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A COMPARATIVE STUDY ANALYSING THE DEMOGRAPHIC AND ECONOMIC FACTORS AFFECTING LIFE EXPECTANCY AMONG DEVELOPED AND DEVELOPING COUNTRIES IN ASIA



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ABSTRACT

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Keywords

Life expectancy at birth
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Population growth
Gross national income per capita
Gross savings
Total health expenditure
Labour force participation rate.

The two aims of the study are to analyse the demographic and economic factors affecting the life expectancy at birth among three developed and three developing countries in Asia, and to assess the gap between the developed and developing countries, based on the determinant factors of life expectancy. The sample consists of secondary data collected from 1990 to 2013. The demographic factors include the crude birth rate, crude death rate and population growth, while the economic factors consist of the Gross National Income (GNI) per capita, gross savings, total health expenditure and labour force participation rate. The factors affecting the life expectancy at birth were analysed by both the linear and logarithmic regression approaches. The logarithmic model was chosen to explain the objectives of the study due to the presence of anomalies in the linear model. The obtained results demonstrate the presence of a gap between the developed and developing countries. It is observed that the crude birth rate and the total health expenditures significantly affect the life expectancy in the three developed countries. However, the rise in the life expectancy in the developing countries cannot be explained by a specific regressor, and may occur due to country-based changes in the demographic or economic factors.

Contribution/ Originality: This paper suggests that different types of demographic and economic factors may have a different impact towards life expectancy. Unlike other studies, this study differentiates between the developed and developing countries using both linear and logarithmic regression approaches.

1. INTRODUCTION

Life expectancy reflects the health status of a country. The previous decades have experienced a drastic rise in the life expectancy around the globe, mainly due to the demographic transition and economic development of countries. Most of the Asian countries being embarked upon a major demographic transition have seen populations move from regimes of high fertility and mortality to regimes of low fertility and mortality (Wei and Hao, 2010). The transition led to a change in the population structure, due primarily to a drop in fertility, which caused the population at younger ages to shrink. This was preceded by a lower mortality rate due to advance in medicine which led to an increase in the working population in later years as well as a rise in the old-age population (Bloom

and Williamson, 1998). These mortality declines mean continuing increases in life expectancy. Improvement in the economic development of Asian countries is mainly caused by changes in the percentage of the working population which led to a rise in the gross national income (GNI) per capita, and thus more resources are available for the government's expenditure to promote the lives of their citizens.

Asia consists of countries belonging to the different income economies and thus, it is thought that according to the income group of the country, the life expectancy at birth may alter. According to the World Bank income group classification, in 2015, Japan, the Republic of Korea and Singapore were categorised as high income economies, and thus are referred to as developed countries. On the other hand, India and Bangladesh belonged to the lower-middle income economies group and Malaysia belonged to the upper-middle income economies group, such that the three countries are referred to as developing countries. The gap between developed and developing countries is also reflected in their life expectancies. In 2015, the World Health Organization displayed the developed countries Japan, Singapore and South Korea, to have an overall life expectancy at birth of 84, 83 and 82 respectively. On the other hand, Malaysia, Bangladesh and India were observed to have an overall life expectancy at birth of 74, 71 and 66 respectively, thus a difference of 18 years between the life expectancy of Japan and that of India.

Developed countries are known to have outpaced developing and under-developed countries in respect to their demographic structure as well as their economies. The main reason is due to the fact that developed countries are expected to have reached their goals by having an ideal economic structure and are intending to sophisticate their economies and global image. On the opposite side, developing countries are still in the transition of demographic and economic changes, and thus they can be compared to with developed countries so as to apply changes to their current models and hence reach their expected economic goals.

This study aims at analysing the demographic and economic factors affecting life expectancy among the three developed and three developing countries in Asia. Moreover, a comparison of the demographic and economic factors will be analysing the two types of economies.

2. LITERATURE REVIEW

Fertility is measured through indicators such as crude birth rate per 1000 living individuals and total fertility rate. Previous research explained that during the demographic transition, decline in the crude birth rate reflected an incline in the life expectancy at birth. Wei and Hao (2010) explained that as crude birth rate being at its peak in 1963 gradually declined due to the family planning program implemented by the government, the life expectancy significantly increased from 36 years to 73 years. Kabir (2008) analysed the determinant factors of life expectancy from both linear and log-linear regression approaches. Results obtained from the linear model showed a rise of 10 percent in the total fertility rate triggered a fall of about 11 percent of the life expectancy at birth. The parameter estimate for the total fertility rate was found to be statistically insignificant for both the regression models but the result was not omitted due to the high marginal influence.

Mortality is determined by indicators such as crude death rate per 1000 living individuals and mortality rate. Previous studies explained the decline in crude death rate which caused a rise in the life expectancy. Bloom and Williamson (1998) pointed out that the decline in the crude death rate started by the end of the 1940s and this led to a rise in the life expectancy at birth, within a time period of 1960 to 1992, from 61.2 to 74.6 years in East Asia, from 51.6 to 67.2 years in Southeast Asia, and from 46.9 to 60.6 years in South Asia. The principle reasons for a decline in mortality in Asia are due to government intervention through public health programs and the medical advances which led to the manufacturing of drugs at lower cost.

During the Asian demographic transition, since the crude birth rate declined to a higher extent compared to the crude death rate, the population growth was seen to decrease substantially. Wei and Hao (2010) explained that the relationship between life expectancy and population growth was viewed as negative and moderate. Bilas *et al.* (2014) explained the result generated from a logarithmic regression model showed that the population growth rate

was statistically insignificant at the one percent level of significance such that it has no significant impact on the life expectancy of the countries forming part of the European Union. The insignificance of population is due to its fluctuation within the time interval of the study such that no relationship was observed between life expectancy at birth and population growth.

The economic behaviour of a nation defines its productiveness and identifies in which income economies the nation belongs to. Previous studies showed that the relationship between life expectancy and GDP per capita (in current USD) is positive such that countries with higher life expectancies are expected to belong to high income economies. *Bilas et al. (2014)* explained that the GDP per capita (in current USD) contributed significant to the logarithmic model. The result also demonstrated that in poor countries, as the GDP increases by a small amount, the life expectancy at birth of the countries increases. However, as GDP continues to flourish, the life expectancy of the countries increases at a decreasing rate.

The savings rate is a macroeconomic factor which provides an understanding of the consumption and saving pattern of the population of a country. *Bloom et al. (2003)* analysed the relationship between savings rates and life expectancy from a standard model of life-cycle saving. The results showed that the relationship between life expectancy and savings rates at each age group – youth, working age, and retirement – was strongly positive and significant. They concluded that as the savings behaviour increases, the healthier the populations' lives such that the life expectancy improved.

The input of the health care system is explained as the amount of resources used to promote the health status of a nation. Previous studies show that an increase in the health expenditures causes the life expectancy at birth to rise. *Jaba et al. (2014)* explained that from the fixed effects panel regression model, results a significant positive relationship between life expectancy and health expenditures for the four types of income groups. The result also explained that the effect of health expenditures on life expectancy is different of each of the income groups whereby the highest effect was obtained from the lower-middle income group and the smallest effect was obtained from the high income group. The working population of a nation is observed through indicators such as labour force participation rate. *Aisa et al. (2012)* explained the positive relationship between life expectancy and labour force participation rate. In the early 1990s, due to advance in technology, the labour force was exposed to less physically demanded workplaces, such the labour participants were less exposed to the risk of permanent injury or death on their workplace, thus improving their health status. This effect triggered a decline in the amount of early retirees and an incline deferred retirement due to healthier lifestyles. Hence, the overall labour force participation rate was observed to increase significantly leading to a rise in the life expectancy due to the presence of a healthier labour force.

3. METHODOLOGY

Secondary data has been collected from the World Bank databank within the time period as from 1990 to 2013 on an annual basis. Due to large number of missing values present most of the variables, the collection of data begins as from 1990. Table 1 represents the variables being used in the study as well as the outcome each of the independent is expected to have on the dependent variable. The study will focus on six Asian countries, whereby the developed countries are Japan, the Republic of Korea and Singapore, and the developing countries are Bangladesh, India and Malaysia.

From the descriptive statistics whereby the dataset of the eight variables for the three developed countries and the three developing countries were each combined, it can be seen that there is a significant gap between the life expectancy of the developed and developing countries. the mean of the life expectancy at birth of developed countries is 78.8 and that of developing countries is 67.1 which shows a difference of more than 10 years. When viewing the demographic factors, the crude birth rate in developing countries is observed to be relatively high, whereby the former's mean exceeds the mean of crude birth rate in developed countries by 13 newborns per 1000

living individuals. The range of the crude death rate for both developed and developing countries is found to be almost the same. The population growth in developed countries is found to have a wider range compared to the developing countries with a standard deviation of 1.31 for the developed countries and 0.43 for the developing countries. The gap between the developed and developing countries based on the GNI per capita is found to be significantly large, whereby the minimum value of the GNI per capita in developed countries is \$6480 while that of developing countries is \$310.

Table-1. Abbreviation of the variables

Notation	Name, as per World Bank	Expected impact on life expectancy at birth
LEB	Life expectancy at birth	-
CBR	Crude birth rate, per 1000 living individuals	Negative
CDR	Crude death rate, per 1000 living individuals	Negative
POPGR	Population growth rate (referred to as annual population growth)	Negative
GNI	Gross national income per capita, in current USD	Positive
GSAV	Gross savings, as a percentage of the GDP	Positive
HEALTH	Total health expenditure, as a percentage of GDP Labour force participation rate, total as the percentage of the population	Positive
LABOUR	aged from 15 to 64	Positive

Due to the existence of missing values for the HEALTH variable for the years 1990 to 1994, a missing value analysis is performed on the dataset. The Little's MCAR test, whereby MCAR stands for Missing Completely at Random, is then performed on the dataset so as to determine whether the values for the variable(s) are missing completely at random. If the p – value of the Little's MCAR test is more than 5%, this shows that the values are missing at complete randomness and the missing values can be imputed by using multiple imputation. On the other hand, if the p – value of the Little's MCAR test is less than 5% this shows that the values are not random such that the missing values are imputed by using the Expectation Maximisation method. It is noted that for all six countries, the p – value of the Little's MCAR test is less than five percent and thus, the missing data is imputed through the Expectation Maximisation (EM) method.

Three data assumptions are made in this study. Firstly, the net migration for each country is considered to be negligible for the chosen time period of the study. This is mainly due to the fact that the immigrants who come from foreign countries may bring along their cultures, traditions and habits to the country in which they are currently residing. As such, this may affect the life expectancy of that particular country due to the better life styles of these individuals. The second assumption made is that the countries being analysed in this study are considered to form part of the same income classification to which they currently belong. It must however be noted that South Korea fluctuated between the high income group and the upper-middle income group but was considered to be a developed country since 2000 according to World Bank. Moreover, the labour force participation rate focuses on economically active individuals aged from 15 to 64.

The logarithmic transformation is performed on the original data. The Pearson correlation analysis was performed on both the original data and the transformed data to confirm the expected relationship of the independent variables with the life expectancy at birth analysed in the literature. The correlation coefficient analysed in the study corresponds to the expected correlation explained in the literature expect for two cases. The relationship between life expectancy and crude death rate for Japan is found to be strongly positive, differing from the expected negative relationship between the variables. When considering the relationship between life expectancy and gross saving, a strong negative correlation coefficient is observed for Japan, differing from an expected positive relationship. Moreover, the correlation coefficient for the labour force participation rate is found

to be strongly negative for the three developing countries, differing from an expected positive relationship. The correlation coefficients for the logarithmic transformation are found to behave in the same way as that for the original data, with similar coefficients and significance. The four assumptions for the Pearson correlation analysis were tested for all eight variables for the six countries and were found to be mostly satisfied. However, the Pearson correlation analysis was explained to be inconclusive since insignificant correlation coefficients were observed to satisfy all the Pearson correlation's assumptions.

The regression analysis was performed on both the linear model and the log-log model. The linear regression model and the logarithmic regression model will be generated as follows:

$$LEB = \beta_0 + \beta_1 CBR + \beta_2 CDR + \beta_3 POPGR + \beta_4 GNI + \beta_5 GSAV + \beta_6 HEALTH + \beta_7 LABOUR$$

$$\log LEB = \beta_0 + \beta_1 \log CBR + \beta_2 \log CDR + \beta_3 \log POPGR + \beta_4 \log GNI + \beta_5 \log GSAV + \beta_6 \log HEALTH + \beta_7 \log LABOUR$$

The regression models are reduced by using the Stepwise method. Hence, the assumptions are tested on the reduced regression models which comprise only of regressors which contribute significantly to the model. The linearity and homoscedasticity assumptions were seen to be satisfied for all the six countries. The normality assumption is found to be violated for three countries – South Korea, Bangladesh and India – for the linear model and the assumption was not satisfied for Malaysia for the log – log model. The normality and independent of error terms assumptions were viewed to be satisfied for most of the countries. The violation of the normality assumption for these four cases is due to the presence of a curve pattern observed in the Normal P-P plot. [Bhuiyan et al. \(2011\)](#) explained that though the presence of a slight curved line in the normal plot of residuals, no abnormalities is present in their study such that the normality assumption is satisfied. The violation of the independence of error terms was observed by Malaysia for both the linear model and log-log model. This can be explained by the fact that the variables being used in this study consist of time series data such that it was expected that for some models, the error terms are dependent on the time period ([Garson, 2012](#)).

Moreover, the multicollinearity analysis was performed on the linear and the log-log models to identify the presence of severe multicollinearity in the models. Severe multicollinearity was obtained for both the linear and log-log models for Bangladesh and India. The models for these two countries were reduced by removing the regressors showing strong multicollinearity.

After analysing the assumptions as well as the outputs of the reduced linear model and the reduced log-log model, the model representing the regressors as well as the life expectancy to a higher extent was chosen. The designated model was the logarithmic model, mainly due to the fact that the linear model showed several anomalies which could not be well explained. An issue encountered for the linear model is that for countries having the GNI variable as a significant regressor contributing to the model, the parameter estimates, are found to be equal to zero for Japan and Malaysia. This contradictory value of zero for the parameter estimate for both Japan and Malaysia shows that the linear regression model is showing some weaknesses which cannot be explained. Another major problem faced by the linear model after the multicollinearity analysis is that when reducing the linear regression model for India, only one significant variable, which is the crude birth rate, was chosen by the Stepwise Method. This issue in this case is that the standard process for the Stepwise Method is to select the first independent variable with a p-value less than five percent such that CBR variable was the first chosen regressor. However, other regressors such as CDR, POPGR and GNI are selected for the other models through the Stepwise Method, thus showing that they also have a p-value of less than five percent. Hence, the linear model for India is biased.

4. RESULTS

Table 2 displays the output of the log-log regression model after assessing the presence of severe multicollinearity in the models and reducing the models for India and Bangladesh.

4.1. Crude Birth Rate

Crude birth rate is found to contribute significantly to the logarithmic model for the developed countries – Japan, South Korea and Singapore. The negative significant impact of crude birth rate on the life expectancy at birth for the three developed countries corresponds to the expected outcome of fertility on life expectancy elaborated in the literature by Kabir (2008). Fertility is considered to have an indirect effect on life expectancy at birth. The decline in the crude birth rate is considered to be an outcome in the decline in the infant mortality rate (Bloom and Williamson, 1998).

Table-2. Output of the Log-log model for the six countries after assessing multicollinearity

Log – log Model						
Variables	Developed Countries			Developing Countries		
	Japan	South Korea	Singapore	Malaysia	Bangladesh	India
Constant	2.082	1.720	1.151	1.850	1.960	2.070
logCBR	-0.102	-0.117	-0.082			
logCDR		0.177	0.051		-0.236	-0.264
logPOPGR		0.037		-0.084		-0.104
logGNI	-0.030				0.022	
logGSAV		0.071	-0.022	0.026		
logHEALTH	0.071	0.068	0.021			
logLABOUR			0.446			
F – test Sig.	0.000	0.000	0.000	0.000	0.000	0.000
Adjusted R^2	0.955	0.992	0.994	0.963	1.000	1.000

Moreover, it can be understood that as fertility decreases due to government invention through contraceptive measures and family planning programs, an improvement in the lifestyle of individuals and the accessibility to vaccines cause the infants to live a healthier life, thus leading to an incline in the life expectancy at birth.

4.2. Crude Death Rate

The crude death rate is found to be significant for four countries, namely, South Korea, Singapore, Bangladesh and India. The parameter estimates for crude death rate is observed to be positive for South Korea and Singapore, whereas life expectancy at birth is found to be negativity affected by crude death rate in Bangladesh and India, by holding the other regressors constant. The negative significant relationship between life expectancy at birth and crude death rate for Bangladesh and India is reflected in the literature. It can thus be understood that as crude death rate decreases due to medical progress and improvement in the lifestyles of individuals (proper sanitation and access to potable water), this has led to an improvement in the health status of individuals such that the life expectancy at birth increases.

However, the positive significant impact of crude death rate on life expectancy at birth for South Korea and Singapore contradicts the explanation in the literature review. One valid explanation to the outcome is due to the fact that the old age population, which is defined as the population aged 65 and above, is relatively high for the three developed countries – Japan, South Korea and Singapore. The old age population as a percentage of the total population are found to be increasing since 2006 from 9.6 percent to 12.7 percent in South Korea, and 8.4 percent to 11.7 percent in Singapore. The percentage of the old age population in Japan is observed to be excessively high, increasing from 20.4 percent to 25.7 percent since 2006. On the other hand, the percentages of the old age population in the three developing countries – Malaysia, Bangladesh and India – are found to be relatively low and constant since 2006 ranging from 4.4 percent to 4.9 percent in 2006, and slightly increasing to 5 percent to 5.7 percent in 2014. Moreover, when analysing the mortality rate under the age of five per 1000 living individuals, it can be observed that the under-five mortality rate is relative low for the three developing countries, being below 5

since 2006. Malaysia also displays a low under-five mortality rate, decreasing from 8 to 7 since 2006. When analysing the under-five mortality rate of India and Bangladesh, it is observed that there is a huge gap between the under-five mortality rates of these countries and that of the three developed countries and Malaysia. The under-five mortality rates declined from 71.5 to 47.7 in India and from 63.0 to 37.6 in Bangladesh.

The analysis of the old age population and the under-five mortality rate may explain the positive significant relationship between life expectancy at birth and crude death rate for South Korea and Singapore. Due to the high percentage of old age population and the low under-five mortality rate in these two countries, the rise in the crude death rates encountered in these two countries is mainly due to the increase in the death of the old age population. Thus as the crude death rate increases due to a rise in the death of the old age population, life expectancy is still observed to significantly incline for South Korea and Singapore.

4.3. Population Growth

The population growth is found to be significant for only three countries – South Korea, Malaysia and India – whereby its parameter estimate is found to be positive for South Korea and negative for both Malaysia and India. The negative significant relationship between life expectancy at birth and population growth for Malaysia and India is relevant to the literature. It can be explained that as the population growth declines, due to the decrease in the crude birth rate overpowering the rate at which the crude death rate decreases, the decline in the mortality rate as well as the decline in the fertility rate imply an incline in the health status of individuals such that the life expectancy at birth increases.

However, the positive impact of population growth on life expectancy for South Korea opposes the explanation in the literature. From the original dataset, the population growth of South Korea is observed to fluctuate to a high extent, by increasing from 0.985 to 1.039 for three years, then decreasing to 0.711 for seven years, and alternately increasing and decreasing afterwards. There is no concrete explanation that may explain this event. However, the positive significant impact of population growth on life expectancy for South Korea occurs by keeping the other significant regressors constant. As such, as the population grows in South Korea, it seems that the lifestyle of the individuals improves such that the life expectancy at birth rises.

4.4. GNI Per Capita

The GNI per capita is significant for only two countries, namely Japan and Bangladesh. The parameter estimate of GNI per capita in Table 5.1 is observed to be negative for Japan while being positive for Bangladesh. The positive significant relationship between life expectancy at birth and GNI per capita for Bangladesh is relevant to the previous studies. When referring to [Bilas et al. \(2014\)](#) in the literature, as the GNI per capita increases, the life expectancy at birth increases significantly. This is due to the fact that as the disposable income of individuals increases, these individuals will save for future consumption during their retirement and also they will purchase more life insurance products to protect themselves from future risks regarding their health. As such the lifestyle of individuals ameliorates, and thus the life expectancy at birth increases.

Nonetheless, the negative significant relationship observed between life expectancy at birth and GNI per capita in Japan differs from the explanation in the literature. This is explained by the fact that Japan has been going through a financial crisis, most commonly referred to as the Japanese Financial Crisis, since the early 1990s. [Mikitani \(2000\)](#) explained that the cause of this financial crisis was the occurrence of excess liquidity which caused a bubble in the stock market. The Japanese financial crisis affected the economic growth of the country, such that negative inflation was observed and the economic growth of Japan was seen to fluctuate. As such, the GNI per capita was observed to have up-and-down movements primarily due to the deflation the country is facing since 1990. According to the World Bank databank, deflation in Japan is still persisting, with values of less than zero percent since 1990.

4.5. Gross Savings

Gross savings is observed to be significant for the logarithmic model for three countries, namely, South Korea, Singapore and Malaysia. The gross savings is found to have a positive impact on life expectancy in South Korea and Malaysia, but a negative effect on the life expectancy in Singapore. The positive significant influence of gross savings on the life expectancy at birth for South Korea and Malaysia is explained in the literature. Thus, as gross savings increases, this infers that more funds are saved for later consumption. On an individual aspect, people will usually save for consumption during their retirement and thus can bear the cost of any health issues they may face in the future, such that the life expectancy is said to rise. On a firm's aspect, most of the companies save part of their profits to fund the pension schemes of their employees. These pension benefits will be provided to the employees as they retire, such that life expectancy is considered to rise.

The negative significant impact of gross savings on life expectancy at birth in Singapore contradicts previous research works. Singapore is observed to have a relatively high gross savings, exceeding 40 percent of the GDP, and reaching its peak of 51.5 percent in 2010. An article written by Heng (2011) argues that the high savings rate of Singapore is an indicative of the Central Provident Fund (CPF) which is the social security system, or defined-contribution pension scheme which the government monitors. However, since above 40 percent of the GDP is being saved, this implies that less than 60 percent of the GDP is being consumed. The lack in the consumption may be a factor contributing to the slow economic growth of the country such that the life expectancy may decline.

4.6. Health Expenditure

Health expenditure is viewed to contribute significantly for the logarithmic model for the developed countries, namely, Japan, South Korea and Singapore. The positive significant impact of health expenditure on the life expectancy at birth for the three developed countries corresponds to the review in the literature. Thus, it can be understood that as health expenditure rises, through medical advance, individuals have access to more health facilities, namely free vaccines, cheaper pharmaceutical products and low cost health care, the health status of individuals ameliorate such that the life expectancy at birth increases significantly.

4.7. Labour Force Participation Rate

The labour force participation rate is found to be significant only for Singapore. The positive significant relationship between life expectancy at birth and the labour force participation rate for Singapore is elaborated in the literature. As the labour force participation rate rises, the more individuals are effectively contributing to the economy, thus boosting the economy of the country. This economic growth causes the disposal income of individuals to rise such that these individuals will tend to invest their income by buying life insurance products so as to protect their life as well as the lives of their children. Hence, this contributes to the rise of the health status of the country and life expectancy is observed to significantly rise.

4.8. Insignificance of Regressors

The insignificance of some regressors in the log-log model for the six countries occurs due to several reasons. The exclusion of the insignificant regressors for the logarithmic model is mainly due to the presence of severe multicollinearity which causes the excluded regressors to have a high correlation with the other regressors, thus causing the complete regression model to be unreliable. Furthermore, the political as well as the economic stability of the countries have not been well assessed such that the occurrence of insignificant regressors for the models may be due to issues faced by the particular countries. The following country-specific issues may cause the insignificance of some regressors in the regression model.

The insignificant impact of crude birth rate on life expectancy at birth observed for the developing countries – Malaysia, Bangladesh and India – can be explained by the fact that the level of crude birth rate in these countries

are relatively high compared to that of developed countries. The insignificant relationship between life expectancy at birth and crude death rate for Japan and Malaysia can be explained by the fact that when considering Japan, the high percentage of the old age population explains the high values of the crude death rate which is observed to increase throughout the years. The relatively high value of the crude death rate for Japan is hence found to be insignificantly related to the life expectancy at birth of the country. On the other hand, when focusing on Malaysia, the crude death rate is observed to increase to a slight extent, while have a constant relative low old age population as well as a low under-five mortality rate. The slim rise in the crude death rate is hence considered to not significantly represent the regression model for Malaysia.

The insignificance of the GNI per capita in the regression model for South Korea, Singapore, Malaysia and India may be due to the fact that the GNI per capita of these countries were affected by the Asian financial crisis in 1998 and global economic crisis in 2008. The insignificant contribution of the labour force participation rate in the regression model for the remaining five countries can be explained as follows. The fluctuation in the unemployment rate within the time of the study, mainly due to the Asian financial crisis in the late 1990s and the economic crisis in 2008, may have affected the labour force participation rate to a great extent.

5. CONCLUSION

The current study analysed the demographic factors as well as the economic factors affecting the life expectancy at birth among three developed countries and three developing countries in Asia by the linear regression approach and the logarithmic regression approach. Seven commonly used independent variables were used as regressors to assess their significance while generating the regression models. When assessing the significant variables for the logarithmic model, it is found that for all the three developed countries the crude birth rate has a significant negative impact on the model while the total health expenditure, as a percentage of the GDP has a significant positive influence on the model. These two variables are found to be insignificant to the logarithmic model for the three developing countries. Moreover, when analysing the effect of crude death rate on life expectancy at birth, it is observed that a rise in the crude death rate for two of the developed countries – South Korea and Singapore – causes a rise in the life expectancy of these countries. This is due to the fact that the high percentages of old age population and the low under-five mortality rates explain that the rise of the crude death rate is due to more deaths being accounted among the old age population in these countries. On the other hand, for two of the developing countries – Bangladesh and India, an increase in the crude death rate is found to cause a fall in the life expectancy at birth. This is accounted by the fact that for these two countries, the crude death rate is declining due to a significant decrease in the under-five mortality rate.

These analyses explain the significant gap between the three developed countries and the three developing countries regarding the factors affecting the life expectancy at birth. The main conclusion that can be deduced is that the logarithmic models for the developed countries depend primarily on the crude birth rate and the total health expenditure. On the other hand, there is no common regressor which explains the logarithmic model for the developing countries.

As such, an implication to this outcome is that the rise in the life expectancy in the developed countries is due to the declining effect of the crude birth rate on the logarithmic model and the incline effect of the health expenditure on the logarithmic model. The rise in the life expectancy in the developing countries cannot be explained by a specific regressor, and may occur due to country-based changes in the demographic or economic factors.

Moreover, the crude death rate is observed to be significant for the logarithmic model for South Korea and Singapore. The insignificance of the crude death rate for the Japan model is due to the relatively high old age population as well as the high incline in the crude death rate compared to the other two developed countries. However, though the insignificant of the crude death rate for the logarithmic model in Japan, another conclusion

that can be assumed is that for the developed countries, the crude death rate is observed to significantly increase and is accounted by the rise in the death of the old age population. On the other hand, the negative impact of crude death rate on the life expectancy at birth for the developing countries, excluding Malaysia, is still explained by the effect of the demographic transition. Furthermore, the negative impact of population growth on the logarithmic model for Malaysia and India is also explained by the effect of the demographic transition.

Hence, it can be said that the developing countries are still going through the demographic transition which hit most of the Asian countries since the mid of 1960s (Bloom and Williamson, 1998). On the opposite, the developed countries to go through the second stage of the demographic transition with the incline in the old age population which causes the crude death rate to have a positive effect on the life expectancy at birth.

Some limitations and anomalies were faced while analysing the datasets for the six countries. The first limitation encountered is the number of countries chosen to analyse the objectives of this empirical study. It is thought that the comparison between the developed countries and the developing countries regarding the determinants of life expectancy at birth might not be concrete since only three developed and three developing countries are being compared such that it may not represent all Asian countries. Thus, one way of analysing the gap between the developed and developing countries in Asia is to increase the number of countries.

Moreover, the occurrence of a particular anomaly in this empirical study caused a lot of confusion while analysing the significance of the regression models. The Pearson correlation coefficients and the parameter estimates for both the linear model and the log-log model for some variables were observed to have different signs. Two reasons can explain this outcome. The Pearson correlation analysis observes the relationship between the dependent variable and each of the independent variables, without taking into account the presence of the other independent variables. As such, the correlation coefficient does not entirely explain the actual relationship between the dependent and independent variables. Another explanation is that the occurrence of multicollinearity causes the signs for the correlation coefficient and the parameter estimate to be different. However, the presence of multicollinearity in this study is minor. It can therefore be recommended to make use of the partial correlation analysis instead of the Pearson correlation analysis. The partial correlation analysis investigates the relationship between the dependent variable and an independent variable, by taking into account the presence of the other independent variables.

Another issue faced in the data analysis is that the linear model has been dropped due to the non-influence of the GNI per capita for Japan and Malaysia. The significance of the GNI per capita for these two countries may be misleading since its parameter estimate is equal to zero. To overcome this phenomenon, the GNI per capita variable can be replaced by other indicators of the economic growth such as the GDP per capita and the growth rate.

The objectives of this empirical study can be extended to strengthen the analyses made, and to explore the limitations faced and provide substantial explanation to the limitations and anomalies. One method of further analysing this study is to make use of more regression models such as logistic model, cox regression model. When considering the present study, the distribution of each of the variables has not been well assessed though the linearity assumption has been satisfied for almost all the variables representing the six countries. However, non-parametric models such as cox regression can be used to analyse the determinants of life expectancy among the developed countries and developing countries in Asia. The models can be compared among each other and be explained sideways, instead of dropping models and choosing one model which represents life expectancy to a higher extent.

Moreover, instead of using different regression model approaches, the objectives of the current study can be extended by making use of disaggregated probit regression. This approach has been used by Kabir (2008) whereby the life expectancy was divided into three categories, namely with low, medium and high life expectancy, and a regression analysis was performed on each of the three categories such that the significant factors affecting the types groups of life expectancy were compared.

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