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Impact of Demographical Structural Change on Public Health Care Expenditure in Malaysia

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Abstract

The main objective of this paper is to shed light on the empirical relationship between demographic structure and public health care expenditure. A voluminous literature has pointed out the significant impact of demographic changes on public expenditure. Some scholars have attributed the growth effects of certain categories of public expenditure to age-specific effects, others recognized them as age-transition effects. On the other hand, past researchers have also identified the aging population as a contributing factor to increasing health care expenditure. Therefore, this paper empirically examines how public health care expenditure in Malaysia responds to population changes using the Autoregressive Distributed Lag (ARDL) Bounds testing approach. Empirical evidence from this finding demonstrated that the demography structure has a significant positive relationship with public health care expenditure. Hence, this study highlighted the existence of generational conflict in the allocation of health care expenditure. Additionally, bi-directional causality was identified to run between public health care expenditure and government education spending, confirming the correlation between these expenditures. The results also provide important implications that need to be taken into consideration by Malaysian policymakers when developing policies.

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1. Introduction

Demography changes have drawn researchers' attention to their consequences on the public expenditure allocation. Population change was considered as one of the major determinants of public expenditure allocation. Ukwueze (2015) posited that the changes in the rate of population growth may well generate changes in age distribution. This trend will then be reflected in the budgetary allocation of public spending. According to Okafor and Eiya (2011), population growth is a major and dominant contributory factor to the growth of both budgetary expenditure and government policies that are geared towards narrowing the population's social and economic gap. Musgrave and Musgrave (1989) and Abeng (2005) were also in agreement with the proposition that the population is a vital determinant of government expenditure growth.

The importance of the demographic variables serving as a determinant of public expenditure allocation therefore conjectures the need to analyze how the changes of the age structure could lead to changes in the trend of public expenditure. This study focuses on public health expenditure as it is considered by many studies to be an area that is most sensitive to demographic change. For example, Korwatanasakul et al. (2021) indicated that a large share of health expenditure is likely to result from having an aging population. Health systems in various countries are facing increasing pressure to cope with needs specific to the elderly population (Ke et al., 2011). The increased share of public health expenditure in GDP was solely due to demographic change (Ahn et al., 2005). The average cost of health care per capita is likely to increase significantly with age (Policy Council, 2012). Thus, an aging population is likely to result in an increase in health care costs. Besides this, generational conflict could have a significant impact on social spending. Generational conflict focuses on analyzing whether there are any shifts in the age composition of the population either from young to old or vice versa, and if these will lead to higher or lower public health care allocation. The lack of research on the fiscal shifts resulting from demographic pressures provides further motivation for this empirical research. Fiscal shifts refer to the competition between different age groups for their shares of public spending. For example, the rising elderly population will decrease spending on education but puts pressure on health care expenditure.

Meanwhile, existing literature such as Poterba (1997) and Grob and Wolter (2005) have advocated the significant impact of demographic change on the allocation of public education resources. However, Cutler et al. (1993) argued that the effect of demographic characteristics on public education expenditure is considered slightly ambiguous. Their argument had seemingly been supported by several other studies which demonstrated similar findings. For example, Chakrabarti and Joglekar (2006) stressed that there were inconsistent results with regard to the demographic indicators on public education spending. Meanwhile, Kelley (1976) noted that many studies had omitted the consideration of population influences on government expenditure. The demographic factor's influence on public education expenditure also appears to be of interest to us as researches and highlighted the possibility of competition for allocation within the different age group populations. Hence, an examination is also performed on the extent of the influence of public education expenditure on government allocation in the health care sector.

Figure 1 presents the demographic structural change in Malaysia from 1971 until 2019. The statistical figures clearly illustrate that the population has increased over the years. The demographic structure experienced changes with lesser births and reducing deaths. This results in an aging population, as illustrated in Figure 2. Meanwhile, the young population has gradually slowed down after reaching their peak in the year 2004 (Figure 3). This indicates that the population in Malaysia has experienced structural changes with a higher elderly population and a lesser young population over the years.

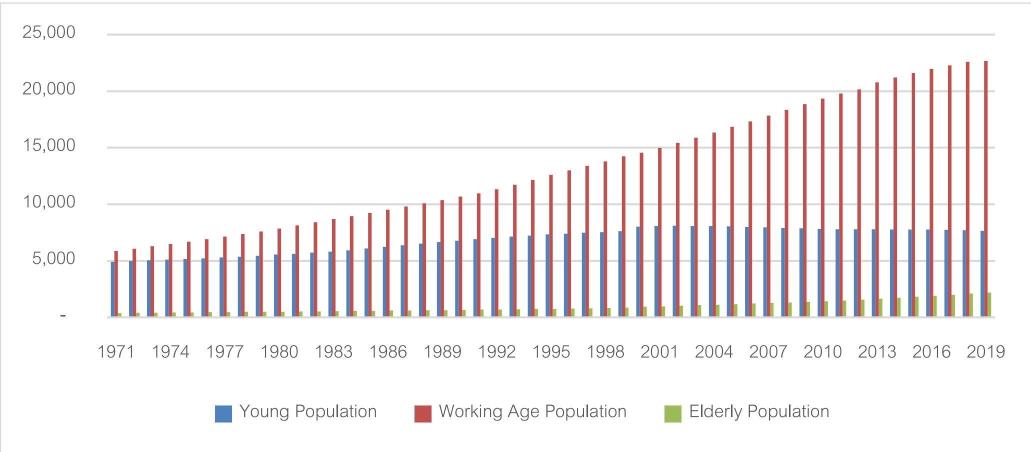

Figure 1: Demographic structure in Malaysia ('000 = million)

Source: Economic Planning Unit (2021)

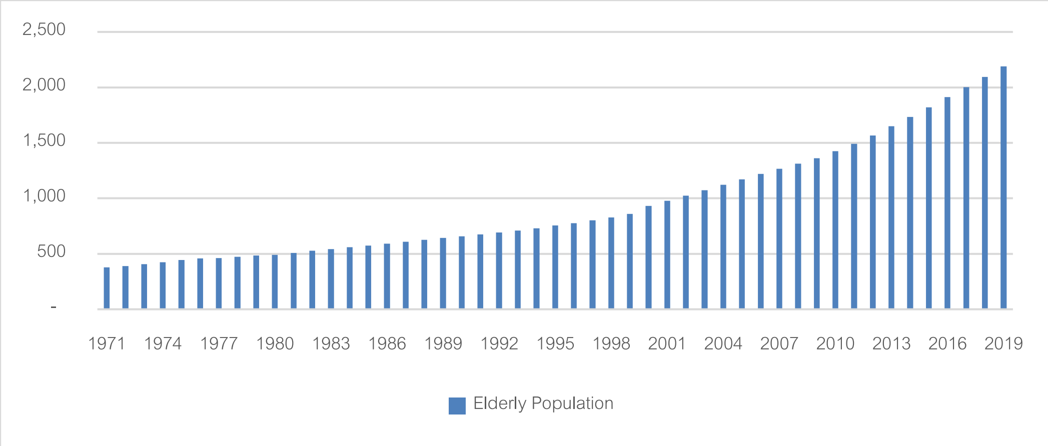

Figure 2: Elderly population in Malaysia (‘000 = million)

Source: Economic Planning Unit (2021)

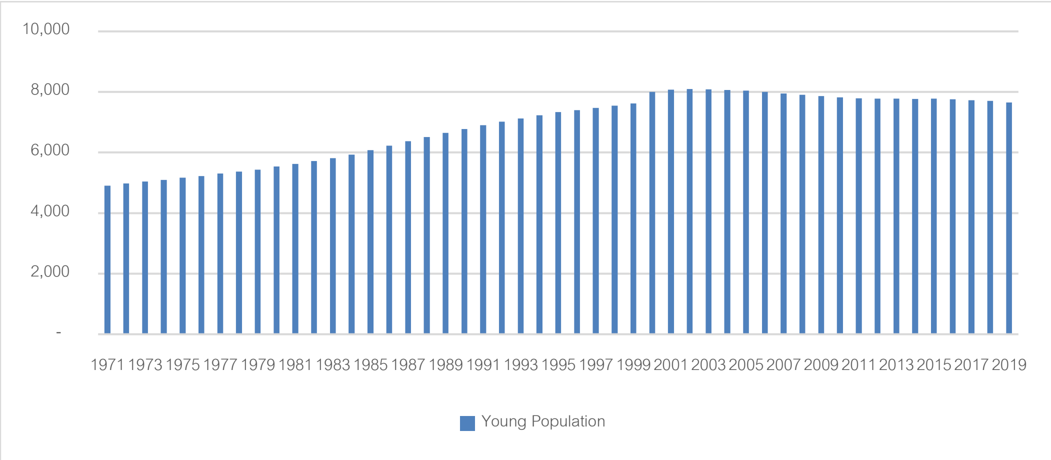

Figure 3: Young population in Malaysia (‘000 = million)

Source: Economic Planning Unit (2021)

These findings put forward the following contributions. First, they will contribute to filling the gaps in the previous literature, which failed to incorporate changes in demographic structure and their impact upon government health care expenditure in Malaysia. Second, this study will stress the arising conflicts between different age cohorts for budgetary allocation. Third, the empirical findings will contribute by providing new insights to policymakers on the importance of age structure changes in deciding policy-making and budgetary allocations. Also, this study will differ from past studies by conducting country-specific research developed within a time series data framework. Findings from country-specific research will be more useful in providing policy recommendations. Moreover, this study attempts to analyze the time-varying effects by examining both long-run and short-run relationships between the variables. Next, this study stresses the correlation between public health care expenditure and government education spending owing to the scarcity of the literature thereof.

2. Literature review

This section provides a literature review on the fiscal effects that arise from demographic structural change and describes the empirical literature review on the influence of demography on public health care expenditure.

2.1 Theoretical literature review

A number of studies such as Foot (1984), Foot (1989), Echevarria (1995), and Luski and Weinblatt (1998) have presented a dynamic analysis focusing on the effects of demographic changes on government expenditure. The analysis by Luski and Weinblatt (1998) was based on the suggested factor that the government provides the public with various services, most of which are directed at specific age groups in the population. Assuming that the government tends to provide each age group with different amounts of various services such as education and health care, a theoretical model was developed based on Luski and Weinblatt's (1998) model to analyze the crucial effect of the demographic characteristics on the varying levels of government expenditure. The model adopted in this study will also be based on a simple growth model with public expenditure in a fiscal federalism framework as presented by Echevarria (1995). The model developed provides a mechanism that allows the estimation of the impact of demographic changes on the relative size of the age groups. We recognized that demographic characteristics, in particular the age structure of the population, have a crucial effect on the levels of government expenditure. Both health care and education expenditure are identified as age-related outlays. Hence, these are claimed to be strongly related to the demographic structure of society.

The impact of demographic change on fiscal federalism was similarly explored by Foot (1984) in an examination of the recipient age groups of government expenditure programs. They further identified that education and training are classified as age-specific public programs. In other words, public education expenditure can be considered as demographic-induced government expenditure. A study on the demographic impacts of age-specific government programs will likely draw insight for future developments.

Meanwhile, Foot (1989) put forth that public sector transfers from sector to sector are likely to be possible due to demography structure changes. This simply means that there may be a reduction in expenditure for programs primarily directed at the young population in favor of programs directed to the elderly under the circumstances of the aging population. In addition, Foot (1989) reported that an increase of the working-age population increases the taxable base. However, the increase of elderly and young dependents will become economic burdens instead. As such, age structure is clearly related to the level of fiscal pressure.

Consequently, relative changes to the population size of respective age cohorts are an important aspect of potential fiscal pressure. Hence, demography cannot simply be ignored given that it is considered a major factor that generates fiscal pressure or relief. Demography generates cycles of fiscal pressure or relief. When a baby boom takes place, the government is likely to increase public education expenditure, which was deemed to be age-related spending. These baby boomers then age, leading to an increasing working-age population and thus creating fiscal relief. When they grow old, the old age population will subsequently increase, leading to fiscal pressure once again.

In the same way, Echevarria (1995) agrees that changes in the size of the population, as well as the age structure imposes consequences on the evolution of government spending. Earlier, Foot (1984) presented the effects and pressures of demographic changes exerted on government spending. It is therefore assumed that expenditure items can be classified based on the age of their recipients. Henceforth, these expenditures may be referred to as age-specific or age-related expenditure. On a separate note, Auerbach et al. (1989) confirmed that public education spending is one such age-specific item. In an attempt to analyze the implications of demographic factors on public expenditure, Echevvaria (1995) developed a simple growth model and assumed three groups existed within the population: (1) young, (2) working-age, and (3) elderly or retirees. The subsequent setup facilitates the examination of the behavior of expenditure as influenced by the size of the population and its age composition.

The simplified demographic model was later applied by Luski and Weinblatt (1998) to investigate the relationship between demographic variables and government expenditure levels. In this simple model, the population is again divided into three different age-structure cohorts: (1) children aged 0 to 14 years, (2) economically active adults aged 15 to 64 years, and (3) elderly aged 65 years and over. It is assumed that the public education expenditure is closely related to the size of the children's population, while the public health care expenditure level may well depend on the size of the elderly population. Thus, it is suggested that demographic characteristics play a crucial role in determining the relative spending on social sectors.

2.2 Empirical literature review

In an attempt to examine the demography factor's influence on public health care expenditure, most of the extant literature shed light on the impact of demographic structure change towards the adjustment of public expenditure. The demographical changes could either undermine or enhance the spending on a certain social sector that provides benefits to a specific age group. According to Holtz-Eakin (2004), if the elderly do not support programs from which they do not directly benefit, it raises the possibility that the demographic structure would undermine the level of public spending for productivity-enhancing social infrastructure. Hence, the degree to which the elderly population will support public spending for productivity-enhancing sectors remains of particular interest.

The issue of generational conflict continues to be empirically investigated by Borge and Rattsø (2008). The analysis was centered on determining whether a shift in the age composition of the population could lead to higher spending in a certain sector and lower in another. Gradstein and Kaganovich (2004) suggested that demographic transition as characterized by increasing longevity could have significant economic implications. Conventional wisdom argues that the aging population will increase pressure and tilt the composition of spending in favor of this age cohort. The demographic consequences of aging were similarly discussed by Bogetic et al. (2015) who said that the elderly could put political pressure on more health care expenditure at the expense of less public education spending.

Meanwhile, studies conducted on the demographic influence on public education expenditure provided a similar argument on the potential competition between the elderly and public education allocation. It has been claimed that this age-cohort population may be competing with scarce public resources on one hand and may have no incentive to vote in favor of governments encouraging greater allocation to public education expenditure on the other (Chakrabarti & Joglekar, 2006). Similarly, Grob and Wolter (2005) shed light on the conflict between young and old on resource allocation. Meanwhile, Kelley (1976) examined the direct impact of changing age distributions on government expenditure by shifting its demand toward sectors that are sensitive to the needs of the specific age cohort population. For example, the circumstances of the rising young age population will demand an increase in education allocation. Similarly, an increasingly aging population may be in need of higher health care expenditure. On a separate note, Yun and Yusoff (2018) revealed that the growth of different age cohort populations can have a varied effect on public education expenditure in Malaysia over time. This implies that changes in the population composition could project a variation effect on public expenditure.

Preston (1984) put forward the idea that demographic changes may have a crucial impact on government spending trends, specifically in the context of children and the elderly. However, this claim was refuted by both Kelley (1976) and Kurban et al. (2015). This latter argued that an increase in the elderly population had in a way resulted in a rise in public education expenditure, instead of an expected decline. A discussion by Kurban et al. (2015) presented a somewhat different view which implied that a rise in the elderly share of the population has been associated with an improvement in financial allocation, refuting the earlier claim that the elderly population is less inclined to support public education allocation. The aging population had in fact made it easier to raise funds for public education expenditure. This seems to contradict the argument of the presence of generational conflict in the allocation of public social spending.

Stromberg (1998) argued that altruism can reduce inter-generation conflict and the potential competition for scarce resources between the young and old. Alternately, Richman and Stagner (1986) proposed that the rising numbers of dependent elderly may seek to raise the training level for younger workers, both to raise the pool of resources from which transfers can be funded and the quality of services they receive. This again downplays the conventional idea that the elderly and young populations could be competing for the allocation. However, a higher proportion of the elderly population (aged 65 years) will occasionally shift the budget to social services such as old-age pensions and health care expenditure provisions for the elderly. The aspect of the population size and population density also have a significant effect on the internal distribution of the government budget.

On a separate note, Chor (2010), Yap and Selvaratnam (2018), Yong (2015), Khan et al. (2016), Cantarero (2005), and Baharin and Saad (2018) have all demonstrated the significance of a population over 65 years of age in explaining the increasing public health care expenditure. Christiansen et al. (2006), Mendelson and Schwartz (1993), and Ahn et al. (2005) also supported the notion that an aging population appears to be associated with increased health care expenditure. Meanwhile, Khan et al. (2016) highlighted the negative influence of population structure on health care expenditure. This demonstrates the increased dependency ratio on the working-age group, which tends to put pressure on the allocation of resources to other sectors of the economy. The population aged less than 15 years are not actively engaged in economic activities but require more spending on health care, whilst the elderly population is more susceptible to illness and so will require even more health care spending.

On the contrary, Gbesemete and Gerdtham (1992) revealed an insignificant effect of the population under 15 years old on health care expenditure. Similarly, Rahman (2008) demonstrated the aging population as statistically insignificant in affecting the health care expenditure. Zweifel et al. (1999) and Zweifel et al. (2004) provide a different argument that population aging is a red herring, which makes it highly unlikely for it to be driving the health care expenditure. Any changes to the age composition of the population due to increased life expectancy will not affect the size of the health care sector due to the aforementioned red herring. In other words, population aging may only become a form of distraction from the real causes of the growth of public health care spending. Getzen (1992) also failed to find any discernible association between age structure and health care costs, whilst a review by Shiu and Chiu (2008) summarized that it is difficult to reach any conclusions about the impact of demographics on health care expenditure due to discordant opinions on population aging. These ambiguous findings deserve further empirical investigation. Introduction of the age structure transition and the analysis of its impact may indeed have encouraged the seeking of new explanations and the creation of a new pathway for future study.

3. Variables and research methodology

This study was conducted to empirically examine the relationship between demographic structure and public health care expenditure in Malaysia. The variables included in this research are health care expenditures (HEALTH), education expenditures (EDU), the population aged less than 15 years (POP14), the population aged between 15 to 64 years (POPW), the population aged more than 64 years (POP65), and real gross domestic product per capita (GDP). The data for the period of 1971 to 2019 were obtained from several sources such as the World Bank and the Economic Planning Unit. An ARDL bounds testing approach will be employed to examine the relationship between demographic structure and public health care expenditure. All the variables are transformed into logarithmic form to demonstrate their impact in terms of the percentage change. Estimation of a log-log model allows the direct interpretation of elasticities. The real gross domestic product per capita (GDP) variable with negative values can be easily transformed using the following procedure (Busse & Hefeker, 2007) to maintain the sign of the variable:

$$y = \ln(x + \sqrt{(x^2 + 1)})$$

The following model is set up for empirical testing:

$$\ln HEALTH_t = \alpha + \beta_1 \ln EDU_t + \beta_2 \ln POP14_t + \beta_3 \ln POPW_t + \beta_4 \ln POP65_t + \beta_5 \ln GDP_t + e_t \quad (1)$$

where

$HEALTH_t$ = Public Health Care Expenditure at time t (% of GDP)

EDU_t = Public Education Expenditure at time t (% of GDP)

$POP14_t$ = Population ages 0 to 14 (% growth rate)

$POPW_t$ = Population ages 15 to 64 (% growth rate)

$POP65_t$ = Population ages 65 and above (% growth rate)

GDP_t = Real Gross Domestic Product per capita (RM Million)

e_t = Error term at time t

The primary step of the research methodology involves testing the stationary properties of the variables by employing unit root tests such as Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests. The testing of the presence of unit roots was essential to ensure that none of the variables are integrated of order 2, *I*(2). This is because ARDL bounds testing can only be employed when variables are either *I*(0) or *I*(1) or a mix of both, but not *I*(2). Subsequently, optimal lag order is selected based on the lag length selection test to ensure that error terms of the equations are not serially correlated (Mohapatra et al., 2016).

The ARDL bounds testing approach is chosen to determine the long-run relationship for several reasons. In a comparison of the ARDL bounds testing approach with other co-integration approaches such as Johansen and Juselius (1990), this approach can be employed irrespective of whether the variables are integrated *I*(0), *I*(1), or a mix of both. Secondly, this technique is more efficient and robust when dealing with a small sample of data. Thirdly, the ARDL can be re-parameterized into an unrestricted Error Correction Model (ECM), which integrates short-run dynamics with long-run equilibrium without causing the loss of long-run information. The model for the ARDL bounds test can be formed as follows:

$$\Delta \ln HEALTH_t = \delta_0 + \sum_{i=0}^{p} \alpha_1 \Delta \ln HEALTH_{t-i} + \sum_{i=0}^{q_1} \alpha_2 \Delta \ln EDU_{t-i} + \sum_{i=0}^{q_2} \alpha_3 \Delta \ln POP14_{t-i} + \sum_{i=0}^{q_3} \alpha_4 \Delta \ln POPW_{t-i} + \sum_{i=0}^{q_4} \alpha_5 \Delta \ln POP65_{t-i} + \sum_{i=0}^{q_5} \alpha_6 \Delta \ln GDP_{t-i} + \gamma_1 \ln HEA_{t-1} + \gamma_2 \ln EDU_{t-1} + \gamma_3 \ln POP14_{t-1} + \gamma_4 \ln POPW_{t-1} + \gamma_5 \ln POP65_{t-1} + \gamma_6 \ln GDP_{t-1} + e_t \quad (2)$$

The long-run co-integration relationship can then be examined based on the joint significance F-test. Under the ARDL bounds test, the null hypothesis of no long-run relationship $H_0: \gamma_1 = \gamma_2 = \gamma_3 = \gamma_4 = \gamma_5 = \gamma_6 = 0$ is tested against the alternative hypothesis $H_1: \gamma_1 \neq \gamma_2 \neq \gamma_3 \neq \gamma_4 \neq \gamma_5 \neq \gamma_6 \neq 0$. The computed F-statistic value was compared with two sets of critical values in Pesaran et al. (2001); these are referred to as the upper bound critical values for the *I*(1) series and lower bound critical values for the *I*(0) series. If the computed F-statistic value exceeds the upper bound critical value, then the null hypothesis is rejected. However, if the F-statistic value falls below the lower bound critical value then the null hypothesis is accepted. This implies that there is no co-integration. Lastly, if the F-statistic value is in between the upper bound critical value and lower bound critical value, this indicates that the test is inconclusive. Upon the confirmation of the presence of co-integration, the following long-run model (3) can be estimated:

$$\ln HEALTH_t = \varphi_0 + \sum_{i=0}^{p} \theta_1 \ln HEALTH_{t-i} + \sum_{i=0}^{q_1} \theta_2 \ln EDU_{t-i} + \sum_{i=0}^{q_2} \theta_3 \ln POP14_{t-i} + \sum_{i=0}^{q_3} \theta_4 \ln POPW_{t-i} + \sum_{i=0}^{q_4} \theta_5 \ln POP65_{t-i} \sum_{i=0}^{q_5} \theta_6 \ln EDU_{t-i} + e_t \quad (3)$$

whereby $\theta_1, \theta_2, \theta_3, \theta_4, \theta_5, \theta_6$ are the long-run elasticities coefficients.

Next, the short-run dynamics parameters can be obtained by estimating the unrestricted error correction model (ECM) associated with the long-run estimates. The ARDL short-run dynamic is specified with the ECM as follows:

$$\Delta \ln HEALTH_t = \phi_0 + \sum_{i=0}^{p} \psi_1 \Delta \ln HEALTH_{t-i} + \sum_{i=0}^{q_1} \psi_2 \Delta \ln EDU_{t-i} + \sum_{i=0}^{q_2} \psi_3 \Delta \ln POP14_{t-i} + \sum_{i=0}^{q_3} \psi_4 \Delta \ln POPW_{t-i} + \sum_{i=0}^{q_4} \psi_5 \Delta \ln POP65_{t-i} + \sum_{i=0}^{q_5} \psi_6 \Delta \ln GDP_{t-i} + \omega ECT_{t-1} + \varepsilon_t \quad (4)$$

whereby ω is the speed of adjustment parameter and $\psi_1, \psi_2, \psi_3, \psi_4, \psi_5, \psi_6$ are the short-run dynamic coefficients of the model's convergence to the equilibrium.

In addition, the Granger causality test is used to determine whether a time series is caused by another time series. This technique is useful to discover whether one-time series is useful in forecasting another. Lastly, diagnostic tests will be performed to verify the robustness of the ARDL model. The diagnostic tests will be conducted to test the serial correlation, heteroscedasticity, normality, and stability of the empirical model.

4. Empirical results and findings

This section analyzes the results and findings from the estimation of the empirical model. Firstly, the unit root tests of ADF and PP, as reported in Tables 1 and 2, show that none of the variables are integrated at second differences, *I*(2). Table 1 shows that all series are integrated at *I*(1), with the exception of LNEDU and LNPOP65 which are stationary at level, *I*(0). On the other hand, Table 2 illustrates that all series are stationary at the first difference, *I*(1) with the exception of LNPOP65 which is stationary at level, *I*(0). Since both the ADF and PP unit root tests had affirmed that the series had a mixed order of *I*(0) and *I*(1), ARDL bounds testing can proceed.

Table 1: Augmented Dickey-Fuller (ADF) test result

Augmented Dickey-Fuller (ADF) Test				
Variable	Level		First Difference	
	Intercept	Trend and Intercept	Intercept	Trend and Intercept
LNHEALTH	-1.537424	-2.990396	-5.120635*	-4.867465*
LNEDU	-3.017359**	-3.426783***	-4.871252*	-4.698802*
LNPOP14	-0.716206	-2.700842	-8.829643*	-8.815985*
LNPOPW	3.479913	3.248620	-6.486019*	-7.102777*
LNPOP65	-3.945861*	-5.416135*	-10.70988*	-10.57959*
LNGDP	-1.538291	-2.573370	-6.004028*	-6.065426*

*Significant at 1% significance level, **Significant at 5% significance level, *** Significant at 10% significance level

Table 2: Phillips-Perron (PP) test result

Phillips-Perron (PP) Test				
Variable	Level		First Difference	
	Intercept	Trend and Intercept	Intercept	Trend and Intercept
LNHEALTH	-2.206431	-2.700200	-6.180976*	-6.177724*
LNEDU	-2.316296	-2.407673	-4.185914*	-4.176962*

LNPOP14	-1.141161	-2.589176	-8.884118*	-8.951493*
LNPOPW	4.681369	2.448031	-6.518940*	-7.090610*
LNPOP65	-4.095023*	-5.427654*	-10.70988*	-10.57959*
LNGDP	-1.491611	-2.588153	-5.968950*	-6.064559*

*Significant at 1% significance level, **Significant at 5% significance level, *** Significant at 10% significance level

The cointegration testing by the ARDL bounds testing approach reported the subsequent results, as demonstrated in Table 3. The computed F-statistics value (10.22592) is greater than the upper bound critical values at the 1% significance level. This leads to the conclusion that the null hypothesis of no cointegration is rejected. Thus, it implies that a long-run relationship exists between public health care expenditure, population changes, public education expenditure, and economic growth.

Table 3: ARDL bounds test for cointegration

Test Statistic	Value	Significance Level	Bound Critical Values	
			I(0)	I(1)
F-Statistic	10.22592*	10%	2.08	3
		5%	2.39	3.38
		2.5%	2.7	3.73
		1%	3.06	4.15

*Significant at 1% significance level

With the inference drawn in the long-run relationship between the variables, the estimation of the long-run equation of the ARDL model is shown in Table 4.

Table 4: Long-run coefficients estimates of ARDL (4, 4, 2, 4, 4, 4) model (Dependent variable: LNHEALTH)

Independent Variables	Coefficient	T-Statistic	Probability
LNEDU*	0.220519	10.16075	0.0000
LNPOP14*	-0.019730	-3.675339	0.0019
LNPOPW	0.032695	1.267994	0.2219
LNPOP65*	0.043849	3.348214	0.0038
LNGDP*	0.049932	4.648789	0.0002
C*	-0.291146	-4.581245	0.0003

*Significant at 1% significance level, **Significant at 5% significance level, *** Significant at 10% significance level

The estimation of the long-run coefficients shows that all of the variables are statistically significant, with the exception of the working-age population (LNPOPW) variable. This implies that public education expenditure, children population, elderly population, and economic growth factors have significant long-run impacts on public health care spending. The long-run model of the corresponding ARDL (4, 4, 2, 4, 4, 4) can be written as follows:

$$LNHEALTH_t = 0.220519\, LNEDU_t - 0.019730\, LNPOP14_t + 0.032695\, LNPOPW_t + 0.043849\, LNPOP65_t + 0.049932\, LNGDP_t \quad (5)$$

The long-run results identify that the coefficient of public education expenditure is positive and statistically significant at a 1% level of significance. This finding implies that public education expenditure tends to have a positive impact on public health care expenditure. The statistically positive coefficient of public education expenditure implies that an increase in public education expenditure will lead to an increase in health care spending in the long-run. This conforms to most studies in various countries that ascertained the existence of a positive association between education and health (Chor, 2011). The general observation is that low educational attainment could lead to poor health. This is because an educated community will be more knowledgeable about the importance of health care. Hence, there would likely be increasing demand for better health facilities from a well-educated population. As a result, the government would need to increase their health care expenditure in order to meet the increasing demand.

On a separate note, economic growth has a positive and significant impact on public health care spending. This infers that the enhancement of economic growth will lead to a higher allocation of public health care expenditure. This finding was in line with Chor (2013) as it indicates that economic growth can affect the health status of the population by changing health care spending.

Meanwhile, demographic structural changes were also found to have a significant effect on public health care allocation. The children population variable appears to have a negative and significant relationship with public health care expenditure. This could imply that an increase in this age group could lead to less health care expenditure being allocated. This finding supports the existence of generational conflict and fiscal shifts that result from changes in the population structure. An increase of young age cohorts would result in a similar increase in the demand for education services. As a result, the government would need to raise public education expenditure in response to the younger age population’s increasing demand. The increase of the budgetary allocation to the education sector will be at the expense of the health care sector. Hence, a fiscal shift can be observed as budgetary allocation is shifted from the health care sector towards the education sector. In contrast, the elderly population coefficient was found to be positive and statistically significant. Any increase in this age cohort may lead to increasing demand for health care spending. The increased elderly population would thus increase the demand for better health care services. The increasing health care costs will then put pressure on the need for higher health care expenditure. This explains the significant positive relationship between the elderly population and public health care expenditure.

Table 5: ARDL-ECM model estimation

ARDL- ECM Estimation				
Dependent Variable: D(LNHEALTH) D(LNHEALTH)=f(D(LNEDU), D(LNPOP14), D(LNPOPW), D(LNPOP65), D(LNGDP))				
Variable	Coefficient	Standard Error	t-statistic	P-Value
D(LNEDU)*	0.168234	0.031332	5.369495	0.0001
D(LNEDU(-1))*	-0.231244	0.054658	-4.230718	0.0006
D(LNEDU(-2))	-0.037197	0.040045	-0.928867	0.3660
D(LNEDU(-3))*	-0.191186	0.050654	-3.774371	0.0015
D(LNPOP14)***	0.034123	0.016653	2.049099	0.0562
D(LNPOP14(-1))*	0.105384	0.015142	6.959616	0.0000
D(LNPOPW)*	0.134826	0.032426	4.157924	0.0007
D(LNPOPW(-1))*	0.178035	0.038814	4.586907	0.0003
D(LNPOPW(-2))*	0.146093	0.037194	3.927834	0.0011
D(LNPOPW(-3))***	0.072015	0.036678	1.963434	0.0662
D(LNPOP65)	-0.009767	0.013933	-0.701041	0.4928
D(LNPOP65(-1))*	-0.119705	0.016630	-7.198280	0.0000
D(LNPOP65(-2))*	-0.103120	0.014807	-6.964074	0.0000
D(LNPOP65(-3))*	-0.066587	0.014814	-4.494780	0.0003
D(LNGDP)*	0.578691	0.119283	4.851411	0.0001
D(LNGDP(-1))*	0.337048	0.110345	3.054505	0.0072
D(LNGDP(-2))*	0.494650	0.157672	3.137209	0.0060
D(LNGDP(-3))*	0.529787	0.142203	3.725570	0.0017
Error Correction Term (-1)*	-2.231723	0.226778	-9.841011	0.0000

*Significant at 1% significance level, **Significant at 5% significance level, *** Significant at 10% significance level

Table 5 illustrates the estimation of the short-run coefficients of the Error Correction Representation of the selected ARDL Model (4, 4, 2, 4, 4, 4). The results indicate that public education expenditure, demographic factors, and economic growth have a significant short-run effect on the public health care allocation. Public education spending was found to be negative and statistically significant. This suggests that education expenditure has a negative impact on health care expenditure in the short-run. Thus, this corroborates the hypothesis of the competition of allocation between the education and health care sectors; more spending on one sector would mean less spending for the other.

Next, demographic factors such as children's population and working-age cohorts were both positive and statistically significant in the short-run. This could mean that these two groups of age-cohorts have a positive impact on the growth of public health care expenditure. Nevertheless, an increase in the children's population does not result in generational conflict for budgetary allocation in the short-run. Hence, a higher younger age population does not lead to less public health care expenditure as expected. Instead, the increase of the working-age population contributes to income generation, hence raising public health care expenditure. Meanwhile, the elderly population was found to be negatively significant; the increase of this age group seems to have a negative effect on public health care expenditure. The aging population could have put an excessive burden on the allocation of health care spending. This conforms to most studies that highlight the impact of an aging population on public health care expenditure. The increase in the elderly population could then drive up health care costs in the short-run.

The findings also highlighted that economic growth has a positive and significant impact on health care spending. This indicates that the increase of economic growth would lead to a potentially higher health care allocation in the short-run. The coefficient of the error correction term (ECT), which represents the speed of adjustment, was found to be negative and statistically significant at the 1% level. This clearly indicated that the public health expenditure had a high rate of convergence to the long-run equilibrium.

Table 6: Granger causality test estimation

Dependent Variables	Independent Variables					
	LNHEA	LNEDU	LNPOP14	LNPOPW	LNPOP65	LNGDP
LNHEA	–	16.6223* (5.E-0.6)	0.34212 (0.7122)	0.30296 (0.7402)	0.26379 (0.7694)	1.80591 (0.1769)

LNEDU	6.04995* (0.0049)	–	0.42610 (0.6558)	0.33641 (0.7162)	0.43679 (0.6490)	1.84781 (0.1702)
LNPOP14	2.17365 (0.1264)	3.26383 (0.0481)	–	–	–	–
LNPOPW	0.43769 (0.6484)	0.55766 (0.5767)	–	–	–	–
LNPOP65	1.47270 (0.2409)	1.25283 (0.2962)	–	–	–	–
LNGDP	0.29322 (0.7474)	0.32314 (0.7257)	–	–	–	–

*Significant at 1% significance level, **Significant at 5% significance level, *** Significant at 10% significance level

Table 6 revealed the causal nexus among the variables. Based on the observation of the Granger causality test results, bi-directional causality runs between public education expenditure and public health care expenditure; the implications of this finding are that public education expenditure influences public health care expenditure. Besides this, public health care expenditure also causes an increase in government education spending. This result is in line with the theoretical findings that both expenditures are correlated.

Table 7: Diagnostic tests results

Breusch-Pagan-Godfrey Heteroskedasticity Test			
F-statistic	0.264473	Prob. F(27,17)	0.9990
Obs*R-squared	13.31089	Prob. Chi-Square(27)	0.9871
ARCH Test			
F-statistic	0.099112	Prob. F(1,42)	0.7545
Obs*R-squared	0.103587	Prob. Chi-Square(1)	0.7476
Breusch-Godfrey Serial Correlation LM Test			
F-statistic	0.648256	Prob. F(2,15)	0.5370
Obs*R-squared	3.580092	Prob. Chi-Square(2)	0.1670
Jarque-Bera Test			
Jarque-Bera	3.140826	Prob.	0.207959

Diagnostic tests were performed to ensure that the model is robust and free from autocorrelation and heteroscedasticity problems. Table 7 shows the results of the diagnostic tests carried out. The results of both the Breusch-Pagan-Godfrey test and ARCH test suggest that the model is free from heteroscedasticity issues. Meanwhile, the Breusch-Godfrey test revealed that the model is also free from serial correlation. Finally, the Jarque-Bera test indicated that the model residuals are normally distributed.

5. Conclusion

As expected, the demographic structure has a significant impact on public health care expenditure in the long-run. The age structure transition becomes one of the major sources of changes in spending levels. The growth of the aging population contributes to the rise in health care costs, which lead to an increase in health care spending. The finding from this study was consistent with Mendelson and Schwartz (1993) and Ahn et al. (2005). Moreover, the generational conflict hypothesis, as highlighted by Holtz-Eakin et al. (2004), Bogetic et al. (2015), Borge and Rattsø (1995), and Borge and Rattsø (2008), was supported in this study. The shift of the age composition of the population from young to old has led to less health care expenditure due to a reallocation of the spending towards a sector that brings benefit to the younger population. This clearly proves that such demographic structural change leads to a fiscal shift as public spending is re-allocated to sectors in need. The change of the population structure with the aging population has resulted in an increasing demand for public health care expenditure. As a result, the public health care allocation increases in response to the demographic structure change in the long-run. Furthermore, the decline of the young population has resulted in fiscal shifts as allocations were shifted from one sector to another. This in turn suggests that Malaysia's health care expenditure and education expenditure are associated whereby policymakers are confronted with a choice to either invest more in education or health care services. Higher allocation in one sector will mean less allocation for the other. The Granger causality test further confirmed the correlation between public health care expenditure and government education spending.

Although policymakers may not be able to significantly affect the demographic structure, it remains equally important for them to understand and anticipate the fiscal impact of such demographic changes (Mendelson and Schwartz, 1993). The estimation from our findings is therefore crucial to understand the extent of the impact of demographic changes on public health care expenditure. The new macroeconomic evidence on the implications of demographic structures would offer useful insights for future planning policies of public health care spending.

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