The Monetary Policy Rule During the Transition to a Stable Level of Inflation: The Case of Colombia *

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Abstract

During the transition from a moderately high level of inflation to an internationally accepted level, the target, the inflation rate, the nominal interest rate and the nominal equilibrium interest rate may be difference stationary. Policy rules estimation, however, is usually performed under stationarity assumptions. In this note we set up a monetary rule useful for characterizing the behavior of a central bank during this transition. As in previous research, estimation may be carried out by GMM on a nonlinear equation. We illustrate these results by characterizing the behavior of the Colombian Central Bank during the period of full inflation targeting, that is after 2000.

1 Introduction

We distinguish two types of monetary policy rules: those dependent on particular models and loss functions and those robust to them. While de-

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pendent rules are useful for monetary policy implementation, robust rules are powerful tools to characterize the behavior of the monetary authority over a time span.

Rules that are dependent on particular transmission mechanism models and loss functions are also known as Targeting Rules, TR. In a targeting rule, the central bank minimizes its loss function conditional on the dynamic behavior of a particular transmission mechanism models. When the system of first order conditions is solved, the explicit form of the targeting rule arises. The explicit form of a targeting rule is regarded as optimal if the policy instrument responds to the whole set of observable variables contained in the model at time t, and is deemed as simple if the policy variable is constrained to respond only to a subset of these variables. The Taylor rule for the federal funds rate and the McCallum rule for the monetary base are examples of simple rules. See Rudebush and Svensson [18].

Moreover, since it is widely accepted that monetary policy affects the inflation rate only after a lag, monetary authorities tend to respond in advance to innovations that may drive the inflation forecast away from its target. By including this element into the rule, Inflation Forecast Based, IFB, rules arise.

Robust monetary policy rules are simple IFB rules that are estimated directly from observable data. Estimates are derived usually under the assumption that the target, the nominal interest rate, the equilibrium nominal interest rate and the inflation rate are stationary.

However, during the transition from a moderately high level of inflation to a stable, internationally accepted level, the Central Bank commitment with this goal implies that the inflation rate, the targets, the nominal interest rates and the equilibrium nominal interest rates are non-stationary. A highly

credible and strongly committed Central Bank may set the targets along a pre specified deterministic trend from π_0 to $\overline{\pi}$, and under the assumptions that the policy is unbiased and inflation expectations are rational, the target, the nominal interest rate and nominal equilibrium interest rate are trend stationary.

However, there are several reasons to explain how a Central Bank induces a unit root behavior on the observed variables during the transition, and these are related to unobserved parameters like credibility and price persistence, as well as the need of a soft landing.

Following Clarida Galí and Gertler [4], in this note we set up a robust monetary policy rule in order to characterize the behavior of a central bank during the the transition to a stable inflation level. As in previous research, this rule is a stationary non linear equation that can be estimated by GMM provided we are able to obtain the required instruments.

We illustrate these results by characterizing the behavior of the Colombian central bank during the period of inflation targeting, that is after 2000.

Our estimation results reveal that after 2000 the Colombian central bank pursued a gentle stabilization program for inflation, a stronger one for the output gap, and a high degree of interest rate smoothing. These results are consistent with the prevailing policy during the sample span. Combining these evidence with that of previous works, our results suggest that the policy rule is state contingent to the output gap, an important result for the implementation of monetary policy models.

We organize the rest of this note as follows. In section 2 we set up the monetary rule. In the third we summarize the Colombian empirical research on policy rules. In the fourth we apply our results to the Colombian case, and in the last we conclude.

2 Setting Up the Policy Rule

In this section we assume that the inflation targeting Central Bank has a long term goal of bringing the inflation rate down from a moderately high inflation level, π_0, to an internationally accepted level $\overline{\pi} < \pi_0$.

2.1 Non Stationarity in the Observed Variables

A highly credible and strongly committed Central Bank may set the targets along a pre specified deterministic trend from π_0 to $\overline{\pi}$. Under the assumptions that the policy is unbiased and inflation expectations are rational, the target, the nominal interest rate and the nominal equilibrium interest rate are stationary around deterministic trends.

However, there are several reasons to explain how a Central Bank induces a unit root behavior on the observed variables during the transition. These reasons relate to the need of a soft landing or to unobserved parameters like credibility and price persistence, which may induce the Central Bank to establish learning schedule. For instance, a Central Bank that is not fully credible but is concerned with the short term costs of its lack of credibility may choose to establish a learning plan. Depending on the past results, the Central Bank adjusts the future targets to balance the cost of reducing the inflation with the credibility gains. As a result, the future targets would be endogenous to past policy results.

Evidence of Central Bank endogenous targeting behavior, for the case of Colombia, may be observed in figure 1 that displays the behavior of the changes in the inflation rate implied by the targets. In this figure we can distinguish four different periods of time; The first three years are consistent with a policy to establish credibility. Once the credibility has been established, the next four years (until 1997) relate to a commitment to reduce

the inflation about 5% a year. Following, there is a two year transition period related to the strong economic slowdown of 1998. After 2000 there is a period of time related to inflation reductions between 0% and 2.5% a year, which are consistent with a soft landing.

Except for the transition period, which is related to the strong economic slowdown of 1998, the policy seems to be related to a commitment to stepping implied inflation reductions. The policy steps are the result of both credibility gains and the inflation level attained the last period of time. In other words, the targets clearly depend on the rate on inflation observed in the last period of time.

Without loss of generality, the following example illustrates the behavior of the observed variables during one of the steps. If the monetary authority commits to an exogenously determined inflation reduction from the last observed result,

$$\pi^*_{t+1} = \pi_t + D_{t+1} \tag{1}$$

where π^*_{t+1} is the core inflation target for $t+1$, π_t is the observed core inflation rate at t, and D_{t+1} is an exogenous stochastic process such that

$$D_{t+1} = \begin{cases} \overline{D} + \psi_{t+1} & \text{During the transition to } \overline{\pi} \\ \psi_{t+1} & \text{After stabilization} \end{cases}$$

where ψ_{t+1} is an exogenous zero mean stationary process and $\overline{D} < 0$ is the time invariant yearly average inflation reduction. During the transition to $\overline{\pi}$ the target is $\pi^*_{t+1} = \pi_t + \overline{D} + \psi_{t+1}$, and $\overline{D}$ determines the ex ante disinflation speed.

By setting and endogenizing the targets on the core inflation, our monetary authority avoids the transmission of transitory innovations to the inflation so that these innovations die out.

The commitment to an exogenously determined time invariant reduction

from the last observed result contained in equation 1 is weaker than fixing the targets along a pre specified linear trend and reflects the fact that Central Banks take into account the last observed results when fixing the new targets.

A closer look to equation 1 reveals that the integration properties of both, the target and the core inflation rate, are by definition the same. In particular, $\pi^*_{t+1} - \pi^*_t = \pi_t - \pi_{t-1}$ during the transition.

Given that the cost of reducing the inflation rate relates inversely to the credibility of the monetary authority, and the credibility is related to policy unbiasedness, we will assume that the monetary policy is unbiased, that is $\pi_{t+n|t} - \pi^*_{t+n}$ is a zero mean stationary process.

We will also assume that expectations are rational, which means that $\pi_{t+n|t} - \pi_{t+n}$ is a zero mean stationary process. Although the rationality assumption has been challenged in the empirical literature, it is standard in many theoretical models[1].

Combining these two assumptions with equation 1, we obtain that the inflation rate is a difference stationary process. In our notation, $\pi_{t+n|t} = E_t[\pi_{t+n}]$, and π^*_{t+n} denotes the inflation target.

The following assumptions are standard in the literature and do not require further discussion. Under the assumption that the real rate

$$r_t = i_t - \pi_{t+n|t} \tag{2}$$

is a stationary process, the nominal interest rate i_t is also a unit root process during the transition to $\overline{\pi}$, and a co-integration relationship between the inflation rate and the nominal interest rate holds $\forall t$.

[1]Dropping the rationality assumption would require the adoption of a learning model leading to a non robust rule.

We will also asume that the deviations from the time varying equilibrium nominal interest rates are stationary,

$$i_t - \bar{i}_t \sim I(0) \tag{3}$$

which implies that $\bar{i}_t$ is also a unit root process. Furthermore, we assume that the long run real interest rate equilibrium, $\overline{r}$, is time invariant.

From this example we conclude that under a (reasonable) particular kind of commitment in which the Central Bank sets the future inflation targets based on the last inflation result, the targets, the inflation rate, the nominal interest rate and the nominal equilibrium interest rate are difference stationary.

2.2 Setting Up The Policy Rule

In this section we assume that the targets are difference stationary but do not assume a particular rule to fix them. We will also assume, as in the previous subsection, policy unbiasedness and rational expectations. As a result, the observed variables will have the integration orders described above, and the co integration relations between them still hold.

We start from the monetary rule equation (2.1) in Clarida, Galí and Gertler [4], which determines the target nominal rate as follows,

$$i_t^* = \alpha + \beta \left\{ \pi_{t+n|t} - \pi_{t+n}^* \right\} + \gamma z_{t|t} \tag{4}$$

where α is "the desired nominal rate when both inflation and output are at their target levels".

We depart from this specification by requiring α to be the time varying equilibrium nominal rate, $\bar{i}_t$. Thus, our monetary authority sets the interest rate targets according to

$$i_t^* = \bar{i}_t + \beta \left\{ \pi_{t+n|t} - \pi_{t+n}^* \right\} + \gamma z_{t|t} \tag{5}$$

where i_t^* is the short term nominal interest rate target and $z_{t|t} = E_t[y_t - y_t^*]$ is the expected output gap.

Under the assumptions made in this section, equation 5 may be viewed as the monetary authority setting targets on a stationary variable, the deviation of the nominal interest rate from the time varying equilibrium rate, $i_t^* - \bar{i}_t$, as a function of two stationary variables, the deviation of the expected inflation rate from the target, $\pi_{t+n|t} - \pi_{t+n}^*$, and the output gap, $z_{t|t}$.

However, under our assumptions, if α is time invariant, equation 4 relates the left hand side non stationary variable to the stationary term in the right hand side.

2.3 The Implied Real Rate Rule

Under the further assumption that the nominal interest rate equilibrium is given by

$$\bar{i}_t = \overline{r} + \pi_{t+n}^* \tag{6}$$

$\forall n \geq 1$, and combining equations 2, 5 and 6 we obtain the real interest rate rule

$$r_t^* = \overline{r} + (\beta - 1)\left\{\pi_{t+n|t} - \pi_{t+n}^*\right\} + \gamma z_{t|t} \tag{7}$$

The signs of the parameter values in this equation provide important insights about the monetary authority behavior. If $\beta > 1$, the response of the target real rate to a deviation of the expected inflation from its target is positive, which is consistent with a slowdown in economic activity and inflation. On the other hand, if $\beta < 1$, the target real interest rate responds in the opposite way creating a destabilizing environment. The same analysis applies to the case of γ. See Clarida, Galí and Gertler [4].

Again, equation 7 differs from the implied real rule in Clarida, Galí and

Gertler [4],

$$r_t^* = \overline{\alpha} + (\beta - 1)\left\{\pi_{t+n|t} - \pi_{t+n}^*\right\} + \gamma z_{t|t} \tag{8}$$

because of the stationarity assumption on $\overline{\alpha} = \alpha - \pi_{t+n}^*$.

2.4 Interest Rate Smoothing

Central banks tend to avoid the immediate nominal interest rate adjustments suggested by a rule like 5, so they tend to smooth out monetary surprises.

In this section we assume that only the nominal interest rate stationary component is smoothed out according to the equation

$$i_t - \overline{i}_t = (1 - \rho)(i_t^* - \overline{i}_t) + \rho(i_{t-1} - \overline{i}_{t-1}) + \nu_t \tag{9}$$

where ν_t is a stationary zero mean stationary process, and $0 < \rho < 1$ determines the degree of interest rate smoothing[2].

By replacing equation 9 into 5, we obtain

$$i_t - \pi_t = (1 - \rho)[\beta(\pi_{t+n|t} - \pi_{t+n}^*) + \gamma z_{t|t}] + \rho\,(i_{t-1} - \pi_{t-1}) + \nu_t \tag{10}$$

Under the rational expectations assumption and provided that at time t we have inflation expectations and output gap measures, equation 10 is a simple IFB rule consistent with rational expectations forecasts. Provided that at time t we have measures of future inflation expectations, equation 10 gives the final form of our monetary rule. Estimation may be carried out by GMM provided that we are able to find a vector of instruments $\mathbf{U}_t$ such that $E_t[\varepsilon_t|\mathbf{U}_t] = \mathbf{0}$.

[2] In this note we are interested in smoothing rules only. Level rules, $\rho = 0$ and difference rules, $\rho = 1$ will not be discussed in this note.

3 The Colombian Case

3.1 Empirical Research on Policy Rules in Colombia

Table 1 summarizes the previous research on monetary policy rules in Colombia. All empirical works, except for Bernal [2], focus on Targeting Rules, TR, as they depend on specified loss functions which are minimized conditional on a pre specified models of transmission mechanisms.

We distinguish two completely different periods of time following the 1991/1992 constitutional reform that required the Colombian central bank to set inflation targets below the last observed result. The main difference between the two periods of time is the choice of the policy instrument and the exchange rate regime.

Although during the two periods the main target was inflation, from 1991 to 1999 the policy instrument was the money growth and there was an exchange rate band target. The second period of time, after 1999, is characterized by the adoption of the overnight interbank lending rate, TIB, as the policy instrument and a free exchange rate float. As a result, the interbank overnight loan rate, the growth of the monetary aggregates and the exchange rate devaluation rate show important behavioral differences between the two periods of time.

3.1.1 Targeting Rules

Early attempts to obtain monetary policy rules in Colombia date back to 1999. See Julio and Gómez [12]. In this paper the authors propose an elementary short run model for the Colombian monetary policy with an unobserved output gap.

Since at that time the policy variable was the money growth, the policy instrument was the monetary surprise. The authors find both the opti-

mal targeting rule and the optimal McCallum type rule. These rules are consistent with a non forward looking loss function which includes actual deviations of the inflation rate, output gap and the monetary surprise, which implies some degree of policy smoothing. The authors find that in an early stage of monetary targeting, the central bank pursued a gentle inflationary stabilization program, a more aggressive one on the output gap and no policy smoothing.

Using an early version of the current MMT model, the central model for forecasting and policy analysis used in the Colombian Central Bank, Gómez and Julio [8] found the coefficients of IFB rules of the form

$$i_t = \rho i_{t-1} + (1-\rho)\left(\bar{i} + \pi_t\right) + \beta\left(\pi_{4|t} - \pi^*_{t+4}\right) \tag{11}$$

by means of stochastic simulations.

The smoothing parameter ρ was set to zero because of the long history of large changes in interest rates in Colombia, and β was calibrated at 0.5, consistent with a pure inflation targeting stabilization program with no policy smoothing.

Using a later forward looking version of the MMT model consisting of seven equations, López [13] studies the choice of a simple rule that is consistent with inflation targeting. Following Batini and Nelson [1], in order to set up the targeting rules, the author uses as loss function the discounted expected weighted deviation of present and future deviations of the inflation rate, output and the change of the interest rate from their targets.

By performing simulations on a grid of the posible coefficients values of three alternative rules, the author finds the values that minimize the loss function. See Black et al [3] and Drew and Hunt [6]. The author's main conclusion match nicely previous results from the international literature.

IFB rules are optimal in comparison to Taylor rules. The optimal policy horizon is between six to eight quarters, and the interest rate smoothing coefficient is zero. However, Taylor rules may achieve lower inflation-output variability than IFB rules at a cost of higher inflation-instrument variability.

Later MMT model versions, MMT4, have used a rule of the form

$$i_t = 0.7i_{t-1} + 0.3\overline{i_t} + 0.75\left(E_t\left[\pi^{nf}_{t+6}\right] - \pi^*_{t+6}\right) + 0.24y^{gap}_t + \varepsilon^i_t$$

where the long run mean interest rate is the 90 days certificate of deposit plus a constant spread, $\overline{i_t} = \overline{i^{cd}_t} + \gamma_i$, and the long run mean CDs rate equals the long run mean real rate plus the expected inflation, a result based on López [13]. These results constitute the benchmark for monetary policy model implementation in Colombia. See Banco de la República [5].

More recently Perez [16] studied the convenience of having the interest rate respond to either the total inflation, the domestic inflation or the external inflation in a Dynamic General Equilibrium Stochastic, DGES, model. Although in this paper no loss function was minimized, the efficiency frontier was found by stochastic simulations on a parameter grid as described above.

The author finds that simple rules that respond to a rule consistent forecast of the total inflation are better than the ones based on the domestic or imported inflation rate. For an economy that is highly vulnerable to external shocks, with an important tradeable sector and perfect pass through, the author finds that the optimal response of the monetary authority is formulated in terms of deviations from the total inflation forecast rather than to the tradeable or non tradeable components.

3.1.2 Robust Rules

Bernal [2] studied alternative estimates of monetary policy rules in Colombia for the 1990's period. The rule used in that paper comes from Clarida, Galí and Gertler [4]

$$i_t = \rho i_{t-1} + (1-\rho)\left\{\bar{i} + \beta\left(\pi_{T|t} - \pi^*_{t+T}\right) + \gamma z_t\right\} + \nu_t \tag{12}$$

where the error term ν_t is an interest rate smoothing random error.

This monetary policy rule corresponds to an IFB smoothing instrument rule consistent with rational expectation inflation forecasts.

By assuming that the inflation targets and the log run equilibrium interest rates are constant, $\pi^*_t = \pi^*$ for all t , and rewriting the rule in terms of realized variables, Bernal [2] gets a convenient form for estimation,

$$i_t = \rho i_{t-1} + (1-\rho)\alpha + (1-\rho)\left\{\beta\pi_{t+n} + \gamma z_t\right\} + \varepsilon_t$$

where $\alpha = \bar{i} - \beta\pi^*$, and the residual term, ε_t depends on ν_t and the forecast error.

The later form is convenient for estimating the monetary policy parameters provided the existence of suitable set of instruments, $\mathbf{U}_t$, that satisfy the population moment condition $E\left[\varepsilon_t/\mathbf{U}_t\right] = 0$. Since rational expectations were assumed, it is sufficient that $\mathbf{U}_t$ satisfy $E\left[\nu_t/\mathbf{U}_t\right] = 0$.

The author finds that $\widehat{\beta} = 1.34$, $\widehat{\gamma} = 0.19$ and $\widehat{\rho} = 0.10$, which support the conclusion that Colombian monetary policy during the nineties is a "soft hearted inflation targeting regime", where there is a modest component of pure stabilization in the rule, and the estimates indicate that the rule focus seems to be only the inflation rate. Moreover, interest rate smoothing is low, as expected, because the policy instrument was at this time the growth of a monetary aggregate, and the exchange rate regime was an exchange rate band.

Under the assumption that the nominal interest rate and the inflation rate are both stationary or at most trend stationary, this form is suitable for estimation by GMM. See footnote 3 of Bernal [2].

However, if the nominal interest rate and the inflation rate are both difference stationary, GMM does not necessarily provide adequate estimates for equation 3.1.2. In this case Johansen's [11] maximum likelihood, Phillips and Hansen's [17] fully modified estimation, Park's [15] canonical cointegrating regression, and Stock and Watson's [19] estimations are more appropriate. See Hall [10] and Mtis [14].

3.2 Estimation Results

3.2.1 Data

The 1991/1992 Colombian constitutional reform required the central bank to set inflation targets not higher than the inflation rate observed in the last December and provided the board of governors independence to pursue its objectives. Although a 1999 Colombian constitutional court ruling relieved the bank from the requirement to set inflation targets below the last observed rate, the Colombian central bank is committed, and has been very successful so far, in bringing the inflation rate down to internationally accepted levels in the long run.

Figure 2 shows the observed inflation rate along with its point target. Decreasing historical targets are consistent with a policy to reduce the inflation rate to internationally accepted levels, and historical observed inflation rates followed suit.

Following an escalade of attacks to the Colombian currency band, it was abandoned in favor of a free floating in September 1999. This move gave priority to the inflation target over any other target. Figure 3 shows the

evolution of the inflation rate and the COP yearly devaluation rate (right scale). As expected, the exchange rate devaluation is more volatile under free floating, showing a clear distinction between the two exchange rate regimes.

However, only after the adoption of a central model for policy analysis and forecasting in 2000, the Colombian central bank satisfied the whole set of criteria to join the inflation targeting club; (i) independence, (ii) explicit inflation targets, (iii) ability to understand the monetary policy transmission mechanism and to reasonably forecast the inflation rate and (iv) priority to the inflation target over any other target. See Gomez, Uribe and Vargas, [9].

Figure 5 displays the evolution of the observed inflation rate and the overnight interbank rate. As expected, prior to the exchange rate band collapse the interbank rate shows higher volatility. In spite of this, the interbank and inflation rates tend to move together in the long run. In the short run the inverse relationship is clear during and after the exchange rate band collapse.

Since it is widely known that the costs of reducing the inflation rate decrease, and can even be null, when the monetary authority is credible, credibility becomes the most important asset for an inflation targeting central bank. Figure 4 shows the evolution of the targets, the observed inflation rate and the result of the expectations survey. Expectations are higher than the observed inflation rate all the time except for the December 2002 to March 2004 period. However, the distance between the expected and observed inflation rate has reduced constantly, which may constitute evidence of central bank credibility gains[3].

[3]Although this expectations behavior seems to be inconsistent with the rational expec-

The full inflation targeting regime in Colombia characterizes for the output gap recovery following the strong slowdown of 1998/1999. Figure 6 displays the behavior of the output gap, the difference between the expected and target inflation rate, and the interbank overnight loan rate (right scale). After reaching a bottom of -4.0% in 2002 the output gap recovered steadily until 2006 when it was close to its natural target, zero. This economic slowdown created enough disinflation pressure to keep the inflation rate aligned with its target without the need of further nominal interest rate increases. Taking advantage of this situation, the Colombian central bank cleverly tuned in the interest rate level during the $2000 - 2003$ period in order to push growth without compromising the inflation target, so that only minor interest rate corrections were required after.

Our data set consists of quarterly measures of the nominal interbank overnight rate, the core CPI inflation rate, the inflation rate targets, the historical inflation expectations survey result and the output gap. The sample includes information from the start of the full inflation targeting regime in Colombia, the fourth quarter of 2000, to the second quarter of 2006.

3.2.2 Results

The following equation contains the estimation results for the baseline equation 10, using as instruments 6 lags of the interest-inflation differential, $i_t - \pi_t$, 4 lags of the expected-target differential, $\pi_{t+n|t} - \pi^*_{t+n}$, and 2 lags of the output gap.

$i_t - \pi_t =$	(1-0.61)$\{$	1.21	$(\pi_{t+n\|t} - \pi^*_{t+n}) +$	0.55	$z_t\}+$	0.61	$(i_{t-1} - \pi_{t-1}) + \eta_t$
Std. Error		0.30		0.18		0.10	
P-Value		0.00		0.01		0.0	

tations assumption, the period of time is too short for expectation errors to cancel out. This backward-looking behavior in expectations may be observed even if expectations are rational. See for instance Erceg and Levin [7].

Parameter estimates are highly significant and sensible both in signs and magnitudes according to the policy that prevailed during the sample span. The inflation stabilization parameter estimate $\widehat{\beta} = 1.21$ and the output gap stabilization parameter estimate $\widehat{\gamma} = 0.55$ reveal that *during this time*, the Colombian central bank pursued a gentle inflation stabilization program and a more aggressive one on the output gap. Moreover, the nominal interest rate smoothing parameter estimate, $\widehat{\rho} = 0.61$, reveals a high degree of Central Bank aversion towards policy surprises, consistent with the observed data. Finally, the over-identifying restrictions test J-statistic took the value, $J = 0.22$, which clearly does not reject the null. See Hall [10] and Mátiás [14].

These results are not surprising given that during the sample span the output gap had been recovering from a strong economic downturn, and only near the end of the sample it is getting close to its natural target, zero.

In comparison with Bernal's [2] results, our estimates imply that after 2000 the central bank shifted its attention from inflation to the gap and increased the level of policy smoothing. These results are consistent with time varying policy rules, an important fact for policy implementation.

4 Conclusions

During the transition from a moderately high inflation level, π_0, to an internationally accepted level of inflation, $\overline{\pi}$, the monetary authority tends to set decreasing, that is time varying, inflation targets. Under the assumptions that the monetary policy is unbiased, inflation expectations are rational and the real rate is stationary, the inflation rate, the nominal interest rate and the equilibrium nominal interest rate are also non stationary, and may be difference stationary.

Under the further assumption that only the stationary component of the

nominal interest rate is smoothed out, we obtain an alternative form of the monetary rule equation adapted to the transition period. This monetary rule resembles an ex-post real interest rate rule, a stationary equation.

Using a data set that covers the full inflation targeting regime in Colombia, a period characterized for the recovery from a strong economic downturn, the proposed monetary rule is estimated. Estimation results show that *during the sample span*, the Colombian Central Bank pursued a gentle inflation stabilization program, a more aggressive one on the output gap and a high degree of interest rate smoothing. These results are consistent with the prevailing policy at that time.

Combining these results with those of Bernal [2], our evidence suggests time varying monetary rule parameters, a relevant issue for policy implementation.

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Type	**Sample**	**Bibliography**	**Rule**	**Method**
Semi TR	1990Q1-2005Q3	Perez [16]	Simple	Stochastic Simulation
TR	1990Q1-2005Q1	Banco Rep. [5]	IFB	Stochastic Simulation
TR	1982Q2-2001Q4	López [13]	IFB Simple	Stochastic Simulation
Robust	1991M9-1999M8	Bernal [2]	IFB	Estimation
Semi TR	1990Q1-2000Q4	Gómez and Julio [8]	IFB	Stochastic Simulation
TR	1984Q1-1998Q4	Julio and Gómez [12]	Optimal McCallum	Analytical Optimization

Table 1: Monetary rules in Colombia: Summary

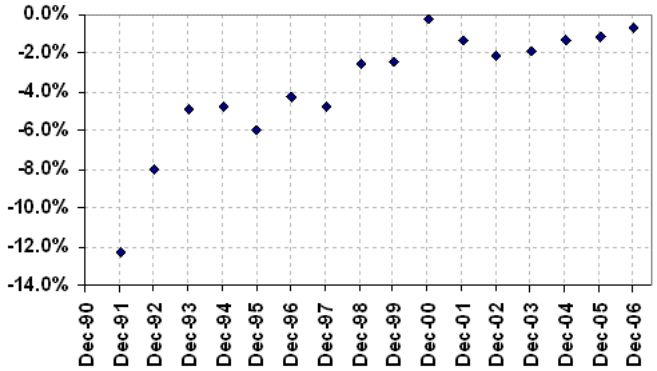

Figure 1: Change of the inflation rate implied by the target

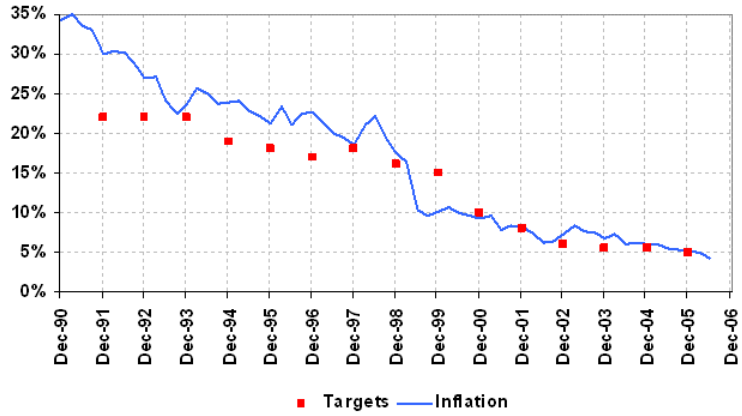

Figure 2: Observed inflation and target

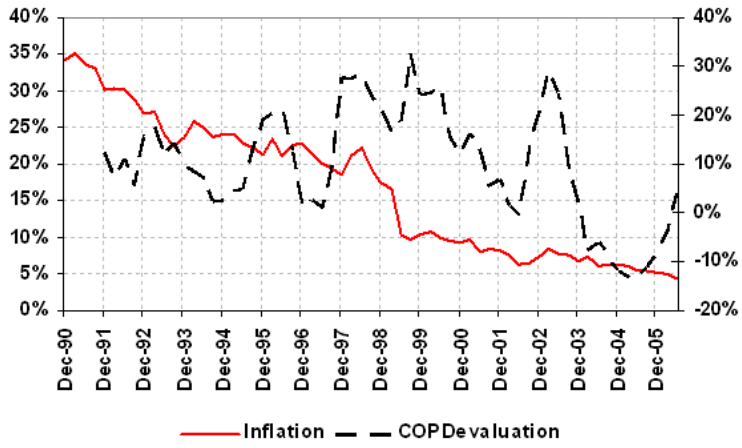

Figure 3: Observed inflation and yearly COP devaluation

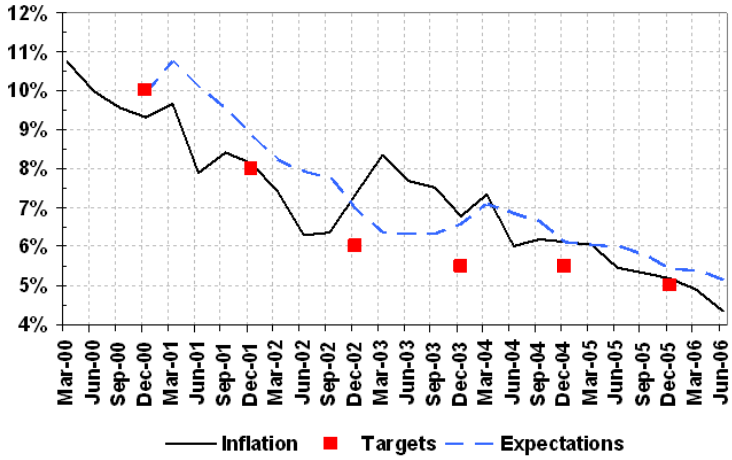

Figure 4: Observed inflation, targets and one year ahead expectations

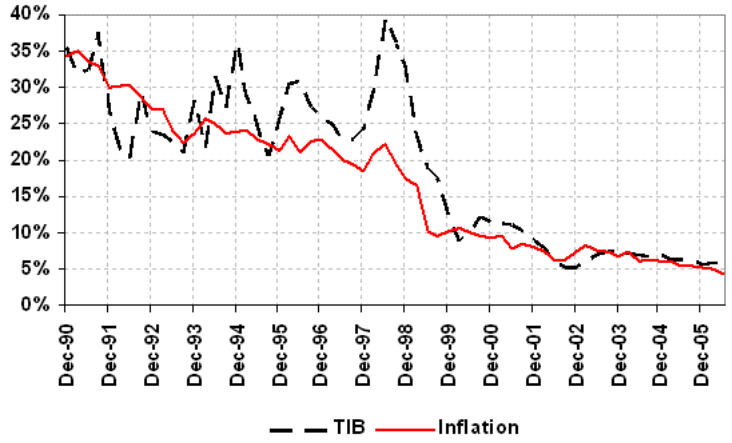

Figure 5: Observed inflation and overnight interbank lending rate

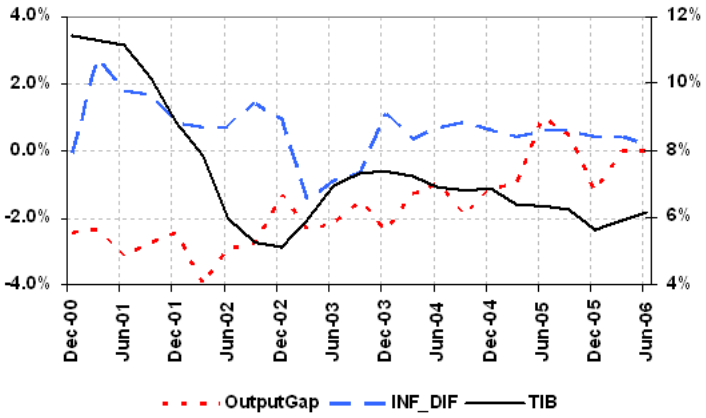

Figure 6: Output gap, expected-target inflation differential and interbank overnight loan rate