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Bank Fragility and International Capital Mobility

Prepared by Enrica Detragiache[1]

Authorized for distribution by Peter Wickham

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Abstract

The paper examines the effects of increased financial integration on the economy and, specifically, the welfare of depositors and the business sector. A simple model of a small open economy with a fragile banking sector and imperfect capital mobility is developed. Increased international integration of the market for bank deposits makes runs on banks more likely and unambiguously hurts the domestic business sector. Depositors may gain or lose depending on the parameters. Even when depositors gain, the overall effect on the economy depends on the size of foreign assets held relative to the costs of bank crises.

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I. INTRODUCTION

The last two decades were a period of fast international economic integration, as international trade flows and international flows of financial assets grew faster than the world economy (IMF (1997)). The globalization of national economies has become a much talked-about (if much less well-understood) phenomenon, often blamed for all the evils and credited for all the goods of the last two decades of economic experience. Among the evils often attributed to globalization, and particularly to increased international capital mobility, is the proliferation of financial crises that has afflicted a large number of countries, ranging from rich industrialized nations to poor "nonemerging" developing economies. Financial crises have involved various combinations of currency collapses, banking panics, sovereign and corporate debt crises. The disruptions brought about by these events have led to calls for the resumption of capital controls, for new international institutions to improve prevention and treatment of financial crises (a new "financial architecture"), as well as a reexamination of the national regulatory framework for financial institutions.

Needless to say, the spectacular disasters of the 1980s and 1990s have also led economists to visit and revisit the theoretical and empirical linkages among currency collapses, international capital mobility, and banking and debt crises. There is a significant body of literature on the relationship between currency crises and international capital mobility (see, among others, Dooley (1996), Obstfeld (1998), and Eichengreen and others (1998)). Also, bank runs and, more generally, banking crises have been a favorite subject of the banking and monetary literature, albeit in the context of closed-economy models.[2] A much smaller literature recently has extended bank runs models to open economies, with particular attention to the connection between currency and banking crises.[3] However, not much has been written specifically on the relationship between banking sector fragility and the degree and patterns of international integration of the domestic financial market. Yet, theoretical models could be useful to understand the possible linkages between banking crises and international capital flows, trace out the welfare effects of financial integration, and possibly provide testable empirical implications, so that the debate over policy could move to more solid grounds.

In this paper, a simple theoretical model of a small open economy with a limited degree of international capital mobility and a fragile banking sector is developed to study the effects of increased international financial integration on the economy. In the model, to reach the business sector and fund productive investment, savings must be intermediated by the banking system, as only banks have the skills to screen loan applicants, monitor the debtor during the life of the loan, and enforce repayment. Banks also perform maturity

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[2]For a recent textbook treatment of the literature on bank runs, see Freixas and Rochet (1997), Chapter 7.

[3]For models of bank runs in open economies, see Garber and Grilli (1989), Chang and Velasco (1997, 1998), Miller (1996 and 1998), and Goldfajn and Valdes (1997).

transformation, namely they raise funds by issuing short-term liabilities (deposits) and invest in long-term assets (business loans); the maturity mismatch between assets and liabilities makes banks vulnerable to runs. Another important feature of the model is that the skills necessary to lend to domestic businesses are assumed to be country-specific so that, even in the absence of regulatory restrictions on external financing by the business sector, foreign banks cannot lend to domestic businesses. Foreign banks (or, more generally, foreign financial institutions) can offer domestic savers an alternative to domestic bank deposits. The degree of international integration of the bank deposit market is measured by the wedge between the foreign interest rate and the effective rate of return on the foreign asset received by domestic investors. As international financial integration progresses, this wedge falls, while the extreme segmentation on the lending side of the market is assumed to remain. The paper addresses the question of how this process affects the economy and, more specifically, the welfare of the depositors and of the business sector.

The first result is that increased international integration increases bank fragility, in the sense that banking panics become more likely: the foreign asset becomes a better alternative to domestic bank deposits from the point of view of domestic savers, so running the bank to put the money into the foreign asset is more attractive.[4] Banking panics lead to deadweight costs, in the form of a reduction in the rate of return of the domestic investment, and they redistribute returns ex post from depositors (whose claims on the banks become impaired) to firms (who benefit from the reduced ability to enforce claims due to bank failure). In equilibrium, the business sector bears the deadweight costs of banking panics (which exceed the gains from redistribution), and reaps no other gains from international financial integration, thus it is always worse off. If, at the contracting date, depositors hold a positive amount of the foreign asset (so domestic savings exceed domestic investment), then the lending rate increases, and the business sector bears that cost as well. In this case, increased international integration reduces domestic investment. The net effect of increased integration on the welfare of depositors depends on whether they hold a positive amount of foreign assets: if so, depositors are unambiguously better off; otherwise, they are unambiguously worse off. Finally, whether the gains to depositors (if any) exceed the losses to the business sector depends on the size of the initial holdings of foreign assets relative to the costs of bank fragility: if these holdings are large, the gains due to the increased rate of return on those asset offset the increased losses due to banking panics, and vice versa.

Thus, when international financial market integration proceeds in an asymmetric fashion, in the sense that the deposit side of the market becomes integrated more quickly than the lending side of the market, the presumption that such integration is welfare-improving needs to be reconsidered: first, the improved opportunities for depositors translate in higher

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[4]It is important to point out that the probability of a banking panic increases not just ex post, after the deposit and lending rate have been negotiated, but also ex ante; thus, bank fragility increases in equilibrium even if the parties can adjust contractual terms to the new regime,

financing costs for the domestic business sector; second, bank fragility increases, with the attendant efficiency losses.

The paper is organized as follows: the next section outlines the model. In Section III the equilibrium is derived. Section IV contains the results on the consequences of international financial integration, and Section V concludes.

II. THE MODEL

There are three dates, denoted by t = 0, 1, 2. A single good is used both for consumption and as an input to production; the good is freely traded internationally. The economy is a small open economy, and the price of the good on world markets is constant over time, so intertemporal relative prices are one.

Agents: The economy is populated by two types of agent: entrepreneurs (or firms), and savers (or depositors). Firms are endowed with a project that requires the investment of one unit of the good at t=0 and yields K units of the good at t=2. Thus, the investment technology is riskless but it is long-term, as it takes two periods to obtain any output. There is a continuum of heterogeneous firms, each characterized by a gross return on the project $k \in [k_0, K]$. The measure of firms with return $k \leq k'$ is $M(k')$; the function $M(k)$ is continuous and differentiable, $M(K)=1$, and $m(k) \equiv M'(k)$. Since entrepreneurs have no endowment of the good at t=0, they must enter a financial transaction with other agents to take advantage of the investment opportunity. Finally, entrepreneurs have linear preferences and derive utility only from consumption at t=2.

There is a continuum of homogeneous depositors of total mass of 1. Each individual is endowed with E units of the good at t=0 and, like the entrepreneur, has linear preferences and derives utility only from consuming in the third period, t=2. In this set-up, of course, there are gains to be had if depositors hand over their initial endowment to the firms, and if the latter invest it in the project and obtain output for consumption at t=2.

Financial intermediation: To create a role for a domestic financial intermediary, it is assumed that depositors cannot lend their endowment directly to the firms, but must enter a contract with a specialized financial intermediary (the bank). The bank, in turn, contracts with the firm. Nothing is lost by assuming that there is only one representative financial intermediary. The existence of the bank can be rationalized in various ways, all of which have been made familiar by the banking literature[5]: for instance, a specialized intermediary may be needed because borrowers must be screened to identify "lemon" projects, loans must be monitored to ensure that entrepreneurs do not "loot" the project, or particular skills are

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[5]For an excellent exposition of modern banking theory, see Freixas and Rochet (1997).

required to enforce the terms of the contract in case of default. Screening and monitoring services give rise to a fixed cost of m units of the good for each unit lent.

Another important element of the model is that banking skills are assumed to be exclusive attributes of domestic financial intermediaries so that, regardless of the administrative and regulatory regime affecting foreign capital flows, domestic firms can borrow only from domestic banks and not from foreign banks. This assumption, while obviously extreme, is meant to capture the fact that at least some bank activities require skills that are local in nature, such as an intimate knowledge of local market conditions, local customs, and local laws and law enforcement techniques, as well as long-term customer relationships. While foreign banks can be expected to acquire such skills over time after entering the local market, there is likely to be a transitional period after capital market liberalization in which foreign banks, although they have entered the domestic market, lend only to a small segment of the business sector (for instance, export firms or subsidiaries of foreign multinationals). It is this transitional period—and the financial conditions of the segments of the economy that do not have access to foreign bank credit—that the model is meant to capture. Also, the decision on the part of a foreign bank to enter the domestic market may be deterred by the existence of country-specific skills, so that the banking sector may remain segmented even after regulatory restrictions are removed. Finally, due to regulatory restrictions or other barriers, domestic banks are assumed to be unable to borrow internationally.

Foreign assets and international capital mobility: As an alternative to domestic deposits, savers can invest in foreign assets, which can be either long-term or short term. A two-period investment in the foreign asset at t=0 yields a safe gross return of ${}_0\rho_2$ at t=2, while an investment at t=1 pays a gross return of ${}_1\rho_2$ at t=2. ${}_1\rho_2$ is the realization of a random variable that takes values on the interval $[\underline{\rho}, P]$, and has a cumulative distribution function $F({}_1\rho_2)$ and density $f({}_1\rho_2)$. The return on the foreign asset between t=1 and t=2 is the only stochastic element in the model.[6] Because of capital controls or other sources of market segmentation, domestic investors must pay a proportional transaction cost on the returns from the foreign assets. As a result, the domestic return on a unit investment in the foreign asset is a fraction 1/g of the foreign interest factor, where $g \geq 1$. Then, g=1 corresponds to the case of perfect international integration of the market for bank deposits, while complete segmentation is the case in which $g \to +\infty$.

The lending and the deposit contract and bank fragility: Another key set of assumptions has to do with the form of the financial contract between the bank and the depositor and between the bank and the firm. Here to keep things simple specific contractual forms are assumed rather than derived from first principles, but they closely resemble standard loan and deposit contracts. Specifically, the bank lends to each firm a unit of output at t=0 in exchange

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[6]The return on the foreign asset may vary due to fluctuations in the foreign interest rate or in the real exchange rate.

for the promise to repay R units of output at t=2. It will be assumed that the lending rate cannot be renegotiated at t=1.

On the deposit side, at t=0 the bank promises to repay a gross return of ${}_0r_2$ at t=2 on every unit of good deposited at t=0. To capture the fact that bank liabilities typically have shorter maturity than bank assets—the fundamental cause of bank fragility—it will be assumed that at t=1 depositors have the right to withdraw their deposit (without receiving any interest); depositors may want to exercise this option because the funds withdrawn can be reinvested in the short-term foreign asset (recall that the rate of return on the foreign deposit between t=1 and t=2 becomes known at t=1). It should be emphasized that in this set-up there is no reason for deposit contracts to be more liquid than loan contracts because there is no benefit to outweigh the cost of bank fragility in terms of efficiency. This is a serious limitation of the model. However, the banking literature provides several models in which, at the cost of more complexity, the illiquidity of bank balance sheet can be rationalized.[7]

Before the depositors withdraw their funds (an event that will be referred to as a bank run), the bank can attempt to stop them by offering a new, higher deposit interest rate ${}_1r_2$. Of course, any credible increase in the deposit rate is limited by the value of the bank assets, namely the value of the loans to the business sector RL: any promise to pay a deposit rate that exceeds the rate of return on the loan portfolio will not be credible, and will not stop a run.[8]

Bank runs and their consequences: If a sufficient amount of deposits is withdrawn at t=1, the banking system becomes illiquid because its loan portfolio cannot be sold at t=1, and illiquidity results in bank failure. To capture the real cost of the collapse of the banking system due to a run, it is assumed that the value of the loan portfolio, which accrues to depositors in case of bank failure, declines to hRL, with $h \in [0, 1)$ and that the return on the investment project also falls by the same amount. The first cost, which is not a deadweight cost but only a cost to depositors, may result from the limited ability of depositors, who become the direct creditors of the firm in case of bank failure, to enforce repayment without the specific skills of the banks. Each depositor is assumed to receive a share of the bankruptcy value of the bank equal to her share in total deposits. On the other hand, the reduction in the return on the project is assumed to be a deadweight cost, arising from disruptions in the flow of credit to enterprises and from the loss of the monitoring services of the banks. So, in case of a bank run, depositors (collectively) receive hRL at t=2 and each entrepreneur receives h(k-R).

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[7]See, among other, Diamond and Dybvig (1983), Calomiris and Kahn (1991), Flannery (1994), and Diamond and Rajan (1998).

[8]In practice, bank assets include also bank capital, reserves, as well as the expected value of government subsidies in case of a banking crisis.

III. THE EQUILIBRIUM

A. The Equilibrium at the Renegotiation Stage (t=1)

The first step to characterize the full equilibrium is to derive the equilibrium outcome of the model from t=1 on. As usual, attention is restricted to pure strategy, symmetric Nash equilibria. At t=1 the volume of credit is given, and so are the lending rate and the domestic deposit rate ${}_0r_2$; also, all uncertainty is resolved, i.e. all parties learn the realization of ${}_1\rho_2$. The following Lemma describes the equilibrium outcome of this stage of the game:

Lemma 1. *At t= 1, for all realizations of the foreign interest factor ${}_1\rho_2$ there is a bank run equilibrium. Furthermore,*

(A) for $gR \leq {}_1\rho_2 \leq P$ a bank run is the only equilibrium;

(B) for $g\,{}_0r_2 \leq {}_1\rho_2 \leq gR$ there is another equilibrium in which depositors renegotiate the deposit contract, and obtain a new deposit rate ${}_1r_2 = (1/g)\,{}_1\rho_2$;

(C) for $\rho \leq {}_1\rho_2 \leq g\,{}_0r_2$ there is another equilibrium in which depositors do not attempt to withdraw or renegotiate the deposit contract.

Proof. Consider the bank-run equilibrium first. If a depositor believes that all other depositors withdraw from the domestic bank at t=1, then the bank will fail irrespective of his decision and of the realization of the foreign interest rate; thus, the depositor is indifferent between withdrawing or keeping the deposit, and withdrawing is an equilibrium. So a bank run equilibrium supported by the pessimistic beliefs that other depositors will withdraw is always a possibility. Consider now an equilibrium with no run. In the region defined by the inequalities under (C), if a depositor believes that the others will not run (and, therefore, the bank will remain in business), then it is a best response not to withdraw, because the domestic deposit rate contracted at t=0 exceeds the return on the foreign asset (net of transaction costs). Thus, there is an equilibrium with no run. For realizations of the foreign return such that $g_0r_2 \leq {}_1\rho_2 \leq gR$ (inequalities under (B)), depositors are better off not withdrawing (given that the others do the same) if and only if the bank offers a new deposit rate high enough to match the rate of return on the foreign asset, namely ${}_1r_2 \geq (1/g)\,{}_1\rho_2$. Since ${}_1\rho_2 \leq gR$, such a rate is feasible, in the sense that it is below the rate of return on loans. In equilibrium, the bank will offer the smallest interest rate that will convince depositors not to withdraw, namely ${}_1r_2 = (1/g)\,{}_1\rho_2$. Thus, also for realizations of the foreign interest rate in (B) there is an equilibrium with no run. Finally, when the foreign interest rate exceeds gR (region (A)) there is no credible deposit interest rate sufficiently high to convince a domestic depositor not to withdraw. Thus, in this region the only equilibrium is for depositors to run the bank.

Notice that when an equilibrium with no run exists (regions (B) and (C)) running the bank is a weakly dominated strategy, while in region (A) not running is a weakly dominated strategy. Thus, the belief-driven bank run equilibrium in regions (B) and (C) is somewhat implausible. Furthermore, as pointed out by Allen and Gale (1998), empirical studies find significant correlations between banking crises and macroeconomic variables.[9] For these reasons, the focus will be on bank fragility arising from the "fundamentals" rather than from self-fulfilling beliefs. So, in what follows we will make the following assumption:

Assumption 1. *If another equilibrium exists, depositors do not play the bank run equilibrium.*[10]

Another interesting characteristic of bank runs in this model is that they occur independent of the existence of a "sequential service constraints" in the bank deposit contract, that is the stipulation that deposits will be paid out on a first-come, first-served basis. Therefore, runs can occur even if banks raise funds by issuing short-term securities, such as commercial paper, or through interbank loans. Accordingly, banking crises need not be preceded or brought about by depositor runs. Unwillingness on the part of other bank creditors to continue funding is sufficient.

B. The Equilibrium at t=0

Given the results of Lemma 1, and given Assumption 1, at t=0 the expected return to a depositor from depositing one unit of endowment in the domestic bank is

$$w(R,{}_0r_2)=F(g_0r_2)_0r_2+\int_{g_0r_2}^{gR}(1/g)_1\rho_2 dF({}_1\rho_2)+[1-F(gR)]hR. \qquad (1)$$

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[9]Gorton (1988) finds that bank runs during the National Banking Era in the U.S. were correlated with economic downturns. Also, cross-country empirical studies find significant and robust correlations between banking crises and macroeconomic conditions after controlling for country characteristics (see, for instance, Demirgüç-Kunt and Detragiache (1998)).

[10]Also Goldfajn and Valdés (1997) consider bank runs driven by increases in foreign short-term interest rates, as opposed to runs driven by self-fulfilling beliefs. The focus on their paper, however, is on the interaction between currency and banking crises, not on the welfare effects of increased international capital mobility. For a model of self-fulfilling runs in an open economy, see Chang and Velasco (1998). In Chan-Lau and Chen (1998), banking crises occur when banks find it profitable not to monitor their borrowers. In this model, large capital inflows into the banking system can be followed by large outflows even while the "fundamentals" change very little.

The first term is the deposit rate contracted at t=0 multiplied by the probability that the foreign interest rate between t=1 and t=2 is below the deposit rate, so that no runs nor recontracting take place at t=1; the second term captures the expected return in states of nature in which the deposit rate is renegotiated to match the foreign rate of return; finally, the third term is the return to depositors when there is a bank run.

The expected profits to a firm of type k are

$$\pi(R,X(k);k)=X(k)[(k-R)F(gR)+h(k-R)(1-F(gR))], \tag{2}$$

where X(k) is an indicator function that takes the value of 1 if firm k receives a loan and a value of zero otherwise. Aggregate profits of the business sector (the producers' surplus) are then

$$\Pi(R,X(k))=\int_k^K \pi(R,X(k);k)dM(k). \tag{3}$$

and the volume of credit to the economy is

$$L(X(k))\equiv\int_k^K X(k)dM(k). \tag{4}$$

The expected profits to the bank are

$$Q(R,{}_0r_2,X(k))=L(X(k))(R[F(gR)(1-h)+h]-w(R,{}_0r_2)-m). \tag{5}$$

Since in equilibrium the bank must make zero expected profits, the deposit rate must be such that

$$w(R,{}_0r_2)=[F(gR)(1-h)+h]R-m\equiv W(R). \tag{6}$$

Thus, once the expected zero-profit condition for the bank is imposed, the rate of return to depositors is a function of the lending rate alone. With these results and definitions in hand, it is straightforward to derive the demand for loans and the supply of deposits as a function of the lending rate R. Maximization of firms' profits by choice of the indicator function X(R) yields the condition that all the firms whose expected profits are positive at the interest factor R demand credit, thus in equilibrium X(k)= 1 if k≥R, and X(R)=0 otherwise. Then, the loan demand function is just the measure of firms with a return higher than R, namely 1-M(R). The supply of deposits as a function of the lending rate R is just as easy to derive: define R* as the solution to

$$W(R)=(1/g)_0\rho_2, \tag{7}$$

where the function W(R) is defined in equation (6). Then, for R < R* the supply of deposits is zero, as depositors are better off investing in the foreign asset; for R=R* deposit supply is [0, E], as investors are indifferent between the two assets; and, finally, for R>R* depositors invest the entire endowment in domestic bank deposits. The supply and demand schedules are depicted in Figure 1. The two panels show the two possible lending equilibria that obtain depending on the values of the parameters. In the equilibrium of panel (a), the domestic endowment is small relative to investment opportunities, so all of it is deposited in domestic banks and used to finance domestic investment. In this equilibrium, L(X(R)) = E, and the equilibrium interest factor, which exceeds R*, is the solution to [1-M(R)] = E. Thus, depositors strictly prefer domestic bank deposits to the foreign asset at t=0. This equilibrium will be referred to as the savings-constrained equilibrium. In the equilibrium of panel (b), on the other hand, the domestic endowment is plentiful relative to investment opportunities, L(X(R)) < E, and domestic depositors hold some of the foreign asset. The interest factor is R=R*, so depositors are indifferent between domestic bank deposits and the foreign asset. This equilibrium will be referred to as the unconstrained equilibrium. The characteristics of the market equilibrium are summarized in the following:

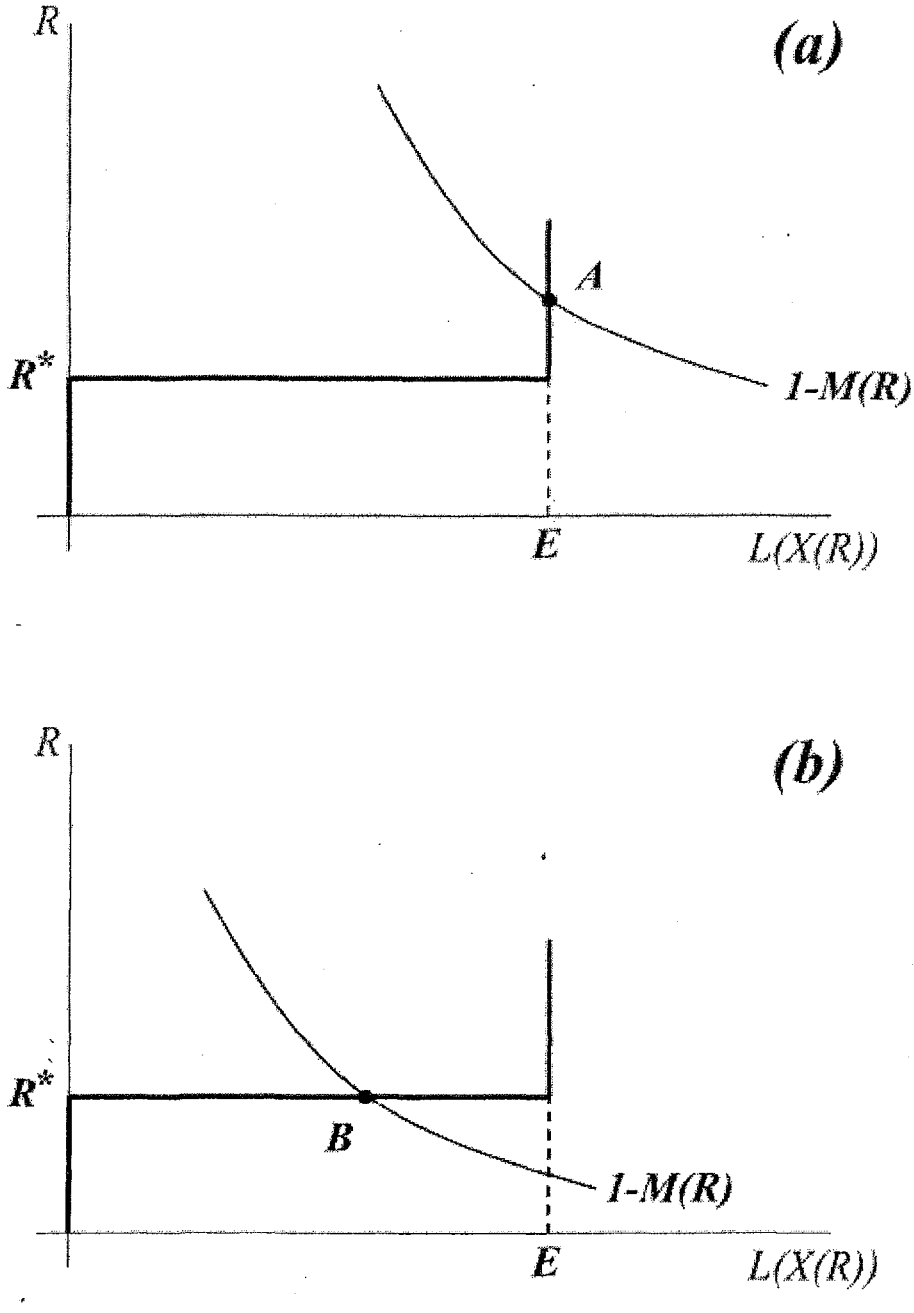
Proposition 1. *Depending on the parameters, two equilibria can occur: a "savings-constrained" equilibrium, in which the entire endowment is deposited in the domestic bank and is used to finance domestic investment. In this equilibrium, the lending interest factor is the solution to [1-M(R)] = E. The second equilibrium, the "unconstrained" equilibrium, is such that the lending interest factor is R* (where R* is the solution to W(R) = $_0\rho_2$), the amount deposited and invested in the domestic economy is [1-M(R*)]<E, and depositors are indifferent between domestic bank deposits and the foreign asset.*

In the next section, we will explore how the equilibrium changes as the domestic financial system becomes increasingly integrated in the international system on the deposit side but not on the lending side.

IV. The Welfare Effects of Asymmetric Financial Integration

The degree of segmentation of the deposit market is captured in the model by the parameter g, the wedge between the rate of return on the foreign asset and what accrues to domestic depositors who invest in such asset. A decline in g, therefore, corresponds to increased international integration, and may reflect a reduction in administrative controls on capital movements, improved technology, financial or regulatory innovation, or other factors. Consider the effects of a change in g on the loan demand and deposit supply schedules. The loan demand equation remains unchanged, since in this simple formulation it depends only on the distribution of the return on the investment project. The deposit supply schedule, on the

Figure 1. The Credit Market Equilibrium



other hand, shifts up as g declines, because R* is a decreasing function of g. This can be verified by implicitly differentiating equation (7):

$$\frac{dR*}{dg} = -\frac{(R*)^2(1-h)f(gR*)+{}_0\rho_2(1/g)^2}{F(gR*)(1-h)+h+R*gf(gR*)(1-h)} < 0. \tag{8}$$

The intuition is the following: R* is the lending rate that gives the bank expected zero profits when the bank pays depositors a rate that matches the return on the foreign asset. As g increases two effects take place: first, the foreign asset becomes more attractive at t=0, so the bank must increase the deposit rate and, consequently, the lending rate to attract depositors; furthermore, because the foreign asset becomes more attractive *at t=1* as well, bank run—with the attending efficiency losses—become more likely, so the deposit rate must be increased further to compensate depositors for the expected costs of the run. Figure 2 illustrates the effect of a decline in g (increased international integration of the bank deposit market) on the two types of equilibrium.

Consider first the constrained equilibrium, represented by point A. Since neither the loan demand schedule nor the deposit supply schedule shift, the equilibrium lending rate and investment level do not change: domestic investment is still equal to the entire endowment, and the lending interest factor is still the solution to [1-M(R)] = E. The intuition is straightforward: in the constrained equilibrium, domestic depositors *strictly* prefer domestic bank deposits to the foreign asset at t=0, so a decline in segmentation that makes the foreign asset more attractive is immaterial as long as the latter remains dominated by the domestic asset. Interestingly, however, even though the equilibrium investment and interest rate do not change, the utility of both depositors and firms does change, because the decline in g makes bank runs more likely. The equilibrium utility of the depositors as a group is:

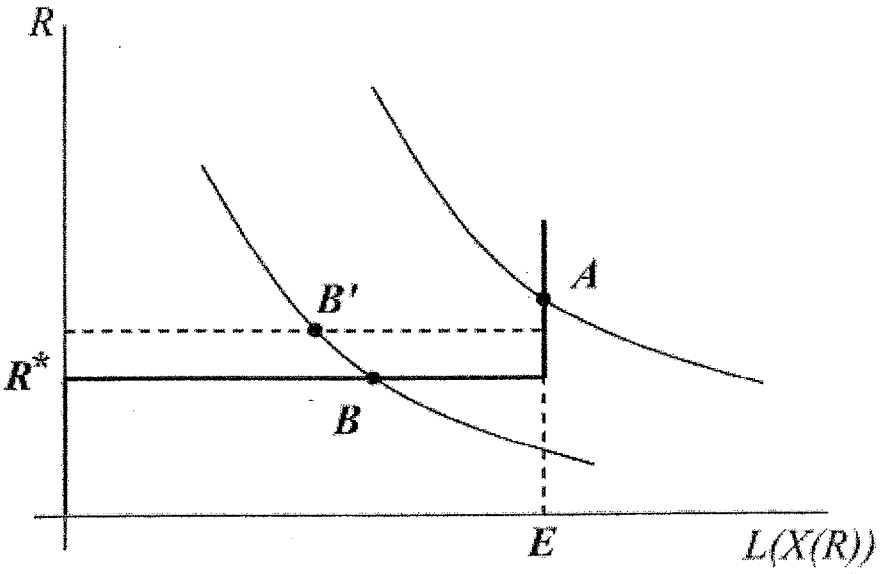
$$U(R;g)=(R[F(gR)(1-h)+h]-m)[1-M(R)]+(1/g)_0\rho_2(E-[1-M(R)]). \tag{9}$$

Since in a constrained equilibrium E=1-M(R) and R does not change,

$$\frac{dU}{dg}=\frac{\partial U}{\partial g}=[1-M(R)][R^2f(gR)(1-h)]>0. \tag{10}$$

This expression shows that the only effect of increased integration on depositors' utility is to increase the probability of a bank run. To see this, recall that bank runs occur for realizations of the foreign interest factor above gR, so F(gR) is the probability that there will not be a run. Even if the foreign asset remains dominated at t=0, at t=1 the probability that this asset will be

Figure 2. The Effects of Increased International Integration of the Market for Bank Deposits



more attractive than bank deposits increases, and this make runs more likely. Consider now the aggregate profits of the business sector:

$$\Pi(R;g)=\int_R^K (k-R)[F(gR)(1-h)+h]dM(k). \tag{11}$$

Since the equilibrium R is unchanged in a constrained equilibrium,

$$\frac{d\Pi}{dg}=\frac{\partial\Pi}{\partial g}=\int_R^K (k-R)R(1-h)f(gR)dM(k)>0. \tag{12}$$

As in the previous case, the only effect of a decline in g is to increase the probability of a bank run at the intermediate date t=1; this effect is welfare-reducing because bank runs have real costs. To sum up, if in the initial equilibrium domestic depositors do not hold any foreign assets, increased financial integration only makes bank runs more likely, thereby reducing the ex ante utility of both depositors and firms. This result, of course, stands in sharp contrast with the presumption that increased international financial integration, by expanding the opportunity set of domestic depositors, leads to welfare gains.

Turning now to the case of an unconstrained equilibrium, as shown by equation (8) a decline in segmentation leads to an increase in the lending rate R*. In Figure 2, the equilibrium moves from point B to point B', so domestic investment declines. The probability of a bank run at t=1, [1-F(gR)], is affected by the change in g both directly and indirectly, through the change in the lending rate. The direct effect tends to increase the probability of a run, since *ceteris paribus* the foreign asset is more attractive at t=1; the indirect effect, however, works in the opposite direction, since a higher lending rate allows the bank to offer a higher deposit rate to keep depositors from running. The following lemma shows that the first effect always prevails, so that also in an unconstrained equilibrium an increase in international integration increases the probability of a bank run.

Lemma 2. *In an unconstrained equilibrium, a bank run at t=1 is more likely the higher is the degree of international integration of the bank deposit market.*

Proof. The probability of a bank run in the unconstrained equilibrium is 1-F(gR*), so what needs to be shown is that d(gR*)/dg>0. Using (6) and (7),

$$R*[F(gR*)(1-h)+h]-m=(1/g)_0\rho_2,$$

hence

$$gR*[F(gR*)(1-h)+h]-{}_0\rho_2=gm.$$

Since the LHS is increasing in (gR*), for the equality to be preserved (gR*) must increase as g increases.

The effect of a change in g on the aggregate profits of the domestic business sector of is

$$\frac{d\Pi}{dg}=\int_R^K(-(dR/dg)[F(gR)(1-h)+h])+(k-R)f(gR)(1-h)[R+g(dR/dg)])dM(k). \qquad (13)$$

Since dR/dg<0 and [R+g(dR/dg)]>0 from Lemma 2, the above expression is positive; thus, as international integration increases (g falls), the corporate sector is worse off. This decline reflects both the increase in the lending rate necessary to attract domestic savings when foreign assets become more competitive and the costs of increased bank fragility. The effect on the utility of domestic depositors is straightforward: since in an unconstrained equilibrium domestic savers are indifferent between domestic deposits and the foreign asset, they must earn $(1/g)\ {}_0\rho_2$ on each unit of endowment. Accordingly, $U(R; g) = E\ (1/g)\ {}_0\rho_2$, and $dU/dg = -\ (1/g)^2\ {}_0\rho_2\ E$. This proves that a decline in segmentation benefits domestic depositors by allowing them to earn a higher rate of return on their savings. The results derived in this section are summarized in the following proposition:

Proposition 2. *As international integration of the bank deposit market increases, if the equilibrium was a constrained equilibrium both firms and depositors become worse off because the only effect is an increase in bank fragility. If the equilibrium is an unconstrained equilibrium, firms are again worse off, but depositors are better off, as they benefit from higher returns on their savings.*

In the case of the unconstrained equilibrium, one may wonder whether the gains to depositors are large enough that a redistributive scheme could be designed to compensate business firms for their losses. Actually, because in this simple model expected utilities are equal to expected consumption in the last period, we can answer this question by just looking at the effect of a change in the segmentation parameter g on aggregate expected consumption in period 2. Aggregate expected consumption in period 2 is

$$C(g)=\int_{R*}^K k[F(gR*)(1-h)+h]dM(k)+(E-[1-M(R*)])(1/g)_0\rho_2. \qquad (14)$$

As this expression illustrates, expected consumption is the sum of the return on domestic investment net of the efficiency loss due to bank fragility and of the return on the portion of the endowment that is invested in the foreign asset. A change in international financial integration changes expected consumption by

$$\frac{dC}{dg} = \int_{R*}^{K} k[f(gR)\frac{d(gR)}{dg}(1-h)] - {}_0\rho_2(1/g)^2(E-[1-M(R*)]). \qquad (15)$$

By Lemma 2, d(gR)/dg is positive, so the sign of the above expression is ambiguous: increased integration (a decline in g) increases expected consumption by increasing the return on the portion of the domestic endowment that is invested in the foreign asset; however, by increasing the deadweight cost of bank fragility, increased integration tends to reduce expected domestic consumption. In countries with a substantial stock of domestic savings invested in foreign assets and where the efficiency losses of banking panics are small, increased international integration is likely to increase aggregate consumption and vice versa.

V. Concluding Remarks

The paper has developed a simple model in which increased international integration of the market for bank deposits makes banking crises more likely and, because banking crises are costly to the economy, it may make both domestic depositors and the business sector worse off. Even when the gains to depositors stemming from a higher return on foreign assets exceed the losses due to greater bank fragility, the overall gains are distributed asymmetrically, and financial integration unambiguously hurts the domestic business sector. This occurs both because the domestic borrowing interest rate raises and because the business sector must bear some of the increased deadweight costs of bank runs.

Because the model is too simple in many respects, and its robustness and empirical implications have not been investigated yet, at this stage it would be premature to draw policy conclusions. However, the results do point to some useful directions for future research: a first question is whether globalization increases banking sector fragility, and, if so, whether the transmission mechanism is that highlighted by the model, namely the fact that globalization gives depositor (and, more generally, bank creditors) a better "outside option" relative to domestic bank deposits. Another issue is whether it is empirically true that international financial integration tends to take place in an asymmetric fashion, as hypothesized in the model, so that the bank deposit market becomes integrated with the rest of the world faster than the bank loan market. If so, then significant segments of the business sector not only would remain without access to foreign financing even as capital controls and transaction

costs fall, but they would also face higher domestic borrowing interest rates. Also, when domestic banks suffer runs, alternative financing from international capital markets for the domestic business sector would be difficult, and this sector would bear significant losses due to the disruptions in the domestic banking system.

A related question is to what extent foreign borrowing by the banking system is an effective substitute for direct access to foreign bank loans by the business sector. By ruling out external borrowing by banks, the model tends to understate the benefits to domestic borrowers of increased international financial integration; on the other hand, it also neglects an important source of instability for the banking sector, as excessive foreign debt taken on by domestic banks, especially when loans are denominated in foreign currency, has played an important part in triggering banking crises in a number of countries (Lindgren, Garcia, and Saal, 1996). Another promising area for future research is the nature of the costs of banking crises: are these costs largely deadweight, or are there significant redistributions of wealth? Who bears the costs and who, if anybody, benefits?

References

Allen, Franlin, and Gale Douglas, 1998, "Optimal Financial Crises," *Journal of Finance*, Vol. 3 No. 53, pp.1245-84.

Calomiris, Charles W., and Charles M. Kahn, 1991, "The Role of Demandable Debt in Structuring Optimal Banking Arrangements," *American Economic Review*, No. 81, pp. 97-513.

Chan-Lau, Jorge, and Zhaohui Chen, 1998, "Financial Crisis and Credit Crunch as a Result of Inefficient Financial Intermediation—with Reference to the Asian Financial Crisis," IMF Working Paper No. 127, (Washington: International Monetary Fund).

Chang, Roberto, and Andres Velasco, 1997, "Financial Fragility and the Exchange Rate Regime," Working Paper No. 16, (Atlanta, Georgia: Federal Reserve Bank of Atlanta).

———, 1998, "Financial Crises in Emerging Markets: A Canonical Model," NBER Working Paper No. 6606, (Cambridge, Massachusetts: MIT Press).

Demirgüç-Kunt, A., and Enrica Detragiache, 1998, "The Determinants of Banking Crises: Evidence from Developed and Developing Countries," *IMF Staff Papers*, March, (Washington: International Monetary Fund).

Diamond, Douglas, and Philip Dybvig, 1983, "Bank Runs, Deposit Insurance, and Liquidity," *Journal of Political Economy*, No. 91, pp. 401-19.

———, and Raghuram G. Rajan, 1998, "Liquidity Risk, Liquidity Creation, and Financial Fragility: A Theory of Banking," mimeo, University of Chicago.

Dooley, Michael P., 1996, "A Survey of the Literature on Controls Over International Capital Transactions," *Staff Papers*, Vol. 43 (December) pp. 639-87, (Washington: International Monetary Fund).

Eichengreen, Barry, and others, 1998, "Theoretical and Practical Aspects of Capital Account Liberalization," *IMF Occasional Paper*, No. 172, (Washington: International Monetary Fund).

Freixas, Xavier, and Jean-Francois Rochet, 1998, *Microeconomics of Banking*, (Cambridge, Massachusetts: MIT Press).

Garber, Peter, and Vittorio Grilli, 1989, "Bank Runs in Open Economies and the International Transmission of Panics," *Journal of International Economics*, No. 27, pp. 165-75.

Goldfajn, Ilan, and Rodrigo Valdés, 1997, "Capital Flows and the Twin Crises: The Role of Liquidity," IMF Working Paper No. 97/87, (Washington: International Monetary Fund).

Gorton, Gary, 1988, "Banking Panics and Business Cycles," *Oxford Economic Papers*, Vol. 40, (December), pp. 221-55.

International Monetary Fund, 1997, *World Economic Outlook*, (May/October/December), World Economic and Financial Surveys (Washington: International Monetary Fund).

Lindgren, Carl-Johan, Guillian Garcia, and Mathew I. Saal, 1996, *Bank Soundness and Macroeconomic Policy*, (Washington: International Monetary Fund).

Miller, Victoria, 1996, "Speculative Attacks with Endogenously Induced Commercial Bank Crises," *Journal of International Money and Finance*, No. 15, pp. 383-403.

———, 1998, "Domestic Bank Runs and Speculative Attacks on Foreign Currencies," *Journal of International Money and Finance*, No. 17, pp. 331-38.

Obstfeld, Maurice, 1998, "The Global Capital Market: Benefactor or Menace?," *Journal of Economic Perspectives.*