FINANCIAL CRISES AND BALANCE OF PAYMENTS CRISES

A Simple Model of the Southern Cone Experience

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This paper starts from a simple model of the domestic banking sector and develops the potentially destabilizing macroeconomic consequences of its role in intermediating foreign capital inflows. Both financial and balance of payments crises may result, reminiscent of the Southern Cone experience.

1. Introduction

In recent years several developing countries have experienced serious difficulties in their domestic financial systems. In the words of Diaz-Alejandro (1985):

> ... 'financial reforms carried out in several Latin American countries during the 1970s, aimed at ending 'financial repression' ... yielded by 1983 domestic financial sectors characterized by widespread bankruptcies, massive government interventions or nationalizations of private financial institutions, and low domestic savings. The clearest example of this paradox is Chile, which has shown the world yet another road to a *de facto* socialized banking system. Argentina and Uruguay show similar trends, which can be detected less neatly in other developing countries, including Turkey'.

At roughly the same time, these countries also experienced serious external imbalances and were eventually compelled to end what had been widely watched stabilization programs based on the monetary approach to the balance of payments. This paper explores the possible connections between these two sets of events.

It is usually taken for granted that macroeconomic disequilibria can affect the health of the financial system. The reverse question of how bank problems

can affect the stability of the macroeconomy is much less commonly asked.[1]
Here I present a simple model of the interaction of the banking system and
the balance of payments in the context of a small open economy. The model
is highly specialized, hoping to capture some of the stylized facts of the
Southern Cone situation, and particularly that of Chile.

The analysis has as its starting point a recently emphasized feature of
banks [Diamond and Dybvig (1983), Bernanke and Gertler (1986), Khan
(1986)]: the asymmetry in the liquidity and riskiness of bank assets and
liabilities, and the peculiar form taken by bank contracts. A bank cus-
tomarily guarantees the nominal value of the deposits it accepts (and
sometimes also a fixed interest yield) while devoting the proceeds to
investments with a variable return. At the same time, bank deposits are
highly liquid, while bank investments are typically long-term and can only be
liquidated at a cost. This means that banks can easily be caught in a
liquidity sqeeze, being forced to resort to additional borrowing or to capital
and reserves to meet their obligations. This feature of banking practice has
led some analysts [Bernanke and Gertler (1986)] to stress the role of bank
capital in permitting the provision of incentive-compatible deposit contracts.
Others [Diamond and Dybvig (1983)] have focused on the usefulness of
deposit insurance in stabilizing bank operations.

The assumption made in this paper is that all bank deposits are implicitly
or explicitly guaranteed (insured) by the government. This is an often-
mentioned feature of the Southern Cone experience [Diaz-Alejandro (1985),
Arellano (1983)]. Deposit insurance steadies the demand for bank deposits
and eliminates the specter of bank runs, but also introduces potential moral
hazard problems. To the extent that deposits are perceived as guaranteed by
the state, depositors will neglect their supervisory role of banks' portfolios.
From the point of view of the investor one bank is as good as the next, and
there is nothing to be gained from obtaining information about the riskiness
of a bank's assets. This adds several degrees of freedom to banks' portfolio
management practices. Bank managers face a distorted risk-return menu, and
to the extent that their activities are not supervised by the insuring
government agency they may be tempted to choose excessively risky projects.
In the event of an exogenous fall in bank income, bankers also enjoy some
freedom: they can choose to borrow to make up for the shortfall rather than
dipping into capital and reserves.

Such practices were present in the Southern Cone countries following the
period of financial liberalization. In Chile, lax lending standards and limited
Central Bank supervision (coupled with implicit insurance) are reported to
have increased the overall riskiness of bank portfolios. After a lengthy period
of real exchange rate overvaluation and high real interest rates, many firms

[1]An important exception is Bernanke (1983).

found their financial costs increasingly burdensome, and began falling behind
in their payments to their creditors. At roughly the same time an adverse
terms-of-trade shock hit the economy, making matters worse. Reluctant to
write off risky or plainly bad loans, banks tended to capitalize earned interest
rather than demand payment in cash [Arellano (1983), Harberger (1985)].
On the liability side, bank operating losses seem to have covered by
borrowing, often from abroad. The economy-wide upshot of such practices
was that a large and mounting financial deficit (to be defined more explicitly
below) became sustainable over a lengthy period of time. Of course, the
system was vulnerable to any number of exogenous perturbations, such as a
drying up of capital inflows.

Why would agents continue to participate in such an unstable process?
Domestic depositors should have been indifferent to the extent they felt they
were under the protective umbrella of the state. Ex post, it turned out that
foreign lenders also had good reason to believe that their money was insured
– in the Chilean case the government would end up guaranteeing all private
external debt [Harberger (1985), Diaz-Alejandro (1985)]. As far as local firms
were concerned, under several plausible assumptions it was also rational for
them to continue operating as long as cash inflows covered wage and other
variable costs plus that portion of financial expenses not capitalized by banks.
One particularly interesting notion [Diaz-Alejandro (1985)] is that in a high-
indebtedness situation even a small firm starts to behave strategically: if it
alone defaults on its loans and/or declares bankruptcy, it will be penalized; if
many firms do it at once, then the costs to each are likely to be much
smaller. It then becomes rational to borrow and wait, in the hope that
mounting debts will force larger numbers of firms into default. Furthermore,
the larger the problem the more likely it is that the government will turn up
on the scene, offering assistance in order to ward off a wave of bank and firm
bankruptcies.

The microeconomic and game-theoretic foundations of such behavior
await detailed modelling [an exception is Hellwig (1977)]. The focus of this
paper is much narrower: the potentially destabilizing macroeconomic effects
of such a process of financial intermediation. Once again, this possibility was
raised by Diaz-Alejandro (1985):

> 'The combination of pre-announced or fixed nominal exchange rate,
> relatively free capital movements, and domestic and external financial
> systems characterized by the moral hazard and other imperfections
> discussed above set the stage not only for significant microeconomic
> misallocation of credit, but also for macroeconomic instability, including
> the explosive growth of external debt, most of which was incurred by
> private Chilean banks, followed by abrupt cessation of capital inflows.
> That macroeconomic instability would occur even assuming tranquil
> circumstances, but it is of course exacerbated by external shocks hitting

economies made particularly brittle and vulnerable by that combination of policies and institutions.'

How do financial and macro variables interact in such a situation? A key observation is that if private agents perceive that mounting private debts will eventually become a liability of the government, then the presence of a large financial deficit may play a central role in undermining the viability of a stabilization program, particularly one that is predicated on the maintenance of a fixed exchange rate regime. In the Chilean case agents who acted according to the logic of state guarantee turned out to be correct. Interventions of troubled financial intermediaries began to take place in late 1981 and credit at subsidized rates was generously extended to troubled firms and banks. The cautious fiscal and monetary stance had to be adandoned (at least temporarily) and the end of the exchange rate regime was not far away.

The 'balance of payments crises' literature[2] pioneered by Krugman (1979) examines the consequences of incompatible monetary and exchange rate policies for the balance of payments of a small open economy. Domestic credit creation in excess of money demand growth leads to a loss of reserves, and ultimately to a speculative attack against the currency that forces the abandonment of the fixed exchange rate regime. The model presented here extends the 'balance of payments crises' literature to a situation in which the private banking system is explicitly modelled. The 'excessive' rate of domestic credit creation is not the result of an exogenously determined fiscal deficit, but results from the governmental commitment to guarantee the liabilities of the banking system. The size of this burden is determined by the behavior of the banks prior to their collapse, particularly by the borrowing undertaken to cover losses.

The structure of the paper is as follows. Section 2 extends the Krugman (1979) model to a situation where foreign assets pay interest. Section 3 reinterprets the model to account for the presence of banks. Sections 4 and 5 present the dynamics of the financial and balance of payments crises, respectively, while the concluding section suggests applications to the Southern Cone experience and some extensions.

2. The basic model

There is only one, perfectly homogeneous tradable good, so commodity arbitrage ensures that the price level is given by

$$P(t) = P^*(t)E, \tag{1}$$

[2]Examples are Buiter (1986), Calvo (1985), Flood and Garber (1984), Obstfeld (1984b), Connolly and Taylor (1984).

where $P(t)$ is the foreign currency perice of the commodity and E is the (fixed) nominal exchange rate. If we assume that $P^*(t)$ is equal to unity, we can write $P(t) = E$. There are two assets: domestic money (not held by foreigners) and foreign bonds. Money demand is proportional to real wealth, with the factor of proportionality depending on the yield on foreign bonds, r^*,

$$M(t)/E = m(t) = L(r^*)W(t)/E = L(r^*)w(t), \qquad L' < 0, \quad 0 \leqq L(r^*) \leqq 1. \quad (2)$$

If output y is constant and we denote foreign bond-holdings held by the domestic private sector by b^*, we have

$$w(t) = m(t) + b^*(t) + y/r^*. \tag{3}$$

Consumption is determined by a simple Metzlerian function,

$$C(t) = C[w(t)], \qquad C' > 0. \tag{4}$$

Finally, we must specify the behavior of the government: it holds a stock of international reserves $R(t)$, which earn interest at a fixed rate r^*. In the absence of any taxation or government borrowing, the governement budget constraint is given by

$$G \leqq r^*R(t). \tag{5}$$

We assume that in the initial steady state the government sets G (a constant thereafter) so that (5) holds with equality.

Wealth accumulation by the private sector is the excess of income over consumption. If we let $Dx = dx/dt$, it can be written as

$$Dw(t) = y + r^*b^*(t) - C[w(t)]. \tag{6}$$

Adding and subtracting r^*m to and from (7) and recalling (4) we arrive at

$$Dw(t) = r^*w(t) - r^*m(t) - C[w(t)]. \tag{7}$$

Eqs. (2) and (8) taken together determine the steady state levels of real wealth and real balances. We shall refer to (2) as the LM schedule. Around the steady state we can compute

$$dDw/dw|_{Dw=0} = [r^* - C'] \gtrless 0, \tag{8}$$

$$dDw/dm|_{Dw=0} = -r^* < 0. \tag{9}$$

The ambiguity in (8) reflects the fact that increases in wealth both raise income (by increasing the revenue from bond-holdings) and raise consumption. To ensure stability we assume here the sufficient condition that $[r^* - C'] < 0$, so that the $Dw = 0$ schedule slopes down in $[m, w]$ space. Fig. 1 depicts steady state equilibrium at point A.

Private asset accumulation equals the current account surplus. With no domestic credit, the Central Bank balance sheet is

$$m(t) = R(t). \tag{10}$$

Differentiating with respect to time we see that $Dm(t) = DR(t)$. Recalling the definition of wealth we conclude

$$Dw(t) = Dm(t) + Db^*(t) = DR(t) + Db^*(t). \tag{11}$$

The equilibrium depicted in fig. 1 is a function of three exogenous variables: r^*, E and y. For future reference it is useful to consider what happens when y experiences an unanticipated and permanent decrease. Substituting eq. (2) into (7) we obtain

$$Dw(t) = r^* w(t) - r^* L(r^*) w(t) - C[w(t)] = F[w(t)]. \tag{12}$$

Given our assumptions, $F'[w(t)] < 0$. Hence, there is one and only one level of w that is congruent with steady state equilibrium. The consequences of a fall in y to a lower permanent level are depicted in fig. 1. Recalling the definition of wealth we see that on impact w must fall (to w_1 in this case). Since the money market is assumed always to be in equilibrium, real balances also drop – they jump instantaneously down to m_1. At w_1, however, wealth is
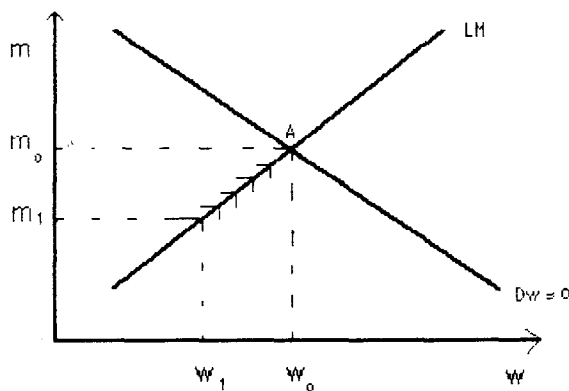

Fig. 1

below steady state equilibrium and, given the assumed consumption function, national income exceeds consumption. Hence, through a sustained current account surplus foreign assets are accumulated and the economy gradually returns to w_0 and m_0. Note that in steady state the level of wealth will be unchanged but its composition will be different. Newly acquired foreign assets yielding r^* per unit time will compensate for the loss of y. Note also that steady state private consumption will be the same, but only after the 'sacrifice' of a period of surplus in the current account.

3. Introducing banks

A reinterpretation introduces banks into the model in the simplest possible way. Imagine a situation in which domestic entities (referred to hereafter as 'banks') acquire from households the claim to all domestic output forever. In exchange for these claims, the banks issue a stock b_0 of bonds (perpetuities) paying a flow of y units of output per unit time. We can imagine that the banks acquire all of the capital stock of the economy (which does not depreciate) and which, without the need for any other inputs, produces a given number of units of the only good.[3] Government guarantee and perfect capital mobility must ensure that the banks had to issue

$$b_0 = \int_t^\infty y \, e^{-r^*(s-t)} ds = y/r^* \quad \text{for all } t \tag{13}$$

units of real bonds in exchange for the titles to the economy's productive resources. From eq. (13) it is clear that

$$y = r^* b_0. \tag{14}$$

Accordingly, the real wealth of non-bankers is

$$w(t) = m(t) + b^*(t) + b_0 = m(t) + b^*(t) + y/r^*. \tag{15}$$

Hence, domestic residents are indifferent between a system with banks or a system such as that described in the previous section – they have the same wealth in both cases. Note that now there are three assets: domestic money and domestic and foreign bonds. The latter two have been implicitly assumed to be perfect substitutes, so that their real yields are equalized. Shares of the two bonds in the public's portfolio are supply determined: all bonds b_0 are

[3] Alternatively, and at the expense of additional notation, we could have assumed that banks own titles only to βy units of domestic output, where $0 \leqq \beta \leqq 1$. None of the main conclusions of the paper would be affected.

held domestically, and any residual $[1-L(r^*)]w-b_0$ is devoted to holding foreign bonds.

To motivate the existence of these banks, we can further assume that there are some economies of scale in the production of the single traded good. Hence banks, while paying a flow of r^*b_0 units of output, can also command a flow of monopoly profits at the constant rate π. More precisely, under these conditions it will be efficient to have only one bank, whose equilibrium cash flow per unit time is

$$y'=r^*b_0+\pi, \tag{16}$$

where y' is the (higher) output per period generated by the economy's total capital stock, enjoying increasing returns under the sole ownership of the bank. Since y' is a constant, π is simply a residual equal to $\pi=y'-y>0$.

Finally, we postulate that bankers, in their capacity as such, own no assets aside from the capital stock and consume only π per unit time. It is conceivable, of course, that any individual may play a dual role – as a banker and as a private agent. But for the present scheme to work, he must behave schizophrenically. As a banker, his consumption is governed by (16); as a private individual, by (4). Then, the current account is still given by eq. (6), and a diagram such as that of fig. 1 depicts asset market and current account equilibrium.

4. The behavior of troubled banks

The presence of banks makes a difference when we consider the reaction of the system to shocks. With no banks we saw that fluctuations in y are reflected immediately in w, and hence in the behavior of consumption and the current account. The same would be true if banks were organized as mutual funds: each individual simply owns a share in the capital stock held by the bank. If either the size or the productivity of this capital falls exogenously, then that would be reflected immediately in the income stream accruing to shareholders. In conventional bank contracts, however, payment of r^* percent per unit time is guaranteed on all deposits the bank chooses to accept. What is a bank to do when a portion of its assets becomes non-performing?[4] Abstracting from the possibility of default, the choices are not many. If the shortfall is perceived to be temporary, then the bank may borrow to get over the squeeze. If it is permanent, the bank may be forced to extinguish some deposits by paying off both principal and interest owed. In order to obtain the resources to do this, the bank may liquidate some of its

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[4]For our examples it does not matter whether some of the assets become entirely non-performing, or whether the average return on all assets falls.

performing assets or dip into capital and reserves. In general, banks are very reluctant to reduce their scale of operation to offset the loss of some performing assets. First, there is the usual problem of distinguishing temporary shocks from permanent ones, with the understandable tendency to engage in some wishful thinking. Second, bank assets may be highly illiquid and sold only at a substantial loss.

In the extremely simple setup described above, banks hold no capital or reserves, so their liquidation is not an option. Nor would they benefit from attempting to liquidate some of the capital they hold. If the yield of each unit of capital has fallen permanently this would be reflected in its market price, which should be nothing more than the present value of the output stream it provides. Furthermore, given the assumed increasing returns to scale, decreases in the size of the capital stock held by banks would reduce the average yield per unit even further. We will, therefore, focus on the case in which the bank borrows to meet its interest obligations after y' falls.

Will π fall in response to a shock? The answer depends on the size of the shock. Rearrangement of the bank's cash flow equation yields

$$\pi = y' - r^* b_0. \tag{17}$$

Hence, small decreases in y' can be cushioned simply by lowering π. However, for small enough levels of y', π would have to be negative, which is impossible. To economize on notation and without loss of generality let y' fall to zero after the shock. The shock is 'sufficiently large' in that any level of bank income below $r^* b_0$ is enough to force the bank to borrow. In such a case the value taken by π is somewhat immaterial, and we will therefore treat it as a constant hereafter.

If the fall in output is permanent, the bank will effectively begin playing a Ponzi game after the adverse shock.[5] It will borrow to pay interest on deposits and also to pay interest on the amount borrowed. To avoid the perverse situation in which the bank's net assets become infinitely negative, we follow Buiter (1986) in imposing a ceiling on the amount the bank (and the small economy as a whole) can borrow.[6] If F stands for bank borrowing, let F_u be the upper limit for F.

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[5]In our world with no uncertainty, we have to assume that this borrowing can take place because *all* of the banks liabilities are perceived to be guaranteed. In the Southern Cone case, foreign bankers seem to have felt that there was a sufficiently high probability that the shock would be temporary, or else a high probability that the state would guarantee their loans. Hence, loans were still profitable in an expected value sense.

[6]This assumption could also be justified on the grounds of international credit rationing [see Eaton, Gersovitz and Stiglitz (1986)]. To the extent that the bank meets its obligations, private domestic wealth (and savings behavior) will be unchanged. Hence, if it wants to borrow the bank will have to do it abroad. But even small open economies cannot borrow any quantity at the going world of interest. For reasons of uncertainty and possible default, they customarily face rationing constraints.

Given these assumptions, bank borrowing abroad per unit time will be

$$DF(t) = r^*b_0 + \pi + r^*F(t). \tag{18}$$

Note that what this bank borrowing does is offset the current account deficit induced by the shock with a matching capital inflow. Letting x_0 denote the level of any variable x before the shock, we recall that

$$Dw_0 = r^*w_0 - r^*m_0 - C[w_0] = 0. \tag{19}$$

Similarly, bankers are not accumulating any assets. After the shock, the combined current account deficit for the public and the bank owners is

$$CA(t) = r^*w_0 - y - r^*m_0 - C[w_0] - \pi - r^*F(t) < 0. \tag{20}$$

Hence, the presence of banks introduces a 'distortion', in the sense that it enables the non-bank public to continue consuming at the pre-shock level even though income for the economy as a whole has fallen. Since the non-bank public is not 'made aware' of the magnitude of the shock, an automatic stabilizing mechanism such as that depicted in fig. 1 does not come into being. On the other hand, the capital account for the economy is given by eq. (18). By definition, the balance of payments of the economy (the variations in official reserves) is given by the algebraic sum of the current and capital accounts. Adding (18) to (20) reveals that Central Bank reserves are unaffected in the period after the shock. The capital inflow simply makes the sustained current account deficit possible.

Eq. (18) has a solution of the form

$$F(t) = [r^*b_0 + \pi][e^{r^*t} - 1][1/r^*]. \tag{21}$$

Suppose T is the time when the ceiling F_u is reached. Then, some rearrangement yields

$$e^{r^*T} = \frac{r^*F_u + [r^*b_0 + \pi]}{[r^*b_0 + \pi]}. \tag{22}$$

At time T the bank runs out of resources and collapses, and the state is left with the responsibility of servicing the liabilities incurred. Why this seemingly bizarre outcome? Because of the combination of deposit insurance and no bank supervision. Without a guarantee on deposits, investors would 'run' on a bank which is effectively playing a Ponzi game because a large portion of its assets have become non-performing. But deposit insurance must be coupled with some controls in order to be efficient. In this example

controls could take the form of penalties to the owners of banks that become bankrupt, with the size of the penalty conceivably proportional to the liabilities left behind at the time of bankruptcy (making this penalty enforceable may also require the holding of capital and/or reserves by banks). In that case, bankers would take this cost into account when deciding how much to borrow and to consume.

As a counterpart, the behavior of bankers also allows the consumption of other agents in society to remain unchanged after the adverse shock to output. However, the current account deficit induced is not the optimal response of agents trying to 'smooth out' consumption over time, but results from the fact that the current income of households does not reflect the fall in permanent national income. And as is the case with any sustained current account deficit, the time of reckoning arrives in the form of higher interest payments on a deteriorated net foreign asset position. How that effect manifests itself in this case is the subject of the next section.

However extreme in some of its assumptions, the model presented in this section captures some important features of the experience of the Southern Cone countries, particularly Chile's. In the early 1980s effectively bankrupt banks continued to operate for an extended period of time, while paying extremely high real interest rates on domestic deposits. Real private wealth was perceived to be very high (partially because of the high interest earnings quickly accruing to the owners of bank accounts and other financial investments) and consumption boomed, while current account deficits reached record levels. With the eventual arrival of both a banking and a balance of payments crisis, the previous levels of consumption were revealed to be unsustainable, while the acquired foreign liabilities were staggering. The bulk of these had to be taken over by the government in order to ensure the nation's continued access to international capital markets. This behavior has been described by Diaz-Alejandro (1985), Harberger (1985), and Arellano (1983).

5. From a bank crisis to a balance of payments crisis

What will happen after the bank collapse? The key fact is that the government will inherit from the bank a stock of liabilities, whose servicing needs can create a deficit. A government which so far had issued no bonds to pay for its (non-existent) deficit suddenly finds itself with a stock of outstanding 'government' bonds, both at home and abroad. The usual inflationary and/or balance of payments problems are soon likely to arise. For the case of Chile this possibility has also been suggested by Diaz-Alejandro (1985):

> 'The massive use of Central Bank credit to 'bail out' private agents raises doubts about the validity of pre-1982 analyses of the fiscal

> position and debt of the Chilean public sector... Ex post, it turned out
> that the public sector, including the Central Bank, had been accumulat-
> ing an explosive amount of contingent liabilities to both domestic and
> foreign agents who held deposits in, or made loans to, the rickety
> financial system... This hidden public debt could be turned into cash as
> the financial system threatened to collapse.'

After the crisis, of course, the government could avoid all problems by
'extinguishing' this deficit – this would involve paying back the principal on
all foreign loans and domestic deposits out of international reserves.[7] In the
real world, however, this is a highly unlikely outcome. There are few
governments, if any, in the world which hold international reserves equal to
the stock of outstanding private foreign debt plus the (foreign currency value
of) the stock of domestic bank deposits. In the absence of sufficient reserves,
the government could alternatively 'extinguish' one of these two stocks of
liabilities (foreign or domestic), while continuing to pay interest on the other.

That is the case studied here. We will consider a situation in which the
government immediately redeems domestic deposits while continuing to hold
on to the foreign loans. Interest payments on these will thereafter constitute
a 'government deficit' and will eventually lead to a balance of payments crisis
in the manner of Krugman. In that literature the deficit is introduced as a
perverse *deux ex machina*; here it is seen as the result of the governmental
precommitment to guarantee the liabilities of the private banks.[8]

After the bank crisis, the government effectively redeems b_0 worth of
deposits, paying for them with international reserves – whether directly or
indirectly. The instant after the crisis, then, reserves fall to $G/r^* - b_0$. Govern-
ment revenue therefore drops by r^*b_0 per unit time, while its expenditures
rise by r^*F_u (G remains constant). The situation is depicted in fig. 2. Before
the bank crisis, reserves were stationary at point G/r^*, at the intersection of
line SS and the horizontal axis. With the acquisition of the banking system's
liabilities, Central Bank reserves can be stationary only if they start at a
level $G/r^* + F_u$. We know, however, that reserves fall to $G/r^*b_0 = R_0 - b_0$ at
the time of the bank collapse. Hence, the instant after the shock the economy
jumps to point A on the diagram, and thereafter reserves steadily fall along
line S'S'. When they reach point B they will be subjected to a speculative
attack, the timing and magnitude of which we will determine.

Algebraically, after time T (the time of the bank collapse) reserves are
governed by the differential equation

$$DR(t - T) = r^*R(t - T) - (r^*F_u + G) \quad \text{for all} \quad t > T, \tag{23}$$

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[7]In our model domestic deposits are denominated in domestic currency, but they cannot be
redeemed simply by printing money. Under free convertibility and a fixed exchange rate, agents
would simply go to the Central Bank window and exchange their newly printed money for
foreign exchange.

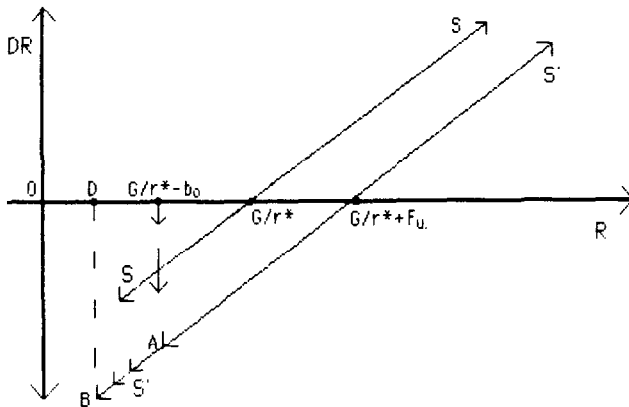[8]The credit ceiling F_u, of course, is exogenously determined.

Fig. 2

which has the solution

$$R(t-T) = [(R_0 - b_0) - (F_u - G/r^*)] e^{r^*(t-T)} + (F_u - G/r^*). \tag{24}$$

If we let T^* be the time of the speculative attack, eq. (28) becomes

$$e^{r^*(T^* - T)} = \frac{R(T^* - T) - (F_u - G/r^*)}{(R_0 - b_0) - (F_u - G/r^*)}. \tag{25}$$

To determine $R(T^* - T)$, we must compute the magnitude of the shift away from money at the time of attack. That magnitude will in turn depend on the speed of devaluation after the abandonment of the fixed rate regime, so it is necessary to specify what policies the government will follow after the collapse. Algebraic complications are minimized if we let the government use a mixture of inflation and lump-sum taxation in order to finance its expenditures of $G + r^*F_u$ per unit time. After the abandonment of the fixed parity, private agents will have to shoulder a new tax burden (whatever its form). Given our assumption about consumption behavior, it is quite likely that wealth will be off its steady state level once these new tax liabilities are introduced. Wealth will therefore evolve, in a fashion to be made more precise below. Eventually a new steady state will be reached, in which private wealth will be constant; so will money holdings, if the rate of devaluation is constant. We will assume here that a forward-looking government will immediately (the instant after the attack) set a constant rate of devaluation (crawling peg) that will be sufficient to finance all of its expenditures only via inflation taxes in the new steady state.[9] In other words, the government will

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[9]Any constant portion of expenditures financed via inflation would produce the same results. One hundred percent is chosen for simplicity.

choose a rate of crawl that is sustainable in the long run in order to avoid recurrent balance of payments crises. In the short run, private wealth and money holdings are different from the new steady state levels, so that the government will collect revenue that can be greater or lesser than $G + F_u$, depending on whether new steady state wealth is lower or higher than w_0, respectively. Since the authorities have no reason to anticipate any future demand for their reserves, they will collect (return) this short-run difference from (to) the public by means of lump-sum taxes (transfers).

We will first describe the features of the new steady state, and study later the characteristics of the transition toward it. In the new steady state, three basic equilibrium conditions must be met (underlined variables denote steady state levels),

$$\underline{m} = L(r^* + \mu)\underline{w}, \tag{26}$$

$$[1 - L(r^* + \mu)]r^*\underline{w} = C[\underline{w}] + G + r^*F_u, \tag{27}$$

$$\mu\underline{m} = G + r^*F_u, \tag{28}$$

where μ is the constant percentage of nominal devaluation that will occur after the abandonment of the fixed rate. The first condition is simply that the money market must clear, with demand for real balance now depending inversely on the rate of nominal devaluation. Eq. (27) says that national income must equal private and government consumption plus payments on the foreign debt. Finally, eq. (28) is the government budget constraint: inflation revenue must equal government expenditure.

Inverting (26) and (28) and substituting into (27) we obtain

$$r^*[\{1/L(r^* + \mu)\} - 1][(G + r^*F_u)/\mu] = C[\{1/L(r^* + \mu)\}$$

$$\{(G + r^*F_u)/\mu\}] + G + r^*F_u. \tag{29}$$

Along this schedule we can compute

$$\partial(\cdot)/\partial\mu = (C' - r^*)\{[\mu L'(\cdot) + L(\cdot)]/[L(\cdot)]^2\} + [r^*(G + r^*F_u)]/\mu^2 \lessgtr 0, \tag{30}$$

$$\partial(\cdot)/\partial G = [r^* - C'][1/L(r^* + \mu)] - (r^*/\mu) - 1 < 0, \tag{31}$$

$$\partial(\cdot)/\partial F_u = r^*[r^* - C'][1/L(r^* + \mu)] - r^*(r^*/\mu) - r^* < 0. \tag{32}$$

Hence, the following is a sufficient condition for μ to be positively related to G and F_u along (29):

$$-\mu L'(\cdot)/L(\cdot) < 1. \tag{33}$$

In other words, we must be operating along the inelastic portion of the money demand schedule. This is the 'normal case'. in which inflation revenue increases with μ. In this case we can, therefore, write

$$\mu = \mu(G, F_u), \quad \mu'_G(\cdot) > 0, \quad \mu'_{F_u}(\cdot) > 0. \tag{34}$$

Eq. (34) is the reduced form of the constant rate of devaluation that will prevail after T^* and forever. Hence, the instant of the attack money demand will be given by $L(r^* + \mu)w_0$,[10] and the condition for the time of the speculative attack becomes

$$R(T^* - T) = L(r^*)w_0 - L(r^* + \mu(G, F_u))w_0. \tag{35}$$

Notice from (35) that the magnitude of the shift away from money is an increasing function of μ. Given (34), the magnitude of the attack is positively related to G and F_u as well.

Substituting (35) into (25) we finally arrive at

$$e^{r^*(T^* - T)} = \frac{L(r^*)w_0 - L(r^* + \mu(G, F_u))w_0 - (F_u - G/r^*)}{(R_0 - b_0) - (F_u - G/r^*)}. \tag{36}$$

It is straightforward to verify from (36) that the period of time $(T^* - T)$ is a decreasing function of w_0 and of initial reserves $(R_0 - b_0)$. It is more tedious but equally simple to check the 'shortening' effect of a higher F_u on $(T^* - T)$. The reason for this inverse relationship is clear from fig. 3. A higher F_u causes reserves to decline more quickly (it makes the trajectory AB steeper); at the same time, it makes the magnitude of the attack (the distance BD) larger.[11]

After the collapse, wealth will be off its new steady state. Its evolution will be governed by

$$Dw(t - T^*) = r^* w(t - T^*) - (r^* + \mu)m(t - T^*) - C[w(t - T^*)]$$

$$+ \mu[m(t - T^*) - \underline{m}]. \tag{37}$$

The last term of (37) is the short-run excess or shortfall in inflation tax revenue. Rearranging and recalling the government budget constraint (28) we

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[10]Recall that private wealth does not change until the moment after T^*.

[11]Contrast this result with that obtained by Buiter (1986). In that paper, the relationship between the amount borrowed by the small open economy and the timing of the attack is ambiguous. This is because in Buiter's setup the principal of the foreign loan becomes part of Central Bank reserves, while here it is consumed.
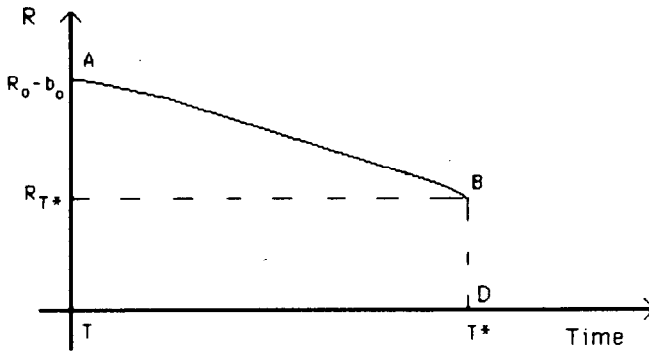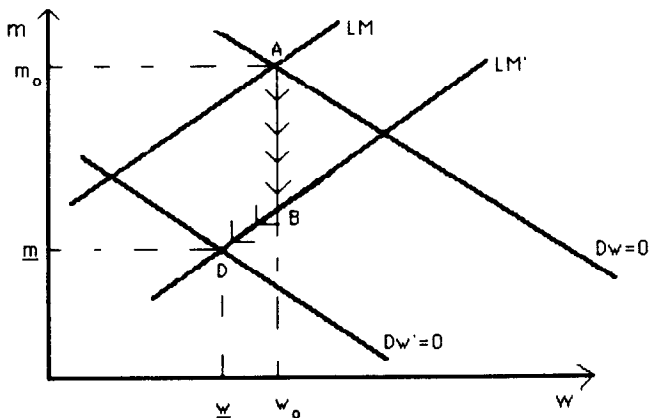
Fig. 3

Fig. 4

can write

$$Dw(t - T^*) = r^*w(t - T^*) - r^*m(t - T^*) - C[w(t - T^*)] - (G + r^*F_u). \quad (38)$$

Hence, after T^*, wealth will gradually evolve toward its new steady state level, where y'' and interest income on foreign bonds will be sufficient to finance private and government consumption plus foreign debt service. Totally differentiating (38) and recalling (26) we can ascertain whether new steady state wealth will be higher than it was initially,

$$w > w_0 \quad \text{if} \quad (G + r^*F_u) < -r^*w_0 L'(\cdot)\mu,$$

$$\quad (39)$$

$$w < w_0 \quad \text{if} \quad (G + r^*F_u) > -r^*w_0 L'(\cdot)\mu.$$

In terms of our diagram in fig. 4, the new intersection of LM and $Dw = 0$ can be to the right or to the left of w_0. As drawn, new steady state wealth is lower. Consequently, after the attack the economy begins to run a current account deficit. Wealth and real balance holdings gradually fall together until reaching the new equilibrium point D. Ultimately, the economy is saddled with lower levels of consumption forever.[12]

6. Applications and extensions

Among theorists of stabilization, there is increasing recognition of the crucial role that credibility plays in disinflation-cum-reform programs.[13] In Chile, a stabilization program coexisted with a mounting private financial deficit that was clearly unsustainable in the long run and which, under the (apparently justified) assumption of government guarantee, would eventually become the responsibility of the government. What measures (domestic credit creation, inflation, etc) the government would choose to deal with this problem one could not know, but they were unlikely to be compatible with the maintenance of a fixed exchange rate regime and careful management of expectations as the backbone on the anti-inflation policy. In short, it is conceivable that the financial sector problem may have been at the root of the doubts about the medium-term viability of the Chilean program.

The point can put in a slightly different way. In the Argentine case financial problems of the sort we have described were serious indeed, though not quite reaching Chilean magnitude. Argentina, furthermore, suffered another clear imbalance: the combination of a slow crawl and a large fiscal deficit made the policy package inconsistent, it is often argued, and hence incredible. In Chile, on the other hand, the deficit was ostensibly zero. Where, then, did the inconsistency of the Chilean program lie? What variable played the role that the deficit is alleged to have played in Argentina? One often-mentioned possibility is the inherent inertia in the rate of domestic inflation, which lagged behind the gradually slowing rate of exchange rate crawl. The resulting overvaluation of domestic prices caused serious trade imbalances and eventually had to lead to an abandonment of the program. This line of argument has been modeled by Dornbusch (1980) and applied by Foxley (1983), among others, to the Chilean case. Another widely discussed inconsistency is the system of lagged wage indexation [see, for example, Edwards (1985)]; combining it with a fixed exchange rate regime was tantamount, it is argued, to imposing two numeraires on the economy – eventually one had to give.

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[12]In the opposite case of $w > w_0$, w and m would rise after the collapse of the fixed rate regime, requiring that the economy run a current account surplus during the transition.

[13]See, for instance, Calvo (1986).

Both these aspects of the Chilean experience have received ample atten-
tion, and another evaluation of their relative importance is certainly beyond
the scope of this essay. My aim here is to suggest the financial deficit as an
additional source of inconsistency in the Chilean case. It is possible to argue
that this deficit played the role usually reserved for the fiscal deficit in
standard models of stabilization in small open economies. This means,
among other things, that credibility analyses such as that of Baxter (1985),
which assume that the Chilean fiscal position was essentially a sound one,
are based on an incorrect premise.

As is the case, with any deficit, it can be financed with money or with
bonds. The Chilean deficit was at first financed with bonds: banks borrowed
abroad and Central Bank reserves swelled, while domestic credit creation
was cautious. This point is important because capital inflows have been
singled out [Obstfeld (1984a), Edwards (1986)] as possible causes of the real
exchange rate overvaluation typical of the Southern Cone experiences. But
for the Chilean case [Edwards (1986)], there is evidence that such inflows
were not responding to interest rate differentials, as conventional theory
would predict. Indeed, it is possible that a large portion of such capital was
being devoted to meet the 'distress borrowing needs' of banks and firms.

Eventually, as the limit on foreign borrowing was reached, many banks
were revealed to be significantly overextended. As discussed they had to be
intervened and/or heavily subsidized by the authorities. The Central Bank
extended almost US$1 billion of credit to the financial credit in the last
quarter of 1981, and lost about US$230 million in net foreign reserves; in the
first six months of 1982 a further US$535 million of Central Bank credit
went to aid the financial system, and an additional US$325 million were lost.
The maxi-devaluation and the effective end of the stabilization program
occurred in June 1982. This is of course a highly stylized account, but it
underscores the quantitative importance of the phenomena the model of this
paper has sought to highlight.

The most unsatisfactory feature of the model as it stands is the fixity of the
real interest rate throughout the episode. This stands in contrast to Southern
Cone experience, where the late 1970s and early 1980s were characterized by
erratic and extremely high (ex post) real rates, often averaging over 30
percent per annum [see Zahler (1987)]. A simple – if somewhat mechanistic –
way to correct this deficiency is to introduce a stochastic component in the
money supply process, so that the time of collapse itself becomes stochastic.
Then, as Flood and Garber (1984) have demonstrated, the collapsing
currency will display a forward discount, and this will push the domestic
nominal interest rate up for the usual interest parity reasons. As long as the
exchange rate remains fixed, the domestic real interest rate will therefore be
above the world norm.

Another simple modification that yields similar results is to face the small

economy with an upward sloping supply-of-funds schedule in world capital markets. Then, as domestic banks increase the quantity borrowed abroad the relevant interest rate will rise, and so will the domestic rate. Similar results obtain if we allow for imperfect substitutability of foreign and domestic bonds, or for slow arbitraging of international interest rate differentials. In all these cases the domestic financial market is somewhat insulated from the rest of the world, and domestic interest rates can deviate from the world level. This is particularly appropriate in the case of Chile, in which restrictions to capital movements existed for much of the period under study. In such a situation, increased bank demand for funds will tend to push up the domestic interest rate. Banks will engage in 'liability management', as described by Fernández (1983) in a paper that focuses on the experience of Argentina, and by Khan (1986): they will raise deposit rates in order to attract more funds. As Fernández shows, this can lead to an unstable path for the domestic rate: the higher the interest rate the larger the amount the bank can borrow, but also the larger its interest bill becomes and the more it will have to borrow in subsequent periods.

The key effect of sustained high real interest rates is that they feed back into the performance of bank assets. In this model we have treated national income as a periodic gift from heaven, in whose gathering from the ground the bank enjoys some economies of scale. In a more realistic setting we must think of a bank whose assets are loans to firms. These firms use borrowed capital as an input in the production process, and the real interest rate they pay for this capital enters their cost bill. The higher interest rates are (particularly when unexpected or when they subsist over long periods of time), the more likely it is that a subset of the firms will default on their loans. Hence, bank difficulties can cause high real interest rates in ways we described above, but the latter can also enhance bank problems.

A similar process obtains for the other variable typically out of line in the Southern Cone cases: the real exchange rate. A persistent appreciation of the relative price of non-traded goods occurred in the same period when the exchange rate was fixed and the financial system liberalized. In turn, firms producing exportables or import-competing goods experienced increasing troubles, and the performance of banks loans to these firms deteriorated accordingly. No such phenomenon can occur in the one-good model of this paper, but simple extensions can allow for this possibility. This has been done by Connolly and Taylor (1984) and Calvo (1987), working with variants of the Krugman crisis model.

At the outset I suggested that the mechanisms through which financial troubles affect the real economy at the aggregate level are not well understood. The model of this paper offers an example of how a shock to output is first reflected in the books of the financial system, but eventually affects the external position of the economy. The possible extensions men-

tioned show that – predictably – real world experiences are immeasurably more complex. In particular, a troubled macroeconomy is likely to display symptoms such as high real interest rates and overvalued real exchange rates, which in turn worsen the health of the financial system even further. In the next round of adjustment, the mounting disequilibria feed yet again into the real sector, creating a vicious circle from which it is difficult to escape. This is just a sketchy account – many of the details remain to be worked out, and are also likely to vary from case to case. One can only hope that greater research into this process can help prevent repetitions of the disastrous Southern Cone experiments of the last decade.

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