Inflation, indexation, and the black market dollar*

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Summary: 1. Introduction; 2. Inflation, indexation, and the black market dollar; 3. The empirical evidence; 4. Conclusions.
Key words: inflation; indexation; causality, exchange rate.

The stationarity of the black market real exchange rate series supports the purchasing power parity theory, PPP, as a theory of nominal exchange rate determination. This paper goes further in this conclusion, and presents empirical evidence that it is possible to have a situation in which the changes in the exchange rate are cause, and not consequence, of inflation.

A estacionaridade da série de taxa de câmbio real do mercado paralelo dá suporte à teoria da paridade do poder de compra (PPC) como uma teoria de determinação da taxa de câmbio nominal. Este artigo aprofunda tal conclusão e apresenta evidência empírica de que é possível haver uma situação em que as variações da taxa de câmbio são uma causa, e não uma conseqüência, da inflação.

1. Introduction

A time series is said to be stationary if it tends to return to a previous level or trend when subjected to exogenous shocks.[1] The concept of stationarity has important implications when applied to economic time series. The stationarity of a real exchange rate series supports the theory of purchasing power parity (PPP), for the determination of the nominal exchange rate.[2] The PPP theory predicts a close relationship between the nominal exchange rate and the domestic and foreign inflation rates. In its relative form, it predicts that the percentage change in the exchange rate equals the difference between the domestic and foreign inflation rates.

In a previous study about the black market for the dollar in Brazil, Holanda (1993) presents evidence that the real exchange rate in this market behaves as a stationary series. The stationarity of the series and the consequent backing of the PPP theory does not come as a surprise, considering the acute inflationary process that has characterized the Brazilian economy in the last two decades.[3]

Traditionally, the PPP theory predicts a causality direction running from inflation rate to changes in the exchange rate. It is interesting to point, however, that in countries like Brazil, where a long period of inflation resulted in a widespread use of indexation, this causality direction may run in the opposite way. That is, changes in the exchange rate would be a cause and not a consequence of inflation.

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[1] Formally, a series is said to be stationary if its mean is constant and its autocorrelation function depend only on the lag, that is: $E[X(t)]=\mu$, $COV[X(t), X(t-k)]=f(k)$.

[2] See Holanda (1993).

[3] See McNown and Wallace (1989), who found that PPP holds for high inflation countries.

Suppose, as an example, that a shoe manufacturer decides to index the domestic price of his production to changes in the exchange rate. Each time the exchange rate changes he adjusts the price, in domestic money, of his shoes in the same proportion of the change in the exchange rate. In such a case, devaluations of the exchange rate, for whatever reason, result in higher prices for the shoes, even if there is no change in such fundamentals as production costs and demand.

The purpose of the this paper is to study the relationship between the inflation rate and the black market exchange rate for the case of the Brazilian economy. Specifically, the paper looks for evidence of a dominant pattern of causality between these two variables. The paper is organized as follows. Section 2 describes the dynamics of a high inflation regime in which widespread indexation is introduced as a mechanism to avoid a collapse of the economic system. This section also describes the way inflation, exchange rate, and indexation interact with each other. Section 3 presents the results of the empirical investigation performed, and section 4 presents some concluding remarks.

2. Inflation, indexation, and the black market dollar

For a person not familiar with the Brazilian economy it is hard to understand how it kept working in the last years, despite a chronic inflationary process that presented yearly inflation rates averaging more than 500%. The explanation for such an apparent neutrality of inflation can be summarized in one word: indexation.

The performance of any modern economy is crucially dependent on the existence of a comprehensive system of laws ruling the way economic agents should interact with each other through contracts, and on the existence of a common unit of value whereby these contracts are agreed upon and settled. A continuous and unpredictable inflationary process negatively affects the economy when it reduces the ability of the domestic currency to serve as a common unit of value. In this case, the agents will tend to look for alternative units of value, or even will tend to reject the use of contracts, introducing a scenario of disorganization and uncertainty into the economy.

Indexation comes as a way to restore the common-unit-of-value function of domestic money. Indexation clauses are introduced in the contracts and the use of domestic money is preserved. This is done, for example, by introducing a clause in a labor contract saying that wages, expressed in domestic money, should be adjusted by a specific escalator (the consumer price index) at the end of each year, or introducing a clause in a selling contract saying that the price of the goods sold should be adjusted by an escalator reflecting the increase in the costs of production at the time of each shipment.

In a context of high inflation, three points about indexation should not be overlooked. First, in the words of Simonsen (1983:130), "risk aversion and price uncertainties cannot be phased out by a government decree. Whenever they are combined, a potential develops for some sort of indexation arrangements. Legal obstacles to escalator clauses can only damage market efficiency". Second, only under extreme conditions, such as stable inflation rates and perfect synchronization in the adjustment of prices, is indexation capable of neutralizing inflation. Third, the operational aspects regarding the implementation of indexation are extremely complex, especially with respect to the choice and computation of appropriate escalators.

Regarding the latter point, one should emphasize the difficulties involving the process of choice and computation of an index to be used as an escalator. A good index should be able to effectively maintain real targets in terms of prices or incomes. That is not an easy task, considering that different agents have different goods in their relevant baskets, or the same goods in different proportions. In such a case, some government intervention in the form of imposition of common-fixed-baskets indices is recommended. The indices to be imposed have to be credible and able to keep real targets. Government intervention would avoid the proliferation of indices of all types, in which case the uncertainties of the agents relative to their inflow and outflow of resources would be very high.

Despite all difficulties involving its implementation and its suboptimal capacity of neutralizing inflation, indexation presents some important benefits:

(a) it avoids the complete extinction of long-term financial markets, especialy the market for long-term government bonds, through the indexation of the yield of the bonds;

(b) it helps to keep the investment capacity of the state by assuring some real targets in terms of revenues, through the indexation of the tax system;

(c) it helps to maintain the competitiveness of the country's exports, through the indexation of the exchange rate;

(d) it facilitates labor-capital disputes, through the indexation of labor contracts;

(e) it avoids a complete flight from domestic money to either goods, which would trigger a hyperinflation, or to foreign money, which would trigger a balance of payment crisis, through the indexation of quasi-monies such as demand deposits.

The benefits just mentioned are not cost-free. Indexation introduces a high degree of inertia in the inflation process, which reduces the chances of success of conventional stabilization programs. It also turns inflation very sensitive to any type of external shock.

The experience of Brazil with indexation is very rich and goes back to the early 60's. By the latter 60's, wages, rents, taxes, exchange rate, financial contracts, and most of the contractual incomes were covered by some type of indexation. Since then, the country has experienced all sorts of indexation schemes: backward-looking escalators, forward-looking escalators, escalators with predetermined values, yearly indexation, monthly indexation, daily indexation etc.[4]

The Brazilian experience presents an interesting point about indexation. As inflation keeps its accelerating path, the agents tend to lose their notion of relative prices. It become very difficult to differentiate a cheap good from an expensive one, or a good from a bad salary. In this circumstance, agents recur to indexation as a way to guarantee their share in the total income of the economy. This is true even in the case of the economy's price-makers.

After many years of high inflation rates, it becomes very difficult for a firm to extract, from the movement of the relative prices, any sign of real changes in terms of demand, preferences, and technology. For some firms, the best way to face the problem is the indexation

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[4] For more information about the Brazilian experience with indexation see Simonsen (1983) and Macedo (1983).

of the prices of the goods or services they produce, using an escalator which would maintain the firm's position in the relative price structure of the economy. That is, the changes in the prices of the firm's goods or services are determined automatically by changes in the value of some escalator, with this escalator not allowing any significant lag between the firm's prices and the other relevant prices of the economy. Differently from the case of wages, rents, and most contractual incomes, which are usually adjusted for past inflation, in this type of indexation the flow supply prices are usually adjusted to expectations of future inflation.

A common escalator for such a type of indexation is the value of the dollar in the black market for foreign exchanges. The indexation to the dollar is done by adjusting the prices of the goods in the same proportion of changes in the value of the black market dollar. In practice, the prices of the goods are not set in terms of domestic money (cruzeiros) anymore, but in terms of dollars. Since in this type of indexation dollars are substituted for cruzeiros, the term "dollarization" is sometimes used to describe the phenomenon.[5] Notice that the prices of the goods are set in dollars, but the settlement of each transaction is made, predominantly, in cruzeiros. This characteristic differentiates the dollarization process of the Brazilian economy from those observed in other countries, in which the dollar substituted the national currency not only as unit of value but also as mean of exchange.[6]

The indexation of prices to the black market dollar presents some attractive features to the firm. Since the value of the dollar is strongly affected by expectations, this type of indexation is forward-looking. This is very important in an environment of increasing inflation rates. Considering that in most of the contractual incomes, especially wages, indexation is backward-looking, the indexation to the dollar would guarantee a lead in terms of price increases. The value of the dollar is available continuously, permitting an almost instantaneous indexation. It is also less liable to manipulations. Finally, the indexation to the dollar facilitates the firm's planning in terms of inflow and outflow of resources.

It is expected that the indexation to the dollar is first introduced in sectors with some oligopolistic power. With the continuation of inflation and its acceleration, it tends to spread to other sectors of the economy, as the losses associated to backward-looking indexation become more visible. In this case, the question about the causality between the inflation rate and the rate of change of the exchange rate becomes less obvious. As said earlier, a situation can develop in which an increase in the value of the dollar results, through indexation, in a generalized increase of prices. That is, the change in the exchange rate from a consequence becomes a cause of inflation.

The following section presents some empirical evidence that such a change of causality direction occurred in the case of the Brazilian economy. Before that, attention should be called to the fact that the widespread use of this type of indexation, paradoxically, results in some favorable conditions toward an effective control of inflation.

With the extensive use of this type of indexation, the relative prices structure of the economy becomes less dispersed. The lags between prices are substantially reduced. This facilitates the use of income policies, such as the freezing of prices and wages or the use of the exchange rate as a nominal anchor. On the other hand, since this type of indexation is forward-looking, its use tends to reduce the degree of inertia of the inflation. The prices, in this

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[5] The currency substitution literature has emphasized the substitution of dollars for domestic currencies, as a result of either agent's portfolio-optimization behavior or increasing transaction costs. Less attention has been given to currency substitution due to indexation.

[6] Argentina is an example of such a strong form of "dollarization".

case, are adjusted more as a function of future inflation and less a function of past inflation. Once the agents realize that the right policies toward an effective control of the inflation were adopted, they start to reduce the rhythm of the increase of prices.

3. The empirical evidence

The Granger causality test is frequently used in studies about the way two economic variables interact with each other. Granger causality is an econometric relationship which tests whether additional information from past values of variable X helps explain variable Y.[7] It is defined as follows:

$$\sigma^2(Y/I) < \sigma^2(Y/I - X) \tag{1}$$

If past values of X help explain Y, the inclusion of X in the information set, I, will reduce the variance of Y.

The test is implemented through the estimation of the following equation:

$$Y_t = \sum_{i=1}^{k} \alpha_i Y_{t-i} + \sum_{i=1}^{k} \beta_i X_{t-i} + u_t \tag{2}$$

The test depends on:

$$Ho : \beta_i = 0, i = 1, 2, 3 ..., k$$

It is important to note that the purpose of the test is to determine if movements in one variable precede movements in another. Its concept of causality is not as it is usually understood.

The proper lag length of equation (2) is defined by Akaike's final prediction error (AFPE). AFPE is defined as:

$$\text{AFPE}_k = (T + K + 1 / T - K - 1) \times (\text{SSR}_k / T) \tag{3}$$

where K is the lag length, $K = 1, 2, 3,...n$; T is the sample size; and SSR is the sum of the squared residuals. The optimal K is set as to minimize the value of AFPE.

The Granger causality test is applied to check any causality between the inflation rate, measured as the percentage change of the general price index of the Fundação Getulio Vargas (IGP/DI-FGV), and the rate of change of the exchange rate, measured as the percentage change of the average value of the cruzeiro/dollar exchange rate in the Brazilian black market for foreign exchanges. The official exchange rate is not considered in this paper, since it is government determined and is itself subjected to indexation.

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[7] The Granger causality test methodology applied in this section is based on Smith, Brocato, and Rogers (1993).

The series are on a monthly basis and the sample period goes from January 1975 to December 1992. The stationarity of both series was checked through the application of the augmented Dickey-Fuller test (ADF).[8] The unit root hypothesis was rejected in both cases.[9]
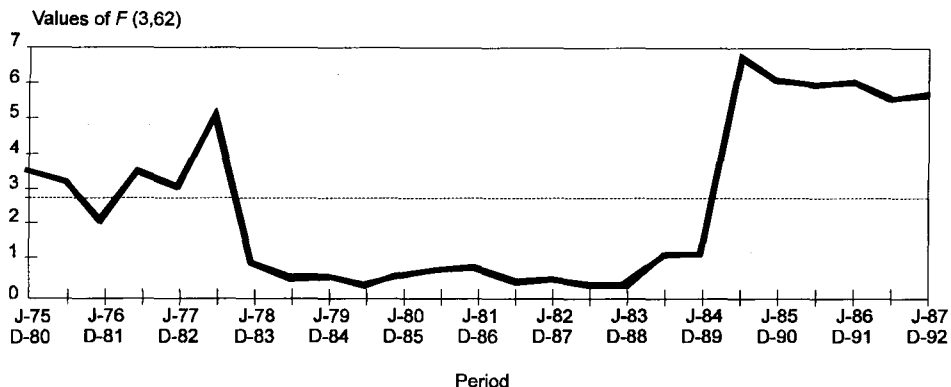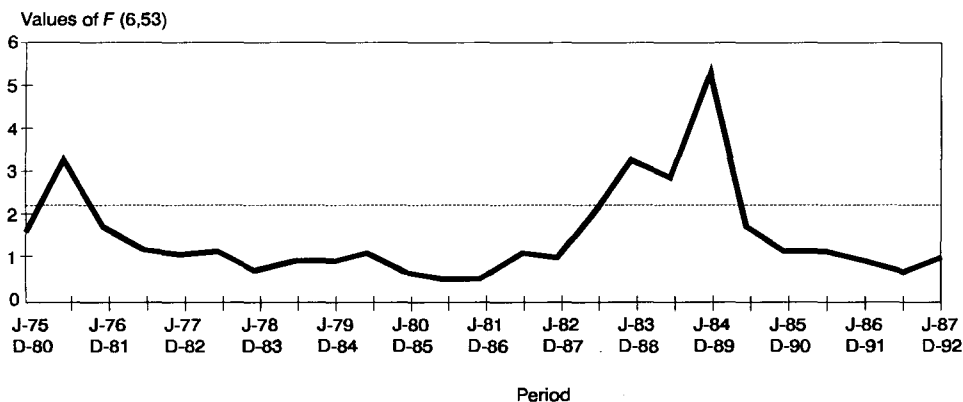
Figure 1
Variable B Granger causality on variable P

Figure 2
Variable P Granger causality on variable B

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[8] The ADF test is implemented through the estimation of the following equation:

$$\Delta Y_t = \alpha + \rho T + \gamma Y_{t-1} + \sum_{i=1}^{n} \delta_i \, \Delta Y_{t-i} + u_t$$

where T is a trend variable. The null of nonstationarity implies $\gamma = 0$.

[9] The "t-values" for $\gamma = 0$ are equal to -4.45 and -5.62 for the inflation rate and exchange rate variables, respectively. For a good discussion on unit roots tests, see Campbell and Perron (1991).

The Granger causality test is implemented using the technique of rolling regressions. Initially, the test is estimated for the January 1975 to December 1980 period, consisting of 72 monthly observations. Then, the last six observations are dropped and six new observations are added to the sample, and equation (2) is reestimated. This is done until no more new observations are available. For each estimation, the value of the F-test, for the hypothesis of $\beta_i = 0$, $i = 1, 2, \ldots k$, is saved. The results are presented in figures 1 and 2. In both figures, the vertical axis contains the values of the F-statistics for each regression, and the horizontal line represents the critical value of the test at the 5% level.

Figure 1 presents the results for the test that the black market exchange rate causes inflation. For the late 70's and early 80's, there is some evidence of causality running from the exchange rate to the inflation. This period, however, is marked by the second oil shock, the sharp increase in international interest rates, and the external debt crisis. Since the effects of such real shocks on the black market exchange rate and on the inflation rate are similar, it is difficult to extract any precise conclusion regarding the causality between the two variables in this period. For most of the 80's, the results suggest that there is no evidence that exchange rate causes inflation. The results change completely by the end of the decade. From the beginning of 1990, they suggest a causality running from the exchange rate to the inflation rate, which persists until the end of the sample period (December 1992). The numbers clearly indicate a structural brake in the relationship between the two variables, occurring in the early months of 1990.

An explanation for such a structural brake is found in the stabilization program that the newly elected government (the president Collor administration) introduced in March 1990. The main features of the program were:

(a) a 45-day prices and wages freeze;

(b) a drastic reduction in the liquidity of the economy through the blocking of about two thirds of the M-4 (currency in circulation, plus demand, savings, and time deposits, plus government bonds in hand of the public);

(c) a cut in the domestic public debt through the underindexation of this type of debt (the debt was adjusted well bellow the inflation rate of March and April);

(d) the replacement, in the private sector, of compulsory wage indexation by free bargaining.

The measures strongly undermined the credibility of the government. The uncertainty of the economic scenario increased remarkably. The underindexation of the domestic public debt further lead agents to look for alternative forms of indexation. At that moment, the use of the dollar as an escalator became very attractive, especially due to its resistance to government manipulation. The end of compulsory wage indexation, whereby wages were adjusted to past inflation, also helped the advance of the indexation to the dollar.

Figure 2 shows that, except for a brief period between the second half of 1988 and the end of 1989, there is no evidence that the inflation causes change in the exchange rate. The uncertainties regarding the consequences of the new Constitution that was to be approved by late 1988, and the failure of a stabilization program introduced in January 1990 (the Summer Plan) can be mentioned as possible reasons for the results obtained in the June 1988 to De-

cember 1989 period. Such episodes triggered large and autonomous price increases, in the first case, in anticipation of the possibility of a new price freeze, and in the second case, as an attempt to reverse losses that took place during the price freeze of the Summer Plan. In both situations, the exchange rate just followed the movement of prices.

The Granger causality test is silent about the contemporaneous relationship between the inflation rate and the black market exchange rate. In order to investigate it, the equation that results from the PPP theory is applied. Based in the results just obtained, the equation is estimated not in its traditional form, but as follows:

$$P_t = \alpha + \beta_1 P_{t-1} + \beta_2 B_t + \beta_3 P_t^* + u_t \tag{4}$$

where P is the domestic inflation rate, P^* is the external inflation rate, proxied by the OECD composed consumer price index, and B is the rate of change of the cruzeiro/dollar black market exchange rate.

The behavior of coefficient β_2 throughout the sample period can offer some insights regarding the contemporaneous relationship between inflation and the black market dollar. On the other hand, it should be noted that coefficient β_1 gives the degree of inertia of the inflation. If $\beta_1 = 1$, the inertia is complete (the inflation rate would be a random walk), and present inflation just reproduces past inflation.

In order to observe the movements of coefficients β_1 and β_2, equation (4) was estimated recursively, with a initial sample of 60 observations (January 1975 to December 1979). Figures 3 and 4 present the results of the regressions.
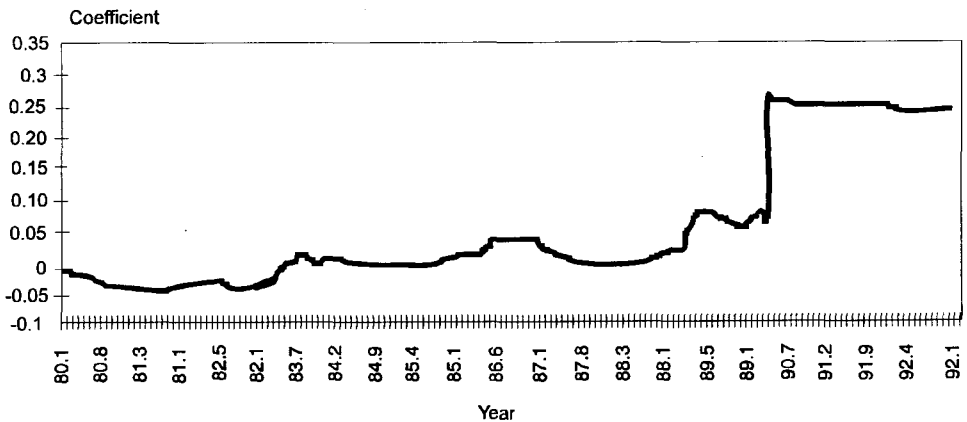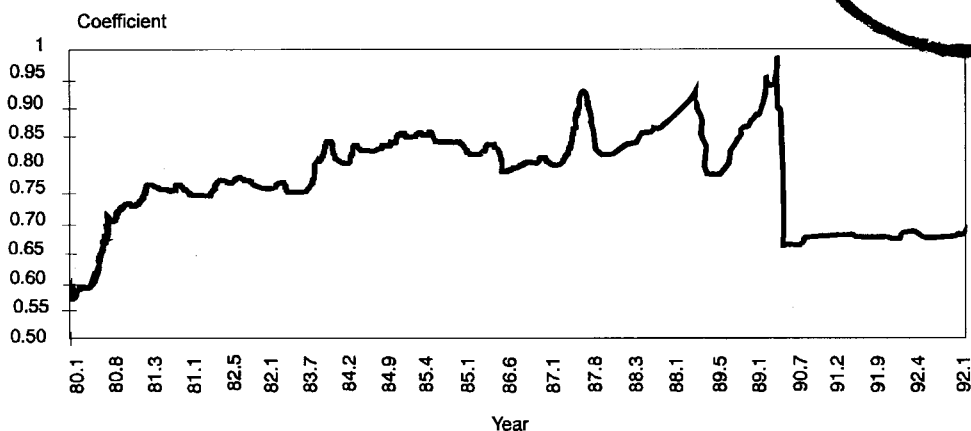
Figure 3
Beta coefficient of variable B

Figure 4
Beta coefficient of variable P(−1)

The numbers for β_2 confirm the results obtained previously. The increase in the value of the coefficient supports the hypothesis of a growing indexation to the dollar. The structural brake in the early months of 1990 is confirmed by the sharp change in the value of the coefficient in this period. Regarding the numbers for β_1, it is interesting to note that the structural brake, also observed for this coefficient, confirms the hypothesis that an increase in the indexation to the dollar tends to reduce the degree of inertia of the inflation. That is, as the value of the coefficient β_2 increases the value of the coefficient β_1, which gives the degree of inertia of the inflation, decreases.

4. Conclusions

The ways economic agents interact with each other in a scenario of continuous inflation are very diverse, as are the approaches to study them.

The present paper investigates one of the consequences of such behavior, which is the extensive use of indexation. For that, it concentrates its analysis in case of the Brazilian economy.

The experience of Brazil shows the importance of indexation as a mechanism to facilitate the ways different agents and sectors of a high inflation economy interact with each other. Indexation is introduced as a way to minimize the distributive conflict which is created by inflation, whereby the income-share claims of each agent or sector end up being greater than the economy's total income. Through indexation, inflationary losses of each agent or sector are periodically recouped, and that avoids a total collapse of the economic system.

The experience of Brazil also shows that as inflation continues, the role of indexation tends to change. It first appears as a consequence of inflation, but later it becomes a source of inflation. The paper presents empirical evidence that, as a result of indexation, the traditional relationship between inflation and exchange rate, as suggested by the PPP theory, can change substantially. The Brazilian case shows that inflation can be a consequence, and not a cause, of changes in the exchange rate.

The paper also offers evidence that in a prolonged inflationary process, forward-looking indexation, like that to the dollar, crowds out backward-looking indexation, like indexation to past inflation. This phenomenon tends to reduce the degree of inertia of inflation and highlights the importance of expectations in chronic inflations.

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