WP/89/2

INTERNATIONAL MONETARY FUND

Research Department

Is Inflation Effective for Liquidating Short-Term Nominal Debt?

Prepared by Guillermo A. Calvo 1/

January 3, 1989

Abstract

The possibility of reducing the real value of domestic non-indexed government debt through inflation is studied. A central result is that this kind of debt liquidation is possible even though prices are sticky and government bonds are short term. A policy implication is that short bond maturities are no safeguard against surprise devaluations intended to lower the burden of the debt. If devaluation incentives are present, it is further argued that nominal non-indexed bonds could give rise to situations where devaluations are a consequence of self-fulfilling expectations cycles.

JEL Classification Numbers:
311, 313, 321, 431

1/ I am thankful to Joshua Aizenman, Pablo Guidotti, Lars Svensson, Eduardo Borensztein and Carlos Végh for very perceptive comments on earlier versions of the paper.

Table of Contents

Summary

The paper studies the possibility of using inflation to reduce the real value of domestic non-indexed government debt. The analysis focuses on debt with short-term maturity, since previous work has suggested that, under those circumstances, inflation will be an effective debt-liquidation device only in the unlikely case that the price level jumps overnight. The paper shows that the conventional wisdom is wrong. This point is made by examining a small open economy under perfect capital mobility. The analysis shows, for example, that a devaluation not expected to be followed by further devaluation can reduce the real value of the debt through both inflation and lower nominal interest rates (because no future devaluation is expected). In other words, inflation effectively reduces the real value of debt because it leads to lower real interest rates. What distinguishes this result from results in the previous literature is that the paper arrives at the result without appealing to Mundell-Tobin or to irrational-expectations assumptions.

Short-maturity nominal debt may not necessarily remove the temptation to devalue in order to lessen the debt-service tax burden. Thus, to the extent that the private sector is aware of the temptation to provoke a surprise devaluation, the temptation will be taken into account by a rise in nominal interest rates. This will increase the fiscal deficit and may actually be a primary force behind a currency devaluation. Therefore, the existence of nominal debt obligations may give rise to a devaluation-inflation cycle fueled by expectations.

The conclusion of the paper is that shortening the maturity of government debt will not necessarily extricate the economy from this self-fulfilling expectations cycle.

I. Introduction

The accumulation of the public debt has recently become one of the focal points in macroeconomic policy discussions. Part of the reason is that after the breakdown of the Bretton Woods system and the ensuing energy crises, industrialized countries have moved to higher deficit plateaus and bigger public debt. Another is that recent anti-inflationary programs in countries like Argentina, Bolivia and Brazil have been associated with relatively high (ex post) real interest rates--at least during the first stages of the process--which, again, contributed to debt accumulation.

In a closed economy where wealth distribution problems are not relevant--like it would be the case in an economy of identical individuals or families à la Ramsey--there is no short-run advantage in having a positive stock of government debt obligations; for, positive debt means that the government will have to raise taxes from the representative individual in order to pay him back in the form of interest on his public debt holdings. Thus, if taxes are distorting, a one-time total debt repudiation is optimal. In practice, of course, wealth distribution aspects are important, and there are political, administrative and even reputation costs that may render the total repudiation solution somewhat unattractive. However, the above pure example helps to understand why policymakers may find it attractive to engage in some kind of partial repudiation.

Having decided to repudiate part of the outstanding debt, a government has yet to solve the problem of "how." Keynes (1971) was apparently sympathetic to the idea of liquidating the debt through a sudden burst of inflation. He evidently felt that repudiation through inflation would be more acceptable than open repudiation or special wealth taxes--a theme that he was going to stress later on in his General Theory in connection with wage stickiness. 1/ Be it as it may, however, Keynes' solution has recently been questioned by several authors (e.g., Blanchard, Dornbusch and Buiter (1985), and Spaventa (1987)), according to whom its relevance has been undermined by the sizeable maturity shortening of the public debt. In the limit, with instantaneous-maturity bonds like NOW accounts, they would argue that anything short of an unanticipated price-level jump would be ineffective. According to this point of view, anticipated inflation would tend to be incorporated in the nominal interest rate, point for point, thus offsetting the effect of inflation on the real stock of government debt. The inflation ineffectiveness argument is completed by noting that in modern economies it is very hard to bring about unanticipated jumps in the price level. In the words of Blanchard, Dornbusch and Buiter (1985):

1/ Unfortunately, Keynes does not seem to have gone beyond the mere description of this money-illusion type phenomenon.

> "...inflation is no longer a way out for governments; this is because debt is now of much shorter maturity, making inflation-induced debt reduction much less effective." (page 5) 1/

More formally, let b, and d denote the stock of instant-maturity bonds and government operational deficit in terms of domestic goods; moreover, let i and π denote the instantaneous nominal interest and inflation rates (where the inflation rate refers to the proportional rate of increase of domestic prices in terms of domestic currency). Then b accumulates according to the following formula:

$$(1) \quad \dot{b} = ib + d - \pi b$$

The first two terms in the right-hand side of equation (1) correspond to the standard definition of the government deficit in real terms, while the sum of the three terms in the right-hand side is the inflation-adjusted deficit.

In a perfect-foresight equilibrium the following Fisher Equation is assumed to hold:

$$(2) \quad i = r + \pi$$

where r is the real interest rate on output-type assets which appreciate in nominal terms at the rate π (e.g., domestic capital goods). Thus, combining (1) and (2), we get

$$(3) \quad \dot{b} = rb + d$$

From this it clearly follows that changes in the rate of inflation would have no effect on debt accumulation, unless inflation has an impact on the real interest rate. 2/ Thus, in other words, in a classical world where the real interest rate is independent of monetary policy, the above equations imply that a change in the rate of inflation will have no impact on the stock of debt. The only way b could be changed would be through a sudden rise in the price level. But, once again, if the latter is not a

---

1/ This point of view has received further support from Spaventa (1987). He says, for example, that for inflation to be effective, a necessary condition "is that a large share of the outstanding debt consists of fixed-coupon long-term bonds, so that real interest payments can fall roughly in proportion with the real value of the stock of debt" (page 385).

2/ Blanchard, Dornbusch, and Buiter (1983) claim that inflation is negatively related to the real rate of interest, r, and that this is an important channel through which inflation could influence the stock of government debt obligations.

feasible alternative, liquidating the debt through inflation would not be a viable policy.

The central objective of the present paper is to show that in a world of international capital mobility, inflation may be an effective instrument to reduce the real value of government debt, particularly for countries that are relatively small in international financial markets. We show this to be the case, even though the relevant interest rate in Fisher Equation (2), i.e., r, is completely independent of the domestic rate of inflation, 1/ all debt is of instantaneous maturity, and prices are sticky. The main (straightforward) argument is developed in Section II. Section III discusses the possibility that inflationary expectations may actually lead the monetary authority to higher inflation in order to partially liquidate the expectations-induced growing debt. Finally, Section IV closes the paper with a summary and further discussion.

II. International Capital Mobility

Consider an economy open to international capital mobility. Letting ρ denote the exogenous and (for simplicity) constant international interest rate, we have the following familiar interest rate parity condition:

$$(4) \quad i = \rho + \varepsilon$$

where ε is the expected rate of devaluation. In other words, equation (4) says that in equilibrium the domestic instantaneous nominal interest rate equals the international one plus the expected rate of devaluation. It differs from (2) because here we are saying that, in equilibrium the opportunity cost of bond investors is the rate of return on foreign-currency denominated bonds, and not domestic capital as in the earlier example. 2/

Equation (4) is our way of characterizing international capital mobility. The exogeneity of ρ with respect to domestic policy is not strictly necessary for the ensuing argument, but it is a convenient assumption because it isolates our results from the ones explored by other authors.

As a benchmark let us consider the case in which international inflation, output and population growth rates, and the expected rates of devaluation and inflation are all equal to zero. Thus, without loss of generality, we can assume output to be unity, a convenient device to get

---

1/ The argument is, thus, independent of the existence and/or relevance of Mundell-Tobin effects.

2/ This does not rule out that bond holders invest in domestic capital. With perfect capital mobility, however, the opportunity cost of funds at the margin is given by the rate of return on foreign bonds.

stocks and flows automatically in terms of output (or GDP) per unit of time. Furthermore, under the present circumstances, the debt accumulation equation is given by equation (3). Thus, for a constant d (i.e., the operational deficit as a share of GDP), we can solve equation (3) to get:

$$(5) \quad b_t = (b_0 + d/\rho)e^{\rho t} - d/\rho$$

Let us now change the above scenario to study the implications of a one-time devaluation at time 0, followed by the expectation of no further devaluation. 1/ First we note that if the devaluation provoked a once-and-for-all increase in the price level, then, of course, debt liquidation would be possible. Furthermore, if gross devaluation (=1 + rate of devaluation) is denoted by D, the initial value of b falls to b_0/D and equation (5) becomes

$$(5') \quad b_t = (b_0/D + d/\rho)e^{\rho t} - d/\rho$$

Consider, instead, the situation where, initially, the price level does not change, but the rate of inflation rises to a constant level π (a simple way to model price stickiness). Therefore, by (4), debt evolves according to

$$(6) \quad \dot{b} = \rho b + d - \pi b$$

Notice that the rate of interest does not change because devaluation has already occurred, and it is not expected to happen in the future. However, inflation is now larger because the price level starts slowly catching up with the higher nominal exchange rate. Comparing (3) and (6), we notice that equation (6) exhibits an element of debt repudiation, namely, πb.

Solving equation (6), and denoting the solution by B, we have

$$(7) \quad B_t = [b_0 + d/(\rho-\pi)]e^{(\rho-\pi)t} - d/(\rho-\pi)$$

To exhibit the debt-repudiation power of inflation, two special cases will be examined. In the first one, the operational deficit is zero. Clearly, then, by (5') and (7), we have

$$(8) \quad B_t/b_t = D\, e^{-\pi t}$$

1/ For the analysis of this section it is irrelevant whether the devaluation has, or has not been anticipated. It is, however, important that no further devaluation is expected. The latter should be thought as an approximation to the more realistic case in which a devaluation momentarily restores trust on the currency's value.

which implies that the relative debt-repudiation power of inflation with respect to a once-and-for-all jump in the price level, at time t, depends on the real exchange rate at time t in comparison with its before-devaluation level. A recent study by Edwards (1988) suggests that an x percent devaluation brings about an 0.6 (times)x percent price-level rise after one year, and about x percent rise after two years. Thus, equation (8) would imply that after one year the real value of bonds will fall, with sticky prices, by about 60 percent of what they would have fallen if prices were perfectly flexible, and that after two years the real value of bonds would be about the same irrespective of price flexibility.

The intuition behind this simple case is straightforward. A devaluation which is not followed by the expectations that the currency will be further devalued has no effect on domestic nominal interest rates. Thus, to the extent that devaluation gives rise to inflation, the real value of bonds will fall. When the operational deficit is equal to zero, i.e., d = 0, then, by (5'), bonds grow at rate ρ with flexible prices, and at rate $(\rho-\pi)$ when prices are sticky; hence, the ratio of the latter to the former falls at rate π. This observation plus the fact that the above-mentioned bonds ratio at time zero is equal to the gross rate of devaluation, D, yields equation (8).

The second case we will examine is the one in which the price level keeps rising (at a constant proportional rate π) until the initial ratio of the exchange rate to the price level (i.e., the real exchange rate) is restored. Therefore, this is a situation where a devaluation brings about a real depreciation of the real exchange rate for a limited amount of time (this is, once again, in line with the empirical findings in Edwards (1988)). We will denote by T the time at which inflation stops, and study the relative debt-repudiation power of inflation at time T. 1/ By definition:

$$(9) \quad D = e^{\pi T}$$

Thus, according to this formulation a relatively small value of T implies quick price adjustment, while a relatively large T corresponds to very sluggish prices.

We will now compare the effect on the stock of bonds of sluggish and perfectly flexible prices. By (5') and (7), we have

$$(10) \quad b_T - B_T = d[(e^{\rho T}-1)/\rho - (e^{\rho T}/D-1)/(\rho-\pi)]$$

which, recalling equation (9), implies

1/ Thus, contrary to the previous case, we will focus on a particular point in time, T, but we are going to let the (constant) operational deficit, d, be any arbitrary number.

$$(11) \quad d \int_0^T [e^{\rho s} - e^{(\rho-\pi)s}]ds \geq 0 \quad \underline{\text{if and only if}} \quad d \geq 0$$

Consequently, we reach the interesting conclusion that at the time the real exchange rate has fully recovered from the effects of a devaluation (or maxi-devaluation), if (realistically) the operational deficit is positive, then the debt will be larger with flexible than with sluggish prices. Thus, not only have we been able to show that inflation could be effective to liquidate part of the debt when prices are slow to adjust, but we have also shown that if there exists a positive operational budget deficit, then the debt will fall even more with sluggish than with flexible prices. Furthermore, (11) implies that the larger is the operational deficit, the bigger will be the advantage of inflation over price-rise debt repudiation.

The intuition behind this case is also straightforward. By previous results, if the operational deficit is zero, i.e., d=0, then the stock of bonds at time T is the same irrespective of price flexibility. When d>0, on the other hand, the new debt which is incurred to pay for d grows at rate ρ when prices are flexible, and, recalling equation (7), at rate $\rho-\pi$ when prices are sticky. This explains (11) and related results.

III. Role of Expectations

This section will more closely examine the role of devaluation expectations. Suppose that, before time 0, the public anticipated that a devaluation ε (per unit of time) was in the offing. Then, by (1) and (4), with a fixed exchange rate we have

$$(12) \quad \dot{b} = (\rho+\varepsilon)b + d$$

Consequently, the larger is ε, the larger will be the growth of public debt under fixed exchange rates. In the interesting case in which devaluation expectations are only fueled by the public's realization that the government could be tempted to devalue in order to liquidate part of the debt, then after a successful devaluation has occurred (from the debt-repudiation point of view), it is quite plausible to assume that devaluation expectations may decline sharply. Consequently, a devaluation may have the double effect of helping to liquidate the debt and to reduce the nominal rate of interest (by lowering expected ε).

However, there may be effects going in the opposite direction. As noted in Calvo (1982), rational price setters are likely to start raising prices before a devaluation actually occurs. Therefore, equation (12) would become

$$(13) \quad \dot{b} = (\rho+\varepsilon-\pi^e)b + d$$

where π^e indicates the actual increase in prices that occurs in anticipation of a devaluation. Thus, π^e tends to offset the effect of ε. Conceivably, prices could have risen so much that an anticipated devaluation will not increase inflation. Thus, this extreme case has similar characteristics to the one discussed in the Introduction, because a devaluation would have no effect on real debt. 1/

Another factor that may detract from the success of a devaluation as a debt-liquidation device is the possibility that a devaluation brings about expectations that the currency will be further devalued in the near future (which raises ε after devaluation in equation (12)). This factor will probably be more relevant if the public perceives that the devaluation has failed to accomplish what the policymakers intended. 2/ Otherwise, experience seems to indicate that after a massive currency devaluation markets tend to calm down, and no further devaluation is expected in less than a year. 3/

Equation (12) illustrates very vividly the role of expectations. The mere fact that people expects a devaluation to occur increases the rate of accumulation of government debt, thus giving incentives to devalue in order to get rid of the debt (at least, partially), except possibly in the extreme case discussed at the end of previous paragraph. 4/ It is, therefore, conceivable that expectations play a crucial role in the determination of the final devaluation/inflation outcome. With flexible prices (implying $\pi^e=0$), a low ε, for example, determines a relatively low rate of debt accumulation, which may be self-validating because the monetary authorities may see no much virtue in liquidating the debt through inflation, given its costs. On the other hand, a high ε will give rise to a relatively high rate of debt accumulation, making the authorities more receptive about proposals to liquidate part of the debt

---

1/ In the staggered-prices model studied in Calvo (1982), however, prices never rise by the full amount of the devaluation before the latter takes place.

2/ In my opinion, some clear and interesting examples of "incomplete" devaluations can be found in Argentina's recent history. These are: Martínez de Hoz devaluation of February 1981, and the one carried out by Sigaut in March 1981 (see Calvo (1986), de Pablo and Martínez (1988)).

3/ In a study of several "crisis" episodes in several OECD countries, it is shown that "in no case did a new crisis erupt within the first year or so of the measures having been taken" OECD (1988, page 17).

4/ If a devaluation was expected and it does not take place, unemployment is likely to increase. Furthermore, once it sinks in that a devaluation will not happen, prices will begin to fall, increasing the real value of debt. Once again, all of these effects are likely to give rise to further devaluation incentives.

through inflation. Thus, in the end expectations of a high devaluation rate may turn out to be self-fulfilling. 1/

It is important to note that the inflation/devaluation bomb could be largely defused if all debt was indexed to the price level. This type of indexation, incidentally, should not be confused with floating rate nominal debt, since the latter is formally equivalent to the debt instruments that we have been discussing (and which, as shown above, could be partially liquidated through inflation). Price indexation removes by definition all incentives to inflate in order to get rid of the debt (unless, of course, the government plays tricks with the price index). 2/ From this point of view, thus, debt indexation to the price level may provide an additional, and maybe even powerful, medicine to fighting the credibility gap. It goes without saying, however, that inflation is just one many debt-liquidation instruments. Hence, removing its tentacles does not ensure that the government will not resort to other, perhaps more socially painful, types of debt repudiation. 3/

IV. Conclusions

The main message coming out of this paper is that inflation may be an effective instrument to get rid of an unduly high level of outstanding public debt. This was shown to be the case even when the monetary authorities are unable to provoke unexpected inflation, and bonds are of instant maturity. This remarkable result is, however, the immediate consequence of capital mobility. When there is a high degree of international capital mobility, the domestic nominal interest rate is highly sensitive to devaluation expectations. Thus, for example, a once-and-for-all devaluation will give rise to inflation but will not necessarily lead to an increase in the nominal interest rate. This decoupling of interest rates and inflation restores the debt-liquidation power of the latter.

Interestingly, the reduced forms of the present model and the one discussed by Blanchard, Dornbusch and Buiter (1985) are very similar. The latter assume that debt liquidation will operate through a lowering of the real interest rate. In the model discussed here, on the other hand, the relevant real interest rate for Fisher Equation (i.e., the international interest rate) is exogenous and, thus, is not affected by domestic inflation. However, the real interest rate in terms of domestic

---

1/ In Calvo (1988a and 1988b) examples are given where multiple expectations-led equilibria occur even though expectations are constrained to be fully warranting, however, that if prices rise ahead of the expected devaluation, then the monetary authority may still have incentives to inflate in order to get rid of unemployment!

2/

3/ Calvo (1988a) shows that open, non-inflationary, debt repudiation can also be fraught with multiple expectations-led equilibriums.

goods, i.e., ρ-π, (which is the one discussed by the above authors) falls (that is how the above-mentioned decoupling works). This paper has shown, however, that in order for the domestic real interest rate to react to changes in the rate of inflation, it is not necessary to assume that the interest rate in Fisher's Equation, ρ, responds to changes in domestic monetary policy.

Nevertheless, our analysis has also shown that the effect of a devaluation on the stock of debt could become smaller if the devaluation was anticipated by the public. This, however, should not be confused with the statement--stressed by previous authors, and not true in the present context--that the debt-repudiation mechanism would be impaired if inflation was anticipated by the public.

The bad news of the paper is that short maturities, although a possible reaction to inflationary expectations and imperfect policy credibility (see Spaventa (1987)), are not a sure way to discourage inflation as a debt repudiation device. Therefore, the existence of a relatively large stock of nominal public debt may very well give rise to the suspicion that the government might try to use inflation to reduce the social cost of servicing the debt. Consequently, the public is likely to try to cover itself against partial repudiation by requiring an interest rate larger than under full credibility. But, as we have argued in the text, the higher expectations-led interest rate may actually play a key role in provoking the inflationary explosion. In my opinion, this conundrum is likely to acquire greater significance for countries that are trying to stabilize their monetary economies, and who are coming from high inflation. The combination of expectations inertia with this rational distrust on government policies associated with large debt may prove deadly: good programs may collapse under the weight of high-inflation expectations.

An easy solution to multiple expectations-led equilibria is to index debt instruments to the price level. But for that to really work, all the other mechanisms of debt repudiation must also be disabled. Otherwise, debt indexation, like the removal of a safety valve, may generate even more serious cracks in the system.

References

Blanchard, Olivier, Rudiger, Dornbusch and Willem Buiter, Public Debt and Fiscal Responsibility, Center for European Policy Studies, Paper No. 22, (1985).

Calvo, Guillermo A., "Staggered Contracts and Exchange Rate Policy," in Jacob A. Frenkel, ed., Exchange Rates and International Macro-Economics (Chicago, IL: University of Chicago Press for the National Bureau of Economic Research, 1982).

———, "Fractured Liberalism: Argentina under Martínez de Hoz," Economic Development and Cultural Change, Vol. 34 (April, 1986): pp. 245-62.

———, "Servicing the Public Debt: The Role of Expectations," American Economic Review, Vol. 78, No. 4, September, 1988a pp. 647-61.

———, "Controlling Inflation: The Problem of Non-Indexed Debt," in Debt, Adjustment and Recovery: Latin America's Prospect for Growth and Development, Sebastian Edwards and Felipe Larrain, eds.(New York: Basil Blackwell), forthcoming, 1988b.

de Pablo, Juan C., and Alfonso Martínez, "Macroeconomic Policies, Crisis and Growth in the Long Run: Argentina Country Study," manuscript (March, 1988).

Edwards, Sebastian, "Real and Monetary Determinants of Real Exchange Rate Behavior: Theory and Evidence from Developing Countries," Journal of Development Economics, forthcoming, 1988.

Keynes, John M., A Tract on Monetary Reform, in Vol. IV of The Collected Writings of John Maynard Keynes (London: Macmillan, 1971).

Spaventa, Luigi, "The Growth of Public Debt: Sustainability, Fiscal Rules, and Monetary Rules" (Washington: International Monetary Fund), Staff Papers, Vol. 34, No. 2, (June, 1987), pp. 374-99.