Inflation Pressures and Monetary Policy in a Global Economy*

Jordi Galí
CREI, Universitat Pompeu Fabra, and Barcelona GSE

What can estimated reduced-form inflation equations teach us regarding the role of global factors as determinants of inflation? Very little, according to modern monetary theory. I illustrate this claim by exploring the channels through which global factors influence inflation in the small open economy of Galí and Monacelli (2005).

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1. Introduction

The potential impact of globalization on inflation has drawn the attention of many policymakers and academics in recent years. Needless to say, the link between those two phenomena has many dimensions. Thus, some authors have pointed to some channels through which globalization may have a permanent impact on inflation. Those channels include a reduction in the inflation bias due to the increased degree of competition associated with globalization (Rogoff 2003), as well as the possibility of "opportunistic disinflations" in the face of favorable movements in international prices (Orphanides and Wilcox 2002).

Yet, much of the recent debate has focused on the implications of globalization for the short-run dynamics of inflation and, in particular, on the findings in Borio and Filardo (2007). Using data for sixteen OECD countries, those authors find a shrinking role for the domestic output gap in estimated inflation equations, combined with

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a rising importance of measures of "global slack," as determinants of domestic inflation. Those findings are often portrayed as a source of concern, since they are interpreted as implying larger costs of disinflations and a certain loss of inflation control by national central banks. They may also suggest a reinterpretation of the factors behind "the conquest of inflation" in industrialized countries, in a way that downplays the role played by central banks.

The empirical analysis of Borio and Filardo (2007) has faced several critical responses. Some of the criticisms have focused on the lack of robustness of their findings of an increasing role of global slack to alternative specifications (see, e.g., Ihrig et al. 2007 and Calza 2008). Others, including the survey analysis of Gaiotti (2010) in the present volume, have failed to uncover any significant relation between openness indicators and the estimated sensitivity of inflation to domestic output, both over time and across countries (see also Ball 2006 and Ihrig et al. 2007).

In the present commentary I take the analysis beyond the reduced-form (partial) correlations between inflation and gap measures that have been the focus of the recent literature. Instead, I propose, as a potentially more fruitful task (or at least a complementary one), thinking about the channels through which globalization may influence inflation dynamics and the extent to which those channels are well captured by current structural monetary models. In particular, I use a small open-economy version of the New Keynesian model, as developed in Galí and Monacelli (2005), as a framework to help me think of the global dimensions of inflation dynamics.[1]

2. Inflation Dynamics in a Small Open-Economy Model

The model of Galí-Monacelli (2005; henceforth, GM) is one among a number of open-economy versions of the New Keynesian model that have been developed in recent years. It assumes a small open economy, with infinitesimal weight in the world economy. Firms, domestic and foreign, set the price for the (differentiated) good each of them produces in terms of their own currency, independently of whether it is sold in the domestic or in foreign markets (*producer*

[1]See Woodford (2009) for a related exercise in the context of a two-country model with somewhat more restrictive assumptions.

currency pricing). As a result, the law of one price holds at all times, with changes in nominal exchange rates being passed on to import prices on a one-for-one basis (full pass-through). The GM model also assumes complete state-contingent securities markets at the international level, allowing consumers to share their diversifiable consumption risk worldwide. Those two assumptions imply a tight link between the small open economy and the rest of the world, and would seem to strengthen the case for a role of global factors in influencing domestic inflation. For simplicity, I stick to the version of the model with perfectly competitive labor markets and no endogenous capital accumulation, since those assumptions are presumably orthogonal to the issue at hand.

3. Openness and CIP Inflation

Let the (log) consumption price index (CPI) of the small open economy be denoted by p_t. The latter can be decomposed as

$$p_t = (1-\alpha)\ p_{H,t} + \alpha\big(e_t + p_t^*\big),$$

where $p_{H,t}$ is the (log) domestic price level, e_t is the (log) nominal exchange rate, and p_t^* is the (log) world price (expressed in terms of foreign currency). If the economy is infinitesimally small, as assumed by GM, the fact that α is less than one captures the presence of some home bias.

Letting $s_t \equiv e_t + p_t^* - p_{H,t}$ denote the price of foreign goods relative to domestic goods (the terms of trade, for short), we can write the CPI as

$$p_t = p_{H,t} + \alpha\ s_t \tag{1}$$

or, after taking first differences,

$$\pi_t = \pi_{H,t} + \alpha \Delta s_t.$$

The previous equation points to a direct channel through which open-economy factors may influence CPI inflation: changes in the terms of trade. Furthermore, we see that the impact of those changes will be proportional to the degree of openness, as measured by the size of α.

The existence of a time-varying wedge between CPI and domestic inflation implies that some priority will have to be given to stabilization of one of the inflation measures versus the other. When formulating policy, however, it is important to realize that such a wedge should not be taken as exogenous; on the contrary, monetary policy is likely to play a key role in determining its size. To see this, note that we can write a "real" version of the uncovered interest parity condition as follows:

$$s_t = r_t^* - r_{H,t} + E_t\{s_{t+1}\},$$

where $r_t \equiv i_t - E_t\{\pi_{H,t+1}\}$ and $r_t^* \equiv i_t - E_t\{\pi_{t+1}^*\}$ are the domestic and world real interest rates, respectively. Iterating forward, we obtain

$$s_t = \sum_{k=0}^{\infty} E_t\{r_{t+k}^* - r_{t+k}\} + \lim_{T\to\infty} E_t\{s_{t+T}\}.$$

Note that the sequence of world interest rates $\{r_{t+k}^*\}$ as well as the (expected) long-run level of the terms of trade $\lim_{T\to\infty} E_t\{s_{t+T}\}$ will be independent of domestic monetary policy, and should thus be taken as given by the small open economy's central bank. On the other hand, and to the extent that the latter can influence the domestic short-term real rate in the short run (e.g., due to the presence of nominal rigidities), it will be possible to influence the terms of trade and, hence, CPI inflation, for any given level of domestic inflation. Thus, through this specific channel the central bank will be able to influence CPI inflation.

4. Openness and Domestic Inflation

Next, I turn my attention to the determinants of domestic inflation and the role that openness may play in that determination, while sticking to the GM model as reference framework. With that purpose in mind, it is useful to distinguish between two key relations: (i) the relation between domestic inflation and the markup gap, and (ii) the relation between the markup gap and measures of economic activity. Combining the two, we can obtain a relation between domestic inflation and economic activity, the so-called New Keynesian Phillips curve.

4.1 Domestic Inflation and the Markup Gap

As in GM, let us assume staggered price setting à la Calvo, with parameter θ representing the fraction of firms that keep their price unchanged in any given period. In that environment the (log) domestic price level evolves according to

$$p_{H,t} \equiv \theta p_{H,t-1} + (1-\theta)\overline{p}_{H,t}, \tag{2}$$

where $\overline{p}_{H,t}$ denotes (log) newly set prices. Optimal price setting implies

$$\overline{p}_{H,t} = \mu + (1-\beta\theta)\sum_{k=0}^{\infty}(\beta\theta)^k E_t\{\psi_{t+k|t}\}, \tag{3}$$

where $\psi_{t+k|t}$ is the (log) marginal cost in period t for a firm that last reset its price in period t, μ is the desired or frictionless markup, and β is the discount factor. Thus, newly set prices are set to equal the desired markup over a weighted average of current and future marginal costs.

Combining (2) and (3), we can derive the equation relating domestic inflation to the markup gap:

$$\pi_{H,t} = \beta E_t\{\pi_{H,t+1}\} - \lambda\ (\mu_t - \mu), \tag{4}$$

where $\lambda \equiv \frac{(1-\theta)(1-\beta\theta)}{\theta(1+\epsilon\psi_y)}$ with ψ_y and ϵ denoting, respectively, the elasticity of marginal cost with respect to output and the price elasticity of the demand for each good. Note that the above inflation equation is not "directly" affected by the degree of openness of the economy. Thus, it is not obvious that it would be affected by globalization, to the extent that the latter takes the form of an increase in that degree of openness. Could there be some indirect effects, not captured explicitly by the model? Sbordone (2008) argues there may be forces working in opposite directions. Thus, the process of globalization may lead to more competition and, as a result, an increase in the price elasticity of demand ϵ. That in turn would reduce λ, i.e., the sensitivity of domestic inflation to changes in the markup gap. Sbordone conjectures that the previous effect may be counterbalanced by a hypothetical increase in price flexibility resulting from the same increase in competition due to globalization. That would be reflected in a lower value for θ and, hence, a greater sensitivity of domestic inflation to the markup gap (i.e., a larger λ).

Is there any evidence of parameter instability in estimated versions of equation (4), whose timing could be associated with that of globalization? While not focusing specifically on this issue, several studies based on U.S. data report estimates of coefficient λ or its determinants. Thus, using single equation methods, Galí and Gertler (1999) estimate equation (4) for different subsample periods but are unable to uncover any significant changes in λ. Boivin and Giannoni (2006) and Smets and Wouters (2007) embed equation (4) in a full-fledged DSGE model which they estimate using full-information methods. Both papers report a significant decline in the estimate of parameter λ. In Boivin and Giannoni (2006), parameters θ and ϵ are not separately identified, so the source of the decline in λ cannot be traced. This is not the case for Smets and Wouters (2007), who show that the estimated decline in λ after 1984 is largely due to stronger price rigidities, as reflected in an increase in the estimate of θ. It is hard to see how globalization may have played a role in generating that change.

4.2 The Markup Gap and Economic Activity

Next I turn to examining the possible impact of openness in the relation between the markup gap—which as shown above is the main driving force behind domestic inflation—and economic activity. Assuming constant returns to labor (as in GM), we can write the average markup as

$$\begin{aligned} \mu_t &= p_{H,t} - (w_t - a_t) \\ &= -\alpha s_t - (w_t - p_t) + a_t, \end{aligned} \tag{5}$$

where the second equality makes use of (1). Thus, we see that for a given (log) consumption wage $w_t - p_t$, an increase in the terms of trade (i.e., a real depreciation) lowers the average markup, thus generating inflationary pressures, as firms adjusting prices try to bring back their markups close to desired levels. Note that the impact of a given change in the terms of trade is proportional to the degree of openness of the economy. Thus, through this channel, globalization should make domestic inflation more sensitive to changes in the terms of trade. Furthermore, the direct effects of the latter on CPI inflation—discussed in the previous section—will be amplified through their indirect effects (in the same direction) on domestic inflation.

The previous argument took the consumption wage as given. But how is the latter likely to be influenced by open-economy considerations? Assuming, as in GM, perfectly competitive labor markets, the household's optimality condition equates the (log) consumption wage to the (log) marginal rate of substitution. Accordingly,

$$\begin{aligned} w_t - p_t &= \sigma c_t + \varphi n_t \\ &= \sigma y_t^* + (1-\alpha)s_t + \varphi(y_t - a_t), \end{aligned} \tag{6}$$

where the second equality makes use of the risk-sharing condition $c_t = y_t^* + \frac{1-\alpha}{\sigma} s_t$, implied by the assumption of complete state-contingent securities markets (see GM for details). Thus, we see that, also through its positive effect on the consumption wage due to the wealth effect on labor supply, a real depreciation brings down the markup, putting further upward pressure on inflation. It is important to note, however, that this additional channel relies critically on the assumption of complete markets. Combining (5) and (6) we obtain

$$\begin{aligned} \mu_t &= -s_t - \varphi y_t - \sigma y_t^* + (1+\varphi)a_t \\ &= -(\sigma_\alpha + \varphi)y_t + (\sigma_\alpha - \sigma)y_t^* + (1+\varphi)a_t, \end{aligned} \tag{7}$$

where the second equality makes use of the goods market-clearing condition (combined with the risk-sharing condition) $y_t = y_t^* + \frac{1}{\sigma_\alpha} s_t$, where $\sigma_\alpha \equiv \frac{\sigma}{1+\alpha(2-\alpha)(\sigma\eta-1)} > 0$, and with η denoting the elasticity of substitution between goods produced in different countries (see GM for details of the derivation).

Evaluating (7) under flexible prices, and subtracting the resulting expression, one obtains

$$\mu_t - \mu = -(\sigma_\alpha + \varphi)\big(y_t - y_t^n\big),$$

where (up to a constant term) $y_t^n \equiv \frac{\sigma_\alpha - \sigma}{\sigma_\alpha + \varphi} y_t^* + \frac{1+\varphi}{\sigma_\alpha + \varphi} a_t$ is the *natural* level of output. By combining the previous expression with (4), one can derive the New Keynesian Phillips curve,

$$\pi_{H,t} = \beta E_t\{\pi_{H,t+1}\} + \lambda(\sigma_\alpha + \varphi)\big(y_t - y_t^n\big). \tag{8}$$

A few points are worth stressing regarding (8). Firstly, we see that the domestic output gap (properly defined) is the *only* driving variable for domestic inflation, even though the economy is arbitrarily open. Secondly, the degree of openness, as captured by parameter α, has an ambiguous effect on the size of the output-gap coefficient, depending on whether $\sigma\eta \gtrless 1$. In particular, if condition $\sigma\eta < 1$ holds, an increase in openness will *raise* the sensitivity of domestic inflation to the domestic output gap, contrary to what is typically believed. In that case an increase in domestic output leads to a real depreciation (which, argued above, has inflationary effects), the size of which is larger the more open is the economy.

Alternatively, and letting variables topped with a ˆ symbol denote deviations from a (common) trend, one can derive a representation for domestic inflation in terms of "more traditional" output-gap measures:

$$\pi_{H,t} = \beta E_t\{\pi_{H,t+1}\} + \lambda(\sigma_\alpha + \varphi)\hat{y}_t + \lambda(\sigma_\alpha - \sigma)\hat{y}_t^* - (1 + \varphi)a_t.$$

Under this representation, which is arguably closer to that found in empirical applications of the kind pursued by Borio and Filardo (2007) and the subsequent literature, the sign of the relation between the size of the coefficient on the domestic output gap and the degree of openness is once again ambiguous, depending on whether $\sigma\eta \gtrless 1$. Furthermore, the same condition determines whether the coefficient on the world output gap is positive or negative. In particular, if $\sigma\eta > 1$, then the deflationary effects of the real appreciation resulting from an increase in world output more than offset the inflationary impact coming from higher aggregate demand. On the other hand, if $\sigma\eta = 1$, those two opposing effects exactly cancel each other and domestic inflation becomes independent of the world output gap, irrespective of how open the economy is.

5. Concluding Remarks

With the present commentary I have sought to convey a relatively simple (and possibly disheartening) message: When viewed through the lens of modern economic theory, much of the empirical literature on globalization and inflation seems misguided. In particular, it is hard to draw unambiguous interpretations regarding the role of globalization in any hypothetical changes in the coefficients of estimated inflation equations.

On the other hand, more research seems needed on price-setting practices of importers and exporters (or import-competing firms) and on how those practices may be being affected by globalization. Given the central role played by the degree of pass-through in determining the nature of optimal monetary policy in open economies (as well as the desirability of alternative rules), that research would be particularly useful and welcome.[2]

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[2]See, e.g., Engel (2009).

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