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INFLUENCING FACTORS OF SELECTED HEALTH INDICATORS ON GDP IN ASEAN COUNTRIES

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ABSTRACT

Gross Domestic Product (GDP) is used widely as the main indicator in measuring economic growth of a country. This paper aims to study the health situations of the ASEAN member countries from a comparative point of view and to examine the relationship between selected health indicators and GDP (PPP) per Capita in the context of ASEAN countries. The data is panel data which consist of ten ASEAN countries for the period of 2007 and 2016. Pooled Ordinary Least Squares Model, Fixed Effect Model and Random Effect Model are applied to examine the influences of selected health indicators on GDP. According to the results, Random Effect Model is most appropriate model. But, diagnostic tests are undertaken to test heteroskedastic and auto-correlation in the Random Effect Model, it is found that there is heteroskedastic and auto-correlation in the selected Random Effect Model. Thus, Feasible Generalized Least Squares Model is used to remedy heteroskedastic and auto-correlation in the model. All coefficients that resulted from Feasible Generalized Least Squares Model are statistically significant. The results proved that Under-Five Mortality Rate, Maternal Mortality Rate and Total Fertility Rate have negative relationship with GDP.

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TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

ADB	Asia Development Bank
AIDS	Acquired Immunodeficiency Syndrome
APEC	Asia-Pacific Economic Cooperation
ASEAN	Association of Southeast Asian Nation
ECM	Error Component Model
FEM	Fixed Effect Model
FGLS	Feasible Generalized Least Squares
GDP	Gross Domestic Product
GLS	Generalized Least Squares
HCE	Health care expenditure
HIV	Human Immunodeficiency Virus
IMF	International monetary fund
LSDV	Least Squares Dummy Variables
MMR	Maternal Mortality Rate
OECD	Organization for economic cooperation and development
OIC	Organization Islamic Conference
OLS	Ordinary Least Squares
PPP	Purchasing Power Parity
TFR	Total Fertility Rate
U5MR	Under-Five Mortality Rate
UNCTAD	United Nations Conference on Trade and Development
WB	World Bank
WHO	World Health Organization
WTO	World Trade Organization

CHAPTER I

INTRODUCTION

1.1 Rationale of the Study

To be healthy, meaning a complete state of physical, mental and social well-being including free from illness or disease, is usually placed in priority among the goals most valued by human beings. Unquestionably are healthy people more vibrant, dynamic and optimistic about life. Not only does good health lead to a positive influence on the social infrastructure but it also directly relates to economic development. Health care is also widely accepted as one of the most important starting points towards the development process. This is supported by the fact that healthy people are essential to making economic and social progress. People with health problems lose more time from work due to illness and are less productive when working. Resulting in low productivity, poor health ends up with unemployment and lack of income which in turn leads to fragile living conditions and inadequate nutrition, increasing vulnerability to infections and eventually deteriorating the overall health status. This linkage between health and income has been widely used as an important policy purpose around the world. Income growth is set as a policy priority by developing countries to the extent that health progress follows income. The poorest developing countries attempt to invest in health as a priority accepting the concept that income is a consequence of good health. At the same time, reduction of poverty, which is closely associated with health problems, is the most viable social strategy for improving health.

Better health is promoted by higher income through improved nutrition, better access to safe water and sanitation, and increased ability to purchase more and better-quality health care. There are also other indirect channels through which health affects the level of output in a country. One of them is that decreased mortality may allow people to save for retirement, thus increasing the level of investment and physical capital per worker. Increase in labor output from healthier workers will increase capital's marginal product, whereby physical capital per worker rises. All these concepts lead to a widespread consensus that improving the health of people, particularly in poor countries will yield significant economic gains. Moreover, a belief that significant improvements in health are within reach of affordable interventions regardless of who lead them, governments or large-scale philanthropies, has prevailed among developing countries these days. With improving the population health as one of the ultimate development goals, ensuring no one left behind in promoting adequate access to essential health care is listed as priority in national development plans of developing countries.

The Association of Southeast Asian Nations, or ASEAN, established in 1967, has ten Member States: Thailand, Indonesia, Malaysia, Philippines, Singapore, Brunei Darussalam, Vietnam, Lao PDR, Myanmar and Cambodia. The ASEAN is characteristically much diverse in many aspects including geography, society, economic development and health outcomes. The region presents with significant global health issues ranging from susceptibility to new diseases including avian influenza to emergence of drug resistant strains of tuberculosis and malaria.

The ASEAN is usually reported as one of the most dynamic regions in the world economic affairs. It is one of the major groupings not only in global trade negotiations among international agencies such as the World Trade Organization (WTO) and United Nations Conference on Trade and Development (UNCTAD) but also in bilateral discussions with major world trading countries such as the United States, Japan and the European Union. As a force in world and regional politics, the ASEAN countries are involved as a major sub-group in the Asia-Pacific Economic Cooperation (APEC) forum. Despite the fast-growing economics, Asia Development Bank raised the low government expenditure on public health as well as unequal distribution of health-related benefits between the rich and the poor. With the weak public financing, some ASEAN countries have as low per-head healthcare spending as just above 4 percent of GDP, for example 4.6 percent in Philippines in 2012.

ADB, therefore, raised concerns over growing personal health expenditures in the Asia Pacific region, which can hinder the progress toward Universal Health Coverage, a key health related theme of the Sustainable Development Goals. In 2012, ASEAN countries had average life expectancy of 73 years, an increase of 8 years since 1990 – among them is Singapore the highest with 83 while Laos and Myanmar sat the lowest with 66. Cambodia witnessed the largest increase by 18 years to 77 in the same period. Growth in average annual healthcare expenditure between 2014-18 was projected to be around 11% of GDP in the ASEAN; however, variations among the countries were quite noticeable: Vietnam with the highest at 6.6% and Myanmar with the lowest at 1.8%. Another common challenge to the ASEAN countries in their effort to improve health is high prevalence of communicable diseases like TB/HIV. In 2013, 400 Cambodians in every 100,000 population were diagnosed with communicable diseases, more than double the ASEAN average of 190. Against this background, it is worth exploring how the ASEAN countries fare in terms of selected health indicators as well as to which extent the health status affects the economic growth of each country.

1.2 Objectives of the Study

The objectives of the study are

(i) To study the health situations of the ASEAN member countries from a comparative point of view.

(ii) To examine the relationship between selected health indicators and GDP in the context of ASEAN countries.

1.3 Method of Study

The study used descriptive analysis and different panel data analysis to examine the relationship between selected health indicators on Gross Domestic Product in ASEAN countries. Pooled ordinary least squares model, fixed effect model and random effect model are used to explore the possible factors that the relationship between GDP (PPP) and selected health indicators in ASEAN countries.

F test, Breusch-Pagan Lagrangian Multiplier test and Hausman test was used to choose the appropriate model of GDP (PPP) per Capita and selected health indicators. Breusch-Pagan Lagrangian Multiplier test was used to diagnostic on heteroskedastic and Wooldridge test was used to diagnostic auto- correlation in the appropriate model. Then, feasible generalized least squares model was used to remedy heteroskedastic and auto-correlation in the model.

1.4 Scope and Limitations of the Study

This study only focused on the relationship between selected health indicators (Under-Five Mortality Rate, Maternal Mortality Rate and Total Fertility Rate)and GDP(PPP) per Capita for ASEAN countries. Data for the selected indicators of the 10 ASEAN countries are compiled for period of 2007 to 2016 from Work Bank official website.

1.5 Organization of the Study

This study concerns with five chapters. The chapter one provides a background of why this study is needed and the objectives of the study. This chapter also briefly explains the methods of the study and its scope and limitations. The chapter two covers the literature reviews which were done on previous studies that related with the relationship between health and economic situation in the countries. The chapter three explains the details of the selected methodology of the study. The chapter four presents data analysis and findings from the study. The chapter five is the conclusions of the study.

CHAPTER II
LITERATURE REVIEW

It is obvious that wealth helps people to succeed their ambitions and goals. In general, people say that healthier make wealthier. It is interesting to learn on the nature of the connection between health and wealth. Different authors used various methods to observe relationship between Health and GDP or Economic growth from different perspective in different areas. Some studies measured economic growth with investment, export and import. But most studies used GDP as a measure of economic growth for respective countries. It was also found that relevant global health indicators were used to analyze health status of countries.

2.1 Reviews on the Relationship between Health and Economic Growth

From 1990s, different investigations have undertaken to decide the determinants of economic growth and development. Among factors that were statistically significant in clarifying economic growth and development, health is observed to be one of them. Continuous growth relies upon levels of human capital whose stocks increment because of better education, higher level of heath, and new learning and training methods. The impact of human capital factors infer that the investment rate will in general increment as levels of education and health rise. (Lopez, Rivera, & Currais, 2005). Until the mid of 1990s, the job of human capital was mostly related distinctly to education. Some authors perceived the significance of different factors, such as, health and nutrition to affect real per capita income.

Lopez, Rivera, and Currais (2005) expressed that good health to be an essential piece of wellbeing in people's life. In light of economic grounds, good health raises levels of human capital, and this positively affects to individual productivity and economic growth rates. Better health builds work power efficiency by lessening insufficiency, shortcoming, and the quantity of days lost to wipe out leave. Besides, healthier workers are physically and rationally increasingly lively and in this way powerful on the work showcase. The impact of having a less productive work is more grounded in developing countries, in light of the fact that higher extent of the work power is occupied with physical work than industrial countries (Scheffler, 2004). There is also positive overflow impact in handling neediness. Upgrade of wellbeing and wellbeing lists in the general public will urge people to have all the more sparing through decrease of mortality and increment of life expectancy. Following expanded saving in the general public, physical capital is relied upon to improve and will in a roundabout way upgrade work power efficiency and economic growth (Weil, 2005).

Understanding the causal connection among health and wealth is essential to unmistakably perceive how the two functions. The presence of conceivable endogeneity among health and wealth makes it hard to break down it. Although good health might be considered as type of human capital that positively affects productivity, income also influences health in a positive manner. Gaining higher pay will build the utilization of health related great, such as, sufficient food and medicine (Lopez, Rivera, and Currais, 2005). There will be enhancement on the living standard and this will in a roundabout way acquire effectiveness the work place. The causal relationship of health and per capita income will bring biasedness and irregularity when breaking down the appraisals of the effect of health on economic growth. The positive effect of health on economic growth is distinguished either in exogenous development models during the change to the consistent state or in endogenous development models, each inside the setting of between setting of between worldly streamlining. Consequently, it is helpful to deliberately explore their connection.

Bloom, Canning, & Sevilla (2004), planned for incorporating health in a well-specified aggregate production function trying to test for the presence of an impact of health on labor productivity, and to gauge its strength. The study assessed a production function model of aggregate economic growth including working experiences and health. Bloom, Canning, & Sevilla (2004), have utilized a panel data of nations observed every 10 years more than 1960–90. The key result is stated that good health has a positive, sizable, and statistically significant impact on aggregate output when controlled for understanding of the workforce. It is presumed that the life expectancy effect in growth regressions seem to be a real labor productivity effect and are not the result of life expectancy acting as a proxy for worker experience. The study recommended that a one-year improvement in a populace's life expectancy contributes to a 4 percent expansion in output. Accordingly upgrades in health may increase output through labor productivity, yet in addition through the aggregation of capital.

Kambiz, Roghieh, Hadi, & Rafat (2011), investigated the relationship between health and economic growth in Organization Islamic Conference (OIC) member states. Panel data of 2001-2009 that utilizing the framework of a Semi log regression model was used in the study. The study followed (Bhargava, Jamison, Lau, and Murray, -) model where economic growth is a factor of real GDP, real of investment to GDP, openness degree of economy, adult life expectancy and fertility rate. Ratio of investment to GDP and transparency level of economy is neglected since it isn't effective in OIC member states. The outcome shows that increased life expectancy has upgraded economic development in these nations. The study discovered fertility to adversely influence economic growth.

Hashmati (2001) studied conditional convergence of OECD nations in Gross Domestic Product (GDP) and Health Care Expenditure (HCE) per capita. This paper is an augmentation of the expanded Solow model proposed by (Mankiw, Romer and Weil, 1992) by utilizing health expenditures as a proxy of wellbeing status in the growth function. The presence of causality connection among GDP and Health care Expenditure (HCE) is considered and it was found that the relationship is one path from HCE to GDP. The outcomes demonstrate that OECD nations unite at 3.7 percent every year to their steady state level of income per capita, proposing that health care expenditure has positive effect on the economic growth and the speed of convergence, yet unlike (Mankiw, Romer, and Weil, 1992) the incorporation of human capital is observed to be insignificant in the growth model. Temple (1999), additionally found the impacts of human capital to be data explicit and sensitive to the model determination and estimation methods utilized.

Rivera and Currais (1999) assessed the relationship between health and growth of OECD member nations for the time of 1960-1990. Health care expenditure per capita was utilized as an intermediary for wellbeing. They demonstrated that nations having more health expenditures have higher economic growth. They additionally thought about interest in health as a significant segment for output. They have determined that education isn't the main successful factor in labor force performance and its productivity but also health.

Barro (1996) has discovered that 10 percent of the increase in life expectancy will prompt right around 0.5 percent increase in economic growth. According to experimental finding on a panel of 100 nations states, economic growth is positively related and upgraded by higher initial schooling and life expectancy, lower fertility, lower government consumption and better support of the rule of law, lower inflation and improvement of terms of trade.

The way health influences Gross Domestic Product per capita is not straightforward. Per capita income can be dependent on better health through a number of pathways as explained in Figure 2.1. First and foremost, better health can alter decisions about expenditures and savings over the life cycle. When mortality becomes so low that retirement becomes a realistic possibility in the future, retirement is well planned – increasing longevity in developing countries incentivize the current generation to save, which can have a considerable effect on national saving rates. In another perspective, environments where healthy labors are available can attract more investors, thereby encouraging foreign direct investment. Access to land and natural resources are also greatly hindered by endemic diseases, denying realization of full production capacity. The next channel important to discuss is through education. With low infant mortality and decreased child morbidities, healthier children have higher school attendance and improved cognitive development and increasing life span attracts more investments in education.

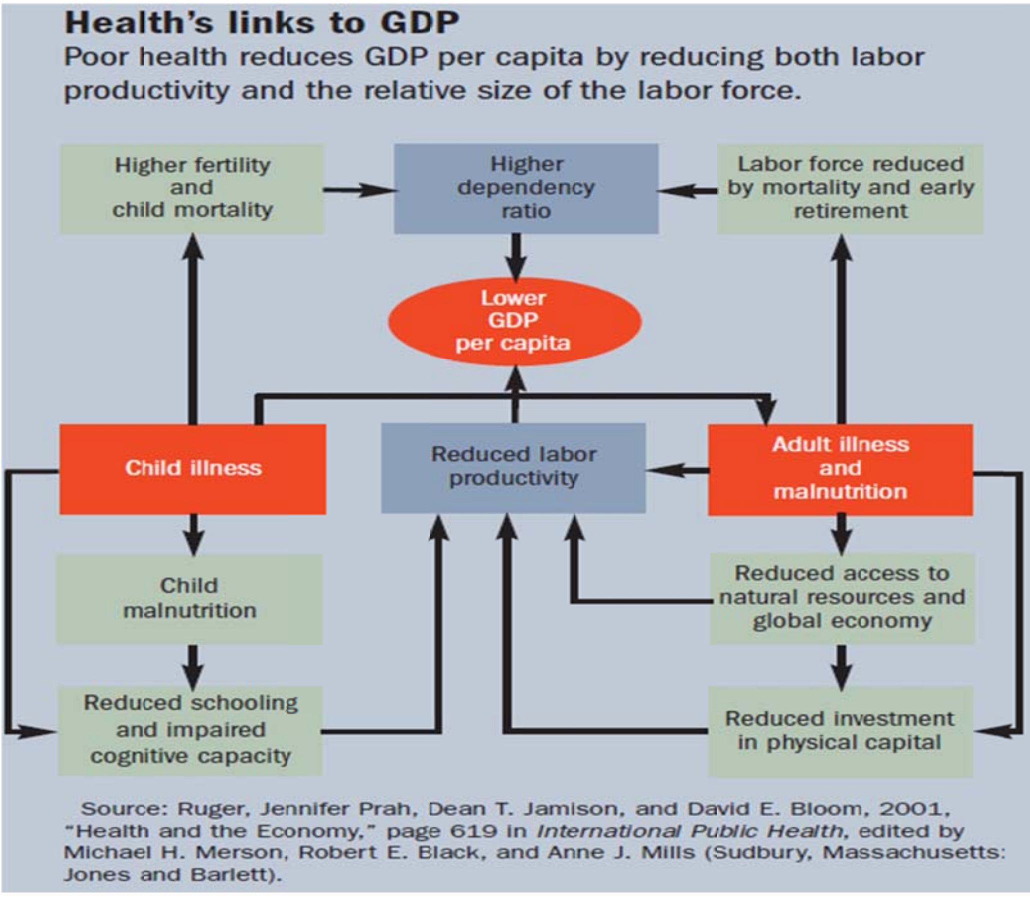

Figure 2.1 Channels how health influences economic growth

Source: Ruger, Jennifer Prah, DeanT. Jamison, and David E. Bloom, 2001, “ Health and the Economy,” page 619 in International Public Health, edited by Michael H. Merson, Robert E. Black, and Anne J.Mills (Sudbury, Massachusetts: Jone and Barlett)

2.2 Reviews on the Need for a Better Health Care

A world report distributed in 2003 highlighted the gap in the life expectancies among rich and poor nations is extending. A child born in Japan has a future of 82 years, despite what might be expected, in Sierra Leone; normal life expectancy during childbirth is around 34 years, in excess of 16 percent of which is spent in sick wellbeing (World Development Indicators, 2010). It is the same situations in Angola and Afghanistan. While AIDS is the major health problem in Africa, heart disease and and other non-communicable disease are taking numerous lives somewhere else (Lopez, Rivera, and Currais, 2005). “For LDCs putting investment into health for the most part gives a method for getting away from the neediness trap. Public health and epidemiological projects help to cut off endless loop normal for poverty and ill health making complementarities inside different types of human capital, such as, education or sustainable fertility rates for families. In reality, it is very much reported how increments in life expectancy after parental choices to put resources into their children’s education by bringing down the expected losses from infant mortality. Thus, women may lessen birth rates since the rate at which the family labor should be supplanted decays. This increases per-capital income. Furthermore, a more highly educated, healthier population is, more productive, and contributes a national income that is shared among a less devastated people.”

As per (World Health Organization, 2002), treatable disease, such as, tuberculosis and malaria are as yet a noteworthy issue in poor nations. The effects of these infections are enormous in poor nations with exceptionally low health consumption.

(Scheffler, 2004), noticed an expansion in health care cost is because of innovation in technology. In many industrialized nations the tremendous development of health care spending is in a roundabout way connected to technology. Previously, health spending was not viewed as essential for advancement. It was believed to be something that would come after a nation was created. However, studies showed that, so as to build up a nation economically, there should be a well-managed and planned health care framework for the fruitful accomplishment of the advancement of a nation. This reasoning is focused on the development of human capital which incorporates; education, training and health.

In under developed nations, people have big families but since of high child and infant mortality rates, few of the children endure. For these and different reasons, such as, low contraceptive utilization of rural populaces of less developed nations, family planning isn't very much polished (Scheffler, 2004). Keeping different variables steady, the development of health care system of a country would help in bringing a more advantageous family. Subsequently families will have a higher quality instead of bigger amounts of children. This is significant for economic growth model.

Besides, bad health is a main reason for poverty. Severe sickness makes people become poor since they drop out of the labor market. So as to build up a nation, health of the population must show signs of improvement. One method for accomplishing this is by educating women. As women are the essential home overseers of a family particularly on account of less developed countries (Scheffler, 2004). Having a well-created health care system will subsequently improve the work efficiency, which prompts higher compensation and gross domestic product.

At the point when nations get wealthier, their spending on health care increments. Accordingly, the elasticity for health care is more prominent than one, which can be ordered as extravagance great. This is basic for each nation since health care add to a more noteworthy quantity and quality of life. In general, the wealthier a nation, the higher the elasticity of health care. In any case, for less developed countries, the elasticity is extremely near one. That is in nations, such as, US, Britain, and France for each 10 percent increase in income, there is a 12.5 percent increase in health care spending (Scheffler, 2004).

2.3 Reviews on Health and Poverty

International Organizations, such as, IMF (International Monetary Fund), OECD (organization for economic cooperation and development), UN (united nation) and WB (World Bank) have made the decrease of poverty one of their major priorities (World Health Organization 2002). Among their seven international development goals; three of them are directly linked to the health. By taking diverse macroeconomic indicators of health, such as, life expectancy, infant mortality and prevalence of tropical and infectious diseases such as Malaria and HIV AIDS, industrialized nations with higher per capital income have lower mortality rates, and the prevalence of HIV in high pay nations are as low as 0.3 percent (world bank data, 2009). Since capita gross domestic product is a key for economic growth and health, it can be say that wealth and health is decidedly related.

As indicated by World Health Organization (WHO, 2002) report, Income together with education is said to be key determinant of wellbeing. Nutrition and child feeding practices improve with more elevated amount of income. In addition, sanitary hygiene, such as, hand washing and disposal of feces are positively correlated with income per capita of a nation. The poor more often than not would postpone their medical needs because of money problems. An expansion in users' fee in public medical facilities will profoundly influence the poor than the happier in light of the fact that they can't bear to cover their therapeutic costs. Higher income elevates openness to improved health facilities, better nutrition, clean water and sanitation, education and medical care (The Economist Intelligent Unit, 2011).

Developing nations with low per capita income straggle with the prevalence of tropical diseases and HIV/AIDS. As expressed by (Bloom, Canning, and Sevilla, 2004), some diseases, such as Malaria that might not have high mortality impact may have progressively negative effect on the economy due to their high mortality burden. Moreover, mortality because of HIV AIDS is said to have negative and critical roundabout impact on long term economic growth since deaths because of this illness are exceptionally focused among youth adult people prompting higher dependency ratio. In Africa south of the Saharan nations, about 5.45 percent (level of individuals ages 15-49 who are infected with HIV) of the complete populace is influenced by HIV (World Bank, 2009).

With all the positive advantages of growth in per capita income, (Bloom, Canning, and Sevilla, 2004) states, improvement in health will win regardless of whether income stays fixed. Particularly in developing nations, low cost tropical illness intercessions bring enormous scale returns in saving individuals lives.

From the literatures works investigated, it can be seen that the majority of the researcher proxy health with life expectancy, mortality rate or health expenditure per capita. The greater part of the examinations discovered good health to raise human capital. Health likewise has a positive and significant effect on economic growth and development. In addition, researchers have concurred that the causal relationship of health and per capita income must be explored to obviously observe their connection. A few investigations demonstrate that the relationship of per capita income and health variable has a bidirectional but others observed it to be only one way. In this manner, it is critical to examine the not just the effect of health on economic growth but also the causal relationship of health and per capital GDP for low income nations. These nations are among the low income nations of the continent of Africa and it is valuable to deal with the improvement of the health sector of the nations and there by encourage their economic growth.

CHAPTER III
RESEARCH METHODOLOGY

3.1 Panel Data

Baltagi, B.(2008), explained that panel data would be the most suitable in applying both time series and cross sectional data, and it can produce a great number of explanations, not only increasing the degree of freedom but also dropping the co-linearity among explanatory variables. (Gujarati, 2004), and (Green, 2003) also supported that panel data improves empirical analysis and it is more flexible for modeling the actions of cross sectional units than time series analysis. A panel data set is outlined from a sample that comprises N cross-sectional units that are collected at different time periods (t). This study is conducted using panel data of ten ASEAN member countries. The relationship between selected health indicators and GDP (PPP) per Capita is examined by using different panel data estimation methods.

3.2 Panel Data Regression Model

The regression model based on panel data is called panel data regression model. Panel data analysis for this study was completed by various econometric methods which are divided into three steps. First step is the model setting and regression analysis of panel data through pooled ordinary least squares model, fixed effects model, and random effects model. Second step is to find out appropriate model through Hausman test and Breusch-Pagan test. Then, resulted appropriate model is tested with Breusch-Pagan test and wooldridge test to diagnostic heteroskedastic and auto-correlation in the model. To fit the heteroskedastic and auto-correlation problem, feasible generalized least squares model estimation is used in the model.

3.3 The Pooled Ordinary Least Squares Regression Model

Pooled Ordinary Least Squares Regression Model or Constant Coefficient Model is an estimation which establishes constant intercept and slope. This model estimates panel data by applying two stages least - the basic model used in this estimation can be written as below:

$$Y = x\beta + \varepsilon \tag{3.1}$$

Under the assumption that $u_{it} \sim iid\ (0, \sigma_u^2)$, all i and t cannot result in auto-correlation problem. Furthermore, time period and error terms of each cross-section have constant deviation.

3.4 The Fixed Effect Model

$$\mathrm{Y_{it}} = \beta_{1i} + \beta_2 X_{1it} + \beta_3 X_{2it} + \beta_4 X_{3it} + u_{it} \qquad (3.2)$$

where, i= 1,2,…, n

t=1,2,…t

i is the i^{th} subject and

t is the time period for the variables

Equation (3.2) is called the fixed effect (regression) model (FEM). The term "fixed effects" derives from the fact that, although the intercept may differ across subjects, each entity's intercept does not vary over time, which means, it is time-invariant. The fixed effect model essentially looks at differences between intercepts, assuming the same slopes and constant variance across entitles or subjects. Since a group (individual specific) effect is time invariant and considered a part of the intercept, where u_{it} is allowed to be correlated to other regressors.

One way to estimate a pooled regression is the fixed-effect within a group estimator. It is to eliminate the fixed effect, β_{1i}, by expressing the values of the dependent and explanatory variables. It will obtain the sample mean values of each variable and subtract them from the individual values of the variables. The resulting values are called 'de-meaned' or mean corrected values.

Dummy variables are not needed in a within group effect model that, however, uses deviations from group mean. Thus, the model is the OLS of $(Y_{it} - \bar{Y}_i) = (X_{1it} - \bar{X}_{1i.})\beta_2 + (X_{2it} - \bar{X}_{2i.})\beta_3 + (X_{3it} - \bar{X}_{3i.})\beta_4 + (u_{it} - \bar{u}_{it})$ without an intercept. In this mentioned model, the incidental parameter problem no longer exists. The parameter estimates of regressors in the within effect model are identical to those of LSDV. The within effect model in turn has several drawbacks.

Since this mode does not report dummy coefficient, it needs to compute them using the formula $\hat{\beta}_{1i} = \bar{Y}_{i.} - \bar{X}_{1i}\hat{\beta}_2 - \bar{X}_{2i}\hat{\beta}_3 - \bar{X}_{3i}\hat{\beta}_4$

$\bar{Y}_{i.}$= dependent variable mean of group i.

$\bar{X}_{i.}$= means of independent variables (IVs) of group i.

3.5 The Random Effect Model

Despite no difficulty in its application, the fixed effect model is not appropriate for estimation when data have high degrees of freedom or a large number of cross-section data. The random effects of both cross-section and time series data are included with error term. This model is called error component model (ECM).

The assumption is that other factors which might affect dependent variable in the regression analysis can be present but are omitted from the investigation causing what is called random error term. The other assumption is that α_i is random factors which are independent and vary in each cross section. With this, the random effects model can be written as:

$$Y_{it} = \beta_{1i} + \beta_2 X_{1it} + \beta_3 X_{2it} + \beta_4 X_{3it} + u_{it} \quad (3.3)$$

These intercepts β_{1i} are assumed to be random variables with mean value E$(\beta_{1i}) = \beta_1$ and the intercept value for individual I can be expressed as

$\beta_{1i} = \beta_1 + \varepsilon_{i,}$ i= 1,…, n

where,

E$(\varepsilon_{i,}) = 0$ and V$(\varepsilon_{i,}) = \sigma_\varepsilon^2$

then,

$$Y_{it} = \beta_{1i} + \varepsilon_i + \beta_2 X_{1it} + \beta_3 X_{2it} + \beta_4 X_{3it} + u_{it} \quad (3.4)$$

$$Y_{it} = \beta_{1i} + \beta_2 X_{1it} + \beta_3 X_{2it} + \beta_4 X_{3it} + w_{it} \quad (3.5)$$

where,

$w_{it} = u_{it} + \varepsilon_i$

The composite error term w_{it} consists of two components $\varepsilon,$ which are the cross section, or individual – specific, error component and u_{it}, which is the combined time series and cross-section error component because it varies both over-section (subject) and time. A random effect model estimates variance component for groups (or times) and error, assuming the same intercept and slopes. u_{it} is a part of the errors and should not be correlated to any regressor; otherwise a core OLS assumption is violated. The difference among groups (or time periods) lies in their variance of the error term, not in their intercepts. A random effect model is estimated by generalized lease squares (GLS).

Assumptions about the error components

$\varepsilon_i \sim N\ (0, \sigma_\varepsilon^2)$

E$(\varepsilon_i \varepsilon_j) = 0\ for\ i \neq j$

$u_{it} \sim N\ (0, \sigma_u^2)$

$\mathrm{E}(u_{it}u_{is}) = E(u_{it}u_{it}) = E(u_{it}u_{js}) = 0 for\ i \neq j; t \neq s$

$\mathrm{E}(\varepsilon_i u_{it}) = 0$

That is, the individual error components are not correlated with each other and are not auto correlated across both cross-section and time series result.

$\mathrm{E}(w_{it}) = 0$

$\mathrm{Var}(w_{it}) = \sigma_\varepsilon^2 + \sigma_u^2$

$\mathrm{Var}(w_{it}) = \sigma_\varepsilon^2 + \sigma_u^2$ shows that error term is homoscedastic. However, it can be expressed that w_{it} and w_{is} (t$\neq s$) are correlated. That is , the error terms of a given cross-sectional unit at two different points in time are correlated. The correlation coefficient, corr(w_{it} ,w_{is}) is

$$f = corr(w_{it}\ , w_{is}) = \frac{\sigma_\varepsilon^2}{\sigma_\varepsilon^2+\sigma_u^2};\ \mathrm{t} \neq s$$

3.6 Fixed Effect versus Random Effects Model

1. If t (the number of time series data) is large and n (the number of cross-sectional units) is small, there is likely to be little difference in the values of the parameters estimated by FEM and ECM. Hence the choice here is mainly upon computational convenience. On the score, FEM may be preferable.
2. When n is large and t is small, the estimates obtained by the two methods can vary significantly. In ECM $\beta_{1i} = \beta_1 + \varepsilon_{i,}$where $\varepsilon_{i,}$is the cross-sectional random component whereas in FEM, β_{1i} is treated as fixed and not random. In this case, FEM is suitably preferred. If the cross-sectional units in the sample are regarded as random drawing, ECM is more appropriate.
3. If the individual error component $\varepsilon_{i,}$ and one or more regressors are correlated, then ECM estimators are biased, whereas those obtained from FEM are unbiased.
4. If n is large and t is small, and if the assumptions underlying ECM hold, ECM estimators are more efficient than FEM.
5. Unlike FEM, ECM can estimate coefficients of time-invariant variables. The FEM does not control for such time-invariant variables

are out of control by the FEM; however, they cannot be directly estimated as is clear from the LSDV or within-group estimator models. If it is assumed that $\varepsilon_{i,}$ and X's are correlated, FEM may be appropriate. In FEM each cross-sectional unit has its own (fixed) intercept representing the mean value of all the (cross-sectional) intercepts and the error component $\varepsilon_{i,}$ represents the (random) deviation of individual intercept for this mean value.

3.7 F-test

In order to check significant between pooled ordinary least squares model and fixed effect model, F statistics is used. F-test is a statistical test that is used to determine whether two populations having normal distribution have the same variances or standard deviation. F test has null hypothesis is OLS model and the alternative hypothesis is fixed effect model.

$$F_{1-way} = \frac{(ESS_R - ESS_U)/(N-1)}{ESS_U/((T-1)N-K)}$$

Where,

ESS_R = the residual sum of squares under the null hypothesis

ESS_U= the residual sum of squares under the alternative hypothesis

Under the null hypothesis the statistics F_{1-way} is distributed as F with (N-1, (T-1) N-K) degrees of freedom. The two sums of squares evolve as intermediate results from OLS and from fixed effect estimation.

3.8 Breusch-Pagan Lagrange Multiplier Test

The Breusch-Pagan Lagrange multiplier (LM) test explores if there is any random effect in the model. The null hypothesis is that individual-specific or time-specific error variance components are zero. The alternative hypothesis is that individual-specific or time-specific error variance components are not zero. If the null hypothesis is rejected, random effect model is preferred. If null hypothesis is not rejected, the pooled OLS model is preferred.

3.9 Hausman's Specification Test

Hausman test is the basic testing for the selection of the efficient model estimation between fixed effects and random effects specification. Statistically, fixed effects estimations are always effective for panel data but for some groups of data, random effects one will give better P-values as being a more efficient estimator. Hence, Hausman test needs to be used to assure the efficient and consistent results. The assumptions of this test are as follows:

H_0: The coefficients estimated by random effects estimator are consistent.

H_1: The coefficients estimated by fixed effects estimator are consistent

3.10 Heteroskedasticity

The standard error component of appropriate model assumes that the regression disturbances are homoscedastic with the same variance across time and individuals. This may be a restrictive assumption for panels. In the presence of heteroskedasticity, the standard errors of the estimates will be biased. The robust standard errors need to be computed to correct for the possible presence of heteroskedasticity. The situation in which the error process is homoscedastic within cross-sectional units, but its variance differs across units is called groupwise heteroskedasticity.

Breusch-Pagan Lagrange multiplier test is used to calculate heteroskedasticity in the residuals of a random effect regression model. The null hypothesis that $\sigma_i^2 = \sigma^2$ for i=1,…,n, where n is the number of cross-sectional units. The resulting test statistic is distributed Chi-squared under the null hypothesis of homoscedasticity.

3.11 Auto-Correlation

If linear panel-data models show auto-correlation, the standard errors from these models biases and cause the results to be less efficient. In order to test auto-correlation, Wooldridge's method is used in the model. Wooldridge's methods use the residuals from a regression in first-differences. The first differencing data removes the individual level effect, the term based on the time-invariant covariates and the constant,

$$y_{it} - y_{it-1} = (X_{it} - X_{it-1})b_1 + \varepsilon_{it} - \varepsilon_{it-1} \tag{3.6}$$

3.12 Feasible Generalized Least Squares Estimator

Park (1967) proposed feasible generalized least-squares (FGLS) for the data with heteroskedasticity as well as for temporal and spatial dependence in the residual of time-series cross-section models. FGLS provides an efficient estimation for the case in which the number of t (time period) is greater than or equal to the number of N (cross-sections).

The FGLS estimation method takes into consideration heteroskedasticity and auto-correlation. The error terms can be explained as

$$E[\varepsilon\varepsilon'] = \Omega = \begin{bmatrix} \sigma_{11}\Omega_{11} & \sigma_{12}\Omega_{12} & \cdots & \sigma_{1N}\Omega_{1N} \\ \sigma_{21}\Omega_{21} & \sigma_{22}\Omega_{22} & \cdots & \sigma_{2N}\Omega_{2N} \\ \vdots & \vdots & \ddots & \vdots \\ \sigma_{N1}\Omega_{N1} & \sigma_{N2}\Omega_{N2} & \cdots & \sigma_{NN}\Omega_{NN} \end{bmatrix}$$

Where

$$\Omega_{ij} = \begin{bmatrix} 1 & \rho_j & \rho_j^2 & \cdots & \rho_i^{t-1} \\ \rho_i & 1 & \rho_j & \cdots & \rho_i^{t-2} \\ \rho_i^2 & \rho_i & 1 & \cdots & \rho_i^{t-3} \\ \cdots & \cdots & \cdots & \ddots & \cdots \\ \rho_i^{t-1} & \rho_i^{t-2} & \rho_i^{t-3} & \cdots & 1 \end{bmatrix}$$

As FGLS panel data model is also known as the Parks-Kmenta method (Kmenta 1986). In the FGLS model, the estimation of regression applies regular OLS. In order to estimate assumed error AR (1) serial correlation coefficient ρ, the estimation residuals are utilized. This coefficient is used to transform the model to eliminate error serial correlation. $\widehat{\Omega}$ is substituted for Ω, using estimated ρ and σ^2, then the FGLS estimator of β is derived as

$$\hat{\beta}_{GLS} = (X'^{\widehat{\Omega}}\mathrm{X})^{-1}X'\widehat{\Omega}^{-1}y.$$

CHAPTER IV

ANALYSIS OF PANEL DATA REGRESSION MODELS

4.1 Comparative Analysis on Selected Variables of ASEAN Countries

The effect of selected health indicators on GDP are studied in this chapter. The model consists of one explained variable and three explanatory variables. The explained variable is GDP (PPP) per Capita and the three explanatory variables are selected health indicators; Under-Five Mortality Rate (U5MR), Maternal Mortality Rate (MMR), Total Fertility Rate (TFR). The panel data which consist of ten ASEAN countries, for the period from 2006 to 2017 time series has been used in this study. The data are shown in Appendix Tables from A-1 to A-10.

4.1.1 GDP (PPP) per Capita

Gross Domestic Product is the dependent variable of the model. GDP per Capita based on purchasing power parity (PPP) is gross domestic product that is converted to international dollars using purchasing power parity rates. GDP at purchaser's prices is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies that are not included in the value of the products. It is calculated without making any deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in constant 2011 international dollars. (World Bank, 2018)

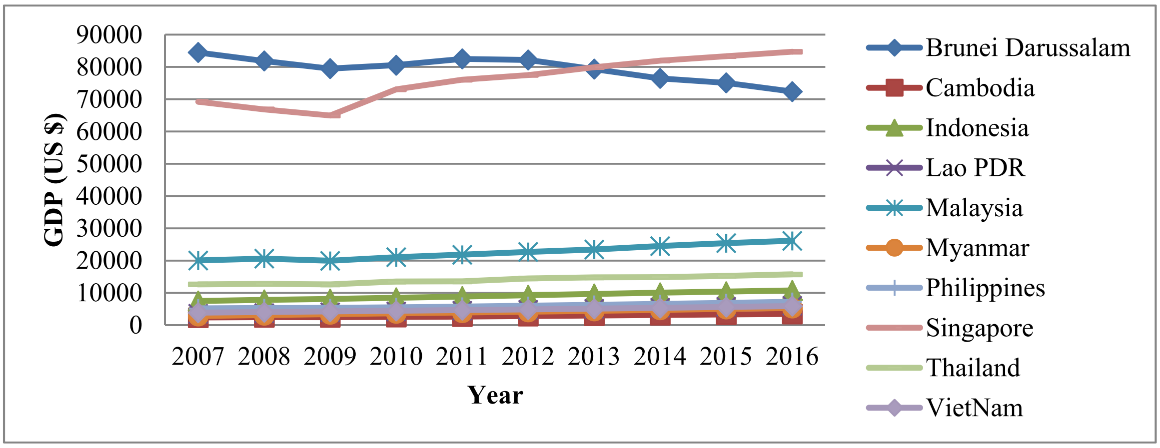

Figure 4.1 GDP flows of ASEAN countries from 2007 to 2016

Source: APPENDIX-A, Table (A-1:A-10)

Figure 4.1 shows that Brunei Darussalam has the highest GDP flow until 2013 and GDP (PPP) per Capita flow of Singapore became the highest rate among the ASEAN countries from 2013 until 2016. Malaysia has lower GDP (PPP) per Capita flow than Brunei Darussalam and Singapore but it is still higher than other member countries. GDP (PPP) per Capita of Cambodia, Lao PDR, Indonesia, Myanmar, Philippines, Thailand and Vietnam does not exceed US$ 20000 per year, being less than Brunei Darussalam, Singapore and Malaysia.

4.1.2 Under-Five Mortality Rate

Under-Five Mortality Rate is the probability per 1,000 that a newborn baby will die before reaching its age of five, if subject to age-specific mortality rates of the specified year. Under-Five Mortality Rates among boys are higher than among girls in the countries where parental gender preferences are insignificant. Under-Five Mortality captures the effect of gender discrimination better than infant mortality does, whereas malnutrition and medical interventions have more significant impacts to this age group. In the situations where female under-five mortality is greater, girls are likely to have more difficulties in accessing resources than boys (World Bank, 2018). In Figure 4.2, Lao PDR and Myanmar have higher Under Five-Mortality Rates than other ASEAN member countries.

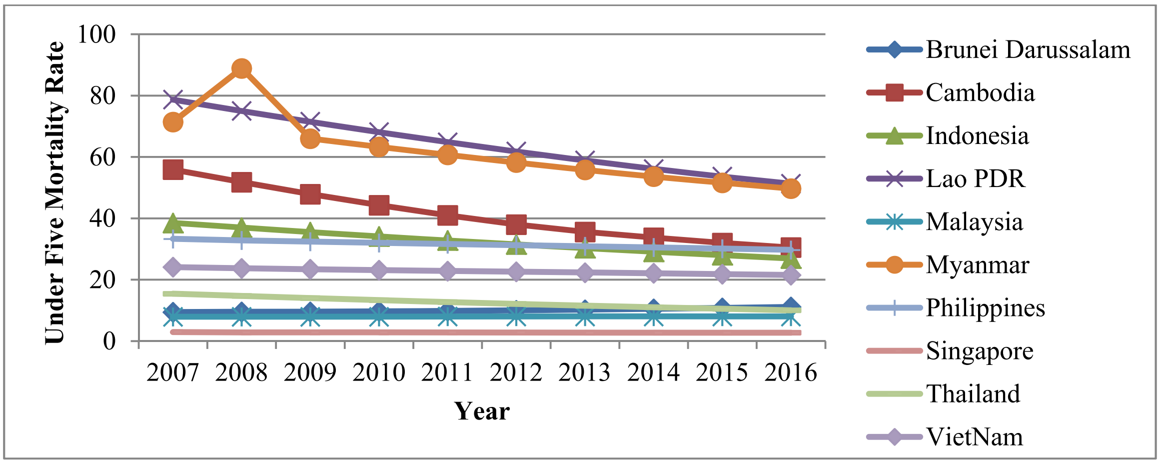

Figure 4.2 Under five mortality flows of ASEAN countries from 2007 to 2016

Source: APPENDIX-A, Table (A-1:A-10)

Cambodia follows as the country with the second highest Under-Five Mortality Rate after Loa PDR and Myanmar. Singapore sit at the lowest in the ranking of Under-Five Mortality Rates in ASEAN countries. On the other hand, the overall Under-Five Mortality tends has declined over the period from 2007 to 2016.

4.1.3 Maternal Mortality Rate

Maternal Mortality Ratio is the number of women who die from pregnancy-related causes while pregnant or within 42 days of pregnancy termination per 100,000 live births (World Bank, 2018). Figure (4.4) compares Maternal Mortality Rate among ASEAN countries, showing that Lao PDR, Myanmar, Cambodia and Indonesia have the highest.

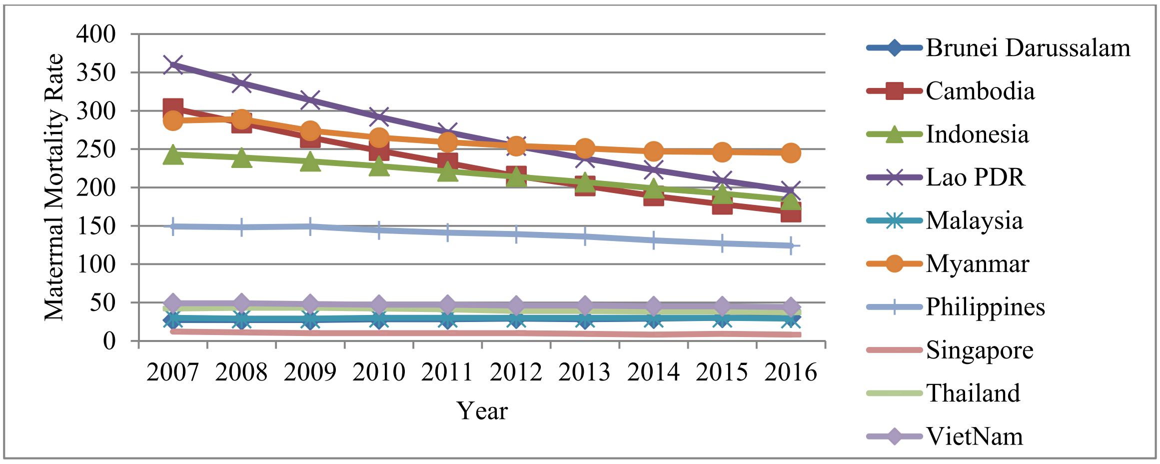

Figure 4.3 Maternal Mortality flows of ASEAN countries from 2007 to 2016
Source: APPENDIX-A, Table (A-1:A-10)

Vietnam, Thailand, Brunei, Philippine and Singapore have the lowest Maternal Mortality Rate, compared with other ASEAN member countries. Maternal Mortality Rate of Malaysia stays in the middle range which is lower than highest countries and higher than lowest countries in ASEAN countries.

4.1.4 Total Fertility Rate

Total Fertility Rate explains the number of children that would be born to a woman if she were to live to the end of her childbearing years and bear children in accordance with age-specific fertility rates of the specified year (World Bank, 2018). Figure 4.3 shows that the lowest Total Fertility Rate is found in Singapore across ASEAN countries. Lao PDR and Philippine have higher Total Fertility Rates than the rest of ASEAN countries.

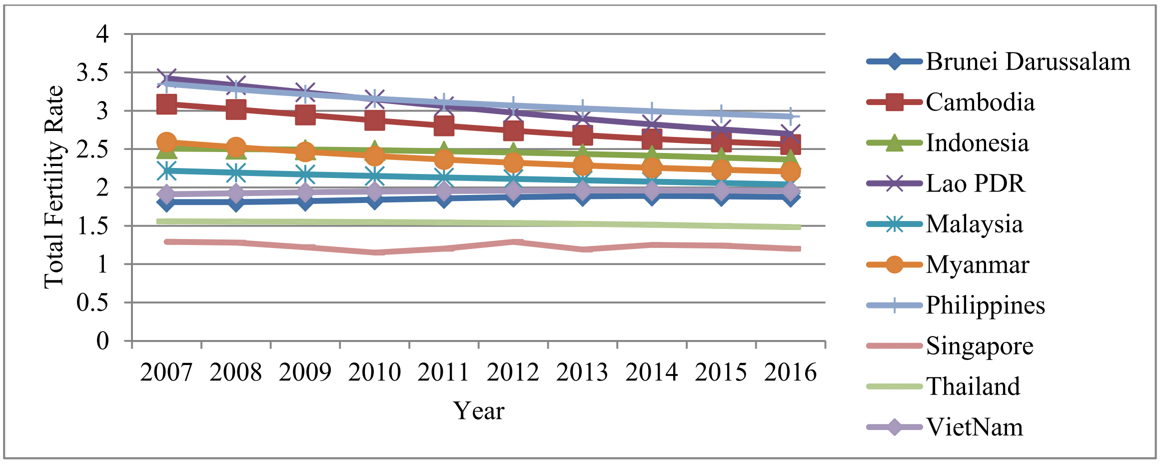

Figure 4.4 Total Fertility flows of ASEAN countries from 2007 to 2016

Source: APPENDIX-A, Table (A-1:A-10)

From 2007 until 2011, Lao PDR and Philippine have similar total fertility rates but from 2008 until 2016, Total Fertility Rate of Loa PDR falls more than that of Philippine.

4.2 Variable Scatterplot Matrix

To examine relationship between explanatory variable and explained variable, the scatter plot matrix was shown in Appendix Figure (B-1). It was found that, the relationship was non-linear. Therefore, the log linear transformation was used in order to be linearity between explanatory variables and explained variable. The scatter plot matrix for log transformation was shown in Figure 4.5.

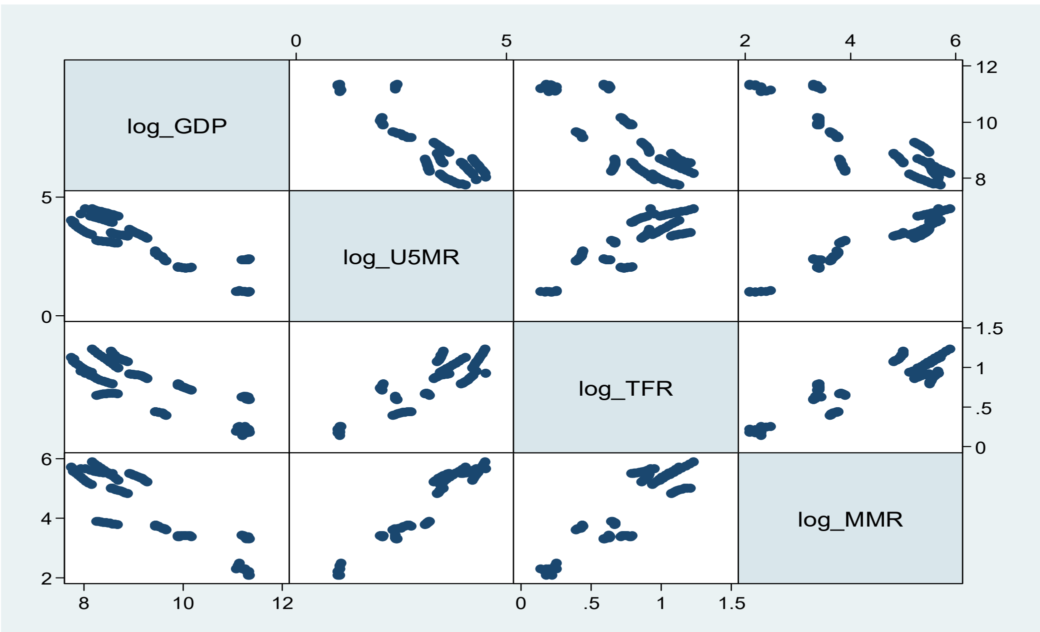

Figure 4.5 The Scatter Matrix Plot for all Variables (2007-2016)

It demonstrates linear relationship between GDP, Under Five Mortality Rate, Maternal Mortality Rate and Total Fertility Rate.

4.3 The Pooled Ordinary Least Squares Model

The explained variable (GDP) and the three explanatory variables (U5MR, TFR and MMR) are analyzed by using ordinary least squares model. The ordinary least squares model for GDP and selected health indicators is as follows;

$$Ln(GDP_{it}) = \beta_{1i} + \beta_{2i}Ln(U5MR) + \beta_{3i}Ln(MMR_{3it}) + \beta_{4i}Ln(TFR_{4it})$$

where,

i= Country (1,2,…,10)

t= Time (1,2,…,10)

β_1= Intercept

β_2= Slope of Under-Five Mortality Rate

β_3= Slope of Maternal Mortality Rate

β_4= Slope of Total Fertility Rate

Ln (GDP)= log of Gross Domestic Product

Ln (U5MR)= log of Under-Five Mortality Rate

Ln (MMR)= log of Maternal Mortality Rate

Ln (TFR)= log of Total Fertility Rate

According to F test, the overall model is statistically significant at 1% level. The following Table (4.1) presents the pooled ordinary least squares model for selected health indicators and GDP inflows in ASEAN countries.

Table 4.1 Summary Results of Pooled Ordinary Least Squares Model for GDP

Variables	Coefficient	Std.error	t	P-value
Constant	12.5496	0.2752	45.61	0.000***
Ln(Under-Five Mortality Rate)	-0.8285	0.2094	-3.96	0.000***
Ln(Maternal Mortality Rate)	-0.1861	0.1990	-0.94	0.352
Ln(Total Fertility Rate)	0.0640	0.4114	0.16	0.877
F(3,96)	97.38			
P-value	0.0000***			
No. of observations	100			

Source : STATA output from APPENDIX-C, Table (C-1)

*** Statistically significant at 1% level

According to the result, Under-Five Mortality Rate is statistically significant at 1% level. But, Maternal Mortality Rate and Total Fertility Rate are not statistically significant .The estimated pooled ordinary least squares model for GDP (PPP) per Capita and selected health indicators of ASEAN countries can be expressed as follow;

$Ln(GDP_{it}) = 12.5496 - 0.8285\, Ln(U5MR_{it}) - 0.1861\, Ln(MMR_{it}) + 0.0640\, Ln(TFR_{it})$

From the above equation, Under-Five Mortality Rate has negative relationship with GDP and it is statistically significant at 1% level. Maternal Mortality Rate and Total Fertility Rate are not statistically significant. If Under-Five Mortality Rate increases by 1%, GDP (PPP) per Capita will decrease by 0.8285% when Maternal Mortality Rate and Total Fertility Rate are constants. Therefore, it can be concluded that If Under-Five Mortality Rate increase, GDP (PPP) per Capita will be decreased.

4.4 The Fixed Effect Model

The explained variable (GDP (PPP) per Capita) and the three explanatory variables (Under-Five Mortality Rate, Maternal Mortality Rate and Total Fertility Rate) are analyzed by using fixed effect model. The fixed effect model for GDP (PPP) per Capita and selected health indicators is as follows;

$$Ln(GDP_{it}) = \beta_{1i} + \beta_{2i}Ln(U5MR_{2it}) + \beta_{3i}Ln(MMR_{3it}) + \beta_{4i}Ln(TFR_{4it})$$

According to the F test result, the overall model is statistically significant at 1% level. The following Table (4.2) presents the fixed effect model for selected health indicators and GDP inflows in ASEAN countries.

Table 4.2 Summary Results of Fixed Effect Model for GDP

Variables	Coefficient	Std.error	t	P-value
Constant	12.5925	0.3348	37.62	0.000***
Ln(Under-Five Mortality Rate)	-0.4411	0.1062	-4.16	0.000***
Ln(Maternal Mortality Rate)	-0.2817	0.1279	-2.20	0.030***
Ln(Total Fertility Rate)	-0.9678	0.3064	-3.16	0.002***
Sigma U	0.6257			
Sigma e	0.0660			
Rho	0.9890			
F(3,87)	90.30			
P-value	0.000***			

Source: STATA output from APPENDIX-C, Table (C-2)

*** Statistically significant at 1% level

According to the result, U5MR, MMR and TFR are statistically significant at 1% level. The estimated fixed effect regression model for GDP (PPP) per Capita and selected health indicators of ASEAN countries can be expressed as follow;

$Ln(GDP_{it})$= 12.5925 - 0.4411 $Ln(U5MR_{it})$ - 0.2817 $Ln(MMR_{it})$ - 0.9678 $ln(TFR_{it})$

From the above equation, all variables have negative relationship with GDP. If Under-Five Mortality Rate rises by 1%, GDP (PPP) per Capita will be decreased by 0.4411% when Maternal Mortality Rate and Total Fertility Rate are constants. Therefore, it can be concluded that Under-Five Mortality Rate increases, GDP (PPP) per Capita will be decreased. Similarly, Maternal Mortality Rate increases by 1%, GDP (PPP) per Capita will be decreased by 0.2817% when Under-Five Mortality Rate and Total Fertility Rate are constants. Therefore, it can be concluded that Maternal Mortality Rate increases, GDP (PPP) per Capita will be decreased. It is found that if Total Fertility Rate increases by 1%, GDP (PPP) per Capita will be decreased by 0.9678% when Under-Five Mortality Rate and Maternal Mortality Rate are constants. Therefore, it can be concluded that if Total Fertility Rate increases, GDP (PPP) per Capita will be decreased.

4.5 The Random Effect Model

The explained variable GDP and the explanatory variables (Under-Five Mortality Rate, Maternal Mortality Rate, and Total Fertility Rate) are analyzed by using the random effect model. The random effect model for GDP (PPP) per Capita and selected health indicators (Under-Five Mortality Rate, Maternal Mortality Rate, and Total Fertility Rate) is as follows;

$$Ln(GDP_{it}) = \beta_{1i} + \beta_{2i}Ln(U5MR_{2it}) + \beta_{3i}Ln(MMR_{3it}) + \beta_{4i}Ln(TFR_{4it})$$

According to Wald Chi-Square test, the overall model is statistically significant at 1% level. The following Table (4.3) presents the random effect model for selected health indicators and GDP in ASEAN countries.

Table (4.3) Summary Results of Random Effect Model for GDP

Variables	Coefficient	Std.error	t	P-value
Constant	12.6108	0.3862	32.66	0.000***
Ln(Under-Five Mortality Rate)	-0.4500	0.1037	-4.34	0.000***
Ln(Maternal Mortality Rate)	-0.2863	0.1222	-2.34	0.019***
Ln(Total Fertility Rate)	-0.9309	0.2937	-3.17	0.002***
Sigma U	0.7303			
Sigma e	0.0660			
Rho	0.9919			
Wald χ^2	296.11			
P-value	0.000***			

Source : STATA output from APPENDIX-C, Table (C-3)

*** Statistically significant at 1% level

All variables in the models are statistically significant at 1% level. The estimated random effect GLS regression model for GDP (PPP) per Capita and selected health indicators of ASEAN countries can be expressed as follow;

$Ln(GDP_{it}) = 12.6108 - 0.4500 Ln(U5MR_{it}) - 0.2863 Ln(MMR_{it}) - 0.9309 Ln(TFR_{it})$

From the above equation, it is found that there are negative relationship between Under-Five Mortality Rate, Maternal Mortality Rate, Total Fertility Rate and GDP (PPP) per Capita. If Under-Five Mortality rate increases by 1%, GDP (PPP) per Capita will be decreased by 0.4500% when Maternal Mortality Rate and Total Fertility Rate are constants. If Maternal Mortality rate increase by 1%, GDP (PPP) per Capita will be decreased by 0.2863% when Under-Five Mortality Rate and Total Fertility Rate are constants and If Total Fertility Rate increases in 1%, GDP (PPP) per Capita will be decreased by 0.9309% when Maternal Mortality Rate and Total Fertility Rate are constants. Therefore, it can be concluded that if GDP (PPP) per Capita increases, Under-Five Mortality Rate, Maternal Mortality Rate and Total Fertility Rate will be decreased.

4.6 Testing for Fixed test (F test, Poolability test between pooled OLS model and fixed effect model)

Fixed test (F test) is used to determine appropriate model between pooled ordinary least squares model and fixed effect model.

Hypothesis

Null Hypothesis : Pooled OLS model is significant

Alternative Hypothesis: Fixed effect model is significant

Test Result:

According to the result of Appendix C, Table (C-2),

F test that all u_i=0

F(9, 87) = 820.22

Prob > F = 0.0000

Decision and Conclusion

Since P-value is < 0.05, null hypothesis is rejected. So, fixed effect model is significant than pooled ordinary least squares model.

4.7 Breusch-Pagan Lagrangian Multiplier test (Poolability Test between Pooled Ordinary Least Squares Model and Random Effect Model)

The Breusch and Pagan Lagrangian Multiplier test is used to determine appropriate model between pooled ordinary least squares model and random effect model.

Hypothesis

Null Hypothesis : Pooled Ordinary Least Square Model is significant

Alternative Hypothesis : Random Effect model is significant

Test Result

According to the result of Appendix C, Table (C-4),

Chi-square (10) = 435.35

Prob> Chi-square= 0.0000***

Decision and Conclusion

Since P values < 0.05, null hypothesis is reject in the model. Thus, random effect model is significant than pooled ordinary least square model.

4.8 Hausman Test (Poolability Test between Fixed Effect and Random Effect Model)

The Hausman test is used to determine appropriate model between fixed effect model and random effect model. Table (4.4) presents the results of Hausman Test.

Table (4.4) Estimate the results of Hausman Test

Variable	Coefficients			
	(b) Fixed effect Model	(B) Random effect Model	(b-B) Difference	Standard Error
Under-five mortality rate	-0.4411	-0.4500	0.0089	0.0227
Maternal mortality rate	-0.2817	-0.2863	0.0046	0.0379
Total fertility rate	-0.9678	-0.9309	-0.03690	0.0871

Source: STATA output from APPENDIX-C, Table (C-5)

Hypothesis

Null Hypothesis : The coefficients estimated by random effects estimator are consistent.

Alternative Hypothesis : The coefficients estimated by fixed effects estimator are consistent

Test Result

According to the result of Appendix C, Table (C-5),

$$\chi^2 = 0.29$$

P-value = 0.9612

Decision and Conclusion

According to the result of the Hausman test, p-value 0.9612 is greater than 0.05. It means that the null hypothesis is failed to reject. Therefore, it can be concluded that the random effect model is more appropriate for this study.

4.9 Diagnostic Checking on Random Effect Model

If there is heteroscedasticity and auto-correlation in the model, the result cannot represent actual situation. Therefore, heteroscedasticity and auto-correlation diagnostic tests for random effect model are done in this study. Breusch and Pagan Lagrangian Multiplier test is used to examine heteroscedasticity and Wooldridge test is used to examine auto-correlation in the random effect model.

4.9.1 Diagnostic Checking on Heteroscedasticity

Breusch and Pagan Lagrangian Multiplier test for random effect is used to identify the heteroscedasticity in the model.

Hypothesis

Null Hypothesis : Random effect model is homoscedasticity

Alternative Hypothesis: Random effect model is heteroscedasticity

Test Result

According to the result of Appendix C, Table (C-4),

Chi-square (10) = 435.35

Prob>Chi-square = 0.0000***

Decision and Conclusion

Since P-value < 0.05, null hypothesis is rejected and there is heteroscedastic in the model.

4.9.2 Diagnostic Checking on First-order Auto-correlation

The Wooldridge test is used to test for first-order autocorrelation in the model.

Hypothesis

Null Hypothesis: There is no first order auto-correlation in the model

Alternative Hypothesis: There is first order auto-correlation in the model

Test Result

According to the result of Appendix C, Table (C-6),

F(1, 9) = 45.805

Prob > F= 0.0001***

Decision and Conclusion

Since P-value < 0.05, null hypothesis is rejected and there is first order auto-correlation in the model.

4.10 Feasible Generalized Least Squares (FGLS) Model

According to Hausman test result, random effect model was defined as appropriate model. After diagnostic with Breusch and Pagan Lagrangian Multiplier test and Wooldridge test, it was found that there are heteroscedasticity and first order auto-correlation in the random effect model. So, random effect model should not use for this study. Thus, feasible generalized least squares (FGLS) method is used to remedy heteroscedastic and auto-correlation in the model.

According to Wald Chi-Square test, the overall model is statistically significant at 1% level. The following Table (4.5) presents the feasible generalized least squares model (FGLS) for selected health indicators and GDP in ASEAN countries.

Table (4.5) Summary Results of Feasible Generalized Least Squares (FGLS) Model for GDP

Variables	Coefficient	Std.error	t	P-value
Constant	12.2339	0.2127	57.53	0.000***
Ln(Under-Five Mortality Rate)	-0.3664	0.1100	-3.33	0.001***
Ln(Maternal Mortality Rate)	-0.3143	0.1115	-2.82	0.005***
Ln(Total Fertility Rate)	-0.6022	0.1994	-3.02	0.003***
Wald χ^2	377.44			
P-value	0.0000***			

Source: STATA output from APPENDIX-C, Table (C-7)

***statistically significant at 1% level

According to the result, in the feasible generalized least squares model, all the variables are individually, statistically significant at 1% level, given the facts that the probability values (0.000,0.001,0.003 and 0.005) is smaller than 0.01.

The feasible generalized least squares model for GDP (PPP) per Capita and selected health indicators of ASEAN countries can be expressed as follow;

$Ln(GDP_{it})= 12.2339 -0.3664\ Ln(U5MR_{it}) -0.3143\ Ln(MMR_{it}) -0.6022\ Ln(TFR_{it,})$

From the above equation, it is found that all variables have negative effect on GDP. If Under-Five Mortality Rate increases by 1%, GDP (PPP) per Capita will be decreased by 0.3664% when Maternal Mortality Rate and Total Fertility Rate are constants. If Maternal Mortality Rate increases in 1%, GDP (PPP) per Capita will be decreased by 0.3143% when Under-Five Mortality Rate and Total Fertility Rate are constants. If Total Fertility Rate increases by 1%, GDP (PPP) per Capita will be decreased by 0.6022% when Under-Five Mortality Rate and Maternal Mortality Rate are constants. Therefore, it can be concluded that if GDP (PPP) per Capita increases, Under-Five Mortality Rate, Maternal Mortality Rate and Total Fertility Rate will be decreased.

CHAPTER V
CONCLUSION

5.1 Findings

In this study, pooled ordinary least squares model, fixed effect model, random effect model and feasible generalized least squares model are used to analyze the panel data. The panel data which consists of ten ASEAN countries for the periods 2007-2016 are used to find the impact of selected health indicators on GDP. Empirical analysis based on data from World Bank 2018.

In pooled ordinary least squares, it has been found that all three selected indicators (U5MR, MMR and TFR) have a negative relationship with GDP. According to the results of fixed effect, the random effect and feasible generalized least squares model, the findings showed that the coefficient of Under-Five Mortality is negative effect on GDP. Furthermore, the coefficient of Maternal Mortality Rate is conversely related with GDP. Likewise, the coefficient of Total Fertility Rate is found to have a negative effect on GDP.

F test, Breusch-Pagan Lagrangian Multiplier test and Hausman's specification test are used to choose the appropriate one among the three models - pooled ordinary least squares model, fixed effect model and random effect model. When the F test is run, the results showed that fixed effect model is significant if compared with the pooled ordinary least squares model. According to the result of Breusch-Pagan Lagrangian Multiplier test, the random effect model is significant if compared with pooled ordinary least squares model. In the Hausman's specification test, the random effect model was found to be appropriate if compared with fixed effect model. Hence, the random effect model is the most significant among all three models. When diagnostic testings are undertaken to test heteroskedastic and autocorrelation in the random effect model, the findings show that the random effect model has heteroskedastic and auto-correction. Therefore, feasible generalized least squares model is used to remedy heteroskedastic and auto-correction in the model. The feasible generalized least squares model shows the same results with random effect model. All these results indicate that Under-Five Mortality Rate, Maternal Mortality Rate and Total Fertility Rate have negative effects on GDP.

Under-Five Mortality Rate is one of the most important public health indicators in measuring the health status of a country. It is lower in the countries with higher income. For poor and underdeveloped countries, public medical care services are not up to the sufficient level to cover all their populations. The private medical care expenses are high and every individual household cannot afford on it. Poor families usually forego their medical care even if they are aware of their health status. High out of pocket expenditures on health pushed them into more financially and socially fragile situations. The findings of this study have proved that reversing high under-five mortality rates is more likely in the countries with high GDP. In other words, if a country has the higher GDP, there can be the lower under-five mortality rate.

Maternal mortality rate is usually interpreted as a general indicator which explains the overall health status of a country. In addition, the role and status of women in society can be known through maternal mortality rate of each specific country. The status of health functioning system can be measured through maternal mortality rate in a country. It is higher in poor countries than rich countries. Women in poor countries are usually at risk of mortality during pregnancy and higher intra and post-partum due to three delays in seeking health care, in reaching health facility and in receiving adequate medical care. Like Under-Five Mortality Rate, the results show the same that there is GDP (PPP) per Capita and Maternal Mortality Rate are negatively related. Maternal Mortality Rates stay very low in the countries with high GDP.

Total Fertility Rate is firmly attached to development rates of countries and can be the best indicator of future population increment or decline for a country or for a population inside a county. Fertility rate is one of the most essential and commonly used statistics in demography. Fertility rates usually influence public policy, budget allocation on education and health system, having a great impact on the prosperity of a country's population. The study results confirm that there is negative relationship between GDP (PPP) per Capita and Total Fertility Rate. If the country has higher GDP rate, there will have lower Total Fertility Rate is more common in the countries with higher GDP than those with lower GDP.

5.2 Recommendations

With limited availability of health data, this study focused only on three of the commonly used health indicators, but a further study is recommended to explore relationships between infectious diseases and other specific health indicators and economic growth. More in-depth analyses on individual health indicators and their impacts on the productivity of countries can inform more issue-based policy developments to effectively bring up and maintain health status of poor countries.

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APPENDIX-A

Table (A-1): GDP (PPP) per Capita, Under-Five Mortality Rate, Maternal Mortality Rate and Total Fertility Rate of Brunei Darussalam (2007-2016)

Country	**Year**	**GDP(PPP) per Capita US ($)**	**Under-Five Mortality Rate**	**Maternal Mortality Rate**	**Total Fertility Rate**
Brunei Darussalam	2007	84480.7770	11.1	27	1.808
Brunei Darussalam	2008	81869.1761	10.9	27	1.809
Brunei Darussalam	2009	79485.0016	10.7	27	1.821
Brunei Darussalam	2010	80556.1807	10.6	28	1.838
Brunei Darussalam	2011	82502.9353	10.5	28	1.857
Brunei Darussalam	2012	82149.9098	10.5	29	1.874
Brunei Darussalam	2013	79323.4375	10.5	28	1.884
Brunei Darussalam	2014	76448.5933	10.5	29	1.888
Brunei Darussalam	2015	75073.9366	10.5	30	1.884
Brunei Darussalam	2016	72369.5234	10.5	31	1.874

Source: World Bank Data, 2018

Table (A-2) – GDP (PPP) per Capita, Under-Five Mortality Rate , Maternal Mortality Rate and Total Fertility Rate of Cambodia (2007-2016)

Country	Year	GDP (PPP) per Capita US ($)	Under-Five Mortality Rate	Maternal Mortality Rate	Total Fertility Rate
Cambodia	2007	2332.1694	56	303	3.086
Cambodia	2008	2451.6909	51.9	284	3.018
Cambodia	2009	2417.2937	48.1	265	2.947
Cambodia	2010	2522.3148	44.4	248	2.875
Cambodia	2011	2658.0626	41.1	232	2.805
Cambodia	2012	2806.3256	38.1	215	2.739
Cambodia	2013	2963.4791	35.7	202	2.682
Cambodia	2014	3123.5598	33.6	189	2.634
Cambodia	2015	3290.1465	32	178	2.594
Cambodia	2016	3466.7857	30.6	168	2.560

Source: World Bank Data, 2018

Table (A-3) – GDP (PPP) per Capita, Under-Five Mortality Rate, Maternal Mortality Rate and Total Fertility Rate of Indonesia (2007-2016)

Country	**Year**	**GDP (PPP) per Capita US ($)**	**Under-Five Mortality Rate**	**Maternal Mortality Rate**	**Total Fertility Rate**
Indonesia	2007	7470.3175	37.9	243	2.505
Indonesia	2008	7815.4487	36.3	239	2.499
Indonesia	2009	8069.2419	34.8	234	2.492
Indonesia	2010	8457.5566	33.2	228	2.483
Indonesia	2011	8859.1400	31.8	221	2.471
Indonesia	2012	9267.2172	30.6	214	2.455
Indonesia	2013	9651.9245	29.4	207	2.436
Indonesia	2014	10003.1718	28.3	199	2.414
Indonesia	2015	10358.8286	27.2	192	2.389
Indonesia	2016	10748.2888	26.3	184	2.363

Source: World Bank Data, 2018

Table (A-4) – GDP (PPP) per Capita, Under-Five Mortality Rate , Maternal Mortality Rate and Total Fertility Rate of Laos (2007-2016)

Country	Year	GDP (PPP) per Capita US ($)	Under-Five Mortality Rate	Maternal Mortality Rate	Total Fertility Rate
Loa PDR	2007	3523.6108	89.4	360	3.423
Loa PDR	2008	3735.4454	86.3	336	3.331
Loa PDR	2009	3949.0518	83.3	314	3.240
Loa PDR	2010	4216.8303	80.4	292	3.149
Loa PDR	2011	4485.1811	77.7	272	3.059
Loa PDR	2012	4772.2669	75	254	2.974
Loa PDR	2013	5079.0342	72.5	238	2.895
Loa PDR	2014	5384.6057	70.1	223	2.823
Loa PDR	2015	5689.1550	67.9	209	2.758
Loa PDR	2016	5995.6052	65.6	196	2.698

Source: World Bank Data, 2018

Table (A-5) – GDP (PPP) per Capita, Under-Five Mortality Rate , Maternal Mortality Rate and Total Fertility Rate of Malaysia (2007-2016)

Country	Year	GDP (PPP) per Capita US ($)	Under-Five Mortality Rate	Maternal Mortality Rate	Total Fertility Rate
Malaysia	2007	20022.1875	7.9	30	2.217
Malaysia	2008	20592.2351	7.8	29	2.191
Malaysia	2009	19915.6594	7.8	29	2.169
Malaysia	2010	21035.6239	7.7	30	2.149
Malaysia	2011	21806.8228	7.6	30	2.129
Malaysia	2012	22670.2933	7.5	30	2.110
Malaysia	2013	23411.6377	7.4	30	2.092
Malaysia	2014	24487.4478	7.5	30	2.074
Malaysia	2015	25390.4353	7.6	30	2.056
Malaysia	2016	26105.8774	7.7	29	2.037

Source: World Bank Data, 2018

Table (A-6) – GDP (PPP) per Capita, Under-Five Mortality Rate , Maternal Mortality Rate and Total Fertility Rate of Myanmar(2007-2016)

Country	Year	GDP (PPP) per Capita US ($)	Under-Five Mortality Rate	Maternal Mortality Rate	Total Fertility Rate
Myanmar	2007	2814.6953	72.1	287	2.591
Myanmar	2008	3084.1970	89.7	289	2.526
Myanmar	2009	3387.8182	66.7	274	2.465
Myanmar	2010	3688.4916	64	265	2.410
Myanmar	2011	3864.9598	61.4	259	2.363
Myanmar	2012	4114.2277	59	254	2.322
Myanmar	2013	4423.1464	56.6	251	2.286
Myanmar	2014	4737.4599	54.4	247	2.256
Myanmar	2015	5030.2641	52.4	246	2.230
Myanmar	2016	5288.5702	50.5	245	2.207

Source: World Bank Data, 2018

Table (A-7) – GDP (PPP) per Capita, Under-Five Mortality Rate , Maternal Mortality Rate and Total Fertility Rate of Philippines (2007-2016)

Country	Year	GDP (PPP) per Capita US ($)	Under-Five Mortality Rate	Maternal Mortality Rate	Total Fertility Rate
Philippines	2007	5174.5136	33	149	3.349
Philippines	2008	5300.6750	32.4	148	3.278
Philippines	2009	5273.8123	31.9	149	3.214
Philippines	2010	5582.5331	31.3	144	3.158
Philippines	2011	5689.7609	30.9	141	3.109
Philippines	2012	5967.4892	30.4	139	3.067
Philippines	2013	6281.8359	30	136	3.028
Philippines	2014	6558.9734	29.6	131	2.992
Philippines	2015	6847.8652	29.1	127	2.958
Philippines	2016	7209.7865	28.6	124	2.925

Source: World Bank Data, 2018

Table (A-8) – GDP (PPP) per Capita, Under-Five Mortality Rate, Maternal Mortality Rate and Total Fertility Rate of Singapore (2007-2016)

Country	Year	GDP (PPP) per Capita US ($)	Under-Five Mortality Rate	Maternal Mortality Rate	Total Fertility Rate
Singapore	2007	69202.6589	2.9	12	1.290
Singapore	2008	66842.1501	2.8	11	1.280
Singapore	2009	64934.7993	2.8	10	1.220
Singapore	2010	73060.9446	2.8	10	1.150
Singapore	2011	76034.3341	2.8	10	1.200
Singapore	2012	77492.6312	2.8	10	1.290
Singapore	2013	79919.2624	2.7	9	1.190
Singapore	2014	81965.3611	2.7	8	1.250
Singapore	2015	83341.5749	2.7	9	1.240
Singapore	2016	84704.2809	2.8	8	1.200

Source: World Bank Data, 2018

Table (A-9) – GDP (PPP) per Capita, Under-Five Mortality Rate , Maternal Mortality Rate and Total Fertility Rate of Thailand (2007-2016)

Country	Year	GDP (PPP) per Capita US ($)	Under-Five Mortality Rate	Maternal Mortality Rate	Total Fertility Rate
Thailand	2007	12609.6619	15.4	42	1.557
Thailand	2008	12759.9911	14.7	43	1.553
Thailand	2009	12608.2061	14	43	1.551
Thailand	2010	13489.3282	13.3	42	1.547
Thailand	2011	13537.4883	12.7	41	1.542
Thailand	2012	14450.0136	12.1	39	1.534
Thailand	2013	14771.1555	11.5	39	1.524
Thailand	2014	14852.4361	11	38	1.512
Thailand	2015	15256.4188	10.4	38	1.498
Thailand	2016	15709.7836	10	37	1.482

Source: World Bank Data, 2018

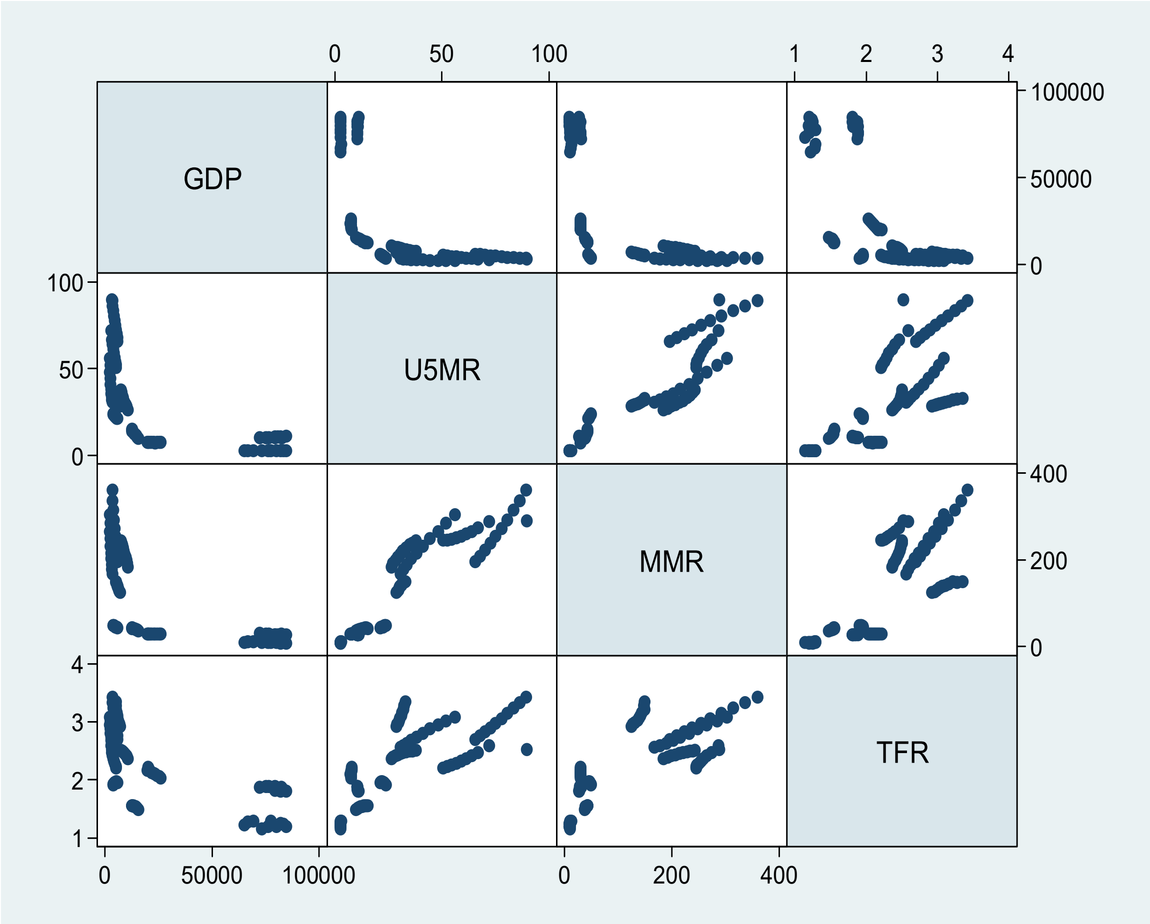
Table (A-10) – GDP (PPP) per Capita, Under-Five Mortality Rate, Maternal Mortality Rate and Total Fertility Rate of Vietnam (2007-2016)

Country	Year	GDP (PPP) per Capita US ($)	Under-Five Mortality Rate	Maternal Mortality Rate	Total Fertility Rate
Vietnam	2007	3852.3236	23.9	49	1.911
Vietnam	2008	4031.5514	23.5	49	1.923
Vietnam	2009	4207.7562	23.2	48	1.936
Vietnam	2010	4433.4678	22.9	47	1.946
Vietnam	2011	4662.2231	22.7	47	1.953
Vietnam	2012	4856.0006	22.4	46	1.957
Vietnam	2013	5065.6434	22.2	46	1.959
Vietnam	2014	5312.4922	21.9	45	1.960
Vietnam	2015	5608.4719	21.6	45	1.958
Vietnam	2016	5895.6285	21.3	44	1.954

Source: World Bank Data, 2018

APPENDIX –B

Table (B-1): The Scatter Matrix Plot for all Variables without log transformation (2007-2016)



APPENDIX –C

Table (C-1): The Stata Output of Pooled Ordinary Least Squares Model

Source	SS	df	MS
Model	98.9324831	3	32.9774944
Residual	32.5090269	96	.338635697
Total	131.44151	99	1.32769202

Number of obs	=	100
F(3, 96)	=	97.38
Prob > F	=	0.0000
R-squared	=	0.7527
Adj R-squared	=	0.7449
Root MSE	=	.58192

Ln_GDP	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Ln_U5MR	-.8284514	.2094019	-3.96	0.000	-1.244111	-.412792
Ln_TFR	.0639674	.411377	0.16	0.877	-.7526096	.8805444
Ln_MMR	-.1861385	.1989986	-0.94	0.352	-.5811477	.2088706
_cons	12.54961	.2751513	45.61	0.000	12.00344	13.09578

Table (C-2): The Stata Output of Fixed Effect Model

```
Fixed-effects (within) regression               Number of obs      =       100
Group variable: Country_ID                      Number of groups   =        10

R-sq:  within  = 0.7569                         Obs per group: min =        10
       between = 0.7288                                        avg =      10.0
       overall = 0.7291                                        max =        10

                                                F(3,87)            =     90.30
corr(u_i, Xb)  = -0.0154                        Prob > F           =    0.0000
```

Ln_GDP	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Ln_U5MR	-.441107	.1061616	-4.16	0.000	-.6521147	-.2300993
Ln_MMR	-.2817015	.1279294	-2.20	0.030	-.5359751	-.0274279
Ln_TFR	-.9678285	.3063868	-3.16	0.002	-1.576805	-.3588515
_cons	12.59247	.3347718	37.62	0.000	11.92708	13.25787
sigma_u	.62572951					
sigma_e	.06597378					
rho	.98900568	(fraction of variance due to u_i)				

F test that all u_i=0: F(9, 87) = 820.22 Prob > F = 0.0000

Table (C-3):The Stata Output of Random Effect Model

```
Random-effects GLS regression                   Number of obs      =       100
Group variable: Country_ID                      Number of groups   =        10

R-sq:  within  = 0.7569                         Obs per group: min =        10
       between = 0.7303                                        avg =      10.0
       overall = 0.7306                                        max =        10

                                                Wald chi2(3)       =    296.11
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000
```

Ln_GDP	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Ln_U5MR	-.4499921	.1037161	-4.34	0.000	-.6532718	-.2467123
Ln_MMR	-.2863119	.1221741	-2.34	0.019	-.5257688	-.0468549
Ln_TFR	-.9308992	.2937432	-3.17	0.002	-1.506625	-.3551731
_cons	12.61081	.3861748	32.66	0.000	11.85392	13.3677
sigma_u	.73028482					
sigma_e	.06597378					
rho	.99190479	(fraction of variance due to u_i)				

Table (C-4):The Stata Output of Breusch and Pagan Lagrangian Multiplier Test for Random Effects

```
Breusch and Pagan Lagrangian multiplier test for random effects

        Ln_GDP[Country_ID,t] = Xb + u[Country_ID] + e[Country_ID,t]

        Estimated results:
```

	Var	sd = sqrt(Var)
Ln_GDP	1.327692	1.152255
e	.0043525	.0659738
u	.5333159	.7302848

```
        Test:   Var(u) = 0
                             chibar2(01) =   435.35
                          Prob > chibar2 =   0.0000
```

Table (C-5):The Stata Output of Hausman Test

	(b) fe	(B) re	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
Ln_U5MR	-.441107	-.4499921	.0088851	.0226552
Ln_MMR	-.2817015	-.2863119	.0046104	.0379396
Ln_TFR	-.9678285	-.9308992	-.0369293	.0871081

```
                  b = consistent under Ho and Ha; obtained from xtreg
   B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test:  Ho:  difference in coefficients not systematic

              chi2(3) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                      =        0.29
            Prob>chi2 =      0.9612
```

Table (C-6):The Stata Output of Wooldridge Test for Auto-correlation

```
Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
    F(  1,       9) =     45.805
           Prob > F =      0.0001
```

Table (C-7):The Stata Output of Feasible Generalized Least Squares Model

```
Cross-sectional time-series FGLS regression

Coefficients:  generalized least squares
Panels:        heteroskedastic
Correlation:   common AR(1) coefficient for all panels  (0.9586)

Estimated covariances      =        10          Number of obs      =       100
Estimated autocorrelations =         1          Number of groups   =        10
Estimated coefficients     =         4          Time periods       =        10
                                                Wald chi2(3)       =    377.44
                                                Prob > chi2        =    0.0000
```

Ln_GDP	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Ln_U5MR	-.3663846	.110027	-3.33	0.001	-.5820335	-.1507357
Ln_TFR	-.6021927	.1993561	-3.02	0.003	-.9929236	-.2114619
Ln_MMR	-.3143283	.1115443	-2.82	0.005	-.5329511	-.0957055
_cons	12.23391	.2126692	57.53	0.000	11.81708	12.65073