Inflation Dynamics and the Cost Channel in Emerging Markets

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31 October 2012

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Abstract

We investigate inflation dynamics and the presence of the cost channel in ten emerging markets since the 1990's from the new Keynesian and triangle Phillips curve perspectives. A negative sign on the output gap is a common finding in new Keynesian specifications. This problem may be addressed by taking into account the endogeneity of the nominal interest rate in the instrument set of GMM estimations. We confirm substantial and significant backward-looking behavior in the inflation process of emerging markets, but its size is not robust to specification in some economies. In almost all the triangle model estimations, except for Hungary, the output gap exhibits the correct sign. Except for Mexico, there is no evidence of the cost channel in emerging market economies. The cost channel is not robust to the endogeneity of the nominal interest rate and to the specification of the Phillips curve.

Keywords: Cost channel, inflation dynamics, Phillips curve

1. Introduction

This paper investigates inflation dynamics and the presence of the cost channel of monetary policy in emerging market economies from the new Keynesian and the triangle Phillips curve perspectives. The cost channel has received attention among researchers because of its potential to complicate the use of the nominal interest rate as an instrument of monetary policy. The cost channel view was popularised by Barth and Ramey (2001). It states that in

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order to produce, firms have to borrow from intermediaries to finance working capital. Consequently, part of their costs will involve the interest rate charged on loans to finance working capital. This idea can also be found in the DSGE model by Christiano et al. (2005). From the policy perspective, Tillmann (2009a) finds that the presence of the cost channel can offset activist policy in the face of model uncertainty and the deliver an attenuated response of monetary policy to inflation.

Evidence of the cost channel has been documented for some developed economies. Ravenna and Walsh (2006) find evidence of the cost channel in the US. Chowdhury et al. (2006) find evidence of the cost channel for the UK, US, Canada and Italy, whereas France, Germany and Japan are found to exhibit small or no effects. Tillmann (2009c, 2009d) also finds evidence of the cost channel in the Euro-area. Henzel et al. (2009), using a DSGE model, find that under plausible parameter restrictions, the cost channel helps explain the price puzzle. They argue that relative stickiness of wages and prices and the financial structure play a role in determining the effectiveness of the cost channel. They find that, in the case of the Euro area, the cost channel helps generate the price puzzle. Similarly Hülsewig et al. (2009) find that the cost channel matters for monetary policy and explains the delayed response of inflation to monetary policy shocks. Gaiotti and Secchi (2006) provide microeconomic evidence of the cost channel from a panel of Italian firms.

However, the significance of the cost channel is not conclusive. Using a DSGE model, Rabanal (2007) finds little evidence of the cost channel in the US and he concludes that the cost channel cannot be used to explain the price puzzle, which may be a result of model misspecification. Similarly, Kaufman and Scharler (2009) find that the cost channel has limited effect on the transmission mechanism of the US and Euro-area. Castelnuovo (2012) also finds no empirical evidence for the cost channel. He provides ample literature that shows that the price puzzle is limited to the pre-Volcker period, results from VAR misspecification, measurement errors and the Choleski identification scheme of a monetary policy shock.

In the context of emerging markets, Agénor and Montiel (2008) note that the new structuralist macroeconomists, e.g. Taylor (1983), argue that the cost channel may be prevalent. This literature assumes that bank debt is a significant source of financing operations for firms, including the acquisition

of fixed capital assets, because of weak stock and corporate bond markets. However studies on the capital structure, e.g. Glen and Singh (2004) and de Jong et al. (2008), seem to find significant cross-country variation of leverage within emerging market and developed economies. Specifically, Glen and Singh (2004) report a median leverage ratio of 0.49 and 0.52 for emerging markets and developed markets respectively. Overall, these authors observe a declining trend in the leverage ratio across countries. This development has implications for the cost channel view of monetary policy. It intuitively suggests that the cost channel may be as important in emerging markets as it is in developed economies and it may be declining in importance.

The contribution of this paper is three-fold. Firstly we build on Agénor and Bayraktar (2010) in estimating models of the Phillips curve in emerging market economies. Our paper differs from Agénor and Bayraktar (2010) in the scope of the economies covered, the issues that are investigated and the models that are estimated. Secondly, we investigate the existence of the cost channel in these economies by controlling for the endogeneity of the interest rate in the context where central banks respond to inflation, as pointed out by Chowdhury et al. (2006). Thirdly, given the controversy that surrounds the new Keynesian Phillips curve as pointed out by Rudd and Whelan (2005, 2007), Fair (2008), Martins and Gabriel (2009), the literature cited by Agénor and Bayraktar (2010) and Gordon (2011), we also investigate whether the cost channel is present in the context of the traditional, triangle Phillips curve as specified in Fuhrer (1995) and Gordon (1997). Thus in relation to the cost channel, we test whether its existence is robust to endogeneity and to model specification.

The paper is structured as follows: Section 2 presents open-economy New Keynesian and the triangle Phillips curves that incorporate the cost channel effect and supply shocks, section 3 conducts an empirical analysis of inflation dynamics and the strength of the cost channel, section 4 concludes.

2. Theoretical Framework

The new Keynesian approach to the Phillips curve builds on the derivations by Gali and Gertler (1999) and Fuhrer (1997). We assume a small open economy in which part of the costs are internally financed and part are externally financed through loans from financial intermediaries. Furthermore we follow

Batini et.al. (2005) and assume that non-labour input requirements depend only on output. We simplify Batini et.al.'s assumption in that the relationship between input requirements and output is a linear one, i.e. $X_{it} = \omega_i Y_t$, where X_{it} is the quantity of non-labour input i and ω_i is a production co-efficient that relates non-labour input i to a unit of output. We can then write total cost as follows:

$$TC_t = R_t^{\chi'} \left(\frac{W_t L_t}{P_t} + \frac{\omega_z E_t P_{zt}^f Y_t}{P_t} + \sum_{i=1}^{n-1} \frac{\omega_i P_{it} Y_t}{P_t} \right), \tag{1}$$

where W_t is the nominal wage, P_t is the domestic aggregate price level, L_t is total employment, P_{zt}^f is the foreign price of the imported input, ω_z is the production co-efficient of the imported input, Y_t is real output, E_t is the nominal exchange rate, P_{it} is the domestic price of input i, R_t is the gross interest rate paid by firms to intermediaries and $\chi' \geq 0$ measures the strength of the cost channel. Based on the above assumptions, we can write the Cobb-Douglas production function as follows:

$$Y_t = A_t L_t^{\alpha} \left[\prod_{i=1}^{n} (\omega_i Y_t)^{\theta_i} \right]^{1-\alpha}. \tag{2}$$

Solving out for Y_t simplifies the production function as follows:

$$Y_t = \widetilde{A}_t L_t^{\sigma}, \tag{3}$$

where $\vartheta = (1-\alpha) \sum_{i=1}^{n} \theta_i$, $\sigma = \frac{\alpha}{1-\vartheta}$ and $\widetilde{A}_t = \left(A_t \prod_{i=1}^{n} \omega_i^{\theta_i} \right)^{\frac{1}{1-\vartheta}}$. Real marginal cost is then given by:

$$MC_t = R_t^{\chi'} \left(\frac{W_t L_t}{\sigma P_t Y_t} + \frac{\omega_z E_t P_{zt}^f}{P_t} + \sum_{i=1}^{n-1} \frac{\omega_i P_{it}}{P_t} \right) \tag{4}$$

Taking the Taylor expansion of eq. (4) we get the following linearisation of real marginal cost:

$$\widehat{mc}_t = \delta'\widehat{s}_t + \lambda'\widehat{q}_t + \sum_{i=1}^{n-1}\gamma_i^{'}\widehat{p}_{it} + \chi'\widehat{R}_t \tag{5}$$

where $\widehat{s}_t$ is the percentage deviation of the labour share from trend, $\widehat{q}_t$ is the percentage deviation of the real import price from trend, $\widehat{p}_{it}$ is the percentage deviation of the real price of non-labour input i from trend, $\widehat{R}_t$ is the percentage deviation of the gross interest rate from trend, $\delta' = \frac{R_0^{\chi} s_0}{mc_0\sigma}$, $\lambda' = \frac{\omega_z R_0^{\chi} q_0}{mc_0}$ and $\gamma_i^{'} = \left(\frac{\omega_i p_{i0} R_0^{\chi}}{mc_0}\right)$. The cost channel exists if $\chi^{'} > 0$. Following Gali and Gertler (1999) and Chowdhury et.al. (2006), we write the reduced-form interest rate augmented Phillips curve as follows:

$$\pi_t = \phi^f \underset{t}{E}\pi_{t+1} + \phi^b\pi_{t-1} + \delta\widehat{s}_t + \lambda\widehat{q}_t + \sum_{i=1}^{n-1}\gamma_i\widehat{p}_{it} + \chi\widehat{R}_t, \tag{6}$$

where $\delta = \varphi\delta^{'}$, $\lambda = \varphi\lambda^{'}$, $\gamma_i = \varphi\gamma_i^{'}$ and $\chi = \varphi\chi^{'}$ and $\varphi > 0$ is the coefficient of marginal cost in the hybrid new Keynesian Phillips curve. The cost channel exists if $\chi > 0$ and is statistically significant. Eq. (6) is a flexible formulation of the new Keynesian Phillips curve, which allows for the incorporation of supply shocks. The significance of supply shocks in the Phillips curve has been emphasised by Gordon (2011) in the context of the traditional Phillips curve. In the context of new Keynesian literature supply shocks e.g. commodity prices, enter as part of the instruments in GMM estimations (Gali and Gertler (1999), Chowdhury et.al. (2006)). In the context of emerging markets, Agénor and Bayraktar (2010) include the oil price and the real exchange rate. Mehra (2004) also finds that the new Keynesian Phillips curve exhibits significant output gap effects once supply shocks, in the form of import prices and Nixon controls, are taken into account for the US.

Agénor and Bayraktar (2010) argue that in the developing country context, the use of the labour share may lead to unreliable inference due to sizeable errors that may be in the data. These errors arise primarily because of the significant number of people in the labour force who are engaged in the informal economy. Consequently they follow Gali and Gertler (1999) and propose a formulation that replaces the labour share with the output gap by assuming $\widehat{s}_t = \kappa y_t$ where y_t is the output gap, so that:

$$\pi_t = \phi^f \underset{t}{E}\pi_{t+1} + \phi^b \pi_{t-1} + \psi y_t + \lambda \widehat{q}_t + \sum_{i=1}^{n-1} \gamma_i \widehat{p}_{it} + \chi \widehat{R}_t, \tag{7}$$

where $\psi = \kappa\delta$. Another version of the new Keynesian Phillips curve is by Fuhrer (1997). This version is used by Jondeau and Le Bihan (2005) and Agénor and Bayraktar (2010), it specifies the NKPC with several leads and lags of inflation as follows:

$$\pi_t = \sum_{x=1}^{4} \omega_x \pi_{t-x} + \sum_{j=1}^{4} \omega_j \underset{t}{E}\pi_{t+j} + \psi y_t + \lambda \widehat{q}_t + \sum_{i=1}^{n-1} \gamma_i \widehat{p}_{it} + \chi \widehat{R}_t \tag{8}$$

The alternative Phillips curve model that we use to investigate the dynamics of the inflation process and to test for the presence of the cost channel is the traditional Phillips curve similar to that of Fuhrer (1995) and Gordon (1997). The triangle model has been severely criticised for its lack of microfoundations. It is however opportune to explore this specification because Eller and Gordon (2003) and Gordon (2011) argue that the traditional triangle Phillips curve, with its long lags, outperforms the new Keynesian Phillips curve. We write the interest rate augmented triangle model as follows:

$$\pi_t = \phi^b(L)\pi_t + \psi y_t + \lambda \triangle q_t + \sum_{i=1}^{n-1} \gamma_i \triangle p_{it} + \chi \widehat{R}_t, \tag{9}$$

where $\phi^b(1) = 1$. The difference between the new Keynesian Phillips and the traditional model is that instead of using deviations from trend for real input prices and the real exchange rate, the traditional model uses the rates of change of the real exchange rate and real input prices. In addition the forward-looking inflation expectations term is absent in the traditional model.

3. Empirical results

Data is drawn from the OECD quarterly database from 1990–2011. For economies and variables that are not in the OECD database we used the

International Financial Statistics database. Inflation is measured using the CPI, supply shocks are measured by consumer prices for energy, food and the import prices are measured by the deflator. Real output is measured by real GDP. Deviations from trend are derived using the HP-filter. The ten economies that we investigate are Brazil, Chile, Mexico, Hungary, Poland, Czech Republic, Turkey, South Africa, Korea Republic and Indonesia.

We follow Chowdhury et.al. (2006), Tillman (2009a), Agénor and Bayraktar (2010) and Vašíček (2012) among others, and estimate the new Keynesian Phillips curve using GMM. Agénor and Bayraktar (2010) include the difference in oil prices and the wage rate while other authors, e.g. Gali and Gertler (1999) and Chowdhury et.al. (2006) use real commodity prices as part of the instruments. Vašíček (2012) uses a measure of marginal cost and wage inflation as part of the instruments. Following the literature, we use four lags of inflation, output gap, real import prices or real exchange rate, the nominal interest rate, real energy and food prices. The triangle model is estimated by means of OLS.

As pointed out by Mavroeidis (2004, 2005), Bardsen et.al. (2004) and Martins and Gabriel (2009) GMM estimation may suffer from weak identification. To test for this we follow Bardsen et.al. (2004), Agénor and Bayraktar (2010) and Vašíček (2011) and use the first-stage F-statistic to check the strength of our chosen instruments. The rule-of-thumb for the F-statistic is that it should exceed 10, based on Bardsen et.al. (2004).

An important issue in our investigation is the endogeneity of the nominal interest rate to the inflation rate, thanks to the inflation-targeting framework that has been adopted by many central banks, especially the ones in our sample. Chowdhury et.al. (2006) address this issue by running simple interest rate rules wherein the interest rate responds to the inflation rate. In our case we run OLS for a simple rule of the form $R_t = \phi_0 + \phi_\pi \pi_t + \xi_t$. The innovations ξ_t is independent of inflation by construction, since $E(\xi_t \pi_t) = 0$. We then HP-filter the innovations ξ_t and insert them in the Phillips curve to check if the existence of the cost channel is robust to endogeneity.

Table 1 provides estimates of the two Phillips curves without taking into account the issue of endogeneity. We note that the output gap in the new Keynesian Phillips curve estimations carries a wrong sign for most of the countries. It can be argued that the assumption that the labour share is

positively related to the output gap, i.e. $\widehat{s}_t = \kappa y_t$ is inappropriate and that in these cases $\kappa < 0$. However estimations of the new Keynesian Phillips curve using the labour share for those countries where data is available yields the same results. The result of a negative sign on the output gap in new Keynesian Phillips curve estimations can be gleaned from Rudd and Whelan (2005, 2007), who interepret it to indicate the failure of the new Keynesian Phillips curve.

In the case of Australia, Abbas and Sgro (2011) report negative 2SLS and OLS coefficients for the output gap and insignificant output gap coefficients for the GMM estimation. For some economies that are in our sample, Vašíček (2011) estimates new Keynesian Phillips curves for the Czech Republic, Hungary, Poland and Slovakia. In the case of the Czech Republic, he reports a "wrong" negative sign for marginal cost and the output gap (when four lags of inflation are included as part of the forcing variables). For Hungary the output gap also has a negative sign while for Poland it has a positive sign. Our results are consistent with these findings, except for Poland.

Estimations of the triangle Phillips curve in Table 1 do not pose the negative sign problem, except for Hungary, where the output gap is not significant. It is clear from this contrast that the negative sign on the output gap, which also emerges when the labour share is used, is due to the inclusion of the forward-looking term in the new Keynesian Phillips curve. Rudd and Whelan (2005, 2007) show that the output gap carries a negative sign, and the labour share is insignificant, in the case of the US.

In terms of forward and backward-looking terms, we observe that the degree of forward-lookingness varies significantly for some countries, while in others it is relatively robust to specification. For example, in South Korea the forward-looking coefficient ranges from 0.61 to 0.77. For other countries the degree of forward-looking behaviour varies between being dominant and being subdued, e.g. for the Czech Republic it ranges from 0.39 to 0.54. For many countries it could be argued that qualitatively both components are equally important. Here too, we see that forward-lookingness is not robust to Phillips curve specification for some countries.

The coefficient of interest in relation to the cost channel is χ, which should be positive and significant. From the new Keynesian perspective, Table 1 suggests that the cost channel is pervasive in emerging market economies,

except for Brazil. Our results confirm Agénor and Bayraktar (2010) for Korea and Mexico. From the triangle perspective these results are contradicted in the case of Poland, Czech Republic and Indonesia. This implies that the cost channel is not robust to alternative Phillips curve specifications in these five countries.

The next step is to check if the cost channel is robust to potential endogeneity arising from monetary policy. The results are provided in Table 2. Firstly we note that the negativity problem now afflicts four of the twelve economies in our sample. It is clear from these results that the endogeneity of the interest rate that is embedded in the forward-looking term may partially account for the negative coefficient problem. The problem is solved in eight of the twelve economies and the output gap turns out to be significant. For the four economies that still exhibit the negative sign problem the output gap is not statistically significant. The fact that this problem still remains in these four countries implies that there are other reasons for its existence.

In terms of the cost channel we find, from the new Keynesian perspective, that the nominal interest rate now carries a negative sign for ten of the twelve countries under consideration, except for Mexico. Therefore from the new Keynesian perspective, the cost channel is not robust to the endogeneity of the nominal interest rate arising from the reaction of monetary policy. This finding is in contrast to the experience of developed economies as documented by Chowdhury et.al. (2006) and Tillmann (2009c, 2009d) among others.

Table 2 also shows estimations of the triangle Phillips curve, where all the countries exhibit positive output gap coefficients. Seven of the twelve countries exhibit negative interest rate effects on inflation, which is a rejection of the cost channel view. In instances where the interest rate carries a positive sign, it is not significant, except for Mexico. There are contrasts with the new Keynesian perspective in some cases. For example in Brazil, the cost channel exists but is not significant. In Hungary, the new Keynesian perspective suggests that the cost channel does not exist, whereas it exists without significance from the triangle perspective. Similar contrasts exist for Turkey. These results imply that the cost channel is not robust to endogeneity. Secondly there are instances where the cost channel is not robust to the specification of the Phillips curve.

Lastly, Table 3 provides estimates based on the new Keynesian Phillips curve

in the spirit of Fuhrer (1997). Here too, we find the negative sign problem in some of the countries and the significance of the output gap disappears (see also Agénor and Bayraktar (2010) in this regard). In addition the cost channel is rejected in four economies, whilst in four others it is not significant, even without controlling for endogeneity. When controlling for endogeneity the cost channel is rejected in all the emerging market economies. When compared to Table 1, we see that even the specification of the new Keynesian Phillips curve matters for the cost channel. In seven of the eight economies that are considered in Table 3, the results that are contained in Table 1 are overturned.

Possible reasons for the overwhelming rejection of the cost channel view are cited by Tillmann (2009c).We think that three of the four reasons he cites are relevant to emerging markets. Firstly, financial innovations and deregulation may have increased the availability of working capital, especially the increase in foreign direct investment to emerging markets. Secondly, the shift towards flexible exchange rates and trade liberalisation may have led to a situation where an increase in domestic interest rates appreciates emerging market currencies, which cheapens the cost of imported inputs (and some consumption items). Thirdly, financial frictions in emerging markets may be prevalent, thereby weakening the transmission of changes in interest rates to inflation.

How do these results relate to the capital structure literature? Two possibilities emerge. Firstly, it may be that a significant number of firms whose activities impact significantly on the domestic inflation process rely more on internal funds (and perhaps equity) to finance their operations and not so much on external debt. This view is consistent with the conjecture that foreign direct investment may weaken the reliance of domestic firm on the domestic banking system to finance their operations. Qualifying that firms should play a significant role in the domestic inflation process is important because, in some of the emerging markets, leverage is high but the cost channel is non-existent. For example between 1994 and 2000, Glen and Singh (2004) note that in Brazil the debt liability of firms increased from 42% to 62%, but our results show that the cost channel does not exist in Brazil. Indonesia experienced rising leverage to as high as 89% in 2000, but the cost channel is ineffective. Secondly, financial systems in emerging markets may indeed be bank-based. However, as pointed out by Chowdhury et.al.(2006),

the low interest rate pass-through may be due to financial sector regulation that exists in these economies. Consequently, specific financial institutional characteristics may work to render the cost channel ineffective in emerging markets.

We conclude that the new Keynesian Phillips curve suffers from the output gap negative sign problem in emerging market economies when the nominal interest rate is not purged of endogeneity. In general terms, this problem is due to the inclusion of the forward-looking term in the new Keynesian model. Specifically, we saw that controlling for endogeneity significantly improves the new Keynesian model. The results suggest that it may be worthwhile to explore the specific role of the nominal interest rate in the instrument set of GMM estimations and to develop a coherent structural interpretation of that role. The second set of results relate to the cost channel. The empirical investigation of the cost channel needs to take into account the problem of endogeneity induced by monetary policy. In addition, our results throw caution at drawing conclusions about the cost channel on the basis of one Phillips curve specification. We find that the cost channel is not robust to endogeneity and neither is it robust to model specification.

The policy implication of these findings is that it is important for policymakers to formulate a model of the inflation process that best describes the data and on that basis test whether the cost channel exists. Alternatively, existing Phillips curves that are used for policy guidance should be subjected to the cost channel test. If the cost channel exists, then the policy recommendations by Tillmann (2009a, 2009b) on the attenuated response of monetary policy to shocks in the context of an uncertain cost channel follow. Surico (2008) proposes that monetary policy must respond to inflation with a coefficient that is above one and must reduce its reaction to output gap fluctuations. A similar result is echoed in the case of Ravenna and Walsh (2006), where interest rate responses to stabilise the output gap are found to increase inflation volatility. Castelnuovo (2012) suggests that heavy interest rate smoothing can weaken the cost channel and make the demand channel to be dominant, thereby delivering stable macroeconomic dynamics. However, all these policy recommendations are derived from closed-economy and forward-looking new Keynesian models, their robustness to exchange rate fluctuations and to model specification remains to be explored.

Table 1: Estimates of the interest rate augmented Phillips curve (Eqs. 7 and 9)

	Brazil	Chile	Mexico	Hungary	Poland	Czech	Turkey	S.Africa	S.Korea	Indonesia
New Keynesian Phillips Curve										
ϕ^f	0.47 (0.03)	0.41 (0.05)	0.60 (0.04)	0.51 (0.03)	0.54 (0.03)	0.47 (0.02)	0.45 (0.03)	0.45 (0.03)	0.61 (0.04)	0.59 (0.03)
ϕ^b	0.55 (0.03)	0.58 (0.05)	0.39 (0.04)	0.49 (0.04)	0.46 (0.03)	0.52 (0.02)	0.54 (0.03)	0.55 (0.03)	0.40 (0.04)	0.42 (0.03)
ψ	-0.08^* (0.03)	-0.09^* (0.06)	-0.03^* (0.01)	0.00 (0.03)	-0.08^* (0.03)	-0.06^* (0.03)	0.04 (0.03)	-0.01 (0.05)	0.06^* (0.02)	-0.05 (0.05)
λ		0.03 (0.01)	0.03 (0.02)					0.03 (0.01)	0.04 (0.01)	0.06 (0.02)
γ_f	0.09 (0.02)									
γ_e				0.06 (0.02)		0.02 (0.01)	0.11 (0.02)			
χ	-0.02^* (0.01)	0.22^* (0.05)	0.10^* (0.01)	0.12^* (0.05)	0.08^* (0.02)	0.13^* (0.04)	0.03 (0.02)	0.08^* (0.04)	0.04^* (0.02)	0.26^* (0.03)
$\overline{R}^2$	0.95	0.95	0.99	0.99	0.99	0.93	0.99	0.96	0.92	0.94
J	0.61	0.66	0.68	0.82	0.85	0.94	0.88	0.69	0.54	0.82
F_1	5.7	8.15	104	51	109	11.8	139	20.4	11.4	15
Triangle Phillips Curve										
Lags	$0-7$	$0-5$	$0-10$	$0-5$	$0-9$	$0-7$	$0-9$	$0-9$	$0-9$	$0-10$
ϕ^b	1.00 (0.00)	1.00 (0.00)	0.96 (0.01)	0.95 (0.01)	1.00 (0.00)	0.98 (0.04)	1.00 (0.00)	1.00 (0.00)	0.95 (0.01)	0.98 (0.03)
ψ	0.15^* (0.07)	0.01 (0.05)	0.03 (0.03)	-0.02 (0.06)	0.23^* (0.01)	0.06 (0.06)	0.07^* (0.03)	0.19^* (0.09)	0.14^* (0.02)	0.53^* (0.18)
λ	0.02 (0.01)	-0.03 (0.01)			0.03 (0.01)	0.05 (0.03)		0.04 (0.02)	0.02 (0.01)	
γ_f			0.14 (0.03)	0.07 (0.03)	0.19 (0.06)				0.07 (0.02)	
γ_e				0.08 (0.03)			0.11 (0.05)			
χ	0.03 (0.03)	0.08 (0.06)	0.08^* (0.03)	0.24^* (0.07)	-0.08 (0.06)	-0.02 (0.08)	0.12^* (0.05)	0.10 (0.07)	0.02 (0.04)	-0.44^* (0.18)
R^2	0.92	0.95	0.99	0.98	0.98	0.95	0.99	0.95	0.93	0.97
LM	0.45	0.45	0.21	0.13	0.71	0.96	0.45	0.10	0.93	0.76
JB	0.74	0.84	0.91	0.25	0.13	0.71	0.56	0.22	0.42	0.97
$ARCH$	0.57	0.65	0.64	0.56	0.13	0.13	0.05	0.22	0.59	0.51

*Significant at 5% level. F_1 is the first-stage F-statistic for identification with π_{t+1} as a dependent variable.

Table 2: Estimates of the interest rate augmented Phillips curve controlling for endogeneity (Eqs.7 and 9)

	Brazil	Chile	Mexico	Hungary	Poland	Czech	Turkey	S.Africa	S.Korea	Indonesia
					New Keynesian Phillips Curve					
ϕ^f	0.47 (0.02)	0.45 (0.02)	0.52 (0.08)	0.54 (0.02)	0.52 (0.03)	0.54 (0.02)	0.54 (0.03)	0.44 (0.02)	0.67 (0.05)	0.44 (0.04)
ϕ^b	0.55 (0.02)	0.56 (0.02)	0.48 (0.07)	0.46 (0.02)	0.48 (0.02)	0.47 (0.02)	0.46 (0.03)	0.56 (0.02)	0.35 (0.05)	0.56 (0.03)
ψ	-0.08^* (0.03)	0.08^* (0.02)	-0.02 (0.02)	0.02^* (0.01)	-0.02 (0.02)	0.00 (0.03)	0.04^* (0.01)	0.13^* (0.04)	0.04^* (0.02)	0.18^* (0.07)
λ									0.04 (0.01)	
γ_f	0.08 (0.02)			0.12 (0.03)	0.03 (0.02)					
γ_e						-0.03 (0.01)	0.11 (0.03)			
χ	-0.03 (0.01)	-0.16 (0.04)	0.07^{**} (0.04)	-0.07 (0.02)	-0.13 (0.02)	-0.21^* (0.03)	-0.10^* (0.01)	-0.18^* (0.05)	-0.04^* (0.02)	-0.48^* (0.06)
$\overline{R}^2$	0.95	0.95	0.99	0.99	0.99	0.96	0.99	0.96	0.93	0.95
J	0.60	0.71	0.54	0.76	0.81	0.96	0.93	0.77	0.53	0.78
F_1	5.7	13	80	52	96	27	182	13.1	11.6	13.1
					Triangle Phillips Curve					
Lags	$0-7$	$0-5$	$0-9$	$0-9$	$0-9$	$0-7$	$0-9$	$0-9$	$0-7$	$0-9$
ϕ^b	1.00 (0.00)	1.00 (0.00)	0.97 (0.01)	0.96 (0.01)	1.00 (0.00)	0.98 (0.04)	1.00 (0.00)	1.00 (0.00)	0.95 (0.01)	0.99 (0.03)
ψ	0.14^* (0.07)	0.04 (0.05)	0.02 (0.03)	0.01 (0.06)	0.23^* (0.08)	0.07 (0.06)	0.07^* (0.03)	0.27^* (0.10)	0.16^* (0.02)	0.62^* (0.14)
λ	0.02 (0.01)	-0.02 (0.01)			0.04 (0.01)	0.05 (0.03)		0.04 (0.03)	0.02 (0.01)	0.05 (0.03)
γ_f			0.13 (0.03)	0.07 (0.03)	0.17 (0.06)				0.05 (0.02)	
γ_e				0.05 (0.03)			0.11 (0.05)			
χ	0.02 (0.03)	-0.04 (0.05)	0.08^* (0.03)	0.11 (0.07)	-0.12 (0.07)	-0.10 (0.07)	0.11 (0.09)	-0.07 (0.09)	-0.14 (0.04)	-0.95 (0.21)
R^2	0.92	0.94	0.99	0.98	0.98	0.95	0.99	0.95	0.94	0.98
LM	0.34	0.40	0.30	0.34	0.24	0.90	0.16	0.39	0.63	0.23
JB	0.75	0.89	0.84	0.36	0.52	0.78	0.04	0.00	0.74	0.57
$ARCH$	0.57	0.76	0.52	0.98	0.11	0.23	0.01	0.53	0.22	0.13

*Significant at 5% level. F_1 is the first-stage F-statistic for identification with π_{t+1} as a dependent variable.

Table 3: Estimates of the interest rate augmented New-Keynesian Phillips curve (Eq.8)

	Brazil	Chile	Hungary	Poland	Czech	S.Africa	S.Korea	Indonesia
	$P(-4,4)$	$P(-2,4)$	$P(-2,2)$	$P(-4,4)$	$P(-4,4)$	$P(-4,3)$	$P(-4,2)$	$P(-2,4)$
ϕ^f	0.51 (0.04)	0.49 (0.05)	0.54 (0.03)	0.53 (0.07)	0.39 (0.07)	0.56 (0.04)	0.74 (0.05)	0.46 (0.05)
ϕ^b	0.49 (0.04)	0.51 (0.05)	0.46 (0.03)	0.47 (0.07)	0.60 (0.06)	0.44 (0.04)	0.26 (0.05)	0.53 (0.04)
ψ	−0.04 (0.06)	−0.10 (0.06)	−0.01 (0.02)	−0.07 (0.05)	−0.06 (0.04)	0.04 (0.06)	0.05* (0.025)	0.04 (0.12)
λ							0.03 (0.01)	
γ_f								
χ	−0.02 (0.02)	0.09 (0.06)	0.01 (0.03)	0.01 (0.05)	−0.22* (0.05)	−0.04 (0.04)	0.05 (0.03)	0.05 (0.06)
$\overline{R}^2$	0.93	0.96	0.99	0.99	0.96	0.97	0.92	0.93
J	0.97	0.45	0.81	0.89	0.77	0.90	0.63	0.84
F_1	5.7	8.15	51	109	11.8	20.4	11.6	15
				Endogeneity controlled				
	$P(-4,4)$	$P(-2,2)$	$P(-2,2)$	$P(-4,2)$	$P(-4,4)$	$P(-4,3)$	$P(-4,2)$	$P(-2,4)$
ϕ^f	0.51 (0.04)	0.45 (0.04)	0.55 (0.03)	0.57 (0.02)	0.46 (0.06)	0.58 (0.04)	0.77 (0.06)	0.45 (0.06)
ϕ^b	0.49 (0.04)	0.55 (0.04)	0.45 (0.03)	0.44 (0.03)	0.53 (0.05)	0.42 (0.04)	0.25 (0.06)	0.55 (0.05)
ψ	−0.03 (0.06)	−0.01 (0.03)	−0.03* (0.01)	−0.06 (0.04)	−0.09* (0.03)	−0.01 (0.05)	0.05 (0.03)	0.08 (0.10)
λ							0.03 (0.01)	
γ_f								
χ	−0.01 (0.01)	−0.03 (0.04)	−0.07* (0.02)	−0.02 (0.03)	−0.22 (0.04)	0.02 (0.06)	0.003 (0.06)	−0.20 (0.10)
R^2	0.97	0.97	0.99	0.99	0.97	0.96	0.92	0.94
J	0.86	0.52	0.78	0.91	0.77	0.75	0.56	0.87
F_1	5.7	13	52	96	27	13.1	0.22	13.1

Excluded countries because they are $P(-1,1)$: Mexico and Turkey.

1 Conclusion

This paper has shown that in emerging markets specifications of the new Keynesian Phillips curve suffer from the negative sign problem on the output gap. This problem exists even in the case where the labour share is used. A comparison with triangle Phillips curve estimations suggests that in general, the forward-looking term in new Keynesian models, especially the introduction of the nominal interest rate as part of the instruments, may explain this negative sign problem. The triangle model does not suffer from this problem, even when the endogeneity of the interest rate is not controlled for. Even if the negative sign problem is solved, we find that there is a problem regarding the significance of the output gap (and the labour share) in new Keynesian models, as Agénor and Bayraktar (2010), Abbas et.al. (2011) and Vašíček (2012) demonstrate. The demand pressure term is not robust to specification in new Keynesian models; Fuhrer (1997) type models tend to deliver insignificant and negative coefficients on the output gap.

In relation to the cost channel, the paper has shown that this phenomenon is not robust to the endogeneity of the nominal interest rate arising from monetary policy reaction. Secondly the existence of the cost channel is not robust to the specification of the Phillips curve. In some instances the triangle model provides contrasting results compared to new Keynesian models. Thirdly, even within the new Keynesian perspective, the cost channel is not robust to specification. The Fuhrer (1997) Phillips curve with several leads and lags provides contrasting evidence compared to the Gali-Gertler type. Results based on the Gali-Gertler type model, for seven of the ten economies that have been considered, are overturned when the Fuhrer-type new Keynesian model is used. We conclude, from the standpoint of the ten emerging markets considered here, that except Mexico, the cost channel is not a major problem for policymakers.

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