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PUBLIC DEBT SUSTAINABILITY AND ECONOMIC GROWTH IN MALAYSIA: THRESHOLD AND CAUSALITY ANALYSIS

Abstract:

The 2008 financial crisis has led to an unprecedented increase in public debt across the world, raising serious concerns about its economic impact. This paper investigates the impact of public debt on long-run GDP growth in Malaysia from the year 1970 to 2013. We employ novel methods and diagnostics from the time-series literature, such as threshold regression approach suggested by Hansen (2000), causality test and cointegration test. The empirical results suggest an inverse relationship between debt and GDP growth, controlling for other determinants of growth. Further, our results suggest that there is strong evidence of causality from growth to public debt. In addition, threshold effect and nonlinearity between debt-growth is examined. We found a non-linear impact of public debt on GDP growth with a turning point—beyond which the public debt-to-GDP ratio has a deleterious impact on long-term growth—at about 50-60% of GDP.

Keywords:

Public debt; Economic growth; fiscal policy; Threshold analysis; Causality

JEL Classification: H63, O40, C50

1. Introduction

Budget deficit remains as a major concern of policy makers in every country. Like many developing countries, budget deficit is a great challenge to Malaysia. The country experienced several budget deficits since 1970 even though the fiscal years from 1993 to 1997 recorded continuous budget surpluses. Noteworthy, the country's public debt level reached a peak in 2009 about 37.43% of gross domestic product (GDP) (World Economic Outlook Database, International Monetary Fund (IMF)), after the outbreak of Global financial crisis and Great Recession in 2008. As noted by Goh and Lim (2010), the Malaysian domestic banking sector was not having a severe effect from the crisis because of less exposure to securities linked to the subprime loans of United States (US). However, the crisis shocks had deteriorating impact on the country's real economy by causing capital flight from the country and reducing exports. Due to Global financial crisis, some foreign financial institutions reallocated their funds on their home countries. As a result, the financial account of Malaysia's balance of payments recorded a decrease from –RM37.71 billion in 2007 to –RM118.50 billion in 2008. Since the second quarter of 2008, the quarterly record had turned negative and continued until the first quarter of 2009. In more details, between the second and third quarters of 2008, foreign direct investments in Malaysia drastically decreased from RM15.89 billion to RM0.34 billion, and portfolio investments plunged from -RM21.95 billion to -RM55.28 billion (Monthly Statistical Bulletin, Central Bank of Malaysia). Further, the value of exports in January 2009 had dropped sharply by 27.9% in year-on-year terms (Department of Statistics, Malaysia). Above all, an increase in government borrowing to fund development is unavoidable under such circumstances. Nevertheless, there is a need to raise public awareness of the danger of over-indebtedness, in which it could lead to debt-overhang that undermines development. Most importantly, country with large public debt burden is exposed to sovereign debt crisis.

This study seeks to provide answer to the important question 'what is the sustainable level of public debt for the emerging economy of Malaysia' which requires determining the optimal threshold level of public debt. In addition, this study aims to analyse the long- and short-run relationships between public debt and economic growth in Malaysia, through cointegration and causality analyses. This paper is organised as follows: Section 2 presents literature review; Section 3 discusses data and methodologies; Section 4 reports the estimated results; Section 5 concludes.

2. Literature Review

Public Debt-Economic Growth Nexus

In the past, researchers have placed great emphasis to the systematic relationship between public debt and economic growth. Jayaraman and Choong (2006) use bounds testing approach to examine the relationship between Fiji's economic growth, with the country's public debt, real interest rate, and the ratio of government recurrent expenditure to total expenditure for the period 1970-2003. It is found that there exist long-run relationships between the growth variable (GDP) with other variables. The vector error correction modelling results suggest a unidirectional long-run causality from public debt, interest rate, and the ratio of government recurrent expenditure to total expenditure towards GDP. In short run, GDP is influenced only by public debt.

Abdul Rahman (2012) examines the impact of Malaysia's Federal Government's debt on the country's economic growth for the period 2000-2011. The study has verified a negative impact from the Federal Government's domestic debt on economic growth in long-run, but the short-run impact is not evident. There is no evidence to support the Federal Government's external debt impact on economic growth in short- and long-run.

Bal and Rath (2014) examine the effect of public debt on economic growth for India from 1980 to 2011. Based on the estimation using autoregressive distributed lag (ARDL) model, the study found a long-run relationship between public debt and economic growth. Total factor productivity growth has no long-run impact on economic growth. In addition, the estimation using error correction model (ECM) reveals that in short-run, economic growth is influenced by the central government debt, total factor productivity growth, and debt service payment. The findings imply the importance of fiscal management in achieving a sustainable development for the country.

Past studies that employ panel data analysis are such as, Panizza and Presbitero (2014), Gómez-puig and Sosvilla-rivero (2015), and Puente-ajovín and Sanso-navarro (2015). Panizza and Presbitero (2012) use an instrumental variable approach to analyse the causal effect of public debt on economic growth for the OECD countries. The findings of study show there is a negative correlation between public debt and economic growth. In addition, this study fails to reject the hypothesis that high debt has no causal effect on growth, however it does not mean countries can sustain any level of debt. The authors emphasize that the debt-growth relationship should not be used by policy makers in applying the austerity policies.

Gómez-puig and Sosvilla-rivero (2015) investigate the existence of a bi-directional causality between public debt and economic growth for the central and peripheral countries of European Economic and Monetary Union during 1980-2013. For the sample period until 2009, there is no evidence showing a negative causation between public debt and economic growth. The study found evidence of negative Granger-causality between the changes in public debt and economic growth in some of the countries after endogenously detects a breakpoint. The evidence is found between the break dates 2007 and 2009 in most cases.

Puente-ajovín and Sanso-navarro (2015) study the Granger causality between debts and economic growth for 16 OECD countries for the period 1980-2009. Instead of public debt Granger cause economic growth, the findings show a causal relation from economic growth to public debt. In more details, low level of economic growth leads to high level of public debt. Meantime, there exists causality from non-financial private debt to economic growth.

Public Debt Sustainability

In a study on 18 OECD countries for the period 1980-2010, Cecchetti *et al.* (2011) conclude that there is a clear linkage of high public debt and low economic growth. When public debt is in the range of 85% of GDP, further increases in public debt will start having a significant impact on economic growth. For instance, a further 10% point increase will reduce economic growth by more than one tenth of 1% point.

Reinhart *et al*. (2012) has identified the major public debt overhang episodes in 26 advanced economies. The ratios of public debt to GDP for these economies are exceeding 90% for at least five years. Égert (2015) carries out estimation based on a nonlinear threshold model using Reinhart-Rogoff dataset but with a shorter time span from 1960 to 2010. The negative nonlinear relationship between public debt and economic growth is very sensitive to modelling choice, as test results can be changed by time dimension, country coverage, data frequency, and the minimum number of observations required in each regime. The negative nonlinear effect can kick in at much lower level of public debt than the finding of Reinhart and Rogoff (2010).

Jernej *et al.* (2014) explore the short-term impact of public debt on economic growth in the European Union (EU) countries. The empirical analysis includes a panel dataset of 25 sovereign member states of the EU, divided into sub-groups, namely, ‘old’ and ‘new’ member states, using panel estimation on a generalized economic growth model augmented with a debt variable, considering heterogeneity and endogeneity problem. The results indicate the nonlinear impact of public debt on the annual growth rate of GDP per capita. The estimated debt-to-GDP turning point, in which the positive effect of accumulated public debt inverts into a negative effect, is between 80% and 94% for the ‘old’ member states. For the ‘new’ member states, the threshold is much lower that is between 53% and 54%.

Eberhardt and Presbitero (2015) analyse the long-run relationship between public debt and economic growth in a large panel of countries by assuming that debt-growth relationship is heterogeneous for different countries. The sample consists of 118 developing, emerging and advanced economies and the period of study spans from 1960 to 2012. It can be noticed that long-run debt coefficients are different across

countries. Countries with relatively higher average debt-to-GDP ratios are more likely to suffer the negative impact on long-run economic growth.

Spilioti and Vamvoukas (2015) examine the relationship between public debt and economic growth for Greece over 40 years. The findings of study suggest a positive and statistically significant impact of public debt on GDP growth. The positive relationship is maintained until the level of debt-to-GDP ratio around 110%, and turns negative when beyound that level. The important determinants of the country's GDP growth include the government debt, GDP per head of population, and the gross national saving.

3. Data and Methodology

3.1. Data

This study utilizes a balanced datasets for the period 1970-2013 which consist of the annual data of selected variables. The data are transformed into natural logarithm in estimation. The variables are GDP growth (LGDP), public debt-to-GDP (LPDEBT), gross fixed capital formation-to-GDP (LGFCF), general government final consumption expenditure-to-GDP (LGGFCE), export-to-GDP (LEXP), and debt service-to-GDP (LDS). The data are extracted from World Development Indicator (WDI) of World Bank Database 2015, and World Economic Outlook Database of IMF.

3.2. Methodology

3.2.1. Unit Root Tests

Prior to modeling the time series data, we determine the order of integration of the variables and ensure that it is equal for all series. For this purpose, firstly we use traditional unit root tests namely, Augmented Dickey and Fuller (ADF, 1979) and Phillip Perron (PP, 1988) to test the null of a unit root against mean stationarity. The PP (1988) unit root test is able to deal with serial correlation and heteroscedasticity of regression residuals. However, in the presence of a structural break, traditional unit root testing procedures may erroneously fail to reject the null hypothesis that a series is integrated of higher order. In order to allow for the possibility of a structural break, we employ the Zivot and Andrews (1992) one break test. There are two versions of the sequential trend break model, Model A and Model C. Model A allows for a change in intercept, while Model C allows for a change in both intercept and slope. The null hypothesis is there is a unit root in the series and the alternative is that the series is breakpoint stationary.

3.2.2. Cointegration Tests

After confirming the series are integrated of same order, the next step is to perform cointegration tests. Conventional cointegration tests have a limitation when dealing with a long data span. The data generating process can be affected by major economic events such as, financial crisis, and the shifts in industrial structure and productivity growth, and thus the equilibrium relationship may be altered. In order to

allow for endogenously-determined break, we employ the Gregory and Hansen (1996) cointegration tests that assume the null hypothesis of no cointegration against the alternative of cointegration with one structural break. The tests are based on different models as follows: 1) change in level (C); 2) change in level and trend (C/T); 3) change in regime (C/S); 4) change in regime and trend (C/S/T).

3.2.3. Causality Tests

The existence of a long-run relationship between the variables would suggest there must be causality at least in one direction. Thus, we employ the Granger-causality testing procedure developed by Granger (1969) known as pairwise granger causality test to examine the possible causation. The pairwise causality test has advantage as it overcomes the problem of invalid asymptotic critical values when causality test are performed in the presence of non-stationary data series.

3.2.4. Threshold Analysis

The last step of analysis is to verify the presence of a threshold and to estimate the optimal threshold level for Malaysia's public debt. The nature of the threshold effect for public debt and economic growth in previous studies has yet to be conclusive. For instance, the serial papers of Reinhart and Rogoff (2010, 2012) claim that there is a threshold effect where debt above 90% of GDP will adversely affect economic growth, however debt is unrelated to economic growth as long as it does not exceed 90% of GDP. Meantime, Caner *et al.* (2010) found a public debt threshold at 77% GDP implying that when below the threshold, debt helps in expanding investment and supporting a faster economic growth while additional debt above the threshold reduces growth.

4. Estimated Results

4.1. Traditional Unit Root Test

Table 1 reports the results of ADF (1979) and PP (1988) unit root tests. The lag length selection of ADF on Schwarz Bayesian information criterion (SIC) with a maximum lags of 9, while PP is using the Bartlett Kernel for Spectral estimation method with a Newey-west bandwidth automatic selection. In the level form, the tests statistics obtained are clearly less than the critical values even at 10% significant level. Therefore, the null hypothesis of a unit root cannot be rejected for the series studied, implying that the series are having a unit root. In the first difference, all the variables used in this study are integrated of order one *I*(1). Thus, we can proceed to investigate the long-run relationship of LGDP and LPDEBT using cointegration test.

Table 1: Results of traditional unit root tests

Test Statistics							
	ADF	PP	Conclusion		ADF	PP	Conclusion
A: Level				**B: First Difference**			
Model Specification: Intercept				*Model Specification: Intercept*			
LGDP	-1.855	-1.797	*I*(0)	∆LGDP	-5.467*	-5.441*	*I*(1)
LPDEBT	-1.804	-1.756	*I*(0)	∆ LPDEBT	-3.986*	-3.956*	*I*(1)
LGFCF	-2.484	-2.401	*I*(0)	∆LGFCF	-4.711*	-4.656*	*I*(1)
LGGFCE	-1.984	-1.812	*I*(0)	∆LGGFCE	-7.826*	-8.837*	*I*(1)
LEXP	-1.551	-1.319	*I*(0)	∆LEXPGDP	-4.797*	-4.799*	*I*(1)
LDS	-1.925	-1.848	*I*(0)	∆LDSGDP	-7.679*	-7.679*	*I*(1)
Model Specification: Trend and intercept				*Model Specification: Trend and intercept*			
LGDP	-1.368	-1.445	*I*(0)	∆LGDP	-5.802*	-5.808*	*I*(1)
LPDEBT	-1.788	-1.772	*I*(0)	∆ LPDEBT	-3.923**	-3.892*	*I*(1)
LGFCF	-2.51	-2.379	*I*(0)	∆LGFCF	-4.645*	-4.584*	*I*(1)
LGGFCE	-2.727	-2.718	*I(0)*	∆LGGFCE	-7.788*	-9.364*	*I*(1)
LEXP	-0.088	-0.273	*I*(0)	∆LEXPGDP	-5.028*	-4.980*	*I*(1)
LDS	-1.691	-1.539	*I*(0)	∆LDSGDP	8.274*	-9.780*	*I*(1)

Notes: ∆ denotes the first difference operator. Asterisks *, ** and *** denote the 1%, 5% and 10% significance levels respectively.

4.2. Zivot and Andrews One Break Unit Root Test

To determine the unit root characteristics of the series with the presence of structural break, we use two forms of the Zivot and Andrews (1992) sequential trend break model. According to Perron, most economic time series are adequately modelled using either Model A or C of Zivot and Andrew testing procedure. However, Sen (2003) points out that there will be substantial loss in power when one uses Model A, but in fact break can be captured by Model C. The loss of power is considered minor when break is found through Model A when one uses Model C. This means that Model C is superior to Model A. Thus, we choose Model C in our analysis of unit root with one structural break.

As shown in Table 2, the results of Model A suggest that we can reject the null of unit root for LGFCF at 1% level of significance in level, but we fail to reject the unit root hypothesis for the remaining series. We find that LGDP, LPDEBT, LEXP, LGGFCE, and LDS are non-stationary, while LGFCF is stationary in the presence of structural breaks in levels. The break dates are also reported in Table 2. In the first difference, the results suggest that we can reject the null hypothesis of unit root for all series at 1% level of significance. As indicated by the results of Model C, all series are non-stationary at level. In the first difference, all series become stationary. Therefore, we can conclude that the Zivot and Andrews (1992) test given the corresponding break points does not change the results of the conventional unit root tests.

The break dates for economic growth (LGDP), public debt-to-GDP (LPDEBT) and export-to-GDP (LEXP) series are around 1988, 1988, and 1987 respectively. The structural breaks may correspond to several important historical events. For instance, the Global Recession in 1985-1986 caused by commodity price shocks at the global level. The US high-interest rate policy led to massive collapse of world commodity trade and the decline in commodity earnings in Malaysia by the mid-1980s (Athukorala, 2010). For gross fixed capital formation-to-GDP (LGFCF) and general government final consumption expenditure-to-GDP (LGGFCE) series, the break date is in 1998 which may correspond to the Asian Financial Crisis in 1997-1998. For debt service-to-GDP (LDS), the break date in 1979 coincides with the second oil price shocks in 1978-1979 due to strong global oil precautionary demand and global economy booming.

Table 2: **Results of Zivot and Andrew unit root test**

	Model A: Break in intercept			Model C: Break in intercept and trend			
	t-statistic	k	TB	t-statistic	k	TB	Conclusion
Level							
LGDP	-2.430	0	1989	-3.519	0	1993	*I*(0)
LPDEBT	-3.388	5	1993	-3.151	5	1981	*I*(1)
LGFCF	-5.492*	1	1998	-4837	1	1998	*I*(1)
LEXP	-1.585	2	2007	-3.812	2	1998	*I*(0)
LGGFCE	-3.868	0	2009	-4.969	0	1996	*I*(0)
LDS	-2.684	1	1982	-3.844	1	1985	*I*(0)
1st Difference							
LGDP	-6.557*	0	1988	-6.614*	0	1988	*I*(1)
LPDEBT	-5.964*	1	1988	-5.924*	1	1988	*I*(1)
LGFCF	-5.039*	0	1996	-5.665*	0	1998	*I*(1)
LEXP	-7.868*	1	1987	-7.661*	1	1987	*I*(1)
LGGFCE	-8.355*	0	1999	-8.223*	0	1999	*I*(1)
LDS	-8.748*	0	1989	-8.647*	0	1979	*I*(1)

Notes: The 1%, 5% and 10% critical values obtained from estimating Model A are -65.34, -4.80, and -4.11 respectively. The 1%, 5% and 10% critical values obtained from estimating model Care -5.57, -5.08, and -4.82 respectively. Asterisk *, **, and *** denote rejections of the null hypothesis of non-stationary at 1%, 5% and 10% significance levels respectively. TB is the estimated break year and *k* stands for the endogenously selected lag order for the min ADF test. The lag is selected using Akaike Information Criteria (AIC).

4.3. Cointegration Test

The estimated cointegration test results with one unknown structural break are presented in Table 3. This test examines the presence of a cointegrating relationship under a structural shift between public debt and economic growth, controlling for gross fixed capital formation-to-GDP, export-to-GDP, and general government final consumption expenditure-to-GDP. All three statistics obtained from the C, C/T, C/S, and C/S/T models are reported for comparison.

The empirical results show that rejection of the null hypothesis of no cointegration at 5% significance level is on modified ADF^* and Z_t^* statistics in Model C and Model C/S/T, while modified ADF^* and Z_t^* statistics confirm the cointegration existence in Model C/T and Model C/S at 1% significance level. The existence of cointegration relationship between public debt and economic growth indicates that the series move together in the presence of structural break, and share common stochastic trends although the trends may deviate from each other in short-run.

The statistically significant structural break detected through Model C corresponds to year 1999 and it is confirmed by the modified ADF^* and Z_t^* statistics. This break date can be explained by Asian financial crisis in 1997-1998. Model C/T shows the break in 1979 which coincides with the second oil price shock in 1978-1979 based on ADF^* statistic, and the break in 1984 that is during Global Recession based on Z_t^* statistic. Turning to Model C/S, the significant structural break in 1986 is confirmed by $ADF^*$and Z_t^* statistics. It can be plausibly explained by Global Recession. In Model C/S/T, $ADF^*$and Z_t^* statistics show the break date in 1998 which is during Asian financial crisis.

Table 3: **Results of Gregory-Hansen (1996) cointegration test for public debt and economic growth**

			Asymptotic Critical Values		
Test statistic	Estimated test value	Break Dates	1% Critical value	5% Critical Value	10% Critical value
(i) Model: Change in Level, C					
ADF^*	**-5.68	1999	-6.05	-5.56	-5.31
Z_t^*	**-5.74	1999	-6.05	-5.56	-5.31
Z_α^*	-38.38	1999	-70.18	-59.40	-54.38

(ii) Model: Change in Level and Trend, C/T

ADF^*	*-6.62	1979	-6.36	-5.83	-5.59
Z_t^*	*-6.65	1984	-6.36	-5.83	-5.59
Z_α^*	-48.84	1984	-76.95	-65.44	-60.12

(iii) Change in Regime, C/S

ADF^*	*-7.37	1986	-6.92	-6.41	-6.17
Z_t^*	*-7.45	1986	-6.92	-6.41	-6.17
Z_α^*	-54.81	1986	-90.35	-78.52	-75.56

(iv) Change in Regime and Trend, C/S/T

ADF^*	**-7.04	1998	-7.31	-6.84	-6.58
Z_t^*	**-7.08	1998	-7.31	-6.84	-6.58
Z_α^*	-47.10	1998	-100.69	-88.47	-82.30

Notes: The asymptotic critical values are from Gregory and Hansen (1996a). The lag length was selected using downward t-statistics with a maximum lags of 8. Asterisks *, **, and *** denote the rejection of the null hypothesis at 1%, 5% and 10% significance levels, respectively.

4.4. Causality Test Results

4.4.1. Pairwise Granger Causality Test

The pairwise Granger causality approach is used to examine the causal relationship between LGDP and LPDEBT. The results are summarized in Table 4. There is no evidence showing a short-run causality from LGDP to LPDEBT and vice versa. The *p*-values for the computed F-statistics are greater than 10% significance level. Therefore, we accept both the null hypothesis of LGDP does not granger cause LPDEBT, and LPDEBT does not granger cause LGDP.

Table 4: Results of pairwise granger causality for public debt and GDP

Pairwise Null Hypothesis	Obs	F-statistics	P-value	Inference
LGDP does not Granger Cause LPDEBT	38	0.515	0.7911	No Granger causality
LPDEBT does not Granger Cause LGDP		0.842	0.5496	No Granger causality

4.5. Threshold Analysis

4.5.1. Test Statistics for Threshold Effect

The results of the threshold analysis based on asymptotic *p*-values obtained through 5000 bootstrap replications are reported in Table 6. We follow the Hansen (2000) testing procedure to determine the number of threshold for public debt. The statistics of *F1* is 19.28 significant at 1% level in one threshold testing, and the bootstrap *p*-value is 0.0000 implying the presence of threshold. The estimated threshold value is 54.86%, which suggests that one threshold exists.

Table 6: Results of the test for threshold effect

Test Hypothesis	*F1* test	Bootstrap *P*-Value	Threshold Estimates (%)	95% Confidence Interval
H_0 : No threshold	*19.28	0.0100	52.66%	[41.22%, 73.32%]

Notes: The null hypothesis is no threshold, and against the alternative hypothesis of threshold. The threshold is found by the minimized sum of the squared residual. Asterisk * denotes 1% significance level.

In order to check the precision of the estimated threshold value, we employ the LR test to examine the confidence interval around the threshold estimates. The 95% asymptotic confidence region is [41.22%, 73.32%]. Figure 1 shows the normalized likelihood ratio sequence $LR_n^*(\gamma)$ statistics as a function of the public debt ($PDEBT$) threshold. The least squares estimate of the threshold (γ) is the value that minimizes the function $LR_n^*(\gamma)$ and occurs at $\hat{\gamma} = 52.66\%$. The 52.66% threshold value corresponds to year 1981 in the sample of time series used in this study. The asymptotic 95% critical value 7.35 which is significant at 5% level is shown by the

dotted line that crosses $LR_n^*(\gamma)$ in which the confidence interval is [41.22%, 73.32%]. The results confirm that the presence of threshold effect in the relationship between public debt and economic growth.

Figure 1: Confidence interval constructions for threshold of external debt

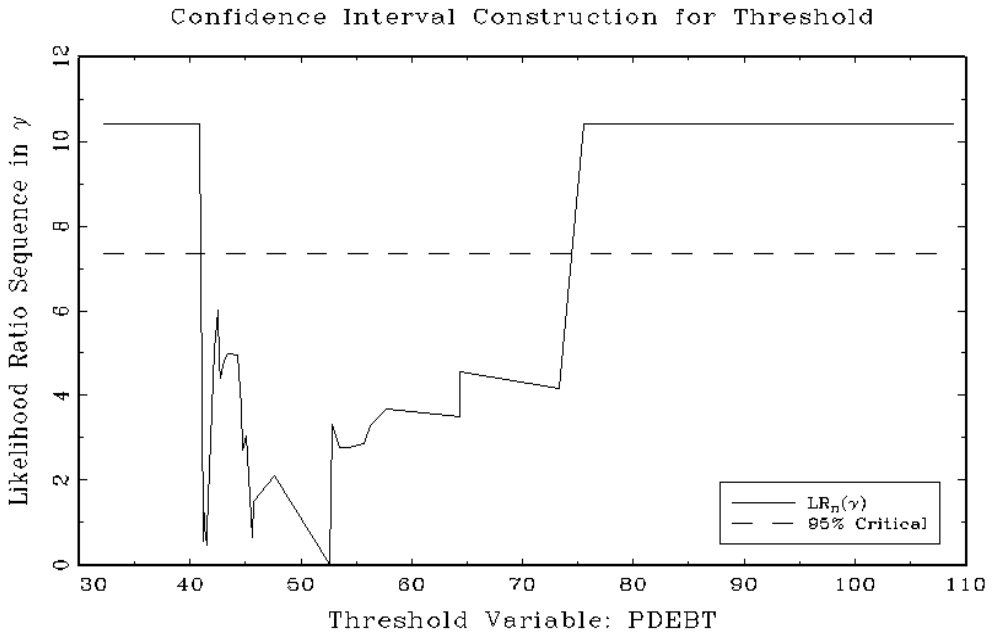

Table 7 summarises the estimation results of public debt-economic growth nexus for Malaysia throughout 1970-2013. The first column presents the estimates of a linear regression equation (1) that ignores the threshold effect. The second and third columns show the estimates of a two-regime TAR model.

Table 7 Regression results of public debt and GDP growth

	Linear Model	Threshold Model	
Variables	(OLS without threshold)	Regime 1 ≤ 52.66%	Regime 2 > 52.66%
Constant	0.0614*	0.0632*	0.0597*
	(0.0032)	(0.0039)	(0.0030)
LPDEBT_GR	-0.1586*	0.2054*	-0.1361**
	(0.0342)	(0.0609)	(0.0337)
LGFCF_GR	0.1359*	0.1518*	-0.0570
	(0.0474)	(0.0492)	(0.0409)

LEXP_GR	-0.0178	-0.0172	-0.0413
	(0.056)	(0.061)	(0.0665)
LGGFCE_GR	-0.0859***	-0.0245	-0.2074*
	(0.0497)	(0.0748)	(0.0365)
LDS_GR	-0.0041	0.0213	-0.0221***
	(0.0113)	(0.0161)	(0.0113)
Observations	43	26	17
R^2	0.65	0.67	0.84

Notes: The dependent variable is the GDP growth rate from 1970 until 2013. _GR denotes growth. Standard errors in parentheses are White Noise corrected for heteroscedasticity. The estimation results correspond to trimming percentage of 15%. Asterisks *, **, and *** denote 1%, 5%, and 10% significance levels, respectively.

Based on the linear model estimation, we find that public debt-to-GDP growth (LPDEBT_GR) has a negative effect on GDP growth (LGDP) with coefficient of -0.1586 and this result is highly significant (at the 1% significance level). Meantime, the threshold model analysis provides a threshold value of 52.66%. In the lower regime, public debt has a highly significant positive effect on economic growth with coefficient of 0.2054. This result is interpreted as, on average, 1% increase in public debt will expand economic growth by 20.54%. In the upper regime, public debt has a negative effect on economic growth with coefficient of -0.1361. This result is significant at the 5% level. This means that, on average, 1% increase in public debt will reduce economic growth by 13.61%.

For the linear model, and the lower regime in the threshold model, gross fixed capital formation-to-GDP growth (LGFCF_GR) is found to be affecting LGDP positively, and the results are highly significant. As implied by the results, investment could contribute to higher economic growth when the country's debt position is below or not exceeding the optimal threshold level of public debt. This further suggests that within the sustainable level of public debt, government borrowing could be effectively transformed into development through greater investment. Nonetheless, in the upper regime, the result for LGFCF_GR is not significant. Therefore, even though we found the negative effect of LPDEBT_GR on LGDP, there is no evidence to support the debt-overhang phenomenon, such that a further increase in public debt will cause distortion in investment when the country's debt position is in the upper regime.

The results of regression also suggest that large public debt seems to have other adverse effects on the country's economic growth. One of effects is via the increase in general government final consumption expenditure-to-GDP growth (LGGFCE_GR). The result of linear model regression shows the coefficient of -0.0859 for this variable at the 10% significance level. In the threshold model, the result for this variable is significant only in the upper regime with coefficient of -0.2074 (the result is highly significant) showing a worse impact on LGDP. These results suggest that when the country's debt position is above the optimal threshold level, a higher LPDEBT_GR may coincide with an increase in LGGFCE_GR which is harmful to economic growth. Meanwhile, the result for LDS_GR in the upper regime shows the coefficient of -0.0221 with 10% significance level. This result simply implies that an additional 1% of debt service-to-GDP growth will lead to a decline in GDP growth by 2.21% if public debt position is above the optimal threshold level.

5. Summary and Conclusion

The main objective of this study is to determine the optimal threshold level of public debt for Malaysia. Other aim is to analyse the long- and short-run relationships between public debt and economic growth for the country.

The analysis begins with the testing for a unit root by using traditional unit root tests and the Zivot and Andrews (1992) one break unit root test. Basically, the results of the unit root tests are consistent. Having confirmed the stationarities of the variables are integrated at first difference *I*(1), we proceed to cointegration analysis for the possible long-run relationship between public debt (LPDEBT) and economic growth (LGDP). In order to give insight of external shocks in long-run, we utilize the cointegration test of Gregory-Hansen (1996) that allows for one structural break. The estimated results suggest that there exists a long-run relationship between LPDEBT and LGDP, and significant break points are captured in 1986, 1984, 1979, 1998, and 1999 which correspond to several important events that worth noting. Cointegration results in this study indicate shifts in the long-run relationship between LPDEBT and LGDP around the break dates. Further, we employ pairwise Granger causality approach and the results do not reveal any causality between LPDEBT and LGDP.

The last step of analysis is to determine the optimal threshold level of the country's public debt. We find that the threshold value is about 52.66% of the country's GDP. This threshold value is at the lower end of the range of standard international threshold level 60-90% as suggested by Reinhart and Rogoff (2010). In essence, the estimated threshold value implies that public debt starts to be deteriorating to the country's economic growth when it is over the level of 52.66% of the country's GDP. In the lower regime (below the threshold level), public debt is contributing towards a faster economic growth of the country. Within the sustainable level of public debt,

government borrowing could be effectively transformed into development through greater investment. As the result for the investment variable (gross fixed capital formation-to-GDP growth or LGFCF_GR) in the upper regime is insignificant, we do not obtain strong evidence to infer on debt-overhang based on the investment channel. However, the results of regression suggest that large public debt seems to have other adverse effects on the country's economic growth. When the country's debt position is above the optimal threshold level, a higher public debt-to-GDP growth (LPDEBT_GR) may coincide with an increase in general government final consumption expenditure-to-GDP growth (LGGFCE_GR). In addition, an increase in debt service-to-GDP growth (LDS_GR) will reduce economic growth if public debt position is beyond the optimal threshold level.

References

Abd Rahman, M. H. (2012). How Federal Government's Debt Affect the Level of Economic Growth? *International Journal of Trades, Economics and Finance,* 3(4), pp. 323-326.

Bal, D. P. and Rath, B. N. (2014). Public Debt and Economic Growth in India: A Reassessment. *Economic Analysis and Policy,* 44(3), pp. 292-300.

Cecchetti, S. G., Mohanty, M. S. and Zampolli, F. (2011). The Real Effects of Debt. *BIS Working Paper*, 352, Bank for International Settlements.

Dickey, D. A. and Fuller, W. A. (1979). Distributions of the Estimators for Autoregressive Time Series with a Unit Root. *Journal of American Statistical Association,* 74(366), pp. 427-481.

Eberhardt, M. and Presbitero, A. F. (2015). Public Debt and Growth: Heterogeneity and Non-linearity. *Journal of International Economics*, 97(1), pp. 45–58.

Égert, B. (2015). Public Debt, Economic Growth and Nonlinear Effects: Myth or Reality? *Journal of Macroeconomics,* 43, pp. 226-238.

Goh, S. K. and Michael Lim, M-H. (2010). The Impact of the Global Financial Crisis: The Case of Malaysia. TWN Global Economy Series, 26, Third World Network (TWN), Penang, Malaysia.

Gómez-puig, M. and Sosvilla-rivero, S. (2015). The Causal Relationship between Debt and Growth in EMU Countries. *Journal of Policy Modeling*, *37(6), pp. 974–989.*

Gregory, A. W. and Hansen, B. E. (1996). Tests for Cointegration in Models with Regime and Trend Shifts. *Oxford Bulletin of Economics and Statistics,* 58(3), pp. 555-560.

Hansen, B. E. (2000). Sample Spilitting and Threshold Estimation. *Econometrica,* 68(30), pp. 575-603.

Jayaraman, T. K. J. and Choong, C. K. (2006). Public Debt and Economic Growth in the South Pacific Islands: A Case Study of Fiji. *Journal of Economic Development,* 31(2), pp. 107–121.

Jernej, M., Aleksander, A. and Miroslav, V. (2014). The Impact of Growing Public Debt on Economic Growth in the European Union. *Amfiteatru Economic,* 16(35), pp. 403–414.

Panizza, U. and Presbitero, A. F. (2012). Public Debt and Economic Growth: Is There a Causal Effect? *Journal of Macroeconomics,* 41, pp. 21-41.

Phillips, P. and Perron, P. (1988). Testing for a Unit Root in Time Series Regression. *Biometrica,* 75(2), pp. 335-346.

Puente-Ajovín, M. and Sanso-navarro, M. (2015). Granger Causality between Debt and Growth : Evidence from OECD Countries. *International Review of Economics and Finance*, 35, pp. 66-77.

Reinhart, C. M. and Rogoff, K. S. (2010). Growth in a Time of Debt (Digest Summary). *American Economic Review,* 100(2), pp. 573–578.

Reinhart, C. M., Reinhart, V. R. and Rogoff, K. S. (2012). Public Debt Overhangs: Advanced-economy Episodes Since 1800. *Journal of Economic Perspectives,* 26(3), pp. 69-86.

Sen, A. (2003). On Unit-root Tests When the Alternative is a Trend-break Stationary Process. *Journal of Business and Economic Statistics,* 21(1), pp. 174-184.

Spilioti, S. and Vamvoukas, G. (2015). The Impact of Government Debt on Economic Growth: An Empirical Investigation of the Greek Market. *The Journal of Economic Asymmetries,* 12(1), pp. 34-40.

Zivot, E. and Andrews, D. W. K. (1992). Further Evidence on the Great Crash, the Oil Price Shock, and the Unit Root Hypothesis. *Journal of Business and Economic Statistics*, 10, pp. 251-270.