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A Phillips Curve to the Dominican Republic

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Abstract

This paper has provided an empirical evidence to support the existence of the Phillips curve in the case of the Dominican Republic. The Phillips curve is estimated using data over the last forty years and includes a role for supply factors. The most striking feature of the model is the strong relationship between inflation and excess demand.

Keywords: Phillips curve, output gap, unemployment gap.

JEL classification: E24, E31.

1 Introduction

The Phillips curve explains a negative relationship between inflation and unemployment. This trade-off has a policy implication since to keep a low unemployment, inflation has to increase. The first investigation in this area comes from Fisher (1926). This author noted that inflation tended to be associated with low levels of unemployment, but he suggested that causation ran from inflation to unemployment. Phillips (1958), in an empirical investigation of United Kingdom nominal wage behaviour, took the level of employment to be the independent variable, reversing the causality presented by Fisher (1926) and showing a strong empirical support for a stable inflation-unemployment trade-off. Researchers soon modified the Phillips curve theory. It was extended and put into a theoretical disequilibrium context by Lipsey (1960), and was applied to the United States and set in a policy context by Samuelson and Solow (1960).

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Phelps (1967) and Friedman (1968) criticized the Phillips curve hypothesis. They argued that it was unreasonable to assume that nominal variables could affect real variables. The critique prompted the formulation of the expectations-augmented Phillips curve. This version specifies price inflation as determined by a measure of excess demand –typically the unemployment gap (the difference between unemployment and its long-run equilibrium or “natural rate”)-and inflation expectations.

The expectations-augmented Phillips curve developed this model further, by suggesting that such a trade-off could only be temporary and that the long-run Phillips curve is vertical. However, in the short-run, the economy can be shifted away from its long-run equilibrium either because changes in aggregate demand create forecasting errors, or because of nominal inertia in the wage and/or price setting process.

In recent years, there has been much discussion regarding the Phillips curve (Fuhrer, 1995; DiNardo and Moore, 1999; Mankiw and Reis, 2002, among others); however, contrary to a large number of empirical studies on the Phillips curve, relatively few studies attempt to empirically probe the hypothesis in developing countries’ context. The purpose of this paper attempts to answer the following main question: Is there a negative relationship between inflation and unemployment in small open economies? To answer this question, this paper focuses on the estimation of the Phillips curve using the Dominican Republic as a case study.

The organisation of this paper is as follows: Section 2 presents the methodological framework and the specification of the Phillips curve to be estimated. Section 3 analyses the data. Section 4 presents results, and finally a conclusion is presented in Section 5.

2 The Phillips curve model

The stylised version of the expectation-augmented Phillips curve, written in terms of unemployment gap, is typically assumed to be of the following form:

$$\pi_t = \pi_t^e - \gamma(u_t - u^*) + \varepsilon_t \quad (1)$$

where π and π^e are actual and expected inflation, u_t is the unemployment rate, u^* is the natural rate unemployment which represents a long-run, real-equilibrium concept, determined by the structural properties of the labour and product markets, γ captures the impact on inflation of deviations in unemployment from its natural rate and ε_t is the error term. According to the equation 1, as soon as unemployment falls below its

natural rate, it will put upward pressure on inflation and inflation will tend to rise. Gordon (1997) suggests that the inflation rate may be dependent on three factors: inertia, excess demand and supply shocks, the so-called triangle model of inflation. Then, the Phillips curve may be re-written as:

$$\pi_t = \beta\pi_{t-1} + \gamma(u_t - u^*) + \varphi z_t + \varepsilon_t \quad (2)$$

where inertia is represented by lags of inflation, unemployment gap is a proxy for excess demand, but now u^* is the non-accelerating inflation rate of unemployment (NAIRU) instead of natural rate¹, and z_t is a set of supply shock variables. A positive shock to demand, which reduces unemployment below the NAIRU, causes inflation to rise. Similarly, a positive supply shock, such as a large change in oil prices, affects the costs of production, which would result in an increase in the inflation.

Similarly, equation 2 may be re-written using output gap as a proxy for excess demand. Then equation 2 should be written as:

$$\pi_t = \beta\pi_{t-1} + \gamma(y_t - y^*) + \varphi z_t + \varepsilon_t \quad (3)$$

where the output gap is defined as actual real (log) GDP minus potential GDP. So a positive output gap corresponds to excess demand. If the economy is operating above the equilibrium output level (output is above its potential level), inflation will tend to rise, and vice versa.

3 Data Description

The data set is annual, spanning 1960 through 2007. Most of the variables used in this analysis are taken from the Central Bank of the Dominican Republic. Interpolation and extrapolation techniques were also resorted to in order to simulate missing data for two years that were not readily available, particularly for unemployment data. The inflation measure employed is annual changes in the consumer price index (CPI) in logarithms. The Hodrick and Prescott (1977) filter method is used to derive the unemployment gap and the output gap with smoothing parameter of 100. The measures

¹When the Phillips curve model is extended to include different sources of inertia and macroeconomic shocks, the equivalence between natural rate and the NAIRU breaks down. The NAIRU is a short-run, reduced-form concept, reflecting the adjustment of the economy to past economic shocks that determine inflation while the unemployment natural rate is a long-run concept (see Estrella and Mishkin, 1998).

of trend unemployment that emerge from this approach are described as estimates of the NAIRU, since they do not explicitly incorporate information on the structural variables that determine the natural rate. Alternatively, an output gap based on measures of potential output derived from the Dominican Republic production function is used. This series is taken from Cruz and Francos (2008).

The main proxies for supply shocks (z_t) used in this study are changes in the international oil price in logarithms and change in the nominal exchange rate. Nominal exchange rate is defined in Dominican pesos per American dollar such that an increase in the nominal exchange rate corresponds to a depreciation of the Dominican currency. The nominal exchange rate is included in the Phillips curve model partly to capture inflation in imported goods. The presence of import prices reflects the fact that a significant proportion of goods consumed within the Dominican Republic are imported and that the cost structure of the Dominican industry is affected by imported goods as well. Both series are taken from the CD-ROM version of the International Monetary Fund's International Financial Statistic (IFS).

4 Empirical Analysis

Following the specification set up by Gordon (1997), two variants of the following equation are estimated:

$$\pi_t = \alpha + \beta(L)\pi_{t-1} + \gamma(L)(D) + \varphi(L) + \varepsilon_t \quad (4)$$

where D is excess demand, and $\beta(L)$, $\gamma(L)$ and $\varphi(L)$ are lag polynomials. Firstly, the equation 4 is estimated using unemployment gap, and then it is re-estimated but now replacing the unemployment gap by the output gap derived from Hodrick-Prescott (HP) filter. Of course, there are a number of shortcomings with these types of Phillips curve based estimates. The first stems from inherent arbitrariness of HP filter and time-trend based output gaps. As a consequence, the equation 4 is estimated using output gap based on the production function method.

The three versions of equation 4 were estimated as an OLS regression. Table 1 presents the results. The sign of the coefficients on the explanatory variables are generally statistically significant and consistent with theory. However, coefficients differ depending on the choice of excess demand measure, as illustrated in Table 1, but the differences are not very large.

Table 1: Phillips curve estimates for the Dominican Republic: 1960-2007

Variable	Model 1	Model 2	Model 3
Constant	4.099 (3.431)*	3.444 (2.898)*	3.943 (3.394)*
Lagged inflation	0.133 (0.952)	0.250 (1.934)***	0.195 (1.553)
Unemployment gap	-0.650 (-2.547)**		
Output gap (HP)		0.626 (2.015)***	
Output gap (production function)			0.825 (3.043)*
Change in international price of oil (lagged)	0.123 (2.356)**	0.114 (2.132)**	0.105 (2.098)**
Change in nominal exchange rate	0.069 (2.514)**	0.069 (2.437)**	0.072 (2.680)*
Adjusted R^2	0.302	0.265	0.337
Durbin-Watson	1.824	1.742	1.750
Akaike info criterion	6.521	6.572	6.481

Notes: Dependent variable is inflation. t-Statistic are displayed in brackets. (*), denote significance at the 1 percent level, (**) at the 5 percent and (***) at the 10 percent level.

Source: Author's claculation.

The inertia, or lagged inflation, is positively correlated with the inflation rate, but is not statistically significant when unemployment gap and production function are used as a proxy for excess demand. A one percentage point increase in the inflation rate in last year is associated with a 0.25 percentage point increase in inflation this year when output gap (HP) is used.

According to the theory on Phillips curve, unemployment gap shows a negative sign. If unemployment falls below the NAIRU, inflation will rise until unemployment returns to the NAIRU. In other words, a one percentage point increase in the unemployment is associated with a 0.650 percentage point decrease in inflation rate over the year. With respect to models 2 and 3, results indicate that there is a positive and statistically significant co-movement between output gap and inflation over the period considered. According to the adjusted R^2 and the Akaike criterion, the output gap derived from production function explains inflation better than output gap derived from statistical trends.

On the other hand, the coefficient of international price of oil shows a positive relationship with the inflation rate. A one percentage point increase in the international price of oil in last year is associated with a 0.10 to 0.12 percentage point increase in inflation this year. Similarly, the changes in the nominal exchange rate pick up the effect in foreign currency prices of imported goods (pass-through), but it has a small effect on inflation rate.

5 Concluding Remarks

This paper examined the existence of Phillips curve in the Dominican Republic in the last forty years. The Phillips curve of the Dominican Republic is clearly characterised by strong excess demand. Inflation is negatively correlated with the unemployment gap and positively correlated with output gap. Moreover, results suggest the supply factors (captured by nominal exchange rate and international oil prices) are playing an important role to determine inflation rate. However, the inclusion of nominal exchange rate has a small effect on inflation rate. Perhaps because the Dominican Republic presented fixed exchange rate between 1960-1984.

To summarise, this paper finds that the data since 1960 strongly supports the existence of a positively relationship between inflation and unemployment in the Dominican Republic, and this observation is robust to alternative specifications.

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