Threshold Level of Debt: The Malaysia Experience

Masoomeh Hashemi Nabi[1], Zukarnain Zakaria[2], and Rossilah Jamil[1]
[1]Azman Hashim International Business School, UniversitiTeknologi Malaysia
[2] Department of Community Medicine, International Medical University

Abstract

In Malaysia, the government debt is in increasing trend. If the debt reaches its unsustainable level, this could affect the stability of the country as unsustainable debt could lead to sharp adjustment, if not a crisis. For this reason, assessing public debt threshold level is very important especially when considering the current level of public debt situations in Malaysia. Therefore, the main objective of this paper is to determine the threshold levels of public debt for Malaysia by examining the link between public debt and the economic growth. Specifically, this paper evaluates Malaysian government capability of running a public debt in the long run and remains solvent using quarterly time series data spanning the period 1990 -2015. Estimation techniques OLS, Spline regression technique, and VECM were employed to ensure the robustness of the results. The results show there is a negative long run relationship between public debt and economic growth of Malaysia. The result also shows the existence of the debt threshold level of 60% of GDP of Malaysia.

Keywords: *Public debt, Debt Threshold, Economic Growth, Vector Error Correction Models (VECM), Malaysia*

1. Introduction

Public debt is the total amount, including total liabilities, borrowed by the government to meet its development budget. Government debt relates to how much a country owes and is owed by a central government which acts as the liability of the nation. Changes in government debt over time is the outcome of government budget deficits. Budget deficit and public debt are interrelated as they affect each other. There has been a strong interest among policy makers and academician in the effect of public debt on economy, particularly since the impact of Asian financial crisis and the global financial crisis. This is because during those periods Malaysia budgets deficits normally were financed by debts.

Economists generally agreed countries that continuously in debt may suffer a slower growth, and more prone to economic and financial instability. Several studies have looked at the relationship between these two variables. For example, Pattillo, Poirson, and Ricci (2004) found that, at the low level, debt positively affect economic growth. However, at the high level, debt would negatively affect economic growth. Study by Krugman (1988) and Sachs (1989) exhibited a negative effect of debt on growth. In case of Malaysia, Aslam and Jaafar (2020)finds a negative impact of public debt on economic growth. Meanwhile, Cunningham (1993) finds a negative and significant impact of the public debt on the economic growth in for Bangladesh, Malaysia,

[1]*Corresponding author: masoomeh.hasheminabi@gmail.com*
Azman Hashim International Business School, Universiti Teknologi Malaysia

Indonesia, South Korea, Philippines, Thailand and Sri Lanka. Karagol (2012) investigated short term and long-term external debt and economic growth relation in Turkey. The study showed in the long run, external debt and economic growth are negatively related. In contrast, Ahmed and Miller (2000)find no relationship between public debt and economic growth of South-East Asian and South Asian countries.

Number of previous studies have provided evidence on the negative relationship between growth and debt of a country. For example, long term negative relationship was found by Mitze and Matz (2015)that investigated the relationship between economic output and regional public debt in German federal states from 1970 to 2010. Gómez-Puig and Sosvilla-Rivero (2015) found evidence of negative Granger causality between growth and many countries' sovereign debt. Siddique, Selvanathan, and Selvanathan (2015)that examined short-run and long-run external debt and economic growth relationships in 40 HIPCs found debt as a share of GDP negatively influence growth. In contrast, Panizza and Presbitero (2013)and Puente-Ajovín and Sanso-Navarro (2015)could not identify negative Granger causality between economic growth and sovereign debt of OECD nations.

Subsequently, this has prompted researchers to determine the threshold level for debt. For example, Reinhart and Rogoff (2010) that examined the relationship between public debt, growth and inflation for both developed and developing countries found the threshold level for government debt at 90% over GDP. The study also found government debt reduces the growth of developed country by 1%, while for developing countries by 2.9%. Caner, Grennes, and Koehler-Geib (2010) also examine the threshold level of debt for developed and developing countries. For the full sample, they found the threshold level of debt is 77%, while for a sub-sample of developing countries, the threshold level is 64% of the GDP.

In the 1990s, Malaysia total outstanding public debt reached an all-time high of 80.7% and a record low of 31.8%. From 1990 to 2018, an average Malaysia's public debt accounted about 50.2% of the country's GDP. To ensure the debt level is manageable, Malaysia has set the self-imposed limit on the public debt. These government self-imposed debt ceiling, however, has been raised multiple times, from 40% in 2003 to 45% in 2008. In 2009, the limit has been increased to 55%, and recently the ceiling was raised temporarily to 60% from last August to end-2022 to bolster Malaysia fiscal position to counter the impact of the Covid-19 pandemic. Even though the ratio of debt to GDP has breached the 55% limits, the Ministry of Finance claims that the debt is still manageable. Therefore, this study seeks to verify this by estimating the threshold level of public debt for Malaysia based on the approach introduced by Khan and Ssnhadji (2001)).

2. Data and Methodology

This study uses quarterly data from 1990 to 2015. For the two main variables, real output growth and public debt, data were obtained from the Thomson Reuters DataStream. The output growth was computed as a change in the real GDP. This paper also employs additional variables such as government revenue and government expenditure, terms of trade (measured as a ratio of export to import), real interest rate, consumer price index, inflation rate, and nominal exchange rate. In the estimation, all data are transformed into logarithm form.

In estimating the threshold level for public debt, this paper follows the same approach as Khan and Ssnhadji (2001)); the technique that they used in threshold analysis for inflation. Using a similar technique, the threshold effect of public debt on economic growth is estimated using the following equation.

$$\Delta gdp_t = \nu_1 X_{t-i} + \gamma_i fiscal_{t-i} + \delta\rho_j[fb_\pi - fb^*] + \varepsilon_t \quad (1)$$

where,

$$\rho_j = \begin{cases} 1: iffb_\pi > fb^* \\ 0: iffb_\pi \leq fb^* \end{cases} \quad (2)$$

Δgdp_t is the change in logs of real GDP, X_{t-i} is a vector of controlled variables (CPI, terms of trade, interest rate and nominal exchange rate), $fiscal_{t-i}$ is a vector of fiscal variables including government expenditure and government revenue (all scaled by GDP), ρ_j is a dummy variable for the public debt, fb^* is the threshold level for public debt which determined arbitrarily based on the value of mean and standard deviation of the series, while ν_1, γi and δ are parameters to be determined, and ε_t is the disturbance term which is independent and identically distributed (*iid*), and, i and $j = 0,1, \ldots$. Parameter fb^* represents the threshold level for public debt ratio. Parameter fb^*represent the threshold level for public debt ratio, while fb_π represent the public debt. The parameter of interest is δ as it determines the existence of a threshold effect of public debt on real GDP growth.

In addition, this study used a spline regression technique, where in Equation (3), ρ_j capture the actual debt levels.

$$\rho_j = \begin{cases} fb_\pi: iffb_\pi > fb^* \\ 0: iffb_\pi \leq fb^* \end{cases} \quad (3)$$

This specification allow for marginal effects of public debt on growth to vary around the threshold value (fb^*) (Adam, Cobham, & Kanafani, 2004). Similarly, the value of fb^* is determined arbitrarily based on the mean and standard deviation values of public debt to GDP ratio, while the threshold level is determined by the fb^* that minimizes the residual sum of the squares (RSS) of the utilized equations in estimation.

The study also used spline regression technique in the Vector Error Correction Model (VECM) framework to investigate the threshold effect of public debt on economic growth in Malaysia. For this, the arbitrary threshold parameters are treated as exogenous variable in the VECM model to determine the threshold level that minimizes the residual sum of squares. In addition, the study also employed different sets of explanatory variables in the VECM analysis to check the robustness of the OLS estimates.

The data are subjected to unit root using Augmented Dickey Fuller (ADF) and Phillip-Perron (PP) test before carrying out the appropriate estimation (Table 1). In general, the results from the unit root tests show that all series involved in this study are stationary at first different. Therefore, the first difference will be used in the subsequent estimation process.

Table 1: Stationary properties of the data

Note: ** significance at 5%. Figure in ( ) is critical value. Figure in [ ] is lag length for ADF and bandwidth for PP test. Critical values for 5% is -2.889 for intercept analysis, while -3.454 is for intercept and trend analysis. All data are in logarithm.

3. Estimation Results and Findings

Multivariate co-integration analysis

The analysis begins with examining the long-run relationship between real GDP growth and the variables studied. For this purpose, the Johansen co-integration tests were conducted on multivariate Vector Autoregressive (VAR) models consisting of GDP growth, public debt, external debt, domestic debt, interest rate, consumer price index, exchange rate and terms of trade. The result from the test is presented in Table 2. The trace tests show that there is three cointegration vector between the variables. The result suggests there is a long-run co-movement between these variables.

Table 2: Result from multivariate cointegration tests

Variables	H_0	Trace Statistic	%5 Critical Value	Maximum Eigenvalue	%5 Critical Value	Conclusion
ΔGDPGR, ΔPD, ΔDD, ΔED, ΔIR, ΔCPI, ΔER, ΔTT	*r = 0*	**236.78***	156.00	**67.80***	51.42	Trace test indicates 3 cointegrating equation at 0.05 significant levels
	r ≤ 1	**168.98***	124.24	**53.79***	45.28	
	r ≤ 2	**115.18***	94.15	**48.23***	39.37	
	r ≤ 3	66.95	68.52	22.40	33.46	
	r ≤ 4	44.54	47.21	21.32	27.07	
	r ≤ 5	23.22	29.68	16.36	20.97	
	r ≤ 6	6.85	15.41	6.790	14.07	
	r ≤ 7	0.06	3.76	0.067	3.76	

Note: Δ indicates first difference, * Significant at 5%. **Significant at 1%

Threshold level of public debt

In estimating the threshold level for public debt, the first step is to determine the arbitrary threshold levels. In this study, the arbitrary levels are determined based on the mean and standard deviation values of the debt series. Based on these two values, the arbitrary threshold levels (*fb**) between 40% and 90% of GDP will be used in this study. The results from the Ordinary Least Square (OLS) estimation with dummy variable for the arbitrary threshold levels for public debt are shown in Table 3.

The estimation results in Table 3 show Model 5 with the threshold level higher than 60% of GDP outperformed other models based on the selection criterion suggested by Khan et al. (2001). Specifically, Model 5 has the lowest residual sum of squares, AIC and SBC, higher likelihood, highest R-square, and passed the entire diagnostics tests at 5% significant levels. The finding suggests the threshold level for Malaysia public debt

is 60% of the GDP. Thus, a public debt higher than 60% of GDP could negatively affects Malaysian economic growth.

This study also used spline regression techniques as a robustness check to the OLS and dummy model. For this, the same ranges of arbitrary threshold (40% to 90% of GDP) have been used, and the significant *fb** is chosen as the threshold level. The model was estimated in the VECM framework that included all the arbitrary threshold levels as exogenous variable. Table 4 provides the results that obtained from spline regression and VECM.

In general, the threshold analysis using VECM framework supports the results obtained from the OLS methods. Model 5 with the public debt threshold level *fb*> 60%* of GDP outperformed other models in Table 4. Model 5 is the model with the lowest residual sum of squares, lowest AIC and SBC, and highest likelihood ratio and R-square. This confirms the earlier results from OLS estimation that Malaysia's public debt threshold level is 60% of GDP. The result implied that if Malaysian public debt is higher than 60% of GDP, it could negatively affect the economic growth.

Table 3: Threshold Estimations from a series of OLS Regressions

variable	Model1	Model2	Model3	Model4	Model5	Model6	Model7	Model8	Model9	Model10	Model11
Intercept	-23.415 [-0.486]	-17.562 [-0.351]	-40.465 [-0.854]	-26.682 [-0.570]	-24.670 [0.541]	-22.293 [-0.488]	-23.168 [-0.506]	-22.979 [-0.496]	-19.434 [-0.423]	-24.285 [-0.526]	-20.992 [-0.459]
ΔGOVR	-7.883 [-1.056]	-9.042 [-1.179]	-2.927 [-0.382]	-7.577 [-1.153]	-7.601 [-1.163]	-8.053 [-1.238]	-7.924 [-1.216]	-7.905 [-1.219]	-7.949 [-1.228]	-8.030 [-1.224]	-7.472 [-1.142]
ΔGOVEXP	3.961 [0.701]	3.497 [0.664]	4.895 [0.972]	4.372 [0.840]	4.452 [0.856]	3.701 [0.726]	3.909 [0.757]	3.909 [0.768]	3.520 [0.698]	4.046 [0.979]	3.837 [0.770]
Debt>0.40 GDP	0.0002 [0.006]										
Debt>0.45 GDP		-0.008 [-0.277]									
Debt>0.50 GDP			0.033 [1.194]								
Debt>0.55 GDP				0.008 [0.301]							
Debt>0.60 GDP					-0.009 [-0.358]						
Debt>0.65 GDP						-0.006 [-0.255]					
Debt>0.70 GDP							-0.0007 [-0.029]				
Debt>0.75 GDP								-0.0009 [-0.041]			
Debt>0.80 GDP									-0.014 [-0.589]		

Debt>0.85 GDP										0.003 [0.123]	
Debt>0.90 GDP											-0.012 [-0.468]
AIR	0.451 [2.526]*	0.458 [2.689]*	0.466 [2.776]*	0.456 [2.693]*	0.452 [2.679]*	0.452 [2.680]*	0.451 [2.675]*	0.451 [2.674]*	0.452 [2.685]*	0.453 [2.678]*	0.444 [2.623]*
ΔCPI	-7.174 [-0.977]	-7.697 [-1.064]	-4.411 [-0.602]	-7.550 [-1.064]	-7.348 [-1.049]	-7.105 [-1.015]	-7.180 [-1.026]	-7.149 [-1.013]	-6.818 [-0.972]	-7.394 -1.028]	-6.775 [-0.962]
Δ $RGDP_{t-1}$	0.887 [9.526]*	0.889 [9.583]*	0.890 [9.680]*	0.884 [9.487]*	0.881 [9.376]*	0.891 [9.466]*	0.887 [9.513]*	0.888 [9.445]*	0.898 [9.523]*	0.886 [9.528]*	0.887 [9.596]*
Δ TT	14.730 [0.910]	15.132 [0.950]	11.408 [0.713]	15.252 [0.956]	14.570 [0.918]	14.764 [0.930]	14.754 [0.929]	14.669 [0.917]	13.958 [0.877]	15.152 [0.934]	13.721 [0.857]
R-squared	0.628	0.629	0.630	0.629	0.637	0.632	0.634	0.632	0.633	0.631	0.632
Sum Squared residual	1671.904	1670.555	1674.807	1670.310	1647.206	1670.761	1671.890	1671.876	1665.832	1671.638	1668.060
Akaike info criterion	5.780	5.779	5.765	5.779	**5.762**	5.780	5.781	5.783	5.777	5.780	5.778
Schwarz criterion	5.985	5.984	5.970	5.983	5.941	5.984	5.985	5.984	5.981	5.986	5.983
Durbin-Watson stat	1.370	1.372	1.383	1.375	1.348	1.368	1.369	1.370	1.371	1.368	1.367
Log likelihood	-289.680	-289.639	-288.914	-289.611	**-298.632**	-289.645	-289.681	-289.680	-289.493	-289.672	-289.562

Note: Δ indicates first difference, figures in [] are t-statistics, *significant at 5% level.

Table 4: Threshold Estimations from VECM Models with Spline Regression Technique

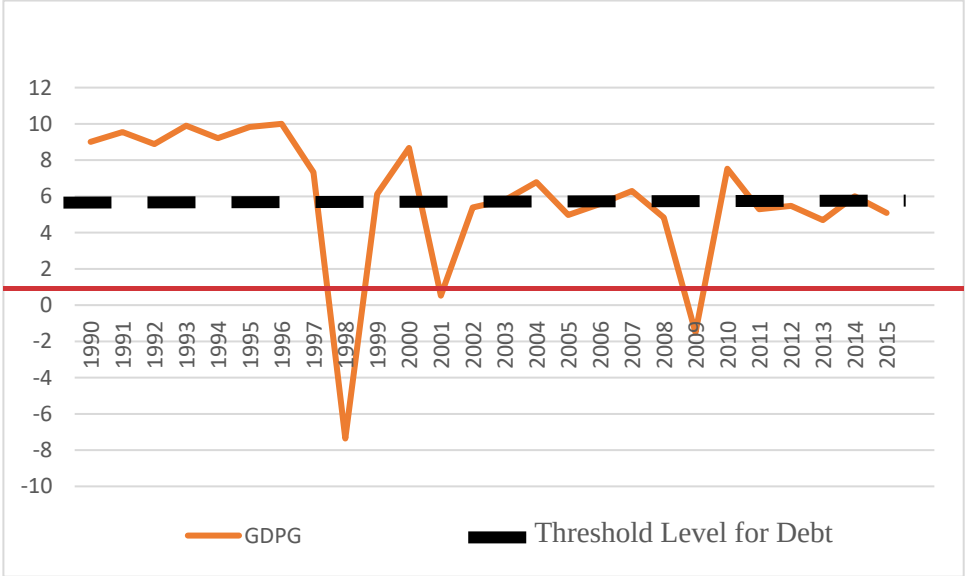
Error Correction Model:											
	Model1	Model 2	Model 3	Model 4	Model 5	Model6	Model7	Model8	Model9	Model10	Model11
Adjustment Coefficients	-0.669 [-6.728]	-0.702 [-7.306]	-0.691 [-7.772]	-0.708 [-7.406]	-0.681 [-7.947]	-0.741 [-7.591]	-0.753 [-7.755]	-0.738 [-7.424]	-0.744 [-7.242]	-0.696 [-7.271]	-0.749 [-7.662]
$GDPG_{t-1}$	0.631 [6.740]	0.598 [6.843]	0.577 [6.872]	0.601 [6.892]	0.570 [6.965]	0.606 [7.002]	0.588 [6.980]	0.617 [6.977]	0.598 [6.732]	0.594 [6.843]	0.638 [7.266]
$GOVREV_{t-1}$	5.237 [0.306]	-2.842 [-0.167]	8.448 [0.500]	-3.176 [-0.186]	0.969 [-0.059]	-8.008 [-0.476]	-10.984 [-0.661]	-12.025 [-0.704]	-11.608 [-0.676]	0.350 [0.021]	-14.045 [-0.841]
$CAPEXP_{t-1}$	0.082 [0.075]	-0.527 [-0.477]	-0.338 [-0.319]	-0.707 [-0.645]	-0.410 [-0.392]	-0.967 [-0.877]	-1.209 [-1.100]	-0.798 [-0.725]	-1.262 [-1.108]	-0.725 [-0.658]	-0.950 [-0.874]
IR_{t-1}	-0.461 [-2.160]	-0.580 [-2.694]	-0.704 [-3.165]	-0.534 [-2.489]	-0.656 [-3.117]	-0.511 [-2.436]	-0.554 [-2.659]	-0.514 [-2.434]	-0.456 [2.141]	-0.557 [-2.578]	-0.503 [-2.430]
CPI_{t-1}	-88.886 [-1.791]	-92.207 [-1.817]	-73.450 [-1.501]	-68.276 [-1.364]	-71.526 [-1.479]	-49.417 [-0.983]	-37.544 [-0.749]	-60.831 [-1.207]	-41.673 [-0.807]	-74.789 [-1.498]	-60.259 [-1.217]
Intercept	0.482 [1.027]	0.469 [0.987]	0.379 [0.824]	0.304 [0.646]	0.338 [0.742]	0.157 [0.335]	0.063 [0.135]	0.223 [0.472]	0.090 [0.187]	0.368 [0.781]	0.213 [0.457]
Debt>0.40 GDP	0.073 [2.201]										
Debt >0.45 GDP		-0.022 [-0.566]									
Debt >0.50 GDP			-0.019 [-0.562]								
Debt >0.55 GDP				0.135 [0.669]							
Debt >0.60 GDP					-0.010 [-0.546]						

Debt >0.65 GDP						0.001 [0.057]					
Debt >0.70 GDP							0.004 [0.222]				
Debt >0.75 GDP								-0.007 [-0.408]			
Debt >0.80 GDP									0.0007 [0.029]		
Debt >0.85 GDP										-0.014 [-0.676]	
Debt >0.90 GDP											0.008 [0.439]
R-squared	0.514	0.5133	0.534	0.516	**0.544**	0.526	0.535	0.517	0.508	0.515	0.531
Sum Sq. residual	970.344	971.046	930.692	964.882	**908.710**	944.960	926.804	963.570	980.833	968.352	935.867
F-statistic	14.033	14.012	15.197	14.188	**15.883**	14.767	15.316	14.255	13.741	14.089	1.039
Log likelihood	-257.571	-257.607	-255.464	-257.286	**-258.262**	-256.232	-255.252	-257.217	-258.114	-257.467	255.774
Akaik AIC	5.2588	5.259	5.217	5.253	**5.193**	5.232	5.213	5.252	5.270	5.257	5.223
Schwarz criterion	5.4659	5.467	5.424	5.460	**5.400**	5.439	5.420	5.459	5.477	5.464	5.430

Note: [] indicates t-statistics. * denote 5% alpha level.

Figure 1 displays the graphical analysis of the Malaysian public debt and economic growth, with the horizontal line representing the estimated public debt threshold level of 60%. The graphical analysis shows that the Malaysian debt ratio to GDP is below the estimated threshold level of 60% except between 1990 to 1992 which were higher than the estimated threshold level. The estimated 60% threshold level of this study is same with the new stationary debt level recently decided by the Malaysia government, in order to cover increase in its expenditure due Covid-19 pandemic.

Figure 1: Threshold level for Public Debt



4. Conclusion

This study examined the link between public and economic growth in Malaysia using quarterly data from 1990 to 2015. Following the work of Khan and Ssnhadji (2001)), this study used both Ordinary Least Square (OLS) for short run dynamic and VECM for long run analysis, incorporating spline regression techniques in both methods. The result shows the existence of the debt threshold level of 60% of GDP in the case of Malaysia for the sample period. The result was robust to different econometric technique and model specification. The findings from this study suggest that a debt level below 60% of GDP would stimulate stable economic growth for Malaysia, while the debt higher than 60% of GDP would be detrimental to long run economic growth. Based on Malaysia public debt figure and the threshold level, then we can conclude the situation for Malaysia, whether the current debt already detrimental to the growth or not. Or could be Malaysia debt is still too low for it negatively affect the growth. This study amplifies the urgency for fiscal restraint to ensure the sustainable economic growth in Malaysia.

REFRENCES

Adam, C., Cobham, D., & Kanafani, N. (2004). Budgetary and fiscal policy. In *The Economics of Palestine: Economic Policy and Institutional Reform for a Viable Palestinian State* (pp. 63-89): Routledge.

Ahmed, H., & Miller, S. M. (2000). Crowding-out and crowding-in effects of the components of government expenditure. *Contemporary Economic Policy*, *18*(1), 124-133.

Aslam, M., & Jaafar, R. (2020). Budget Deficit and the Federal Government Debt in Malaysia. *Perspectives on Economic Development Public Policy, Culture, and Economic Development*.

Caner, M., Grennes, T., & Koehler-Geib, F. (2010). Finding the tipping point--when sovereign debt turns bad.

Cunningham, R. T. (1993). The effects of debt burden on economic growth in heavily indebted developing nations. *Journal of economic development*, *18*(1), 115-126.

Gómez-Puig, M., & Sosvilla-Rivero, S. (2015). On the bi-directional causal relationship between public debt and economic growth in EMU countries. *Available at SSRN 2604869*.

Karagol, E. (2012). The causality analysis of external debt service and GNP: The case of Turkey. *Central Bank Review*, *2*(1), 39-64.

Khan, M. S., & Ssnhadji, A. S. (2001). Threshold effects in the relationship between inflation and growth. *IMF staff papers*, *48*(1), 1-21.

Krugman, P. (1988). Financing vs. forgiving a debt overhang. *Journal of development Economics*, *29*(3), 253-268.

Mitze, T., & Matz, F. (2015). Public debt and growth in German federal states: What can Europe learn? *Journal of Policy Modeling*, *37*(2), 208-228.

Panizza, U., & Presbitero, A. F. (2013). Public debt and economic growth in advanced economies: A survey. *Swiss Journal of Economics and Statistics*, *149*(2), 175-204.

Pattillo, C. A., Poirson, H., & Ricci, L. A. (2004). What are the channels through which external debt affects growth?

Puente-Ajovín, M., & Sanso-Navarro, M. (2015). Granger causality between debt and growth: Evidence from OECD countries. *International Review of Economics & Finance*, *35*, 66-77.

Reinhart, C. M., & Rogoff, K. S. (2010). Growth in a Time of Debt. *American economic review*, *100*(2), 573-578.

Sachs, J. (1989). The Debt Overhang of Developing Countries," in G.A. Calvo, R. Findlay, P. Kouri and J. B. de Macedo, (eds.), Debt Stabilization and Development, Basil Blackwell, Oxford and Cambridge, MA, pp. 80-102.

Siddique, A., Selvanathan, E. A., & Selvanathan, S. (2015). *The impact of external debt on economic growth: Empirical evidence from highly indebted poor countries*: University of Western Australia, Economics.