Discussion of "Has Globalization Changed the Phillips Curve?"*

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This paper by Eugenio Gaiotti is a refutation paper: it tests and rejects the idea popularized by Borio and Filardo (2007) that globalization explains the flattening of the Phillips curve. While several papers have already been devoted to assessing the Borio and Filardo theory, the distinctive feature of the present article is that it uses microeconomic data. Microeconomic data can be helpful in the present context because they help circumvent the lack of variability in macroeconomic data, and also because of the fact that expectations are not observed.

The main result and message of the paper is that globalization had no effect on the price/activity relationship. This result is found to be robust to using various measures of globalization. It is worth underlining that the paper uses a very rich panel data set of Italian firms. One feature of the data set is that it contains observations at the firm level on both price and real quantities. By contrast, much of the recent research on price setting (Bils and Klenow 2004, Dhyne et al. 2006) uses data on price quotes that contain little, if any, information on costs or the firm environment.[1]

The paper has two distinct but related dimensions. First, it provides empirical evidence on price setting at the firm level. Second, it discusses implications of these findings for the Phillips curve, an aggregate macroeconomic relationship. This discussion will tackle the two dimensions in turn, providing some remarks on the econometric specification, then discussing the link between microeconometric evidence and the breakup of the (reduced-form) Phillips curve.

*The opinions in this discussion are those of the author and may not necessarily reflect the views of the Banque de France. I am grateful to Mark Harris for suggestions.

[1]See, however, Carlsson and Nordström Skans (2009) and Horny and Sevestre (2009) for examples of analyses with similar data sets.

1. Two Econometric Remarks

The empirical specification of the paper is a linear model for the rate-of-growth of prices. The specification is equation (7a) of the paper, which we replicate below for convenience (we denote X_{it} as the vector of variables other than capacity utilization):

$$\Delta p_{it} = s_i + d_t + a_1 CU_{it} + a_2 T_{it} CU_{it} + bX_{it} + \eta_{it}. \tag{1}$$

The interest of the paper is in testing whether parameter a_2 is different from zero, implying that the slope of the Phillips curve depends on the exposure to globalization. Equation (1) has some resemblance to a Phillips curve. Typically, however, in macroeconomic theory the Phillips curve is an aggregate relationship only. At the firm level, the decision variable is the price level. The paper's rate-of-growth specification is probably driven by the fact that the data set contains the growth rates of prices, Δp_{it}, rather than the price level. Equation (1) should probably better be viewed as a first-differenced form of a price equation. Given that the structural shock is plausibly affecting the level of prices p_{it}, one sensible option would be to model error term η_{it} as an MA(1), more precisely $\eta_{it} = u_{it} - u_{it-1}$, where u_{it} is a shock to the price level. This should matter for tests on the parameter of interest (i.e., a_2) and for the consistency of estimates in the specification with lagged inflation. We may nevertheless conjecture that accounting for the autocorrelation implied by MA errors would increase standard errors, so that variables capturing globalization would be even less significant. Presumably therefore, the rejection of the assumption that globalization has changed the slope of the Phillips curve would be confirmed by such an approach.

Another remark on the specification is related to the assumption on price flexibility. As stated in section 2 of the paper, the author "adopts the assumption that all prices are adjusted within a single year." This assumption is obviously a simplification, since in the data it is *observed* that 80 percent of prices change each year (as stated in section 3, and also apparent from the distribution of price changes in figure 3). In other words, 20 percent of the observations are exactly equal to zero, which a specification like (1) cannot rationalize. In econometric terms, this pattern of the data could be handled by substituting linear regressions with a hurdle-type model—that is, a joint model of the probability of a price change, $P[\Delta p_{it} \neq 0]$, and of the conditional size of the change, $E(\Delta p_{it}|\Delta p_{it} \neq 0)$.

This is potentially important, as is it known from the literature on Tobit models (Amemiya 1984) that including the "zero" observations in a linear model leads to estimation biases. We can wonder whether the simplification adopted matters for the conclusions in the paper. The topic of price rigidity is not just an econometric problem, since it is very much related to the theoretical foundations of the Phillips curve. I have investigated the consequences of neglecting price rigidity when estimating linear pricing models. It turns out that the answer depends on the structure of price rigidity.

For illustration purposes, I consider a simplified form of the model, and assume the "desired" price change of a firm is given by the equation $\Delta p^*_{it} = \beta x_{it} + \varepsilon_{it}$. I consider two cases of price rigidity: a pseudo-Calvo model and a pseudo-(S,s) rule.

Case 1: Pseudo-Calvo Model. Let us suppose that firms have an annual probability θ of changing prices that is exogenous, as in the Calvo (1983) model of price stickiness. I use the label "pseudo-Calvo" because in the genuine Calvo (1983) setup, firms acknowledge price rigidity when optimally resetting their prices in a forward-looking manner, which we neglect here. Under this exogeneity assumption, the expectation of the price change is

$$E(\Delta p_{it}) = P(\Delta p_{it} \neq 0)E\big(\Delta p^*_{it}|\Delta p_{it} \neq 0\big) = \theta\beta x_{it}.$$

We thus observe that, when both zero and non-zero data are included in estimation, parameters of interest are biased downward by the factor θ. Here $\theta = 0.8$, since 20 percent of the observations are zeros.

Case 2: Pseudo-Ss Rule. Suppose now that the price rigidity is described by an alternative family of price rigidity models—namely, (S,s) models. In these models the pricing decision is characterized by an inaction band: if the deviation from the optimal frictionless price change is smaller than a certain threshold (which is a function inter alia of the size of menu costs), then the price is kept unchanged. I model this by adopting a price-change rule of the form

$$\Delta p_{it} = \Delta p^*_{it} \ if \ \left|\Delta p^*_{it}\right| > S_t$$
$$\Delta p_{it} = 0 \text{ otherwise.}$$

S_t is a threshold which I assume to be stochastic: $S_t = S + s_t$ with $E(s_t^2) = \sigma_s^2$. As with the above case, this is a pseudo-(S,s) rule, since I disregard the fact that the optimally reset price may differ from the optimal frictionless price. I consider stochastic (S,s) bands for realism, because they can account for small price changes and for variability in the size of price changes (patterns which are apparent in figure 3 of the paper). The assumption of time-varying (S,s) bands can be given a structural motivation based on stochastic menu costs (Gautier and Le Bihan 2009).

The expected price change is then in this setup:

$$\begin{aligned} E(\Delta p_{it}) &= P\left[\Delta p_{it}^* < -S_t\right] E\left(\Delta p_{it}^* \middle| \Delta p_{it}^* < -S_t\right) \\ &\quad + P\left[\Delta p_{it}^* > S_t\right] E\left(\Delta p_{it}^* \middle| \Delta p_{it}^* > S_t\right). \end{aligned}$$

To proceed, I assume normality of the shocks to the optimal price and of the shock to the threshold. For illustration, I in addition assume $x_{it} = 1$. Then the expectation of price changes (including the set of price changes equal to zero) is found to be

$$\begin{aligned} E(\Delta p_{it}) = \Phi\left((-S-\beta)/\sqrt{\sigma_s^2+\sigma_\varepsilon^2}\right) & \\ \times \left(\beta - \frac{\sigma_\varepsilon}{\sqrt{1+(\sigma_s/\sigma_\varepsilon)^2}} \frac{\varphi\left((-S-\beta)/\sqrt{\sigma_s^2+\sigma_\varepsilon^2}\right)}{\Phi\left((-S-\beta)/\sqrt{\sigma_s^2+\sigma_\varepsilon^2}\right)}\right) & \\ + \Phi\left((-S+\beta)/\sqrt{\sigma_s^2+\sigma_\varepsilon^2}\right) & \\ \times \left(\beta + \frac{\sigma_\varepsilon}{\sqrt{1+(\sigma_s/\sigma_\varepsilon)^2}} \frac{\varphi\left((-S+\beta)/\sqrt{\sigma_s^2+\sigma_\varepsilon^2}\right)}{\Phi\left((-S+\beta)/\sqrt{\sigma_s^2+\sigma_\varepsilon^2}\right)}\right), & \end{aligned}$$

where $E(\varepsilon_{it}) = \sigma_\varepsilon^2$, $\varphi(.)$ is the probability density function of the Gaussian distribution and Φ its cumulative distribution function. This formula involves inverse Mills ratios typically encountered in Heckman selection models. The parameter of interest is β. Given the assumption of a constant x_{it}, the question of whether a linear regression provides biased estimates amounts to whether $E(\Delta p_{it})$ differs from β. The answer depends on the parameter set considered. I set $\beta = 3$, $S = 2$, $\sigma_s^2 = 1.5$, and $\sigma_\varepsilon^2 = 6$: this set of parameters allows us to roughly replicate some moments of the data. Indeed, they lead to $P[\Delta p_{it} \neq 0] = 0.77$, $E(\Delta p_{it}) = 2.98, s.e.(\Delta p_{it}) = 5.96$, moments which are broadly consistent with those reported in table 1.

With this parameter set, one obtains

$$E(\Delta p_{it}) = E(\widehat{\beta}^{OLS}) = 0.979.\beta.$$

Thus, the bias from neglecting lumpiness in price change is very small. Similar results are obtained for different values of the parameters. The intuition for this result is that, unlike in the Calvo case above, zero observations ($\Delta p_{it} = 0$) are precisely those observations for which the latent variable is close to zero (because $-S_t < \Delta p^*_{it} < S_t$).

On the whole, although some improvements to the econometric specification could be considered, conclusions in the article are presumably robust to these refinements.

2. The Findings in the Paper and the Phillips Curve(s)

The paper provides evidence of a shift in the aggregate Phillips curve for Italy. More specifically, table 6 provides evidence of a decrease in persistence and in the sensitivity of prices to capacity utilization in a reduced-form Phillips curve of the form[2]

$$\pi_t = \sum \rho \pi_{t-k} + b(y_t - y^*_t) + \eta_t. \quad (2)$$

One may note that aggregating the paper's price equations allows us to recover a variant of the reduced-form Phillips curve:

$$\pi_t = \frac{1}{N}\left(\sum \Delta p_{it}\right) = K + d_t + a\overline{CU}_t + b\overline{X_t} + \overline{\eta_t},$$

where K is a constant, bars indicate averages, and the average error term ($\overline{\eta_t}$) should be close to zero. What the microeconometric evidence in the paper shows is that the parameter a has not been

[2]Incidentally, it may be noted that using the PPI or GDP deflator would be more consistent than using CPI data in the Phillips curve, in order to reach a better comparability between the results of aggregate regression with results using microeconomic data.

affected by globalization. The shift embodied by the parameter instability in the Phillips-curve equation (2) *must* then be captured by the terms t_t. Note that these terms may also capture changes in a unrelated to globalization.

One question left open by the paper is how to explain the breakdown of the reduced-form Phillips curve and interpret this shift. One relevant benchmark for understanding aggregate price dynamics is the structural "New Keynesian" Phillips curve (NKPC). The NKPC is identical to equation (1) in the paper:

$$\pi_t = \pi_{t+1}^e + \alpha\big(y_t - y_t^*\big) + \eta_t.$$

Note equation (1) in the paper is formally identical to this NKPC, but is derived from other arguments (in particular, because price rigidity is disregarded). With this framework in mind, one may think of several competing explanations of the shift of the reduced-form Phillips curve. First, following the standard "monetary policy view" on the flattening of the Phillips curve, it may be that good (monetary) policy has succeeded in anchoring expectations, thus affecting the reduced form while leaving the NKPC unchanged: such an argument is investigated quantitatively by Roberts (2006). Another rationalization of a break in the reduced-form Phillips curve (without implying a change in the price process) is a change in wage process, presumably the end of automatic indexation in Italy. Another possibility, if one believes in the NKPC, is that there was a structural change in price setting. For instance, the degree of price stickiness should increase at low inflation rates, an argument put forward by Ball, Mankiw, and Romer (1988), which lowers parameter α.

The data set used by the author might be useful to discriminate among alternative possibilities. For instance, a simple way to assess whether price stickiness increased would be to plot the degree of price rigidity over time. Further, it would arguably be relevant to consider a specification without time dummies (the t_t term), in order to get better insight. Indeed, if nominal rigidity is regarded as unimportant, then—in the logic of the NKPC at least—expectations may not matter, provided one observes the marginal cost (as reflected in equation (2) in the paper). Here, there are several ingredients, in addition to the national contractual wage and the intermediate input prices actually used in the paper, that could be used to build to a relevant proxy for the marginal cost. Indeed, firm-level productivity can be computed from the SIM data set, and a firm-specific wage level may be obtained by matching data sets. A recent example of such a strategy is followed by Carlsson and Nordström Skans (2009) using a data set similar to the SIM. One may, further, then investigate the firm-specific marginal cost schedule and assess whether a shift in this schedule contributed to the breakup of the reduced-form Phillips curve.

Overall, the paper provides a convincing rejection of the globalization and inflation theory. Yet, microeconomic data, particularly from this data set, presumably have the potential to say more about whether, and why, a shift in the aggregate Phillips curve has occurred.

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