Potential Output and the Output Gap in Malaysia

1. INTRODUCTION

"The principal objects of the (Central) Bank shall be to promote monetary stability and financial stability conducive to the sustainable growth of the Malaysian economy."

Central Bank of Malaysia Act 2009

The economy can be broadly regarded as operating on a sustainable growth path when it is growing at its full capacity with prices remaining low and stable. This level of output is known as the potential output and it is one of the important factors that central banks consider in formulating monetary policy to achieve their mandates.

There are at least two reasons to be concerned about potential output. First, in the short-run, the output gap - the difference between the actual and potential output - reflects the economy's position in the business cycle and, correspondingly, the possible presence of inflationary pressures arising from the level of utilisation of factors of production and possible capacity constraints. As monetary policy operates with lags, it is necessary to estimate the future path of potential output to access whether the current monetary policy stance is consistent with the desired inflation trajectory. Second, potential output reflects the maximum level of output that an economy is able to sustainably produce over a longer time horizon. Faster growth in potential output would allow for a faster growth in actual output without generating undue price pressures. Knowledge of the determinants of potential output can therefore help in formulating structural policies that are focused on increasing the economy's growth rate in a sustainable manner by improving its growth potential. For instance, selected government initiatives in the New Economic Model (NEM) and Economic Transformation Programme (ETP) strive to achieve this by stimulating private investment in technology-intensive capital and by increasing the talent pool of the labour force.

Despite being a reasonably intuitive and useful concept, potential output is unobservable and needs to be estimated. It cannot be easily embedded into policy functions with certainty as its estimates are known to vary with different estimation approaches. In balancing between the uncertainty surrounding the estimates of the potential output and its inherent usefulness, policymakers in general consider potential output as just one of a wider range of indicators to assess the state of the economy.

The purpose of this note is to outline one of the methodologies that Bank Negara Malaysia uses to estimate the potential output of the Malaysian economy. The production function approach is adopted to estimate potential output and its determinants. In doing so, the linkages between inflation, labour market conditions and the output gap are also established.

The remaining sections of this note are organised as follows. Section II details the methodology for estimating potential output. Section III presents the results. The final section concludes this note.

2. METHODOLOGY

Potential output and the output gap provide crucial information about the state of the economy. When output is above its potential level (positive output gap), the economy is experiencing high resource utilisation. During these periods, labour markets tend to be tighter and wage pressures higher, which can lead to higher inflation. Conversely, the economy is operating with surplus capacity when actual output is below its potential level (negative output gap). This in turn is associated with higher unemployment, lower wage pressures and lower inflation. A reliable estimate of potential output can therefore aid the Central Bank in implementing monetary policy to smooth business cycle fluctuations and manage inflationary pressures.

Broadly speaking, there are two conceptual approaches to estimate potential output, each possessing its own advantages and disadvantages. The first is based on the univariate statistical approach, which involves making a judgement on the components of output that are permanent and transitory. The permanent component is considered to be a measure of potential output, while the transitory component reflects the cyclical and idiosyncratic fluctuations in output. Some examples of such statistical methods are the Hodrick-Prescott (HP) filter, Baxter-King filter and univariate Kalman filter. These methods are appealing because of their low data requirements and ease of application. However, a pitfall is that these methods are atheoretical data-driven techniques and thus provide no guidance to policymakers on the determinants of potential output and its association with inflation.

The second approach relies on multivariate specifications suggested by economic theory such as the Phillips curve, Okun's Law and other more complex representations of the economy. The models are estimated or calibrated using a wide range of techniques, including the production function approach (Hong Kong Monetary Authority, 2001 & 2011 and Congressional Budget Office, 2001), Structural Vector Autoregression (SVAR) models (Arora and Bhundia 2003), multivariate Kalman filters (Benes, Clinton, Garcia-Saltos, Johnson, Laxton, Manchev and Matheson, 2010) and more recently, dynamic stochastic general equilibrium (DSGE) models (Edge, Kiley and Laforte, 2007 and Coenen, Smets and Vetlov, 2009). The appeal of this approach is its economic content. However, the complexities involved in estimating some of these models often result in potential output estimates that are highly sensitive to the underlying assumptions imposed by the researchers[1].

2.1 The Production Function Approach

One of the methods used by Bank Negara Malaysia to estimate potential output and the output gap is the production function, or growth accounting, approach. The biggest advantage of this method is that it relates potential output to the factor inputs of the economy – capital, labour and the level of technological progress. Structural changes that affect any of the three determinants are therefore captured in the computation of potential output. The methodology's robustness to structural change relative to other methods and the ability to provide insight to the determinants of potential output has led to its widespread use by other central banks, government agencies and academics.

[1] A discussion of the various methods and their advantages/disadvantages is beyond the scope of this paper. Refer to Cotis, Elmeskov and Mourougane (2003) for a thorough presentation of the relevant issues and methods and Mishkin (2007) for a non-technical discussion of the issues in estimating potential output.

In keeping with the literature, the production function is assumed to take the following Cobb-Douglas functional form:

$$Y_t = A_t \; L_t^{\alpha} \; K_t^{1-\alpha} \qquad (1)$$

Y_t is seasonally adjusted output, A_t is Total Factor Productivity (TFP), L_t is employment and K_t is capital stock[2]. The production function is assumed to be constant returns to scale, with α and (1-α) being the respective labour and capital shares. We use the income account[3] method to derive the factor shares. This results in α currently being set to 0.4[4], reflecting the current labour income share to GDP. This value is adjusted over time in accordance with the evolution of Malaysia's economic structure.

A is unobserved and is computed as the "Solow residual" by subtracting the contributions of capital and labour from actual output in the following log-linear transformation of the production function:

$$\ln A_t = \ln Y_t - \alpha \ln L_t - (1-\alpha) K_t \qquad (2)$$

Potential output is then computed by:

$$\overline{Y}_t = \overline{A}_t \; \overline{L}_t^{\alpha} \; K_t^{1-\alpha} \qquad (3)$$

With $\overline{Y}_t$ being potential output, $\overline{A}_t$ the trend level of TFP and $\overline{L}_t$ potential employment. The underlying trend of TFP is obtained by the Hodrick-Prescott filter. The output gap, Gap, is computed as:

$$\text{Gap}_t = \frac{Y_t - \overline{Y}_t}{\overline{Y}_t} \qquad (4)$$

2.2 Potential Employment and the Non-Accelerating Inflation Rate of Unemployment (NAIRU)

Potential employment, an input in (3), represents the level of employment that is consistent with a low and stable inflation rate. It is expressed as:

$$\overline{L}_t = L_t^f (1 - \text{NAIRU}_t) \qquad (5)$$

L_t^f is the labour force. The Non-Accelerating Inflation Rate of Unemployment (NAIRU) refers to the level of the unemployment rate where wage, and subsequently, inflationary pressures are absent in either direction. Upward wage pressures tend to be present when unemployment is below NAIRU (i.e. the unemployment gap is negative), and vice versa.

[2] Quarterly capital stock was derived from the annual capital stocks data published by the Department of Statistics Malaysia (DOSM).
[3] Income Account refers to the Distribution and Use of Income Accounts and Capital Account (2006-2008) which is published by the Department of Statistics Malaysia (DOSM).
[4] This value comprises of 2 components in the Income Account. Firstly, it consists of compensation to employees. Secondly, it consists of income earned by the self-employed or people employed in small and medium enterprises, in which the distinction between labour income and company profits is blurred. This aspect of income is accounted for by adding a classification in the Income Account that is known as "mixed income".

NAIRU is estimated in a two step procedure. In the first step, the unemployment rate is decomposed into a trend and a cyclical component[5]. The cyclical component is then used as a reference to estimate the unemployment gap in the subsequent step. In the second step, the Kalman filter is used to estimate the unemployment gap and hence NAIRU. The unemployment gap is modelled as an unobserved component within a Philips curve framework. This approach draws from Turner et al. (2001), Greenslade et al. (2003) and Epstein and Macchiarelli (2010). The details of the steps are as follows:

Step 1: Decomposition of unemployment into trend and cyclical components

The unemployment rate, U_t, is assumed to comprise of a trend, T_t, and a cyclical component, C_t:

$$U_t = T_t + C_t \qquad (6)$$

Step 2: Kalman filter estimation of the Philips curve

The unemployment gap, G_t, is modelled as an unobserved component and is estimated from a Philips curve relationship between inflation and its determinants. The Philips curve model is expressed by the following functional form:

$$\pi_t = \beta\pi_{t-1} + \gamma G_t + \delta Z_t + \epsilon_t \qquad (7)$$

π_t is the year-on-year percentage change in core inflation. This series excludes administered and volatile price items from the consumption basket, and is used to control for supply side influences and to have a series that reflects the underlying demand conditions in the economy. G_t is the unemployment gap, which is unobserved and assumed to follow an AR(1) process. Finally, Z_t is the year-on-year change in import price inflation and is included to control for supply-side and exchange rate influences. For increased precision in estimating equation (7), the coefficients are initialised with values from an OLS regression of a similar functional form, but with the unemployment gap (G_t) that was approximated by the cyclical component from Step 1. G_t is consequently treated as an unobserved component and estimated using the Kalman filter. Finally, NAIRU is computed as the difference between the unemployment rate and the estimated unemployment gap, G_t, and smoothed using the HP filter.

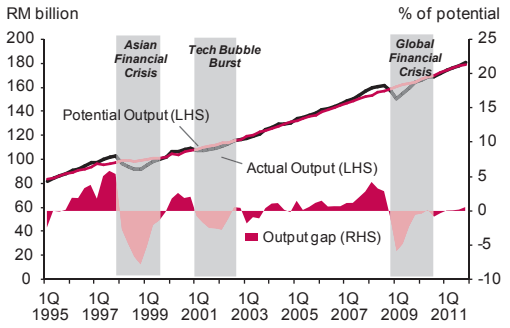
3. RESULTS

3.1 Potential Output and the Output Gap

The estimates of potential output and the output gap are illustrated in Figure 1. The output gap was broadly positive or close to zero for most of the period studied, i.e., 1995-2011. There are three episodes in which large negative output gaps were seen: The Asian Financial Crisis (AFC), the bursting of the technology bubble in the US (Tech Bust) and the recent financial crisis in the advanced economies. In all three cases, the gaps closed within 2 years with improving demand as the economy recovered (Figure 2). Not surprisingly, the output gap was negative for the longest period (8 quarters) and experienced its deepest trough of -8% of GDP in 4Q 1998 during the AFC, given that actual GDP contracted by 7.2% in 1998, the worst decline over the period studied. In contrast, Malaysia's experience during the Tech Bust and the recent crisis was less severe both in depth and duration as actual output recovered back to its potential level within 6 quarters.

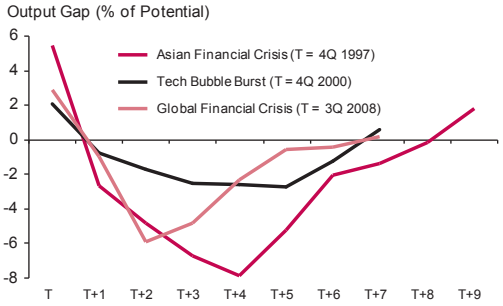
[5] The trend-cycle decomposition was done using the Hodrick-Prescott filter.

Figure 1: Actual and Potential GDP in Malaysia



Source: Authors' calculations and Department of Statistics Malaysia

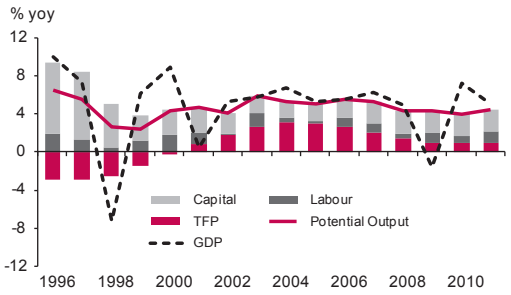
Figure 2: Narrowing of Output Gap during Three Episodes of Economic Slowdown



Source: Authors' calculations
Note: T denotes the quarter before the output gap turned negative

Figure 3 illustrates the growth in GDP, potential output and its respective contributions from capital, labour and total factor productivity (TFP). Growth in potential output normally moderates during economic downturns as investments decline and employment conditions weaken. In Malaysia's case, potential output only declined noticeably during the AFC but did not deviate much from its pre-crisis trend during the Tech Bust and the recent crisis. This is mainly attributable to the slower rate of capital accumulation as total investment declined by 42% in 1998 during the AFC, much larger compared to the investment rates of -1.8% in 2001 during the Tech Bust and -0.5% in 2009 during the recent crisis. Nonetheless, the output gap became negative in all three episodes as the contraction in domestic and external demand caused actual output to fall below the productive capacity of the economy.

Figure 3: Factors Contributing to Potential Output Growth



Source: Authors' calculations and Department of Statistics Malaysia

Table 1: Philips Curve Estimates using the Kalman Filter

Dependent variable is π_t	
Variable	**Kalman filter**
G_t	-0.9169
π_{t-1}	0.7299
Z_t	0.2258
G_{t-1}	0.5692

Note: All estimates are significant at the 1% level

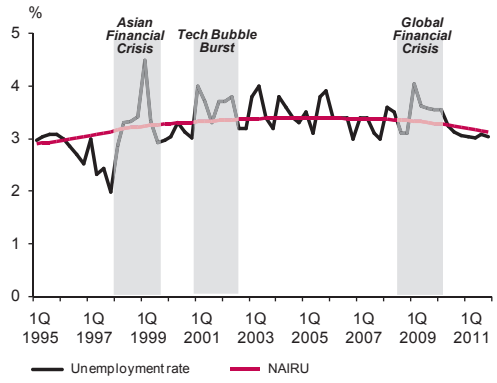
3.2 The Relationship between Inflation, Unemployment and the Output Gap

The estimates of equation 7 are shown in Table 1. The estimated coefficients all possess the expected signs and provide evidence of a statistically significant relationship between inflation and the unemployment gap. Specifically, a higher unemployment gap leads to lower inflation, while higher import prices[6] are passed-through to higher inflation.

[6] This can occur through depreciation in the exchange rate or a higher input cost of imported goods.

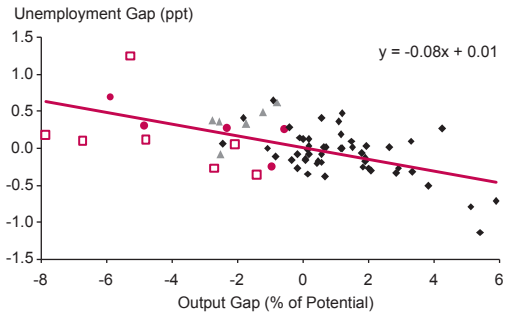
Figure 4 displays the unemployment rate together with NAIRU from 1Q 1995 to 4Q 2011. The figure shows that the unemployment rate was below NAIRU (negative unemployment gap) during the quarters just prior to the AFC, the Tech Bust and the recent crisis, coinciding with periods when the output gap was persistently positive. Figure 5 corroborates this observation, by illustrating evidence of a negative relationship between the unemployment gap and the output gap. A stronger labour market, reflected by a lower unemployment gap, corresponds to a higher output gap. Conversely, the unemployment gap was noticeably higher during the three aforementioned episodes when economic conditions were weak and output gap was negative.

Figure 4: Actual Unemployment and NAIRU



Source: Authors' calculations and Department of Statistics Malaysia

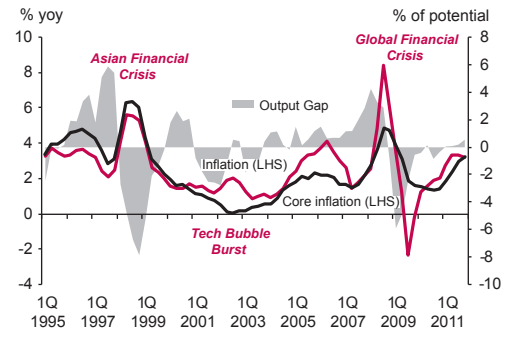
Figure 5: Output Gap and Unemployment Gap



Source: Authors' calculations and Department of Statistics Malaysia
Note: Observations from 1Q 1995 to 4Q 2011

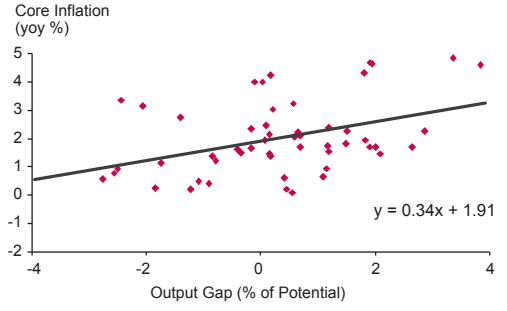
Although lower inflation is normally seen alongside negative output gaps, this was only witnessed during one of the three highlighted episodes – the Tech Bust. In fact, even with large negative output gaps, the economy experienced higher inflation during the AFC and the recent crisis (Figure 6). One explanation is the large depreciation in the exchange rate[7] during the AFC and the sharp increase in global commodity prices during the recent crisis. Figure 7 lends support to this hypothesis. It illustrates a positive relationship between core inflation and the output gap, implying that once we strip out the supply-side and exchange rate related shocks from the inflation time series, the relationship between the output gap and inflation is indeed positive.

Figure 6: Output Gap and Inflation



Source: Authors' calculations and Department of Statistics Malaysia

Figure 7: Output Gap and Core Inflation



Source: Authors' calculations and Department of Statistics Malaysia
Note: Observations from 1Q 1995 to 4Q 2011, excluding periods with supply shocks

[7] A depreciation in the exchange rate typically leads to higher import prices which can result in increased inflationary pressures.

4. CONCLUSION

This note outlines one of the methodologies that is used by the Central Bank to estimate potential output and the output gap for Malaysia. Using the production function approach, the estimations establish linkages between inflation, unemployment and the output gap that are in accordance with expectations – a higher output gap corresponds with higher inflation (excluding supply shocks) and lower unemployment, and vice versa.

The results show that the output gap was broadly positive or close to zero for most of the period studied (1995-2011) except for three episodes during which large negative output gaps are observed: The Asian Financial Crisis (AFC), the bursting of the technology bubble in the US (Tech Bust) and the recent financial crisis in the advanced economies. The negative output gap was the largest and longest during the AFC, followed by the recent crisis and the Tech Bust. This is not surprising as the economic downturn during the AFC was caused by a regional financial crisis. This disrupted financial intermediation and the supply of credit to firms and households during this period, causing a large decline in private sector spending. In contrast, the latter two episodes were temporary external demand shocks. While the country was adversely affected through lower exports during these episodes, financial stability was preserved and domestic demand remained comparatively resilient. Overall, the robustness and intuitiveness of the results support the inclusion of the output gap as one of the important indicators that the Central Bank monitors to assess the state of the economy.

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