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THE NEXUS BETWEEN HEALTH AND ECONOMIC GROWTH IN SELECTED ASIAN COUNTRIES

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ABSTRACT

This study has two objectives. The first objective is to analyse the typology of the relationship between economic growth and health while the second objective is to examine short-run and long-run causality between economic growth and health. Annual data from the World Bank were used and Asian countries having at least 24 years of continuous annual data were selected for the study. The result of typology shows that countries in Asia are proportionally distributed into four cycles (virtuous, vicious, health lopsided and economic growth lopsided cycles). Lower middle-income countries have the most dynamic cycles since they are distributed into all four cycles while the other countries are only distributed into two cycles. Moreover, the results of the Granger causality test generate three conclusions. First, causality between economic growth and health is more likely to occur in the long-run than in the short-run. Second, the direction of causality is dynamic, as indicated by the causality direction in the short-run and the long-run, which are not necessarily the same. Lastly, the direction of causality between economic growth and health vary between countries. The Asian countries tend to concentrate in the long-run causality running from economic growth to health rather than running from health to economic growth.

Keywords: Causality; GDP; Economic Growth; Life Expectancy; Health; Asia.

1. INTRODUCTION

The importance of health in human development has been recognized by many countries. This is indicated by the popularity of the Human Development Index (HDI). To date, health together with education and income, as a base for a composite index in HDI, has gained popularity compared to when the concept was first introduced by the United Nations Development Programme (UNDP) in 1990. The HDI is popular with governmental bodies as well as with opposition parties and non-governmental organizations. Thus, the political value of HDI cannot be avoided. For instance, a study in Organization for Economic Co-operation and Development

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(OECD) countries shows that incumbents tend to increase public expenditure on health in election years (Niklas, 2010). Above all, the latest report on human development based on 135 countries over 40 years has concluded that development in the world tends to have a more active role in public policy and a more humane development objective (UNDP, 2010).

Asia is experiencing the most rapid human development in the world. Seven out of the ten top movers of the world's human development, from 1970 to 2010, are countries located in Asia while the bottom movers are dominated by countries in Africa (UNDP, 2010). South Korea and Indonesia are the top two movers in Asia both in non-income HDI and in income (Table 1). The report also shows that rapid income improvement is not necessarily followed by rapid non-income improvement and vice versa. For instance, Oman, Nepal and Saudi Arabia are the top movers in the non-income HDI alone while China is the top mover only in income. Countries not included in the top seven movers may also experience a rapid change in non-income HDI only, such as Libya and Iran, or in rapid change in income only such as Hong Kong China, Malaysia, Vietnam and India.

Table 1: Top Seven Movers in World's HDI, Non-Income HDI and Income in Asia, 1970-2010

Rank in top movers	Improvement in		
	HDI	Non-income HDI	Income
1	Oman	Oman	China
2	China	Nepal	South Korea
3	Nepal	Saudi Arabia	Hong Kong China
4	Indonesia	Libya	Malaysia
5	Saudi Arabia	Iran	Indonesia
6	Lao PDR	South Korea	Vietnam
7	South Korea	Indonesia	India

Source: UNDP, 2010.

Although Asia is experiencing impressive human development, studies on the relationship between economic growth and health status in this continent are still limited. The studies tend to concentrate on developed countries (Haldar, 2008). One of the latest studies in Asia was conducted by Li and Liang (2010), who claimed that their study was one of the first empirical studies on the influence of human capital represented by health and education on economic growth in Asia. In terms of methodology, studies using the Granger causality are more likely to employ health expenditure as a health indicator (among others see Erdil and Yetkiner, 2009; Devlin and Hansen, 2001; Awe and Ajayi, 2010; Narayan *et al*., 2010; Mayer, 2001; Tang, 2010a; Tang, 2010b; Hartwig, 2010; and Rao *et al*., 2008) rather than life expectancy (for example, Haldar, 2008; Mazumdar, 2000; and Zaman *et al*., 2009). Moreover, studies using life expectancy as a health indicator tend to employ a simple correlation, Ordinary Least Squares (OLS) or Two-Stage Least Squares (2SLS) regression based on cross-section or panel data (for example Preston, 2007; Ehrlich and Lui, 1991; Barro, 1996; Pritchett and Summers,

1996; Sala-I-Martin, 1997; Gupta and Mitra, 2004; Duraisamy and Mahal, 2005; Rannis and Stewart, 2005; Biggs *et al*., 2010; and Bloom *et al*., 2004). Less attention has been given to these studies because of the difficulty in separating the cause and effect and the limited availability of longer-term time series data (Gupta and Mitra, 2004).

Considering the limitations in the previous studies, this proposed study will fill the gap by contributing to the empirical literature on the Granger causality between economic growth and health status measured by life expectancy in selected Asian countries based on time series data. This study has two objectives. The first objective is to analyse the typology of the relationship between economic growth and health and the second is to examine causality between economic growth and health. The paper is organised as follows: A brief literature review on the relationship between economic growth and health is discussed in section 2. Section 3 provides an overview of economic and demographic characteristics followed by an explanation of the data and methodology in section 4. The empirical evidence is analysed in section 5 while section 6 presents the conclusion of the study.

2. LITERATURE REVIEW

The relationship between economic growth and health can be explained using the augmented endogenous growth theory. The endogenous growth theory of the neoclassical economic school of thought originally proposed by Solow, only includes technology and labour as inputs for production. The theory represented by the production function model has been augmented by accommodating human capital as an input for growth (Mankiw *et al*., 1992). This augmentation is based on the concept of capital in the neoclassical theory, which not only includes physical goods but also human capital in the form of education, experience and health (Barro, 1996). The meaning of production has also been extended in terms of goods as well as health. Health can be regarded as a durable capital stock producing healthy time as output. The initial health stock is assumed to be inherited by individuals, which depreciates with age and can be developed by investment (Grossman, 1972). Hence, the production function model may treat both economic growth and health as an input as well as output. Health, representing human capital, is an input for production while health production also requires investment represented by economic growth as an input.

Although many studies have been conducted on the relationship between economic growth and health, the findings are controversial. Based on a study covering 69 developing countries Ranis and Stewart (2005) proved a very strong two-way relationship between economic growth measured by Gross Domestic Product (GDP) per capita growth and human development measured by education and life expectancy. The same finding was also found in 65 countries by the World Bank (1993), and in 15 major states in India by Gupta and Mitra (2004). In the production function model, based on 30,856 regressions across-countries, Sala-I-Martin (1997) concluded that life expectancy strongly affects economic growth. This result has been supported by across-country studies conducted by Preston (2007) from 1938 to 1963 and Duraisamy and Mahal (2005) using panel data of 14 states in India from 1970/71 to 2000/01. In the health production model, Pritchett and Summers (1996), and Biggs *et al*. (2010), based on across-countries studies, revealed a positive significant effect of income on health status.

However, the latest report on human development shows a weak correlation between human development and economic growth (UNDP, 2010). Bourguignon *et al*. (2008) even argued that there is zero correlation between GDP per capita growth and the non-income Millennium Development Goal (MDG). Similarly, Acemoglu and Johnson (2007), based on their study in 59 countries, concluded that the increase in life expectancy does not cause more rapid growth of income per capita. Biggs et al. (2010) also found that GDP may not have any significant effect on life expectancy due to increasing poverty. The significant effect of life expectancy or mortality rate on economic growth might only occur in low-income countries (Bhargava et al., 2001) while life expectancy has almost no effect on economic growth at very high levels of life expectancy (Sachs and Warner, 1997).

Mixed results on the causal link between economic growth and life expectancy are also shown by the studies employing the Granger causality test. A study covering 92 countries from 1960 to 1990 by Mazumdar (2000) revealed various causalities according to the country's income group whereby life expectancy causes GDP per capita in all the countries, GDP per capita causes life expectancy in high-and median-income countries and life expectancy causes GDP per capita in low-income countries. Haldar's study (2008), in 15 major states in India from 1980/81 to 2005/06, also found various directions of causality between states, which are bi-directional causality between income and Infant Mortality Rate (IMR), unidirectional causality from income to IMR or from IMR to income and from health expenditure to IMR. Employing data from 1980 to 2007 in Pakistan, Zaman *et al*. (2009) concluded that life expectancy has a significant negative effect on GDP in the short-run and a non-significant positive impact in the long-run.

Other than using econometric tools, a simple typology may also be used in describing the relationship between economic growth and health status. The typology is divided into four cycles, which are able to show the relative position of each country compared to the other countries. Employing that typology in their study, Ranis and Stewart (2005) found that most developing countries were either towards an upward spiral of development (high economic growth and high human development) covering mostly East Asian countries, or in a human development trap (low economic growth and low human development) covering mostly Sub-Saharan and many Latin America countries. Latin American countries mainly had high human development and low economic growth (human development lopsidedness) while African countries were mostly on economic growth lopsidedness (low human development and high economic growth). The status of the country in the typology is dynamic. For instance, from 1960 to 2001, China, Vietnam, Malaysia and Chile moved from human development lopsidedness to the upward spiral of development (Ranis and Stewart, 2005).

3. OVERVIEW OF ECONOMIC AND DEMOGRAPHIC CHARACTERISTICS IN SELECTED ASIAN COUNTRIES

The Asian continent consists of countries with diverse economic and demographic conditions (Table 2). Countries in Asia are concentrated in the lower middle-income group (11 countries) followed by the high-income (8 countries), low-income (4 countries) and upper middle-income (2 countries) groups. A wide gap exists between countries having the highest and the lowest per capita income. Among the 25 Asian countries under study, the GDP per capita in Japan is

the highest (US $ 38,177.33) while Tajikistan (US $ 249.06) is the lowest. The GDP per capita of Japan is around 153 times higher than the GDP per capita of Tajikistan. The economic gap between countries in Asia has increased international migration between countries in this continent. Some countries mainly receive migrant workers, such as Saudi Arabia, Malaysia, Singapore, Korea and Hong Kong, while other countries, such as India, Indonesia, Bangladesh and the Philippines, mainly send migrant workers. Moreover, the GDP growth rates of countries vary considerably. Countries with relatively lower per capita income tend to have rapid GDP growth compared to countries that have higher per capita income. Six countries had negative GDP growth and three of them had high per capita income, namely, Japan, Cyprus and the United Arab Emirates. Countries with positive GDP growth rates range from the highest in China (9.1 per cent) and India (9.1 per cent) to the lowest rate in Israel (0.77 per cent) and Saudi Arabia (0.6 per cent).

Table 2: Economic and Demographic Characteristics, Selected Asian Countries, 2009 and 2010

Country	GDP Per Capita (US$) (2009) [1]	GDP Growth (%) (2009) [1]	Health Expenditure (% of total public expenditure) (2009) [1]	Population size (million) (2009) [1]	Life Expectancy (Years) (2009) [1]	HDI' rank in the world (2010)[2]
High Income Countries						
Brunei Darussalam	18149.65**	0.62**	7	0.4	77.51	Very high
Japan	38177.33	-5.23	17.92	127.56	82.93	Very high
Cyprus	15208.7	-1.02	5.83	0.87	79.77	Very high
Israel	21806.03	0.77	10.02	7.44	81.55	Very high
Oman	10779.04*	12.8*	5.76	2.85	76.14	High
Saudi Arabia	9863.18	0.6	8.38	25.39	73.43	High
United Arab Emirates	25606.81	-0.07	8.9	4.6	77.9	Very High
Bahrain	16967.80*	6.30*	10.87	0.79	76.08	Very High
Upper Middle Income Countries						
Malaysia	4992.39	-1.71	7.25	27.47	74.58	High
Iran	2168.46	1.8	8.67	72.90	71.69	High
Lower Middle Income Countries						
Indonesia	1124.06	4.55	6.86	229.96	71.18	Medium
Philippines	1214.75	1.06	6.09	91.98	72.08	Medium
Thailand	2566.56	-2.25	13.99	67.76	69.05	Medium
Vietnam	674.16	5.32	8.91	87.28	74.58	Medium
China	2206.26	9.1	10.27	1331.46	73.31	Medium
Mongolia	715.85	-1.55	10.53	2.67	66.92	Medium
Jordan	2497.29	2.33	16.14	5.95	72.94	High
Syrian Arab Republic	1349.53	4	4.62	21.09	74.42	Medium
India	766.38	9.1	4.06	1155.35	64.05	Medium
Pakistan	656.87	3.63	3.78	169.71	66.85	Medium
Sri Lanka	1232.56	3.54	7.32	20.3	74.26	Medium
Low Income Countries						
Laos	495.79	6.43	3.73	6.32	65.41	Medium
Bangladesh	482.25	5.4	7.52	162.22	66.56	Low
Nepal	260.66	4.66	8.63	29.33	67.07	Low
Tajikistan	249.06	3.40	6.43	6.95	67.01	Medium

Source: [1] World Bank, 2011 and [2] UNDP, 2010.
Notes: ** Data for 2007 and * data for 2008.

The population size in Asian countries is varied. More than one billion people live in both China and India while Indonesia, Pakistan, Bangladesh and Japan have more than 100 million people each. Asia also has countries having a population of less than 1 million – Brunei and Cyprus. The population of Asia has a relatively long life expectancy – more than 70 years – with Japan and Israel having the longest life expectancy (more than 80 years). Five countries – Bangladesh, India, Nepal, Pakistan and Thailand – have a life expectancy of less than 70 years. India has the lowest life expectancy with 64.05 years. The commitment of governments to the health of the population is indicated by the public expenditure on health. Thailand, China, Japan, Israel and Jordan have allocated more than 10 per cent of their public budget to health with Japan allocating the largest proportion of public budget on health (18 per cent). The Syrian Arab Republic, India and Pakistan are the only three countries that allocated less than 5 per cent of their budget on health. In terms of human development, in 2010, the rank of HDI in 25 Asian countries was 12 countries in the medium rank, six countries in the very high rank, five countries in the high rank and four countries in the low rank. Not all countries in the same income category had the same rank of HDI. For instance, Oman and Saudi Arabia had a lower rank of HDI than the other countries in the same high-income category, while not all low-income countries had a low rank of HDI. Out of the four low-income countries, two had medium rank and the other two had a low rank of HDI.

4. DATA AND METHODOLOGY

This study used annual data from World Development Indicators published by the World Bank. The countries with at least 24 years of continuous data up to 2009 were selected as samples, which resulted in 25 Asian countries under study. Data on Life Expectancy (LE) were used to measure health status for answering the first and the second objectives. Moreover, data on real GDP growth and real GDP were used to measure economic growth for the first and second objectives, respectively.

The study employed the typology method for the first objective. Four classifications proposed by Ranis and Stewart (2005) were adopted, namely, the virtuous cycle (high GDP growth and high LE), the vicious cycle (low GDP growth and low LE), LE lopsidedness (high LE and low GDP growth) and GDP growth lopsidedness (high GDP growth and low LE). The "high" and "low" in the typology are relative values because they depend on the mean value of each variable in all 25 countries under study as a reference category. For instance, the term "high" refers to mean value of a variable within the years of observation that is higher than the mean value of the same variable in the reference category.

The study utilized the cointegration test (Johansen and Juselius, 1990) and Granger causality test (Granger, 1988) to meet the second objective. All the data were transformed into logarithms. Prior to conducting these tests, the Phillips and Perron (PP) unit root test was conducted to ascertain the order of integration for each variable in the model in order to avoid spurious results. The PP test has an advantage of providing robust estimates for small and moderate sample sizes and when the series has serial correlation and time-dependent heteroscedasticity (Phillips and Perron, 1988). Moreover, the Granger causality test would be conducted in the Vector Error Correction Model (VECM) approach if cointegration is present (Masih and Masih,

1996). Otherwise, the Granger causality test would be conducted in a standard first difference Vector Autoregressive (VAR) model (Granger, 1988). The estimated Granger causality test is based on the following regression:

$$\Delta logLEt=\beta 0+\beta 1ii=1k\Delta logLEt-i+\beta 2ii=0k\Delta logGDPt-i+\delta\phi t-1+\eta 1t \qquad (Eq.1)$$

$$\Delta logGDPt=\gamma 0+\gamma 1ii=1k\Delta logGDPt-i+\gamma 2ii=0k\Delta logLEt-i+\mu\varepsilon t-1+\eta 2t \qquad (Eq.2)$$

Where GDP is real GDP (in US $), LE is life expectancy (in years), Δ is the first difference operator, *k* is optimal lag length, $\phi t-1$ in LE equation and $\varepsilon t-1$ in GDP equation are the error-correction term (ECT) and η is the disturbance term. The ECT is not included in the equation in the case where the variables are not cointegrated. Lag length is selected by the Schwarz information criterion. The significance of lagged error-correction term implies Granger causality towards the dependent variable. Short-run dynamics is captured by the differenced terms *ΔlogLEt–i* and *ΔlogGDPt–i*.

5. EMPIRICAL EVIDENCE

5.1. Typology analysis

The typology results show that the 25 countries under study are distributed almost proportionally into four cycles – the virtuous cycle and LE lopsided cycle (seven countries respectively), GDP growth lopsided cycle (five countries) and the vicious cycle (six countries) (Tables 3 and 4). Countries having high-, upper medium- and low- income are only distributed into two cycles while countries in the lower medium-income group are distributed into four cycles. Countries in the virtuous cycle are from all income groups except low-income countries while countries in the vicious cycle include all income groups except high-income countries. High-income countries dominate LE lopsidedness (five out of seven countries) while three lower middle- and two low-income countries are in GDP growth lopsidedness. High-income countries generally have high LE and they are either in the virtuous cycle or in LE lopsidedness. In contrast, low-income countries have low LE and they are either in GDP growth lopsidedness or in the vicious cycle. Asian top movers in HDI are also distributed into the four cycles. Oman and China are in the virtuous cycle, Nepal is in the vicious cycle, Indonesia and Lao are in the GDP growth lopsidedness and Saudi Arabia is in the LE lopsidedness. This indicates the dynamic position of each country whereby being the vast movers can help Oman and China to reach the virtuous cycle but it has not been sufficient for Nepal to exit from the current position of the vicious cycle.

Table 3: Typology of GDP Growth and LE by Income Group in Selected Asian Countries, 2010

	Number of countries by income group				
Cycles of GDP growth and LE	High Income	Upper Middle Income	Lower Middle Income	Low Income	Total
Virtuous (high GDP growth-high LE)	3	1	3	-	7
GDP growth Lopsided (high GDP growth-low LE)	-	-	3	2	5
Vicious (low GDP growth-low LE)	-	1	3	2	6
LE Lopsided (high LE-low GDP growth)	5	-	2	-	7
Total	8	2	11	4	25

Source: Analysis of the World Bank data based, 2010
Notes: Mean of GDP growth= 4.5 per cent; Mean of LE= 68.89 years

Table 4: The Typology by Countries

Cycles of GDP growth and LE	Countries
Virtuous (high GDP growth -high LE)	Oman, United Arab Emirates, Bahrain, Malaysia, China, Sri Lanka, and Vietnam.
GDP growth Lopsided (high GDP growth-low LE)	India, Indonesia, Pakistan, Bangladesh, Lao.
Vicious (low GDP growth -low LE)	Iran, Philippines, Thailand, Mongolia, Tajikistan, Nepal.
LE Lopsided (high LE-low GDP growth)	Brunei Darussalam, Cyprus, Israel, Japan, Saudi Arabia, Jordan, Syrian Arab Republic.

Source: Table 3

5.2. Causality test

Before conducting the cointegration and the causality tests, the data series for the order of integration of the series for GDP and LE were tested employing the PP test (Appendix 1). The null hypothesis of unit root cannot be rejected for the series in levels if the test regression includes either a constant, a constant and a linear time trend, or neither -especially for Cyprus and China-. However, the series can be rejected in first difference in all 25 countries at either the 1, 5 or 10 per cent levels of significance. The PP test statistic indicates that GDP and LE are stationary after first differencing (I(1)).The next step was the cointegration test. The result shows that GDP and LE are only cointegrated in 17 countries (Appendix 2), which implies the existence of long-run causality though the direction is still not clear. Furthermore, the Granger causality test was conducted based on VAR for countries where GDP and LE are not cointegrated and based on VECM for countries where GDP and LE are cointegrated (Tables 5 and 6).

Table 5: Results of Granger Causality Test

Country	Lag	LE as a Dependent Variable	GDP as a Dependent Variable	LE as a Dependent Variable	GDP as a Dependent Variable
		GDP->LE	LE->GDP	GDP->LE	LE->GDP
		Short-run (t statistic)		Long-run (t statistic)	
High Income Country					
Brunei Darussalam	1	1.01034	1.33579	No Cointegration	
Japan	1	-0.63561	-0.41225	-2.13755**	-3.94559*
Cyprus	1	0.12638	-1.75987***	-3.08975*	0.30953
Israel	1	0.25405	-0.2403	-4.81734*	2.65228*
Oman	2	-2.35177**	-0.37812	-4.41055*	-0.29965
Saudi Arabia	2	-1.7148***	0.33891	-5.19186*	-0.24784
United Arab Emirates	1	0.60161	1.393	No Cointegration	
Bahrain	1	1.20038	-0.81545	-3.86894*	3.32483*
Upper Middle Income Country					
Malaysia	1	0.35271	-0.02441	-4.19498*	-0.81231
Iran	2	1.24016	1.91083***	No Cointegration	
Lower Middle Income Country					
Indonesia	2	0.40388	-0.72936	4.41896*	1.13209
Philippines	4	1.41116	-0.75008	No Cointegration	
Thailand	2	-0.71999	1.77303***	3.1505*	1.377
Vietnam	2	-0.70367	1.19462	-3.44239*	0.50103
China	1	-0.17336	-1.55179	-5.73827*	-1.35694
Mongolia	2	-0.29999	0.8847	No Cointegration	
Jordan	3	0.37329	-0.93273	-3.23539*	-0.55888
Syrian Arab Republic	2	-0.25925	-0.40653	-3.96445*	-0.46764
India	1	-1.15288	0.60952	-3.78922*	2.9811*
Pakistan	1	0.43713	-1.02549	-2.83564*	-0.75444
Sri Lanka	*1*	*0.24877*	*1.00638*	*-2.99854**	*1.29779*
Low Income Country					
Lao	2	-0.45204	1.08868	-3.7916*	2.63449*
Bangladesh	2	-1.76058***	-0.33806	No Cointegration	
Nepal	2	-1.53213	-0.48462	No Cointegration	
Tajikistan	1	-0.74486	3.00747*	No Cointegration	

Notes: The asterisks (*), (**) and (***) denote rejection of the corresponding non-causality hypothesis at the 1 %, 5 % and 10% respectively. Lag length was selected on the basis of the Schwarz criterion.

Table 6: Summary of Granger Causality Tests

Direction of causality	Short-run (Countries)	Long-run (Countries)
GDP causes LE	Oman, Saudi Arabia, Bangladesh.	Japan, Cyprus, Israel, Oman, Saudi Arabia, Bahrain, Malaysia, Indonesia, Thailand, Vietnam, China, Jordan, Syrian Arab Republic, India, Pakistan, Sri Lanka, Lao.
LE causes GDP	Cyprus, Iran, Thailand, Tajikistan.	Japan, Israel, Bahrain, India, Lao.
Bi-directional causality	-	Japan, Israel, Bahrain, India, Lao.
No-causality	Brunei Darussalam, Japan, Israel, Oman, Bahrain,United Arab Emirates, Malaysia, Indonesia, Philippines, Vietnam, China, Mongolia, Jordan, Syrian Arab Republic, India, Pakistan, Sri Lanka, Lao.	Brunei Darussalam, United Arab Emirates, Iran, Philippines, Mongolia, Bangladesh, Nepal, Tajikistan.

Source: Table 5

The results of the causality test show that the causal link between GDP and LE is more likely to occur in the long-run than in the short-run. Each direction of causality from GDP to LE and from LE to GDP occurs in more countries in the long-run than in the short-run. Only seven countries have short-run causality. Meanwhile 17 countries having cointegration have long-run causality in at least one direction either from GDP to LE (17 countries) or LE to GDP (five countries). Bi-directional causality between GDP and LE does not occur in the short-run but it occurs in five countries in the long-run.

The causality direction is dynamic. Causality between GDP and LE in the short-run does not necessarily sustain in the long-run because they either do not have any long-run causality or their direction of causality changes in the long-run. As many as 15 out of 17 countries having long-run causality from GDP to LE have either no-causality in the same direction or no-causality at all in the short-run. Oman and Saudi Arabia are the only countries having causality direction from GDP to LE both in the short-run and in the long-run while Bangladesh only has causality direction from GDP to LE in the short-run and no-causality in the long-run. None of the countries with long-run causality from LE to GDP has short-run causality in the same direction meaning that it takes a long time for LE to cause GDP. Four countries, namely, Cyprus, Iran, Thailand and Tajikistan, have short-run causality from LE to GDP but the direction of causality does not sustain in the long-run. The direction of causality in Cyprus and Thailand has changed to from GDP to LE in the long-run while Iran and Tajikistan do not have any long-run causality.

The study also found various directions of causality between GDP and LE by countries which are running from GDP to LE, LE to GDP, bi-directional causality and no-causality. In the short-run, the number of countries having the causality from GDP to LE (three countries) is almost

the same as the causality from LE to GDP (four countries). However, in the long-run the number of countries having the causality from GDP to LE (17 countries) is more than three times those having the causality from LE to GDP (5 countries).

6. CONCLUSION

This study has attempted to answer two objectives, which are the typology of the relationship and short-run and long-run causality between economic growth and health status. Based on the results of GDP growth and LE typology, the study found no concentration in the Asian countries in a particular cycle of GDP growth and LE. This is indicated by the insignificant number of countries distributed into the four cycles (virtuous cycle, GDP growth lopsidedness, vicious cycle and LE lopsidedness). Lower middle-income countries have the most dynamic cycles since they are distributed into four cycles while countries in the other income categories are only distributed into two cycles. High-income countries dominate LE lopsidedness while lower middle and low-income countries are in GDP growth lopsidedness. This is similar to the finding of Ranis and Stewart (2005) in mostly Latin American countries for health lopsidedness and in mostly African countries for economic growth lopsidedness.

The study also examined short-run and long-run causality between GDP and LE in the second objective. Three conclusions can be generated by the study. First, causality between GDP and LE is more likely to occur in the long-run than in the short-run indicating that changing economic growth typically may not cause health immediately and vice versa. Second, the direction of causality is dynamic whereby countries may have a different direction of causality between the short-run and the long-run. The countries may also have only short-run causality or only long-run causality. For instance, Iran and Tajikistan have only short-run causality running from LE to GDP and they do not have any causality in the long-run. This finding is supported by Zaman et al. (2009) who found that health causes economic growth in the short-run but health does not cause economic growth in the long-run.

Third, the direction of causality between GDP and LE is varied, being from GDP to LE, from LE to GDP, bi-directional causality and no-causality. The first three types of causality are similar to the findings of Mazumdar (2000) and Haldar (2008) who found various directional causality in their study. These findings are also supported by Rannis and Stewart (2005) and Gupta and Mitra (2004) who revealed a strong two-way relationship between economic growth and human development. Finding on the direction of causality from LE to GDP in this study is confirmed by Sala-I-Martin (1997), Preston (2007), Duraisamy and Mahal (2005) and Bhargava et al. (2001) while the direction of causality from GDP to LE supports the findings of Mazumdar (2000), Pritchett and Summers (1996) and Biggs et al. (2010). Moreover, no-causality between GDP and LE found by this study is similar to the findings of Bourguignon et al. (2008), Acemoglu and Johnson (2007), and Sachs and Warner (1997) concerning the weak correlation between economic growth and health. The long-run causality running from GDP to LE seems to dominate the type of causality between GDP and LE. This indicates that the health production function model (Grossman, 1972) is more likely to hold in explaining the relationship between economic growth and health in the Asian countries compared to the classic production function model. Government in Asia tend to view health as a durable capital stock, which has to be developed by investment requiring economic growth.

The main limitation of this study is a limited number of observations which may affect the result. Nevertheless, based on the findings, the study recommends that the policy to improve economic growth and health cannot be generalized for all countries since not all countries have the same pattern of causality between economic growth and health. Some countries should pay more attention to economic growth since it will affect health while the other countries should pay more attention to health since good health or good quality of human capital will contribute to economic growth. Some countries even have bi-directional causality where both policies in economic growth and health should be carried out together because they are complimentary. The study also found that economic growth and health may not have any causal link. It means that economic growth or health is determined by factors other than health and economic growth. Last but not least, a series of positive shock and effective government policy, as argued by Strulik (2004), will help countries that are in the vicious cycle to exit from the population trap.

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APPENDIX

Appendix 1: Results of Phillips-Perron Test

Country			LGDP	LLE
Brunei Darussalam	**Level**	**Constant**	-1.978283	-1.306793
		Constant, Trend	-2.711033	-2.953295
	1st Δ	**Constant**	-4.519301*	-10.21996*
		Constant, Trend	-4.511062*	-13.79345*
Japan	**Level**	**Constant**	-7.988894*	-3.227682
		Constant, Trend	-1.758300	-2.819677
	1st Δ	**Constant**	-2.1583	-8.683843*
		Constant, Trend	-4.547972*	-10.42436*
Cyprus	**Level**	**Constant**	-5.06723*	-2.194862
		Constant, Trend	-3.905238**	-3.185415
		None	5.813492	6.448481
	1st Δ	**Constant**	-4.524614*	-7.257806*
		Constant, Trend	-6.829145*	-7.878476*
		None	-3.303940*	-3.240995*
Israel	**Level**	**Constant**	-2.241298	0.435232
		Constant, Trend	-2.131678	-8.076661*
	1st Δ	**Constant**	-4.293383*	-15.46213*
		Constant, Trend	-4.770524*	-16.27477*
Oman	**Level**	**Constant**	-2.166058	-3.807584*
		Constant, Trend	-1.494655	1.010081
	1st Δ	**Constant**	-3.621563*	-6.489556*
		Constant, Trend	-3.7699**	-9.301051*
Saudi Arabia	**Level**	**Constant**	-3.328474**	-11.42474*
		Constant, Trend	-2.874548	-2.213215
	1st Δ	**Constant**	-2.874710***	-7.089085*
		Constant, Trend	-3.417654***	-13.15598*
United Arab Emirates	**Level**	**Constant**	-1.152616	-1.343333
		Constant, Trend	-2.29779	-1.672466
	1st Δ	**Constant**	-4.368675*	-5.916561*
		Constant, Trend	-4.323175*	-5.888312*
Bahrain	**Level**	**Constant**	1.784697	-3.7915*
		Constant, Trend	-4.374163*	-2.405969
	1st Δ	**Constant**	-4.515461*	-6.633585*
		Constant, Trend	-5.349755*	-11.40519*
Malaysia	**Level**	**Constant**	-1.454775	-5.217495*
		Constant, Trend	-1.178773	-2.013231
	1st Δ	**Constant**	-5.408022*	-8.979163*
		Constant, Trend	-5.634078*	-12.57335*
Iran	**Level**	**Constant**	-1.810689	-5.228119*
		Constant, Trend	-2.520106	-2.585803
	1st Δ	**Constant**	-3.284347**	-13.12505*
		Constant, Trend	-3.283435***	-20.49874*

Country			LGDP	LLE
Indonesia	**Level**	**Constant**	-0.456332	-4.182253*
		Constant, Trend	-1.497543	-0.774670
	1st Δ	**Constant**	-4.733938*	-10.71810*
		Constant, Trend	-4.690368*	-16.46201*
Philippines	**Level**	**Constant**	-1.166908	-1.087453
		Constant, Trend	-1.96492	-5.489138*
	1st Δ	**Constant**	-3.805365*	-18.76304*
		Constant, Trend	-3.831988**	-22.23846*
Thailand	**Level**	**Constant**	-2.123343	-2.563404
		Constant, Trend	-0.451293	-0.71825
	1st Δ	**Constant**	-3.520776**	-8.293398*
		Constant, Trend	-4.074359**	-9.344572*
Vietnam	**Level**	**Constant**	1.166195	-5.537305*
		Constant, Trend	-3.132725	-0.340847
	1st Δ	**Constant**	-2.944669***	-5.932703*
		Constant, Trend	-2.954064	-25.35231*
China	**Level**	**Constant**	-1.454775	-6.439570*
		Constant, Trend	-1.178773	-4.687309*
		None	7.181462	2.608029
	1st Δ	**Constant**	-5.408022*	-4.657636*
		Constant, Trend	-5.634078*	-5.761632*
		None	-3.576096*	-1.828746***
Mongolia	**Level**	**Constant**	-0.100838	-1.695796
		Constant, Trend	-1.726362	-4.781075*
	1st Δ	**Constant**	-7.205767*	-10.56381*
		Constant, Trend	-7.376463*	-12.93085*
Jordan	**Level**	**Constant**	-1.934249	-4.660091*
		Constant, Trend	-3.236809***	-2.842981
	1st Δ	**Constant**	-4.853811*	-8.829852*
		Constant, Trend	-4.767784*	-20.98196*
Syrian Arab Republic	**Level**	**Constant**	-1.545160	-5.444199*
		Constant, Trend	-1.995150	-0.654316
	1st Δ	**Constant**	-8.511699*	-10.51933*
		Constant, Trend	-8.680962*	-19.41244*
India	**Level**	**Constant**	6.197826*	-7.055039*
		Constant, Trend	1.125854	-1.881411
	1st Δ	**Constant**	-6.336423*	-9.144924*
		Constant, Trend	-8.997276*	-20.02406*
Pakistan	**Level**	**Constant**	-2.221451	-2.285077
		Constant, Trend	-1.344754	-4.433526*
	1st Δ	**Constant**	-5.746428*	-10.37989*
		Constant, Trend	-6.168319*	-12.00980*
Sri Lanka	**Level**	**Constant**	0.951009	-2.224241
		Constant, Trend	-2.638929	-1.805892
	1st Δ	**Constant**	-5.506445*	-8.854696*
		Constant, Trend	-5.507231*	-9.435552*

Country			LGDP	LLE
Lao	**Level**	**Constant**	1.476307	-2.544804
		Constant, Trend	-2.653502	-3.088439
	1st Δ	**Constant**	-4.247990*	-11.54636*
		Constant, Trend	-4.647219*	-16.02003*
Bangladesh	**Level**	**Constant**	2.171466	-0.088555
		Constant, Trend	-0.371294	-2.089571
	1st Δ	**Constant**	-6.263649*	-13.91635*
		Constant, Trend	-6.977727*	-14.00871*
Nepal	**Level**	**Constant**	2.413822	0.945563
		Constant, Trend	-1.743873	-6.657710*
	1st Δ	**Constant**	-8.575785*	-16.42624*
		Constant, Trend	-9.863520*	-16.25833*
Tajikistan	**Level**	**Constant**	-1.415948	1.240017
		Constant, Trend	-0.987486	-0.723604
	1st Δ	**Constant**	-2.860836***	-4.420476*
		Constant, Trend	-3.022060	-10.44535*

Notes: The asterisks (*), (**) and (***) denote significant at the 1%, 5% and 10 % levels

Appendix 2: Results of Johansen – Juselius Cointegration Test

Country	No. of years	Rank (r)	Max-Eigen Statistic	Trace Statistic
Brunei Darussalam	34	0	10.47863	12.04415
		≤1	1.565515	1.565515
Japan	49	0	21.17677*	25.4536*
		≤1	4.276829	4.276829
Cyprus	34	0	18.76825*	18.80909*
		≤1	0.040839	0.040839
Israel	44	0	35.64215*	37.87107*
		≤1	2.228915	2.228915
Oman	48	0	25.6772*	33.31565*
		≤1	7.638448	7.638448
Saudi Arabia	41	0	28.40345*	29.16394*
		≤1	0.760488	0.760488
United Arab Emirates	36	0	3.37342	5.296529
		≤1	1.923109	1.923109
Bahrain	28	0	20.44113*	20.66379*
		≤1	0.222658	0.222658
Malaysia	49	0	16.24756**	18.82941**
		≤1	2.581852	2.581852

Country	No. of years	Rank (r)	Max-Eigen Statistic	Trace Statistic
Iran	44	0	16.56105	21.69321
		≤1	5.132157	5.132157
Indonesia	49	0	31.26001*	36.5762*
		≤1	5.316192**	5.316192**
Philippines	49	0	5.344355	7.888517
		≤1	2.544162	2.544162
Thailand	49	0	17.6568**	22.75449**
		≤1	5.09769	5.09769
Vietnam	25	0	14.71153**	17.21737**
		≤1	2.505832	2.505832
China	49	0	23.41776*	23.58052*
		≤1	0.162762	0.162762
Mongolia	28	0	5.79472	8.703702
		≤1	2.908981	2.908981
Jordan	34	0	15.65829**	15.86247**
		≤1	0.204173	0.204173
Syrian Arab Republic	49	0	15.78559*	17.07747*
		≤1	1.291878	1.291878
India	49	0	47.12996*	50.67677*
		≤1	3.546811	3.546811
Pakistan	49	0	30.04624*	30.14806*
		≤1	0.10182	0.10182
Sri Lanka	49	0	22.10653*	23.39632*
		≤1	1.289785	1.289785
Lao	25	0	23.93013*	26.86314*
		≤1	2.933007	2.933007
Bangladesh	49	0	10.17944	14.81844
		≤1	4.638997	4.638997
Nepal	49	0	12.22067	12.34035
		≤1	0.119673	0.119673
Tajikistan	24	0	6.138751	6.800516
		≤1	0.661765	0.661765

Notes: Rank (r) denotes the number of cointegration equations for each tested hypothesis. Lag length was selected on the basis of the Schwarz criterion. The asterisks (*) and (**) denote significant at the 1% and 5% levels respectively.