THE LINKAGES BETWEEN HEALTH EXPENDITURE AND INCOME IN THE SOUTHEAST ASIA ECONOMIES

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March 2010

ABSTRACT

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The objective of this study is to investigate the health-income relationship for the ASEAN-5 economies within the time series framework from 1970 to 2006. This study adopted the bounds testing approach to cointegration developed by Pesaran et al. (2001) to examine the presence of long run equilibrium relationship via the autoregressive distributed lag (ARDL) framework. The empirical evidence reveals that health expenditure and income are cointegrated for the case of Indonesia, Singapore and Thailand. On the contrary, for the case of Malaysia and the Philippines, we found that these variables are not moving together in the long run. Apart from that, the bootstrap Granger causality tests results suggest that income Granger cause health expenditure for all the selected ASEAN countries, except Indonesia (neutral causality).

JEL Classification codes: C01; C22; H51; I18

KEYWORDS: ASEAN; Bootstrapping; Health; Income; MWALD

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ISSN : 2180-0146

1. INTRODUCTION

In 1962 an influencing article on health economics – "Health as an Investment" was published in the *Journal of Political Economy*. Mushkin (1962) postulated that health is a capital and thus investment on health is a prominent source for economic growth. Aftermath of this thesis, a voluminous of empirical literatures have emerged to investigate the relationship between health expenditure and income or economic growth. A major consensus evidence emerged from the existing empirical studies is that most of them found that health expenditure and income is positively correlated (for example Newhouse, 1977, 1987; Parkin et al., 1987; Wang and Rettenmaier, 2007). Nevertheless, the causal relationship between health expenditure and income remains an open issue.

Review to the health economic literature, the extant empirical studies on health expenditure and income has focused on the cross-sectional or panel data analysis. Among them are Parkin et al. (1987), Gerdtham and Löthgren (2000), Wang and Rettenmaier (2007) and Hartwig (2008) and so on. The use of either cross-sectional or panel data for the analysis of health-income relationship is not without question and may be bias. Solow (2001) claimed that an economic model should be dynamic in nature, thus we can observe the evolution of economic behaviour over time. Furthermore, cross-sectional and panel data studies are based on a restrictive assumption of homogeneity in the observed relationship across countries to which there are not always the case (see Athukorala and Sen, 2002). Deaton (1989) argued that the nature and the quality of data vary seriously across countries, therefore cross-sectional and panel data studies are likely to yield spurious results. In practice, the economic relationship tends to be heterogeneous owing to difference in the nature of economic, income and demographic factors.

Second, the existing empirical studies on health expenditure and income have been thus far focus on the OECD and developed countries (see for example Hansen and King, 1996; Devlin and Hansen, 2001; Carrion-i-Silvestre, 2005; Narayan, 2006; Hartwig, 2008; Michaud and Soest, 2008). Therefore, systematic time series studies on other blocks of economies such as ASEAN and developing economies are relatively scarce or almost non-exist. In this sense, the health expenditure and health care studies in ASEAN have not been given the attention. As far as ASEAN economies are concern, only two recent empirical studies were detected to investigate the relationship between health expenditure and income. However, both studies were focus on Malaysia. For example, Semudram et al. (2008) employed the annual data from 1970 to 2004 to analyse the relationship between disaggregate public expenditures and income in Malaysia through the bounds testing approach to cointegration developed by Pesaran et al. (2001). Specifically, they found that health expenditure and income are co-move in the long run and the relationship is positive. However, Tang and Evan Lau (2008) attempt to revisit Samudram's et al. (2008) paper by employing the Bartlett-corrected trace test for cointegration (see Johansen 2002) to examine the existence of long run relationship between public expenditure on health and income in Malaysia. As a value added to Samudram's et al. (2008) study, they employed the Modified Wald (MWALD) causality test suggested by Toda and Yamamoto (1995) to

ascertain the causal relationship between health expenditure and income. Interestingly, they found that health expenditure and income are cointegrated. Furthermore, the MWALD test evidence revealed that the causal relationship between health expenditure and income is bi-directional in nature. Thus, they surmised that for the case of Malaysia, health expenditure is a vehicle for economic growth and development.

Third, to the best of our knowledge, empirical study on the causal relationship between health expenditure and income is very few and the causality evidences are also reach mixture results. To this end, only Devlin and Hansen (2001) and Tang and Evan Lau (2008) have tested the causality direction for the health-income nexus. However, the findings of these studies are inconsistent. Understanding of the causal relationship between health expenditure and income is vital in determining a country's development policies. If health expenditure is an engine to the income growth, the goal of development policy should encourage health expenditure because it can be regarded as an investment on human capital (see Mushkin, 1962; Grossman, 1977). Thus, it is pertinent for this study to examine the causal relationship between health expenditure and income or economic growth.

The prime concern of this study is to investigate the relationship between health expenditure and income in the five ASEAN founding economies – ASEAN-5 within the time series analysis from the period of 1970 to 2006. This study differs from the extant health-income studies in at least four novel ways. First, this study attempts to analyse the health-income relationship for individual country in the ASEAN-5 economies owing to the scarcity of country-specific research work, in particularly on ASEAN economies.

Second, Perron (1989) argued that if the estimated variable contained structural break(s), the power of standard unit root test decreases tremendously and may lead to spurious rejection of the null hypothesis of a unit root when the structural break(s) was ignored. For this reason, this study undertakes a complete investigation of the time series properties of the data. Apart from using the standard unit root test – Augmented Dickey-Fuller (ADF, 1979; 1981) and Phillips and Perron (PP, 1988), we also employ the Zivot and Andrews (Zivot-Andrews, 1992) unit root test with one structural break and Lumsdaine and Papell (Lumsdaine-Papell, 1997) unit root test with two structural breaks to re-check the order of integration for each series under investigation.

Third, the extant empirical studies in health-income relationship such as Hansen and King (1996), Clemente, et al. (2004) and Tang and Evan Lau (2008) have used Engle and Granger (1987) residuals-based cointegration test and the Johansen cointegration approach to examine the presence of long run relationship. Unfortunately, estimates using the Engle-Granger and Johansen tests of cointegration are less robust when the sample size is small and the order of integration are not purely $I(1)$ process (see Cheung and Lai, 1993; Gonzalo and Lee, 1998). With this regards, we apply a more robust cointegration test such as the bounds testing approach to cointegration proposed by Pesaran et al. (2001) to examine the presence of a potential long run equilibrium relationship between health expenditure and income. The advantage of applying this cointegration approach is that it has superior

performance in finite samples. Furthermore, this approach can be applied irrespective of either the order of integration is purely $I(0)$ or purely $I(1)$ process.

Fourth, the residual-based bootstrap MWALD causality tests will be used in this study to determine the causal relationship between health expenditure and income. To the best of our knowledge, the bootstrap causality test has not been previously applied in the health-income relationship analysis.

The rest of this paper is structure as accordingly. Section 2 will briefly discuss the health expenditure in the ASEAN-5 economies. Model specification, econometric techniques, and data sources used in this study will be explained in Section 3. Next, the empirical result and concluding remarks will be reported in Section 4 and Section 5, respectively.

2. A REVIEW OF HEALTH EXPENDITURE IN ASEAN-5 COUNTRIES

This section will briefly review the health expenditure in particular the public expenditure on health in the five original member countries in the Association of Southeast Asia Nations or ASEAN (i.e. Indonesia, Malaysia, the Philippines, Singapore and Thailand). The ASEAN block of economies was established on 8th August 1967 with the primary objective to accelerate economic growth, social progress and cultural development that is including health and education system development in the region. The public expenditure on health is of concern because public sector was the biggest players in providing health care system in each country in the world. Furthermore, the role of public sector in health is particularly important for the poor countries (Asian Development Bank, 2006). In similar vein, Musgrove et al. (2002) also pointed out that the government intervention is required when the free market operation failed to fulfil the basic need of the people.

Ramesh and Asher (2000) documented that over the past decades the Southeast Asia nations have experienced significant improvements in their health care system. Moreover, the United Nations (2007) report also shows that, health expenditure in the ASEAN economies increased tremendously together with a high growth economic performance. Thus, expenditure on health may be a prominent source for this sustainable economic growth and development. This is because the healthier individuals may more productive than those who are ill, hence enabling them to accumulate more wealth or income. Subsequently, stimulate the economic growth in macroeconomics point of view. Figure 1 gives a broad sense of health expenditure (in US dollar) in the ASEAN-5 economies.

By and large, after ASEAN was founded, the member countries have made considerable progress in the economic and health care system development. Evidently, over the decade from 1970 to 1979, the public expenditure on health in ASEAN-5 economies increases steadily from USD205.7 million in 1970 to around USD1,108 million in 1979, that is

almost 400 per cents increment on health expenditure in these countries. Moreover, in 1980 for example, the ASEAN's Health Ministers coherently emphasised on the important of promoting health care system such as exchange of information, experiences and expertise in health development.
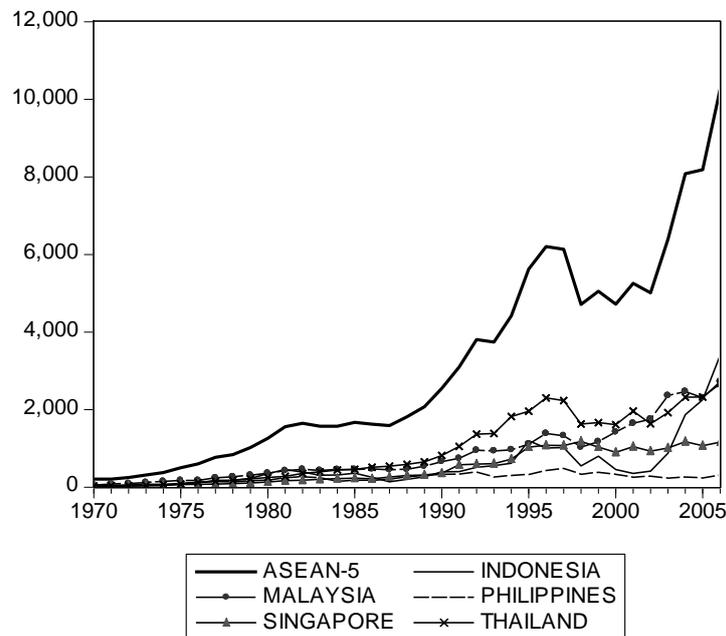
Figure 1: The plots of health expenditure in ASEAN-5 economies

In this respect, they also called to promote health manpower development and corroborative research on health in order to improve the quality of life among the ASEAN's member countries. Therefore, the public expenditure on health in the ASEAN-5 economies further increased from USD1260 million in 1980 to USD1648 million in 1982. Nevertheless, owing to the world economic recession in the mid-1980s, the public expenditure on health in the ASEAN-5 economies dropped about 4.7 per cent over the period of 1982 to 1984 and the public expenditure on health creep up again after 1985 until the outbreak of Asian financial crisis. In 1997, the Asian financial crisis has hit the ASEAN economies seriously, thus caused the public expenditure on health in each of the ASEAN-5 economies to decrease tremendously. During the crisis period from 1997 to 1998, health expenditure decreases drastically – for Indonesia (from USD1020 million to USD544 million), for Malaysia (USD1324 million to USD1031 million), for the Philippines (USD480 million to USD331 million), for Singapore (USD1074 million to USD1033 million), and for Thailand (USD2233 million to USD1629 million). Furthermore, as a result of fears arising from Severe Acute Respiratory Syndrome (SARS) and Avian flu, the health expenditure in ASEAN-5 economies increased about 27.6 per cent from USD5008 million in 2002 to USD6391 million in 2003 to prevent and control the spread of these diseases in the region. In order to manage the spread of these diseases, the members of ASEAN countries have to cooperate in providing public information and education to create public awareness for better understanding of the SARS epidemic.

3. DATA, MODEL SPECIFICATION AND ECONOMETRIC TECHNIQUES

3.1 Data and Model Specification

In this study, we employed annual data of gross domestic product (GDP), public expenditure on health as a proxy to health expenditure due to unavailability of data. This study cover annual data from the period 1970 to 2006 extracted from various sources – International Monetary Funds (IMF), *International Financial Statistics* (*IFS*), Asian Development Bank, *Key Indicators*. The population and consumer price index (CPI, 2000 =100) data were used to compute the real per capita variables.

To estimate the health-income relationship for the ASEAN-5 economies, we use the bivariate demand or consumption model presented in equation (1). This model has been extensively employed to examine the relationship between health expenditure and income (see for example Parkin et al., 1987; Devlin and Hansen, 2001; Wang and Rettenmaier, 2007).

$$\ln HE_t = \alpha_0 + \alpha_1 \ln Y_t + \varepsilon_t \qquad (1)$$

where ln denotes the natural logarithm form. $\ln HE_t$ is the real per capita health expenditure, $\ln Y_t$ represents the real per capital income. The errors-term ε_t are assumed to spherically distributed and white noise.

3.2 Econometric Techniques

3.2.1 Unit root tests

It is essential for this study to begin the health-income relationship analysis by determining the degree of integration with the unit root tests – ADF, PP, Zivot-Andrews and Lumsdaine-Papell. This is because the estimated time series results may be misleading or spurious if the estimated series are non-stationary and/or non-cointegrated (see Granger and Newbold, 1974; Phillips, 1986). To conserve space and standard unit root testing procedure has been well define in the extant literature, this study will briefly explain the Zivot and Andrews (1992) and Lumsdaine-Papell (1997) unit root tests for one and two structural breaks, respectively. Zivot-Andrews unit root test is an endogenous structural break unit root tests, meaning that the breakpoint will search endogenously. They argued that exogenous structural break unit root test may be bias as shock to economic series usually is lagged. Zivot and Andrews (1992) proposed three models – Model A, Model B and Model C for unit root test with one structural break. Sen (2003a) claimed that when the

breakpoint is treated as unknown, Model C is preferable. Furthermore, Monte Carlo simulation result provided by Sen (2003b) reveals that Model C will yield more reliable unit root result. For this reason, we estimate the following regression – Model C that unit root which allows for a structural break in the intercept and trend shift:

$$\Delta y_t = \mu_0 + \mu_1 t + \mu_3 DU1_t + \mu_4 DT1_t + \delta y_{t-1} + \sum_{i=1}^{k} c_i \Delta y_{t-i} + e_t \tag{2}$$

Where Δ is the first different operator $(y_t - y_{t-1})$, the residuals e_t are assumed to be normally distributed and white noise. The first different lagged dependent variable(s) Δy_{t-i} is incorporated into Model C to correct the serial correlation problem if any. $DU1_t$ is the dummy variable for structural break in the intercept occurring at time $TB1$ and $DT1_t$ is the dummy variable for trend shift, where:

$$DU1_t = \begin{cases} 1 & \text{if } t > TB1 \\ 0 & \text{otherwise} \end{cases} \quad \text{and} \quad DT1_t = \begin{cases} t - TB1 & \text{if } t > TB1 \\ 0 & \text{otherwise} \end{cases}$$

The optimal lag length (k) is selected using the "t-significant" method and the potential breakpoint $(TB1)$ is chosen where the ADF t-statistics is maximised in absolute term.

Nevertheless, in practice there might be more than one structural break, hence Zivot-Andrew unit root test may not be suitable because it is low power when the estimated series contain more than one structural break. In order to overcome this problem, we employ the Lumsdaine-Papell unit root test for two structural breaks which is relatively more practical approach. This two breaks unit root test is an extension from the Zivot and Andrews (1992) endogenous one structural break unit root test. In accord to Sen (2003a, b) recommendation, we employ the Model CC for testing the order of integration. The estimated regression is presented as follow:

$$\Delta y_t = \mu_0 + \mu_1 t + \mu_3 DU1_t + \mu_4 DT1_t + \mu_5 DU2_t + \mu_6 DT2_t + \delta y_{t-1} + \sum_{i=1}^{k} c_i \Delta y_{t-i} + e_t \tag{3}$$

where $DU1_t$ and $DU2_t$ are dummy variables for structural breaks in the intercept occurring at time $TB1$ and $TB2$, respectively, where $TB2 > TB1 + 2$. $DT1_t$ and $DT2_t$ are dummy variables corresponding to change in the trend (t) variable.

$$DU1_t = \begin{cases} 1 & \text{if } t > TB1 \\ 0 & \text{otherwise} \end{cases} \qquad DT1_t = \begin{cases} t - TB1 & \text{if } t > TB1 \\ 0 & \text{otherwise} \end{cases}$$

and

$$DU2_t = \begin{cases} 1 & \text{if } t > TB2 \\ 0 & \text{otherwise} \end{cases} \qquad DT2_t = \begin{cases} t - TB2 & \text{if } t > TB2 \\ 0 & \text{otherwise} \end{cases}$$

We follow Hall (1994) suggestion that the optimal lag length (k) is selected using the "t-significant" method and the breakpoints $(TB1 \text{ and } TB2)$ are chosen where the ADF t-statistics is maximised in absolute term. The GAUSS^{TM} programme code will use to perform the Zivot-Andrews and Lumsdaine-Papell unit root tests.

3.2.2 Bounds testing approach to cointegration

This study employ the bounds testing approach to cointegration developed by Pesaran et al. (2001) to assess the existence of long run relationship between health expenditure and income for the ASEAN-5 economies. To implement the bounds testing approach to cointegration, we begin by estimating the following autoregressive distributed lag (ARDL) framework through the Ordinary Least Squares (OLS) estimator.

$$\Delta \ln HE_t = \beta_0 + \pi_1 \ln HE_{t-1} + \pi_2 \ln Y_t + \sum_{i=1}^{k} \delta_i \Delta \ln HE_{t-i} + \sum_{j=0}^{k} \lambda_j \Delta \ln Y_{t-j} + \xi_t \qquad (4)$$

Here, Δ is the first difference operator $(z_t - z_{t-1})$, k is the optimal lag length and the residuals ξ_t are assumed to be normally distributed and white noise. According to Pesaran et al. (2001), once the optimal lag length for the final ARDL model has been specified, the restricted F-test can be apply on the lagged level variables $(\ln HE_{t-1} \text{ and } \ln Y_{t-1})$ to determine the presence of long run relationship between health expenditure and income. Clearly, this is a joint significant F-statistics for the null hypothesis of no cointegrating relation $(H_0 : \pi_1 = \pi_1 = 0)$ against the alternative hypothesis of cointegrating relation $(H_1 : \pi_1 \neq \pi_1 \neq 0)$. Pesaran et al. (2001) have tabulated two set of critical values bounds – the upper and the lower bounds. Ironically, Narayan (2005) pointed out that the asymptotic critical values bounds tabulated in Pesaran et al. (2001) are not suitable for small sample. For this reason, we use the small sample critical values bounds tabulated in Narayan (2005) to test for cointegration. If the computed F-statistics is greater than the upper bounds critical values, $I(1)$ given by Narayan (2005) the null hypothesis of no cointegrating relation can be rejected. Otherwise, health expenditure and income are not cointegrated. Nevertheless, it is interesting to point out here that if the computed F-statistics fall between the lower and upper bounds critical values, statistical inference for cointegration test would be inconclusive. In this sense, Pesaran et al. (2001) suggest that one would need to know the order of integration for the variables under investigation.

3.2.3 Toda and Yamamoto (1995) Granger causality test

Next, the causality test suggested by Toda and Yamamoto (1995) within the augmented-VAR framework will be employ to verify the causal relationship between health expenditure and income for the ASEAN-5 economies. To use the MWALD test, we have to decide the maximum order of integration (d) for the variables in the system and the optimal lags structure (p) for the VAR model. Following Dolado and Lütkepohl (1996), we use $d = 1$ because it performs better any orders of d. The augmented $\mathrm{VAR}(p+d)$ system for testing the causal interaction between integrated variables is as follow:

$$
y_t = \begin{bmatrix} \ln HE_t \\ \ln Y_t \end{bmatrix} = \begin{bmatrix} \alpha_1 \\ \alpha_2 \end{bmatrix} + \begin{bmatrix} A_{11,1} & A_{12,1} \\ A_{21,1} & A_{22,1} \end{bmatrix} \times \begin{bmatrix} \ln HE_{t-1} \\ \ln Y_{t-1} \end{bmatrix} + \cdots + \begin{bmatrix} A_{11,p} & A_{12,p} \\ A_{21,p} & A_{22,p} \end{bmatrix} \times \begin{bmatrix} \ln HE_{t-p} \\ \ln Y_{t-p} \end{bmatrix}
$$
$$
+ \begin{bmatrix} A_{11,p+d} & A_{12,p+d} \\ A_{21,p+d} & A_{22,p+d} \end{bmatrix} \times \begin{bmatrix} \ln HE_{t-p-d} \\ \ln Y_{t-p-d} \end{bmatrix} + \begin{bmatrix} \xi_{1t} \\ \xi_{2t} \end{bmatrix} \tag{5}
$$

where p is the optimal lag order in the VAR system. From equation (5), $A_{12,p} \neq 0 \forall_p$ implies that income Granger causes health expenditure; whereas if $A_{21,p} \neq 0 \forall_p$ holds, the health expenditure Granger causes income. The residuals ξ_{1t} and ξ_{2t} are assumed to be spherically distributed and white noise.

Before defining the MWALD statistics, we simply derive:

$$
Z := (y_1, \ldots, y_T) \qquad (k \times T) \text{ matrix,}
$$
$$
D := (\alpha, A_1, \ldots, A_p) \qquad (k \times (kp+1)) \text{ matrix,}
$$
$$
W_t := \begin{bmatrix} 1 \\ y_t \\ y_{t-1} \\ \vdots \\ y_{t-p-d} \end{bmatrix} \qquad ((kp+1) \times 1) \text{ matrix,}
$$
$$
W := (W_0, \ldots, W_{T-1}) \qquad ((kp+1) \times T) \text{ matrix,}
$$
and
$$
\delta := (\varepsilon_1, \ldots, \varepsilon_T), \qquad (k \times T) \text{ matrix}
$$

Based on the above notation for $t = 1, \ldots, T$, the augmented VAR($p+d$) model including an intercept (α) can be written compactly as follow:

$$
Z = DW + \delta \tag{6}
$$

The estimated $(k \times T)$ matrix of the residuals from the restricted and unrestricted regression are denoted as $(\hat{\delta}_R)$ and $(\hat{\delta}_U)$, respectively. Then we compute the variance-covariance matrix of these estimated residuals as $S_R = \hat{\delta}_R'\hat{\delta}_R$ and $S_U = \hat{\delta}_U'\hat{\delta}_U$, respectively. Finally, the MWALD test statistics proposed by Toda and Yamamoto (1995) can be written as accordingly:

$$MWALD = T \times \frac{(S_R - S_U)}{S_U} \tag{7}$$

It is worth while to point out here that the parameters for the extra lag, i.e. $d = 1$, in equation (5) are unrestricted as the inclusion of extra lag into the augmented VAR system is to ensure that the asymptotic χ^2 distribution critical value can be applied when the test for causality between the integrated variables are conducted (see Toda and Yamamoto, 1995).

3.2.4 *Bootstrapping simulation approach*

The idea of bootstrap simulation approach was originated by Efron (1979). This is also known as residuals-based bootstrap simulation approach. Aftermath, many of the published articles such as Mantalos and Shukur (1998), Mantalos (2000) and Hacker and Hatemi-J (2006) employed this bootstrap simulation approach to compute a set of robust critical values for Granger causality tests. This is because they claimed that the MWALD test statistics are bias when (a) the sample size is small, (b) the estimated residuals are non-spherically distributed and/or (c) the residuals variance is heterogeneous (i.e. Autoregressive Conditional Heteroskedasticity, ARCH). By and large, the bootstrap simulation procedure for causality test can be set out as follows.

(1)   Obtain the raw residuals $(\hat{\delta})$ by estimate equation (6) with the restriction for the null hypothesis of no Granger causality on one of the included equations.

(2)   Rescale the estimated raw residuals $(\hat{\delta})$ with the leverages procedure suggested by Davison and Hinkley (1999) to obtain a correct variance.

(3)   Compute the adjusted residuals $(\hat{\delta} - \bar{\delta})$ to ensure that the mean of the adjusted residuals are zero.

(4)   Generate the simulated data, y_t^*, based on the estimated coefficients, $\hat{\alpha}, \hat{A}_1, \ldots, \hat{A}_p$; the original data $y_{t-1}, y_{t-2}, \ldots, y_{t-p}$; and the bootstrapped adjusted residuals $\hat{\varepsilon}_t^*$.

(5)   Calculate the MWALD* statistics with the regression of y_t^* on $y_{t-1}, y_{t-2}, \ldots, y_{t-p}$. Repeating this step N_b times and compute a bootstrap distribution, then the α-level of leveraged bootstrap critical values can be obtained.

An important issue in applying the bootstrapping simulation approach is the size of the bootstrap sample N_b. In this respect, we following Davidson and MacKinnon (2004) to use $N_b = 1000$. The GAUSS$^{\text{TM}}$ programming codes will use to compute the bootstrap critical values.

4. EMPIRICAL RESULTS

4.1   *Unit root tests results*

Owing to the reason of spurious regression, we performed the ADF, PP, Zivot-Andrews and Lumsdaine-Papell unit root tests to establish the degree of integration of the various variables used in this study.

The results of ADF and PP unit root tests reported in Table 1 suggests that all the estimated variables are integrated of order one, *I*(1) process, except for Indonesia. According to the standard PP unit root test results, the income $(\ln Y_t)$ variable is stationary at level. As noted in the literature that the standard unit root tests – ADF and PP are relatively low power when the estimated series contain structural break(s). With this regards, we perform both one and two structural breaks unit root tests – Zivot-Andrews and Lumsdaine-Papell to affirm the order of integration for each series under investigation. An interesting finding emerged from these unit root tests results (see Table 1) is that the order of integration for the estimated variables were either *I*(0) or *I*(1) process, except for Thailand.

Table 1: The results of unit root tests

Variables	ADF	PP	Zivot-Andrews	Lumsdaine-Papell
Indonesia:				
$\ln HE_t$	−0.605 (0)	−0.612 (4)	−4.239 (6) [1999]	−6.461 (6) [1984, 1995]
$\Delta \ln HE_t$	−5.062 (0)*	−4.998 (6)*		
$\ln Y_t$	−1.479 (2)	−3.853 (25)*	−4.148 (1) [1982]	−8.650 (8)* [1982, 1996]
$\Delta \ln Y_t$	−5.241 (1)*	−4.961 (12)*		
Malaysia:				
$\ln HE_t$	−0.589 (0)	−0.535 (4)	−4.490 (7) [1992]	−5.536 (6) [1995, 2002]
$\Delta \ln HE_t$	−6.177 (0)*	−6.377 (5)*		
$\ln Y_t$	−0.890 (0)	−0.896 (2)	−6.309 (8)* [1995]	−7.652 (8)* [1995, 2000]
$\Delta \ln Y_t$	−5.588 (0)*	−5.582 (2)*		
Philippines:				
$\ln HE_t$	−2.062 (0)	−2.109 (2)	−4.427 (2) [1989]	−6.697 (7)** [1983, 1997]
$\Delta \ln HE_t$	−4.335 (2)*	−8.698 (14)*		
$\ln Y_t$	−1.149 (1)	−0.508 (2)	−4.207 (5) [1990]	−5.470 (3) [1983, 1994]
$\Delta \ln Y_t$	−4.424 (1)*	−4.592 (4)*		
Singapore:				
$\ln HE_t$	−1.156 (2)	−0.672 (3)	−9.332 (0)* [2002]	−9.395 (0)* [1997, 2000]
$\Delta \ln HE_t$	−5.222 (1)*	−9.703 (1)*		
$\ln Y_t$	−1.943 (0)	−1.901 (4)	−4.554 (1) [1992]	−5.592 (1) [1984, 1992]
$\Delta \ln Y_t$	−4.548 (0)*	−4.476 (4)*		
Thailand:				
$\ln HE_t$	−1.662 (0)	−1.981 (4)	−4.480 (3) [1995]	−5.347 (3) [1986, 1995]
$\Delta \ln HE_t$	−6.609 (0)*	−6.607 (1)*		
$\ln Y_t$	−0.711 (2)	−0.552 (3)	−4.124 (8) [1986]	−6.223 (5) [1986, 1994]
$\Delta \ln Y_t$	−3.335 (1)**	−3.063 (3)**		

Note: The asterisks *, ** and *** denotes the significance level at 1, 5 and 10 per cents, respectively. ADF and PP refer to Augmented Dickey-Fuller and Phillips-Perron unit root tests. The optimal lag length for ADF test is selected using the AIC while the bandwidth for PP test is selected using the Newey-West Bartlett kernel. Figure in parentheses denotes the optimal lag length and bandwidth. The critical values for ADF and PP tests are obtained from MacKinnon (1996). The parentheses ( ) and [ ] represent the optimal lag length and break point(s), respectively. The critical values for Zivot-Andrews and Lumsdaine-Papell tests are collected from Zivot and Andrews (1992) and Lumsdaine-Papell (1997), respectively.

For the case of Thailand, all four unit root tests are consistently affirmed that the order of integration for the estimated series are belong to $I(1)$ process. These unit root results are contrary to the finding of Nelson and Plosser (1982), but it is corroborated to the Hansen and Parkin (1996) assertion that the order of integration for health expenditure and income are mix. Consequently, the used of standard cointegration approach such as Engle and Granger (1987) and Johansen and Juselius (1990) may have been biased. In this case, the bounds testing approach to cointegration within the ARDL framework is very suitable to the present formulation of the health-income relationship.

4.2   Cointegration test results

In practice, the statistical software – Microfit version 4.1 were used for all the computations of the bounds testing approach to cointegration and the cointegrating vector if any. In terms of optimal lag order for the ARDL model, we used Akaike's Information Criterion (AIC) because Liew (2004) and Lütkepohl (2005) suggest that AIC is superior to any other selection criteria when the sample size is relatively small (e.g. $T \le 60$).

Table 2: The results for bounds testing approach to cointegration

Panel A: Bounds Cointegration test

F-Statistics	ASEAN-5 Economies				
	Indonesia ARDL [2, 0]	Malaysia ARDL [2, 3]	Philippines ARDL [0, 2]	Singapore ARDL [4, 0]	Thailand ARDL [0, 0]
$F\left(\ln HE\middle| \ln Y\right)$	5.094***	1.780	4.142	9.083*	6.598**

Panel B: Diagnostic Tests

R-Squares	0.285	0.445	0.386	0.554	0.348
Adjusted R-Squares	0.152	0.218	0.272	0.451	0.281
F-statistics	2.150***	1.960***	3.396**	5.380*	5.169*
Serial Correlation:					
LM test (1)	0.401	1.207	0.078	2.115	2.018
LM test (2)	0.754	1.224	0.279	2.224	4.374
ARCH (1)	0.024	0.430	0.675	0.355	1.344
Ramsey RESET (1)	0.071	0.860	0.200	0.551	1.529
Normality test	0.501	0.535	1.505	1.881	0.896

Panel C: Estimated long run coefficients with ARDL

Constant	−9.939*	–	–	−3.759*	−8.902*
$\ln Y_t$	1.284*	–	–	0.933*	1.411*

Note: The asterisks *, ** and *** denote the significant level at 1, 5 and 10 per cents level, respectively. The optimal lag length is determined by the AIC statistic. The Narayan (2005) critical values were employed for cointegration test. [ ] represent the optimal lag order for the ARDL model, while the parentheses ( ) denotes the diagnostic test order.

The estimated results for the bounds testing approach to cointegration together with batteries of diagnostic tests are presented in Table 2. By and large, the diagnostic tests suggest that the classical assumptions are complied (see Panel B, Table 2). Specifically, the Jarque-Bera normality test statistics failed to reject the null hypothesis of normality. Therefore, suggest that the residuals are spherically distributed. With this normality evidence, we may surmise that the statistical inferences such as R-squares, t-statistics and F-statistics are valid. The Breusch-Godfrey LM test exhibited that the estimated residuals are not serially correlated up to order two. Moreover, the Ramsey RESET test cannot reject the null hypothesis of no specification error. Thus, the estimated ARDL models for the ASEAN-5 economies are free from specification error. Unfortunately, the CUSUM of Squares statistics for Malaysia crossed the 5 per cent critical bounds (see Figure 2). Hence, the estimated coefficients are not stable for the period of 1997 to 1999. The Asian currency crisis that caused the Malaysian economy since 1997 may be a plausible explanation for this structural break.

Figure 2: The plots of CUSUM and CUSUM of Squares Statistic
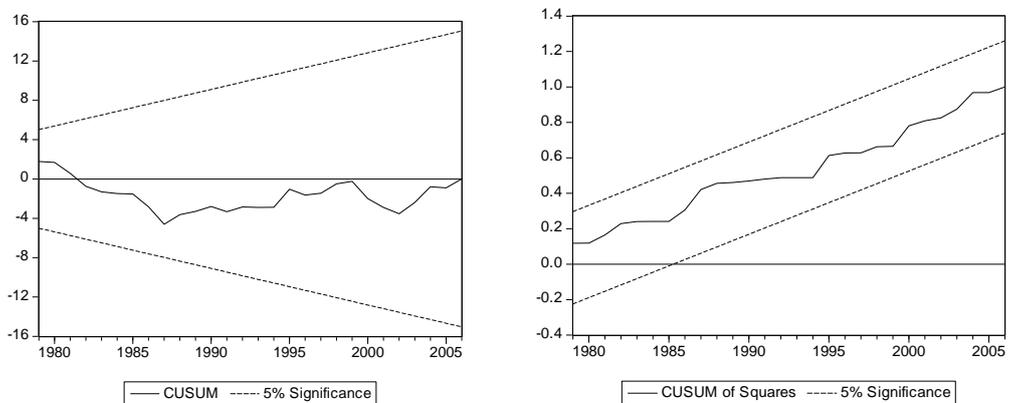
Indonesia
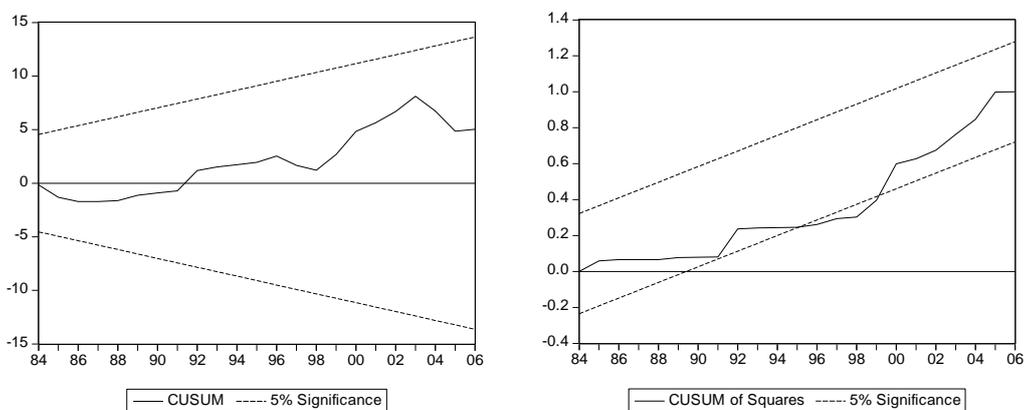
Malaysia
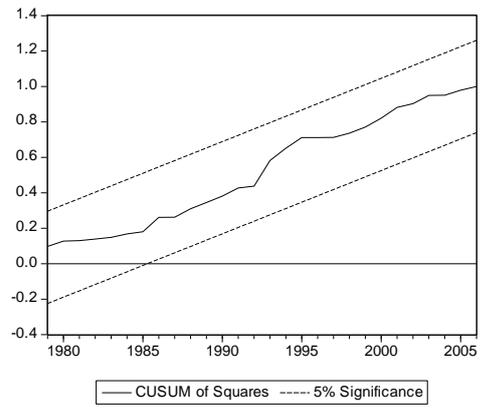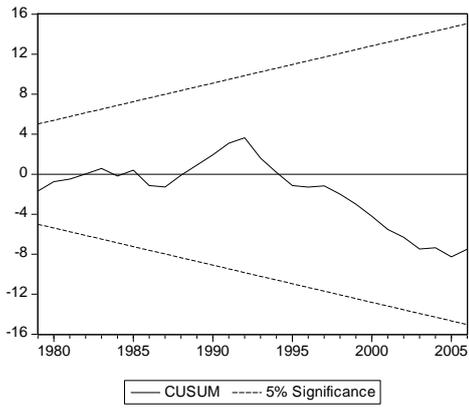
Philippines
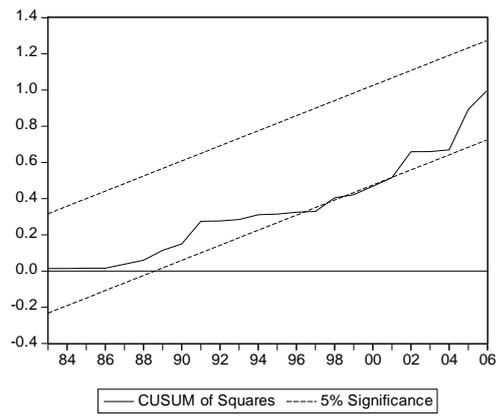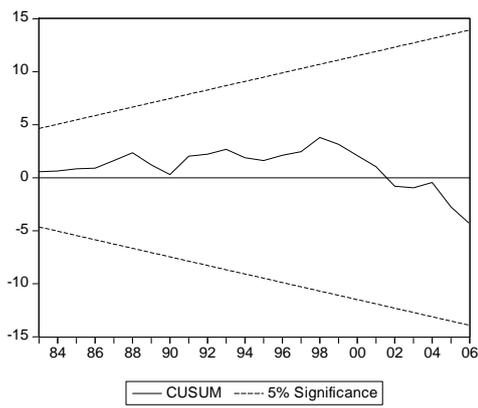
Singapore
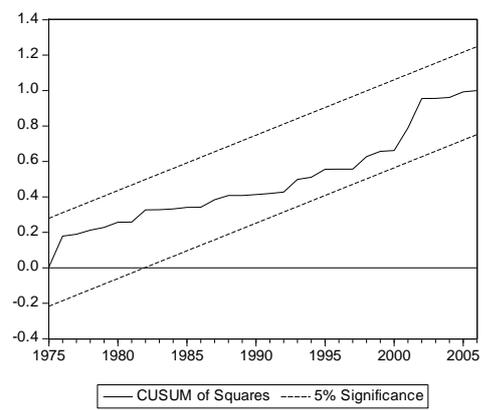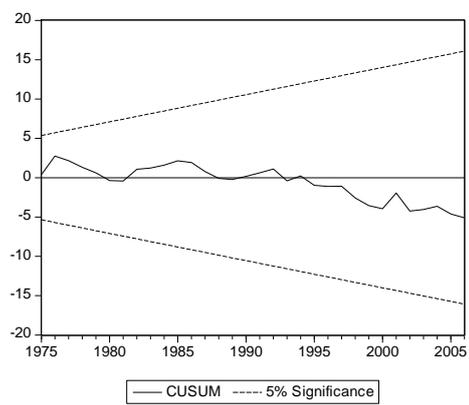
Thailand

Next, we examine the presence of long run equilibrium relationship between health expenditure and income for the ASEAN-5 economies by applying a joint significance F-test for $H_0 : \pi_1 = \pi_2 = 0$. The calculated F-statistics for bounds testing approach to cointegration are reported in Panel A, Table 2. The F-statistics for Indonesia, Singapore and Thailand are greater than the 10 per cents upper bounds critical values tabulated in Narayan (2005), meaning that the health expenditure and income are coalescing in the long run. In contrast, the calculated F-statistics suggest that these variables are not cointegrated for the case of Malaysia and the Philippines.

As the variables are cointegrated for Indonesia, Singapore and Thailand, the cointegrating coefficient together with the asymptotic significance level are computed with the following ARDL model:

$$\ln HE_t = a_0 + \sum_{j=1}^{m} b_1 \ln HE_{t-j} + \sum_{j=0}^{m} c_2 \ln Y_{t-j} + \xi_t \qquad (8)$$

The AIC was used to determine the optimal lag order for the ARDL model and the cointegrating coefficients together with the t-statistics are reported in Panel C, Table 2. From the estimation result, the sign of the long run coefficients are complied with the economic theory and our prior expectation. In line to the extant empirical studies, we also found that the long run relationship between health expenditure and income is positive and statistically significance at the conventional level for three cointegrated ASEAN countries. Nevertheless, although knowing the relationship between health expenditure and income is essential in formulating an effective macroeconomic policy, it is not a sufficient condition as the direction of causality also plays an important role. For this reason, we turn to examine the causal relationship between health expenditure and income.

4.3 Granger causality test result

It was also noted in the literature that although the presence of cointegration implies at least one causal relationship, it does not imply any explicit causal relationship (see Dolado et al., 1990). Therefore, it is of paramount important to establish the causal relationship between health expenditure and income for the ASEAN-5 economies. We employed the MWALD causality test to ascertain the causality direction between health expenditure and income within the augmented-VAR system. It was well noted in the literature that either VAR or augmented-VAR is sensitive to the lag order incorporated into the system. Thus, we used AIC to determine the optimal lag order for the augmented-VAR model. The MWALD causality test results together with the leveraged bootstrap critical values are reported in Table 3.

With the exception of Indonesia, the MWALD test statistics are consistently reveals that income Granger-cause health expenditure for Malaysia, the Philippines, Singapore and Thailand, nevertheless there is no evidence for reversal causation. This implying that the causal relationship between health expenditure and income for ASEAN-5 economies tend to

be uni-directional. The causality result that we provided in Table 3 is contrary to the finding of Tang and Evan Lau (2008), in particular for the case of Malaysia. Two potential explanations are given for this contrary result. First, the causal relationship may vary over time owing to the frequent change of political and global economic environments, hence causality result may different period of analysis has been used (see Tang, 2008). Second, the present study used the real per capital variables to examine the health-income relationship, whereas Tang and Evan Lau (2008) focused on the real term variables. Therefore, it is no surprise to obtained different estimation result. We prefer to use real per capital variables because this study involved comparison among ASEAN economies. Moreover, although our empirical evidence gives less support to the conventional wisdom, it doesn't means that policies initiatives that encourage health expenditure may be not effective in stimulating economic growth or development in the ASEAN-5 economies.

Table 3: The results of bootstrap causality tests

Null Hypothesis	MWALD test statistics	Bootstrap critical values		
		1 per cent	5 per cent	10 per cent
Indonesia:				
$\ln HE_t \nrightarrow \ln Y_t$	0.950	7.412	4.043	2.983
$\ln Y_t \nrightarrow \ln HE_t$	0.791	6.064	3.991	2.778
Malaysia:				
$\ln HE_t \nrightarrow \ln Y_t$	0.836	8.464	4.360	2.952
$\ln Y_t \nrightarrow \ln HE_t$	5.455**	6.904	3.794	3.097
Philippines:				
$\ln HE_t \nrightarrow \ln Y_t$	3.838	10.143	7.050	5.605
$\ln Y_t \nrightarrow \ln HE_t$	5.578***	11.231	6.248	4.637
Singapore:				
$\ln HE_t \nrightarrow \ln Y_t$	0.978	7.851	3.804	2.700
$\ln Y_t \nrightarrow \ln HE_t$	4.001***	8.425	4.372	3.005
Thailand:				
$\ln HE_t \nrightarrow \ln Y_t$	2.490	11.700	7.813	5.574
$\ln Y_t \nrightarrow \ln HE_t$	5.657***	10.501	6.665	5.272

Note: The asterisks *, ** and *** denote the significance level at 1, 5 and 10 per cents, respectively. The AIC statistics was used to determine the optimal lag length in the VAR system. 1000 times of bootstrap was used to compute the bootstrap critical values. The GAUSS[TM] codes have been used to compute the bootstrap critical values.

5. CONCLUDING REMARKS

Over the past decades, the health expenditure and economic growth in ASEAN-5 economies have improved greatly. For this regards, we suspect that "Health is Wealth" that may be used to boost economic growth and development in the ASEAN-5 economies. This is corroborating to Mushkin (1962) assertion that "Health as an Investment". Therefore, encourage health expenditure will stimulate the economic growth. For this reason, the intention of this study is to proof the truth of the relationship between health expenditure and income for the ASEAN-5 economies within a time series frameworks. This study covered the annual data from the period of 1970 to 2006. The bounds testing approach to cointegration and MWALD causality tests were employed to examine the presence of the long run and the causal relationships between health expenditure and income. It is interesting to note that the cointegration test results revealed that the health expenditure and income are cointegrated only for Indonesia, Singapore and Thailand. However, these variables are not co-move in the long run for the case of Malaysia and the Philippines. The long run elasticity between health expenditure and income are consistently positive and statistically significant at the conventional level (i.e. 1, 5 and 10 per cents). Beyond that, we also undertook tests of the direction of causality between health expenditure and income because it is directly relate to the effectiveness macroeconomics policies in generating sustainable economic growth. With the exception of Indonesia, the bootstrap Granger causality test results showed that the direction of causality between these variables are uni-directional running from income to health expenditure.

The findings of this study may have some important implications for policymaking regarding health expenditure and economic growth in the ASEAN-5 economies. First, although the empirical evidence shows that health expenditure does not Granger cause income growth in the ASEAN-5 economies, it doesn't means that health expenditure is not an effective policy instrument for stimulate economic growth. This is because relying on one econometrics test such as Granger causality may not be enough to identify the true causal relationship owing to omission of relevant variable(s), unequal variance, different in sample size and some other relevant factors (see also Engel, 1996; Lee et al., 2002). Therefore, the policymakers should encourage expenditure on health in order to build up a healthier and productive society. Subsequently, we believe that it will foster economic growth and development in the ASEAN-5 economies. Second, apart from generating economic growth, poverty remains as a dominant concern in most of the developing countries in Asia, thus the present health care system may be improper and inadequate (Asian Development Bank, 2006). In light to this concern, we suggest that the policymakers in ASEAN should cooperate to improve the basic health care system in particular for the lower layer or poor society. Therefore, improve the welfare and also minimise the gap of inequality distribution of health care among the ASEAN countries. Ultimately, in order to improve the quality of life for people in ASEAN economies, the health policies and corrective action have to impose frequently to ensure that the implemented health policies are appropriate and adequate for the present health care environment.

6. REFERENCES

Athukorala, P. and Sen, K. (2002) *Saving, Investment, and Growth in India*. Oxford University Press, Oxford.

Asian Development Bank (2006) *Key Indicators 2006: Measuring Policy Effectiveness in Health and Education*. Asian Development Bank

Carrion-i-Silvestre, J.L. (2005) Health care expenditure and GDP: Are they broken stationary? *Journal of Health Economics*, 24, pp. 839-854.

Clemente, J., Marcuello, C., Montañés, A. and Pueyo, F. (2004) On the international stability of health care expenditure functions: Are government and private function similar. *Journal of Health Economics*, 23, pp. 589-613.

Cheung, Y.W. and Lai, K.S. (1993) Finite-sample sizes of Johansen's likelihood ratio tests for cointegration. *Oxford Bulletin of Economics and Statistics*, 55(3), pp. 313-328.

Davidson, R. and MacKinnon, J.G. (2004) *Econometric Theory and Methods*. New York: Oxford University Press.

Davison, A.C. and Hinkley, D.V. (1999) *Bootstrap Methods and Their Application*. Cambridge University Press, Cambridge.

Dickey, D.A. and Fuller, W.A. (1979) Distribution of the estimators for autoregressive time series with a unit root. *Journal of the American Statistical Association*, 74, pp. 427-431.

Dickey, D.A. and Fuller, W.A. (1981) Likelihood ratio statistics for autoregressive time series with a unit root. *Econometrica*, 49, pp. 1057-1072.

Deaton, A.S. (1989) Saving in developing countries: Theory and review. In: *Proceedings of the World Bank Annual Conference on Development Economics 1989* (Eds) S. Fischer and D. de Tray, World Bank, Washington, D.C., pp. 61-108.

Devlin, N. and Hansen, P. (2001) Health care spending and economic output: Granger causality. *Applied Economics Letters*, 8, pp. 561-564.

Dolado, J.J., Jenkinson, T. and Sosvilla-Rivero, S. (1990) Cointegration and unit roots. *Journal of Economic Surveys*, 4(3), pp. 249-273.

Dolado, J.J. and Lütkepohl, H. (1996) Making Wald tests work for cointegrated VAR system. *Econometric Reviews*, 15(4), pp. 369-386.

Efron, B. (1979) Bootstrap methods: Another look at the jackknife. *Annals of Statistics*, 7, pp. 1-26.

Engel, C. (1996) The forward discount anomaly and the risk premium: A survey of recent evidence. *Journal of Empirical Finance*, 3, pp. 123-192.

Engle, R.F. and Granger, C.W.J. (1987) Co-integration and error-correction: Representation, estimation and testing. *Econometrica*, 55(2), pp. 987-1008.

Gerdtham, U. and Löthgren, M. (2000) On stationary and cointegration of international health expenditure and GDP. *Journal of Health Economics*, 19, pp. 461-475.

Gonzalo, J. and Lee, T.H. (1998) Pitfalls in testing for long run relationships. *Journal of Econometrics*, 2, pp. 111-120.

Granger, C.W.J. and Newbold, P. (1974) Spurious regression in econometrics. *Journal of Econometrics*, 2, pp. 111-120.

Grossman, M. (1972) On the concept of health capital and the demand for health. *Journal of Political Economy*, 80, pp. 223-255.

Hacker, R.S. and Hatemi-J, A. (2006) Tests for causality between integrated variables using asymptotic and bootstrap distribution: Theory and application. *Applied Economics*, 38, pp. 1489-1500.

Hakkio, C.S. and Rush, M. (1991) Cointegration: How short is the long run? *Journal of International Money and Finance,* 10(4), pp. 571-581.

Hall, A.D. (1994) Testing for a unit root in time series with pretest data based on model selection. *Journal of Business and Economic Statistics*, 10, pp. 321-335.

Hansen, P. and King, A. (1996) The determinants of health care expenditure: A cointegration approach. *Journal of Health Economics*, 15, pp. 127-137.

Hartwig, J. (2008) What drives health care expenditure? – Baumol's model of 'unbalanced growth' revisited. *Journal of Health Economics*, 27, pp. 603-623.

Hitiris, T. and Posnett, J. (1992) The determinants and effects of health expenditure in developed countries. *Journal of Health Economics*, 11, pp. 173-181.

Johansen, S. (2002) A small sample correction for the test of cointegrating rank in the vector autoregressive model. *Econometrica*, 70(5), pp. 1929-1961.

Lee, H.Y., Lin, K.S. and Wu, J.L. (2002) Pitfalls in using Granger causality tests to find an engine of growth. *Applied Economics Letters*, 9, pp. 411-414.

Liew, K.S. (2004) Which lag length selection criteria should we employed? *Economics Bulletin*, 3, pp. 1-9.

Lumsdaine, R. and Papell, D. (1997) Multiple trend breaks and the unit root hypothesis. *Review of Economics and Statistics*, 79(2), pp. 212-218.

Lütkepohl, H. (2005) *New Introduction to Multiple Time Series Analysis*. Springer-Verlag, Germany.

Mantalos, P. (2000) A graphical investigation of the size and power of the Granger-causality tests in integrated-cointegrated VAR systems. *Studies in Nonlinear Dynamics and Econometrics*, 4(1), pp. 17-33.

Michaud, P.C. and Soest, A.V. (2008) Health and wealth of elderly couples: Causality tests using dynamic panel data models. *Journal of Health Economics*, 27, pp. 1312-1325.

Musgrove, P., Zeramdini, R. and Carrin, G. (2002) Basic patterns in national health expenditure. *Bulletin of the World Health Organisation*, 80(2), pp. 134146.

Mushkin, S.J. (1962) Health as an investment. *Journal of Political Economy*, 70(5), pp. 129-157.

Narayan, P.K. (2005) The saving and investment nexus for China: Evidence from cointegration tests. *Applied Economics*, 37, pp. 1979-1990.

Narayan, P.K. (2006) Examining structural breaks and growth rates in international health expenditures. *Journal of Health Economics*, 25, pp. 877-890.

Nelson, C.R. and Plosser, C.I. (1982) Trends and random walks in macroeconomic time series: Some evidence and implications. *Journal of Monetary Economics*, 10(2), pp. 139-162.

Newhouse, J.P. (1977) Medical-care expenditure: A cross-national survey. *Journal of Human Resources*, 12(1), pp. 115-125.

Newhouse, J.P. (1987) Cross-national differences in health spending: What do they mean? *Journal of Health Economics*, 6, pp. 159-162.

Parkin, D., McGuire, A. and Yule, B. (1987) Aggregate health care expenditures and national income: Is health care a luxury goods? *Journal of Health Economics*, 6, pp. 109-127.

Perron, P. (1989) The great crash, the oil price shock and the unit root hypothesis. *Econometrica*, 57(6), pp. 1361-1401.

Pesaran, M.H. and Pesaran, B. (1997) *Working with Microfit 4.0: Interactive Econometric Analysis*. Oxford: Oxford University Press.

Phillips, P.C.B. (1986) Understanding spurious regression in econometrics. *Journal of Econometrics*, 33(3), pp. 311-340.

Phillips, P.C.B. and Perron, P. (1988) Testing for a unit root in time series regression. *Biometrika*, 75, pp. 335-359.

Ramesh, M. and Asher, M. (2000) *Welfare Capitalism in Southeast Asia: Social Security, Health, and Education Policies in Indonesia, Malaysia, the Philippines, Singapore and Thailand*. Basingstoke: Macmillan.

Sen, A. (2003a) On unit root tests when the alternative is a trend break stationary process. *Journal of Business and Economics Statistics*, 21, pp. 174-184.

Sen, A. (2003b) Some aspects of the unit root testing methodology with application to real per capita GDP. Manuscript, Department of Economic and Human Resources, Xavier University, Cincinnati, OH.

Shukur, G. and Mantalos, P. (2000) A simple investigation of the Granger-causality test in integrated-cointegrated VAR systems. *Journal of Applied Statistics*, 27, pp. 1021-1031.

Solow, R. (2001) Applying growth theory across countries. *World Bank Economic Review*, 15, pp. 283-288.

Samudram, M., Nair, M. and Vaithilingam, S. (2008) Keynes and Wagner on government expenditures and economic development: The case of a developing economy. *Empirical Economics*, 36(3), pp. 697-712.

Tang, C.F. (2008) Wagner's law versus Keynesian hypothesis: New evidence from recursive regression-based causality approaches. *ICFAI Journal of Public Finance*, 6(4), pp. 29-38.

Tang, C.F. and Evan Lau, P.H. (2008) Wagner versus Keynes hypotheses: Disaggregated public expenditure and income for Malaysia. In: *Proceedings of the 3rd International Borneo Business Conference 2008*, Kota Kinabalu, Sabah, Universiti Malaysia Sabah, pp. 286-296.

Toda, H.Y. and Yamamoto, T. (1995) Statistical inference in vector autoregressions with possibly integrated processes. *Journal of Econometrics*, 66(1-2), pp. 225-250.

United Nations (2007) *Measuring Human Development: A Primer*. New York, United Nations.

Wang, Z.J. and Rettenmaier, A.J. (2007) A note on cointegration of health expenditures and income. *Health Economics*, 16, pp. 559-578.

Zivot, E. and Andrews, D. (1992) Further evidence of the great crash, the oil-price shock and the unit-root hypothesis. *Journal of Business and Economic Statistics*, 10(3), pp. 251-270.