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Fiscal sustainability in an emerging market economy: When does public debt turn bad?

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Abstract

This paper proposes a Markov-switching model to assess the sustainability of fiscal policy in Malaysia for the period 1980–2014. Our results indicate the policymakers in the past have followed a sustainable fiscal policy, except during the brief periods of economic difficulty. The empirical analysis reveals that the government should cut the deficits only if they exceed a certain level, to ensure their sustainability in the long-run. Specifically, we find that after public debt exceeds a certain threshold level (above 55% of the gross domestic product), it is negatively correlated with economic activity. In addition to the threshold effect, we confirm the presence of a unidirectional causal relation between debt and growth.

JEL classification: E62; F34; H63

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1. Introduction

One of the most challenging issues faced by both developed and developing countries in recent years are dealing with the accumulation (size) of public debt. A build-up of public debt can

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adversely affect economic progress through several channels (higher long-term interest rates, higher taxation, greater uncertainty, vulnerability to crises, etc.), especially when their level exceeds a certain threshold. In addition, fiscal sustainability is most likely to be aggravated in those countries experiencing debt distress. On the contrary, a low level of public debt allows the fiscal policy to play more of a stabilizing role during economic downturns and dampens, or at least does not exacerbate, economic cycles.[1] Maintaining fiscal sustainability is important to obtain enough "*fiscal space*" for orderly adjustments to mitigate the impacts of financial crises. The recent global financial crisis (GFC) is a case in point. A sustainable debt ratio is one such that the government has no incentive to default on its internal debt. From another perspective, the notion of sustainability implies that there is a limit to the flexibility of fiscal policy as a stabilization policy tool.

This paper has two main objectives. The first is to examine the sustainability of fiscal policy over the period from 1980:Q1 to 2014:Q3, including the Asian financial crisis (AFC) and the recent GFC.[2] The usual approach applied to investigate the behavior of a nation's fiscal stance is based on the intertemporal budget constraint (IBC) of the government (Mahdavi & Westerlund, 2011). Fiscal policy is considered sustainable if it satisfies the IBC in present-value terms—that is, the current level of debt equals the present discounted value of primary surpluses. To examine the sustainability of budget deficits, many researchers rely on the evidence from unit-root tests of which rejection imply sustainability.[3] Adding to concerns about fiscal deficits is the fear that public debts have reached levels that might hinder economic growth and the starting of a debt, growth and high employment vicious circle. It is widely accepted that, with a moderate level of public debt, fiscal policy can induce economic growth, but at high levels of public debt, the expected tax increases will mitigate the positive results of the fiscal outcome, decreasing investment and consumption, reducing employment, and lowering growth rates of the gross domestic product (GDP).[4] Since the subprime crisis that began in the US in 2007, many countries around the world have found themselves with high ratios of debt-to-GDP. These are due to high budget deficits as a result of declining tax revenue and rising public spending due to economic slowdown. In times like these, the central question that arises concerns the relationship between public debt and economic growth. Specifically, we try to provide an answer whether fiscal policy has a Keynesian or non-Keynesian effects on economic activity.

Like the other Asian countries, Malaysia is concerned about the large debts as they could derail the sound economic growth experienced before the GFC. This brings us to the second objective of the study—that is, to investigate the existence of a threshold level of public debt in

[1] By comparing the 1980s with the 1990s, Pattillo, Poirson, and Ricci (2002) observed that economic growth for the panel of 98 developing countries (Malaysia included) declined during the early period when total debt was accumulating but accelerated during the 1990s when debt reduction occurred.

[2] During the AFC, the region suffered a massive reversal of capital inflows as investor confidence in the region fall. During the GFC, financial institutions in the US and Europe, withdrew their funds from Asia in order to support their badly damaged balance sheet at home.

[3] Most of the analysis conducted in the past has in fact provided mixed results. The outcome of these tests depends on the length of sample period and whether breaks are accounted for to account for the financial crisis and the slowing down of economic activities, among other things; see Baharumshah and Lau (2007) and articles cited therein.

[4] High levels of debt may place serious constraints on a nation's ability to conduct countercyclical policies and thus increase output volatility and reduce economic growth. However, the relationship between debt and the ability to conduct countercyclical policy is more likely to depend on the composition of public debt rather than on the level of public debt. Therefore, countries with different debt structures and monetary arrangements are likely to start facing problems at very different levels of debt.

the debt-growth nexus and the effect of the tipping point(s) on economic growth. Reinhart and Rogoff (2010), whose work has garnered a great deal of attention, alluded to debt ratios above 90% (60%) as detrimental to economic growth for the advanced countries (emerging market economies).[5] Their work was based on a large set of countries, which had major variations in the quality of their economic and political institutions.[6] A number of studies that followed this seminal paper to investigate the debt-growth nexus broadly confirmed their findings, showing that the turning point beyond which debt sharply slows economic growth is a ratio of around 90%; see Cecchetti, Mohanty, and Zampolli (2011, 85% of GDP) for member countries of the Organization for Economic Cooperation and Development (OECD) and Baum, Checherita-Westphal, and Rother (2013, 95% of GDP) for the Eurozone countries. To further support their empirical findings, Baum et al. (2013) showed that interest rates are subject to increased pressure when the debt-to-GDP ratio rises above 70% level.

Our research is closely related to Caner, Grennes, and Koehler-Geib (2010) and Égert (2015), who based their empirical analysis on a threshold regression. Caner et al. (2010) apply a two-regime model developed by Hansen (1999, 2000) and found that the negative nonlinear correlation between debt and economic growth kicks in when the public debt level in 101 countries is around 77% of debt-to-GDP ratio.[7] According to these authors, the effect more pronounced in the developing economies, including Malaysia (threshold is around 64%). Égert (2015) conducted a similar study, but finds that in very rare cases when the nonlinearity like that in Reinhart and Rogoff (2010) can be detected. Égert (2015) also provides a lower threshold band (between 20% and 60%) for public debt, which clearly excludes the point estimates reported in some of the earlier studies. They conclude by pointing out that the nonlinear effects might be more complex and difficult to model than previously thought (p. 238). Whether there is a tipping point in the level of public debt above which a nation's economic progress is dramatically compromised is critically important to determine because of its implications for debt accumulation. If there is no such clear threshold level, and the evidence suggests that weak growth causes high debt, rather than the other way around, then higher priority should be placed on increasing growth, rather than on reducing debt level. Such a conclusion would indicate that much less fiscal austerity is appropriate to attain sustainable growth in the aftermath of GFC.

This paper differs from previous literature in the following ways: First, we apply a Markov-switching nonlinear framework to test for fiscal sustainability. The sheer size of the deficits during that period contributed to justifiable concern about sustainability.[8] This approach allows not only for shifts in the mean but also the variance in the series being examined. The methodology allows us to determine whether the government debt-to-GDP ratio is stationary after considering major regime shifts in the data generating process. Second, we apply a threshold regression using public

[5] Cecchetti et al. (2011) and Checherita and Rother (2010) found that the negative correlation between debt and growth becomes particularly stronger when debt level approaches 100% of GDP. The threshold level also referred to as "tipping point" has received much attention in recent years because many countries have reached or expected to cross this point in near future.

[6] Their analysis was based on descriptive statistics. For the emerging market economies, the analysis reveals that when the debts exceed the threshold of 90%, GDP growth rate drops by two percentage points. While Reinhart and Rogoff (2010) and others consider a one threshold model, our study provides a complementary evidence based on two thresholds.

[7] For a recent survey of studies on the public debt-growth nexus, see Mitze and Matz (2015).

[8] If the interest rate is higher than the growth rate of GDP, the ratio of debt-to-GDP will tend to rise and poses serious challenges, while if it is lower, the debt will tend to decline, for a given level of the primary balance. Narayanan (2012) pointed out that the growth of debt has outpaced the growth of GDP, suggesting that economic growth (after 1997 crisis) has been unable to absorb the increasing debt.

debt as threshold variable to show economic growth is negatively affected when the debt level exceeds a certain tipping point(s). Unlike previous studies, the empirical analysis allows for three regimes.[9] Third, we test the causality interplay of debt-growth nexus and answer the question of when the debt goes bad for the Malaysian economy. We also depart from previous studies by formally showing that public debt Granger cause economic growth and not vice versa. The latter finding implies that expansionary fiscal policies that increase in the level debt (above the tipping point(s)) may reduce economic growth, and hence partly negate the positive effects of fiscal stimulus.[10]

The rest of this paper organized as follows. Section 2 briefly reviews the theoretical framework. Section 3 discusses the statistical strategy utilized in the analysis. The empirical results are interpreted in the following section, and the final section contains the conclusion and policy implications of this study.

2. Fiscal sustainability hypothesis

An approach to fiscal sustainability can be presented as follows, called the Government Budget Identity (GBI):[11]

$$G_t + (1 + r_t)Debt_{t-1} = R_t + Debt_t, \tag{1}$$

where G_t is the level of government primary expenditure, r_t is the interest rate, R_t is the level of government revenue, and $Debt_t$ is the debt level at time $t = 1,\ldots,T$. Therefore, the level of debt can be expressed as $Debt_t = \phi_t(R_{t+1} - G_{t+1} + Debt_{t+1})$, where $\phi_t = (1 + r_{t+1})^{-1}$. By repeating substitutions, assuming a constant future interest rate and solving forward, the IBC can be derived, which is equivalent to the expected present value constraint: $Debt_t = \sum_{i=1}^{\infty}\phi^i E_t(R_{t+i} - G_{t+i})$, which will hold as long as the $\lim_{n\to\infty} \phi^n E_t(Debt_{t+n}) = 0$ (transversality condition) is satisfied. In other words, public debt is sustainable if the government does not engage in a Ponzi scheme. The integrated property of the debt ratio is highly debated in the literature. Some studies (e.g., Ahmed & Rogers, 1995; Chen, 2014; Hamilton & Flavin, 1986; Holmes, Otero, & Panagiotidis, 2010) investigate the time series property of the fiscal indicators. However, Bohn (2007) argues that the use of purely time series methods (e.g., a unit-root test) to test sustainability is invalid. In particular, the author claims that any order of integration of debt is in fact consistent with the transversality condition. Eq. (1) can be rearranged and presented as the responsiveness of primary surplus to the debt-GDP level as:

$$\frac{(R - G)_t}{GDP_t} = (i - g)\frac{Debt_{t-1}}{GDP_{t-1}}, \tag{2}$$

[9] Earlier studies relied on spline functions (e.g., Pattillo et al., 2002) or histograms (Reinhart & Rogoff, 2010) to determine the threshold level. The only study we are aware of using a two thresholds model for testing the debt-growth nexus is Baum et al. (2013) but for a set of European Union countries.

[10] In this paper, we do not address the issue whether fiscal expansions always lead to an increase in debt. For a more discussion on this point; see DeLong and Summers (2012).

[11] A majority of the theoretical discussion is taken from Byrne, Fiess, and MacDonald (2011, p. 139).

where g is the growth rate of nominal GDP. Accordingly, the budget balance response function can be expressed as:

$$\frac{(R-G)_t}{GDP_t} = \beta_1 + \beta_2 \frac{Debt_t}{GDP_t} + u_t. \tag{3}$$

The expected sign for β_2 is positive, which indicates fiscal probity on the part of the government. Any increase in debt is reflected in an increase in the government balance, that is, evidence of the sustainability of the implemented fiscal policy path. Rising debt ratios lead to a higher primary surplus/GDP, which exerts a tendency toward mean reversion.

3. Methodology and data description

Recent literature has recognized that borrowing (debts) variables do not follow a linear path (Doğan & Bilgili, 2014; Raybaudi, Sola, & Spagnolo, 2004; Wagner & Elder, 2005).[12] The switching regression approach was popularized by Hamilton (1989), applying a two-regime autoregression to the quarterly growth rate in the real US gross national product, in which the regimes exogenously switched according to an unobserved Markov process. Because tax revenue clearly depends on GDP, it seems logical to estimate a switching regression for tax revenue. By permitting switching between these N regimes, in which the dynamic behavior of the series is markedly different, more complex dynamic patterns can be characterized. The switching mechanism is controlled by an unobservable state variable that follows a first-order Markov chain.[13]

Following Hamilton (1989), we use Markov-switching intercept autoregressive heteroskedasticity error correction model (MSIAH-ECM) to test the sustainability of fiscal policy. The MSIAH model considers a full parameter shift as well as the change in the variance of the residuals. Specifically, the particular feature of this model is that it allows for different behavior in different states of nature. The model with switching in the mean, error variance, and the coefficients of exogenous regressors is presented as:

$$\Delta\frac{(R-G)_t}{GDP_t} = \alpha_1(s_t) + \sum_{i=1}^{q}\alpha_{2i}(s_t)\Delta\left(\frac{R-G}{GDP}\right)_{t-i} + \sum_{i=0}^{q}\alpha_{3i}(s_t)\Delta\left(\frac{Debt}{GDP}\right)_{t-i} + \lambda(s_t)ECT_{t-1} + u_t, \tag{4}$$

where Δ is the difference operator, ECT_{t-1} refers to a coefficient error correction term that measures the speed of adjustment toward the long-run equilibrium, and s_t is the random variable denoting the regime (unobserved random variable) with $u_t \sim N[0, \sigma^2(s_t)]$. The s_t is following a Markov chain defined by transition probabilities among the N states. The error correction coefficient is expected to carry a statistically significant negative sign if the variable returns to a

[12] Focusing on the current account deficits for several countries (e.g., Japan, Brazil and US), Raybaudi et al. (2004) claim that, even though one state could be associated with untenable (unsustainable) trade policy, the overall debt process may be still sustainable, depending on the duration of the states and on the values of the parameter estimates of the switching model. Similarly, Doğan and Bilgili (2014) conclude that public borrowing (external debt) and economic growth do not follow a linear path but notice the nonlinearities effects of public borrowing on growth.

[13] The basic advantage of the Markov-switching process is the features such as the persistence of extreme observations and the nonlinearity and having the ability to take into account the asymmetry of time series.

long-run equilibrium. The coefficient of λ in Eq. (4) is of interest because if $\lambda = 0$, then there would be no long-run relationship among the variables.

The model is evaluated using the filtering procedure of Hamilton (1990), followed by the smoothing algorithm proposed by Kim (1994). The transition probabilities are estimated that govern the movement from one regime to another. For instance, the probability of moving from state j in one period to state i in the next depends only on the previous state, as $p_{i|j} = P[s_{t+1} = i|s_t = j]$, $i, j = 0, \ldots N-1$. The full matrix of transition probabilities P is $P = p_{i|j}$, with conditional probabilities in columns summing to one. The models are estimated up to q lags, which are determined using model selection criteria, and varying the regime allows different dynamics within each regime. The number of regimes is chosen based on model selection criteria. Feasible sequential quadratic programming in Lawrence and Tits (2001) is used for a maximization method to ensure that the parameters stay within the feasible region.

Following Kim and Lima (2010), the half-life property of local persistence is obtained as:

$$\hat{h}_{0.50} = \ln(0.5b(\hat{1}))/(-1/n^{\hat{d}}), \tag{5}$$

where $\hat{d} = -\ln(1-\hat{\lambda})/\ln(n)$, $b(\hat{1}) = 1 - \sum_{j=1}^{k} \hat{\lambda}^{*}_{j-1}$ is the correction factor, $\hat{\lambda}$ is obtained from the MSIAH-ECM, and n is the number of observations. Under the local-to-unity model, that is when the parameter is locally persistent, the half-life goes to infinity at a rate n. However, the half-life of the locally persistent model is always less than the local-to-unity model for a given n. Thus, the local persistence process allows a speed of convergence that is not allowed by a local-to-unity approximation, even when d is close to unity.

As elaborated in Phillips, Moon, and Xiao (2001), the local persistence process yields the standard Central Limit Theorem. Using the delta method, the 95% confidence intervals (CIs) are given by:

$$\hat{h}_{0.50} \pm 1.96se(\hat{\lambda})([-\ln 0.5/\hat{\lambda}][\ln(\hat{\lambda})]^{-2}), \tag{6}$$

where $se(\hat{\lambda}) = \sqrt{2}/(n^{\frac{1}{2}} + \frac{\hat{d}}{2})$. If d is between 0 and 1, the series is considered to be a standardized local persistence process. As illustrated in Kim and Lima (2010), the series is a special case of a local-to-unity process, as proposed by Rossi (2005), when $d = 1$; if $d = 0$, then the time series process has a short-memory dynamic.

This empirical analysis covers quarterly data over the period 1980:Q1 to 2014:Q3 (139 observations). The data for debt (total debt, external debt, domestic debt) and the budget balance (the difference between government revenue and government expenditure) come from Bank Negara Malaysia (BNM) and the Malaysian Ministry of Finance.

4. Empirical results and discussions

Table 1 provides descriptive statistics for the variables used. The median (and mean) level of domestic debt is higher than it is for external debt. Those debt variables are unstable relative to the budget balance, as suggested by the higher standard deviations. The analysis begins by examining the persistence in the variables of interest. To this end, we conduct an augmented Dickey–Fuller unit-root test. The unit-root test statistics for all series fail to reject the unit-root null, except for budget balance at the 10% significance level. Hence, the unit-root tests suggest that Malaysia's fiscal stance does not satisfy the IBC over the sample period considered and the fiscal authority has to change the course of its fiscal policy. Many earlier papers find evidence of structural breaks

Table 1
Descriptive statistics, 1980:Q1-2014:Q3 (in percentage of GDP).

	Mean	Median	Max.	Min.	SD	Skewness	Kurtosis	ADF	
Domestic debt	42.770	40.546	70.785	26.418	11.618	0.619	2.486	−2.481	(8)
External debt	11.352	7.344	36.466	1.503	9.911	1.012	2.741	−1.603	(5)
Total debt	54.122	48.654	100.719	29.633	19.655	0.957	2.707	−2.128	(4)
Government revenue	5.732	5.693	8.354	3.148	1.082	0.105	2.836	−1.639	(9)
Government expenditure	6.831	6.316	15.410	2.868	2.421	1.044	4.109	−2.565	(11)
Budget balance, (R-G)	−1.100	−0.857	2.382	−7.322	1.909	−0.985	4.276	−2.718*	(11)

Notes: * indicates significant at the 10% level. Max and min refer to maximum and minimum value, respectively. SD indicates the standard deviation of the series, and ADF is the augmented-Dickey Fuller unit-root test. The values in parentheses refer to length lag selected based on modified Akaike information criterion. The critical value for unit-root test at 1% = −3.481, 5% = −2.884, and 10% = 2.579.

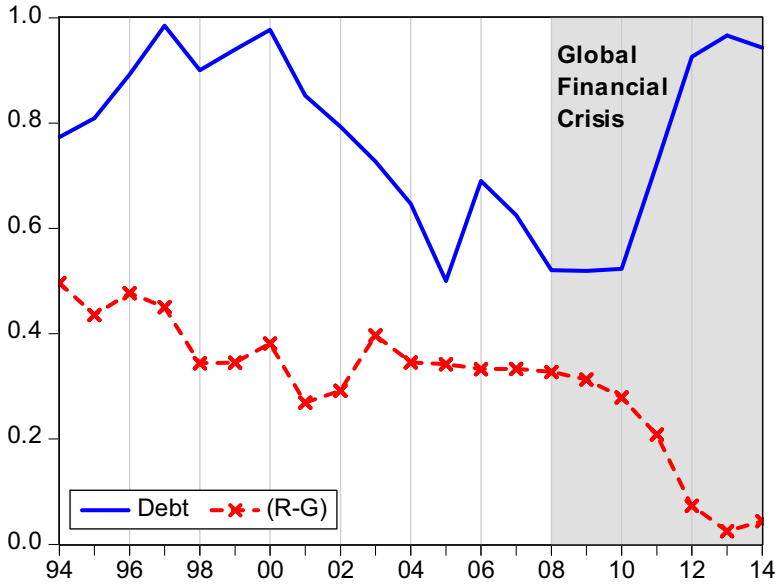

Fig. 1. Dynamics of fiscal policy persistence based on 15-year rolling window against the end year of sample period.

and nonlinearities in the debt process (Quintos, 1995). This means that to test for sustainability, we have to apply models that are equipped to handle these issues.

We further analyze the dynamics of fiscal policy deviation persistence in 15-year rolling window estimates against the end year of the sample period. We adopt the model by Phillips et al. (2001) using a 15-year (1980:Q1 to 1994:Q4) sample period. Four quarterly observations (1995:Q1 to 1995:Q4) are then added to re-estimate the persistence parameter. This one-year increment is repeated until the end of the sample period (2014:Q3).[14] Fig. 1 displays the 15-year rolling window estimates of the persistence parameter for total debt levels and the deficits that produce them. An interesting pattern emerged from this analysis, especially after the 2008 GFC.

[14] It should be noted the first 15 years of our sample period are characterized by high but declining fiscal deficits. The second period is characterized by growing deficits and increasing public debts.

Table 2
Transition matrix and regime properties.

	Stable regime	Unstable regime
Stable regime	0.9063	0.2168
Unstable regime	0.0937	0.7832
Regime properties		
Number of observations	87	34
Probability	0.719	0.281
Duration (in Quarters)	14.50	5.67
Regime classification	1984:Q1–1984:Q4	1982:Q2–1983:Q4
	1987:Q4–1990:Q2	1985:Q1–1987:Q3
	1991:Q4–1997:Q4	1990:Q3–1991:Q3
	1999:Q1–2000:Q4	1998:Q1–1998:Q4
	2002:Q1–2008:Q3	2001:Q1–2001:Q4
	2009:Q3–2014:Q3	2008:Q4–2009:Q2
LR linearity test	25.019 [0.003]	

Notes: The transition probabilities were estimated to govern the movement from one regime to another. To be more specific, the probability of moving from state j in one period to state i in the next would only depend on the previous state as $p_{i|j} = P[s_{t+1} = i|s_t = j], i, j = 0,\ldots,N-1$. The value in square brackets of linearity test refers to probability. The likelihood ratio (LR) linearity test statistic to test the null hypothesis of a linear model against the alternative hypothesis of the two regimes.

Before the GFC, the degree of persistence of these two series trends downward, but then diverges after the crisis. This rolling window estimate indicates that the speed of adjustment budget balance is much more rapid than it is for total debt. This is to be expected, since deficits add to outstanding debt levels, and it is natural to expect debt levels to exhibit a higher degree of persistence. Moreover, we observe that the persistence of debt trends upward during the recent period of high economic uncertainty.

Next, MSIAH-ECM is used to test the sustainability of fiscal policy. The short-run dynamic analysis is based on the autometric tree search procedure. Briefly, autometrics is a computer implementation of general-to-specific modeling procedures. Following the theory of reduction and to reduce complexity, the insignificant variables are removed from the initial general unrestricted model (GUM), subsequently moving from an unknown data generating process to a specific model. We note that extreme values (outliers) are present. Specifically, impulse dummy variables (1989:Q3, 1991:Q1, and 2008:Q4) were added to the GUM to account for these extreme values.

The linear ECM survived a battery of diagnostic checking.[15] However, the error correction term in the linear model is insignificant, suggesting an absence of a long-run relationship between the government's balance and debt. Could the presence of nonlinear dynamics be the key explanation for the empirical failure to detect long-run relationship between budget balance and debt? The absence of this relationship in the linear model suggests nonlinearities and structural breaks. A linearity test is used to check the validity of nonlinearities. The test [LR = 25.019, p-value = 0.003] rejects the null hypothesis of a linear relationship among the variables at the indicated level, even at the upper bound (Davies, 1987), supporting the existence of parameter instabilities.

Table 2 presents estimates of the transition matrix for the Markov two-state models. The duration of the transition can be inferred from the transition probabilities: the closer the value is to one, the more persistent the state is likely to be. We noted that the probability of moving

[15] The unreported results are available upon request from the authors.

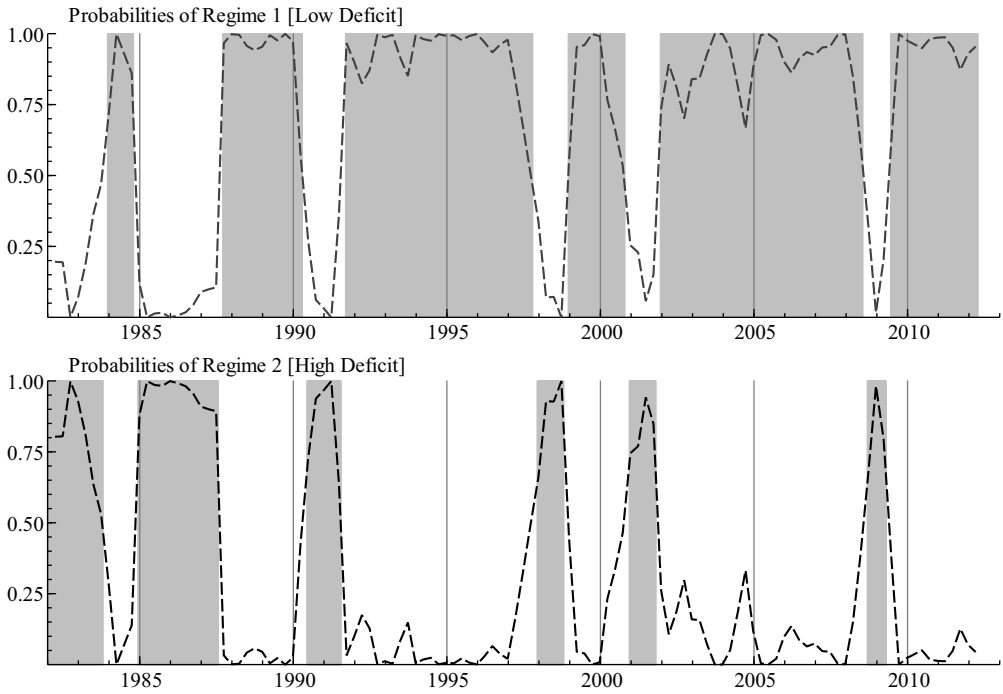

Fig. 2. Filtered and smoothed probabilities.

from a stable regime to an unstable one is higher than the probability of moving from an unstable regime to a stable one. The expected duration of the stable regime is estimated to be around 14.50 quarters while that of the unstable regime is around 5.67 quarters. Clearly, the stable state is more long lasting than the unstable one, as we expect that periods without recession or crisis tend to last longer; an important guiding policy for Malaysia.

The explanation of this situation lies in the definition of the switching process. Countries might satisfy the solvency criterion but face important short-run imbalances, which may become large enough to violate solvency in the future: when the long-run sustainability condition is satisfied, but the presence of temporary deviations from this condition create the danger that a country might be faced with debt problems in the future. This can also be seen from the duration of the regimes; if the duration of the unsustainable regime is longer than it is for the other regimes, it shows that the economy can remain on the unsustainable path without violating the solvency condition. However, the longer the economy remains on that unsustainable path, the more likely it is that it will end up with a balance of payments crisis.

We computed Fig. 2 using expectation maximization algorithm to present the filtered and smoothed probabilities of being in a stable regime (low-deficit) and unstable regime (high-deficit). As expected, there is a clear tendency for the model to indicate a switch to an unstable regime during the economic downturns associated with the events of the commodity crisis in the late 1980s, the AFC in 1997, the global economy slowdown in the early 2000s, and the recent GFC. From the viewpoint of policymakers and investors, it is comforting to know that the debt process is currently in a less volatile, stationary state. One must recall that the debt ratio dropped after the AFC but has increased slightly in the past few years. This insight is more than one gets from

Table 3
Regime-switching error correction regressions.

	Stable regime		Unstable regime	
Constant	-0.018^{***}	(0.006)	0.058^{***}	(0.014)
$\Delta Debt_{t-4}$	0.251^{***}	(0.062)	0.448^{***}	(0.111)
$\Delta Debt_{t-8}$	0.288^{***}	(0.048)	0.234^{*}	(0.128)
$\Delta R\text{-}G_{t-7}$	0.093	(0.077)	0.552^{***}	(0.153)
$\Delta R\text{-}G_{t-8}$	0.347^{***}	(0.080)	0.697^{***}	(0.207)
ECT_{t-1}	-0.206^{*}	(0.118)	0.237^{***}	(0.098)
σ^2	0.052^{***}	(0.004)	0.058^{***}	(0.006)
DUM1989Q3	-0.253^{***}	(0.019)		
DUM1991Q1	-0.703^{***}	(0.048)		
DUM2008Q4	0.268^{***}	(0.091)		
Diagnostic checking				
LogL	162.173			
AIC	−2.366			
Standard error	0.373			
Normality test (2)	0.271		[0.873]	
ARCH (4)	1.858		[0.124]	
Auto (12)	9.487		[0.661]	
Half-life estimate				
$\hat{d}$	0.3538			
HL (Q)	3.36			
95% CIs	[1.15, 5.58]			

Notes: ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. The values in square brackets are probability values. Robust standard errors are in parentheses. σ^2 refers to error variance. AIC is Akaike information criterion, and LogL is maximum log-likelihood. ARCH (m) is an mth order test for autoregressive conditional heteroskedasticity. Auto(m) is an mth order for autocorrelation. $\hat{d}$ refers to the persistence parameter which computed from the error correction term (ECT_{t-1}). HL(Q) is the half-life for the local-persistent model measured in quarters by $\ln(0.5b(\hat{1}))/(-1/n^{\hat{d}})$. The two-sided 95% confidence intervals (CIs) measured in quarterly were constructed according to $\hat{h}_{0.50} \pm 1.96se(\hat{\lambda})([-\ln 0.5/\hat{\lambda}][\ln(\hat{\lambda})]^{-2})$, where $se(\hat{\lambda}) = \sqrt{2}/(n^{(1/2)+(\hat{d}/2)})$.

the unit-root tests showing whether the variable is stationary or nonstationary and illustrates the merits of a switching model toward policy making in Malaysia.

Table 3 shows the results for the regime-switching regression (MISAH-ECM). The model passed all the standard diagnostic tests. The impulse dummies are significant at the usual levels, indicating the presence of extreme values in the model. The equilibrium error correction term has a negative sign and is significant at the indicated level in a low-deficit regime. We also observed that the sign for the sum of the debt coefficients is positive. This verifies the long-run fiscal sustainability hypothesis, but in a low-deficit regime. To complement the analysis, we estimate the speed of adjustment. The persistence parameter estimate is around 0.354 with a half-life point estimate around 3.36 quarters, with the upper bound of the CIs of 5.58 quarters. Therefore, we can conclude that rising debt ratios lead to a higher surplus, which has a tendency toward mean reversion. Implementing such a fiscal policy during a low-deficit regime should only be done with caution.

4.1. Debt-growth nexus

To better understand the role of debt in an economy and when it becomes detrimental to economic growth, we apply the threshold regression model, as in Hansen (1999, 2000). We use

Table 4
Debt-growth nexus in Malaysia.

	Coefficient	Standard error
Regime-dependent regressors		
$\hat{\theta}_1(\hat{\gamma} \leq 41.88)$	0.282^{***}	(0.073)
$\hat{\theta}_2(41.88 < \hat{\gamma} < 54.71)$	0.207^{***}	(0.057)
$\hat{\theta}_3(\hat{\gamma} > 54.71)$	-0.146^{***}	(0.043)
Regime-independent regressors		
Initial condition	−0.230	(0.425)
Inflation	-0.108^{***}	(0.009)
Investment growth	0.112^{***}	(0.028)
Export growth	0.535^{***}	(0.038)
Money growth	0.083	(0.126)
Real uncertainty	-0.663^{***}	(0.080)
Test for the number of thresholds		
LR test for threshold effect		
H_0: No threshold (K = 0)	10.157	[0.000]
H_0: At most one threshold (K = 1)	6.958	[0.000]
H_0: At most two threshold (K = 2)	3.450	[0.999]
Estimated threshold, $\hat{\gamma}$		
Lower threshold	41.88	
95% CIs	[29.95, 55.22]	
Upper threshold	54.71	
95% CIs	[30.85, 65.51]	

Notes: *** significance at the 1% level. Standard errors are in parentheses and probability values in square brackets. Following Hansen (1999), each regime has to contain at least 5% of all observations. 1000 bootstrap replications were used to obtain the *p*-values to test for the number of thresholds.

debt ratio as the threshold variable in order to search for the threshold effect in the debt-growth nexus. To this end, consider the following threshold model of the debt-growth nexus:

$$\Delta \ln \quad GDP_t = \theta_1 Debt_t I(Debt_t \leq \gamma) + \theta_2 Debt_t I(\gamma < Debt_t < \gamma) + \theta_3 Debt_t I(\gamma > Debt_t) + \sigma w_t + \upsilon_t, \tag{7}$$

where the dependent variable is the GDP growth rate at time $t = 1,\ldots,T$. The debt level serves as a regime-dependent regressor. The set of control variables (w) consists of domestic inflation, the growth rate of the money supply (money growth), the growth rate of gross fixed capital formation (investment growth), the growth rate of exports (export growth), initial condition and real uncertainty. The threshold estimation proposed by Hansen (1999, 2000) is used to figure out the marginal impact of debt on economic growth in high- and low-debt regimes. Hansen considers two sequential tests for models with zero, one, and two thresholds. If the null hypothesis of no threshold is not rejected, there is no support for asymmetry. If the null hypothesis of no threshold and the null of a single threshold easily rejected, this indicates the existence of two-regime.

The null hypothesis of no threshold versus the alternative of a single threshold, the null hypothesis is rejected (see Table 4). To probe further, we then proceed with the test of a single threshold versus a double thresholds model. The likelihood ratio statistic (test statistic = 6.958) favors the double thresholds model. Estimate of the three-regime model has an upper threshold of 54.71% and lower threshold of 41.88%. The debt level below the threshold point of 41.88% has a significant positive effect on growth. However, the positive effect drops from 0.282 to 0.207 if the debt level surpasses the 41.88% (95% CIs: 29.95–55.22) level while it becoming negative (−0.146)

Table 5
LA-VAR granger causality tests.

H_0	k	Economic growth / → debt		Debt / → economic growth	
Linear Model	4	4.174	(0.243)	7.507	(0.057)
$\hat{\gamma} \leq 41.88$	3	4.898	(0.180)	8.380	(0.039)
$41.88 < \hat{\gamma} < 54.71$	7	3.231	(0.863)	9.304	(0.036)
$\hat{\gamma} > 54.71$	2	8.493	(0.014)	7.946	(0.019)

Notes: The null hypothesis H_0: economic growth / → debt represents economic growth does not Granger-cause debt. Figures in ( ) refer to probability. k = optimum lag based on SIC. $\hat{\gamma}$ indicates the estimated debt threshold level.

if the threshold goes beyond 54.71%. In other words, debt has a simulative effect on growth below 54.71% and it found to hamper the health of the economy if it is higher than this level. By comparison, our estimated threshold level is close to the one provided by Caner et al. (2010) and Reinhart and Rogoff (2010). Focusing on the regime-dependent coefficients, investment and exports tended to promote economic growth, but inflation and real uncertainty have a negative effect on economic growth. The negative impact of real uncertainty on growth is supported by Baharumshah and Soon (2014). Finally, the model finds that financial depth did not play any important role in economic growth in the sample period under review.

In sum, our empirical results have immediate implications for the government during periods of high debt. High debt represents an extra cost of the policy, which has been ignored in most empirical research. As argued in Cecchetti et al. (2011, p. 1), fiscal authorities "should also aim to keep debt well below the estimated thresholds so that even extraordinary events are unlike to push their debt to levels that become damaging to growth". Debts can be beneficial as long as it is at modest levels, but beyond a certain tipping point, it becomes dangerous and excessive. Our results also echo the view in Spilimbergo, Symansky, Blanchard, and Cottarelli (2008) that the impact of discretionary fiscal policy (like those adopted by the government after the GFC) on GDP is contingent on the level of debt. In particular, the positive impact on growth is larger when lower debt levels are targeted. We find that the level of debt matters for fiscal policy effectiveness in Malaysia of which borrowing (debts) can be beneficial as long as it is at modest levels, but beyond a certain tipping point, it becomes dangerous and excessive.

Although many papers have reported a negative correlation between debt and growth, we find only a few (e.g., Jayaraman & Lau, 2009; Panizza & Presbitero, 2014; Gomez-Puig & Sosvilla-Rivero, 2015) that can make a case for causality between debt and economic growth. The causality issue is important in the present context: high debt may be the result of sluggish growth. In other words, it is not obvious that indebtedness is the source of low economic growth. To this end, the lag augmented vector autoregressive (LA-VAR) approach of Toda and Yamamoto (1995) suggested a unidirectional causality from debt to economic growth [Modified Wald χ^2-statistics = 7.507; p-value = 0.057]. Table 5 presents the results for LA-VAR granger causality tests. However, there is no evidence of causality from growth to debt [Modified Wald χ^2-statistics = 4.174; p-value = 0.243]. For robust check, we take the analysis further by splitting our sample into two—one to present debts level below 54.71% and others to present the period where debt levels exceed 54.71%. Two points are noted from the causality test. First, the unidirectional causality mentioned earlier is found to hold if the debt is below 54.71. Second, we untangle feedback causality between debt and growth when the debt is above the 54.71 threshold level. Tax revenues and government expenditure tend to be functions of economic growth, and growth has the potential to reduce the deficit/GDP and debt/GDP ratios as well. But high debt

also causes low growth in a vicious cycle. Again, all these findings confirm that there is a clear threshold above which economic progress is compromised and debt matters in economic growth.

5. Conclusions

This paper explored fiscal sustainability and its threshold with debt-growth nexus for Malaysia using numerous econometric techniques that provide guidance for policy options. First, empirical results reveal that Malaysia's fiscal deficits path is essentially sustainable, except during the brief periods of economic difficulty (the AFC and, more recently, the GFC). Second, the debt-growth nexus has threshold effects (or high vulnerability region) in which economic progress is dramatically compromised. Specifically, we observed that debt contributes to economic growth if it is below 54.71% below the limit of 55% set by the government and switch from positive to negative if it exceeds the estimated threshold value. Beyond this tipping point, the economy begins to suffer from a debt overhang with all its distortionary effect kicks in.

Targeting a higher debt level to support growth is not a wise policy option for Malaysia. Lowering the debt level would benefit the country's growth performance of which the Malaysian data on the average debt-to-GDP ratio over the full sample period seems to support this view. To address the long-term fiscal and economic challenges, the debt-GDP level should be set below 54.71%. Further, reduction in subsidies can create fiscal space within the budget while at the same time channeling the subsidies to the poor. Third, debt has a causal effect on growth and a negative relationship between public debt and growth exists. Our results confirm that high levels of debts (specifically above 54.71% of GDP) can be a source of low economic growth. However, there is no evidence to suggest that weak growth is the cause of high levels of debt. It is important then for policymakers in Malaysia to understand the debt-growth nexus in order to formulate sound macroeconomic policies for future growth prospects.

The high total debt-to-GDP ratio in the post-AFC period has led to a consensus that restoration of fiscal balance was essential for promoting sustainable output growth without being trapped with a high debt burden. The ongoing expenditure or revenue increase through efficient tax policy (government service tax) is necessary for the government to achieve lower debt levels. Attention should be focused on reducing reliance on petroleum revenues, introducing a value-added tax (VAT), trimming the size of the public sector and public financial enterprises and refraining from producing chronic budget deficits. As mentioned in Kawai and Morgan (2013), maintaining explicit fiscal rules to ensure compliance with budgetary discipline, as practiced in the European Union (and some Asian countries), provides additional measures to deal with fiscal sustainability and debt issues. It should be noted that the fiscal rules are not free of critique, for being too tight and creating a pro-cyclical and low-growth bias in fiscal policy, and could affect debt levels negatively. Our results suggest that the Keynesian deficit spending to spur economic growth does not necessarily have adverse consequences on growth as long as it is coupled with a credible fiscal policy that ensure debt burden are on sustainable levels.

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