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Joel Bogdanski, Paulo Springer de Freitas, Ilan Goldfajn and Alexandre Antonio Tombini

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Edited by:

Research Department (Depep)
(e-mail: conep.depep@bcb.gov.br , workingpaper@bcb.gov.br)

Authorized by Ilan Goldfajn (Director of Economic Policy)

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Banco Central do Brasil
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Joel Bogdanski
Paulo Springer de Freitas
Ilan Goldfajn
Alexandre Antonio Tombini

Abstract

This paper examines the recent evolution of monetary policy since the adoption of formal inflation targeting in Brazil. We argue that the new policy framework has been subject to a severe test in its first years of existence, represented by external shocks – oil prices, and increased international financial volatility. Moreover, we examine some selected issues that deserve due consideration given their importance to the conduct of monetary policy. The first issue is the presence of a substantial portion of prices with backward-looking adjustment, a fact that affects monetary policy reaction since it reduces the efficiency of domestic interest rates in controlling inflation. The second addresses the question of how inflation targets should be monitored in a country that has an ongoing economic program with the International Monetary Fund. This last issue is particularly important when considering the effects of shortening monitoring horizons on the variability of inflation and output.

Inflation Targeting in Brazil: Shocks, Backward-looking Prices, and IMF Conditionality[◊]

1. Introduction

In mid-January 1999, Brazil abandoned its crawling exchange-rate band regime. Surprisingly enough, the country's economic performance in the aftermath of this episode was much better than what was expected, given the performance of other emerging market economies after a move toward floating. In fact, despite the large devaluation of the domestic currency that followed the regime shift, GDP grew 0.8% in 1999 and 4.5% in 2000, while consumer price inflation behaved much in line with the declining targets established in mid-1999, of 8% and 6%, respectively.

This paper examines the main factors that helped Brazil withstand the negative effects of a change in the exchange rate regime and enabled the economy to recover rapidly, namely, the combination of fiscal restraint with a well-defined purpose for monetary policy. The following section describes the macroeconomic background that culminated in the currency devaluation, the volatile expectations environment that followed, and the evolution of monetary policy in the transition to inflation targeting.

Section 3 presents a stylized model that we use in our discussion of the transmission mechanism. Section 4 discusses the transmission mechanism, highlighting the main channels, the lag structure and the exchange rate passthrough. These issues are presented with a prospective view of their evolution as the economy converges to its new steady state.

The model outlined in Section 3 serves as the basis for the simulations performed in Sections 5 and 6. Section 5 describes how monetary policy has reacted to shocks since

[◊] The opinions in this paper reflect the authors' view, not necessarily the official position of the Central Bank of Brazil. Needless to say, any errors are our own responsibility.

the implementation of the inflation-targeting regime based on inflation forecasting. We examine the Central Bank's track record in responding to all sorts of shocks, including international oil prices, food price, and volatility in international financial markets. Given the relative weight of institutionally backward-looking prices in the consumer basket, we decompose the model into inertial prices and market prices to show how the institutional framework in Brazil affects the transmission mechanism of monetary policy and therefore its instrument's efficiency when reacting to shocks.

Section 6 focuses on alternative ways to monitor the performance of monetary policy under inflation targeting. This issue is especially relevant when a country has an ongoing program with the IMF, since the traditional quarterly reviews demand a monitoring horizon much shorter than that of the targeting economy. We show that if the higher-frequency targets are not set in accordance with the lower frequency ones, and if policymakers try to meet all the targets, there will be suboptimal outcomes in terms of inflation and output variability. Section 7 concludes.

2. Macroeconomic Background

The Brazilian economy has undergone significant structural changes in the last decade. In the early 1990s the country's real income has remained stagnant, with low investment and saving rates, and very limited access to international capital markets. Inflation was high and rising, helping to conceal the serious structural imbalances of the public sector and making extremely difficult to carry out even the simplest planning activities. Brazil has started to make real progress in economic and financial stability only since 1994, with good results in terms of inflation, growth, trade liberalization, and international insertion. Despite this relative success, critical problems remained to be addressed, mainly the rising deficits in the current account and the deterioration of fiscal position. It is important to discuss this macroeconomic evolution in order to understand the current economic environment, characterized by a consistent combination of inflation targeting, floating exchange rate, and fiscal discipline.

2.1 From Exchange-Rate-Based Stabilization to Floating

The stabilization program known as *Real* Plan was successful in putting an end to Brazil's history of chronic high inflation. It was preceded by a minimal fiscal adjustment and followed by tight monetary control. The key issue was to coordinate a deindexing process to break the inflationary inertia, since the automatic price adjustments to past inflation were not synchronized. The solution was the introduction in March 1994 of a new unit of account, the unified reference value (URV), whose value the Central Bank fine-tuned on a daily basis in line with the loss of the currency's purchasing power. All prices and wages, as well as the exchange rate, were denominated in URV. Prices were converted directly, while wages were converted by their average past purchasing power. Then, on July 1st 1994, the indexation mechanism was extinguished and the URV became the new currency, called the *real*. Demand pressures naturally arose with the sharp inflation decline – for example, the reduction of inflation tax alone accounted for an additional disposable income of R$ 15 billion in the subsequent twelve months – and a very tight monetary policy was needed to counter these pressures, mainly with high real interest rates and stringent credit restrictions.

Even though the stabilization program was correctly conceived with due attention to fiscal austerity, the implementation of the comprehensive agenda of structural reforms was much slower and more difficult than had been expected, especially when legislative support was needed. On the other hand, the international financial environment seemed favorable, and the Brazilian economy reentered the route of foreign investment after the rescheduling of its external debt within the Brady Plan. With these perspectives, it was natural for policymakers to concentrate first on the fight against inflation and indexation, since the immediate results in this front would determine the future of stabilization, and there seemed to be enough time to address the remaining fundamentals.

Another key issue in the first phases of stabilization was the choice of a suitable exchange-rate policy. The monetary authorities decided to start with a float, which immediately led to a continuous nominal appreciation, given that the high real interest rates were effectively attracting capital inflows. The Mexican crisis in late 1994 prompted a shift to a crawling-band regime, which was formally adopted in March 1995. From July 1995 through mid-January 1999, exchange-rate policy was conducted on the basis of an annual devaluation target of around 7.5 percent. The price stabilization plan was successful, since the economy eliminated short-run indexation practices, and annual inflation dropped from 929% in 1994 to less than 2% in 1998.

The stabilization process included a wide program of economic reforms. The size of the public sector was substantially reduced through privatization of state companies operating in sectors like telecommunications, chemistry, steel, railroads, banking and mining. Likewise, trade liberalization was deepened through the reduction of import tariffs and elimination of non-tariff barriers. The financial system was submitted to a full-fledged restructuring: unsound institutions were liquidated, merged or restructured; prudential regulation was updated; and supervision was reorganized to take on a more preventive approach. This strengthening of the financial system was a crucial element in the country's reaction to the external crises that were to come.

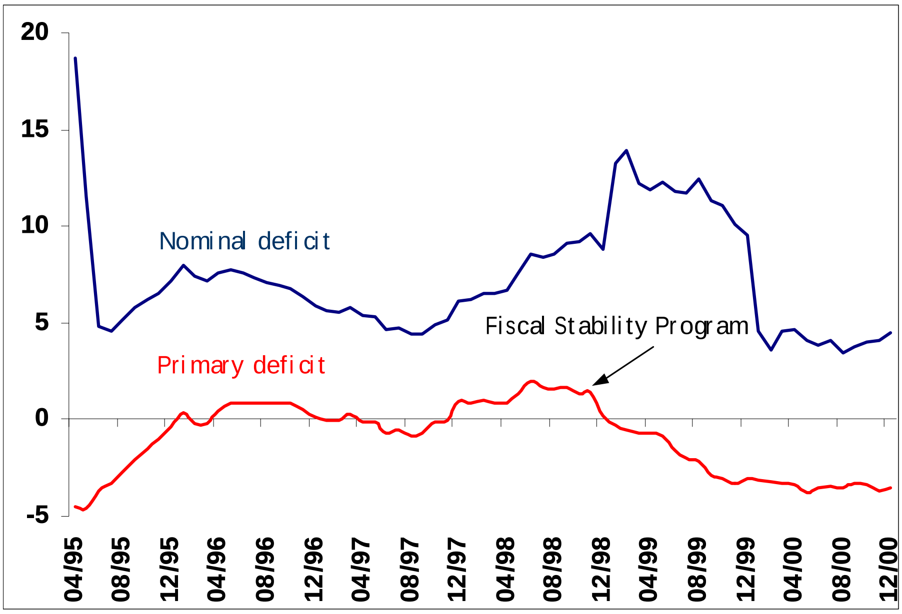
The fiscal position gradually worsened, however, as the inflation decline unveiled the structural imbalances of public accounts due to the elimination of the so-called inverted Olivera-Tanzi effect, or the reduction of real spending that results from the postponement of non-indexed public expenditure[1]. Despite the initial fiscal adjustment, conditions for its sustainability were not created. Several constitutional reforms of high priority to the government remained stuck in the congressional agenda, including the tax reform, the establishment of limits on public spending in all levels of administration, and the social security reform for both private and public sectors. The lack of political agreement on the need to change the fiscal regime, combined with continued high interest rates and sterilized intervention – which were required to support the exchange-rate policy – fuelled the public sector debt (see figure 1). Currency appreciation, growth of domestic demand, and incentives to short-term capital inflows resulted in a rapid

[1] Bacha (1999) provides a comprehensive discussion of the fiscal problems that characterized the initial years of the *Real* Plan.

growth of the current account deficit, thereby increasing Brazil's vulnerability to confidence shocks.

Figure 1 - Public Sector Borrowing Requirement

(percentage of GDP in 12 months)



The first shock was triggered by the Asian crisis in the second half of 1997. In the face of capital outflows, the Central Bank promptly reacted by doubling the basic interest rate to 43.4% p.a. in November. The government pressed for a strong fiscal response to complement the monetary tightening. In a matter of weeks, the Congress approved a fiscal program called '*Package 51'*, which featured spending cuts and tax increases totaling R$20 billion, or about 2% of GDP.[2] The fast recovery of international reserves that followed allowed the Central Bank to reduce interest rates, but only gradually: they reached their pre-crisis level in July 1998. The fiscal program was not fully implemented, however. In particular, the spending cuts were postponed, as the political will to undertake them diminished in line with the perceived contagion effects.

The second shock, which followed the Russian moratorium in August 1998, met a much-deteriorated fiscal outlook. The country was much more affected by international

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[2] The name '*Package 51*' derives from the fact that it consisted of fifty-one different fiscal measures.

turbulence than in the previous episode as a result of a worldwide reassessment of risk exposure to emerging markets. Capital outflows were substantial in the ensuing months. The authorities responded with the same policy mix used to counter the Asian crisis effects. In September, the basic interest rate doubled to 40%, calling for a new fiscal tightening. This time, however, the government could not count on market support, a price it paid for not delivering the previously promised fiscal results. To address the issue of enforceability of fiscal discipline, the government sought a preventive program with the IMF. The financial support package amounted to US$41.5 billion, with about two thirds of the total becoming available in the first year. However, expectations deteriorated further at the end of 1998 after Congress rejected a bill to increase social security contributions for civil servants and to extend it to pensioners.

This time, the fiscal tightening measures were mostly implemented. Market confidence, however, continued to erode up to January 1999, partly reflecting concerns over the newly elected governors' commitment to adjust their states' finances. Any new sign of potential deviation from the fiscal target induced extreme market nervousness. Given its limited ability to sustain the exchange-rate crawling band regime, the Central Bank tried to promote a controlled devaluation of the *real* in the second week of January, but the absence of credibility led the market to bet massively against the new arrangement. Without alternatives, the monetary authority allowed the exchange rate to float, and the dollar value quickly moved from R$1.21 prior to the devaluation to nearly R$2.00 at the end of January (see figure 2).

Figure 2 – Exchange rate evolution (R$/US$)

The exchange rate devaluation had an immediate impact on tradable-goods prices at the wholesale level, fuelling expectations of a permanent rise in consumer inflation. The wholesale price index (IPA) increased 7% in February, the highest monthly rate since 1994, while consumer price inflation rose less, at slightly more than 1%. Given the change in the exchange-rate regime, the agreement with the IMF had to be reformulated. The estimates set in the reviewed Memorandum of Economic Policy were -3.5% for GDP growth and 17% for inflation, measured by the general price index[3]. The great uncertainties surrounding the country's future prompted a volatile expectations environment, with inflation and recession forecasts much larger than those above.

At the beginning of March, a new Board of Governors took office at the Central Bank. The policy guidelines set by the new team had two aims: to control inflation expectations, thereby reducing the degree of uncertainty in the short-run; and to design the new monetary regime based on inflation targeting.

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[3] The general price index in Brazil is a weighted average of wholesale prices (60%), consumer prices (30%) and civil construction prices (10%).

2.2 Transition to Inflation Targeting (March to June 1999)

The shift to a floating exchange-rate regime occurred in a moment of crisis. Even so, the regime seemed reasonable for Brazil. The country does not present the classical features required for an optimal currency area with the dollar or any other currency, and it is hard to find arguments to justify the adoption of a fixed exchange-rate regime, even in the more recent literature about monetary integration as a credibility instrument. Therefore, the first task of the Central Bank's new board was to find a monetary policy strategy compatible with the floating exchange-rate regime.

A fully discretionary monetary policy did not seem suitable, given the unstable nature of expectations during the transition period. It was natural to opt for a more rigid system, one that would represent a definite, strong commitment but that could also offer some indication of the future path of the economy; one that would allow enough flexibility for policymaking but that could also effectively anchor the public's expectations. The authorities therefore decided to set up an inflation-targeting regime.

An interesting feature of the new monetary policy regime was its gradual implementation. Adopting formal inflation targets was not feasible right after the floating, given the uncertainties surrounding the post-devaluation inflationary process. At the same time, the adoption of the framework required institutional changes to ensure operational independence for the Central Bank, as well as some time for consolidating the shift in fiscal policy. The Central Bank therefore immediately announced its intention to adopt an inflation-targeting framework, but it left the formal introduction of the program, together with the specification of the target value, to the second half of the year.

In relation to fiscal policy, a series of reforms were in course. In January, Congress approved an increase in social security contributions for working and retired civil servants (the same bill that had been rejected one month earlier), as well as the 1999 budget. In March, the bill extending the Provisional Contribution on Financial Transactions (CPMF) was approved, though with a five-month delay in the government's original schedule. Additional temporary tax increases and spending cuts were set up in the first quarter to compensate for this loss of revenues and to ensure strict adherence to the fiscal targets (namely, a consolidated public sector primary surplus of 3.1% of GDP in 1999). These measures included an increase in the turnover tax (COFINS) from 2% to 3% and its extension to financial institutions; an increase in the social contribution on net profits (CSLL) from 8% to 12%; and a marginal 0.38% increase in the tax on financial operations (IOF) in investment fund deposits and credit operations.

All of these actions were a clear demonstration of the government's commitment to fiscal adjustment. Policymakers seized the opportunity created by the crisis to enforce a major shift in the fiscal regime, thus laying a fundamental pillar to support inflation targeting. Although the reforms that were needed to ensure long-run fiscal equilibrium were far from complete, the government had the necessary instruments to achieve a reasonable fiscal performance for at least a decade. Even the most skeptical analysts had to acknowledge the feasibility of the announced fiscal targets.

The new Board took office at the Central Bank on March 4th, and the team immediately worked to calm financial markets. The expectation that an inflation hike could cause the real rates of return on public debt instruments to drop into the negative range was the first to be attacked. The Monetary Policy Committee (Copom), whose voting members are the Governor and Deputy Governors, raised the basic short-term interest rate (the *Selic*) from 39% p.a. to 45% p.a., taking into account that the future contracts for the next maturity were already trading at 43.5%. The idea was to accommodate the devaluation shock, but to counter its further propagation. It was acceptable that the relative price movements set in march with the devaluation would shift the price level upward, but the interest rate had to be set high enough to prevent the second-round inflationary process that could follow. The question was how to translate these ideas into practice, given the then chaotic state of expectations.

Expectations therefore had to be anchored one way or another, and for that purpose clear communication was crucial. The Committee therefore released a brief explanation of the policy decision right after the meeting – the minutes used to be released only after 3 months – asserting that "*maintaining price stability is the primary objective of the Central Bank*"[4]. Other official declarations indicated that price stability meant a monthly rate of inflation in the range of 0.5-0.7% by the end of the year. Moreover, *"in a floating exchange rate regime, sustained fiscal austerity, together with a compatible monetary austerity, supports price stability; as fiscal policy is given in the short-run, the control over inflationary pressures should be exerted by the interest rate; observed inflation is due to the currency depreciation, and markets expect a further rise in the price level this month; the basic interest rate should be sufficiently high to offset exchange-based inflationary pressures; and so, we decided to raise the basic interest rate to 45% p.a., but with a downward bias*[5]*, for if the exchange rate returns to more realistic levels, keeping the nominal interest rate that high would be unjustified."*[6]

In addition to the interest rate hike, the remunerated reserve requirement on time deposits was raised from 20% to 30% in order to reduce bank liquidity. Temporary incentives for capital inflows were granted in the form of tax reductions scheduled to last until the end of June. In the foreign exchange market, the rule was free floating, but the Central Bank kept the prerogative to make a limited amount of unsterilized intervention to counter disorderly market conditions[7]. The efforts to seek the voluntary commitment of foreign banks to maintain their exposure to Brazil continued.

The general outlook started to improve soon after, with a reversal of the exchange rate overshooting (the exchange rate fell from R$2.20 in the first week of March to R$1.66 at the end of April) and a reduction in both observed and expected inflation rates. The downward bias was applied twice before the Copom's next meeting: the interest rate was reduced first to 42% in late March and then to 39.5% in early April.

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[4] Explanatory Note to Copom's Decision – March 4, 1999.

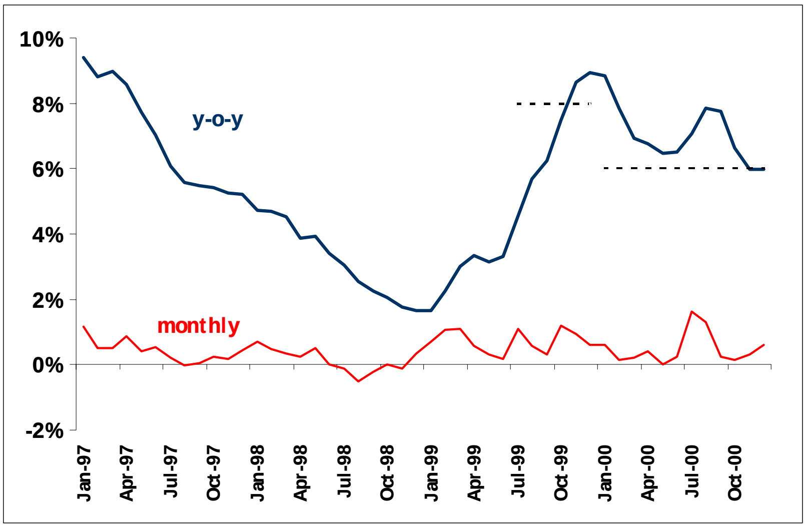
[5] The bias on the interest rate was also an important novelty: it delegated to the Central Bank's Governor the power to alter interest rates during the period between two ordinary Committee meetings (usually 5 weeks). A downward bias allows the Governor to reduce the interest rate. However, if an increase in the interest rate is needed instead, while a downward bias is valid, an extraordinary meeting is required.

[6] Explanatory Note to Copom's Decision – March 4, 1999.

[7] Brazil Memorandum of Economic Policies, released on March 8, 1999.

Market confidence was also strengthening as a result of delivered fiscal promises. The public sector primary surplus reached 4.1% of GDP in the first quarter, in excess of the government's target. The first evidence of decelerating inflation materialized in the April figures. The reversal of the exchange rate overshooting and the effect of the new crop on food prices were held responsible for the immediate decline in inflation. The wholesale price index, in which tradable goods have a large weight, registered negative changes in April (-0.3%) and May (-0.8%). Consumer inflation measured by the broad consumer price index (IPCA) fell to 0.6% in April and 0.3% in May (figure 3). Inflation expectations followed suit: the median of market forecasts of consumer inflation for 1999 was revised from 13% in March to 7.7% at the end of May[8].

Figure 3 – Inflation evolution



The positive evolution of the macroeconomic environment allowed further reductions of the basic interest rate. However, the level of uncertainty rose again as a result of external developments. By mid-May, the U.S. Federal Reserve Board introduced an upward bias for the federal funds rate, which remained constant at 4.75% after December 1998, signaling a gradual monetary tightening for the second half of the year.

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[8] The Central Bank's Investor Relations Group (GCI) collects market inflation forecasts daily, sampling 70 financial institutions and consulting companies. The survey was initiated in April 1999. The data are available on CD-ROM (*Focus and other Reports: 1999-2000*), and at http://www.bcb.gov.br/updatescd/default.asp. For IPCA, the survey begins in June, when this index was chosen as the reference for inflation targeting (see figure 5). Data before June are based on a preliminary unpublished survey of a very small number of institutions.

Expectations of higher international interest rates undermined risk perception, as did potential contagion effects stemming from doubts about the electoral process and the currency board sustainability in Argentina. The immediate repercussions were on market-determined interest rates and the exchange rate. The slope of the term-structure curve turned from negative to positive and the exchange rate moved upward to the R$1.75-1.80 range (Figure 4). A subjective explanation to this new depreciation then became popular in the specialized press and was to recur in similar subsequent episodes: foreign exchange market participants, who were still unused to the new floating regime, tried to infer the "Central Bank's intervention band" – if there was one, considering the limits imposed by the performance criterion on net international reserves set up in the IMF agreement. More objective factors included the concentration of amortization payments of private sector external debt due in June, the combination of rising risk premium and a declining interest rate differential, and the near termination of the temporary tax incentives on capital inflows introduced in March. Therefore, monetary policy became somewhat more conservative, reducing the interest rate at a slower pace.

Figure 4 – Interest Rates and Exchange Rate

In sum, the policy response to the crisis triggered by the initial exchange rate devaluation consisted of fiscal and monetary tightening, and it was successful in subduing inflation expectations. Although an inflation-targeting framework was not formally in place, the Central Bank already justified its monetary policy decisions as if it were. The short-term interest rate became the main instrument for attaining the inflation objectives, and with inflation expectations under control, it was cut in half in less than four months.

3. The Stylized Structural Model[9]

According to Mishkin and Savastano (2000), inflation targeting comprises five main features: (i) the public announcement of medium-term numerical targets for inflation; (ii) an institutional commitment to price stability as the primary goal of economic policy, to which other objectives are subordinated; (iii) an information-inclusive strategy, encompassing the use of several variables and models, to enable the monetary authority to set policy instruments; (iv) a transparent monetary policy strategy that ascribes a central role to communicating to the public the plans, objectives and rationale of the central bank's decisions; and (v) mechanisms for making monetary authorities accountable for achieving the inflation targets. The first feature, a numerical target value, must be low, feasible and compatible with the macroeconomic outlook.

With this in mind, the Brazilian authorities placed a high priority on understanding the transmission mechanism of monetary policy to prices, with emphasis on developing a set of forecasting tools, including structural models for the transmission mechanism, non-structural time-series vector autoregression (VAR) and autoregression moving average (ARMA) models for short-term forecasting, measures of core inflation, leading inflation indicators, and surveys of market expectations. The most important of these tools is the family of structural models, which is estimated and/or calibrated with the dual objective of identifying the mechanism of monetary policy and assessing the transmission lags involved. A representative structural model of this family contains four basic equations. The first is a standard IS equation that captures the aggregate demand response to real interest rate and real exchange rate. The second is a typical open-economy Phillips curve, representing the supply-side trade-offs. The third is an equation for the exchange rate and the fourth is an interest rate rule that is essential for simulations.

The standard specification of an IS curve with quarterly frequency could be as follows:

(I) $h_t = \beta_0 + \beta_1 h_{t-1} + \beta_2 r_{t-1} + \beta_3 \theta_t + \varepsilon_t^h$

where *h* is the log of the output gap; *r* is the log of the real interest rate (log(1+R)); θ is the log of real exchange rate; and ε^h represents a demand shock. Other specifications might include different lag structures or additional explanatory variables. Bogdanski *et al*. (2000), for example, present a 'fiscal' IS specification, which explicitly considers the effects of the shift in fiscal regime on aggregate demand.

The first problem for the Central Bank was how to measure the variables that are not directly observable, like the output gap. The usual starting point is the calculation of potential output, either by extracting a linear time trend from historical GDP data, by filtering out the GDP series, or by estimating production functions. In the Brazilian case, the linear trend and HP filter were preferred since both produced similar results. The output gap was then obtained by the difference between actual and potential GDP, allowing direct estimates of the different IS curves. However, research efforts on this crucial topic are far from over.

The estimation results posed a second problem, since they were heavily influenced by post-*Real* Plan data (third quarter 1994 to fourth quarter 1998). As mentioned in the previous section, the managed exchange-rate regime in the *Real* Plan was very instrumental in reducing inflation and keeping it low, at the cost of setting the domestic interest rates high enough to attain a balance-of-payments position compatible with the desired parity. The equilibrium real interest rate under the current floating exchange-rate regime should therefore be substantially lower than under the previous regime. The transition effects stemming from the new equilibrium level of real interest rates called for a long-term calibration of the demand side reduced-form model. In the long-run steady state, the output gap should remain constant at zero. As a first approximation, it

[9] This section is based on Bogdanski, Tombini and Werlang (2000).

is assumed that the long-term equilibrium real interest rate must equal the potential GDP growth rate. A thorough analysis of this question should also include fiscal policy considerations, like the long-run fiscal balance and debt administration issues, which may add or subtract a few percentage points to the first approximation for the neutral rate. In the IS curve specification above, this is equivalent to setting $\bar{r} = -\beta_0/\beta_2$, since β_3, the real exchange rate coefficient, is very close to zero. So, a straightforward calibration would consist of estimating the IS curve with the additional restriction on the pair (β_0,β_2), whose ratio must equal the long-term equilibrium real interest rate.

The supply side of the economy is modeled with a Phillips-curve specification, directly relating price inflation to some measure of real disequilibrium (typically the output gap), inflation expectations, and exchange-rate changes. For example,

(II) $$\pi_t = \alpha_1\pi_{t-1} + \alpha_2 E_t(\pi_{t+1}) + \alpha_3 h_{t-1} + \alpha_4\Delta(p_t^F + e_t) + \varepsilon_t^n$$

where: π is the log of consumer price inflation, h is the log of the output gap, p^F is the log of foreign producer price index, e is the log of the nominal exchange rate, Δ represents the first-difference operator, $E_t(\cdot)$ is the expectation operator, conditional on information available at time t, and ε^n stands for a supply shock. The coefficients on the right-hand side of the equation, except for the output gap one, are constrained to sum to unity; this ensures the long-run verticality of the Phillips curve, that is, that inflation is neutral with respect to real output in the long run.

This specification combines backward- and forward-looking elements. A purely backward-looking specification would be simpler to estimate and would fit past data. However, it would also be vulnerable to the Lucas critique. Its predictive power would be weak because of the recent changes in monetary policy and exchange-rate regimes, which almost certainly have altered the formation of inflation expectations and the short-run trade-off between inflation and output. Using a purely forward-looking specification would be an attempt to overcome the parameter instability commonly found after structural breaks. It might also stem from the natural assumption that as the inflation-targeting regime gains credibility, expectations tend to converge to the targeted value. Such a specification raises difficult estimation issues, however, about the appropriate measures of expectations, especially when reliable survey data are not available.

The Central Bank tested different assumptions about the expectations mechanism, but the estimations generally led to a weighted average of past and future inflation, with at least 60% on the forward-looking component. The preferred Phillips-curve specification, together with the other equations in the complete model, exhibited the desired dynamic properties of the economy, with inflation persistence arising from sluggish adjustment forced by the backward-looking terms, while the rational expectations environment was preserved by the forward-looking component, thought to be increasingly important in the transition period after the changes in monetary policy and exchange-rate regimes.

For the purpose of running simulations to investigate the implications for inflation and output of different monetary policy rules, it is easy to experiment with alternative assumptions about the expectations formation mechanism. For example, expectations can be taken exogenously from a market survey and augmented by a hypothesis about how they react to new information, or they can be calculated recursively to ensure consistency with the model.

The passthrough of exchange-rate changes to domestic inflation is another key issue in the Phillips curve setup. Several linear and non-linear specifications for the passthrough coefficients were tested, and the alternatives implemented in the preferred simulation tool were narrowed down to four. The first is a standard constant coefficient $\alpha_4 = \text{constant}$, simply estimated from a suitable sample of past data. The second is a quadratic transfer from exchange rate variations to inflation, $\alpha_4 = \alpha_{41} + \alpha_{42}\Delta(p_{t-1}^F + e_{t-1})$. The third is a level-dependent coefficient, $\alpha_4 = \alpha_{41} + \alpha_{42} e_{t-1}$, which is estimated under the assumption that the passthrough depends on the level of the log of the nominal exchange rate. Finally, the fourth is a quadratic function of the nominal exchange rate level, $\alpha_4 = \alpha_{41}\dfrac{E_{t-1}^2 - \alpha_{42}}{E_{t-1}^2 + \alpha_{42}}$, motivated by a simple partial equilibrium model in which exchange-rate devaluations shift the supply curve of competitive producers of tradable goods[10]. All non-linear variants aim to capture more precisely the effects of a temporary exchange rate overshooting. Given the small number of observations available in a quarterly frequency, however, their results were very close to the linear variant and consistent with international evidence that the passthrough coefficient is inversely proportional to the degree of real exchange rate appreciation at the moment prior to the devaluation.

The determination of the nominal exchange rate is as important as it is difficult. The Central Bank's first approach was to use an uncovered interest parity (UIP) condition to model the link between the exchange rate and the interest rate through capital markets. The UIP condition relates expected changes in the exchange rate between two countries to their interest rate differential and a risk premium:

(III) $E_t e_{t+1} - e_t = i_t - i_t^F - x_t$

where: e is the log of the exchange rate, i is the log of domestic interest rate, i^F is the log of foreign interest rate, and x is the log of risk premium. Taking the first difference $E_t e_{t+1} - E_{t-1} e_t - \Delta e_t = \Delta i_t - \Delta i_t^F - \Delta x_t$ and assuming for simplicity that the expectation change follows a white noise process[11] $E_t e_{t+1} - E_{t-1} e_t = \eta_t$, it is possible to specify the exchange rate dynamics as:

(IV) $\Delta e_t = \Delta i_t^F + \Delta x_t - \Delta i_t + \eta_t$.

This equation contains two exogenous variables: the foreign interest rate and the risk premium. Given the relative stability of foreign interest rates, reasonably accurate projections can be obtained from contracts traded in international futures markets. However, the risk premium, which can be measured by the spread between U.S. Treasury bonds and Brazilian sovereign debt, has presented high volatility in recent years. The risk premium is usually associated with macroeconomic fundamentals and a number of other subjective factors that are not easily anticipated. Two alternative approaches were therefore considered. The first was to gather the opinions of Copom members about the future evolution of the country's risk premium, conditional on the

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[10] See the appendix in Goldfajn and Werlang (2000).

overall scenario and based on anecdotal evidence; these opinions were then translated into an exogenous expected path to be used in simulations. The second approach was to make assumptions linking the risk premium behavior to the main objective factors thought to influence it, thereby allowing the model to endogenously determined the premium. A list of these factors would typically include the fiscal stance, perspectives on the current account balance, international liquidity conditions and interest rates, the performance of foreign capital markets, commodity prices, and country rating.

Finally, the fourth equation is left unspecified in the general model. Since the primary instrument of monetary policy is the short-term interest rate set by the Central Bank, it is necessary to choose a policy rule in order to run simulations in any of the different reduced-form model specifications. The rules can be divided in three basic families: fully exogenous interest rate paths, linear combination of system variables and optimal response functions.

An exogenous interest rate path is useful for analyzing the consequences of a particular interest rate trajectory, such as that implied by financial market instruments or the implicit path considered in the government budget. A particular rule of this family is helpful for institutional communication. The inflation forecasts published in the quarterly inflation report are traditionally constructed under the assumption that the short-term interest rate will remain constant at the current level along the projection period. This projection is illustrated by means of an inflation fan chart, which shows the probability distribution around the central forecast for each quarter. On visual inspection, one can infer whether monetary policy should be altered and in which direction[12].

The interest rate rule can be written as a linear function of some system variables. For example, monetary policy can react contemporaneously to the output gap and deviations

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[11] This is equivalent to a random walk with monetary surprise, where a surprise is characterized by changes in interest rate differentials or in risk perception.

[12] Britton, Fischer and Whitley (1998) explain how to interpret inflation forecasts presented as fan charts. Haldane (1997) discusses how the introduction of a partially subjective probability distribution may help clarify the policymakers' assessment of the current economic stance. The Brazilian *Inflation Reports* make use of both resources to convey information about monetary policy decisions.

of inflation from target: $i_t = (1-\lambda)i_{t-1} + \lambda(\omega_1(\pi_t - \pi^*) + \omega_2 h_t + \omega_3)$. When λ=1, this is equivalent to a standard Taylor rule, whereas it is a Taylor rule with interest rate smoothing when $\lambda \in (0,1)$. The values of ω_i can be set arbitrarily or using specific optimization procedures available in the simulation tool. Finally, an optimal interest rate rule can be found by minimizing an appropriate loss function, subject to the model in use.

4. The Transmission Mechanism

The initial modeling efforts succeeded in reaching an early mature stage – that is, a reasonable degree of reliability and sensible dynamics. Two qualifications must be stressed, however. First, the general limitations stemming from model and parameter uncertainty apply. Second, the statistical time series for the Brazilian economy after the floating is too short to yield sufficiently robust results. Moreover, a sequence of failed stabilization plans from 1986 to 1994 produced important structural breaks in many economic series, thus making it extremely difficult to treat them with the usual econometric techniques. The various non-structural tools are therefore fundamental for complementing and checking the consistency of structural modeling results. Policymakers are well aware of the limitations of the available tools and have no illusions about their effectiveness. Nonetheless, the models have been very useful and have helped discipline the discussion on monetary policy within the Central Bank.

This modeling approach embodies the understanding that as in most other economies, the most important transmission channels are through aggregate demand, exchange rate and expectations. Preliminary estimation results with quarterly data indicate that permanent changes in the basic interest rate take one to two quarters to impact aggregate demand. This aggregate demand response, in turn, takes an additional quarter to be fully perceived in consumer inflation. Changes in short-term interest rates are thus transmitted to inflation through the aggregate demand channel with an estimated lag of two to three quarters. The exchange rate channel is estimated to have a shorter transmission lag: the effect of permanent interest rate changes on consumer prices through this channel is contemporaneous (on a quarterly basis), but its magnitude is smaller than through the demand channel. These results are based on the strong assumptions that expectations remain consistent with the model after any policy change and that the policy change itself is a sufficiently small departure from the initial position so that the log-linear approximation remains valid.

Further qualifications come into play at this point. First, the lag structure in the aggregate demand channel is shorter than that found in the majority of either industrialized or developing economies. This may be the result of the large swings in real interest rates that characterize the post-*Real* Plan sampling period. These large swings generated prompt output and inflation responses, although the magnitude of the responses was relatively small in comparison with the interest rate variations. The lag is expected to increase gradually as the economy converges toward its long-run steady-state equilibrium.

Second, although the lag structure is short, the overall effect is modest, for several reasons. The financial system, for example, is overregulated, with a variety of credit restrictions, mandatory allocation of funds, and distorting taxes. The banking spread has therefore remained extraordinarily high, and the system as a whole presents a low leverage compared to international standards. This banking spread makes the transmission channel from the basic interest rate to market-determined final loan rates much weaker than desirable, and it explains part of the high volatility of interest rates observed in the last three to five years. This fact leaves the impression that a slight deviation from the expected path requires a significant change in the basic interest rate to bring the economy back to the central path. In other words, the interest-rate elasticity of the macroeconomic equilibrium is low. A series of parallel projects is underway to correct these distortions in the financial system and improve the efficiency of the transmission mechanism.

The third qualification has to do with the passthrough. Goldfajn and Werlang (2000), who analyze panel data, conclude that the passthrough coefficient generally depends on four main factors: the degree of overvaluation of the exchange rate prior to the devaluation, the previous level of inflation, the degree of openness, and the economic activity level. On this ground, Brazil shifted to a floating exchange rate regime with good prospects for a low degree of passthrough, since inflation was low and the exchange rate showed clear signals of overvaluation after the deterioration of the terms of trade and the Russian crisis in 1998. Open and heated economies tend to present higher passthrough coefficients, other things equal. Although trade liberalization progressed well and fast in the 1990s, the degree of openness of the Brazilian economy (around 14 percent) is considerably low in comparison with international standards. Furthermore, the economy evolved below its potential after the Russian crisis. When the *real* floated, the output gap was undoubtedly negative, which provided a major force for countering passthrough pressures. Preliminary results thus confirm the tendency for a low passthrough.

5. POLICY REACTION TO SHOCKS

In this section we examine how monetary policy reacted to shocks after inflation targeting was implemented in Brazil. We begin by identifying the main shocks that occurred after July 1999 and the corresponding policy behavior. The identification addresses the nature as well as the duration of shocks. This task is obviously easier with the benefit of hindsight, although in some cases even the *ex post* interpretation of shocks is not straightforward.

The problem of inflation persistence is another key factor for understanding the policy reaction. Given the Brazilian institutional setting, which features a high weight of backward-looking prices in the consumer basket, policy responses are different from those in an environment in which all prices are forward-looking. Other peculiarities of the Brazilian inflation-targeting framework are also relevant for discussing policy reactions. These include the absence of escape clauses, the use of a headline price index, and the adoption of multi-year targets. All these peculiarities leave relatively little room for accommodation by monetary policy.

The term “backward-looking prices” deserves an explanation. These prices are also known as “government-managed prices”, given that they used to be arbitrarily set by the government before the privatization of state companies. Government-managed prices are now those that, in one way or another, are defined or affected by a public-sector agency, independently of current supply and demand conditions, but not arbitrarily. The major administered prices (and respective weights) in the reference consumer price index (IPCA) fall into two categories: those that are defined at the federal government level, including oil by-products (6%), electricity fees (3.3%), telephone and postal services fees (3%), and the minimum wage (3%); and those that are defined at the local governments level, including water and sewage fees (1,5%), public transportation (6%), and property taxes (1%)[13]. Taken together, these components account for around 25% of IPCA, reflecting their importance in daily expenditures of households in the income bracket from one to forty minimum wages. It is important to stress that 'managed' does not mean 'controlled'. Public utility fees constitute a substantial component of these prices. Their adjustment leaves no room for discretion: they follow the terms of their concession contracts; this links them to the past behavior of general price indices and thus justifies the designation of "institutionally backward-looking prices". The minimum wage, in turn, is set by the Congress. The central government only has effective direct control only over the wholesale prices of oil by-products, and it has been resetting them in accordance with international prices, in anticipation of the full liberalization of the domestic oil market scheduled for 2002.

5.1 Description of Main Shocks and Corresponding Policy Behavior

We identified a total of eight shocks between July 1999 and November 2000, including a wide variety of supply and "financial" shocks. The supply shocks were primarily associated with food market conditions and backward-looking prices, which include the effects of international oil prices. The financial shocks mainly derived from increased international volatility and deterioration of the market perception of Brazil's risk premium, which immediately alters the exchange rate value. Seven out of eight are classified as adverse shocks to the extent that their preponderate effect was to press inflation upward. The taxonomy is somewhat dubious, given the fact that the economy

[13] These figures are approximations, given that the actual weights vary over time.

is generally hit by more than one shock at the same time. Disentangling the combined effects of simultaneous shocks is somewhat arbitrary, as it is to associate monetary policy decisions with individual shocks.

The Brazilian economy in this period was far from its long-run balance, particularly with regard to the level of nominal and real interest rates. This means that in the absence of shocks, the interest rate would be expected to follow a declining path. Therefore, when policy reacted by keeping the interest rate constant, this actually represented a policy tightening, and not an accommodative stance.

Table 1 summarizes the main shocks that hit the Brazilian economy in the first eighteen months of inflation targeting.

Table 1 – Main Shocks and Policy Reaction

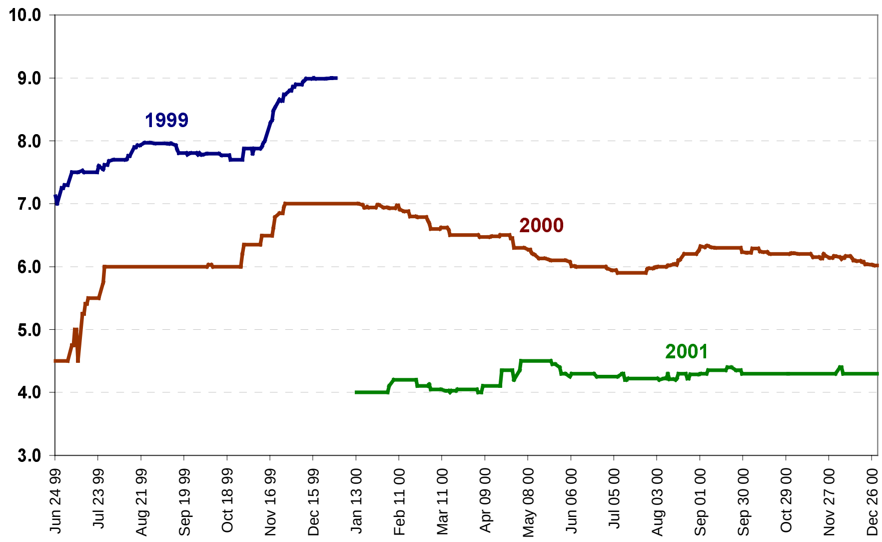
	Type of shock	Timing	Description	Reaction
1	Backward-looking prices (BLP)	Jul 1999	BLP higher than expected by the market; oil price	Interest rate reduced from 22% to 21%
2	BLP	Jul / Aug 2000	BLP accompanied by adverse oil and food prices	Interest rate held constant at 16.5%
3	Food prices	Jun 2000	Inflation much lower than expected in the first half	Interest rate reduced from 18.5% to 17.5%
4	Financial	Aug 1999	Disagreement with monetary policy, increased hedging demand	Interest rate held constant at 19.5%
5	Financial	Oct 1999	Inflation above expectations; trade deficit; concerns about passthrough and Y2K-related capital outflows	Interest rate held constant at 19%; NIR floor reviewed
6	Financial	Apr / May 2000	Int. stock market volatility; oil price upsurge; robustness of fundamentals	Interest rate held constant at 19%
7	Financial	Nov 2000	Oil price; Argentina	Interest rate held constant at 16.5%
8	Oil prices	Dec 1999	Concerns about tightening abroad, oil price evolution, and BLP for 2000; unexpected rise in food prices	Interest rate held constant at 19%; foreign exchange auctions

The shocks that we classify as "backward-looking prices" (BLP) stem from the annual resetting of public utility fees (including electrical energy, telecommunications, and water and sewage) that occurs at the beginning of the third quarter in most of the eleven cities covered by IPCA.[14] A great part of these services were privatized in the late

[14] Other managed prices, like minimum wage, oil by-products, and urban bus fares, are not necessarily readjusted at the beginning of the third quarter.

1990s, and their price adjustment follows contracts linked to the past variation of general price indices. The first shock (number 1 in table 1) is considered so because market participants did not anticipate it correctly. After the inflation figures for July 1999 were released, inflation expectations rose by one full percentage point (see figure 5). However, Copom had been taking this temporary inflation rise into consideration since the first issue of the Central Bank's *Inflation Report* (June 1999). The Committee decided to reduce the basic interest rate, since forecast year-end inflation was very close to the targeted level.

Figure 5 – Inflation Expectations



Median of market expectations for y-o-y IPCA inflation.
Source: Investor Relation Group – Central Bank.

When the second BLP shock (number 2) occurred, one year after the first, it was fully anticipated. Throughout the previous three quarters, monetary policy decisions had been explained to the public as aiming to counter possible second-round effects of this expected rise in backward-looking prices. However, this shock coincided with other two adverse developments. First, the domestic price of oil by-products was raised as a result of a new upsurge in international prices. Second, bad weather conditions throughout the country pushed food prices strongly upward. Consequently, the inflation forecast for the year was revised upward, and the interest rate was held constant. At the time, evidence from previous episodes (for example, in the last quarter of 1999) indicated that the effects of supply shocks vanish quickly once they are recognized as temporary, and they seem to have little impact on inflation expectations. This low price inertia was confirmed with the substantial decline in inflation that was observed in September and October 2000 (see figure 3).

The food price shock (number 3) was the only positive supply shock in the covered period.[15] It consisted of a gradual reduction in food prices that began in February 2000, but became stronger only in May and June. Thus, although this shock was identified early, the presence of other shocks in April and May concealed its effect on inflation expectations. The external uncertainties were attenuated in late June and the inflation forecast was revised downward with the positive influence of food prices, allowing a one percentage point reduction in the basic interest rate.

The shocks we denominate as "financial" comprise four episodes featuring considerable shifts in the financial market perception of risks, which led to an increased difference between medium- and short-term interest rates, as well as to changes in the value of the exchange rate. These financial shocks reflect both the market reaction to monetary policy stance and changes in risk premium motivated either by domestic fundamentals or by external developments.

The first of these shocks (number 4), which hit the economy in August 1999, stemmed from a combination of factors. First, as shock number 1 caused market inflation expectations to rise sharply in July, the pace at which the Central Bank was reducing the interest rates was seen as too rapid (see figure 5). Second, the level of external uncertainties was rising fast, mainly because monetary tightening in the United States generated concerns that financing for the Brazilian private sector would be inadequate, especially toward the end of the year. Also, for the first time since the Gulf war, oil prices became a serious concern, together with their potential inflationary impact on Brazil. This caused a continuous depreciation of the real, and the demand for hedging instruments against further devaluation rose. Monetary policy response was twofold. First, hedge demand was matched by increased placement of dollar-indexed liabilities, since private market instruments were not available in appropriate amounts.[16] Second, the interest rate was held constant, interrupting the sequence of reductions initiated in mid-March 1999 (see figure 4). The interest rate level was thought to be enough to take care of inflationary pressures through the aggregate demand channel. If expectations deteriorated further, however, then the passthrough could endanger the achievement of the year target, making a tougher policy response advisable. The strategy was successful, as expectations improved: fiscal policy delivered better results than targeted, observed inflation fell until September, and sovereign risk perception started a continuous decline that ended only in April 2000.

In October the foreign exchange market experienced a liquidity shrink that coincided with a concentration of amortization payments of private sector debt (shock number 5). Moreover, the trade deficit was not recovering at the expected velocity and there were mounting concerns that Y2K fears would trigger capital outflows by the end of the year. These factors brought about renewed pressure on the exchange rate. The policy reaction this time was of a different nature, aimed at coping with the temporary liquidity shortage expected for the upcoming weeks. The measures included lowering the floor on net international reserves (NIR) – a performance criterion in the IMF agreement – by around US$ 2 billion; issuing new sovereign bonds; and arranging a loan from the Inter-American Development Bank (IDB). In early December, the Central Bank structured two forward foreign exchange auctions, in which it would sell a certain amount of dollars in the end of December and repurchase the same amount in the beginning of January, thereby eliminating doubts about possible currency shortages arising from Y2K problems. The strategy was instrumental for improving confidence, and as a result, capital inflows expected only for the next year were anticipated.

Shock number 6 is a good example of how the robustness of domestic fundamentals is capable of avoiding the harmful effects of high external volatility. It started in April 2000 with the strong asset price correction in international markets, combined with a

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[15] Positive here means that it contributed to bringing inflation down.

[16] These dollar-indexed bonds are not foreign debt, as they are payable in domestic currency, even though their face value is adjusted according to the current exchange rate at maturity. The share of these bonds in total public domestic debt had been declining gradually since January 1999.

new upsurge in oil prices and an additional rise in the U.S. federal funds rate. As in all other recent cases of increased external uncertainty, the risk premium was the first variable to adjust to the new conditions. Inflation expectations did not deteriorate, however. Expectations even improved somewhat, as the domestic macroeconomic outlook presented no fundamental misalignment and the food price shock kept current inflation low. The foreign exchange market adjusted itself smoothly, without any intervention. There was no perceptible increase in hedging demand, and the maximum exchange rate variation was less than 7% during the April-May period (see figure 4). Copom held the interest rate constant in this period, but it clearly signaled in the minutes from the April meeting that the real interest rate would decline as soon as the external uncertainties were mitigated.

This brief description of the Brazilian experience shows that there is no unique prescription for how monetary policy should react to shocks. Similar events may demand different responses because the overall economic conditions should be taken into account. Inflation targeting in Brazil was subject to serious tests right from start. For example, the oil price shock, which pervaded this entire period with unprecedented intensity since the 1980s, led to a substantial rise in domestic fuel prices, which more than doubled in less than a year. Nonetheless, inflation was kept within target in 1999 and 2000.

5.2 Monetary Policy Response: Theoretical and Empirical Evidence

This section presents impulse response functions to different shocks and compares them to the actual reaction of monetary policy to supply and financial shocks. The results are summarized in figures 6 through 9.

We suppose that the economy can be described by the three-equation system presented in section 3: the IS curve specification is given in equation **(I)**, the augmented Phillips curve in equation **(II)**, and the exchange rate dynamics in equation **(IV)**. To complete the model, we assume that the interest rate is set by the Central Bank with the objective of minimizing the following loss function:

$$\min_{\{i\}} L_t = \sum_{j=1}^{T} \rho^j [\omega_\pi D_{t+j} (E_t \pi_{t+j} - \pi^*_{t+j})^2 + \omega_h (E_t h_{t+j})^2 + \omega_i (\Delta i_{t+j})^2]$$

This loss function is a weighted average of the squares of the deviation of expected inflation (π) from the target (π^*), of the expected output gap (h) and of the nominal interest rate variation. The weighted average is discounted by a factor ρ ($0<\rho<1$). D is a dummy variable that equals one in the last quarter of each year and 0 otherwise; it characterizes the fact that the Central Bank is concerned only with year-end deviations of realized inflation from the established target.

We assume that the economy starts from a steady-state equilibrium and is hit by shocks of one standard deviation, whose magnitudes are 0.3 percentage points for supply (equation (**II**)), 0.45 percentage points for demand (eq. (**I**)), and 5 percentage points for financial shocks (eq. (**IV**)).

Figure 6 — Impulse response of nominal interest rate

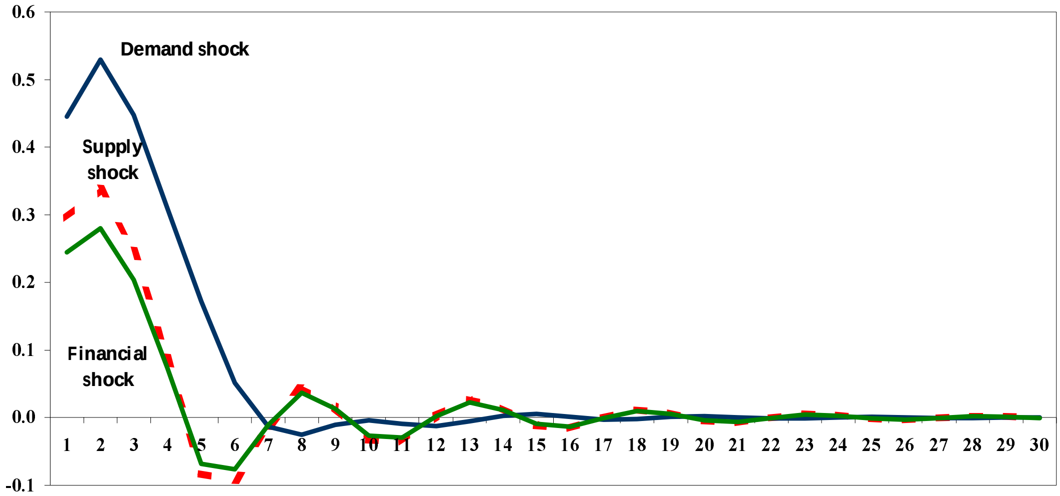


Figure 7 — Impulse response of real interest rate

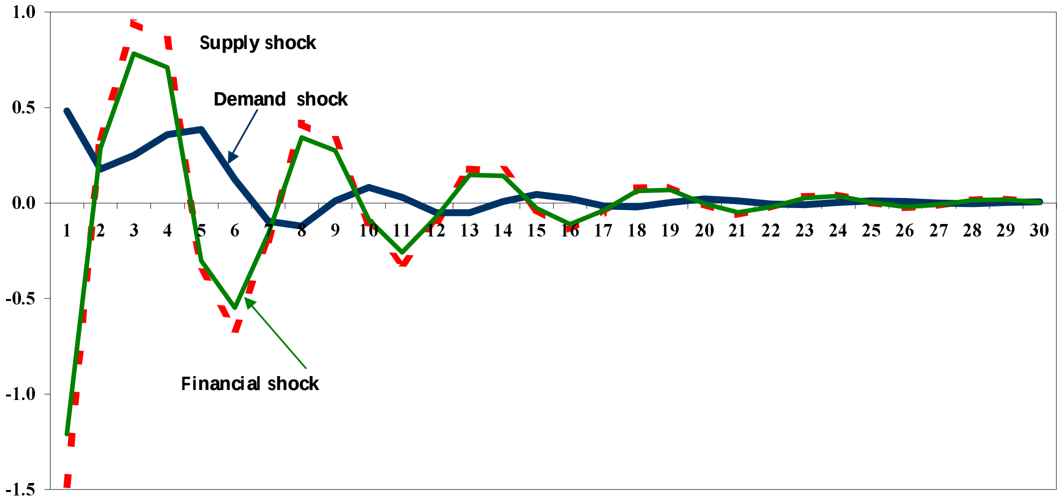


Figure 8 — Impulse response of inflation

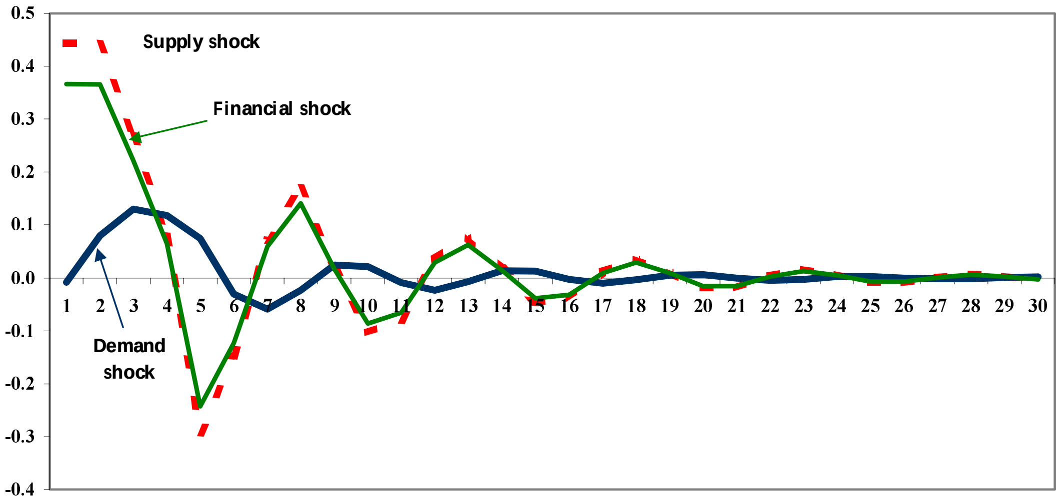
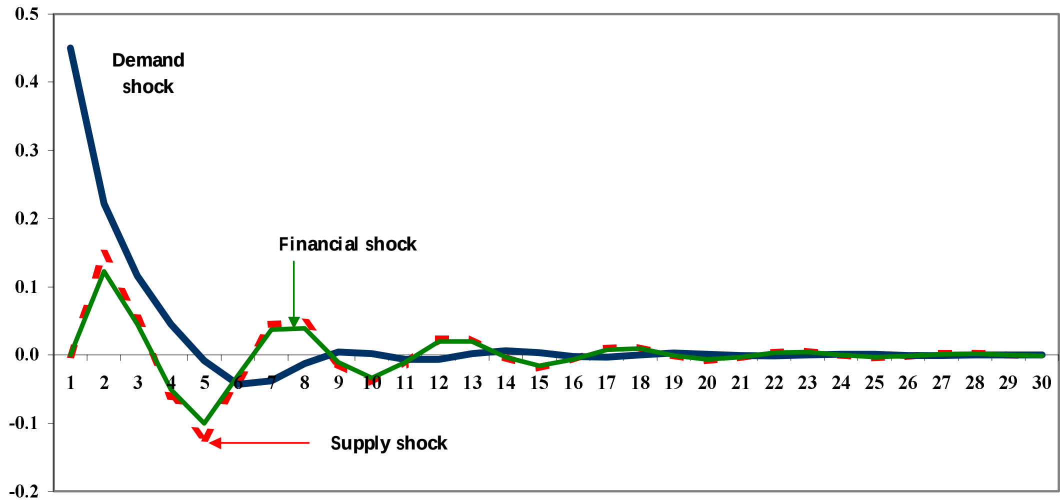


Figure 9 — Impulse response of output gap



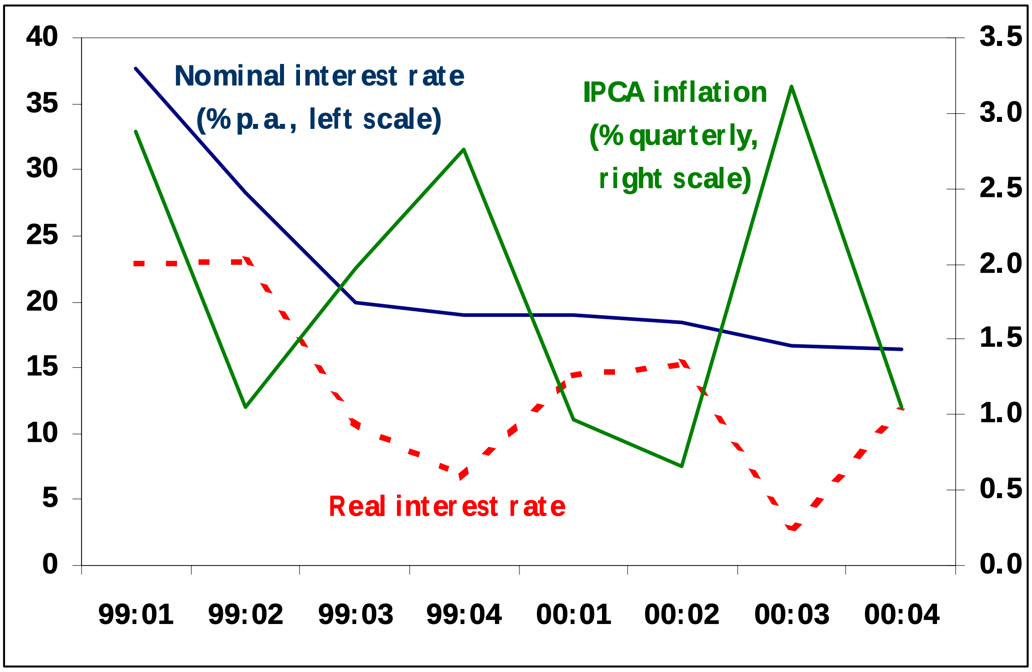
As standard models would predict (see Clarida, Galí and Gertler (1999)), demand shocks require the largest reaction. Figure 6 shows that demand shocks lead to the highest nominal interest rates during the first six quarters. Supply and financial shocks lead to very similar reactions, despite the fact that the financial shock is almost ten times as large as the supply shock. This can be explained by the fact that the reaction of monetary policy to financial shocks is mainly through its effect on inflation, with a negligible influence on the output gap. Since the passthrough from exchange rate variations to inflation is about 10%, the final impact of a financial shock on inflation is approximately the same as the supply shock, which suggests that a similar reaction is appropriate for both cases.

The real interest rate presents a different response pattern. It increases in the first period after a demand shock, but it decreases in the first period after supply and financial shocks. In other words, right after the economy is hit by the latter two shocks, the optimal response of the Central Bank is to increase nominal interest rates by a lower amount than the increase in inflation, thus bringing about an initial reduction in real interest rates. In the following periods, however, real interest rates rise above equilibrium, putting inflation into a sine-wave convergence path to its steady-state value. Figure 7 shows that the deviations of real interest rates from equilibrium after supply and financial shocks are usually higher than those observed after demand shocks.

The counterpart of this finding is a more stable path for the output gap following supply and financial shocks, as shown in figure 9. The accumulated deviations of the output gap, measured by the area between the impulse response curve and the horizontal axis, can be interpreted as the sacrifice ratio. After one year, the accumulated deviation of the output gap is 0.83 for demand shocks, 0.14 for supply shocks, and 0.12 for financial shocks; the long run values are 0.73, 0.04, and 0.03, respectively.

One should not expect the real economy to replicate the behavior of an impulse response function, since it is awkward to identify and isolate the effects of individual shocks. However, an analysis of figure 10 reveals some similarities between the actual behavior of nominal interest rate and inflation and the prediction of the impulse response functions. Only supply and financial shocks occurred after the devaluation of the *real* in early 1999, as described in section 5.1.

Figure 10 – Quarterly Inflation and Interest Rates



It is interesting to examine the shocks that hit the economy in the second half of 1999. The exchange rate depreciated by 10% from the second to the third quarter of that year; backward-looking prices increased 8% in the third quarter and 3% in the last quarter; and food inflation reached 5.6% in the last quarter. In the face of such supply shocks, the Central Bank kept the nominal interest rate constant for almost six months. Given the prevailing out-of-equilibrium environment, this procedure was equivalent to an increase in the nominal interest rate when the economy is in steady state. It took from two to three quarters for the nominal interest rate to resume its downward trajectory, as in the impulse response cases.[17] The behavior of real interest rates was also consistent with the predictions of the impulse responses: despite the "increasing" nominal interest rate in the first period (fourth quarter 1999), there was a contemporaneous reduction in real interest rate. In the following quarter, however, real interest rate did rise. Finally, as predicted, inflation increased in tandem with the shocks, but it declined faster than expected: in the first quarter of 2000, IPCA inflation was already below the target value for the year, if expressed in annualized terms.

5.3. Inflation Targeting and Backward-Looking Prices

In the Brazilian framework, the inflation target is set for the annual variation of IPCA, a consumer price index in which the weight of backward-looking prices is approximately 25%. This particularity poses an additional challenge for monetary policymaking, since backward-looking prices are insensitive to interest rate decisions.

The most important items with backward-looking prices are public utilities, fuel, public transportation, and minimum wage.[18] The adjustment of these prices follows several rules. To respect contractual clauses, increases in utility fees are generally based on past inflation as measured by the general price indices. Prices of gasoline and oil by-products tend to increase in accordance with the exchange rate and international oil prices. Finally, the annual adjustment of the minimum wage is not defined by formal rules, but the political discussion in Congress usually starts from past consumer price inflation.

The group of backward-looking prices accumulated a 36.6% increase in 1999-2000, while other prices of the economy rose only by 8.8%. Figure 11 shows the evolution of

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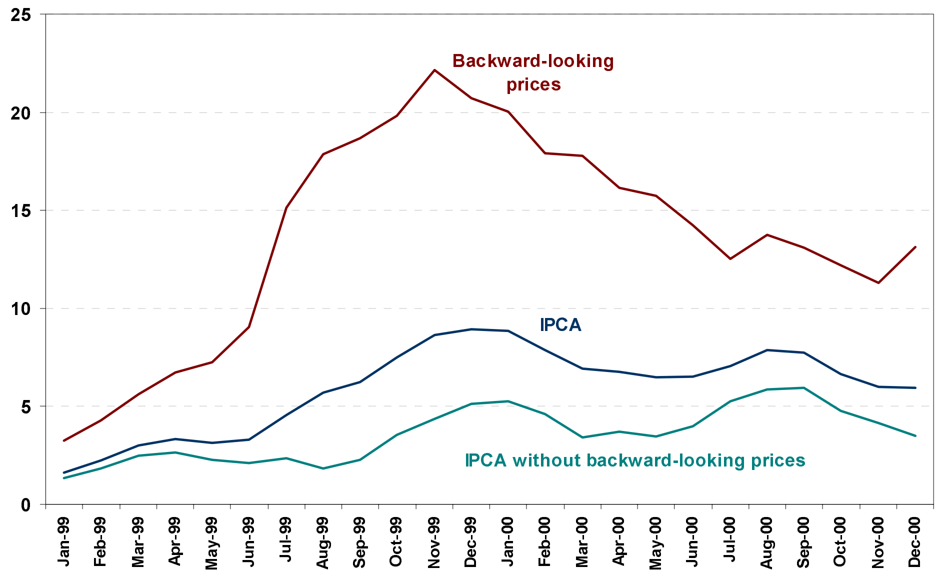
[17] The overnight rate was lowered from 21% to 19.5% in July 1999, and it remained constant until October, when it was reduced by 0.5 percentage point. The overnight rate was not lowered again until March 2000, this time to 18.5% (see figure 4).

headline IPCA inflation, along with a breakdown of the behavior of backward-looking prices and the remaining prices. Because the targets are set for headline IPCA inflation, the behavior of backward-looking prices clearly imposes an important restriction on monetary policy: real interest rates need to be high in order to keep the forward-looking prices at levels below the inflation target.

Figure 11 – Year-over-year inflation



To quantify the influence of backward-looking prices on monetary policy decisions, we simulate the behavior of monetary policy from 2000 to 2002, assuming that the economy starts from the initial conditions that prevailed at the end of 1999. We then compare this behavior using different assumptions about the weight of backward-looking prices in the IPCA and about their adjustment rules. The results of the exercises are based on the four-equation model presented in section 3. The only difference is that the Phillips curve is modified to take explicit account of backward-looking prices in explaining inflation.

The estimation of the Phillips curve is based on the following system:

$$p_t = \omega \cdot p_t^m + (1-\omega) \cdot p_t^{bl} \qquad (5.1)$$

[18] In the IPCA, the minimum wage variation corresponds to the full variation of the "Domestic Employee" category, whose weight is around 3%.

$$z_t \equiv e_t + p_t^* \tag{5.2}$$

$$p_t^m = \delta \cdot w_t + (1-\delta) \cdot z_t \tag{5.3}$$

$$w_t - w_{t-1} = \psi \cdot E_{t-1}\pi_t + (1-\psi)\pi_{t-1} + \kappa \cdot h_{t-1} \tag{5.4}$$

All variables are expressed in logarithms, *p* stands for the price level, *w* for wages, *h* for the output gap, *e* for the nominal exchange rate, the superscript "*m*" for market goods (that is, goods and services whose prices are free to adjust to market conditions), and the superscript "*bl*" for backward-looking prices.

Equation (5.1) establishes that consumer prices are a weighted average of market and backward-looking prices. Equation (5.2) defines the variable *z* as international prices (p^*) expressed in terms of the domestic currency. Note that the exchange rate, *e*, is the number of units of domestic currency needed to buy one unit of foreign currency, such that an increase in *e* means a depreciation of the domestic currency. Equation (5.3) is the price equation for market goods. Such prices are a weighted average of international prices and domestic wages. Equation (5.4) defines the wage dynamics, which depends on expected inflation, past inflation and the output gap. The restriction that the coefficients of expected and past inflation sum to one guarantees the verticality of the Phillips curve.

After differentiating equations (5.1) and (5.3), and substituting equations (5.3) and (5.4) into equation (5.1) we get the reduced-form Phillips curve:

$$\pi_t = \omega \cdot \delta \cdot \left[\psi \cdot E_{t-1}\pi_t + (1-\psi)\pi_{t-1} + \kappa \cdot h_{t-1}\right] + \omega(1-\delta)\Delta z_t + (1-\omega)\pi_t^{bl} \,. \tag{5.5}$$

The estimated coefficients presented the expected sign, and all were significant at conventional values. Wald tests also showed that the reduced-form coefficients were statistically different from zero at conventional significance levels.

Varying the value of ω, the weight of market prices in the consumer basket, generates a family of Phillips curves. We now define "market inflation equation" as the Phillips curve that results when ω = 1. Otherwise, we refer to the “headline inflation Phillips curve”. Before comparing the two curves, it is necessary to model backward-looking prices. By assumption, they are a weighted average of past inflation and external price variation:

$$\pi_t^{bl} = \beta \cdot \pi_{t-1} + (1-\beta)\Delta z_{t-1}. \qquad (5.6)$$

Table 2 shows the difference between the estimated coefficients of the market and headline inflation equations, for different values of β. The degree of inertia, measured by the estimated coefficient of past inflation in the reduced form, depends positively on the value of β. When β increases, headline inflation shows stronger persistence, as evidenced by a larger coefficient of π_{t-1}, while for β = 0, market inflation is more lag dependent. The exchange rate passthrough is smaller for market inflation only if β = 1. Finally, as expected, the sensitivity of inflation to the output gap is larger in the absence of backward-looking prices (ω = 1). In this case, the transmission mechanism of monetary policy through the aggregate demand channel is relatively efficient.

Table 2 – Difference between Headline and Market Inflation Coefficients

Variable	Headline Inflation Coefficient minus Market Inflation Coefficient		
	β = 1	**β = 0.5**	**β = 0**
E(π)	-0.073	-0.073	-0.073
π_{t-1}	0.086	0.017	-0.052
h	-0.031	-0.031	-0.031
$\Delta z_t + \Delta z_{t-1}$	-0.012	0.056	0.125

A more reactive monetary policy is expected under strong inertia, as in the case β = 1, since the level of interest rate needed to reduce inflation by any amount is higher than in the case of weak inertia. On the other hand, since monetary policy is relatively inefficient in this environment and the Central Bank’s loss function is assumed to include output gap and interest rate smoothing, monetary policy should not react strongly to deviations of inflation from the target, as Clarida, Galí, and Gertler (1999) point out. Henceforth, we refer to these two factors as inertial and efficiency effects.

Since they work in opposite directions, it is not possible to tell *a priori* in which case the Central Bank would be more aggressive.

Based on the equations for headline and market inflation, we ran simulations with the assumption that the economy starts from the initial conditions that prevailed at the end of 1999 and that the Central Bank chooses the interest rate path (from 2000 to 2002) to minimize the loss function presented in section 5.2:

$$\min_{\{i\}} L_t = \sum_{j=1}^{T} \rho^j [\omega_\pi D_{t+j} (E_t \pi_{t+j} - \pi^*_{t+j})^2 + \omega_h (E_t h_{t+j})^2 + \omega_i (\Delta i_{t+j})^2] . \qquad (5.7)$$

Tables 3 and 4 display the results of the simulations under two alternative rules for the adjustment of backward-looking prices, that is, different values of β. The first column in table 3 presents the baseline case of year-end market inflation, generated from simulations using the estimated coefficients of the Phillips curve (ω = 1). The remaining columns show how the baseline results change in the presence of backward-looking prices, when their weights in the Phillips curve are restricted to 13% and 20%. These columns exhibit the difference between the cases of headline and market inflation for three variables: year-end inflation, and yearly averages of nominal and real interest rates. Finally, table 4 shows the differences in results that arise when we simulate a faster disinflation, that is, instead of pursuing inflation targets of 6%, 4%, and 3.5% from 2000 to 2002, the Central Bank would need to meet targets of 5%, 3%, and 2.5%.

Table 3 – Effect of Backward-Looking Prices

Period	Market Inflation ω = 1	Difference between the cases of Headline and Market Inflation					
		β = 1			β = 0		
		Inflation	Interest rate		Inflation	Interest rate	
			Nominal	Real		Nominal	Real
Weight of backward-looking prices = 13% (ω = 0.87)							
2000	5.55	-0.03	0.55	0.55	-0.27	-1.59	-1.22
2001	4.05	0.16	0.58	0.39	0.03	-0.50	-0.52
2002	3.64	0.03	-0.15	-0.18	-0.10	-0.68	-0.55
Weight of backward-looking prices = 20% (ω = 0.80)							
2000	5.55	-0.01	0.93	0.90	-0.32	-2.39	-1.93
2001	4.05	0.24	0.80	0.52	-0.02	-0.95	-0.89
2002	3.64	0.01	-0.37	-0.36	-0.18	-1.05	-0.83

Table 4 – Effects of a Faster Disinflation (ω = 0.87)

Period	Market Inflation			Headline Inflation, β = 1			Headline Inflation, β = 0		
	Inflation	Interest rate		Inflation	Interest rate		Inflation	Interest rate	
		Nominal	Real		Nominal	Real		Nominal	Real
2000	-0.97	-0.56	0.50	-0.98	0.06	1.10	-1.15	-1.75	-0.45
2001	-0.95	-0.85	0.19	-0.79	-0.24	0.61	-0.88	-1.04	-0.07
2002	-0.97	-0.89	0.12	-0.95	-1.10	-0.10	-1.04	-1.32	-0.22

For 2000 and 2001, when the degree of inertia is the highest (β = 1), the inertial effect dominates the efficiency effect. Nominal and real interest rates would have to be about half percentage point higher in the case of the headline inflation Phillips curve than in the case of the market inflation Phillips curve. The difference in interest rates would have to be even greater if the weight of backward-looking prices increased from 13% to 20%. This pattern is reversed for 2002, however: nominal and real interest rates are smaller under the headline inflation than under market inflation.

We attribute this result to the offsetting nature of the inertial and efficiency effects. To achieve the target in 2000, inflation should be reduced by 2.9 percentage points, which is the difference between observed inflation in 1999 (8.9%) and the 6% target for 2000. For 2001, inflation would have to be reduced by 1.55 pp in the market inflation case. For 2002, however, the disinflation effort is significantly smaller, at 0.55 pp for market inflation. The inertial effect thus dominates the efficiency effect when annual disinflation is high. The figures in table 4 are consistent with this interpretation. When disinflation is faster, the interest rate difference between headline and market inflation rises to 1.10 pp in 2000 and 0.61 pp in 2001, implying a stronger inertial effect.[19]

It is more difficult to compare the case of headline inflation with β = 0 with the baseline market inflation case. The higher passthrough may slow the reduction in interest rates, given the inflationary effects of the consequent exchange rate depreciation. On the other hand, the case of β = 0 presents a relatively small degree of inflation inertia and a

[19] A faster disinflation allows the Central Bank to set relatively lower nominal interest rates. In the model, this results from the fact that a smaller target for inflation would also reduce inflation expectations and, hence, current inflation. Since the optimal real interest rates are higher, a faster disinflation still implies a tighter monetary policy.

reduced efficiency of monetary policy, which encourages the Central Bank to cut interest rates aggressively. According to table 3, the balance of all these factors favors a faster reduction in interest rates when the Central Bank faces a headline inflation Phillips curve with $\beta = 0$.

6. MONITORING INFLATION TARGETS UNDER AN IMF PROGRAM

This section focuses on alternative ways of assessing the monetary policy stance in inflation-targeting countries that have an ongoing program with the IMF. Brazil was the first country to adopt inflation targeting while a financial support program was under way. This raised some important issues with regard to assessment. The usual performance criterion on net domestic assets is not adequate for an inflation-targeting regime, because it harms transparency and may induce unnecessary monetary movements.

We compare the behavior of inflation, the output gap and interest rates under alternative criteria to evaluate the monetary policy stance, which may be more suitable for an inflation targeting country. We first describe four accountability alternatives:

> I) Year-end inflation target. This is the original inflation-targeting framework in Brazil. The Ministry of Finance sets the year-end target and the tolerance bands two years in advance. The current targets are 6%, 4% and 3.5% for 2000, 2001 and 2002, respectively, and the Central Bank is considered successful in achieving the target if actual year-end inflation falls within a ±2 pp band around the target.
>
> II) Quarterly inflation targets, set by a linear convergence rule, as established in the fourth review of the current agreement with the IMF. According to this criterion, twelve-month inflation for each quarter should equal the value obtained by linear interpolation of the adjacent year-end targets. For example, given the 6% and 4% year-end targets for 2000 and 2001, the target path from the first to the third quarters of 2001 should be 5.5%, 5% and 4.5%. A potential problem with this criterion is the fact that shocks in a given year contaminate the quarterly

twelve-month inflation figures of the following year, and forces the monetary authority to react unnecessarily to such shocks.

III) Quarterly inflation targets that take into account the actual outcomes observed in the previous year. Whereas the previous alternative outlines a quarterly target path based on year-end targets, this criterion is based on the actual inflation figures of the previous year. In logarithm terms, this target is set according to the formula below:

$$\tilde{\pi}^*_{T,i} = \sum_{\substack{j=i+1 \\ i<4}}^{4} \pi_{T-1,j} + \frac{i}{4}\pi^*_T$$

where $\tilde{\pi}^*_{T,i}$ is the twelve-month inflation target for quarter *i* in year *T*; $\pi_{T-1,j}$ is the actual inflation observed in quarter *j* in year *T-1*; and π^*_T is the inflation target for year *T*. The target for the first quarter of a year would be the actual inflation observed in the last three quarters of the previous year, plus ¼ of the inflation target for the current year; the target for the second quarter would be actual inflation observed in the second half of the previous year, plus ½ of the inflation target for the current year; and so on. The target path should be reset at the beginning of each year, once the previous year's inflation is known. This criterion overcomes one of the major drawbacks of alternative II, namely, the fact that shocks in a given year contaminate monetary policy decisions in the following year, irrespective of the effects such shocks have on inflation. Both criteria, however, have the potential drawback of increasing the frequency of monetary performance evaluation, from yearly to quarterly.

IV) A Taylor-type rule.

The starting point of the analysis is to assume the Central Bank sets the nominal interest rate *i* to minimize the loss function:

$$\min_{\{i\}} L_t = \sum_{j=1}^{T} \rho^j [\omega_\pi D_{t+j} (E_t\pi_{t+j} - \pi^*_{t+j})^2 + \omega_h (E_t h_{t+j})^2 + \omega_i (\Delta i_{t+j})^2] \qquad (6.1)$$

subject to:

$$\pi_t = \alpha_1 E_t \pi_{t+1} + \alpha_2 \pi_{t-1} + (1-\alpha_1-\alpha_2)\Delta(e_t + \pi_t^f) + \alpha_3 h_{t-1} + \varepsilon_{\pi,t} \tag{6.2}$$

$$h_t = \beta_0 + \beta_1 h_{t-1} + \beta_2 (i_{t-1} - \pi_{t-1}) + \beta_3 \theta_{t-1} + \varepsilon_{h,t} \tag{6.3}$$

$$\Delta e_t = \Delta i_t^f + \Delta x_t - \Delta i_t + \varepsilon_{e,t} \tag{6.4}$$

$$\Sigma = \begin{bmatrix} \sigma_\pi^2 & \sigma_{\pi,h} & \sigma_{\pi,i} \\ \sigma_{\pi,h} & \sigma_h^2 & \sigma_{h,e} \\ \sigma_{\pi,i} & \sigma_{h,e} & \sigma_e^2 \end{bmatrix} = \begin{bmatrix} \sigma_\pi^2 & 0 & 0 \\ 0 & \sigma_h^2 & 0 \\ 0 & 0 & \sigma_e^2 \end{bmatrix}. \tag{6.5}$$

Equation (6.1) is the loss function already discussed in section 5.2. The value of the dummy variable, D, varies according to the alternative chosen. For alternative (I), in which the Central Bank cares only about year-end inflation, D equals one in the last quarter of each year and zero in all other quarters. Under alternatives (II) and (III), D equals one in all quarters, meaning that monetary policy should be evaluated every quarter.

Equations (6.2) to (6.4) are the constraints of the minimization problem; they form a small structural macroeconomic model in the lines presented in section 3. Condition (6.5) assumes a diagonal variance-covariance matrix. Additionally, the error terms are assumed to be independent, identically and normally distributed. The calibrated values for the standard errors were 0.5 percentage point for output gap, 0.3 percentage point for inflation, and 5 percentage points for the exchange rate.

To run stochastic simulations, we assumed the Central Bank minimizes the loss function taking into consideration eight periods ahead, with a discount rate of 1% ($\rho = 0.99$). This horizon might be considered relatively short by international standards, but it is a reasonable hypothesis for the Brazilian economy, which is characterized by a higher level of uncertainty, given it is still in transition to its steady-state inflation level. Furthermore, evidence shows that optimizing periods beyond 8 quarters do not yield gains in terms of efficiency in the output-inflation variability locus (see Freitas and Muinhos (2001)). Finally, this optimization horizon is also in line with the *Inflation Report*, which releases the forecasts of inflation up to two years ahead.

In the stochastic simulations, we assumed that at the beginning of quarter *t*, when the interest rate is set, the central bank knows the realization of all variables up to *t-1*, but does not know the shock. The results presented in table 5 were obtained after 150 simulations. We performed the simulations as if the economy were at the beginning of 2000. All variables took their actual values as initial conditions, except for the output gap, which was set to zero at the end of 1999. This modification in the initial conditions regarding the output gap allows us to concentrate on the contamination effect described in alternative II above, since IPCA inflation in 1999 was 0.9 percentage point above the target.

Finally, the simulations for alternative IV do not need the optimization procedure, since with the Taylor-type rule the interest rate is simply set according to observed outcomes. The specification of the traditional Taylor rule is:

$$i_t = i_t^* + 1.5(\pi_{t-1} - \pi_{t-1}^*) + 0.5h_{t-1} \qquad (6.6)$$

where i is the annualized quarterly interest rate and i^* is the equilibrium nominal interest rate. To be consistent with the loss function, we introduced interest rate smoothing: the actual interest rate is the weighted average of the previous value of the interest rate and the one given by equation (6.6), with weights 0.60 and 0.40, respectively.

Table 5 shows that all alternatives lead to a level of expected year-end inflation that is well within the ±2-percentage point tolerance bands established in the Brazilian inflation-targeting framework, despite the initial conditions (inflation was almost one percentage point above the target). Such results can be explained by the short lag of the transmission mechanism. Decisions regarding interest rates affect inflation contemporaneously through the exchange rate channel and take only two quarters to affect inflation through the aggregate demand channel. The output gap performance was also good, in the sense that it stayed within a band of ±1 percentage point during most of the period for all alternatives.

Table 5 – Results of the Stochastic Simulations

Year	Q	12-month inflation				Output gap				Nominal interest rate				Std. dev. of inflation			
		I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
2000	**1**	8.28	8.26	8.27	8.14	1.05	0.98	1.05	1.04	20.2	20.5	21.0	24.9	0.51	0.50	0.53	0.56
2000	**2**	8.65	8.63	8.54	8.28	1.16	1.12	1.10	0.77	20.5	20.9	21.7	33.2	1.53	1.50	1.44	1.26
2000	**3**	7.62	7.59	7.49	7.19	0.77	0.65	0.62	-0.62	20.1	20.1	20.9	30.4	1.24	1.22	1.12	0.98
2000	**4**	**6.03**	**5.99**	**5.91**	**5.66**	**0.23**	**0.25**	**0.13**	**-1.50**	**19.0**	**18.4**	**19.0**	**20.3**	**0.60**	**0.55**	**0.53**	**0.72**
2001	**1**	5.22	5.22	5.14	4.89	0.06	0.09	0.01	-1.10	17.6	16.6	17.7	13.3	0.56	0.63	0.61	0.89
2001	**2**	5.11	5.12	5.11	4.72	0.01	0.19	-0.03	-0.25	15.9	14.9	16.1	13.4	0.68	0.67	0.67	0.74
2001	**3**	4.94	5.01	4.98	4.55	-0.02	0.18	-0.09	-0.07	14.2	13.3	14.4	14.7	0.82	0.87	0.83	0.81
2001	**4**	**4.29**	**4.40**	**4.29**	**3.95**	**-0.19**	**0.04**	**-0.31**	**-0.35**	**12.7**	**11.8**	**12.5**	**13.5**	**0.69**	**0.74**	**0.71**	**0.84**
2002	**1**	3.61	3.64	3.57	3.57	-0.37	-0.17	-0.41	-0.50	11.0	10.3	10.6	9.3	0.61	0.68	0.61	0.87
2002	**2**	3.28	3.33	3.31	3.48	-0.35	-0.14	-0.34	-0.14	9.4	8.9	9.1	8.4	0.79	0.73	0.75	0.84
2002	**3**	3.39	3.47	3.44	3.57	-0.21	0.04	-0.10	0.07	7.9	7.7	7.9	8.7	0.65	0.62	0.67	0.80
2002	**4**	**3.58**	**3.69**	**3.66**	**3.57**	**-0.05**	**0.18**	**0.01**	**-0.09**	**6.8**	**6.8**	**6.9**	**9.1**	**0.60**	**0.65**	**0.66**	**0.89**

Table 5 (cont.) – Results of the Stochastic Simulations

Year	Q	Std. dev. of output gap				Prob (π-π*>1 pp)				Prob (π-π*>2 pp)			
		I	II	III	IV	I	II	III	IV	I	II	III	IV
2000	**1**	0.45	0.41	0.47	0.46	3.0	3.3	7.3	9.3	0.0	0.0	0.0	0.0
2000	**2**	0.52	0.52	0.55	0.61	67.0	72.7	66.0	43.7	13.0	10.7	10.0	8.7
2000	**3**	0.56	0.56	0.54	0.64	50.5	52.0	45.3	30.0	5.5	4.7	2.0	4.3
2000	**4**	**0.57**	**0.57**	**0.57**	**0.76**	**11.0**	**7.3**	**5.3**	**17.0**	**0.0**	**0.0**	**0.0**	**0.3**
2001	**1**	0.59	0.64	0.58	0.95	7.0	10.0	10.7	25.3	0.0	0.7	0.0	1.3
2001	**2**	0.66	0.65	0.53	0.96	14.0	11.3	12.7	20.0	0.0	0.7	0.0	0.0
2001	**3**	0.65	0.57	0.54	1.06	22.5	27.3	23.3	21.3	0.5	1.3	0.7	1.7
2001	**4**	**0.59**	**0.63**	**0.58**	**1.05**	**13.0**	**20.0**	**14.7**	**24.0**	**0.5**	**0.0**	**0.7**	**0.7**
2002	**1**	0.65	0.64	0.62	1.08	10.0	15.3	9.3	22.0	0.0	0.0	0.0	2.3
2002	**2**	0.66	0.57	0.66	1.12	20.5	14.7	17.3	22.3	1.0	0.7	0.7	1.3
2002	**3**	0.58	0.57	0.65	1.19	12.0	10.7	13.3	20.0	0.5	0.0	0.0	1.0
2002	**4**	**0.58**	**0.59**	**0.60**	**1.15**	**9.5**	**14.0**	**12.0**	**22.7**	**0.0**	**0.0**	**0.7**	**2.7**

Obs.: i) Alternative I: original Brazilian IT framework, with targets set only for year-end inflation.
ii) Alternative II: quarterly inflation targets set by a linear convergence rule.
iii) Alternative III: quarterly target path based on the actual inflation figures of the preceding year.
iv) Alternative IV: use of a Taylor-type rule.
v) The standard deviation of inflation refers to deviations from the target, not from the mean. Since there is no quarterly target defined for Alternative I, the standard deviation was estimated using the target set for Alternative II.

It is difficult to rank the alternatives by looking only at the variability of inflation and output. Only the Taylor rule (alternative IV) yielded generally higher volatility for both inflation and output. The figures for the other three alternatives do not prompt clear-cut conclusions, either because the qualitative pattern is not stable or because the differences in standard deviations are small. The results presented in table 6 were calculated from the loss function for alternative I (in which only year-end inflation rates matter). The performance of the Taylor rule[20] was clearly the worst, while alternatives II (linear target path) and III (the target path based on the previous year's outcomes) yielded a relative loss of approximately 15%.

Table 6 – Absolute and Relative Losses

	Alternatives			
	I	**II**	**III**	**IV**
Loss	0.85	0.99	0.97	5.29
Relative Loss (%)	-	16.2	14.0	521.4

The similar performance of the first three alternatives is a surprising result. We expected alternative I to present a visibly better performance for year-end inflation, because it ignores inflation outcomes in the first three quarters of the year, while alternative II was expected to yield the worst outcome, since it forces monetary policy to react to large deviations of inflation from the target in the previous year. The presence of output gap and interest rate variation in the loss function in all quarters may have contributed to making the three alternatives more similar. Another possible explanation is related to the backward-looking component of inflation. To meet the year-end inflation target, the monetary authority needs to put a high weight on the inflation outcomes of the interim quarters. Therefore, the effect of changing the accountability frequency may have been mild.

These findings, however, do not imply that the Central Bank should be indifferent in choosing among the first three alternatives. If the Central Bank is in fact concerned only with the year-end accumulated inflation, then setting a quarterly target path for inflation is not likely to severely alter the behavior of macroeconomic variables. Should monetary policy be evaluated on a quarterly basis, however, there is a high probability that unnecessary false alarms would be triggered in the course of the year. In the context of the current agreement, an informal consultation with the IMF is triggered if inflation deviates from the target path by more than one percentage point, and a formal consultation is required if the deviation exceeds 2 percentage points. The probability of

[20] It is possible, however, that the performance of the Taylor rule could dramatically improve if a different set of parameters is chosen.

inflation deviating from the target by more than one percentage point falls significantly as the year progresses (see table 5). This is a particularly delicate issue for an emerging economy, because false alarms may trigger a confidence crisis and thus make the conduct of monetary policy more difficult. A compromise solution to this problem would be to increase the tolerance interval for the first three quarters of the year; this would preserve the quarterly accountability frequency while reducing the probability of triggering false alarms.

7. CONCLUSIONS

The relative success of economic policy in Brazil since the 1999 devaluation stems from a variety of factors, including the initial macroeconomic conditions, the strong international support, and the inflation-targeting regime that provided an adequate and timely anchor for expectations. The most important factor, however, was the long-awaited fiscal reversal, which was a necessary (but obviously not sufficient) condition for the sustainability of the inflation-targeting framework.

Despite the huge devaluation in early 1999, the year ended with single digit consumer price inflation, which fell within the target set by mid-year, and with a near 1 percent GDP growth, which was well above the preliminary prospects. Inflation behavior showed a very low passthrough, which can be in part attributed to the output gap in the period, the overvalued *real* just before the floating, and the low initial inflation. The inflation-targeting regime guided expectations in line with the multi-year disinflation targets, allowing the relative price realignment after the devaluation to be processed without igniting overwhelming pressures on consumer prices.

However, the large swing in relative prices poses some idiosyncratic challenges for the monetary authority. The evolution of the backward-looking prices is if particular concern. Such prices correspond to around 25% of the IPCA and have increased by 36.6% in 1999-2000, while all other prices taken together rose by only 8.8% in the same period.

The results of simulation using different assumptions regarding the adjustment rule and the weight of backward-looking prices in the IPCA show that when the adjustment of these prices is based on past inflation, the degree of inertia increases and forces the Central Bank to be more restrictive in order to disinflate the economy. Nominal and real interest rates are 0.5 to 1 percentage point higher when the Central Bank faces a Phillips curve with backward-looking prices. When inflation is closer to its steady-state value, however, the presence of administered prices in the IPCA does not alter the behavior of monetary policy significantly.

We presented a brief description of the Brazilian experience, showing how monetary policy reacted to different shocks. In the inflation-targeting period, all the shocks that hit the economy propagated their effects mainly through the supply side and financial markets. Although the shocks displayed some common features, such as rising oil prices, the rapidly changing overall economic conditions demanded different responses.

We confronted the theoretical policy prescriptions with estimated impulse responses to different kinds of shocks in a simple empirical model. As expected, the results showed that a central bank should be fairly restrictive when countering aggregate demand shocks, but it should partially accommodate supply and financial shocks by contemporaneously increasing nominal interest rates while allowing real interest rates to fall. Real interest rates eventually rise with the subsequent fall in inflation. This pattern, suggested by the impulse response functions, was observed in recent episodes in Brazil. When facing supply and financial shocks in the last two quarters of 1999, the Central Bank kept nominal interest rates constant at a level above long-run equilibrium and allowed real interest to fall. With inflation under control, real interest rates rose again in the following quarter, and the Central Bank resumed the trend of reducing interest rates.

Finally, the paper addressed the issue of how to monitor inflation targeting under agreements with the IMF. We used a simple structural model to show that except in the case of a Taylor rule, the behavior of relevant macroeconomic variables does not change significantly when the frequency at which monetary policy is evaluated increases from yearly to quarterly. However, a central bank should not be indifferent when choosing between year-end accountability only and quarterly monitored accountability, such as that established in recent Brazilian agreements with the IMF. The reason is simple: if the relevant macroeconomic variables are initially out of equilibrium, then the probability of meeting the target by year-end may be high while the probability of breaching the tolerance bands in the intermediate quarters is also high. Monitoring quarterly inflation figures under such circumstances can send unnecessary false alarms, introducing an unwarranted noise in the conduct of monetary policy by affecting expectations.

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