Fiscal Deficits, Exchange Rate Crisis and Inflation

Sweder Van Wijnbergen

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FISCAL DEFICITS, EXCHANGE RATE CRINES AND INFLATION

by

Sweder van Wijnbergen

World Bank,

and CEPR

Helpful discussions with Willem Buiter, Elhanan Helpman, Homi Kharas, Torsten Persson and Assaf Razin are gratefully acknowledged. This paper does not necessarily reflect the views of the institutions I am affiliated with. A mathematical appendix with some of the derivations presented in this paper is available on request.
Abstract

This paper extends earlier work on unsustainable monetary policies by endogenizing the regime switch that ultimately restores sustainability. Within this framework we analyze exchange rate based stabilization programs and show how constraints on CB borrowing during an exchange crisis influence timing and nature of the post-collapse equilibrium. Such constraints introduce non-neutralities; more restrictive pre-collapse credit policies increase the post-collapse inflation rate. External shocks can destroy consistency between fiscal programs and inflation targets, causing reserve losses, exchange rate changes and higher inflation. BoP crises are the mechanism through which fiscal imbalances translate into higher inflation rather than an alternative explanation of it.
1. **INTRODUCTION**

This paper deals with inflation, fiscal deficits and exchange rate policy in high inflation countries. The experience in the past decade has presented a series of puzzles. For example, countries attempting to stabilize inflation through an exchange rate freeze often saw inflation accelerate after the collapse of the experiment to levels well above those observed before the program was implemented. Another puzzle concerns the relation between inflation and Balance of Payments crises. In many countries, a BoP crisis forcing a change in exchange rate policy often led to a persistent increase in inflation (Liviatan and Piterman (1984)). This has led to doubts about the relevance of fiscal deficits in explaining inflationary episodes, leading many to see BoP crises as an independent explanation of inflation. But this apparent relation is a puzzle; a BoP crisis cum devaluation can at most explain a jump in the price level, but not a sustained increase in inflation.

In this paper we demonstrate that these puzzles can be explained, fully drawing on the public finance approach to inflation initiated by Phelps (1973). Thus the fiscal versus BoP controversy is not a real one; our analysis shows that BoP crises and exchange rate shifts are part of the mechanisms through which fiscal imbalances translate in higher inflation, rather than alternative explanations.

To make these points, we present a simple open economy model to analyse the transition to a fixed exchange rate regime, discuss sustainability, and demonstrate what happens when policy measures are inconsistent and the fixed regime unsustainable. We also demonstrate how the constraints under which the Central Bank has to operate the exchange
rate regime influence the timing of the attack, the post-collapse inflation rate and the effects of pre-collapse fiscal policy on the post-collapse equilibrium.

The analysis builds on the work of Sargent and Wallace (1982) and Liviatan (1984) on unsustainable monetary policies (cf. Buiter (1988, 1989) and Drazen and Helpman (1987) for open economy variants). Contrary to this literature, we link the timing of the regime switch to sustainable policies to rational speculative behavior rather than assuming it exogenous. The introduction of rational speculators forcing a regime switch draws on the literature on speculative attacks on Central Bank reserves initiated by Krugman (1979). That literature typically pays no attention to the intertemporal budget constraint of the government, a constraint that plays a crucial role in our analysis.

The rest of the paper is organized as follows. In Section 2, the model and its mechanics under floating and fixed exchange rates are presented. Section 3 analyzes attempts to use the exchange rate to bring down inflation and the effects of a failure to back up such attempts with a matching fiscal contraction. The focus is mainly on the conditions for collapse, the post-collapse inflation rate and the importance of the borrowing constraints on the Central Bank. Section 4 uses the same framework to demonstrate how external shocks (in particular an increase in world interest rates) can destroy consistency between fiscal programs, exchange rate policy and inflation targets. We show how the resulting fiscal inconsistency will lead to reserve losses and forced devaluation and subsequent permanent increases in inflation. This suggests that the strong link between BoP crises and exchange rate regime shifts and subsequent accelerations in inflation cannot be construed as arguments
against the fiscal approach to inflation; rather, these phenomena should be seen as the mechanism through which fiscal imbalances translate into higher inflation.

2. **THE MODEL**

Assume one good with world price normalized to 1. The domestic price hence equals e, the nominal exchange rate. Output y is exogenous. To avoid corner solutions in intertemporal trade when interest rates and rate of time preference are different, we use the Blanchard (1979) framework of uncertain life times. Thus, at each moment, a cohort of size p is born; p also equals the probability of death. Individuals hold domestic money m=M/e and foreign bonds b, with a real rate of return r. Consumers maximize the discounted value of utility derived from consumption c and from money holdings m:

\[
\int e^{-(\rho+p)t} \log(u(c,m)) dt
\]

The intertemporal budget constraint is equivalent to the flow budget constraint (2a) coupled with a terminal constraint on wealth (2b):

\[
(2a) \quad w = rb + pw + y - r - wm - c
\]
\[
= (r+p)w + y - r - c - im
\]

\[
(2b) \quad \lim_{t \to \infty} e^{-(r+p)t} w(t) = 0.
\]
The first order conditions of this maximization problem imply:

\[(3a) \quad c + im = (\rho + p)(w + \frac{y-r}{r+p})\]

\[(3b) \quad \frac{u_m(m)}{u_c(c)} = i\]

(3a,b) give consumption \(c_t\) and demand for money \(m_t^d\) as a function of wealth and rates of return on bonds, \(r\), and on money, \(-\pi_t\). Using (3a,b) and money market equilibrium \(m_d^t = m\), one can express \(c\) and \(\pi\) as functions of asset stocks and the real interest rate \(r\):

\[(4) \quad c_t = \tilde{c}(m,V;r); \quad \pi_t = \tilde{\pi}(m,V;r)\]

Finally, one needs the evolution of the asset stocks over time. Aggregating the flow budget constraints over all individuals alive and substituting equation (3a) in it to link \(c+im\) to total wealth yields aggregate private savings (see Blanchard (1979)):

\[(5) \quad \dot{V} = (r-\rho) \frac{y-r}{r+p} + (r-\rho-p)V\]

The public sector consists of a government proper and a Central Bank. The government issues foreign debt \(d\) at a cost \(r\). The Central Bank operates the exchange rate system, incurs no administrative costs and transfers its profits to the government. Its profits equal \(rR\) with \(R\) the level of reserves measured in foreign currency terms. Thus the public sector's flow budget constraint is:
(6) \[ g + r(d-R) - r = \dot{d} - R + \dot{m} + \pi m \]

\( g (r) \) is real government expenditure (tax revenue).

\( d^* \) is the maximum level of public sector debt that can be supported in steady state. \( d^* \) is finite since \( g \) cannot fall below zero and there are limits to the tax revenue that can be raised through both \( r \) and through use of the inflation tax. No rational lender will lend to the public sector beyond \( d^* \):

(7) \[ d(t)-R(t) \leq d^* \text{ for all } t. \]

**Dynamics of the Model: Floating Exchange Rates**

Since aggregate financial savings \( V \) is independent of inflation and real money stocks under the utility structure chosen (cf equ.5), intertemporal equilibrium \( V=0 \) is a vertical locus in \( m-V \) space (fig.1). Higher financial wealth \( V \) reduces financial savings \( V \) unambiguously, so \( V \) is falling to the right of \( VV \) and rising to the left of it \( (V_V<0; \text{ see the appendix for formal expressions}) \).

**FIG.1 HERE**

The second dynamic equation follows from money market equilibrium \( m_d=m \) and the government budget constraint (6). Using (5) and the fact that under floating exchange rates the Central Bank's reserve level \( R \) is fixed,
one can obtain:

\( m = g - r + r(d - R) - \pi(m, V; r)m - d \)  

A higher money stock accelerates the increase in real balances if money demand is inelastic with respect to inflation:

\( \dot{m} = -m\pi(1 - \epsilon^m) < 0 \) if \( \epsilon^m < 1 \).

An increase in \( m \) for given \( V \) requires a fall in inflation \( \pi \) to trigger a matching increase in money demand and so maintain monetary equilibrium; this reduces revenue from inflation tax if at least \( \epsilon^m < 1 \). Therefore an increase in real balances is necessary for the government to still meet its flow budget constraint. Thus \( m \) is rising above MM (the locus on which \( m = 0 \)) and falling below MM.

MM itself slopes upward for the inelastic part of the money demand function. An increase in \( V \) for given \( m \) will cause excess money demand and thus requires an increase in \( \pi \) to restore money market equilibrium. This raises inflation tax revenue \( \pi m \) for given \( m \) and thus reduces public reliance on seignorage (\( m \) falls). To restore dynamic equilibrium (i.e. raise \( m \) back to zero) an increase in \( m \) is necessary according to (9). Hence MM slopes upward. See fig.1 and the annex.

Steady state equilibrium obtains if the real value of both \( m \) and \( V \) is constant; this happens at the intersection of \( VV \) and MM, at \( \bar{m} \) and \( \bar{V} \).

Out of steady state equilibrium the dynamics are governed by (7) and
(8). The only \((m, V)\) combinations that will eventually lead to the steady state are those along the eigen vector associated with the single negative root of the dynamic system (7) and (8); this "saddle path" is represented by the dotted line in fig.1\(^1\). \((m, V)\) combinations off the saddle path will lead to violation of either the private or the public sector's budget constraint and are hence ruled out.

**Mechanics of the Model: Fixed Exchange Rates**

Abstracting from sustainability issues until the next section, the model needs only minor adjustment to describe developments under a fixed exchange rate regime. First, we use "fixed" as shorthand for the more accurate description "predetermined"; thus the analysis presented here also applies to regimes where a path for \(e\) is preannounced along which \(e = 0\). Since consumers are price takers, (3a,b) and (5) still describe private behavior. But now (3b), for given value of \(c\), determines the equilibrium money stock \(m\), because under a fixed exchange rate regime the rate of inflation \(\pi\) is exogenous. Hence we can use (3a) to substitute out \(c\) and obtain a money demand equation, an equilibrium relation between \(m\) and \(V\) that has to hold for the value of \(\pi\) implied by the choice of exchange rate regime:

\[
\frac{u_m(m)}{u_c((\rho+p)(V+(y-r)/(r+p))-im)} = r+\pi
\]

\(^1\)Consumers will only stay on this saddle path if current policies are anticipated to remain unchanged. Section 3 analyzes the dynamics of the economy when changes in policies are expected.
(10) defines the MD locus in fig. 2. As long as the fixed exchange rate regime lasts, the economy has to be on that locus. The slope of that locus equals the marginal propensity to hold money out of wealth:

\[
\frac{(\rho+p)u_{cc}/u_c}{(r+\pi)(u_{cc}/u_c)+(u_{mm}/u_m)} > 0
\]

FIG. 2 here

Of course the location of the curve shifts if the preannounced rate of crawl \( \hat{\pi} \) and thus \( \pi \) changes, since this shifts the demand for money:

\[
\frac{\partial m}{\partial \pi} = \frac{-(r+\pi)m(u_{cc}/u_c)+1}{(r+\pi)(u_{mm}/u_m + (r+\pi)u_{cc}/u_c)} < 0
\]

Long run equilibrium obtains at the intersection of MD and VV. As to the location of that intersection, let us anticipate the experiment performed in Section 3, a transition from a high inflation floating regime to a low inflation (say zero) fixed regime. In that case (10) will not be satisfied at the old equilibrium values for \( m \) and \( V \) (\( m_A, V_A \) in fig. 2). At \( A, u_m(m_A)/u_c = r+\pi_A \), but during the freeze \( \pi < \pi_A \). Money demand increases in line with the fall in \( \pi \) and MD goes through B in fig. 2, above A.

Discrete changes can be effected through one-for-one swaps between b and m: the public can buy discrete quantities of foreign exchange from the Central Bank in order to buy interest bearing foreign assets, with the CB losing an equivalent amount of foreign reserves. Hence under fixed rates, jumps take place vertically maintaining V while m changes, and with R
going through a matching stock adjustment during the jump.

The government budget constraint will tell us whether the fixed exchange rate regime is feasible or not. But the way that constraint is presented in equ. (6) needs amendment under fixed exchange rates. Under a fixed exchange rate regime, changes in Central Bank foreign assets $R$ (fixed under a floating regime) may drive a wedge between changes in claims on the government held by the Central Bank, $C$, and changes in the stock of nominal money, $M$. The government budget constraint then becomes:

$$(13) \quad g - r + r(d - R) = \dot{d} + \frac{C}{e}$$

Changes in the nominal stock follow from private decisions on asset accumulation and on the allocation of total financial assets $V$ over money and bonds. The desired nominal increase in money hence equals:

$$(14) \quad \frac{M}{e} = \dot{m} + \pi m$$

with $m$ and $m$ determined from (5) and (10) and the policy choice of the rate of crawl $\hat{\pi} = \pi$. Reserve changes follow from changes in money demand and changes in domestic credit:

$$(15) \quad \dot{R} = \frac{(M - C)}{e}$$

With full integration of the government and the Central Bank, the only sustainability constraint on the fixed exchange rate regime states that the total interest bearing public sector debt should never exceed $d^*$:
(16) \( d(t) - R(t) \leq d^* \forall t \)

However, the assumption that foreign creditors consider net public debt \( d-R \) only, while defensible from a solvency point of view, ignores the incentive problems that exist in the case of sovereign debt. In practice, the amount of money devoted to debt service by debtor countries is only tenuously related to their level of foreign reserves, as Bulow and Rogoff (1988) argue forcefully. High levels of reserves increase a country's ability to conduct commodity trade through advance payments even if banks do not lend additional resources to provide trade credit. This undermines the one threat commercial lenders have against sovereign lenders, a cut-off from new money. On the other hand, low reserves makes a country's insistence on debt reduction more credible under the "you cannot squeeze blood from a stone" theory (Bulow and Rogoff (1988)). The net impact on creditworthiness and hence on creditors' willingness to lend is thus not clear. In practice there have been many cases where no line of credit was extended during a crisis although the net public debt was allowed to increase later on, suggesting a credit cut-off during the crisis although \( d-R < d^* \). Such an additional constraint implies that reserve losses cannot go on indefinitely, adding an additional sustainability constraint.

The existence of a separate floor on Central Bank reserves in addition to general solvency constraints on the public sector as a whole has a major impact on the dynamics of exchange rate crises and on the conditions that need to be satisfied to avoid them. It is thus of great practical interest to explore the implications of alternative constraints on Central Bank foreign exchange operations. The literature on exchange rate crises has only considered reserve floors, ignoring any link with the
government budget constraint 2/.

3 AN EXCHANGE RATE FREEZE, SPECULATIVE ATTACKS AND THE POST COLLAPSE INFLATION RATE

Consider now an exchange rate based attempt to reduce the rate of inflation in the following environment. A country has had a period of high, stable inflation, with roughly constant debt-output ratios. During that period, the nominal exchange rate adjusted in line with inflation differentials abroad and at home in what in effect was a floating rate regime (A in fig.2). Then a fixed exchange rate is put in place with the announced objective of bringing the domestic inflation rate down to world levels. Consider first the perhaps more realistic case where creditworthiness considerations cause foreign lenders to cut off the Central Bank before the public sector's solvency limit has been reached.

3.1 UNSUSTAINABLE EXCHANGE RATE POLICY UNDER A RESERVE CONSTRAINT.

Assume an exchange rate freeze is implemented at time 0. Such a switch to a fixed rate (or to a preannounced crawling peg at a rate below the rate of devaluation prevailing before the stabilization program) creates an MD locus through a point like B, above A in Fig. 2.

$R_A$ is the level of CB reserves available at the announcement of the stabilization program. After the start of the program, a vertical jump brings the economy from A to B (fig.2): a discrete inflow of CB reserves

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2An exception is Drazen and Helpman (1988) who go to the other extreme and only consider a solvency constraint for the public sector as a whole.
expands the money supply from $m_A$ to $m_B$. At B it is in line with the new, lower inflation rate $\pi_B$.

To see whether the freeze is sustainable, inspect the government constraint at B: is the implied rate of domestic credit creation compatible with the increase in nominal money demand at B? Assume first that the government does not issue interest bearing debt ($d=0$). The economy was in equilibrium at A before the freeze, therefore:

\[
(17) \quad g_A - \tau_A + r(d_A - R_A) = \pi_A m_A
\]

Also, between A and B, a reserve inflow of $\Delta R - m_B - m_A$ has taken place, so at B profit transfers by the CB into the government budget have increased by $r\Delta R$. On the other hand the private sector will absorb domestic credit at the rate $\pi_B m_B$: anything higher will cause unsustainable reserve losses. Using (17) and $r\Delta R - r(m_B - m_A)$, one gets:

\[
(18) \quad g_B - \tau_B + r(d_R_R) - \pi_B m_B = g_A - \tau_A + r(d_A - R_A - \Delta R) - \pi_B m_B
\]

\[
- i_A m_A - i_B m_B > 0
\]

Since $i_A m_A - i_B m_B > 0$

But the inequality at the end of (18) implies that the situation at B is not sustainable; from (18) and (15) it is clear that the initial reserve inflow will be followed by a period of reserve losses:

\[
(19) \quad R(t) = i_B m_B - i_A m_A < 0
\]
Krugman (1979) shows that such a situation leads to a speculative attack on the exchange rate regime exhausting the CB's foreign reserves, thus forcing a return to floating exchange rates.

The timing of the speculative attack can be derived from the fact that asset arbitrage will rule out anticipated discrete changes in e. We will not repeat this by now standard procedure; instead we highlight an important issue not covered in the speculative attack literature: a speculative attack will exhaust the CB's reserves and thus reduce its post-collapse profits from interest earnings on reserves to zero. As a consequence, its positive contribution to the government budget comes to an end after the collapse and the government's basic budget balance deteriorates not only with respect to B, but even with respect to the pre-stabilization situation at A. Thus at the post-collapse equilibrium C:

\[
(20) \quad g_C - r_C + r \left( d_C - R_C \right) = g_A - r_A + r d_A
\]

The first inequality obtains because a speculative attack exhausts the CB's foreign reserves, hence \( R_C = 0 \). Therefore the post-collapse equilibrium will be at C, below the pre-stabilization equilibrium A (cf fig.2), since the budget deficit has increased by \( r A \). But at C, inflation is:

\[
(22) \quad \pi_C = \pi(m_C, V_C) = \pi(m_C, V_A) \quad \text{since} \quad V_A = V_C
\]

\[
> \pi(m_A, V_A) > \pi_A \quad \text{since} \quad m_A > m_C, \quad \pi < 0.
\]
This is an important result: if the exchange rate freeze ends through a speculative attack, the post-collapse inflation rate will exceed the inflation rate that prevailed before the start of the stabilization program. The increase in inflation beyond $\pi_A$ will be such that the additional inflation tax revenue will be just enough to offset the fall in interest rate revenue $r_{RA}$. The extra decline in money demand, below $A$, and the extra reserve outflow necessary to realign money supply, equals:

\[
(23) \Delta = r_{RA} \left. \frac{\partial m}{\partial (rR)} \right|_{VM} - r_{RA} \left( \begin{array}{c}
\frac{m}{MM} \\
V - \bar{V}
\end{array} \right) \\
- r_{RA} \frac{\varepsilon^m}{\pi_A(1 - \varepsilon^m)} = \phi r_{RA}
\]

where $\phi$ is a positive constant defined for later use.

Consider also the case where the government, instead of keeping $d$ constant, instead manipulated $d$ so as to avoid reserve losses in the period immediately following the freeze. In that case

\[
(24) \dot{d} = i_{A}^{m_A} - i_{B}^{m_B} > 0
\]

for as long as the freeze lasts. This, in turn, will in the absence of a speculative attack, lead to a steady rate of increase of the public debt $d$, until net debt reaches the maximum level $d^*$. Then the policy will need to be discontinued and, if there still is no speculative attack, the economy is back in the situation analyzed in the preceding paragraphs.

There is however a difference. In the process, government external
debt has increased from $d_A$ to $d^*$. Hence the downward shift of MM from C to A is larger than in the case where $d=0$:

$$|A|_{d>0} = \phi r A + \phi r (d^* - d_A) > |A|_{d=0}$$

This is a form of debt non-neutrality: the composition of the government's debt in the period before the crisis influences both the timing of the crisis and the equilibrium that will obtain afterwards. This lack of neutrality is due to the separate constraint on Central Bank reserves.

(25) also implies that the post-collapse equilibrium with a tighter domestic credit policy before and hence a higher public debt afterwards, will be below C, at F. Inflation will therefore be even higher:

$$\pi_F = \pi(m_F, V_F) > \pi(m_F, V_C) > \pi_C > \pi_A$$

It is in fact possible that the attack will take place before $d^*$ will be reached (see van Wijnbergen (1988)). In that case the speculative attack will take place without any gradual loss of Central Bank reserves. The conditions on reserve losses necessary to avoid an attack derived in Krugman (1979) are therefore necessary but not sufficient. In addition conditions need to be satisfied on the growth rate of the government's interest rate bearing debt (cf also Buiter (1989) on this point). In fact
we will see that in the case of no separate reserve constraint on the Central Bank's foreign exchange operations, that those are the only conditions for sustainability of a fixed exchange rate regime.

3.2 UNSUSTAINABLE EXCHANGE RATE POLICY UNDER A SOLVENCY CONSTRAINT.

If only a public sector solvency constraint applies to the foreign exchange operations of the Central Bank, without a separate reserve constraint for the Central Bank, the distinction between different components of the public debt becomes irrelevant. A corollary is that the distinction drawn in the previous section between different debt management policies during the stabilization program becomes irrelevant too. Hence it does not matter any more whether domestic credit policy is geared to avoiding CB reserve losses, or whether credit policy is set to avoid any further government issue of interest bearing debt, with CB reserve losses as a consequence.

Assume that the government relies on Central Bank credit in such a way that reserve losses will be avoided. Thus $R$ is stationary at $R_B$, the pre-program reserve level plus the capital inflow at the time of the start of the program ($R_B = R_A + \Delta$). To achieve this, the nominal increases in domestic credit must match the nominal increase in money demand at the inflation target of the stabilization program. This implies a steady rate of growth in $d$, the government's interest bearing foreign debt (cf (25)).

Should we expect foreign lenders to simply continue lending ($d > 0$) until $d - R_B$ hits the solvency constraint $d^*$? Consider what would happen if they would. Note that when $d - R_B$ reaches $d^*$, net debt exceeds the
pre-program debt \( d_A - R_A \). Hence the post collapse inflation rate \( \pi_C \) will exceed the pre-program rate \( \pi_A \), and thus certainly the program rate \( \pi_B \), like in the previous section. Therefore the money stock after the collapse will be lower than it was just before: \( m_C < m_B \). This in turn implies a reserve outflow that will exceed the initial inflow because \( m_C < m_A \). But if before the outflow net debt \( d - R_B \) stood at \( d^* \), the outflow of reserves would bring net debt above that level:

\[
(28) \quad d_C = d_B + d^* + R_B - d_C - R_C = d^* + R_B + (m_B - m_C) > d^*
\]

since \( m_C < m_B \). Thus this lending strategy would bring the country beyond its solvency point. But this is predictable and thus incompatible with rational lender behavior. Instead, rational lenders would foresee the reserve outflow and stop lending at a level \( d \) that would bring the country's net debt at its solvency point AFTER the anticipated reserve outflow:

\[
(29) \quad d = d^* + R_C = d^* + R_B - (m_B - m_C) < d^* + R_B
\]

The lending cutoff would trigger a change in exchange rate regime and a reserve outflow equal to \( m_C - m_B \); after that the public sector's net total debt would remain at \( d^* \) and the money stock would be at its post-collapse equilibrium level. Inflation (and nominal exchange rate depreciation) would be just enough to close the government's financing gap:

\[
(30) \quad \pi_C m_C = g - r + rd^* > g - r + r(d_A - R_A - m_A) \quad \pi_A > \pi_A > \pi_B.
\]
Hence some results of the separate reserve constraint case carry over; the most important one is that in this case too inflation after a failed exchange rate based stabilization program will be higher than the rate that obtained before the program was put in place. What does not carry over is the relevance of debt management during the stabilization effort. In the case of a separate reserve constraint, restrictive credit policies during the stabilization program do nothing to enhance the survivability of the program, and actually worsen the post-collapse equilibrium inflation rate. With a solvency constraint as the only constraint on public sector operations, debt management decisions during the stabilization program have no impact on its duration nor on the characteristics of the post-collapse equilibrium.

4 EXTERNAL SHOCKS, INFLATION AND FISCAL DEFICITS.

1982 saw the beginning of a period of BoP crises, exchange rate collapses and accelerating inflation in much of Latin America. That experience, and similar developments in Israel, has led some to believe in a "BoP" theory of inflation, with fiscal matters playing a minor role. However, 1982 also saw sharp increases in world interest rates, as nominal rates stayed high but inflation fell under the impact of tight monetary policy in the USA and the UK. But with most LDC debt tied to short term interest rates in world capital markets (typically LIBOR), such an increase in world interest rates has an immediate impact on fiscal balance and hence sustainability of earlier inflation targets.

Consider, in the context of the model of Section 2, an economy at a fixed exchange rate and with a consistent fiscal policy. The domestic
equilibrium is thus sustainable at say A in Fig.3. Then world interest rates rise: \( dr > 0 \). An increase in \( r \) lowers money demand for given inflation, and thus inflation tax revenue; at the same time \( dr > 0 \) raises government expenditure for debt service. As a consequence, public sector finances become unbalanced. Without fiscal adjustment, intertemporal equilibrium now requires more revenue from the inflation tax. Thus the MM curve shifts down. At the same time, foreign borrowing becomes less attractive because of the higher interest rate: the VW-curve shifts to the right. With a sufficiently high level of initial foreign debt, the downward shift in MM dominates and the new equilibrium, C involves higher inflation and lower real balances (cf the Annex for proof).

FIG. 3 HERE

Lower money demand will immediately trigger a reserve outflow. This may or may not bring the country on the saddle path towards the new equilibrium. If the Central Bank operates under separate borrowing constraints, a large enough shock in \( r \) will shift the saddle path down more than \( R_A \), the level of reserves in A. Thus the limit to \( R \) would be reached at say A' (Fig.3), short of the saddle path. At that time the exchange rate regime will collapse and a discrete devaluation will reduce the real money stock until the economy reaches B on the new saddle path. The move from A to A' to B takes place instantaneously; thus there are no exploitable profits associated with the discrete devaluation from A' to B.

From B onwards, the economy will move up towards the new long run equilibrium at C with higher inflation and higher (real value of) foreign assets \( V \), or lower real value of foreign debt. Along the transition path
from B to C, real money balances are rising but at a slightly lower pace than real foreign assets (minus the real value of foreign debt). In the Annex it is shown that, as long as $\pi > p$, wealth effects increase money demand more than a rising inflation rate reduces it while the economy moves from B to C along the saddle path.

Thus the increase in world interest rates triggers an immediate reserve outflow and a discrete collapse in the exchange rate, followed by private foreign asset accumulation and accelerating inflation. This continues until a steady state is reached at C with inflation stable, but at a higher level than before the increase in world interest rates. One would thus observe a BoP crisis and an exchange rate collapse immediately followed by accelerating inflation, with inflation eventually settling down at a higher rate than before the crisis. Sequences like this have led many to associate BoP crises and shifts in exchange rate policy with accelerating inflation. The analysis of this section shows, however, that rather than arguments against the fiscal approach to inflation, such events are part of the mechanism through which fiscal imbalances translate in higher inflation.

5 CONCLUSIONS.

This paper demonstrates the power of the public finance approach to inflation by using it to explain a series of puzzles that the inflationary experience of the eighties has presented to the profession. To do so we built on the seminal work by Sargent and Wallace on unsustainable monetary policies, extending it by endogenizing the regime switch that ultimately restores sustainability. This was done through linking this approach to
the speculative attack literature pioneered by Krugman.

We analyse exchange rate based stabilization programs and derive conditions that need to be satisfied for such a stabilization program to be sustainable from the government budget constraint. A domestic credit policy designed to prevent reserve losses during the stabilization program is shown to be insufficient to prevent speculative attacks in fixed exchange rate regimes, contrary to the analysis presented in the early speculative attack literature. Furthermore we show that if a collapse occurs, the post-collapse inflation rate is higher than the inflation rate that prevailed prior to the stabilization experiment, which accords well with actual experience. The explanation is related to the loss of interest earnings on the foreign assets of the Central Bank that are lost during the speculative attack, and the ensuing decline in profit transfers from the Central Bank into the government budget.

The analysis also highlights the importance of the particular set of constraints on the Central Bank during an exchange rate crisis. If only aggregate public sector solvency constraints apply, both the timing of the attack and the post-collapse equilibrium will be different from what they are if, in addition, non-negativity constraints apply to CB reserves during an exchange rate crisis. Such an additional constraint on CB reserves can bring forward a speculative attack and will influence the post-collapse inflation rate.

In addition, such an additional constraint introduces a non-neutrality into the system. With a reserve constraint, the public sector's debt management policies during the stabilization attempt will now influence both the timing of the attack and the post-attack equilibrium inflation rate. In particular, more restrictive credit
policies during the program will in fact increase the post-collapse inflation rate. This ultimately inflationary effect of tight credit policies under an unsustainable fixed exchange rate regime is related to the Sargent-Wallace result of high inflation in response to temporary tight money policies in a closed economy context.

We then use the same framework to demonstrate how external shocks (like an increase in world interest rates) can destroy consistency between fiscal programs and exchange rate based inflation targets. The resulting fiscal inconsistency will lead to reserve losses, discrete exchange rate changes and subsequent permanent increases in the inflation rate. This analysis suggests that the link between BoP crises and shifts in exchange rate policy and subsequent accelerations in inflation cannot be construed as arguments against the fiscal approach to inflation; rather, these phenomena should be seen as the mechanism through which fiscal imbalances translate into higher inflation.

REFERENCES:


APPENDIX

I Derivation of $\pi(m,V;r)$ and $C(m,V;r)$.

Total Differentiation of equ. (3a,b) in the main text yields:

$$\frac{d}{dr} \left[ (r+\pi)A - 1 \right] + \frac{d}{dm} \left[ \frac{d}{dr} \left( \frac{U_{mm}}{U_c} \right) \right] =$$

$$1 + m \left[ -\frac{\rho p}{(r+p)^2} (y-r) \right] \frac{d}{dr} \left( (r+\pi) \frac{d}{dr}(\rho p) + \frac{d}{dr} \left( \frac{U_{mm}}{U_c} \right) \right)$$

with $A = -\frac{U_{cc}}{U_c}$, the coefficient of relative risk aversion. Define the determinant of the left hand side matrix as $\Delta$:

$$\Delta = (r+\pi)A + 1 > 0$$

Hence

A.2a $\tilde{\pi}_m = -\Delta^{-1} (r+\pi) \left( (Am+1) + \frac{\rho p}{(r+p)^2} (y-r) \right) > 0$

A.2b $\tilde{\pi}_V = \Delta^{-1} (r+\pi) A (\rho p) > 0$

A.2c $\tilde{\pi}_r = -\Delta^{-1} (r+\pi) \left( Am+1 + \frac{\rho p}{(r+p)^2} (y-r) \right) > 0$

A.2d $\tilde{C}_m = -\Delta^{-1} (r+\pi) \left( 1 + m \frac{U_{mm}}{U_c} \right) > 0$

A.2e $\tilde{C}_V = \Delta^{-1} (\rho p) > 0$
A.2f $\frac{\zeta_r}{r} = -\Delta^{-1} \frac{\rho + p}{(r+p)^2} (y-r) < 0$

where we repeatedly used $U_c^{-1} = (r+p)U_m^{-1}$. Two terms involving $\Delta^{-1}m$ cancel in $C_r$.

II Derivation of $\dot{m}(m,W;r)$ and $\dot{V}(m,V;r)$.

Differentiation of (7) and (8) in the main text yields:

A.3a $\dot{V}_m = 0$

A.3b $\dot{V}_V = (r-\rho-p) < 0$

A.3c $\dot{V}_r = \frac{(V_+ (y-r_1) - (r-\rho)(y-r)}{(r+p)(r+p)(r+p)}$

\[ = \frac{y-r}{r+p} \frac{p(r+p)+(r-\rho)^2}{(r+p)(r-\rho-p)} > 0 \]

In deriving the second from the first expression for $\dot{V}_r$, we use that in steady state the following holds:

\[ (r-\rho) \frac{y-r}{r+p} + (r-\rho-p) V = 0 \]

Thus the expression holds exactly when evaluated at $V=\dot{V}$, but only approximately away from $\dot{V}$. 
A.3d \( \frac{\dot{m}}{m_m} = -(\pi + m \bar{\pi}_m) = -m \bar{\pi}_m (1 - \varepsilon^m) > 0 \quad \varepsilon^m > 1 \)

A.3e \( m_V = m \bar{\pi}_V < 0 \)

A.3f \( \frac{\dot{m}}{m} = d - m \bar{\pi} > 0 \)

III The Slope of the Saddle Path around E.

The characteristic equation of the matrix of partial derivatives of \( m \) and \( V \) (equ. (11) and (12)) with respect to \( m \) and \( V \) is:

A.4 \( (\lambda + m \bar{\pi}_m (1 - \varepsilon^m))(\lambda - (r - \rho - p)) = 0. \)

Therefore the eigenvalues are:

A.5 \( \lambda^- = r - \rho - p < 0, \lambda^+ = -m \bar{\pi}_m (1 - \varepsilon^m) > 0. \)

Around E (cf Fig. 1 in the main text), \( \varepsilon^m < 1 \), therefore the system has one positive and one negative root. It is thus saddle point stable.

Straightforward calculation shows that the eigenvector corresponding to \( \lambda^- \) is:

A.6 \( (m, V) = \left( \frac{Z}{Z + Z_1}, 1 \right) \)

with \( Z = m(r + \pi)A(\rho + p) > 0 \), \( Z_1 = -m \bar{\pi}_m (1 - \varepsilon^m) - r(1 - \varepsilon^m) \pi / \varepsilon^m - r. \)
Clearly, the slope of the saddle path equals $Z/(Z+Z_1)$, so that the slope is smaller than one of $Z_1>0$. This is the case if:

\[ A.7 \quad (1-\epsilon_m^m)/\epsilon_{m}^{m}\pi > 0 \Rightarrow \epsilon_1^m < 0 \text{ or, equivalently, } \epsilon_1^m < \frac{\pi}{\pi+\pi}. \]

This is a slightly stronger condition than $\epsilon_1^m < 0$, which we will assume to hold.

\[ \text{IV} \quad \text{Inflation on the Saddle Path} \]

Define the slope of the saddle path as $\psi = Z/(Z+Z_1)$. Inflation on the saddle path then equals

\[ A.8 \quad d\pi_{SP} = \frac{\pi_m}{m} d\pi_{SP} + \frac{\pi_v}{V} d\pi_{SP} = (\frac{\pi_m}{m} \psi + \frac{\pi_v}{V}) d\pi \]

Thus for inflation to be rising on the saddle path with increasing $m$ and $V$ (cf Section 4), one needs:

\[ A.9 \quad \frac{d\pi_{SP}}{dV} = (\frac{\pi_m}{m} \psi + \frac{\pi_v}{V})  > 0 \]

Note that with $\epsilon_1^m < 1$, $0 < \psi < 1$; thus $-\frac{\pi_v}{\pi_m} > 1$ is sufficient for A.9 to hold strictly. Inspection of A.2a-b shows that this holds if $\pi > p$, a reasonable assumption to make for high-inflation countries.
Figure 1: Dynamics of the Model Under Floating Exchange Rates

Figure 2: The Fixed Exchange Rate Regime
Figure 3: Impact of Higher World Interest Rates