Estimating Potential Output and the Output Gap - An Application to Brazil

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Abril 20, 2010

JEL classification: C32, E31, E52.

Abstract

This work attempts to estimate potential output and the output gap for Brazil using the following methods: Hodrick-Prescott filter, Band-Pass Filter, Moving Average, Deterministic Trend, Beveridge-Nelson decomposition, Univariate Unobserved Components Model, Production Function Method, and Structural VAR approach by Blanchard and Quah. Measures of potential output and output gap are essential in assessing a non-inflationary and sustainable growth, guiding macroeconomic policies with supported forecasts. The estimates of potential output help in determining sustainable growth and output gaps indicate inflationary or disinflationary pressures. Comparing all results it is concluded that policymakers should not rely on one single measure of

*I am grateful to CNPq for the financial support.

output gap, since there are substantial uncertainties associated with the estimation of potential output and output gap for the Brazilian economy.

1 Introduction

This work will estimate the potential output and the output gap for Brazil using a series of methods. Potential output measures the capacity production (maximum sustainable level of output) of the economy and output gap is just the percentage difference between actual output and potential output. Essentially, there are two methodologies for estimating potential output, namely statistical detrending and estimation of structural relationships. The former attempts to divide a time series into permanent and cyclical components, the latter attempts to isolate the effects of structural and cyclical influences on output, using economic theory, [Cerra and Saxena (2003)]. Some of the detrending methods include the Hodrick-Prescott filter, the Band-Pass filter, the unobserved components methods (univariate, bivariate, and common permanent and cyclical components) and so on. The approaches for estimating structural relationships include the structural vector autoregression (VAR) method, production function method and so forth. Attention must be paid to hybrid methods, namely the mixture of economic and statistical approaches. One interesting method is the HP filter with additional structural equations described in Karagedikli and Plantier (2004). The usefulness of these estimates is emphasized by their applicability in guiding policymakers. They are used by several central banks, International Monetary Fund (FMI), European Central Bank (ECB) among others.

Estimates can be very important in modeling monetary policies, although these policies can be misleading by measurement errors. In fact, policymakers are subject to estimates, being difficult to adopt the right policy or decision only looking at estimates. Reside here a crucial question: If we can not estimate precisely potential output and the output gap, what are monetary policymakers to do? The answer certainly can not be solved yet, perhaps we should focus on inflation but there are several controversial matters that must be explained and solved.

The general objective is to estimate several measures of potential output and output gap for the Brazilian economy and analyze their properties. To analyze the differences among the measures of output gaps. To test the performance of alternative measures in Taylor rule and Phillips curve. To compare the characteristics and to identify the most suitable for Brazil.

2 Methodology

This section describes each one of the alternative methods used to compute potential output and output gap for the Brazilian economy.

- The Hodrick-Prescott filter

$$\min \sum_{t=0}^{T} (y_t - y_t^p)^2 + \lambda \sum_{t=2}^{T-1} [(y_{t+1}^p - y_t^p) - (y_t^p - y_{t-1}^p)]^2, \tag{1}$$

- The Band-Pass filter

$$y_t = \int_{-\pi}^{\pi} e^{i\omega} dZ(\omega). \tag{2}$$

- Moving average

$$y_i = \begin{cases} \frac{\sum_{j=0}^{M-1}(s_{i+j})}{M}, & \text{if} \quad i > 0 \wedge i < N - (M-1) \\ 0, & \text{otherwise,} \end{cases} \tag{3}$$

- Deterministic trend

$$y_t^* = \xi + \lambda t, \tag{4}$$

- Beveridge-Nelson decomposition

$$\phi(L)\Delta y_t = c + \theta(L)\epsilon_t, \quad \epsilon \sim i.i.d.(0, \sigma^2), \tag{5}$$

- Univariate unobserved components model

$$y_t = y_{1t} + y_{2t}, \tag{6}$$

- Production function method

$$y_t = \alpha_0 + \alpha_1 l_t + (1 - \alpha_t) k_t + e_t, \tag{7}$$

- Structural VAR by Blanchard and Quah

$$\Delta y_t = \sum_{k=0}^{\infty} s_{11}(k) v_{1t-k} + \sum_{k=0}^{\infty} s_{12}(k) v_{2t-k} + \sum_{k=0}^{\infty} s_{13}(k) v_{3t-k}, \tag{8}$$

$$\Delta l_t = \sum_{k=0}^{\infty} s_{21}(k) v_{1t-k} + \sum_{k=0}^{\infty} s_{22}(k) v_{2t-k} + \sum_{k=0}^{\infty} s_{23}(k) v_{3t-k}, \tag{9}$$

$$\Delta \pi_t = \sum_{k=0}^{\infty} s_{31}(k) v_{1t-k} + \sum_{k=0}^{\infty} s_{32}(k) v_{2t-k} + \sum_{k=0}^{\infty} s_{33}(k) v_{3t-k}, \tag{10}$$

3 Empirical Approach

3.1 Estimation and Empirical Results

The estimates use quarterly data for the period 1995Q1 to 2006Q4. All variables are seasonally adjusted. In order to evaluate if the data are or not integrated we apply unit root tests using three methods: Augmented Dickey-Fuller (1979), Phillips-Perron (1988) and Kwiatkowski, Phillips, Schmidt, and Shin (KPSS, 1992) tests. Analyzing the results we conclude that Unemployment Rate has a unit root at 90% of confidence. Figure 1 presents the various measures of output gaps. Apparently, production function and structural VAR methods – which are multivariate methods – are more volatile than the others, showing deeper upturns and downturns.

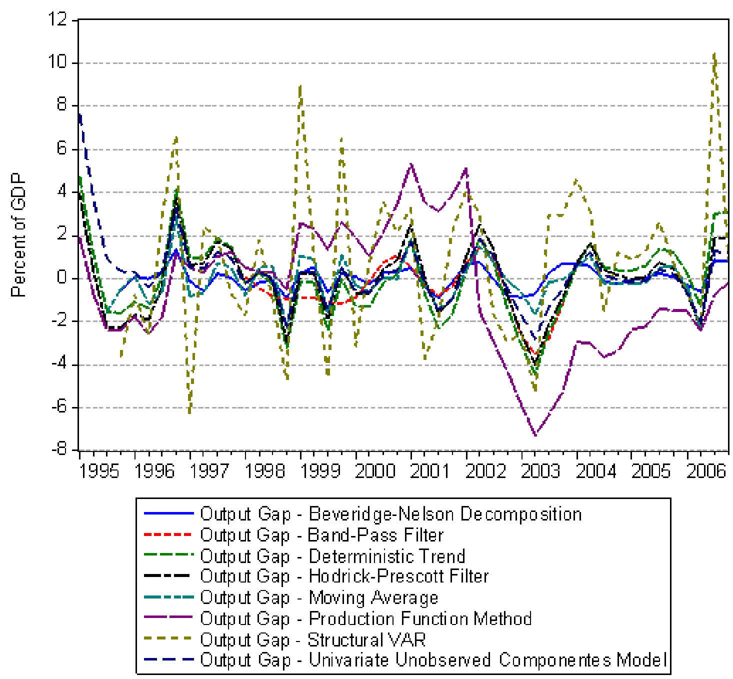

Figure 1: Alternative measures of the output gap

3.2 Taylor rule

In order to evaluate the performance of the alternative measures of output gap in the Taylor rule, the following equations are estimated:

$$\text{Model A} : i_t = \alpha + \beta\pi_t + \phi y_{t-1} + \epsilon_t, \tag{11}$$

$$\text{Model B} : i_t = \alpha + i_{t-1} + \beta^{'}\pi_t + \phi^{'} y_{t-1} + \epsilon_t, \tag{12}$$

The results conclude that only UUC method fitted in the Taylor rule though small coefficients. The inclusion of the lagged interest rate appears to improve the estimates but the model seems to be misspecified for the Brazilian case. The specified Taylor rules may not be capturing the true Brazilian monetary policy response.

3.3 Phillips Curve

A simple way to compare the methods is to compute their capability in forecasting inflation. The root mean-squared forecast error (RMSFE) is used to compare forecast quality [Orphanides and van Norden (2004)]. Basically, this procedure involves estimating a simple Phillips curve relationship between domestic inflation and the output gap of the form:

$$\pi^h_{t+h} = \alpha + \sum_{j=1}^{n} \beta_j \pi^1_{t-j} + \sum_{j=1}^{m} \lambda_j y_{t-j} + \epsilon_{t+h}, \tag{13}$$

A comparison of the RMSE of alternative methods with the AR indicates that all eight alternative methods have upper RMSE errors, namely there is not additional information in putting output gap as an explanatory variable in the Phillips curve. However, there are little differences between them. To ratify the values above cited it is imperative to do tests for statistical significance. Diebold and Mariano (1995) developed a way for comparing predictive accuracy. In this case, the test assesses whether the inflation rate predicted by adding each output gap to the Phillips curve is significantly more accurate than the benchmark AR process. The results demonstrate that at all holdback periods only Beveridge-Nelson is significantly better than the AR forecast at 10 percent level. Hence, the Beveridge-Nelson decomposition helps to improve the prediction of inflation and assessing the actual economic situation.

4 Conclusion

Observing the estimates for Taylor-type rules we conclude that only UUC method fitted in the Taylor rule though small coefficients. Although, the specified Taylor rules may not be capturing the true Brazilian monetary policy response. Notwithstanding some major uncertainties, this work elaborated a way to compare the measures of output gap evaluating their capability in forecasting inflation. This procedure involves estimating a simple Phillips curve relationship between domestic inflation and the output gap and an AR process. Then, we compare both to determine if the output gap contains additional information. Diebold-Mariano test is applied to determine significance of forecasts. The results demonstrate that the Beveridge-Nelson

Decomposition achieves better results than someone else, which goes in according with Araujo et al. (2004) findings.

In short, comparing all results one can conclude that policymakers should not rely on one single measure of output gap. Thus, a full treatment of each measure of output gap is required to do more reliable monetary policies.

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