



# Inflation targeting and exchange rate volatility smoothing: A two-target, two-instrument approach<sup>☆</sup>



Carlos Castillo<sup>\*</sup>

Economic Research Department, Bank of Guatemala, 7a. avenida 22-01 zona 1, Guatemala, Guatemala

## ARTICLE INFO

### Article history:

Accepted 14 August 2014  
Available online xxx

### Keywords:

Bayesian estimation  
Inflation targeting  
Guatemala

## ABSTRACT

This paper introduces a strategy to model a small open economy, whose central bank has established two simultaneous policy objectives: an inflation target, and a maximum limit for nominal exchange rate volatility. In line with the Tinbergen–Aoki condition, the monetary authority establishes two policy instruments, one for accomplishing each target: the monetary policy rate, and the stock of foreign exchange reserves. Monetary policy analysis is built around a non-microfounded augmented New Keynesian DSGE model estimated through Bayesian techniques for the Guatemalan economy. It is found that each instrument is efficient in accomplishing its own target. Nevertheless, a coordinated effort is required for central bank policymakers before employing both instruments simultaneously, in order to avoid sending mixed signals to economic agents about its monetary policy stance, and endanger the achievement of its inflation target.

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## 1. Introduction

During the past 30 years the way to conduct monetary policy has experienced a large transformation. A growing number of countries have adopted a monetary policy framework based on inflation targeting, since empirical evidence shows that it has effectively anchored inflation expectations and reduced long run inflation and output volatility (Batini et al., 2005; Freedman and Laxton, 2009; Mishkin, 2007). However, those central banks, whose monetary policy framework is based on exchange rate flexibility, do closely monitor their nominal exchange rate behavior to avoid its negative consequences on inflation, output, and financial stability (Calvo and Reinhart, 2000; De Gregorio, 2006). Hence, such a concern have lead them (some of them with higher intensity than others) to limit nominal exchange rate fluctuations through the establishment of different types of foreign exchange market intervention mechanisms, which in turn, might have an effect on monetary policy transmission (Edwards, 2006; Holub, 2004; Mishkin, 2007).

The Central Bank of Guatemala established inflation targeting in 2005, but fear of floating becomes evident through periodic-partially-sterilized interventions at the foreign exchange market (Castillo, 2010). Because of the importance to consider such intervention effects

in the monetary transmission mechanism, this study introduces a strategy to model a central bank, whose monetary policy establishes two simultaneous targets: an inflation target, and a currency volatility target, where the latter refers to a maximum permissible fluctuation for the nominal exchange rate from its long run trend. In that order, we construct a New Keynesian DSGE non-microfounded model, whose monetary transmission is augmented to include a *liquidity effect* of interest rates on monetary aggregates, a direct impact of money supply and banking credit fluctuations on economic activity, and fiscal policy effects on monetary policy decisions. Based on the Tinbergen–Aoki condition, which requires at least an equivalent number of instruments to achieve a given number of targets (Aoki, 1975; Tinbergen, 1963), the macroeconomic model developed in this document contains two central bank reaction functions: i) a traditional *Taylor Rule*, where the monetary policy rate reacts to inflation deviations from its long run target, and to output gap; and ii) an *Exchange Rate Intervention Rule*, where foreign currency reserves react to nominal exchange rate deviations from its long run trend.<sup>1</sup> The proposed model structure allows comparing shock responses under alternative fear of floating scenarios.

Equation parameters were estimated through Bayesian methods, based on quarterly data for the Guatemalan economy during the period 2003–2012.<sup>2</sup> It was found that central bank interventions at the foreign

<sup>☆</sup> I would like to express my deep gratitude to an anonymous referee for providing thoughtful comments, which helped to improve this paper. The views expressed in this document are solely the responsibility of the author and should not be interpreted as reflecting the views of Bank of Guatemala.

<sup>\*</sup> Corresponding author. Tel.: +502 2238 1552; fax: +502 2485 6000x3600.  
E-mail address: [cecm@banguat.gob.gt](mailto:cecm@banguat.gob.gt).

<sup>1</sup> The second reaction function is an innovative form to model what the Central Bank of Guatemala has done in practice during recent years.

<sup>2</sup> Empirical estimation followed Smets and Wouters (2003, 2004, 2007), and Adolfson et al. (2007).

exchange (FOREX) market to moderate nominal exchange rate volatility tend to reduce monetary transmission efficiency when using the monetary policy rate to control for inflation. It was also found that partially-sterilized FOREX market interventions could be inflationary, particularly if those interventions are made on periodical basis. Even though each monetary policy instrument is efficient in accomplishing its own target, a necessary coordination effort should be made by central bank authorities to apply its two instruments simultaneously, in order to achieve both targets.

The remaining part of the discussion is classified as follows. Section 2 illustrates the modeling strategy; Section 3 describes the main model equations; Section 4 portrays the data base, and depicts the estimation methodology; Section 5 describes the results obtained, and illustrates some simulations; finally Section 6 presents the main conclusions.

## 2. Modeling strategy

The modeling strategy consists of the monetary transmission mechanism resulting from the model structure, and the economic intuition that stands behind it. In this respect, the model presented in this document is built under the New Keynesian spirit. However, it departs from the standard macroeconomic models of this nature in the following: i) monetary aggregates and bank lending are included as important elements within the transmission mechanism, which triggers complementary effects on the aggregate demand, and the exchange rate transmission channels; and ii) total output is disaggregated into its main components to reflect monetary policy effects on a better detail.

### 2.1. Introducing money into New Keynesian Models

In standard New Keynesian Models, there is no explicit role for money, since it is assumed that monetary policy interest rate adjustments, originated by central bank actions, can be transmitted to most asset prices (of longer maturity) within the economy to the extent that they can be enough to explain fluctuations in aggregate demand and inflation. We argue that the conventional New Keynesian specification is incomplete, since it disregards several important channels of monetary transmission where money aggregates play an important role.<sup>3</sup> Although policy driven changes in the monetary policy rate are spread to longer term average banking rates, there are additional effects generated by monetary aggregates that are worth to model. First, there is a complementary outcome produced simultaneously through a *liquidity effect* on currency issue, since monetary policy actions modify the central bank's balance sheet composition through open market operations. These endogenous fluctuations in narrow money are transmitted to a broader measure of money supply that is a more comprehensive account of all asset yields within an economy, and influence household consumption choices and firms investment decisions (Bridgen and Mizen, 1999; Friedman, 1956; Hauser and Bridgen, 2002; Janssen, 1996; Thomas, 1996). Therefore, broad money supply drives fluctuations on aggregate demand, since private consumption and investment is its main component. Second, the endogenous response of money supply to monetary policy rate adjustments has a direct consequence on the domestic foreign exchange market, additional to the effect produced through the uncovered interest rate parity. Indeed, the broad money supply contraction that follows a monetary policy tightening would tend to reduce the banking sector demand for foreign currency, and prompt a short run nominal exchange rate appreciation. Third, foreign exchange market interventions also modify the central bank's balance sheet composition through changes in foreign currency reserves. If those interventions are partially-sterilized, there is an effect in currency issue directly proportional to the non-sterilized component of each intervention,

<sup>3</sup> This argument is not new (see Friedman (1956); Meltzer (1999); Nelson (2002); Hauser and Bridgen (2002); King (2002), among others).

**Table 1**  
Total imports' destination.

| Total imports' destination | 2001 | 2006 | 2012 |
|----------------------------|------|------|------|
| Consumption                | 80.2 | 76.9 | 79.4 |
| Investment                 | 17.9 | 22.2 | 19.6 |
| Government expenditure     | 1.0  | 0.8  | 0.9  |
| Exports                    | 0.9  | 0.1  | 0.1  |
| Consumption + investment   | 98.1 | 99.1 | 99.0 |

which affects private consumption and investment.<sup>4</sup> This particular transmission channel is a novel introduction of the macroeconomic model presented in this document.

Bank lending is also introduced into the monetary transmission, given its effect on household consumption and firm investment decisions. Households and small-medium sized firms do not have access to international financial markets, so their external financing depends on resources they can borrow from local financiers (Bernanke and Blinder, 1988; Bernanke and Gertler, 1995; Gertler and Gilchrist, 1993, 1994; Kashyap et al., 1993). Banks have an advantage over other financial intermediaries, since they can provide their customers with bank deposits and payment services. This in turn, allows bank to access information on their clients' financial background, and reduces their exposure to costs incurred through adverse selection (Diamond, 1984; Fama, 1985). Therefore, banks play an important role in money creation. In fact, when banks make loans, they create additional deposits for borrowers at a price (interest) affected by monetary policy actions. However, local bank loans also depend on banks' lending policies, creditworthiness of borrowers, and loan to value ratios for secured borrowing (among others). Therefore, money supply could change without any central bank adjustment in the monetary policy rate.

### 2.2. Total output disaggregation

Total output (Y) is decomposed into three main components: Net Private Consumption and Investment ( $CI = C + I - M$ ), Government Expenditure (G), and Total Exports (X). The first component is the net sum of three items; i) Total Final Consumption (C), which includes all consumer goods (durables and nondurables) and services that are used by households to satisfy their individual needs; ii) Total Final Investment (I), which refers to expenditures on goods and services that are employed as inputs in the production process; it includes Gross Capital Formation and Inventory Variations; and iii) Total Imports (M), which are foreign purchases of goods and services by an economy's local residents. It is important to mention that M is subtracted from the sum of the former two terms (C + I) to form Net Private Consumption and Investment (CI) to avoid double counting, since most of what is purchased from abroad is either consumed or invested.

Table 1 shows the proportion of Guatemalan Imports during selected years that are accounted into the remaining expenditure accounts. According to such information, in 2001, 2006, and 2012, the proportion of total imports destined for consumption were 80.2%, 76.9% and 79.4%, respectively, while 17.9%, 22.2% and 19.6% of them were destined for investment. As a result, during the years described in Table 1, over 98% of Guatemalan imports were either consumed or invested. On statistical grounds, this result justifies CI's utilization into the monetary policy transmission mechanism of the model presented in this document.

<sup>4</sup> A partially-sterilized intervention at the FOREX market is understood as a central bank sale/purchase of foreign currency (US dollars), whose shortage/excess of domestic currency resulting from such operation, is neither exactly compensated in the local money market by additional open market operations, nor it generates any change in the monetary policy rate, or in any other monetary instrument interest rate. Therefore, the non-sterilized domestic currency component of such FOREX intervention affects money supply.

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