

CHAPTER 3: METHODOLOGY

3.1 Introduction

In this chapter, the methodology used to test the fiscal sustainability is set forth. It is divided into two key segments where in the first segment the methodology for empirical test of fiscal sustainability is detailed. Section 3.2 detailed the test of inter-temporal budget constraint while section 3.3 discusses the methodology on the simulation works and ratio test for 3 key indicators of fiscal sustainability is assessed.

3.2 Testing Inter-Temporal Budget Constraint

The methodologies used in testing the above NPG and PVBC conditions. As highlighted earlier standard NPG test requires the test of whether the below condition hold

$$\lim_{j \rightarrow \infty} \theta_{t+j} D_{t+j} = 0$$

where

D = government debt

θ = discount factor given by $\sum_{i=0}^j (1+r_{t+j})^{-1}$

S = government budget surplus

Hamilton and Flavin (1986) test the debt process that satisfies the condition

$$\lim_{j \rightarrow \infty} \theta_{t+j} D_{t+j} = C$$

where C can be any constant. In this instance, the budget constraint can be translated into

$$D_{t-1} = -\sum_{j=0}^{\infty} \theta_{t+j} S_{t+j} + C(1+r)^t + v_t \dots\dots\dots (3.1)$$

where v_t is the regression disturbance term reflecting the various measurement errors not captured under the standard equation. The literature in Hamilton and Flavin (1985) indicated that the test of PVBC is equaled to the test that $C=0$. If the condition holds, then it simply implies that the debt will disappear in limit, which is tantamount to the condition that the government cannot run a Ponzi scheme in financing its assets.

Therefore, the standard test is to see whether $\sum_{j=0}^{\infty} \theta_{t+j} S_{t+j}$ is stationary and whether D_{t-1} is also stationary. If both are stationary processes, then $C=0$ and the PVBC condition is satisfied.

The empirical test procedures are as follow:

Trehan and Walsh (1991) test empirically the condition for No Ponzi Schame as the test of the siationarity of the first difference of the stock of public debt. For the stationary of D_{t-1} , apply the unit root test on a series of public debt. Only a stationary debt process implies the sustainability of the above equation.

From the test of $\sum_{j=0}^{\infty} \theta_{t+j} S_{t+j}$, the equation could be simplified into

$$G_t - R_t = \sum_{j=0}^{\infty} \theta (VR_{t+j} - \Delta G_t + r \Delta D_{t+j-1}) \dots \dots \dots (3.2)$$

where

R_t = government revenue

G_t = government expenditure including interest payment and seigniorage

r = real interest rate

D = government debt

Equation (3.2) shows that the stationarity property suggests that if R_t and G_t are $I(1)$, they are cointegrated. Co-integration suggests the satisfaction of inter-temporal budget constraint in the long run. However, if the two are not cointegrated, then there is no reason to assume that the inter-temporal condition will hold and hence the debt of stock cannot be sustainable. Hakkio and Rush (1991) empirical test use the following regression:

$$R_t = \alpha + \beta G_t + \varepsilon_t$$

It is assumed that $0 < \beta \leq 1$. If the individual series are integrated of order 1 or $I(1)$, then the condition for the co-integration is deemed to be satisfied. If an individual series is found to be stationary whereas the other is integrated of $I(1)$, the series will eventual diverge and the inter-temporal budget constraint condition cannot be said to be satisfied.

Although it is not necessarily that $\beta = 1$, Hakkio and Rush (1991) pointed out that if $\beta < 1$, then government expenditure will outpace the revenue and debt will grow and in the limit, the undiscounted bonds will go to infinity, making it

difficult to market debts. In this case, Quitos (1995) highlighted that where co-integration is rejected and $0 < \beta < 1$, it is only a weak form of sustainability.

3.3 Indicators Of Fiscal Sustainability

In this section, the methodologies for three key indicators or group of indicators are laid down.

3.3.1 Debt-to-GDP ratio

Here we look at the external debt-to-GDP and overall debt-to-GDP to assess the solvency and the short term debt-to-GDP to assess the liquidity aspect of sustainability. The currency effect is another aspects of the debt that need further consideration. The external debt denomination in currencies other than the domestic currency tends to move the ratio in reverse of the currency strength of domestic currency. The debt-to-GDP ratio will rise when the domestic currency depreciate and vice versa. We shall consider at what level the depreciation of the domestic currency will bring the ratio to the threshold. In other words, what is percentage level the debt will be increased when domestic currency depreciates such that the threshold is breached? This gives an indication of the buffer available to cushion any adverse development and whether this buffer has been reducing over the year. We set the threshold for the analysis of external-debt-GDP ratio in accordance with the IMF paper i.e. 40%. If a country's external debt-to-GDP breaches this threshold at any point in time, then the fiscal policy must shown to be consolidating if it is to be sustainable.

Total public debt-to-GDP will incorporate both the external debt and domestic debt. In assessing the external debt of the public, the debts of Non Financial Public Enterprises (“NFPE”) are also included. The inclusion of NFPE’s debts is to capture the often intricacies relationship between the public sector and the NFPEs. It is often perceived that the public sector has an implicit obligation for the debts of the NFPEs and such that this relationship resulted in an unspoken guarantee of the NFPEs debts. While the emphasis has been on the external debt as it is viewed as more risky than the domestic debt since a country can always resort to seigniorage to pay its domestic debt. However, it cannot continuously do so as this would imply the violation of the “No Ponzi Scheme” condition. Nonetheless, this part of the analysis has been adequately captured in the stationarity test when total debt level is test for unit root. This is important because from the perspective of sustainability analysis, debt is only part of the equation. If seigniorage is heavily used, the debt-to-GDP ratio may fail to capture the long term consequences of seigniorage on the sustainability and inflation. In this respect, our analysis will compare the growth of seigniorage “ δ ” (which is taken as $\delta = \frac{\pi + g + \pi g}{(1 + \pi)(1 + g)} \tilde{m}$, where \tilde{m} is the based money as % of GDP with the

growth in domestic debt Δ . In the event that

$$\delta \geq \Delta$$

then it is assumed that seigniorage is a preferred method of financing for the fiscal deficit. If the reverse

$$\delta < \Delta$$

Then debt is the preferred choice of financing the deficit.

3.3.2 Primary Gap Ratio

The key requirement here is to ascertain the appropriate policy targets to be included to solve the equation

$$\tilde{s} = \frac{(r-g)}{(1+g)} d_0 - \delta_0$$

where

\tilde{s} = primary surplus

r = real interest rate

g = GDP growth rate

d = debt-to-GDP ratio

$$\delta = \frac{\pi+g+\pi g}{(1+\pi)(1+g)} \tilde{m}$$

\tilde{m} = based money as % of GDP

such that we are able to arrive at the level of primary gap that will allow us to maintain the debt-to-GDP ratio after taking into account the seigniorage of the public sector.

i) Nominal interest rate (i)

An average interest rate approximation can be used to ascertain the nominal interest rate by taking the ratio of the interest payment made in the year divided by the outstanding debts. In this respect, interest rate is ascertained by taking the following formula:

$$\text{Interest rate} = \frac{\text{Debt service burden}}{(\text{Debt at beginning of year} + \text{Debt at end of year})/2}$$

For the 15 year period between 1988-2000, Malaysia's debt service ratio was relatively stable at about 7.3%. However, the ratio fell to about 6.1% in the recent 3 years due to drastic interest rate easing globally. As the ratio, hence the implied interest rate, was relatively stable between 1988-2000 and the fact that the current low interest rate environment is generally perceived as neither sustainable nor stable going forward, therefore interest rate of 7.3% could be adopted as a sustainable level.

ii) Inflation (π)

The inflation rate for Malaysia as measured by the CPI was relatively stable with the exception of two periods. Between 1991-92, inflation rose to a high of 5.3% in August led by strong economic growth and rapid monetary expansion. The 1998 episode of high inflation was the result of Asian financial crisis and hence is also inappropriate benchmark for steady state inflation. Excluding these periods, the average annual inflation between 1987 and 2003 stood at 2.4%. However, CPI as a measure of inflationary pressure suffers some limitation. Firstly, it fails to account for both demand and supply side price pressure on the economy. Secondly, the significant part of the components in the CPI basket is priced control items that failed to reflect the CPI as inflation measure. Therefore, GDP deflator is also used as an alternative measure of the underlying inflation for comparison. The average GDP deflator for the Post crisis period between 1999-2003 is 2.1%.

iii) Real interest rate (r)

The benchmark real interest rate r is arrived at from the equation

$$r = (i - \pi) / (1 + \pi)$$

where

r = real interest rate

i = nominal interest rate

π_1 = inflation rate which is based on CPI

π_2 = inflation rate which is based on GDP deflator

where the estimates of i and π are estimates established in i) and ii).

Based on the two inflation rates arrived at in i), the real interest rates for Malaysia are as follows

$\pi_1 = 2.4\%$	$\pi_2 = 2.1\%$
$r_1 = (7.3\% - 2.4\%) / (1 + 2.4\%) = 4.8\%$	$r_2 = (7.3\% - 2.1\%) / (1 + 2.1\%) = 5.1\%$

iv) Growth rate

Between 1988 – 1997, Malaysia's economy expanded at an average annual rate of 7.8%. The economy experienced two periods of high growth and contraction during this period. High growth was seen between 1988 to 1997 while contractions were seen in 1998. Post crisis, the economy has been growing on average 5.0% between 1999-2003. Given the differences in the make up of the economic structure prior to the 1993 period where, manufacturing share of the economy is only just over 22% as compared to over 31% in the recent year, it is therefore inappropriate to

use the growth rate prior to this period. 1993-1997 saw strong capital driven growth with the investment as a share of the economy rose to 50% as compared to 22% now. This capital accumulation phase is also an inappropriate yardstick for our purpose. The latest Bank Negara annual report (2003) highlighted that the potential GDP for the economy is at 3.4%. This is not far from the average GDP growth between 1999 and 2003 of 5.0%. Therefore, it is assume that the steady state growth to be in that region. Here, we assume the average of the two at 4.3% as the steady state growth rate.

v) Debt-to-GDP ratio (d)

As the purpose of the analysis is to ascertain the level of primary gap that will stabilize that Debt-to-GDP ratio at the current level, the appropriate ratio for this is hence the current federal government's Debt-to-GDP ratio for Malaysia of 48%.

vi) Seigniorage

The issuance of money is captured by the change in the reserve money. As Malaysia fiscal position was relatively healthier prior to the crisis with fiscal surplus peaked at 2.4% of GDP in 1997 and average surplus of 1.3% between 1993 and 1997. There was less need during this period for the fiscal authority to resort to seigniorage. The situation was presumably much different after crisis with fiscal position deteriorating. However, it is

found that the seigniorage effect is gradually declining after the crisis.

The effect is given by:

$$\delta = \frac{\pi + g + \pi g}{(1 + \pi)(1 + g)} \tilde{m}$$

where

δ = seigniorage

π = inflation rate

g = GDP growth rate

\tilde{m} = based money as % of GDP

3.3.3 Financial Sector Stability Indicators

Here we look at the following 10 FSI over a period of time when the fiscal position is in deficit and assess how the trend in these indicators suggests. A substantial part of Government borrowings are raised domestically either through the issuance of Malaysian Government Securities (MGS), Khazanah National Berhad's Bond and Cagamas. Also a large amount of these debts are hold by financial institutions as liquid assets. If the financial sector indicators are weakened at the time when the fiscal position is deteriorating, then it raises the risk of unsustainable fiscal policy as weaker banking sector strength on the back of weakness in fiscal position may limit the ability of the fiscal authority to borrow.

The indicators are:

Financial Strength

Capital Adequacy

- 1 Tier 1 capital adequacy ratio
- 2 Risk weighted capital adequacy ratio

Earnings and Profitability

- 3 Return on equity
- 4 Return on asset
- 5 Interest profit to interest income
- 6 Cost to income

Vulnerability

Asset Quality

- 7 NPL to total loans
- 8 NPL less provision to total loans

Liquidity

- 9 Liquid asset ratio
- 10 Liquid to short term liabilities