The determinants of health expenditure in Malaysia: A time series analysis

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ABSTRACT

The purpose of this study is to investigate the determinants of health expenditure in Malaysia within the time series framework from 1967 to 2007. This study employed the Johansen-Juselius cointegration test to examine the cointegration relationship. The results showed that health expenditure and its determinants are cointegrated. Consistent with economic theory, the TYDL and variance decomposition analysis reveals that the key explanatory variables in Malaysia's health expenditure model are income, health care price and the proportion of population aged more than 65 years old. Moreover, the TYDL causality indicates that health expenditure and income is bi-directional in nature, thus policies initiative to promote health expenditure should be implemented to achieve sustainable economic growth and development.

Keywords: Cointegration; Health; Income; Malaysia; TYDL
JEL Classification Code: C01; C22; H51; I18

1. INTRODUCTION

The role of health expenditure on economic growth has been advocated by Mushkin (1962). The author postulated that health is a capital and thus investment on health should be a prominent source for economic growth (see also Grossman, 1972). This theory has sparked the interest of researchers and thus generated voluminous empirical studies over the last few decades. Several studies such as Newhouse (1977, 1987), Parkin et al. (1987) and Wang and Rettenmaier (2007) have investigated this theory. A number of empirical studies have documented a strong and positive relationship between health expenditure and income. However, the causal relationship between health expenditure and income remains ambiguous.

There are two main strands of literature on the health expenditure-income relationship. The first strand of literature is concentrating on the health-income relationship studies on OECD and developed countries (see for example Hansen and King, 1996; Blomqvist and Carter, 1997; Devlin and Hansen, 2001; Hartwig, 2008). Only a few studies such as Tang and Evan Lau (2008), Samudram et al. (2009) and Tang (2009) examined the issue for Asian and developing countries using the cointegration and causality tests. Nevertheless, the causal link evidence between health expenditure and income remains ambiguous. Apart from that, the second strand of literature has focused on the cross-sectional and panel data analysis (see for example Parkin et al., 1987; Gerdtham and Löthgren, 2000, Wang and Rettenmaier, 2007; Hartwig, 2008). The use of either cross-sectional or panel data on health-income relationship analysis may be bias and the estimated results may be inappropriate for policymakers to formulate effective policies for specific country. In this sense, Solow (2001) claimed that an economic model should be dynamic in nature, thus an observation of the evolution of economic behaviour over time can be made. Furthermore, cross-sectional and panel data studies are based on a restrictive assumption of homogeneity in the observed relationship across countries to which homogeneity are not always the case (see Athukorala and Sen, 2002). In similar vein, 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 nonsensical relationship. As a result, it is more appropriate and interesting to conduct country-specific studies by examining the dynamic interaction of the variables of interest over time and thus formulate effective macroeconomic policy based on the findings of country-specific studies.

This study differs from the other studies in at least three ways. First, this study attempts to analyse the relationship between health expenditure and its determinants for Malaysia owing to the scarcity of country-specific research work. To the best of our knowledge, no empirical study has modelled the determinants of health expenditure for Malaysia using time series data within the cointegration and causality techniques.

Second, this study could be considered as the first study that systematically investigates the determinants of health expenditure in Malaysia via a multivariate framework. Looking through the existing empirical studies, only three studies have attempted to model the health expenditure in Malaysia within a time series framework. Tang and Evan Lau (2008), Samudram et al. (2009), and Tang (2009) have used the bivariate time series model to investigate the long run and causal relationships between health expenditure and income. Obviously, the former studies assumed that income is the only variable that explains health expenditure in Malaysia is too restrictive. Hitiris and Posnett (1992), and Hansen and King (1996) argued that the health care price and aging population play important roles in explaining the behaviour of health expenditure. Therefore, the use of bivariate model is potentially mis-specified and may be inappropriate due to the absence of relevant variable(s). Consequently, the cointegration and causality tests would also yield biased results with this bivariate model.

Third, the extant empirical studies applied the Engle and Granger (1987) residuals-based cointegration test to examine the presence of long run equilibrium relationship between health expenditure and its determinants (see for example, Hansen and King, 1987). Ironically, it is well noted in the econometric literature that the residuals-based cointegration test is inefficient and may lead to contradictory results, in particular when there are more than two $I(1)$ variables under consideration because the approach is only suitable for bivariate framework analysis (Pesaran and Pesaran, 1997). With this regard, we employ the multivariate Johansen-Juselius cointegration test to investigate the existence of long run relationship between health expenditure and its determinants in Malaysia.

The remainder of this paper is organised as follows. The next section will briefly review the behaviour of health expenditure and income growth in Malaysia. In Section 3, we discuss the data, model specification, and econometric methods used in this study. Section 4 reports the empirical result of this study. Finally, we present the conclusions and some policy recommendations in Section 5.

2. SOME STYLISED FACTS ON HEALTH EXPENDITURE IN THE MALAYSIAN ECONOMY

This section reviews the behaviour of health expenditure in Malaysia over the period of 1970 to 2007. Malaysia is a small, open and growing economy located in the Southeast Asia region. It is well endowed with abundant of natural resources. Since the colonial days, Malaysia became the world's largest producer of tin and natural rubber. After gaining independence at 31st August 1957, the Malaysian government undertook a fundamental restructuring of the economy. Nowadays, it has moved far away from the primary commodity sector and has increasingly relied on manufacturing and services sectors. Together with prudent macroeconomics policies, practical development planning and human capital investment (e.g., health and education), the economy has grown steadily. On average, the economy achieved real GDP growth rate of approximately 9.5 per cent per annum during the period of 1970 to 1980. Also, before the onset of Asian financial turmoil, the average growth rate was approximately 10.1 per cent per annum during 1980s to 1996.

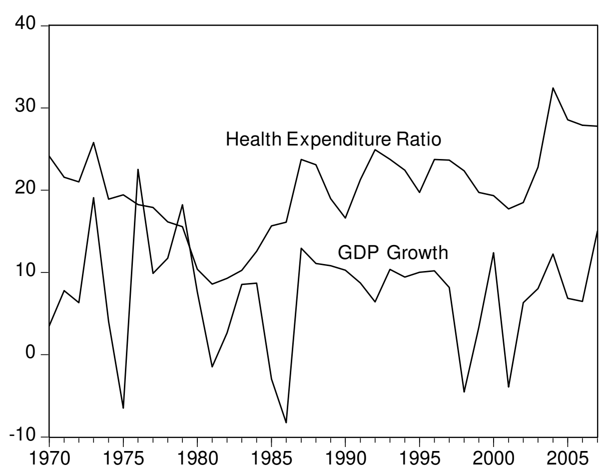

Figure 1: The plots of health expenditure ratio and GDP growth

Nevertheless, as a result of Asian financial turmoil, the average growth rate of real GDP has dropped tremendously to 5.5 per cent per annum for the period of 1997 to 2006. Specifically, the economic growth has deteriorated to –4.5 per cent in 1998 and subsequently –3.9 per cent in 2001 due to the terrorist suicide attack on the United States of America on 11th September 2001.

In view of health expenditure behaviour, Ramesh and Asher (2000) pointed out that over the past decade, Southeast Asia nations have experienced significant improvements in their health care system. As far as Malaysia is concerned, Ramesh and Wu (2008) stated that Malaysia has been one of the countries with largest improvement in the health care sector among the ASEAN countries. Malaysia's health care is a mix of private-public system which operates in parallel with heavy involvement of the public sector in the provision of health services. The plots of public health expenditure ratio to government expenditure and real GDP growth in Malaysia are depicted in Figure 1. Mushkin (1962) noted that health is an investment. Therefore, investment on health is vital in stimulating long run economic growth in a nation. As shown in Figure 1, it is evidence that health expenditure may be a prominent source for sustainable economic growth in Malaysia as these variables are closely correlated over the analysed period of 1970 to 2007. Specifically, over the period of 1970 to 1979, the health expenditure ratio in Malaysia decreased from 24.1 per cent to 10.4 percent. Nevertheless, in early of 1980, the ASEAN's Health Ministers coherently emphasised on promoting health care system such as exchange of information on health, as well as expertise in health development. In addition to that, the Ministry of Health department also implemented some corporative research works and promote health manpower development to improve the quality of life. For this reason, Malaysian government increased the allocation on health expenditure from 8.5 per cent in 1981 to 23.8 per cent in 1987. Although the world economic recession in the middle of 1980s affected economic growth in Malaysia, the expenditure on health over the period of 1988 to 1997 fluctuated between 16.6 per cent to 23.8 per cent of the government expenditure in Malaysia. Furthermore, as a result of fears arising from Severe Acute Respiratory Syndrome (SARS) and Avian flu, the health expenditure in Malaysia increased from 17.7 per cent in 2001 to 32.4 per cent to prevent and control the spread of these diseases. Moreover, in order to contain the spreading of these diseases, the members of ASEAN countries including Malaysia have cooperated in providing public information and education to create public awareness for better understanding of the SARS epidemic.

3. DATA, MODEL SPECIFICATION AND ECONOMETRIC METHODS

3.1 Data and Model Specification

This study employs the annual data of real per capita health expenditure, real per capita gross domestic product (GDP), consumer price index for health care (P), and the proportion of the population over the age of 65 years old (POP65) from 1967 to 2007 in Malaysia. The data are extracted from *International Financial Statistics*

(IFS), Bank Negara Malaysia, *Monthly Statistical Bulletin*, and Malaysian Economic Report, respectively. Annual data are used in this study because there is no other frequency of data for such a long span. The consumer price index (CPI, 2000 = 100) and total population are used to derive the real per capita term.

Following Hitiris and Posnett (1992) and Hansen and King (1996), we employed the following health expenditure framework to investigate the determinants for health expenditure in the Malaysian economy. In equation 1, we employed the log-linear model.[1]

$$\ln HE_t = \beta_0 + \beta_1 \ln Y_t + \beta_2 \ln P_t + \beta_3 POP65_t + \varepsilon_t \tag{1}$$

where ln denotes the natural logarithm, $\ln HE_t$ is the real per capita health expenditure, $\ln Y_t$ is the real per capita income, $\ln P_t$ represents the health care price and $POP65$ represents the proportion of population aged more than 65 year old. The residuals, ε_t are assumed to be white noise and follow the classical linear regression model assumptions; $\beta 's$ are parameters of interest.

3.2 Multivariate Johansen-Juselius cointegration test

In this section, we test the presence of long run equilibrium relationship between health expenditure and its determinants with the multivariate Johansen-Juselius cointegration approach (see Johansen, 1988; Johansen and Juselius, 1990). The Johansen-Juselius cointegration approach can be applied within the vector error-correction model (VECM) as follow:

$$\Delta W_t = \Phi D_t + \Pi W_{t-1} + \Gamma_1 \Delta W_{t-1} + \cdots + \Gamma_{k-1} \Delta W_{t-k+1} + \mu_t \tag{2}$$

where Δ is the first difference operator $(w_t - w_{t-1})$, W_t is $(n \times 1)$ and each of the A_i is an $(n \times n)$ matrix of parameters. The deterministic term D_t contains constants, a linear terms or seasonal dummies. $\Gamma = -(I - A_1 - \cdots - A_i)$, $(i = 1, \ldots, k-1)$, and $\Pi = -(I - A_1 - \cdots - A_k)$. This way of specifying the system contains information on both short and long run adjustments to changes in W_t, through the estimates of $\hat{\Gamma}$ and $\hat{\Pi}$, respectively. k is the lag structure and the error terms μ_t are assumed to be normally distributed and complied the classical assumption. In Johansen-Juselius

[1] Gerdtham and Jonsson (1991) pointed out that double-log functional form is the most adequate in examining the health expenditure in the context of cross-country analysis (see also Herwartz and Theilen, 2003). However, we re-examined the appropriateness of both log-linear and double-log models with the model selection statistics such as R-squared, Adjusted R-squared, Akaike's Information Criteria (AIC), and also the Ramsey RESET specification error tests. Remarkably, the model selection statistics consistently showed that the log-linear model is the best fitted model. In addition, the Ramsey RESET test indicated that the double-log model contains specification error at the 5 percent significance level. For these reasons, the uses of log-linear model should be more appropriate.

approach, $\Pi = \alpha\beta'$ is $(n \times n)$ coefficient matrix called the impact matrix and contains information about the long run relationship between the variables under investigation. α is the parameter denoting the speed of adjustment to disequilibrium, while β is a matrix of cointegrating vectors.

Johansen-Juselius cointegration approach offered two likelihood ratio (LR) test statistics, namely trace test, $LR(\lambda_{\text{trace}}) = -T\sum_{i=r+1}^{k} \ln\left(1-\hat{\lambda}_i\right)$ and maximum eigenvalues test, $LR(\lambda_{\max}) = -T\ln\left(1-\hat{\lambda}_{i+1}\right)$, where T represents the total numbers of observations and $\hat{\lambda}_i$ are the eigenvalues $(\lambda_1 \geq \lambda_2 \ldots \geq \lambda_k)$. Furthermore, we noted that Johansen-Juselius cointegration test prone to reject the null hypothesis of no cointegrating relation when the estimated sample size is small (see Reimers, 1992; Cheung and Lai, 1993). For this reason, we employed the surface responses procedure developed by Cheung and Lai (1993) to correct the critical values avoid the small sample bias problem.

3.3 Granger causality test

Once the variables under consideration are found to be cointegrated, then there must be Granger cause in at least one direction to hold the existence of long run equilibrium relationship. For this reason, we employ the Toda and Yamamoto (1995) and Dolado and Lütkepohl (1996) – TYDL causality test within the level augmented-VAR system to verify the causal relationship between health expenditure and its determinants (i.e., income, price and POP65) in Malaysia. The advantage of using this approach is that TYDL causality approach can be applied without knowing the order of integration and cointegration for the variables under investigation. Furthermore, in common practice, when the variables are cointegrated, the error-correction model (ECM) and VECM can be used to examine the causal relationship. However, Rambaldi and Doran (1996) argued that both ECM and VECM specification for testing the causal relationship are cumbersome and sensitive to the values of nuisance parameters in particular when the sample size is relatively small (see also Zapata and Rambaldi, 1997). Indeed, Yamada and Toda (1998) conducted a Monte Carlo simulation study to examine the performance of three causality procedures in small sample. The simulation results indicate that among the three causality procedures, TYDL is the most stable approach. Furthermore, the Error-Correction Modelling (ECM) and Fully-Modified VAR (FM-VAR) causality approaches tend to have larger size distortion than the TYDL approach. Therefore, we prefer to use the TYDL causality test in this study. Next, to implement the TYDL test, we have to decide the maximum order of integration $(d_{\max})$ for the variables in the system and the optimal lags structure (k) for the VAR model. In this respect, we chose to use $d_{\max} = 1$ because it can perform better than other order of $d_{\max}$ (see Dolado and Lütkepohl, 1996). Eventually, the TYDL test could be easily conducted by estimates the following augmented-VAR system.

$$\begin{bmatrix} \ln HE_t \\ \ln Y_t \\ \ln P_t \\ POP65_t \end{bmatrix} = \begin{bmatrix} \alpha_1 \\ \alpha_2 \\ \alpha_3 \\ \alpha_4 \end{bmatrix} + \begin{bmatrix} A_{11,1} & A_{12,1} & A_{13,1} & A_{14,1} \\ A_{21,1} & A_{22,1} & A_{23,1} & A_{24,1} \\ A_{31,1} & A_{32,1} & A_{33,1} & A_{34,1} \\ A_{41,1} & A_{42,1} & A_{43,1} & A_{44,1} \end{bmatrix} \times \begin{bmatrix} \ln HE_{t-1} \\ \ln Y_{t-1} \\ \ln P_{t-1} \\ POP65_{t-1} \end{bmatrix} + \cdots + \begin{bmatrix} A_{11,k} & A_{12,k} & A_{13,k} & A_{14,k} \\ A_{21,k} & A_{22,k} & A_{23,k} & A_{24,k} \\ A_{31,k} & A_{32,k} & A_{33,k} & A_{34,k} \\ A_{41,k} & A_{42,k} & A_{43,k} & A_{44,k} \end{bmatrix}$$

$$\times \begin{bmatrix} \ln HE_{t-k} \\ \ln Y_{t-k} \\ \ln P_{t-k} \\ POP65_{t-k} \end{bmatrix} + \begin{bmatrix} A_{11,p} & A_{12,p} & A_{13,p} & A_{14,p} \\ A_{21,p} & A_{22,p} & A_{23,p} & A_{24,p} \\ A_{31,p} & A_{32,p} & A_{33,p} & A_{34,p} \\ A_{41,p} & A_{42,p} & A_{43,p} & A_{44,p} \end{bmatrix} \times \begin{bmatrix} \ln HE_{t-p} \\ \ln Y_{t-p} \\ \ln P_{t-p} \\ POP65_{t-p} \end{bmatrix} + \begin{bmatrix} \xi_{1t} \\ \xi_{t2} \\ \xi_{3t} \\ \xi_{4t} \end{bmatrix} \tag{3}$$

where the residuals ξ_{1t}, ξ_{2t}, ξ_{3t} and ξ_{4t} are stationary and spherical distributed. The lags order of p represents the $(k + d_{\max})$ and optimal lags structure k in the VAR system is determined by Akaike's Infomation Criterion (AIC). From Equation (3), the income does not Granger-cause health expenditure if the following null hypothesis $A_{12,k} = 0 \forall_k$ could not be rejected, while if the following null hypothesis $A_{21,k} = 0 \forall_k$ is rejected, implying that health expenditure is Granger-causing income growth. Ultimately, the following null hypotheses $A_{13,k} = 0 \forall_k$, $A_{31,k} = 0 \forall_k$, $A_{14,k} = 0 \forall_k$ and $A_{41,k} = 0 \forall_k$ can be interpreted in the same way in terms of health expenditure, price and POP65, respectively.

4. EMPIRICAL RESULTS

4.1 Unit root tests results

As usual in time series analysis we begin by testing the order of integration for each series under investigation $[\ln HE_t,\ \ln Y_t,\ \ln P_t,\ POP65_t]$ to avoid the spurious regression phenomenon (see Granger and Newbold, 1974; Phillips, 1986). This study applied the Augmented Dickey-Fuller (ADF) (Dickey and Fuller, 1979, 1981) unit root test and also the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) (Kwiatkowski et al., 1992) null stationarity test to confirm the order of integration for each series. The Monte Carlo experiment conducted by Amano and Norden (1992) and Schlitzer (1995) consistently suggested that the joint unit root testing procedure (i.e. ADF-KPSS) gives the most reliable results. Table 1 reported the ADF and KPSS tests results.

According to unit root test results, we found that the ADF test statistics cannot reject the null hypothesis of a unit root for the levels of all the variables. Nevertheless, at the 5 percent significant level the ADF test statistics rejected the null hypothesis of a unit root for the first difference of all variables under consideration. Similarly, at the 5 per cent level the KPSS test also suggests that the variables are stationary after first differencing. Therefore, we surmise that the estimated variables are integrated of order one $I(1)$ process. These results are consistent to the assertion that most of the macroeconomics time series are non-stationary at level, but it is stationary after first differencing (see Nelson and Plosser, 1982). With these findings, we proceed to examine the presence of long run equilibrium relationship between health expenditure and its determinants for Malaysia through the multivariate Johansen-Juselius cointegration test.

Table 1: The results of unit root tests

Variables	ADF	KPSS
$\ln HE_t$	–2.234 (0)	0.768 (5)***
$\Delta \ln HE_t$	–5.940 (1)***	0.209 (13)
$\ln Y_t$	–2.534 (0)	0.790 (5)***
$\Delta \ln Y_t$	–5.211 (1)***	0.056 (2)
$\ln P_t$	–1.903 (2)	0.770 (5)***
$\Delta \ln P_t$	–4.147 (0)**	0.159 (4)
$POP65_t$	–2.191 (3)	0.644 (5)**
$\Delta POP65_t$	–4.465 (1)***	0.210 (5)

Note: The asterisks ***, ** and * represent the significance level at 1, 5 and 10 per cent. ADF and KPSS refer to Augmented Dickey-Fuller and Kwiatkowski et al. (1992) unit root tests. The optimal lag length for ADF test is selected using the AIC while the bandwidth for KPSS tests are selected using the Newey-West Bartlett kernel. Figure in parentheses ( ) denotes the optimal lag length and bandwidth. The critical values for ADF test is obtained from MacKinnon (1996) while the asymptotic critical values for KPSS test are obtained from Kwiatkowski et al. (1992).

4.2 Johansen cointegration test results

The common practice for the multivariate Johansen-Juselius cointegration test is to determine the lag structure for the VAR system. In this respect, Hall (1991) pointed out that the choice of lag structure in the VAR system is vital because too few lags may lead to serial correlation problem, whereas too many lags specified in the VAR system will consume more degree of freedoms thus lead to small sample problem. For this reason, the optimal VAR system for multivariate Johansen-Juselius cointegration test was determined by minimising the system-wise Akaike's Information Criterion (AIC). The AIC was used because Liew (2004) and Lütkepohl (2005) found that AIC performed better than any other information criterions (e.g. SBC and HQ) when the estimated sample size is relatively small (e.g. less that 60 observations). The AIC statistic indicates that 3 years lag is the optimal lag length for the multivariate Johansen-Juselius cointegration test. Panel A, Table 2 presents the results for both multivariate Johansen-Juselius likelihood ratio (LR) cointegration test – $LR(\lambda_{\text{trace}})$ and $LR(\lambda_{\max})$.

Table 2: The result of Multivariate Johansen cointegration test

Panel A: Multivariate cointegration test				
Tests		LR tests statistics	Adjusted critical values#	
H_0	H_A		5 percent	10 percent
$LR(\lambda_{\text{trace}})$				
$r=0$	$r\geq 1$	77.259**	57.8031	60.0517
$r\leq 1$	$r\geq 2$	39.735*	40.6443	36.6049
$r\leq 2$	$r\geq 3$	14.777	21.1027	18.2136
$r\leq 3$	$r\geq 4$	1.563	5.1490	3.6755
$LR(\lambda_{\max})$				
$r=0$	$r=1$	37.524**	37.4029	34.0341
$r\leq 1$	$r=2$	25.257	28.9745	25.5978
$r\leq 2$	$r=3$	12.915	19.4407	16.6111
$r\leq 3$	$r=4$	1.563	5.1952	3.7021
Panel B: Normalised cointegrating vector				
$\ln HE_t$	$\ln Y_t$	$\ln P_t$	$POP65_t$	*Constant*
1.000	4.081***	–4.161***	2.014***	–22.503

Note: ***, ** and * denote the significant level at 1, 5 and 10 per cent, respectively. # represent that the critical values were adjusted by the Cheung and Lai (1993) surface response procedure. The system-wise Akaike's Information Criterion (AIC) was used to select the optimal lag order.

Compare the trace test $LR(\lambda_{\text{trace}})$ statistics with the 10 percents adjusted critical value, we reject the null hypotheses of no cointegrating relation $r=0$ and at most one $r\geq 1$ cointegrating relation, implying that there are two cointegration ranks exist among four variables under investigation. On the contrary, at the 5 percent significant level, both trace and maximum eigenvalue $LR(\lambda_{\max})$ tests statistics suggested that there is only one cointegration relation. According to Johansen and Juselius (1990) the cointegration result suggested by maximum eigenvalues test is more robust and it is more powerful than the trace test. Therefore, we conclude that there is only one cointegration vector in the Malaysian data. With this evidence, we interpreted that Malaysia's health expenditure and its determinants income, price and POP65 are moving together in the long run.

As the variables are cointegrated and the interest of this study is to examine the responses of health expenditure to income, price, and POP65, the cointegrating vectors are normalised by health expenditure. The normalised cointegrating vectors are reported in Panel B, Table 2. In general, the coefficients sign for the estimated variables are consistent to the economic theory. In the long run, $\ln Y_t$ and $POP65_t$ are both positively related to health expenditure $(\ln HE_t)$, while the relationship between price and health expenditure is negative. Moreover, all the estimated variables are elastics and statistically significant at the 1 percent level. For example, a 1 percent increase in income and $POP65_t$ will lead to the increase of health expenditure by 4.1 and 2.0 per cents respectively. However, a 1 percent increases in the health and medical care prices $(\ln P_t)$ reduces the health expenditure by 4.2 per cent.

Our empirical finding supports the conventional wisdom that as income and older population increase, the tendencies for spending on health expenditure increase. Furthermore, the health expenditure will decrease when the price for health care increases. For example, Musgrove et al. (2002) found that the relationship between health expenditure and income is positive and statistically significant for the low, medium and high income countries (see also Wang and Rettenmaier, 2007).

4.3 Causality test results

According to Granger (1986), the existence of a cointegrating relation implied that there must be at least one direction of causation to maintain the presence of long run relationship. In addition to that, verification for the causality direction also plays an important role in determining the effectiveness of policies. For example, if the causality evident suggests that health expenditure Granger cause income, this reflects that policies prioritize on encouraging health expenditure will stimulate income growth. For these reasons, the present study employed the TYDL causality test to verify the causal relationship between health expenditure and its determinants. Prior to testing for causality, the optimal lag length in the VAR system must be determined because the causality test is very sensitive to the number of lag length used (see Thornton and Batten, 1985; Xu, 1996). Interestingly, both system-wise AIC and SBC showed that 3 years lag of VAR system is the best. Therefore, the augmented-VAR with 4 lags will be performed for causality test. The TYDL causality test results are reported in Table 3.

Table 3: The results of MWALD causality tests

Dependent Variable	$\ln HE_t$	$\ln Y_t$	$\ln P_t$	$POP65_t$
$\ln HE_t$	–	16.312***	18.336***	34.031***
$\ln Y_t$	14.345***	–	1.438	13.067***
$\ln P_t$	0.665	17.190***	–	15.657***
$POP65_t$	0.368	0.776	0.286	–

Note: The asterisks *** denotes significance at 1 level. The optimal lag length for the augmented-VAR system was selected by system-wise AIC and SBC.

The causality test results show that health expenditure and income in Malaysia are bi-directional in nature. Indeed, this result indicates that health expenditure is a vehicle to economic growth in Malaysia over the analysis period of 1967 to 2007. This is consistent to Mushkin (1962) assertion that health is a capital and thus investment on health is a prominent source to generate economic growth. While the TYDL causality evidence also implies that price $(\ln P_t)$ and the proportion of population aged more than 65 $(POP65_t)$ are consistently Granger causing health expenditure in Malaysia, but there is no evidence on the reverse causation.

4.4 Variance decomposition analysis

To this end, the analysis has been restricted to within-sample test and has not considered the dynamic interaction of the variables when the system exposes to shock. For this reason, it is interesting to evaluate the effects of shock on health expenditure in Malaysia through the variance decomposition analysis. Particularly, variance decomposition analysis provides information on the percentage of variation in the forecast error variance attributed to its own shock and the percentage of variation attributed to other variables shock in the system. Table 5 summarised the results of the variance decomposition (up to 12 years) on the effect of health expenditure, income, price, and POP65 on health expenditure in Malaysia.

Table 4: The results of variance decompositions analysis

Years	$\Delta \ln HE_t$	$\Delta \ln Y_t$	$\Delta \ln P_t$	$\Delta POP65_t$
1	100.00	0.00	0.00	0.00
2	81.28	5.13	8.34	5.25
3	72.75	4.09	9.24	13.92
4	65.05	3.81	9.81	21.33
5	63.29	3.74	9.52	23.45
6	60.85	3.99	11.55	23.60
7	58.62	5.44	12.52	23.42
8	57.28	6.64	12.92	23.16
9	56.77	7.36	12.92	22.96
10	55.68	7.82	13.00	23.50
11	53.84	8.24	12.88	25.04
12	51.46	8.58	12.69	27.27

Note: Cholesky Ordering: $\Delta \ln HE$, $\Delta \ln Y$, $\Delta \ln P$, $\Delta POP65$.

These variance decompositions analyses are computed by disturbing each variable in the system with one-standard deviation. There are several interesting findings emerged from the variance decomposition results. On average over the period of 12 years horizon, approximately 64.2 per cent of the variations in the forecast error for the health expenditure in Malaysia are attributed to its own shock, however the effect decline gradually over time. Moreover, the variance decomposition results demonstrated that on average over the period of 12 years horizon, 5.4 per cent, 10.5 per cent and 19.4 per cent of the forecast error variance for the Malaysian health expenditure are explained by income, price and POP65, respectively. This empirical evidence implied that only small portion of variation in health expenditure is attributed to shock in the income level.

Apart from that, the result also implied that a shock in health expenditure explains most of the variation in health expenditure in the short run. For example, at the forecast horizon of 3 years (short run), 72.8 per cent of the variation in health expenditure is explained by its own shocks. Nevertheless, in the long run such as 12 years, only 51.5 per cent of the variation in health expenditure is explained by its own shock and the rest of 49.5 per cent of the variation in health expenditure is explained by income, price and the proportion of population aged more than 65. Furthermore, among three explanatory variables, a large proportion of the variation in health expenditure in Malaysia is explained by the proportion of population aged more than 65 in the long run. This implied that aged structures play an important role in explaining the long run health expenditure in Malaysia. These results are corroborated with the finding of Hitiris and Posnett (1992), Hansen and King (1996) and Metteo (2005).

5. CONCLUSION AND POLICY RECOMMENDATIONS

This paper employed the cointegration, causality and variance decomposition analyses to investigate the relationship between health expenditure, income, health care price and POP65 for Malaysia over the period of 1967 to 2007. Here, we applied the multivariate Johansen-Juselius cointegration test in association with Cheung and Lai (1993) surface response procedure to test the presence of long run equilibrium relationship between health expenditure and its determinants in Malaysia. The Johansen-Juselius cointegration test results suggest that health expenditure and its determinants are cointegrated. This implied that the explanatory variables such as real per capital income, health care price and POP65 are moving together with real per capita health expenditure to achieve the steady-stead in the long run, although there may be deviations in the short run. In addition to that, this study found that real per capital income and POP65 are positively related to real per capita health expenditure in the long run and these variables are statistically significant at the 1 per cent level. Besides, the finding also suggests that health care price and real per capital health expenditure is having negative relationship in Malaysia. This is in line with the *Law Of Demand* assertion that when the price of goods or service increase, while consumer demand for goods and service will decrease and vice versa.

Turning to the TYDL causality test, the results demonstrate that health expenditure and income are bi-directional causality in nature. Therefore, our empirical evidence supports the conventional wisdom that health expenditure will lead economic growth through the increase of productivity. Apart from that, there is uni-directional causality evidence run from health care price and POP65 to health expenditure in Malaysia. Beyond this, we also undertook a variance decomposition analysis to examine the percentage of variation in health expenditure attributed to its own innovations and shock in other variables in the system. Interestingly, we found that in the short run, health expenditure variations are mostly explained by its own shock (e.g. on average 64.4 percent). In the long run (up to 12 years forecast horizon), on average the combined impact of variables (i.e. income, health care price and POP65) increased from 34.5 per cent to 49.5 per cent. These results highlight that in the long run, income, health care price and POP65 are the important variables in explaining the behaviour of health expenditure in Malaysia.

In view of policy recommendations, the findings of this study suggest that health expenditure played an important role in economic development in Malaysia. Therefore, policies to encourage health care expenditure are required to build up a healthier and productive society to support Malaysia's economic growth and development. This is because healthier individual may be more productive than those who are ill, thus enabling them to generate more output. In addition to that, the Ministry of Health should aggressively minimise the gap of inequality distribution of health care among people in Malaysia by providing the basic health care to the poor society, particularly in the rural area. Furthermore, the Ministry of Health and also the Ministry of Education have to cooperate in promoting the important of health care and providing health care information to the Malaysian society. Moreover, external cooperation such as World Health Organisation is also required to exchange of expertise and health care information. In line with the Ninth Malaysian Plan (2006 to 2010), health expenditure is vital either for individual or country because without healthier society, it will be difficult to create a society with high capacity of knowledge and innovation and nurture first class mentality.

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