# Comments on the paper

## "Asymmetric (S,s) pricing: Implications for monetary policy" by Z. Babutsidze

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### 1. Summary of the paper

Firms' pricing behavior determine aggregate prices and therefore affect movements in aggregate prices and in aggregate output. Moreover the propagation of money supply shocks depends on pricing patterns, in general depending on the assumptions about financial markets monetary policy may have or not real effects. The present paper deviate from the presence of imperfections in financial market while the author concentrates on the assumption that firms in setting prices may deviate from the optimal level with non negligible consequences in terms of effectiveness of monetary policy not only during equilibrium periods in the business cycle but also during booms and busts.

The author develops, within a Dixit-Stiglitz framework, a structure os $(S, s)$ pricing introducing an inaction interval around the price's optimal level. In particular, if the price is inside the interval the optimal behavior for the firm consists in not adjusting the price and it is well documented in the literature that monetary policy in this framework is neutral. However, once asymmetry in the inaction band above and below the optimal price is introduced money is non neutral.

Even if asymmetries at the micro and macro level are well documented by the empirical evidence it is well known by the profession that to study the link and interaction between micro and macro asymmetries is not an easy task. Therefore the aim of the paper consists in modeling and analyze the link and interaction between micro and macroeconomic asymmetries and in studying monetary policy effectiveness during different phases of the business cycle. In order to achieve this goal the author starts from a Dixit-Stiglitz monopolistic competition framework, adopts a model of firms' asymmetric pricing and builds an Agent-Based-Model (ABM) to perform monetary policy exercises. The author achieves two main findings:

— If shocks are sufficiently high the model reproduces significant asymmetries in the reaction of output to positive and negative macro-shocks.

— The economy under scrutiny responds differently to similar shocks across different periods of the business cycle. In other words the author finds an asymmetry in response to similar shocks during a boom and during a recession.

I think this is a crucial issue and very worth studying with new tools such as the ABM approach.

## 2. Comments

The author adopts a Dixit-Stiglitz (DS hereafter) monopolistic competition set up where the individual demand function faced by the firms is represented by:

$$Y = \left(\frac{P}{\overline{P}}\right)^{-\eta} \frac{M}{\overline{P}} \tag{1}$$

where $\eta > 1$ is the price elasticity of demand, $M$ is individual money supply, $P$ the price set by the firm and $\overline{P}$ represents the aggregate price. The author seems to interpret $M$ as an idiosyncratic shock but it is not clear from the paper which is the role of this shock and how it exactly works. It is not immediately clear to me what the author means by "idiosyncratic, mean zero shocks in money supply". A change in money supply is by definition an aggregate shock. I think it is necessary to explain in more details what is the idiosyncratic shock in the model and how it is eventually related to individual money supply.

On p. lines the author goes on stating that "idiosyncratic, mean zero shocks in money supply would call for no aggregate price changes". Why? Is there a typo in the paper? In the Dixit-Stiglitz model it is exactly the opposite, in fact a money supply shock does not have real effects since it completely translates into a change in the aggregate price.

In my opinion notation can be misleading I would rewrite individual demand following the specification below:

$$Y_j = \left(\frac{P_j}{\overline{P}}\right)^{-\eta} \frac{1}{n} \frac{M}{\overline{P}} \tag{1bis}$$

where $M$ represents total money supply, $n$ is the number of firms and $P_j$ is individual price.

The author defines the aggregate price as a simple average of individual prices in the economy:

$$\bar{P} = \frac{1}{n}\sum_{j=1}^{n} P_j \tag{2}$$

The definition of the aggregate price introduced into the DS model is more complicated than the simple average and the author does not explain why he is using the simple average instead of the aggregate price defined by DS:

$$\bar{P} = \left(\frac{1}{n}\sum_{j=1}^{n} P_j^{1-\eta}\right)^{\frac{1}{1-\eta}} \tag{2bis}$$

The implementation of the simple average to define the aggregate price does not seem to be coherent with the DS framework where the aggregate price level is derived from the household's minimization problem, therefore I would keep the original one specified into Equation (2bis).

Using the original definition of the aggregate price, taking the logarithms and totally differentiating you should end up with the following relation:

$$d\bar{P} = \frac{\frac{1}{n}\sum_{j=1}^{n} P_j^{1-\eta} dP_j}{\bar{P}^{1-\eta}} \tag{3}$$

Therefore, equation (14) in the paper will be slightly different and the effect of price elasticity on demand (η) does not disappear in the aggregate.

It seems to me that using a simple average to define the aggregate price you are ruling out by definition the effects of the parameter η at the aggregate level. What are the consequences of your assumption on the results? Will your results be different once you take into account relation defined into Equation (3) instead of Equation (14) in the paper?

To conclude I think that the paper deals with a really interesting and crucial issue and I am under the impression that it can make a non negligible contribution. However, it is hastily written so that only the insiders of this literature can retrieve the full line of reasoning behind few lines which briefly touch upon crucial developments. My suggestion is that if you want the "general economist" to be able to read, understand and take the message home you should try to fine-tune better the structure and the exposition of the paper and clarify the points mentioned above.

# Reply to Comments

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I am pleased to find that the discussant finds the paper interesting and I am grateful for her thoughtful discussion, which has raised few important points. In this note I want to follow up on three of them.

I want to start with the clarification on why idiosyncratic mean-zero shocks call for no aggregate price changes and why aggregate shocks with non-zero mean affect real economy. This is indeed at odds with Dixit and Stiglitz (1977). The reason is that in Dixit and Stiglitz (1977) prices of all producers at all times are in optimum. In contrast, our paper adds (S,s) pricing to the original framework. Therefore we deviate from this optimality feature. In our case price deviations from optimum have non-trivial distribution given by equation (9) in the paper. This feature introduces effective monetary policy in the setup.

The problem with modeling the shock process in the setup is duly noted. Indeed, I have not modeled the shock explicitly and I see why the process is hard to understand/interpret in the framework of the paper. Let me take this opportunity to clarify the issue.

The idiosyncratic shock is not $M$. What I had in mind instead is an idiosyncratic shock that hits the firm and calls for change in the optimal price. It is indeed very hard to think about the shock in per-firm money supply that can be idiosyncratic and discussant's proposal to rewrite the variable $M/n$ would indeed expose this impossibility. It would have been a significant improvement on the current state of paper if I'd modeled the shock process explicitly and had made necessary adjustments so that the equation (3) in the paper read

$$p^* = g + m + \varepsilon,$$

where $\varepsilon$ would be interpreted as an idiosyncratic shock *not related to money supply*. For instance, it could be a shock coming from production process, supply chain or some other entirely unrelated place.

Then it would be necessary to distinguish this shock from the monetary shock that is controlled by the government. We can do this by further changing the above equation to

$$p^* = g + m + \mu + \varepsilon,$$

where $\mu$ is the instrument of the monetary policy. It is government that decides on the size of $\mu$. As the consequence the complete shock process that we are describing in the paper without modeling explicitly is $\mu + \varepsilon$. This process is distributed normally with the mean $\mu$ controlled by monetary policy.

The third issue that I want to discuss is the issue of the simple average as opposed to the weighted average used by Dixit and Stiglitz (1977). Using weighted average would change the results qualitatively. More precisely, the results of the paper are just the subset of more general results that would be generated by not eliminating $\eta$. After all, we would have an additional parameter to take into account. This would further increase the complexity in relationships that paper investigates. However, qualitative results would stay the same for the reasonable values of $\eta$. Different values of $\eta$ would simply call for different definition of how large the shock should be in order for producers to adjust prices. As I am not calibrating the model, I believe the abstraction from the effects of $\eta$ is justified.

This problem would, however, become more acute if I had proceeded to provide exact bounds for aggregate shock sizes that would call for price adjustment by all producers and thus make monetary policy (relatively!) ineffective. Despite this problem let me still elaborate on this issue in the framework of the model as presented in the paper.

Indeed, in this setup such bounds are calculable.[1] Recall the shock process is normally distributed in the paper. For further simplification of these results in this short format it is convenient to change the distribution of the chock process to the one that has a bounded support. Therefore, let's assume that shock process has a uniform distribution on support *[-u;u]*. In this case the size of the shock after which every producer has to adjust the price is *a+b+u*. If the size of the aggregate shock exceeds this bound it becomes ineffective, as every producer will adjust prices.

However, there is a small caveat in the reasoning.[2] In the framework of the model the pre-shock average price is always above the average optimal price. This relationship is given by equation (11) in the paper. In contrast, if every firm resets their price to the new optimum in response of a shock, new average price will be equal to

1. I thank the discussant and Domenico Delli Gatti for pointing this out to me in a private discussion.
2. I am grateful to Peter Howitt for pointing this out to me.

new average optimal price. This characteristic still leaves the room for the monetary policy. For demonstration of this implication consider the expansionary monetary policy on a large scale (such that aggregate shock accedes $a+b+u$). Even though in this case every firm adjusts the price the monetary shock will not be entirely absorbed by the price, as average price will increase less then proportionately to the size of the shock. This is exactly due to the fact that average firm was holding the price higher than its optimal price before the policy became effective.

What is peculiar in this mechanism is the response of the economy to contractionary monetary policy. In this respect the model produces somewhat counter-intuitive results. Because of positive average deviation from the optimal price, large negative monetary shock induces the fall of prices more then proportionally with respect to the contraction of the monetary mass. Then, it follows that large contractionary policy can stimulate real economy. However, this effect is not persistent as it goes to zero relative to the size of the monetary shock as size of the monetary shock increases.