Impacts of public debt on economic growth in six ASEAN countries[1]

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Abstract

The linkage between public debt and economic growth has been taken into consideration especially after the Global Financial Crisis and the recent European sovereign debt crisis. This paper examines the impact of public debt on economic growth in six ASEAN countries, namely Indonesia, Malaysia, Philippines, Singapore, Thailand, and Vietnam over the period 1995-2015, by including a set of control variables such as FDI, gross fixed capital formation, as well as real effective exchange rate. Furthermore, it determines whether a negative impact of public debt on economic growth at a higher level of debt exists. Regression analyses based on General Method of Moments (GMM) estimation, reveal a significant and positive impact of public debt upon the real GDP per capita growth rate. However, the adverse impact of higher indebtedness has not been found from the empirical analysis on ASEAN countries. This result is contrary to the general discussion on the negative effects of public debt and economic growth. It shows that public debt is utilized to finance effective public investment of ASEAN countries in the current stage of development and thereby has promoted economic growth in the long-term. Besides, FDI and gross fixed capital formation are two key factors contributing to the development of ASEAN economies.

1. Introduction

Public debt and its management have recently forcefully revived a debate among academics and policymakers, especially after the Global Financial Crisis in 2008. Although a large number of studies have mentioned this issue, their results are still ambiguous. Woodford (1990) stated that a higher public debt, in so far as

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1. The Association of Southeast Asian Nation, or ASEAN, was established on 8 August 1967 in Bangkok, Thailand

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it implies a higher proportion of liquid assets in private sector wealth, increases the flexibility of the private sector in responding to variations in both income and spending opportunities, and so can increase economic efficiency. On the other hand, Krugman (1988) identified the "debt overhang" problem when the expected present value of potential future resource transfers is less than its debt. As the stock of public sector debt increases, the government's debt service obligation will be financed by distorted measures (the inflation tax, for example), as in Agénor & Montiel (1996). Moreover, recent empirical studies suggest that a non-linear relationship between public debt and economic growth should be described through an inverted U-shaped curve with a certain turning point beyond which an increase in public debt has a significant and negative impact on growth (Reinhart & Rogoff, 2010; Checherita & Rother, 2010; Cecchetti et al., 2011; Baum et al., 2013; Fincke & Greiner, 2014).

Furthermore, most of the past studies have focused on public debt in advanced economies or emerging countries in Latin America while the number of research on this issue in Asian countries is still limited. Emerging countries in Asia, particularly Southeast Asia, have low levels of infrastructure capacity (Kumar & Dee 2008). Due to a significantly insufficient investments in infrastructure since 2000, most ASEAN governments have heavily relied on external sources such as FDI, ODA to finance infrastructure development projects. Thus, public debt, of which a majority has been utilized for infrastructure investment or social programs in order to achieve higher economic productivity, has not become a matter of concern to these ASEAN economies yet.

During the late 1990s, several ASEAN countries suffered heavy losses from the Asian Financial Crisis with one of the main reasons being the "maturity mismatch" when short-term debt was used to finance domestically long-term oriented investment projects. In this period, government debt, driven by financial bailouts and deficit spending to jumpstart demand, has already risen to 35-50 percent of GDP in Malaysia, and Thailand, and to 90-100 percent of GDP in Indonesia and the Philippines during the Asian crisis (World Bank, 2000). By the end of 2000, public debt-to-GDP ratio was over 60 percent Maastricht criterion in these four Southeast countries (Nick, 2003). Along with a sharp increase in public debt-to-GDP ratio during the crisis, ASEAN economies experienced a significant slowdown with the devaluation of currencies, increasing inflation and bad debt, bankruptcies of corporations and companies, and a high unemployment rate. For instance, Indonesia's GDP decreased by 15%, Thailand's and Malaysia's also decreased by nearly 10% in 1998 (Leblang & Satyanath, 2005).

More recently, although the Global Financial Crisis in 2008 did not directly affect ASEAN economies, it still caused a deterioration in economic growth of the countries that much rely on trade (Thailand, Singapore, Malaysia) through the decline in demand for Southeast Asian goods on the global market, which lead to a drop in export value by more than 25 percent in the first half of 2009 (Emmers & Ravenhill, 2010). In addition, the current financial situation in Europe may still lead to a global economic slowdown if the debt problems are not resolved, and may even push the global financial system into another deep crisis compared to that of 2008 (Ramayandi, 2011). The public debt has caused external borrowings that have resulted in the sovereign bond crises and economic crises in GIIPS[2] (the origin of Euro Crisis). The aftermath of the public debt crisis in Europe is a good lesson for ASEAN countries to be careful with their budgetary decisions. In fact, the public debt-to-GDP ratio began to rise again in some ASEAN countries. Particularly, it has increased significantly and reached the range of 48-55% at the end of 2015 in Malaysia, Vietnam, Thailand, and Lao. Singapore - a country with the highest per capita income in the region - has a high public debt ratio compared to the GDP (105.6%) and ranked the 13th in the world in 2015 (Muhammad, 2017). Hence, although the debt levels of ASEAN countries are still under the safety level, it is essential that public debt and its impacts on economic growth in ASEAN countries should be taken into consideration to prevent negative effects on sustainable growth in the long-term.

This paper attempts to fill in the gap in the literature by applying a new approach of public debt (Panel data regression) and by addressing the question of how public borrowing may have had a negative impact on economic growth. Specifically, it examines the public debt-growth nexus in the past 21 years (1995-2015) of six selected ASEAN countries, whose data on public debt and macroeconomic indicators are available, namely Indonesia, Malaysia, Philippines, Thailand, Singapore, and Vietnam. In addition, this paper determines the maximum affordable public debt level beyond which additional indebtedness may reduce the economic growth. The basic hypothesis is that there is a negative impact of public debt on economic growth at a higher level of debt. To confirm this hypothesis, this paper includes the debt squared variable and other control variables that can affect the public debt-growth relationship, such as gross fixed capital formation, fiscal balance, as well as real effective exchange rate.

Despite the difference in stages of development and economic structure among

2. GIIPS refer to the economies of Portugal, Ireland, Italy, Greece, and Spain.

the six ASEAN countries, this paper chose the sample of these countries due to the following reasons. First, until now there are few studies on impacts of public debt on economic growth in literature emphasized on countries in the ASEAN region. One example is Muhammad (2017). Other authors focused on individual countries such as Muhammad (2008), Pham (2011), Lee & Ng (2015). In addition, some studies that focused on ASEAN countries were out of date and thus may not be applicable to the current situation of the six ASEAN countries. Second, this paper is the first of its kind to study the GDP growth and public debt in Vietnam. Third, by using different approaches, such as methodology and database compared to previous studies, this paper is expected to contribute to the understanding of the debt burden in ASEAN countries. Future studies are recommended to examine the comparative effects of public debt on economic growth among ASEAN countries based on the particularities of each country in this region.

Three research questions arise from the purpose of this study:

(1) How does public debt affect economic growth in ASEAN countries?

(2) Does a non-linear relationship between public debt and economic growth exist?

(3) What other factors impact economic growth, apart from public debt?

The remainder of the paper is structured as follows: Section 2 presents the past studies related to the impact of public debt on economic growth. Section 3 specifies the empirical model and describes the data and methods of analysis. Section 4 shows the results and discusses the outcomes of this paper. Finally, the concluding remarks of this study are presented in section 5.

2. Literature review

The relationship between public debt and economic growth has been widely considered after the debt crisis that hit many developing countries in Latin America since the early 1980s. In the 1990s, several studies focused on the impact of public debt on economic growth in developed countries (Woodford, 1990; Greene & Villanueva, 1991; Savvides, 1992). Recently, the consequences of the sovereign debt crisis in Europe once again caused concern for policymakers and researchers and most for studies concentrating on developed economies, for instance, Ferreire, 2009; Kumar & Woo, 2010; Checherita & Rother, 2010; Reinhart & Rogoff, 2010; Cecchetti et al., 2011; Baun et al., 2013. In brief, although this issue has been mentioned largely in the existing literature, the results are different, depending on the groups of countries, the time framework and the methodology of the analysis.

Main findings can be divided into 3 groups: negative, positive, and non-linear (inverted U-shaped curve) effects.

2.1. Studies on negative effect of public debt on economic growth

Regarding the negative effect of public debt on economic growth, Krugman (1988) identified the "debt overhang" problem when the expected present value of potential future resource transfers is less than its debt. As the stock of public sector debt increases, the government's debt service obligation will be financed by distorted measures (the inflation tax, for example), as in Agénor & Montiel (1996). Subsequently, Kumar & Woo (2010) provided empirical evidence of an inverse relationship between initial debt on growth for a panel of 38 advanced and emerging countries over the period 1970-2007. Panizza & Presbitero (2012) examined the relationship between public debt and economic growth using the instrumental variable technique in OECD Countries. The results showed a negative correlation between public debt and economic growth. Fincke & Greiner (2013) examined the impact of public debt on economic growth in seven developed countries for the period 1970-2012, using pooled regression and random effects model. They found that there is a significant negative relationship between public debt and economic growth.

Other authors focused on the impacts of public debt on economic growth via the effect of crowding out private investment or altering the composition of public spending. Elmendorf & Mankiw (1999) argued that higher sovereign debt yields may lead to an increase in private interest rates and a decrease in private spending growth, both by households and firms. This also may induce an increased net flow of funds out of the private sector into the public sector. A significant number of recent studies, such as Ardagna et al. (2007), Barrios et al. (2009), Laubach (2009) suggest that high debt and deficits may contribute to rising sovereign long-term interest rates and yield spreads. For example, Ardagna et al. (2007) used a panel of 16 OECD countries over the period 1960-2002 to investigate the effects of government debts and deficits on long-term interest rates. The results indicated that a one percentage point increase in the primary deficit-to-GDP ratio increases contemporaneous long-term interest rates by about 10 basis points. Barrios et al. (2009) provided an empirical analysis of the determinants of sovereign bond yield differentials in the euro area[3] during the period 2003-2009 (weekly and quarterly data). The results showed that countries with high debt and large current account

3. Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, and Spain.

deficits are expected to experience the highest bond yield increases as consequences of deteriorated public finances.

2.2. Studies on positive effect of public debt on economic growth

With regards to the positive effects, one of the earliest studies on this topic is Domar's model (1944). He showed that a continuing budget deficit does not necessarily lead to a default of the government when the economy grows. The budget deficit in this context is a conventional one (the gap between government expenditure including interest payment and tax revenue), not a primary deficit. If the growth rate of the economy is positive, irrelevant of the relative magnitude between interest rate and economic growth rate, Domar's proposition always holds.

In the 1980s and 1990s, various theoretical models indicated that a reasonable level of current debt inflows is expected to have a positive effect on growth. For example, Woodford (1990) stated that a higher public debt, in so far as it implies a higher proportion of liquid assets in private sector wealth, increases the flexibility of the private sector in response to variations in both income and spending opportunities, and so can increase economic efficiency. Cohen (1993) proved that low levels of debt are still associated with higher growth than in financial autarky. Recently, Fincke & Greiner (2014) found a significant positive correlation between public debt and the subsequent growth rate of per capita GDP in eight selected emerging market economies[4] during the period 1980-2012, by using Panel Fixed and Random effect estimations.

2.3. Studies on non-linear effect of public debt on economic growth

Recent empirical studies suggested that a non-linear relationship between public debt and economic growth should be described by an inverted U-shaped curve with a certain turning point beyond which an increase in public debt has a significantly negative impact on growth (Reinhart & Rogoff, 2010; Checherita & Rother, 2010; Cecchetti et al., 2011; Baum et al., 2013; Fincke & Greiner, 2014). Particularly, Reinhart & Rogoff (2010) provided the evidence of a threshold level of government debt in 20 developed countries for the period 1946-2009 and 24 emerging market economies for the periods 1946-2009 and 1900-2009. The main finding of the study is that across both advanced countries and emerging markets, high debt/GDP levels (90 percent and above) lead to lower growth outcomes.

Focusing only on advanced economies in Europe, Checherita & Rother (2010)

4. Brazil, India, Indonesia, Malaysia, Mexico, South Africa, Thailand and Turkey.

selected the period of 1970-2009 and found that government debt is a hurdle to economic growth and that it has a negative and non-linear relation in 12 Euro countries[5]. Empirical results found a non-linear impact of debt on growth with a turning point—beyond which the government debt-to-GDP ratio has a deleterious impact on long-term growth—at about 90-100% of GDP. Confidence intervals for the debt turning point suggested that the negative growth effect of high debt may start already from levels of around 70-80% of GDP, which calls for even more prudent indebtedness policies. Subsequent studies attempted to provide robustness checks for their claim. For example, Cecchetti et al. (2011) found that there is a threshold effect of public debt at around 85 percent of GDP for 18 OECD countries from 1980 to 2010, whereas Baum et al. (2013) obtained a similar result, namely a threshold level of around 95 percent for the 12 Euro countries over the period of 1990-2010.

2.4. Studies on impacts of public debt on economic growth in ASEAN countries

Many developing countries in Asia in general and ASEAN countries in particular have different situation from countries in Africa and Latin America with regards to some aspects. First, Asian countries' productive investment has been the major characteristic of investment from the imported capital. Second, emerging economies in Asia have achieved a high growth rate by maintaining an "environment conducive to high rate of savings and investment", as well as by keeping their economies open to foreign technology and capital (Kim, 2015). Therefore, more and more studies on the public debt issue in Southeast Asia have been conducted recently.

Muhammad (2008) analyzed long-term and short-term relationships between public debt service and GDP in Indonesia by applying the co-integration analysis of time series model during the period 1980-2005. The debt overhang problem has been found in the long-run period since increasing the public external debt service slows down economic growth, whereas it has not been found during the short-run period. Similarly, Lee & Ng (2015) investigated whether public debt contributed to the economic growth in Malaysia over the period 1991-2013. The results indicated that public debt has a negative impact on GDP. In addition, it is found that budget deficit, government consumption, and external debt service are decreasing function of GDP.

Pham (2011) analyzed risks and challenges of Vietnam's public debt using a

5. Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal and Spain.

combination of statistical description and numerical simulation. The research indicated that the public debt sustainability and liquidity are still below the conventional safety thresholds, whereas the macroeconomic conditions are quickly deteriorating because of the recent considerble increase in public debt. Muhammad (2017) examined the relationship between public debt and economic growth in eight countries in Southeast Asia that are members of ASEAN, using 10 years of data from 2006 to 2015 and the analysis tool Vector Auto regression (VAR). The main finding of this study is that public debt shows a positive and significant effect in increasing the GDP.

To sum up, most recent studies on the correlation between public debt and economic growth in ASEAN countries have concentrated on a single country with a limited database or a group of countries in a short time period. In addition, these studies merely examined the relationship between public debt and GDP growth, which can explain only positive or negative effects.

Hence, this paper is different from past studies in terms of sample of countries and methodology. Particularly, this is the first study which conducts an empirical analysis on this issue in six selected ASEAN economies, using a different method (Panel data regression) during the most recent years (1995-2015) to determine the public debt-growth nexus. Public debt may not be negative for economic growth in certain stages of development, which is exemplified in this paper by means of the ASEAN cases. Further details of analysis will be discussed in the next section.

3. Methodology

3.1. Model specification

The non-linear effect of public debt on economic growth is discussed in several studies with regards to advanced economies in Europe while this approach has not been used in the cases of developing countries in Southeast Asia. This paper attempts to apply the research approaches of Checherita & Rother (2010) and Baum et al. (2013) to investigate the impact of public debt on economic growth in some selected ASEAN countries and to determine the public debt threshold level beyond which the relationship is expected to negative. Particularly, following Checherita & Rother (2010) and Baum et al. (2013), this paper investigates the impact of public debt on economic growth of six ASEAN countries, namely Indonesia, Malaysia, Philippines, Thailand, Singapore, and Vietnam, over the past 21 years from 1995 to 2015, by applying the Panel data regression. This analysis consists of two steps.

The first one is to investigate the relationship between public debt and economic growth. In the second step, the existence of a non-linear effect of public debt on growth is analyzed, by including the squared value of public debt variable in the model.

The starting point for the threshold analysis is the specification of a linear model, which is a balanced panel of the form:

$$GDP\_gr_{it} = \alpha_i + \beta_1 Ini\_GDP_{it} + \beta_2 Debt_{it} + \beta_3 Crisis_{97} + \beta_4 Crisis_{08} + X_{it}\beta' + \mu_i + \varepsilon_{it} \quad (1)$$

Where:

i: country; t: year

GDP_gr: the growth rate of real GDP per capita, in percent (dependent variable)

Ini_GDP: real GDP per capita in the starting year, referred to the year 1995

Debt: the public debt-to-GDP ratio, in percent

X: the vector of control variables that affect economic growth (including gross fixed capital formation, population growth rate, fiscal balance, FDI, and real effective exchange rate)

$Crisis_{97}$: dummy variable that captures the existence of Asian Crisis (it takes the value 1 if the years are 1997 and 1998, and 0 otherwise)

$Crisis_{08}$: dummy variable that captures the existence of Global Financial Crisis (it takes the value 1 if the years are 2008 and 2009, and 0 otherwise)

α: the constant term

β: the coefficients of independent variables

μ: country fixed effect

ε: the error term

Since the hypothesis is that public debt has a non-linear effect on economic growth, the model specification is in a quadric form, by including the debt squared variable ($Debtsq_{it}$) in the model as follows.

$$GDP\_gr_{it} = \alpha_i + \beta_1 Ini\_GDP_{it} + \beta_2 Debtsq_{it} + \beta_3 Crisis_{97} + \beta_4 Crisis_{08} + X_{it}\beta' + \mu_i + \varepsilon_{it} \quad (2)$$

3.2. Data

The dependent variable in this paper is real GDP per capita growth. Annual percentage growth rate of GDP per capita is based on constant local currency. Aggregates are based on constant 2010 U.S. dollars. GDP per capita is gross domestic product divided by midyear population. The advantage of using this variable is that it shows the relative performance of the countries when making cross-country comparisons. In addition, the GDP per capita reflects the value resulting from dividing the total GDP by the country's population and therefore, it captures the varying sizes of countries.

The first explanatory variable is real GDP per capita in the starting year, referred to the year 1995, denoted by Ini_GDP_{it} in the model. The unit of this variable is in US$ constant price 2010, thus it is adjusted for inflation. By including this variable in the statistical model, the size of the economy is controlled. This variable is used to capture the catching-up progress (Kumar & Woo, 2010). The hypothesis of the catching-up effect or convergence is that poor countries with lower per capita income will tend to grow at faster rates than richer economies. Thus, the expected sign of its coefficient is negative.

The second explanatory variable is public debt-to-GDP ratio which is denoted by $Debt_{it}$. In detail, this paper uses the General Government Gross Debt as percentage of GDP, which is provided by the Historical Public Debt Database (HPDD) of the International Monetary Fund (IMF). According to the IMF, the HPDD aims to cover public debt at the general government level[6]. However, due to the lack of public debt data at the general government level for many countries, particularly in the earlier periods, debt data for the central government were used instead. Since the hypothesis is that public debt may have negative effect on economic growth if it exceeds the threshold level, the expected sign of the *Debt*'s coefficient is positive while that of *Debtsq* is negative.

A set of control variables, which is used in this model to account for the impacts of other determinants of economic growth, are gross fixed capital formation, population growth rate, fiscal balance, FDI, and real effective exchange rate. These control variables selection is based on the results of former empirical studies (Clements et al., 2003; Kumar & Woo, 2010; Checherita & Rother, 2010).

Gross fixed capital formation (formerly gross domestic fixed investment) reflects the impact of physical capital accumulation. Since domestic investment is one of the most important factors, besides foreign investment, contributing to the development of the economy, the coefficient of this variable is expected to have a positive sign.

Population growth is a proxy for the rates of the growth of the factor input (labor) in the production process. Although the growth rate of the population in ASEAN countries has been very fast for the past two decades, the quality of human resources in the region is still low compared to other countries in Asia. In addition, according to the ASEAN+6 population forecast, the population growth rate is

6. The general government sector consists of all government units and all nonmarket nonprofit institutions that are controlled and mainly financed by government units, comprising the central, state, and local governments. The general government sector does not include public corporations or quasi-corporations.

expected to slow down in most countries in the next two decades, the portion of the young population will decrease over time while improved healthcare services and medical technologies extend the Southeast Asian life expectancy. Consequently, the proportion of the aging population (over 65 years) will grow. Therefore, the expected sign of its coefficient is negative.

The fiscal balance is used to assess the impact of fiscal budgetary policies. The selected countries in ASEAN, except for Singapore, had fiscal deficits in the recent 10 years. This was due to the priority of government spending on socio-economic investment projects to enhance economic growth in the long-term. Hence, the coefficient of this variable is expected to be positive.

Moreover, ASEAN countries have received remarkable foreign capital inflows since 1990 to implement the socio-economic development targets of governments. FDI is considered as one of the key factors which directly affect the development of the economy. Particularly, FDI tends to boost economic growth via the spillover effect on total factor productivity and technology transfer. Thus, the coefficient of FDI is expected to have a positive sign.

Real effective exchange rate (REER) is used to identify the effect of external competitiveness. Since the depreciation of local currency is used to enhance economic growth via export promotion in most ASEAN countries, the expected sign of REER's coefficient is positive.

In addition, the dummy variables ($Crisis_{97}$ and $Crisis_{08}$) are used to capture the effect of two financial crises on the economic growth. The coefficient of these variables is expected to have a negative sign.

The lists of variables and data sources are summarized in Table 1.

Table 1. Summary of variables and data sources

Variables	Definition	Measurement	Period	Expected signs	Sources
GDP_gr	Economic growth	Real GDP per capita growth (annual %)	1995-2015		World Bank Development Indicators (WDIs)
Ini_GDP	GDP per capita in starting year	Real GDP per capita in the starting year refers to the year 1995 (based on constant 2010 price $US)		-	WDIs
Debt	Public debt	General government gross debt (% of GDP)	1995-2015	+/-	IMF (Historical Public Debt Database)
Fiscal	Budget balance	Overall budgetary surplus/ deficit (% of GDP)	1995-2015	+	Asian Development Bank (ADB)
Cap	Capital formation	Gross fixed capital formation (% of GDP)	1995-2015	+	WDIs
POP	Population growth	Population growth (annual %)	1995-2015	-	WDIs
FDI	Foreign direct investment	Foreign direct investment inflows (as % of GDP)	1995-2015	+	WDIs
REER	Exchange rate	Real effective exchange rate index (2010=100)	1995-2015	+	WDIs & Bank for International Settlement (BIS)
$Crisis_{97}$	Asian Financial Crisis	It takes the value 1 if the years are 1997 and 1998, and 0 otherwise		-	
$Crisis_{08}$	Global Financial Crisis	It takes the value 1 if the years are 2008 and 2009, and 0 otherwise		-	

3.3. Method of analysis

This paper analyses the impact of public debt on economic growth based on the Panel data regression of the selected ASEAN countries. However, when estimating equation (1) & (2), we need to take into consideration three possible issues of bias. The first problem is the omitted variable bias, which arises because of unobserved country heterogeneity. This can be effectively addressed by adopting the fixed effects (FE) or first-differencing methods (Wooldridge, 2015). FE estimation can yield consistent estimates, given country heterogeneities. If we assume that the individual specific effect which is correlated with the independent variables, FE method would remove the effect of those time-invariant characteristics. An important

assumption of the FE model is that those time-invariant characteristics are unique to the individual and should not be correlated with other individual characteristics. Each country is different; therefore, the country's error term and the constant (which captures individual characteristics) should not be correlated with the others. In a fixed effects model, the intercept varies across countries.

The second problem is a possible reverse causality between public debt and economic growth. In fact, the growth of GDP affects the size of public debt and in contrast, the accumulated public debt may have a positive or negative impact on the GDP growth (Checherita et al., 2010, Irina et al., 2015; Alejandro Jacobo et al., 2017). The reverse causality or simultaneity is one of the main sources of the endogeneity issue (Antonakis et al., 2014). There are some ways to solve the strong potential for endogeneity issue and one of them is the Instrument Variable (IV) estimation method (Wooldridge, 2015). The benefit of this technique is that it can determine the causes of growth if the instruments specified do not directly affect growth but only through the endogenous variables. However, it is difficult to find a good external instrument in IV estimation. Meanwhile, the IV estimation is not an effective strategy due to the third bias issue engendered by the persistency or the dynamic of the dependent variable.

Another satisfactory response to tackle the above problem is the Generalized Method of Moments (GMM) estimators – the difference and the system (Arellano & Bond, 1991; Arellano & Bover, 1995; Blundell & Bond, 1998). The fundamental estimation of the dynamic GMM panel consists of two main steps. The first one is first differencing which can be expressed as follows:

$$\Delta GDP\_gr_{it} = \beta_1 \Delta Ini\_GDP_{it} + \beta_2 \Delta Debt_{it} + \beta' \Delta X_{it} + \Delta \varepsilon_{it} \quad (3)$$

$$\Delta GDP\_gr_{it} = \beta_1 \Delta Ini\_GDP_{it} + \beta_2 \Delta Debtsq_{it} + \beta' \Delta X_{it} + \Delta \varepsilon_{it} \quad (4)$$

where Δ is the first difference sign.

In the Arellano-Bond method, first difference of the regression equation is taken to eliminate the presence of time-invariant unobserved heterogeneity. After this transformation, equations (1) and (2) are estimated by the GMM employing the lagged values of the explanatory variables as instruments for the current explanatory variables. The instruments are collected from the set of lagged dependent variables.

Nevertheless, the difference estimation method suffers from weak instrument bias, given the high time persistency of the dependent variable and the short time period (Arellano & Bover, 1995, Blundell & Bond, 1998). In such cases, the lagged levels of variables are weakly correlated with the corresponding first difference, leading to weak instruments. Hence, the system GMM estimation method, which is

developed by Arellano & Bover (1995), Blundell and Bond (1998), has been widely applied in numerous studies to alleviate potential biases and inaccuracies associated with the difference GMM estimator. Particularly, the equations in first differences employ lagged levels as appropriate instruments while the equations in levels use lagged first differences as instruments.

$$\begin{bmatrix} GDP\_gr_{it} \\ \Delta GDP\_gr_{it} \end{bmatrix} = \beta_1 \begin{bmatrix} Ini\_GDP_{it} \\ \Delta Ini\_GDP_{it} \end{bmatrix} + \beta_2 \begin{bmatrix} Debt_{it} \\ \Delta Debt_{it} \end{bmatrix} + \beta' \begin{bmatrix} X_{it} \\ \Delta X_{it} \end{bmatrix} + \Delta\varepsilon_{it} \quad (5)$$

$$\begin{bmatrix} GDP\_gr_{it} \\ \Delta GDP\_gr_{it} \end{bmatrix} = \beta_1 \begin{bmatrix} Ini\_GDP_{it} \\ \Delta Ini\_GDP_{it} \end{bmatrix} + \beta_2 \begin{bmatrix} Debtsq_{it} \\ \Delta Debtsq_{it} \end{bmatrix} + \beta' \begin{bmatrix} X_{it} \\ \Delta X_{it} \end{bmatrix} + \Delta\varepsilon_{it} \quad (6)$$

Therefore, with the GMM estimator, we also correct for the heteroskedasticity and autocorrelation that may be present in the error structure by using the inclusion of lagged internal instruments. This paper adopts the use of the debt and debt square variables for each country through either of its time lags. While using lagged terms of regressors as instruments is a relatively common practice with macroeconomic data, for the debt-to-GDP ratio, however, this may be problematic given the high persistency of the debt stock variable (Checherita et al., 2010). The endogeneity problem is also mitigated in this regression by using the lagged 1 to 2 years of independent variables. Furthermore, the two-step GMM presents some efficiency gains over the traditional IV/2-SLS estimator derived from the use of the optimal weighting matrix, the over identifying restrictions of the model, and the relaxation of the independent and identical distribution assumption (Baum et al., 2007).

Finally, the validity of the instruments and the reliability of this estimates will be verified with second-order serial correlation or AR(2) test, suggested by Arellano and Bond (1991). This test is used to verify the hypothesis of no second-order serial correlation to make sure that the original error terms are serially uncorrelated. Rejecting the AR(2) test, which supports no autocorrelation in the second-differenced errors, validates the moment conditions.

4. Results and Discussion

The Panel data regression results for the impact of public debt on economic growth of the six ASEAN countries, including Vietnam for the period 1995-2015 are presented in Table 2-1 and Table 2-2. Since FDI and fiscal balance are highly correlated with public debt and *Ini_GDP* (Appendix 1-Table 2), these variables are in the separate run in Model 1 and Model 2 to avoid multicollinearity problem.

Table 2-1. Real GDP per capita growth regression results (Model 1)

Explanatory variables	Real GDP per capita growth (%), 1995-2015											
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Ini_GDP	-0.710*** (0.264) [-2.693]	-0.668** (0.289) [-2.306]	-0.558 (0.403) [-1.383]	-0.876** (0.735) [-2.392]	—	—	-2.286** (1.019) [-2.243]	-0.216 (0.538) [-0.403]	-0.981** (0.423) [-2.318]	-0.660** (0.266) [-2.476]	—	—
Debt	0.036** (0.016) [2.286]	—	—	—	—	—	0.086** (0.035) [2.434]	0.041* (0.024) [1.719]	0.035* (0.018) [1.868]	0.032** (0.015) [2.118]	—	—
GFCF	—	0.455* (0.232) [1.964]	—	—	—	—	0.474* (0.261) [1.817]	—	—	0.07* (0.06) [1.759]	—	—
POP	—	—	0.643 (1.245) [0.516]	—	—	—	—	-1.494 (1.515) [-0.986]	—	-0.716* (0.424) [-1.691]	-1.378*** (0.525) [-2.626]	-1.187** (0.488) [-2.431]
REER	—	—	—	0.212* (0.116) [1.828]	—	—	—	—	0.064*** (0.022) [2.968]	0.046* (0.024) [1.953]	0.050** (0.020) [2.404]	0.046** (0.022) [2.165]
Fiscal	—	—	—	—	0.098* (0.086) [2.412]	—	—	—	—	—	0.287** (0.132) [2.164]	—
FDI	—	—	—	—	—	0.048* (0.058) [2.837]	—	—	—	—	—	0.169** (0.079) [2.144]
Crisis_97	-5.679*** (0.921) [-6.161]	-7.901*** (1.501) [-5.264]	-6.103*** (1.269) [-4.808]	-8.841*** (1.511) [-5.582]	-5.817*** (0.939) [-6.192]	-5.655*** (0.933) [-6.061]	-8.021*** (1.686) [-4.756]	-4.612*** (1.383) [-3.336]	-5.282*** (0.918) [-5.758]	-9.544*** (1.119) [-8.527]	-4.974*** (0.955) [-5.207]	-4.612*** (0.966) [-4.771]
Crisis_08	-3.232*** (0.921) [-3.507]	-3.659*** (1.009) [-3.625]	-3.463*** (1.045) [-3.314]	-3.507*** (0.956) [-3.365]	-3.338*** (0.933) [-3.576]	-3.321*** (0.936) [-3.546]	-3.348*** (1.045) [-3.204]	-2.745** (1.060) [-2.589]	-3.233*** (0.910) [-3.551]	-3.087*** (0.783) [-3.941]	-2.888*** (0.922) [-3.131]	-2.845*** (0.935) [-3.045]
C	8.144** (1.962) [4.151]	-1.659 (5.078) [-0.327]	7.827** (2.306) [3.394]	-8.651 (8.986) [-0.963]	4.222*** (0.317) [13.304]	3.876 (0.449) [8.615]	6.794** (3.364) [2.019]	5.802* (3.306) [1.755]	4.329 (3.170) [1.366]	2.679 (2.674) [1.002]	1.592 (2.173) [0.733]	0.486 (2.010) [0.242]
No. of observations	120	114	114	108	120	120	114	114	114	108	120	120
R2	0.32	0.23	0.25	0.31	0.29	0.295	0.26	0.30	0.36	0.56	0.35	0.34
Adjusted R2	0.29	0.21	0.22	0.28	0.27	0.28	0.22	0.27	0.33	0.53	0.32	0.31
AR(2) p-value	0.67	0.82	0.36	0.79	0.24	0.52	0.68	0.53	0.21	0.57	0.62	0.98

Note: Figures in ( ) and [ ] are standard errors and t-statistic value, respectively.
, **, and * denotes significance at 10%, 5%, and 1%, respectively.*
Countries included: Indonesia, Malaysia, Philippines, Thailand, Singapore and Vietnam.
Lists of instrumented variables: (1)[Debtsq(-1)]; (2) [FDI(-1), POP(-1)]; (3) [FDI(-1), GFCF(-1)]; (4) [FDI(-1), GFCF(-1), POP(-1)]; (5) [Debt(-1), FDI(-1), GFCF(-1)]; (6) [Debt(-1), Fiscal(-1), GFCF(-1)]; (7) [Debtsq(-1), Fiscal(-2), FDI(-1), POP(-1), REER(-1)]; (8) [Debtsq(-1), Fiscal(-2), FDI(-1), GFCF(-1), REER(-1)]; (9) [Debtsq(-1), Fiscal(-2), FDI(-1), GFCF(-1), POP(-1), REER(-1)]; (10) [Debtsq(-1), Fiscal(-2), FDI(-1), GFCF(-1), POP(-1), REER(-1)]; (11) [Debt(-1), POP(-1), REER(-1)]; (12) [Debt(-1), POP(-1) REER(-1)].

In the first step of this empirical analysis, 12 different regressions have been estimated. Table 2-1 shows the impact of public debt and other control variables on economic growth in model 1. Particularly, column (1) through column (6) indicate separate effects of each explanatory variable on real GDP while column (7) through column (12) reveal several combinations of impacts of debt and other variables on real GDP. Since the list of variables for input of regression is defendable and there is not much multicollinearity, the model would be fine even with a low R-squared.

The results shown in column (1) and (7)-(10) indicate that public debt has a significant impact on the growth rate of real GDP per capita. The coefficient is significant at the 5 percent and 10 percent levels of confidence. An appropriate explanation for the positive impact of public debt on economic growth in ASEAN countries is that the accumulated debt is not oversized and government borrowing to finance increased public spending have a beneficial impact on the nation's productivity. Particularly, while debt-financed public investment raises a country's debt ratios in the short-run, it can also enhance productivity through the construction of infrastructure, thus leading to higher economic growth. The finding is in line with Fincke & Greiner (2014) and Muhammad (2017). In fact, the public debt to GDP ratio in Vietnam and other countries in ASEAN is still under the safety threshold level. However, once the public debt exceeds the maximum level, it may have adverse effect on economic growth. Therefore, public debt accumulation should be kept low to avoid interest rates variability that may lead to a fall in real output (Ebi & Imoke, 2017).

Moreover, depending on the particularities of each country as well as the periods or stages of development and economic structure, the threshold level of public debt in each country is different. For example, except for Singapore, the five selected ASEAN countries have set up the public debt ceiling at 55 to 65 percent of their GDP at present. However, in some countries like Malaysia or Philippines, the debt ceiling level is in fact not mandatory. Malaysia's debt limit was set at 40 percent in April 2003, revised to 45 percent in June 2008 and subsequently 55 percent in July 2009.

As in the case of public debt, fiscal balance shows the positive and significant impact on real GDP per capita growth at the 10 percent and 5 percent significance level in column (5) and (11), respectively. This may be explained by the fact that although ASEAN countries, except for Singapore, have kept fiscal deficit in the past decades, the public expenditure is utilized for investment development purposes which can enhance economic growth in the long-term.

FDI shows the significant and positive correlation with economic growth at the significance of 10 percent and 5 percent levels in column (6) and (12), respectively. This finding is in line with findings in previous studies such as Borensztein, Gregorio and Lee, 1995, Yerrabati & Hawkes, 2014. In fact, the ASEAN countries received massive FDI inflows since the early 1990s, and FDI has become an important vehicle for the transfer of technology, contributing relatively well to employment and the export of manufactured goods as well as to economic growth, more generally.

As indicated in columns (2), (7), and (10) gross fixed capital has a positive and significant correlation with GDP at the 10 percent significance level. This reflects the fact that apart from FDI, domestic investment is another factor which promoted economic growth in the ASEAN region over the period 1995-2015. This finding is consistent with several previous empirical studies such as Almasaied et al., 2008 and Ridzuan et al., 2018.

Furthermore, as shown in columns (4) and (9)-(12), the results reveal that real effective exchange rate (REER) positively and significantly affects GDP growth. This can be explained by the fact that an undervaluation of the exchange rate boosts export supply and export diversification, and thereby on economic growth in ASEAN countries. This empirical result is also similar to the earlier empirical findings by Dubas et al., 2005 and AbuDalu et al., 2014.

On the other hand, as indicated in columns (10)-(12), population growth has a negative and significant correlation with economic growth. This could be explained by the fact that an increase in the population growth rate can decline the capital per worker as well as the steady-state output per worker. In addition, given current patterns of old-age consumption, production, and transfers, the total demand for pension assets will increase substantially over the coming decades (Mason & Lee, 2011). As a result, higher population growth can become detrimental to productivity and economic growth.

As shown in columns (1)-(4) and (7)-(10), the initial level of real GDP per capita is significantly and negatively correlated with its growth rate. The results of the initial GDP variable are in line with findings from Barro & Sala, 1991 and Mankiw et al., 1992 for the convergence of income levels among countries which indicated that rich countries grow slower than the poor countries.

Finally, the Asian Financial Crisis and Global Financial Crisis have had a significant and negative impact on economic growth in ASEAN countries during the period 1995-2015. Furthermore, the Asian Financial Crisis in 1997 had a greater impact than the Global Financial Crisis in 2008. This might be explained

by the fact that the capital inflows into ASEAN before the Asian Crisis were higher than that after the crisis as governments of these countries have well-management their financial systems and prudential capital controls have been introduced to ASEAN countries in order to maintain macroeconomic stability since the 2000s.

As this paper follows a number of previous empirical analyses which suggested the possibility of an "inverted U-shaped curve" effect, implying a negative impact of public debt on economic growth at a higher level of debt, the second step of this analysis is to investigate the presence of this non-linear effect by including the squared values of public debt (*Debtsq*) in model 2.

Table 2-2. Real GDP per capita growth regression results (Model 2)

Explanatory variables	Real GDP per capita growth (%), 1995-2015							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ini_GDP	-0.801*** (0.278) [-2.877]	-1.380*** (0.415) [-3.324]	-0.516 (0.399) [-1.291]	-0.918*** (0.318) [-2.887]	-0.796*** (0.286) [-2.784]	-0.847*** (0.281) [-3.015]	—	—
Debtsq	0.00034** (0.00013) [2.525]	0.00052*** (0.00019) [2.772]	0.00047** (0.00019) [2.379]	0.0003* (0.00014) [1.901]	0.0004*** (0.00013) [3.044]	0.0004*** (0.00013) [2.886]	—	—
GFCF	—	0.529** (0.253) [2.083]	—	—	0.131** (0.059) [2.237]	0.085* (0.064) [1.614]	—	—
POP	—	—	-1.868 (1.640) [-1.139]	—	-0.651 (0.476) [-1.565]	-0.866* (0.485) [-1.789]	-1.297** (0.515) [-2.520]	-1.126** (0.479) [-2.356]
REER	—	—		0.082* (0.101) [1.809]	—	0.071* (0.044) [1.596]	0.052** (0.021) [2.524]	0.049** (0.021) [2.347]
Fiscal	—	—	—	—	—	—	0.242* (0.125) [1.930]	—
FDI	—	—	—	—	—	—	—	0.138* (0.072) [1.956]
Crisis_97	-5.679*** (0.921) [-6.126]	-8.212*** (1.595) [-5.148]	-4.443*** (1.453) [-3.509]	-5.181*** (1.109) [-4.669]	-5.880*** (0.970) [-6.062]	-5.083*** (1.070) [-4.478]	-4.942*** (0.946) [-5.221]	-4.643*** (0.956) [-4.857]
Crisis_08	-3.232*** (0.921) [-3.181]	-3.481*** (1.035) [-3.361]	-2.528*** (1.118) [-2.261]	-3.232*** (0.898) [-3.599]	-3.034*** (0.896) [-3.386]	-2.997*** (0.874) [-3.427]	-2.937*** (0.913) [-3.216]	-2.912*** (0.922) [-3.158]
C	8.144** (1.962) [4.542]	0.733 (5.258) [0.139]	9.473** (2.402) [3.942]	3.111 (8.246) [0.377]	7.083*** (2.248) [3.150]	2.292 (3.720) [0.616]	1.258 (2.134) [0.589]	0.295 (1.979) [0.149]
No. of observations	120	114	114	120	120	120	120	120
R2	0.30	0.20	0.25	0.36	0.38	0.42	0.36	0.35
Adjusted R2	0.28	0.16	0.22	0.34	0.35	0.38	0.33	0.32
AR(2) p-value	0.57	0.77	0.31	0.55	0.50	0.79	0.66	0.98

Note: Figures in ( ) and [ ] are standard errors and t-statistic value, respectively.
, **, and * denotes significance at 10%, 5%, and 1%, respectively.*
Countries included: Indonesia, Malaysia, Philippines, Thailand, Singapore and Vietnam.
Lists of instrumented variables: (1) [Debt(-1)]; (2) [Debt(-2), POP(-1), REER(-1)]; (3) [Debt(-1), Fiscal(-2), FDI(-1), GFCF(-1)]; (4) [Debt(-1), GFCF(-1), FDI(-1), POP(-1)]; (5) [Debt(-1), POP(-1), FDI(-1), GFCF(-1), REER(-1)]; (6) [Debt(-1), POP(-1), FDI(-1), REER(-1)]; (7) [Debtsq(-1), POP(-1), REER(-1)]; (8) [Debtsq(-1), POP(-1), REER(-1)].

The results of Table 2-2 show that the other control variables such as FDI,

fiscal balance, gross fixed capital formation, population growth, and real effective exchange rate still retain the same effect on the growth rate of real GDP per capita as in model 1.

The squared value of public debt has a positive impact on the real GDP per capita growth rate. Specifically, the coefficient of *Debtsq* is significant at the range of 1 percent to 5 percent levels of significance in all equations in model 2. This result is consistent with the effect of the public debt variable in model 1. A possible explanation for a positive impact of higher public debt on growth would be that accumulated past budget deficits were used to finance productivity public investment (Checherita & Rother, 2010). In fact, public debt is necessary for these countries at the earlier stage of development due to the high requirement for infrastructure investment or socio-economic programs to improve economic growth in the long-term.

Furthermore, this result implies that there is no existence of an adverse effect of high indebtedness on economic growth. This could be explained by the fact that the number of countries of this study is comprised of only six ASEAN countries, which is relatively small compared to other previous studies with a larger sample of emerging countries, as in Reinhart & Rogoff, 2010, Cecchetti et al., 2011. In addition, most of the external borrowings and public debt in ASEAN have been used for real purposes, like infrastructure development and manufacturing investment, which is different from the cases of Latin America.

Moreover, it should be noted that depending on the particularities of each country and the periods of development, negative effects on growth may occur at even lower public debt ratios, while the contrary can also not be excluded (Bilan & Ihnatov, 2015). Therefore, besides the public debt threshold level, the debt situation also needs to be evaluated based on the practical macroeconomic condition in each country.

Regarding the threshold level of public debt which is proposed in many past papers, these estimation results may suggest that the countries in our sample would not have reached a level below such a tipping point, beyond which the relationship between debt and growth turns negative. However, if the accumulated debt exceeds the safety threshold level, public debt may have a negative effect on economic growth. In detail, a high level of public debt raises concerns about fiscal sustainability in the future and puts high pressure on debt repayment obligation. As a result, governments will increase tax rates or introduce new taxes to finance budget deficits. This may lead to a reduction of capital inflows and a negative impact on savings and private investment, and thereby on economic growth. Hence,

governments should be cautious about public and external debt management in the context of increasing accumulated debt and the deterioration of economic conditions after the Global Financial Crisis.

5. Concluding remarks

This empirical study investigated the impacts of public debt on real GDP per capita growth based on Panel data analysis for six ASEAN countries (Indonesia, Malaysia, Philippines, Thailand, Singapore, and Vietnam) over the past 21 years from 1995 to 2015. A set of control variables such as FDI, fiscal balance, gross fixed capital formation, real effective exchange rate, were included in the regression model. Most studies in the past examined impacts of public debt on economic growth in advanced economies or emerging countries in Latin America. Meanwhile, studies focusing on the effects of public debt on growth in Asia in general and ASEAN in particular are still scarce. This study is different from those of the past in two aspects: (i) it investigated the influence of public debt on economic growth; and (ii) it analyzed whether higher debt level may reduce economic growth in these countries.

Regression analyses based on dynamic Panel GMM estimation, reveal a significantly positive correlation between public debt and real GDP per capita growth over the period 1995-2015. This evidence proves that in the two past decades, ASEAN countries have not faced the problem of high levels of debt. In addition, this analysis shows that there is no existence of a non-linear or "inverted U-shaped curve" effect of public debt on economic growth within the selected ASEAN countries. In fact, although public debt-to-GDP ratio in most ASEAN countries are still under the safety level[7], once this threshold level is exceeded, public debt will undermine economic growth because high debt may not only increase uncertainty about economic perspectives and policies but also raise vulnerability to crises (Kumar & Woo, 2010).

The fiscal deficit is found to be positively associated with the growth rate of real GDP per capita in the selected ASEAN countries. This may be due to the fact that in the case of the ASEAN countries, past budget deficits were utilized to finance long-term socio-economic investments and thereby boost future economic

7. Except Singapore, the level should be an appropriate threshold of public debt for five selected ASEAN countries is roughly between 50% to 70% , based on the actual situation of each countries at present. The finding is in line with findings in studies in literature such as Reinhart & Rogoff (2010), Cecchetti et al. (2011), Baum et al. (2013).

growth. Besides, FDI and gross fixed capital formation are two key factors that play a critical role on the development of ASEAN economies. Similarly, real effective exchange rate also has a significantly positive impact on economic growth. Meanwhile, population growth and the two past crises had a negative impact.

The limitation of this paper is that the collected data only evaluates the correlation between public debt and GDP growth in the past two decades. Therefore, a study would be required in the future to review and assess the debt and growth in ASEAN as well as identify the channels through which public debt is likely to have an impact on the economic growth rate. This may give different results and help reach a new conclusion regarding the debt burden in developing countries. Moreover, when the data is available to process, further studies are recommended to determine a non-linear effect of public debt on economic growth for each ASEAN countries, comparing it with the practical situation to obtain full comprehension on public debt-growth relation in Southeast Asia.

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APPENDIX 1

Table 1. Descriptive Statistics

	GDP	Ini_GDP	GFCF	POP	REER	FDI	Debt	Debtsq	Fiscal
Mean	3.360361	8.344127	26.16137	1.576056	95.35715	5.372619	53.81125	3386.236	-0.48033
Median	4.049367	8.13	25.27286	1.409684	96.12991	3.305	48.00273	2304.269	-1.35298
Maximum	13.21649	10.86	43.58616	5.321517	122.5131	26.52	111.12	12347.65	14.55498
Minimum	-14.3468	6.29	18.24804	-1.47453	9.322361	-2.59	12.2164	149.2404	-7.61937
Std. Dev.	3.562648	1.203204	5.663707	0.833333	13.76578	6.118828	22.23759	2792.318	4.137096
Skewness	-1.90066	0.633497	1.115343	0.940548	-2.107	1.865301	0.690498	1.354378	1.411621
Kurtosis	9.210166	2.554015	3.979055	7.199372	14.43348	5.725402	2.819522	3.9762	4.812635
Jarque-Bera	278.335	9.471939	31.15618	111.1595	779.5312	112.0623	10.18355	43.52423	59.0958
Probability	0.00000	0.008774	0.00000	0.00000	0.00000	0.00000	0.006147	0.00000	0.00000
Sum	423.4055	1051.36	3296.333	198.5831	12015	676.95	6780.217	426665.8	-60.5215
Sum Sq. Dev.	1586.558	180.9625	4009.698	86.80538	23687.09	4680.007	61813.81	9.75E+08	2139.446
Observations	126	126	126	126	126	126	126	126	126

Table 2. Correlation Matrix

	GDP	Ini_GDP	GFCF	POP	FDI	REER	Debt	Debtsq	Fiscal
GDP	1								
Ini_GDP	-0.13271	1							
GFCF	0.141267	0.159166	1						
POP	-0.22358	0.368983	0.093942	1					
FDI	0.155993	0.673917	0.234406	0.224382	1				
REER	0.273321	0.219521	0.223884	0.148812	0.223757	1			
Debt	0.112345	0.402487	-0.09708	0.338338	0.656485	0.132523	1		
Debtsq	0.081045	0.44105	-0.07071	0.33091	0.702615	0.092302	0.978888	1	
Fiscal	0.10339	0.62344	0.402567	0.375701	0.732202	0.198028	0.586463	0.614008	1

APPENDIX 2

Figure 1. GDP per capita (Left axis, $US 2010 price), and growth rate (Right axis, %), 1995-2015

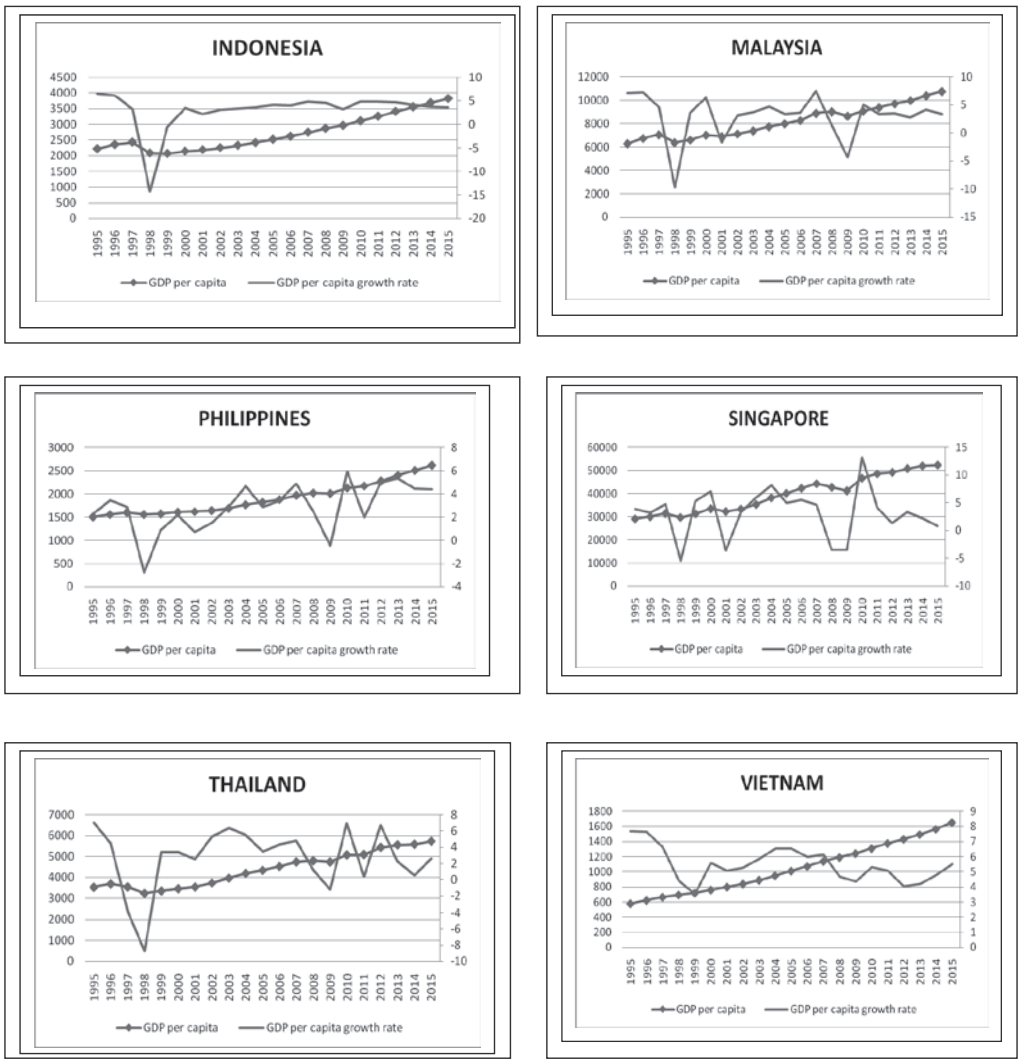

Figure 2. Public debt-to-GDP ratio (Left axis, %), and Fiscal balance (Right axis, as % of GDP), 1995-2015