the null hypothesis of no cointegration even at the 10% significant level.

The Johansen Fisher type proposed by Maddala and Wu (1999) reaches to the results that the two series are cointegrated by the trace statistics of 40.60 and the maximum Eigenvalue statistic of 35.59 at the 1% significant level, under the assumption of no trend in the model. When time trend is included, the tests also suggest that there is a cointegrating relationship between SSW and GDP by both the trace

statistic and the maximum Eigenvalue statistic at the 5% significant level.

Westerlund tests find that the null hypothesis of no cointegration is rejected in all four tests at the 1% and 5% significant level under the assumption of without trending variable. When a time trend included, however, the tests can reject the presence of cointegrating relationship between SSW and GDP only two out of four tests. Furthermore, the Westerlund tests, using 100 bootstrap replications, reject the null hypothesis in all of four tests for the case of no trend, and only two out of four tests for the case of with time trend.

Therefore, Maddala and Wu tests seem to have the highest power relative to Pedroni, Kao, and Westerlund tests. Together, the majority of performed tests indicate that there is a cointegrating relationship between SSW and GDP for the Asia data. And, they show that the inclusion of a time trend variable can affect the estimation results in this case study.

Table 6 - 11: Summary results of panel unit root and cointegration tests, “No Trend”

	Cointegration testing				
Study	Test	Statistic	p -value	Weighted Stat	p -value
Pedroni (1999, 2004)	Panel v-stat	2.384230	0.0086	0.589886	0.2776
	Panel rho-stat	-4.071460	0.0000	-3.587301	0.0002
	Panel PP-stat	-3.834628	0.0001	-3.385464	0.0004
	Panel ADF-stat	-2.436008	0.0003	-3.413148	0.0003
	Group rho-stat	-2.436008	0.0074		
	Group PP-stat	-3.095107	0.0010		
	Group ADF-stat	-3.243043	0.0006		
Kao (1999)	ADF t-Stat	-1.236536	0.1081		
Maddala & Wu (1999) (Johansen Fisher Type)	Trace test, Rank=0	40.60	0.0042		
	Trace test, Rank=1	32.66	0.0367		
	Max-eigen test, Rank=0	35.59	0.0172		
	Max-eigen test, Rank=1	32.66	0.0367		
				Bootstrap Stat	p -value
Westerlund (2007)	Panel statistics P_{τ}	-6.437	0.040	-6.437	0.040
	Panel statistics P_{α}	-8.090	0.005	-8.090	0.005
	Group statistics G_{τ}	-2.636	0.001	-2.636	0.001
	Group statistics G_{α}	-12.265	0.002	-12.265	0.002

Note: *and ** and ***represent 5% and 1% and 10% levels of significance

Table 6 - 12: Summary results of panel unit root and cointegration tests, “With Trend”

	Cointegration testing				
Study	Test	Statistic	p -value	Weighted Stat	p -value
Pedroni	Panel v-stat	-0.038183	0.5152	-1.344886	0.9107
	Panel rho-stat	-2.758034	0.0029	-2.414995	0.0079
	Panel PP-stat	-4.106321	0.0000	-3.732207	0.0001
	Panel ADF-stat	-3.830931	0.0001	-3.843617	0.0001
	Group rho-stat	-1.453726	0.0730		
	Group PP-stat	-3.768136	0.0001		
	Group ADF-stat	-3.562044	0.0002		
Maddala & Wu (1999) (Johansen Fisher Type)	Trace test, Rank=0	29.02	0.0873		
	Trace test, Rank=1	13.40	0.8595		
	Max-eigen test, Rank=0	29.42	0.0799		
	Max-eigen test, Rank=1	13.40	0.8595		
				Bootstrap Stat	p -value
Westerlund	Panel statistics P_{τ}	-7.172	0.284	-7.172	0.284
	Panel statistics P_{α}	-9.675	0.351	-9.675	0.351
	Group statistics G_{τ}	-3.142	0.001	-3.142	0.001
	Group statistics G_{α}	-15.752	0.033	-15.752	0.033

Note: *and ** and ***represent 5% and 1% and 10% levels of significance

6.4. Analysis on Short-run and Long-run for SSW

The results of ECM tests are presented in Table 6.13. The tests show that short-run income elasticity in most series appears to be largely lower than one, meaning that SSW spending is a necessity good. In fact, many tests indicate significant negative income elasticity (Giffen goods). This finding deserves for further investigations whenever data is available to include more control variables such as relative price, proportion of population age (e.g. less than 15 and over 65), private expenditures on security (e.g. insurances) and/or structural break in the model. Nevertheless, some series show that the results are statistically insignificant. In the case of Bangladesh, Sri Lanka and Thailand, short-run income elasticity is greatly over one meaning that social security and welfare expenditures are a luxury good.

In table 6.14, we attempt to test the long-run income elasticity in the case of Asia over the period 1973-2012. Since the existing studies on this topic tend to pay attention on the long-run relationship between SSW and economic growth, its direction of causality rather than to concern on the scale of the elasticity, it is not easy to compare the results of this study with others. Nevertheless, we find that the elasticity of absolute value of SSW spending against income is significantly greater than one for Hong Kong, Korea, Singapore and Taiwan.

Table 6 - 13: Error Correction Model (ECM) results 1973-2008, “No Trend”

	Bangladesh	Hong Kong	Korea	Malaysia	Nepal	Philippines	Singapore	Sri Lanka	Taiwan	Thailand
Δ SSW	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000
Δ GDP	5.919884*	-3.410933	-2.530002	-0.322318	-0.032614	0.996849	-2.617204	7.363629*	-1.630735	1.058388*
	(2.15489)	(0.39922)	(0.36129)	(0.30828)	(0.15562)	(0.48830)	(0.23383)	(2.44875)	(0.04967)	(0.63218)
Constant	-15.24757	12.37294	7.819420	-0.511202	-0.274117	-4.012558	9.231181	-23.83390	4.074066	-5.301160
R ²	0.234843	0.210961	0.246834	0.299804	0.353725	0.318814	0.330141	0.013486	0.220651	0.194403
F-statistic	1.902914	1.657659	2.031914	2.654669	3.393446	2.901772	3.055682	0.084756	1.755354	1.496158
Schwarz Criteria	-3.128304	-7.904232	-4.011336	-4.535744	-3.733181	-3.730429	-2.619405	-1.880786	-5.746793	-3.337779

Note: * and ** represent 5% and 1% levels of significance. Standard errors in parentheses

Although it is statistically significant, the long-run income elasticity against SSW is also positive for eight countries. The elasticity seems to be neutral for Bangladesh, Malaysia, Nepal and Philippine. The elasticity shows a negative sign in Sri Lanka and Thailand, while it is insignificant for other remaining countries. These findings suggest that the link between SSW and income is still an open question for further investigations.

Table 6 - 14: Long-run GDP elasticity, 1973-2012

	Income elasticity	t-test	p-value
Bangladesh	0.877309	1.503665	0.1409
Hong Kong	2.521852	13.74668	0.0000
Korea	2.019092	14.89755	0.0000
Malaysia	0.631262	5.447473	0.0000
Nepal	0.035673	0.355663	0.7241
Philippines	0.231027	1.332587	0.1906
Singapore	2.341845	13.30011	0.0000
Sri Lanka	-1.229160	-4.101993	0.0002
Taiwan	1.582814	37.71362	0.0000
Thailand	-0.148633	-0.507343	0.6148

The causality between SSW and GDP is examined as presented in Table 6.15. Using Granger causality tests, the null hypothesis of D (GDP) does not cause D (SSW) can be rejected for four countries. Unidirectional causality exists between SSW and GDP for Korea, Philippine, Singapore and Taiwan. The reverse causality can be rejected for only Hong Kong at the 10% significant level. This result clearly suggests that unidirectional causality does exist. This finding lends a support to the majority of previous empirical studies that expenditures on SSW can play an important role for economic growth.

Table 6 - 15: Results of Granger Causality Tests

	Null Hypothesis	F-statistics	p-value
Bangladesh	ΔGDP growth does not Granger Cause ΔSSW growth	0.86473	0.4305
	ΔSSW growth does not Granger Cause ΔGDP growth	0.90170	0.4156
Hong Kong	$\Delta GDP \nrightarrow \Delta SSW$ growth	1.97575	0.1547
	$\Delta SSW \nrightarrow \Delta GDP$ growth	2.93065***	0.0674
Korea	$\Delta GDP \nrightarrow \Delta SSW$ growth	2.63642***	0.0867
	$\Delta SSW \nrightarrow \Delta GDP$ growth	0.99920	0.4372
Malaysia	$\Delta GDP \nrightarrow \Delta SSW$ growth	0.99920	0.3790
	$\Delta SSW \nrightarrow \Delta GDP$ growth	0.06599	0.9363
Nepal	$\Delta GDP \nrightarrow \Delta SSW$ growth	0.22144	0.8025
	$\Delta SSW \nrightarrow \Delta GDP$ growth	0.29357	0.7475
Philippines	$\Delta GDP \nrightarrow \Delta SSW$ growth	4.69571*	0.0160
	$\Delta SSW \nrightarrow \Delta GDP$ growth	0.30869	0.7365
Singapore	$\Delta GDP \nrightarrow \Delta SSW$ growth	5.78950**	0.0070
	$\Delta SSW \nrightarrow \Delta GDP$ growth	0.95189	0.3964
Sri Lanka	$\Delta GDP \nrightarrow \Delta SSW$ growth	0.26384	0.7697
	$\Delta SSW \nrightarrow \Delta GDP$ growth	0.36359	0.6979
Taiwan	$\Delta GDP \nrightarrow \Delta SSW$ growth	3.06470***	0.0601
	$\Delta SSW \nrightarrow \Delta GDP$ growth	0.96771	0.3905
Thailand	$\Delta GDP \nrightarrow \Delta SSW$ growth	1.75347	0.1889
	$\Delta SSW \nrightarrow \Delta GDP$ growth	0.48498	0.6200

Note: * and ** represent 5% and 1% levels of significance. Standard errors in parentheses

CHAPTER 7

CONCLUSIONS

7.1: Research Findings and Policy Implication

This study examines the long-run relationship between three public expenditures on education, health, and social security and welfare and economic growth, using new data from 11 Asia countries for the period of 1973-2012. Existing research rarely pay attention on using Asia countries data, thus, it is a new contribution produced by this study. Since the data sets used in the previous studies are mainly based on OECD countries which nearly identical, but reach inconclusive results. It is preferable to apply several panel unit root and cointegration tests recently developed because no single test is likely to be definitive.

In Chapter 4, the relationship between education expenditures (EE) and economic growth is examined. It utilizes data from 9 Asia countries for the period of 1973-2012. In brief, the results of five panel unit root tests generally indicate that the two series of EE and GDP are non-stationary 17 out of 20 for both with and without time trend in the regressions. The results of four panel cointegration tests indicate that the two series are co integrated for both with and without time trend in the regressions. Whether education is a necessity good or a luxury good, this study shows that it remains controversial. Moreover, the tests suggest that only one country bidirectional causality does exist.

In Chapter 5, the link between health expenditures (HE) and economic growth is investigated. It employs data from 9 Asia countries for the period of 1973-2012. In brief, the results of five panel unit root tests clearly indicate that the two series of HE and GDP are non-stationary 18 out of 20 for both with and without time trend in the regressions. The results of four panel cointegration tests indicate that the two series are obviously cointegrated for both with and without time trend in the regressions. Whether health care is a necessity good or a luxury good, this study shows that it remains controversial. Moreover, the tests suggest that only one country bidirectional causality does exist. And two countries have unidirectional causality (GDP cause HE).

In Chapter 6, the relationship between social security and welfare expenditures (SSW) and GDP is examined. The association among them is admittedly so complicated and the literature is still very scarce. It utilizes data from 10 Asia countries for the period of 1973-2012. In brief, the results of five panel unit root tests generally indicate that the two series of SSW and GDP are non-stationary 19 out of 20. The results of four panel cointegration tests generally indicate that the two series are cointegrated. The presence of a time trend variable seems to affect the results of both panel unit roots and cointegration. Moreover, the tests suggest that four countries unidirectional causality (GDP cause SSW) does exist.

Therefore, researchers studying public expenditures, especially on education, health, social security and welfare need to be concerned about the presence of unit roots and cointegration in the data. They also need to pay attention on the causes and directions and the short-run and long-run effects of public expenditure on economic development.

7.2: Remarks for Further Development

Previous empirical evidence tends to use time-series/cross-countries technique to examine the relationship between education and economic growth, but the findings are not conclusive. This paper analyzes the case study of 11 Asian countries using panel data. The implication found by this study is that panel unit and cointegration tests have a higher power as compared with previous tests, and the findings are generally conclusive.

We note that all reported results are somewhat conditioned. The results shown here may be sensitive to inclusions of additional regressors such as the relative price of each public service and the age structure of population, which are currently not available in our case study. We also note that heterogeneous structural breaks in the series can be mistaken for non-stationarity. We believe that further analyses of the link between EE and GDP, HE and GDP, and SSW and GDP in Asia data are desirable.

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Appendix

