# Domestic and International Sources of Brazilian Inflation: 1947-80

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## 1 Introduction

Inflation is a phenomenon so imbedded in the Brazilian economy that perhaps like Carnival and football it has become a trademark of our society.

The Brazilian experience with regard to inflation during the post-war period is so rich that it cuts across different political regimes and governments. It has lived together with democracy and authoritarism and witnessed the suicide, resignation and deposition of Presidents. It has been managed by Ministers who identified it as a powerful enemy that had to be attacked with all kinds of weapons and by others who did not even bother with its presence. It has witnessed the transformation of a predominantly rural society into an urban-industrial economy, was held accountable by some economists as one of the causes of the concentration in the distribution of income that occurred during part of the period, and used by others to redistribute income towards low wage-earners. A large spectrum of sources have been selected to explain its vitality, some of them as charming and exotic as the prices of xuxu vegetables, the price of a regular hair cut, and the whims of Arab sheiks. A good number of medicines have been developed in order to curb its effects; and even so it goes on benefiting some people and harming others.

Before monetarism became very popular in the northern hemisphere, the term was used in Latin America to name a group of economists who identified monetary policy as the main source of the high rates of inflation that were observed in those less developed countries. By the same token, before supply shocks became very popular among economists in the United States and Western Europe, after the OPEC cartel, a group of Latin America economists, called structuralists, identified changes in relative prices as the major source of inflation in less developed countries which tried to change the path of economic growth by means of economic policy.[1]

[1] The controversy between monetarists and structuralists developed during the 1950s and still goes on today. For an earlier account of this debate see, for example, Prebisch (1961), Campos (1961), Seers (1962), Olivera (1964) and the more recent survey article by Kirkpatrick and Nixson (1976). For a test of these two alternative models for Brazil see Barbosa (1983). It is interesting to note that Latin American monetarists could, in the taxonomy of schools of

The aim of this chapter is to identify the domestic and international sources that lie behind the Brazilian inflation during the period 1947-80. The approach we use here is based on an aggregate supply and demand model, which combines some traits of the monetarist and structuralist schools to build up a final form equation for the rate of inflation that identifies monetary and fiscal policies, as well as supply shocks due to external and internal factors, as the main sources of inflation.[2]

This paper is structured as follows. Section 2 presents a very simple structural model which offers a rationale for the final form equation for the inflation rate that we use in the empirical part of the paper. Section 3 presents the empirical evidence for the period 1947-80, and Section 4 gives a summary of our major conclusions.

## 2 Structure and Final Form of the Model

The structure of the model that we present in this section illustrates the fact that the final form equation we use in the empirical part of this paper for the inflation rate is based and indeed can be deduced from a very simple model in which some basic features of economic policy such as monetary and fiscal policy instruments are included, as well as some supply shock variables.

We start by assuming that real cash balances $m_t$ are related to real income $y_t$ and nominal interest rate $i_t$ according to:

$$\log m_t = \alpha_o + \alpha_1 \log y_t - \alpha_2 \, i_t \tag{1}$$

The nominal interest rate depends upon the expected rate of inflation $p_t^e + 1$ and the size of public deficit as a proportion of the output:

$$i_t = p_t^e + \delta \log \frac{F_t}{Y_t} \tag{2}$$

where $F_t$ is equal to the difference between government expenditures and tax revenues; $F_t = G_t - T_t$, and nominal output $Y_t$ is equal to the price index $P_t$ times real income $y_t$. Equation (2) embodies the hypothesis that the government deficits is always positive, otherwise the logarithm would not be defined in the set of real numbers. We would like to remark that such an assumption is not such a strong one when we consider countries which have a historical record of great and sustained public deficits.

thought (Davidson, 1982), be described either as Monetarist-Neoclassical os as Neoclassical Synthesis Keynesians. A structuralist would be more inclined, according to the same calssification, to be affiliated with the Keynesian, Neo-Keynesian or the Socialist Radical School of thought.

[2] The theoretical framework we apply here is one that follows the main stream as represented by Dornbusch and Fischer (1981). The econometric approach is based on the final form equation introduced by Theil and Boot (1962),

The rate of inflation is by definition equal to the difference between the rate of growth of money supply $\mu_t$ and the rate of increase in real cash balance demanded:

$$p_t = \mu - Dm_t \tag{3}$$

where $\mathrm{Dm}_t = \log m_t/m_{t-1}$.

By combining equations (1), (2) and (3), and taking into account that $y_t = P_t\ y_t$,we get:

$$p_t = \frac{\mu_t}{1+\alpha_2\delta} - \frac{\alpha_1 + \alpha_2\delta}{1+\ \alpha_2\delta}\ DY_t + \frac{\alpha_2}{1+\ \alpha_2\delta}\ \Delta p^e_{t+1} + \frac{\alpha_2\ \delta}{1+\ \alpha_2\delta}\ DF_t \tag{4}$$

where $DF_t = \log F_t/F_{t-1}$ is the public deficit growth. This equation can be seen

as an aggregate demand equation that results from a set of IS and LM curves. The rate of inflation is negatively related to the rate of increase in money supply, to the acceleration in the expected rate of inflation and to the rate of growth of public deficit.

With regard to the process of expectation formation we suppose that the past is extrapolated to the future as:

$$p^e_t + 1 = p_t \tag{5}$$

This assumption is made to keep things simple and is not intended as an accurate description of reality. Other more elaborated schemes of expectation formation could be introduced into the model at the cost of increasing the algebra but without any gains in terms of content of the final form equation for the rate of inflation that would be generated by the model.

From the supply side, we start by assuming that the rate of inflation is a weighted average of the rate of increase in industrial and agricultural prices.[3]

$$p_t = (1-\Phi)\ p_{it} + \Phi\ p_{at} = p_{it} + \Phi\ (p_{at} - p_{it}) \tag{6}$$

The rate of change in the terms of trade between agriculture and industry depends basically upon the behavior of agricultural production. We assume that

$$p_{at} - p_{it} = \theta\ A_t \tag{7}$$

where $\mathrm{A}_t$ is equal to the difference between the actual rate of growth of agricultural production $Dy_{at}$ and the trend rate of growth of this sector, that is $A_t = Dy_{at} - D\overline{y}_{at}$.

[3] We use here the assumption that consumer goods are not imported. This is a stylised fact of the Brazilian economy with some minor qualifications.

With regard to industrial prices, we use the hypothesis that the market structure of the industrial sector is an oligopolist one in which prices are determined by a mark-up over unit costs. Therefore, the rate of increase in industrial prices is equal to a weighted average of the rate of growth of wages $s_t$, corrected for increases in labor productivity $q_t$ and the rate of growth of imported raw materials prices $\Pi_t$.

$$p_{it} = \gamma(s_t - q_t) + (1 - \gamma)\ \Pi_t \tag{8}$$

The rate of increase in imported raw material prices depends upon the rate of growth of international prices of those goods $\Pi_{mt}$ and the percentage variation $e_t$ of the exchange rate according to:

$$\pi_t = e_t + \pi_{mt} \tag{9}$$

The exchange rate policy is such that it intends to maintain the same purchasing power parity in relation to a basket that includes other goods, such as capital goods, besides raw materials. Thus,

$$e_t = p_t - \pi_t \tag{10}$$

where $\pi$, is a measure of the international inflation rate.

The rate of increase in wages is related to the past inflation rate, to the prevailing conditions in the labor market and also to the desired rate of growth of real wages, according to:[4]

$$s_t = p_{t-1} - \beta\ h_t + \widehat{s}_t \tag{11}$$

where the output gap $h_t$ is defined by $h_t = \log \widehat{y}_t / y_t$, and $\widehat{y}_t$ is the level of potential output.

When we substitute equations (7)-(11) in equation (6) we obtain the following result:

$$p_t = p_{t-1} - \beta\ h_t + \frac{1-\gamma}{\gamma}\ O_t - \frac{\phi\theta}{\gamma}\ A_t + \overline{s}_t - q_t \tag{12}$$

where $O_t = \pi_{mt} - \pi_t$ measures supply shocks due to changes in the prices of imported raw materials.[5]

The equation can be interpreted as an aggregate supply equation, and it shows that the rate of inflation depends upon the past rate of inflation, the level of idle capacity in the economy, supply shocks due to changes in prices of imported raw materials, agricultural shocks, and increases in real wages greater than the rate of growth of labor productivity.

[4] In specifying the wage rate equation we use the past rate of inflation instead of the expected rate in order to take into account Brazilian wage policy, which establishes a minimum rate of change for the wage based on past inflation. Of course, firms can offer a different adjustment by using promotion to give more than the law requires or by increasing the turnover rate when the market wage is below the one that would be set by the official rate.

[5] It is not difficult to show that $O_t$ measures not only changes in imported raw material international prices but also changes in the excjange rate which do not obey the parity rule.

The rate of growth of real output and changes in output gap are related by the following identity:

$$Dy_t \equiv D\overline{y}_t - h_{t-1} \tag{13}$$

By combining this expression with (5) and (4), the aggregate demand and supply equations can be written in the following system

$$\begin{bmatrix} 1 & \beta \\ 1 - \frac{\alpha_1+\alpha_2\delta}{1+\alpha_2\delta-\alpha_2} & \end{bmatrix} \begin{bmatrix} p_t \\ h_t \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ -\frac{\alpha_2}{1+\alpha_2\delta-\alpha_2} & -\frac{\alpha_1+\alpha_2\delta}{1+\alpha_2\delta-\alpha_2} \end{bmatrix} \begin{bmatrix} p_{t-1} \\ h_{t-1} \end{bmatrix} + \tag{14}$$

$$+ \begin{bmatrix} \frac{1-y}{y} & O_t & -\frac{\theta\,\phi}{y}A_t & + & \overline{s}_t - q_t \\ \frac{\mu_t}{1+\alpha_2\delta-\alpha_2} & + & \frac{\alpha_2\,\delta}{1+\alpha_2\delta-\alpha_2}DF_t & - & \frac{\alpha_1+\alpha_2\delta}{1+\alpha_2\delta-\alpha_2} \end{bmatrix} D_{yt}$$

The solution for this system of difference equations, without taking into account transient terms, will be given by: [6]

$$p_t = p + \omega_1(L)\,\mu_t + \omega_2(L)DF_t + \omega_3(L)O_t + \omega_4(l)A_t \tag{15}$$

$$h_t = \omega_1^*(L)\,\mu_t + \omega_2^*(L)DF_t + \omega_3^*(L)O_t + \omega_4^*(L)A_t \tag{16}$$

where we assume a constant rate of growth of potential output and a rate of growth of real wages equal to the increase in labor productivity. The letter p stands for the inflation rate when both $u_t$ and $DF_t$ are equal to zero and there are no supply shocks. The polynomials $\omega_i(L)$ and $\omega_i^*(L), i = 1, 2, 3, 4$, in the lag operator $L(LZ_t = Z_{t-1})$ depend upon the structural parameters of the model according to the following expressions:

$$\omega_1(L) = \frac{\beta}{\Delta}: \qquad \omega_2(L) = \frac{\beta\alpha_2\delta}{\Delta}$$

$$\omega_3(L) = \frac{(\alpha_1+\alpha_2\delta)(1-\gamma)}{\Delta\gamma}; \qquad \omega_4(L)\frac{(\alpha_1+\alpha_2\delta)\,\theta\,\phi}{\Delta\gamma}$$

$$\omega_1^*(L) = \frac{-(1-L)}{\Delta}; \qquad \omega_2^*(L)\frac{-\alpha_2\gamma(1-L)}{\Delta}$$

$$\omega_3^*(L) = \frac{1 + \alpha_2\delta - \alpha_2(1-L)(1-\gamma)}{\Delta\gamma};$$

$$\omega_4^*(L) = \frac{-1 + \alpha_2\delta - \alpha(1-L)\,\theta\phi}{\Delta\gamma}$$

$$\Delta = (1-L)^2\,(\alpha_1 + \alpha_2\delta) + \beta\,[1 + \alpha_2\delta - \alpha_2(1-L)]$$

When L=1,$\Delta$ is equal to:

$$\Delta(1) = \beta(1 + \alpha_2\delta)$$

Thus it is not difficult to prove that the polynomials $\omega_i(L)$ and $\omega_t^*(L)$ satisfy the following restrictions:[7]

$$\omega_1(1) + \omega_2(1) = 1$$

[6] We assume that the model structural parameters are such that the model is a stable one.

[7] There is also the following restriction among the coefficients of the two equations: $\omega_4(1)/\omega_4^*(1) = \omega_3(1)/\omega_3^*(1)$.

$$\omega_1^*(1) = 0$$

$$\omega_2^*(1) = 0$$

These results can be interpreted in a very simple way. First of all, let us take a look at the meaning of the two last restrictions that belong to the output gap final form equation. When supply shocks are not present, equation (15) can be written in the following way:

$$h_t = \sum_{1=0}^{\infty} \omega_{1i}^* \, \mu_{t-1} + \sum_{i=0}^{\infty} \omega_{2i}^* \, DF_{t-i} \tag{17}$$

If the rates of growth of money supply and public deficit were constants and equal to $\mu$ and DF respectively, the output gap would be given by:

$$h_t = \left( \sum_{i=0}^{\infty} \omega_{1i}^* \right) \mu + \left( \sum_{1=0}^{\infty} \omega_{2i}^* \right) DF$$

Since the sum of each set of weights is equal to zero, then it follows that in the long run both monetary and fiscal policies do not affect the level of economic activity.

With regard to the inflation rate, its final form equation shows that it depends on the historical evolution of the monetary and fiscal policies, as well as on the time path, from the past to the present, of the supply shocks. That is:

$$p_t = p + \sum_{i=0}^{\infty} \omega_{1i} \, \mu_{t-1} + \sum_{i=0}^{\infty} \omega_{2i} \, DF_{t-i} + \sum_{i=0}^{\infty} \omega_{3i} 0_{t-i} + \sum_{i=0}^{\infty} \omega_{4i} \, A_{t-i} \tag{18}$$

In the long run, in a situation defined when there are no supply shocks, inflation is fully expected and the proportion of the public deficit in relation to nominal output is constant, the rate of growth of money supply will be equal to the rate of growth of the public deficit subtracted from the rate of growth of income velocity that comes from the increase in potential output. Under these conditions we arrive at the monetarist proposition that in the long run inflation is a purely monetary phenomenon, due to the fact that the sum of the weights $\omega_1 S$ and $\omega_2 S$ is equal to one.

Therefore, for constant rates of growth of money supply and potential output we conclude that, in the long run, the rate of inflation is equal to the difference between the rate of increase in money supply and the product of money demand income elasticity times the rate of growth of potential output: $p_t = \mu - \alpha_1 D\overline{y}$.

## 3 Empirical Evidence for the Period 1947-80

The final form equation for the inflation rate depends upon the historical record of fiscal and monetary policies. It also includes two variables that measure

supply shocks due to increases in agricultural and imported raw material prices. Equation (18) was estimated by ordinary least squares by using annual data for the period 1947-80. We measure the rate of inflation by four different indices: the General Price Index )GPI), the Wholesale Price Index (WPI), the Cost of Living Index of Rio de Janeiro City (CLIRJ) and the Implicit Output Deflator (IOD).[8]

The money supply rate of growth is indeed an endogenous variable because it is not directly controlled by monetary policy. Thus, we prefer to use the rate of growth of monetary base.

Due to some peculiar aspects of Brazilian monetary institutions, it is a very difficult job to quantify the true federal government deficit. This is so because the National Monetary Council has the legal power to create expenditures without having to include it in the fiscal budget, and the monetary budget is not required to be approved by the Congress. We use as a proxy for the rate of growth of the public deficit the rate of growth of government expenditures as measured by the national accounting system. At this point we would like to make two remarks. First, these expenditures include all levels, i.e. federal, state and municipal governments. Second, we are aware of the possibility that the use of this proxy may bias some coefficient estimates.

The variable that captures external shocks is measured by the acceleration in the rate of growth of oil products' domestic prices.

With regard to the agricultural supply shock variable, this is measured by the difference between the actual rate of growth of agricultural production and its trend rate of growth.

The number of lags for each variable in equation (18) is basically an empirical problem. The best results we arrived at included only one lag for the monetary and fiscal variables, and no lags for the supply shocks variables. Table 26.1 presents the results obtained for the following equation:

$$p_t = -p + \omega_{10}\, B_{t-1} + \omega_{20}\, DG_t + \omega_{21}\, DG_{t-1} + \omega_{30}\, O_t + \omega_{40}\, A_t + \varepsilon_t \qquad (19)$$

where $\varepsilon$ is the stochastic disturbance, and B and G stand respectively for the rate of growth of monetary base and government expenditure.

The Durbi-Watson statistics do not show serially correlated residuals, the determination coefficients $R^2$ are high and the signs of the estimated coefficients are as expected. However, some standard errors are high probably because of multicollinearity in the data.

The sum of the monetary base coefficients is greater than the sum of government expenditure coefficients, excepted for the IOD equation. However, the thrust of fiscal policy is greater in the first period for the GPI, WPI and IOD equations.

As suggested by the model we presented in the previous section, the sum of the weights for the two variables B and DG is very close to one. Indeed, in

[8] The General Price Index (GPI) has a long tradition in Brazilian price statistics and is a weighted average of the Wholesale Price Index, Cost of Living Index of Rio de Janeiro City and the Civil Construction Cost Index, with the following weights: 0.6, 0.3 and 0.1.

all cases we cannot reject the hypothesis that the sum of those weights is equal to one. Thus we may conclude tentatively, based on the empirical evidence, that when there are no supply shocks, inflation is in the long run a monetary phenomenon.

Table 26.1

Regression:
$\mathrm{p}_t = -p + \omega_{10} B_t + \omega_{11} B_{t-1} + \omega_{20}\, DG_t + \omega_{21}\, DG_{t-1} + \omega_{30}\, O_t + \omega_{40}\, A_t$

| Dependent variable | -p | $\omega_{10}$ | $\omega_{11}$ | $\omega_{20}$ | $\omega_{21}$ | $\omega_{30}$ | $\omega_{40}$ | $\frac{\sum \omega_{1i}}{\sum \omega_{2i}}$ | D-W | R |
|---|---|---|---|---|---|---|---|---|---|---|
| GPI | $-8,417$ | $0,381$ | $0,219$ | $0,706$ | $-0,235$ | $0,042$ | $-0,842$ | $1,071$ | 2,08 | 0, |
| | (4,804) | (0,166) | (0,189) | (0,208) | (0,206) | (0,049) | (0,349) | (0,111) | | |
| WPI | $-5,999$ | $0,347$ | $0,433$ | $0,740$ | $-0,487$ | $0,033$ | $-8,885$ | $1,033$ | 1,97 | 0, |
| | (5,446) | (0,188) | (0,214) | (0,236) | (0,234) | (0,055) | (0,396) | (0,124) | | |
| CLIRJ | $-6,501$ | $0,508$ | $0,238$ | $0,427$ | $-0,137$ | $0,018$ | $-0,572$ | $1,036$ | 2,34 | 0, |
| | (4,579) | (0,158) | (0,180) | (0,198) | (0,196) | (0,047) | (0,333) | (0,104) | | |
| IOD | $-10,976$ | $0,227$ | $0,192$ | $0,608$ | $0,072$ | $0,036$ | $-0,388$ | $1,099$ | 2,05 | 0, |
| | (2,894) | (0,100) | (0,114) | (0,125) | (0,124) | (0,030) | (0,210) | (0,066) | | |

The estimated coefficients for the oil supply shock variable are small, and they have high standard errors. Therefore, we cannot accept the hypothesis that the oil shock played an important role in the Brazilian inflation during the period we studied.

With regard to agricultural shocks, the empirical evidence points out that, as structuralists usually emphasize, fluctuations in agricultural production do affect the inflation rate since the estimated coefficients of this variable are statistically significant. However, the potency of agricultural shocks is small when compared with the long-run potency of fiscal and monetary variables.

# 4 Concluding Remarks

The sources of Brazilian inflation during the post-war period were mainly domestically created and its connection with international events cannot be grounded on empirical evidence. This statement is based on the fact that monetary and fiscal policies plus agricultural shocks were most important variables in explaining the Brazilian inflationary experience.

When one looks at periods of high inflation rates the contribution of agricultural shocks is minor. When one wants to disentangle the effects of the monetary and fiscal policy variables in the short run, this becomes a very difficult task due to the high degree of multicollinearity between the two variables.

The allegation of a substantial contribution of the oil shock to the acceleration in the inflation rate observed after 1973 is not warranted. This finding contradicts the hypothesis that attributes an important role to the behavior of the OPEC cartel in explaining that event.

The most important result, based on the empirical evidence presented here, is that in the long run inflation is a monetary phenomenon. It follows that the most challenging task for Brazilian society in the near future is to shape a monetary-fiscal constitution that precludes financing much of the budget deficit through the inflation tax.

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