

INFLATION TARGETING IN BRAZIL: AN EMPIRICAL EVALUATION

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ABSTRACT

In this paper we implement some initial tests on the effectiveness of inflation targeting in Brazil. For this purpose, we use two approaches. Firstly, we estimate a Taylor style reaction function, and look for a change in relative weights of real activity and inflation terms. Secondly, we obtain two Vector Auto-Regression (VAR) models, a restricted and an unrestricted one. The two models are used to perform an out-of-sample forecasting exercise. The results, although still preliminary due to the short span of data, allow us to conclude that the initial impact of inflation targeting was positive. Our results indicate that inflation targeting was an important mechanism to keep the price stability obtained after the Real Plan, even in a sharp exchange rate devaluation context.

Key Words: Inflation Target; Monetary Policy; Vector Auto-Regression (VAR);

JEL Classification: E52.

1. Introduction

There has been a growing interest, both theoretical and empirical, in the effectiveness of inflation targeting, especially in the literature on monetary policy. Theoretically, literature separates into two major fronts. The first, based on the vast discussion about rules versus discretion, finds inspiration in the classical articles published by Kydland and Prescott (1977) and Barro and Gordon (1983a; 1983b), and attempts to show that inflation targeting can be “designed” to tackle the problem of time inconsistency. The second front is concerned with the implementation and monitoring of inflation targets, and consists basically of structural models. The studies carried out by Walsh (1995), Svensson (1997) and King (1997) are good examples of the first front, whereas Svensson (1996; 1998) and Haldane (1997) are good examples of the latter.

Empirically speaking, different studies have been conducted with the aim of testing the macroeconomic impact of inflation targeting in the last few years. Although several methods were employed, most studies used VAR models.

This article tries to add to the available literature by implementing some initial tests on the effectiveness of the inflation-targeting regime in Brazil. Therefore, the procedures used herein are similar to those previously presented in the literature. The major difference lies in the use of both restricted and unrestricted VAR models.

We are aware that very little time has elapsed since inflation targeting was adopted in Brazil. Even so we believe it is possible to make some preliminary considerations about the Brazilian experience.

Apart from this brief introduction, the present article includes another six sections. In section two, we use the model suggested by Svensson (1996) as an introduction to inflation targeting. In sections three and four, respectively, we make some considerations about the international and Brazilian experiences with inflation targets. Section five is a summary account of the main empirical studies carried out in other countries on the effectiveness of inflation targets. Section six shows the results obtained in Brazil, while the last section presents some conclusions.

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2. The theoretical model

In general, inflation targeting has some characteristic elements, namely: (1) a public announcement of numerical targets for the inflation rate in the future; (2) a clear commitment towards price stability as the overriding goal of monetary policy; (3) the use of inflation forecasting as an intermediate target; (4) a growing increase in the level of transparency of monetary policy; and consequently (5) a significantly enhanced commitment of the central bank towards the established targets.

There are two basic conditions for an effective inflation-targeting regime. Firstly, the central bank has to manage monetary policy in a relatively independent manner. In other words, the central bank has to be sufficiently independent to choose the instruments that best suit the goals of monetary policy. The independence stated here refers to the operation itself, not to goals.³ In a similar vein, monetary policy should not be severely restricted by fiscal matters. The existence of growing public deficits, which cause inflation expectations to rise, and/or the dependence on inflationary financing enjoins the central bank to use monetary policy only to achieve price stability.⁴ This is a crucial aspect of the regime, since the “unpleasant monetarist arithmetic” presented by Sargent and Wallace (1981) shows us that monetary policy cannot affect inflation rate on a permanent basis in the presence of fiscal dominance. Furthermore, a restrictive monetary policy today will result in increased inflation tomorrow, provided that there is a limit to the government’s indebtedness.

Lastly, the central bank should have enough technical and institutional ability to model, forecast, and analyze the behavior of inflation and also that of its determinants. Considering this, the central bank should accurately understand the functioning of the transmission mechanism of monetary policy, time lags, and kinds of shock to which economy is subject, and how these shocks affect inflation, output, etc. The use of inflation targets combined with increasing public transparency and control is a strong incentive for the central bank to improve its ability to understand and forecast economic behavior.

The focus on price stability may be justified in two ways: (1) currency is neutral in the long run, that is, any monetary expansion will only act upon higher prices in the long run; and (2) although monetary policy is neutral in the long run, it exerts important influences in the short run and, as a result, the central bank would be motivated to explore the trade-off so as to increase output and employment.

Therefore, defining price stability as a primary goal allows the central bank to concentrate only on what monetary policy does better, that is, maintaining price stability. This way, the central bank will not be pressured to use monetary policy as a means to expand output and employment at the expense of higher inflation in the long run (Debelle, 1997).

A simple way to understand inflation targeting is to use a model suggested by Svensson (1996). For instance, assume that the central bank is systematically trying to minimize the following loss function:

$$L = \frac{1}{2}[(\pi_t - \pi^b)^2 + \lambda y_t^2], \quad (2.1)$$

where,

π_t = inflation at time t
 π^b = inflation target

³ “Instrument independence would seem to be the form of independence that maximizes central bank accountability and minimizes opportunistic political interference, while still leaving ultimate goals of policy to be determined by democratic processes” Bernanke and Mishkin (1997)

⁴ The inefficiency in obtaining revenues by the traditional way, either by tax collection or loans from the private sector, increases the need for government’s inflation financing through *seignorage*. Furthermore, the inexistence of a well-developed financial market combined with imperfect access to the foreign capital market limits the government’s capacity to make loans that allow increasing revenues. Consequently, the government has to resort to *seignorage*. This is one of the major setbacks for the implementation of inflation targeting in underdeveloped countries (Masson et al , 1997).

λ = relative weight on output stability
 y_t = output gap

The intertemporal loss function is

$$E_t \sum_{r=t}^{\infty} \delta^{r-t} L(\pi_r, y_r) \quad (2.2)$$

The model can be yet describe by the following equations

$$\pi_{t+1} = \pi_t + \alpha_1 y_t + e_{t+1} \quad (2.3)$$

$$y_{t+1} = \beta_1 y_t - \beta_2 (i - \pi_t) + \eta_{t+1} \quad (2.4)$$

Initially, it is possible to highlight two important aspects of the loss function above. First, the loss function evens up the variables deviations of the respective targets. In other words, the loss associated with overshoots and undershoots of the target is exactly the same.⁵

The second aspect is concerned with the fact that, although price stability is defined as the overriding goal of monetary policy, the loss function allows the central bank to concentrate on output and employment stabilization. In practice, all central banks have placed considerable weight on output stabilization, at least at a level that is consistent with potential output (natural rate of unemployment).⁶ This is shown by factor λ . When $\lambda = 0$ no weight is assigned to output stability but, when λ values are above zero, the relative weight placed on output stability becomes important in the decision-making process. The higher the λ value is, the higher the weight on the real side of economy will be. In this context, mistargeting will be corrected at a slower pace, allowing economy to adjust itself more gradually (Svensson, 1996). It is worth mentioning that λ values above zero in the loss function do not necessarily lead to an inflation bias. This is true provided that the implicit target for the output is consistent with the natural rate of unemployment (or NAIRU).⁷

By simply assuming that the central bank retains perfect control over inflation rate, and over output gap, we notice the values that minimize the loss function are given by:

$$(\pi_t, y_t) = (\pi^b, 0).$$

Therefore, if the inflation rate and output gap are perfectly controlled, it is incumbent upon the central bank to simply set out the interest rate in such a way that inflation can equal the target and the output can reach its potential level.

However, in practice, the control exerted by the central bank over variables is flawed. At the moment of deciding on instrument changes with the aim of meeting the target, current inflation is predetermined. Therefore, the bank would not be able to match current inflation with the specified target. Flawed control originates from the lag between the time at which the instrument is changed and the instant of its total impact upon inflation. Moreover, the uncertainty about the length of time lags, the current status of economy and the way it may evolve (unforeseen shocks) also explain why the central bank cannot control inflation efficiently.

Svensson (1996, 1998) shows that in the presence of imperfect control, the best thing the central bank can do is to use inflation forecasting as intermediate target. Actually, forecasted inflation is an

⁵ This aspect of the loss function has an important practical implication, since central banks get concerned when inflation rate threatens to reach values above or below the target. Unanticipated inflation or deflation generate costs to the economy, and the loss function captures this.

⁶ The term “overriding” is more related to a long-term idea, when all the effect of monetary policy is put on prices. However, monetary policy recognizably influences the dynamics of output and employment. See Bernanke and Mishkin (1997).

⁷ The natural rate of unemployment is equivalent to the NAIRU when the Phillips curve is linear. In the non-linear, convex case, the two rates are different. For further information on NAIRU estimates for Brazil, see Tejada and Portugal (2001), Portugal and Madalozzo (2000).

optimal intermediate target. There is no other variable with so much information on inflation during target achievement than inflation forecasting itself.⁸

As a matter of fact, inflation forecasts will guide all monetary policy decisions. Therefore, when inflation forecasts indicate that the target cannot be met, the central bank changes the instrument so as to ensure that it will be. The importance of inflation forecasting demands that the central bank develop more sophisticated and efficient models. On top of that, it should use a wide range of extra-model indicators to provide further information on the future behavior of inflation.⁹

The importance of inflation forecasts is more evident when we obtain the first-order condition that minimizes the loss function above

$$\pi_{t+2/t} - \pi^b = c(\lambda)(\pi_{t+1/t} - \pi^b). \quad (2.5)$$

where coefficient $c(\lambda) \geq 0$ increases with λ , with $c(0) = 0$ and $\lim_{\lambda \rightarrow \infty} c(\lambda) = 1$.

The first-order condition (2.5) shows that the central bank is “doing the right thing” when it sets the instrument in such a way that the expected inflation deviation two periods ahead is a fraction of the same deviation with a lag period.

Observe that coefficient $c(\lambda)$ determines the speed at which the adjustment is made. The closer to the unit $c(\lambda)$ is, the greater weight will be given to output stabilization and, therefore, the more gradual the adjustment will be.

The first-order condition (2.5) can also be written as

$$\pi_{t+2/t} - \pi^b = -\theta y_{t+1/t} \quad (2.6)$$

$$\text{where } \theta = \frac{\alpha c(\lambda)}{1 - c(\lambda)} \geq 0$$

Therefore, the previous affirmation that central banks are concerned with output stabilization at the moment they have to decide on monetary policy is corroborated. The moment the expected output is below the potential (unemployment rate higher than the natural rate), the central bank could respond by facilitating monetary conditions. Otherwise, when output forecast is above the potential, the central bank would restrict monetary conditions, thus eliminating inflation movements that would cause inflation to miss the target. All actions taken by the central bank are forward-looking, that is, the bank immediately answers to inflationary pressures that might jeopardize inflation targeting in the future. This feature of monetary policy is the major difference among inflation targets and other monetary regimes. In inflation targeting, monetary policy is concerned with inflation expectations instead of the current inflation (Masson et al, 1997; Svensson, 1996 and 1998b; Haldane, 1997).

When no weight is placed on output stabilization ($\lambda = c(\lambda) = 0$), the bank uses monetary policy as a way to equalize forecasted inflation and inflation target, that is:

$$\pi_{t+2/t} = \pi^b$$

This is the case of “strict” inflation targets when the central bank is exclusively concerned with maintaining inflation as close as possible to the target, disregarding output fluctuations. The strict regime is equivalent to what King (1997) defined as inflation nutter. He shows that, in this case, all shocks that affect economy are absorbed by output fluctuations, thus entailing increased output volatility. Haldane (1997), Svensson (1998b) and Mishkin (1999) argue that, in practice, most central banks, which use inflation targets, are close to the flexible case, that is, they act as stabilizers on the real side in the event of adverse shocks.¹⁰

⁸ An intermediate target is ideal when: it is highly related to the objective; it is easier to be controlled than the objective; simpler to be observed by the central bank and by the public; and transparent as it facilitates the comprehension by the public (Svensson, 1996).

⁹ For detailed information on the importance of inflation forecasts, see Haldane (1997) and Mason et al (1997), in addition to Svensson (1996) and (1998b). Haldane (1997) suggests the use of alternative models to forecast inflation; the larger and better the “model portfolio” is, the more the bank will reduce the uncertainty caused by the imprecision of forecast models.

¹⁰ See Svensson (1997b) for further information on the debate over the use of strict or flexible inflation targets.

3. International experience with inflation targets

Throughout the last few years, several countries have adopted inflation targets as their monetary policy regime. New Zealand was the first to introduce inflation targeting in March 1990, followed by Canada in February 1991, and by the United Kingdom in October 1992. The United Kingdom, just like Sweden, started to use inflation targets after suffering speculative attacks against its currency, which culminated in the abandonment of the exchange rate bands and their breakup with the Exchange Rate Mechanism. Finland and Australia introduced inflation targets at the beginning of 1993. Other countries such as Spain, Israel, Chile and, especially, Brazil, also adopted inflation targets.

Although the structure of the inflation-targeting regime is quite similar in several countries, there are some peculiarities. There is, for instance, a certain agreement when deciding which inflation rate incorporates the concept of price stability, something around 2%-3% a year. However, there is considerable discrepancy among these countries as to the use of bands or point targets.

New Zealand, Canada, and Australia opted for the targets bands, arguing that it offered greater flexibility to monetary policy in the event of supply shocks. Countries such as the United Kingdom, Sweden, Finland, and Spain use point targets. Their justification is that point targets confer enhanced clarity and symmetry to monetary policy. These targets work as a more clean-cut anchor for inflation expectations than bands. In the United Kingdom, experience showed that private inflation expectations were located at the top of the band throughout the target band regime (1-4%), despite the government's intention of reaching the mean point (2.5%).¹¹

Regarding the time necessary for meeting the target, which incorporates the concept of price stability, a period of about 2 to 3 years is expected, since the effects of a faster disinflation on the real side of economy cannot be neglected. The concern with output and employment stabilization has compelled most countries to use a gradual approach, establishing decreasing targets during 2 to 3 years, in the hope of attaining price stability in the meantime. This was the case of New Zealand and Canada in the early 90's.

Most countries share a certain agreement when establishing the indicative series for the target. They have opted for core inflation instead of headline consumer price index.¹² The calculation of core inflation usually does not include items regarded as more volatile such as the prices of foods and electric power, the first-round impacts of taxes, payment of real estate interest rates, etc. These items are usually excluded because they do not reflect the "real" inflation trend. They only contemplate the temporary effects on the price level, thus showing no need for a change in the monetary policy. New Zealand, Canada, Finland, and Australia are examples of economies that employ core inflation. The United Kingdom uses an index that excludes the payment of real estate loan interests.

The crucial role that the transparency of monetary policy decisions plays in inflation targeting has been a common ground among several countries. Even though there are discrepancies concerning the optimal transparency level, there does not seem to be any doubt that transparency is essential. Especially because it allows the public to monitor the actions of the central bank, holding it increasingly more accountable for meeting the inflation targets. Systematic deviations suggest loss of credibility and reputation. In the case of New Zealand, for instance, the president of the central bank and all of his/her staff could be fired. New Zealand is the only case in which there is a formal punishment mechanism. Other countries such as Canada and the United Kingdom decided not to use this mechanism.

¹¹ A crucial matter when establishing bands is their width. A very large band may offer monetary policy greater flexibility, but it may also indicate a certain indifference or fragile commitment of the central bank towards price stability. On the other hand, a very narrow band shows a stronger commitment; however, in this case, deviations are more likely. Consequently, if this occurs too often, the credibility of monetary policy may be affected. The selection of the bandwidth varies according to the framework perceptions of each economy, especially in terms of shock variance. In other words, it shows a trade-off between flexibility and credibility of monetary policy.

¹² Although most countries use core inflation nowadays, some of them (New Zealand and Canada, for instance) formerly used the headline index.

Various instruments have been implemented in the quest for transparency, and inflation reports issued by central banks have surely become one of the most widely used. In general, each inflation report includes an assessment of the previous economic performance, and features the central bank's actions aimed at meeting the inflation targets. This kind of report also compares current inflation with previous forecasts made by the central bank, presents the main factors that jeopardize price stability, and provides inflation forecasts for the upcoming years.

Some central banks publish the minutes of the committees on monetary policy. These minutes provide important information, allowing the public to check the quality of arguments and assessments made by the bank team about the internal and external economic scenario. In other words, this is a way to check whether the central bank is "doing the right thing".

Apart from output and employment stabilization, monetary policy should consider other important factors. Dealing with exchange rate oscillations is one of them. Most economies, which use inflation targets, may be considered small and open and, in this context, the exchange rate system plays a vital role in the transmission mechanism of monetary policy.

Today, exchange rate oscillations may be approached in two ways. The first attempts to absorb the impact of exchange rate variation on inflation through the Monetary Condition Index (MCI). The MCI is a linear combination of real short-term interest rate with real exchange rate. The MCI is used as a short-term operational target for monetary policy. The reasons for using such index are related to its supposedly ideal path, which would be consistent with the minimization of the loss function. Therefore, exchange rate (or monetary condition) variations dragging the MCI off its path would be counterbalanced by the central bank through instrument changes. In other words, using monetary policy instruments to keep the MCI within its optimal path would allow us to meet the inflation targets. This approach has been used in New Zealand and Canada, but the focus on its usefulness, when deciding on instrument changes, has decreased with time.¹³

The second approach consists in identifying the nature of exchange rate shocks. In this case, those shocks that cause a temporary effect on price level would be quickly counterbalanced through instrument changes, while permanent changes in exchange rate would be accepted by the central bank without any reaction. This is the approach used in the United Kingdom.¹⁴

Although exchange rate is an important variable, this does not mean that the government should establish exchange rate targets, as in a fixed exchange rate system; and if the government did so, there would be an inconsistency. In a fixed exchange rate system, monetary policy is endogenous and, in such case, it is rather impossible to establish an inflation target different from the country's inflation the currency is bound up with (DeBelle, 1997; Mishkin, 1999). Svensson (1996) argues that it is theoretically possible to establish intermediate (transient) targets for the exchange rate along with inflation targets, provided that the latter has priority in case of a conflict. Spain is a typical example of a country that on the one hand utilizes inflation targets, and on the other, for being a member of the Exchange Rate Mechanism (ERM), also applies exchange rate targets. Masson et al (1997) question the practical implementation of this type of policy, since the central bank would have some difficulty showing *ex ante* which of the two objectives should be prioritized in the event of a conflict. Therefore, using exchange rate targets in conjunction with inflation targets would make the bank's commitment towards price stability look less credible to agents.

Given the importance of exchange rates, the central bank can and, at the same time, should try to make their path easier, thus avoiding abrupt fluctuations. The interventions by the central bank in the exchange rate market should be as transparent as possible, making evident that their intention is to reduce exchange rate fluctuations, allowing exchange rates to naturally follow market tendencies. This is a very important issue, considering that strong and frequent interventions may

¹³ Svensson (1998a) is very critical of the efficiency of MCI as an intermediate target. He argues that monetary policy affects inflation in a variety of ways, through different lags, which are not captured by MCI. Moreover, this index is only relevant as an impact measure of monetary policy on the aggregated demand, not on inflation. Thus, he concludes that there is no practical advantage in using MCI.

¹⁴ For further information on how the Bank of England handles exchange rate movements, see Haldane (2000b).

point out that the central bank is establishing a specific exchange rate target and that, in fact, the exchange rate might be the “true” nominal anchor for monetary policy (Mishkin and Savastano, 2000).

4. The implementation of inflation targeting in Brazil

For many years, Brazilian economy has coped with high inflation rates and different attempts have been made to stabilize inflation. Between 1986 and 1994, five economic plans were implemented: the Cruzado Plan, the Bresser Plan, the Summer Plan, the Collor Plan, and the Real Plan.¹⁵ Beyond any doubt, the Real Plan has turned out to be the most successful stabilization plan ever implemented in Brazil. However, in spite of successfully fighting off inflation, the stabilization process involved a gradualist approach, and several important economic problems, such as a permanent fiscal adjustment, remained unresolved.

The absence of a fiscal adjustment, which would possibly minimize the deterioration of public deficit and insolvency in the long run, combined with frequent crises in the international financial market, made the fixed exchange rate system untenable.

After Brazil abandoned the fixed exchange rate system, another nominal anchor for monetary policy had to be found. At that time, there were three possibilities. The first would be a monetary anchor. However, this option proved unfeasible due to the unpredictability of Brazilian economy. Moreover, since the relationship between inflation and monetary aggregates is not stable, this could originate more uncertainty rather than reinforcing stability. The second option would be a totally discretionary policy, without any explicit anchor. However, considering the moment of instability, a more transparent and more “rigid” policy was required, that is, a policy for which monetary authorities were more accountable (Fraga, 2000). By and large, these needs were met through inflation targeting, since this type of regime is characterized by transparency and the accountability of monetary authorities for meeting the target.

Brazil officially adopted the new monetary policy regime on July 1st, 1999. Decree 3088, issued on June 21st, 1999, established that “the central bank was held accountable for implementing the necessary policies in order to meet the established targets”. The freedom to choose the instruments and make monetary policy decisions is a prerequisite for the effectiveness of inflation targeting.

Initially, the targets established by the central bank were 8% for 1999, 6% for 2000, and 4% for 2001. The initial proposition is that all targets be publicized one and a half years beforehand. Therefore, the inflation report of June 2000 set a target of 3.5% for 2002, and the report of June 2001 established a target of 3.25% for 2003. All targets are measured by the accumulated variation at the end of each year.

In addition, a 2% overshoot and undershoot was defined for each of the targets. This target bands allow the central bank some flexibility in case of economic shocks, as there are no escape clauses.¹⁶ Figure 4.1 shows the inflation rates measured by the accumulated variation of Amplified Consumer Price Index (IPCA) during 12 months, as well as inflation targets for 1999, 2000 and 2001.

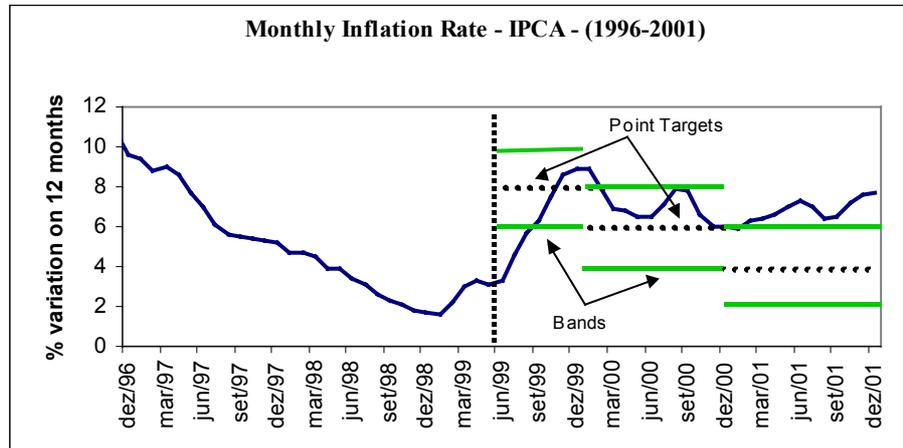
As shown in Figure 4.1, although the point target for 1999 was not met, the inflation rate remained within the 2% exchange band. The inflation rate accumulated during the last 12 months was 8.94%, while the target had been set at 8%. In 2000, the inflation rate (5.97%) was somewhat below the point target (6%) established for that year. For 2001, inflation has exceeded the upper limit of the target band, reaching 7.7%. The electric power crisis in Brazil, and the Argentinean economic and financial crisis have caused inflation expectations to rise. Furthermore, some companies have transferred to consumer goods the increase in the price of raw materials that have occurred as a result of the strong currency devaluation that has assailed the country since the beginning of 2001. The wholesale price index (IPA-DI) was more affected by the exchange rate

¹⁵ For a summary of different stabilization plans, see Portugal (1996).

¹⁶ A 2% band may be considered too large, indicating perhaps lesser commitment of the bank towards the target, but the inexistence of escape clauses, combined with a headline index, justifies the adoption of a 2% band (Bogdanski, 2000).

devaluation, since it includes a larger number of tradable goods, and had an increase of 11.9% in 2001. The very small pass-through from exchange rate depreciation to inflation experienced by the Brazilian economy is quite remarkable. In 1999, the Brazilian currency depreciated 48% and the inflation rate reached 8.9%, whereas in 2001, the exchange rate devaluation was 18.7% and the inflation rate was limited to 7.7%. This makes a very sharp contrast with other Latin American economies where the pass-through is almost 100%.

Figure 4.1
Brazil: Inflation Rates and Targets



Source: IBGE/Brazilian Central Bank.

Brazil has adopted a strategy similar to that used in the United Kingdom, by publishing an inflation report every three months with all the information on economic performance during the inflation-targeting regime, in addition to giving a picture of inflation targets for the near future. The aim is to clearly inform the public, the market and, especially, politicians, about “the goals and limitations of monetary policy (what the central bank can do in the long run is to control inflation; what it cannot do is to raise economic growth through monetary expansion); the numerical values of inflation targets and the grounds on which they were selected; and how the targets are to be achieved, given current economic stance and expected future developments”.¹⁷

Each report provides inflation forecasts for upcoming years. In Brazil, the central bank uses the same approach employed in the United Kingdom; forecasts are made by means of confidence intervals in relation to the central projection. In a certain way, these forecasts recognize that Brazilian economy is subject to shocks, which, in their turn, may cause inflation to deviate from the expected target. In addition, confidence intervals are not necessarily symmetrical in relation to the target.

Inflation reports also show the results of two surveys into inflation expectations carried out by the central bank in the financial and non-financial sectors. The first survey consisted of daily inflation expectation research in 70 financial organizations and consulting businesses on a wide series of macroeconomic variables, including inflation. The second one is called Market Perception Research, and is conducted quarterly in 100 financial and non-financial organizations. An interesting and, at the same time expected result, is that such surveys have pointed out a private expectation consensus in terms of the established inflation target. International experience has shown that targets, whenever credible, act as an anchor for private inflation expectations in the medium run (Debelle, 1997).

Instead of escape clauses, Brazil uses a mechanism called “Open Letter”. If an unforeseen economic shock that leads inflation off target happens, the president of the central bank should write an open letter to the Minister of Finance, explaining the reasons for such mistargeting, in addition to informing the measures to be taken so as to bring inflation back to the target, and

¹⁷ Bogdanski (2000), p.17.

appointing the time required for the measures to take effect. The same mechanism is also used in the United Kingdom.

There is no formal punishment mechanism if the target is not met. The idea is similar to that applied in the United Kingdom and Canada, that is, punishment means loss of credibility of the Central Bank before the public at large.

Monetary policy decisions are taken by the Monetary Policy Council (COPOM), which holds a monthly meeting to assess the “ins and outs” of Brazilian economy, checking whether there are risks that might hinder the achievement of the inflation target. Based upon the results obtained, the council decides to change or not the basic interest rates (SELIC). The minutes of these meetings are also published by the central bank.

Inflation targeting has achieved its primary objective so far: keeping inflation under control. The targets for 1999 and 2000 were easily met, although the rate of inflation in 1999 was a bit higher than the inflation-control target range; still, it remained within the 2% band. For 2001 the open letter will have to be written.

5. Assessment of international experience

Huh (1996) is considered one of the groundbreaking works regarding the assessment of inflation targeting. By estimating a Bayesian Vector Auto-Regressive (BVAR) model, Huh (1996) attempted to check whether there was a perceptible (structural) change in the relationship between short and long-term interest rates, and inflation, soon after the adoption of inflation targets by the United Kingdom.

Two important results show that the adoption of inflation targets caused a significant change in the way monetary policy started to interact in the post-target period. The first reveals that the model consistently overpredicts the short-term interest rate, indicating that the monetary conditions in the new regime are “easier” than those forecasted (previous experience/information). The second result shows forecasted inflation values, which, despite a brief forecast deterioration, converge towards effective values.

As a whole, these results may be interpreted as follows: the model, based on previous experience, indicates that interest rates should have been higher than those actually observed, to be consistent with the current inflation behavior. According to the author, this result reflects exactly the credibility effect of the inflation-targeting regime. The author concludes that inflation targets in the United Kingdom had a significant impact on the macroeconomic variables considered.¹⁸

Mishkin and Posen (1997) estimated an unrestricted Auto Regressive Vector (VAR) for Canada, New Zealand, and the United Kingdom, testing the hypothesis that inflation targeting had a significant impact on the dynamics of these three economies.

The estimated model was used to predict the future values for the three variables and these values were compared with those actually observed. The rationale behind it all is that significant differences between the forecasted and actual values may signal a change in regime. The results obtained for the three countries show that the actual values for inflation and interest rate were below the values predicted by the model throughout the period. Meanwhile, the forecasted values for GDP growth were quite close to the actual values. These results are similar to those obtained by Huh (1996), that is, inflation targets efficiently reduced and/or kept inflation rate low, without the need for a more restrictive monetary policy, with higher interest rates. In addition, the implementation of the regime did not have a significant impact on the Gross Domestic Product of these countries, at least, not as predicted by the model.

Lane and Van Den Heuvel (1998) estimated an unrestricted Vector Auto-Regressive (VAR) with real GDP growth rate, unemployment, inflation, nominal effective exchange rate, and short-term and long-term interest rates for the United Kingdom, France, and Italy. These authors used the same approach employed by Mishkin and Posen (1997). However, in addition to including other

¹⁸ The same exercise was applied in the United States and France, countries that experienced low inflation rates, but did not adopt inflation targets. The results are different from those obtained in the United Kingdom, that is, given the current inflation level, the “tightness” of monetary policy is close to that expected by the model.

variables such as unemployment and exchange rate, they divided the forecast period into two parts. The first part is the period during which the United Kingdom was a member of the European Rate Mechanism (ERM), and the second part comprises the inflation target period. The results obtained by Lane and Van Den Heuvel (1998) show that inflation was not more significantly different than that predicted by the model, while both short-term and long-term interest rates were below the expected value. Once again, the conclusion is that the new regime conferred credibility to monetary policy, allowing improved monetary conditions, as the low (below expectation) interest rates show.¹⁹

Kuttner and Posen (1999), using data for the United Kingdom, New Zealand, and Canada, implemented two types of analyses. First they estimate a Taylor-type reaction function, checking whether there was a change in the way the central bank responds to movements in inflation and unemployment rates before and after the implementation of the inflation-targeting regime. In the second type of analysis, they obtained impulse response functions from a VAR in order to identify how short-term and long-term interest rates respond to unexpected inflation shocks.²⁰ On the whole, these authors conclude that inflation targets improve the response of the central bank to supply shocks, and provide public credibility to the commitment of the central bank towards the long-term inflation target. This way, there is no need for a rigid monetary policy as the inflation targets enhance transparency through regular communication with the public about objectives and forecasts.

Bernanke et al (1999) studied nine countries, four of which used inflation targets: the United Kingdom, Canada, New Zealand, and Sweden. The remaining five countries, namely the United States, Germany, Italy, Switzerland, and Australia, did not use the inflation-targeting regime during the study period. The authors applied three kinds of tests to assess the effectiveness of inflation targeting. The first test consisted of estimates for the sacrifice rate and Phillips curve with the aim of checking whether disinflation is achieved at lower costs in terms of output and unemployment in the countries that adopted inflation targets. The second test analyzed the private sector expectations with the aim of checking whether inflation targets offered greater credibility to the central bank.²¹ Finally, they used the same method (VAR) employed by Mishkin and Posen (1997) to determine whether the interactions among inflation, monetary policy, and real GDP shift after the adoption of the new regime. The key difference between these two studies is that Bernanke et al (1999) use a “control group” strategy, that is, they compare the results obtained for the countries that utilize inflation targets with a similar country that has not adopted the regime.

The results of the first test suggest that the adoption of inflation targets did not significantly change the real economic costs of a disinflation process, at least for the countries in question. In the second group of tests, private expectations did not change immediately after the announcement of the new monetary policy. However, as inflation targeting is implemented, the evidence found by the authors suggests that numerical targets work as effective anchors for inflation expectations in the medium run.²² The last type of test showed that both inflation and interest rates were below the expectations of the reproduced model during the forecast period. With regard to GDP growth rate, in spite of a brief period during which effective values were below expectations, the situation tends to reverse with time.

¹⁹ The last results are in agreement with those obtained by Mishkin and Posen (1997), although they found a different result for the inflation rate.

²⁰ Again, the hypothesis is that different inflation rate results between periods, in the short and long run, indicate the nature of policymakers' change in behavior. An enhanced response of short-term interest rates to an inflation shock in a post-target period could be associated with increased conservatism of the central bank, while, in the case of “credibility construction”, we would expect long-term interest rates to be attenuated.

²¹ Credibility gain would be observed through reduced private uncertainty about the future behavior of monetary policy, and smaller risk premiums on government's deficit. To analyze the behavior of risk premiums on government's deficit, they compared interest rate differentials from New Zealand, Canada, and Australia to those obtained in the United States, and interest rate differentials in the United Kingdom, Sweden, and Italy to those obtained in Germany.

²² This result is in agreement with the idea that the inflation-targeting regime has been used as a means of “credibility construction”, as shown by Kuttner and Posen (1999).

Garcia (2000), using four different types of econometric models (ARMA, ARCH, GARCH and VAR), tested the effectiveness of the Chilean inflation-targeting regime. Just like most previously mentioned authors, he estimated these values for a period prior to the adoption of inflation targets (January 1980 to December 1990 for univariate models, and January 1986 to December 1990 in the case of VAR), and used the estimated models to make predictions for the post-target period. The results showed that the adoption of inflation targeting in Chile was efficient in reducing inflation. These results are in agreement with all the other tests carried out in other countries that adopted the same regime.

Honda (2000), using data for New Zealand, Canada, and the United Kingdom, estimated an unrestricted VAR for inflation, rate, GDP growth rate, short-term nominal interest rate, and change in nominal exchange rate. This author was concerned with the implementation of more elaborate statistical tests in an attempt to check whether the adoption of inflation targets originated a structural change in the economy. Therefore, the author carried out two kinds of test: a traditional Chow test for each of the equations separately, and another test for the set of VAR equations.

The results of both types of test indicated that inflation targets did not imply a change in regime in the four countries in question. There are two possible conclusions. The first conclusion is that inflation targets did not actually have a significant impact on these countries, at least in terms of the dynamics of the considered variables. The second explanation, which seems more likely, is that the number of estimated parameters for the VAR may be too large, when compared to the small number of observations made after the inflation-targeting regime. Within this context, the implemented tests would have little power to reject the null hypothesis that no change in framework occurred. Therefore, the author concludes that the effectiveness of inflation targets is at least questionable, considering the tests he implemented.

Some aspects regarding the analyses implemented so far with the aim of assessing the effectiveness of the inflation-targeting regime can be summarized now. First of all, most previous studies lack more elaborate statistical analyses. Moreover, there is no common agreement in the literature as to which type of test is more suitable for evaluating structural change, at least in terms of a vector auto-regressive. Last but not least, even if tests for structural change are implemented, there are important qualitative effects that will not be captured, especially the impact that the targets may have on private inflation expectations.

6. Empirical evidence for Brazil

An issue that has been currently highlighted in the available literature on inflation targeting is that the targets, when credible, act as an effective anchor for private sector inflation expectations in the medium and long run. This means that expectations tend to stabilize around the numerical inflation target, even when economy suffers remarkable shocks. In other words, inflation targets would reduce the persistence of shocks on inflation rate.

A simple way to check whether inflation targets reduce the persistence of inflation is to compare the values for sample autocorrelations in the period after the implementation of inflation targets with that before their implementation. These values are shown in Table 6.1.

Table 6.1
Sample Autocorrelations for the Inflation Rate

Period	1	2	3	4	5	6
Pre-inflation target ¹	0.582	0.368	0.445	0.456	0.390	0.425
Post-inflation target ²	0.183	-0.387	-0.048	-0.188	-0.206	-0.001

Notes: (1) Period corresponding to the Real Plan (July 1994 to June 1999);

(2) July 1999 to July 2001.

Noticeably, the implementation of the inflation-targeting regime has altered the behavior of inflation rate in Brazil. Persistence was significantly reduced, going from 0.582 in the previous period to 0.183 after the regime was implemented. The change is even more perceptible in higher

autocorrelations. The values are not only lower, but also present a negative sign, that is, persistence was reduced, and the shocks in one period are perceived as being temporary.²³

Even though the sample autocorrelations show that a change in the dynamics of inflation has occurred, this is just a preliminary test. The next step is to estimate a Taylor-type reaction function, and check whether there was a change in the way the central bank responds to inflation expectations in relation to real activity. In other words, we want to know whether the implementation of the new regime meant an increase in the conservatism of the Brazilian central bank, with greater weight on inflation vis-à-vis employment stabilization, or whether the recent Brazilian experience with inflation targets may be actually characterized as a case of “credibility construction”, according to Kuttner and Posen (1999) nomenclature. In this case, we do not expect any significant change in the importance given by the central bank to inflation versus the real side of economy.

The short-term interest rate (r^*) is assumed to be the monetary policy instrument. This rate depends on the unemployment gap, and also on inflation. Thus, the reaction function may be described as

$$r_t^* = \alpha + \beta(E_t\pi_{t+j}^e - \pi^*) + \lambda(u_t - u^*) \quad (6.1)$$

where, π^* is the inflation target, $E_t\pi_{t+j}^e$ is the expected inflation for a given $j>0$ period, u is the unemployment rate, and u^* is assumed to be its respective target. As in Clarida et al. (1997) and Kuttner and Posen (1999), it is possible to incorporate a specification in (6.1) that allows a partial adjustment of interest rates.

$$r_t = (1 - \rho)r_t^* + \rho r_{t-1} + e_t \quad (6.2)$$

By combining these two equations, we can obtain a reaction function that may be estimated.

$$r_t = b_0 + b_1\pi_t^e + b_2u_t + \rho r_{t-1} + e_t \quad (6.3)$$

In this specification, inflation and unemployment targets are incorporated into the constant term and $b_1 = (1 - \rho)\beta$ and $b_2 = (1 - \rho)\lambda$. Since there is no expected inflation series, we therefore have to use a proxy variable.²⁴ As in Portugal and Madalozzo (2000), we are going to assume rational expectations, that is, the economic agents form their future inflation expectations by incorporating all the relevant information.²⁵

An important issue in the estimation of the reaction function is that the unemployment rate might be determined endogenously, in conjunction with the interest rate. In other words, the unemployment rate would influence and be influenced by the interest rate (the covariance between them would be different from zero). This would imply that the Ordinary Least Squares estimates are biased and inconsistent. In this case, the use of instrumental variables is recommended. We tested the null hypothesis of forecast error through Hausman test; however, this hypothesis was rejected at any significance level.²⁶

We established two distinct periods to estimate the reaction function. The first period corresponds to the beginning of the Real Plan up to the period prior to the implementation of the inflation-targeting regime (July 1994 to June 1999). The second one corresponds to the period during which inflation targets were already in effect (July 1999 to July 2001).

²³ A possible explanation is that the initial period of inflation targets was characterized by disinflation; during this period, the central bank was interested in matching the inflation rate measured by the IPCA during the last 12 months with an established numerical target. The major concern was to safeguard credibility to the new regime.

²⁴ The inflation expectation series published by the Central Bank was not used because it is not available for the analyzed period.

²⁵ The hypothesis of rational expectations assumes that agents try to find the best model to generate inflation forecasts. The model obtained was: $\pi_t = c_0 + c_1\pi_{t-1} + e_t$, where $c_0=0.7168$ and $c_1=0.4924$. Several other models were tested, but this was the one that presented the best specification.

²⁶The downside of this test is that it is asymptotic, that is, valid for large samples, which is not our case. Therefore, even after rejecting the hypothesis of measurement error, we attempted to improve estimates, using instrumental variables. The results were not significantly different. For detailed information on Hausman test, see Greene (1997, p. 443-444).

The strategy is identical to that used by Kuttner and Posen (1999) to assess the experience in New Zealand, the United Kingdom, and Canada. A higher value for the inflation coefficient (b_1) in relation to the unemployment coefficient (b_2) after the inflation-targeting regime compared to the period before its implementation means that the adoption of the new regime originated an increase in the conservatism of the central bank. Otherwise, had no change occurred, we would be face to face with a case of “credibility construction”.

The key difference between the analysis made by Kuttner and Posen (1999) and the one used in the present study lies in obtaining the series of expected inflation. While those authors obtained this series via a six-month moving average (adaptive expectations), we preferred to use the hypothesis of rational expectations, and obtained the referred series through a more suitable forecast model.²⁷

The main results of the estimation are shown in Table 6.2.²⁸

Table 6.2
Estimate results for the Reaction Function

Period Coefficient	Pre-target (July 94-June 99)	Post-target (July 99-July 01)	Whole period (July 94 – July 01)
Expected inflation (b_1)	0.188349* (0.071557)	0.111876* (0.049145)	0.163207* (0.053447)
Unemployment (b_2)	-0.135689* (0.036855)	0.096375* (0.026886)	-0.084202* (0.028642)
ρ	0.915423* (0.04166)	0.390843** (0.227353)	0.937977* (0.031140)

Notes: (1) * a 5% significance level
 (2) ** a 10% significance level
 (3) All estimates are corrected for heteroscedasticity. For the period prior to inflation targeting, we included dummy variables that correspond to several shocks inflicted on the world economy during this period: Mexican crisis (Dec. 94), Asian crisis (Oct. 97), Russian moratorium (Aug. 98), and change in exchange rate system (Jan.99). We also used other dummy variables for the period during inflation targeting.
 (4) The values between parentheses are the respective standard deviations.

We may draw two conclusions from Table 6.2. First, the Brazilian experience with inflation targets seems to be characterized as a case of “credibility construction” instead of an increase in the conservatism of the central bank. The ratio between the expected inflation and unemployment coefficients (b_1/b_2) decreases during the estimation period. The ratio was approximately *1.38* prior to the implementation of the inflation targets, decreasing to *1.16*, in the following period. This means that the adoption of a new regime did not confer a greater weight on inflation stabilization to the detriment of the real side of economy. This is certainly a positive aspect of the new regime.

Another particularly interesting result is that the long run response of the interest rate (β) to a 1% increase in the expected inflation gap ($E_t \pi_{t+j}^e - \pi^*$) is reduced after the inflation-targeting regime. Whereas the increase in the interest rate was approximately 2.23% for each 1% increase in the expected inflation gap in the previous period, this increase is only 0.18% now for the same 1% variation in the expected inflation gap. Such a result is not surprising at all, especially because it

²⁷ The hypothesis of rational expectations is not essential for our results. We just believe that it is more suitable than adopting adaptive expectations, in view of the experience with high inflation and flawed stabilization plans. In that context, individuals used all the available information, paying attention not to make systematic mistakes; otherwise, costs would be remarkable. The same argument was used by Portugal and Madalozzo (2000) to obtain the same series for the 80's and early 90's. We also made estimations using moving averages. The results using the three-month moving average were not significantly different from the estimation assuming rational expectations.

²⁸ The estimations for the reaction function were performed using the software Eviews 3.0.

was observed in other countries after the adoption of inflation targets. Besides, it is in full agreement with the notion that the inflation-targeting regime brings some relief to monetary conditions. The instrument is only altered when the shocks, either external or internal, have a significant impact on inflation. This allows lower instrument variability, reducing uncertainty and improving the economic situation.²⁹

One of the major difficulties posed by the estimation of the reaction function for the post-target period is the low number of available observations thus far, which can lead to a problem of micronumerosity. The consequences of micronumerosity are the same presented by multicollinearity, that is, t statistics tend to be insignificant, and slight changes to the data cause great variation in the coefficients, which may have their signs altered or present implausible magnitudes.³⁰ On top of that, the presence of some outlier dummy variables may influence the estimations, thus explaining the altered sign in b_2 in the post-target period. There is no theoretical or empirical reason that justifies a positive relationship between interest and unemployment rates in the reaction function.³¹

After estimating the reaction function, the next step was the estimation of an vector autoregressive through monthly data, between January 1980 and July 1999.³² We included four variables: inflation rate, measured as a percentage variation every month; Amplified Consumer Price Index (IPCA); real interest rate (Selic/Over); real exchange rate index, obtained from the nominal exchange rate deflated by the U.S. consumer price index and by the IPCA; and real gross domestic product index, supplied by the Applied Economic Research Institute (IPEA).

An unrestricted VAR model may be described as

$$y_t = A_1 y_{t-1} + A_2 y_{t-2} + \dots + A_p y_{t-p} + u_t \quad (6.4)$$

where y_t is a vector of k endogenous variables, that is, $y_t = (y_{1t}, y_{2t}, \dots, y_{kt})'$ and $u_t = (u_{1t}, \dots, u_{kt})'$ is a non-observable white noise vector with zero mean, and positive definite covariance matrix that is defined and invariable over time $E(u_t u_t') = \Sigma_U$. A_i 's are coefficient matrices with $k \times k$ dimension.

The initial procedure consisted in testing the stationarity of the series in question.³³ The inflation and interest rate series were regarded as stationary, while the real exchange series and GDP series presented first-difference fluctuations.³⁴

The behavior of the inflation series in Brazil, especially during the considered period, is quite atypical. Traditional unit root tests like those applied in the present study show stationarity for the inflation series. Nevertheless, the results obtained by Perron, Garcia and Cati (1996) show that, although traditional unit root tests indicate that the inflation series is $I(0)$, these tests are biased when they accept stationarity. The varied number of economic plans devised during this period caused this series to reproduce a stationary behavior with mean reversion, by promoting an abrupt break with inflation rates. However, when more elaborate tests are used, inflation may be characterized as having a unit root, at least during the 1980's and part of the 1990's.

Nevertheless, Fiorencio and Moreira (1999) argue that, although inflation rates have had a non-stationary behavior during the last few years, they became stationary with the Real Plan. The

²⁹ For further details on why inflation targets reduce uncertainty, and reduce instrument variability, see Debelle (1997), Mishkin and Posen (1997), Kuttner and Posen (1997) and Mishkin (2000). A more sophisticated way to check how interest rates respond to inflation shocks consists in estimating impulse-response functions through a VAR, but, again, the low number of observations during the inflation-targeting period does not allow for such estimation.

³⁰ For further information on micronumerosity, see Gujarati (1995, p.326).

³¹ Following this argument, a more formal structural rupture test may be suggested. However, this test would not have enough power to reject the null hypothesis, due to the low number of observations since inflation targeting was implemented. Mishkin and Posen (1997, p.121) also suggest the same argument for the case of New Zealand, Canada, and the United Kingdom.

³² In addition, estimations based on data collected during three months were made; however, the results were similar to those obtained through monthly data.

³³ The series stationarity was assessed by Augmented Dickey-Fuller (ADF) test, following the procedure suggested by Enders (1995, p. 257).

³⁴ Lima et al (1995) find the same stationarity results for real interest rates in Brazil.

question is then whether or not to work with the series in first difference. According to Blough (1988) and Cochrane (1991), “in finite samples, any I(1) process may be arbitrarily well approached (in the sense that the autocovariance structure is arbitrarily close) by an I(0) process and vice versa” (Lima et al, 1995, p. 260). Thus, we decided not to differentiate the inflation series.³⁵ Therefore the series used in the VAR model were the inflation and interest rate, the GDP growth and the change in the real exchange rate.

Another basic step for VAR estimation is to determine the extension of lags. Three statistical criteria, widely used in the literature, were used to establish the auto-regressive order of our VAR: multivariate versions of Akaike Information Criterion (AIC) and Schwarz criteria (SC), and likelihood ratio (LR). The latter may be used to identify the extension of lags in the set of VAR equations, and test the collective significance of coefficients in the equations in an isolated manner.³⁶

The estimation of (6.4) may be separately made by means of least squares without loss of efficiency in relation to generalized least squares. An important aspect in the estimation process is that, although we may use least squares in the unrestricted VAR, this is not possible when our VAR equations do not have the same number of lags. This would be the case of a restricted VAR model. In this case, the estimations must be made using Seemingly Unrelated Regressions (SUR).

We tested models with several different lags, however, the VAR with twelve lags was the one that presented a better performance, according to the three criteria used. In a certain manner, this result was already expected, since the twelve lags capture the seasonal change across variables.

We estimated two types of models. The first, and most common in the literature, was an unrestricted VAR, and the second was a restricted VAR.³⁷ The restrictions were imposed using the data obtained through joint significance tests (LR test) for each of the variables, in each VAR equation, separately.³⁸ Imposing restrictions on the unrestricted VAR model, with the aim of reducing parameter space, may generate an efficiency gain in forecasts. It is common knowledge that more parsimonious models produce better forecasts than overparametrized models. These restrictions may be made using the economic theory or statistical criteria.

The estimated models were used to obtain the forecasted inflation rate values, the first difference of the real exchange rate, and the real GDP index, and the interest rates. This way, the forecasted values could be compared with those effectively observed. The idea is that the forecasts obtained through VAR, tend to reproduce the previous relationship of variables. Considering the hypothesis that no shock occurred, we would not expect any significant change in the way variables interact among themselves. Otherwise, if inflation targets implied a change in regime, we would expect the forecasted and actual values to have distinct behaviors, and in the specific case of inflation, the values would be systematically overestimated.

The simple visual inspection of the forecast graphs of the two vector auto-regressive (VAR) models showed that the inflation-targeting regime succeeded in changing the behavior of the analyzed variables. However, a more adequate procedure is to obtain the average forecast error and check the correspondent signs. The results of this procedure are shown in Table 6.3.

The data in Table 6.3 indicate that, in the case of inflation and real interest rate, the model overpredicts the respective values when compared to the observed values. Whereas, in the case of real GDP and real exchange rate, the forecasted values were, on average, lower than the actual values. These signs show that the inflation and interest rates were lower, and that GDP growth was higher than it would be if the previous regime had been sustained. The real exchange presents a more devalued rate.

³⁵ Estimations were made by using inflation in first difference; however, the results in terms of forecasting were not significantly different from those obtained using level inflation.

³⁶ For further information on these two criteria, and on other procedures, see Enders (1995) and Lutkepohl (1999).

³⁷ For the estimation of VAR models and forecasts, we used RATS for Windows (v. 4.30) software. Restricted VAR was estimated through Seemingly Unrelated Regressions (SUR).

³⁸ The procedure consisted in estimating the models with or without restrictions and, after that, it tested whether these restrictions were supported by the data. The result, obtained from the LR test, would indicate if the restrictions are valid or not. This procedure is quite flexible, allowing us to test several other restriction combinations.

Table 6.3
Forecast errors– (1999:06 – 2001:07)

Average forecast error	Inflation	Real Interests	Real GDP *	Real Exchange
unrestricted				
VAR	-4.57031	-0.12598	0.000967	0.003271
restricted				
VAR	-4.453108	-0.128907	0.000633	0.002483

Notes: (*) The data supplied by IPEADATA comprise the period up to December 2000.

These results allow us to make some considerations about the initial performance of the inflation-targeting regime in Brazil. First, based on the results above, we can say that inflation targets have actually changed the behavior of the inflation rate, and also the way in which they interact with the other variables. However, the most sensible interpretation of these results is that a significant change in the dynamics of inflation was not really made; the new regime was indeed efficient in controlling inflation. Inflation targets successfully replaced the exchange rate band system. The Real Plan has significantly changed the path of inflation, turning it around to a stationary behavior when compared to its explosive behavior during the period of heterodox plans (Perron et al, 1996; Fiorenco and Moreira, 1999). Therefore, we could not expect any significant change in this dynamics. Instead, we observed that the new regime efficiently maintained the gains obtained from the stabilization of economy. Nevertheless, the benefits of inflation targeting do not refer to the inflation rate alone.

The second consideration is related to the monetary conditions after the adoption of targeting inflation. Its implementation brought about a relief to monetary conditions when compared to the previous experience with exchange rate bands. This is translated by the negative average forecast error for interest rates. This means that, considering all previous information, interest rates should be higher than those which were effectively observed. Therefore, in addition to maintaining the advantages of price stability, the new regime did that under “easier” monetary conditions than those predicted by the model.

In a certain way, these results corroborate the ones previously obtained for the reaction function, and are the ones expected by the theory. In the case of reaction function, we noticed that the instrument is less actively responsive to an increase in the expected inflation during the inflation-targeting period, when compared to the previous period, in which exchange bands (crawling peg) predominated.

These results taken altogether may be explained through two basic reasons: inflation targets work as a more efficient anchor for private inflation expectations than the exchange rate bands, and the new regime allows monetary policy to be more concerned with domestic considerations than with exchange market oscillations.

In the case of exchange rate targets, oscillations in the exchange market were counterbalanced by changes in the interest rate. Consequently, monetary policy became passive towards inflation, although this was not true about the payment balance. In inflation targeting, however, the interest rate is or should be only changed when a shock to the exchange market or any other kind of market threatens to deviate inflation off the established target.³⁹

Finally, the values forecasted for the real GDP were lower than those observed during the forecast period. This means that the performance of economy was higher than the one that would be forecasted using the previous experience, i.e., what would have occurred if the regime had not

³⁹ As previously stated, monetary policy in the inflation-targeting regime is primarily concerned with inflation, allowing the adjustment of payment balance to be made through the “free” exchange market fluctuation, differently from exchange rate targets.

changed. Even though we cannot say that the implementation of the new regime is responsible for this, inflation targeting allowed a more favorable environment to Brazilian economy by controlling inflation and bringing relief to monetary conditions. This may mean the possible beginning of a new stage of sustained development.

7. Conclusions

Inflation targeting is relatively new, a bit older than ten years. Therefore, studying its characteristics and assessing its implications is a crucial part in the implementation process of this new monetary regime. The present article attempted to add to the existing empirical literature, implementing some initial tests to assess the Brazilian experience with inflation targeting.

The results obtained for the sample autocorrelations showed that the persistence of shocks on the inflation rate has been reduced from the moment the inflation-targeting regime was implemented in Brazil. In other words, numerical targets have acted as an efficient anchor for private inflation expectations.

The results for the reaction function of the central bank allow us to draw two interesting conclusions. First, the Brazilian experience with inflation targeting may be characterized as a case of “credibility construction” instead of an increase in the conservatism of the central bank. This means that the implementation of the new regime did not represent a greater concern with inflation in detriment of the real side of economy. Second, monetary policy in inflation targeting became “easier” once the instrument is only changed when external or internal shocks have a significant impact on inflation. This means lower instrument variability, which, in its turn, reduces uncertainty and improves the economic situation.

Finally, the results for the two estimated VAR models make us arrive at the conclusion that the implementation of the inflation-targeting regime was a positive shock on the Brazilian economy, at least in terms of the macroeconomic variables analyzed. Both models, based on previous observations, showed that the values for inflation, real interest rate, and real exchange rate should have been greater than those effectively observed since the new regime was introduced. At the same time, in the case of GDP, the forecast indicated that the growth should have been smaller than that which was actually observed. In other words, considering these results, we may conclude that the implementation of the inflation-targeting regime allowed for a reduction in inflation and in the actual interest rate, avoided a stronger devaluation in real terms, and allowed the economic performance to be better than it would have been if the regime had been changed.

Although the results favor the argument that the regime has caused a change in the dynamics of variables, we should take them cautiously. They indicate what occurred at the beginning, but longer experience is required before we can affirm something more categorically. However, our perspective is that these results will turn out to be more favorable in the medium and long run, especially when the regime acquires strength and credibility from the public.

Furthermore, it is impossible to deny that the inflation-targeting regime managed to maintain the stabilization results obtained through the Real Plan, especially in a context where inflationary expectations are deteriorated due to the striking currency devaluation that affected the country in January 1999 and then again in 2001.

There are still some important adjustments and fine-tuning to be made, mainly in terms of the informal characteristic of the Brazilian regime. The uncertainty about who will be elected president in the next elections in 2002 casts some doubt on whether or not inflation targeting will be maintained. In addition, the fact that the credibility of the Brazilian regime is associated with “people” instead of an “institution” is one more reason for worry. These aspects may jeopardize all the gains that have been achieved so far. It is important to mention that the United Kingdom has gone through a similar problem. However, the Labour Party assumed the responsibility of maintaining the regime long before the elections and gave formal operational independence for the Bank of England after winning them, thus ensuring their commitment towards price stability.

8. References

- ARCHER, D. J. The New Zealand approach to rules and discretion in monetary policy. *Journal of Monetary Economics*. v. 39, p. 3-15, 1997.
- BANCO CENTRAL DO BRASIL Issues in the adoption of an inflation targeting framework in Brazil. In: BLEJER, M., et al. *Inflation targeting in practice: strategic and operational issues and application to emerging market economies*. Washington: International Monetary Fund. 2000.
- _____. *Boletim de Inflação*. Several issues.
- BARRO, R. J.; GORDON, D. B. Rules, discretion and reputation in a model of monetary policy. *Journal of Monetary Economics*. v. 12, p. 101-121, 1983a.
- _____. A positive theory of monetary policy in a natural rate model. *Journal of Political Economy*. v. 91, n.41, p. 589-610, 1983b.
- BERNANKE, B. S.; MISHKIN, F. S. Inflation targeting: a new framework for monetary policy?. *Journal of Economic Perspectives*. v.11, n. 2, p. 97-116, Spring 1997.
- BERNANKE, B.; LAUBACH, T.; MISHKIN, F. S.; POSEN, A. S. *Inflation targeting : lessons from international experience*. New Jersey : Princeton University Press. 1999, 382p.
- BOGDANSKI, J; TOMBINI, A.A.; WERLANG, S.R.C. *Implementing Inflation Targeting in Brazil*. Banco Central do Brasil. 2000, 19p (Working Paper).
- CLARIDA, R. GALÍ, J. GERTLER, M.. *Monetary policy rules in practice: some international evidence*. National Bureau of Economic Research. Nov. 1997. (Working Paper, n. 6254).
- DEBELLE, G. *Inflation Targeting in practice*. International Monetary Fund. 1997, 32p (Working Paper n. 35).
- ENDERS, W. *Applied econometric time series*. New York : John Wiley & Sons. 1995. 433p.
- _____. *Rats handbook for econometric time series*. New York : John Wiley & Sons. 1996. 204p.
- FIORENCIO, A.; MOREIRA, A. B. Measuring the stability of price system. Instituto de Pesquisa Econômica Aplicada (IPEA). Sep. 1999, 23p. (Discussion Paper n. 673).
- FISCHER, S. Why are central banks pursuing long-run price stability?. In: *Achieving price stability*. Federal Reserve Bank of Kansas City Symposium Series. 1996.
- FRAGA, A. Monetary policy during the transition to a floating exchange rate: Brazil's recent experience. *Finance and Development*, v. 37, n. 1, March 2000.
- FREEDMAN, C. The Canadian experience with targets for reducing and controlling inflation. In: IMF Seminar on Inflation Targeting, Washington: International Monetary Fund. May 2000. Also previously published In: LEIDERMAN, L.; SVENSSON, L. *Inflation Targets*. London : CEPR, 1995.
- GARCIA, C. J. Chilean stabilization policy during the 1990. University of California at Los Angeles (UCLA). 2000. (mimeo).
- GOLDFAJN, I.; WELANG, S. R. C. *The pass-through from depreciation to inflation: a panel study*. Banco Central do Brasil. Sep. 2000, 47p. (Working Papers Series. n.5).
- GREENE, W. H. *Econometric Analysis*. Prentice Hall. 3rd Ed. 1997.
- GUJARATI, D. *Basic Econometrics*. New York: McGraw-Hill. 3rd Ed. 1995.

- HALDANE, A. *Some issues in inflation targeting*. Bank of England. Unpublished working paper. 1997.
- _____. Targeting inflation: the UK in retrospect. In: BLEJER, M., et al. *Inflation targeting in practice: strategic and operational issues and application to emerging market economies*. Washington : International Monetary Fund. 2000a.
- HUH,C. Some evidence on the efficacy of the UK inflation targeting regime: an out-of-sample forecast approach. International Discussion Papers, N. 565. *Board of Governors of the Federal Reserve System*. Sep/1996. 30p.
- KING, M. Changes in UK monetary policy: rules and discretion in practice. *Journal of Monetary Economics*. v. 39, p. 81-97, 1997.
- KUTTNER, K. N.; POSEN, A. S. Does talk matter after all? Inflation targeting and central banking behavior. *Institute for International Economics*. 1999. 47p.
- KYDLAND,F.; PRESCOTT, E. Rules rather than discretion: the inconsistency of optimal plans. *Journal of Political Economics*. v. 85, n.3, p. 473-90, 1977.
- LANE, T. ; VAN DEN HEUVEL, S. *The United Kingdom's experience with inflation targeting*. International Monetary Fund. June 1998. (Working Paper 98/87)
- LIMA, E. C. R. et al. Tendência estocástica do produto no Brasil: efeitos das flutuações da taxa de crescimento da produtividade e da taxa de juros real. *Pesquisa e Planejamento Econômico*. v. 25, n.2, p. 249-278, ago. 1995.
- LUTKEPOHL, H. Vector Autoregressions. *Institut fur Statistik und Okonometrie*. Mimeo. Jan/99, 29p.
- MASSON, P. R.; SAVASTANO, M. A.; SHARMA, S. *The scope of inflation targeting in developing countries*. International Monetary Fund. 1997, 53p (Working Paper n. 130).
- McCALLUM, B. *Inflation targeting in Canada, New Zealand, Sweden, and the United Kingdom, and in general*. National Bureau of Economic Research. March 1996. (Working Paper, n. 5579).
- MISHKIN, F. *International experiences with different monetary policy regimes*. National Bureau of Economic Research. March 1999. (Working Paper, n. 7044).
- _____. *Inflation Targeting in emerging market countries*. National Bureau of Economic Research. March 2000. (Working Paper, n. 7618).
- MISHKIN, F.; SAVASTANO, M. A *Monetary policy strategies for Latin America*. National Bureau of Economic Research. March 2000. (Working Paper, n. 7617).
- MISHKIN, F; POSEN, A. S. *Inflation Targeting: lessons from four countries*. National Bureau of Economic Research. Aug. 1997. (Working Paper 6126).
- PERRON, P., CATI, R.; GARCIA, M. *Unit roots in the presence of abrupt governmental interventions with application to Brazilian data*. Departamento de Economia. Pontificia Universidade Católica do Rio de Janeiro. 1995. (Discussion Paper).
- PORTUGAL, M. S. O Combate à Inflação no Brasil: do Cruzado ao Real”. em M. S. Portugal (org.), *A Economia do Real: Uma análise da política econômica de estabilização no período 1994-1996*. Porto Alegre: Editora Ortiz, p. 9-20, 1996.
- PORTUGAL, M. S.; MADALOZZO, R.C. Um modelo de NAIRU para o Brasil. *Revista de Economia Política*. V. 20, n. 4, p. 26-47. 2000.

- PORTUGAL, M.S.; HILLBRECHT, R. O.; MADALOZZO, R. C. Inflation, unemployment and monetary policy in Brazil. *Anais do XXI Encontro Brasileiro de Econometria*. V.2, p.522-541. Belém, 1999.
- SARGENT, T. J.; WALLACE, N. Some unpleasant monetarist arithmetic. *Federal Reserve Bank of Minneapolis Quarterly Review*, Fall, 1981.
- SVENSSON, L. E. O. *Inflation forecasting targeting: implementing and monitoring inflation targets*. National Bureau of Economic Research. 1996. (Working Paper n. 5797).
- _____. Optimal inflation targets, “conservative” central banks, and linear inflation contracts. *American Economic Review*, v. 87, n.1, , p. 98 – 115, 1997a.
- _____. *Inflation targeting in an open economy: strict or flexible inflation targeting*. Reserve Bank of New Zealand. 1997b (Working Paper G97/8).
- _____. *Inflation targeting as a monetary policy rule*. National Bureau of Economic Research. 1998. (Working Paper n. 6790).
- TEJADA, C. O.; PORTUGAL, M. S. Credibility and Reputation: An application of the ‘external circumstances’ model for the Real Plan. *Revista Brasileira de Economia*, forthcoming, 2001.
- WALSH, C. E. Optimal contracts for central bankers. *American Economic Review*, v. 85, n.1, p. 150 – 167, 1995.