

HOW DEMOGRAPHIC AND ECONOMIC GROWTH
AFFECTING HEALTHCARE EXPENDITURE:
MALAYSIA, THAILAND, SINGAPORE AND
INDONESIA

BY

CHAN KAI TECK

A research project submitted in partial fulfillment of
the requirement for the degree of

BACHELOR OF ECONOMICS (HONOURS)
GLOBAL ECONOMICS

UNIVERSITI TUNKU ABDUL RAHMAN

FACULTY OF ACCOUNTANCY AND MANAGEMENT
DEPARTMENT OF ECONOMICS

MAY 2024

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DECLARATION

We hereby declare that:

- (1) This undergraduate research project is the end result of our own work and that due acknowledgement has been given in the references to ALL sources of information be they printed, electronic, or personal.
- (2) No portion of this research project has been submitted in support of any application for any other degree or qualification of this or any other university, or other institutes of learning.
- (3) Equal contribution has been made by each group member in completing the research project.
- (4) The word count of this research report is 9530.

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LIST OF ABBREVIATIONS

WHO	World Health Organization
CHE	Current Healthcare Expenditure
POP65	Population 65 years old and above
POP15	Population within 0-15 years old
IMR	Infant Mortality Rate
GDPPC	Gross Domestic Products Per Capita
ASEAN	Association of Southeast Asian Nations
JKN	Jaminan Kesehatan Nasional
VECM	Vector Error Correction Model
VIF	Variance Inflation Factors
REM	Random Effect Model
FEM	Fixed Effect Model

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PREFACE

The research paper submitted as a part of requirement to complete the Bachelor of Economics (Hons) Global Economics. The paper hope to determine how the demographic shift and economic growth affecting the current healthcare expenditure. ASEAN countries currently fast developing and face the ageing issue problem as other developed countries does. Therefore, discussion on the sectors and the region need to be done to understand will the two factors affected the current healthcare expenditure of countries. It may provide a macro view for the region's policymaker.

ABSTRACT

The paper studies the possible relationship between the demographic and economic growth through healthcare expenditure. With the time period 2000 to 2020, the paper had selected Current Health Expenditure (CHE) as the dependent variable to measure the healthcare expenditure. For the measurement of demographic, the population with 65 years old and above (POP65), the population between 0-15 years old (POP15), and infant mortality rate (IMR) had been selected. GDP per capita (GDPPC) was chosen to measure the economic growth. The observation countries are Indonesia, Malaysia, Thailand and Singapore.

As the result of the research, it shows that the demographic factor, which the POP65, POP15 and IMR are cointegrated in long term equilibrium. In short run, POP65 and IMR show a negative relationship with current healthcare expenditure and POP15 shows a positive relationship through the dependent variable. GDPPC shows insignificant either in short run or long run estimation in this paper.

Keywords: ASEAN, Healthcare Expenditure, Ageing population, VECM

CHAPTER 1: RESEARCH OVERVIEW

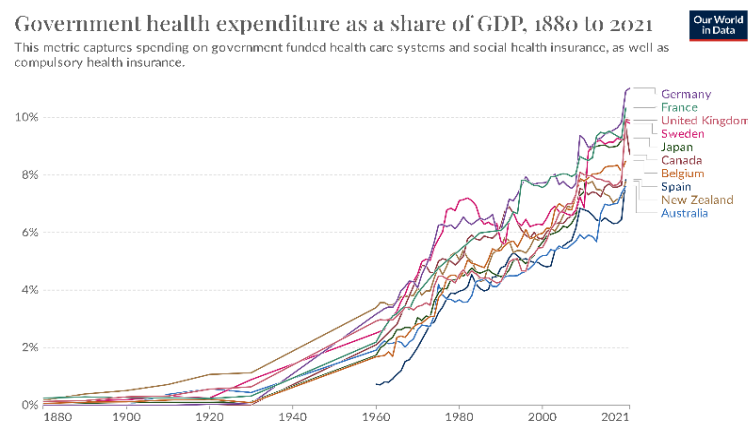
1.0 Introduction

An overview of the paper is given in this chapter. Research background will be introduced as starting point. Problem statement will point out the issue. Research questions and research objectives will be guided the direction of the paper. Hypothesis of the study may provide an estimated outcome for this paper. Significance of the study was expressed in the paper's advantages. Follow by the Chapter Layout, which briefly introduces the order of chapters of the paper.

1.1 Research Background

In 2020, a serious pandemic disrupted the world's operations, leading to unprecedented challenges in healthcare systems worldwide. As the number of deaths increasing, another alarming trend emerged: a significant increase in healthcare expenditure. The COVID-19 pandemic put great burden on healthcare systems, necessitating massive investments in medical supplies, testing capabilities, hospital infrastructure, and personnel training.

Figure 1.1: Government Health Expenditure as a share of GDP 1880-2021



Source: Our World in Data

Figure 1 shows historical trends of healthcare expenditure in some high-developed countries. There was a sharp rise throughout the 1930s, mainly attributable to the implementation and growth of social welfare programs and healthcare reforms.

The expansion of healthcare coverage and the establishment of social safety nets led to a rise in healthcare expenditure as governments invested resources into building healthcare infrastructure, expanding access to medical services, and providing financial support for healthcare costs.

Prior to that, healthcare expenditure related issues mentioned when discussing population aging. Human population had a rapid growth after World War II. A large portion of the world's population, particularly in developed countries, belongs to the baby boomer generation (Erickson, 2014). The environment after war renders a conviction that the future will be affluent and safe. Therefore, many people began building bigger families, which aided in the quick increase in population.

However, as countries continue to develop and become more prosperous, they often experience a decline in fertility rates as people have fewer children. This can lead to a demographic shift known as population aging, where the proportion of older adults in total population increases relative to younger people.

Population aging can have significant implications for a country's economic and social development. As the working-age population decreases, there may be a shortage of skilled workers to drive economic growth. Additionally, the increasing number of older adults may place greater demands on healthcare systems and social safety nets.

1.2 Problem Statement

The phenomenon of population aging is not limited to developed countries. As the report “World Population Ageing 2019 Highlights” (Nations, 2019) mentioned, many developing countries, particularly in Eastern Asia and Southeast Asia, are also experiencing rapid population aging. In Eastern Asia and Southeast Asia, the proportion of people aged 65 or elder nearly quadrupled from 6% in 1990 to 11% in 2019. This presents a significant challenge for these countries as they seek to build their economies and provide for their aging populations.

The Economic Outlook 2023 Report, published by Malaysia's Finance Ministry, shows that the country has officially begun to age, with the proportion of people 65 and older predicted to reach 7.3% of the total in 2023. According to the survey, this trend may be attributed to a rise in life expectancy brought on by improved healthcare and living conditions as well as a drop in fertility rates. The aged population has grown from 5% in 2010 to 6.8% in 2020, and Malaysia's fertility rate decreased from 2.1% in 2010 to 1.7% in 2020. By 2050, more than 15% of Malaysia's population, according to the Department of Statistics Malaysia (DoSM), would be over the age of 65.

The same situation not only occurs in Malaysia, but its neighboring countries also face the same dilemma due to regional economic development. The dependent population is increasing year by year, which challenges the government's financial planning and development plans.

1.2.1 Current Issue of Selected Country: Population and Healthcare System

1.2.1.1 Indonesia

Indonesia is the country with largest land area in Southeast Asia. It was the 4th largest population country in world and the largest population country in Southeast Asia region. According to World Bank database, the total population of Indonesia in 2020 are approximately 270 million. There are nearly 28 million elderly population in Indonesia aged 60 years and above and the amount is expected to double up till 57 million by 2040 (ERIA, 2020). From that information it shows that Indonesia currently facing the growth of population and the demographic structure had changed. In long term, ageing population issue will arise.

Healthcare system in Indonesia has not kept pace with Indonesia's rapid development. Compared to the others selected countries, Indonesia place in a lower pick, it places a 92nd (World Population Review, n.d.). Indonesia is undergoing significant social and economic transitions and affecting its healthcare system. Indonesia's healthcare system has shown improvement in certain areas such as increased life expectancy at birth and reduced infant and under-five mortality rates. However, challenges persist, especially in maternal mortality, where progress has been slower.

Healthcare spending in Indonesia has historically been low, leading to challenges in infrastructure, staffing and service quality (Mahendradhata, Y et al., 2017). Following the economic recession in the late 1990s, Indonesia government spending on health care had been gradually increased in response to social welfare issues, particularly for the poor group. The Universal Health Coverage Scheme (JKN) launches in 2014 aim to address the problem of healthcare equality. Nevertheless, the JKN primarily focus on treatment services, resulting in low supportive to public health services, health promotion and vaccination programs. Over the last two decades, government and private sector support in healthcare

sector with increasing funding. As the result, it improved health infrastructure in the nation, including primary care facilities and referral health facilities. Despite these investments, the ratio of hospital beds and primary health centres (puskesmas) to population remains below World Health Organization standards and falls behind neighboring countries.

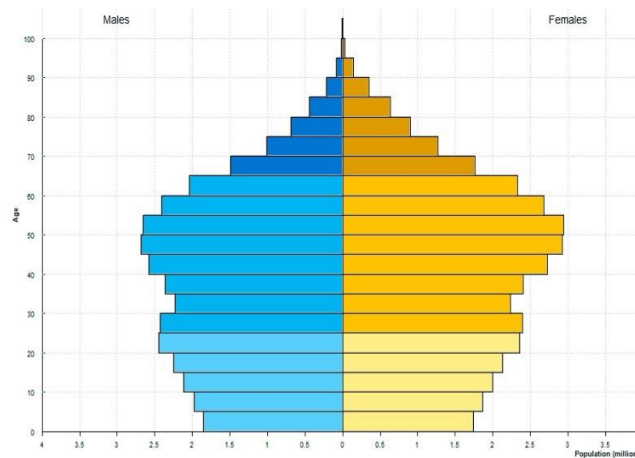
1.2.1.2 Malaysia

Malaysia is a developing country located in between Indonesia, Thailand and Singapore. The total population of Malaysia in 2020 is 32 million, a small amount compared to Indonesia. Similar to Indonesia, Malaysia faced the ageing population issue as stated as above. Although Malaysia was not classified as an ageing nation based on Housing and Population Census 2020, the DoSM estimates that 7.3% of total population will reach age 65 by 2022 (Jalil, 2022). Apparently, it results in the ageing issue for future in Malaysia.

Malaysia had been ranked as the 49th in the list of best healthcare in world 2020. Malaysia's healthcare system achieves significant public health with low-cost (Example: Clinic 1Malaysia), universal services that funded through general revenue. Malaysia obtains a comprehensive public primary healthcare mode, which including provide services to rural areas. All in good situation when not take private healthcare sector into account. The growth of private healthcare sector led the increase in cost of patients received equality in healthcare. Government may face that growth of the government expenditure to provide an equal healthcare environment in the competition with the private sector (World Health Organization, 2012).

1.2.1.3 Thailand

Figure 1.2 Population Pyramid of Thailand in 2020



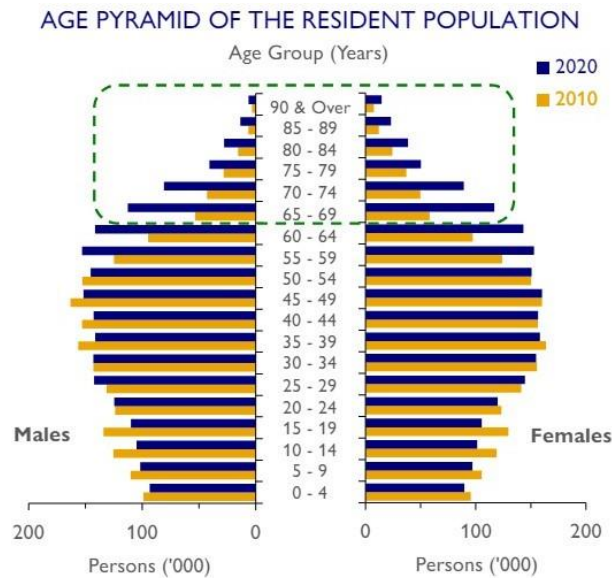
Source: Chaisomboon et al. (2020)

Thailand is among the fastest ageing countries in the world. There are 12 million population are elderly population in the 67 million of total population according to the national statistics report (World Health Organization: WHO, 2023). Thailand has been categorized as "aged society" since 2005 due to there is 10% of its population is 60 years of age and above. Thailand population had been forecasted 28% of the population is elder in 2030. Soon after, Thailand will become “super-aged society” which burden the government. Figure 1.2 shows the large amount of dependent elder population in the future.

Thailand positions a higher ranking position ,which is 47th better than Malaysia result in 2020. This is because the implication of universal health coverage program that benefited every Thailand population. Thailand government put a lot of effort on equality of received healthcare service especially Thailand is a country that high poverty rate (Sumriddetchkajorn, K et.al, 2019). The government currently burden the healthcare expenditure to reduce the barrier for poor individual, the ageing population issue will bring a heavier workload to the government financial because of its dependent population that is growing year by year.

1.2.1.4 Singapore

Figure 1.3 Population Pyramid of Singapore Compared 2010 And 2020



Source: Singapore Department of Statistics

Although Singapore has the least land area compared to 4 selected countries, it represents the prosperity of Southeast Asia economy and stated itself as developing country. However, Singapore population faced a slow growth rate in total population, which 1.1% a year in the time period of 2010 to 2020 (Department of Statistics Singapore, 2021). As the Figure 1.2 shows the demographic structure change of Singapore compared 2010 to 2020. The number of elder has increased from 338 thousand in 2010 to 614 thousand in 2020. The elder population hold 9% in total population in 2010 and compared to 15.2% in 2020, the ageing population issue had emerged.

Singapore always a role model in healthcare system for the Southeast Asia due to its rapidly developing. Ever more, Singapore performed the best of its healthcare system in 2023. Even though in 2020, Singapore healthcare ranking places in a top 10 position in worldwide. Singapore has established a high-quality healthcare system at a lower cost than any other high-income country. Singapore's National

Health Care Plan implemented in 1983, it aimed to keep healthcare affordable and meet the needs of a growing population. The Singapore government promotes restructuring the public hospital system for more independency and competition. The government also introducing Medisave for medical savings to make citizen more responsible on own out-pocket-money for healthcare and less reliance on nation welfare or third-party medical insurance (Brookings, 2016). It shows that the Singapore government had foreseen the increase of government burden due to the growth of elder population and layout in advance.

1.3 Research Questions

A few research questions have been developed for this study based on the research topic.

The research questions as bellow:

- 1) What is the relationship between healthcare expenditure, demographic change, and economic growth?
- 2) How do variations in healthcare expenditure influence economic growth indicators within a given economy
- 3) What is the impact of variation in long-term and short-term?

1.4 Research Objectives

1.4.1 General Objective

The general objective for this study is to explore how healthcare spending, demographic changes, and economic growth relate to each other within Malaysia, Thailand, Indonesia and Singapore.

1.4.2 Specific Objectives

- 1) To clarify the relationship between healthcare expenditure, demographic change, and economic growth.
- 2) To examine how variations in healthcare expenditure influence economic growth indicators within a given economy.
- 3) To determine the impact in short-term and long-term between variables

1.5 Hypotheses of the Study

Hypothesis 1

H_0 : There is no significant relationship between elderly population and healthcare expenditure

H_A : There is significant relationship between elderly population and healthcare expenditure

Hypothesis 2

H_0 : There is no significant relationship between young population and healthcare expenditure

H_A : There is significant relationship between young population and healthcare expenditure

Hypothesis 3

H_0 : There is no significant relationship between infant mortality rate and healthcare expenditure

H_A : There is significant relationship between infant mortality rate and healthcare expenditure

Hypothesis 4

H_0 : There is no significant relationship between GDP per capita and healthcare expenditure

H_A : There is significant relationship between GDP per capita and healthcare expenditure

1.6 Significance of the Study

This paper may provide empirical evidence for the policymakers as a direction for policymaking. With having compared to a neighbour country that similar geographical factor and historical factor, policymakers may implement a similar policy on domestic.

Other than that, the study's contribution to academic literature can help advance the understanding of the relationships between healthcare expenditure and demographic and economic aspect. Future research in these fields can benefit from this information, which also helps to build more complete theoretical frameworks.

1.7 Chapter Layout

There is total 5 (five) chapters for this paper.

Chapter 1 provides a brief synopsis of the structure of the paper. It starts with background information to frame the study and ends with a clear problem statement. Research questions and objectives released to lead the research and its hypothesis determines its expected result. The study's the potential impact emphasize how important it is. The chapter concludes by outlining the structure of the paper and giving a quick summary of the chapters that follows.

Literature review will be proceeded in Chapter 2 Review on dependent and explanatory variables that past study. Theory that fitted for this paper will be discussed. Conceptual framework will be showed.

Methodology will be mentioned in Chapter 3. The data sources and its scale and definitions will be the content. Research design will be mentioned. A short brief with the tool for analysis. Methods and tests will be used for the study will be discussed.

Chapter 4 will show the results of tests. Interpretation of results will be done. In the end, a short summary of the results will be prepared for Chapter 5.

In Chapter 5, discussions in results will be done. Some recommendations may be provided based on the discussion issue(s). Conclusion will be completed as a closing of the paper.

1.8 Conclusion

This chapter introduces the topic of this paper, how the demographic structure change and the growth of economic in developing countries affecting the demand of healthcare and the healthcare expenditure. Ageing population is a long-term issue that affects the policymakers to allocate the financial resources. Due to the development of a country, the reform of healthcare system is important to the population health and its equality. In Southeast Asia region, developing countries is a common and majority. Therefore, this paper focuses on 4 countries in the region which is Indonesia, Malaysia, Thailand and Singapore. To define the relationship between healthcare expenditure, demographics and economic growth. Dependent variable display as the Current Healthcare Expenditure (CHE) and its explanatory variables population which 65 years old and above (POP65), population which between 0-15 years old and infant mortality rate. For economic growth, the variable to determine that is GDP Per Capita (GDPPC).

CHAPTER 2: LITERATURE REVIEW

2.0 Introduction

This section looks at these theoretical and empirical study. Determination and explanation of dependent variable and independent variables may clarify the meanings of variables and the reason on selected the variables. In addition, earlier research on variables could offer a potential conclusion for this work. To determine whether there is a positive association between the variables, hypothesis will be established in the last.

2.1 Review of the Literature

2.1.1 Current Healthcare Expenditure (CHE)

Current Healthcare Expenditure (CHE) has selected as the dependent variable in this study. It is the indicator that alternative to the Total Healthcare Expenditure (THE). For THE, it covers present consumption for healthcare and the investments for future. It may not sufficiently represent current period expenditure due to the capital formation. Therefore, CHE had been recommended as the indicator that determinate the aggregate final consumption expenditure of resident units on health care goods and services in current period (OECD, 2017).

The fundings by Konatar et al. (2021) shows that there is relationship between healthcare expenditure, population change especially in ageing population ,and economic development. The growth of the elderly population has a positive relationship with healthcare expenditure. However, there is significant in long term observation, but insignificant in short term. For economy growth, the research team justified that the higher the developed level of a country, the higher the demand for

advanced healthcare service. In result, it has a positive relationship with healthcare expenditure. In individual perspective, increase in income simultaneously increase the willingness of individual to seek for healthcare service.

2.1.2 Population 65 Years Old and Above (POP65)

Population 65 years old and above as one of the variables may represented the change in demographic of elder population. In this study, the indicator allows the researcher to directly observed the trend of ageing population. Normally, the proportion of elder population increase results in the increase in healthcare expenditure in previous study and form high pressure on demographic cost (Lindberg, C., & Mccarthy, T., 2021).

According to Nordin et al. (2015), they highlighted that the relationship between healthcare expenditure and ageing population in China and India is significantly in both short-run and long-run positive effect. The researchers also suggested to fulfil the research gap with select other variables to determine the healthcare expenditure, such as youth population and infant mortality rate .

There are also some research focuses on Southeast Asia region, from the research by Baharin, R., & Saad, S. (2018) mentioned that the growth of elder population will positively affect healthcare expenditure in long-term and Khan et al.(2016) found that short-term positive relationship between both. It may cause by the high usage in acute care expenditure from elder population (De Meijer, C et.al., 2013). But there is still opposite result, Sagarik (2016) stated not significant relationship between elder population and healthcare expenditure, but significant in economic growth, industrialization, and urbanization factor.

Although there are conflict results when comparing previous studies, worldwide institutions had noticed the growth of ageing population and hope to reduce the negative effects.

2.1.3 Population Between 0-15 Years Old (POP15)

The population bellow 15 years is one of the components to measure dependent population in a country (WHO, n.d.). Logically, change in population bellow 15 years may lead the change in dependent population, since the change in dependent population may result in shift of healthcare expenditure.

Some research recognizes that there is relationship between the youth population and healthcare expenditure. The indicator has negative relationship with healthcare expenditure in long-run estimation (Günel, 2018). The research applied a time series VECM model to measure the relationship between young population and healthcare expenditure.

For the research in Malaysia, Khan et al. (2016) also discovered that POP15 is significant negatively effect to healthcare expenditure.

2.1.4 Infant Mortality Rate (IMR)

Infant mortality rate is one of the indicators affecting demographic and able to reflect the standard of a healthcare system. The healthcare industry had advanced over the past few centuries as technology does, as the result delivery process for baby is more secure for both pregnant and offsprings. However, level of development of a region holds a major cause for the infant mortality rate and healthcare expenditure. Previous study shows that the developing country and underdeveloped country has a significant effect between healthcare expenditure and

infant mortality rate (Kiross et al., 2020, Owusu et al., 2021). As the example, the sub-Saharan Africa region, its infant mortality rate is strongly affected by the government healthcare expenditure.

There is also research for OECD countries. The finding showed a significant impact of health spending reducing infant mortality rate (Owusu et al., 2021). The researcher Theint, T. T. (2020) conclusion that infant mortality rate has a negative relationship to healthcare expenditure in ASEAN region, and it is more related to government healthcare expenditure. The research mentioned that increasing government healthcare expenditure is the way for ASEAN region to decrease the infant mortality rate.

In short, infant mortality rate has a relationship with the healthcare expenditure which increase in healthcare expenditure may decrease the infant mortality rate.

2.1.5 Gross Domestic Products Per Capita (GDPPC)

This indicator aims to reflect the economy growth as macro. Look into a micro view, GDP Per Capita is an indicator that enable to measure the income. For research in OECD region, GDP Per Capita significantly important to determinate healthcare expenditure (Akça et al., 2017). It shows positive relationship between healthcare expenditure and economic growth. (Beylik et al., 2022). Against, Lopreite & Mauro (2017) stated that change of GDP Per Capita less affecting the healthcare expenditure.

Tang (2010) mentioned the finding of the economy growth that led by the increase of healthcare expenditure may explain by improving in productivity for Malaysia's situation. With higher income levels potentially leading to increased healthcare spending to meet evolving healthcare needs and demands (Keegan et al., 2017). A

positive and significant bidirectional relationship between income per capita and healthcare expenditure in Malaysia (Khan et al., 2016b)

With using Quantile-On-Quantile analysis, the relationship between healthcare expenditure and economic growth in Asia shows not linear and can fluctuate based on the level of healthcare spending (Wu et al., 2021)

There are also shows inconsistent results in relationship and effect between economy growth and healthcare expenditure in panel research that investigated EU countries (Özyılmaz et al., 2022).

2.2 Review of Relevant Theoretical Models

Grossman's health capital theory

Grossman's health capital investment model proposed in 1972 has been the foundation for health economics which is follow the Gary Becker tradition of human capital theory. The framework in view takes the human individual as the forward-looking and rational agent involved in a process of continuous utility maximization across time. In this conception health is not understood as just the absence of diseases, but it acquires the status of a capital that can be accumulated through investments or losses which are a consequence of ignorance or negative health issues (Laporte, A., 2015).

To Grossman's theory, people always review the costs and benefits of health investment, with the investment plans for the long run. In the cost-side, people will bear immediate costs such as healthcare, preventive measures or lifestyle adjustment in addition to the long-term ones of give up current consumption or leisure to healthy behaviors.

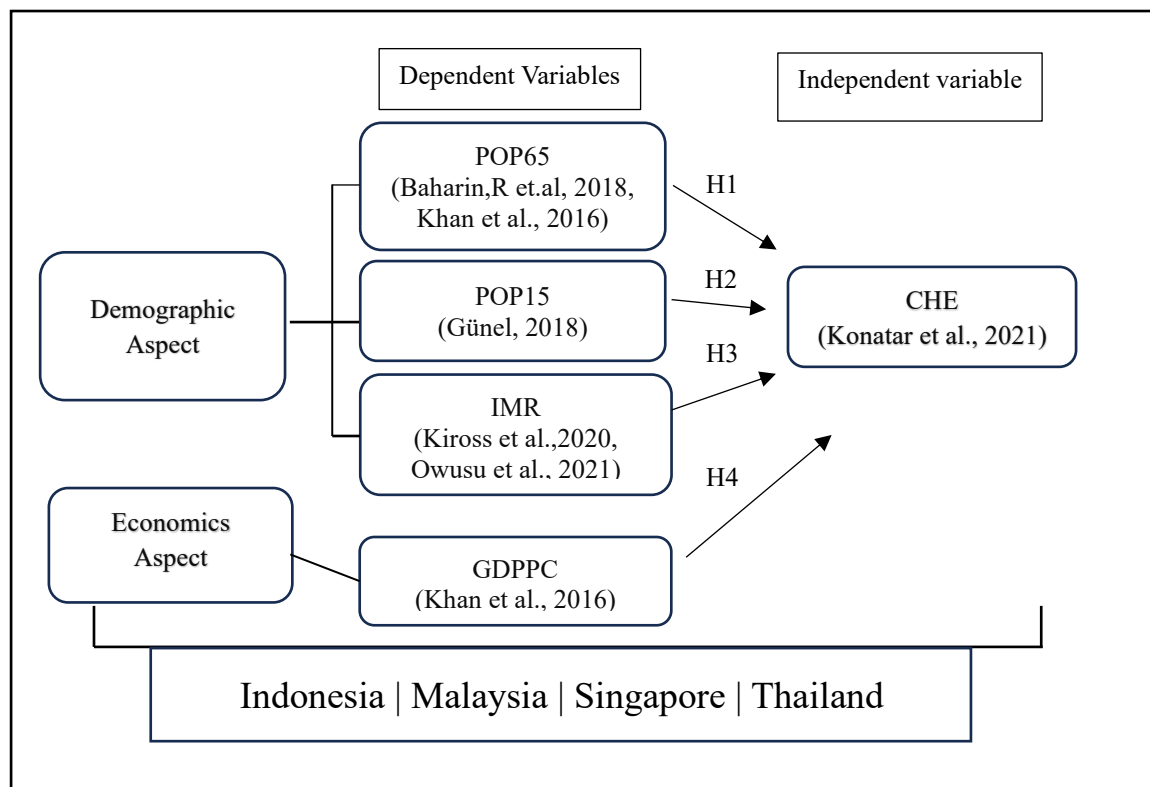
On the opposing side, the positive health wealth outcomes are intertwined. They provide social benefits both for the short run (because of the direct improvement in health status) and for the long term (since this leads to better productivity, income and general well-being). In his view, productive benefits are generated off the direct use of one's health for example, to earn income, and consumption benefits, which cover the individual's enjoyment, while being healthy.

Grossman's model, which adopts a lifespan approach, is particularly effective in exploring the connections between health-related choices and consequences as individuals age, both on an individual perspective and within aggregate level. Its

collective insights offer valuable understanding into how population aging could influence healthcare systems and expenditure patterns over time (Laporte, A., 2020).

2.3 Proposed Theoretical/ Conceptual Framework

Figure 2.1: Conceptual Framework



Source: Own Merged

Based on the conceptual framework shown in Figure 2.1, a linear regression equation had been proposed as follows:

$$CHE_{it} = \beta_0 + \beta_1 POP65_{it} + \beta_2 POP15_{it} + \beta_3 IMR_{it} + \beta_4 GDPPC_{it} + \varepsilon_{it}$$

Which,

CHE : Current Healthcare Expenditure (% in GDP)

POP65: Total Population 65 Years Old and Above (% in total population)

POP15: Total Population between 0-15 Years Old (% in total population)

IMR: Infant Mortality Rate (Per 1,000 Live Births)

GDPPC: Gross Domestic Product Per Capita (Constant 2015 US\$)

ε : The Error Term

The data of variables had standardized with logarithm and show as bellow:

$$\begin{aligned} \ln CHE_{it} = & \beta_0 + \beta_1 \ln POP65_{it} + \beta_2 \ln POP15_{it} + \beta_3 \ln IMR_{it} + \beta_4 \ln GDPPC_{it} \\ & + \varepsilon_{it} \end{aligned}$$

2.4 Hypotheses Development

For Hypothesis 1 (POP65):

H_0 : There is no relationship between elderly population and healthcare expenditure

H_A : There is relationship between elderly population and healthcare expenditure

For Hypothesis 2 (POP15):

H_0 : There is no relationship between young population and healthcare expenditure

H_A : There is relationship between young population and healthcare expenditure

For Hypothesis 3 (IMR):

H_0 : There is no relationship between infant mortality rate and healthcare expenditure

H_A : There is relationship between infant mortality rate and healthcare expenditure

For Hypothesis 4 (GDPPC):

H_0 : There is no relationship between GDP per capita and healthcare expenditure

H_A : There is relationship between GDP per capita and healthcare expenditure

2.5 Conclusion

This chapter had been reviewed on previous study. Discussions on each variable provide a view on possible outcome. Study on theory to ensure the paper is related to it and form a conceptual framework for this paper. Lastly, hypothesis development had shown.

CHAPTER 3: METHODOLOGY

3.0 Introduction

In this chapter, discussion on the data collection process and its scale and definition illustrate the credibility of the sources of the data. Other than that, data analysis instrument and data analysis methods will be covered to explain the econometric calculations in this study.

3.1 Research Design

This paper fall on quantitative research as well as a casual study on relationship between current healthcare expenditure and explanatory variables: demographic and economic growth with panel data. Study on the casual between current healthcare expenditure, demographic factors (population that 65 years old and above, population between 0-15 years old and infant mortality rate) and economic growth (GDP per capita) may identify the relationship between variables and its affect in short-run and long-run.

3.2 Data Collection Methods

Data collected in this paper was through online which is secondary data. Official or public credibility website(s) had selected as the source(s) for variables may make this quantitative study and its results more reliable.

The variables and its respective source shows in the table below:

Table 3.1: Data Source

Variable (s)	Source (s)
CHE	• Worldbank database (Singapore, Malaysia, Thailand, Indonesia)
POP65	• Department Of Statistic (Malaysia) • Department Of Statistic (Singapore) • Worldbank database (Thailand, Indonesia)
POP15	• Department Of Statistic (Malaysia) • Department Of Statistic (Singapore) • Worldbank database (Thailand, Indonesia)
IMR	• Macrotrends database (Malaysia, Singapore) • Worldbank database (Thailand, Indonesia)
GDPPC	• Worldbank database (Malaysia, Singapore, Thailand, Indonesia)

Source: Developed for research

In this paper, panel data study for 4 selected countries, they are Indonesia, Malaysia, Thailand and Singapore. Data had been collected for these four countries which cover 21 years period which from 2000 to 2020.

3.3 Research Instrument

The instrument used to analyse the data set of this paper is EViews12. EViews is a software allow user to visualize the collected data. EViews (n.d.) offers strong statistical forecasting and modelling tools to researchers, enterprises, government organizations. Analysis of data such as unit root test, residual test and correlation may be carried out to explain variables. Model build may allow user to study the relationship of explanation variables and forecastable.

3.4 Constructs Measurement (Scale and Operational Definitions)

Table 3.2: Scale and Operational Definitions

Variable (s)	Scale	Definitions
CHE	Percentage in GDP	Final consumption on healthcare goods and services during each year
POP65	Percentage in total population	Proportion of population that 65 years of age and elder in total population
POP15	Percentage in total population	Proportion of population that within the age of 0-15 in total population
IMR	Per 1,000 Live Births	The number of infants dying before reaching one year of age
GDPPC	Constant 2015 US\$	Gross domestic product is divided by mid-year population to determine a country's prosperity based on economic growth.

Source: Developed for research

Table 3.2 has stated the scale for variables and its definition. For CHE, POP65 and POP15 are expressed in percentage. IMR and GDPPC have the different scale but for simple understanding, the paper using “unit” to express them.

3.5 Data Processing

After the reliable data of variables had been collected, to study the relationship and trend of the dataset, diagnosis tests proceeding to avoid econometrical error. Stationary of dataset will be examined. Model will be selected based on its characteristics and the functions that this paper expected. VECM model allows this study to observe the short-term and long-term relationship of variables.

3.6 Data Analysis

3.6.1 Descriptive Analysis

Descriptive analysis summarize data by showing its central tendency, such as mean, median and mode. Next, the variability, which using standard deviation and variance (Hayes, 2024). With descriptive analysis, key characteristics of a dataset may define in short time.

Kaur et al. (2018) mentioned that descriptive analysis is suitable for public health and health sciences study. It benefits the policymaker on implement health policy which more effective with targeted specific populations.

3.6.2 Correlation Analysis

The strength and direction of linear connections between two variables are assessed using correlation analysis. If the two variables are normally distributed, Pearson's correlation is significant for apply (Gogtay et al., 2017).

Pearson's correlation coefficient represents as a linear regression, with a range from -1 to +1 (Kenton, 2022). When there is positive relationship between two variables, the result will be biased toward the value of +1, Variable A increases and Variable B responds with the same direction, which is increasing. Vice versa for the negative relationship which the result biases toward the value of -1. If the result shows up the value of 0, it means relationship between two variables.

Table 3.3 Strength of Correlation

Strength	Correlations Value
Very Weak	Bellow 0.20
Weak	0.20-0.39
Moderate	0.40-0.59
Strong	0.60-0.79
Very Strong	Above 0.80

Source: Papageorgiou S. N. (2022)

However, Evans (1996) classified the correlation value into five level based on the strength. The interpretation shows as the Table 3.3.

3.6.3 Unit Root Test

Panel unit root test is statistical test that determine if a time series variable in a panel dataset has a unit root process. In other words, it decides whether the variable remains stationary over time

The Levin et al. (2002) formed the panel unit root tests, Levin-Lin-Chu (LLC) test, which permitting variations in individual effects, time effects, and potentially a time trend. Lags of the dependent variable can be added to allow for serial correlation in the errors (Budiono, S., & Purba, J, 2022). It is valid with the analysis of cross-section time series data (Levin et al., 2002). The hypothesis testing of the tests are listed as below:

$$H_0 : \text{Series is non-stationary}$$

$$H_A : \text{Series is stationary}$$

3.6.4 Hausman Test

According to Baltagi (2014), The test of Hausman is a tool that helps to determine if the assumptions guiding the selection between fixed effects models (FEM) and random effects models (REM) in panel data analysis are accurate. It focuses on assessing the relationship between the model's variables and specific effects. If the test indicates that the individual effects are not correlated with the variables researchers can opt for the efficient random effects model. On the other hand, if there is a correlation between effects and explanatory variables using the fixed effects model is recommended as it provides reliable estimates.

Sheytanova (2015) has stated that the test aids in evaluating the efficacy of panel data model estimating the procedures by analyzing the size and strength with simulations that duplicate the data. Several critical criteria are used to ensure the test is accuracy and reliability for datasets. Hypothesis for the test design as:

$$H_o: REM \text{ is preferred}$$
$$H_A: FEM \text{ is preferred}$$

3.6.5 Panel Cointegration Test

Panel cointegration tests are used to observe if a group of non-stationary time series variables in a panel dataset are cointegrated, which means they have a long-run connection that can be described as a linear combination. Many panel cointegration tests are available, including the Pedroni and Kao tests.

According to Pedroni (2004), the Pedroni test is a pooled time series test that allows for heterogeneous slopes and intercepts across individual time series in the panel dataset. The test statistic is based on the panel regression residuals and has a normal distribution. The Pedroni test has both asymptotic and finite-sample features,

making it suitable for a variety of data circumstances. The Kao test, as defined by Kao (1999), is a residual-based test that examines cointegration in a panel dataset using the mean of the cross-sectional augmented Dickey-Fuller (ADF) statistic. The test statistic is normally distributed, and critical values can be found in the literature. The Kao test features asymptotic and finite-sample properties that are applicable to various data circumstances.

H₀: There is no cointegration in nonstationary panel

H_A: There is cointegration in nonstationary panel

3.6.6 Cointegration Rank Test

As stated by Lütkepohl, Saikkonen, & Trenkler (2001), understanding the amount of Cointegrating relations is crucial in economic research since it influences model construction and inference techniques. At an early stage of analysis, the cointegration rank test looks at the number of cointegrating relationships between a collection of time series variables. With that stated, economists frequently utilize specific tests known as cointegration rank tests.

These tests, such as Johansen's Trace and Maximum Eigenvalue Tests, can assist in determining how many connections, or cointegrating linkages, exist between variables. It is similar to counting the number of bridges that connect various regions of a city. The Trace Test, a likelihood ratio (LR) type test established by Johansen (1988, 1995), is used in empirical investigations to evaluate a system's cointegration rank. It compares the log likelihood ratio under the null hypothesis of no cointegration to the alternative hypotheses with increasing number of cointegrating equations. While the Maximum Eigenvalue Test is another likelihood ratio (LR) type test established by Johansen (1988, 1995), it is widely utilised in empirical investigations to evaluate a system's cointegration rank. It compares the log likelihood ratio under the null hypothesis (no cointegration) to the alternative hypothesis (fewer cointegrating equations than the total number of variables in the

system) (Lütkepohl, Saikkonen, & Trenkler, 2001). Hypothesis had designed based on the framework.

H₀: There are no cointegration between variables in long run relationship

H_A: There are few cointegration between variables in long run relationship

3.6.6 Vector Error Correction Method (VECM) Model

Vector Error Correction Method (VECM) model had applied for this study. VECM model has the advantage on estimate the dataset which some in non-stationary condition. With the VECM model, both short-term and long-term estimation could be made. The ECM does integrate short-run dynamics with long-run equilibrium while preserving long-run information and avoiding issues like spurious relationships brought on by non-stationary time series data (Shrestha & Bhatta, 2018).

In this paper, CHE is the dependent variable and the explanatory variables are POP65, POP15, IMR and GDPPC. The VECM model will be modified and analysis their short-term dynamics relationship and long-term cointegration estimation.

3.6.7 Residual Diagnosis Test

3.6.7.1 Normality Test

A normality test is a statistical technique used to assess whether a given data set is well-modeled by a normal distribution, according to Ghasemi and Zahediasl (2012). It determines if the data follows a Gaussian distribution, which is identified by a bell-shaped curve with certain features such as mean and standard deviation. A normality test's primary function is to determine whether or not the data fits the

assumptions necessary for certain statistical analysis. Normality tests are critical for assuring statistical validity, particularly parametric tests that assume a normal distribution. To make educated selections regarding the statistical approaches to utilize, normality tests must be combined with visual evaluations.

H₀: Residuals are normally distributed

H_A: Residuals are not normally distributed

3.6.7.2 Heteroscedasticity Test

Heteroscedasticity is critical in statistics and economics. Heteroscedasticity occurs when the variance of errors in a regression model differs across all data. This variance variation can have a considerable influence on the predicted coefficients and regression standard errors. In summary, it can provide biased and inconsistent findings, which is why it is critical to detect, test, and solve this problem in any statistical analysis (FasterCapital,2024).

H₀: Residuals are no heteroscedasticity

H_A: Residuals are heteroscedasticity

3.6.7.3 Residual Cross-Section Dependence Test

As stated by Hsiao, Pesaran and Pick (2007), the Residual Cross-Section Dependence Test is a technique for determining the presence of interdependence or correlation among residuals in panel data models. In order to find cross-sectional dependency, this test looks at the average pair-wise residual correlation coefficients. It is especially useful in nonlinear panel data models where residual definitions might be unclear. Pesaran (2004) showed the test's consistency, demonstrating its asymptotically dependable nature.

H₀: Residuals are no autocorrelation

H_A: Residuals are autocorrelation.

3.6.7.4 Multicollinearity Test

Based on Daoud (2017) has mentioned that when two or more predictors are linked multicollinearity happens, causing the standard error of the coefficients to rise. The higher standard errors suggest that some or all variables' coefficients are substantially distinct from zero. To put it simply multicollinearity inflates the errors rendering variables statistically insignificant when they should be important.

The method that will be applied to detecting the multicollinearity issue is Variance Inflation Factors (the VIFs). Reject the H₀ if the VIF value is higher than 5, on the contrary, accept H₀.

H₀: Residuals are no multicollinearity

H_A: Residuals are multicollinearity

Table 3.4: Residual Diagnosis Analysis

Test	Hypothesis	Condition
Normality Test	H ₀ : Residuals are normally distributed H _A : Residuals are not normally distributed	P-value>0.05
Heteroscedasticity Test	H ₀ : Residuals are no heteroscedasticity H _A : Residuals are heteroscedasticity	P-value>0.05
Residual Cross-Section Dependence Test	H ₀ : Residuals are no autocorrelation H _A : Residuals are autocorrelation.	P-value>0.05
Multicollinearity Test	H ₀ : Residuals are no multicollinearity H _A : Residuals are multicollinearity	VIF<5

Source: Developed for research

In Table 3.4, it shows a summary of the residual tests should be tested and its hypothesis with the decision rule.

3.7 Conclusion

In Chapter 3, the way of data collection in this paper had been introduced. The paper will analysis the panel dataset that had been collected with EViews 12. A brief section on tests of data analysis that will be proceed in Chapter 4. With the result of tests, the paper may visualize the trend on healthcare expenditure.

CHAPTER 4: DATA ANALYSIS

4.0 Introduction

In this chapter, interpretation for the results of analysis tests will be presented. After the interpretation section on analysis, a summary of the result will be concluded the findings of this paper. Those tests ensure the dataset is valid to proceed the analysis section and fit to the VECM model for estimation.

4.1 Descriptive Analysis

Table 4.1: Description Analysis Result

	CHE	POP65	POP15	IMR	GDPPC
Mean	0.007	0.0008	0.0002	0.0005	-0.003
Median	0.008	0.0005	0.0001	0.000000	-0.0007
Maximum	0.236	0.022	0.025	0.063	0.147
Minimum	-0.207	-0.009	-0.012	-0.118	-0.099
Std. Dev.	0.096	0.005	0.005	0.023	0.037
Skewness	0.032	1.840	1.195	-1.640	0.589
Kurtosis	2.991	8.462	10.473	12.755	6.609
Jarque-Bera	0.013	137.340	194.905	335.362	45.635
Probability	0.994	0.000	0.000	0.000	0.000
Sum	0.566	0.0617	0.012	0.039	-0.187
Sum Sq. Dev.	0.685	0.0020	0.002	0.039	0.102
Observations	76	76	76	76	76

Source: Own Data Calculation

Data set had been processed in second differentiation. CHE presents a maximum value 0.236, minimum value is -0.207, with standard deviation of 0.096. Next, POP65 has a maximum value of 0.022 and minimum value of -0.009 with a standard deviation value 0.005. For POP15, it has a maximum value of 0.025 and minimum value -0.012, standard deviation value is 0.005. There is maximum value of 0.025, minimum value of -0.012 and a standard deviation value 0.005 for the variable IMR. For the variable GDPPC, it has a maximum value of 0.147 and minimum value of -0.099 with the standard deviation of 0.037.

4.2 Inferential Analysis

4.2.1 Correlation Analysis

Table 4.2: Correlation

Variable	CHE
POP65	-0.105
POP15	0.029
IMR	-0.338
GDPPC	-0.438

Source: Own Calculation

The result shows the correlation relationship between the dependent variable CHE and explanatory variables. There shows a very weak negative correlation between CHE and POP65. Weak negative correlation shows between CHE and IMR. Next, CHE has a negative moderate correlation with GDPPC. For POP15, the dependent variable CHE has is very weak correlation with it.

4.2.2 Unit Root Test

Table 4.3: Levin Lin & Chu Unit Root Test

Variables	Level	1 st diff	2 nd diff
CHE	0.465 [0.679] ^{NS}	-2.452 [0.0071] ^{***}	-5.011 [0.0000] ^{***}
POP65	3.509 [0.999] ^{NS}	-1.347 [0.0890] [*]	-3.503 [0.0002] ^{***}
POP15	-2.959 [0.0015] ^{***}	-1.866 [0.0310] ^{**}	-4.702 [0.0000] ^{***}
IMR	-1.347 [0.0890] [*]	-3.107 [0.0009] ^{***}	-4.346 [0.0000] ^{***}
GDPPC	-3.997 [0.0000] ^{***}	5.878 [1.0000] ^{NS}	1.587 [0.944] ^{NS}

Note: Statistically significant at $\alpha = 0.01$ level (***), at $\alpha = 0.05$ level (**), and at $\alpha = 0.10$ level (*).

Source: Own Data Calculation

At level, there are 2 variables that not statistically significant which is the CHE and POP65. The variable POP15 and GDPPC are significant at 0.01 level. For IMR, it is significant in 0.10 level.

Move to 1st difference, CHE and IMR are significant at 0.01 level. POP15 and POP65 are significant at the 0.05 and 0.10 level respectively. No significant for GDPPC.

The result of 2nd difference data show that the CHE, POP65, POP15 and IMR are statistically significant at the 0.01 level. The exception is GDPPC, it shows no significant.

Compared to the result , most variables are stationary at 2nd difference data.

4.2.3 Hausman Test

Table 4.4 :Hausman Test

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Period random	0.724	4	0.948

Source: Own Data Calculation

H_0 = REM is preferred

H_A = FEM is preferred

The result of Hausman Test shows a value 0.724 in Chi-Square statistic with a degree of freedom of 4.

Decision Rule:

If the P-value is lower than the significant level $\alpha = 0.05$, reject the H_0 .

In result, the P-value (0.948) is higher than α 0.05 level. Thus, accept the H_0 which the random effect model more suitable for analysis which may be uncorrelated with the regressors.

4.2.4 Panel cointegration test

Table 4.5: Result of panel cointegration test

Pedroni Residual Cointegration Test		Kao Test	
	Statistic		Statistic
Panel v-Statistic	-1.270	ADF	-3.823***
Panel rho-Statistic	-0.2875		
Panel PP-Statistic	-9.913***		
Panel ADF-Statistic	-4.176***		
Group rho-Statistic	0.394		
Group PP-Statistic	-13.562***		
Group ADF-Statistic	-5.354***		

Note: Statistically significant at $\alpha = 0.01$ level (***)

Source: Own Data Calculation

The Table 4.5 illustrates the panel cointegration test results of Pedroni Residual Cointegration Test and Kao Test.

Result shows that there are four out of seven statistics are statistically significant at $\alpha = 0.01$ level. They are the Panel PP-Statistic, Panel ADF-Statistic, Group PP-Statistic and Group ADF-Statistic in Pedroni test.

Kao test result indicates that the null can be rejected at $\alpha = 0.01$ level. As a result, there is sufficient evidence of a cointegration relationship between variables in the model. It indicates that the series has a similar trend in the long run. Current healthcare expenditure, population 65 years old and above, population between 0-15, infant mortality rate and gross domestic product per capita may be cointegrated.

4.2.5 Johansen Cointegration Ranking Test

Table 4.6: Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.768	302.919	69.819	0.0000
At most 1 *	0.718	203.624	47.856	0.0000
At most 2 *	0.502	117.585	29.797	0.0000
At most 3 *	0.450	70.187	15.495	0.0000
At most 4 *	0.352	29.534	3.841	0.0000

Trace test indicates 5 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Source: Own Data Calculation

The results of trace test indicated that 5 cointegrating equations were significant at 0.05 level, which meant that the long-term equilibrium between the variables were met.

Table 4.7: Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	Critical Value	Prob.**
None *	0.768	99.294	33.877	0.0000
At most 1 *	0.718	86.039	27.584	0.0000
At most 2 *	0.502	47.39849	21.132	0.0000
At most 3 *	0.450	40.653	14.265	0.0000
At most 4 *	0.353	29.534	3.841	0.0000

Max-eigenvalue test indicates 5 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Source: Own Data Calculation

The results of maximum eigenvalue test indicated that 5 cointegrating equations were significant at 0.05 level, which meant that the long-term equilibrium between the variables were met.

In short both resulting in reject H_0 at significant level of 0.05. Therefore, there are few cointegration between variables in long run relationship.

4.2.6 VECM Model

$$\Delta CHE_t = 0.00695 - 9.325\Delta POP65_{t-1} + 10.381\Delta POP15_{t-1} + 0.817\Delta IMR_{t-1}$$

$$t \text{ stat} = \quad \quad \quad [-2.399^{**}] \quad \quad [3.178^{**}] \quad \quad [1.500^*]$$

$$-0.078\Delta GDPPC_{t-1} - 0.475\Delta CHE_{t-1} + 0.0127\epsilon_t$$

$$[-0.302^{NS}] \quad \quad [-3.641^{**}]$$

$$R^2 = 0.557$$

$$\text{Adj. } R^2 = 0.514$$

About 55.7% of the variation in the Current Healthcare Expenditure (CHE) equation could be explained by the explanatory variables, according to the findings from the CHE VECM model.

The estimate shows that the population 65 years of age and older (POP65), the population between the ages of 0 and 15 (POP15), and the infant mortality rate (IMR) were the significant explanatory variables with statistical significance at the α 0.05 and α 0.10 levels.

Holding constant with other variables, an average 1 percent rise in the population 65 years old and above (POP65) has a negative influence on decrease in the CHE by 9.325 units with statistically significant at the 0.05 level.

Next, assuming all other factors remain constant, an average 1 percent increase in the population between 0-15 years old (POP15) has a positive influence on the CHE, raising it by 10.381 percent with statistical significance at the 0.05 level.

When the other variables are held constant, a one-unit increase in the infant mortality rate (IMR) has an average positive effect of 0.817 units on the CHE with a statistical significance level of 0.10.

When the other variables are held constant, a one unit increase in the infant mortality rate (IMR) has an average positive effect of 0.817 percent on the CHE, with a statistical significance level of 0.10.

$$\Delta \text{POP65}_t = 0.0000705 + 0.00791 \Delta \text{CHE}_{t-1} - 0.291 \Delta \text{POP15}_{t-1} + 0.039 \Delta \text{IMR}_{t-1}$$

t stat= [1.932*] [-2.840**] [2.287**]

$$+ 0.012 \Delta \text{GDPPC}_{t-1} + 0.522 \Delta \text{POP65}_{t-1} + 0.0004 \varepsilon_t$$

[1.50*] [4.282**]

$$R^2 = 0.497 \qquad \text{Adj. } R^2 = 0.448$$

The explanatory variables in the population 65 years old and above (POP65) equation explained approximately 49.7% of the variable follow by the results of the POP65 VECM model.

The estimates show that the important explanatory variables with statistical significance at the α 0.05 and α 0.10 levels, respectively, were the current healthcare expenditure (CHE), population between 0 and 15 years old (POP15), infant mortality rate (IMR), and GDP per capita (GDPPC).

When all other factors remain constant, a rise of one percent in current healthcare expenditure (CHE) on average has a positive effect on the POP65, raising it by 0.00791 percent with statistical significance at the 0.10 level.

Maintaining constant with other variables, a 1 percent increase in the population between 0-15 years (POP15) has a negative influence on decrease in the POP65 by 0.291 percent with statistically significant at the 0.05 level on average.

Given that all other variables remain constant, a rise of one unit in the infant mortality rate (IMR) has an average positive effect of 0.039 units on the POP65, with statistical significance at the 0.05 level.

When all other factors remain constant, an average rise of one unit in GDP per capita (GDPPC) has a positive influence on the POP65, increasing it by 0.012 units with statistical significance at the 0.10 level.

$$\Delta \text{POP15}_t = 0.000163 + 0.0175 \Delta \text{CHE}_{t-1} + 0.215 \Delta \text{POP65}_{t-1} + 0.0758 \Delta \text{IMR}_{t-1}$$

$$t \text{ stat} = \quad \quad \quad [4.406^{**}] \quad \quad [1.813^*] \quad \quad [4.556^{**}]$$

$$+ 0.0282 \Delta \text{GDPPC}_{t-1} + 0.308 \Delta \text{POP15}_{t-1} + 0.00039 \epsilon_t$$

$$\quad \quad \quad [3.611^{**}] \quad \quad [3.099^{**}]$$

$$R^2 = 0.670$$

$$\text{Adj. } R^2 = 0.637$$

Based on the POP15 VECM model's results, about 67% of the variation in the population between the ages of 0 and 15 (POP15) equation was explained by the contributory variables.

Based on estimates, the explanatory variables, namely the current healthcare expenditure (CHE), population 65 years old and above (POP65), infant mortality rate (IMR) and GDP per capita (GDPPC) were the important explanatory variables with statistically significance at the α 0.05 level and α 0.10 level.

Thus, assuming no adjustments in other variables, an average 1 percent growth in current healthcare expenditure (CHE) has a positive influence on the POP15 by 0.0175 units with statistical significance at the 0.05 level.

Therefore, assuming no change in other variables, an average 1 percent increase in the population 65 and above (POP65) has a positive influence on raising the POP15 by 0.215 units with statistical significance at the 0.10 level.

Still, assuming the other variables remain constant, a rise of one unit in the infant mortality rate (IMR) has an average positive effect of 0.0758 units with statistical significance at the 0.05 level on an increase in the POP15.

Lastly, when all other variables remain constant, an average rise of 1 unit in GDP per capita (GDPPC) has a positive influence on the POP15, raising it by 0.0282 units with statistical significance at the 0.05 level.

$$\Delta \text{IMR}_t = -0.00207 + 0.111 \Delta \text{CHE}_{t-1} - 1.272 \Delta \text{POP65}_{t-1} + 1.414 \Delta \text{POP15}_{t-1}$$

$$t \text{ stat} = \quad \quad \quad [3.539^{**}] \quad \quad [-1.361^{\text{NS}}] \quad \quad [1.80^{*}]$$

$$-0.0287 \Delta \text{GDPPC}_{t-1} + 0.308 \Delta \text{IMR}_{t-1} + 0.00305 \varepsilon_t$$

$$\quad \quad \quad [-0.466^{\text{NS}}] \quad \quad [-3.141^{**}]$$

$$R^2 = 0.642 \quad \quad \quad \text{Adj. } R^2 = 0.607$$

Based on the IMR VECM model's results, approximately 64.2% of the variation in the infant mortality rate (IMR) equation was explained by the explanation variables.

The explanation variables having statistical significance at the α 0.05 and α 0.10 levels, respectively, were the population between 0 and 15 years old (POP15) and current healthcare expenditure (CHE) which according to the estimates.

Consequently, assuming no change in other variables, an average 1% rise in current healthcare expenditure (CHE) has a positive impact on an increase in the IMR of 0.111 units with statistical significance at the 0.05 level.

Apart from that, 1 percent increase in population between 0 to 15 years old (POP15) on average positively increasing the IMR by 1.414 unit with statistically significance at the 0.10 level, holding constant with other variables.

$$\Delta \text{GDPPC}_t = -0.00642 + 0.0353 \Delta \text{CHE}_{t-1} + 2.127 \Delta \text{POP65}_{t-1} - 2.847 \Delta \text{POP15}_{t-1}$$

$$t \text{ stat} = \quad \quad \quad [0.594^{\text{NS}}] \quad \quad [1.202^{\text{NS}}] \quad \quad [-1.914^*]$$

$$+ 0.223 \Delta \text{IMR}_{t-1} - 0.573 \Delta \text{GDPPC}_{t-1} + 0.00578 \varepsilon_t$$

$$[0.898^{\text{NS}}] \quad \quad [-4.911^{**}]$$

$$R^2 = 0.361$$

$$\text{Adj. } R^2 = 0.298$$

Results based on the GDPPC VECM model, the explanatory variables accounted for approximately 36.1 percent of the variation in the GDP per capita (GDPPC) equation.

The estimate indicates that the explanatory variables, namely the population between 0 to 15 years old (POP15) was the important explanatory variables with statistically significance at the α 0.10 level respectively.

Therefore, a 1 percent increase in population between 0 to 15 years old (POP15), on average, has a negative effect on decreasing in the GDPPC by 2.847 unit with statistically significance at the 0.10 level, holding constant with other variables.

4.2.7 Cointegration Equation

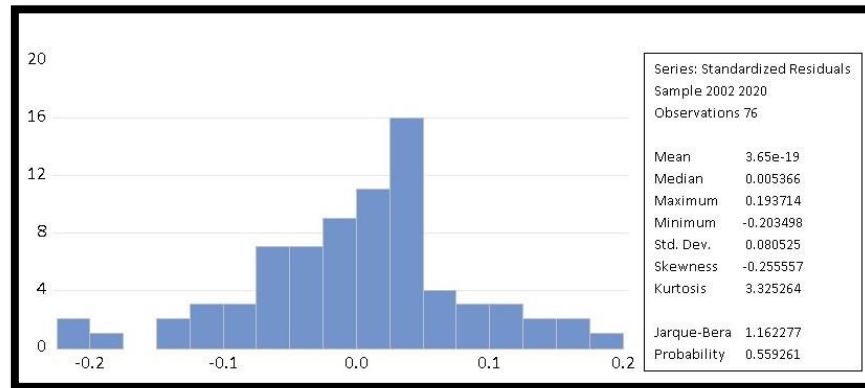
$$\begin{aligned}
 & -0.4259 \Delta \text{CHE}_{t-1} - 0.0202 \Delta \text{POP65}_{t-1} + 0.0425 \Delta \text{POP15}_{t-1} - 0.0928 \Delta \text{IMR}_{t-1} \\
 \text{t stat} = & \quad [-2.39^{**}] \quad \quad [-3.62^{**}] \quad \quad [-7.82^{***}] \quad \quad [-2.16^{**}] \\
 & + 0.0035 \Delta \text{GDPC}_{t-1} = 0 \\
 & \quad \quad [0.0426]
 \end{aligned}$$

In the CHE cointegration equation, the variables of POP65, POP15 and IMR are cointegrated between the variables.

The result valid that long-term relationship between POP65, POP15 and IMR variables statistically significant at α 0.05 level and α 0.01 level.

4.2.8 Normality Test

Figure 4.1: Normality Test



Source: Own Data Calculation

H_0 : Residuals are normally distributed

H_A : Residuals are not normally distributed

Critical value of Jarque-Bera:

Significant level, $\alpha=0.05$, $N=76$, $K=4$

Degree of freedom= $N-K-1$

$$= 71$$

Critical value= 2.337

Since the Jarque-Bera statistic value is 1.162, which less than the critical value 2.337, therefore the result accepted H_0 and rejected H_A . The residuals are normally distributed.

Decision rule: If $P\text{-value} > 0.05$, do not rejected H_0

Since the p-value (0.559) of the result is greater than α 0.05. Therefore, accepted H_0 and rejected H_A . The residuals are normally distributed.

4.2.9 Heteroscedasticity Test

Table 4.8: Panel Cross-section Heteroskedasticity LR Test

	Value	df	Probability
Likelihood ratio	8.328	4	0.08

Source: Own Calculation

H_0 : Residuals are no heteroscedasticity

H_A : Residuals are heteroscedasticity

The result shows as Table 4.7, the p-value is 0.08. Based on the decision rule, reject H_0 if p-value is lower than the critical level α 0.05. P-value (0.08) is greater than critical level α 0.05. Thus, do not reject H_0 and free from heteroscedasticity issue.

4.2.10 Residual Cross-Section Dependence Test

Table 4.9:Residual Cross-Section Dependence Test

Test	Statistic	d.f.	Prob.
Breusch-Pagan LM	6.273	6	0.393
Pesaran scaled LM	0.079		0.937
Pesaran CD	-0.811		0.417

Source: Own Calculation

H_0 : Residuals are no autocorrelation

H_A : Residuals are autocorrelation.

The result of the test shows that p-value of Breusch-Pagan LM (0.393), Pesaran scaled LM (0.937) and Pesaran CD (0.417) is greater than the critical value α 0.05. With the decision rule, do not reject H_0 and the residuals are not suffer in autocorrelation.

4.2.11 Multicollinearity Test

H_0 : Residuals are no multicollinearity

H_A : Residuals are multicollinearity

Given that,

$$R^2 = 0.29$$

Calculation for VIF:

$$\begin{aligned} \text{VIF} &= \frac{1}{1-R^2} \\ &= \frac{1}{0.71} \\ &= 1.409 \end{aligned}$$

The value of VIF (1.409) is less than 5, with the decision rule, H_0 accepted. Thus, residuals do not suffer in multicollinearity.

4.3 Conclusion

In short, analysis on the dataset results with no residual issue. Hausman test for panel data shows the result that the dataset fitted with random effect model. With the Correlation, VECM model and Cointegration model, the short-term and long-term relationship between current healthcare expenditure and explanatory variables had verified. Discussion will be done in Chapter 5.

CHAPTER 5: DISCUSSION, CONCLUSION AND IMPLICATIONS

5.0 Introduction

This chapter will discuss on the results of analysis and the findings. Implications and limitations of study may reflect the advantages and disadvantages of this study. In the end, provide some possible way for future researcher.

5.1 Summary of Statistical Analyses

Table 5.1: Summary of Hypothesis Testing

Hypothesis	Decision	Conclusion
H_0 : There is no relationship between elderly population and healthcare expenditure H_A : There is a relationship between elderly population and healthcare expenditure	T – Statistic Value: -2.399**	Rejected H_0
H_0 : There is no relationship between young population and healthcare expenditure H_A : There is a relationship between young population and healthcare expenditure	T – Statistic Value: 3.178**	Rejected H_0
H_0 : There is no relationship between infant mortality rate and healthcare expenditure H_A : There is a relationship between infant mortality rate and healthcare expenditure	T – Statistic Value: 1.500*	Rejected H_0
H_0 : There is no relationship between GDP per capita and healthcare expenditure H_A : There is a relationship between GDP per capita and healthcare expenditure	T – Statistic Value: -0.302 ^{NS}	Support H_0

Source: Developed for research

Table 5.1. presents the result of the relationship between dependent variable and explanatory variables in short run.

5.2 Discussions of Major Findings

In the short-term relationship analysis, this paper shows there is relationship between healthcare expenditure and demographic change but the result does not bring out significant on the correlation between healthcare expenditure through economic growth.

The results have reflected that the region's current healthcare expenditure is affected by the dynamic of demographic in short run. It shows that there is negative relationship between elderly population and healthcare expenditure. Although the result conflicts with the traditional expectation, the abnormal relationship between variables may just affected by the Covid-19 pandemic in short run. Since, it will be equilibrium in long-term estimation.

The young population shows a positive relationship with healthcare expenditure in short run. It shows that the increase in dependency population will burden the government. ASEAN countries are still in developing, the situation of increase in young population will restructure the population pyramid in a long-term period.

For infant mortality rate, the estimation is in line with previous studies, negatively correlation with healthcare expenditure. It proves that effect of healthcare expenditure is functioning on reducing the infant mortality rate, which mean the healthcare quality in the region perform well.

Although health is important input for the labor and productivity based on the Grossman's theory, the paper captures an insignificant result on economic growth. The possible reason that the healthcare expenditure unable to measure with the economic growth is the economic growth in the selected countries are expansion in business activities. With using the Wagner's law, economic growth does not dictate healthcare expenditure (Ssssagarik, D., 2016).

Even in long run estimation, the relationship between healthcare expenditure and economic growth still not significant in this paper. For demographic factor, they are still having relationship between the healthcare expenditure.

The demographic factor estimations are fit to the previous study research, there is relationship between current healthcare expenditure. The growth of ageing population and young population may rise the dependency ratio of the society, resources allocation have to restructure to deal with it. High social cost to public depressed the social environment.

5.3 Implications of the Study

From the result of this paper, suggestion for the policymakers will be notice to the change in demographic structure. Certainly, the suggestion may not be suitable for those countries had faced to the ageing population issue. Using Singapore as example, they set up a stable healthcare system in advance, get prepared to get through the ageing problem. Decrease the government healthcare expenditure by reduce the dependence of citizen to the government will be a possible policy for government avoid the ageing population cost.

Follow the previous studies, more healthcare expenditure from government side may bring benefit for the social in developing countries. As developing countries, Malaysia, Thailand, and Indonesia may improve the health system and quality through government spending.

5.4 Limitations of the Study

Apart from the benefits of this study, there exist some certain difficulties related to it. First, complete secondary online data may prove hard to obtain due to different language in nation official website, example, Thailand.

Healthcare expenditure study usually facing the limitation on uncertainty on the result on the relationship between healthcare expenditure and selected explanatory variables. Furthermore, considering only four countries in the Southeast Asia would be limited in the illustrations of the findings of the other regions, because of the different scenario may account for different results in country view.

In this paper, the model is determining in aggregate indicator, therefore result in the constricted or simplify dynamics of the healthcare systems, possible misleading or inaccurate results may take place. Public and private healthcare sector expenditure unable to separate and obverse.

5.5 Recommendations for Future Research

From this point forward, it is suggested that follow-up studies concentrate on the extension of the area of the research by considering other countries or areas for instance. This escalation creates more complicated multifactor interdependence (between health expenditure and economic and demographic change). In this work, policymakers are strongly referred to take into consideration the implications mentioned above, particularly on the ageing population and economic growth. With this evaluation, policy makers, therefore, will formulate policies that tackle emerging healthcare needs in a most efficient way. Eventually, econometric models can be upgraded to include more variables or additional dimensions into the established relationships which may increase the accuracy of our insights into the healthcare expenditures determinants.

5.6 Conclusion

The paper provides empirical evidence that demographic factors like population age structure and infant mortality significantly influence healthcare expenditure in Malaysia, Thailand, Singapore and Indonesia in the long run. As these countries experience demographic transitions, healthcare policies and resource allocation need to be adjusted accordingly to meet the changing healthcare needs of the population in a sustainable manner. Targeted interventions for young and elderly healthcare can optimize healthcare expenditure while improving health outcomes.

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APPENDIX

Appendix 1: Descriptive Analysis

	LNCHED2	LNPOP65D2	LNPOP15D2	LNIMRD2	LNGDPPERCAPITAD2
Mean	0.0074	0.000811	0.000152	0.0005	-0.0025
Median	0.0075	0.000486	0.000131	0.000000	-0.0007
Maximum	0.2363	0.02202	0.0250	0.0627	0.1467
Minimum	-0.2068	-0.00945	-0.0118	-0.1181	-0.0989
Std. Dev.	0.0956	0.00522	0.0050	0.0228	0.0370
Skewness	0.0319	1.8398	1.1947	-1.6396	0.5890
Kurtosis	2.9912	8.4618	10.4726	12.7545	6.6088
x Jarque-Bera	0.0131	137.3396	194.9047	335.3621	45.6354
Probability	0.9935	0.000000	0.000000	0.000000	0.000000
Sum	0.5660	0.0617	0.0115	0.0391	-0.1871
Sum Sq. Dev.	0.6854	0.0020	0.0019	0.0388	0.1024
Observations	76	76	76	76	76

Appendix 2: Correlation

	LNCHED2	LNPOP65D2	LNPOP15D2	LNIMRD2	LNGDPPERCAPITAD2
LNCHED2	-	-0.105480	0.029265	-0.338309	-0.437939
LNPOP65D2	-0.105480	-	0.554788	-0.111867	0.128629
LNPOP15D2	0.029265	0.554788	-	-0.127145	-0.038189
LNIMRD2	-0.338309	-0.111867	-0.127145	-	0.089788
LNGDPPERCAPITAD2	-0.437939	0.128629	-0.038189	0.089788	-

Appendix 3: Unit Root

	Levin Lin & Chu		
Variables	Level	1 st diff	2 nd diff
CHE	0.46456 [0.6789]	-2.45235 [0.0071]***	-5.01051 [0.0000]***
POP65	3.50948 [0.9998]	-1.34683 [0.0890]*	-3.50259 [0.0002]***
POP15	-2.95947 [0.0015]***	-1.86614 [0.0310]**	-4.70239 [0.0000]***
IMR	-1.34715 [0.0890]*	-3.10718 [0.0009]***	-4.34590 [0.0000]***
GDP per capita	-3.32069 [0.0004]***	3.51481 [0.9998]	0.62694 [0.7347]

Statistically significant at $\alpha = 0.01$ level (***), at $\alpha = 0.05$ level (**), and at $\alpha = 0.10$ level (*).

Appendix 4: Hausman Test

Correlated Random Effects - Hausman Test

Equation: Untitled

Test period random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Period random	0.724186	4	0.9483

** WARNING: estimated period random effects variance is zero.

Period random effects test comparisons:

Variable	Fixed	Random	Var(Diff.)	Prob.
LNPOP65D2	-1.546532	-1.994844	2.088297	0.7564
LNPOP15D2	0.700015	0.668633	1.674289	0.9807
LNIMRD2	-1.109179	-1.305067	0.099194	0.5340
LNGDPPERCAPITAD 2	-0.798851	-1.020902	0.166593	0.5864

Period random effects test equation:

Dependent Variable: LNCHED2

Method: Panel Least Squares

Date: 04/24/24 Time: 20:24

Sample (adjusted): 2002 2020

Periods included: 19

Cross-sections included: 4

Total panel (balanced) observations: 76

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.007202	0.010074	0.714877	0.4778
LNPOP65D2	-1.546532	2.722827	-0.567987	0.5724
LNPOP15D2	0.700015	2.708427	0.258458	0.7971
LNIMRD2	-1.109179	0.539956	-2.054202	0.0449
LNGDPPERCAPITAD 2	-0.798851	0.490543	-1.628504	0.1093

Effects Specification

Period fixed (dummy variables)

Root MSE	0.071154	R-squared	0.438602
Mean dependent var	0.007448	Adjusted R-squared	0.205569
S.D. dependent var	0.095596	S.E. of regression	0.085206
Akaike info criterion	-1.842674	Sum squared resid	0.384781
Schwarz criterion	-1.137320	Log likelihood	93.02160
Hannan-Quinn criter.	-1.560780	F-statistic	1.882147
Durbin-Watson stat	2.751712	Prob(F-statistic)	0.031045

Appendix 5: Pedroni Residual Cointegration Test

Pedroni Residual Cointegration Test
Series: LNCHED2 LNPOP65D2 LNPOP15D2 LNIMRD2 LNGDPD2
Date: 04/07/24 Time: 17:00
Sample: 2000 2020
Included observations: 84
Cross-sections included: 4
Null Hypothesis: No cointegration
Trend assumption: Deterministic intercept and trend
User-specified lag length: 1
Newey-West automatic bandwidth selection and Bartlett kernel

Alternative hypothesis: common AR coefs. (within-dimension)				
	Statistic	Prob.	Weighted Statistic	Prob.
Panel v-Statistic	-1.269760	0.8979	-2.103492	0.9823
Panel rho-Statistic	-0.286542	0.3872	-0.327398	0.3717
Panel PP-Statistic	-9.913300	0.0000	-12.98559	0.0000
Panel ADF-Statistic	-4.175777	0.0000	-7.110481	0.0000

Alternative hypothesis: individual AR coefs. (between-dimension)

	Statistic	Prob.
Group rho-Statistic	0.393986	0.6532
Group PP-Statistic	-13.56193	0.0000
Group ADF-Statistic	-5.354360	0.0000

Appendix 6: Kao Test Result

Kao Residual Cointegration Test
Series: LNCHED2 LNPOP65D2 LNPOP15D2 LNIMRD2 LNGDPD2
Date: 04/07/24 Time: 16:58
Sample: 2000 2020
Included observations: 84
Null Hypothesis: No cointegration
Trend assumption: No deterministic trend
User-specified lag length: 1
Newey-West automatic bandwidth selection and Bartlett kernel

	t-Statistic	Prob.
ADF	-3.823374	0.0001

Residual variance	0.016963
HAC variance	0.002611

Appendix 7: Johansen Cointegration Ranking Test

Date: 04/07/24 Time: 17:05

Sample (adjusted): 2004 2020

Included observations: 68 after adjustments

Trend assumption: Linear deterministic trend

Series: LNCHED2 LNPOP65D2 LNPOP15D2 LNIMRD2 LNGDPPERCAPITAD2

Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.767813	302.9187	69.81889	0.0000
At most 1 *	0.717841	203.6242	47.85613	0.0000
At most 2 *	0.501941	117.5850	29.79707	0.0000
At most 3 *	0.450000	70.18650	15.49471	0.0000
At most 4 *	0.352293	29.53360	3.841465	0.0000

Trace test indicates 5 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.767813	99.29449	33.87687	0.0000
At most 1 *	0.717841	86.03925	27.58434	0.0000
At most 2 *	0.501941	47.39849	21.13162	0.0000
At most 3 *	0.450000	40.65290	14.26460	0.0000
At most 4 *	0.352293	29.53360	3.841465	0.0000

Max-eigenvalue test indicates 5 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Appendix 8:VECM model and Cointegration Model

Vector Error Correction Estimates

Date: 04/07/24 Time: 15:15

Sample (adjusted): 2004 2020

Included observations: 68 after adjustments

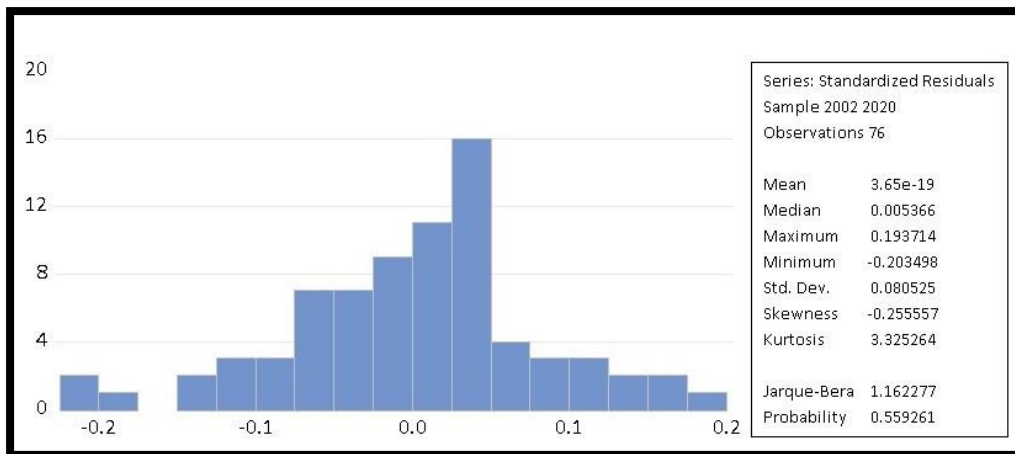
Standard errors in () & t-statistics in []

Cointegrating Eq:	CointEq1				
LNCHED2(-1)	1.000000				
LNPOP65D2(-1)	-2.113788 (1.38349) [-1.52787]				
LNPOP15D2(-1)	16.90756 (1.72537) [9.79937]				
LNIMRD2(-1)	3.887936 (0.50280) [7.73258]				
LNGDPPERCAPITAD2(-1)	0.391874 (0.29410) [1.33245]				
C	-0.004879				
Error Correction:	D(LNCHED2)	D(LNPOP65D2)	D(LNPOP15D2)	D(LNIMRD2)	D(LNGDPPERCAPITAD2)
CointEq1	-0.425889 (0.17840) [-2.38733]	-0.020249 (0.00560) [-3.61795]	-0.042490 (0.00544) [-7.81670]	-0.092821 (0.04288) [-2.16443]	0.003461 (0.08121) [0.04262]
D(LNCHED2(-1))	-0.475383 (0.13058) [-3.64050]	0.007913 (0.00410) [1.93152]	0.017530 (0.00398) [4.40568]	0.111079 (0.03139) [3.53859]	0.035309 (0.05945) [0.59396]
D(LNPOP65D2(-1))	-9.324798 (3.88710) [-2.39891]	0.522190 (0.12195) [4.28208]	0.214680 (0.11844) [1.81252]	-1.271679 (0.93443) [-1.36092]	2.127155 (1.76959) [1.20206]
D(LNPOP15D2(-1))	10.38140 (3.26710) [3.17756]	-0.291123 (0.10250) [-2.84031]	0.308495 (0.09955) [3.09886]	1.413573 (0.78538) [1.79985]	-2.847226 (1.48733) [-1.91432]
D(LNIMRD2(-1))	0.816744 (0.54621) [1.49530]	0.039197 (0.01714) [2.28741]	0.075829 (0.01664) [4.55611]	-0.412467 (0.13130) [-3.14132]	0.223337 (0.24866) [0.89817]
D(LNGDPPERCAPITAD2(-1))	-0.077461 (0.25619) [-0.30235]	0.012036 (0.00804) [1.49753]	0.028193 (0.00781) [3.61145]	-0.028710 (0.06159) [-0.46617]	-0.572729 (0.11663) [-4.91060]
C	0.006949 (0.01270) [0.54698]	7.05E-05 (0.00040) [0.17696]	0.000163 (0.00039) [0.42203]	-0.002069 (0.00305) [-0.67755]	-0.006418 (0.00578) [-1.10968]
R-squared	0.557238	0.497437	0.669691	0.641891	0.360562
Adj. R-squared	0.513687	0.448005	0.637202	0.606667	0.297667
Sum sq. resids	0.667315	0.000657	0.000620	0.038563	0.138301
S.E. equation	0.104592	0.003281	0.003187	0.025143	0.047615

F-statistic	12.79523	10.06297	20.61259	18.22321	5.732713
Log likelihood	60.72821	296.1322	298.1152	157.6611	114.2385
Akaike AIC	-1.580241	-8.503889	-8.562210	-4.431209	-3.154074
Schwarz SC	-1.351763	-8.275410	-8.333732	-4.202730	-2.925595
Mean dependent	0.005963	8.70E-06	9.57E-05	-0.001282	-0.004957
S.D. dependent	0.149983	0.004417	0.005291	0.040090	0.056817

Determinant resid covariance (dof adj.)	6.31E-19
Determinant resid covariance	3.67E-19
Log likelihood	960.8679
Akaike information criterion	-27.08435
Schwarz criterion	-25.77876
Number of coefficients	40

Appendix 9: Normality Test Result



Appendix 10: Heteroskedasticity Test

Panel Cross-section Heteroskedasticity LR Test

Equation: EQ03

Specification: LNCHD2 C LNPOP65D2 LNPOP15D2 LNIMRD2
LNGDPPERCAPITAD2

Null hypothesis: Residuals are homoskedastic

	Value	df	Probability
Likelihood ratio	8.328059	4	0.0803

LR test summary:

	Value	df
Restricted LogL	84.12185	71
Unrestricted LogL	88.28588	71

Appendix 11: Residual Cross-Section Dependence Test

Residual Cross-Section Dependence Test

Null hypothesis: No cross-section dependence (correlation) in residuals

Equation: EQ03

Periods included: 19

Cross-sections included: 4

Total panel observations: 76

Note: non-zero cross-section means detected in data

Cross-section means were removed during computation of correlations

Test	Statistic	d.f.	Prob.
Breusch-Pagan LM	6.272838	6	0.3933
Pesaran scaled LM	0.078762		0.9372
Pesaran CD	-0.811320		0.4172

Appendix 12: The OLS

Dependent Variable: LNCHED2

Method: Panel Least Squares

Date: 05/03/24 Time: 00:05

Sample (adjusted): 2002 2020

Periods included: 19

Cross-sections included: 4

Total panel (balanced) observations: 76

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.007125	0.009685	0.735666	0.4644
LNPOP65D2	-1.994844	2.241534	-0.889946	0.3765
LNPOP15D2	0.668633	2.311123	0.289311	0.7732
LNIMRD2	-1.305067	0.426011	-3.063456	0.0031
LNGDPPERCAPITAD 2	-1.020902	0.264301	-3.862646	0.0002
Root MSE	0.079994	R-squared		0.290448
Mean dependent var	0.007448	Adjusted R-squared		0.250474
S.D. dependent var	0.095596	S.E. of regression		0.082763
Akaike info criterion	-2.082154	Sum squared resid		0.486326
Schwarz criterion	-1.928816	Log likelihood		84.12185
Hannan-Quinn criter.	-2.020873	F-statistic		7.265795
Durbin-Watson stat	2.688707	Prob(F-statistic)		0.000058