



CAPITAL FLOWS AND BANKING SYSTEM FRAGILITY*

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ABSTRACT

Financial intermediation in emerging economies is almost always bank-dominated: that is, the bulk of capital inflows is channeled through the domestic banking system. Concern about the linkages and interactions among domestic financial institutions and foreign investors arises from the fact that they have played a crucial role in most of the key financial events in the developing world during the last several decades.

As most of the flows intermediated through the domestic banking system are short run flows dependant on portfolio decisions, their effects on the banking system depend on the factors that affect those decisions.

The instability of bank deposits has been studied in the literature, and “contagion” runs have been the main factor identified in banking crises: Uncertainty about the soundness of the banking sector generates a preference for liquidity. Then, the “first-come, first-served” process whereby deposits are paid out to depositors starts a run.

Following this same line of thinking, this paper focuses on banking crises stemming from a change in international financial market conditions or from agent fear of a possible devaluation.

Whatever the reason for withdrawals, banks face a so-called *liquidity risk*, the inability to obtain funding to satisfy current obligations. Bank balance sheets show the true nature of this problem.

RESUMEN

La intermediación financiera en las economías emergentes es, casi siempre, basada en bancos. Esto implica que la mayor parte de los flujos de capital son canalizados a través del sistema bancario doméstico. El interés acerca de las vinculaciones e interacciones entre esas instituciones financieras y los inversores internacionales, surge del hecho que tales relaciones jugaron un rol central en la mayoría de los eventos financieros en el mundo emergente durante las últimas décadas.

En tanto la mayoría de los fondos intermediados a través del sistema bancario doméstico son, típicamente, de corto plazo y dependientes de decisiones de cartera, los efectos de éstas sobre ese sistema bancario dependen críticamente de los factores que afectan esas decisiones.

La inestabilidad de los depósitos bancarios ha sido estudiada en la literatura, habiéndose identificado a las corridas “por contagio”, como el principal factor que genera crisis bancarias. El proceso es el siguiente: La incertidumbre acerca de la salud del sector bancario genera una preferencia por la liquidez. Dado un proceso para la devolución de los depósitos del tipo “primero que llega, primero que cobra”, la corrida se inicia.

Pensando en el mismo mecanismo, el interés aquí es, en cambio, enfocado a las crisis bancarias que surgen por retiros de depósitos debidos a cambios en los mercados financieros internacionales, o en el temor de los agentes acerca de una posible devaluación, y no a los originados en la confianza en los bancos.

Cualesquiera sea la razón para los retiros de los depósitos, los bancos enfrentan el denominado riesgo de liquidez, que es la imposibilidad de obtener fondos para satisfacer las obligaciones corrientes. La hoja de balance de los bancos muestra la verdadera naturaleza de este problema.

I. INTRODUCTION

The access of Latin American economies to international capital markets changed dramatically during the nineties. As it is well known, those economies had been facing credit rationing for almost a decade after the so-called “debt crisis.” Moreover, during the same decade those economies underwent the structural reforms of the Washington Consensus. Whatever the role played by those reforms in the significant increase in capital inflows was,¹ the new situation seemed to be a return to “normality” from the point of view of the development literature, which considers capital inflows necessary to complete national saving, financing investment, or macroeconomics disequilibria.

Paradoxically, some troubles like overvalued exchange rates, excessive current account deficits, inflationary pressures, and overexpansion of domestic credit appeared. These distortions could be found alone or intertwined in those economies that received the massive capital inflows. But while the value of the exchange rate, the current account deficit, and inflation have been studied in this and other capital inflow episodes, the expansion of domestic credit has received less attention, especially banking credit.² This has happened in spite of the fact that financial intermediation in developing economies is bank dominated, and that the domestic banking system channels the bulk of capital inflows. On the other hand, the concern over the linkages and interactions between these domestic financial institutions and foreign investors is fully justified, to the extent that these have played a crucial role in key financial events in the developing world during the seventies and eighties.³

While the flows that the domestic banking system intermediates are, typically, those of a short run nature, direct foreign investment is not channeled by national banks. As the former depend on portfolio decisions, their effects on the banking system depend on the factors that affect those decisions. Moreover, the characteristics and impact produced by those factors are different if both the policy regime adopted and the macroeconomic environment are different.

From the beginning of the eighties and all through the decade, several Latin-American economies faced financial distress. In Argentina, there was a chronic excess of demand in financial markets, originating in the central government’s fiscal deficit. This

was a very important structural feature, which added to an endemic high inflation problem, and fueled an acute demonetization process. The consequence of downfalls in both money demand and fiscal deficit was increased uncertainty and additional capital flight, and then lower domestic financing. The transfer from private to public sector needed to close the fiscal gap was achieved through the inflation tax, given that no available commercial bank deposits were held in the Central Bank.

As was mentioned above, the Latin American economies had been rationed in the international financial markets since 1982. Transactions in these markets and for these countries were compulsory and originated in “delays” in indebted countries’ payments. It must be noted that this mechanism made it possible to close the fiscal gap with no consequences on domestic monetary aggregates.

During the following decade the price level stabilized and the fiscal deficit reduced substantially. Consequently, sources of uncertainty seemed to be *closed*. Moreover, capital inflows fueled a remonetization, while the Brady Plan modified credit rationing in the international financial markets. If we add the fact that it was the private sector which managed flows, the stability of the domestic financial system seemed to be guaranteed.

Around 1997 the situation in Argentina seemed to be stable. My PhD dissertation, however, considered the danger implied by the relation between the fragility of the banking system and capital flows, particularly in a context of a currency board system (but not only restricted to that). This paper summarizes the main arguments in my dissertation: namely, that uncertainty about the stability of the exchange rate or the international interest rate may impact on the structure of financial holdings of both residents and foreign agents in an open and small economy. Furthermore, this diversification of portfolios may trigger another crisis, this time a balance of payments one. The Balance Sheet Approach, which was at that time rather disregarded, shows itself to be a powerful tool for this analysis, which ended up being an anticipation of the deep crisis of 2001–2002 in Argentina.⁴ At that time the “Twin Crises” literature was also disregarded, or at least not fully developed. Those kinds of crises are closely related to those analyzed in this paper.⁵

The rest of the paper is organized as follows. Section II introduces or recalls the notions of liquidity, bank runs, uncertainty, and financial fragility. Section III presents a framework based on asset and liabilities matrices which will allow us to analyze domestic financial relationships. In section IV, partial equilibrium models are used to evaluate conditions of financial fragility in a specific financial system. Finally, section V presents the conclusions and discusses the policy lessons that can be drawn from the ideas in this paper.

II. CAPITAL FLOWS AND FINANCIAL FRAGILITY

Although there are several kinds of debt contracts, this paper is concerned with two types: those owed by end-users to intermediaries (bank loans) and those owed by intermediaries to investors (deposits). We focus on these kinds of contracts because of the central role played by banks in capital inflows—if the domestic banking system channels a decisive proportion of those flows, a reversion in their sign threatens the stability of these contracts.

Such stability is crucial in the analysis of bank crises, since contagious runs are the principal identifying factor of those crises (Davis, 1995). Diamond and Dybvig's model (1983) on the ability of banks to provide liquidity insurance to risk-averse consumers facing private liquidity risk shows that the risk-sharing deposit contract, given illiquid bank assets, may give depositors an incentive for panic runs, especially in the absence of a safety net of deposit insurance and lender-of-last-resort facilities.

A. Liquidity and Bank Runs

The instability in bank deposits has been studied in the literature, where contagious runs have been the principal identifying factor for banking crises. Uncertainty regarding the banking sector's soundness generates a preference for liquidity. And given the "first-come-first-served" process whereby deposits are paid out to depositors, the run starts.

Thinking in the same terms, our interest here, nevertheless, is focused on a banking crisis stemming not from withdrawals due to mistrust in the banks, but from of a change in international financial market conditions or agents' fear of a devaluation. In the

former case, agents reduce their demand for deposits, increasing their demand for a monetary base and using it as a liquidity hedge; in the second one, people flee from both the bank deposits and the monetary base, increasing their demand for assets abroad.⁶ Note that, if so, the pressure is exerted not only on deposits but also on the international reserves of central bank.

Whatever the reason for withdrawals, banks face the so-called *liquidity risk*, that is, the inability to obtain funding for current obligations. Bank balance sheets show the nature of this problem. On the liabilities side, depositors try to get their liquid deposits, while, on the other side, long-term and illiquid bank assets (bank loans) are held. As the liquidity of bank assets, like that of any other financial instrument, is determined by the time needed to sell them to obtain the total value without incurring excessive transactions cost, the nature of the end-users/intermediaries debt contract determines the illiquidity of loans, due to the credit process. Thus, a maturity mismatch arises.

Information asymmetries in the absence of complete contracts make it necessary for lenders to screen the quality of borrowers and to monitor their performance to avoid adverse selection and moral hazard. Screening and monitoring provides banks with informational advantages, because that information about borrowers is not public. But the intangible nature of this information makes it difficult, or at least costly, to transmit to markets or other lenders. Hence loans are typically non-marketable. Whatever the event that triggers the run, when it exhausts liquid assets (normally a small proportion of assets used to meet normal demand for withdrawals), banks are likely to be insolvent, due to the need to dispose of illiquid assets at “distress” prices.

Banks are unable to generate incentives to roll over deposits, because under these conditions agents increase their liquidity preference and a rollover or a new deposit entails an increased risk given the uncertainty. In others words, agents compare the low cost of a withdrawal with the risk of a total loss.⁷

If the risk faced is an unexpected devaluation, agents will prefer a higher proportion of foreign assets in their portfolio. In this context, it could be possible that agents with a liquid position in domestic currency will try to shift to a liquid position in foreign currency. So here the liquidity preference of the agents is actually a *preference*

for flexibility, understood as the search for hedged positions given the uncertainty that arises because of the devaluation risk.

B. Uncertainty

The high level of uncertainty arising from macroeconomic instability is the main reason for the poor development of financial markets in developing countries (Fanelli, 1997). For an agent who brings capital from abroad and demands domestic currency denominated deposits, an unanticipated change in the nominal exchange rate implies a systemic risk which is not diversifiable. The withdrawal of deposits and the subsequent demand for foreign assets is the only way to avoid that risk. The withdrawal of deposits would occur in the same manner if the uncertainty concerned banking system soundness. However, in that case agents would not necessarily shift to foreign assets. Domestic currency hoarding or fixed capital in the country may be investment alternatives if relative prices are expected to remain unchanged. Both cases imply a future event incapable of being reduced to objective probability. The uncertainty notion appears as different from risk, as was set out by Knight.⁸

Uncertainty arises because the stochastic component of changes that could be produced in the economic environment cannot be well represented by a stable probability distribution. Hence, it is not possible to know the future making inferences from past data. This applies to events that change the economic environment in ways that cannot be anticipated or events with no diversifiable risk.

If an economic theory about how to make decisions under uncertainty is not available, uncertainty may be ignored if the mentioned events are perceived as unlikely and *information costly*. However, the alternative is to use a model where those events are represented by a subjective probability distribution plus a parameter that depends on the degree of uncertainty, which represents the risk premium. That parameter must focus on the *relevant* uncertainty of the agent. Hence, uncertainty about the interest rate matters if short run assets/long run assets substitution is the privileged relationship. On the contrary, if uncertainty about price level matters, emphasis should be focused on financial assets/fixed capital substitution. Notice that, from the perspective of capital movements, if the uncertainty represented by that parameter is focused on the stability of the exchange

rule maintenance, then the relevant substitution is between domestic currency denominated assets and assets abroad.

Increasing uncertainty triggers a loss of confidence that leads to a liquidity crisis in the financial system. Literature on default risk in the financial systems of developed countries highlights the impact on agents' confidence of events such as those discussed above, namely those to which objective probability cannot be applied (significant changes in policy regime, financial crises in other markets and/or other countries, etc.). It must be pointed out, however, that similar questions can be raised concerning the behavior of capital flows.

Davis (1995) indicates that negative surprises which do not necessarily imply a sizeable negative shock may trigger a loss of confidence that, given uncertainty and imperfect information, may induce an overshoot. Both an adverse surprise as trigger and overshooting have been recognized by the literature as a relevant feature in capital movements. Small shocks may start speculative attacks on the domestic currency if significant portfolio diversification exists, given the high sensitivity of investors who face small shocks in a globalized context (Calvo, 1995). Even so, uncertainty tends to be higher in unregulated financial markets or in those undergoing financial innovation processes. Needless to say, these are central features in the so-called emerging markets—including several Latin American economies—which received massive capital flows during the nineties.

Taking into account that an unanticipated devaluation is a very important source of uncertainty, several economies have introduced the so-called “dollarized fraction” into their domestic banking systems: banks can take dollar-denominated deposits, and make dollar-denominated loans. Given that, agents can substitute domestic-issued dollar-denominated assets for domestic-issued assets denominated in pesos. In this way, they can hedge their assets against capital losses arising from unanticipated devaluations. However, if the uncertainty continues to increase, agents will try to substitute assets issued abroad for assets issued domestically (whatever the currency in which they are denominated). In other words, they try to replace a domestic debtor with an international one.

It is worth mentioning that in an economy with a fixed exchange rate and liberalized capital account, the former implies that a higher level of uncertainty leading to a higher volatility in bank deposits transmits that volatility to the level of international reserves. Uncertainty explains changes in domestic monetary aggregates equal to capital flows, but of an opposite sign.

C. Financial Fragility

It is necessary now to establish the conditions under which financial intermediaries face risky situations due to issues related to both bank run characteristics and the consequences of high uncertainty on banking systems. In this sense, *financial fragility* must be understood here as the danger that unanticipated changes in prices and quantities in financial instrument markets lead to the possibility of the bankruptcy of financial intermediaries which, in turn, leads to disruption in the provision of payments services and in the capability of the financial system to allocate capital.⁹ This paper uses the term financial fragility only to refer to the high vulnerability of *the whole* financial system.

Given that definition, the question is: what type of events can lead to the appearance of those situations in financial intermediaries? It is necessary to figure out how to assess their fragility. Minsky (1977), pointed out that the financial robustness/fragility of an agent can be expressed by the ratio of the cash payments for debt servicing to the cash receipts from current operations. The higher the ratio, the weaker is the agent's financial position.

From the point of view of the balance sheet of a financial intermediary, the ratio may be put as follows:

*Return of deposits (principal plus interests) / repayment of the loans (principal plus interest)*¹⁰

Bank assets—the denominator—are long-term and illiquid, except for a small liquid proportion to meet normal demand for withdrawals. Bank liabilities—the numerator—are liquid, or at least more liquid than assets. It is a well-known rule in safe financial management that agents must set the value of their short-run assets higher than the value of their short-run liabilities if they want to avoid liquidity problems.

Nevertheless, this can not be assumed for all agents and for the system as a whole. Since one agent's financial asset is another's liability, there must be some agents whose short-term liabilities exceed their short-term assets.

The banking system plays this role in the economy, and consequently it has a greater amount of short-term liabilities than short-term assets. In a sense, liquidity is created out of a paradox: under normal conditions, the public perceives the banks as the most liquid agents, when in fact they are highly exposed to liquidity shocks. However, if any event provokes a change in the public perception, it may be followed by an increase in the numerator. Then, the ratio increases and the financial fragility increases, too. A higher level of uncertainty, for example, may lead depositors to greater preference for flexibility. It means that the maturity of deposits would shorten, thus increasing the numerator of the ratio for each significant period.

This way to assess financial fragility points out that the balance sheet of the banking sector is the most important source of concern, and that both the banks' balance sheets and capital flows must be included in the same framework, which allows analysis of the linkages and interactions between them.

As it is easy to see, for the banks the numerator represents a payment that can be exactly calculated, but the same is not true for the denominator. In effect, the denominator is conditioned by the borrower's credit quality. Thus, if something worsens that quality—adverse selection mechanisms, for example—the fragility increases.

A change in relative prices can also worsen the ratio of financial fragility. As both the numerator and the denominator are flows originated in certain stocks, changes in the stocks value imply changes in flow value. Then, if a relative price change leads to a change in stock value, the ratio becomes different. A typical example appears when bank assets and bank liabilities are denominated in different currencies (currency mismatch), and a change in the exchange rate occurs. Nevertheless, even with no changes in the exchange rate, conditions of financial fragility can arise if the economy undergoes a deflation process. This is due to deflation affecting bank assets and bank liabilities in a different way. Both numerator and denominator are denominated in nominal terms. However, the second is related to the performance of borrowers and thus closely affected by prices. Thus, deflation has asymmetric consequences on both sides of bank balance

sheets, worsening the value of assets. The deflation increases the debt burden for creditors, negatively affecting banks assets.¹¹

III. DOMESTIC FINANCIAL RELATIONSHIPS

Traditional macroeconomic models, generally IS-LM based, contain an external sector added to the monetary and goods market equilibrium but they specify incorrectly, for our *analytical necessities*, the financial asset supply. Usually, the problem arises from the aggregation criteria. In these models, all non-monetary liability instruments are added up in the bonds market, and then are removed by Walras' Law. Note that, in this way, money—which is a banking liability—remains in the model, but banking credit doesn't, and as we will show, credit is very important in understanding financial fragility. Additionally, as there is no banking system in these models, it is not possible to assess financial fragility as we understand it, since there are no bank balance sheets either.

Although other models that correct the aggregation problems can be found in the literature,¹² the problem remaining is that the banking sector balance sheet is not included. Finally, other models don't take into account the stock/flow interaction, which is a central issue in some emerging economies—especially in Latin America—since several of the most important structural disequilibria arise from stocks/flows *disarrangement*.

Rejecting these models, we chose one based on an assets and liabilities matrix representative of the economy under study. The matrix used here presents the financial linkages between the most important agents in a unified framework. Besides, it allows us to analyze the interactions between the capital flows and the domestic financial system.

The rows in the matrix record financial instruments in the economy, while the columns represent aggregate agents. Although we will use simpler matrices later, in the example that follows there are nine assets, eight of which are financial ones. The financial assets are: monetary base (H), loans to the government (LG), international reserves (R), bank deposits (D), loans to the non-financial private sector (LP), government bonds (B), foreign assets (FA), foreign loans (FL); physical capital (K) is the ninth asset. The following row—NFW—records the net financial worth of each agent. Given that each agent's financial asset is another agent's liability, the aggregation of all

agents' financial assets and liabilities add up to zero. The aggregate value of the agents' net worth equals the value of aggregate physical capital. This can be seen in the last row, which records each agent's net worth—NW.

TABLE 1

Assets and Liabilities Matrix						
	Central Bank	Banks	Government	Non-Financial Private Sector	Rest of the World	Σ
H	- Hc ^s			+ Hp ^d		0
LG	+ LGc ^d		- LGg ^s			0
R	+ Rc ^d				- Rw ^s	0
D		- Db ^s	+ Dg ^d	+ Dp ^d		0
LP		+ LPb ^s		- Lpp ^d		0
B	+ Bc ^d		- Bg ^s	+ Bp ^d		0
FA				+ FAp ^d	- Faw ^s	0
FL		- FLb ^s		- FLp ^d	+ FLw ^s	0
K	KC	KB	KG	KP	KW	K
NFW	FNWC	FNWB	FNWG	FNWP	FNWW	0
NW	FNWC+KC	FNWB+KB	FNWG+KG	FNWP+KP	FNWW + KW	K

Each cell shows the amount that each agent holds of the corresponding instrument and is denoted by the capital letters corresponding to the instrument. It is followed by a lower-case letter which stands for the agent holding the instrument and by a “d” or “s” superscript to signify demand or supply, respectively. In each cell, the variable representing the instrument is preceded by a negative or positive sign depending on whether it represents a liability or an asset for the agent.

As we can see, each row corresponds to one of the existing financial instruments (the “market” for the instrument), and each column represents the portfolio of an aggregate agent. If we interpret the assets and liabilities of each agent as stock demand and stock supply of financial instruments, then the rows may be considered as the equilibrium condition in each market, and the columns as the equilibrium condition of each agent in terms of portfolio composition.

Note that, since the matrix is a specific economy's financial structure, it could contain as many rows as number of assets existing in this economy, and as many columns as agents demanding and supplying those assets. Obviously, such a matrix could not be constructed. So, the aggregation criterion chosen depends on the features of the economy that we want to highlight. Since there are assets and liabilities of different maturities which are denominated in different currencies, the column analysis allows us to assess the risk faced by each agent when there is a mismatch between the maturity of assets and liabilities and/or exchange risk exposure. The banks, for example, may reduce maturity mismatch by relying on long-run foreign funds to extend the maturity of credit but only at the cost of higher exchange risk exposure (currency mismatch).

For the analysis of capital flows, the usefulness of the matrix is clear, if we assume that an agent who brings capital into the economy represented by the matrix demands bank deposits among other assets. Moreover, as foreign assets are also included, the framework contains all possibilities for substitution between different assets. In the same way, it is possible to construct another matrix, one in which each cell represents the variation in an asset or a liability; this would be a flow matrix. Now we can model capital movements as variations in financial instruments. An increase in banking deposits financed by a decrease in foreign assets represents a capital inflow.

IV. FINANCIAL FRAGILITY AND CAPITAL FLOWS

There are several different possibilities of financial fragility conditions arising from different causes and different institutional configurations. Moreover, our interest is focused on fragility conditions arising from: (i) devaluation risk *perspectives* originating in changes in agent perceptions of the possibility of maintaining a pegged exchange rate and—in a regime of full dollarization—of the country risk; and (ii) changes in the international interest rate.

The financial fragility conditions assessed in this paper are those of a specific banking system, which is a deregulated one. It works in an economy which has liberalized the capital account, has a fixed exchange rate regime, and the Central Bank backs the total amount of the monetary base with foreign exchange reserves. As it can be noted, those are the characteristics of the Argentine economy during the nineties.

However, although the last condition is the feature that makes the Argentine regime a Currency Board system, the other conditions may be found in many of the economies of Latin America and in other emerging economies that underwent market-friendly reform processes. So, many of our conclusions may be extended to the functioning of other national banking systems.

Partial equilibrium models focused on the demand and the supply of banking deposits *used* show, in a stylized way, how the banking system works.¹³ Here, as the outstanding uncertainty is related to the future exchange rate, to assess changes in uncertainty and then in fragility, the analysis must take into account the relationship between domestic assets and foreign ones.

A. A Financial System Model

Table 2 shows the aggregation criteria chosen for agents and financial instruments. There are only three agents: Financial system, Non-Financial Private Sector (NFPS), and the Rest of the World (ROW). One of the differences between the former matrix and this one is the consolidation of the balance sheets of the Central Banks and Commercial Banks, resulting in an agent labeled Financial System. We chose these aggregation criteria because when lack of confidence arises from devaluation risk, depositors flee from both commercial bank liabilities and central bank liabilities,¹⁴ unless, as is shown below, depositors can demand dollar-denominated deposits.

International reserves R are equal to Monetary Base H multiplied by nominal exchange rate e ($R = H \cdot e$), and it is assumed that the whole of the base money issued by the Central Bank is held by commercial banks, while the money supply consists entirely of bank deposits. That explains why H doesn't appear in the matrix; it is an asset for commercial banks and a liability for the Central Bank, and we have consolidated their balance sheets.

TABLE 2

Assets and Liabilities Matrix					
		Financial System	Non-Financial Private Sector	Rest of the World	Total Assets/Liabilities
1	R	R		- R	R
2	D ₁	- D ₁	DP ₁	DE ₁	D ₁
3	D ₃		D ₃	- D ₃	D ₃
4	L ₁	L ₁	- L ₁		L ₁
5	TA	R + L ₁	DP ₁ + D ₃	DE ₁	R + L ₁ + (DP ₁ + DE ₁) + D ₃
6	TL	- D ₁	- L ₁	- (R + D ₃)	- (D ₁ + L ₁ + R + D ₃)
7	NFW	R + L ₁ - D ₁	DP ₁ + D ₃ - L ₁	DE ₁ - R - D ₃	0

R = International Reserves; D₁ = Bank Deposits in the Domestic Banking System; D₃ = Bank Deposits in the Rest of the World; L₁ = Bank Loans in the Domestic Banking System

The NFPS demands domestic deposits (D1) and deposits abroad (D3), while bank loans (L1) are the liabilities of the private sector. The rest of the world demands domestic deposits, too; its liabilities are D3 and R. If the agents, either in the country or abroad, want to substitute deposits (D1) for deposits (D3) or vice versa, they have to buy or sell dollars to the Central Bank, which implies that the private sector does not demand dollars for domestic transactions. Thus the change in the foreign reserve level will be equal to the change in deposits abroad with the opposite sign.

$$dR = -dD_3 \quad (1)$$

On the other hand, this change in deposits abroad is equal to the capital flow, assuming that the result of the current account is zero, and there are no other transactions in the capital account.

$$FK = -dD_3$$

1. Demand and supply of bank deposits

Be L_1^s and D_1^s credit supply and deposit demand, respectively, and suppose that banks make full use of their lending capacity. Then:

$$H + L_1^s = D_1^s \quad (2)$$

Or, which is the same:

$$(m - 1) \cdot H = L_1^s \quad (3)$$

where m is the money multiplier. Note that adding up in a single asset notes and coins and all kind of deposits, the money multiplier is equal to the inverse of the reserve ratio ϕ ,

$$m = 1/\phi; \text{ which leads to: } \wedge$$

$$H \cdot m = D_1^s \quad (4)$$

In terms of R , deposits supply (only asset offered to the NFPS) is:

$$D_1^s = m \cdot e \cdot R \quad (5)$$

making $e = 1$, it follows:

$$D_1^s = m \cdot R \quad (6)$$

On the other hand, the balance sheets of both the NFPS and the Rest of the World show that total demand of assets (D^d) equal the sum of domestic currency deposits plus deposits in the rest of the world ($D_1 + D_3$). For each investor, return and risk depends on portfolio composition which is addressed to maximize utility. Bank deposits, unlike consumer goods, do not yield utility directly but by the income they bring: interest. In this case, moreover, risk arises from the possibility of changes in exchange rate.

Calling β the proportion of domestic currency deposits held in each single agent's portfolio, we can write:

$$\beta = D_1^d / D^d$$

To analyze an agent's optimal β we will use portfolio theory. We assume that the expectation of a domestic currency devaluation is a random variable with a subjective probability distribution with mathematical expected value $E(\dot{e})$ and standard deviation $\sigma(\dot{e})$, \dot{e} being the rate of devaluation. Disregarding other costs, the return on domestic currency deposits is:

$$r = i_1 - \dot{e}$$

with i_1 being the rate of the domestic deposits. Expected value and standard deviation of that return are, respectively:

$$r^* = i_1 - E(\dot{e})$$

and $v^* = \sigma(\dot{e})$

Then, the whole portfolio return is:

$$z = \beta r + (1 - \beta) i_3 \quad 0 < \beta < 1$$

with i_3 representing the interest rate on ROW deposits.

Mathematical expected value and standard deviation of the portfolio become:

$$E(z) = \beta r^* + (1 - \beta) i_3 \quad (7)$$

$$\sigma(z) = \beta v^* \quad (8)$$

Utility of the portfolio is defined as:

$$U[E(z), \sigma(z)]$$

such that: $dU / dE(z) > 0$

and $dU / d\sigma(z) < 0$

Replacing (8) in (7) yields:

$$E(z) - [(r^* - i_3) / v^*] \sigma(z) - i_3 = 0 \quad (9)$$

Optimal portfolio's composition results from maximizing the utility function subject to (8), then

$$dE(z) / d\sigma(z) = (r^* - i_3) / v^*$$

FIGURE 1

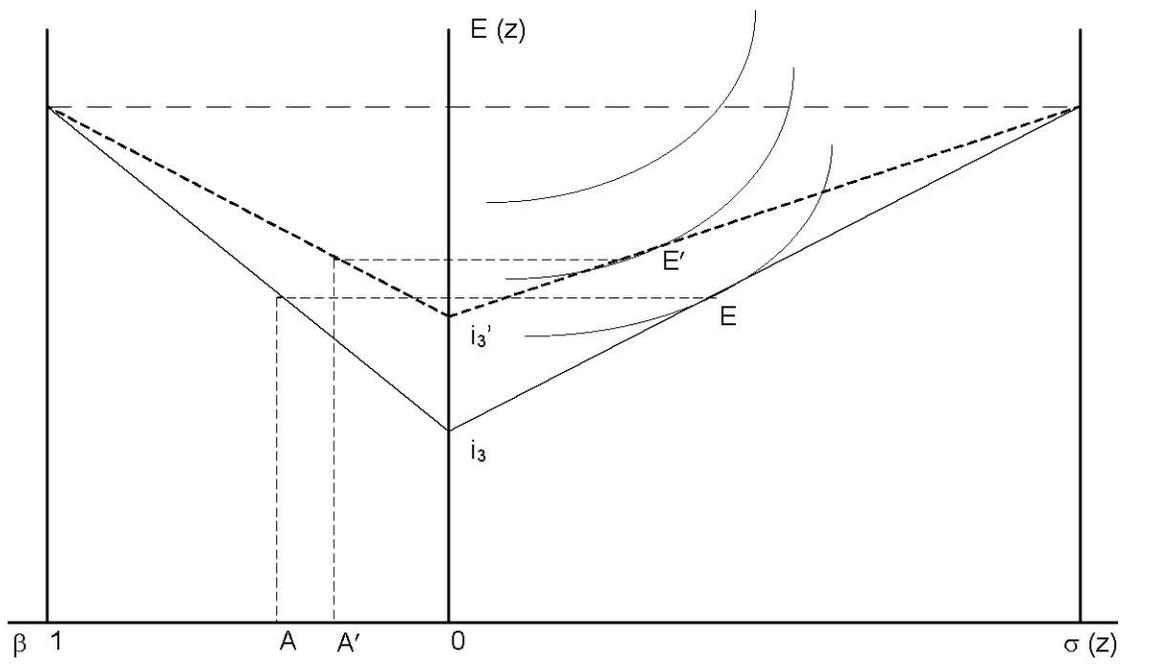


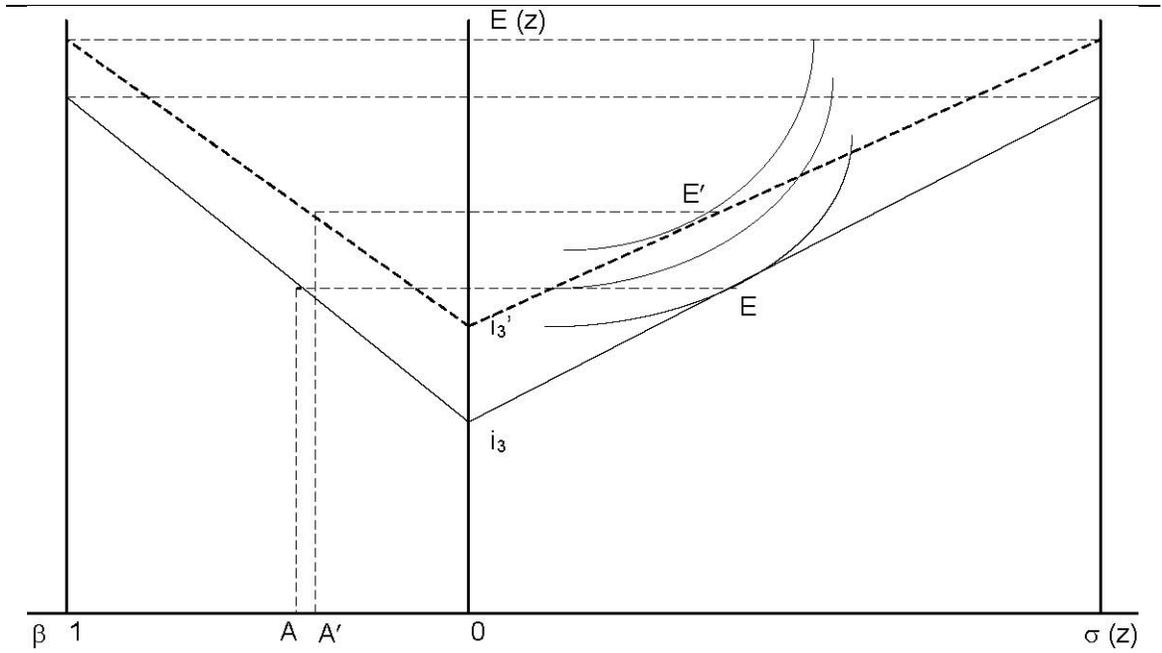
Figure 1 illustrates the optimal composition. The indifference curves of a typical risk averse investor, which are upward sloping and convex from below, and the line representing equation (9), with intercept i_3 and slope $(r^* - i_3) / v^*$, are plotted in quadrant I. Optimal composition is reached at E. The line representing equation (7), determining the portfolio return and whose slope depends on $i_3 < r^*$ to allow $\beta > 0$, is plotted in quadrant II. It follows that the domestic currency optimal proportion is $\beta = OA$. β is a function of i_3, r^*, v^* such that:

$$d\beta / di_3 < 0, d\beta / dr^* > 0 \text{ y } d\beta / dv^* < 0$$

Assuming the utility function as given, which implies assuming r^* and v^* as parameters, yields $\beta = \beta(i_3)$, and then an increase in the international interest rate (i_3') causes a decrease in the proportion of domestic deposits over total deposits: $OA' < OA$.

Taking into account that $r^* = i_1 - E(\hat{e})$, it's not easy to assume r^* as a parameter in the face of an international rate increase, because that would imply that the domestic rate as well as expectations are constants, when both rates usually show movements in the same direction. However, given an increase in i_3 , the assumption of a lower increase in i_1 is enough to hold the condition mentioned above. That means that both rates increase but a lower differential provokes a lower proportion of domestic deposits in the portfolio. This alternative is illustrated in Figure 2.

FIGURE 2



The last assumption must be accepted, because otherwise we would be implying that it is possible to increase domestic rates indefinitely in order to avoid capital outflows when international asset return increases. However, as Calvo et al. (1993) pointed out, from the investors' perspective information embodied in changes in international and domestic rates are not equivalent. Therefore, the correlation function between the assets of developing economies and those of developed economies is not stable. It follows that a higher international rate drives the domestic rate to a higher level too, but when a certain level is reached additional increases in the latter can't be expected. The models used in this paper must be assumed to be working within a range in which domestic interest rates cannot increase. For graphical simplicity, in the following analysis i_1 is assumed constant.

Aggregate deposit demand is obtained by adding up each agent's demand, where domestic deposits are determined by β which depends on the international rate given expectations. At an aggregate level, β also depends on preferences and expectations whose distribution explains the shape of the deposit demand function. We suppose that, whatever that distribution is, when facing changes in expectations or uncertainty, every agent will move in the same direction. That includes all deposits aggregated in D1 which, as the assets and liabilities matrix shows, records both residents' deposits (DP1) and non-residents' deposits (DE1). Here it can be expected that, facing instability signals, the domestic financial system's creditors behave as if they were foreigners, at least in portfolio decisions.¹⁵

2. The equilibrium of the money market

Demand for domestic currency deposits depends on income level, expectations, physical capital return, domestic rates, and international rates. Adding up the first four in a vector μ , which is assumed as constant, aggregate demand becomes function of ROW's deposit rate:

$$D_1^d(\mu, i_3)$$

being

$$d D_1^d / d i_3 < 0$$

Using $\beta(i_3)$ this demand can be expressed as function of the proportion of domestic deposits over total deposits:

$$D_1^d = \beta(i_3) D^d \quad (10)$$

The market reaches equilibrium when the supply of domestic currency deposits matches demand:

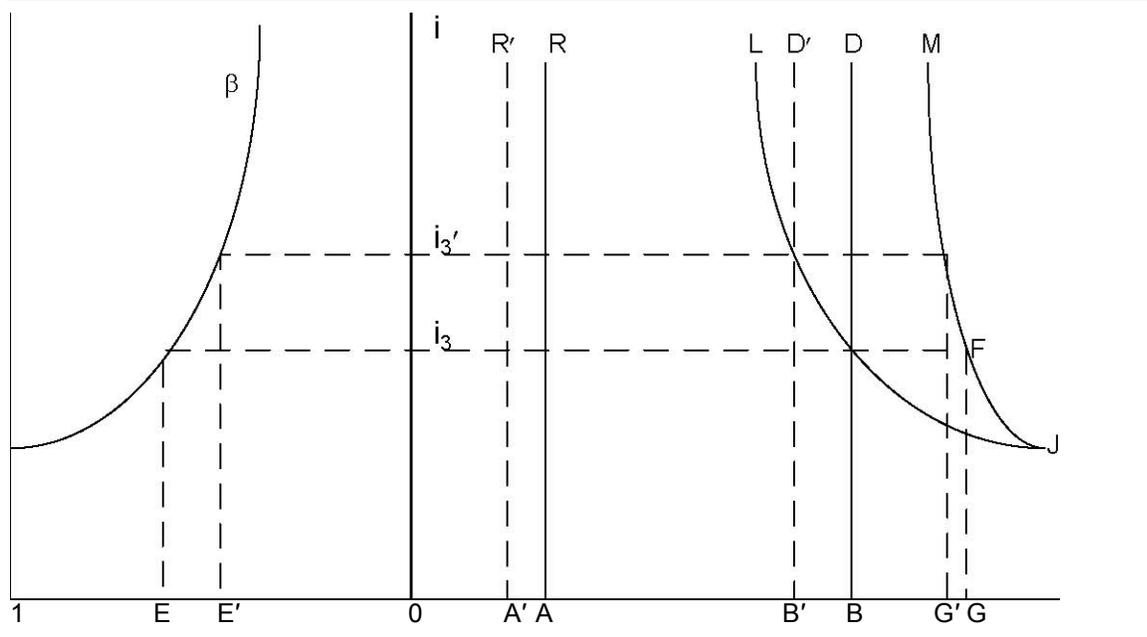
$$D_1^s = D_1^d \quad (11)$$

Substituting (5) and (10) into (11), we set the equilibrium condition:

$$m \cdot e \cdot R = \beta(i_3) D^d \quad (12)$$

The equilibrium of the money market is illustrated in Figure 3. Function $\beta(i_3)$ is plotted in quadrant II. In quadrant I, LJ represents domestic currency deposits demand, line RA represents reserves, DB is domestic currency deposits supply, and domestic credit is represented by AB.¹⁶ Equilibrium in money market is determined by the intersection of DB with curve LJ. The equilibrium rate is i_3 and the proportion of domestic currency deposits over total deposits is $\beta = OE$. Total deposits demand is illustrated by curve MJ, which allows us to see that BG is the proportion of ROW deposits over total deposits.

FIGURE 3



That equilibrium can be seen through an assets and liabilities matrix. Suppose that the proportion of total deposits in a domestic financial system held by the NFPS is θ . In

terms of Matrix 1 notation it follows: $DP_1 = \theta D_1$; $DE_1 = (1 - \theta) D_1$, which is represented by the matrix in Table 3.

Suppose that an increase in international rate i_3' leads to an increase in deposits abroad (dD_3). From (1) it provokes a reserves contraction, $-dR = dD_3$, which is now represented by line $R'A'$. Given the money multiplier, a domestic currency deposits reduction BB' follows, which is m times more than the fall in reserves, and sets those deposits in $D'B'$.

TABLE 3

Assets and Liabilities Matrix					
		Financial System	Non-Financial Private Sector	Rest of the World	Total Assets/Liabilities
1	R	OA		- OA	OA
2	D_1	- θ OB	θ OB	$(1 - \theta)$ OB	OB
3	D_3		BG	- BG	BG
4	L_1	AB	- AB		AB
5	TA	OA + AB	θ OB + BG	$(1 - \theta)$ OB	OA + AB + BG + [θ OB + $(1 - \theta)$ OB]
6	TL	- OB	- AB	- (OA + BG)	- (OB + AB + OA + BG)
7	NFW	0	θ OB + BG - AB	$(1 - \theta)$ OB - OA - BG	0

$A'B' < AB$ shows that domestic loans must be reduced too, and that their contraction, AB minus $A'B'$, equals $(m - 1) A'A$. Moreover, it can be seen that deposits abroad rise and become $B'G' > BG$.

The flows equilibrium can be represented by the matrix in Table 4.

TABLE 4

Variation Matrix					
		Financial System	Non-Financial Private Sector	Rest of the World	Net Variation
1	R	$-A'A$		$A'A$	$A'A$
2	D1	$B'B = m A'A$	$-m\theta A'A$	$-m(1-\theta)A'A$	$m A'A$
3	D3		$+(B'G' - BG)$	$-(B'G' - BG)$	$B'G' - BG$
4	L1	$-(AB-A'B)=-[(m-1)A'A]$	$AB - A'B' = (m - 1) A'A$		$(m - 1) A'A$
5	TA	$-A'A - [(m - 1) A'A]$	$-m\theta A'A + (B'G' - BG)$	$-m(1-\theta)A'A$	$-2mA'A + (B'G' - BG)$
6	TL	$m A'A$	$(m - 1) A'A$	$A'A - (B'G' - BG)$	$2mA'A - (B'G' - BG)$
7	NFW	0	$-m\theta A'A + (B'A' - BG) + (m-1)A'A$	$-m(1-\theta)A'A + A'A - (B'G' - BG)$	0

From the fact that stocks had been in equilibrium at the beginning of the period and that flow equilibrium has been achieved, it follows that stock equilibrium at the end of period is guaranteed.¹⁷ However, to assess fragility conditions changes in balance sheets must be considered.

In this model, reserve falls lead to monetary base contractions, which imply larger reductions in both domestic deposits and domestic credit. If those movements are provoked when external assets replace domestic assets in local portfolios in response to small and smooth changes in international rates, banks can adjust their deposits and loan stocks in the same way. However, given a sudden, large change in international financial conditions that provokes a larger contraction of international reserves, the fall in domestic assets and liabilities required to preserve the currency board regime increases financial fragility, because of the maturity differences between assets and liabilities, as was pointed out in Section II.

If liquidity constraints faced by banks make it impossible for depositors to convert their deposits into cash, a financial crisis starts. To stop that crisis requires that the Central Bank supports institutions facing liquidity difficulties. However, since in this model the monetary authority can't act as lender of last resort, confidence continues eroding, which provokes agents to run on the Central Bank's liabilities too. In financial

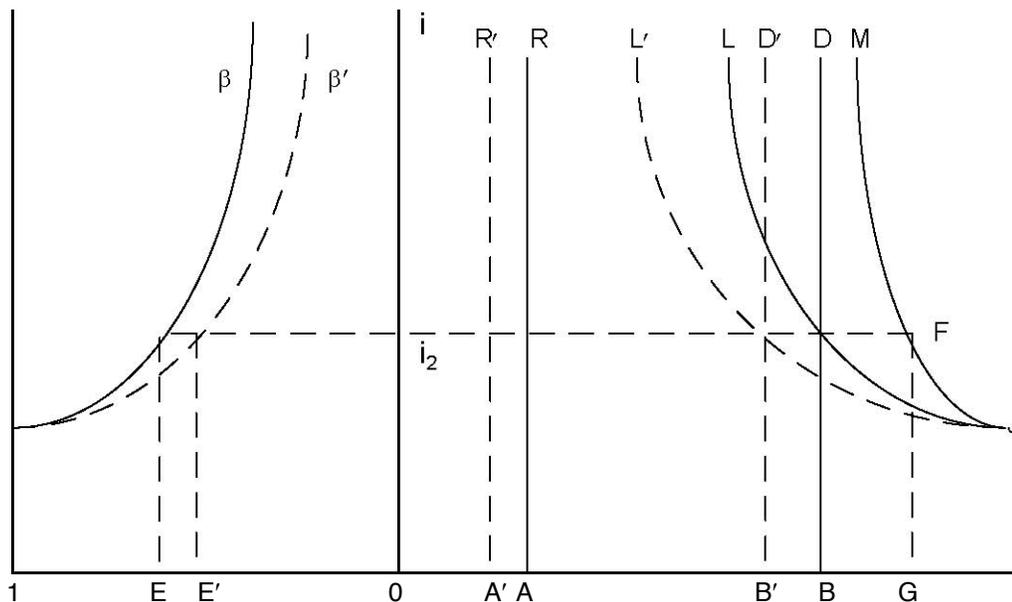
systems with convertibility and fixed exchange rates, this kind of financial crisis becomes a balance of payments crisis.

3. Changes in uncertainty

In the previous section, expectations, preferences, and uncertainty are treated as given, looking for an assessment of adjustments driven by changes in the international financial market's conditions, namely an increase in interest rates. Now we will analyze changes in uncertainty over the exchange rate, while the international rate, preferences, and expectations' distribution remain unchanged.

Taking into account the utility function used here, an increase in uncertainty is represented by a larger standard deviation. Let us suppose that the expected standard deviation increases from v^* to v^{*} '. As illustrated in Figure 4, with the same expectation and risk aversion unchanged, an increase in uncertainty shifts curve β to the right. It is easy to see that, with no changes in interest rate, a larger uncertainty leads to a lower proportion of domestic assets in the portfolio. Curve LJ shifts to L'J' and equilibrium is achieved where the latter crosses D'B'. This is the new supply of domestic deposits following an adjustment similar to those of Subsection 2, and started by a monetary base contraction due to the new portfolio composition decided by agents given the increase in uncertainty.

FIGURE 4



As in the case of an increase in the international rate the question here is about the consequences of changes in parameters on the financial system, especially if those changes are smooth or abrupt. Notice that given an increase in uncertainty a higher domestic rate is needed to maintain the same proportion of domestic financial assets in the agents' portfolio. As in the previous example, if the economy is working in the model's relevant interest rate's range, a capital outflow follows an uncertainty increase.

4. Interest rate differentials, the liabilities of the banks and policy instruments

As pointed out above, increases in the international rate lead to an increase in the domestic rate; however, even though the spread tends to be lower, consequences on deposits still hold. Even if the spread does not change, inflows may be possible given that at least two domestic interest rates must be considered: deposits and loans. So, if some firms hold deposits abroad and, at the same time, are indebted domestically, those firms may bring in capital if the rates on loans are high, although deposit rates do not change (Fanelli and Machinea, 1994).

In addition, some issues concerning the interest rate on deposits deserve careful attention. Assuming that this rate is in turn a function of the loan interest rate, a contraction in domestic credit leads to an increase in both loan interest rates and interest rates on deposits. Nevertheless, it is possible that the banks put limits on the loan interest rate due to the credit rationing problems mentioned above. However, if banks do not proceed in this way, an increase in the rate on loans may generate a higher fragility in the financial system. Moreover, the higher the fragility perceived by the agents, the lower will be the demand for domestic assets. If the process continues, there might not be any domestic interest rate high enough to ensure further demand for those assets.

Some may think that the contraction of domestic credit following an adjustment is overestimated given the way banking liabilities are modeled in this paper. In effect, with liabilities fully composed of deposits, after an adjustment, banking system equilibrium may require a drop in domestic credit equal to the money multiplier times the loss of deposits. Although deposits constitute usually only a portion of banking liabilities, in Argentina, like in most Latin American economies, deposits are by far the most important of those liabilities, playing a role much more important than in developed countries. Even

though there are other sources of funding for banks—financial instruments issued domestically and/or abroad—it is enough to assume both that banks face an imperfectly elastic demand of their non-deposit liabilities, and that a reduction in deposits leads to a lower supply of credit (Bernanke and Gertler, 1995). On the other hand, the elasticity of demand depends on the liquidity and degree of development of the markets for financial instruments. If those markets exhibit a lower liquidity and/or a lower degree of deepening than the market for deposits, the substitution of deposits for alternative liabilities may require a higher interest rate. Then, although a capital outflow does not imply that banking deposits must contract in an amount equal to the money multiplier times that outflow, it is true that a reduction in deposits becomes necessary. Since that reduction must be financed by sales of financial instruments with lower liquidity—note that banking loans are non-marketable assets—the liquidity problems faced by banks will persist. Consequently, the problems of financial fragility that arise from liquidity constraints also persist.

Under a currency board regime, monetary authorities have fewer policy instruments. One of them is the reduction of the reserve ratio. As our model shows, in this case a decline in international reserves would imply less contraction in domestic credit. The question that remains, however, is that of its consequences in terms of the induced financial fragility of banks.

Taking into account the ratio used to assess financial fragility, it may be assumed that, in the face of a bank run, it is possible to increase the denominator resorting to the reserves that were accumulated before the run starts. In other words, the flow originating in changes in bank reserves may be added up to the repayment of loans (principal plus interest). Notice, however, that this is a once-and-for-all possibility, since once bank reserves are fully used, new deposits will be necessary to create new reserves. Even though the run may stop, if deposits reach a lower level than before the last run, the banking system becomes even more fragile. This is because the reserves that may prevent a new run add up to the denominator and make that index lower than during the last run.

Finally, a proportion of the equity shares held by financial intermediaries is constituted by liquid reserves and must, therefore, be added up to the denominator of the ratio. Thus, the higher the liquid reserves the lower the financial fragility. Nevertheless, if

liquid reserves do not represent a significant proportion of total assets, the conditions discussed above persist.

B. Dollar-denominated Assets and Liabilities in the Domestic Banking System

When the source of turbulence is the fear of a currency devaluation, agents hedge against devaluation risk by demanding foreign currency. Nonetheless, small investors with no access to international markets will find that the allocation of loanable funds to non-interest-bearing foreign currency has an important opportunity cost. Taking that into account, in some emerging markets domestically issued but dollar-denominated deposits were allowed. That strategy was based on the idea that residents trust domestic debtors but they don't trust domestic currency. Thus, banks issue their own dollar-denominated liabilities to satisfy the preferences of depositors.¹⁸

To assess fragility conditions in a system in which dollar-denominated deposits are included, a model similar to that of the one in the earlier section is used. There is a difference, however, since in the following model, residents do not demand deposits abroad. *Ceteris paribus* the assets and liabilities matrix is the following:

TABLE 5

Assets and Liabilities Matrix

		Financial System	Non financial Private Sector	Rest of the World	Total assets/liabilities
1	Rt	Rt		- Rt	Rt
2	D ₁	- D ₁	DP ₁	DE ₁	D ₁
3	D ₂	- D ₂	DP ₂	DE ₂	D ₂
4	C ₁	C ₁	- C ₁		C ₁
5	C ₂	C ₂	- C ₂		C ₂
6	TA	Rt + C ₁ + C ₂	DP ₁ + DP ₂	DE ₁ + DE ₂	Rt + C ₁ + C ₂ + (DP ₁ + DE ₁) + (DP ₂ + DE ₂)
7	TL	- (D ₁ + D ₂)	- (C ₁ + C ₂)	- Rt	- (D ₁ + D ₂ + C ₁ + C ₂ + Rt)
8	NFW	0	DP ₁ + DP ₂ - (C ₁ + C ₂)	DE ₁ + DE ₂ - Rt	0

Financial instruments not included in previous matrix are: (3) dollar-denominated deposits in domestic banking system (D₂); (5) dollar-denominated loans in domestic banking system (C₂).

As can be noted, in this matrix new rows have been added. As dollar-denominated deposits (D_2) and dollar-denominated loans (D_2) are allowed in the domestic banking system, both are included in the matrix of Table 5. For simplicity deposits abroad (D_3) were not included. Besides, banking system reserves are now R_t (total reserves) because a new concept appears here: the reserves of deposits issued domestically but dollar-denominated. Then,

$$R_t = R + R_d$$

with R being the Central Bank's "own" reserves—which are still equal to the monetary base—and R_d the reserves of dollar-denominated deposits ("argendolares"). The last ones depend on the reserve ratio ϕ . However, as the balance sheets of the Central Bank and Commercial Banks remain consolidated, both kinds of reserves are not disaggregated.

In this model, the private sector only demands domestic deposits; peso-denominated deposits and dollar-denominated deposits constitute its assets, while loans in domestic currency (C_1) and dollar-denominated loans (C_2) constitute its liabilities. The rest of the world's assets are (DE_1), peso-denominated deposits, and (DE_2), dollar-denominated deposits, with (R_t) being its liabilities.

Like the previous model, if the agents in the country or abroad want to substitute deposits (D_1) for deposits (D_2) or vice versa, they have to buy or sell dollars to the Central Bank, which, again, implies that the private sector does not demand dollars for domestic transactions. However, in this case total reserves (R_t) remain constant, although the change in the Central Bank's "own" reserves will be equal to the change in dollar-denominated deposits with the opposite sign.

$$dR = -dD_2 \quad (13)$$

To assure $dR_t = 0$, variation in both Current account and Capital account must be 0, so $FK = 0$.

1. Supply in the market for dollar-denominated deposits

In peso-denominated deposits, the model is identical to the previous one. In dollar-denominated deposits, banks make full use of their lending capacity, too. Then:

$$R_d + C_2^s = D_2^s$$

Or, which is the same:

$$(md - 1) \cdot Rd = C_2^s$$

where md is the money multiplier in dollar segment. Since notes, coins and all kinds of deposits have been added up in a single asset too, the money multiplier depends on the reserve ratio only: $md = 1 / \phi d$. Dollar-denominated supply is then:

$$D2^s = md \cdot Rd \quad (14)$$

2. The demand for deposits

In this model the total demand for both NFPS and ROW assets is D^d , which equals the sum total of all types of deposits in the banking system. To obtain this demand, the same development as in Section IV A.1 is used, assuming that deposits abroad are similar to dollar-denominated deposits in the domestic system, and then that i_3 must be replaced by i_2 , this being the dollar-denominated deposit rate.

Figure 1 can be used to illustrate the optimal composition, here:

$$\beta = D_1^d / (D_1^d + D_2^d)$$

In quadrant I, optimal composition is reached in E, while in the other quadrant $\beta = OA$ represents the optimal proportion of peso-denominated deposits over total deposits. Arguments of function β are i_2 , r^* and V , with partial derivatives:

$$d\beta / di_2 < 0, d\beta / dr^* > 0 \text{ y } d\beta / dv^* < 0$$

With the dollar-denominated deposit interest rate higher than the foreign interest rate on deposits ($i_2 > i_3$), there is an incentive for capital inflows to avoid devaluation risk, although the country risk remains. Given that, the analysis that follows focuses on the consequences of changes in the country risk perceived by agents, while the other parameters remain constant, which implies that interest rates don't change. Changes in country risk are modeled here as variations of v^* . In the next section, another variable will be introduced to represent those changes

3. Money market equilibrium

In this model deposit supply equals the sum of both dollar-denominated and peso-denominated supply:

$$D^s = D_1^s + e \cdot D_2^s, \quad (14)$$

from

$$e \cdot D_2^s = m \cdot e \cdot R + md \cdot e \cdot Rd \quad (15)$$

which is dollar-denominated deposits expressed in domestic currency. From (5) and (15) it follows that:

$$D^s = m \cdot e \cdot R + md \cdot e \cdot Rd \quad (16)$$

Deposits' total demands equal the sum of both types of deposits:

$$D^d = D_1^d + e \cdot D_2^d \quad (17)$$

To make both demands' graphical representation easy, it is convenient to express each one as a proportion of the total demand.

In peso-denominated deposit demand as in the total demand function, we follow a similar procedure as the one followed in Section IV A.2. Thus, by analogy to (10), and remembering that here i_3 must be interpreted as i_2 , we have:

$$D_1^d = \beta (i_2) D^d \quad (18)$$

The dollar-denominated deposit demand expressed in pesos, as proportion of total demand, can be written:

$$D_2^d \cdot e = [1 - \beta (i_2)] D^d \quad (19)$$

Replacing (18) and (19) in (17), we have:

$$D^d = \beta (i_2) D^d + [1 - \beta (i_2)] D^d \quad (20)$$

The equilibrium condition is:

$$D^s = D^d \quad (21)$$

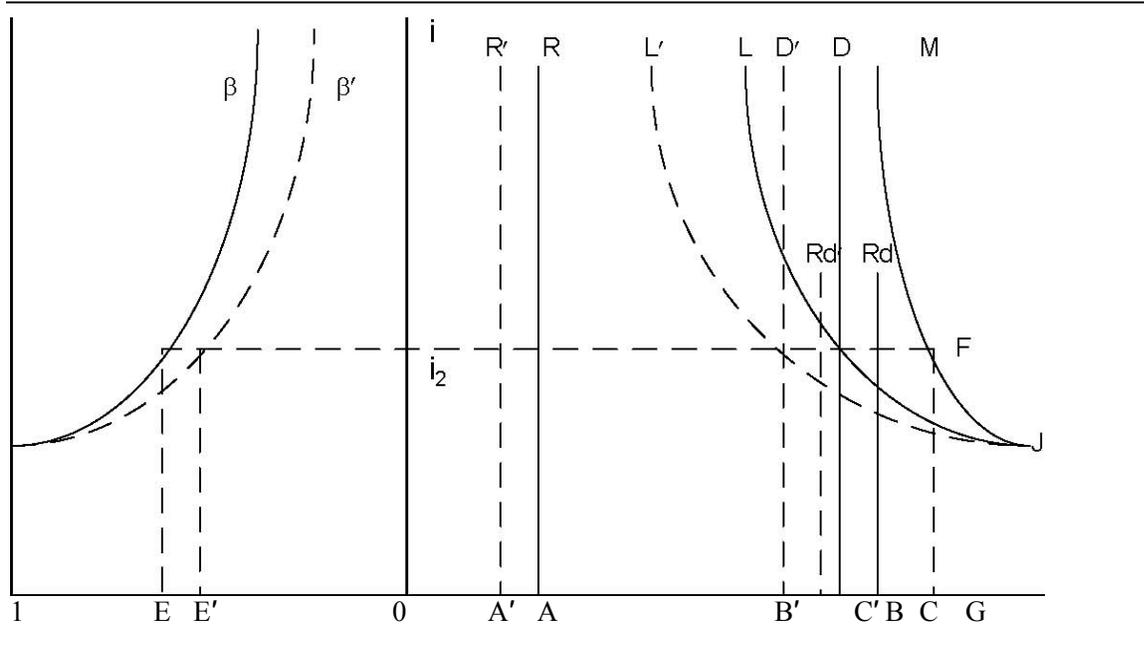
Replacing (16) and (20) in (21), we have:

$$m \cdot e \cdot R + md \cdot e \cdot Rd = \beta (i_2) D^d + [1 - \beta (i_2)] D^d \quad (22)$$

Figure 5, used to illustrate this equilibrium, is similar to Figure 4. Both represent changes in function β as a consequence of changes in uncertainty. In quadrant I the initial equilibrium is achieved at point F, which is the intersection of curve MJ (the RHS of (22)) with line DG (the LHS of (22)). As can be noted in quadrant II, given an interest rate i_2 that equilibrium determines an OE proportion of deposits in a dollar-denominated market.

As in the former model, curve LJ is $\beta (i_2) D^d$ and its intersection with line DB (the first term of the LHS) shows the equilibrium in the peso-denominated market. It follows that OB is the supply in that market and then BG the supply in dollar-denominated deposits. Those supplies arise, given the reserves RA (in pesos) and RdC (in dollars) which, in turn, are multiplied by m and md respectively; which leads to a lending capacity AB in pesos and CG in dollar-denominated currency.

FIGURE 5



Suppose that, as in Section IV.A.3, the standard deviation increases from v^* to v^{*} . Given a higher standard deviation in agents' utility function, β shifts to β' and keeping interest rates constant, it implies a lower proportion of deposits in domestic currency ($OE' < OE$). A AA' withdrawal of peso deposits makes a BB' contraction in the supply of peso deposit, and the new equilibrium is reached at OB' level, given that the change of β moves the demand to $L'J$. In turn, AA' is deposited in the dollar-denominated market which expands its supply, shifting it from CG to $B'G$.

The figure includes lines RdC and $Rd'C$, which represent, respectively, the dollar-denominated market's reserves before and after free adjustments. As it can be seen, the difference between those reserves equals the Central Bank's "own reserves" variation

($B'C' = BC + AA'$). It must be noted that the total supply OG remains unchanged ($OB + BG = OB' + B'G$); however, the proportion of deposits in different currencies changes ($OB > OB'$, $BG < B'G$). This achievement requires equal multipliers in both dollar-denominated and peso-denominated markets ($m = m_d$). As it is obvious, different multipliers lead to expansions/contractions in the aggregate supply of deposits and loans. For example, if agents withdraw deposits in the peso-denominated fraction and deposit them in the dollar fraction, given $m_d > m$ the total effect is expansionary.

Even though in this model both types of deposits belong to the same banking system, the adjustment process is quite similar to the model with domestic assets and deposits abroad. Thus, conclusions on the consequences of increasing uncertainty hold. As in the former example, the monetary authority has limited instruments to moderate the effects of an increase in the velocity of asset substitution, almost no instruments if the portfolio shift becomes generalized.

On the one hand, changes in reserve ratios may reduce the required fall in the peso-denominated deposits and loans. However, as was pointed out above, that generates fragility conditions. On the other hand, it is possible to establish new regulations that stimulate re-arrangements that lead to replacing loans in domestic currency for dollar-denominated loans in order to maintain the required reserve in each segment of the system.¹⁹ Anyway, those kinds of measures may work in the face of an increase in the velocity of asset substitution, but they could not stop a run against peso-denominated deposits.²⁰ If the run starts, only a massive intervention in private financial contracts can stop it.

C. Dollarization and Financial Fragility

If portfolio asset substitution is like that described in the last section, smooth enough to avoid a collapse in the peso-denominated segment; if, besides, agent asset substitution always goes from deposits in hard currency to deposits in domestic currency, then it is possible to arrive in a nontraumatic way at the full dollarization of the monetary and financial system.

The behavior of a fully dollarized system may be represented by a model that contains dollar-denominated deposits issued domestically and deposits abroad. *Ceteris paribus* aggregation criteria, Figure 6 matrix refers to this case.

With full dollarization of the financial system, the expected domestic currency devaluation becomes irrelevant. However, since there is a differential between the domestic interest rate and the international one, investors—residents and nonresidents—will try to benefit from it, maintaining, without devaluation risk, a proportion of domestic assets in their portfolios. The question that follows is whether in that system conditions of financial fragility disappear or whether they remain, despite full dollarization.

The model used here is formally equivalent to that of Section IV A.1. Note, nevertheless, that now peso-denominated deposits must be interpreted as domestically issued dollar-denominated deposits. The behavior of the model in the face of changes in the differential between both rates is identical to that of the first model and, thus it will not be repeated here.

Increases in uncertainty deserve additional analysis. Up to now, those increases have been modeled as an increase in the future exchange rate's standard deviation ($v^* > v$). It seems that, with no devaluation risk and unchanged preference distribution, portfolio compositions depends on rate differential only.

TABLE 6

Assets and Liabilities Matrix

		Financial System	Non financial Private Sector	Rest of the World	Total assets/liabilities
1	R	R		- R	R
2	D_2	- D_2	DP_2	DE_2	D_2
3	D_3		D_3	- D_3	D_3
4	C_2	C_2	- C_2		C_2
5	TA	$R + C_2$	$DP_2 + D_3$	DE_2	$R + C_2 + (DP_2 + DE_2) + D_3$
6	TL	D_2	C_2	$R + D_3$	$D_2 + C_2 + R + D_3$
7	NFW	$R + C_2 - D_2$	$DP_2 + D_3 - C_2$	$DE_2 - R - D_3$	0

Nonetheless, there is a risk remaining, namely the country risk. This one is a systemic risk and it explains a domestic interest rate higher than the international one. Agents can not diversify this risk, and it could be avoided by a portfolio which is not shared with domestic assets. Therefore, in this model an increase in country risk leads to a greater proportion of deposits abroad over total deposits.

As a matter of fact, country risk does not appear as a consequence of the dollarization process, and it should have been included in former models. Its inclusion here tries to highlight the persistence of fragility in a financial system with no currency mismatch. Note, however, that if country risk had been included in those models, the β function would have shown lower stability. This is a consequence of expectation volatility higher than that obtained in those models, which, to be sure, is a better representation of the economy modeled here.

In a model defined by the matrix in Figure 2, it follows that:

$$i_3 = r^* - s$$

with s being a country risk premium. Replacing r^* by its definition and assuming that devaluation expectations become irrelevant and solving, is easy to see that

$$s = i_2 - i_3$$

As the model formally works as in the previous sections,²¹ effects of country risk variations on financial system are equal to those provoked by changes in v^* . Figure 4 allows us to illustrate this model: line DB and curve LJ are interpreted as supply and demand, respectively, of dollar-denominated deposits in the domestic system. AB shows lending capacity in dollar-denominated instruments.

Although country risk is lower in a stable macroeconomic environment,²² agents' perceptions can change even with a well-functioning financial system and unchanged macroeconomic variables. As was pointed out above in the analysis of bank runs, those changes can occur even with small events. A negative surprise can cause shifts in confidence and subsequent more severe runs than those expected by the intrinsic significance of those events. Unregulated financial markets and/or those that undergo a process of financial innovation are prone to such overshooting.

Frenkel R. (1983) argues that these are not "irrational" expectations. On the contrary, they are rational ones in the sense that agents make the best use of available

information, but the way in which the information is assessed changes rapidly.²³ On the other hand, portfolio shifts that lead investors to quickly substitute dollar-denominated deposits in the country for deposits abroad, even though not justified when the run starts, may have a rational result *ex-post* through a self-fulfilling prophecy.

Even though a full dollarization process made the devaluation expectations less relevant, financial fragility in the banking system may arise from higher domestic interest rates, since the differential between domestic and international rates persists. Fragility can arise too, despite the dollarization, from a higher uncertainty level that provokes higher country risk. As in previous models, a sudden change in agents' preferences that lead to a higher demand for assets issued in the rest of the world implies a capital outflow with effects over domestic monetary aggregates that can end in a banking system collapse.

V. CONCLUSIONS

The previous analysis suggests that despite the structural reforms in the nineties, with liberalization and deregulation in several markets, and given the policy regime after convertibility, financial fragility conditions remain. Then, the key issue is about why those conditions remain if both the macroeconomic context and the international environment during the nineties were quite different from those that prevailed during the eighties.

In spite of macroeconomic stability and capital inflows that imply the end of the credit rationing in international financial markets of Argentina, some hysteresis in the behavior that developed in the eighties, during the high inflation period, can be noted. As some features last—shortening maturity, dollarization—portfolio composition does not change significantly between the 1980s and 1990s, and fragility conditions remain.

This is related to two key issues. On the one hand, the “preference for flexibility” mentioned above becomes a structural change. Hence, behaviors observed during the eighties, like maturity shortening or the trend towards the internationalization of portfolios, which started in a context of domestic macroeconomic disequilibria and international credit rationing, consolidated in the nineties under macroeconomic stability and high international liquidity. Two reasons explain this: i) microeconomic mutations

originated in macroeconomic disequilibria in the high inflation period,²⁴ ii) the integration of the domestic financial market in international markets.

On the other hand, the fiscal deficit and inflation are not the only sources of uncertainty. As has been pointed out above, during the 90s the price level was stabilized and the fiscal deficit reduced substantially, thus closing the sources of uncertainty. However, structural reforms have become the new source of uncertainty. First, the credibility of the initial reforms: not only portfolio decisions are related to them,²⁵ but agents may believe that those reforms are temporary and thus fuel a consumption boom financed by overborrowing (McKinnon and Pill, 1996). Moreover, this overborrowing, as funds are allocated after a low-quality screening process, weakens the banking system (Sachs et al., 1996). It is worth mentioning also that the credit expansion is provoked by capital inflows. Second, since the structural reform period is one of transition, no one knows who the “winners” and the “losers” will be when the new model is fully operational.²⁶ Thus, a wait-and-see behavior becomes rational and prevents the lengthening of the horizon of expectation formation. Hence, portfolio decision behavior remains as in the pre-structural-reform period.

Endnotes

¹ See, for example, Calvo G. et al. (1993), Chohan et al. (1993), Fernández-Arias (1994), and Calvo S. and Reinhart (1995).

² Calvo (1995) points out that macroeconomic theory has given less attention to banks, and that banking credit has been fully ignored.

³ About financial crises in Latin-America during the last decades see, among others, Diaz-Alejandro (1985).

⁴ On the literature of the Balance Sheet Approach after 1997, see Krugman P. (1999), Allen M. et al. (2002), Pettis M. (2001), Roubini and Setser (2004), Roubini and Hemming (2003).

⁵ On this literature see Kaminsky and Reinhart (1999).

⁶ It is possible that some withdrawals are used to put foreign currency “under the mattress,” but this would have the same effect on the banking system.

⁷ For an investor, the decision to roll over a deposit depends on the amount of the deposit times the probability of default. Therefore, even with a low probability of default or of a change in the exchange rate, there may be an incentive for massive withdrawals, especially for big depositors.

⁸ About differences between risk and uncertainty see Hicks (1979).

⁹ The definition follows Davis (1995), although this author uses *systemic risk* to refer to the danger of generalized disorder in the financial markets, and *financial fragility* to refer to individual agents, be these banks, firms, or households.

¹⁰ Actually, the denominator may be larger, if other bank assets and the reserves maintained by the banks are added.

¹¹ On the effects of deflation on bank balance sheets, see Bernanke and James (1991).

¹² See Tobin (1982), where a flow model is presented.

¹³ Similar models, but used in demand and supply of loans analysis, can be seen in Frenkel (1983).

¹⁴ Sachs et al. (1996) highlight that, given that governments are averse to bankruptcy, total commercial banks’ liabilities may be considered a potential Central Bank liability.

¹⁵ This issue causes controversy in the literature. Griffith-Jones (1995) says that in 1994, during the Mexican crisis, residents started a run on domestic assets, selling them to investors abroad. On the same episode, Calvo (1995) pointed out the volatility of assets owned by foreigners. Bernanke and James (1991), analyzing the inter-war period, highlight that most banking problems were suffered by countries with a higher proportion of domestic assets owned by nonresidents.

¹⁶ Being multipliers independent of interest rate, both deposits and loans supplies result vertical lines.

¹⁷ Full equilibrium requires equilibrium of both stocks and flows. However, from three equilibrium conditions—one for flows and two for stocks (at the beginning and at the end of period)—only two are independent. Thus, stock equilibrium at the beginning of period and a flows equilibrium, as in our model, guarantee full equilibrium.

¹⁸ The dollarized fraction of banking operations—the so-called “argendolares”—became decisive regarding capital movements. Fanelli and Machinea (1994) show that capital inflows during convertibility’s first years fueled the dollar-denominated financial instruments expansion. Investors in the country and abroad used them to hedge their deposits against devaluation risk.

¹⁹ Solvency risk arises with that kind of measure, if it leads to a higher share of non-tradable producers—with peso-denominated incomes—in bank’s total lending.

²⁰ Regarding velocity of agents’ portfolio adjustment, is noteworthy that after the 1994 Mexican crisis Argentine banks were allowed to hold their reserves of peso-denominated deposits in dollars. Banks made full use of that possibility immediately, while NPFS started that process some time ago but in a slow way.

²¹ In Section C model, the equilibrium interest rate is:

$$i_3 = i_1 - [(\dot{\epsilon}) + s]$$

In Section B :

$$i_2 = i_1 - [E(\dot{\epsilon}) + s]$$

Expectation of future exchange rate plus country risk premium explain rate differential in both cases.

²² Damill and Fanelli (1994), show that country risk changes are closely related with the evolution of macroeconomic stability. Owing to that, both s level and variance have been lower during the Convertibility Plan most of the time.

²³ What happened in Argentina's financial system during November 1992 and in the aftermath of the Mexican crisis proves the possibility suggested by Frenkel.

²⁴ On this and other micro-macro interactions, see Fanelli and Frenkel (1995).

²⁵ Machinea (1996) pointed out that although remonetization was quite important during the Convertibility Plan, the level of monetary aggregates with respect to GDP shows credibility problems.

²⁶ McKinnon and Pill (1996) introduced this kind of uncertainty modeling of the productivity of the "modern" production technologies (those used to alter reforms) as a stochastic variable. They highlight that that uncertainty immediately involves the financial system's role, which faces, after that, a nondiversifiable macroeconomic risk.

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