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REAL INTEREST RATE AND THE DYNAMICS OF HIPERINFLATION. THE CASE OF ARGENTINA

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SUMMARY

Standard analyses of high inflation episodes usually assume that the real interest rate is either a constant or suffers changes small enough to be safely ignored. However, in several highly indebted countries, the real interest rate is perhaps the single most important variable affecting the government budget.

This paper presents a model where the real interest rate affects the demand for money and debt, thus helping to explain the recent experience of Argentina. The model also provides a new perspective to the analysis of several issues in stabilization and monetary theory. One issue is the possibility that increasing the fraction of the deficit financed with bonds, instead of money creation, might increase inflation. In contrast to previous literature, this result is obtained for an economy that may be on either side of the Laffer curve.

Other issue is that, as unique solutions are possible on both sides of the Laffer curve, a "high inflation trap" is not possible; and the old remedy to cure inflation by reducing deficits or increasing primary surplus will always work, independently of how high is the prevailing rate of inflation.

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March, 1990.

1. Introduction.

The Argentine hyperinflation started at the beginning of 1989 and continued, with a brief hiatus between july and november, during the first months of 1990. It shares with other hyperinflations its ultimate cause: debt and fiscal disarray in the public sector. It also shares the frustration of policy makers whose initial policy actions were not able to put a full stop to accelerating prices.

The Argentine hyperinflation does not share with European hyperinflations of more than half a century ago the state of the art in economic theory. After decades of inflation, policy makers were well aware of an inflation revenue curve of the Laffer type. It would be an oversimplified interpretation of the facts to claim that hyperinflation resulted from a government inadvertently attempting to collect too much revenue from the inflation tax.

Although how much revenue can be collected cannot be easily determined, inflation tax theory of a Cagan type (either with adaptive or rational expectations), and the related discussion of the maximum revenue from inflation, offer some important clues. On the one hand, it provides a straightforward link to the government budget constraint and to the issue of the dynamics of inflation and stability of equilibrium. On the other hand, empirical money demand functions of the Cagan type are the state of the art in most Central Banks. They are estimated weekly - not only in Argentina but almost everywhere. Most financial programming exercises use monetary projections based on real money demands derived from a Cagan specification.

But beyond a reasonable statistical fit - that varies according to the period of estimation - most of the work done on inflation tax with a Cagan form does not fully explain the related issues of debt, real interest rates, and capital flight. Also, it is often difficult to explain the poor association between deficit and inflation without resorting to agents' anticipations of future policy actions; a serious limitation because deficit reduction is at the heart of most stabilization plans.

It is also difficult to interpret the short run empirical evidence on real monetization. Usually, it is thought that lower nominal interest rates produces real monetization thaw in turn, implies higher seigniorage and more revenue for the government. Yet it would appear that the short run dynamic process of real monetization or de-monetization is poorly correlated with the nominal interest rate. These are empirical issues for which Argentina provides rich evidence from four recent stabilization plans. Three were frustrated stabilization plans that did not stop inflation; on the contrary, they ended up in hyperinflation. The other was a plan unable to end the hyperinflation.

The purpose of this paper is to extend traditional inflation tax theory to explain some facts observed in Argentina during the recent experience leading to a hyperinflation. Section 2, 3, and

4 present the facts giving the necessary insight to identify a set of basic relationships to built up a simple model. Section 5 develops a theoretical model coherent with some empirical findings. Section 6 presents the comparative dynamics of the model explaining some important aspects of the Argentine high inflation dynamics. Section 7 contains concluding remarks.

2. Empirical Evidence on the Austral Plan

There is abundant literature on the Austral Plan. This section presents a brief account of its main characteristics. Most of the data description will be provided with graphics. The actual monthly data and its sources are in Fernández (1990).

The Austral Plan was based on three basic measures. First, prices of public sector enterprises were increased to reduce their cash flow deficit. Second, all prices, public and private, were frozen at the level prevailing on June 14, 1985. For some sectors, however, prices were frozen at the level of some weeks before that date on the basis that there had been some anticipation of price controls. After the freeze, the Secretary of Commerce was in charge of authorizing price adjustments when necessary. Third, the President promised in a public speech that from June 14 on, the Central Bank would not print any money to finance current expenditures of the public sector.

A few days after the announcement the plan was accepted by the IMF. The plan essentially respected the monetary and fiscal targets of the Standby agreement reached in the previous week; even more, it was said that - from a fiscal point of view - the plan set more ambitious targets than those agreed with the IMF.

The government commitment to stop monetary emission to finance public sector operations was not honored. The Banco Hipotecario Nacional (Mortgage National Bank) spent almost five billions of US dollars in concessional loans presumably related to political campaigning. Another two billions were granted in domestic currency to Cuba, Nicaragua, and African countries presumably to support the Argentine foreign policy. These two operations alone meant more than doubling the monetary base.

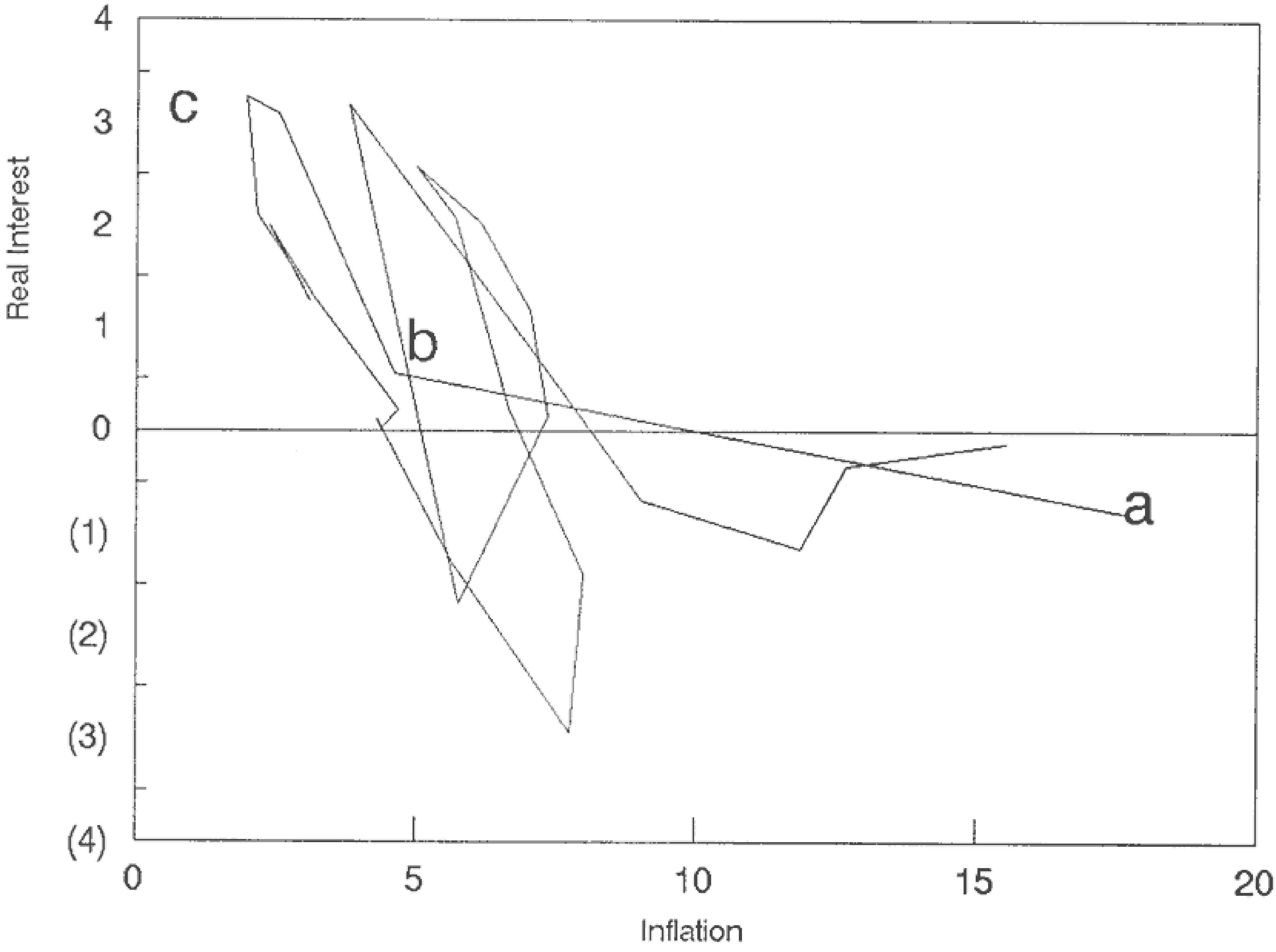
As fiscal discipline was not achieved with the Austral Plan, the government had to decide how to finance deficits. One source of financing was monetary creation by the Central Bank. To sterilize part of the monetary emission the Central Bank increased reserve requirements, paying competitive interest rates on them. Therefore, the most important issue in economic policy was to decide what share of the deficit should be financed by printing money and what type of debt should be issued to finance the rest. This turned to be a dominant force in determining the dynamics of real interest and inflation.

Figure 1 shows the dynamics - with monthly data - of inflation and ex-post real interest rate during the Austral Plan. Inflation is measured as the rate of change in monthly consumer price index. Real interest rate is the ratio of two factors: the numerator is one plus the weekly geometric average of 30 days nominal interest rate; the denominator is one plus the geometric average of the current and one month ahead inflation. The geometric average of inflation is necessary because nominal interest rates are weekly geometric averages. Therefore the nominal interest rate of the first week of a given month predicts inflation of three weeks of the current month and one week of the next month. The nominal interest rate of the second week of a given month predicts two weeks of the current month plus two weeks of the next month; and so on so forth.

Three important facts in Figure 1 will motivate the theoretical analysis of section 6. First, the stabilization process starts from point "a" with decreasing inflation and increasing real interest toward points b and c (a topic also analyzed by Calvo and Végh (1990)). Second, when the plan fails and inflation starts to accelerate real interest rate falls. Third the stabilization loop in the first part of the Austral Plan is counter-clock-wise. After this first loop there is not clear pattern except the persistence of a negative relation between inflation and real interest rate.

FIGURE 1.

Austral Plan: Inflation and Real Interest Rate.



The dynamics of real interest rates is of particular importance because, as mentioned above, most of the domestic debt in the banking system is government debt. Reserve requirements were high and were remunerated at market interest rate. Therefore, a stabilization plan should carefully look at the dynamics of real interest rate.

In contrast with most of the previous work on inflation tax theory, the model of section 5 pays special attention to real interest rate dynamics. It is usual in the literature discussing this subject, see for example Blanchard and Fischer (1989), to assume that real interest is constant. Or, alternatively, it is assumed that real interest moves slowly enough compared to nominal variables that their movement can be ignored. The wide fluctuation of real interest shown in Figure 1 shows that a constant real interest might not be the right assumption, specially when government debt is involved.

3. Empirical Evidence After the Austral Plan

By mid 1987 the failure of the Austral plan was evident with inflation rates above 10% monthly. The government decided to launch another stabilization plan that the press denominated "Australito" (Little Austral Plan). Credibility in the economic team was lost, and there was social unrest. In October 1987 the economic authorities increased minimum wage by 75% (from 200 to

300 Australes per month), and increased in 12% general wages in the private and public sector as well as pensions.

As in previous stabilization plans, the government had serious problems in reducing public spending. Again the policy issue was what share of the deficit should be financed with monetary creation and what share by borrowing. Inflation was already high, and borrowing in the capital market meant a severe crowding out and high real interest rates, therefore, the government opted by a seudo-tax called "forced borrowing."

This measure implied that the government obtained from tax payers a mandatory loan equivalent to 40% of last period revenue from income tax and net assets tax. First introduced in 1985/86 as an once-and-for-all emergency measure, forced borrowing was reintroduced in 1987, affecting again government credibility and reputation.

The government increased the fiscal burden by rising the tax on imports, cigarettes and checking accounts. This last tax - a true innovation in fiscal policy - consists of charging current accounts each time the account is debited. To avoid tax elusion check endorsements were restricted. The tax was paid by current account holders, and commercial banks acted as a withholding agent for the government.

FIGURE 2.
Australito Plan: Inflation and Real Interest.

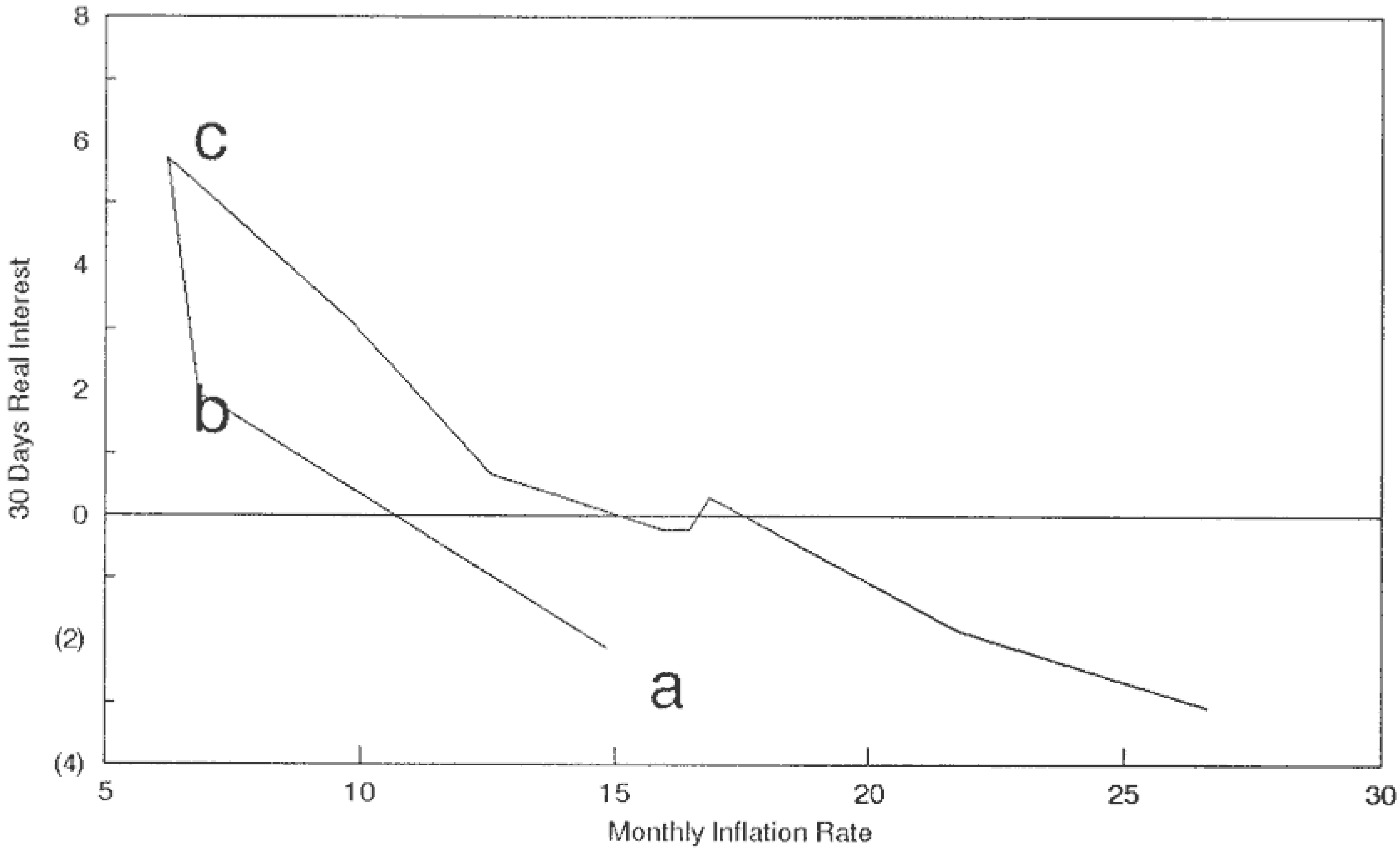


FIGURE 3
Primavera Plan: Inflation and Real Interest.

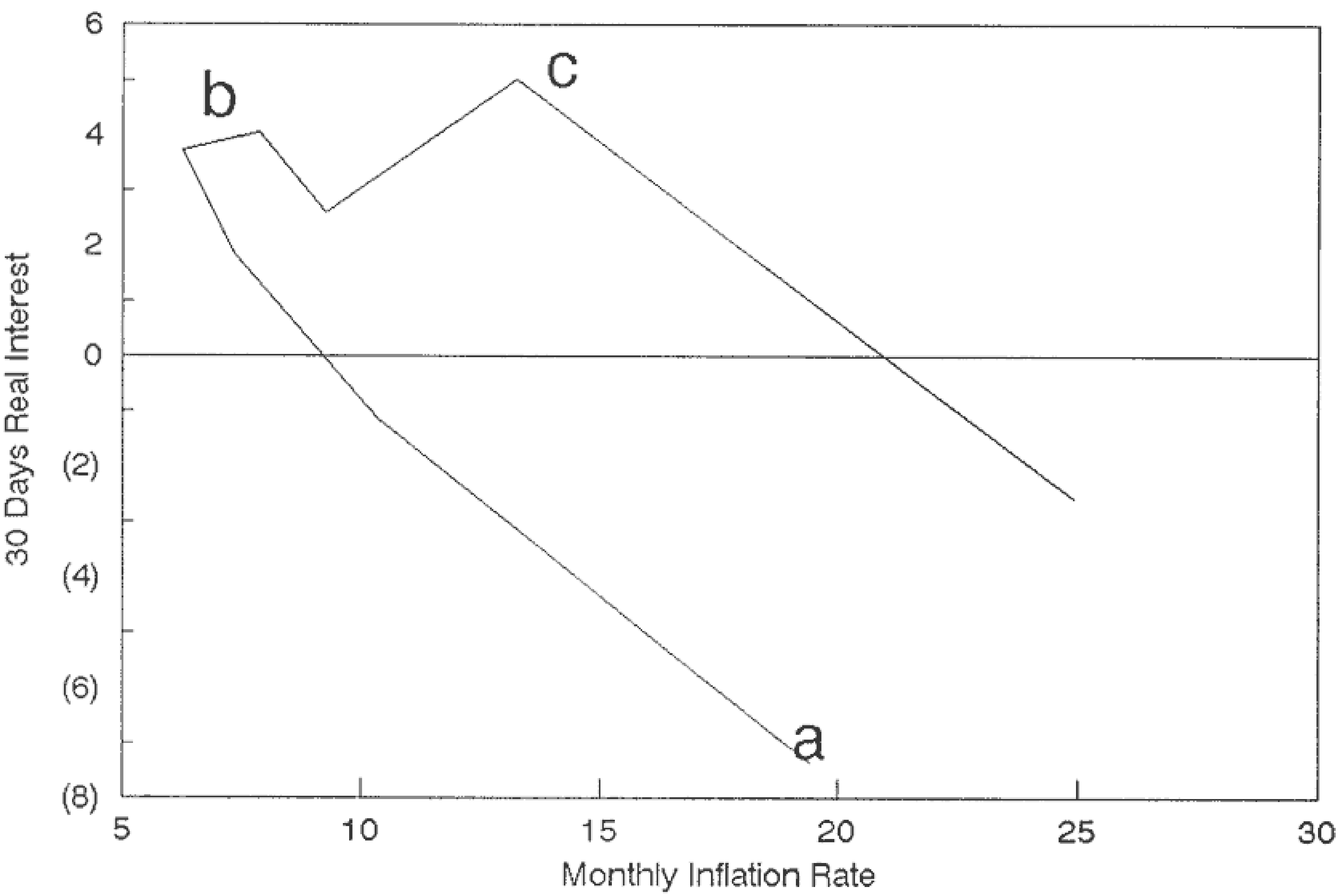


Figure 2 shows the dynamics of inflation and real interest rate during this new attempt. Notice that, as in Figure 1, there exists a negative association between inflation and real interest rate. The path of decreasing inflation is accompanied with increasing real interest rate. When the stabilization cycle is reversed with inflation accelerating, real interest rate decreases. Here, in contrast with the first loop of Figure 1, there is a clock-wise loop that ends in July 1988 at the time of the launching of the "Primavera Plan."

"Primavera" means "spring season" in Spanish, and that was the name given by the press to the economic plan introduced at the end of July 1988. At that time Argentina counted with favorable terms of trade, which were mostly due to the drought in the northern hemisphere that increased the international price of some agricultural commodities.

The Primavera Plan allowed the government to announce a fiscal profit in the exchange operations. The proceeds from exports would be obtained at a lower commercial exchange rate and would be sold at a higher rate in the financial market. During several months the spread between the financial rate and the commercial rate exceeded 20%. To sell dollars in the financial market the Central Bank fixed a minimum value above which would sell foreign exchange, although not in unlimited amounts. The amounts announced were large enough to affect the price of the dollar in the short run.

Another important measure was a special reestructuring of government debt with commercial banks. All debt in the form of reserve requirements for different kind of deposits was substituted by two special government obligations denominated "A-1241" and "A-1242" according to the Central Bank resolutions that created the obligations. Although we have liberally used the denomination of "reserve requirements" to give a first approximation to the idea, a word of caution is necessary. A large part of reserve requirements were not "reserves" because banks could not cash them. They were special bonds (or non- disposable deposits in the Central Bank) that substituted reserve requirements.

The government obligations A-1241 and A-1242 were remunerated with the average deposit rate of commercial banks plus 0.5% monthly. This meant that a large part of commercial banks assets was a particular bond that, in average, would pay whatever average interest rate the commercial banks were willing to pay to depositors.

Figure 3 shows the dynamics of inflation and real interest rate during the Primavera Plan. Notice, again, the wide fluctuation and negative association between inflation and real interest rate. The path of decreasing inflation is accompanied with increasing real interest rate, and when the stabilization cycle is reversed with inflation accelerating, real interest rate decreases. Again, in contrast with the first loop of Figure 1, there is a clock-wise loop that sets in motion the hyperinflation of 1989.

4. Empirical Evidence During the Hyperinflation

During the second half of 1988 the nominal exchange rate (and, presumably, inflation) was kept under control with the Central Bank auctioning dollars in the free market. But a growing debt and the political campaign for presidential elections - that would be held in May 1989 - were the dominant forces driving the economy.

At the end of 1988 the polls showed a clear advantage for the opposition candidate. The political advertisement of the ruling party was that the opposition candidate represented "chaos." Therefore the situation of Argentina at the beginning of 1989 was a ruling party driving the economy to ever increasing inflation and an opposition party that represented future "chaos."

The hyperinflation measured as the rate of devaluation of the Austral in the free market reached its peak of 186.4% monthly in June. If measured with the consumer price index the peak is in July with 196.5% monthly. Figure 4 shows the dynamics of inflation and real interest rate with the hyperinflation period showing a clock-wise loop (points a to c) and the negative association of inflation and real interest rate during the short lived stabilization of the BB Plan discussed below.

FIGURE 4.
Hyperinflation and the BB Plan.

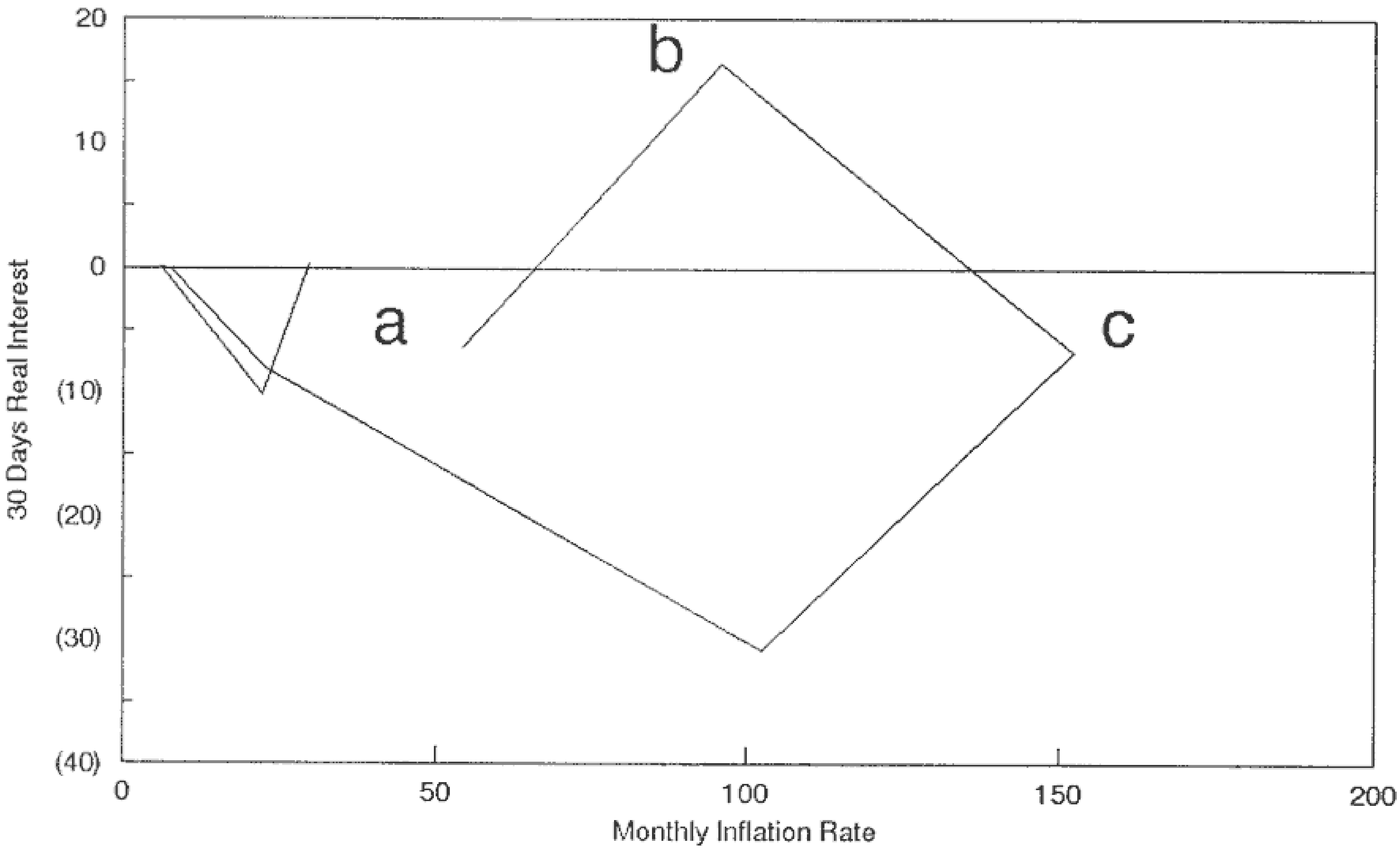
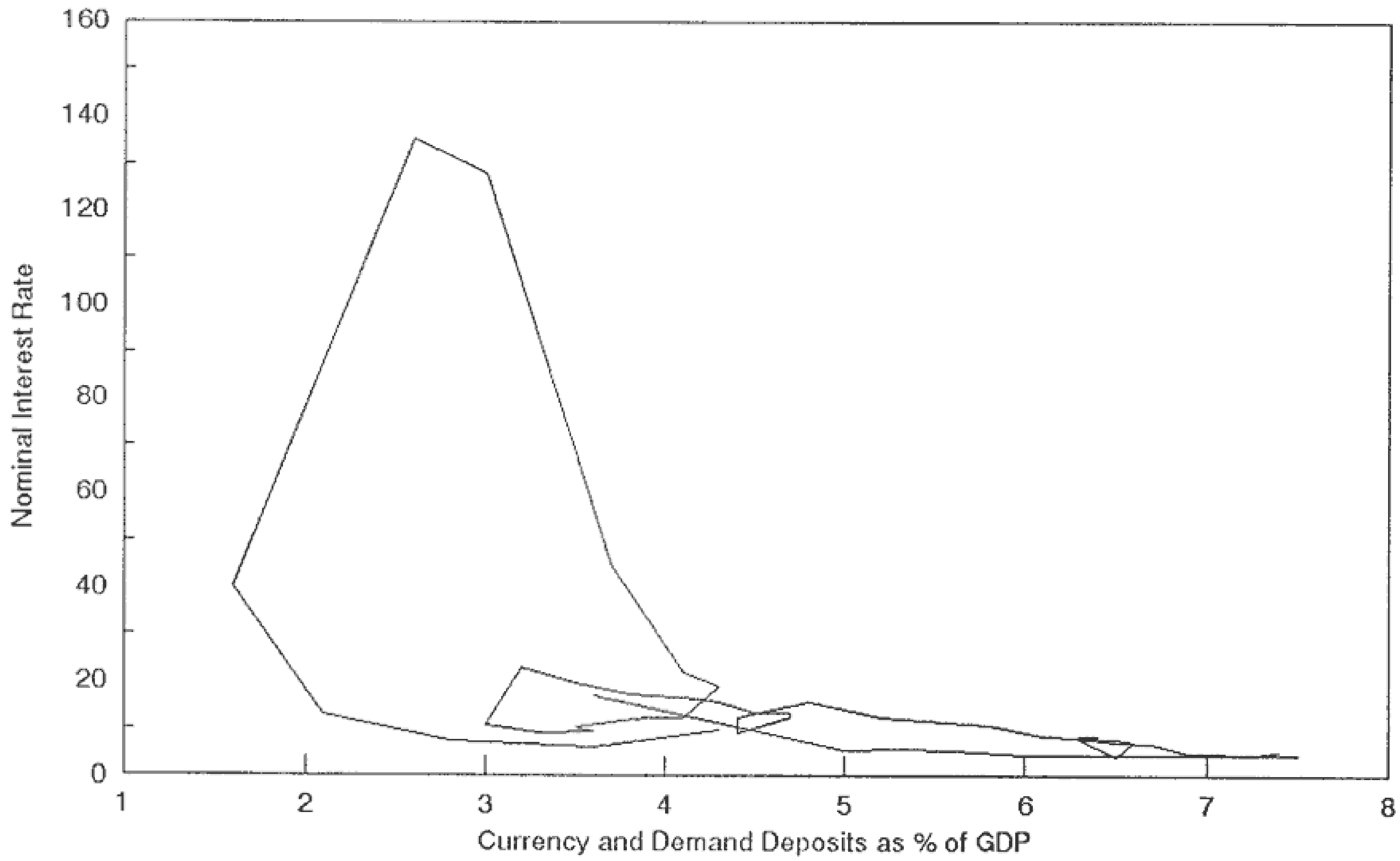


FIGURE 5
Real M1 and Nominal Interest Rate.



The severity of hyperinflation and the danger of social unrest forced the elected government to accept an immediate transfer of power. The first plan of the Menem administration was the BB Plan. BB stands for Bunge Born Corporation; the multinational firm that provided the government with a high ranking executive to take the post of Economic Minister.

The BB Plan was effective to stop the hyperinflation of the moment and to reach inflation levels of one digit per month during September, October and November. But in December the Argentine economy was again heading to hyperinflation with a monthly rate of 40.1% in consumer price index.

The evidence available so far does not support the hypothesis of a fiscal-ridden high inflation process toward the end of 1989. During the months following the hyperinflation the Central Bank did not issue any significant amount of money to cover operating expenses of the public sector. Most of the monetary emission of the period was generated by the purchases of foreign exchange by part of the Central Bank (a small amount of it paid government external debt with international organizations). Part of the monetary emission was sterilized issuing CEDEPS or short term Central Bank debt.

This new debt was issued at very high nominal rates. Given that it was announced that the exchange rate would remain fixed at 650 Australes per US dollar up to the end of 1990, in the period going from July to October the average yield of financial assets was more than 15% monthly in US dollars. This seemed not to be a serious trouble for bankers or depositors because most of the money was lent to the government, which remunerated average reserve requirements of about 80% of private banks deposits.

Even the most naive of depositors knew that the situation could not last long, and eventually they would convert Austral deposits to US dollars. In a few months a few smart depositors could obtain in Argentina a gain that would take almost a decade in world financial markets. Of course, not all could obtain such a gain. It was the attempt of many to capitalize such a gain what promoted a run on the financial system leading to hyperinflation. I believe that this is the most simple and more powerful explanation of the hyperinflations of 1989, the one beginning in February and the other starting in October.

The period going from the Austral Plan to the hyperinflation of 1989 illustrates some fundamental empirical relations on the demand for money. Figure 5 plots the currency and demand deposits with nominal interest rate. This figure suggests a weak negative relationship of M1 with nominal interest rate. A negative relationship is coherent with standard economic theory when money is not remunerated.

Figure 6 plots M1 and expected inflation. As mentioned above, actual and expected inflation is measured by the geometric average of current and one month ahead inflation. This figure also confirms standard economic theory providing a negative association between this two variables.

FIGURE 6
Real M1 and Expected Inflation.

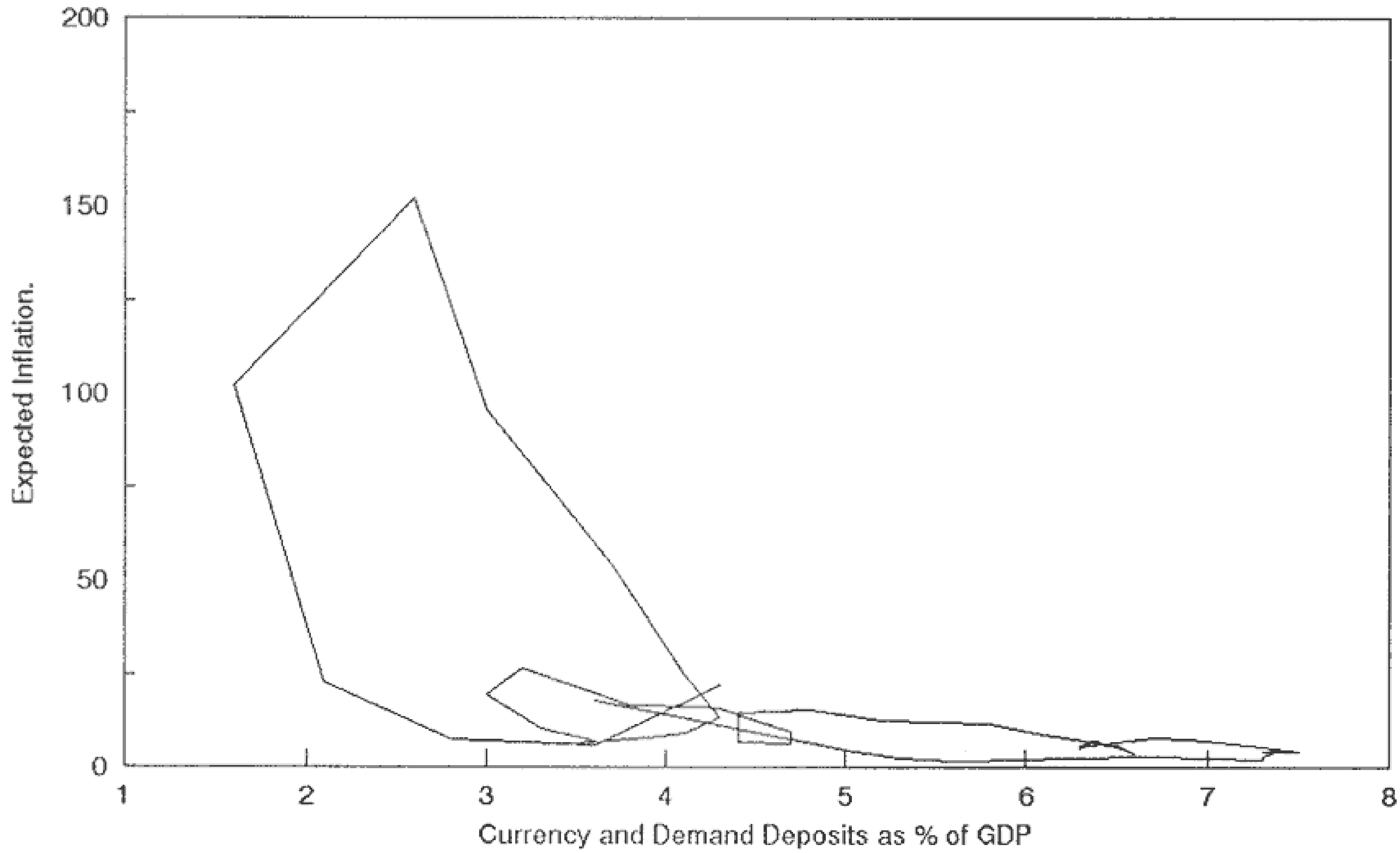


FIGURE 7
Real M1 and Real Interest Rate.

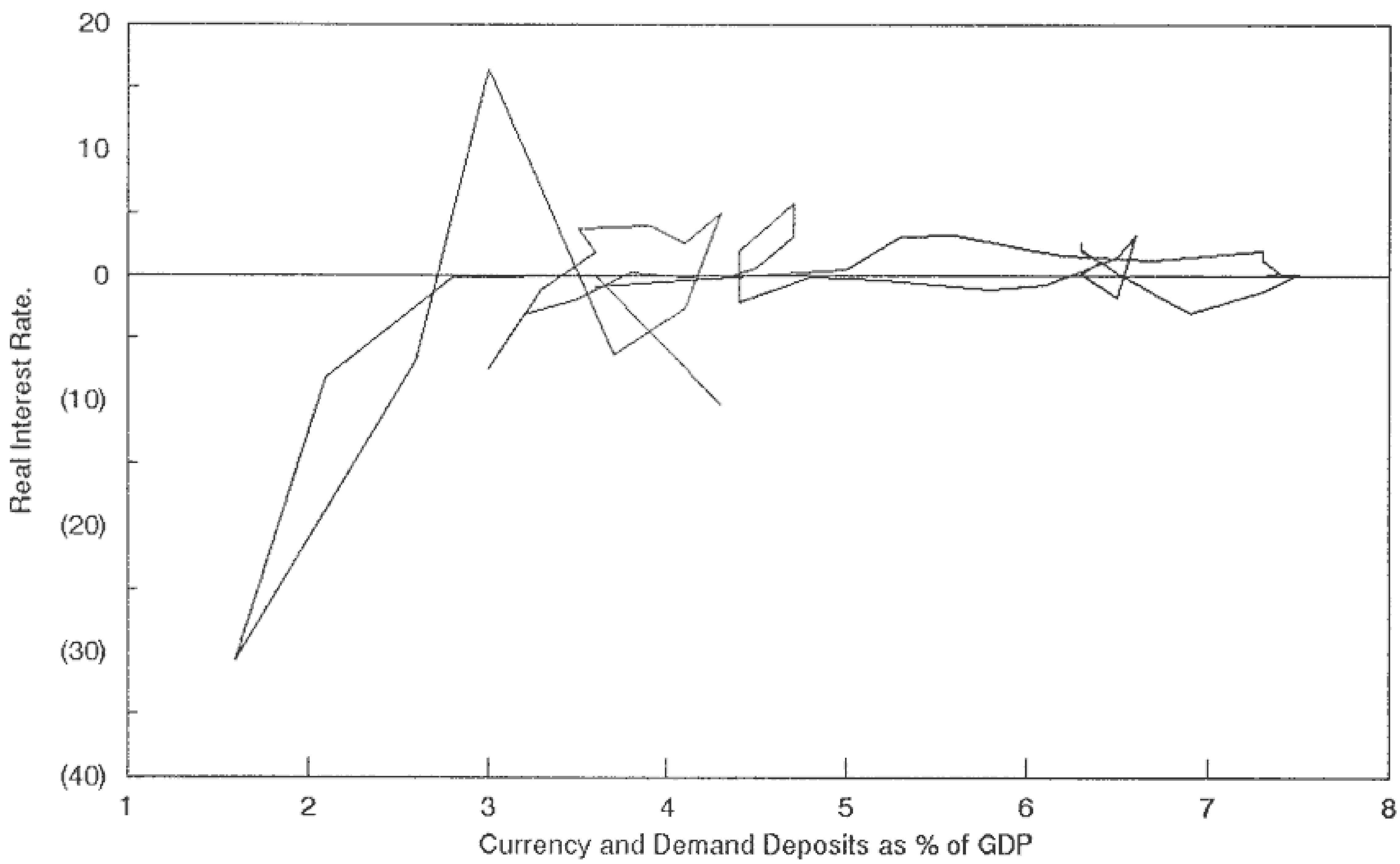


Figure 7 plots M1 and expected real interest rate with a positive association not confirmed by standard economic theory. Usually a Fisher equation is assumed and the real interest rate and expected inflation are added in a nominal interest rate. Therefore, a negative relationship with the nominal interest rate is assumed to hold for expected inflation and real interest rate. An unrestricted specification of the demand for money should allow for an independent influence of real interest rate and expected rate of inflation.

During high inflation real interest rate is the dominant force explaining the dynamics of demand deposits. Sometimes the real interest rate is explicit when deposits are indexed, in other cases the expected real interest rate is implicit in nominal interest rate or in indexation mechanisms linked to nominal interest rate.

The relationships presented in the previous figures will be used in the next section to formulate a simple theoretical model that would explain some important aspects of the dynamics of high inflation.

5. Modeling High Inflation.

One main reason for a positive association between the real interest rate and M1 is the complementarity between time deposits and M1 in producing liquidity services. This can be formalized in several ways: either using a standard cash in advance constraint of the Clower type where money and deposits (bonds) are needed to buy goods; or with M1 used jointly with other deposits to save shopping time (Brock (1989) follows this approach but assumes substitutability).

Assume three assets: money yielding no interest (M); a bond (B) that represents all government obligations, including high reserve requirements yielding competitive interest rate; and foreign assets (E) in the form of US dollars "under the mattress" plus deposits in foreign banks. Let P be the general price level, total real wealth, $a \equiv A/P$, is

$$A/P = M/P + B/P + E/P \qquad (1).$$

All variables are time dependent, but time-subscripts are omitted to simplify notation.

The lifetime utility of the representative consumer is given by

$$\int_{o}^{\infty} u(c)\exp(-\delta t)dt \qquad (2),$$

where u(.) is increasing, twice-continuously differentiable, and strictly concave; c denotes consumption; and $\delta > o$ is a constant subjective discount rate.

Following Calvo and Végh (1990) and Walsh (1984), we will assume that the consumer is subject to a liquidity-in-advance constraint that requires the use of money (foreign and domestic) and interest-bearing deposits (most of them were government bonds in Argentina) to purchase goods. Formally,

$$c \leq g(m,b,e), \qquad (3)$$

where m, b, and e denote the real stock of money, bonds, and foreign assets held by domestic residents. The partial differentiation of g is as follows: $g_m>o$, $g_b>o$, $g_e>o$, $g_{mm}<o$, $g_{bb}<o$, $g_{ee}<o$, $g_{mb}>o$, $g_{me}>o$, and $g_{be}>o$.

Defining non-financial real income with y, interest on bonds with i, interest on foreign assets with r^* (international inflation is assumed equal to zero), and with τ government lump- sum net subsidies, the consumer's flow constraint can be written as:

$$\dot{a} = y + \tau - c + a.r^* + b.(i-\pi-r^*) + e.(\epsilon-\pi) - m.(r^*+\pi) \quad (4)$$

where $\dot{a}=da/dt$, π is the rate of inflation, and ϵ the rate of devaluation of the domestic currency.

The consumer's optimization problem consists of maximizing (2) subject to (1), (3) and (4). As in Calvo and Végh, output will be always demand-determined so that the consumer is not subject to quantity constraints, and the analysis will be restricted to equilibrium paths where (3) holds with equality to assure the existence of positive financial assets. Steady state equilibrium and the first order conditions for a maximum, imply the following relationships:

$$g_m/g_e = (\delta + \pi)/[\delta-(r^*+\epsilon-\pi)] \qquad (5)$$

$$g_b/g_e = [\delta-(i-\pi)]/[\delta-(r^*+\epsilon-\pi)] \qquad (6)$$

where r is the domestic real interest rate defined by $i - \pi$. (5) and (6) state that the ratio of marginal products of assets producing liquidity services must equal the ratio of their corresponding opportunity costs. With δ and r^* constant and exogenously given; (5), (6), and (3) (holding with equality) implicitly define the demand for money, the demand for bonds, and the demand for foreign assets.

The sign for the arguments of the explicit form depends upon the relative sizes of the partial differentials of the liquidity constraint. Assets functions consistent with the empirical finding discussed in previous sections requires the following conditions: $g_e^2 g_{mm} g_{bb} > g^2_{mb}$; $g_e g_{mb} - g_b g_{em} > g_m g_{be} - (g_b/g_e) g_{ee} g_m$; and

$g_e g_{mb} - g_m g_{eb} > g_b g_{me} - (g_m/g_e) g_{ee} g_b$; which are assumed to be met. Then the demand functions representing equilibrium in assets markets are:

$$M/P = L(r,\pi,x,c), \quad L_r>o,\ L_\pi<o,\ L_x<o,\ L_c>o \tag{7}$$

$$B/P = b(r,\pi,x,c), \quad b_r>o,\ b_\pi<o,\ b_x<o,\ b_c>o \tag{8}$$

$$f.E/P = e(r,\pi,x,c), \quad e_r<o,\ e_\pi>o,\ e_x>o,\ e_c>o \tag{9}$$

where the real stock of foreign assets is redefined as f.(E/P) to distinguish the physical stock of foreign assets from the real exchange rate, now defined E/P=e; and where $x \equiv \epsilon - \pi$ denotes appreciation of the real exchange rate.

The control problem set in equations (1) to (4) is not the only theoretical formulation that can give the assets functions (7) to (8). The same set of relationships could be derived including an additional pure indexed bond ("pure" meaning that the bond yields no liquidity services) paying a constant real interest rate. In this case the constant real rate of the indexed bond subtitutes the constant subjective discount rate (δ) in equations (5) and (6).

The government will be assumed "honest", as in Auernheimer (1974), and will not permit price jumps. If a change of policy occurs the government will accommodate all once and for all portfolio shifts of private agents modifying its physical holdings of foreign assets. This means that the government (Secretary of Commerce) enforces a path for prices (and inflation) and the Central Bank keep a crawling peg or an indexation scheme to maintain a constant real exchange rate, by setting $\epsilon=\pi$ at all times.

Although foreign assets can be held by domestic residents and by the government, a closed economy is assumed. There is no trade in goods, sevices, and foreign assets with the rest of the world; but the government and private agents can trade domestic assets against foreign assets, and viceversa, at all times.

The economy produces a fix amount of aggregate output, that jointly with real earnings of foreign assets held by private agents and government give a fixed amount of real income. For simplicity, consumption, that will always equals fixed real income, will be ignored form assets functions.

To get results that could be easily compared with previous studies of hyperinflations, the demand for money is redefined as follows:

$$\Phi(\pi).b(\pi,r,x) \equiv L(r,\pi,x,c), \quad \Phi_\pi<o \qquad (10).$$

Also it is assumed that $\pi.\Phi(\pi)$ is increasing in $\pi < \pi'$ and decreasing in π for $\pi > \pi'$. This implies that if the stock of bonds b(.) were a constant or independent of π and r (as in most of the literature on inflation tax), the graph of seigniorage revenue against the inflation rate would have the usual Laffer curve property.

Let T be revenue generated by net lump-sum taxes and by earnings of government's foreign assets, the budget constraint is:

$$b.i + \dot{f}e_o = T + \dot{m} + m.\pi + \dot{b} + b.\pi \qquad (11).$$

where $\dot{f}e_0$ is the change in government's foreign assets evaluated at the constant real exchange rate e_0; and $\dot{m}$, $\dot{b}$ the change in real money and bonds respectively. Equation (11) states that the current interest deficit and changes in government's foreign assets are financed by current revenues, by printing money, or by printing bonds.

At each moment of time the government sets a fiscal policy modifying lump-sum taxes or subsidies such that the following relationship holds

$$T = s + \dot{f}e_0 \qquad (12)$$

where s represent a constant primary surplus (that is, a surplus definition that excludes from government spending interest accruals). Fiscal policy represented by (12) means that neither the primary surplus nor the financial policy to be described below will be affected by flow changes in government's foreign assets. Notice that in the steady state $\dot{f}=0$, and the second term in the right hand side of (12) vanishes. Out of the steady state the fiscal policy sterilizes the transitory impact on the budget of gradual changes in the stock of foreign assets.

Using $i = r + \pi$, (11), (12), and the differentiation of (8) and (10), the budget constraint can be written,

$$b.r - s = (b.\Phi_\pi + (1+\Phi)b_\pi)\dot{\pi} + (1+\Phi)b_r\dot{r} + \Phi.b.\pi \qquad (13).$$

The term "b.r" is sometimes denominated the quasi-fiscal deficit when most of the debt has the form of remunerated reserve requirements. In Argentina - for the period under analysis - most of the domestic debt was Central Bank debt with different type of obligations, the most important of which were remunerated reserve requirements. Other domestic government debt existed, and some of it was adjusted for different type of indexes. For simplicity we assume that all debt is remunerated with competitive, market determined, nominal interest rates.

Given the budget constraint (13), financial policy is undetermined. The reason is that to finance the deficit the government can print money, can print bonds, or can print both. It has been frequently claimed that a driving force to hyperinflation was the expected monetary emission by part of the Central Bank to pay for the quasi-fiscal deficit. We will not make a priori judgment of this statement, but we will introduce a financial policy that will allow us to analyze that type of conjecture.

We will incorporate a financial policy - similar to one previously introduced by Blanchard and Fischer - stating that a fraction of real interest accruals is financed by the seigniorage of the Central Bank. The part that is not paid by seigniorage would be paid either with the primary surplus or borrowing. Using α to split the financing of the deficit we will represent this sort of assumption with the following two relationships to split the right hand side of (13):

$$\alpha.b.r = (b.\Phi_{\pi} + \Phi.b_{\pi} + b_{\pi})\dot{\pi} + \Phi.b.\pi \qquad (14),$$

$$(1-\alpha).b.r - s = (1+\Phi)b_{r}\dot{r} \qquad (15).$$

Equation (14), in a steady state equilibrium (or with $d\pi/dt=o$), will be understood as the fraction of quasi-fiscal deficit financed with inflation, while (15), in steady state, is the fraction financed with primary surplus (s). Notice that the right hand side of (14), out of steady state, is not strictly seigniorage neither the right hand side of (15) is strictly borrowing. The terms in (13) have been grouped, not based on the demand for money and the demand for bonds, but under a policy assumption of netting the effects of inflation and real interest on the government budget constraint.

Define $\beta \equiv -b/[b\Phi_\pi + (1+\Phi)b_\pi]$ and $\Gamma \equiv 1/[(1+\Phi)b_r]$, and the reduced form of the system is

$$\dot{\pi} = \beta.[\Phi\pi - \alpha.r] \qquad (16),$$

$$\dot{r} = \Gamma.((1-\alpha).b.r - s) \qquad (17).$$

Equations (16) and (17) give a solution path for π and r. With P given at t=0, equations (7), (8), (9) must solve the rest of the system as follows. The "honest" government assumption implies that immediately with the announcement of a new policy at t=0 the government step in the assets market and trade money and bonds against foreign assets to avoid a once and for all changes in E. As the economy moves along the trajectory for π and r determined by (16) and (17), equations (7), (8) and (9) set the path for nominal money, nominal bonds and the real stock of foreign assets in private hands.

6.Clock-wise and Counter-clock-wise Inflation Cycles

Straightforward computations in the system given by (16) and (17) show that the system is either unstable or has unique solution with a saddle point equilibrium. Divergent equilibrium paths can be ruled out with arguments similar to those of Obstfeld and Rogoff (1983, 1986). A saddle point requires that the isocline for $\dot{r} = 0$ cuts from below the isocline $\dot{\pi}=0$.

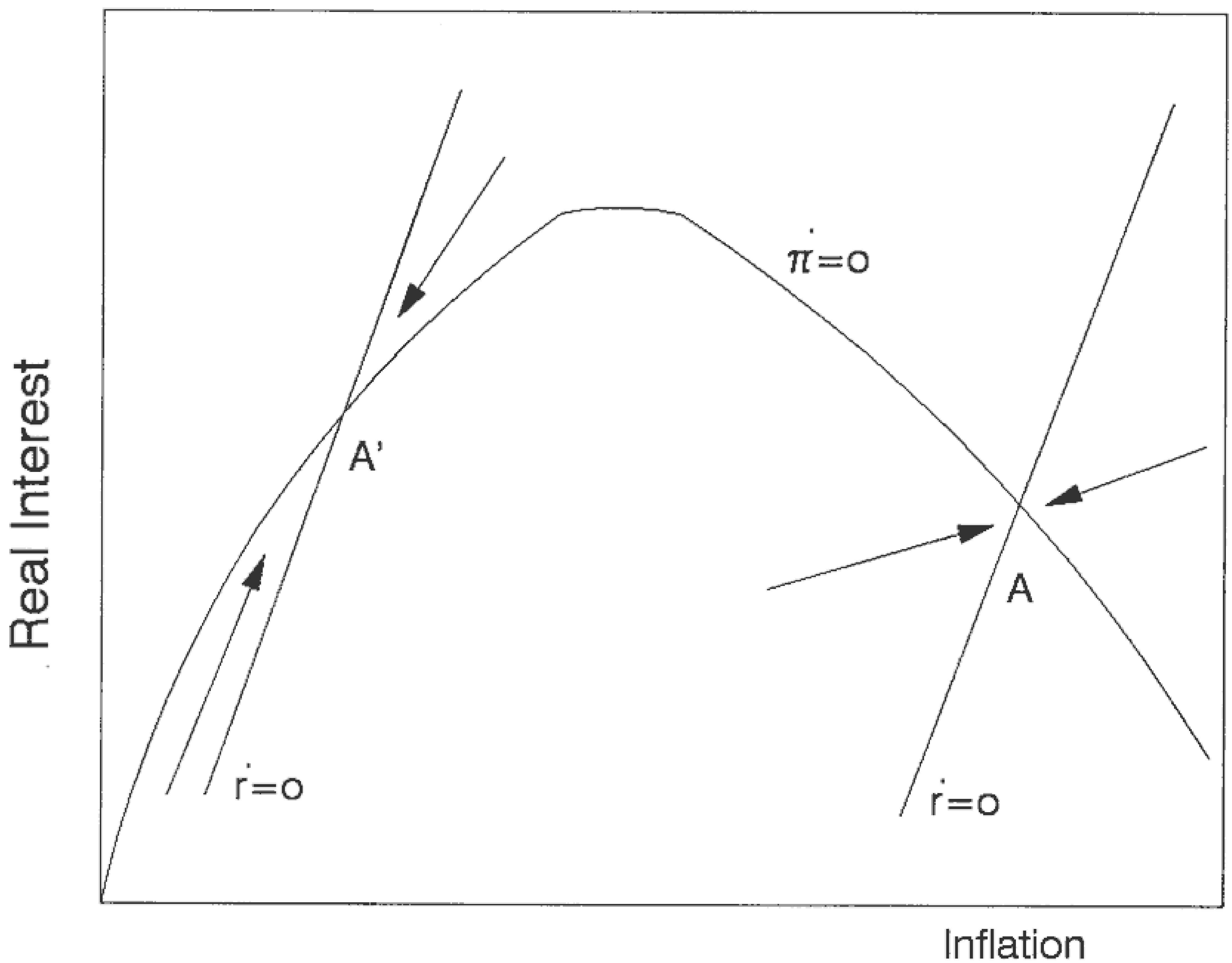
Saddle points are illustrated with points like A or A', which in turn show that unique equilibrium is possible on any side of the Laffer curve, as defined by the isocline $\dot{\pi}$=o. This result contrasts with previous rational expectations literature where the right hand side of the Laffer curve is usually associated with multiple solutions.

As point A' implies a higher primary surplus than A, it is perfectly possible to stabilze an economy standing on the right hand side of the Laffer curve. In this economy, an "inflation trap" (Bruno and Fischer (1987)) is not possible. Hyperinflation can be produced by policies that moves the economy along a Laffer curve and not as result of an unstable path. Consequently, the old remedy to cure inflation (increasing primary surplus or reducing the deficit) works independently of the side of the Laffer curve. This result contrast with most of the standard analysis on the inflation tax.

Figure 9 will be used to replicate the Austral Plan counter-clockwise cycle, first illustrated in Figure 1. Consider a stabilization plan that, starting from point A, increases the primary surplus. This implies an upward shift of the isocline $\dot{r}=0$ intersecting the $\dot{\pi}=0$ isocline at C. As real interest rate is free to jump, it will jump up to reach the saddle path in point B. From B to C we observe a path of decreasing inflation and real interest rates. At C the real interest reaches a level higher than at A showing a negative relationship with inflation.

FIGURE 8.

Real Interest and Inflation.



It is precisely the negative relationship between inflation and real interest across equilibrium states, shown in Figure 9, which suggests that high inflation countries might be operating on the right hand side of the Laffer curve.

In moving from A to C debt holders demand more real debt as it depends negatively on inflation and positively on real interest. Notice also that a higher surplus allows the government to finance a larger stock of real debt at a higher interest rate, therefore, from point A to C we also observe a growth in real government indebtedness and real debt services.

Suppose that after a period of fiscal restraint the government gives up, the primary surplus is reduced and the economy returns to A. This implies a downward jump in real interest to point D, after which real interest increases and inflation accelerates.

The counter-clockwise cycle illustrates not only the dynamics of real interest and inflation but also the phenomenon of "monetization." At the beginning of a stabilization plan the traditional financial programing exercise assumes an increase in real M1 that is not obvious to occur if nominal interest rate increases. Here, stabilization implies an upward jump in real interest, and irrespective of what happens with the nominal interest rate (which initially also increases) a real monetization will be observed.

FIGURE 9.
Austral Plan: Counter-clockwise Loop.

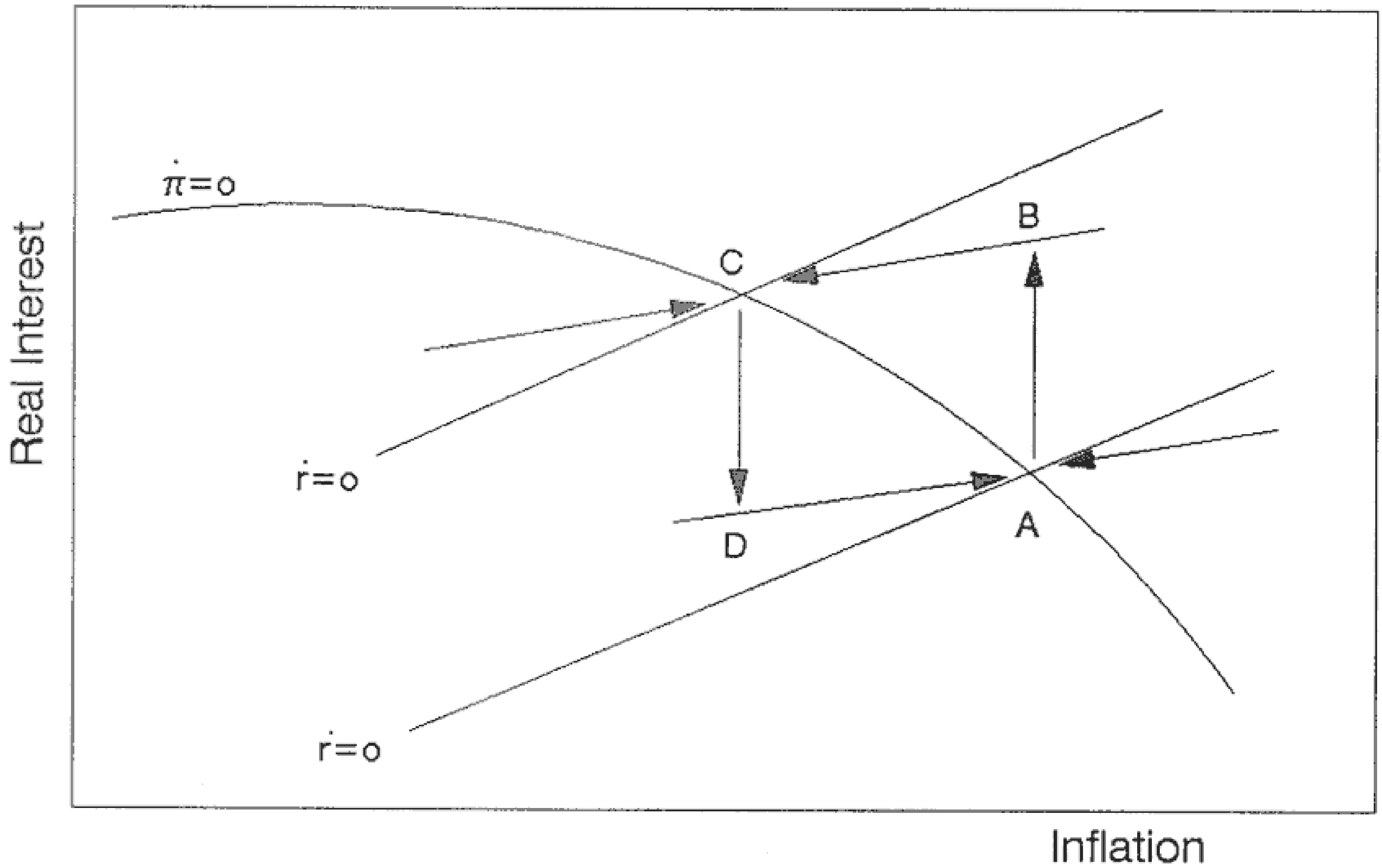
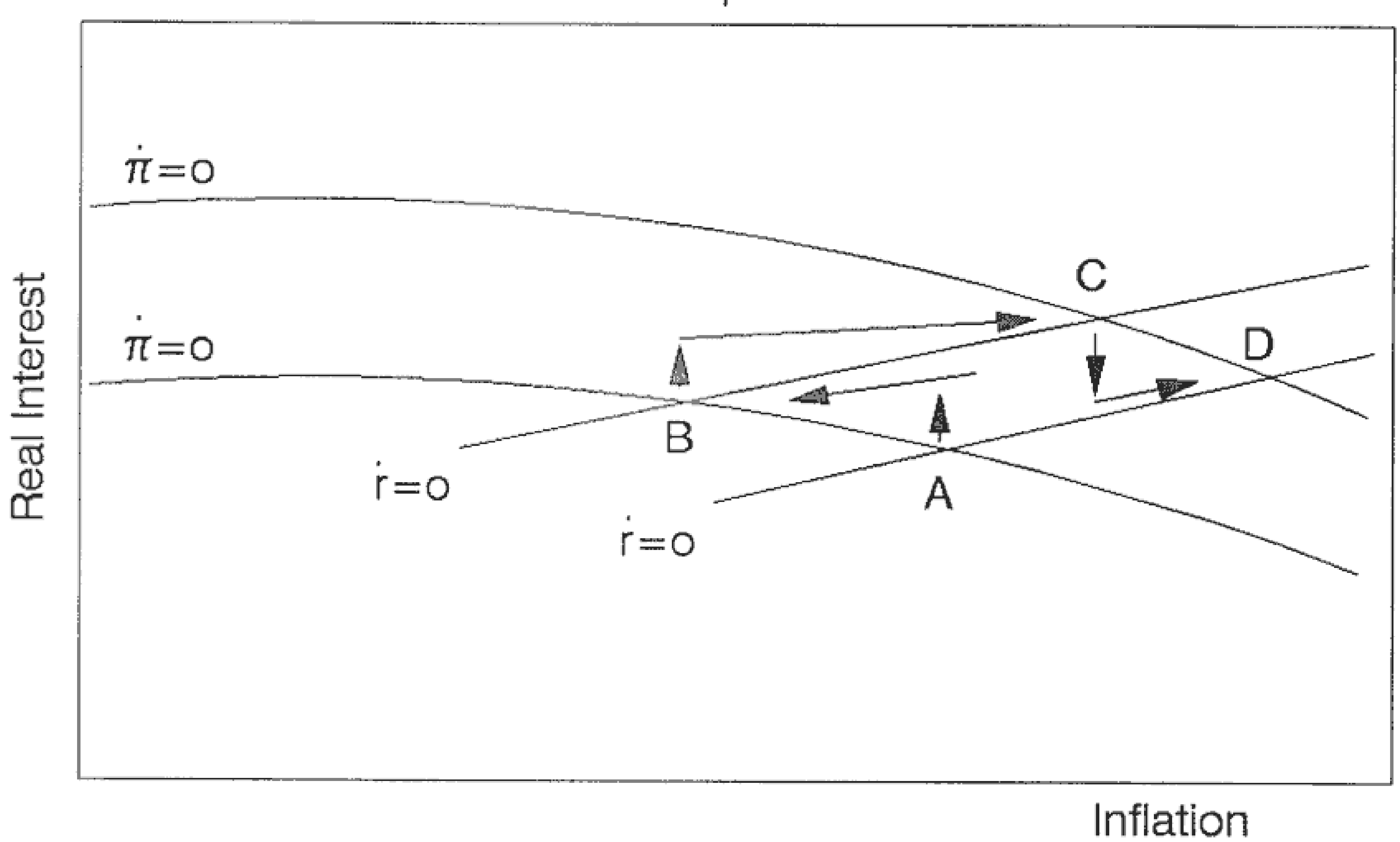


FIGURE 10.
Australito and Primavera:
Clock-wise Loop.



Similarly, the failure of stabilization is immediately observed with de-monetization. From C to D, a fall in real interest rate, for a given π, implies a lower demand for money and deposits (or government bonds). From C to A real interest decreased and inflation accelerated, the demand for real M1 unambiguously decreased, irrespective if the nominal interest rate rose or fell. Figure 10 illustrates the clock-wise cycle of the Australito and Primavera Plans. Starting from a point like A an increase in primary surplus drives the economy to a new equilibrium B following the same dynamics illustrated with the Austral Plan.

Suppose now that B is an equilibrium point where inflation is considered to be too high and the government decide to do something about it. Assume that the government decides to increase further the primary surplus and to reduce the share α, perhaps under the political pressure that inflation is still too high because too much money is being printed. A decrease in α shifts upward the isocline for $\dot{\pi}=0$.

A decrease in α also shifts the isocline $\dot{r}=0$ in an opposite direction to the increase in s. For simplicity assume that α is decreased and s is increased in such a way that the isocline for $\dot{r}=0$ does not change; that is, assume $ds = -[s/(1-\alpha)]d\alpha$. This implies that the new equilibrium state will be at C. From B to C we observe that real interest and inflation increased, similar to the case illustrated with the Primavera plan in Figure 3.

Now suppose that the government gives up, and s is reduced at the original level and the $\dot{r}=0$ isocline shifts rightward. A new stationary equilibrium is reached at D with higher inflation and a lower interest rate completing a clock-wise loop of the sort illustrated by the Australito and Primavera Plans.

Other conclusions emerge as one try to answer other general questions related to monetary theory. One question is the "unpleasant monetarist arithmetic" of Sargent and Wallace (1981) that, as originally formulated, is true only if the economy is on the left side of the Laffer curve. In the way formulated in this paper is true on both sides.

Sargent and Wallace ask the question of what would happen if the government decides to decrease the share of the deficit financed by money creation. By itself this would tend to decrease inflation. But if the government is expected to shift to full money creation later, lower money creation means faster transitory accumulation of debt and higher monetary creation in the future. Anticipations of higher money creation in the future imply higher inflation today.

The same argument also can be stated as follows. With a positive constant real interest rate, a higher debt means higher interest payments in the steady state. If the economy is on the left side of the Laffer curve an increase in the stock of debt implies a higher inflation tax in the steady state. However, if the economy is on the right side of the Laffer curve, a higher debt will require a lower inflation. And the Sargent and Wallace proposition would not hold.

When the assumption of a constant interest rate for different levels of government debt is replaced by the assumptions of this paper, higher inflation is obtained on both sides of the Laffer curve. This can be verified with Figure 8. A decrease in α implies an upward shift in the $\dot{\pi}=0$ isocline and a rightward shift in the $\dot{r}=0$ isocline. In both cases we obtain a solution with higher inflation. Recall that in the steady state α represent the proportion of the deficit that is financed by "money creation", and a decrease in α is equivalent to increase the paticipation of bonds in deficit financing.

Another implication of the model is with respect to the maximum steady state revenue from inflation. By straightforward computation of a maximum for a steady state equilibriums it can be shown that in this model the maximum need not coincide with Cagan maximum. As discussed in other papers in the literature (Calvo and Fernández (1983), Brock (1989)), the maximization problem involves and additional parameter. In this model the government can be imagined as choosing π and α (and indirectly r) to maximize revenue.

7. Conclusions.

Most of the literature discussing episodes of high inflation is based upon the hypothesis of a constant real interest.

Supporting this hypothesis is the fact that real interest series present small variations relatively to other series of nominal variables, and its movement could be ignored.

The Argentine evidence shows that variations in monthly real interest from -4% to 4% monthly are small relative to variations in monthly inflation from 0% to 200%. Yet, a high inflation country with a government debt paying a real interest of 4% monthly - equivalent to a yearly real interest of 60% - cannot ignore the impact of real interest on government finance.

Allowing for the impact of real interest on financial assets opens a new perspective to the traditional analysis of inflationary finance and macroeconomic dynamics. To isolate this perspective we have developed a model that assumed the existence of a main financial asset in the form of a government bond. This turns to be a useful hypothesis for countries like Argentina where remunerated high reserve requirements were an important source of government finance.

Under the assumption that currency and deposits (foreign and domestic) are complementary inputs yielding liquidity, it is possible to specify the demand for money depending negatively on expected inflation and positively on real interest. This in turn presents a policy dilemma for the government whose action can affect inflation and real interest.

High inflation countries face a serious policy dilemma in financing the government budget. Printing money might imply increasing inflation and borrowing might imply higher real interest. However, after a deficit is generated the only available alternatives are either to print money or to print bonds. This paper deal with this policy dilemma splitting the financing of the government in terms that are associated with change in inflation and terms that are associated with changes in real interest. Then the policy dilemma can be analyzed changing the fraction of the budget that is financed with changes in inflation or changes in real interest.

The model serves to explain several episodes of the recent stabilization efforts in Argentina whose failure lead to hyperinflation in an economy characterized by endemic high inflation. In particular the model reproduces the negative association of inflation with real interest and the dynamic loops across steady states produced by stabilization plans.

With respect to inflationary finance across steady states the following conclusions emerge. A decrease in the fraction of the deficit that is financed with money creation implies higher inflation. This result is obtained irrespective if the economy is in the right side or the left side of the Laffer curve. This result provides - for high inflation environments - a generalization of previous results in the literature discussing "unpleasant monetarist arithmetic." See for example Manuelli and Sargent (1987), where the unpleasant arithmetic holds only in the left side of the Laffer curve.

Given that unique solutions are possible on both sides of the Laffer curve, there is not such thing as a "high inflation trap"

(Bruno and Fischer (1987)); and the old remedy to cure inflation by reducing deficits or increasing primary surplus will always work independently of how high is the prevailing rate of inflation.

Finally, another implication of the model is with respect to the maximum steady state revenue from inflation. As the maximization problem involves and additional parameter, the government can be imagined as choosing inflation and real interest to maximize revenue. This results in the possibility of a different maximum revenue from the usual Cagan maximum. This has the important implication that estimates of the usual Cagan demand function might overestimates the maximum revenue achievable.

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