Phillips Curves: An Encompassing Test

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Abstract

This paper tests Phillips curves using an autoregressive distributed lag (ADL) specification that encompasses the New Keynesian Phillips curve (NKPC), the Hybrid Phillips curve (HPC), the Sticky-Information Phillips curve (SIPC), and the accelerationist Phillips curve (APC). We use data from the United States (1985Q1–2007Q4) and from Brazil (1996Q1–2012Q2), using the output gap and alternatively the real marginal cost as measure of inflationary pressure. The empirical evidence rejects the restrictions implied by the NKPC, the HPC, and SIPC, but does not reject those implied by the APC.

Este artigo testa curvas de Phillips usando uma especificação autoregressiva de defasagem distribuída (ADL) que abrange a curva de Phillips Novo Keynesiana (NKPC), a curva de Phillips Híbrida (HPC), a curva de Phillips de Informação Rígida (SIPC) e a curva de Phillips Aceleracionista (APC). Utilizamos dados dos Estados Unidos (1985Q1–2007Q4) e do Brasil (1996Q1–2012Q2), usando o hiato do produto e alternativamente o custo marginal real como medida de pressão inflacionária. A evidência empírica rejeita as restrições decorrentes da NKPC, da HPC e da SIPC, mas não rejeita aquelas da APC.

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1 Introduction

The empirical evidence shows that inflation tends to be pro-cyclical: periods of above average inflation tend to be associated with above average economic activity. This statistical relationship is known as the Phillips curve. The Phillips curve was perceived in the 60's as a menu for monetary policymakers: they could choose between high inflation and low unemployment or low inflation and high unemployment. But this interpretation of the Phillips curve assumed that the relationship between unemployment and inflation was stable and would not break down once a policymaker attempts to exploit the tradeoff. After Friedman's (1968) paper and the high inflation episodes experienced by many economies in the 1970s, this interpretation of the Phillips curve was discredited. After a period of low inflation in the 1980s and early 1990s, economists have again worked on a theoretical framework for the Phillips curve. The New Keynesian Phillips curve (NKPC) provides an interpretation of the short-run inflation-unemployment trade-off by deriving it from an optimizing framework featuring rational expectations and nominal rigidities. This is a structural model, designed to be capable of explaining the behavior of inflation without being subject to the Lucas critique. The NKPC is part of the New Keynesian model which is the workhorse model for monetary analysis[1]. However, to use the NKPC for policy analysis requires that it has a good econometric track record in describing inflation dynamics.

A large body of research has used time series methods to estimate the NKPC. Initial attempts to estimate the NKPC using aggregate time series data for the U.S. were not very successful (Galí and Gertler (1999, GG henceforth): the estimated coefficient on the output gap (proxied by detrended real GDP), was small and often negative in quarterly data. One interpretation for the poor results using a standard output gap measure is that it is simply a poor proxy for real marginal cost, which according to the theory would be the appropriate variable. GG report evidence in favor of the New Keynesian Phillips curve when labor's share of income, rather than a standard output gap variable, is used to proxy for real marginal cost. In order to capture the inflation persistence found in the data, GG modify the basic Calvo model of sticky prices to introduce lagged inflation into the Phillips curve, called hybrid Phillips curve. Based on U.S. data and using real marginal cost as the forcing variable, GG conclude that not only the forward looking behavior is predominant but, given the small estimate of the degree of backwardness, the pure forward looking model may do a reasonably good job of describing

[1] According to table C of Hammond (2010), 20 out of 27 inflation targeting central banks either use or are developing Dynamic Stochastic General Equilibrium (DSGE) models based on the New Keynesian framework for forecasting and policy analysis.

the data. Following the steps of GG, Galí, Gertler and López-Salido (2001) provided evidence on the fit of the NKPC for the Euro area.

Rudd and Whelan (2007) in a critical review of the New Keynesian model argue that the labor's share version of the model actually provides a very poor description of observed inflation behavior. This failure of the model extends along two dimensions: first, labor's share fails to provide a good measure of inflationary pressures; and second, this version of the model cannot account for the important role played by lagged inflation in empirical inflation regressions. They provide an alternative interpretation of the empirical estimates obtained from the hybrid Phillips curve, and argue that the data actually provide very little evidence of an important role for forward-looking behavior of the sort implied by these models.

As an alternative to the models of sticky prices, Mankiw and Reis (2002) [MR] argue that sticky information—the slow dispersion of information about macroeconomic conditions—can help account for the sluggish adjustment of prices and for the real effects that occur in response to monetary shocks. Kiley (2007) attempted to test the sticky information model of inflation against the sticky price for the United States using maximum-likelihood techniques. He finds that, once hybrid-behavior is allowed, hybrid sticky-price models provide a better description of inflation dynamics than a sticky-information model.

In a small open-economy exchange-rate movements play an important role in the transmission process that links monetary disturbances to output and inflation movements. Economic disturbances that originate in other countries have to be taken into account in monetary policy design that are absent in a closed-economy environment. In addition, part of the intermediate inputs are imported from abroad, which consist of mainly raw materials and energy. Usually the prices of imported inputs are more variable than of domestic labor as well as domestically produced intermediate inputs. This should—other things equal—induce firms to change their prices more frequently and possibly also by a larger amount in response to more variable input costs. Price setting is also more complex as the choice of currency, competition from abroad and the pass-through of exchange rate changes into prices become an issue. It is therefore not surprising that model building becomes increasingly difficult when it comes to modelling inflation dynamics in an open economy where the relationship between inflation and exchange rate is a key concern.

Several authors have attempted to estimate the Phillips curve for Brazil, and some of them were concerned specifically with the NKPC. For example, Areosa and Medeiros (2007) derive and estimate a structural model for inflation in a small open economy based on the models developed by Campos and Nakane (2003) and Galí and Monacelli (2005). Their model considers price rigidity according to Calvo (1983) and has inflationary inertia in a way similar to Woodford (2003) and GG. The estimated negative sign in the specification with the output gap contrasts with theory and although the impact of the estimate associated with the marginal cost is negligible, it is statistically significant. They find a small direct impact of the variables associated with economic openness, with the sum of their coefficients being close to zero. However, the indirect impact is significant, consistently changing the weights associated with lagged inflation and the expected future inflation. Mazali and Divino (2010) apply for Brazil the new Keynesian model of Blanchard and Galí (2007) with real wage rigidity and supply shocks. As the estimated coefficients satisfied a set of restrictions imposed by the theoretical model and over-identifying restrictions were not rejected, they concluded that the estimated new Phillips curve adjusted very well to the Brazilian data[2].

This paper tests Phillips curves using an autoregressive distributed lag (ADL) specification that encompasses the New Keynesian Phillips curve (NKPC), the Hybrid Phillips curve (HPC), the Sticky-Information Phillips curve (SIPC), and the accelerationist Phillips curve (APC). We use data from the United States (1985Q1–2007Q4) and from Brazil (1996Q1–2012Q2), using the output gap and alternatively the real marginal cost as measure of inflationary pressure. The empirical evidence rejects the restrictions implied by the NKPC, the HPC, and SIPC, but does not reject those implied by the APC.

The paper is organized as follows. Section 2 presents the ADL Phillips curve and shows how the different Phillips curve specifications considered in the literature can be seen as special cases of the ADL Phillips curve. Section 3 tests for the U.S. the restrictions implied by the different Phillips curve specifications. Section 4 tests for Brazil the restrictions implied by the different Phillips curve specifications. Finally, section 5 brings the concluding remarks.

2 Autoregressive Distributed Lag (ADL) Phillips Curve

A model of inflation dynamics general enough that encompasses the NKPC, the APC, the HPC, and the SIPC as special cases takes the form

$$\Delta\pi_t = \alpha_1 x_t + \alpha_2 x_{t-1} + \alpha_3 \Delta\pi_{t-1} + \varepsilon_t. \tag{1}$$

[2]Other articles that estimates the Phillips curve for Brazil include Cysne (1985), Lima (2003), Minella et al. (2003), Fasolo and Portugal (2004), Schwartzman (2006), Lima and Brito (2009), Holland and Mori (2010), Mendonça, Sachsida and Medrano (2012).

Let us show how each model is embedded in equation (1). The simple APC (SAPC) is given by

$$\Delta\pi_t = \kappa x_t + \varepsilon_t.$$

This is a particular case of equation (1) when $\alpha_1 = \kappa > 0$ and $\alpha_2 = \alpha_3 = 0$.

When expected inflation of the Phillips curve depends on additional inflation lags we have

$$\pi_t = (1-\omega)\pi_{t-1} + \omega\pi_{t-2} + \kappa x_t + \varepsilon_t.$$

This is equivalent to

$$\Delta\pi_t = -\omega\Delta\pi_{t-1} + \kappa x_t + \varepsilon_t.$$

This specification is a particular case of equation (1) when $\alpha_1 = \kappa > 0$, $\alpha_2 = 0$ and $\alpha_3 < 0$.

The NKPC is given by

$$\begin{aligned} \pi_t &= \beta E_t\pi_{t+1} + \kappa x_t + \varepsilon_t \\ &= \beta E_t(\pi_{t+1} - \pi_t) + \beta\pi_t + \kappa x_t + \varepsilon_t. \end{aligned}$$

Assuming rational expectations, $E_t\pi_{t+1} = \pi_{t+1} - \mu_{t+1}$, the NKPC can be written as

$$\Delta\pi_{t+1} = \frac{1-\beta}{\beta}\pi_t - \frac{\kappa}{\beta}x_t + \eta_{t+1}.$$

Assuming that $\beta = 1$, the acceleration of inflation in period t can be expressed as[3]

$$\Delta\pi_t = -\kappa x_{t-1} + \eta_t.$$

This follows from equation (12) when $\alpha_1 = \alpha_3 = 0$ and $\alpha_2 = -\kappa < 0$.

The HPC proposed by GG is given by

$$\pi_t = \omega\pi_{t-1} + (1-\omega)E\pi_{t+1} + \kappa x_t + \varepsilon_t.$$

As with the NKPC, we assume rational expectations and after some algebra we obtain

$$\Delta\pi_t = \frac{\omega}{(1-\omega)}\Delta\pi_{t-1} - \frac{\kappa}{(1-\omega)}x_{t-1} + \xi_t.$$

This is a particular case of equation (12) when $\alpha_1 = 0$, $\alpha_2 = -k/\left(1-\omega\right)$ and $\alpha_3 = \omega/\left(1-\omega\right)$.

[3] The assumption that β=1, or more generally that the sum of the coefficients of inflation equals to one, implies that the Phillips curve is vertical in the long-run, that is, there is no tradeoff between inflation and output (in the long-run).

The SIPC derived by MR is given by

$$\pi_t = \lambda \sum_{j=0}^{\infty} (1-\lambda)^j E_{t-1-j}(\pi_t + \alpha \Delta x_t) + \frac{\alpha\lambda}{1-\lambda} x_t + \varepsilon_t.$$

Assuming rational expectations and using the lag operator $L^j E_{t-1} = E_{t-1-j}$, we obtain after some algebra the following expression for the acceleration of inflation

$$\Delta\pi_t = \frac{\alpha\lambda(2-\lambda)}{(1-\lambda)^2} x_t - \frac{2\alpha\lambda(1-\lambda)}{(1-\lambda)^2} x_{t-1} + \varsigma_t$$

This expression is a particular case of equation (1) when $\alpha_1 = \alpha\lambda(2-\lambda)/(1-\lambda)^2 > 0$, $\alpha_2 = -2\alpha\lambda(1-\lambda)/(1-\lambda)^2 < 0$, and $\alpha_3 = 0$.

Table 1 shows the restrictions implied by each Phillips curve model subsumed by equation (1), which is an ADL(1,1).

Model	Parameters		
	α_1	α_2	α_3
APC	+	0	-
NKPC	0	-	0
HPC	0	-	+
SIPC	+	-	0

Table 1: Model Typology

The ADL Phillips curve [equation (1)] actually encompasses all Phillips curves as special cases. This provides a convenient framework for analysing the properties of each model used in empirical research, highlighting their respective strengths and weaknesses.

The extended ADL Phillips curve includes additional lags of both ourput gap and inflation acceleration, according to:

$$\Delta\pi_t = \sum_{s=0}^{m} \alpha_s x_{t-s} + \sum_{s=1}^{n} \beta_s \Delta\pi_{t-s} + \varepsilon_t \tag{2}$$

In this paper we test the NKPC against the HPC, the SIPC, and the APC based on the encompassing ADL Phillips curve [equation (2)]. The empirical strategy is as follows:

(i) Formulate a Phillips curve model that encompasses the NKPC, the HPC, the SIPC, and the APC as special cases — the ADL Phillips curve; (ii) Reduce the ADL Phillips curve model based on statistical criteria; (iii) Check which (if any) of the Phillips curve models fits better the estimated Phillips curve.

3 Empirical Evidence: United States (1985Q1–2007Q4)

The U.S. sample goes from 1985Q1 to 2007Q4, the period known as "Great Moderation" due to the decline in the variability of both output and inflation[4]. The inflation rate (π_t) is measured as the weighted median of price changes across industries (median inflation)[5]. The output gap (x_t) is given by 100 times the difference between the log of the quarterly real GDP and the log of the Congressional Budget Office's estimate of the potential real GDP.

We start from the (extended) ADL Phillips curve [equation (2)]. Then, we reduce the ADL Phillips curve by sequential elimination of regressors based on t-ratios of the parameters estimators. Allowing an increased number of lags, we estimate the full model by OLS and then sequentially delete those regressors with the smallest t-ratios, until the t-ratios are all greater than the threshold $\gamma = 2$, see table 2[6].

Table 2 shows that the selected model is composed by the first two lags of the change in inflation, and the lags of order one and four of the output gap. The diagnostic tests does not indicate any problems concerning autocorrelation, conditional heteroscedasticity, normality, and regression specification. Using equation (1) and comparing the values of Tables 1 and 2, we observe that none of the restrictions implied by the SIPC are verified. Only one of the restrictions implied by the NKPC and the HPC is accepted ($\alpha_1 = 0$), while all their other restrictions are rejected by the U.S. data. The APC has

[4] James Stock coined the phrase "the great moderation" while writing a research paper with Mark Watson in 2002 ("Has the Business Cycle Changed and Why?"). It was brought to the attention of the wider public by Ben Bernanke (then member and now chairman of the Board of Governors of the Federal Reserve) in a speech titled "The Great Moderation" in 2004.

[5] Since Gordon (1982), many empirical researchers add supply shocks to the Phillips curve. Excluded supply shock variables are positively correlated with inflation and positively correlated with the output gap, so the omission of these supply shock variables causes the coefficient on the output gap to be biased towards zero. Following Ball and Mazumber (2011), we define core inflation as the part of inflation explained not by supply shocks. With this definition one can measure core inflation by removing the effects of supply shocks from total inflation. If supply shocks are asymmetries in the distribution of price changes, then a measure of core inflation should eliminate the effects of these asymmetries. A simple measure, proposed by Bryan and Cecchetti (1994), is the weighted median of price changes across industries (median inflation).

[6] For the estimations we made two assumptions that are standard in the literature [see, for example, Ball and Mazumber (2011)]. First, we assumed that the current level of the output gap (x_t) is uncorrelated with the error term (ε_t). Second, we assumed that the sum of the coefficients of inflation equals one.

one restriction right ($\alpha_3 < 0$) and restrictions on the output gap ($\alpha_1 > 0$ and $\alpha_2 = 0$) that are consistent with the fact that their sum is positive when inflation depends on additional lags of output gap. Furthermore, if we allow expected inflation of the PC to depend on additional inflation lags

$$\pi_t = \omega_1 \pi_{t-1} + \omega_2 \pi_{t-2} + \omega_3 \pi_{t-3} + \kappa x_t + \varepsilon_t \ , \ \sum_{i=1}^{3} \omega_i = 1.$$

This expression can be rewritten as

$$\Delta\pi_t = -(1-\omega_1)\Delta\pi_{t-1} + -(1-\omega_1-\omega_2)\Delta\pi_{t-2} + \kappa x_t + \varepsilon_t.$$

That is,

$$\Delta\pi_t = \alpha_1 x_t + \alpha_3 \Delta\pi_{t-1} + \alpha_4 \Delta\pi_{t-2} + \varepsilon_t, \tag{3}$$

where $\alpha_3, \alpha_4 < 0$ – which are not rejected by the U.S. data.

We conclude that for the U.S. the best fit for explaining inflation from 1985Q1–2007Q4 comes from the APC model.

Dependent Variable: Δ (median inflation)$_t$		
Estimation Method: OLS		
sample: 1985Q1–2007Q4		
Variable	Coefficient	Standard Error
Δ (median inflation)$_{t-1}$	-0.648	0.097
Δ (median inflation)$_{t-2}$	-0.308	0.097
x_{t-1}	0.122	0.035
x_{t-4}	-0.071	0.034
Adjusted R-squared	0.349	
S.E. of regression	0.311	
Sum squared residuals	8.228	
Log likelihood	-20.328	
Durbin-Watson statistic	2.097	
Mean dependent variable	0.001	
S.D. dependent variable	0.385	
Schwarz criterion	0.658	
AR 1-5 test: F(5,79)	1.210 [0.312]	
ARCH 1-4 test: F(4,80)	0.549 [0.700]	
Normality test: Chi^2(2)	0.630 [0.729]	
Hetero test: F(8,79)	0.701 [0.689]	
Hetero-X test: F(14,73)	0.946 [0.514]	
RESET23 test: F(2,82)	0.976 [0.380]	

The values in brackets denote probability values (p-values).

Table 2: U.S. ADL Phillips Curve, using median inflation: 1985Q1 - 2007Q4

Motivated by the NKPC literature, we modified the ADL Phillips curve by replacing the output gap with the real marginal cost, proxied by the labor share of income [7]. The results are displayed on Table 3. The labor share of income (equivalently, real unit labor costs) does not appear to be a (statistically) relevant variable for explaining inflation dynamics. Furthermore, the signs of inflation acceleration are consistent only with the APC. Still, the diagnostic tests does not indicate any problems with the estimates.

[7] Most papers in the recent literature on the NKPC have referred to labor's share of income as real unit labor costs. Our measure of labor share of income (equivalently, real unit labor cost) corresponds to the GG measure of log-real unit cost as described by King and Watson (2012), with the difference that we applied the Hodrick-Prescott (HP) filter to get the deviaton from steady-state.

Dependent Variable: $\Delta\,(\text{median inflation})_t$		
Estimation Method: OLS		
sample: 1985Q1–2007Q4		
Variable	Coefficient	Standard Error
$\Delta\,(\text{median inflation})_{t-1}$ *	-0.582	0.100
$\Delta\,(\text{median inflation})_{t-2}$ *	-0.229	0.100
$(\textit{labor share})_{t-2}$	-0.042	0.042
Adjusted R-squared	0.287	
S.E. of regression	0.270	
Sum squared residuals	9.337	
Log likelihood	-25.956	
Durbin-Watson statistic	1.989	
Mean dependent variable	-0.001	
S.D. dependent variable	0.385	
Schwarz criterion	0.734	
AR 1-5 test: F(5,80)	0.471 [0.796]	
ARCH 1-4 test: F(4,80)	1.139 [0.343]	
Normality test: Chi^2(2)	1.156 [0.560]	
Hetero test: F(6,81)	0.778 [0.589]	
Hetero-X test: F(9,78)	1.173 [0.324]	
RESET23 test: F(2,83)	0.052 [0.949]	

The values in brackets denote probability values (p-values).
Significant variables at 5% level are shown by one star.

Table 3: U.S. ADL Phillips Curve, using median inflation and labor income share: 1985Q1 - 2007Q4

4 Empirical Evidence: Brazil (1996Q1–2012Q2)

We extend the encompassing ADL Phillips curve [equations (1)–(2)] to introduce the exchange rate, an important open-economy modelling feature.

Including the exchange rate in the study of inflation dynamics is important because the exchange rate allows additional channels for the transmission of monetary policy. In an open economy, the real exchange rate will affect the relative price between domestic and foreign goods, which in turn will affect both domestic and foreign demand for domestic goods, and hence contribute to the aggregate-demand channel for the transmission of monetary policy. There is also a direct exchange rate channel for the transmission of monetary policy to inflation, in that the exchange rate affects domestic currency prices of imported final goods, which enter the consumer price index

(CPI) and hence CPI inflation. Finally, there is an additional exchange rate channel to inflation: the exchange rate will affect the domestic currency prices of imported intermediate inputs, affecting the cost of domestically produced goods, and hence domestic inflation (inflation in the prices of domestically produced goods).

In order to capture the importance of the exchange rate for inflation dynamics we supplement the (extended) ADL Phillips curve [equation (2)] with a 'level' term in the real exchange rate gap (q_t):

$$\Delta\pi_t = \sum_{s=0}^{m} \alpha_s x_{t-s} + \sum_{s=1}^{n} \beta_s \Delta\pi_{t-s} + \sum_{s=0}^{p} \gamma_s q_{t-s} + \Psi D_t + \varepsilon_t, \qquad (4)$$

where D_t is a vector of intervention dummies.

The level term can be interpreted as capturing the presence of intermediate imported goods as in McCallum and Nelson (2000), where all imports are material inputs to the production process for domestically produced goods.

In the case of Brazil the sample goes from 1996Q1 to 2012Q2. The inflation rate (π_t) is measured as the exclusion core inflation reported by the Central Bank of Brazil[8]. The output gap (x_t) is given by 400 times the log of the quarterly real GDP seasonaly adjusted, detrended by the HP filter. The real exchange rate gap (q_t) is calculed as 400 times the log of the quarterly average of monthly indexes of real effective exchange rates, detrended by the HP filter.

We start from the extended open-economy ADL Phillips curve [equation (4)]. Then, we reduce the extended ADL Phillips curve by sequential elimination of regressors based on t-ratios of the parameters estimators. We estimate the full model by OLS and then sequentially delete those regressors with the smallest t-ratios, until the t-ratios are all greater than the threshold γ =2.[9]

Table 4 shows that the selected model is composed by the first three lags of the change in inflation, the current value of the level of the output gap, the current value of the level of the real exchange rate and its lag of order four. The diagnostic tests does not indicate any problems concerning autocorrelation, conditional heteroscedasticity, normality, and regression specification.

[8] In the exclusion core inflation, food, energy and regulated & administered prices are excluded from the measurement of inflation.

[9] In addition the same assumptions that we made in the estimation for the U.S., for Brazil we also employed two intervention dummies. One is "Lula" which tries to capture the effect of the election of President Lula on inflation (2002Q3– 2003Q1). The other "Energy Crisis" which tries to capture the negative effect of the energy crisis on the output gap (2001Q3–2002Q1).

Dependent Variable: $\Delta(\textit{core inflation})_t$		
Estimation Method: OLS		
sample: 1996Q1–2012Q2		
Variable	Coefficient	Standard Error
$\Delta(\textit{core inflation})_{t-1}$	-0.227	0.129
$\Delta(\textit{core inflation})_{t-2}$	-0.199	0.099
$\Delta(\textit{core inflation})_{t-3}$	-0.191	0.080
x_t	0.642	0.291
q_t	0.153	0.044
q_{t-4}	-0.081	0.041
Adjusted R-squared	0.146	
S.E. of regression	2.858	
Sum squared residuals	490.280	
Log likelihood	-159.825	
Durbin-Watson statistic	1.671	
Mean dependent variable	-0.244	
S.D. dependent variable	3.094	
Schwarz criterion	5.224	
AR 1-5 test: F(4,52)	0.841 [0.505]	
ARCH 1-4 test: F(4,54)	1.962 [0.113]	
Normality test: Chi^2(2)	3.173 [0.204]	
Hetero test: F(12,49)	1.307 [0.245]	
Hetero-X test: F(27,34)	1.617 [0.092]	
RESET23 test: F(2,54)	1.858 [0.165]	

The values in brackets denote probability values (p-values).

Table 4: Brazil ADL Phillips Curve using core inflation: 1996Q1 - 2012Q2

Using equation (4) and comparing the values of tables 1 and 4, we observe that all restrictions implied by the NKPC ($\alpha_1 = 0$, $\alpha_2 < 0$, $\alpha_3 = \alpha_4 = 0$) and the HPC ($\alpha_1 = \alpha_4 = 0$, $\alpha_2 < 0$, $\alpha_3 > 0$) are rejected by the Brazilian data. The SIPC gets one restriction right ($\alpha_1 > 0$) and three wrong ($\alpha_2 < 0$ and $\alpha_3 = \alpha_4 = 0$). The APC gets all restrictions right ($\alpha_1 > 0$, $\alpha_2 = 0$, α_3 , $\alpha_4 < 0$). Therefore, also in a small open economy like Brazil the best fit for explaing inflation dynamics from 1996Q1–2012Q2 comes from the APC model.

We modified the ADL Phillips curve by replacing the output gap with the real marginal cost, proxied by the labor share of income [10]. The results

[10] Our measure of labor's share of income is based on Bastos (2012), which ends on 2010Q2. To his series we applied logs and the HP filter.

are displayed on Table 5. In this case there is no clear evidence in favour of any of the models analysed. Still, the diagnostic tests does not indicate any problems with the estimates.

Dependent Variable: $\Delta(\textit{core inflation})_t$		
Estimation Method: OLS		
sample: 1996Q1–2010Q2		
Variable	Coefficient	Standard Error
$(\textit{labor share})_{t-2}$	-0.288	0.090
q_t	0.123	0.035
q_{t-2}	-0.102	0.037
Adjusted R-squared	0.335	
S.E. of regression	2.577	
Sum squared residuals	378.631	
Log likelihood	-140.402	
Durbin-Watson statistic	2.360	
Mean dependent variable	-0.237	
S.D. dependent variable	3.162	
Schwarz criterion	4.884	
AR 1-5 test: F(4,51)	2.025 [0.104]	
ARCH 1-4 test: F(4,50)	0.489 [0.743]	
Normality test: Chi^2(2)	4.419[0.109]	
Hetero test: F(6,51)	0.597 [0.731]	
Hetero-X test: F(9,48)	0.616[0.777]	
RESET23 test: F(2,53)	0.082[0.920]	

The values in brackets denote probability values (p-values).

Table 5: Brazil ADL Phillips Curve using core inflation and labor share: 1996Q1 - 2010Q2

5 Concluding Remarks

As yet there is no consensus on two key Phillips curves issues. First, inflation expectations are forward-looking or backward-looking? If expectations are forward-looking, future events (including changes in monetary policy) can influence the current inflation rate. If, instead, expectations are backward-looking, inflation has inertia. Such inertia affects the design of monetary policy. Second, what is a proper measure of inflationary pressures—the output gap or the real marginal cost?

In this paper we test Phillips curves using an ecompassing framework. We conclude that the NKPC does not provide an useful description of the inflation process in the cases of the U.S. and Brazil. The evidence presented here rejects the restrictions implied by the NKPC, the HPC, and SIPC, but does not reject those of the APC. We also conclude that the APC is the best fitting model of inflation dynamics for those countries, at least for the sample considered.

Regarding the two fundamental Phillips curves issues, our results suggest that inflation expectations are backward-looking and that the output gap is a better measure of inflationary pressures than the real marginal cost.

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