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Public Debt-Growth Nexus: Threshold Effects on Selected Southeast Asian Countries

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Abstract
The goal of this study is to analyze the impact of the public debt threshold on economic growth in selected Southeast Asian countries (Indonesia, Malaysia, Philippines, Singapore, Thailand and Vietnam) using annual data from 1996 to 2016. Empirical results suggest that there is a negative long-term connotation between public debt and economic growth through the estimator method of Pooled-Mean Group (PMG). Furthermore, Threshold Regression method is adopted to examine the different effects of public debt levels on economic growth as either below or above the threshold level. The results revealed that the public debt threshold level for the six Southeast Asian countries is approximately 68.31%. Public debt has a positive effect on development when debt is below the level of 68.31%. However, public debt will be detrimental to growth if the debt level exceeds the threshold.

Keywords: Public Debt, Economic Growth, PMG Estimator, Threshold Effects

Introduction

Public debt serves as one of the tools to fund development of a country despite mitigating the negative impact of short-term economic shock. A government has to borrow from foreign countries or private sectors as to upkeep the economic growth of the country. Ribeiro et al. (2012) stated that public debt is classified as one of the macroeconomic indicators that shapes the reputation of a country within global market. However, accumulation of debt may have triggered concerns where the additional debt leads to negative growth of a country. Therefore, public debt indicates significant measurements for the deficit coverage in the budget of a country.

Debt can be characterized as a dual-purpose tool as it can either expand or deteriorate the economy of a country. A study by Mencinger et al. (2014) found that a moderate amount of public debt enhances and improves the economic growth of a country. Hence, the optimum level of debt can improve economic growth as it helps in the process of infrastructure development of a country. High rates of debt in a country would therefore have a significant effect on economic growth. Once the debt level is at the country's threshold, the added debt will force a negative growth. Several researchers' empirical evidence indicates a non-linear relationship between debt and economic growth (Cecchetti, Mohanty and Zampolli, 2010; Woo & Kumar, 2015; Reinhart & Rogoff, 2012).

Moreover, the high level of public debt will also cause ‘debt overhang’. The ‘debt overhang’ theory states possibility of future debt of a country greater than the ability of the government can repay the debt. Thus, the anticipated cost of debt-servicing will decelerate the investments. On the other spectrum, ‘crowding out’ effect happens when the public debt level is too high. When the government has a greater share of foreign capital, there will only be a few monetary funds to invest on the development of a country as they will use it to service the debt (Akram,

2016). According to Mencinger et al. (2014), the debate regarding the association between public debt and economic growth is still inconclusive among the economic studies. The rising of concern regarding a high public debt levels could direct to the deteriorating of the economic growth in Southeast Asian countries. This study aims to investigate the threshold effects of public debt on economic growth in countries in Southeast Asia.

Southeast Asian countries have recorded an increase in debt-to-GDP ratio during the Asian financial crisis 1997-1998. Based on data obtained from International Monetary Fund (IMF) 2016, Malaysia's debt-to-GDP ratio increased by 13.59%, Singapore's debt-to-GDP ratio and Thailand' debt-to-GDP ratio rose up by 19.32% and 23.30%, respectively, in 1998. However, Philippines was an exception and the debt-to-GDP ratio has dwindled by 13.56% in 1998. The debt-to-GDP ratio in Philippines started to increase over the period of 1999-2003. After the Asian Financial Crisis, the debt-to-GDP ratio in Southeast Asian countries fell significantly over the period of 2004-2008 due to the continuously effort in managing prudent debt repayment. In the 2008 Global Financial Crisis, the debt-to-GDP ratio of the Southeast Asia countries had increased gradually from 2008 to 2009, which increased by 11.39% on average. Indonesia was the only country where the debt-to-GDP ratio decreased, which went down by 12.46% in 2009. After the Asian Financial Crisis, Indonesia withstood the financial turbulence because they were well-prepared for this shock. For instance, they have strengthened their external balances, reduced government debt, and enhanced their banking supervision. Philippines' debt-to-GDP ratio has decreased gradually since 2010 and was sustainable in 2016. This also can be observed through the high GDP which was indicated as US$304,905 million in 2016. Besides that, the prudent fiscal policies, manageable inflation, and low interest rate also helped to lower the debt-to-GDP ratio in Philippines. The strong fiscal position has enabled the reduction of the debt in harmony with the robust balance of payments position. Last but not least, Singapore has reached an all-time high public debt-to GDP of 105.67% in 2012 and a record low of 68.29% in 1997. The debt-to-GDP ratio in Singapore averaged 92.30% from 1996 until 2016.

This paper contributes in the following ways. This study will examine the relationship between public debt and economic growth in selected South East Asian countries by incorporating the non-linearity approach. It will also assess the threshold impact of public debt on economic development in selected South East Asian countries. As far as concerned, there are no other studies emphasizing on the threshold level of public debt on the Southeast Asian countries. This study makes a significant contribution to the empirical literature, in terms of identification of threshold level of public debt on Southeast Asian countries.

Literature Review

Most of the studies showed that public debt (Ribeiro et al., 2012, Akram, 2013, Panizza and Presbitero, 2014, Swamy, 2015) and external debt (Zouhaier & Fatma, 2014; Kwoba & Kosimbei, 2015) have negative impact on economic growth. Nevertheless, the study of Baum et al. (2013), Akram (2016), and Wibowo (2017) indicated somewhat a discordant note in their research for the relationship between public debt and economic growth.

Fosu (1996) discovered the consequences of external debt on economic growth on a panel of 29 Sub-Saharan Africa (SSA) countries where the burden of debt has been deleterious to the economic growth. The positive relationship was last before the debt level achieved 16% of GDI/GDP threshold. In the other words, the debt is actually beneficial to a country before reaching the debt threshold level. In addition, this is very similar to researchers (Clements et al., 2003; Caner et al., 2010; Cecchetti et al., 2011; Greenidge et al., 2012; Reinhart & Rogoff, 2012; Baum et al., 2013; Afonso & Alves, 2014; Antonokakis, 2014; Bilan & Ihnatov, 2015;

Gomez-Puig & Sosvilla-Rivero, 2015; Serrão, 2016) who highlighted that debt threshold existed in their sample countries.

For instance, Reinhart and Rogoff (2012) studied economic growth and debts for 44 countries from 1790 to 2009. Their outcomes implied weak association between government debt and GDP growth if debt is below threshold 90% of GDP in advanced and emerging economies. The annual growth of the country will be reduced by 2% when external debt reaches 60% of GDP, in the meanwhile, the growth rates will decrease about half of it for higher levels of external debts. Baum et al. (2013) conducted a dynamic threshold panel methodology to examine the non-linear impact of public debt on GDP growth for 12 Euro area countries from 1990 to 2010. Their outcomes revealed that the impact of debt on GDP growth is positive. Unfortunately, it will lose significance beyond public debt-to-GDP ratio of around 67% and has negative impact on economic growth debt is above 95% level. By using a similar country selection which is panel of 12 Euro countries (Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal and Spain), Antonakakis (2014) examined the character of non-sustainable and sustainable debt with debt threshold on economic growth from 1970 to 2013 via Generalized Method of Moments (GMM). The robustness analysis results indicate that non-sustainable debt-ratios more or less than the 60% thresholds will have negative effect on economic growth in short run. The debt would have a positive impact on a country's economic growth in the short term when the sustained debt levels are below the 90% threshold. The country will undergo a healthy and stable growth when both debt ratios is beyond 90% threshold or below 60% of GPD, which is considered as non-sustainable. Afonso & Alves (2014) examined the impact of government debt on economic growth for 14 European countries, using annual data covering the years of 1970-2012 via Generalized Least Squares (GLS) method. Their results indicate that public debt is detrimental to growth. Every additional percent increment of public debt will lead to -0.01% of growth for the country. Bilan & Ihnatov (2015) conducted study on the association between debt and growth for 33 European countries from 1990 to 2011. The results confirm there is a "U-inverted" relationship at 94% of GDP debt threshold. Nevertheless, this threshold level is resulted to be twice as low in developing European countries as compared to the developed ones.

Fundamentally, several researches concluded that the debt would have a detrimental effect on economic development after reaching the country's threshold. There is a concave relationship between the country's debt and economic growth, also known as an inverted-U relationship.

Methodology

The panel model is adopted by using annually data from the period of 1996-2016. The reason for selecting this period of study is to concentrate on the post Asian financial crisis period and incorporate the 2008 Global financial crisis. There are six variables in this study which consists of economic growth (GDP), public debt (PD), trade openness (TO), population (POP), inflation (INF), and exchange rate (EXC). All the data are retrieved from the CEIC data, except the data on PD, which is retrieved from the World Economic Outlook, International Monetary Fund (IMF). There is some non-availability of public debt data of Indonesia (1996-2000) and Vietnam (1996-1999) in World Economic Outlook. All the variables are transformed to the logarithmic form as to minimize the scale between the variables.

The relationship between the economic growth, public debt, trade openness, population, inflation, and exchange rate can be expressed as following:

$$GDP_{it} = F(PD, TO, POP, INF, EXC) \quad (1)$$

From this current model, it can be developed to an empirical growth model:

$$GDP_{it} = \beta_0 + \beta_1 PD_{it} + \beta_2 TO_{it} + \beta_3 POP_{it} + \beta_4 INF_{it} + \beta_4 EXC_{it} + \varepsilon_{it} \quad (2)$$

The GDP refers to the Gross Domestic Product (GDP) per capita (US$ million), as the proxy for economic growth; PD refers to the gross government debt (% over GDP), as proxy of public debt; TO refers to trade openness index, as the proxy for trade openness; POP refers to the population (million persons), as the proxy of population; INF refers to the consumer price index, as the proxy of inflation, whereas EXC refers to the period average of national currency per US$, as the proxy of exchange rate.

Besides that, this study will adopt three models to examine the association between public debt and economic growth. The three models are expressed as follows:

Model 1:

$$GDP_{it} = \beta_0 + \beta_1 PD_{it} + \varepsilon_{it} \quad (3)$$

Model 2:

$$GDP_{it} = \beta_0 + \beta_1 PD_{it} + \beta_2 TO_{it} + \beta_3 POP_{it} + \beta_4 INF_{it} + \beta_4 EXC_{it} + \varepsilon_{it} \quad (4)$$

Model 3:

$$GDP_{it} = \beta_0 + \beta_1' x_i 1(q_i \leq \alpha) + \beta_2' x_i 1(q_i \geq \alpha) + \varepsilon_{it} \quad (5)$$

where β_1' denotes the coefficients of parameter interest if threshold variable is below the threshold level, β_2' refers to the coefficients of parameter interest if threshold variable is exceeding the threshold level, q_i is the threshold variable, α refers to threshold level, $1(.)$ is the function of q(x_i) and consists of a continuous distribution. Model 1 and 2 will be adopted to test on the presence of cointegration between the variables through panel cointegration tests; Model 2 will be used in the panel long-run estimators, while Model 3 will be further discussed on the threshold regression method which was introduced by Hansen (2000).

Panel Unit Root Tests

All variables that are integrated with the same order need to be verified before implementing the panel cointegration test. Thus, first generation of panel unit roots test which was proposed by Levin, Lin, & Chu (2002), Im, Pesaran & Shin (2003), and Maddala & Wu (1999) are performed respectively. The null hypothesis of a unit root fails to be rejected for the variables if the t-statistics is smaller than 5 % significance level. The basic Augmented Dickey Fuller regressions (ADF) for the panel unit root tests is as follows:

$$\Delta y_{it} = \alpha_i y_{i,t-1} + \sum_{L=1}^{p_i} \theta_{iL} \Delta y_{i,t-L} + X_{it}\delta + \varepsilon_{it} \quad (6)$$

where ***y*** is the dependent variable, ***X*** is the independent variable, ***α*** and ***δ*** are individual entity and time effect respectively, p_i is the lag order which is allowed to vary across individuals ***i*** =1, …, N is an index of the six countries is cross-section, ***t*** =1,2,…, T is time and ***ε*** is the stationary error term.

Panel Cointegration Tests

In this study, Pedroni test which was proposed by Pedroni (1999, 2004) is used. The Pedroni test can be expressed as below regression:

$$y_{i,t} = \alpha_i + \delta_i t + \beta_1 x_{1i,t} + \beta_2 x_{2i,t} + \beta_3 x_{3i,t} + \varepsilon_{i,t}\,, \quad (7)$$

where y is the dependent variable and x is the independent variable. Both of the variables are supposed to be integrated at order one. Moreover, α_i and δ_i are the fixed effects and individual specific deterministic trend effects respectively, whereas ε indicates the residuals. In order to test the integration of the residual, there are two regressions that can be used which are expressed as below:

$$\varepsilon_{it} = \rho_i \varepsilon_{it-1} + u_{it} \quad (8)$$

$$\varepsilon_{it} = \rho_i \varepsilon_{it-1} + \sum_{j=1}^{\rho_i} \varphi_{ij} \Delta\varepsilon_{it-j} + v_{it} \quad (9)$$

Both equations (8) and (9) can be adopted for each cross section. The null hypothesis, H_0 and the alternative hypothesis, H_1 of the cointegration test are expressed as follows:

$$H_0: \rho_i = 1, \text{ for all } i$$

$$H_1: \rho_i = \rho < 1 \text{ , for all } i$$

There are two types of alternatives, which Pedroni terms the within-dimension or panel statistics test and the cointegrating vector, β_i is homogenous. Besides that, there is another alternative which stated that Pedroni terms the between-dimension or group statistics test. Pedroni (1999, 2004) allowed Pedroni test to be used for multiple regressors and for the cointegration vectors to differ across different sections of the panel data. Furthermore, Pedroni test is also suitable for heterogeneity in the errors across the cross-sectional units and there are a total of seven different cointegration statistics.

The Kao test is the extension of the Engle and Granger (1987) cointegration test. The homogenous cointegrating vectors and Auto-Regression (AR) coefficients are included in the Kao tests. However, the multiple exogenous variables were not allowed in the cointegrating vector. In addition, the question of defining the cointegrating vectors and the cases where there is more than one cointegrating vector was not discussed.

Panel Long Run Estimators

As presented by Pesaran et al. (1999), Pool Mean Group (PMG) estimator is a combination of pooling and averaging the coefficients. This PMG estimator makes short-term responses versatile and unregulated across categories, while grouping of individual groups imposes long-term constraints. Pesaran et al. (1999) proved that PMG estimator is less sensitive to outliers when N is small. Thus, the serial autocorrelation and endogenous regressors' problems can be corrected through selecting the preferable lag structure for the variables in this study. Furthermore, PMG estimator is focused on the adjustment of dynamics between the short-run and the long-run. The error term is independently distributed across time and it is an *I(0)* process for all countries when the variables are *I*(1) and co-integrated (Engle & Granger, 1987). Pesaran et al. (1999) proposed the autoregressive distributed lag with a maximum of one lag for all variables which is ARDL (1, 1) model. The proposed model which is adapted from Blackburne & Frank (2007) is shown as follows:

$$y_{it} = \sum_{j=1}^{p} \lambda_{ij} y_{i,t-j} + \sum_{j=0}^{q} \delta'_{ij} X_{i,t-j} + \mu_i + \varepsilon_{it} \quad (10)$$

Then, the ARDL regression will reparameterize into the error correction equation as follows:

$$\Delta y_{it} = \emptyset_i \left(y_{i,t-1} - \theta'_i X_{it}\right) + \sum_{j=1}^{p-1} \lambda^*_{ij} \Delta y_{i,t-1} + \sum_{j=0}^{q-1} \delta'^*_{ij} \Delta X_{i,t-j} + \mu_i + \varepsilon_{it} \quad (11)$$

where,

$\emptyset_i = -(1 - \sum_{j=1}^{p} \lambda_{ij})$;

$\theta_i = \sum_{j=0}^{q} \delta_{ij} / (1 - \sum_k \lambda_{ik})$;

$\lambda^*_{ij} = -\sum_{m=j+1}^{p} \lambda_{im}$, j=1, 2, …, p-1;

$\delta'^{*}_{ij} = -\sum_{m=j+1}^{q} \delta_{im}$, j=1, 2, …, q-1;

If the error-correcting speed of adjustment term ($\emptyset_i$) is equal to zero, there is no evidence to prove the long-run relationship. In addition, $\emptyset_i$ is expected to be significantly negative which indicates that the variables show a convergence to a long-run equilibrium. Besides that, the vector θ' consists of the long-run association between the variables. In this study, the empirical results are based on the PMG estimators, whereas MG estimator, FMOLS and DOLS are considered as robustness checking.

Threshold Regression Method

As introduced by Hansen (2000), threshold regression is one of the methods to determine the likelihood ratio tests for the threshold variable. Moreover, the threshold variable is adopted to categorize the sample into two regimes. The functional equation is defined as follows:

$$y_i = \beta_1' x_i + e_i , \qquad q_i \leq \alpha \tag{12}$$

$$y_i = \beta_2' x_i + e_i , \qquad q_i \geq \alpha \tag{13}$$

Both equation above (12 & 13) can be expressed as the form below:

$$y_i = \beta_1' x_i 1(q_i \leq \alpha) + \beta_2' x_i 1(q_i \geq \alpha) + e_i \tag{14}$$

where y_i is the dependent variable, x_i is the whole set of independent variables, β_1' denotes the coefficients of parameter interest if threshold variable is below the threshold level, β_2' refers to the coefficients of parameter interest if threshold variable is exceeding the threshold level, q_i is the threshold variable, α refers to threshold level, $1(.)$ is the function of q(x_i) and consists of a continuous distribution. Moreover, the interaction between the economic growth (as the dependent variable) and public debt (as the independent variable) are the parameters' interest in this study. The scenario is the presence of the significant negative association between public debt and economic growth for the observations (countries) whether it is below or above the threshold level. Therefore, estimation of the coefficients can be obtained simultaneously for both samples below and above the threshold level. Fundamentally, there consists of two segments that need to be presented in the threshold regression method. First of all, it is vital to examine the significance of the presence of the threshold level. Secondly, the estimation of the threshold regression is achieved by the means of bootstrapping techniques. Last but not least, there are two possibilities in this threshold regression method, which are convexity and concavity. When public debt is in a convexity situation, it will improve the economic growth of the selected Southeast Asian countries, even though the public debt has exceeded its threshold level. In this study, the public debt of the selected Southeast Asian countries is in a concavity situation. Before the public debt has achieve its threshold level, the economic growth of the countries will keep on increasing. However, the economic growth of the countries will deteriorate if it exceeds the public debt's threshold level.

Empirical Evidences

Panel Unit Root Tests Results

Table 1 depicts that all unit root tests indicate that GDP is integrated of order one, *I*(1) whereas EXC appears to be integrated of order zero, *I*(0). However, mixed results were obtained for the variables which are PD, TO, POP, and INF. It can be concluded that the variables in the pooled data are either stationary at level *I*(0) or first differences *I*(1). Thus, the results show that there is a mixture of stationarity and enable us to test the cointegration among the variables.

Table 1: Panel Unit Root Test Results

	Test Statistics					
Variables	**LLC**		**IPS**		**ADF Fisher**	
	I	**I & T**	**I**	**I & T**	**I**	**I & T**
A: Level						
GDP	1.309 (0)	0.901 (4)	4.160 (0)	-0.313 (4)	0.701 (0)	11.944 (4)
PD	-1.538 (2)	-3.721 (4) **	-0.658 (2)	-3.635 (4)	27.019 (2)	43.924 (4) **
TO	-0.064 (0)	-2.814 (1) **	1.043 (0)	-1.587 (1)	10.107 (0)	22.738 (1) **
POP	-1.778 (4) **	-1.028 (4)	1.291 (4)	-0.710 (4)	8.779 (4)	18.157 (4)
INF	-3.215 (1) **	-1.650 (4) **	0.447 (1)	-1.503 (4)	14.150 (1)	20.269 (4)
EXC	-4.792 (4) **	-2.594 (4) **	-5.309 (4) **	-4.319 (4) **	53.423 (4) **	43.146 (4) **
B: First Differences						
GDP	-6.598 (0) **	-3.062 (3) **	-5.256 (0) **	-1.770 (3) **	47.737 (0) **	25.123 (1) **
PD	-11.156 (1) **	-9.747 (1) **	-8.763 (1) **	-7.528 (1) **	90.350 (1) **	62.922 (1) **
TO	-8.882 (1) **	-7.206 (2) **	-8.686 (1) **	-7.747 (2) **	80.568 (1) **	67.032 (2) **
POP	-1.815 (2) **	-10.562 (1) **	-3.503 (4) **	-0.759 (6) **	39.551 (4) **	22.354 (3) **
INF	-6.274 (0) **	-6.233 (0) **	-4.714 (0) **	-4.217 (0) **	42.963 (0) **	37.359 (0) **
EXC	-14.900 (1) **	-12.071 (3) **	-13.633 (1) **	-9.198 (3) **	151.952 (1) **	77.189 (3) **

Notes*:* The test statistics are reported above, along with the lag lengths in parentheses. The optimum lag lengths are determined by Schwarz Information Criterion (SIC). Asterisks (**) indicate statistically significant at the 5% level. I represents intercept and T & I represent trend and intercept. GDP-Gross Domestic Product; PD-Public Debt; TO-Trade Openness; POP-Population; INF-Inflation; EXC-Exchange Rate.

Panel Cointegration Tests Results

Table 2 indicates the rejection of the null hypothesis of no cointegration at 5% significance level. For Pedroni test, majority of the statistics are statistically significant at 5% significance level in these two models. Hence, there is a strong evidence to reject the null hypothesis of no cointegration for all seven statistics. Likewise, in Kao (1999) panel cointegration tests, we can reject the null hypothesis of no cointegration. Thus, the variables are co-integrated and have a long-term relationship for the study duration.

Table 2: Pedroni Panel Cointegration Tests Results

	Model 1	**Model 2**
Panel υ-statistic	-1.669 (0.953)	0.607 (0.272)
Panel rho-statistic	-1.424 (0.077)	0.388 (0.651)
Panel PP-statistic	-2.262 (0.012) **	-5.643 (0.000) **
Panel ADF-statistic	-2.130 (0.017) **	-5.386 (0.000) **
Group rho-statistic	-0.236 (0.407)	2.050 (0.980)
Group PP-statistic	-1.768 (0.039) **	-7.223 (0.000) **
Group ADF-statistic	-1.809 (0.035) **	-4.757 (0.000) **
Kao Test		
	Model 1	**Model 2**
ADF	-2.280 (0.011) **	-1.805 (0.036) **

Notes: Asterisks (**) denote the significance at 5% level. The optimum lag lengths are determined by Schwarz Information Criterion (SIC). Probability values are in parentheses. The variables that are included in Model 1-GDP, PD; and Model 2-GDP, PD, TO, POP, INF, EXC. The abbreviations of variables represent as follows: GDP-Gross Domestic Product; PD-Public Debt; TO-Trade Openness; POP-Population; INF-Inflation; EXC-Exchange Rate.

Panel Long Run Estimator

As the results reported in Table 3, PMG estimator is the best choice to estimate the long run coefficients. This is because pool mean group estimator is considered in different lag compared to other two estimators. For MG estimator, it allows distinct estimations for each group in the panel and hence, it will provide an average estimate with consistent results. Although MG estimator allows heterogeneity across countries, it will omit the long-run homogeneity between groups (Pesaran and Smith, 1995). Therefore, it can be concluded that MG estimator is not preferable when the error-correction coefficients are homogenous across the countries. In this paper, PMG estimator is more appropriate than MG estimator as it is more comprehensive. According to Pesaran et al. (1999), PMG estimator compels the homogenous long-run coefficient while permitting heterogeneity and providing estimation in the dynamic short-run coefficients. Furthermore, PMG estimator also provides estimation for the independent error-corrections coefficients across nations while treating the long-run coefficients to be the same crosswise over nations. The empirical results are based on the PMG estimators, whereas MG estimator, FMOLS, and DOLS are considered as robustness checking.

The results in Table 3 report that the estimated coefficient for PMG estimator is -0.487. In other words, this indicates that GDP will bring all the variables to long-run equilibrium in the system. The speed of adjustment is about 48.7% annually, which takes about 2 years to adjust the long-run equilibrium. Meanwhile, 1% increase in public debt decreases real GDP by 0.12% which indicates that public debt is stressing a negative impact on the economic growth. This is because the countries are over-borrowing and unable to repay its debt interest payment. Supposedly the external borrowing is used for the country's development purposes, however, the country uses it to repay the interest payment. For instance, the aids for the interest payment of public debt will divert the funds from the other sectors such as education sector which would benefit the people. Thus, it will decrease the economic growth of the countries in the long-run. The finding is in line with Checherita-Westphal & Rother (2012), Akram (2013), Herndon et al. (2014), Panizza & Presbitero (2014), Woo & Kumar (2015), and Serrão (2016) which proved there is a inverse association between public debt and economic development. For control variables such as population, each 1% increase in population will increase~~s~~ real GDP by 3.84%. This study validated the positive relationship between population and economic growth. Due to the increasing number of population, the size of workforce will also relatively increase. Moreover, the productive capacity of the economy will expand and help to improve the tax revenue of the country. Thus, the economic growth of the countries will increase. In addition, the findings are consistent with the studies of Chowdhury (1994), Presbitero (2012), and Ribeiro et al. (2012).

Furthermore, the results indicate that 1% rise in trade openness, GDP will rise by about 0.11%. Therefore, trade openness will contribute positively to the economy. This finding aligns with the trade-led growth hypothesis as it expresses that the extension of trade will prompt a more elevated amount of economic output. Fundamentally, trade openness helps to open doors for businesses in local organizations through exploring new markets, evacuating pointless barriers, and also making it simpler to export. Trade openness can help to boost development and generate more income. In this study, the findings for trade openness is in accordance with several prior studies, which includes Caner et al. (2010), Cordella et al. (2010), Greenidge et al. (2012), Akram (2013), Afonso & Alves (2014), Schclarek (2014), Zouhaier & Fatma (2014), Bilan & Ihnatov (2015) Woo & Kumar (2015), and Swamy (2015). However, 1% increase in exchange rate will decrease real GDP by 1.12%. An appreciation of the exchange rate will make exports become more expensive for the importing nations in the long-run. In addition, the nation with a higher currency rate may see the demand of exports decrease if the other nations can provide a more reasonable rate with the same goods. This is the scenario where the reverse J-curve effect happens in the country. Thus, it will worsen the trade balance

and cause shrinkage of economic development in the country. The results yielded is consistent with the findings of Ghura & Grennes (1993), Bleaney & Greenway (2001), Hua (2012) and Antonakakis (2014) which stated that there is a negative association between exchange rate and economic growth. However, the studies of Rapetti, Skott, & Razmi (2012) and Bilan & Ihnatov (2015) argued that exchange rate will exert a positive impact on the economic growth of the country.

Apart from that, the results show that 1% increase in inflation will increase real GDP by 0.66%. In other words, inflation will exert positive impact on the economic growth in the selected Southeast Asian countries. A higher level of inflation can be considered good as it reflects a higher purchasing power. According to the Tobin effect which was introduced by Tobin (1965), the level of output for a country will increase when the inflation rate increases. It has suggested that the increase of inflation will cause people to substitute out of cash and into the interest earning assets. Furthermore, Tobin (1972) contended that, due to the descending rigidity of prices which includes wages, the modification in relative prices amid financial development could be better accomplished by the upward price changes of some individual prices. This is consistent with the findings of Malik & Chowdhury (2001) and Hussain & Malik (2011) stated that there is a positive association between inflation and economic growth.

Table 3: Panel Long-Run Estimators Results

	PMG	**FMOLS**	**DOLS**
	Long-run coefficients		
PD	-0.120**	-0.087	-0.375**
	[-6.948]	[-1.240]	[-8.826]
POP	3.843**	2.083**	2.727**
	[19.546]	[7.227]	[27.691]
TO	0.106**	0.198**	-0.071
	[0.030]	[2.216]	[-2.866]
INF	0.664**	1.553**	1.629**
	[8.229]	[15.060]	[24.357]
EXC	-1.117**	-1.073**	-0.960**
	[-30.595]	[-9.080]	[-38.656]
	Speed of Adjustment		
ECT	-0.487**[-2.276]	-	-

Notes: The PMG was estimated using a ARDL (1,1) specification. As for DOLS, 1 lead and 1 lag have been included. Asterisks (**) denote statistical significance at 5% level. Value indicates coefficients and the figures in the brackets are *t*-statistics. FMOLS-Fully Modified OLS; DOLS- Dynamic OLS; PMG-Pool Mean Group; PD-Public Debt; TO-Trade Openness; POP-Population; INF-Inflation; EXC-Exchange Rate.

Threshold Regression Results

According to Table 4 and Figure 1, all independent variables (PD, POP, TO, INF, EXC) are significant towards the economic development in the selected Southeast Asian countries. The threshold regression results reveal that there is an estimated threshold level in the selected Southeast Asian countries, which is 68.31%. On top of that, the results from PMG estimator show that debt is negatively associated with the economic growth in the selected Southeast Asian countries. This scenario is happening either in the long-run or without the threshold effects. The positive magnitude of the findings below the threshold suggests that there is a strong positive association between the public debt and economic growth. An increase of 1%

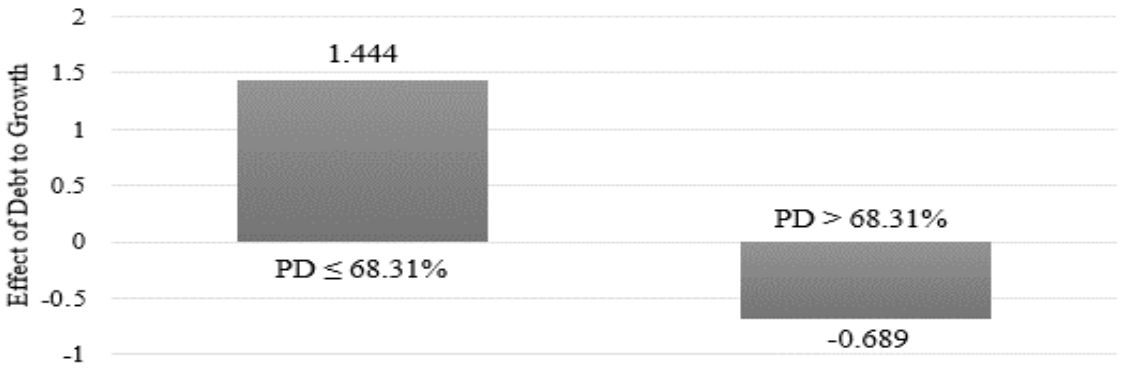
of public debt leads to increase of the economic growth by 1.44% of GDP. When the public debt level of a country is below the threshold level, it means that the country may not encounter any difficulties in managing its debt. Furthermore, the country is able to repay its interest payment and taking the debt for productive uses. In other words, extra borrowings are injected to the development expenditure for the economy to progress. Therefore, the empirical results suggested that the countries should borrow cautiously as indicated by its government policy while they enhance the economic performance of their countries. Besides that, the negative magnitude appears when the public debt is beyond the threshold level. This suggests that the selected Southeast Asian countries have negative association between public debt and economic growth. When 1% increase in public debt, it will lead to a decrease of economic growth by 0.689% of GDP. Public debt is not considered a detrimental thing to the growth of the nation. However, if it has breached over the debt threshold level of the countries, then this may provide detrimental effects on the economic development of the countries. For instance, countries may experience obstacles to refinance their existing mounting debts in the future. Therefore, the extra debt borrowing will be utilized for debt repayment purpose instead of country development purposes. When a country needs to repay the debt interest payment rather than develop its facilities and infrastructure, the economic growth of the country will deteriorate.

Table 4: Thresholds Regression Results

	Public Debt Threshold	
	Below debt ≤ 68.31%	**Above debt > 68.31%**
Public debt	1.444 ** (0.492)	-0.689 ** (0.143)
Population	-1.636 ** (0.370)	1.682 ** (0.089)
Trade openness	-3.004 ** (0.328)	0.511 ** (0.090)
Inflation	2.774 ** (0.257)	2.680 ** (0.140)
Exchange rate	0.145 ** (0.054)	-0.450 ** (0.037)
Observations	126	
R-Squared	0.948	

Notes*:* GDP as dependent variable and trimming percentage is 15%. Asterisks (**) indicate significance at 5% level. The values in parentheses are denoted as standard errors. The public debt threshold is 68.31% of GDP.

Furthermore, the threshold regression results are also presented in illustration as below:



Notes: PD indicates the public debt of selected Southeast Asian countries.

Figure 1: Effects of the public debt threshold level for panel of 6 Southeast Asian countries

Conclusion

The goal of this paper is to investigate the relationship between public debt and economic growth in selected countries in South East Asia covering Indonesia, Malaysia, the Philippines, Singapore, Thailand and Vietnam. Based on the threshold regression method results, it shows that the threshold level is 68.31% of GDP. The positive relation between public debt and economic growth is found when the public debt is less than 68.31% of GDP and it immediately changes to negative when debt exceeds the threshold level. Furthermore, if a government debt is below the threshold, an increase of 1% of public debt will increase the economic growth by 1.44% of GDP. On the contrary, an increase of 1% of public debt will decrease the economic growth by 0.689% of GDP when it has exceeded the threshold level. Thus, this endogenous threshold level which was obtained in this study may offer some important guidelines for the policymakers in order to manage the public debt level in selected Southeast Asian countries. With regards to panel long run estimators, PMG estimator is adopted to capture the evidence of long-run and speed of adjustment in this study. The results of the PMG estimator indicate that public debt and exchange rates have a negative effect on economic growth, while trade openness, population and inflation have a positive impact on economic growth in the selected countries of Southeast Asia. In particular, public debt has a negative impact on economic growth due to over-borrowing countries and their debt interest payments may not be repaid. This would thus deteriorate the countries' economic development in the long run.

On the perspective of policy recommendations, the government and policymakers need to monitor the debt frequently to prevent the public debt of the countries from exceeding the threshold level. The debt that has been borrowed should be channelled to the productive sectors such as service sectors. It can help the country to generate income and thus, the country will have sufficient money to repay the interest payment and for development purposes. Besides, the economic integration is concluded as one of the vital factors for the investors to decide whether they should invest in the Southeast Asian countries region. Therefore, Southeast Asian countries should utilize the ASEAN community region to tie back with the debt development and ensure that the debt of the countries are sustainable.

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