6 – Inflation outlook

This chapter of the Inflation Report presents the Monetary Policy Committee’s (Copom) assessment of the performance of the Brazilian economy since the last Report, in September 2002, as well as its assessment of prospects for inflation through 2004. The projections presented herein are based on the assumption that the basic interest rate will remain unchanged during the period under analysis at 25.00% a year, which is the rate set by the Copom at its last meeting, held on December 17-18, and that the exchange rate will remain approximately at the same level as on the eve of that meeting (R$ 3.55). As an alternative, an inflation fan chart is also presented taking into account the future path of the basic interest rate and the exchange rate expected by market participants on December 16. It is important to note that these procedures are strictly technical. Hence, these assumptions should not be taken as forecasts of the future interest rate path.

The inflation and GDP growth forecasts presented in this Report are not meant to be restricted to point estimates. Rather, they are projected within probability intervals, reflecting the degree of uncertainty present when setting the basic interest rate. Inflation forecasts are based not only on the interest rate assumption, but also on assumptions concerning the behavior of relevant exogenous variables. The baseline scenario, which the Copom uses to make its decisions regarding interest rates, utilizes the set of assumptions considered most likely by the Copom. The Copom’s forecasts that are presented in this Report are intended to enhance monetary policy transparency and its effectiveness in controlling inflation, which is its main objective.

6.1. – Determinants of inflation

The last Report noted a gap between production and sales: while sales registered positive results, the rate of production was stable. In this quarter, the data for industrial activity point to a slight recovery.
According to seasonally adjusted data from the IBGE, industrial production grew for the fifth consecutive month in October. The growth trend of real sales in the transformation industry indicated in the last Report was maintained with an increase of 9.3% between August and October, according to seasonally adjusted data from the National Industrial Confederation (CNI). In 2002, GDP is expected to grow by 1.6%.

Consumption and exports have been the main factors sustaining aggregate demand in 2002. Consumption has grown moderately in recent months, particularly purchases of low-value items. This movement will continue in the next few months as a result of ongoing factors such as the release of FGTS (Warranty Fund for Severance Pay) funds, payments related to the 13th salary, and improved expectations. The Consumer Intentions Index, measured by Fecomercio of São Paulo, rose by 5.0% in December, accumulating a 6.4% increase in the fourth quarter. This positive performance is mainly attributed to an increase in the Future Intentions Index, which reached its highest level since March 1999. In the medium and long run, however, this growth in consumption will be moderate, given the decline in real wages and the modest growth of employment.

In 2002, the foreign trade sector played an important role in ensuring positive economic growth. This is to a certain extent an exceptional result, considering the relatively low trade openness of the Brazilian economy, and it is derived from the large improvement in the trade surplus, which is expected to be above the mark of US$ 12 billion in 2002. In relation to 2001, this represents an increase of approximately US$ 10 billion, or approximately 2% of GDP. In 2003, the trade surplus is expected to reach US$ 15 billion. Since the trade surplus will grow less in 2003, its contribution to GDP growth should be lower than observed in 2002.

Particularly because of the positive trade balance results, the 12-month current account deficit has been falling steadily since August 2001. In September, the current account had its highest monthly surplus (US$ 1.2 billion) since 1980, when the monthly series began. Up to November, the entry of foreign direct investments in 2002 was sufficient to finance twice the current account gap accumulated over the same period (US$ 15.0 and US$ 7.5 billion, respectively).
The Quarterly National Accounts calculated by the IBGE show that investment spending dropped during the first two quarters of 2002 in relation to 2001. Despite some positive indicators more recently, such as higher production of capital goods and construction inputs, the situation is not expected to have changed in the second half of the year as a result of the current high level of uncertainty. The Index of Industrial CEOs’ Confidence has not recovered from the significant drop registered in the third quarter of this year.

Regarding aggregate supply, the labor market has not been exerting pressure on corporate costs. The average seasonally adjusted open unemployment rate as measured by the IBGE hit 7.7% in October, the highest rate registered since February 2000. According to seasonally adjusted data from the IBGE, the real average income of employed personnel in the third quarter of 2002 was lower than in the previous two quarters. No salary pressures are expected in the next few months either, since most collective salary negotiations will be held in the second half of 2003.

Looking ahead, the scenario for capacity utilization is not clear. According to the Getúlio Vargas Foundation (FGV), capacity utilization stood at 80.4% in October, the highest figure in 2002. However, the average rate of utilization in 2002 is still lower than in 2001. According to seasonally adjusted data from the CNI, installed capacity utilization in the transformation industry hit 81.77% in October, the highest rate since the beginning of the data series. More detailed analyses of the series, however, show that capacity use is high in some sectors linked to exports, such as transportation and steel. Therefore, the high rate of capacity utilization may give rise to some inflationary pressure in specific sectors without pressuring costs at large.

The main cost pressure for corporations has been the deprecation of the exchange rate, which accumulated 45%, when one compares the average of the last quarter of 2002 with the same period of 2001. Given the magnitude of the recent IPCA results, the evaluation of the future exchange rate pass-through in 2003 has been reviewed since the last Report. If the magnitude of exchange rate pass-through does not change in the future, the exchange rate depreciation is not expected to produce direct pressure on the inflation of market prices in 2003. As for the
inflation of managed prices in 2003, which are adjusted according to the IGPs (General Price Indices), this will probably be more influenced by the exchange rate depreciation observed in 2002.

The expected inflation (IPCA) for 2003 as collected by the Central Bank of Brazil’s Investor Relations Group (Gerin) has increased significantly over the last three months. The median of expectations rose from 5.2% to 11% between the Copom meeting in September and the eve of the December meeting. There was also an increase in the dispersion of expectations, as the standard deviation rose from an average of 1.2 p.p. in September to 2.3 p.p. on December 6. According to the Copom’s evaluation, the factors that might have led the market to increase its expectations for 2003 inflation by this large magnitude include the following: i) the evaluation that some sectors will be affected by a delayed exchange rate pass-through that would put pressure on the inflation of market prices in 2003; ii) uncertainties in relation to the conduct of monetary policy in the next federal administration; iii) inflation inertia associated with the high inflation observed in the last quarter of 2002.

In relation to the first factor, as mentioned above, the evaluation that there is no exchange rate pass-through still to be realized means that the effects of the exchange rate depreciation in 2002 will be mainly felt on managed prices in 2003. Regarding inflation inertia, the Copom believes that some pressure will indeed be felt on market prices, particularly early in 2003. However, the abnormally high inflation registered in the last quarter of 2002 can, to a large extent, be attributed to temporary phenomena such as the period between harvests, the higher international price of some commodities, preventive price adjustments, and less optimistic expectations. Some of these factors, such as the large increase registered in the price of food products and preventive price adjustments, could have a positive effect on inflation early in 2003, as they enhance the probability of a reversion in prices. It should be highlighted that although over 80% of the items that make up the IPCA were positively readjusted in November, the inflation that was registered could be better characterized as a change in relative prices between tradable and non-tradable goods. In particular, “personal services” items registered inflation
of 1.70% in the last three months, compared to the 5.12% increase registered by the IPCA.

In sum, economic activity has been growing gradually and monotonically during the year, reflecting the higher domestic consumption and exports. Inflation rates increased in the last quarter of 2002 as a consequence of the exchange rate depreciation occurred during 2002 and temporary factors and has been accompanied by higher inflation expectations. The main risk factors for 2003 will be price adjustments caused by high inflation expectations and the inertial effects on market and administered prices.

6.2 – Baseline scenario: assumptions and associated risks

The Copom’s forecasts are based on a set of underlying assumptions about the behavior of key economic variables. This set of assumptions and respective associated risks are part of the baseline scenario under which the Copom makes monetary policy decisions.

The main risk factor for inflation in 2003 is the possible impact of the expectations of higher inflation observed in recent months. The behavior of the exchange rate and its pass-through to prices also constitute recurrent sources of uncertainty for the projections. Finally, as has been the case in recent years (see box Managed Prices and the Monetary Policy), the inflation of managed prices is expected to be higher than that of market prices, pushing inflation up until 2004.

According to the baseline scenario, the average exchange rate in the last quarter of 2002 (R$ 3.68) will be more depreciated than the one anticipated for 2003 (R$ 3.55). Despite this more favorable conjuncture, the volatility of the exchange rate and of other markets continues to generate uncertainties for inflation forecasts for 2003, since the exchange rate depreciation registered in 2002 led to an upward review of the projected figures and also enhanced the uncertainties in relation to the persistence of this depreciation and to the pass-through coefficient to market prices. As explained in section 6.1, according to the estimate of the exchange rate pass-through and given the high inflation registered in the last quarter of 2002, the Copom believes that the impact of the
exchange rate depreciation in 2002 has been incorporated into the inflation observed this year already, meaning that no repressed exchange rate pass-through will push inflation up in 2003.

In October, prices managed by contract and monitored prices were redefined to exclude three items: wood coal, school transportation, and domestic workers. With this new definition, prices administered by contract and monitored prices had a weight of 27.7% in the IPCA as of October, instead of 31.1% as in the old definition. According to this new definition, a 15.4% increase is anticipated for managed items in 2002 and 13.0% in 2003. The higher inflation projected for managed items in 2003 was mainly determined by the exchange rate devaluation and by a new assessment of expectations around the IGP-M, the index which determines the readjustment of a high proportion of the prices of managed items. For 2004, a 7.6% inflation rate is projected for items managed by contract and monitored items, assuming that the prices of all these items will be adjusted according to the IGP-M for that year.

A change in the Contribution for Interventions in the Economic Domain (Cide) for oil by-products constitutes the highest risk factor for the projection of managed prices. In December, the Chamber of Representatives passed a Cide increase for gasoline from R$0.50 a liter to R$0.86 a liter and for liquefied petroleum gas from R$136.70 a ton to R$250.00 a ton. The baseline scenario does not incorporate these price adjustments, which should have a direct impact of 1 p.p. on the IPCA. For this reason, the baseline scenario assumes that the projected price adjustments in reais for oil by-products result from the evolution projected for international prices and for the exchange rate. The gasoline price is projected to drop by 3.8% and cooking gas price should increase by 2.0% in the next year.

The December projections for residential electricity rates, which had a weight of 4.24% in the November IPCA, assume that electricity prices will rise by 30.3% in 2003. In relation to the last Report, the projection for electricity rates in 2003 rose by 9.6 p.p. Former projections were reviewed as a result of the exchange rate depreciation observed over the last three months and of the significantly higher projections for the IGPs, which constitute an important component in electricity rate adjustments.
The projection for the *spread* between the six-month interest rate and the Selic rate, following the specification of an error correction model, and provided that the Selic rate remains constant at 25.0% a year, begins at 300 basis points in the first quarter of 2003 and declines to -125 basis points late in that year.

As in the September *Report*, no factors that could restrict the growth of aggregate supply have been identified. For agriculture/livestock products, the underlying assumption made in the last *Reports* – that their prices will evolve according to the inflation of market prices up to the end of 2003 – was maintained. Although the baseline scenario does not incorporate this underlying assumption, the inflation of food products is likely to remain below the inflation of market prices in the first months of 2003 as a result of a reversion of the marked price hikes observed in the last quarter of 2002.

Regarding fiscal policy, it is assumed that the target of 3.88% set for the primary surplus of the consolidated public sector in 2002 and of 3.75% in coming years will be achieved.

As detailed in section 6.1, inflation expectations for the IPCA in 2003, as collected by the Central Bank of Brazil’s Investor Relations Group (Gerin), have deteriorated significantly between the Copom meetings in September and December, as the median and the dispersion of expectations have increased. The forecasting models adopted by the Copom usually take these expectations into account. The Copom has built an alternative scenario that incorporates a faster decline of inflation expectations, which would drop to 8% for 2003. In addition, instead of keeping the exchange rate approximately at the level observed on the eve of the Copom meeting (US$ 1 = R$ 3.55), this scenario assumes an exchange rate of R$ 3.20. These scenarios are among the several others analyzed by the Copom. The other underlying assumptions of the baseline scenario were maintained in the alternative scenario.

### 6.3 – Inflation forecast

Based on the assumptions and associated risks considered by the Copom and on all the information available, the 12-month change in the IPCA was projected using a basic interest rate of 25.00% a year, as defined at
the meeting held on 17-18 December 2002, and the exchange rate at R$3.55, a value close to the one registered on the eve of the Copom meeting. The inflation projection based on an alternative scenario defined by the Copom is also presented.

The central path expected for inflation accumulated in 12 months rises up to the third quarter of 2003, when it hits the mark of 14.8%, and declines continually after that to 9.5% late in 2003 and 4.5% in the last quarter of 2004.

The high 12-month accumulated inflation up to the third quarter is a consequence of the inclusion in the calculation of the high inflation projected for the fourth quarter of 2002 (6.5%). The inflation estimated for the last quarter of 2003 is 1.6%, much lower than the 6.5% rate projected for the last quarter of 2002. Consequently, inflation accumulated in 12 months drops by 5.3 percentage points between the third and fourth quarters of 2003. In addition, inflation in the third quarter rises due to the concentration of managed price adjustments in this period.

It should be noted that deviation probabilities are asymmetrically distributed around the median, with greater dispersion for figures below the path associated with the baseline scenario. This asymmetry incorporates the higher weight that the Copom attributes to the fall in inflation expectations and to the appreciation of the real, as described in the alternative scenario in section 6.2, as compared to other scenarios.

Prices administered by contract and monitored prices cause the highest inflationary pressure. For 2002, 2003 and 2004, the inflation projected for managed prices is 15.4%, 13.0%, and 7.6%, respectively. Over the same period, the inflation of market prices is expected to be 11.3%, 8.2%, and 3.3%. Because of the effects associated with inflation inertia, the impacts caused by managed price adjustments, and expectations of high inflation, the inflation of market prices is only expected to drop back to figures consistent with the inflation targets after the second half of 2003.
Comparing the current projection with the one made in the September Report, a change can be observed in the expected path. Although it is not possible to compare them directly, because the projections are based on different assumptions in terms of scenario and interest rates, it is worthwhile to comment on some issues. The central projection for 2003 rose from 4.5% in the last Report to 9.5% in the present Report.

The main causes of the higher projection for 2003 were the deterioration in expectations for next year and the inertial effects of the anticipated 6.5% inflation rate in the fourth quarter of 2002. Since the last Report, the projection rose by 5 percentage points. Out of this increase, 1.3 p.p. are attributable to the higher inflation of managed prices, which are now projected to increase by 13.0% versus 7.9% in the last Report. The remaining 3.7 percentage points are attributable to the higher projection for the inflation of market prices, which are now projected to increase by 8.2% versus 2.9% in the last Report.

As in previous Reports, this issue also presents the fan chart for output growth that was built based on the same underlying assumptions used in the baseline scenario. It should be stressed that the forecasting errors associated with GDP growth projections are considerably larger than in the case of inflation projections, both because they involve the path of two non-observable components, namely, potential output and the output gap, and because calculating output is, by definition, more complex and less precise than calculating inflation. The central projection for output growth in 2002 is approximately 1.6%, which represents an increase of 0.2 percentage points since the last Report. For 2003, growth of 2.8% has been projected.

An inflation fan chart is also shown taking into account an alternative scenario outlined by the Copom, where inflation expectations for 2003 drops more rapidly to 8% and the exchange rate becomes stable at
R$3.20, against R$3.55 in the baseline scenario. This alternative scenario is one among several others analyzed by the Copom. The remaining assumptions are the same as those spelled out in the baseline scenario. The inflation projected according to these underlying assumptions is 7.3% in 2003 and 3.4% in 2004. What this means is that a more rapid reversion of expectations associated with an appreciation of the real will play a significant role in bringing inflation down in the next year.
Monetary Policy in Brazil

Arminio Fraga Neto and Ilan Goldfajn

Governing involves managing wishes, conflicts and, many times, inconsistencies. Monetary policy is not an exception, especially in Brazil. The public wishes the maintenance of the hard-won price stability that has been sustained in recent years; however, it also wants the immediate reduction of real interest rates. It wishes a less volatile exchange rate, but it does not appreciate foreign exchange interventions that reduce Brazil’s international reserves. It wishes the reduction of the external debt, but it rejects the depreciated exchange rate and the pressure this induces on prices.

In these moments of transition it is important to think about the Central Bank’s role. To begin with, it is worth emphasizing that the Central Bank has only one instrument, monetary policy; therefore, it should have only one objective as a target. Currently there is a consensus in the world that this objective should be price stability. In the long run, monetary policy is unable to engineer rates of output growth higher than the economy’s rate of productivity growth. Empirical evidence suggests that the most effective use of monetary policy is to ensure price stability. This stability can generate higher output growth rates by reducing uncertainties and distortions, extending decision-making horizons, and allowing for an increase in investments and productivity gains. Therefore it should be made clear that a higher sustainable growth rate with more inflation is not an option.

Even with only one objective and one instrument, it is possible to organize Central Bank actions in different ways. One of the options is to anchor the price level by returning to the fixed (or “administered”) exchange rate regime, a choice which is not recommended for many reasons. Another option is to try to control a monetary aggregate, such as money held by the public or credit in the economy. However, in practice, due to the instability of the demand for these aggregates, the great majority of central banks have given up on this option. Finally, there is the use of the interest rate as an instrument to control inflation, the option preferred by the majority of central banks. In this case, a central bank can act with a higher or lower degree of transparency and commitment. In the Inflation-Targeting Regime Framework, the inflation targets for the following years are made explicit, the Central Bank’s inflation projections are reported on a quarterly basis, and the reasons for the Central Bank’s actions are detailed in the minutes after the decisions.

The US Fed, with the credibility acquired under the presidency of Paul Volcker and Alan Greenspan, have chosen not to adopt this framework. Other Central Banks, including in England, Canada, New Zealand, Australia, Brazil, Mexico and Chile, among others, have adopted inflation-targeting regimes.
In Brazil, since the adoption of the inflation-targeting regime, Central Bank policy has been based upon some basic principles implemented by the Monetary Policy Committee (Copom). First, the Copom begins with an evaluation of the future trend of inflation. These projections are obtained through the best available information, using both quantitative methods, including structural models, simulations and other statistical procedures, and qualitative and disaggregated methods, which require a more subjective evaluation.

Second, the Copom attempts to analyze the reasons for the differences between the inflation projection and the target, in order to react according to best international theory and practice. In order to react appropriately, it is necessary to distinguish between demand and supply shocks, and between temporary and permanent shocks. Demand shocks should be fought one-for-one. A demand contraction, for instance, should be offset by an expansionary monetary policy. In the case of supply shocks (also known as cost-shocks) the Copom has followed the traditional recommendation: the direct impact of the shock on the price level is accommodated (that is, it does not provoke any monetary policy reaction), but monetary policy attempts to counteract the secondary (or inertial) effects of the shock.

When confronted with shocks of great magnitude, as over the last 18 months, monetary policy has been adjusted in order to extend the period over which the price index converges to the inflation target. This procedure takes into account the output costs of the adjustment process that are related to the existence of inflationary inertia. According to this policy, and consistent with the design of the inflation targeting system, the Central Bank should give due consideration to the volatility of economic activity in its decision-making, but without setting aside its main objective of achieving the inflation targets.

For the Central Bank to be able to act with the necessary flexibility, without jeopardizing the credibility of its commitment to the targets, it is essential that its performance be totally transparent, so that an appropriate decision is not interpreted as an unjustified deviation from its stated goals. To meet this condition, the Copom tries to measure the primary price effect of economic shocks. The Copom then evaluates the time period necessary to eliminate the associated inflationary inertia, in view of the magnitude and of the persistence of the shock. Given this period, the Committee estimates the share of the inertia to be accommodated in the year under consideration; this share is then added to the estimate of the primary shock and incorporated into the target, for the purpose of comparison with the Copom’s inflation projection. In the case of the shocks in 2003, the Copom decided to neutralize the associated inertia over a period of two years. Adding together half the impact of the inflationary inertia and the primary shock on administered prices yields a total of 2 p.p., and increases the adjusted inflation target in 2003 to a rate of around 6%. Thus, the BCB does not aim to achieve its target at any cost, but considers the nature and persistence of the shocks, and the associated costs on the level of economic activity.
Based on this framework and on the basic principles adopted, it is interesting to evaluate the performance of the inflation-targeting regime in Brazil since its implementation in mid-1999. Table I shows that in the period of the inflation-targeting regime the volatility of both inflation and GDP growth (quarter in relation to the previous quarter) have declined (to 0.4 from 0.9 and to 1.5 from 3.2, respectively). Likewise, on average, GDP growth increased (to 2.4% from 2.0%) and inflation and interest rates fell (to 7.1% from 10.3% and to 18% from 35.4%, respectively).

As a consequence of their influence on inflation expectations, the inflation targets themselves played an important role in achieving this result by reducing inflationary inertia to one third of the previous level (to 0.2 from 0.6). Another improvement is the increased capacity of the economy to absorb exchange rate fluctuations, which have been required to achieve external adjustment. This has depended to a great extent on the success of monetary policy in fighting the inflationary effects of exchange rate depreciation. Table II shows that in the last years only 14-16% of the exchange rate depreciation was passed through to prices.

These results indicate that the Inflation-Targeting Regime has been successfully fulfilling its role. During the entire period that followed the adoption of the regime, the BCB has been loyal to its commitments, using the flexibility allowed by the regime, while trying not to lose control over inflation expectations. Until the worsening of the confidence crisis that began in the middle of this year, inflation expectations remained within the tolerance intervals of the targets for future inflation (see graph I that shows the expectations of inflation for 12 months ahead and the respective inflation target calculated as a weighted average). More recently, however, inflation expectations have surpassed acceptable levels for the first time, denoting a high degree of uncertainty in regard to the future commitment to inflation control. This situation cannot be maintained without an answer, or we will once again experience the painful, frustrating and socially unfair times of high inflation.

The BCB provided an answer in the last extraordinary meeting of the Copom by increasing the basic interest rate by 3 p.p. Adding to this effort was the contribution of the elected President and his team by reaffirming their campaign commitment to conduct a responsible macroeconomic policy, including low inflation. Thus, as these commitments solidify, we believe that the confidence crisis, which already shows signs of reversion, will be eliminated.
### Table I
Before and After the Inflation-Targeting Regime

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<tr>
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<tbody>
<tr>
<td><strong>Volatilities - Variation Coefficient (standard deviation/average, quarterly data)</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Inflation</td>
<td>0.9</td>
<td>0.8</td>
<td>0.4</td>
</tr>
<tr>
<td>GDP Growth (seasonally adj.)</td>
<td>3.2</td>
<td>2.5</td>
<td>1.5</td>
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<tr>
<td>Interest Rate</td>
<td>0.4</td>
<td>0.2</td>
<td>0.1</td>
</tr>
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</table>

**Average (annualized)**

<table>
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<tr>
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<tbody>
<tr>
<td>Inflation</td>
<td>10.3</td>
<td>5.8</td>
<td>7.1</td>
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<tr>
<td>GDP Growth (seasonally adj.)</td>
<td>2.0</td>
<td>2.0</td>
<td>2.4</td>
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<tr>
<td>Interest Rate</td>
<td>35.4</td>
<td>28.2</td>
<td>18.0</td>
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**Inflationary Inertia (monthly data)**

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</thead>
<tbody>
<tr>
<td>Inflation (t-1) – significant</td>
<td>0.6</td>
<td></td>
<td>0.2</td>
</tr>
</tbody>
</table>

Sample: 1995:08 - 2002:06 (equation also includes the exchange rate change in the previous 12 months and the employment rate)


### Table II
Exchange rate Pass-Through in 12 months to Administered Prices, to Free Prices and to the IPCA (Real Plan)

<table>
<thead>
<tr>
<th>Model</th>
<th>Administered Prices</th>
<th>Free Prices</th>
<th>IPCA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structural Model and Information regarding Administered Prices</td>
<td>25%</td>
<td>12%</td>
<td>16%</td>
</tr>
<tr>
<td>Modelo VAR</td>
<td>20%</td>
<td>8%</td>
<td>14%</td>
</tr>
</tbody>
</table>

Medium-Size Macroeconomic Model for the Brazilian Economy *

Marcelo Kfoury Muinhos and Sergio Afonso Lago Alves**

1. Introduction

Small-scale macroeconomic models are very useful for forecasting the short run, but they are not very useful for anchoring the key variables in the long run. They are not able to answer questions about the macro equilibrium of the economy, nor to establish fiscal or external constraints. Larger macroeconomic models work better in providing information about the interaction of stabilization and growth in the medium run. Questions concerning technology, investment, labor markets and the current account balance are better addressed by a more comprehensive model. Micro-founded models are also able to present long run properties consistent with economic agents’ optimal behavior. On the other hand Keynesian models are important because they can be used to simultaneously determine the equilibrium levels of output, employment, inflation, current account, rate of investment and fiscal balance. However, in Keynesian models the long-run equilibrium of some key variables such as the interest rate and exchange rate are not endogenously determined.

Many Central Banks have built micro founded structural models. Examples include the Bank of Canada’s QPM, the Bank of England’s MM (Macroeconomic Model) and also the IMF’s Multimod. Among the models in the Keynesian paradigm, one example is the Financial Programming model of the International Monetary Fund, which uses the monetarist approach to the balance of payments. This model was used in the creation of an entire generation of IMF programs and is still being applied. The World Bank has a line of two-gap growth models (domestic saving and external saving) called RMSM-X. The Central Bank of Chile has built a Keynesian model very similar to the one presented in this paper. The major difference between the models is in the derivation of the steady-state equilibrium. In the Chilean model, consumption is divided into durable and non-durable goods, which is a future goal for our model. In Brazil, IPEA has set up a Keynesian macroeconomic model, based on the national accounts, especially the balance of payments and the fiscal budget. A quarterly version of this model has been released recently.

The main contributions of our model, compared to other macroeconomic models developed in the Central Bank of Brazil, are:

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* We would like to thank Gil Riella for his outstanding help in running the model in Matlab. Flávia Mourão Graminho, Eduardo Loyo and Andrew Levin also helped us in the estimations and with suggestions. The views expressed in this work are those of the authors and do not reflect those of the Banco Central do Brasil or its members.

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Aggregate demand is calculated by estimating: (1) family consumption, investment in (2) machinery and (3) construction, (4) net exports, (5) government spending, (6) government taxes, (7) changes in inventories;
- The model uses a Phillips curve that includes dummies for the structural break in the pass-through coefficient in 1999 and a proxy for labor productivity (unit labor cost);
- Potential output is estimated by a Cobb-Douglas production function;
- The model includes a partial calibrated-estimated Uncovered-Interest-Parity (UIP) equation, together with an equation for the risk premium, to which responses for changes in fiscal and external conditions are added;¹
- The model includes ad-hoc steady-state conditions for the current account deficit and the primary fiscal surplus.

2. Diagrams of The Transmission Mechanisms and Equilibrium Conditions

In order to compare the monetary transmission mechanisms of the medium-scale and the small-scale models, it is necessary to explain the mechanisms in the latter model, as shown in Figure 1.

![Small Model Transmission Mechanism](image)

The model includes the traditional channel, the output gap, and a second channel, the exchange rate. The IS curve shows that an increase in the real interest rate will negatively affect the output gap, directly and indirectly via the term structure of interest rates. A more negative output gap will decrease inflation via the Phillips curve. By the UIP non-arbitrage condition, an increase in the
interest rate causes an appreciation of the exchange rate in the spot market, and, via the Phillips curve, a decrease in imported prices will generate lower inflation.

The two monetary transmission mechanisms described for the small model also occur in the medium model, shown in Figure 2. But now it is possible to distinguish between supply and demand effects. An increase in the interest rates will affect household consumption and investment in construction and machinery through the term structure, generating a decrease in aggregate demand. A higher interest rate will cause an exchange rate appreciation and a decrease in net exports, decreasing aggregate demand. On the supply side, the effects of a higher interest rate will take more time to occur, because a lower level of investment will cause a decrease in the growth rate of the capital stock, affecting potential output growth. The decrease in aggregate demand leads to a drop in inflation through a more negative output gap. But this drop would be partially offset by the decrease in potential output growth.

Figure 2  Medium Model Transmission Mechanism
The exchange rate mechanism is still available in the medium size model. But now the fiscal and external variables also affect the exchange rate via the risk premium. An increase in the interest rate that worsens the fiscal accounts will generate an increase in the risk premium and a devaluation of the exchange rate that might offset the aggregate demand channel. The current account deficit also affects the risk premium and consequently, the exchange rate and inflation. Rapid GDP growth may cause an increase in inflation via the output gap and also via a worsening of the trade balance.

The absence of micro-founded behavior equations does not allow us to find endogenous steady state values for variables such as the interest rate or exchange rate. The UIP derived equation, for instance, presents an error correction mechanism that drives the system to the long run equilibrium steady-state exchange rate, defined as the exchange rate that leads to an ad-hoc long-run current account/GDP ratio. This ratio, in turn, is consistent with a steady-state ratio of external liabilities/GDP. For the interest rate, the use of the Taylor rule assures a long-run equilibrium compatible with the inflation target and a neutral output gap.

3 Simulations

The model is simulated in a Matlab/Simulink environment until 2100:4, but we only show the first 30 years of results for simplicity. Our closure rule is an ad-hoc end-point for the current account/GDP ratio, which brings us to a long-run equilibrium value for the real exchange rate. The current account surplus was set at 0% for the last period of the simulation. The primary fiscal surplus follows an exogenous vanishing path to the long run. We also assumed that world and domestic growth converge in the long run.

The paper is about to be released as a Working Paper of Central Bank of Brazil, and contain a more detailed description of the equations and of the hypothesis used in the modeling process. There is also an estimation process for the latent variables of the supply side, as the full employment capacity utilization and unemployment rate. Simulations include forecasting under different Taylor Rule specifications and impulse responses for shocks on interest rate, risk premium and administered prices.

1 Muinhos, Alves and Riella (2002) already have similar equations for UIP and Risk premium.
2 Although the main blocks of the medium model are represented in Figure 2, there are some interactions between variables not shown in the figure in order to obtain a clean representation of the model. Nevertheless, the model equations are commented in the paper about to be released as a working paper of Central Bank of Brazil. As this is still a work in progress, our blocks are subject to future improvements.
Managed Prices and Monetary Policy*

In recent years, prices managed by contract or monitored prices have posted much higher increases than so-called market prices, putting pressure on the consumer price index (IPCA) that is used in Brazil’s inflation targeting regime. Between January 1999, the year in which the exchange rate was floated and the inflation targeting regime was adopted, and October 2002, the headline IPCA rose by 33.0%, while managed prices rose by 61.2%.

Broadly speaking, prices managed by contract or monitored prices (henceforth, managed prices) are those prices that are relatively insensitive to supply and demand, although they are not necessarily directly regulated by the government. Also included in this category are prices that despite being determined by supply and demand require the authorization or prior notification of some governmental agency. The set of items with managed prices includes taxes and fees (the IPVA (automobile tax), the IPTU (property tax), and the water and sewage taxes), public utilities whose rates are regulated or authorized by the government through regulatory or inspection agencies (telephone, electricity, health insurance, toll agencies), oil by-products whose market is being liberalized but whose prices are set by state enterprise, and items whose prices can be considered virtually free (fuel alcohol and airline tickets).

At first glance, the larger rise in managed prices versus market prices might seem to be a realignment of the relative prices of these two groups that simply reverses a previous change in the opposite direction. However, when examining a longer sample, for example since January 1995 as has been done here, the results also indicate a higher increase in managed prices. This can be seen in the chart below, which shows the changes in the headline IPCA and the main components of managed prices between 1995 and October 2002.

### Evolution of the main managed prices

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>IPCA</td>
<td>43.46</td>
<td>32.98</td>
<td>90.78</td>
</tr>
<tr>
<td>Managed Prices</td>
<td>88.00</td>
<td>61.19</td>
<td>203.04</td>
</tr>
<tr>
<td>Urban bus transportation</td>
<td>97.82</td>
<td>53.23</td>
<td>203.12</td>
</tr>
<tr>
<td>Gasoline</td>
<td>51.50</td>
<td>113.30</td>
<td>223.14</td>
</tr>
<tr>
<td>Residential electricity</td>
<td>89.60</td>
<td>86.77</td>
<td>254.11</td>
</tr>
<tr>
<td>Domestic worker</td>
<td>85.70</td>
<td>40.94</td>
<td>161.73</td>
</tr>
<tr>
<td>Fixed telephone lines</td>
<td>309.66</td>
<td>48.83</td>
<td>509.70</td>
</tr>
<tr>
<td>Health insurance</td>
<td>126.63</td>
<td>27.46</td>
<td>188.85</td>
</tr>
<tr>
<td>Water and sewage tax</td>
<td>84.45</td>
<td>45.95</td>
<td>169.21</td>
</tr>
<tr>
<td>Cooking gas</td>
<td>121.24</td>
<td>149.67</td>
<td>425.37</td>
</tr>
</tbody>
</table>

Source: IBGE
* Up to October/02

Various factors have determined the path of managed price inflation over this period. One of these has been the process of tariff realignment and elimination of cross-subsidies in privatized sectors, such as the telephone and electricity industries.

A second factor has been the rise of international oil prices and the devaluation of the exchange rate, which have both played an important role in determining the behavior of the domestic prices of oil by-products. The prices of gasoline, cooking gas (liquefied petroleum gas), diesel oil, and fuel oil represent, as a set, about 5.7% of the IPCA (October 2002), and about 20.6% of the total group of managed prices. In addition, changes in the prices of these items have an indirect bearing on other managed prices, such as on transportation and electricity.

A third factor that has influenced the evolution of managed prices has been the effect of the exchange rate’s depreciation on Brazil’s general price indices. Repeated devaluations have resulted in a higher growth of general price indices relative to consumer indices, leading those managed prices with contracts indexed to general indices to rise above market prices. Moreover, the impact of changes in the exchange rate on managed prices tends to be different from the impact on market prices both in terms of magnitude and of price gap. Regarding the magnitude, given managed prices’ lower elasticity of demand, the pass-through to managed prices tends to be higher than to market prices, even though the exchange rate has a similar bearing on the cost structure of the two groups of goods. As for the gap of the pass-through to managed prices, it will depend on the contracts involved, which in the case of electricity or telephony cannot be less than one year. In the case of oil by-products, prices can be adjusted as a result of changes in the exchange rate within the same month according to the methodology implemented in early 2002.

A fourth factor that should be mentioned is the strong inertial component of managed prices, which is responsible for a higher degree of inflation persistence in these prices vis-à-vis market prices during the process of disinflation and in the face of shocks. As indicated by Bogdanski, Freitas, Goldfajn and Tombini (2001)¹, many managed prices in Brazil are chiefly inertial because their adjustments are governed by contracts linked to the past behavior of general price indices. Therefore, these prices tend to be somewhat persistent, as is more evident during a process of disinflation such as the one experienced in Brazil between 1995 and 1998.

The bearing of various factors on the behavior of managed prices can be better illustrated through the following regression between the ratio of the inflation of managed prices and of market prices, and some of the factors described above:²
\[
\left( \frac{\Delta I_{\text{admin}}}{\Delta I_{\text{liv}}} \right) = -0.004 + 0.053 \Delta e_{t-1} + 0.038 \Delta e_{t-3} + 0.581 \Delta igp_{t-3} + 0.021 \Delta p_{t-1} + 0.021 \Delta p_{t-2} + 0.020 \Delta p_{t-3} + 0.026 d + \varepsilon_t
\]

where:

\[
\frac{\Delta I_{\text{admin}}}{\Delta I_{\text{liv}}} = \text{ratio between the monthly change of managed prices and market prices;}
\]

\[\Delta e = \text{monthly change of the nominal exchange rate;}\]

\[\Delta igp = \text{monthly inflation as measured by the IGP-DI;}\]

\[\Delta p = \text{monthly change of the international oil price;}\]

\[d = \text{seasonal dummy for the month of July, when most managed prices are adjusted}\]

\[\varepsilon = \text{error}\]

It can be seen that all the coefficients display the expected signs, showing that the proposed factors truly contribute toward a scenario where the growth rates of managed prices are higher than those of market prices.

Among the factors analyzed here, the IGP-DI appears to be the most relevant for the behavior of the ratio of the inflation of managed prices to the inflation of market prices. In addition to being the most significant coefficient (except for the dummy), it is also the one with the largest magnitude. Even after adding the effects of the exchange rate or of the oil price in the different price gaps (0.091 and 0.062, respectively), figures that are considerably lower than the coefficient on the IGP-DI are obtained.

Once the differences between the behavior of market prices and managed prices are identified, one can analyze the response of the Central Bank to these differences. For this purpose, we estimated the following Taylor rule, which relates interest rates to the inflation of market prices, to the inflation of managed prices, and to the interest rate set in the previous period.\(^4\)
\[
i_i = 0.034 + 0.757i_{i-1} + (1-0.757)(0.636(liv_{i-1} - \pi^*_i) + 0.498(adm_{i-1} - \pi^*_i)) + \varepsilon_i
\]

\[
\begin{align*}
(4.809) & \quad (23.075) & \quad (2.262) & \quad (2.292) \\
R^2 & \to 0.962 & R^2_{adj} & \to 0.959 & SER & \to 0.005
\end{align*}
\]

where:

\[
i = \text{nominal interest rate (Selic rate)}
\]

\[
liv = \text{inflation of market prices accumulated over the past 12 months}
\]

\[
\pi^* = \text{inflation target for the past 12 months}
\]

\[
adm = \text{inflation of managed prices accumulated over the past 12 months}
\]

By analyzing the results, it is possible to conclude that monetary policy reacts more strongly to changes in market prices than to changes in managed prices. However, the underlying assumption that the coefficients are equal cannot be rejected.

One might consider that changes in interest rates in reaction to managed price inflation would not be fully effective, since these prices are less sensitive to changes in supply and demand. However, the Central Bank should neutralize the secondary effects of managed price shocks. Although the Monetary Authority is not supposed to respond to the primary effects of the shock, it should prevent the propagation of its effects, since they could affect the general level of prices in the economy. For this reason, a shock to managed prices leads the Central Bank to react by raising the Selic rate for the purpose of inhibiting the secondary effects of this shock.

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2 The monthly changes mentioned below refer to the log difference of the variables. The sample covers the period between April 1999 and June 2002.

3 In fact, most managed prices are adjusted between June and August. The dummy in July would capture this effect.

4 The Taylor rule estimated above should not be strictly interpreted as a reaction function of the Central Bank. For this purpose, using expected future inflation in the Taylor rule would be a more appropriate procedure. However, the series of expectations and inflation forecasts, separated by market prices and managed prices, are more recent, and this fact jeopardizes the estimation. For an analysis of the reaction function of the Central Bank based on future inflation, see Minella, André, Paulo S. de Freitas, Ilan Goldfajn and Marcelo K. Munhos (2002), “Inflation Targeting in Brazil: Lessons and Challenges”. Working Paper Series, Central Bank of Brazil, n. 53.