Draft version

Inflation Targeting in Brazil

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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, increasing international financial volatility - and domestic factors such as the adjustment of government-managed prices with no link to market conditions. Moreover, we examine some selected issues that deserved due consideration given their importance to the conduct of monetary policy. The first is monetary policy reaction in the presence of a substantial portion of prices set by the public sector, which impacts 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 interesting when considering the effects of shortening monitoring horizons on the variability of inflation and output.

Inflation Targeting in Brazil[◊]

1. Introduction

In mid January 1999, Brazil was forced to abandon its crawling exchange-rate band regime. Surprisingly enough, the country's economic performance in the aftermath of this episode was much better than what could be observed in other emerging market economies after a move towards floating.

In this paper, we discuss the main points that we believe helped Brazil to withstand the negative effects of a forced shift in macroeconomic policy and recover in record time, namely the combination of fiscal restraint with a well defined purpose for monetary policy. Section 2 provides a description of the macroeconomic background that culminated in the currency devaluation, the chaotic expectations environment that followed, and the evolution of monetary policy in the transition to inflation targeting.

Section 3 presents a stylized model that will be used in our discussion of the transmission mechanism. The model will serve as a basis for the simulations performed in Sections 5 and 6. 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.

Section 5 describes how monetary policy has reacted to shocks since the implementation of inflation targeting. Under an inflation-forecast based inflation targeting we examine the Central Bank's track record in responding to all sorts of shocks, such as international oil prices, exchange rate, food, and volatility in international financial markets. Given the relative weight of government-managed prices in the consumer basket, we decompose our model into public sector and market

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[◊] 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.

prices to show how the institutional framework in Brazil affects the transmission mechanism of monetary policy and therefore its efficiency when reacting to shocks.

Section 6 focuses attention on alternative ways to monitor the performance of monetary policy under inflation targeting. The 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

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, URV, whose value the Central Bank fine-tuned in 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 indexator was extinguished as the URV became the new currency, named *real*. Demand pressures naturally arose with the distributive effects of the sharp inflation fall — 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 had to counter these pressures, chiefly with high real interest rates and stringent credit restrictions.

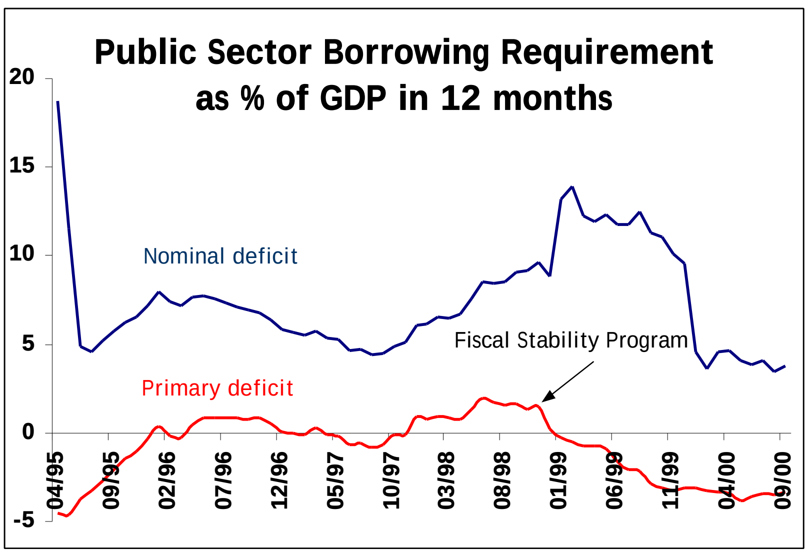
Even though the stabilization program was correctly conceived with due attention to fiscal austerity, the pace of implementation of a comprehensive agenda of structural reforms was much slower and effort demanding than previously expected, especially when there was need of legislative support. On the 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 beginning of stabilization was the choice of a suitable exchange rate policy. The decision was 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 at the end of 1994 prompted a shift to a crawling-band regime, which was formally adopted in March 1995. From July 1995 until mid-January 1999, exchange rate policy was conducted following an annual devaluation target of around 7.5%. The battle for price stabilization was won and the economy got rid of short run indexation practices as inflation came down from 929% in 1994 to less than 2% in 1998.

The stabilization process included also 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 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 crucial to determine the country’s reaction to the external crises.

However, the fiscal position gradually worsened, as the inflation decline unveiled the structural imbalances of public accounts due to the elimination of the inverted Olivera-Tanzi effect (reduction of real spending due to 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 Congress agenda: the tax reform, the establishment of limits for public spending in all administration levels, and the social security reform for both private and public sectors. The lack of political agreement around the fiscal regime change, combined with the permanence of high interest rates and sterilized intervention – needed to support the exchange rate policy – fuelled the public sector debt (Figure 1). Currency appreciation, growth of domestic demand and incentives to short term capital inflows resulted in a rapid growth of current account deficit, increasing Brazilian vulnerability to confidence shocks.

Figure 1



A first confidence crisis followed the international turmoil triggered by the Southeast Asia currencies devaluation 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. Besides the monetary tightening, the government seized the opportunity to

[1] Bacha (1999) provides a comprehensive discussion of the Real Plan imbalances.

press for a strong fiscal response. In fact, the Congress approved in a matter of weeks a R$ 20 billion —about 2% of GDP — fiscal program that included spending cuts and tax increases, named '*Package 51*'[2]. The fast recovery of international reserves that followed allowed the Central Bank to reduce interest rates, but they would return to pre-crisis level only in July 1998. In the issue of rebuilding confidence, Brazil failed to deliver its fiscal promises. The measures related to spending cuts were not fully implemented, as the political will to undertake them diminished in line with the perceived contagion effects.

The Russian moratorium in August 1998 met a much-deteriorated fiscal outlook. In this episode the country was much more affected by international turbulence due to a worldwide reassessment of risk exposure to emerging markets. There were substantial capital outflows 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 was fixed at 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 the year after Congress rejected a bill to increase social security contributions for civil servants and to extend it to pensioners.

The government put into practice the fiscal tightening measures, but market confidence continued to erode up to January 1999, also reflecting concerns over the newly elected governors' commitment to adjust their states' finances. Any sign of potential deviation from the fiscal target induced extreme market nervousness. With 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 made the market bet massively against the new arrangements. Without alternatives, the monetary authority allowed the exchange rate to float, and the dollar

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

value quickly moved from R$ 1.21 – prior to the devaluation – to near R$ 2.00 at the end of January (Figure 2).

Figure 2 – Exchange rate evolution

The exchange rate devaluation had an immediate impact on tradable goods prices at the wholesale level, fuelling expectations of a permanent rise of consumer inflation. The Wholesale Price Index - IPA indeed increased 7% in February, the highest monthly rate since 1994, while consumer price inflation rose less, to around 1% (Table 1). The agreement with the IMF had to be reformulated, losing its preventive nature. 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. The great uncertainties surrounding the country's future prompted a chaotic-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, reducing the degree of uncertainty in the short-run; and to design the new monetary regime based on inflation targeting.

Table 1 – Inflation rates

Month	Broad Consumer Price Index IPCA		Wholesale Price Index IPA		General Price Index - Market IGP-M	
	monthly	year-over-year	monthly	year-over-year	monthly	year-over-year
Jan/98	0.71	4.74	0.75	6.82	0.96	6.89
Feb-98	0.46	4.69	-0.15	6.30	0.18	6.62
Mar-98	0.34	4.52	0.13	4.77	0.19	5.61
Apr-98	0.24	3.85	-0.28	3.93	0.13	5.03
May-98	0.50	3.95	0.13	3.92	0.14	4.95
Jun-98	0.02	3.41	0.17	3.84	0.38	4.57
Jul-98	-0.12	3.06	-0.61	3.30	-0.17	4.30
Aug-98	-0.51	2.55	-0.04	3.42	-0.16	4.04
Sep-98	-0.22	2.27	0.06	2.54	-0.08	3.45
Oct-98	0.02	2.05	-0.19	1.92	0.08	3.16
Nov-98	-0.12	1.76	-0.20	0.63	-0.32	2.18
Dec-98	0.33	1.66	1.74	1.50	0.45	1.78
Jan-99	0.70	1.65	1.58	2.34	0.84	1.66
Feb-99	1.05	2.24	6.99	9.65	3.61	5.14
Mar-99	1.10	3.02	2.84	12.62	2.83	7.92
Apr-99	0.56	3.35	-0.34	12.55	0.71	8.55
May-99	0.30	3.14	-0.82	11.49	-0.29	8.09
Jun-99	0.19	3.32	1.35	12.80	0.36	8.07
Jul-99	1.09	4.57	2.03	15.80	1.55	9.92
Aug-99	0.56	5.69	2.15	18.33	1.56	11.81
Sep-99	0.31	6.25	2.30	20.98	1.45	13.52
Oct-99	1.19	7.50	2.58	24.34	1.70	15.37
Nov-99	0.95	8.65	3.59	29.06	2.39	18.50
Dec-99	0.60	8.94	1.60	28.88	1.81	20.10
Jan-00	0.62	8.85	1.02	28.17	1.24	20.58
Feb-00	0.13	7.86	0.17	20.00	0.35	16.78
Mar-00	0.22	6.92	-0.05	16.63	0.15	13.74
Apr-00	0.42	6.77	-0.02	17.00	0.23	13.20
May-00	0.01	6.47	0.69	18.78	0.31	13.88
Jun-00	0.23	6.51	1.45	18.90	0.85	14.43
Jul-00	1.61	7.06	2.79	19.79	1.57	14.46
Aug-00	1.31	7.85	2.56	20.27	2.39	15.39
Sep-00	0.23	7.77	1.09	18.85	1.16	15.06
Oct-00	0.14	6.65	0.56	16.50	0.38	13.57

Sources: IPCA - National Bureau of Geography and Statistics (IBGE)
IPA & IGP-M - Getulio Vargas Foundation (FGV)

2.2 Transition to inflation targeting (March-June 1999)

Far from a planned decision, the shift to a floating exchange rate regime occurred in a moment of crisis. Despite that, 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. It is hard to find arguments, even in the more recent literature about monetary integration as a credibility instrument, to justify the adoption of a fixed exchange rate regime. 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 could also offer some notion about the future path of the economy; one that would allow enough flexibility for policymaking but could also effectively anchor the public's expectations. So the decision was taken to put in place an inflation-targeting regime.

An interesting feature of the new monetary policy regime was its "gradual" implementation. It was not feasible to adopt formal inflation targets right after the floating, given the uncertainties regarding the post-devaluation inflationary process. At the same time, the adoption of the framework required a deep research effort to quantify the firepower of the interest rate policy and institutional changes to ensure operational independence for the Central Bank. The new regime also required some consolidation of the intended shift in fiscal policy in order to establish a minimum of credibility on the consistency of the policy combination. Consequently, the intention to adopt an IT framework was immediately announced, but its formal introduction, as well as the target value, was left 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 CPMF (Provisional Contribution on Financial Transactions) was approved, though with a five-month delay in the government's original schedule. To compensate for this loss of revenues and to ensure strict adherence to the fiscal targets (consolidated public sector primary surplus of 3.1% of GDP in 1999), additional temporary tax increases and spending cuts were set up in the first quarter. These measures included the increase from 2% to 3% of the turnover tax (COFINS) and its extension to financial institutions; the increase of social contribution on net profits (CSLL) from 8%to 12%; and a marginal 0.38% increase of the tax on financial operations (IOF) in investment fund deposits and credit operations.

All this was a clear demonstration of the government's commitment to fiscal adjustment. Policymakers in fact seized the opportunity created by the crisis to force a major shift in the fiscal regime, thus laying a fundamental pillar to support inflation targeting. Even though the reforms needed to assure long-run fiscal equilibrium were far from over, the government already 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 immediately worked to calm down financial markets. The expectation that an inflation hike could bring the real rates of return on public debt instruments to 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 (*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 upwards, 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, as all quantitative analysis was unreliable given their dependence on the then chaotic state of expectations.

Therefore, expectations had to be minimally anchored, and clear communication was crucial. So, for the first time, the Committee released a brief explanation of the policy decision right after the meeting – the minutes used to be released only after 3 months – stating that "*maintaining price stability is the primary objective of the Central Bank*". 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 support* *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*[3]*, for if the exchange rate returns to more realistic levels, keeping the nominal interest rate that high would be unjustified.*"

Simultaneously with 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 a free floating, but the Central Bank kept the prerogative to make a limited amount of unsterilized intervention to counter disorderly market conditions[4]. 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 – it came down from R$ 2.20 in the first week of March to R$ 1.66 in the end of April – and a reduction both in observed and expected inflation rates. Coherently, the downward bias was applied twice before the next Copom's meeting: the interest rate was reduced first to 42% in the end of March and then to 39.5% in the beginning of April.

Market confidence was strengthening also 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 April figures. The reversal of the exchange rate overshooting and the new crop effect on food prices were held responsible for the immediate decline in inflation. The Wholesale Price Index (WPI), in which tradable goods have a larger weight, registered negative changes

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[3] The bias on the interest rates was an important novelty: it delegated to the Central Bank's Governor the power to change interest rates during the period – usually 5 weeks – between two ordinary Committee meetings. A downward bias allows only interest rate reductions. If a tightening is needed, an extraordinary meeting should be called for first.

in April (-0.3%) and May (-0.8%). Consumer inflation measured by IPCA (Broad Consumer Price Index) fell to 0.6% in April and 0.3% in May (Table 1, Figure 4). Inflationary expectations followed suit: the median of market forecasts of consumer inflation for 1999 was revised from 13% in March to 7.7% in the end of May[5].

The positive evolution of the macroeconomic environment allowed further reductions of the basic interest rate. However, the level of uncertainty rose again due to external developments. By mid-May, the Federal Reserve Board introduced an upward bias for the fed funds rate, which was held constant at 4.75% since December 1998, signaling a gradual monetary tightening for the second half of the year. Expectations of higher external interest rates, coupled with doubts about the electoral process and the currency board sustainability in Argentina, undermined risk perception. 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 upwards to the R$ 1.75-1.80 range (Figure 3). A subjective explanation to this new depreciation then became popular in the specialized press and was to recur in similar subsequent episodes: still unused to the new floating regime, the foreign exchange market participants tried to infer the "Central Bank's intervention band" – if there was one, considering the limits imposed by the floor for net international reserves set up in the IMF agreement. More objective factors were the concentration of amortization payments on private sector external debt due in June, the combination of rising risk premium with 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.

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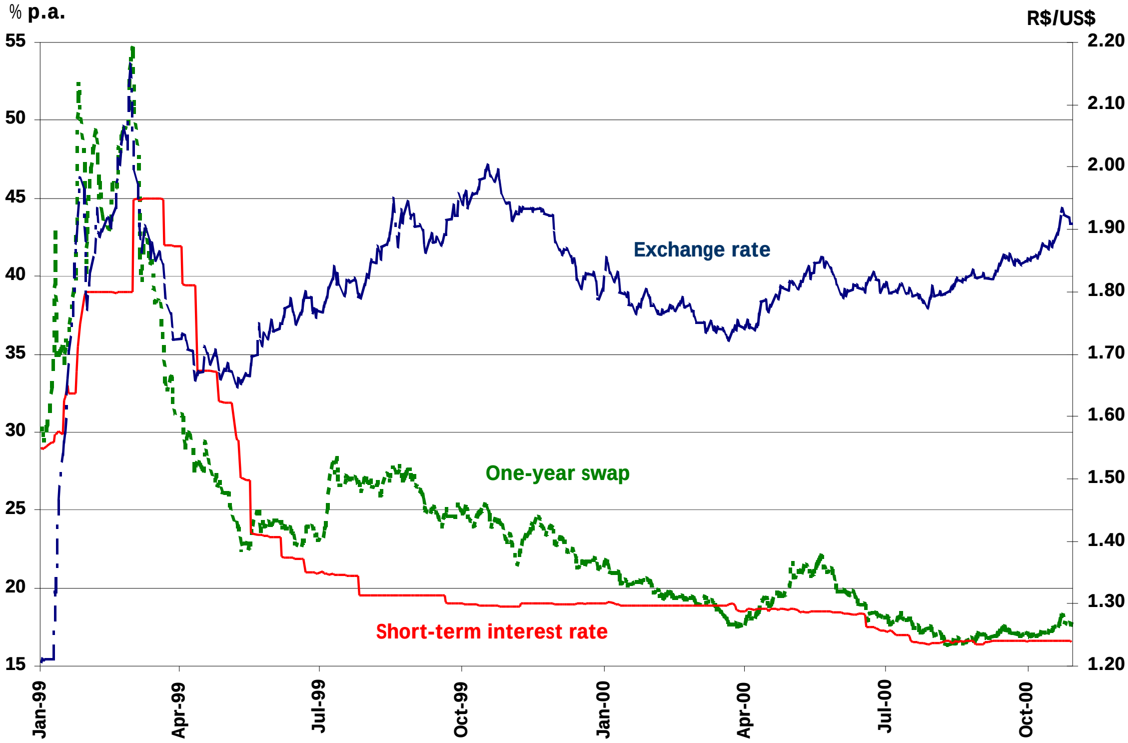
[4] Brazil Memorandum of Economic Policies, released on March 8, 1999.

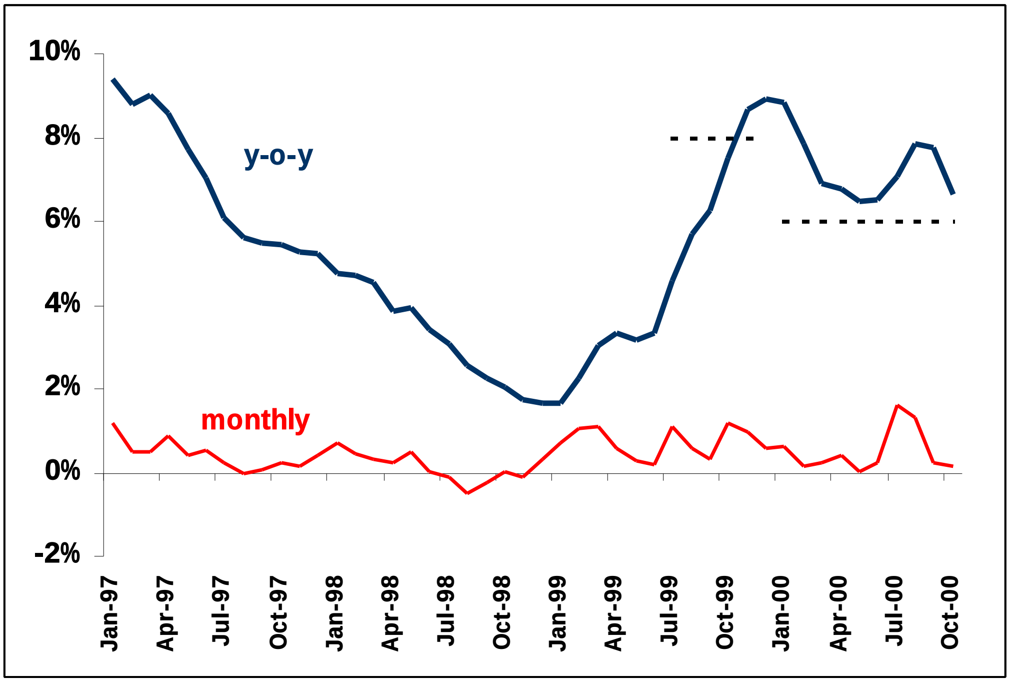
[5] The Central Bank's Institutional Communication Group (GCI) collects market inflation forecasts daily, sampling 70 financial institutions and consulting companies. The survey was initiated in April and data has recently been published in a CD-ROM (*Focus and other Reports: 1999-2000*). For IPCA, the survey begins only in June, when this index was chosen as reference for inflation targeting (see Figure 5). Therefore, data before June is based on a preliminary unpublished survey of a very small number of institutions.

Figure 3 – Interest rates and exchange rate



Summing up, the policy response to the crisis triggered by the initial exchange rate devaluation consisted of fiscal and monetary tightening, which 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 has been the main instrument to attain the inflation objectives and, with inflation expectations under control, it was cut by half in less than four months.

Figure 4 – Inflation evolution



3. The stylized structural model[6]

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 decisions; and (v) mechanisms for making monetary authorities accountable for achieving the inflation targets. The first feature, a numerical target value, had to be low, feasible and compatible with the macroeconomic outlook.

With this in mind, high priority was placed on understanding the transmission mechanism of monetary policy to prices, with emphasis on developing a set of

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[6] This section is based on Bogdanski *et al.* (2000).

forecasting tools: (i) structural models for the transmission mechanism; (ii) non-structural time-series VAR and ARMA models for short-term forecasting; (iii) measures of core inflation; (iv) leading inflation indicators; and (v) surveys of market expectations.

Among these tools, the most important is the family of structural models, which is estimated/calibrated with the 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 type 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 tradeoffs. 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 could be, in a quarterly frequency:

(I) $$h_t = b_0 + b_1 h_{t-1} + b_2 r_{t-1} + b_3 q_t + e_t^h$$

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

A first problem at this stage was how to measure the variables that are not directly observable, like the output gap. The starting point was, as usual, 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, the 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 (1994:III to 1998:IV). As mentioned in Section 2, 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. Thus, it is reasonable to conclude that the equilibrium real interest rate under the current floating exchange-rate regime should be substantially lower than in the previous regime. The transition effects due to 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 is assumed that the long-term equilibrium real interest rate must equal the potential GDP growth rate. Of course a thorough analysis of this question should also include fiscal policy considerations, like the long run fiscal balance, debt administration issues, and the like, 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 $\bar{r} = -{}^{b_0}\!/_{b_2}$, since b_2, 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 (b_0,b_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 real exchange-rate changes. For example:

(II) $p_t = a_1 p_{t-1} + a_2 E_{t-1}(p_t) + a_3 h_{t-1} + a_4 \Delta(p_t^F + e_t) + e_t^n$

where: p is log of consumer price inflation, h is log of output gap, p^F is the log of foreign producer price index, e is the log of nominal exchange rate, Δ represents the first-difference operator, $E_{t-1}(\cdot)$ is the expectation operator, conditional on information available at time t-1, and e^n stands for a supply shock. The coefficients on the right side of the equation, except for the output gap one, are constrained to sum to unity to ensure the long-run verticality of the Phillips curve, i.e. 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 well past data. However, it would also be vulnerable to the Lucas critique. Its predictive power would be weak due to the recent changes in monetary policy and exchange-rate regimes, which almost certainly have altered the formation of inflation expectations and the short-run inflation/output tradeoff. A purely forward-looking specification would be an attempt to overcome the parameter instability commonly found after structural breaks. It can also be motivated by the natural assumption that, as the inflation targeting regime gains credibility, expectations tend to converge to the targeted value. However, it raises difficult estimation issues about the appropriate measures of expectations, especially when reliable survey data are not available.

Different assumptions about the expectations mechanism were tested, but in general the estimations led to a weighted average of past and future inflation, with at least 60% on the forward-looking component. These results were rejected for two reasons. First, they did not match the current surveys of market expectations. Second, they generated an inflation/output dynamics with almost no inertia and consequently a fast adjustment of both real and nominal variables, which was not believed to yield a reasonable representation of reality. 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 due to sluggish adjustment forced by the backward-looking terms, while keeping a 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, together with an additional hypothesis about how they react to new information. Or expectations can be calculated recursively in order to be model-consistent.

The passthrough of exchange rate changes to domestic inflation is another key issue in the Phillips curve set-up. Several linear and non-linear specifications for the passthrough coefficients have been tested, reducing to four the alternatives implemented in the preferred simulation tool. The first one is a standard constant coefficient ($a_4 = \text{constant}$), simply estimated from a suitable sample of past data. The second one is a quadratic transfer from exchange rate variations to inflation ($a_4 = a_{41} + a_{42}\Delta(p_{t-1}^F + e_{t-1})$). The third one is a level-dependent coefficient ($a_4 = a_{41} + a_{42}e_{t-1}$). It is estimated under the assumption that the passthrough depends also on the level of the (log) nominal exchange rate. The last one is a quadratic function of the nominal exchange rate level ($a_4 = a_{41}\dfrac{E_{t-1}^2 - a_{42}}{E_{t-1}^2 + a_{42}}$), motivated by a simple partial equilibrium model in which exchange-rate devaluations shift the supply curve of competitive producers of tradable goods[7]. All non-linear variants intend to capture more precisely the effects of a temporary exchange rate overshooting. For 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 difficult. The first approach was to model the link between the exchange rate and the interest rate through capital markets by an uncovered interest parity condition, which relates expected changes in the exchange rate between two countries to their interest rates 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 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

[7] See Goldfajn and Werlang (2000), Appendix.

change follows a white noise process[8] $E_t e_{t+1} - E_{t-1} e_t = h_t$, it is possible to specify the exchange rate dynamics as:

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

There are two exogenous variables in this equation: 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 over Treasury bonds of Brazilian sovereign debt – has presented high volatility in the last years. The risk premium is usually associated to macroeconomic fundamentals and a number of other subjective factors that are not easily anticipated. Hence, two alternative approaches have been considered. The first is to gather the opinions of Copom members about the future evolution of the country's risk premium, conditional on the overall scenario and based on anecdotal evidence, translating it to an exogenous expected path that will be used in simulations. The second approach is to make assumptions linking the risk premium behavior to the main objective factors thought to influence it, letting it be endogenously determined by the model. A list of these factors would typically include the fiscal stance, current account balance perspectives, international liquidity conditions and interest rates, foreign capital markets performance, commodities prices, and country rating.

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 to analyze 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

[8] This is equivalent to a random walk with monetary surprise, where a surprise is characterized by

helpful for institutional communication. The quarterly inflation report traditionally presents inflation forecasts constructed under the assumption that the short-term interest rate will remain constant at the current level along the projection period. This projection is made clear by means of an inflation fan chart, which shows the probability distribution around the central forecast for each quarter. By visual inspection, it is possible to infer whether monetary policy should be altered and in which direction[9].

The interest rate rule can be a linear function of some system variables. For example, monetary policy can react contemporaneously to output gap and deviations of inflation from target: $i_t = (1 - l)i_{t-1} + l\,(w_1(p_t - p^*) + w_2 h_t + w_3)$. When λ=1, this is equivalent to a standard Taylor rule, while when $\lambda \in (0,1)$ this is a Taylor rule with interest rate smoothing. The ? $_i$´s can be set arbitrarily or using specific optimization procedures available in the simulation tool. Alternatively, an optimal interest rate rule can be found by minimizing an appropriate loss function, subject to the model in use.

4. The transmission mechanism

Surprisingly enough, the initial modeling efforts succeeded to reach the stage of practicality – a minimum level of reliability and sensible dynamics – in a very short time. However, some qualifications must be stressed. First, this kind of small structural models is a very recent work (for Brazil) that has not benefited from academic in-depth empirical research to support it. Even if this were not the case, the common limitations due to model and parameter uncertainty would 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 on many economic series, thus making it extremely difficult to treat them with the usual econometric techniques. This assigns a fundamental role to the several non-structural tools in complementing and checking the consistence of structural modeling results. Policymakers are well aware of the limitations of the

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changes in interest rate differentials or in risk perception.

available tools and have no illusions about their effectiveness. Nonetheless, the models have been very useful and have helped discipline the discussion with the staff and within the Copom.

This modeling approach embodies the understanding that the most important transmission channels are, like in most other economies, 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 on consumer inflation. Therefore, changes in short-term interest rates are transmitted to inflation through the aggregate demand channel with an estimated 2- to 3-quarter lag. The exchange rate channel is estimated to have no transmission lag: the effect of permanent interest rate changes on consumer prices is contemporaneous (on a quarterly basis), but its magnitude is smaller than through the demand channel. Needless to say, these results are based on the strong assumptions that expectations remain consistent with the model after the policy change and that the policy change itself is a sufficiently small departure from the initial position so as to keep valid the log-linear approximation.

At this point, some qualifications should be highlighted. First, the short lag structure in the aggregate demand channel is a very uncommon feature, quite different from the empirical findings for the vast majority of either industrialized or developing economies. This result may be the consequence of the large swings in real interest rates that characterize the post-*Real* Plan sampling period, which enabled prompt output and inflation responses but with relatively small swings. It is expected that the control lag will gradually increase as the economy converges toward its long run steady state equilibrium.

Second, the transmission mechanism of monetary policy in Brazil seems to present a great deal of sand in its gears due to a variety of reasons, most of which derive from the

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[9] 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

recent history of hyperinflation. The financial system, for example, has been over-regulated, with a variety of credit restrictions, mandatory allocation of funds, and distorting taxes. Consequently, the banking spread has 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 explains part of the high volatility of interest rates observed in the last three to five years. There is an impression that a slight deviation from the expected path requires a significant change in the basic interest to bring the economy back to the central path. In other words, the interest-rate elasticity of the macroeconomic equilibrium is low. For this reason, there is a series of parallel projects under way aimed at correcting these distortions and improving the transmission mechanism.

The third is relative to the passthrough. Goldfajn and Werlang (2000) concluded on the basis of panel-data evidence, that the passthrough coefficient depends in general on two mains factors: the degree of overvaluation of the exchange rate prior to the devaluation, and the previous level of inflation. 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 terms of trade and the Russian crisis in 1998. So the preliminary results confirmed the tendency for a low passthrough and this was most reassuring. Other variables related to the passthrough, like the degree of openness and the economic activity level also worked in the same direction. Open and heated economies, other things equal, tend to present higher passthrough coefficients. Although trade liberalization progressed well and fast in the 1990s, the degree of openness of the Brazilian economy – around 14% – is considerably low in the international comparison. And after the Russian crisis the economy evolved below its potential, so when the *real* floated the output gap was undoubtedly negative, providing a major force to counter passthrough pressures. This explanation for the low initial passthrough appears to be still valid in 2000, when the economy is probably growing at 4%. We leave to Section 5 the discussion of the

clarify the policy maker's assessment of the current economic stance.

inflationary effects of the contractual link between the exchange rate variation and some government-managed prices.

5. Policy reaction to shocks

In this section we examine monetary policy reaction to shocks, since inflation targeting was implemented in Brazil. We begin by identifying the main shocks since July 1999 and the corresponding policy behavior.

The identification has to address the nature as well as the duration of shocks. This is obviously easier with the benefit of hindsight. Nevertheless, in some cases the ex-post interpretation of shocks may not be straightforward. Take the case of the oil shock which could be interpreted in several ways. For instance, one might consider it as a pure cost push shock; however, such a shock might be similar to a tax increase, reducing disposable income in an oil importing country; finally, one could interpret it as a shock to potential output, since it could impact total factor productivity once it was perceived as permanent.

Likewise, policy reaction may not be understood if one does not address the problem of inflation persistence. We argue in this section that, given our institutional setting with, among other characteristics, a high weight of government-managed prices in the consumer basket[10], policy responses are different from those under an environment where all prices are market determined. Moreover, one has to consider other features of the basic IT framework when discussing policy reactions. These are the absence of

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[10] "Government-managed prices are those that, in one way of another, are defined or impacted by a public sector agency, independently of current supply and demand conditions. The major administered prices and respective weights are: 1) defined at the federal level: oil by-products (6%), electricity fees (3.3%), telephone and postal services fees (3%), minimum wage (3%); 2) defined at local governments' levels: water and swages fees (1,5%), public transportation (6%), property taxes (1%). 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'. A substantial part of these prices are public utility fees whose adjustments are based on concession contracts, and leave no room for discretion. The minimum wage is set by the Congress. The central government has effective direct control only over wholesale prices of oil

escape clauses, the use of a headline index and the adoption of disinflating multi-year targets. All these peculiarities end up leaving less room for accommodation by monetary policy.

5.1 Description of main shocks and corresponding policy behavior

A total of eight shocks were identified between July 1999 and November 2000. Among these we find a wide variety of supply and exchange rate shocks. The supply shocks are mainly associated with food market conditions and government-managed prices, which include the effects of international oil prices. The exchange rate shocks are mainly derived from increased international volatility and deterioration of the market perception of Brazil risk premium. Most of them – seven out of eight – are classified as adverse shocks to the extent that their preponderate effect was to press inflation upwards. The taxonomy is somewhat dubious due to the fact that in general the economy is hit by more than one shock at the same time, and disentangling the combined effects of simultaneous shocks is not possible without some arbitrariness. Along the same line, it is complex to associate monetary policy decisions to individual shocks.

In order to understand the policy reaction, we should highlight again that the Brazilian economy in this period was far from its long run balance, particularly in 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, it is possible to conclude that there was in fact a policy tightening, and not an accommodative stance.

The following table is an attempt to summarize the main shocks that have hit the Brazilian economy in the inflation-targeting period.

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by-products, but has been resetting them in accordance to international prices, in line with the full liberalization of the domestic oil market scheduled for 2001.

Table 5.1 – Main shocks and policy reaction

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

The shocks that we classify as "government-managed prices" should be understood as a block annual resetting of public utility fees (electrical energy, telecommunications, water and sewage, and the like) that occurs in the beginning of the second half of the year[11]. Great part of these services were privatized in recent years, and their price adjustment follows contracts linked to general price indices. The first shock (numbered 1 in Table 5.1) is considered so because market agents did not correctly anticipate it. After the July inflation figures were released, inflation expectations rose by one full percentage point. However, Copom had been taking this temporary inflation rise in consideration since the first issue of the Inflation Report (end of June), and thus reduced the basic interest rate, since forecasted year-end inflation was very close to the targeted level.

When the second shock (numbered 7) occurred, it was fully anticipated. In fact, along the previous three quarters, monetary policy decisions have been explained to the public as aiming to counter possible second round effects of this expected rise in government-managed prices. However, this shock coincided with other two adverse developments.

[11] There are other government-managed prices, like minimum wage, oil by-products, and urban bus fares, that are not necessarily readjusted in the beginning of the second half of the year.

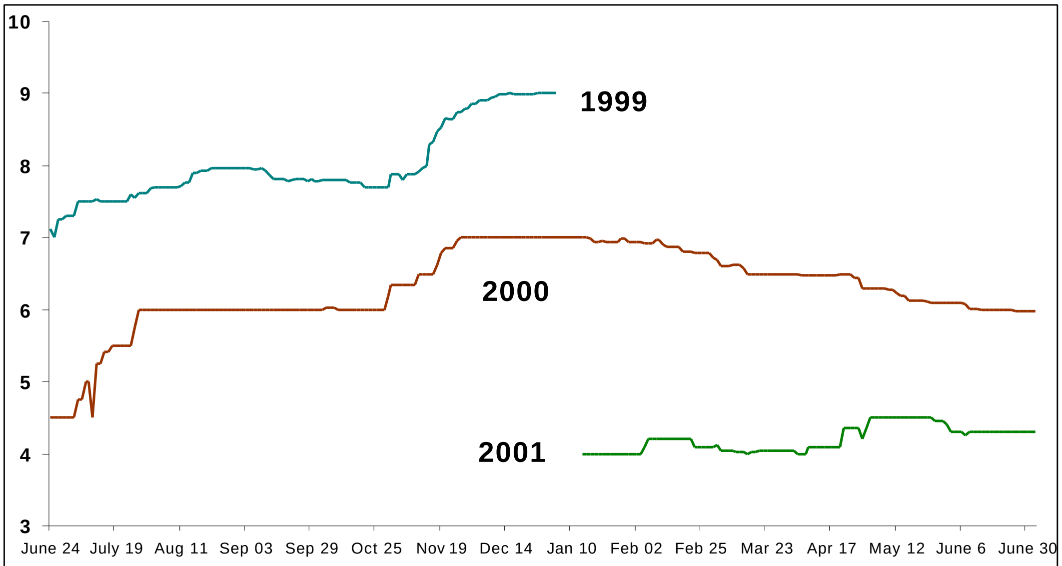
First, the domestic price of oil by-products was raised due to the new upsurge of international prices. Second, bad weather conditions along the country pushed food prices strongly upwards. As a result, the inflation forecast for the year was revised, and the interest rate was held constant. At the time, there was evidence from previous episodes (e.g. last quarter of 1999) that the effects of supply shocks, once recognized as temporary, vanish quickly and seem to keep inflation expectations essentially unaltered. This low price inertia has been confirmed with the substantial decline in inflation that was observed in September and October 2000 (see Table 1).

The food price shock (numbered 6) was the only positive[12] supply shock in the covered period. It consisted of a gradual reduction in food prices that began in February 2000, but became stronger only in May and June. Thus, even though it was identified earlier, the presence of other shocks in April and May concealed its effect on inflation expectations. In the end of June, the external uncertainties were attenuated and the inflation forecast was revised downwards with the positive influence of food prices, allowing a one-percentage point reduction in the basic interest rate.

The shocks we denominate “exchange rate” comprise four episodes in which there were considerable shifts in exchange rate. Of course, in a floating regime, the exchange rate can be taken as a thermometer of market expectations, in the sense that it reflects in part the reactions to monetary policy stance through the uncovered parity condition, and in part the changes in risk premium motivated either by domestic fundamentals or by external shocks. This way, the denomination “exchange rate shock” is a misnomer: it represents the set of factors that change the value of the foreign currency, and not the exchange rate change itself.

The first of these shocks (numbered 2) hit the economy in August 1999, and consisted of a combination of factors. First, as market inflation expectations rose sharply in July due to shock number 1, 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 due to monetary tightening in the US, which could lead to a situation of inadequate financing for the Brazilian private sector exposure, especially towards the end of the year. Also, for the first time since the Gulf war, serious concerns with oil prices were entering the agenda, with potential inflationary impact on Brazil. In this scenario, there was 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[13], since private market instruments were not available in appropriate amounts. Second, the interest rate was held constant, interrupting the sequence of reductions since mid-March. The interest rate level was thought to be more than enough to take care of inflationary pressures through the aggregate demand channel, but if expectations deteriorated further, then the passthrough could endanger the achievement of the year target, advising a tougher policy response. The strategy was successful, as expectations improved: fiscal policy delivered better results than targeted, observed inflation was falling until September, and sovereign risk perception started a continuous decline that was to stop only in April 2000.

Figure 5 – Market Inflation Expectations
Median of 12-month IPCA for 1999, 2000 & 2001 (%)
(daily figures: June 24, 1999 to June 30, 2000)



Source: GCI / Banco Central

[12] Positive in the sense of bringing inflation down.

However, in October the foreign exchange market experienced a liquidity shrink that coincided with a concentration of amortization payments of private sector debt. Moreover, trade deficit was not recovering at the expected velocity and there were mounting concerns about possible capital outflows in response to Y2K fears 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 temporary liquidity shortages expected for the upcoming weeks. The measures included: lowering by around US$ 2 billion the floor on net international reserves (NIR), a performance criterion in the IMF agreement; issuance of new sovereign bonds, and an IDB loan. Later, in the beginning of December, the Central Bank structured two forward foreign exchange auctions. In this operation, the Central Bank would sell a certain amount of dollars in the end of December and repurchase the same amount in the beginning of January, hence eliminating doubts about possible currency shortages due to Y2K problems. The strategy was instrumental to improve confidence, and as a result, capital inflows expected only for the next year were anticipated.

Shock number 5 is a good example that the robustness of domestic fundamentals is capable of avoiding the harmful effects of a high level of external volatility. It started in April 2000 with the strong asset price correction in international markets, combined with a new upsurge in oil prices and an additional rise in the fed funds rate. As in all other recent events of increased external uncertainty, the risk premium was the first variable to adjust to the new conditions. However, in this case, inflation expectations did not deteriorate. Indeed, as the domestic macroeconomic outlook presented no fundamental misalignment, and the food price shock was keeping current inflation low, expectations even improved somewhat. Without any intervention, the foreign exchange market adjusted itself smoothly. 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 3). Copom held the interest rate constant in this period, but signaled

[13] 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 was declining gradually since January.

clearly in the April-meeting minutes 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 to what should be the correct monetary policy reaction to shocks. Similar events may demand different responses because the overall economic conditions should be taken into account. It is plausible to say that inflation targeting in Brazil has been subject to serious tests right from start. The oil price shock, which pervaded all this period with unprecedented intensity since the 1980s, lead to a substantial rise in domestic fuel prices – that more than doubled in less than a year. Nonetheless, inflation was kept within target in 1999 and almost surely it will be within target in 2000.

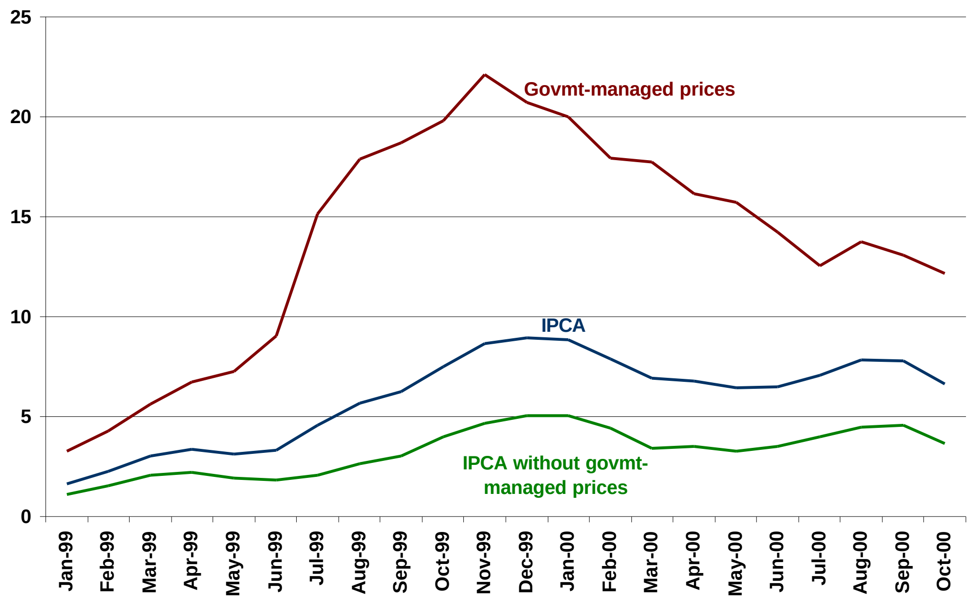
5.2 Monetary policy response: theoretical and empirical evidence

Since the floating of the real, in January 1999, an important realignment of relative prices occurred in Brazil. Up to October 2000, the real depreciated approximately 55%, the general price index rose by 30% and IPCA by 15%. Because of the adjustment rules of government-managed prices, they increased by 32% in the period, while other prices of the economy rose only by 7.9%. The chart below compares the evolution of 12-month inflation of the IPCA with that of government-managed prices and of the remaining prices.

It is clear that since the Central Bank of Brazil targets the headline IPCA inflation, the behavior of government-managed prices has been imposing an important restriction in the conduct of monetary policy, since it is being necessary to keep real interest rates at high levels in such a way to avoid inflationary pressures on the other prices of the economy[14]. This issue will be further discussed in section 5.3.

[14] The high real interest rates in the recent period can also be justified by the necessity of the Central Bank to ensure credibility.

Chart 5.1 — Twelve-month inflation



We estimate impulse response functions to different shocks and compare to the recent reaction of monetary policy to supply and exchange rate shocks. The results are summarized in Table 5.2 and in Charts 5.2 to 5.4.

It is assumed that the economy starts from a steady state equilibrium and is hit by shocks of one standard deviation, whose magnitudes are 0.3 pp, 0.45 pp and 5% for supply, demand and exchange rate shocks, respectively. Table 5.2 shows the accumulated responses of inflation, nominal and real interest rates to each shock.

Table 5.2 – Response to shocks, deviation from equilibrium

		Supply	Demand	Exchange Rate
Inflation	**1 year**	0.06	0.10	0.05
	2 years	0.22	0.06	0.17
	long term	0.06	-0.10	0.02
Nominal Interest Rates	**1 year**	0.24	0.43	0.20
	2 years	0.21	0.48	0.17
	long term	0.20	0.47	0.17
Real Interest Rates	**1 year**	0.18	0.33	0.15
	2 years	-0.01	0.41	0.00
	long term	0.14	0.57	0.15

As standard models would predict (see Clarida *et al* (1999)), demand shocks are the ones that require the largest reaction: the increase in nominal interest rates was 0.20 pp higher in the first year and around 0.30 pp in the long run, compared to the reactions to supply and exchange rate shocks. These last two lead to very similar reactions, despite the fact that the shock in exchange rate is almost 10 times as large as the supply shock. This finding can be explained by the fact that the reaction of monetary policy to exchange rate shocks is only through its effect on inflation. Since the passthrough from exchange rate devaluation to inflation is about 10%, the final impact of this shock on inflation is approximately the same of the supply shock, advising a similar reaction.

Chart 5.2 - Impulse response of nominal interest rate

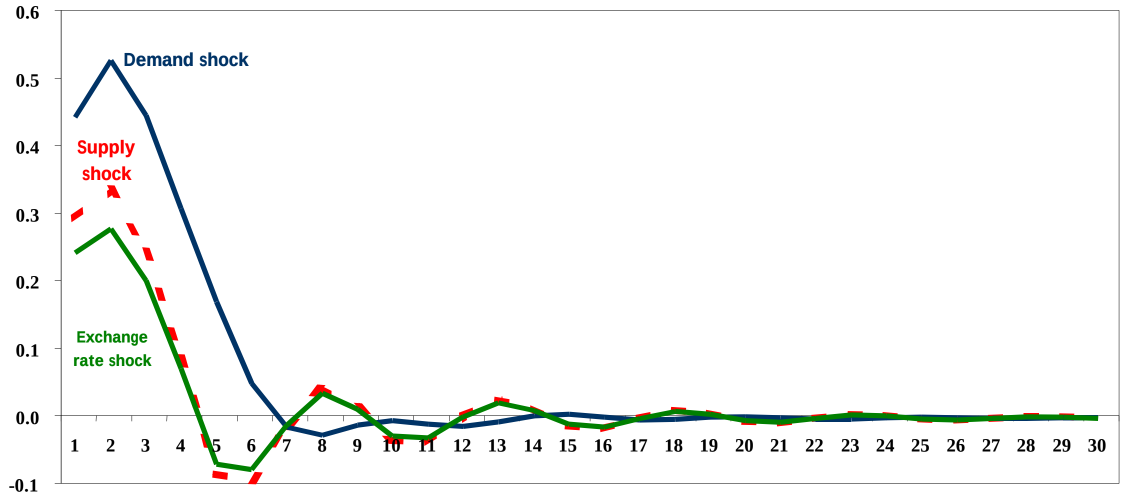


Chart 5.3 - Impulse response of real interest rate

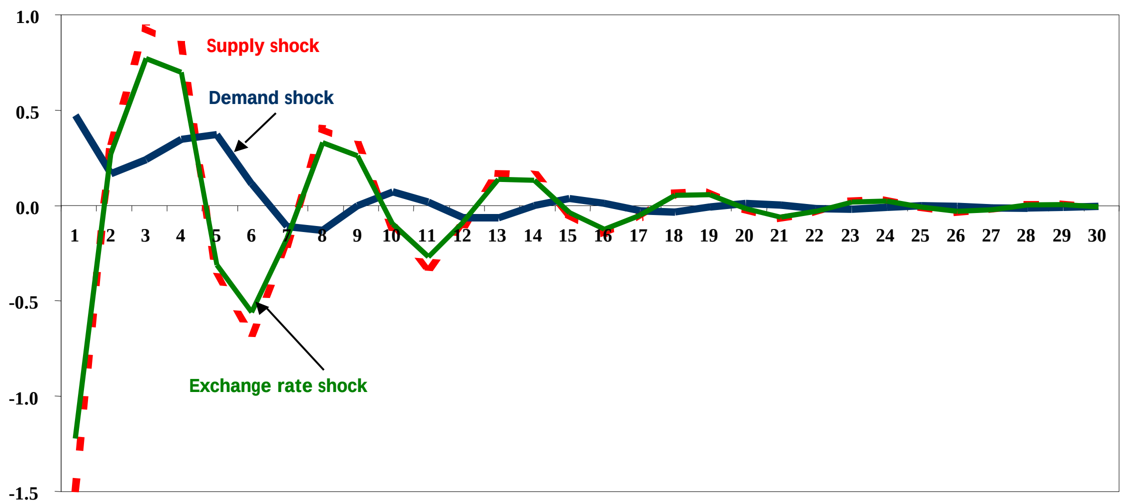
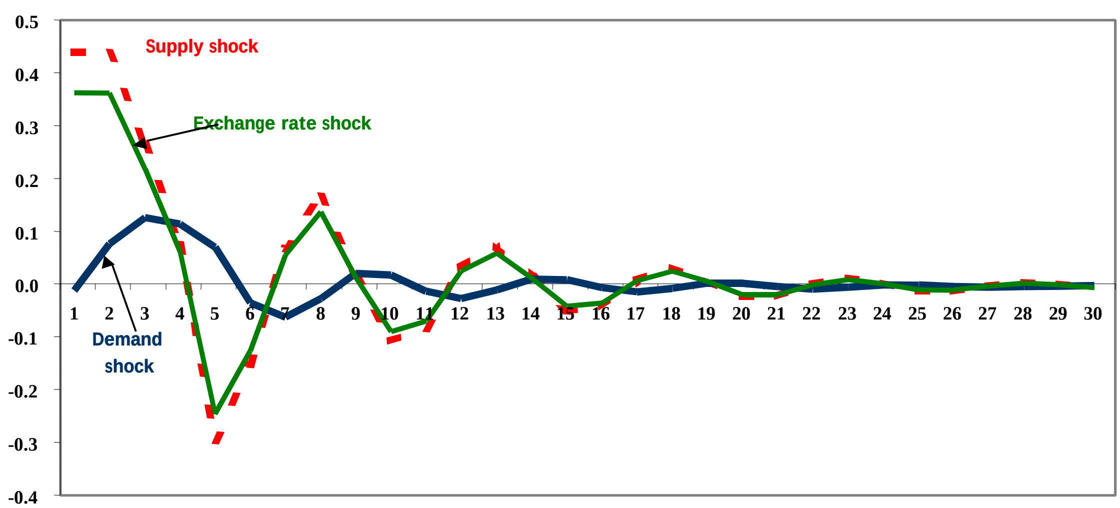


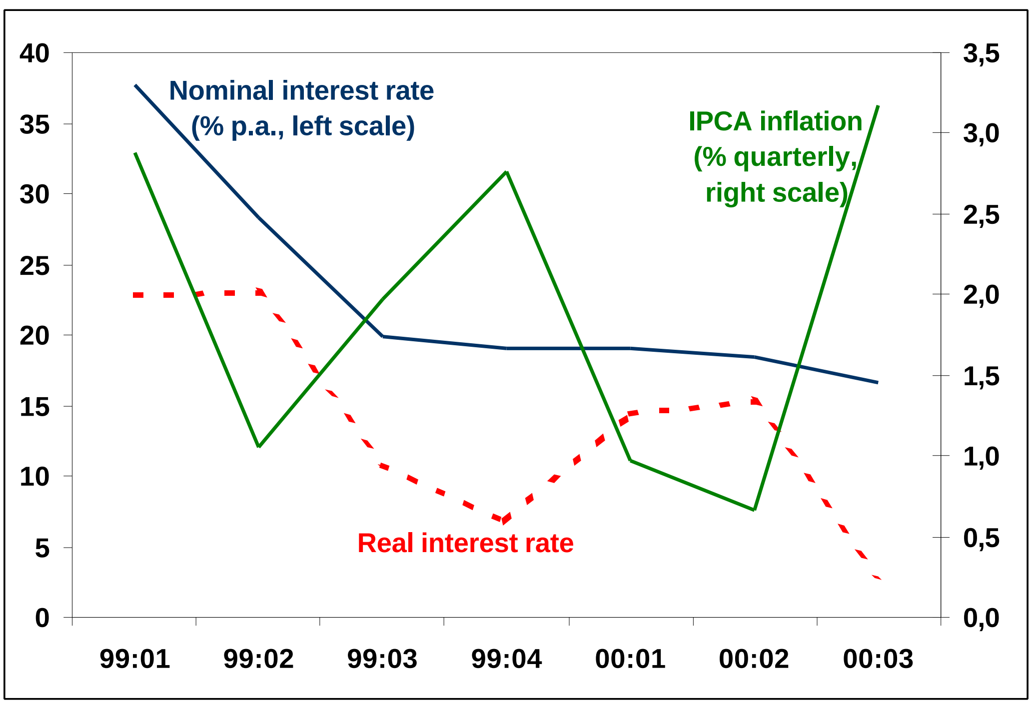
Chart 5.4 - Impulse response of real interest rate



Charts 5.2 to 5.4 above show the impulse response of inflation, nominal and real interest rates for each kind of shock. They show the same results as Table 5.2 about a less accommodative reaction of the Central Bank when faced by demand shocks. It is clear that both nominal and real interest rates should be raised when a demand shock hits the economy and thus inflation does not deviate significantly from equilibrium. Concerning supply and exchange rate shocks, the initial reaction of the Central Bank can be labeled as accommodative, in the sense that the increase in nominal interest is not sufficient to increase real interest rates. In the following period, however, real interest rates are already above equilibrium, putting inflation into a sine-waive convergence path to its steady-state value.

One should not expect the real economy to replicate the behavior of an impulse response function, since the real world is constantly hit by shocks. However, an analysis of Chart 5.5 reviews some similarities between the actual behavior of nominal interest rate and inflation with the prediction of the impulse response functions. Since the devaluation of the real in the beginning of 1999, we could identify only supply and exchange rate shocks, as presented in Section 5.1.

Chart 5.5 – Quarterly inflation and interest rates



It is interesting to examine the shocks that hit the economy in the second half of 1999. From the second to the third quarter of that year, exchange rate depreciated by 10%; government-managed prices increased by 8% in the third quarter and by 3% in the last quarter of 1999; and food inflation reached 5.6% in the last quarter. Facing such supply shocks, the Central Bank of Brazil decided to keep nominal interest rates constant during almost 6 months. As explained in Section 5.1, this procedure would be equivalent, in our out-of-equilibrium environment, to an increase of nominal interest rates when the economy is in steady state. As in the impulse response cases, it took from 2 to 3 quarters for nominal interest resume its downward trajectory[15]. The behavior of real interest rates is also consistent with the predictions of the impulse responses: despite "increasing" nominal interest rate in the first period, such movement was not enough to prevent a contemporaneous fall in real interest rates. In the following quarter, however, real interest rate rose again. Finally, as predicted, inflation also increased in tandem with the shock, but fell faster than expected: in the first quarter of 2000, if expressed in annualized terms, IPCA was already below the year target.

5.3. Inflation targeting and government-managed prices

In the Brazilian IT regime, the Central Bank should monitor the IPCA inflation, a consumer price index whose weight of government-managed prices is approximately 25%. The most important prices among this group are utility fees, gasoline, public transportation and minimum wage[16]. Compared to other inflation targeting regimes, the high weight of administered prices in the IPCA poses different challenges to the monetary authority since the sensitivity of such prices to interest rate decisions is much smaller than the sensitivity of other prices.

There are several rules for adjusting government-managed prices. Because of contractual clauses, increases in utility fees are generally based on past inflation measured by the General Price Index (IGP), a price index whose composition is 60% of

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[15] The overnight rate was lowered from 21% p.y. to 19.5% in July 1999 and remained constant until October when it was cut by 0.5 percentage point. Only in March 2000, the overnight rate would be lowered again, this time to 18.5%.

wholesale prices, 30% of consumer prices and 10% of construction prices. Prices of gasoline and oil by-products tend to increase in accordance with the exchange rate and the international oil prices. Finally, there are no formal rules for raising minimum wage, it is generally the result of political negotiations that tends to replicate past consumer price inflation.

In order to assess the importance of the government-managed prices in the monetary policy decisions we will simulate the behavior of monetary policy from 2000 to 2002, assuming the initial conditions were the ones that prevailed at the end of 1999. We will compare this behavior under different assumptions regarding the weights of government-managed prices in the IPCA and regarding the rules of how these prices are adjusted. The results of the exercises are based on the four-equation model presented in section 3. The only difference refers to the Phillips curve, which takes explicit account of government-managed prices in explaining inflation.

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

$$p_t = w_1 p_t^m + (1 - w_{11}) p_t^{ad} \tag{5.1}$$

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

$$p_t^m = d_1 w_t + (1 - d_1) z_t \tag{5.3}$$

$$w_t - w_{t-1} = y E_{t-1} p_t + (1 - y) p_{t-1} + k h_{t-1} \tag{5.4}$$

All variables are expressed in logarithms, p stands for price level, w for wages, h is the output gap, “e” is nominal exchange rate and the superscripts “m” and “ad” stand for “market” goods, i.e., goods and services whose prices are free to adjust, and administered prices.

Equation (5.1) says that consumer prices are a weighted average of market and administered prices. Equation (5.2) defines variable z as the international prices (p*)

[16] Minimum wage is considered a managed price because, for IPCA purposes, it indexes the cost of wages paid for domestic services, which corresponds to approximately 3% of the IPCA.

converted into domestic currency through nominal exchange rate (e). Observe that “e” is defined in terms of domestic currency needed to buy the foreign currency, in such a way that higher values of “e” mean devaluation 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 output gap. The restriction that the coefficients of expected and past inflation sums to one is necessary to guarantee the verticality of the Phillips curve.

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

$$p_t^t = w_1 d_1 y_1 E_{t-1} p_t + w_1 d_1 (1 - y_1) p_{t-1} + w_1 d_1 k h_{t-1} + w_1 (1 - d_1) \Delta z_t + (1 - w_1) p_t^{ad} \qquad (5.5)$$

Table 5.3 summarizes the meaning of the structural parameters.

Table 5.3 – Structural parameters in the Phillips curve

Parameter	Meaning
w_1	weight of market prices in inflation
d_1	weight of wages in market inflation
y_1	weight of expected inflation in wages
k	elasticity of wages to output gap
$1 - w_1$	weight of managed prices in inflation
$1 - d_1$	weight of exch. rate in market prices
$1 - y_1$	weight of past inflation in market prices

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

By varying the value of ω we can get a family of Phillips curves. We will define as market inflation equation the Phillips curve resulting from setting $\omega = 1$. Otherwise, we will refer to headline inflation Phillips curve. In order to compare the two curves, it is still necessary to explicitly model administered prices, that is assumed to be a weighted average of past inflation and external prices variation, according to (5.6) below:

$$p_t^{ad} = bp_{t-1} + (1 - b)\Delta z_t \qquad (5.6)$$

Table 5.4 shows the difference between the coefficients of the market and headline equations.

Table 5.4 – Difference between headline and market inflation coefficients by ß

Variable	Headline - Market Inflation Coefficients		
	b = **1**	b = **0.5**	b = **0**
E(p**)**	**-0.073**	**-0.073**	**-0.073**
p_{t-1}	**0.086**	**0.017**	**-0.052**
h	**-0.031**	**-0.031**	**-0.031**
D**z**	**-0.012**	**0.056**	**0.125**

The reduced form coefficients show that the degree of inertia depends positively on the value of β. For β ≥ 0.5, the headline inflation shows a stronger persistence, as evidenced by a larger coefficient of the past inflation, while for β = 0, market inflation is more lag dependent. Concerning the exchange rate passthrough, it is smaller for market inflation only if β = 1. Finally, as expected, the sensitivity of inflation to output gap is larger in the absence of government-managed prices, implying the transmission mechanism of monetary policy has a stronger aggregate demand channel.

Under stronger inertia, as in the β = 1 case, it is expected a less accommodative monetary policy, and the Central Bank should set high interest rates if it wants to disinflate. On the other hand, since monetary policy is less efficient under this environment, the Central Bank should be less reactive to deviations of inflation to the target, as Clarida *et al.* (1999) pointed out. Henceforth, these two factors will be referred to as the inertial and efficiency effects. Since they offset each other, it is not possible to tell *a priori* in which case the Central Bank would be less accommodative.

Based on the equations for headline and market inflation, we ran the simulations, assuming the initial conditions were the ones prevailing at the end of 1999 and let the Central Bank minimize the following loss function to determine the optimal interest rate path from 2000 to 2002:

$$\min_{i} L_t = \sum_{j=1}^{T} \rho^{j} [w_\pi D_{t+j} (E_t\pi_{t+j} - \pi^{*}_{t+j})^2 + w_h (E_t h_{t+j})^2 + w_i (\Delta i_{t+j})^2] \tag{5.7}$$

This loss function is a weighted average of the square of the deviation of expected inflation (π) to the target (π*), of the output gap (h) and of nominal interest rate variation. A discount factor ρ was also introduced to express the higher weight given to outcomes closer to the present date. There is also a dummy variable D that is equal to 1 in the last quarter of the year and 0 otherwise. It means that the Central Bank is only concerned with year-end deviations between realized and target inflation. The weights chosen were 16, 1 and 2 for inflation, output gap and interest rate variation, respectively. For this loss function, it was also assumed an optimization horizon of 8 periods and the inflation target beyond 2002 was set at 3.5%.

Tables 5.5a to 5.5c show the inflation, nominal and real interest rates resulting from the simulation, under alternative specifications of the government-managed prices adjustment processes (i.e., different values of β). Table 5.5a is the baseline case, where the results reported are obtained from simulations that used the estimated coefficients of the Phillips curve. In Table 5.5b we report the results obtained when we restricted the weight of government-managed prices in the Phillips curve to be equal to 20%. Finally, Table 5.5c shows the results of the simulation of a more rapid disinflation, ie, instead of pursuing an inflation target of 6%, 4% and 3.5% from 2000 to 2002, the Central Bank would need to meet targets of 5%, 3% and 2.5% in the same period.

For 2000 and 2001, when the degree of inertia is the highest, i.e., β=1, the inertial effect dominates the efficiency one. According to Table 5.5a, if the Central Bank faces the headline inflation Phillips curve, it would have set nominal and real interest rates about 0.5 pp higher for 2000 and 2001, compared to the case where the Central Bank faces a market inflation Phillips curve. Table 5.5b shows that this pattern is even more accentuated if the weight of administered prices is raised to 80%. In this case, if β=1, nominal and real interest rates are approximately 1 pp higher in 2000 and 2001 than the ones obtained for the market inflation. For 2002, however, this pattern is reversed and nominal interest rates are smaller under the headline inflation case. The intuition for this result is based on the offsetting character of the inertial and efficiency effects. In order to achieve the target in 2000, the Central Bank would need to reduce inflation by 2.9 pp, the difference between the 1999 inflation of 8.9% and the 6% target of 2000. For 2001, it would be necessary to reduce inflation by 1.55 pp in the market inflation case, the difference between the 5.55% inflation in 2000 and the 4% target of 2001, and 1.53 pp in the headline inflation case. For 2002, however, the disinflation effort drops significantly, to 0.55 pp for market inflation and 0.71 pp for headline inflation. We explain this result by arguing that the trade-off between inertia and efficiency favors the latter when the need to disinflate is smaller. The figures of Table 5.5c are consistent with this interpretation. When disinflation is faster, the interest rate differential between headline and market inflation raises from 0.50 to 0.60 pp, implying a stronger inertial effect.

Table 5.5a – Weight of government-managed prices = 13%

Period	Market Inflation			Headline Inflation, ß = 1			Headline Inflation, ß = 0		
	Inflation	Nominal Interest	Real Interest	Inflation	Nominal Interest	Real Interest	Inflation	Nominal Interest	Real Interest
2000	5.55	17.61	11.42	5.53	18.16	11.97	5.40	17.05	11.06
2001	4.05	14.43	9.97	4.21	15.01	10.36	4.08	13.90	9.44
2002	3.64	9.14	5.31	3.67	8.99	5.13	3.58	8.82	5.06

Table 5.5b – Weight of government-managed prices = 20%

Period	Headline Inflation, ß = 1			Headline Inflation, ß = 0		
	Inflation	Nominal Interest	Real Interest	Inflation	Nominal Interest	Real Interest
2000	**5.54**	**18.55**	**12.32**	**5.36**	**16.68**	**10.74**
2001	**4.29**	**15.23**	**10.49**	**4.05**	**13.54**	**9.12**
2002	**3.64**	**8.78**	**4.95**	**3.54**	**8.70**	**4.98**

Table 5.5c: Experience with a faster disinflation

Period	Market Inflation			Headline Inflation, ß = 1			Headline Inflation, ß = 0		
	Inflation	Nominal Interest	Real Interest	Inflation	Nominal Interest	Real Interest	Inflation	Nominal Interest	Real Interest
2000	**4.59**	**17.05**	**11.92**	**4.58**	**17.67**	**12.52**	**4.51**	**16.90**	**11.85**
2001	**3.10**	**13.58**	**10.16**	**3.26**	**14.19**	**10.58**	**3.17**	**13.34**	**9.86**
2002	**2.67**	**8.25**	**5.43**	**2.69**	**8.05**	**5.21**	**2.64**	**8.19**	**5.41**

It is more difficult to compare the case of headline inflation where β=0 with market inflation. The higher passthrough should constrain the Central Bank to reduce interest rates because of its consequences on exchange rate devaluation that would eventually feed inflation. On the other hand, the β=0 case presents smaller degree of inflation inertia and less efficiency of monetary policy, which encourages the Central Bank to be more aggressively to cut interest rates. According to Table 5.5a, the balance of all these factors favors a more rapid reduction in interest rate when the Central Bank faces a headline inflation Phillips curve with β=0.

6. Monitoring inflation targets under an IMF program

This section will compare the behavior of inflation, output gap and interest rates under the following criteria to evaluate the monetary policy stance:

I) accountability given by a year-end inflation target. This is the original IT framework in Brazil. It states that the Ministry of Finance should set the year-end target and the tolerance bands 2 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 with a +/- 2 pp band around the target;

II) accountability given by a quarterly inflation target, set by a linear convergence rule, as stated in the current agreement with the IMF. According to this criterion, 12-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 1st to the 3rd quarter 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 12-month inflation figures in the following year, and forces the monetary authority to (unnecessarily) react to such shocks.

III) accountability given by a quarterly inflation target, set by the actual outcomes observed in the previous year. Instead of the quarterly target path be based on year-end targets, as in the current agreement, this criterion suggests the use of actual inflation figures of the previous year. In logarithm terms, this target is set according to the formula below:

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

where $\tilde{p}^{*}_{T,i}$ is the 12-month inflation target for quarter i in year T; $p_{T-1,j}$ is the actual inflation observed in quarter i+j in year T-1; and p^{*}_{T} is year-end inflation target for year T.

That is, in logarithm terms, the target for the first quarter of a year would be the actual inflation observed in the last 3 quarters of the previous year, plus ¼ of the inflation target of the current year; the target for the second quarter would be actual inflation in the last semester of the previous year, plus ½ of the inflation target of the current year; and so on. In this mechanism, the target path should be re-set in the beginning of each year, when inflation of the previous year is known.

This third 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, beyond 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) use of a Taylor rule as a guideline for monetary policy decisions.

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

$$\min_{i} L_t = \sum_{j=1}^{T} r^{jj} [w_p D_{t+j} (E_t p_{t+j} - p^{*}_{t+j})^2 + w_h (E_t h_{t+j})^2 + w_i (\Delta i_{t+j})^2] \qquad (6.1)$$

s.t.:

$$p_t = a_1 E_t p_{t-1} + a_2 p_{t-1} + (1 - a_1 - a_2)\Delta(e_t + p^{f}_{t}) + a_3 h_{t-1} + e_{p,t} \qquad (6.2)$$

$$h_t = b_0 + b_1 h_{t-1} + b_3 (i_{t-1} - p_{t-1}) + b_3 q_{t-1} + e_{h,t} \qquad (6.3)$$

$$\Delta e_t = i^{f}_{t} + x_t - i_t + e_{e,t} \qquad (6.4)$$

$$\Sigma = \begin{bmatrix} s_p^2 & s_{p,h} & s_{p,i} \\ s_{p,h} & s_h^2 & s_{h,e} \\ s_{p,i} & s_{h,e} & s_e^2 \end{bmatrix} = \begin{bmatrix} s_p^2 & 0 & 0 \\ 0 & s_h^2 & 0 \\ 0 & 0 & s_e^2 \end{bmatrix} \qquad (6.5)$$

Equation (6.1) is the same loss function presented discussed in section 5.3. The value of the dummy variable D varies according to the alternative chosen. For alternative (I), where the Central Bank cares only about year-end inflation, D equals to 1 for the last quarter of the year and 0 for the other quarters. Under alternatives (II) and (III), D equals to 1 for all quarters, meaning that evaluation of monetary policy performance should be made at each quarter.

Equations (6.2) to (6.4) are the constraints of the minimization problem and form the small structural macroeconomic model presented in Section 3.

Condition (6.5) assumes a diagonal variance-covariance matrix. It is also assumed the error terms are i.i.d. normally distributed. Instead of using historical variance, we calibrated the standard errors to be 0.5 pp, 0.3 pp and 5% for output gap, inflation and exchange rate, respectively.

In order to do the stochastic simulations, we assumed the Central Bank minimizes the loss function taking into consideration 8 periods ahead, with a discount rate of 1% ($\rho = 0.99$). This horizon might be considered relatively short by international standards, but is a reasonable hypothesis for the Brazilian economy, which is characterized by a higher level of uncertainty, given it is still in a transition to steady state inflation levels. Furthermore, there is some evidence (see Freitas and Muinhos (2000)) that optimizing periods beyond 8 quarters do not yield gains in terms of efficiency in the output-inflation variability locus. Finally, this optimization horizon is also in line with the Inflation Report that releases the forecasts of inflation up to 2 years ahead. The weights of inflation, output gap and interest rate variability were 4, 1 and 4, respectively[17].

[17] Observe that for alternative I, the loss function takes into account output gap and interest rate variability in each quarter, but considers only year-end deviations of inflation from the target. Therefore, it was necessary to adjust the weight given to inflation to 16.

In the stochastic simulation, it was assumed that in the beginning of quarter t, when the Central Bank sets the interest rate, it knows the realization of all variables up to t-1, but does not know the shock. The results presented in Table 6.1 were obtained after 150 simulations. We performed the simulations as if we were in the beginning of year 2000. Except for the output gap, which was set to 0 in the end of 1999, all other variables took their actual values as initial conditions. This modification in the initial conditions regarding the output gap allow us to concentrate on the consequences for monetary policy conduct of the contamination effect described in the exposition of Alternative II above, since IPCA inflation in 1999 was 0.9 pp above the target.

Before commenting on the results, a last remark should be made about alternative IV. Since it refers to Taylor rule, where interest rate is set according to past outcomes, there is no need to perform an optimization procedure. The specification of the traditional Taylor rule is:

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

where i is the annualized quarterly interest rate; i^* is the equilibrium nominal interest rate.[18,19]

Table 6.1 shows that all alternatives lead to expected year-end inflation well within the +/- 2 pp tolerance bands established in the Brazilian IT framework, despite the initial conditions, where inflation was almost 1 pp above the target. Such results can be explained by the short transmission mechanism found in the Brazilian economy. As explained in Section 4, decisions regarding interest rates affect inflation contemporaneously via the exchange rate channel and take only 2 quarters to affect inflation via the aggregate demand channel. The output gap performance was also good, in the sense that it stayed within a ±1 pp during most of the period for all alternatives.

[18] This rate is defined by that ($r^* + \pi^*$), where r* is the equilibrium real interest rate.
[19] In order to be consistent with the loss function, we also introduced an interest rate smoothing parameter, in such a way that actual interest rate should be a weighted average of previous interest rate and the one given by equation (6.6), with weights 0.60 and 0.40, respectively.

It is difficult to rank the alternatives by looking only at the variability of inflation and output gap. Except for the Taylor rule (alternative IV), that in general implied higher volatility for both inflation and output gap, the figures concerning the other alternatives do not allow us to make clear-cut conclusions, either because the qualitative pattern is not stable or because the differences in the standard deviations are small. The results from Table 6.2, which estimates the loss assuming the "true" Central Bank utility function is the one implied by alternative I (only year-end inflation figures matter), enable us to have a better assessment of the performance of the different criteria. The performance of the Taylor Rule[20] was clearly the worst while alternatives II (current agreement with the IMF) and III (use of actual inflation in the previous year to set the target path) yield a loss of approximately 15%.

The similar performance of Alternatives I to III is a surprising result. Alternative I was expected to present a visibly better performance for year-end inflation, because it ignores inflation outcomes for the first 3 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 to the target in the previous year. It is possible that the incorporation in the loss function of output gap and interest rate variation in all quarters made the three alternatives more similar. Another possible explanation is the quantitatively important backward looking component of inflation, which implies that, in order to achieve year-end inflation target, the monetary authority needs to put a high weight on the inflation outcomes of the interim quarters. Therefore, monetary policy was not severely affected when the accountability frequency changed from annually to quarterly.

These findings, however, do not mean that the Central Bank should be indifferent among the first three alternatives. As stated, if the Central Bank is in fact concerned only with the year-end accumulated inflation, setting a quarterly target path for inflation is not likely to severely alter the behavior of macroeconomic variables. However, should monetary policy be evaluated on a quarterly basis, there is a high probability that

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

unnecessary false alarms would be triggered along 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 1pp and a formal consultation should occur if the deviation exceeds 2 pp. According to Table 6.1, there are many circumstances were, as we move along the year, there is a big drop in the probability of inflation deviating from the target by more than 1 pp. This is a particularly delicate issue for an emerging economy, because false alarms may trigger a confidence crisis, making the conduct of monetary policy more difficult. A compromising solution to this problem would be to increase the tolerance interval for the first 3 quarters of the year, in such a way that the quarterly accountability frequency is preserved along with a reduction in the probability of triggering false alarms.

Table 6.1 – Results of the Stochastic Simulation

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 6.1 (cont.) – Results of the Stochastic Simulation

Year	Q	Std. dev. of output gap				Prob (p-p*>1 pp)				Prob (p-p*>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: current framework under the agreement with the IMF, with 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 Taylor type rule for guiding monetary policy.
v) The standard deviation of inflation refers to deviations around the target, instead of the mean. Since there is no quarterly target defined for Alternative I, the standard deviation was estimated using the target set for Alternative II.

Table 6.2: 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

7. Conclusions

The relative success of economic policy since the 1999 devaluation has to do with a variety of factors. We highlighted in this paper some of the most important: the initial macroeconomic conditions, the strong international support, and the prompt policy design that provided an adequate and timely anchor to expectations. However, it should be stressed above all the importance of 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 the beginning of 1999, the year ended with single digit consumer price inflation, within the target set by mid-year, and with a near 1% GDP growth, 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, to the overvalued *real* just before the floating, and to the low initial inflation. The public's aversion to inflation resurgence also cannot be overlooked. In this environment, the transparency and the clearness of purpose of the new monetary policy regime were able to guide 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 has been posing some idiosyncratic challenges for the monetary authority. It is of special concern the evolution of the government-managed prices, which corresponds to around 25% of the IPCA and increased 32% since the devaluation of the *real* in January 1999, while all other prices taken together rose only by 7.9% in the same period.

We presented simulation results using different assumptions regarding the adjustment rule and the weight of government-managed prices in the IPCA. We showed 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 from 0.5 pp to 1 pp higher when the Central Bank faces a Phillips curve with government-managed prices. However, when inflation is closer to the steady state value, the presence of administered prices in the IPCA does not alter significantly the behavior of monetary policy.

Another interesting issue we discussed is how to monitor inflation targeting under agreements with the IMF. In a simple model for Brazil, we showed that, except for 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 is increased from yearly to quarterly. However, this is not to say that a central bank would be indifferent between only-year-end accountability, as in the original Brazilian framework, and quarterly monitored accountability, as in recent agreements with the IMF. The reason is simple: there can be circumstances in which the probability of meeting the target by year-end is high, but the probability of breaching the tolerance bands in the intermediate quarters is also high, a very likely phenomenon when the variables are initially out of equilibrium. Hence, monitoring quarterly figures can send unnecessary false alarms, introducing an unwarranted noise in the conduct of monetary policy by affecting expectations.

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

Finally, we confronted the theoretical policy prescriptions with estimated impulse response to different kinds of shocks in a simple empirical model. As expected, the results showed that a central bank should be more restrictive when countering aggregate demand shocks. In response to supply and exchange rate shocks, a central bank should be partially accommodative, by contemporaneously increasing nominal interest rates, but allowing real interest rates to fall. With the subsequent fall in inflation, real interest rates eventually rise. This pattern suggested by the impulse response functions could be observed in recent episodes in Brazil. When faced by supply and exchange rate shocks in the last two quarters of 1999, the Central Bank kept nominal interest rates constant in a level above long run equilibrium and allowed real interest to fall. In the following quarter, with inflation under control, real interest rates rose again and the Central Bank could resume the trend of reducing interest rates.

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