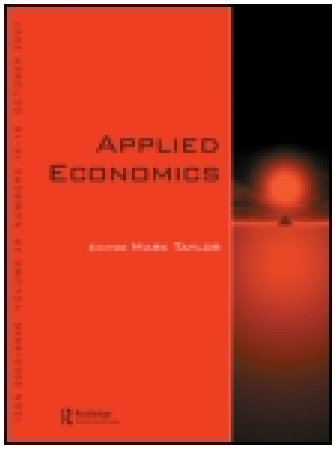

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Towards credibility from inflation targeting: the Brazilian experience

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Towards credibility from inflation targeting: the Brazilian experience

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This article analyses the use of the basic interest rate after the adoption of inflation targeting in Brazil and the credibility of this monetary regime through two indices that consider the Cukierman and Meltzer (1986) definition for credibility. It also shows the main theoretical and practical motives for changes in the conduction of the monetary policy in the 1970s; the way that inflation targeting strategy is inserted in rules vs. discretion analysis; and the main points that characterize the literature concerning inflation targeting. The findings denote that the strategy implemented in Brazil is not a good mechanism to develop credibility.

I. Introduction

The conduction of the monetary policy was an object of intense evaluation in the last decades. Until the beginning of the 1970s the monetary policy was understood to be an instrument in achieving full employment. Nevertheless, in the middle of the 1980s the search for price stability became the main objective for monetary policy.[1] The period between 1971 and 1973 supplied the main motives in understanding the changes in the theory and practice of the monetary policy. On the practical side there was the necessity to find a new nominal anchor due to: (i) the end of the Bretton Woods system; and (ii) the first Oil Shock.[2] At the same time, the theoretical analysis experienced serious modifications due to the introduction of rational expectations into economic theory, especially considering the interpretation of the economic agents in relation to monetary policy.[3] The main result is the belief that the overriding objective for monetary policy in the long run is the search for price stability.

Besides the above-mentioned modifications there was the creation of a new subject for macroeconomic theory known as rules vs. discretion. Since then, a question that deserves attention has arisen – how to minimize social loss when political decisions need to be taken at different times. Kydland and Prescott (1977) initiated the credibility analysis of the monetary policy highlighting the dynamic inconsistency problem. According to this view, the use of rules is the best option for the conduction of the monetary policy. Barro and Gordon (1983) added the importance of reputation as a means to attenuate the dynamic inconsistency problem in monetary policy. Under this interpretation, the inflationary persistence in economy is a consequence of the government's loss in reputation due to its failure in keeping its promises to society.

[1] See Romer and Romer (2002) for an analysis of stabilization policies in the USA after the 1950s.
[2] The strategy adopted by several countries (e.g. Germany, Japan and USA) was the use of a rule à la Friedman (1968) proposal.
[3] During this time several papers by Lucas (1972 and 1973) and Sargent (1973) influenced in a large way the academic analysis.

The Kydland and Prescott (1977) and Barro and Gordon (1983) articles are fundamental in the literature on the relationship among government, central bank and inflation. Based on their ideas, several studies were elaborated obeying two conditions in equilibrium: (i) rational expectations are validated; and (ii) the marginal benefit from an unexpected inflation is equal to the marginal cost of the inflation. Furthermore, the literature concerning credibility can be divided into two points (Clarida *et al.*, 1999): (i) theoretical – the inflationary persistence is analysed under discretionary behaviour of the monetary authority; and (ii) application of policies – if the monetary policy is not directed to control the inflation, the attempt to avoid the inflation can imply a high social cost. Both points suggest that the central bank credibility is capable of reducing inflation with low cost. Therefore, in the 1990s several countries adopted inflation targeting with the objective of reducing inflation or assuring price stability.[4]

The prime objective of this article is to make an analysis of the main points that characterize the inflation targeting literature, to show how the basic interest rate is defined after the adoption of this strategy in Brazil and to evaluate the credibility of the monetary regime implemented from two indices. This article is organized as follows: the next section shows the theoretical referential from a variation of Kydland and Prescott's (1977) model, section III summarizes the main features of inflation targeting, Section IV makes an analysis of the credibility of the Brazilian case and Section V concludes the article.

II. The Theoretical Referential

The old literature on rules vs. discretion focused on the intention and the capacity of the policymaker. The arguments favourable to rules are derived from imperfect knowledge of the economy and the idea that the majority of time the conduction of policies is inadequate for maximizing social welfare. From Kydland and Prescott's (1977) article this perspective was modified, so that rules became a commitment for the policymaker.

The theoretical core for the development of the inflation targeting regime can be comprehended by a variation of the standard model in rules vs. discretion analysis. For this, it is assumed that the monetary authority has as its objectives an inflation rate close to zero and a low unemployment rate. Besides, it is given that the inflation rate is determined in large measure by the rate of growth of the money supply and that the unemployment level is associated with a nonexpected rate in the increase of money supply. Thus, the central bank's objectives can be expressed through the monetary variation (ΔM_t) and through the unexpected monetary expansion ($\Delta M_t - \Delta M_t^e$). Therefore, the objective of the monetary authority for t is to minimize

$$L_t = \frac{a}{2}\Delta M_t^2 - b(\Delta M_t - \Delta M_t^e) \quad (1)$$

where a and $b > 0$.

Given the hypothesis that the public has rational expectations for the variation in money supply, this implies that $\Delta M_t^e = E_{t-1}\Delta M_t$, i.e. on average the public finds their expectations in relation to ΔM_t.

The relevant question is to find the value of ΔM_t in Equation 1 under rule and discretion.[5] If the monetary authority decides to achieve the best value of ΔM_t for a large number of periods, i.e. does not use an active rule and the expectations are rational (on average $\Delta M_t^e = \Delta M_t$), the problem becomes finding the value of ΔM_t that minimizes

$$L_t = \frac{a}{2}\Delta M_t^2$$

i.e.

$$\frac{\partial L_t}{\partial M_t} = a\Delta M_t \Delta M_t = 0, \quad \forall t \Rightarrow L_t = 0$$

In other words, for the case based on rules, the best result would be achieved with the compromise that the central bank does not utilize monetary expansion.

On the other hand, if discretion behaviour is considered, this implies that choices are made each time. Thus, the monetary authority can choose ΔM_t at any point in time. Considering the situation where the central bank tries to achieve the best monetary variation for instant 3, the objective becomes the choice of ΔM_3 that minimizes the value of

$$L_3 = \frac{a}{2}\Delta M_3^2 - b(\Delta M_3 - \Delta M_3^e) \quad (2)$$

In relation to the previous case the difference is that ΔM_3^e was defined at the end of period 2.

[4] Example of countries that adopted this monetary regime are: Australia, Brazil, Canada, Chile, Colombia, Czech Republic, Finland, Iceland, Israel, Korea, Mexico, New Zealand, Norway, Peru, Philippines, Poland, South Africa, Spain, Sweden, Thailand, United Kingdom.

[5] For simplifying the analysis it is understood that the parameters a and b are constants, consequently ΔM_t has a constant value.

Therefore, ΔM_3^e is a known number for the monetary authority and so, there exists the possibility that the second term in Equation 2 is different from zero.

The value of ΔM_3^e that minimizes (2) is achieved through

$$\frac{\partial L_3}{\partial M_3} = a\Delta M_3 - b \Rightarrow \Delta M_3 = \frac{b}{a}$$

Under discretion, this result is valid only for period 3. If the central bank wants to find the best result of ΔM_t for period 4 it is necessary to minimize

$$L_4 = \frac{a}{2}\Delta M_4^2 - b(\Delta M_4 - \Delta M_4^e) \Rightarrow \Delta M_4 = \frac{b}{a} \quad (3)$$

Therefore, regardless of the period that is considered in the analysis, the best choice for monetary authority is given by

$$\Delta M_t = \frac{b}{a}, \quad \forall t \Rightarrow \Delta M_t^e = \frac{b}{a} \quad (4)$$

Substituting this result in Equation 1, results in

$$L_t = \frac{b^2}{2a} \quad (5)$$

Consequently, it is shown that the loss associated to discretion behaviour is higher than the case where rules are adopted ($L_{\text{rules}} = 0 < L_{\text{discretion}} = (b^2/2a)$). However, the result of the model cannot be understood as a definitive result. Albeit a dynamic analysis has been made, the possibility of shocks to the economy is not considered. In the majority of the models concerning this subject the shock is a variable without serial correlation and has an average that tends to zero.

Instead of using the same hypothesis present in the previous model the possibility of a lack of accuracy of the monetary policy on inflation and unemployment is considered. Therefore, there is the need to add a term that represents the undesired effects from monetary variation ($ab\Delta\xi_t$) to the Equation 1. In other words, Equation 1 can be written as

$$L_t = \frac{a}{2}\Delta M_t^2 - b(\Delta M_t - \Delta M_t^e) + ab\Delta\xi_t \quad (6)$$

It is important to highlight that the term $ab\Delta\xi_t$ in Equation 6 does not modify the result for optimal monetary variation in rules case due to the impossibility of answering shocks. Nevertheless, there is a difference in relation to the previous case. The result of minimizing L_t can be different from zero, because

$$L_t = ab\Delta\xi_t \quad (7)$$

Consequently, the result of (7) depends on the magnitude of the shock to the economy.

In discretionary behaviour the use of economic policies as an answer to shocks is permitted. Thus, since it is understood that the variation in money supply is responsible for shocks in the economy, the loss function given for Equation 6 can be written for discretionary case as

$$\begin{aligned} L_t &= \frac{a}{2}\Delta M_t^2 - b(\Delta M_t - \Delta M_t^e) + ab\Delta M_t \\ \frac{\partial L_t}{\partial M_t} &= a\Delta M_t - b + ab \\ &\Rightarrow \Delta M_t = \frac{b(1-a)}{a} \\ \therefore L_t &= \frac{b^2(1-a^2)}{2a} \end{aligned} \quad (8)$$

This result matters, because if a is 1 the value of L_t is zero. The intuitive interpretation of this result is that if there is an adequate effort by the policymaker in the fight against inflation ($a = 1$) it is possible to achieve the best result for the loss function ($L_t = 0$).

From the results above one obtains the corollary – in the absence of shocks to the economy the behaviour associated with rules is better than a discretionary behaviour. On the other hand, when monetary shocks to the economy are considered, the discretionary behaviour with an adequate effort by the policymaker in the control of inflation, is the best result.

In the search for mechanisms that induce an ideal behaviour by the monetary authority against inflation (removal of the inflationary bias in the conduction of the monetary policy) Rogoff (1985) suggested the adoption of an independent central bank with a conservative central banker (an aversion to inflation higher than that of society). Lohman's (1992) trade-off analysis based on flexibility and commitment verified that in the presence of supply shocks and conflict between monetary and fiscal authorities the best solution would be the choice of a conservative central banker for partially independent central banks.

The literature concerning central bank independence has greatly increased since the middle of the 1980s. Among several articles on this subject, the analysis made by Walsh (1995) and Svensson (1997) deserves attention. In Walsh's analysis the inflationary problem is solved by a contract that imposes costs on the central bank when the inflation deviates from an optimal level. In other words, under this view, the principal (government) subscribes an incentive contract with an agent (central bank) with a set of penalties *ex post* that are defined in relation to the inflation target deviation. The advantage of this framework is that the best result for society is achieved regardless of the necessity that the government and the central bank have of having the same

objective function and set of information. In Svensson's model an inflation targeting strategy is analysed in a principal-agent framework (the society – principal – delegates the monetary policy to the central bank – agent). It is also assumed that the central bank has perfect control over inflation. The findings denote that it is possible to achieve an equilibrium that corresponds to an optimal rule under commitment.

The diffusion of the inflation targeting strategy is a consequence of the recognition that goal independence for a central bank is not essential.[6] This observation is linked to the idea of money neutrality and so, the search for price stability is a natural target for a monetary authority. In this sense, it is necessary to develop mechanisms that assure that the central bank has the necessary instruments for achieving the natural target. In other words, the central bank needs instrument independence.[7]

In accordance with the above-mentioned ideas, Herrendorf (1998) highlights that the adoption of inflation targeting improves the central bank instrument independence. In his words (1998, p. 443):

> [The] inflation targeting arrangement that gives instrument independence to the central bank reduces the inflationary bias of monetary policy making. The reason for this result is that if the inflation target is publicly announced the arrangement is transparent, solves the private information problem and makes reputation more effective. This observation deserves attention because the success of an inflation targeting regime demands the absence of fiscal dominance. The justification for this condition is that the presence of high fiscal deficits can promote the monetization of the public debt and thus, start an inflationary process. (Mishkin and Savastano, 2000)

III. Inflation Targeting Features

Inflation targeting regime has as its main feature the official announcement of ranges for inflation fluctuations and the explicit recognition that the main objective of the monetary policy is to assure a low and stable inflation rate. In general, there are two options for implementing this monetary regime (Svensson, 2002): (i) strict – one that neglects the real effects of the monetary policy in the short and medium term and focuses on only the inflation control; and (ii) flexible – one that maintains the search for price stability as the fundamental objective for monetary policy, but recognizes the necessity for stabilizing the business cycle and thus, the necessity for stabilizing the output close to the potential level.

The flexible case denotes that the adoption of inflation targeting implies effects not only on inflationary variation, but also on the real side of the economy. Mishkin (1999) reminds us that this is the practice, since policymakers in the majority of countries that use this monetary regime denote the preoccupation in accommodating fluctuations in output and employment. In spite of this, it is important to highlight that in the absence of supply shocks (there is no trade-off for stabilizing employment in the short term) a strict inflationary target would work well, but not in the presence of shocks. Thus, a constrained flexibility must be preferable to a discretionary monetary policy or strict target. Another point is that the presence of the output in the objective function of monetary authority does not mean that inflationary bias will occur.

In contrast to simple political rules, the inflation targeting allows the central bank to use the instruments together with all relevant information to achieve the target. Besides this, there is the advantage that this monetary regime permits the use of discretionary policies without implying a loss of credibility. In other words, the inflation target must be understood as a case where there is constrained discretion.

In practice, the most used anti-inflationary political rule has been the announcement of ranges for inflation fluctuation.[8] A wide range implies more flexibility and probability of a target being achieved. The problem with this framework is that it is not a good guide for inflation expectations. If there is a lack of credibility the public considers the superior limit in the expectations thus implying more time for achieving the price stability. Notwithstanding, the ranges offer more transparency and small fluctuations in the inflation rate cannot be justified to the public.

The main features of inflation targeting can be summarized in five points (Mishkin and Savastano, 2000): (i) public announcement of medium term for inflation targets; (ii) institutional commitment to price stability; (iii) information on the behaviour of the main variables responsible for the monetary

[6] Goal independence refers to the freedom that the central bank has in defining the target to be reached. (Fischer, 1995).
[7] It is important to highlight that although the literature reveals a narrow relation between central bank independence and inflation targeting an independent central bank is not necessary to implement the monetary regime.
[8] Most of the time, the core of band is 2% allowing a fluctuation of 2% (Meyer, 2001).

regime; (iv) transparency of the conduction of the monetary policy (a crucial point for communication with public and market planning);[9] and (v) mechanisms that make the central bank accountable for attaining its inflation objectives.

A considerable problem for inflation targeting success is the choice of a target (optimal) that minimizes the possible negative effects on output. (Brunilla and Lahdenperä, 1995) In general, the countries that implemented inflation targeting have adopted a target greater than zero. This position is due to the argument that a low inflation does not create problems with inflation expectation or central bank credibility. Furthermore, it is recognized that an inflation rate close to zero could imply a persistent pressure on unemployment putting the economy on a recession track.

Another point is that although inflation targeting increases the transparency and attenuates the inflationary bias in monetary policy, a discretionary central bank behaviour is possible. In other words, inflation targeting does not remove full inflationary bias in the conduction of the monetary policy. Therefore, the adoption of this monetary regime does not guarantee that the central bank is always averse to inflation. (Herrendorf, 1998) The possible benefit from an explicit inflation target is that if the target is credible the public will adjust their expectations more quickly concerning the realization of the target.

In relation to central bank objectives, even if low and stable inflation is considered a priority in the long run, other objectives cannot be neglected in the short term (especially output and exchange rate). This observation matters because central banks that attempt to achieve more than one objective with only one instrument (interest rate) decrease the monetary credibility. (Fuhrer, 1997) In practice, central bank interference on output and employment is common. Thus, the dynamic inconsistency problem can emerge putting planned targets in risk.

Stevens and Debelle (1995) showed, through a simple model, the central bank difficulty in controlling instruments so that inflation expectation would be within a predetermined range. An important observation made by the above-mentioned authors is the presence of stochastic elements in the price process and thus, the inflation forecast depends on the estimation (subject to error) of other variables. Hence, the main problem in relation to inflation targeting is that monetary authority is responsible for the achievement of a target without having the full capacity for guaranteeing the result. Besides this, another inconvenience is the lag of the monetary policy effects on the economy.

The main doubt present in the literature concerning this subject is if the inflation is sufficiently forecasted and controllable to receive a target. The difficulty in inflation forecasting for short and long periods implies two potential problems for inflation targeting: (i) operational – due to a lag between monetary policy action and inflation response there is a low forecast that can imply inaccuracy in achieving the target; and (ii) central bank credibility – as inflation is associated with a high degree of unpredictability it is difficult for the public to judge the central bank's effort in the achievement of the announced target (Bernanke and Mishkin, 1997).

IV. Inflation Targeting Credibility in Brazil

Due to the crisis in Asia (1997) and Russia (1998) along with the fragility of the Brazilian economy in early 1999 (high domestic debt with the major part consisting of short-term financing; current account deficit; the economy entering recession) the capital flows to Brazil came to a halt. This fact obligated Brazil to abandon the crawling peg to the dollar in January of 1999. As a consequence, the Brazilian currency, the Real, devaluated considerably and the risk of a lack of control on inflation became serious. It is important to highlight that Brazil had success against inflation only after the introduction of the Real Plan (1994).[10] Therefore, the history of inflation at normal levels was too recent and the abrupt end of the nominal anchor implied a threat for consolidating the process started with the Real Plan.

[9] The best example of transparency of central bank actions is the New Zealand case. In this country the government can dismiss the central bank governor if the inflation deviates 25% from the announced target. Other examples of benefits from transparency are Canada (1996) and England (1997). For a detailed analysis of these countries see Mishkin and Posen (1997). For an analysis of the countries that adopted inflation targeting in the 1990s see Bernanke *et al.* (1999).

[10] The Real Plan was a stabilization program divided into three steps: (i) budgetary equilibrium; (ii) introduction of a new stable unity of account to align the most important relative prices in the economy; and (iii) the conversion of this unity (URV – real unity of value) to the new currency of this country (Real) with the parity semi-fixed with the dollar.

The change in exchange regime to a floating system implied the necessity of a new nominal anchor for economic policy. The impossibility to use exchange rate and monetary aggregates as anchors due to the high degree of instability expected and the necessity to achieve a framework that would contribute to inhibit inflationary spiral and help a deceleration of the rate of inflation, the Central Bank of Brazil decided to adopt a strategy based on two-step: (i) bring inflation down to a single-digit annualized rate by the last quarter of 1999; and (ii) the adoption of inflation targeting system to be in place by the end of June.

In June of 1999 the National Monetary Council determined inflation targeting as the new strategy for the monetary policy in Brazil. The main points present in Decree No. 3088 of June 21st are listed below:

- The inflation targets will be established on the basis of variations of a widely known price index;
- The inflation targets, as well as the tolerance intervals, will be set by the National Monetary Council on the basis of a proposal by the Finance Minister;
- Inflation targets for the years 1999, 2000 and 2001 will be set no later than 30 June 1999; for the year 2002 and subsequent years' targets will be set no later than 30 June two years in advance;
- The Central Bank is given the responsibility to implement the policies necessary to achieve the targets;
- The price index that would be adopted for the purposes of the inflation targeting framework will be chosen by the National Monetary Council on the basis of a proposal by the Finance Minister;
- The targets will be considered to have been met whenever the observed accumulated inflation during the period January to December of each year (measured on the basis of variations in the price index adopted for these purposes) falls within the tolerance intervals;
- In case the targets are breached, the Central Bank's Governor will need to issue an open letter addressed to the Finance Minister explaining the causes of the breach, the measures to be adopted to ensure that inflation returns to the tolerated levels and the period of time that will be needed for these measures to have an effect; and
- The Central Bank will issue a quarterly inflation report that will provide information on the performance of the inflation targeting framework, the results of the monetary policy actions and the perspectives regarding inflation.

The main motivation for introducing inflation targeting was due to the expectation that the use of this strategy could eliminate the uncertainty caused by devaluation of currency and would restore the control on inflation. As the most important step in controlling inflation is to control inflationary expectations, one main task of the CBB has been to build credibility as a monetary authority committed to price stability. Such credibility is important because it influences expectations affecting interest and exchange rates and thereby affects the cost of reducing inflation in terms of lost output and employment.

One important function of inflation targeting is the role of guiding private-sector decision makers' expectations about future inflation. However, inflation targeting success depends of central bank credibility in its conduction of the monetary policy. Since reputation is a basic condition to develop credibility, it is necessary for the public to believe that the announced economic policy will be implemented with success. In accordance with Andersson and Berg (1995) a high operational credibility of inflation targeting is a consequence of the central bank proving its competence in the attainment of the announced target. Therefore, there is a clear role of inflation targets influencing monetary policy.

The use of the basic interest rate

The objective of this section is to show the main motive that impedes a perfect control of inflation by the CBB. This analysis matters because it identifies the source of policy misses and, as a consequence, the impediment for developing credibility.

In Brazil, the basic interest rate level (Selic) is defined, every month, through monthly meetings of the Committee of Monetary Policy (COPOM) with the objective to achieve the inflation target. It is important to note that a share of inflationary pressure on the economy can be a result of supply shocks. Due to the differences in the behaviour of prices in the Brazilian economy, these prices can be divided into market prices (prices defined by market force) or administered prices (prices defined by contracts and prices which are monitored depending on previous government authorization).

The official price index that is used in inflation targeting is the National Consumer Price Index (extended) – IPCA (official price index). The IPCA is too sensitive to the readjustment in the

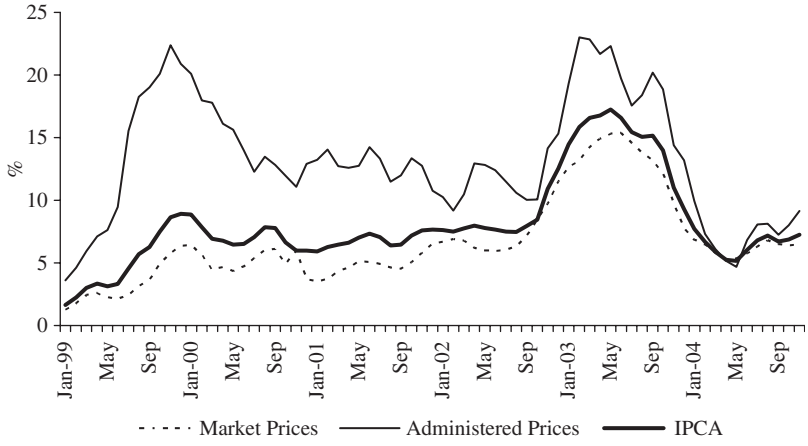

Fig. 1. Evolution of IPCA, market prices and administered prices
Note: Percentage variation accumulated in 12 months.

administered prices.[11] One feature of administered prices is that the components are slightly sensitive to the market forces, as for example energy prices. Furthermore, there is an inertial characteristic in administered prices due to the fact that readjustments are made through contracts that consider the past variation of price indices. The administered prices, which are considered in the composition of IPCA, are divided into tax, public utility services and petroleum derivatives.

Due to the devaluation of currency in the beginning of 1999 and to the sensitivity of some administered prices in relation to the exchange rate, it can be seen that the administered prices run a path above the market prices (Fig. 1).[12] Another fact that pressured administered prices was the increase in the international price of oil because this implied an increase in the prices of petroleum derivatives and in the goods that use oil as a raw material. Furthermore, the privatization of public services and the elimination of subsidies contributed to this path of administered prices.

With the objective of evaluating the determination of the interest rate by CBB in response to inflation from market prices (*mp*) and administered prices (*adm*), in the period after the adoption of inflation targeting, an estimate (OLS) based on Taylor's reaction rule for CBB, has been made. Thus, the estimated equation is given by:

$$i_t = \alpha_1 + \alpha_2 i_{t-1} + (1-\alpha_2) \times \left[\alpha_3\left(mp_{t-1} - \pi^*_{t-1}\right) + \alpha_4\left(adm_{t-1} - \pi^*_{t-1}\right)\right] \quad (9)$$

where

i = basic nominal interest rate (SELIC);
mp = inflation of market prices accumulated in the last 12 months;
π^* = inflation target for the last 12 months; and
adm = inflation of administered prices accumulated in the last 12 months.

The first condition to be analysed before estimating the effect of market and administered prices on Selic rate is to check if series have unit root. In the case that series are not stationary there is a high possibility that results are spurious. Therefore, with the objective of testing the existence or not of unit root in *i*, *mp* and *adm* the unit-root tests (Augmented Dickey–Fuller – ADF and Phillips–Perron) were made. Both tests denote the acceptance of null hypothesis (series nonstationary) for original values of series with a significance of 99% (Table A.1 – appendix). Therefore, the series are $I(1)$.

The above-mentioned result suggests that it would be adequate to use the first difference of series in the regression, however, this procedure can imply a loss of relation in the long run among series. Consequently, it is necessary to evaluate if a linear combination among series is stationary even if individually series are nonstationary. In other words, it is necessary to verify if series are cointegrated because, in this situation, the regression of series in level would imply reliable statistics.

The cointegration test proposed by Johansen (1991, LR test statistic), based on the significance of the estimated eigenvalues, indicates that the trace

[11] Since August of 1999 the weight of administered prices on IPCA is 28.7%.
[12] The justification for the sensitivity of administered prices to the exchange rate is due to the fact that some prices are indexed to the General Price Index (IGP). This price index is more sensitive to the variation of exchange rate than to IPCA.

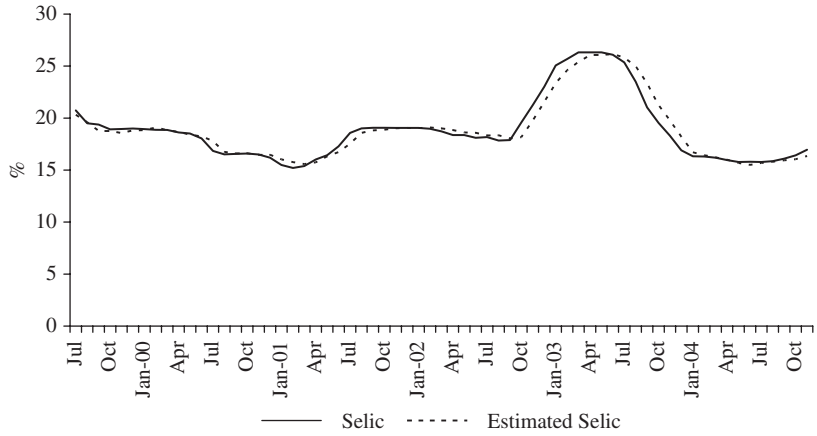

Fig. 2. Evolution of Selic and estimated Selic (1999–2004)

statistic rejects the no cointegration hypothesis at 5% significance level, but not the hypothesis that there is more than a cointegration relation (Table A.2 – appendix). As series are cointegrated and, thus, there is a relation of equilibrium of long run among series, the Equation 9 can be estimated with the series in level without problem of spuriousness in the result.

The estimate for interest rate considering monthly data (source CBB) between July of 1999 and November of 2004 is given by:

$$i_t = \underset{(3.131)*}{2.021} + \underset{(20.748)*}{0.859}\, i_{t-1} + (1-0.859) \times \left[\underset{(2.534)**}{0.815} \left(mp_{t-1} - \pi^*_{t-1}\right) + \underset{(3.588)*}{0.383} \left(adm_{t-1} - \pi^*_{t-1}\right) \right] \quad (10)$$

$R^2 = 0.945$, $n = 65$.[13]

The result shows that the behaviour of the estimated interest rate is very close to the observed Selic rate in the period (Fig. 2). The high value and significance of the constant denote a strong component for increasing interest rate. The importance of the lagged interest rate is also confirmed. In relation to the response of the interest rate to market and administered prices, a higher sensitivity to market prices than to administered prices is observed, as expected. Notwithstanding, the response of the interest rate to administered prices is not negligible and has a high statistical significance. This point shows that the monetary policy has been used with the intention of eliminating the secondary effect from supply shocks on inflation thus preserving the initial realignment of relative prices.

Cecchetti and Krause's index

A previous analysis of the credibility effect on the Brazilian economy, taking into consideration a disinflation program, was made by Agénor and Taylor (1992 and 1993). In that analysis, the authors developed a methodology for evaluating the credibility effect and analysed the Brazilian Cruzado Plan implemented during 1986. The main result is that credibility rose sharply after the adoption of the Cruzado Plan, but its impact on the inflationary process was insufficient.

Based on the argument presented by Agénor and Taylor (1992) where series of expected inflation could be applied to derive a credibility index, this section and the next consider this possibility for two credibility indices applied to the Brazilian economy after the adoption of inflation targeting.

Recently Cecchetti and Krause (2002) developed from Cukierman and Meltzer's credibility definition (1986)[14] a central bank credibility index (CI_{CK}). In this sense, such as Svensson (2000) proposed, the credibility can be measured by the difference between expected inflation and the target. Thus,

$$CI_{CK} = \begin{cases} 1 & \text{if } E(\pi) \le \pi_t \\ 1 - \frac{1}{0.2-\pi_t}[E(\pi) - \pi_t] & \text{if } \pi_t < E(\pi) < 20\% \\ 0 & \text{if } E(\pi) \ge 20\% \end{cases} \quad (11)$$

The credibility index assumes a value equal to one if the expected annual inflation is equal to or lower than the inflation target (π_t) and decreases in a linear manner while the expected inflation rises. In the case where the expected inflation is higher than 20%, it is

[13] *(**) denotes rejection of H_0 at the 1% (5%) significance level. White (1980) *t*-statistics in parentheses.
[14] '(...) the absolute value of the difference between the policymaker's plans and the public's beliefs about those plans' (Cukierman and Meltzer, 1986, p. 1108).

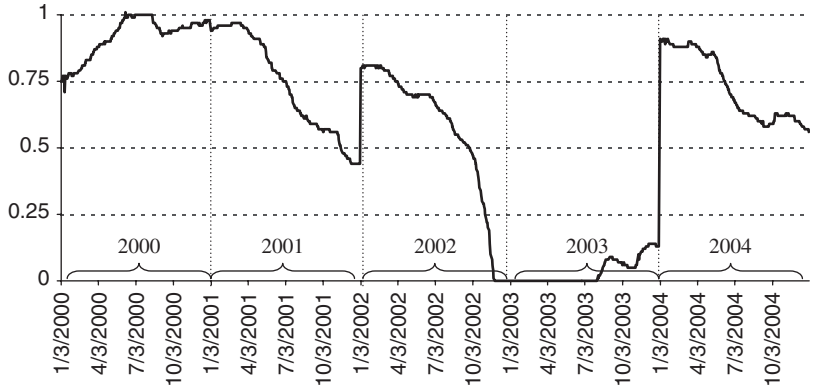

Fig. 3. CI_{CK} performance

understood that the index assumes a value equal to 0. Consequently the index variation is between zero (null credibility) and one (full credibility).

From CI_{CK} the inflation targeting credibility implemented in Brazil was measured using information available by the Central Bank of Brazil on market expectations (starting in January of 2000) for inflation and respective annual targets. These observations have been made on a daily frequency (5 day week) implying 1.251 observations until 30 December 2004.

It is important to note that the index developed by Cecchetti and Krause (2002) was made with the objective of making international comparisons. Thus, the above-mentioned authors used an inflation target that is considered standard in the literature, i.e. 2% for making the index. The limit of 20% introduced in this index means that the authors believe that by exceeding this percentage the central bank would lose control over the inflation. With the objective of adjusting this index for the Brazilian case, instead of using 2% as the target, the annual inflation targets defined by Central Bank of Brazil were applied. Further, the limit of 20% is too high for an economy that desires to keep the inflation under control. Therefore, a limit of 10% was used.[15] The performance of the index is shown in Fig. 3.

In accordance with this index the credibility had a very good performance (high and stable) during 2000. Notwithstanding, a distinct behaviour for the following years is observed. As can be seen by Fig. 3, there is a clear indication that credibility decreases during 2001 and 2002. The credibility level starts high in January of 2001, but diminishes considerably during the year and arrives in December under 0.5. In relation to 2002 the index performance was worse than the two previous years. The bad result at the end of 2002 abides during 2003 and returns to the levels present at the beginning of 2002 only in 2004. Therefore, according to CI_{CK} the inflation targeting credibility has been unstable and denotes the necessity to avoid a significant loss of credibility.

Ad hoc *index for the Brazilian case*

Assuming that the credibility of an economic policy objective depends on the market expectation in relation to success in the achievement of the announced targets, an inflation target has full credibility if it is equal to the market expectation for inflation. In other words, there is little credibility if the market expectation for inflation is too different from the target determined by the monetary authority.

It is important to highlight that in the Brazilian case credibility is still being built and thus, in this stage, credibility is synonymous with reputation. Therefore, the success (failure) in achieving the inflation target improves (worsens) the inflation expectations and thus contributes to developing (reducing) credibility. Thus, considering Cukierman and Meltzer's (1986) definition for credibility and the suggestion made by Svensson (2000), a credibility index (CI) was made for monetary policy that considers deviations in the expected inflation from the inflation target core (π_t).

One of the main characteristics of Brazilian inflation targeting was the adoption of an inflation target (IPCA variation) with tolerance intervals (±2% until 2002 and ±2.5% after). With the objective of considering the essence of the implemented strategy, the credibility index has a value equal to

[15] The targets were at 6% for 2000, 4% for 2001, 3.5% for 2002, 4% for 2003 and 5.5% for 2004 – accumulated annual variations by the year-end. Tolerance intervals of ±2% until 2002 and ±2.5% after were also defined.

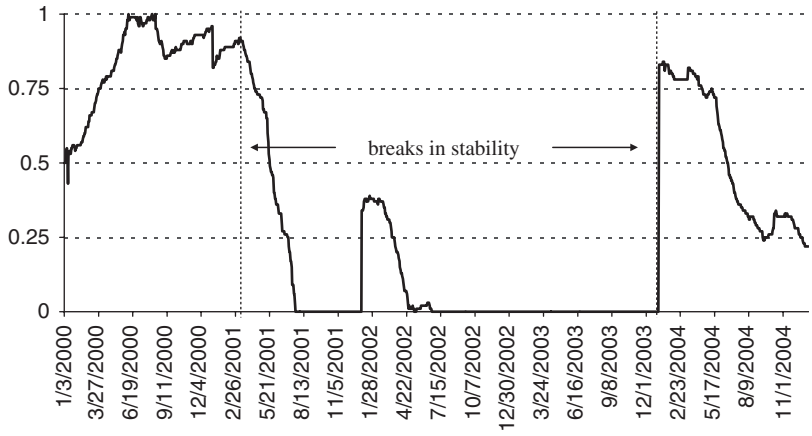

Fig. 4. CI performance

1 when the annual expected inflation ($E(\Pi)$) is equal to the target inflation and decreases in a linear way while inflationary expectation deviates from the announced target. Therefore, the credibility index shows a value between 0 and 1 strictly if the expected inflation is situated between the maximum and minimum limits (π_t^*) established for each year and assumes a value equal to 0 when the expected inflation exceeds one of these limits. That is,

$$CI = \begin{cases} 1 & \text{if } E(\pi) = \pi_t \\ 1 - \dfrac{1}{\pi_t^* - \pi_t}[E(\pi) - \pi_t] & \text{if } \pi^*_{tMIN} < E(\pi) < \pi^*_{tMAX} \\ 0 & \text{if } E(\pi) \geq \pi^*_{tMAX} \\ & \text{or } E(\pi) \leq \pi^*_{tMIN} \end{cases}$$

Considering the information made available by the Central Bank of Brazil and the information used in the previous index, the inflation target credibility was measured based on this methodology. The index evolution is shown in Fig. 4. In general, it can be seen that the credibility index performed well during 2000. In March of that year the index exceeded 0.75 and continued to grow until May when it stabilized denoting a variation between 0.85 and 1. Nevertheless, the same performance is not observed for the following years. The success in 2000 implied that the beginning of 2001 had a high level of market expectation for the achievement of the announced target. Notwithstanding, the effects of the result of the year 2000 vanished quickly. The combination of three factors: (i) the announcement of electrical energy rationing; (ii) the expected crisis in Argentina and (iii) the fall of economic activity in the world; implied that the credibility index was null from the end of July.

Figure 4 shows that the credibility index for 2000 maintained a satisfactory level during the entire year. Although the beginning of each year represents a new opportunity for achieving the announced target, the failure in 2001 implied that the market expectation for the Central Bank of Brazil to achieve the inflation target (3.5%) was less than 39%. In the middle of April the credibility was close to zero and became null from June. The instability in the American stock market, the losses incurred by US companies and the recent Argentine episode, drove away investment in emergent countries' bonds implying a jump in the country risk. As a consequence, there was an increase in sending capital abroad. Another important fact in this period was the speculative behaviour during the presidential election. The result from the combination of these adverse effects was a strong devaluation of the currency that culminated in market nihilism where the achievement of the inflation target was concerned. The deterioration of inflationary expectations implied a null credibility during 2003. The impossibility of the achievement of inflation target was verified at the beginning of the year. In the first five months of 2003 the inflation reached 6.8% (73% of the inflation for the entire year).

The year 2004 represented a change in the prior path of credibility, but it was not sufficient to assure a stable credibility. The main motive for an improvement in credibility in comparison with 2003 was the adjustment of the inflation target (changed from 3.75% to 5.5% with a tolerance interval of ±2.5%). Notwithstanding, a strong deterioration in credibility at the end of the first semester was observed. The bad performance in the second semester was due to: supply shocks, indexation of some prices and the pressure of demand.

Empirical evidence

The previous section showed the credibility index behaviour for the inflation target. One important point is to ascertain the relative importance of inflation expectation, inflation target, credibility index

Table 1. Variance decomposition

	Period	INFT	SELIC	EINF	IC
INFT	1	76.34074	7.655689	15.69445	0.309128
	2	70.45900	7.637571	20.80049	1.102945
	3	69.29402	7.450453	21.58158	1.673944
	4	69.07832	7.459616	21.56729	1.894775
Selic	1	26.02851	63.62691	9.978873	0.365709
	2	40.77317	51.39416	6.980147	0.852522
	3	45.97296	46.81647	5.788623	1.421945
	4	47.74215	44.86733	5.471895	1.918631
EINF	1	12.80228	13.09301	74.04780	0.056912
	2	28.17652	20.82485	50.91596	0.082668
	3	35.44914	22.44122	41.77219	0.337448
	4	38.06936	22.49262	38.74787	0.690150
IC	1	43.00744	20.22549	15.19530	21.57177
	2	43.76516	21.28261	18.13692	16.81531
	3	42.61846	20.14779	21.76737	15.46638
	4	42.01679	19.87164	22.89177	15.21981

Note: Series order - INFT, Selic, EINF and IC. Annual periodicity.

and the use of the basic interest rate (Selic – the main instrument of CBB against inflation) for the Brazilian economy. A vector autoregression analysis (VAR) from Selic and data used in the credibility index is made with this objective.

The first condition to be evaluated is to verify if the series (credibility index – *IC*; inflation target – *INFT* inflation expectation – *EINF* and *Selic*) have unit root. Through graphical analysis of the correlogram from the original values of the series mentioned (Fig. A.1 – appendix) it is observed that in all cases the autocorrelation decreases slowly and gradually while lags increase. Thus, it can be seen that the present values depend on past values suggesting a presence of unit root in the series. The unit-root tests (Augmented Dickey–Fuller – ADF and Phillips–Perron) denote the acceptance of the null hypothesis (nonstationary series) for the original values of the series. On the other hand, for the case of first difference, the null hypothesis is rejected at the 1% significance level and thus the series are stationary (Table A.3 – appendix).

The next step is to define the VAR order. For this Akaike (AIC), Schwarz (SIC) and Hannan–Quinn (HQ) criteria are used. It is observed that both models (with constant and no constant) indicate that the lag order for VAR is 1 (Table A.4 – appendix).

Considering that the errors are orthogonalized by Cholesky decomposition, this implies that the disposition of the variables is important in the analysis of the impulse–response and variance decomposition analyses. Considering the results of Granger causality test (Table A.5 – appendix), the ordination for analysis is given by: inflation target, Selic, inflation expectation and credibility index. Based on this result, Table 1 shows the decomposition of variance of the series (inflation target, Selic, inflation expectation and credibility index) with 960 observations (period of 4 years). The same period is considered for impulse–response analysis (Fig. 5).

Considering the analysis for inflation target, it is observed that the relative importance of inflation target in the explanation of its own variance decomposition is very important. This result is confirmed by impulse–response analysis (see first graph in the first row in Fig. 5). The intuition of these results is that an increase in inflation target implies a gradual process of disinflation and thus, a persistence of inflation target at a higher level. Excluding inflation target, the main variable for explaining variance is the inflation expectation (average of 20%). The impulse–response graph (see third graph in the first row in Fig. 5) shows that an increase in inflation expectation promotes an increase in inflation target. This result is not surprising, because, for most of the time, inflation targets are defined (or modified) based on what the economic agents consider possible to achieve. Another relevant point is that the role of Selic is not negligible in the explanation of inflation target variance (average of 7.5%). Further, an increase in Selic tends to imply a fall in inflation target (see second graph in the first row in Fig. 5). This result suggests that the use of a tight monetary policy contributes to a lower inflation target in the short run. In relation to the relevance of credibility index, both analyses (variance decomposition and impulse–response) denote that it is not significant in this case.

The variance decomposition of Selic indicates that the inflation expectation is responsible for 48% of

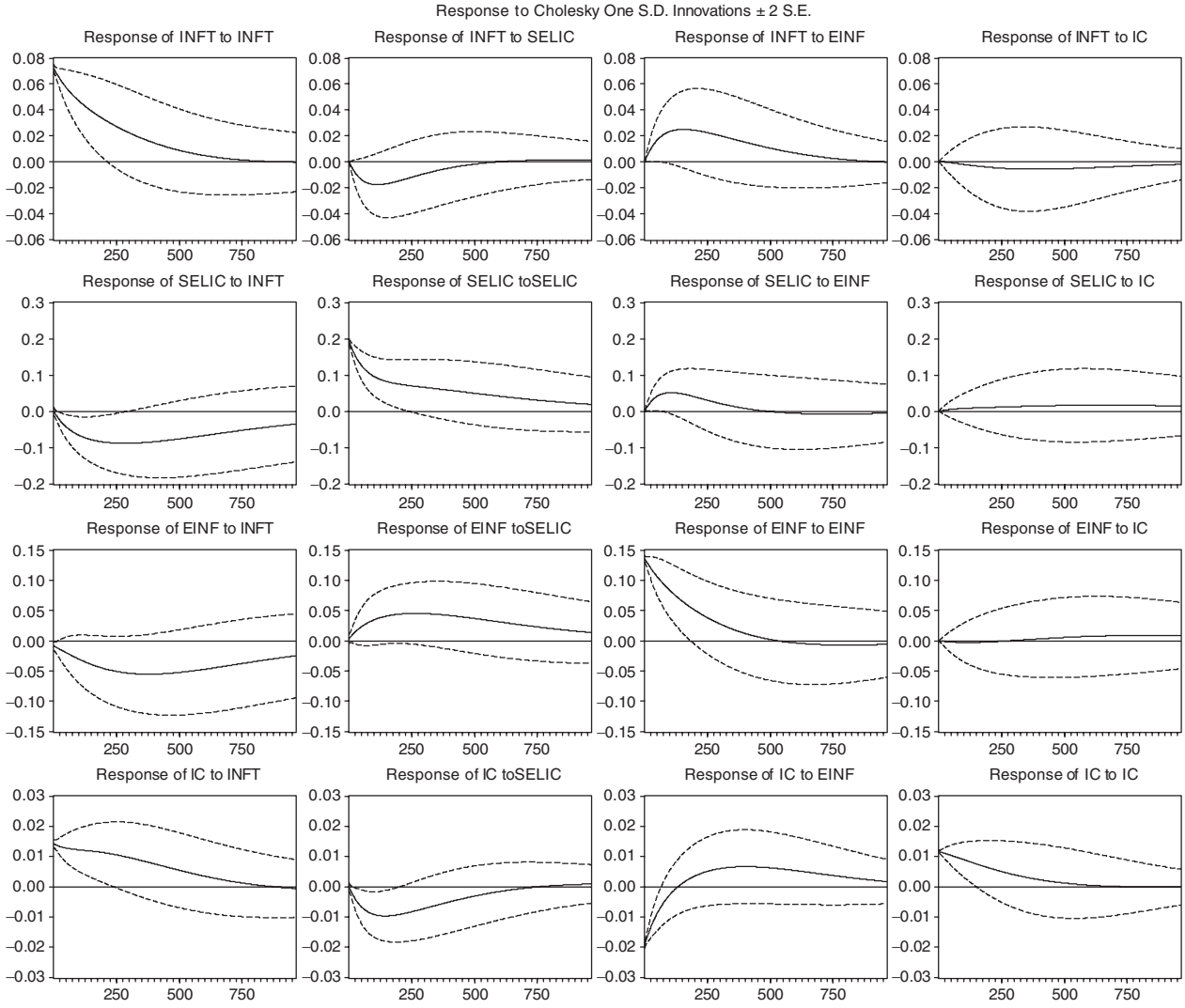

Fig. 5. Impulse–response

this decomposition (Table 1). Furthermore, the impulse–response analysis (see first graph in the second row in Fig. 5) suggests that a raise in inflation target provokes a decrease in Selic. The idea is that a higher inflation target is compatible with a slackening of monetary policy. In short, this result is a clear indicative that basic interest rate is used in an attempt to achieve the inflation target. On the other hand, the significant relative importance of Selic in the explanation of its own variance decomposition (45%) and the impulse–response graph (see second graph in the second row in Fig. 5) reveal that a high Selic is an impediment to the reduction of the interest rate. Besides this, the inflation expectation has a secondary role in the explanation of Selic variance (limited to 5.5%). However, the third graph in the second row in Fig. 5 shows that an increase in the inflation expectation implies an increase in Selic. This observation reveals the essence of inflation targeting – the use of the basic interest rate in response to inflation expectation when it deviates from the inflation target. Once again, credibility index is not relevant. The justification for this result is that credibility is not sufficiently developed to smooth the use of Selic in achieving the inflation target.

In relation to the variance analysis of the inflation expectation it can be seen that inflationary expectation, inflation target and Selic are significant. This result matters because it suggests that the inflation target and the use of Selic are expressive in the building of market expectation. The impulse–response analysis indicates that an increase in the inflation target contributes to a reduction in inflation expectation (see first graph in the third row into Fig. 5). This result suggests that the use of a lower inflation target is associated with the idea that the

central bank has a better control of inflation and thus, there is an improvement in the inflation expectation. On the other hand, an increase in Selic is associated with an increase in inflation expectation (see second graph in the third row in Fig. 5) because it denotes the presence of inflationary pressure on the economy. One important result is that the credibility index was not relevant for the inflation expectation analysis. In other words, there is not sufficient credibility in inflation targeting in Brazil for guiding inflation expectation.

Finally, it is observed that the inflation target (42% – see Table 1) is the main element in the explanation of the credibility index variance. The impulse–response graph (see first graph in the fourth row in Fig. 5) shows that an increase in inflation target implies an increase in credibility index that abides for more than three years. Inflation expectation is responsible for ~23% of the variance and impulse–response analysis suggests that an increase in inflation expectation is associated with a decrease in the credibility index in the short run. The relative importance of Selic (20%) in the credibility index variance is close to that given by the inflation expectation. Further, it can be seen that an increase in Selic provokes a decrease in the credibility index that abides during three years (see second graph in the fourth row in Fig. 5). Contrary to previous cases, credibility index is not negligible in the explanation of variance decomposition (15%) and an impact of an increase in credibility index takes more than two years to vanish (see last graph in the fourth row in Fig. 5). As a consequence, these results imply that it is not possible to put the market expectation for inflation on a second plane in the analysis.

V. Final Considerations

Both indices used to analyse the inflation targeting credibility in Brazil reveal a paradoxical result. While the Cecchetti and Krause index denotes a reasonable credibility for the recent period (except the last quarter of 2002 and 2003), the other index reveals a too low level of credibility (except 2000). The main motive for this divergence is due to the methodology for building the indices. In the first case, the index considers the ideal inflation target (2%), however, for a total loss of credibility an inflation that exceeds 10% is needed. In the second index, the inflation target is higher than 2%, but the limit for fluctuation in relation to the target was too rigorous to achieve credibility.

It is important to note that all inflation measured by IPCA is a result of administered prices and market prices, thus it is the responsibility of the CBB to use the instrument (Selic) in an adequate manner to achieve the inflation target. The empirical evidence shows that CBB used the interest rate in an attempt to neutralize the inflation pressures on the economy. Albeit, the problem of monetary policy in Brazil during the period under analysis is that the CBB did not use the interest rate at a sufficient level to neutralize the inflationary focus. The fact that the CBB did not use the core of the announced target as a real objective contributed to the deterioration of the inflationary expectations of the public. As a consequence, this is hardly a good way of establishing credibility.

Due to the change in the exchange regime in January of 1999, inflation target in Brazil was implemented with the main objective of a gradual elimination of the inflation. Therefore, the Minister of Finance and the Governor of the Central Bank of Brazil decided that the use of escape clauses was not adequate. The justification for this is that the Central Bank of Brazil should demonstrate competence in the achievement of the announced targets (independent of shocks) in order to develop credibility.[16] Nevertheless, in accordance with the second index used in this article, this framework was not correct for achieving the aspired objectives. The results denote that the inflation targeting strategy, the way it was introduced in Brazil (without escape clauses), is not a good guide for public expectations in the presence of supply shocks and exchange rate volatility. In this sense, the framework implicit in the first index could help to restore reputation in inflation targeting which would in turn contribute to the development of credibility.

The Central Bank of Brazil, in June of 2002, decided to alter the inflation target and tolerance interval for 2003 and 2004 due to the risk of a permanent loss in credibility for inflation targeting in Brazil.[17] In spite of these changes, in January of 2003,

[16] The use of escape clauses in extreme situations implies that there is no loss in credibility when the target is not achieved, because changes in planned policies are not a result of time inconsistence problem, but a result of variables that cannot be foreseen.

[17] The target in 2003 was changed from 3.25% to 4% and in 2004 the target is 3.75%. Besides this, the tolerance interval was changed from ±2% to ±2.5%. After this, a new change in targets occurred – the target for 2003 was 8.5% and for 2004 is now 5.5%.

the Central Bank of Brazil, anticipating that it would not be capable of achieving the announced target, decided to modify the target again. The target for 2003 became 8.5% while the target for 2004 changed from 3.75% to 5.5%.

These successive changes in the inflation targets damage the trust in economic agents in inflation targeting as a guide for building expectations. One problem that is necessary to correct for the conduction of the monetary policy in Brazil refers to the time horizon for defining targets. The imprudence of the Central Bank of Brazil in defining inflation targets for several successive years represents a risk for its monetary regime. Economies that are too susceptible to external shocks, such as the Brazilian economy, are too unstable and do not permit a reasonable inflation forecast. Therefore, with the objective of recuperating the credibility in this monetary regime it is not necessary to announce inflation targets for several successive years. An annual announcement of the inflation target defined by consensus between the government and the Central Bank of Brazil would imply an increase in quality in defining the target, because it would be possible to analyse the economic conditions and project it for a short period.

According to Cecchetti and Krause (2002) a definition for the inflation target up to an upper limit close to 20% is possible. It is obvious that this limit is not an ideal inflation rate for the economy, but it represents the maximum level that the central bank can control. The main point is that the inflation targeting needs not only the definition of an ideal target (2%), but also an evaluation of the economic conditions for defining the target. The definition of a high inflation target (the public believes in its success – such as in 1999) is better than a definition of an inflation target that does not have credibility. As highlighted by Blinder (2000, p, 1422) 'A central bank is credible if people believe it will do what it says.'

The attempt of the Central Bank of Brazil in achieving quick credibility by defining inflation targets lower than what can be achieved tends to be disastrous. In this case, the necessity of maintaining the interest rate at a high level in order to guide the public expectation in the direction of the announced targets can put at risk the macroeconomic stability in the long term. The main negative effects that justify this possibility are an increase in management of the public debt and a fall in the economic growth rate. Therefore, the lack of the Central Bank of Brazil credibility is not a fault of the monetary regime used, but a result of the bad configuration of targets in relation to their magnitude and the time horizon.

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Appendix

Table A.1. Unit root tests (ADF and PP)

	ADF				PP			
Series	Lag	Test	Critical values 1%	Critical values 5%	Lag	Test	Critical values 1%	Critical values 5%
i	1	−3.1284	−3.5384	−2.9084	5	−0.6228	−2.6016	−1.9460
D(*i*)	0	−2.8749	−2.6022	−1.9461	3	−3.1449	−2.6022	−1.9461
mp	2	−2.4743	−3.5402	−2.9092	5	−0.4990	−2.6016	−1.9460
D(*mp*)	1	−2.8869	−2.6028	−1.9462	3	−4.2869	−2.6022	−1.9461
adm	1	−1.1856	−2.6022	−1.9461	3	−0.9031	−2.6016	−1.9460
D(*adm*)	0	−5.4287	−2.6022	−1.9461	0	−5.4287	−2.6022	−1.9461

Note: Augmented Dickey–Fuller test (ADF) – the final choice of lag was made based on Schwarz criterion (SC). No-constant specification or time trend was used for series D(*i*), D(*mp*), adm and D(*adm*). Constant was used for series: *i* and *mp*. Phillips–Perron test – lag is the lag truncation chosen for the Bartlett kernel. No-constant specification or time trend was used.

Table A.2. Johansen's cointegration test (*adm*, *mp*, *i*)

Hypothesized no. of CE(s)	Eigenvalue	Likelihood ratio	5% Critical value	1% Critical value
$R = 0$*	0.349179	35.07856	29.68	35.65
$R \leq 1$	0.090561	7.589226	15.41	20.04
$R \leq 2$	0.023377	1.513867	3.76	6.65

Note: (*) denotes rejection of H_0 at the 5% significance level. The critical values were tabulated by Osterwald-Lenum (1992).

Table A.3. Unit root tests (ADF and PP)

	ADF				PP			
Series	Lag	Test	Critical values 1%	Critical values 5%	Lag	Test	Critical values 1%	Critical values 5%
IC	0	−1.131900	−2.566737	−1.941066	12	−1.206708	−2.566737	−1.941066
D(IC)	0	−35.83325	−2.566738	−1.941067	12	−35.99147	−2.566738	−1.941067
INFT	0	−0.511572	−2.566737	−1.941066	0	−0.511572	−2.566737	−1.941066
D(INFT)	0	−36.08324	−2.566738	−1.941067	0	−36.08324	−2.566738	−1.941067
EINF	0	−0.235465	−2.566737	−1.941066	14	−0.309662	−2.566737	−1.941066
D(EINF)	0	−34.82541	−2.566738	−1.941067	14	−35.31552	−2.566738	−1.941067
Selic	20	−0.329762	−2.566764	−1.941070	3	−0.362220	−2.566737	−1.941066
D(Selic)	19	−5.377473	−2.566764	−1.941070	3	−35.21825	−2.566738	−1.941067

Note: Augmented Dickey–Fuller test (ADF) – the final choice of lag was made based on Schwarz criterion (SC). Phillips–Perron test – lag is the lag truncation chosen for the Bartlett kernel. No-constant specification or time trend was used.

Table A.4. AIC, SIC and HQ criteria for VAR

VAR	With constant			No constant		
Order	AIC	SIC	HQ	AIC	SIC	HQ
0	10.34747	10.36340	10.35345			
1	−10.14250*	−10.06286*	−10.11261*	−10.14028*	−10.07657*	−10.11637*
2	−10.14225	−9.998903	−10.08846	−10.14018	−10.01276	−10.09236
3	−10.12906	−9.921996	−10.05136	−10.12742	−9.936288	−10.05570
4	−10.10768	−9.836909	−10.00608	−10.10631	−9.851465	−10.01068
5	−10.10405	−9.769561	−9.978536	−10.10294	−9.784385	−9.983409
6	−10.09996	−9.701767	−9.950547	−10.09914	−9.716870	−9.955699
7	−10.08433	−9.622424	−9.911008	−10.08363	−9.637647	−9.916281

Note: (*) denotes lag order selected by the criterion.

Table A.5. Granger causality test

VAR(1)			
Null hypothesis:	Obs	*F*-statistic	Probability
SELIC does not Granger Cause INFT	1304	0.00031	0.98598
INFT does not Granger Cause SELIC		2.41973	0.12006
EINF does not Granger Cause INFT	1304	1.11195	0.29185
INFT does not Granger Cause EINF		2.55759	0.11001
IC does not Granger Cause INFT	1304	0.90484	0.34166
INFT does not Granger Cause IC		2.17044	0.14093
EINF does not Granger Cause SELIC	1304	2.69245	0.10107
SELIC does not Granger Cause EINF		2.94108	0.08659
IC does not Granger Cause SELIC	1304	2.42754	0.11946
SELIC does not Granger Cause IC		0.08139	0.77547
IC does not Granger Cause EINF	1304	1.65878	0.19800
EINF does not Granger Cause IC		2.47997	0.11555

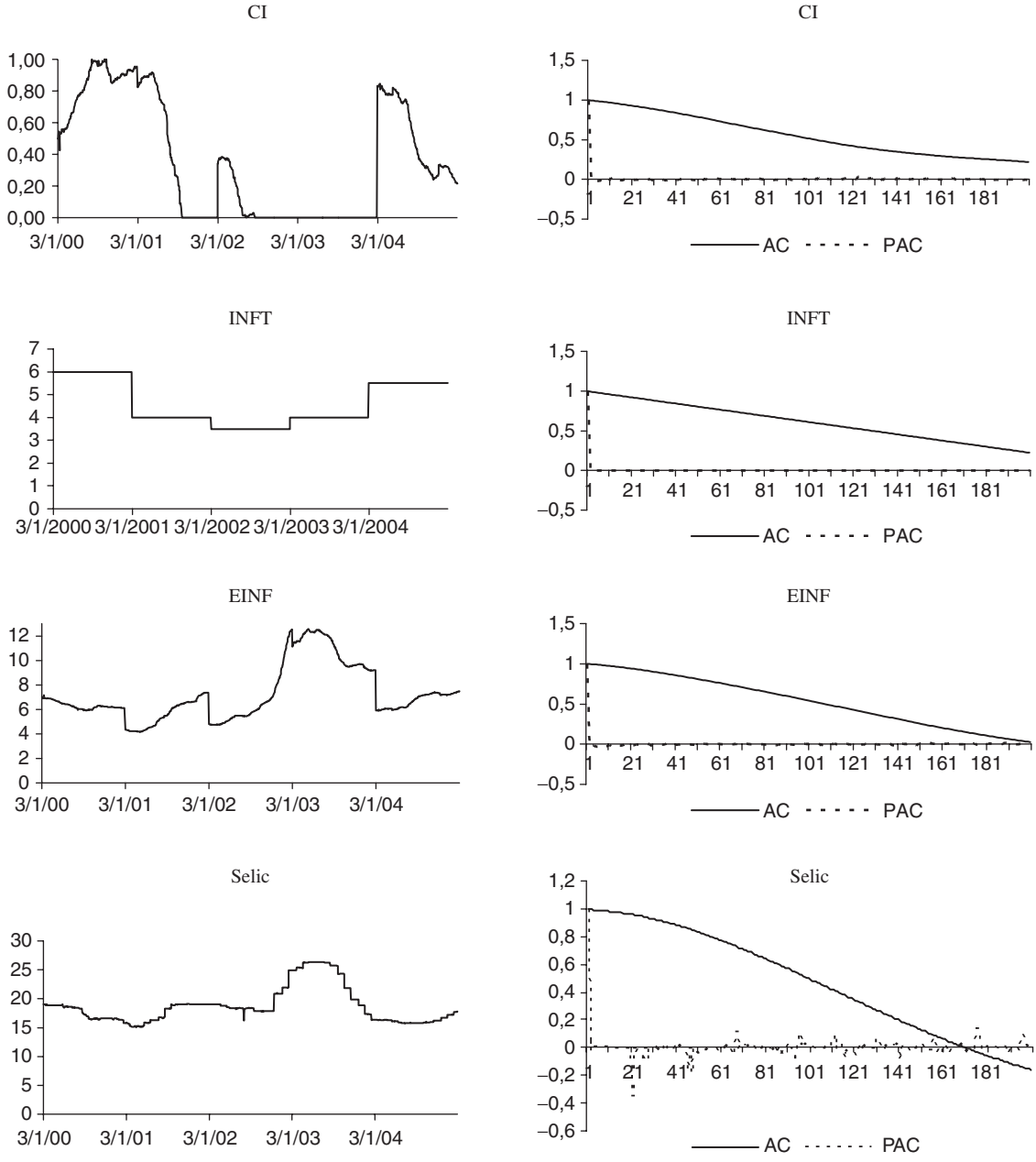

Fig. A.1 Evolution and correlogram of the series