CHAPTER 12

International Financial Crises*

Guido Lorenzoni
Northwestern University, Evanston, IL, USA
National Bureau of Economic Research, Cambridge, MA, USA

Abstract

This chapter surveys recent research on international financial crises. A financial crisis is characterized by a sudden, dramatic outflow of financial resources from an economy with an open capital account. This outflow may be primarily driven by the expectation of a large nominal devaluation, in a situation in which the domestic monetary-fiscal regime appears inconsistent with a fixed exchange rate. Or the outflow may be driven by a reallocation of funds by foreign and domestic investors, due to a changed perception in the country's growth prospects, to an increase in the risk of domestic default, or to a shift in investors' attitudes toward risk. Often times, monetary and financial elements are combined. A drop in domestic asset prices and in the real exchange rate can act as powerful amplifiers of the real effects of the crisis, through adverse balance-sheet adjustments. The chapter surveys research that looks both at the monetary and at the financial side of crises, also discussing work that investigates the accumulation of imbalances preceding the crisis and the scope for preventive policies.

Keywords

Currency crisis, Current account reversal, Sudden stop, Sovereign debt crisis

JEL classification codes

F32, F34, F41, G15

1. INTRODUCTION

This chapter surveys the recent literature on international financial crises. I define international financial crises broadly as episodes of financial turbulence in which the international dimension plays an important role. The typical immediate manifestation of an international financial crisis is a large capital flight from the country affected, in which both foreign investors and domestic residents sell domestic assets and buy foreign assets. The associated pressure on the currency market leads to a depreciation of the domestic currency. If the central bank is pursuing a pegged exchange rate, the capital flight pushes the central bank to abandon the peg and devalue. While these elements are common to different episodes, the underlying causes and imbalances behind the crisis can be very different, depending on what triggered the capital flight in the first place. In particular, a

* I thank for useful comments Fernando Broner, Gita Gopinath, Olivier Jeanne, and Ken Rogoff. Dan Reese and Dejanir Silva provided excellent research assistance.

Handbook of International Economics, Volume 4
ISSN 1573-4404, http://dx.doi.org/10.1016/B978-0-444-54314-1.00012-4

capital flight can be triggered by concerns with the country's monetary or fiscal outlook, by bad news about the country's growth prospects, by concerns with the ability to repay of some domestic sector that accumulated debt in the past, or by a generalized flight to safety in international capital markets. Often these different elements come combined. Moreover, crises can have very different consequences on the country affected depending on the monetary regime in place, the balance sheets of banks and firms, and so on. In this chapter, I will present and discuss models that have been used to interpret different types of crises, both in terms of the different underlying causes and in terms of the different transmission channels.

From an empirical point of view, we distinguish international crises in terms of their immediate measurable effects. In particular, a common distinction is between a *currency crisis*, defined as an episode in which the nominal exchange rate drops by more than a certain amount and/or in which the central bank experiences reserve losses larger than some threshold, and a *current account reversal*, defined as a sharp reversal from a large current account deficit into a much smaller deficit or a small surplus. Many researchers have also emphasized the connections between external crises and domestic banking crises, defined as episodes in which a large number of bank failures occurs and large scale public sector intervention in the banking sector takes place (Kaminsky and Reinhart, 1999). This leads to identify a peculiar type of crisis, a *twin crisis* in which balance of payment and domestic banking trouble coexist.

I will use the empirical distinction between currency crises and current account reversals as a way of organizing the presentation. I begin with models that focus on the currency crisis dimension, starting with the classic contributions of Krugman (1979) and Obstfeld (1994a), covered in Sections 2 and 3. These models focus on the nominal exchange rate as a monetary phenomenon and on the sustainability of fixed exchange rate regimes. Under a fixed exchange rate regime, free capital mobility imposes constraints on monetary policy. A crisis is a situation in which these constraints are put to the test and a capital flight occurs when monetary and fiscal policy are perceived to be inconsistent with the fixed exchange rate regime.

In the following sections, I turn to current account reversals, presenting models that put more emphasis on financial flows. In particular, I look at so-called *sudden stops* in capital flows, i.e., a sudden loss of access to international borrowing which forces a country to drastically reduce its current account deficit, a notion introduced by Dornbusch et al. (1995) and Calvo (1998). In Section 4, I look at models that take the sudden stop as an exogenous event and analyze its effects on the exchange rate and real activity. In the dynamics of a sudden stop an important amplifying mechanism comes from the presence of external liabilities denominated in foreign currency. Therefore, my treatment of sudden stops will be integrated with the treatment of the balance sheet effects due to currency mismatch.

Next, I will look at models that try to explain the sources of sudden stops, rather than taking them as exogenous events. A first step in this direction is to take as given some initial conditions, in particular some accumulated stock of debt coming from the past, and to investigate the mechanisms by which international investors may suddenly turn away from a borrowing country. In Section 5, I do so focusing on models with defaultable debt, in which the fear of default can trigger self-fulfilling capital flights. In that section, I also discuss the role of debt maturity in exposing a country to self-fulfilling liquidity crises.

The next step is to go further back and investigate the root causes of a crisis: Why do countries accumulate external debt? Why does the real exchange rate become overvalued? Why do borrowing countries choose short-term and/or foreign-currency-denominated liabilities? What is the role of international banking in the buildup of imbalances? Here I will discuss different ways of approaching these hard questions and discuss the potential for preventive policies that limit the exposure of a country to crises.

This organization of the material roughly reflects a timeline of the evolution of the literature over the last thirty years or so, which, in turns, was stimulated by major developments in international capital markets. In the exposition, I discuss how some notable crisis episodes have shaped the debate and prompted the construction of new models. However, I will avoid the common labels of "first, second, and third generation" models. This is because I prefer to distinguish the various models discussed here in terms of the mechanisms they emphasize, rather than in some overall philosophy of what causes a crisis and whether crises are caused by fundamentals or sunspots.

The chapter focuses on models and mechanisms and so I cover only a small part of the enormous empirical literature on the subject. Also, I do not hope to be exhaustive in covering all the theoretical work in the area, but rather to give a guide to some useful tools that have been developed to interpret different facets of actual crises.

2. FISCAL-MONETARY IMBALANCES

In this section and the next I focus on currency crises. When a country chooses to peg its exchange rate, in a regime of capital mobility, it loses the independent use of monetary policy. The central bank commits to conduct a monetary policy consistent with maintaining the peg. However, different pressures can induce the central bank to abandon this commitment. Two pressures explored here are the pressure to monetize government debt, in this section, and the pressure to respond to a recession, in the next section.

In the 1970s and 1980s, many emerging economies facing high inflation tried to use a fixed exchange rate as a nominal anchor for the purpose of inflation stabilization. Sometimes these experiments succeeded, but in a number of cases they failed. Many saw at the roots of this failure the presence of persistent fiscal deficits combined with a lack of central bank independence. This combination makes the low inflation regime not credible, as the public expects the central bank to eventually cave in to pressures to monetize government debt, leading to inflation and devaluation. However, the process by which the exchange rate was abandoned was typically characterized by a sudden, dramatic capital flight, leading to large losses of reserves by the central bank trying to defend the peg and eventually by devaluation. These crisis dynamics were often interpreted as the outcome of an irrational swing in the moods of currency markets. The classic Krugman (1979) model of currency crises shows instead that a discontinuous process of adjustment can be the outcome of rational behavior. Facing an unsustainable policy regime, forward-looking investors can trigger a sudden adjustment that anticipates the "day of reckoning." Let me illustrate these ideas using a simple version of the model, which builds on expositions in Flood and Garber (1984) and Obstfeld (1994).

2.1. Model

The model is a small open economy model set in continuous time. The first ingredient of the model is the domestic money demand equation

$$\frac{M}{P} = f(i)Y, \tag{1}$$

where M is the stock of money, P is the price level, i is the domestic interest rate, and f is a decreasing function. We consider an endowment economy and take the output level Y as a fixed constant, normalized to $Y = 1$. The second ingredient is the assumption that there is a single good in the world and that the law of one price holds. This implies that the domestic price level is equal to the foreign price level P^* converted in domestic currency at the nominal exchange rate $\mathcal{E}$, that is, we have the purchasing power parity (PPP) assumption

$$P = \mathcal{E}P^*.$$

We assume that the foreign price level is constant at $P^* = 1$, another convenient normalization. Next, we have the uncovered interest parity (UIP) condition

$$i = i^* + \dot{\mathcal{E}}/\mathcal{E},$$

where i^* is the foreign interest rate. Combining PPP and UIP implies that the real interest rate $r = i - \pi$ is given and equal to i^* (π denotes price inflation).

The last ingredient is the government budget constraint, which is really the consolidated budget constraint of the government and of the central bank,

$$\dot{D} - \mathcal{E}\dot{R} + \dot{M} = PH + iD - i^*\mathcal{E}R, \tag{2}$$

where D is government debt, H is the real primary deficit, and R are foreign currency reserves held by the central bank. I assume that foreign reserves earn the foreign interest rate i^*.

To complete the description of the model we need to specify the way in which monetary and fiscal policy are conducted. The assumption here is that fiscal policy is non-Ricardian, meaning that the government sets a path for the primary deficit H and the central bank needs to choose a path for money supply that ensures that the net liabilities of the government satisfies the no-Ponzi condition. To see how this constrains the choice of monetary policy, it is useful to derive the government intertemporal budget constraint, integrating (2). Define the net real liabilities of the government as

$$N \equiv \frac{D+M}{P} - \frac{\mathcal{E}}{P}R.$$

Differentiating this equation and using PPP yields

$$\dot{N} = \frac{\dot{D}+\dot{M}}{P} - \frac{\dot{P}}{P}\frac{D+M}{P} - \dot{R}.$$

Substituting (2) on the right-hand side and using $i^* = r$, we get

$$\dot{N} = rN + H - i\frac{M}{P}.$$

Finally, we can integrate, substitute the money demand (1), and use the no-Ponzi condition $\lim_{t\to\infty} e^{-rt}N(t) = 0$ to obtain the intertemporal budget constraint

$$N(0) = \int_0^{\infty} e^{-rt}\left[i(t)\frac{M(t)}{P(t)} - H(t)\right]dt. \tag{3}$$

The initial stocks of money, bonds, and reserves are inherited from the past. With a pegged exchange rate at date 0, we have $P(0) = \mathcal{E}(0) = 1$. Therefore, $N(0)$ is given and equal to $D(0) + M(0) - R(0)$. The intertemporal constraint (3), together with the money demand equation (1), give us a menu of paths for $i(t)$ consistent with the intertemporal budget constraint. The idea is that if the government is not going to adjust the path for the primary deficit $H(t)$, the central bank cannot at the same time sustain the peg at date 0 *and* choose its desired path for the nominal rate $i(t)$. Rather, the interest rate path needs to adjust at some point in the future to deliver inflation tax revenues consistent with the repayment of the initial debt.

Now assume the government fixes a constant level for the deficit $\bar{H}$ and keeps government debt fixed at the level $D(0) = \bar{D}$ and assume the initial conditions are such that $rN(0) > rf(r) - \bar{H}$ and $R(0) > f(r) - f(r + \mu)$. Suppose the central bank's only objective is to keep the currency pegged at $\mathcal{E} = 1$ for as long as possible. How long can the peg last? The central bank uses its foreign currency reserves to back up its commitment to a stable exchange rate. Basically, the central bank stands ready to exchange foreign for domestic money one for one, so the peg can survive as long as there are reserves to satisfy the demand for foreign currency. The problem is that the central bank is also under pressure to satisfy the government budget constraint. The central bank does not want to use money creation to finance the deficit, as it would create inflation and undermine the peg, so its only alternative is to run down its reserves to finance the government deficit. This leads reserves to fall at the following rate:

$$\dot{R} = -\bar{H} - r(\bar{D} - R). \tag{4}$$

An equivalent way to tell the same story is that the central bank uses money creation to finance the deficit, but its commitment to the peg implies that the private sector immediately converts the newly printed money into foreign currency, so the money creation is undone at every instant. The final result is the same: the money supply remains constant and the central bank loses reserves at the rate shown in equation (4).

It would seem natural at this point to conjecture that the central bank will lose reserves gradually, as in (4), and the peg will last until the time T when the central bank hits $R(T) = 0$. At this point, the central bank will abandon the peg and start printing money so as to generate seignorage revenue sufficient to cover the deficit, i.e., at the rate μ that satisfies[1]

$$\mu f\left(r + \mu\right) = \bar{H} + r\bar{D}. \tag{5}$$

This conjecture is, however, incorrect. The problem is that the demand for foreign currency reserves is affected by the agents' forward-looking behavior. As long as the peg holds, UIP is satisfied and investors (domestic and international) have an infinitely elastic demand for foreign currency reserves, so they are happy to absorb the amount of reserves that the central bank is selling to plug the fiscal deficit. However, a moment before time T the UIP fails to hold. To see why this is the case, notice that along the conjectured path the money supply is continuous at T while real money balances need to jump from $f(r)$ to $f(r+\mu)$. This requires a discrete increase in the price level from 1 to $f(r)/f(r+\mu) > 1$. By PPP, the exchange rate needs to increase discretely by the same amount. But a discrete increase in the exchange rate is incompatible with UIP as long as the nominal interest rate is finite. Therefore, the conjectured path is not an equilibrium path.

To solve for the correct equilibrium dynamics, we need to find a path in which the price level and the exchange rate change continuously at the time when the peg is abandoned, so that UIP is satisfied. This requires a discrete jump in M. Namely, at time T^* investors (domestic and foreign) will suddenly absorb all the reserves still in the hand of the central bank, so reserves will move discontinuously from a positive level $R(T^*_-) > 0$ immediately before T^* to zero at time T^*.[2] The reserve outflow will be exactly matched

[1] This equation can be derived by writing the intertemporal budget constraint (3) at time T, and noticing from then on we will have constant real money balances, inflation equal to the rate of money growth, and a constant nominal interest rate $i = r + \mu$. Notice, that if $\bar{D}$ and $\bar{B}$ are too large there may be no value of μ that satisfies this equation. In that case, seignorage is insufficient to plug the fiscal deficit and the government will have either to adjust the deficit or default.

[2] The reserve path is continuous for $t < T^*$ and $R(T^*_-)$ denotes the limit $\lim_{t \to T^*_-} R(t)$.

by an equivalent discontinuous reduction in money supply. From T^* onwards, the central bank will finance the deficit with money creation, according to equation (5). Therefore, money supply has to drop by the amount $\Delta M = f(r) - f(r+\mu)$. To find the time T^* when the peg collapses we then need to solve the differential equation (4) with the terminal condition $R(T^*_-) = \Delta M$. Since $\Delta M > 0$ the time T^* at which the peg collapses arrives earlier than the time T we derived under our initial, incorrect conjecture.

A crucial observation here is that reserve losses can suddenly accelerate when a crisis approaches: the fact that the central bank is losing reserves at a relatively slow pace today cannot be taken as a sign that the same pace will continue into the future. As investors start anticipating the risk that the peg will be abandoned, they start buying reserves at a faster rate, so that the defenses of the central bank that seemed sufficient to defend the peg for months can be exhausted in a matter of days.

2.2. Discussion

There are two main messages here. First, unsustainable policies can lead to a possibly discontinuous adjustment process. The discontinuity is due to the fact that forward-looking agents anticipate a regime change and adjust their behavior accordingly. Notice that in the original model the discontinuity concerns the dynamics of the stock of reserves but not of the exchange rate. Broner (2008) shows that enriching the model's informational structure introduces the possibility of discrete jumps in the exchange rate in equilibrium. Also, one may wonder whether the discontinuity is driven by the way the behavior of the policy-maker is formulated. Rebelo and Végh (2008) study what happens when policy is the result of explicit optimizing behavior by a monetary authority who is trying to avoid a devaluation.

The second message is that the conduct of fiscal policy can be a source of exchange rate instability. As long as agents entertain the possibility that monetary policy will lose its independence at some point in the future, this will affect their behavior today. This message is closely linked to the idea that monetary policy and fiscal stability are linked by the government intertemporal budget constraint (Sargent and Wallace, 1981), a linkage captured here by equation (3). An important observation that follows is that current deficits are not necessary to put a fixed exchange regime under stress, as long as the public foresees the risk of high deficits in the future. In the East Asian crisis of 1997 the countries involved did not display high fiscal deficits in the years preceding the crisis.[3] Corsetti et al. (1999) and Burnside et al. (2006) notice that, however, the crisis had a large impact on the banking sector in these countries and that there were strong ties between the banking sector and the government. This combination meant that investors expected the government to step in and spend substantial fiscal resources to bail out banks. The

[3] See Table 8 in Radelet and Sachs (2000).

prospective deficits associated to future bail-outs can then be used to interpret also the East Asian crisis as a fiscal-monetary phenomenon.[4]

An important observation that follows the analysis above is that a successful fixed exchange rate regime requires both central bank independence and some form of commitment to fiscal discipline. This idea is at the root of the institutional design of the European currency union. Both the budgetary rules in the Maastricht treaty of 1992 and the rules governing the European Central Bank were explicitly designed to minimize the risk of debt monetization. These rules are being put to the test in the current euro crisis. However, a big difference between a fixed exchange rate regime and a currency union is that in a currency union there is a single central bank. The situation in a currency union is equivalent to a fixed exchange regime in which national central banks are bound to provide each other unlimited reserves to defend the peg. In the context of the euro area, such an arrangement is made explicit in the functioning of the payment system, the so-called TARGET2 system, as discussed in Garber (1999). There is currently a heated debate on what are the fiscal implications of such an arrangement.[5] But the size of the balances accumulated by deficit nations suggests that, absent this regime, the euro system would have already succumbed to speculative attacks.

The simple model above does not capture another important feature of the euro crisis, namely the possibility that an unsustainable fiscal regime is not resolved by inflation, but by outright default. The role of default and risk premia in financial crises will be discussed in Section 5. Uribe (2006), Jeanne (2011), and Aguiar et al. (2012) explore the interaction between monetary and fiscal policy in models where government default is possible.

3. OVERVALUATION, UNEMPLOYMENT, AND MULTIPLE EQUILIBRIA

The model in the previous section focused on fiscal-monetary issues and abstracted, for simplicity, from the effects of currency dynamics on relative prices. Under the assumption of PPP holding at all times, a devaluation was simply the international manifestation of an inflationary event.

In this section, I use an open economy new Keynesian model in which movements in the nominal exchange rate have real effects in the short run. This model allows us to consider episodes in which a nominal depreciation leads to a real depreciation. More generally, the model allows us to explore the effects of currency crises on real activity and the options faced by the central bank in these episodes. In particular, I use the model to discuss the possibility of multiple equilibria à la Obstfeld (1994a), in which lack of

[4] A fact that is harder to square with this interpretation of the East Asian crisis is that, after devaluing, these countries did not experience high inflation and the nominal devaluation was associated to a real devaluation. I will return below to these issues and to alternative interpretation of the East Asian crisis.

[5] See Buiter and Rahbar (2012).

credibility of the central bank commitment to a peg is self-fulfilling, as it leads to a recessionary shock that pushes the central bank to choose a devaluation.

3.1. A Small Open Economy New Keynesian Model

The model is a general equilibrium open economy model with nominal rigidities in the tradition of Obstfeld and Rogoff (1995) and Corsetti and Pesenti (2001). In particular, I consider the case of a small open economy, as in Galí and Monacelli (2005). I simplify the environment relative to standard treatments. In particular, I focus on a perfect foresight equilibrium with no shocks and only look at the effect of one-time unexpected shocks. At the same time, I avoid log-linearization, which allows me to capture some interesting non-linearities in later sections.[6]

Consider a small country, populated by infinitely lived consumers with utility function

$$\sum_{t=0}^{\infty} \beta^t \left(\frac{1}{1-\sigma} C_t^{1-\sigma} - \frac{\psi}{1+\phi} N_t^{1+\phi} \right).$$

Consumption C_t is a Cobb-Douglas aggregate of a home good C_{ht} and a foreign good C_{ft}:

$$C_t = \xi C_{ht}^{\omega} C_{ft}^{1-\omega},$$

with $\xi = \omega^{-\omega}(1-\omega)^{-(1-\omega)}$. The home good is a CES aggregate of a continuum of varieties $j \in [0, 1]$ produced by monopolistic competitive firms à la Dixit-Stiglitz, owned by the representative consumer. Using $Y_t(j)$ to denote the production of variety j, the total production of the home good is

$$Y_t = \left(\int_0^1 Y_t(j)^{\frac{\varepsilon-1}{\varepsilon}} dj \right)^{\frac{\varepsilon}{\varepsilon-1}},$$

and its price index is

$$P_{ht} = \left(\int_0^1 P_{ht}(j)^{1-\varepsilon} dj \right)^{\frac{1}{1-\varepsilon}}.$$

Each firm j uses the linear technology $Y_t(j) = N_t(j)$. The foreign good is in perfectly elastic supply at the price $P_{ft} = 1$ in foreign currency. The nominal exchange rate is $\mathcal{E}_t$, so the price of the foreign good in domestic currency is $\mathcal{E}_t$.

Since the representative consumer receives the entire domestic income $P_{ht} Y_t$, in the form of wages or profits, his/her budget constraint is

$$\sum_{t=0}^{\infty} Q_{t|0} \left(P_t C_t - P_{ht} Y_t \right) = \mathcal{E}_0 B_0,$$

[6] See, in particular, Section 4.

where B_0 is the country's initial asset position in foreign currency and $Q_{t|0}$ is the price of a unit of domestic currency at time t in terms of date 0 domestic currency.

Consumer optimality implies that the domestic demand for the home good is

$$C_{ht} = \omega \left(\frac{P_{ht}}{P_t} \right)^{-1} C_t, \tag{6}$$

where the domestic consumer price index P_t includes the price of the home and foreign good and is

$$P_t = P_{ht}^{\omega} \mathcal{E}_t^{1-\omega}. \tag{7}$$

The demand of home goods by the rest of the world is given by

$$C_{ht}^{*} = \zeta \left(\frac{P_{ht}}{\mathcal{E}_t} \right)^{-\rho}. \tag{8}$$

This demand function captures two assumptions: (i) we are in a small open economy, so consumption of home goods is a negligible fraction of spending in the rest of the world, and (ii) the foreign consumption level and the foreign CPI are constant and are captured by the parameter ζ. Also the foreign interest rate i^* is constant and equal to $1/\beta - 1$. There is perfect capital mobility and the UIP condition is

$$1 + i_t = \frac{\mathcal{E}_{t+1}}{\mathcal{E}_t} \left(1 + i^* \right). \tag{9}$$

For simplicity, I assume we are in a cashless world, where the domestic central bank directly controls the nominal interest rate i_t. When prices are flexible, the choice of the nominal interest rate will only have nominal effects and monetary policy will be completely neutral. Not so with nominal rigidities.

Consumer optimality implies the consumer Euler equation:

$$C_t^{-\sigma} = \beta \left(1 + i_t \right) \frac{P_t}{P_{t+1}} C_{t+1}^{-\sigma}, \tag{10}$$

and the optimal labor supply condition:

$$\frac{W_t}{P_t} C^{-\sigma} = \psi N_t^{\phi}. \tag{11}$$

For simplicity, I will abstract from wage rigidities and assume the nominal wage W_t is flexible.

Prices are sticky. In period 0, a fraction α of firms cannot adjust their price and keep it at the level $\bar{P}_h$ inherited from the past, a fraction $1 - \alpha$ of firms are free to adjust their price. To simplify the analysis, we assume that from time $t = 1$ onwards all prices can be freely adjusted. Optimal price setting implies that firms that are allowed to adjust their price, set it as a constant markup over marginal costs,

$$P_{ht}(j) = \frac{\varepsilon}{\varepsilon - 1} W_t. \tag{12}$$

For the rest of the analysis, it is useful to define the relative price of the home good in terms of foreign goods

$$p_{ht} \equiv \frac{P_{ht}}{\mathcal{E}_t},$$

and to express the relative prices of the home and foreign good in terms of domestic consumption as

$$P_{ht}/P_t = p_{ht}^{1-\omega},$$
$$\mathcal{E}_t/P_t = p_{ht}^{-\omega}.$$

3.2. Equilibrium

We solve the model backward. In periods $t = 1, 2, \ldots$ the economy reaches a flexible price steady state equilibrium. So we first characterize prices and quantities in steady state and then go back to period $t = 0$ and complete our characterization.

Steady state variables are denoted by an asterisk. The steady state is characterized by a constant net foreign asset position $B_t = B^*$, constant consumption and output, $C_t = C^*$ and $Y_t = Y^*$, and a constant relative price $p_{ht} = p_h^*$. Given B^*, which is inherited from period 0, the equilibrium values of C^*, Y^*, and p_h^* are found solving the equations

$$C^* = \left(p_h^*\right)^{1-\omega} Y^* + \left(1 - \beta\right) \left(p_h^*\right)^{-\omega} B^*, \tag{13}$$

$$\left(p_h^*\right)^{1-\omega} \left(C^*\right)^{-\sigma} = \frac{\varepsilon}{\varepsilon - 1} \psi \left(Y^*\right)^{\phi}, \tag{14}$$

$$Y^* = \omega \left(p_h^*\right)^{-(1-\omega)} C^* + \zeta \left(p_h^*\right)^{-\rho}. \tag{15}$$

The first equation comes from the budget constraint, the second from combining optimal price setting and optimal labor supply, and the third from market clearing in the domestic good market.

I make the following assumptions

$$\frac{\varepsilon}{\varepsilon - 1} \psi = 1, \tag{16}$$

$$\omega + \zeta = 1, \tag{17}$$

which imply that if the steady state net foreign asset position B^* is zero, all quantities and relative prices are equal to 1 in steady state.

Let us go back to time $t = 0$. To simplify notation, I drop the time subscript for time zero variables. The equilibrium is determined by combining forward-looking spending decisions by consumers with equilibrium in the home good market. Combining the consumer's Euler equation with the UIP, and using the fact that the foreign interest rate is $1/\beta - 1$, we have

$$C^{-\sigma} = \left(\frac{p_h}{p_h^*}\right)^{\omega} \left(C^*\right)^{-\sigma}. \tag{18}$$

Equilibrium in the domestic good market requires

$$Y = \omega p_h^{-(1-\omega)} C + \zeta p_h^{-\rho}. \tag{19}$$

The consumer flow budget constraint gives

$$\beta B^* = p_h Y - p_h^{\omega} C + B. \tag{20}$$

Finally, I assume that the central bank successfully targets an inflation rate of π so the UIP condition becomes

$$1 + i_0 = \left(\frac{p_h}{p_h^*}\right)^{\omega} \left(1 + i^*\right)\left(1 + \pi\right). \tag{21}$$

Given that prices are sticky in period 0, monetary policy has real effects: the central bank is free to choose the value of i_0 and the quantities and prices C, Y, p_h, C^*, Y^*, p_h^*, B^* are then determined by equations (13)–(15) and (18)–(21).

To complete the equilibrium characterization, we need to solve for employment N, for the price of flexible price goods, denoted by $\hat{P}_h$, and for the price indexes P_h and P. These variables are found solving the equations

$$N = JY, \tag{22}$$

$$\hat{P}_h = PC^{\sigma} N^{\phi}, \tag{23}$$

$$P_h = \left(\alpha \bar{P}_h^{1-\varepsilon} + (1-\alpha)\,\hat{P}_h^{1-\varepsilon}\right)^{\frac{1}{1-\varepsilon}}, \tag{24}$$

$$P = p_h^{-(1-\omega)} P_h, \tag{25}$$

where

$$J = \alpha \left(\frac{\bar{P}_h}{P_h}\right)^{-\varepsilon} + (1-\alpha)\left(\frac{\hat{P}_h}{P_h}\right)^{-\varepsilon}. \tag{26}$$

Equation (22) comes from labor market clearing, after summing the demand of goods (and hence of labor) of flexible price and fixed price firms. Equation (23) combines optimal price setting for flexible price firms with optimal labor supply. The following equations simply follow from the price index for home goods and the definition of p_h. The factor J captures the inefficiency associated to price dispersion, commonly found in sticky price environments, and is useful in the welfare derivations below.

3.3. A Policy Game

Suppose the central bank is committed to keep the nominal exchange rate pegged at $\mathcal{E} = 1$. Suppose also that we are coming from a period of real appreciation, so $\bar{P}_h > 1$. In the following sections, I will look more into the roots of a currency crisis and show that a real appreciation can be the by-product of boom-bust dynamics in capital flows. For now, I just take $\bar{P}_h > 1$ as an initial condition.

Given initial conditions, we analyze a game between price setters and the central bank, with the following timing:

1. the $1 - \alpha$ flexible price firms set the price $\hat{P}_h$, this determines the prices P_h and P;
2. the central bank sets the nominal interest rate i_0, this determines consumption C, the exchange rate $\mathcal{E}$ and all remaining prices and quantities.

The central bank is benevolent and its objective is to maximize domestic consumers' welfare.

For the purpose of this section, I make some additional simplifying assumptions. First, I assume that the initial asset position B_0 is zero. Second, I assume that consumers have log utility, $\sigma = 1$, and that foreign demand for domestic good is unit elastic, $\rho = 1$. Third, I assume that $\omega = \psi$, which simplifies the analysis of optimal monetary policy.

Under our additional assumptions, the domestic economy maintains a zero net foreign asset position in all periods, independently of monetary policy.[7] In particular, consumption and output in period 0 simplify to

$$C = p_h^{-\omega}, \tag{27}$$

$$Y = 1/p_h, \tag{28}$$

and the current account $P_h Y - PC$ is zero, for any value of p_h.[8] This means that the steady state allocation and welfare from period $t = 1$ onward are independent of what happens in period 0. Therefore, the central bank monetary decisions in period 0 only affect utility in period 0. Using (27) and (28), we can express period 0 utility in terms of current output, defining the function

$$W\left(Y, J\right) \equiv \omega \log Y - \frac{\psi}{1+\phi}\left(JY\right)^{1+\phi}. \tag{29}$$

I further assume that there is a fixed long-run welfare cost $\kappa > 0$ from abandoning the peg. This welfare cost could be microfounded in a richer, repeated game model in which inflation is costly, the central bank has a positive inflation bias, and a pegged exchange

[7] This result is a version of a result of Cole and Obstfeld (1991).

[8] Guess that the foreign asset position is $B^* = 0$. This implies that all steady state quantities and prices are equal to 1. Equation (18) then simplifies to (27). Substituting for C in (19) and using the assumption $\omega + \zeta = 1$ then yields (28). The current account in terms of foreign goods can then be written as $p_h Y - p_h^{\omega} C$, which equals zero since both terms are equal to 1. Since $B_0 = 0$, equation (20) then confirms the conjecture $B^* = 0$.

rate is a way to commit to a low inflation equilibrium. In such a model, abandoning the peg would trigger a Nash punishment phase with higher inflation. Here, to simplify the analysis, I just introduce an exogenous fixed cost.

We can now analyze our policy game formally. First, flexible price setters maximize expected profits and set prices according to

$$\hat{P}_h = \tilde{P}\tilde{C}\tilde{N}^{\phi}, \tag{30}$$

where the tilde denotes price setters' expectations.[9] The choice of $\hat{P}_h$ by price setters determines P_h and J through equations (24) and (26). Next, given J, the central bank chooses either to defend the peg or to abandon it. If the central bank defends the peg, the relative price p_h is equal to P_h and the value of i_0 needed to defend the peg can be derived from the UIP equation (21) (with $p_h^* = 1$). If instead the central bank decides to abandon the peg, it then chooses i_0 to maximize $W(Y, J)$. In this case, the choice of i_0 determines p_h through the UIP equation (21). In both cases, given the relative price p_h consumption, output, employment, and the consumption price index are determined, respectively, by equations (27), (28), (22), and (25). In the case of floating, the nominal exchange rate can be derived from $\mathcal{E} = p_h^{-\omega}P$. To have a Nash equilibrium, we need to check that the values of P, N, and C associated to the optimal choice of i_0 by the central bank are equal to the price setters' expectations $\tilde{P}$, $\tilde{N}$, and $\tilde{C}$.

3.4. Multiple Equilibria

We are now ready to derive the main result of this section, showing that, under some parameter configurations, the game above has multiple equilibria. In particular, there can be a "good" equilibrium in which price setters are confident in the peg and the central bank is able to maintain it, and a "bad" equilibrium in which price setters lose confidence in the peg and the central bank abandons it. The crucial step of the argument is to show that the beliefs of the price setters affect the short-run cost of defending the peg.

Consider first a good equilibrium. In a good equilibrium, price setters expect the peg to survive. In this case the relative price p_h is equal to the domestic price index P_h and the equilibrium price for flexible price firms $\hat{P}_h$ is the solution to the equation[10]

$$\hat{P}_h = \left(\frac{\alpha \bar{P}_h^{-\varepsilon} + (1-\alpha)\, \hat{P}_h^{-\varepsilon}}{\alpha \bar{P}_h^{1-\varepsilon} + (1-\alpha)\, \hat{P}_h^{1-\varepsilon}} \right)^{\phi}. \tag{31}$$

[9] Given that flexible price setters set prices before the central bank moves and are not allowed to change it afterwards, "flexible" is a bit of a misnomer here, but it is useful to distinguish them from the price setters that keep their price at $\bar{P}_h$. Allowing for a third group of price setters that act after the central bank sets i_0 would complicate the algebra, but not alter the results.

[10] Substituting $p_h = P_h$ and equating P, C, N with their expectations, yields

$$\hat{P}_h = PCN^{\phi} = P_h^{\omega} P_h^{-\omega} \left(J/P_h\right)^{\phi}.$$

Substituting (23) and (26) and rearranging gives the desired expression.

We can then use (23) and (26) to compute J. Two results are useful here: first, the domestic price level in equilibrium must satisfy

$$1 < P_h < \bar{P}_h; \tag{32}$$

second, since there is price dispersion, $J > 1$.[11] We can then turn to the central bank's behavior. If the central bank sticks to the peg, the nominal exchange rate is fixed at 1 and output is given by

$$Y^{peg,good} = 1/P_h < 1,$$

where the inequality follows from (32). Since we are coming from a period of overvaluation, if the nominal exchange rate is kept fixed, output is depressed relative to its flexible price level, which is 1. If the central bank decides to float, it can freely choose the nominal interest rate and thus determine the exchange rate and the level of output. A good equilibrium exists if the short-run gains from floating are less than the long-run costs, that is, if

$$\Delta W^{good} \equiv \max_{Y} \left\{ W\left(Y, J\right) - W\left(Y^{peg,good}, J\right) \right\} < \kappa. \tag{33}$$

Consider next a bad equilibrium. We guess and verify that an equilibrium exists in which flexible price firms expect the central bank to float and all set their price equal to the price of fixed price firms, so that

$$P_h = \hat{P}_h = \bar{P}_h.$$

Since all firms set the same price we have $J = 1$. If the central bank decides to float, it then chooses output to maximize $W(Y, 1)$. Given the definition of the function W, in (29), and given the assumption $\omega = \psi$, the optimal level of output is $Y = 1$. From (28) this requires an exchange rate equal to

$$\mathcal{E} = P_h > 1.$$

The quantities in the floating equilibrium are then equal to their flexible price level, that is,

$$C = Y = N = 1.$$

Given these prices, if instead the central bank decides to deviate and defend the peg $\mathcal{E} = 1$, we have

$$Y^{peg,bad} = 1/\bar{P}_h < Y^{peg,good} < 1. \tag{34}$$

[11] The first result can be proved using the right-hand side of (31) to construct a fixed point mapping for $\hat{P}_h$ and arguing that the fixed point must be in between the value that yields $P_h = 1$ and the value $\overline{P}_h$. The second result can be proved using a Jensen's inequality argument.

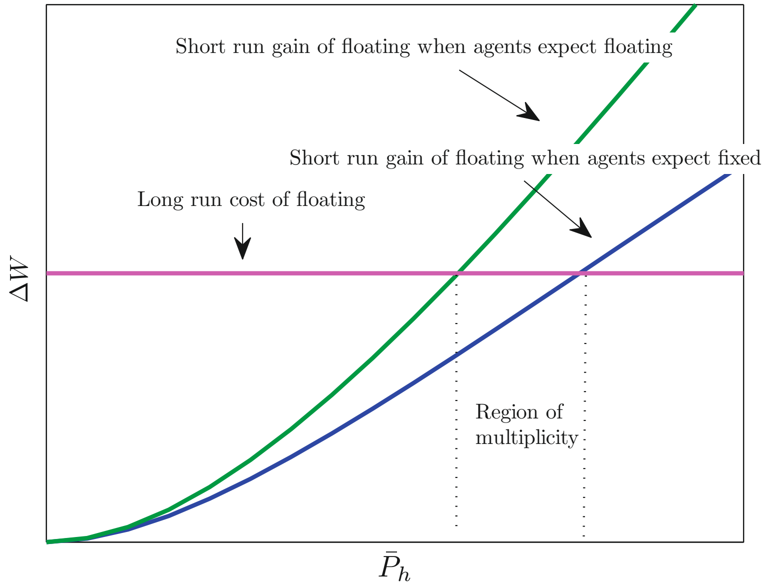

Figure 12.1 Initial Overvaluation and Multiple Equilibria

A bad equilibrium exists if the short-run gains from floating are larger than the long-run costs, that is, if

$$\Delta W^{bad} \equiv \max_{Y} \left\{ W\left(Y, 1\right) - W\left(Y^{peg,bad}, 1\right) \right\} > \kappa. \tag{35}$$

Both the good and the bad equilibrium exist if both (33) and (35) are satisfied. To understand why multiple equilibria are possible it is useful to start from interpreting inequality (34). If price setters expect the central bank to defend the peg, they lower their prices to a value lower than $\bar{P}_h$, as per equation (32). In this case, the real exchange rate is overvalued (and output is depressed), but at least the country achieves some amount of real exchange rate devaluation via domestic deflation. If instead price setters expect the central bank to float they keep the price level at $\bar{P}_h > 1$. If then the central bank decides to defend the peg, the real exchange rate is more overvalued and domestic output is more depressed than in the case of optimistic expectations. Therefore, when price setters expect the peg to be abandoned, their pricing decisions make it more costly for the central bank to defend the peg.[12]

The possibility of multiple equilibria is illustrated in Figure 12.1. The figure shows a numerical example in which ΔW^{bad} and ΔW^{good} are computed for different values

[12] The presence of the term $J > 1$ in (33) reinforces this argument, as the distortion due to price dispersion also reduces the benefits from increasing output under optimistic expectations.

of the initial price level $\bar{P}_h$. Both gains coincide and are equal to 0 when $\bar{P}_h = 1$, since then the optimal policy after floating is to leave the exchange rate unchanged. As $\bar{P}_h$ increases, the gain from floating increases both under "good" and "bad" expectations, but it increases more under bad expectations. The figure shows that when $\bar{P}_h$ is large enough we have $\Delta W^{bad} > \kappa$ and $\Delta W^{good} < \kappa$ so both equilibria are possible. In other words, the possibility of multiple equilibria depends on the initial degree of overvaluation. When $\bar{P}_h$ is sufficiently large the good equilibrium disappear and the unique equilibrium involves a certain abandonment of the peg.

There are two main reasons why a country may find itself with an overvalued exchange rate. A first case, is a country that is using a fixed exchange rate to anchor inflation expectations. If the inflation stabilization program is not fully credible, inflation will adjust downward gradually. As the exchange rate is pegged, the domestic currency will then gradually appreciate. These dynamics were the subject of a rich literature in the 1980s, that aimed to explain the difficult experiences of many countries that attempted exchange-rate-based stabilizations.[13] A second case, is a country that experiences positive capital flows that go to finance a boom in domestic spending. The boom will lead to a domestic appreciation, both due to an increase in the price of non-tradables and to an increase in the price of domestically produced tradables (due to home bias in spending). If the capital flow slows down, or worse, is reversed, the country will find itself with an overvalued exchange rate. These capital flow reversals are the subject of Section 4. Of course, these two elements may go hand in hand, and indeed several countries have experienced domestic consumption booms associated to exchange-rate-based stabilizations.

The exposition above emphasizes overvaluation as the original imbalance tilting the incentives of the central bank in favor of abandoning the peg. Other shocks may push the economy in a region where the peg may be abandoned in equilibrium. In particular, Obstfeld (1994a) aimed to develop a model to describe the currency attacks of 1992–1993 leading to sharp devaluations in Britain, Italy, Spain, and Sweden. The countries attacked did not fit the model of fiscal-monetary imbalances of Section 2. Some displayed an overvalued real exchange rate. But the common element was that they were all facing recessionary shocks that made a defense of the peg especially costly.[14] It is easy to adapt the model above to introduce these types of recessionary shocks and to show that a large enough shock can push the economy in the multiple-equilibria region.[15]

[13] See Calvo and Végh (1999) for a comprehensive review of the literature on inflation stabilizations and balance of payment crises.

[14] A common shock was an increase in interest rates in Germany, in response to the expansionary fiscal policies enacted following Germany's reunification. Sweden was also facing the contractionary effects of a banking crisis.

[15] Notice also that multiple equilibria are also possible in models that emphasize fiscal-monetary interactions as the one examined in Section 2. In fact, the seminal Obstfeld (1986) article first discusses the possibility of multiple equilibria in currency crises in the context of a similar model.

A feature of the Obstfeld (1994a) model is that the cost of defending the peg arises because people expected in the past that the exchange rate will be devalued today. In the model above, this was captured in the timing: first flexible firms were choosing prices, then the central bank was choosing the nominal rate. Krugman (1996) notices that an alternative modeling approach is to assume that the fixed rate is costly to defend, because agents expect now that the peg will be devalued in the future. By UIP, a higher expected nominal exchange rate in the future requires a higher nominal interest rate today, if the nominal exchange rate today is to remain fixed. But increasing the nominal exchange rate today leads to output losses. So a large expected devaluation may push the central bank to abandon the peg. This alternative modeling approach seems to capture well the dynamics of the devaluation of the Swedish krona 1992, in which the central bank abandoned the peg after attempting a defense with sharp increases in the nominal interest rate. Extending the new Keynesian model to capture this forward-looking channel seems a promising avenue to explore.

3.5. A Detour: Multiple Equilibria and Global Games

The model above displays multiple equilibria. Models with multiple equilibria capture well situations in which a change in sentiment can trigger a sudden, dramatic change in economic outcomes. In some crises, market participants seem to be unaware of any looming problem until some critical moment in which prices and financial flows take a sharp turn following no apparent shock to fundamentals. For example, Radelet and Sachs (1998) make a compelling case that in the case of the East Asian crisis of 1997 there were very few warning signs and the crisis was mostly unexpected. In other crises, the critical point is reached after a gradual and inexorable process of deterioration, so that market participants are hardly taken by surprise, as for example in the case of Argentina's default in 2001. The first type of episodes are usually taken as natural candidates for multiple-equilibria stories. In this chapter, I use multiple equilibria as a useful device to identify feedback effects. In practice these effects may not be strong enough to generate multiplicity, but still be powerful sources of amplification.

The literature has sometimes overly emphasized the distance between multiple-equilibria models and models driven by fundamentals. As shown in Figure 12.1, the possibility of a bad equilibrium is not independent of fundamentals, as multiple equilibria are only possible when the currency is sufficiently overvalued and if it is too overvalued a devaluation is the unique outcome. Still, if we are in the region of multiplicity, the model's predictions are not tight: we know that a devaluation is possible, but the probability of a devaluation is not monotonically related to the degree of overvaluation and indeed the relation between the two can be completely arbitrary.

A large theoretical literature, starting from Carlsson and Van Damme (1993) and Morris and Shin (1998), has used a so-called "global games" approach to reduce the distance between multiple equilibrium models and models with a unique equilibrium.

The idea of these models is not to ignore the strength of amplification effects or the possibility of discrete jumps between different outcomes, but to obtain sharper predictions on the occurrence of crises, speculative attacks, devaluations, and so on. These tighter predictions should make both empirical testing and policy analysis easier to conduct.[16] While this approach has been applied to a variety of applied contexts, currency crises have been prominent examples, as in the benchmark model used by Morris and Shin (1998).

The starting point of Morris and Shin (1998) is a simple game-theoretic model, with a single unobservable state, call it θ, which captures some aggregate fundamental. The central bank is facing a continuum of speculators, who have a binary choice: attack the currency or not. The central bank prefers to defend the peg if θ is high enough *and* not too many speculators are attacking. On the other hand, the speculators' gain from attacking is positive only if the central bank abandons the peg and devalues. Since the central bank moves after the speculators make their decision, we can solve for the central bank's best response and analyze the game just as a coordination game among the speculators. This game displays strategic complementarity: more speculators attacking increases the benefits of attacking for any individual speculator, because it increases the chances that the central bank will devalue. Under perfect information, this coordination game admits two equilibria if the parameter θ is in some region $\left[\underline{\theta}, \overline{\theta}\right]$. In this region, a speculative attack is a purely self-fulfilling event.

The novelty of Morris and Shin (1998) is to add a small amount of imperfect information in the game above. The speculators, instead of observing θ exactly, observe it perturbed by noise, namely they observe $\theta + \epsilon_i$, where ϵ_i is an agent-specific idiosyncratic shock. Morris and Shin (1998) show that with this modification the model delivers a unique equilibrium and that this uniqueness survives even as we make the noise vanishingly small. The idea of the uniqueness argument is that coordination failures require a high degree of coordination in expectations. If agents are uncertain about other agents' beliefs on the country's fundamental, they will take into account that some other agents may get a sufficiently positive signal that they will decide to not attack the currency irrespective of the behavior of others, or that they may get a sufficiently negative signal that they will decide to attack irrespective of the behavior of others. If this is not a situation they are contemplating, they may still contemplate the possibility that other agents may contemplate this situation, or the possibility that other agents are contemplating this possibility, and so forth. Once this uncertainty is made explicit into the model it is possible to prove uniqueness, using an argument based on iterated deletion of dominated strategies.[17]

For the purpose of deriving uniqueness results and of understanding their logic, it is useful to send the noise in private signals to zero. However, from the point of view of

[16] The econometrics of multiple equilibria is growing, but there are few applications to the case of currency crises. An exception is Jeanne (1997).

[17] See Proposition 2.1 in Morris and Shin (2001a).

applications, models with non-negligible amounts of private noise have nice properties. In particular, if we also enrich the information structure by letting all speculators observe a public signal $y = \theta + \eta$, we get a model in which, when y is in some range, the probability of a currency attack is in between zero and one, and is monotonically increasing in y. That is, we have a model in which there is a self-fulfilling element to a crisis, in the sense that a bad outcome is triggered by enough agents having pessimistic expectations, and, at the same time, there are tight predictions about the stochastic process generated by the model.[18]

The role of policy in the Morris and Shin (1998) game is fairly limited, as the central bank responds mechanically to the actions of the speculators. Things get more interesting on the policy front if we consider the possibility of policy intervening before speculators act—for example, by trying to defend the peg with domestic interest rate increases—and if we consider the possibility that the policy-maker has privileged access to information on the country's fundamentals (which include parameters in the policy-maker objective function). Then, the actions of the policy-maker can be interpreted in different ways by market participants, leading to very different outcomes. For example, a central bank may signal its determination to defend the peg by raising interest rates sharply, but the same intervention may also signal its desperation and thus accelerate an attack. The concern with how policy interventions will be interpreted by the markets is always present in policy discussions preceding crises. Angeletos et al. (2006) explore this question in a currency attack model similar to that used in Morris and Shin (1998). They show that the endogeneity of policy can undermine the uniqueness result and that multiple regimes are possible in which the same actions of the central bank can be interpreted in different ways. Moreover, they show that preventive policy interventions arise only when fundamentals are in an intermediate range, which means that, for example, if the policy-maker knows fundamentals are weak but not too weak, the signaling cost of intervening outweighs the benefit of the intervention itself. The paper also emphasizes that the market expectations about policy actions can impair the effectiveness of policy. This idea of "policy traps," may be useful to capture the difficulty facing emerging economies who, in the language of Qian et al. (2010), try to "graduate" from a pattern of recurrent crises.

Morris and Shin (2001a) notice that the presence of sufficiently informative public signals can undermine the uniqueness result. In market interactions, asset prices typically provide endogenous sources of public information. Therefore, an important question is whether the information in asset prices is sufficiently strong to generate multiplicity. Angeletos and Werning (2006) and Hellwig et al. (2006) address this question and, at the same time, provide useful tools to develop rational expectations equilibria with partially revealing prices in crisis settings.

[18] See Morris and Shin (2001b).

4. FINANCIAL FLOWS, SUDDEN STOPS, AND BALANCE SHEET EFFECTS

In the models seen so far, financial flows do not play a prominent role. Capital mobility of course places a constraint on the conduct of monetary policy and this is captured by the UIP condition. This means that there is an off-the-equilibrium-path threat of an unbounded capital flight if the domestic interest rate ever deviates from UIP. But since the UIP is satisfied in equilibrium, equilibrium capital flows do not play much of a role. In the one good economy of Section 2, capital flows are indeterminate, while in the two goods economy of Section 3 we made simplifying assumptions that implied a zero current account balance in all periods.

In this section, I turn to models where financial flows play a more direct role in the story. As more countries liberalized their capital accounts through the 1980s and 1990s, we have witnessed an increasing number of episodes of capital flow reversals. A country is running a persistent current account deficit, which may go to finance the government deficit or a consumption or investment boom in the private sector. At some point a domestic or external shock hits and the country loses the ability to raise external finance, leading to a sudden contraction in the current account deficit. The adjustment following these episodes typically involves a recession and a sharp exchange rate depreciation. If the country is pegging its currency, the peg is typically abandoned. This type of event has been dubbed a sudden stop by Dornbusch et al. (1995) and Calvo (1998). In this section, I discuss macroeconomic adjustment following a sudden stop, taking the event as purely exogenous. In the following sections, I will discuss possible reasons behind the stop and possible interpretations of the boom-bust dynamics leading to it.

The main stylized facts on sudden stop events were first documented in Reinhart and Calvo (2000) and Ferretti and Razin (2000). Mendoza (2010) offers a recent update looking at 33 episodes identified by Calvo et al. (2006): in the median episode, net exports to GDP go from −2% to a positive 1% in the year of the sudden stop, so the median current account reversal is about 3%, this is associated to a severe recession, with GDP going from 3% above trend to 4% below trend, consumption going from 4% above trend to 4% below trend, and investment going from about 12% above trend to about 20% below trend. Other regularities include a sharp depreciation of the real exchange, a sharp fall in the domestic stock market and in credit conditions (Calvo et al., 2004; Calvo et al, 2006).

Many pointers suggest that domestic fiscal conditions are not always the main culprit in these episodes and that a crisis may be purely triggered by a cutback in financial flows driven by external factors. First, there are episodes in which public debt clearly plays a minor role and in which most of the capital flows preceding the crisis were going to the private sector. For example, at the inception of the 1997 crisis, Korea's public debt hovered around only 10% of GDP. Second, there are "contagious" episodes, in which a generalized retreat of international investors from risky assets hits several countries unrelated by geography, trade, or institutions. An outstanding example is given by the events following the Russian August 1998 crisis, in which virtually all emerging markets suffered serious sudden stops and increases in country risk premia.

It is possible to interpret a sudden stop episode as driven purely by news about the growth prospect of the domestic economy. A standard permanent-income argument implies that a country facing a reduction in growth prospects will cut back on consumption. This adjustment can lead to a reversal in capital flows if the reduction in permanent income is larger than the reduction in current income. Standard business cycle models that focus on transitory deviations of income from a deterministic trend cannot generate this outcome. However, Aguiar and Gopinath (2007) show that enriching an open economy Real Business Cycle model with shocks to the growth rate of TFP can generate current account reversals and they offer a calibrated interpretation of Mexico's 1994 crisis along these lines. However, the bulk of the literature on sudden stops has put financial constraints at the center of the story, assuming that the domestic economy has imperfect access to international capital markets and that this access is restricted in a sudden stop episode (either for domestic or external reasons).[19]

It will be useful to explore a sudden stop in the context of a model in which external debt is denominated in foreign currency, since this opens the door to valuation effects that make the adjustment especially painful. The role of foreign-denominated debt was highlighted by several researchers following the Asian crisis of 1997–1998, in particular by Krugman (1998) and Aghion et al. (2000).

Consider the economy introduced in Section 3.1 and suppose the economy is coming from a period of current account deficits and has accumulated a stock of debt D, denominated in foreign currency. The initial net foreign asset position in domestic currency is thus $B_0 = -D$. Suppose the economy has reached a steady state at date 0—characterized by equations (13), (14), and (15)—and is keeping its foreign debt constant at D and paying interests on it each period. A shock hits which makes foreign investors concerned about the country's ability or willingness to repay in the future. Following this shock, foreign investors are willing only to finance a maximum stock of debt $\bar{D} < D$ in all future dates.[20] This implies that the country has to make a sharp correction in the current account, which needs to go from zero—since we start from a steady state with constant debt—to a temporary surplus in the adjustment period. After the adjustment period, the country goes back to a different steady state, in which it repays only the interest on $\bar{D}$. This tightening of the borrowing limit is a simple form of sudden stop.[21]

[19] Clearly, shocks to the country's growth prospects can be an important driver of the domestic country's access to external finance. In fact, Aguiar and Gopinath (2006) first introduced growth-rate shocks in the context of a model in which the country has imperfect access to domestic capital markets due to domestic default risk.

[20] The model does not explicitly allow for default, so here I am just giving an informal story for the capital flight. Models with default will be discussed in the next sections.

[21] Starting the economy in a steady state with zero current account is a convenient simplification. The results are similar if we use as a term of comparison not a steady state with constant current account but a period of current account deficit.

Since the country faces a binding financial constraint and has to make a large repayment in the first period, the Euler equation becomes an inequality and C is determined by the flow budget constraint

$$C = \frac{p_h Y - \Delta}{p_h^{\omega}}, \tag{36}$$

where $\Delta = D - \beta \bar{D}$ is the trade balance needed to reach the new debt level. Substituting for C in the goods market equilibrium condition (19) we then obtain

$$Y = \omega \frac{p_h Y - \Delta}{p_h} + \zeta p_h^{-\rho}. \tag{37}$$

4.1. Adjustment with Flexible Prices

Consider first the case in which prices are flexible. In this case, combining optimal price setting with labor market equilibrium we obtain a relation analogous to (14). After substituting (36) and rearranging yields the following relation between the relative price p_h and output,

$$p_h^{1-\omega+\sigma\omega} = \left(p_h Y - \Delta\right)^{\sigma} Y^{\phi}. \tag{38}$$

Under flexible prices the equilibrium values of Y and p_h are then found solving equations (37) and (38). Monetary policy can affect the nominal exchange rate, but has no effects on the real allocation and on relative prices. In particular, if the nominal exchange rate $\mathcal{E}_0$ is fixed, the price P_{h0} adjusts to ensure that (37) and (38) are satisfied. The flexible price benchmark provides useful insights about the problems facing a country that needs to quickly repay external debt denominated in foreign currency.

Leaving aside our dynamic setup for a moment, we can look at equations (37) and (38) as two standard demand and supply equations in a static Walrasian economy, except that the domestic consumer holds a "negative endowment" of the foreign good $-\Delta$. Then we can make the following observations:

- the demand of domestic consumers in (37) is increasing in p_h due to an income effect and to the foreign denomination of domestic debt: as the relative price of the domestic good increases it gets less costly to repay debt, boosting domestic demand;
- the demand of foreign consumers in (37) is decreasing in p_h due to a substitution effect, since the economy is small there are no income effects on foreign consumers;
- the supply of domestic goods in (38) may be increasing or decreasing in p_h depending on the relative strength of the income and substitution effect for domestic workers and the presence of Δ tends to reinforce the income effect.

Figure 12.2 illustrates a numerical example, comparing the equilibrium in the original steady state (which is given by the same equations with $\Delta = 0$) and after a sudden stop. Let us focus first on the non-monotone demand curve. A lower relative price of domestic goods means that the real burden of debt repayment is large. This impoverishes domestic

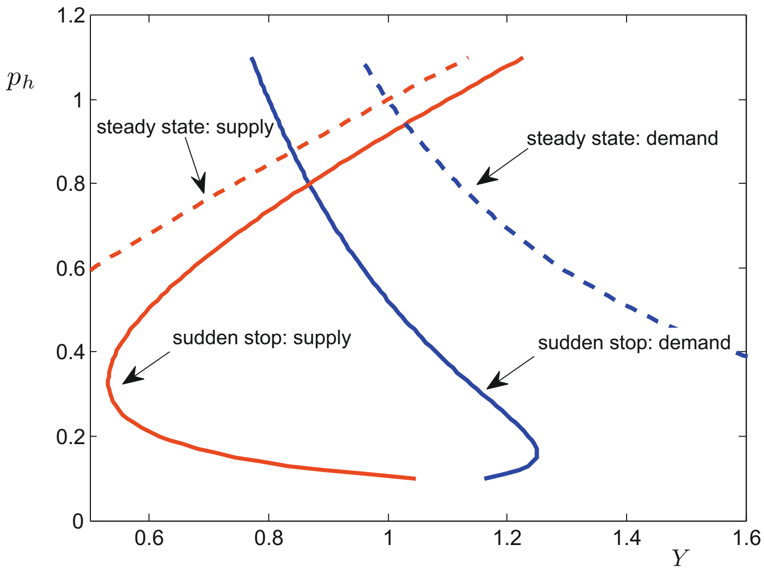

Figure 12.2 Output and the Real Exchange Rate in a Sudden Stop

consumers and depresses domestic demand. Due to the depreciated real exchange rate, higher foreign demand can make up for the drop in domestic demand. However, if foreign demand is not sufficiently elastic, it is possible that a large depreciation ends up having a stronger depressing effect on domestic demand—through the balance sheet channel—than the expansionary effect through the external channel. In the figure, for example, this happens for a real exchange rate lower than 0.2. The general point here is that balance sheet effects can make aggregate demand for domestic output relatively unresponsive to a domestic depreciation. This leads to a sharper contraction in output and to a sharper devaluation.

The mechanism at work here goes back to the so-called "transfer problem" of Keynes (1929): as the country needs to make a transfer to the rest of the world, the relative demand for domestic goods is depressed, making it harder for the country to repay. The problem is especially bad for a small open economy, as the transfer Δ received by foreign consumers has no expansionary effect on foreign spending on domestic goods, as only an infinitesimal fraction of foreign spending goes toward goods produced in the home economy.

The non-monotonicity of the demand curve implies that multiple equilibria are possible, as illustrated in the figure.[22] Here, I focus on the equilibrium with the higher

[22] In the figure we only see two equilibria, while in general equilibrium we are used to finding an odd number of equilibria (and to rule out unstable ones). The problem here is the presence of a region in which the price is so low that consumption would be negative. To resolve the issue we can assume that when the burden of debt repayment gets

exchange rate, but the presence of multiplicity emphasizes the power of the feedback effect at work. The general point is that if a country is forced to make a large payment in foreign goods in a short period of time, the general equilibrium effects on the real exchange rate can make the burden of repayment very costly.

Turning to the supply side, notice that the need to repay Δ shifts the supply curve to the right. In the example illustrated in Figure 12.2, this effect is not too strong and in equilibrium the demand shift dominates, leading to a reduction in equilibrium output. However, under different parameterizations it is possible to obtain the opposite result, leading to a sharp depreciation with a domestic boom in output. The observation that a sudden stop can generate a domestic output boom through income effects was recently made by Chari et al. (2005).[23]

Martin and Rey (2006) is a recent paper that emphasizes the role of the feedback between domestic demand and relative prices in a stochastic two-country, two-period model that focuses on investment and asset pricing. Domestic firms have to make an initial investment to produce domestic goods. If they choose to invest, domestic wealth is higher and demand for domestic goods is higher. Due to home bias in consumption, this generates strategic complementarity in investment decisions, which yields multiple equilibria, one with a positive amount of domestic investment and one with zero domestic investment. Interestingly, this multiplicity arises when financial markets are at an intermediate level of integration. If trading assets across borders is very costly, domestic savers have no option but to invest in domestic firms, which rules out a bad equilibrium with zero domestic investment. If trading assets across borders is very easy, domestic savers can perfectly diversify, breaking the link between the profits of domestic firms and the wealth of domestic consumers.[24]

4.2. A Monetary Policy Dilemma

Now let us go back to the model with nominal rigidities as in Section 3.2. To simplify things, suppose that all producers have pre-set prices at $t = 0$ (that is, $\alpha = 1$). Then, equation (38) drops from the system and the determination of output and the real exchange rate depends on monetary policy. In other words, by choosing the nominal interest rate, the central bank chooses a point on the demand curve (37).

Now we must distinguish what happens under different exchange rate regimes. If the exchange rate is fixed and the central bank decides to defend the peg, the real exchange rate remains at its steady state level of 1 and the drop in output can be read directly from the shift in the demand curve at $p_h = 1$ in Figure 12.2. In other words, we are

too large, the country renegotiates debt repayments to reach some minimum consumption level $\underline{C}$. This makes the demand curve downward sloping for low levels of p_h yielding a third equilibrium.

[23] In particular, if we assume $\sigma = 1$ and so have preferences consistent with balanced growth, the response of output is always positive.

[24] A paper that also exploits a home-bias feedback, to capture the possibility of inefficient diversification, albeit not in an explicit international context, is DeMarzo et al. (2005).

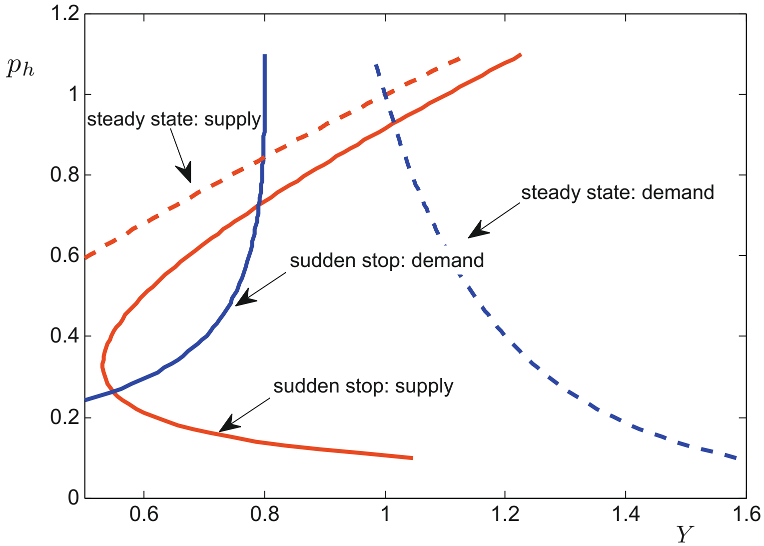

Figure 12.3 Output and the Real Exchange Rate in a Sudden Stop: The Case of a Contractionary Devaluation

in a situation in which, at the goods prices inherited from the past, the real exchange rate is overvalued relative to the level that would deliver the "natural" level of output. In other words, to sustain the peg the central bank has to be ready to accept a deep recession. Notice that this is a situation very much like the one analyzed in Section 3, where an overvalued exchange rate was taken as a primitive. Now we made some progress in explaining what can be the shock that puts a country in the position of suffering a currency attack. A sudden stop in capital flows can make the real exchange rate inherited from the past too high. If the central bank had committed to a peg, a sudden stop can make the commitment especially costly and create a situation in which a self-fulfilling shift in expectations may produce a currency crisis. This relation between sudden stops and currency crises was first emphasized in Calvo (1998). The empirical literature has noticed that not all current account reversals are associated to currency crises, but that the presence of a current account reversal increases the probability of a currency crisis (Hutchison and Noy, 2006). This discussion points out that the notion of an "overvalued" exchange rate shouldn't be an absolute notion based on some deviation from trend, but rather it should be based on the ability of a country to reach its potential output, given the capital flows it is able to attract at a given point in time.

Consider next what happens if we are in a flexible exchange rate regime or if we are in a fixed exchange rate regime and the central bank decides to abandon the peg. Now the central bank faces a potential dilemma. Letting the exchange rate depreciate can stimulate external demand, but, through the valuation channel, it can depress domestic demand even more. The non-monotonicity of the demand curve in Figure 12.2 captures this dilemma. In Figure 12.3, I show an example in which a devaluation would be counterproductive. Of course, in reality there is considerable uncertainty on the shape of the demand curve and on its slope at different levels of the domestic interest rate, making it hard to assess the potential benefits of a devaluation. The observation that valuation channels can generate non-monotone responses of domestic demand to the exchange rate was made by DeLong (2001) in the context of a standard IS-LM model.

4.3. Financial Frictions

In the model presented here I have emphasized a simple aggregate financial friction, modeling the domestic economy as a representative agent that faces an aggregate borrowing limit and using a model with no investment. In practice, domestic financial markets are at least partially segmented, and, in a crisis, a cutback in foreign lending may hit with different force different domestic agents. Moreover, loss of access to external financing for domestic firms and banks will also have depressing effects on investment spending. The role of segmented domestic financial markets has been explored in Caballero and Krishnamurthy (2001), who have emphasized how loss of access to foreign financing for some agents can lead to higher financing premia in domestic financial markets. The role of a tightening financial constraint on investment and the role of firms' balance sheets are analyzed in Aghion et al. (2004).

In the model presented, I have emphasized the idea that financing restrictions and balance sheet effects bite on the demand side. However, once we introduce the possibility that firms are financially constrained, it is possible that the availability of outside finance affects firms' ability to hire workers, either because hiring is a form of investment or through some working-capital constraint. Then a sudden stop can also lead to a depressed labor demand, and thus to a leftward shift of the supply curve. The model presented also abstracts from asset prices. Domestic asset prices can drop dramatically in a sudden stop and this drop can have real effects, through credit availability and collateral constraints. These additional ingredients have been explored in the large literature on the role of financial frictions in open economies. A partial list of papers that have developed small scale dynamic models to analyze sudden stops includes Mendoza (2002), Christiano et al. (2004), Cook and Devereux (2006), Cúrdia (2007), Gertler et al. (2007), Braggion et al. (2009), Mendoza (2010). These papers incorporate some version of a collateral constraint in the spirit of Kiyotaki and Moore (1997) and Bernanke et al. (1999), where the value of collateral responds to asset prices and to the real exchange rate. In some of these papers outside finance is required to pay wages, with a working-capital constraint of the type introduced in Neumeyer and Perri (2005). This type of constraint introduces the possibility of a contractionary supply side effect of a devaluation. Christiano et al. (2004) focus on the effects of monetary policy and show the possibility of a contractionary effect of lower nominal interest rates, where the contractionary effect is due to the associated real devaluation, as in the simple case illustrated in Figure 12.3.[25] Mendoza (2010) argues that the presence of endogenous asset prices plays an important role in the quantitative performance of this class of models. He also argues that for the sudden stop to have large effects it must hit an economy that has accumulated sufficient leverage, so that an asset price correction has an amplified effect on net worth. We return to these issues in Section 6.

5. SPREAD SPIRALS AND ROLLOVER CRISES

In this section, we explore some ways in which a country can lose access to international credit, focusing on the possibility that international investors get concerned about the country's ability to repay. This requires modeling explicitly the possibility of default. There is a huge literature that studies international borrowing with the possibility of default (see Chapter 11 by Aguiar and Amador in this handbook). Given that the focus of this chapter is crisis episodes, here I focus on the risk of default as a potential source of instability, focusing on two mechanisms that seem especially important in international debt crises.

The first mechanism focuses on the equilibrium determination of the sovereign spread, the difference between the interest rate at which a country can borrow and a benchmark risk-free world interest rate. If international investors lose confidence in a government's ability to repay its debt, they demand higher rates of return, to be compensated for the possibility of default. These higher rates of return imply that, for a given level of the primary deficit, the stock of debt accumulates faster. Over time, the stock of debt will then reach a level that triggers a default episode, thus validating the concerns of international investors. This narrative has been recently used in the context of the recent crisis in the euro area, to interpret the sudden increase in sovereign spreads on government debt issued by Italy and Spain in the Summer of 2011. The change did not seem triggered by any specific exogenous event and has been interpreted as the possible result of a self-fulfilling switch to pessimistic expectations in international capital markets. As in the case of instability and multiple equilibria associated to a real exchange rate overvaluation, the country's initial conditions—in particular, the initial stock of debt—are crucial for the possibility of a self-fulfilling crisis in sovereign spreads.

A related source of fragility/multiplicity, also relevant in sovereign debt crises, is the possibility of lack of coordination between creditors in a situation in which the government needs to roll over a sizable amount of debt. At some point, international investors may lose faith in the ability of a sovereign to successfully roll over its debt. This implies that the government may have trouble placing new bond issues in auctions or borrowing

[25] An important difference with the model developed here is that real exchange rate movements in their model, and in most of the papers discussed, are driven by the relative price of tradables vs non-tradables, rather than by the relative price of home vs foreign goods. This rules out the "transfer" problem channel emphasized above, given that, by definition, net trade of non-tradables with the rest of the world is zero.

from foreign banks. Given the lack of liquidity, the government may find the only way out in some form of default or restructuring. Therefore, the initial change of sentiment of the investors can be self-fulfilling.

In this section, I present a simple model that captures these two mechanisms—the feedback between spreads and debt-accumulation and coordination failures in debt rollovers. I will first show how both forms of fragility can arise. Then, I will show that assumptions about timing and about the size of the investors are crucial in determining the possibility of multiplicity.

5.1. A Model of Debt Dynamics and Default

The possibility of self-fulfilling crises due to some form of government's repudiation on its debt obligations goes back at least to Calvo (1988). The main model in Calvo (1988) considers the case in which debt is denominated in domestic currency and default is achieved via inflation, which reduces the real value of a given stock of nominal debt. Here I present a dynamic variant that focuses on outright default, based on Lorenzoni and Werning (2013). Early papers that focus on explicit default are Alesina et al. (1990) and Giavazzi and Pagano (1990). Unlike in most of the recent literature, I do not microfound the government's behavior and assume it follows an exogenous rule, so I can focus on the coordination problem among investors. A similar approach is taken in Ghosh et al. (2011). Time is infinite and discrete. A government starts at $t = 0$ with a stock D_0 of one-period bonds to repay. At the beginning of each period t the government stock of debt is D_t and the government runs a primary fiscal surplus S_t, which is used to repay debt. The difference between debt repayments D_t and the surplus S_t is covered by new issuances of one-period bonds, at the price Q_t. So the government's budget constraint, if default does not occur, is

$$Q_t D_{t+1} = D_t - S_t. \tag{39}$$

We assume that S_t is an exogenous i.i.d. random variable with c.d.f. F, and that the government's behavior is completely mechanical: as long as it can, the government rolls over its debt. Government debt is held by risk neutral investors that discount the future at rate β and, for simplicity, I assume investors receive nothing in the event of default. So the equilibrium bond price must satisfy the rational expectation condition

$$Q_t = \beta \Pr\left[\text{Repayment at time } t+1\right].$$

We now look for equilibria in which default depends only on the current net financing need $N_t = D_t - S_t$. More precisely, we look for Markov equilibria in which N_t is the relevant state variable and the bond price satisfies these properties:

- when N_t exceeds some threshold $\overline{N} > 0$, the bond price Q_t jumps to zero, the government is unable to rollover its bonds, and we have default;
- when N_t is below some threshold $\underline{N}$, the probability of default is zero and the bond price Q_t is equal to the investors' discount factor β;

- when N_t is in the intermediate range $\left(\underline{N}, \overline{N}\right)$, there is no default today but a positive probability of default in the next period and the bond price is $Q_t \in (0, \beta)$.

From the point of view of time t, the probability of default at $t+1$ is $F\left(D_{t+1} - \overline{N}\right)$, since the government will repay if $D_{t+1} - S_{t+1} \leq \overline{N}$. Combining rational expectations and the government budget constraint, we then have the condition

$$Q_t = \beta \left(1 - F\left(\frac{D_t - S_t}{Q_t} - \overline{N}\right)\right). \tag{40}$$

Depending on the distribution F and on the value of the financing need $D_t - S_t$, there can be multiple positive values of Q_t that solve this equation. This possibility is illustrated in Figure 12.4, for an example in which the distribution F is log-normal. The three curves correspond to the expression on the right-hand side of (40), for three different values of $D_t - S_t$. An equilibrium price corresponds to a value of Q_t for which these curves cross the 45° line.

Let us analyze now each of the three configurations in Figure 12.4. The topmost curve corresponds to a low value of $D_t - S_t$. In this case, the only positive Q_t that satisfies (40) is β. In this case, the country's financing needs are low enough that the investors expect the country to repay for sure in the next period. The bottom curve, on the other hand, corresponds to a value of $D_t - S_t$ high enough that the only positive Q_t that satisfies (40) is smaller than β. In this case, the country's financing needs are high enough that

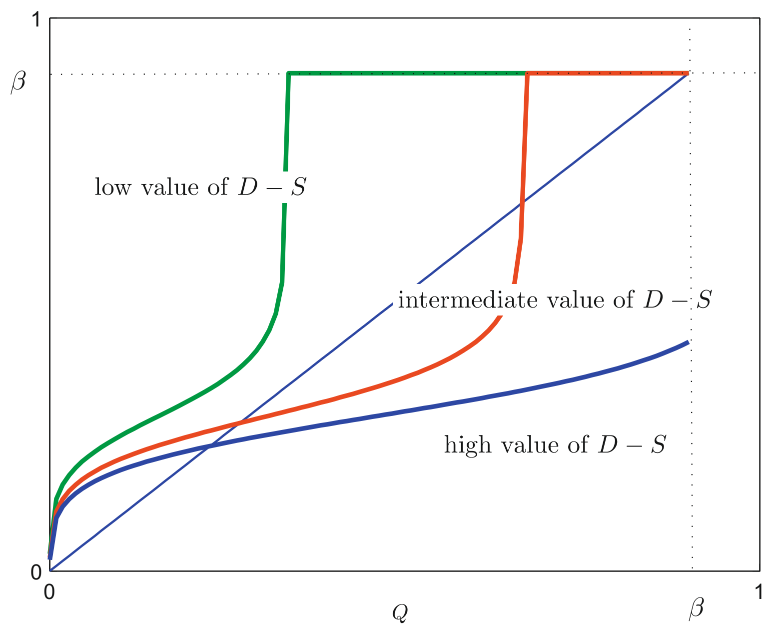

Figure 12.4 Multiple Equilibria in Bond Prices

the investors expect the country to default with positive probability in the next period. The most interesting case is the intermediate curve. In this case, there are two possible positive equilibrium values of Q_t, one smaller and one equal to β.[26] If international investors expect the country to repay for sure next period, they demand a low interest rate, i.e., they are willing to pay a high price for the bond. The country then accumulates debt more slowly (remember that debt next period is $(D_t - S_t)/Q_t$) and this implies that the country won't be forced into default next period for any realization of S_{t+1}. If instead international investors expect the country to default with some probability, they demand a high interest rate, i.e., they offer a low bond price. The country accumulates debt faster and so it enters the default region with positive probability next period.

The multiplicity illustrated in Figure 12.4 captures the feedback between cost of borrowing and debt accumulation. Notice that the dynamics of the model also capture well the cumulative nature of the process: if the bad equilibrium is played in one period, debt accumulates faster. So, in the following period, if default does not take place, the country is more likely to remain in the multiple equilibrium region. An important observation is that the initial stock of debt is crucial in determining whether a country can enter the multiplicity region in which market sentiment can set in motion a cumulative process leading to default.

The model also captures the second form of multiplicity discussed above, which here is captured by the possibility of switching to the "very bad" equilibrium with $Q_t = 0$. That equilibrium reflects a situation in which creditors coordinate on expecting instantaneous default and, indeed, default occurs. In the construction above, I assumed that this possibility only materializes when $D_t - S_t > \overline{N}$, but that was just a way of constructing a possible equilibrium. Notice also that the construction above leaves to some extent indeterminate the choice of the cutoff $\overline{N}$ itself.

Both forms of multiplicity stem from a coordination problem among lenders at time t. However, they differ in the nature of the problem. In the first case, miscoordination does not cause a liquidity crisis right away, but it leads the country to accumulate debt at a faster rate and, thus, to a higher probability of a future crisis. In the second case, miscoordination leads to an instantaneous lack of funding. In the first case, lenders are worried that the bidding behavior of other lenders in the bond market will make debt accumulate faster and thus increase the probability of default. In the second case, lenders are worried that the government will simply be unable to raise the needed funds today.

I have illustrated the logic of both types of multiplicity in the context of a standard model based on a mechanical use of the dynamic budget constraint (39). The advantage of this approach is that it is only a step away from so-called "debt sustainability" exercises, which are used in practice to evaluate the repayment prospects of governments and countries. The model here shows that once we endogenize bond prices and default

[26] There is a third equilibrium with $Q_t > 0$, which we can rule out based on a usual stability argument. The same argument can be used to rule out the equilibrium at $Q_t = 0$ which always exists as long as $D_t > S_t$.

events, the model can display multiple equilibria, making debt dynamics especially hard to forecast. A natural next step is to enrich the model by letting the fiscal surplus S_t respond to the debt stock and to the cost of borrowing. Lorenzoni and Werning (2013) follow this route and explore how different fiscal rules can help rule out bad equilibria. The following step is to fully endogenize both the decision to adjust S_t and the decision to default, by specifying an objective function for the government and solving for its optimal behavior. There is a large recent literature on sovereign debt that follows this approach and is reviewed extensively by Aguiar and Amador in Chapter 11 of this handbook. A subset of this literature explores the possibility of multiple equilibria. In particular, I will discuss Cole and Kehoe (2000) below.

5.2. Timing and Coordination Issues, Liquidity Crises

While the simple model just developed captures nicely our two sources of instability in debt accumulation, it is sensitive to the assumptions made on the timing of the game between the government and the investors. If we change a bit our assumptions the multiplicity identified in Figure 12.4 disappears. In the model above, we assumed that the investors have to bid for the bonds issued by the country *before* the country announces the amount of bonds it is issuing. That is, Q_t is determined before the government gets to choose D_{t+1}. An alternative timing assumption is that the government first announces the amount D_{t+1} it plans to issue (say in an auction) and then the investors bid for it, determining Q_t. This timing assumption has become the dominant approach in the recent literature on sovereign borrowing. This approach requires us to specify the equilibrium price schedule $Q_t(D_{t+1})$. When issuing debt D_{t+1} the government forms rational beliefs on the price that investors will bid for any potential value of D_{t+1}, and these beliefs are captured by $Q_t(D_{t+1})$. Let us go through our analysis again, with this alternative timing assumption.

Focusing attention on Markov equilibria and exploiting the i.i.d. assumption for S_t, we have a price schedule $Q(.)$ that is constant over time. Then we can derive the maximum amount of resources that can be raised by the government on the bond market solving[27]

$$\max_D Q(D)D.$$

Let $\overline{N}$ be the maximum of this problem. We can then find an equilibrium in which the borrower repays if $D_t - S_t \leq \overline{N}$, by choosing the smallest D_{t+1} that satisfies $Q(D_{t+1})$ $D_{t+1} = D_t - S_t$, and defaults if $D_t - S_t > \overline{N}$, because in that case, by construction, no amount of debt issued is sufficient to cover the government's current financing needs. The price of debt is then given by

$$Q\left(D_{t+1}\right) = \beta \Pr\left[D_{t+1} - S_{t+1} \leq \overline{N}\right], \tag{41}$$

[27] I am assuming for now that the function $Q(.)$ is continuous and that this problem is well defined, a conjecture that will be verified later.

and the value of $\overline{N}$ can be found solving the following fixed point problem:

$$\overline{N} = \max_{D} \beta \left(1 - F\left(D - \overline{N}\right)\right) D. \tag{42}$$

An envelope argument can be used to show that there is a unique fixed point and so there is a unique equilibrium of this type.[28] This means that the first type of multiplicity identified in the previous section disappears when we adopt the new timing and look for an equilibrium price schedule $Q(D)$. We'll return to the second type of multiplicity below.

The logic that rules out the first type of multiplicity is the following. If we are in a "bad" equilibrium in Figure 12.4, with a high interest rate, it means that the government is issuing a large amount of debt—in terms of face value—which the market is pricing at a low Q_t since it is expecting repayment with low probability. However, the presence of a "good" equilibrium means that the government can achieve the same amount of resources today by offering a lower face value tomorrow. Faced with this lower issuance the market will price the debt at a higher Q_t. So in case of multiplicity the government can always choose the equilibrium with the lower promised repayment and lower probability of default.

Which timing assumption is more plausible? On the face of it, one would favor the timing in which the government chooses D_{t+1} first, since it seems to capture better the way treasury auctions work in reality. However, this timing assumption hides an assumption of commitment. Suppose we are in a case where multiple equilibria are possible, under the timing assumption of Section 5.1. What happens if the government announces it is issuing the amount D_{t+1} corresponding to the good equilibrium and investors decide to bid the price that corresponds to the bad equilibrium? The government will not be able to raise enough resources to cover its current financing needs and plausibly will have to resort to an additional issuance. But then, as long as the markets insist on paying the bad equilibrium price, the total amount of bonds issued will eventually be the bad equilibrium level of D_{t+1}, thus validating the market's expectations. This argument is proposed and formally analyzed in Lorenzoni and Werning (2013). This discussion suggests that there are arguments in favor of both ways of modeling the game between the government and the investors and that the ability of the government to commit to a certain path of debt issuances, even in the short run, can have important consequences. Of course, matters get more complicated once, as it is natural, we extend the model to allow the government some leeway in the choice of the primary surplus. The take away from the analysis above is that if our objective is to study spread spirals it may be useful to

[28] The first-order condition for the maximization problem implies $f\left(D - \overline{N}\right) D = 1 - F\left(D - \overline{N}\right)$. The envelope theorem implies that the derivative of the expression on the right-hand side of (42) with respect to $\overline{N}$ is equal to $\beta f\left(D - \overline{N}\right) D$, which is then equal to $\beta\left(1 - F\left(D - \overline{N}\right)\right) < 1$ for any $\overline{N}$. Therefore, this function of $\overline{N}$ has a unique fixed point.

rethink the common approach of modeling the game by letting the government choose D_{t+1} before the market opens.[29]

Notice that the analysis above also rules out the second type of multiplicity and pins down a unique Markov equilibrium, with a unique level of $\overline{N}$. When we assume that there is a risk neutral international investor, we can interpret the model as featuring a certain number of risk neutral investors, each with a large endowment. With this interpretation, a single investor can buy all the debt issued by the government. Then the price of the bond issued is given by (41) and there is no coordination problem between lenders. However, it is easy to change the interpretation of the model and assume that there is a continuum of small investors, each with an endowment that is infinitesimal relative to the bonds issued by the borrowing country. With this interpretation, coordination problems are back, since the borrower can only successfully rollover if all lenders are willing to lend.

Cole and Kehoe (2000) is an example of a paper where the second type of coordination problem arises, while the first does not. Using the notation above, their approach is to assume that the government faces a bond schedule $Q(D_{t+1}, D_t, S_t, \omega_t)$ where ω_t is a sunspot variable drawn from a uniform distribution on $[0, 1]$. If $D_t - S_t \leq 0$ the sunspot has no effect, but when $D_t - S_t > 0$ and the sunspot is below some threshold $\hat{\omega}$ we have a coordination failure, $Q(D_{t+1}, D_t, S_t, \omega_t)$ is identically equal to zero for all values of D_{t+1} and the government is forced into default.

The fundamental ingredient of a debt panic is the presence of sufficiently strong strategic complementarity among the decisions of lenders to supply funding to the borrowers in a country. In particular, the decision of a large number of lenders not to provide funds must have the effect of reducing the expected return for a lender who decides to lend.

While many researchers agree that panic elements are present in some debt crises, the specific channels of complementarity are different in different models and the question is still open on which of these channels are most relevant in international crises. In the simple model above, the complementarity was generated by the default decision of the borrowing government. If enough lenders bid a zero price for the bonds issued today, the government is forced to default. An important assumption we made above is that once default occurs at date t, the government will not repay in future dates. However, there are other potential channels by which the refusal to rollover by a given creditor can lead to a loss for creditors that continue lending. Chang and Velasco (1999) use a modeling approach similar to the classic Diamond and Dybvig (1983) paper on bank runs. In that context, creditors that refuse to rollover short-term loans to banks located in the borrowing country trigger a liquidation of domestic assets. In this case it is the liquidation of domestic assets that lowers the payoffs of the creditors that continue lending to the country. Therefore, this class of models emphasizes complementarities that arise due to the real effects of a default event. A default event may be self-fulfilling because it

[29] Chamon (2007) is a recent paper that explores how different auction protocols can eliminate multiple equilibria.

harms capital accumulation and growth in the home country, thus reducing the country's ability to pay in the future. The financial sector is clearly the place where the potential for liquidity crises is higher, due to the nature of banks' liabilities. We will return to this topic in Section 6.1.

6. SOURCES OF FRAGILITY

Summing up different remarks made in previous sections, currency crises and current account reversals are typically preceded by one or more different symptoms of fragility: budget deficits, current account deficits, an overvalued real exchange rate, large stocks of public or private debt, especially if short-term and foreign-currency denominated. These symptoms are not unrelated, as, for example, current account deficits driven by a capital inflow can be the underlying cause of the overvaluation. A vast empirical literature has explored the role of these variables in forecasting financial crises (e.g., Eichengreen et al., 1995). But while these symptoms capture well the proximate causes of a crisis, a harder question is what are the underlying sources of fragility. In this section, I discuss different ways of approaching this question.

6.1. Boom-Bust Cycles and Banking

A narrative that goes back at least to Diaz-Alejandro (1985) is that of a country that opens up its capital markets and starts borrowing from abroad. The inflow of foreign funds contributes to fuel a domestic credit boom and an expansion in domestic demand. This leads both to the accumulation of debtor positions and to an appreciation of the exchange rate. This sets the stage for a potential reversal of capital flows, with the consequences discussed in Section 4. Recent papers that document the dynamics of credit booms and busts in developed and emerging economies are Gourinchas et al. (2001) and Mendoza and Terrones (2008).

In the classic intertemporal approach to the current account, a simple way to interpret a boom-bust episode is to imagine that when the country opens up its capital markets, this is associated to optimistic growth expectations as the country can increase domestic investment by borrowing abroad. So the country's borrowing in the boom phase is justified by the anticipation of higher domestic income in the future. The bust can then be interpreted as a negative shock, that disappoints the ex ante optimistic growth expectations. This is the interpretation that, for example, Blanchard and Giavazzi (2002) and Blanchard (2007) hold of the experience of Portugal after entering the euro area.

However, when one develops this idea in the context of models with reasonable degrees of risk aversion, it is hard to replicate observed crises, because domestic borrowers in the model prefer to accumulate precautionary assets to be protected in the event of a crisis. Models with occasionally binding financial constraints can partly address this issue. Mendoza (2010) shows a model that can generate severe crises, which occur with non-negligible frequency, and are typically preceded by a credit-financed expansion. The crucial state variable in the model is the leverage of the domestic economy, that is the ratio of domestic capital to external debt. A sequence of good shocks leads the economy to finance domestic investment with foreign borrowing, leading to high leverage. However, when leverage is high the economy becomes very sensitive to negative shocks, because of a binding financial constraint. This is why a boom can be followed by a severe crisis, generating a boom-bust cycle. The further development of non-linear models that capture these dynamics is certainly a promising area for future research.

While the standard intertemporal approach emphasizes net borrowing and lending positions that arise out of differences in growth profiles, the current account literature has recently shifted toward paying more attention to gross financial flows. That is, to the combination of debt, equity, and direct investments that are driven by the portfolio choice of a set of domestic and foreign actors. The current account is then the flow variable that results from the simultaneous adjustment of these gross positions.[30] Two recent papers that document the patterns of gross flows that generate net flows along the business cycle and during crises are Forbes and Warnock (2012) and Broner et al. (2013a). The latter paper, in particular, shows that a reduction in net flows during a crisis is associated to a reduction in foreign holdings of domestic assets and, more surprisingly, to a reduction in domestic holdings of foreign assets. A possible interpretation of this finding is that during crises domestic assets are reallocated from foreign to domestic agents, and domestic agents liquidate their foreign positions to finance this reallocation. This interpretation leads to favor models in which during a crisis the foreign demand for domestic assets contracts more dramatically than the domestic demand.[31]

Another recent literature has emphasized the importance of disaggregating the domestic economy and looking separately at the foreign exposures of financial firms. The idea is that financial institutions hold much more leveraged positions, compared to the whole country. So looking at the balance sheet of these agents is important to understand the dramatic reversals of financial flows associated to leveraging and de-leveraging. Many recent episodes, in which financial turbulence has been transmitted from country to country, point to the important role of gross flows and banking. For example, the transmission of the 2007 crisis from the U.S. to Germany traveled through the gross positions taken by German banks in the U.S. market for mortgage backed securities. In the years preceding the crisis, German banks had financed these investments by borrowing dollars short-term. So German banks were at the same time increasing their foreign assets and their foreign liabilities. These changes in gross positions were not associated to an overall increase in the net debtor position of Germany vs the U.S. In fact, Germany was running a current account surplus in the years before the crisis. However, the gross positions made

[30] See Obstfeld (2012) for an overall evaluation of the relation between gross financial flows and the current account.

[31] A different but related interpretation is offered in Bianchi et al. (2013), who focus on the different role of long-maturity government debt and foreign reserve accumulation for liquidity purposes.

the German banking system vulnerable to a crash in the MBS market in the U.S. Acharya and Schnabl (2010) provide a detailed analysis of this mechanism. Bruno and Shin (2012) is a recent paper that models banks' leverage as a source of transmission of financial crises across countries and documents the importance of cross-country exposures.

Understanding better the role of financial intermediaries seems important also to understand the sources of financial contagion and the transmission of shocks across countries. Pavlova and Rigobon (2008) solve a three countries portfolio model, with two periphery countries—representing emerging markets—and a center country—representing an international banking center. They then introduce portfolio constraints and show how they can lead to a stronger transmission of shocks across countries. A novel feature of their approach is that they distinguish home goods and foreign goods and allow for home bias in consumption. This implies that shocks to the wealth distribution can be amplified through the response of relative prices, through a "transfer" mechanism similar to that discussed Section 4. Combining portfolio choice in multi-good, multi-country models, will most likely continue to be a challenging and open line of research. Recognizing the presence of constraints and limits to arbitrage in international capital markets can also contribute to our understanding of the choice of short-term borrowing for emerging economies. Broner et al. (2013b) show that the risk premia on long-term lending increase dramatically in periods of financial turbulence. This increased risk premia are not a reflection of higher probabilities of default at longer horizons, but instead capture a decrease in the willingness of international investors to absorb the higher price risk of long-term bonds.

It is important to remark that while gross positions are crucial to evaluate the fragility of a given configuration of financial flows, net flows are still important for their macroeconomic implications. For example, if banks in a given country accumulate financial exposures to some other country, but the net result is not a current account deficit, the country will not experience a real appreciation and will be less at risk of a currency crisis of the type discussed in Section 3. A recent example of the fact that current account deficits still contain important information is in Shambaugh (2012), who shows that current account deficits in the years before the crisis are very effective at predicting the severity of the sovereign debt crisis across European countries (measured by sovereign spreads during the crisis).

The interest toward international banking has also grown due to the special nature of banks' liabilities and the fact that they may be subject to panics. We already touched on the subject of liquidity crises in Section 5.2. There is a vast banking literature that capture mechanisms that are important for the transmission of international crises across borders. Allen and Gale (2000) show how contagion can take place when banks hold claims on each other and withdrawals in some region can trigger a chain of withdrawals across banks. Recent work on the sensitivity of debt capacity to asset values with short-term debt financing by Acharya et al. (2011) and on the dynamics of debt panics by

He and Xiong (2009) can provide useful lessons to understand rollover crises in international debt markets. Liquidity considerations are also important in understanding the effects of increased financial integration. Traditional models of risk-sharing emphasize the idea that increased integration leads to diversification and reduced volatility, as in Obstfeld (1994b). Castiglionesi et al. (2010) develop a model with assets of different liquidity and show that increased financial integration can lead to lower liquidity ratios and deeper crises.

Finally, the recent euro-zone crisis has fueled a growing interest in the interplay between sovereign risk and banking stability. Research following the 1997 Asian crisis by Corsetti et al. (1999) and Burnside et al. (2006) did emphasize one side of the interaction between the banks' and the government's budget constraints. Trouble in the banking sector can result in severe fiscal costs, when the government intervenes to bail out financial institutions. Recent research points attention to the reverse channel. Fiscal trouble and the risk of sovereign default can hurt the banking sector if domestic banks are overly exposed to domestic government debt. Basu (2010) and Gennaioli et al. (2012) argue that the distress caused to the banking sector by a sovereign default can be an important channel making defaults more costly. Gennaioli et al. (2012) show that in a panel of countries, larger holdings of domestic government bonds by domestic banks are indeed associated to larger declines in credit in the event of a default and to less frequent defaults.

6.2. Fragility and Moral Hazard

As noticed above, some forms of borrowing make a country especially exposed to a crisis. In particular, debt financing makes domestic firms' obligations less sensitive to domestic conditions relative to equity financing, short-term borrowing increases the probability of debt runs, and foreign-currency-denominated debt opens the possibility of a feedback between the exchange rate and domestic borrowers' balance sheets. An important open question is why private and public borrowers choose these forms of borrowing. More generally, one can ask why borrowers do not try to make their future repayments state contingent, so as to reduce the debt burden following negative aggregate shocks. If we endogenize the choice of loans in the type of models presented so far, the domestic borrowers would prefer long-term, domestic-currency-denominated debt, and, if possible, they would prefer to use equity financing or some form of state-contingent debt.

The literature has explored this question in different ways. First, a group of papers have emphasized the idea that exposure to international crises can be useful from an ex ante point of view. The idea is that the possibility of a crisis acts as a discipline device that helps induce the country's government to implement some costly reform effort or not to be tempted by the opportunity to expropriate foreign investors. Other papers have looked at the problem from a different perspective, looking at the accumulation of fragile debt as an inefficient outcome that is the result of various forms of externalities. Let me start by looking at two models that capture the first idea of *ex ante efficient crises*. In the next two subsections, I will look at models that explore the idea of externalities causing *ex ante inefficient crises*.

Consider a two-period model of a country that is receiving an exogenous income stream y_1 in the first period and a random income stream y_2 in the second period. In particular, let y_2 be a discrete random variable with probability distribution $\pi(y_2)$. Suppose the government is benevolent and maximizes the utility of a representative consumer with utility function:

$$u\left(c_1\right) + E\left[u\left(c_2\right)\right]. \tag{43}$$

The country faces risk neutral international investors with zero discount factor and can issue fully state-contingent bonds, that is, it can issue claims that promise repayment contingent on the realization of y_2. The country has the option to default, in which case it loses a fraction θ of its output, so we have the limited enforcement constraint

$$c_2 \geq \left(1-\theta\right) y_2. \tag{44}$$

We then can set up the problem of the domestic government as maximizing (43) subject to the limited enforcement constraint (44) and the budget constraint

$$c_1 + E\left[c_1\right] \leq y_1 + E\left[y_2\right]. \tag{45}$$

The optimality condition takes the form

$$\pi\left(y_2\right) u'\left(c_2\left(y_2\right)\right) + \nu\left(y_2\right) = \lambda\pi\left(y_2\right),$$

where λ is the Lagrange multiplier on the budget constraint and $\nu(y_2)$ is the Lagrange multiplier on the limited enforcement constraint. It is possible to show that the optimal contract involves a constant c_2 for y_2 below some cutoff $\hat{y}_2$ and $c_2 = (1-\theta)y_2$ for y_2 above the cutoff $\hat{y}_2$.

This simple model shows in a nutshell why it is hard to generate crisis episodes in models with fully state-contingent borrowing and default. If in equilibrium the country is borrowing in period 1, then it must be the case that $E\left[c_2\right] < E\left[y_2\right]$, so that c_2 must be lower than y_2 in some state of the world. However, given the optimal shape of $c_2(y_2)$, this means that the country will tend to repay more in *good states* of the world. In other words, this model cannot be used to deliver a situation in which the country is hit by a bad shock—i.e., a low realization of y_2—and experiences larger than usual capital outflows—i.e., a larger value of $y_2 - c_2$.

The observation above was the motivation behind the seminal paper by Atkeson (1991).[32] The solution offered by Atkeson (1991) is to introduce a form of moral hazard.

[32] Atkeson (1991) is also a seminal paper in developing recursive-contract methods to analyze dynamic models of international borrowing. Here, I use a simple two-period version to focus on its interpretation of crises.

Suppose that the country can use the funds received in period 1 for two purposes: to consume or to invest. Investment k affects the country's ability to produce output in the second period and, for simplicity, can only take two values $\underline{k}$ and $\overline{k}$, with $\underline{k} < \overline{k}$. The probability distribution of second-period output is now given by $\pi\left(y_2|k\right)$. The crucial assumption is that investment is unobservable. That is, the foreign country observes the difference between the endowment y_1 and total domestic spending $c_1 + k$, but does not observe the composition of domestic spending. Then, in order to induce the country to choose $k = \overline{k}$ the country consumption profile has to satisfy the incentive compatibility constraint

$$u\left(c_1\right) + E\left[u\left(c_2\right)|\overline{k}\right] \geq u\left(c_1 + \overline{k} - \underline{k}\right) + E\left[u\left(c_2\right)|\underline{k}\right]. \tag{46}$$

Suppose now that it is part of an optimal plan to implement the high investment level $\overline{k}$, then the optimal consumption profile can be derived choosing c_1, $c_2(y_2)$ that maximize expected utility of the borrowing country subject to the limited enforcement constraint (44), the incentive compatibility constraint (46), and the budget constraint

$$c_1 + \overline{k} + E\left[c_1|\overline{k}\right] \leq y_1 + E\left[y_2|\overline{k}\right].$$

The first-order condition for $c_2(y_2)$ can be rearranged to yield, for the states in which the limited enforcement constraint is not binding,

$$\frac{u'\left(c_2\left(y_2\right)\right) - \lambda}{u'\left(c_2\left(y_2\right)\right)} = \mu\left[1 - \frac{\pi\left(y_2|\underline{k}\right)}{\pi\left(y_2|\overline{k}\right)}\right],$$

where μ is the Lagrange multiplier on the incentive compatibility constraint. A standard result in the moral-hazard literature is that a monotone likelihood ratio $\pi\left(y_2|\overline{k}\right)/\pi\left(y_2|\underline{k}\right)$ implies that the consumption profile $c_2(y_2)$ is increasing. It is then possible to construct examples in which this effect is so strong (i.e., the signal y_2 is so informative about the unobservable "effort" level k) that the difference $c_2(y_2) - y_2$ is also increasing. In such examples, a bad realization of the endowment y_2 is associated to a reduction in capital inflows.

These type of examples show that it may be optimal for a country to expose itself to capital flow reversals that hurt exactly when things get worse. The idea is that this exposure is efficient from an ex ante perspective, because it induces the country to make the best use of the resources it's receiving from international investors. The model here is very stylized, but it may be used to capture not just the effects of capital accumulation but also the effects of various market-oriented reforms which may be costly in the short run but increase the country growth prospects in the future. The idea is that international financial crises are a useful discipline device that punishes countries exactly when they are sending negative signals.

The model here takes the point of view of a benevolent domestic social planner who can directly control the state-contingent financial flows between the country and the rest of the world. Let me now look at a model that contains a similar message, but that makes an explicit distinction between private financing decisions and policy choices made by the government. This extension is important because of the role that private capital flows play in many actual crisis episodes. The model is a simplified version of Tirole (2003).

The model is a two-period model and features three groups of agents: domestic entrepreneurs, domestic investors, and foreign investors. They are all risk neutral and only consume in the second period. Entrepreneurs hold some initial wealth A and choose how much to invest I in a risky project. The amount $I - A$ they raise from domestic and foreign investors, in exchange for promises of repayment in period 2. The project payoff is $R^S I$ in the event of success and $R^F I$ in the event of failure. However, there is an upper bound on how much entrepreneurs can promise to repay. This upper bound is $r^S I$ in the event of success, with $r^S < R^S$, and $r^F I$ in the event of failure, with $r^F = R^F < r^S$.[33] The probability of success is p and is taken as given by entrepreneurs and investors. For simplicity, assume success is perfectly correlated across entrepreneurs. Finally, there is a domestic government, whose objective is to maximize the sum of the utilities of domestic entrepreneurs and domestic investors. The government can increase the probability of success p of all the domestic entrepreneurial projects, through reform efforts or other forms of public investment. The social cost associated to the probability p is given by the increasing, convex function $\gamma(p)$. An important timing assumption is that the government choice of p happens after financial contracts have been written and the investment I has taken place, and that the government cannot commit.

A financial contract is given by an investment level I and two levels of promise repayments: D^S, in the event of success, and D^F, in the event of failure. We assume that entrepreneurs make a take-it-or-leave-it offer to investors. Then, given that domestic and foreign investors are risk neutral, the optimal contract optimal between lenders and entrepreneur comes from the solution of the maximization problem:

$$
\begin{aligned}
\max_{I,D} \quad & p\left(R^S I - D^S\right) + \left(1-p\right)\left(R^F I - D^F\right) \\
s.t. \quad & D^j \le r^j I, \quad \text{for } j = S, F \\
& pD^S + \left(1-p\right) D^F + A = I.
\end{aligned}
$$

Assuming $pR^S + (1-p)R^F > 1$ and $pr^S + (1-p)r^F < 1$ the problem is well defined and the solution is to choose maximum leverage, setting investment equal to

$$
I = \frac{1}{1 - pr^S - \left(1-p\right) r^F} A. \tag{47}
$$

Suppose the optimal contract is implemented by issuing two types of securities: safe debt claims that repay $R^F I$ and equity claims that repay $\left(r^S - R^F\right) I$ only in the event of

[33] See Tirole (2005) for microfoundations of this type of pledgeability constraint.

success. Since domestic and foreign investors are both risk neutral, how these securities are allocated is, to some extent, indeterminate. Assume that domestic investors have a limited endowment $\bar{I}_d$ in period 1. Then, as long as $\bar{I}_d < I$, the domestic entrepreneurs must sell securities valued $I - \bar{I}_d$ to foreign investors. Using α^D and α^E to denote the fraction of debt and equity claims sold to foreigners, any pair α^D, α^E is fine as long as

$$I - \bar{I}_d = \alpha^D R^F I + \alpha^E p \left(r^S - R^F\right) I. \tag{48}$$

The sum of the expected payoffs of domestic entrepreneurs and domestic investors is then given by the total payoff of the investment projects minus the payments made to foreign investors:

$$p\left[\left(R^S - R^F\right) - \alpha^E \left(r^S - R^F\right)\right] I + \left(1 - \alpha^D\right) R^F I.$$

The government payoff is given by the last expression minus the cost of reform $\gamma(p)I$. This implies that the government's best response is given by the first-order condition

$$\left(R^S - R^F\right) - \alpha^E \left(r^S - R^F\right) = \gamma'(p). \tag{49}$$

An equilibrium of the model is then given by four values I, p, α^D, α^E that satisfy the three equations (47)–(49). Since there are only three equations, the model admits equilibria for α^E in some interval. From equation (49) we see that equilibria with lower values of α^E correspond to higher values of p. It is easy to show that higher values of p are Pareto superior, since in equilibrium there is, in general, under-provision of reform effort. Notice that equilibria with lower values of α^E display more financial fragility, in the sense that they display more volatile domestic consumption. In other words, international financial flows provide less insurance against the "failure" shock hitting the domestic economy.

The conclusions we want to draw from the model are: (1) that there are many equilibria associated with different levels of fragility; (2) the equilibria which display more fragility are Pareto superior. The paper thus questions the wisdom of policy proposals oriented at reducing fragility, by noticing that it is this very fragility which provides incentives for reform. The presence of indeterminacy in the model is not crucial for the argument, but it helps present it in a stark form, because it implies that adding a small incentive in favor of equity or debt financing in international capital markets can tilt the economy toward very different equilibria, and that the optimal policy in this case is to subsidize debt financing.

While here I have exposed models that focus on abstract state-contingent contracts, it is clear that the logic of these models extends to specific forms of fragility. For example, Missale and Blanchard (1994) and Jeanne (2000) focus on the discipline benefits of short-term borrowing using a similar logic.

Both the Atkeson (1991) model and the Tirole (2005) model emphasize the ex ante efficiency properties of crises from a normative point of view. When applying these models as positive models, one is faced with delicate issues of decentralization and implementation. Since crises are aggregate events, their incentive benefits must show up for some agent who internalizes the effects of his actions on the probability of a crisis. Tirole (2005) emphasizes the distinction between the large agent in the model (the government) who can affect the probability p and the small agents who take it as given and yet determine the structure of the country's liabilities. The decentralized nature of the financing decisions imply that in equilibrium there is too little fragility and too little crises. Therefore, to employ these models as positive models of why crises occur, one needs to spell out what kind of policies are present to induce private agents, who have an incentive to protect themselves against crises, to take less protection so as to give the right reform incentives to the central government.[34]

6.3. Bailouts and Policy-Induced Externalities

We now take a different view and look at a country's exposure to international crises not as the efficient response to an incentive problem but as a symptom of inefficiency not internalized by private contracts.

A first source of inefficiency may come from policy. In particular, after the East Asian crisis of 1997, a number of observers have pointed out the close ties between banks and political power in the countries affected and noticed that bailout expectations can lead to asset overvaluation and excessive borrowing (McKinnon and Pill, 1996; Krugman, 1998). If a bank is borrowing money abroad to finance investment, say, in domestic real estate, the bank (and its foreign creditor) will be less concerned about downside risks if they expect the government to step in. This will lead both to excess borrowing and to capital misallocation, as investment is distorted in favor of risky projects that benefit more from the bailout option. Another channel of misallocation arises in general equilibrium as financial institutions with bailout guarantees will bid up asset prices discouraging investment by other firms.

Schneider and Tornell (2004) show that the combination of bailout guarantees and binding financing constraints in the event of a crisis can lead to an inefficient boom-bust episode. An important observation they make is that the presence of *systemic* bailout guarantees tends to lead to taking correlated risks. If the government is expected to step in and bailout financial firms only if a sufficient fraction of them is in trouble, then in

[34] In the Atkeson (1991) model one could interpret the investment decision k as the aggregate of private investment decisions of a large number of agents. However, if one goes that route and one models k as affecting the pdf of the endowment at date 2 agent by agent, the issue is not easily resolved. In that kind of model, it is typically optimal to do relative performance evaluation and not punish or reward the individual in response to aggregate shocks. So country-level crises would be perfectly insured.

equilibrium firms will tend to be exposed to correlated risk as each single firm prefers to face trouble when other firms do, so as to receive assistance. Schneider and Tornell (2004) use this idea to explain the preference for foreign-currency-denominated debt, since the burden of this debt increases precisely at times of economy-wide trouble. Farhi and Tirole (2012) further develop this idea in a model in which bailout policies are endogenous and welfare maximizing, thus emphasizing the fact that these distortions do not need to arise from "crony capitalism" but can also arise with a benevolent policy-maker that cannot commit.

6.4. Pecuniary and Aggregate Demand Externalities

I will now go back to the simple model introduced in Section 3.1 and use it to discuss two other forms of externality that can produce excess fragility. Consider a time prior to $t = 0$, say time $t = -1$, in which the country is running a current account deficit and suppose the current account deficit is driven by private sector borrowing. At that time, the decisions of individual borrowers are determining the level of debt D that will have to be repaid at $t = 0$. Domestic borrowers may be accumulating debt for consumption-smoothing reasons, as they expect future productivity growth, or because they are facing high expected returns to investment and are borrowing to finance an investment boom. For our purposes here, all that matters is that the accumulation of debt D is the result of optimal borrowing decisions of domestic private borrowers. The question is, will private borrowers choose a socially efficient level of D, from an ex ante point of view? Or is the domestic credit boom inefficient?

Consider first the flexible price environment discussed in Section 4.1. To simplify the analysis, I slightly modify the model, assuming that the domestic good is sold on a competitive market, so I can abstract from the distortion due to monopolistic competition. If we replace the assumptions of monopolistic competition and $\psi\varepsilon/(\varepsilon - 1) = 1$ with the assumptions of competitive markets and $\psi = 1$, the equilibrium conditions (37) and (38) still characterize the equilibrium and the rest of the analysis is unchanged, except that the level of output is socially efficient in equilibrium.

Consider now a private borrower who is considering a marginal increase in borrowing at $t = -1$. The private marginal cost of increasing D is

$$\frac{\mathcal{E}}{P} C^{-\sigma},$$

because, by promising to repay a unit of foreign currency at date 0, the consumer is foregoing $\mathcal{E}/P$ units of consumption and $C^{-\sigma}$ is his/her marginal utility of consumption. However increasing D also affects the equilibrium real exchange rate p_h, as we saw in

Figure 12.2, so if *all* domestic borrowers increase D the total effect on their welfare is[35]

$$\frac{\mathcal{E}}{P}C^{-\sigma}\left[1+\left(Y-C_h\right)\frac{dp_h}{dD}\right], \tag{50}$$

where dp_h/dD denotes the equilibrium response of the real exchange rate to the debt level D. The second term in square brackets is present because when the relative price of the domestic good increases, domestic consumers benefit as they are net sellers of the domestic good on the world market, and their utility gain is proportional to their net sales of domestic goods $Y-C_h$.

The presence of the additional term in expression (50) captures a pecuniary externality by which increasing borrowing ex ante makes domestic consumers worse off ex post, given that $dp_h/dD<0$. The presence of this pecuniary externality is not sufficient, per se, to make the equilibrium ex ante Pareto inefficient. While domestic consumers are losing ex post due to the real depreciation, foreign consumers are gaining as they are buying domestic goods at a lower price. But the pecuniary externality does lead to an inefficiency result if we embed this analysis in a stochastic model, in which the sudden stop event occurs at date 0 with probability smaller than one and in which borrowing is not state contingent. In that model, due to incomplete markets, the marginal utilities of the domestic consumer and of the foreign consumer are not equalized across states of the world, and, in particular, the domestic marginal utility is relatively higher in the sudden stop event. In a model with these features, an ex ante coordinated reduction in D, together with an ex ante transfer from domestic consumers to foreign consumers can make everyone better off. This observation goes back to the result of inefficiency of competitive equilibria with incomplete markets of Geanakoplos and Polemarchakis (1986). In this case, the credit boom preceding the sudden stop event is constrained inefficient, and policies aimed at curbing borrowing at $t=-1$ may be welfare improving.

In the context of international financial crises, welfare-reducing pecuniary externalities have been explored in a number of recent papers, that have emphasized different channels by which borrowing ex ante can lead to adverse relative price changes ex post. Bianchi (2011) and Korinek (2011) explore the real exchange rate channel, along the lines

[35] To derive this expression notice that the indirect utility of the domestic consumer at date 0, under perfect competition, is

$$V\left(D,p_h\right)=\max_{C,C_h,C_f,N}\left\{\left(\frac{C^{1-\sigma}}{1-\sigma}-\psi\frac{N^{1+\phi}}{1+\phi}\right),\text{ s.t. } C=\xi C_h^{\omega}C_f^{1-\omega},\, p_hC_h+C_f=p_hY+\beta\bar{D}-D\right\}.$$

Letting λ denote the Lagrange multiplier on the budget constraint and using the envelope theorem and the first-order condition with respect to C_h, we have

$$\frac{\partial V}{\partial p_h}=\lambda\left(Y-C_h\right)=\frac{1}{p_h}C^{-\sigma}\omega\frac{C}{C_h}\left(Y-C_h\right)=\frac{\mathcal{E}}{P}C^{-\sigma}\left(Y-C_h\right).$$

The last equality follows from $P_hC_h=\omega PC$ and $p_h=P_h/\mathcal{E}$.

of the model presented here. The main difference is that real exchange rate movements in their model are driven by changes in the relative price of tradables vs non-tradables. Since net trade of non-tradables is zero, by definition, the pecuniary externality in (50) is thus absent in their model. However, a different pecuniary externality arises because the relative price of non-tradables appears in the financial constraint faced by domestic agents.[36] Caballero and Krishnamurthy (2001, 2003) study pecuniary externalities associated to the determination of the spread charged on domestic financial markets, in models in which financial markets are segmented and only some domestic firms have access to foreign borrowing. In their model, firms with international collateral help to keep domestic interest rate low in the domestic credit market in the event of a crisis. A pecuniary externality arises because the benefit of low interest rates accrues partly to firms with no access to foreign lending. So firms with access do not fully internalize the social benefit of holding international collateral and hold too little of it in equilibrium. Caballero and Lorenzoni (2007) explore a pecuniary externality that works through the dynamics of the export sector. Domestic exporters are hurt by an exchange rate appreciation in the boom phase of a boom-bust cycle in foreign borrowing, and this can lead to a slow recovery in the bust phase, with depressed real wages. Reducing borrowing ex ante may be beneficial for the consumers as it props up real wages in bust. Jeanne and Korinek (2010) focus on the effect of excessive borrowing on asset prices.[37]

A different form of externality arises when we introduce nominal rigidities. Going back to our small open economy of Section 3.1, consider what happens when prices are sticky. In particular, consider the case in which no firm can adjust its price in $t = 0$, as in Section 4.2. Now the model implications differ depending on the response of monetary policy after the shock. Suppose we are in a fixed exchange rate regime and the central bank is keeping the nominal exchange rate fixed at $\mathcal{E} = 1$. In period $t = 0$, home good prices are pre-set at their steady state level $\bar{P}_h = p_h^*$.[38] From equation (37) we then get output in period 0,

$$Y = \frac{\zeta \left(p_h^*\right)^{-\rho} - \omega \Delta / p_h^*}{1 - \omega}.$$

As we did in the flexible price case, consider the marginal effect of increasing D (and thus Δ). The effect on output is

$$\frac{dY}{d\Delta} = -\frac{\omega / p_h^*}{1 - \omega} < 0,$$

[36] This goes back to the general observation that in models with optimal contracting, pecuniary externalities arise when relative prices appear in some incentive constraint. See Arnott et al. (1994).

[37] This links the international literature to a growing literature on over-borrowing and asset price volatility in financial markets and in closed economies, e.g., Gromb and Vayanos (2002), Lorenzoni (2008), Bianchi and Mendoza (2011), Jeanne and Korinek (2013).

[38] In the initial steady state discussed in Section 4, p_h^* is not equal to 1, because in steady state the country is making the interest payment $\left(1 - \beta\right) D$ each period.

and the effect on consumption, from (36), is

$$\frac{dC}{d\Delta} = \left(p_h^*\right)^{-\omega} \left(p_h^* \frac{dY}{d\Delta} - 1\right) < 0. \tag{51}$$

When individual borrowers choose D optimally they only internalize the second term in parenthesis in (51). The remaining effects on C and Y capture an aggregate demand externality. As consumers are more indebted, they need to cut back on consumption. Since monetary policy cannot respond, under a fixed exchange rate, the reduction in consumption leads to a reduction in output. As consumers are against their borrowing constraints, the reduction in domestic output further depresses domestic consumption through a standard Keynesian multiplier effect. The welfare effect of this aggregate demand externality is

$$\left[\left(p_h^*\right)^{1-\omega} C^{-\sigma} - \psi N^{\phi}\right] \frac{dY}{d\Delta} < 0.$$

This inequality follows because the term in square brackets is positive. This follows from two considerations: first, there is a monopolistic distortion which is present also in the steady state (see equation (14)); second, C and N are below their steady state value in a sudden stop with a fixed exchange rate.

Notice that the relative price of domestic goods remains unchanged. So if we model the foreign lenders as having linear intertemporal preferences, we can construct simple non-stochastic examples in which foreign lenders' welfare is unaffected by changes in D, so that the aggregate demand externality leads immediately to Pareto inefficient overborrowing ex ante. Recent papers that have introduced this notion of aggregate demand externality are Farhi and Werning (2012) and Schmitt-Grohe and Uribe (2012). The magnitude of the effects found in these studies suggest that aggregate demand externalities will be an active area of research in coming years.

In the example above, the presence of aggregate demand externalities is due to inefficient monetary policy ex post. If monetary policy was not constrained by the fixed exchange rate regime, it could replicate a flexible price equilibrium in which the only remaining externality is the pecuniary externality discussed above. Clearly, given that externality, replicating the flexible price equilibrium may not be the optimal policy. This brings us to a broader question: if the government has access to instruments that mitigate the effects of a crisis ex post, how should they optimally be combined with ex ante preventive policies? This is an open research question and the answer surely depends on the power of the ex post tools available and on the potential problems associated to time consistency. For example, Benigno et al. (2013) show that in a model similar to Bianchi (2011), if the government has sufficient tools to prevent a sharp real depreciation ex post, then the welfare benefit of ex ante interventions is smaller.

7. CONCLUDING REMARKS

This paper has surveyed a number of mechanisms that can be at work during episodes of capital flights and currency crises. To conclude, let me go over some of the open questions that have been identified as potential areas of future research. On the interaction between fiscal and monetary policy discussed in Section 2, the recent crisis in the euro zone has pointed to a number of open questions: What kind of fiscal commitment is needed to sustain an exchange rate peg? If a country is part of a monetary union, what kind of fiscal integration is needed to stave off speculative capital flights driven by the expectation of default of a single country? Much work also remains to be done on how the expectation of a devaluation can lead to a capital flight, forcing the central bank to tighten domestic policy and thus to a domestic recession, a mechanism explored in Section 3. The mechanism seems to be at work also in flexible exchange rate regimes, as long as the central bank tries to dampen the effects of swings in expectations on the current exchange rate. These swings in expectations seem to be a major reason why monetary authorities are concerned about a pure floating regime. Where do these swings in expectations come from? How should we update our models of the currency market to capture this form of financial volatility and its real consequences?

The model of capital flows used in Section 4 to explore the effects of capital flights was in the tradition of the intertemporal approach to the current account, in which capital flows are simply the outcome of net lending or borrowing by the country as a whole. As mentioned in Section 6, there is a growing interest toward models of gross flows, that disintiguish different asset classes and different groups of agents inside each country to reach implications about the financial flows at the macro level from the aggregation of portfolio adjustments by each group. In particular, models that explicitly account for financial intermediation and for the cross-border activities of banks are likely to play an important role for our understanding of capital account crises.

REFERENCES

Acharya, V., Schnabl, P., 2010. Do global banks spread global imbalances? Asset-backed commercial paper during the financial crisis of 2007–09. IMF Economic Review 58 (1), 37–73.

Acharya, V., Gale, D., Yorulmazer, T., 2011. Rollover risk and market freezes. Journal of Finance 66 (4), 1177–1209.

Aghion, P., Bacchetta, P., Banerjee, A., 2000. A simple model of monetary policy and currency crises. European Economic Review 44 (4), 728–738.

Aghion, P., Bacchetta, P., Banerjee, A., 2004. A corporate balance-sheet approach to currency crises. Journal of Economic Theory 119 (1), 6–30.

Aguiar, M., Gopinath, G., 2006. Defaultable debt, interest rates and the current account. Journal of International Economics 69, 64–83.

Aguiar, M., Gopinath, G., 2007. Emerging market business cycles: the cycle is the trend. Journal of Political Economy 115 (1).

Aguiar, M., Amador, M., Farhi, E., Gopinath, G., 2012. Crisis and Commitment: Inflation Credibility and the Vulnerability to Sovereign Debt Crises. Discussion Paper, Mimeo.

Alesina, A., Prati, A., Tabellini, G., 1990. Public confidence and debt management: a model and a case study of Italy. In: Dornbush, R., Draghi, M., (Eds.), Public Debt Management: Theory and History. Cambridge University Press, p. 94.
Allen, F., Gale, D., 2000. Financial contagion. Journal of Political Economy 108 (1), 1–33.
Angeletos, G., Werning, I., 2006. Crises and prices: information aggregation, multiplicity, and volatility. American Economic Review 96 (5), 1720–1736.
Angeletos, G., Hellwig, C., Pavan, A., 2006. Signaling in a global game: coordination and policy traps. Journal of Political Economy 114 (3), 452–484.
Arnott, R., Greenwald, B., Stiglitz, J., 1994. Information and economic efficiency. Information Economics and Policy 6 (1), 77–82.
Atkeson, A., 1991. International lending with moral hazard and risk of repudiation. Econometrica 59 (4), 1069–1089.
Basu, S.S., 2010. Sovereign Debt and Domestic Economic Fragility. Mimeo, MIT.
Benigno, G., Chen, H., Otrok, C., Rebucci, A., Young E., 2013. Financial crises and macro-prudential policies. Journal of International Economics 89 (2), 453–470.
Bernanke, B., Gertler, M., Gilchrist, S., 1999. The financial accelerator in a quantitative business cycle framework. In: Taylor, J.B., Woodford, M., Handbook of Macroeconomics, vol. 1. Elsevier, pp. 1341–1393.
Bianchi, J., 2011. Overborrowing and systemic externalities in the business cycle. American Economic Review 101 (7), 3400–3426.
Bianchi, J., Mendoza, E., 2011. Overborrowing, Financial Crises and Macro-Prudential Policy? Discussion Paper, International Monetary Fund Washington, DC.
Bianchi, J., Hatchondo, J., Martinez, L., 2013. International Reserves and Rollover Risk. IMF Working Paper 13/33.
Blanchard, O.J., 2007. Adjustment within the euro. The difficult case of Portugal. Portuguese Economic Journal 6 (1), 1–21.
Blanchard, O.J., Giavazzi, F., 2002. Current account deficits in the euro area. The end of the Feldstein-Horioka puzzle? Brooking Papers on Economic Activity 2, 147–209.
Braggion, F., Christiano, L., Roldos, J., 2009. Optimal monetary policy in a 'sudden stop'. Journal of Monetary Economics 56 (4), 582–595.
Broner, F., 2008. Discrete devaluations and multiple equilibria in a first generation model of currency crises. Journal of Monetary Economics 55, 592–605.
Broner, F., Didier, T., Erce, A., Schmukler, S.L., 2013a. Gross capital flows: dynamics and crises. Journal of Monetary Economics 60, 113–133.
Broner, F., Lorenzoni, G., Schmukler, S., 2013b. Why do emerging economies borrow short term? Journal of the European Economic Association 11, 67–100.
Bruno, V., Shin, H.S., 2012. Capital Flows, Cross-Border Banking and Global Liquidity. Mimeo, Princeton University.
Buiter, W.H., Rahbar, E., 2012. Target2 Redux. CEPR Discussion Paper 9211.
Burnside, C., Eichenbaum, M., Rebelo, S., 2006. Government finance in the wake of currency crises. Journal of Monetary Economics 53 (3), 401–440.
Caballero, R., Krishnamurthy, A., 2001. International and domestic collateral constraints in a model of emerging market crises. Journal of monetary Economics 48 (3), 513–548.
Caballero, R., Krishnamurthy, A., 2003. Excessive dollar debt: financial development and underinsurance. Journal of Finance 58 (2), 867–894.
Caballero, R.J., Lorenzoni, G., 2007. Persistent Appreciations and Overshooting: A Normative Analysis. Discussion Paper, NBER Working Papers.
Calvo, G., 1988. Servicing the public debt: the role of expectations. American Economic Review 78 (4), 647–661.
Calvo, G.A., 1998. Capital flows and capital market crises: the simple analytics of sudden stops. Journal of Applied Economics 1, 35–54.
Calvo, G.A., Végh, C.A., 1999. Inflation stabilization and BOP crises in developing countries. In: Taylor, J.B., Woodford, M. (Eds.), Handbook of Macroeconomics, vol. 1. Elsevier, pp. 1531–1614 (Chapter 24).

Calvo, G., Izquierdo, A., Mejia, L., 2004. On the Empirics of Sudden Stops: The Relevance of Balance-Sheet Effects. Discussion Paper, National Bureau of Economic Research.

Calvo, G., Izquierdo, A., Talvi, E., 2006. Phoenix Miracles in Emerging Markets: Recovering Without Credit from Systemic Financial Crises. Discussion Paper, National Bureau of Economic Research.

Carlsson, H., Van Damme, E., 1993. Global games and equilibrium selection. Econometrica: Journal of the Econometric Society 61 (5), 989–1018.

Castiglionesi, F., Feriozzi, F., Lorenzoni, G., 2010. Financial Integration and Liquidity Crises. Mineo, Tilburg University.

Chamon, M., 2007. Can debt crises be self-fulfilling? Journal of Development Economics 82 (1), 234–244.

Chang, R., Velasco, A., 1999. Liquidity crises in emerging markets: theoy and policy. In: Bernanke, B., Rotemberg, J. (Eds.), NBER Macroeconomics Annual 1999, MIT Press, pp. 11–58.

Chari, V., Kehoe, P., McGrattan, E., 2005. Sudden stops and output drops. American Economic Review 95 (2), 381–387.

Christiano, L., Gust, C., Roldos, J., 2004. Monetary policy in a financial crisis. Journal of Economic Theory 119 (1), 64–103.

Cole, H., Kehoe, T., 2000. Self-fulfilling debt crises. Review of Economic Studies 67 (1), 91–116.

Cole, H., Obstfeld, M., 1991. Commodity trade and international risk sharing: how much do financial markets matter? Journal of Monetary Economics 28 (1), 3–24.

Cook, D., Devereux, M., 2006. Accounting for the East Asian crisis: a quantitative model of capital outflows in small open economies. Journal of Money, Credit, and Banking 38 (3), 721–749.

Corsetti, G., Pesenti, P., 2001. Welfare and macroeconomic interdependence. Quarterly Journal of Economics 116 (2), 421–445.

Corsetti, G., Pesenti, P., Roubini, N., 1999. Paper tigers? A model of the Asian crisis. European Economic Review 43 (7), 1211–1236.

Cúrdia, V., 2007. Optimal Monetary Policy Under Sudden Stops. FRB of New York Staff, Report No. 278.

DeLong, J.B., 2001. International Financial Crises in the 1990s: The Analytics. Mimeo, Berkeley.

DeMarzo, P., Kaniel, R., Kremer, I., 2005. Diversification as a public good: community effects in portfolio choice. The Journal of Finance 59 (4), 1677–1716.

Diamond, D., Dybvig, P., 1983. Bank runs, deposit insurance, and liquidity. The Journal of Political Economy 91 (3), 401–419.

Diaz-Alejandro, C., 1985. Good-bye financial repression, hello financial crash. Journal of Development Economics 19 (1–2), 1–24.

Dornbusch, R., Goldfajn, I., Valdés, R.O., 1995. Currency crises and collapses. Brookings Papers on Economic Activity 2, 219–293.

Eichengreen, B., Rose, A., Wyplosz, 1995. Exchange market mayhem: the antecedents and aftermath of speculative attacks. Economic Policy 21, 249–312.

Farhi, E., Tirole, J., 2012. Collective moral hazard, maturity mismatch and systemic bailouts. American Economic Review 102, 60–93.

Farhi, E., Werning, I., 2012. Fiscal Unions. Mimeo, Harvard.

Ferretti, G., Razin, A., 2000. Current account reversals and currency crises, empirical regularities. In: Krugman, P. (Ed.), Currency Crises. University of Chicago Press, pp. 295–323.

Flood, R.P., Garber, P.M., 1984. Collapsing exchange-rate regimes: some linear examples. Journal of International Economics 17 (1–2), 1–13.

Forbes, K.J., Warnock, F.E., 2012. Capital flow waves: surges, stops, flight, and retrenchment. Journal of International Economics 88 (2), 235–251.

Galí, J., Monacelli, T., 2005. Monetary policy and exchange rate volatility in a small open economy. Review of Economic Studies 72 (3), 707–734.

Garber, P., 1999. The target mechanism: will it propagate or stifle a stage III crisis? In: Carnegie-Rochester Conference Series on Public Policy, vol. 51. Elsevier, pp. 195–220.

Geanakoplos, J., Polemarchakis, H., 1986. Existence, regularity and constrained suboptimality of competitive allocations when the asset market is incomplete. Uncertainty, Information and Communication: Essays in Honor of KJ Arrow 3, 65–96.

Gennaioli, N., Martin, A., Rossi, S., 2012. Sovereign Default, Domestic Banks, and Financial Institutions. Mimeo, CREI.

Gertler, M., Gilchrist, S., Natalucci, F., 2007. External constraints on monetary policy and the financial accelerator. Journal of Money, Credit and Banking 39 (2–3), 295–330.

Ghosh, A., Kim, J., Mendoza, E., Ostry, J., Qureshi, M., 2011. Fiscal Fatigue, Fiscal Space and Debt Sustainability in Advanced Economies. Discussion Paper, National Bureau of Economic Research.

Giavazzi, F., Pagano, M., 1990. Confidence crises and public debt management. In: Dornbush, R., Draghi, M. (Eds.), Public Debt Management: Theory and History. Cambridge University Press.

Gourinchas, P., Valdés, R., Landerretche, O., 2001. Lending booms: Latin America and the world. Economía 1 (2), 47–89.

Gromb, D., Vayanos, D., 2002. Equilibrium and welfare in markets with financially constrained arbitrageurs. Journal of Financial Economics 66 (2), 361–407.

He, Z., Xiong, W., 2009. Dynamic Debt Runs. Discussion Paper, National Bureau of Economic Research.

Hellwig, C., Mukherji, A., Tsyvinski, A., 2006. Self-fulfilling currency crises: the role of interest rates. American Economic Review 96 (5), 1769–1787.

Hutchison, M., Noy, I., 2006. Sudden stops and the Mexican wave: currency crises, capital flow reversals and output loss in emerging markets. Journal of Development Economics 79 (1), 225–248.

Jeanne, O., 1997. Are currency crises self-fulfilling? A test. Journal of International Economics 43 (3–4), 263–286.

Jeanne, O., 2000. Foreign currency debt and the global financial architecture. European Economic Review 44 (4), 719–727.

Jeanne, O., 2011. Capital Account Policies and the Real Exchange Rate. Mimeo, Johns Hopkins University.

Jeanne, O., Korinek, A., 2010. Excessive volatility in capital flows: a Pigouvian taxation approach. American Economic Review 100 (2), 403–407.

Jeanne, O., Korinek, A., 2013. Macroprudential Regulation versus Mopping Up After the Crash. Discussion Paper 18675, NBER.

Kaminsky, G.L., Reinhart, C.M., 1999. The twin crises: the causes of banking and balance-of-payments problems. American Economic Review 89 (3), 473–500.

Keynes, J., 1929. The German transfer problem. Economic Journal 39 (153), 1–7.

Kiyotaki, N., Moore, J., 1997. Credit cycles. Journal of Political Economy 105 (2), 211–248.

Korinek, A., 2011. Excessive Dollar Borrowing in Emerging Markets: Balance Sheet Effects and Macroeconomic Externalities. Mimeo, Maryland.

Krugman, P., 1979. A model of balance-of-payments crises. Journal of Money, Credit and Banking 11 (3), 311–325.

Krugman, P., 1996. Are currency crises self-fulfilling? In: Bernanke, B., Rotembers, J. (Eds.), NBER Macroeconomics Annual 1996, vol. 11. MIT Press, pp. 345–407.

Krugman, P., 1998. What Happened to Asia. Mimeo, MIT.

Lorenzoni, G., 2008. Inefficient credit booms. The Review of Economic Studies 75 (3), 809–833.

Lorenzoni, G., Werning, I., 2013. Slow Moving Debt Crises. Mimeo.

Martin, P., Rey, H., 2006. Globalization and emerging markets: with or without crash? American Economic Review 96 (5), 1631–1651.

McKinnon, R., Pill, H., 1996. Credible liberalizations and international capital flows: the overborrowing syndrome. In: Ito, T., Krueger, A. (Eds.), Financial Deregulation and Integration in East Asia. University of Chicago Press, pp. 7–50.

Mendoza, E., 2002. Credit, prices, and crashes: business cycles with a sudden stop. In: Preventing Currency Crises in Emerging Markets. University of Chicago Press, pp. 335–392.

Mendoza, E., 2010. Sudden stops, financial crises, and leverage. American Economic Review 100 (5), 1941–1966.

Mendoza, E., Terrones, M., 2008. An Anatomy of Credit Booms: Evidence from Macro Aggregates and Micro Data. NBER Working Paper Series 14049.

Missale, A., Blanchard, O., 1994. The debt burden and debt maturity. American Economic Review 84 (1), 309–319.

Morris, S., Shin, H., 1998. Unique equilibrium in a model of self-fulfilling currency attacks. American Economic Review 88 (3), 587–597.

Morris, S., Shin, H., 2001a. Global Games: Theory and Applications. Discussion Paper.

Morris, S., Shin, H., 2001b. Rethinking multiple equilibria in macroeconomic modeling. In: NBER Macroeconomics Annual 2000, vol. 15. MIT Press, pp. 139–182.
Neumeyer, P., Perri, F., 2005. Business cycles in emerging economies: the role of interest rates. Journal of Monetary Economics 52 (2), 345–380.
Obstfeld, M., 1986. Rational and self-fulfilling balance-of-payments crises. American Economic Review 76 (1), 72–81.
Obstfeld, M., 1994a. The Logic of Currency Crises. NBER Working Paper 4640.
Obstfeld, M., 1994b. Risk-taking, global diversification, and growth. American Economic Review 84 (5), 1310–1329.
Obstfeld, M., 2012. Does the Current Account Still Matter? National Bureau of Economic Research Inc., Discussion Paper.
Obstfeld, M., Rogoff, K., 1995. Exchange rate dynamics redux. Journal of Political Economy 103 (3), 624–660.
Pavlova, A., Rigobon, R., 2008. The role of portfolio constraints in the international propagation of shocks. Review of Economic Studies 75 (4), 1215–1256.
Qian, R., Reinhart, C., Rogoff, K., 2010. On Graduation from Default, Inflation and Banking Crisis: Elusive or Illusion? Discussion Paper, National Bureau of Economic Research.
Radelet, S., Sachs, J., 1998. The East Asian financial crisis: diagnosis, remedies, prospects. Brookings Papers on Economic Activity 1998 (1), 1–90.
Radelet, S., Sachs, J., 2000. The onset of the East Asian financial crisis. In: Currency Crises. University of Chicago Press, pp. 105–162.
Rebelo, S., Végh, C., 2008. When is it optimal to abandon a fixed exchange rate? 1. Review of Economic Studies 75 (3), 929–955.
Reinhart, C., Calvo, G., 2000. When capital inflows come to a sudden stop: consequences and policy options. In: Kenen, P.B., Swoboda, A.K. (Eds.), Reforming the International Monetary and Financial System. International Monetary Fund, Washington, DC, pp. 175–201.
Sargent, T., Wallace, N., 1981. Some unpleasant monetarist arithmetic. Federal Reserve Bank of Minneapolis Quarterly Review 5 (3), 1–17.
Schmitt-Grohe, S., Uribe, M., 2012. Prudential Policy for Peggers. Discussion Paper, Mimeo, Columbia.
Schneider, M., Tornell, A., 2004. Balance sheet effects, bailout guarantees and financial crises. Review of Economic Studies 71 (3), 883–913.
Shambaugh, J., 2012. The euro's three crises. Brookings Papers on Economic Activity 44 (1), 157–231.
Tirole, J., 2003. Inefficient foreign borrowing: a dual- and common-agency perspective. American Economic Review 93 (5), 1678–1702.
Tirole, J., 2005. The Theory of Corporate Finance. Princeton University Press.
Uribe, M., 2006. A fiscal theory of Sovereign risk. Journal of Monetary Economics 53 (8), 1857–1875.