

## **On the Use of Models for Monetary Policy in Colombia: a Technocrat's Perspective**

Por Franz Hamann<sup>1[1]</sup>

In 1999 the Banco de la República formally implemented an "Inflation Targeting" (IT) strategy for the conduction of monetary policy. In a nutshell, this strategy is operated as follows: the Central Bank sets and announces a target for inflation and adjusts the interest rate to drive inflation to the target.<sup>2[2]</sup> An IT regime is based on the following principles:

1. Monetary policy is conducted to anchor expectations consistently with the announced target
2. The monetary authority should have a high degree of transparency
3. The monetary authority should be accountable and should explain why has taken a given decision
4. The existence of lags makes almost impossible to keep inflation on target at all times
5. A successful monetary policy also depends on other economic policies that make the task of monetary policy easier and more credible

A key element in monetary policy is the ability of the Central to communicate its decisions in a clear and transparent way to the public. In particular, it is fundamental that the monetary authority provides the public a sound explanation of the current state of the economy and a consistent description of how the economy may evolve in the future to support its decisions. For that purpose, the Banco de la República, as many other Central Banks around the world, has maintained a macroeconomic model for the quarterly forecast process as well as for monetary policy analysis. ([See Webpondo's Models at Central Banks](#)) The results of the analysis and forecasts are condensed in a quarterly [Inflation Report](#), as well as in the [Report to the Congress](#).

This note aims to describe and explain the role and nature of a model in an inflation targeting regime. I support the view that any model should be based on solid theoretical economic principles, given the state of knowledge. The note is divided in three parts: The first one, describes the role of any model in the monetary policy decision process. It explains what I consider are the central characteristics that a model should meet in order to be a useful tool in this process. The second part briefly describes the "menu" of models available to a Central Bank. Finally, I argue in favour of using dynamic stochastic general equilibrium models for policy decisions.

### **The role of a Model for Monetary Policy**

Here is how the theory says that monetary policy should be conducted in paradise: first, setup the model. This model should be an explicit dynamic, multi-sector general

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<sup>1[1]</sup> Director of the Department of Macroeconomic Modelling (Banco de la República). The views expressed in this note are strictly personal. They do not necessarily reflect the views of the Junta Directiva, the technical staff.

<sup>2[2]</sup> Strictly speaking Colombia has implemented a Flexible Forecast Inflation Targeting (FFIT) strategy. "Flexible" means that the Bank also considers output stability when adjusting the interest rate and "Forecast" means that it is the forecast of inflation (not observed inflation) the intermediate target.

equilibrium model that specifies the agent's optimization problems, the markets in which agents can trade in, the information at agents' disposal and the law of motion of shocks. The second step is to estimate the unknown parameters of the model to obtain a complete description of the data generating process. Third, we solve a Ramsey problem: that is, we find a map from shocks impacting on the economy to policy instruments. Once we have this, we can replace the Central Bank with our Ramsey rule.

Of course we are not in paradise and we must recognize that monetary policy faces many challenges. There is no such a thing as a "true model" and even in the event that there is a structural and invariant one, the estimation of its parameters is still problematic: for instance the classical simultaneous equations procedure based on asymptotic distribution theory assumes that sample size is very large relative to the number of parameters being estimated. Clearly, this condition is very difficult to meet in practice. In consequence, there will always be a role for judgement in any forecasting exercise.

A fundamental question is: what is the role of a model in an inflation targeting strategy?

For me, it's role is to facilitate the communication of monetary policy decisions and make them more transparent to the public. The idea is simple: since the target is set in quantitative terms, and the policy decision is taken in quantitative terms, why should our diagnostic of the current state of the economy and its likely evolution be communicated in qualitative terms? The language that a Central Bank uses to communicate its decisions to the public should be clear and consistent. A model provides the discipline to understand the economy and furthermore provides a unified, structured and consistent language.

Here is what I consider the main characteristics that a model should have in order to serve as the core of any Forecasting and Policy Analysis System (FPAS) for a Central Bank. Recall that the main purpose of any model is to support the Inflation Targeting strategy. The success of the strategy depends crucially on the ability of the Central Bank to anchor expectations. Agent expectations usually are formed taking all information available to them at a given moment. A model is a key part of that information set. If the model is based on sound economic principles and it is communicated in a simple language agents will "buy" the model more easily, facilitating the job of the Central Bank. Therefore one should build a model that is:

1. theoretically rich but tractable, consistent, coherent and explicable at the same time
2. useful for contrasting competing economic stories
3. able to match the main properties and facts of the Colombian data
4. reliable and efficient under different forecasting assumptions
5. flexible to the imposition of judgemental adjustments

These "desirable" features articulate not only the external policy of the Central Bank but also the operations within the Bank in the following sense: the model is the anchor of the research agenda for the Bank as well as its institutional language.<sup>3[3]</sup> In the next section, I

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<sup>3[3]</sup> By an anchor of the research agenda I mean that the Central Bank needs an articulated research program in which the structure of the economy is carefully studied. For example, a research program oriented to understand the mechanics of the labor, capital, financial and goods markets.

will briefly describe the different types of models available to the Central Banks and their ability to satisfy the policy maker's needs.

### The Menu

Central Banks have a wide variety of models for forecast and policy analysis: time series models (VAR's, for example), simultaneous equations econometric models, small semi-structural theory-based models and dynamic stochastic general equilibrium (DSGE) models.<sup>4[4]</sup> We can start comparing the models in terms of their forecast accuracy and theoretical consistency (criteria 1 and 3 above). In terms forecasting accuracy, unlike semi-structural and structural models, time series models perform really well in the short-run (up to 4 quarters). However, in terms of explicability it is virtually impossible to obtain a coherent economic story that forms the basis of a policy decision. That basically hinders the possibility of using time-series models of being used as the main tool for communicating and explaining policy decisions.

On the other side we have more "theory-structured" models for monetary policy analysis. I would say there are two main groups: the semi-structural models and the DSGE models. Typically, in a semi-structural model the variables are flows, gaps and rates. Their inter-temporal evolution is determined by a subset of economic relations: a Phillips curve, an IS curve, an interest rate policy rule, a Fisher equation and an Uncovered Interest Rate Parity condition in the case in which an open economy is being modelled.<sup>5[5]</sup>

Mathematically, these types of models are a system of dynamic linear stochastic difference equations. It is common practice to "calibrate"<sup>6[6]</sup> the parameters of the model so as to replicate the main features of the data as well as to guarantee a subset of desirable theoretical properties<sup>7[7]</sup>.

Semi-structural models are very popular among Central Banks.<sup>8[8]</sup> They have proven to be a very useful tool for disciplining the discussion about the current state of the economy, its possible future evolution and the main risks that the Board faces. At the same time, they have improved the internal communication between the staff and the Board and the external communication between the Board and the public. However Central Banks have quickly recognized that these models have three important limitations:

1. There are no market clearing conditions
2. All parameters in the model are subject to the Lucas critique
3. The aggregate description of the economy is consistent with different microeconomic stories

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<sup>4[4]</sup> This classification is somewhat arbitrary, but summarizes the broad type of models that has been used by many Central Banks around the world.

<sup>5[5]</sup> See Carl Walsh (2003) Monetary Theory and Policy.

<sup>6[6]</sup> This is not the calibration procedure commonly used in the Real Business Cycle literature. Here calibration means, given an initial econometric estimation of the parameters to adjust them without a well-defined metric.

<sup>7[7]</sup> For example, long run neutrality, super-neutrality and convergence to the target.

<sup>8[8]</sup> See Gómez, Uribe and Vargas (2002) "[The implementation of Inflation Targeting in Colombia](#)". Borradores de Economía, BANCO DE LA REPUBLICA.

Many of these problems are inherent to the nature of the model itself. The fact that we use only a subset of semi-structural economic relationships, with no specifications about the agents, the markets and their interaction limits the scope, the consistency and the interpretability of the model. The consequence is that the language used to support the monetary policy decisions is usually vague and sometimes even inconsistent. This poses an undesirable risk to the conduct of monetary policy: the IT strategy is limited by the nature of the model used to communicate monetary policy decisions.

The DSGE models can overcome most of the objections to the semi-structural models, but at the same time present new challenges to the modellers. DSGE models define clearly what the households, the firms and the government do. The agents meet in the markets. Their interaction defines precisely the economic outcome. Furthermore, all the goods in the economy are listed as well as its associated market structure. As a result, the outcomes in these models are consistent with explicit constrained optimization problems for each agent and the restrictions imposed by markets. Therefore there is little room for inconsistencies within the stock-flow accounting (provided the model is correctly designed). These features make DSGE models attractive to build economic stories. There are however some challenges. These models are difficult to estimate not only because of their nonlinearity, but also because their structure imposes clear cross equation restrictions to the dynamics of the observed data (see [Professor Cole's interview with Webpondo](#)). Finally, depending on the model, there may be situations in which *some* of the parameters of these models *may* be subject to the Lucas critique. Ultimately, in practice it is very difficult to build a model that is immune to the Lucas critique.

### **The Key Question**

The relevant practical question for the Board of a Central Bank is: do the benefits of using a DSGE model for policy analysis and forecast outweigh the costs of not doing so? I think the answer is affirmative. I have already mentioned some theoretical (and technical) reasons. However, at the practical level, the policy level, there is a simpler reason: if we agree that one of these models is a reasonable description of the general structure of the economy, its internal consistency will be able to support:

1. the process of taking policy decisions
2. the communication of the decisions to the public
3. the problem of anchoring the private agent's expectations
4. the process of having the Board accountable for their decisions
6. the implementation of the Inflation Strategy in general

Another reason is to look outwards. It is interesting to observe the trends in modelling strategies at other Central Banks around the world. The recent experience of several inflation targeting central banks (Bank of England, the Bank of Canada, the Riksbank, the Bank of Japan, to name a few) shows that a full structural model is a step forward in satisfying these criteria (see the [Workshop on DSGE's at Central Banks 2004](#)). Finally, one aspect that is crucial to understand about the use of models for the conduction of monetary policy is that there is no such a thing as "the model". Building a model is always an on-going process: it is subject of discussion, revision, adjustment and

change. A model will always be conditioned on the state of knowledge about the theory and the empirical evidence. The challenge is for researchers and professional economists to increase the stock of knowledge that supports the policy decisions. There should be no reason to limit the process of monetary policy decisions by using anything different than the state of the art. This, I think, is the basic principle of good economic policy.