TWIN CRISIS AND FIXED-EXCHANGE-RATE REGIMES: THEORY AND RELATED EMPIRICAL STUDIES

by

Eugenio M. Cerutti

A dissertation submitted to Johns Hopkins University in conformity with the requirements for the degree of Doctor of Philosophy.

Baltimore, Maryland

October 2005

INFORMATION TO USERS

The quality of this reproduction is dependent upon the quality of the copy submitted. Broken or indistinct print, colored or poor quality illustrations and photographs, print bleed-through, substandard margins, and improper alignment can adversely affect reproduction.

In the unlikely event that the author did not send a complete manuscript and there are missing pages, these will be noted. Also, if unauthorized copyright material had to be removed, a note will indicate the deletion.

ProQuest Information and Learning Company
300 North Zeeb Road
P.O. Box 1346
Ann Arbor, MI 48106-1346

ABSTRACT

In recent years, currency crises have often happened simultaneously with banking crises (e.g. Chile 1982, Mexico 1994, East Asian Crises 1997, and Argentina 2001). This phenomenon has been termed "twin crises". This dissertation underlines the importance of studying banking and currency crises together.

On the theoretical side, I develop a model that highlights the circular link between banking and currency crises generated by the impact of a fiscal banking sector bailout on the government budget and depositors' reactions to a devaluation. The model suggests that the abandonment of a fixed-exchange-rate is more plausible when one takes into consideration the possibility of twin crises. It also supports the intuition that dollarization and currency boards might offer more protection than soft pegs against currency crises in terms of fiscal fundamentals. Nevertheless, these two hard pegs might further increase the degree of currency mismatch in the banks' balance sheets, raising the possibility of twin crises due to worse banking fundamentals.

On the empirical side, I focus on understanding some determinants of depositors' behavior and foreign banks' preferences regarding the operation of foreign branches or subsidiaries in host countries. Using Argentinean data for Dec 1994-Dec 2001, I find that, as assumed in the model, increases in devaluation expectations, especially at high levels, tended to lead to withdrawals of both domestic and foreign-currency denominated deposits. I uncover the existence of important levels of currency mismatch among the non-tradable sector, but there is no conclusive evidence about depositors' reactions to changes in the level of currency mismatch exposure. Evidence is also inconclusive on the question of whether the presence of foreign banks helps avoid bank crises. The results suggest that foreign banks, especially foreign branches, gained

proportionally more deposits during most bank runs but not all. Finally, using data on the operations in Latin America and Eastern Europe of the top 100 international banks, I find that differences in the parent bank's responsibility for the liabilities of branches and subsidiaries play an important role in the choice of organizational form. Banks prefer to operate as branches in host countries characterized by relatively low economic risk.

Advisors: Thomas Lubik

Christopher Carroll

ACKNOWLEDGMENTS

I am especially indebted to my advisors Professors Christopher Carroll and Thomas Lubik for their advice and guidance, and to Professor Laurence Ball and Louis Maccini for helpful comments and suggestions on earlier versions of this work. I am grateful to my co-authors of the last chapter of this dissertation, Giovanni Dell'Ariccia and Maria Soledad Martinez Peria, for sharing their experience and knowledge during several months of work. This work also benefited from valuable comments by participants at the Mexico 2003 Latin America and Caribbean Economic Association Meeting, Madrid 2004 European Economic Association Meeting, and Johns Hopkins Economics Department Seminars. The financial support provided by the Latin American Center at JHU in order to build the Argentinean dataset is acknowledged, as well as the help provided by Analia Cialdella, Laura D'Amato, and Hernan Rodriguez, from the Argentinean Central Bank, and Concepcion Pinavarina and Federico Presciuttini, from the Argentinean Ministry of Finance, in obtaining the Argentinean data. Finally, I would also like to thank my friends and family, in particular my fiancee Sarah, for their support and understanding during the last few years.

TABLE OF CONTENTS

[1]Chapter 4 is based on "How Banks Go Abroad: Branches or Subsidiaries" by Cerutti, E., G. Dell'Ariccia and S. Martinez-Peria, 2005, mimeo.

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

After twin crises like those in Chile 1982, Mexico 1994, East Asian Crises 1997, and Argentina 2001, it is difficult to understand how a currency crisis can occur within fixed-exchange-rate regimes, especially hard pegs such as currency boards and dollarization, without taking into consideration a banking crisis. In this context, this dissertation contributes to the debate both theoretically and empirically.

On the theoretical side, this dissertation's contribution to the currency crises literature consists of a model that takes into account the government fiscal budget, the banking sector, and the circular self-fulfilling link generated by the impact of a fiscal banking sector bailout on the government budget and the reaction of depositors to the potential impact of a devaluation on their payoffs. Several models have been developed in the literature, which have improved our understanding of currency crises, but they do not capture this special type of circular link between a currency crisis and a banking crisis. The model developed in this dissertation belongs to, what are often labeled, 'third generation' models of currency crises. Third generation models emphasize the links between banking crises and currency crises, and they can be classified into three subgroups, which are briefly reviewed in order to highlight the characteristics and contributions of my model.

In the first subgroup, there are extensions to the well-known Diamond and Dybvig (1983) banking crisis model. Chang and Velasco (2000, 2001) are important models within this group. Chang and Velasco (2000) introduce money as an argument in the depositors' utility function in a Diamond and Dybvig (1993) banking crisis model.

They study the equilibrium outcomes under a variety of exchange rates and monetary arrangements. The Chang and Velasco (2001) model is similar to Chang and Velasco (2000). The difference is that the crisis is due to a liquidity squeeze caused by panicked foreign lenders who run on domestic financial intermediaries. However, neither model can capture a circular link between a currency crisis and a banking crisis because they do not model the government budget constraint and the existence of explicit or implicit government bailouts even without the figure of a lender of last resort.

In the second subgroup, there are twin crises models related to the first generation currency crisis models.[1] Most models, as in my model, highlight the importance of the fiscal banking sector bailout cost on the links between currency and banking crises. More specifically, in this subgroup, the cost of bailing out the financial sector will trigger the necessary government deficit to activate the first generation currency crisis' mechanism of loosing reserves. Velasco (1987) shows that, given an explicitly or even an implicitly guaranteed bailout, the banks could increase their portfolio riskiness due to moral hazard problems. After a negative output shock, the banks will start borrowing externally at a risk free-rate in order to pay interest on deposits and previous loans (i.e. like a Ponzi scheme) until they reach a certain borrowing limit. At this point a financial crisis occurs and the government becomes responsible for the banks' liabilities. In other words, in Velasco (1987) as in many other papers in this group such as Burnside, Eichenbaum and Rebelo (2001a and 2001b), the collapse of the exchange rate regime is inevitable and is driven by fiscal considerations.

Nevertheless, other papers in the second subgroup show self-fulfilling characteristics similar to the model developed in this dissertation. Burnside, Eichenbaum and

[1] The first generation currency crises models include the classic approach to balance-of-payments crises that was laid out by Krugman (1979) and Flood and Garber (1984). They showed, within a monetary framework, how a country will be forced to abandon a fixed-exchange-rate regime if it is engaged in an unsustainable attempt to monetize a persistent fiscal deficit due to domestic expansionary policies. A special feature of these models is that currency crises are inevitable because the government follows an inconsistent fiscal policy.

Rebelo (2002), although it does not explicitly model the depositors' decisions, introduces the idea of a banking sector as a way of generating future deficits -at least partly seigniorage financed- that will produce a currency crisis when all agents believe that the government is going to devalue. Goldfajn and Valdes (1997) do a similar analysis but place emphasis on the depositors' role.[2] Even though their model does not rely on the bailout cost of the banking sector, the central bank reserve losses are caused by the foreign depositors who withdraw early from the banks and exchange their domestic-currency payoff for foreign currency. The international investors' expectations of an eventual currency crisis increase the probability of a bank run. It is worth noting two points: first, international investors' expectations are modeled only as a function of the level of the central bank's reserves (i.e. the government fiscal budget is not being considered). Second, Goldfajn and Valdes (1997) do not take into account the fact that the government would have to bail out the banking sector.

The third twin crises subgroup contains models related to second generation currency crises models.[3] There are not many models in this subgroup. For example, Goldstein (2004) highlights strategic complementarities between depositors and speculators. The link between the crises is a self-fulfilling argument about depositors and speculators' incentives. The higher the depositors' withdrawals when they anticipate a devaluation, the higher the loss of government foreign reserves. This, in turn, increases the incentive of speculators to attack the currency, as they know that the attack is more likely to succeed. However, this twin crises model does not highlight the importance of the government budget and the fiscal cost of even a partial banking

[2]Although Goldfajn and Valdes (1987) do not follow the first generation models inconsistency of present or prospect government deficits, they reserve loss mechanism resemble much to a first generation than a second generation model because they do not model the government loss function.

[3]The second generation currency crises models introduce the reaction of government policies to changes in private behavior. The large second-generation currency crises literature shows that the viability of a fixed exchange rate hinges not only on the ability to defend parity, but also on the willingness to defend it. For more about second generation models see Obstfeld (1994 and 1996).

sector bailout. Under some fixed exchange rates regimes (e.g. currency boards) the government cannot use foreign reserves to bail out the banking sector. In general, under fixed-exchange-rate regimes in emerging countries, bailing out implies either using fiscal surpluses, issuing new debt or abandoning the monetary regime.

The model presented in this dissertation belongs to this last subgroup. In the model, a banking crisis can trigger a currency crisis due to the bailout cost. A currency crisis can trigger a banking crisis due to the impact of a devaluation on depositors' payoffs. The self-fulfilling characteristics of the link between crises is given by the fact that, if depositors believe that there will be a devaluation, they may try to anticipate the government action and withdraw their deposits. Then, the government may validate depositors' expectations because it might be forced to devalue in order to pay the bailout cost. The introduction of the government budget together with the fiscal cost of a banking sector bailout not only expands on similar previous models, but it also allows for an easier distinction to be made between soft pegs (e.g. crawling pegs and basket pegs) and hard pegs (e.g. currency board and dollarization) as a function of fiscal fundamentals. In this sense, the model supports the intuition that dollarization and currency boards might offer more protection than soft pegs against currency crises in terms of fiscal fundamentals. Nevertheless, these two hard peg regimes might further increase the degree of currency mismatch in the banks' balance sheets (e.g. through currency mismatch among borrowers), raising the possibility of twin crises due to worse banking fundamentals.

On the empirical side, this dissertation examines foreign banks' preferences regarding the operation of foreign branches or foreign-owned subsidiaries in host countries, and some determinants of depositors' behavior, which are essential to understanding not only banking crises but also twin crises. Three main topics are empirically analyzed. First, are depositors' withdrawal decisions, as assumed in the theoretical model, a function of their devaluation expectations as well as the degree of currency

mismatch in the banking-sector balance sheets? Using the Argentinean experience during Dec 1994-Dec 2001, the results indicate that an increase in devaluation expectations, especially at high levels, induces withdrawals of both domestic and foreign currency denominated deposits. The results are not as clear for the degree of currency mismatch. I document the existence of important levels of currency mismatch, but there is insufficient variation in currency mismatch to determine how depositors' behavior is affected by the level of currency mismatch.

Second, one of the most common economic prescriptions for avoiding bank crises within fixed-exchange-rate regime economies, the (large) presence of foreign banks within the banking sector, is empirically tested. The presence of foreign-owned banks is discussed in the literature [e.g. Fisher (2001), Peek and Rosengren (2000), etc.] largely as a way of mitigating the limited existence of a lender of last resort within fixed-exchange rate regimes. Foreign banks' access to their parent bank's capital and liquidity is sometime considered a strong enough factor to convince depositors to not withdraw their deposits from the banking sector. The differences between foreign-owned subsidiaries and foreign branches are also taken into account. In theory, foreign branches offer more protection than foreign-owned subsidiaries since a parent bank, in the case of foreign-owned subsidiaries, is under no legal obligation to honor their liabilities and its potential losses are limited to the capital invested and the costs of closing the operations. The evidence for a potential positive role for foreign banks in avoiding bank crises seems to be inconclusive in the Argentinean case. The results suggest that foreign banks, especially foreign branches, gained proportionally more deposits during most bank runs but not all.

Finally, the differences between foreign-owned subsidiaries and foreign branches from the foreign banks point of view are analyzed. The type of foreign banks' presence in developing countries is studied as a function of parent bank characteristics (e.g. parent bank's size, business orientation, degree of international presence, etc), home-

country regulations, the desired level of penetration in the host market (as proxied by affiliate bank characteristics) and host-country factors (e.g. economic and political risk, legal restrictions on foreign bank operations, entry requirements, taxation levels, etc).

Using data related to the operation in Latin America and Eastern Europe of the largest 100 banks in the world, the results suggest that differences in the parent bank's responsibility for the liabilities of branches and subsidiaries play an important role in the choice of organizational form. Banks prefer to operate as subsidiaries in host countries characterized by relatively high economic risk. However, the evidence also suggests that when it comes to risks stemming from possible government intervention and other major political events (such as civil unrest or wars) parent banks seem to prefer to operate as branches, since the latter are often protected against such events by ring fencing provisions, which generally establish that parent banks are not required to repay the obligations of a foreign branch if the branch faces repayment problems due to extreme circumstances (such as war or civil conflict) or due to certain actions by the host government (e.g., exchange controls, expropriations, etc.).

The organizational structure of this dissertation is the following: a twin crises model is presented in Chapter 2, the empirical study of depositors' behavior regarding devaluation expectation, currency mismatch, and their attitudes towards foreign banks is presented in Chapter 3, the study of foreign bank organizational choice is performed is Chapter 4. Chapter 5 offers some concluding comments and future research considerations.

CHAPTER 2

A TWIN CRISES MODEL

2.1 Introduction

The links between currency crises and banking crises are many and complex, due especially to the unique characteristics of the banking sector. The banking sector can have a mismatch of assets and liabilities not only in terms of liquidity, but also in terms of currency composition.

Two important links between banking and currency crises will be the focus of attention in this study of twin crises within fixed exchange rate regimes. First, I focus on the impact of a fiscal banking sector bailout on the government budget. The size of a government bailout is generally large. For example, Caprio and Klingebiel (2003) estimate that the fiscal bailout costs were: 28 percent of GDP in the Korean 1997 crisis, 38.8 percent of GDP in the Thai 1997 crisis, 42 percent of GDP in the Chilean 1982 crisis, and 19.3 percent of GDP in the Mexican 1994 crisis. The government does not necessarily make explicit bailout commitments before a banking crisis. They can however be implicitly known by economic agents since they know that the government will not allow the total disruption of the banking sector.[1] Second, I focus on depositors' reaction to the potential impact of a devaluation on the banking sector balance sheet, and hence, on the depositors' payoffs. Depositors' reactions are not only a function of the currency denomination of the banking sector deposits and assets (loans), but also of the potential currency mismatch among the borrowers.

[1] This fact is true even if the government has repeatedly insisted that financial intermediaries will not be rescued (e.g. Chile 1982).

These two links describe a circular connection between a banking crisis and a currency crisis. A banking crisis can trigger a currency crisis due to the bailout cost. A currency crisis can trigger a banking crisis due to the impact of a devaluation on depositors' payoffs. Moreover, the circular connection has self-fulfilling characteristics. If depositors believe that there will be a devaluation, they may try to anticipate the government action and withdraw their deposits. Then, the government may validate depositors' expectations because it might be forced to devalue in order to pay the bailout cost.

In the literature, banking crises are generally modeled as being a result of weak banking sector fundamentals and/or a coordination failure equilibrium.[2] The coordination failure equilibrium is a banking crisis equilibrium when depositors panic and withdraw early. This equilibrium is usually derived from the assumption of early liquidation cost in the banks' investments [e.g. Diamond and Dybvig (1983)] . Similarly, currency crises are modeled as being a result of the government's fiscal budget problems and/or a coordination failure equilibrium related to matters of credibility. Figure 2.1 shows these links and the circular connection created by the government bailout cost and the banks' balance sheet problems caused by a devaluation.

Chang and Velasco (2000) is perhaps the most influential model which has studied twin crises under a variety of exchange rates and monetary arrangements. They develop a open economy extension of Diamond and Dybvig (1983) introducing money as an argument in the depositors' utility function.[3] They find several observations among different fixed exchange rate regimes. First, currency boards are subject to

---

[2]It is worthwhile to note that I am referring to the banking system as an homogeneous entity. Hence, I do not include the possibility that a banking crisis is an episode of market discipline during which depositors attempt to sort among ex-ante solvent and ex-ante insolvent banks in a world of asymmetric information regarding bank asset values. In this chapter, the depositors will try to differentiate between a solvent or an insolvent banking system given a potential government devaluation.

[3]Chang and Velasco's (2001) model is similar to Chang and Velasco (2000). The difference is that the crisis is due to a liquidity squeeze caused by panicked foreign lenders who run on domestic financial intermediaries.

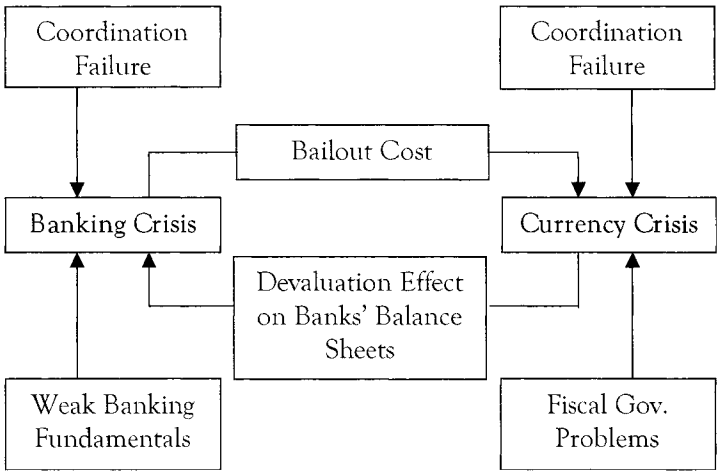

Figure 2.1. Twin Banking-Currency Crises' Links

banking crises *but not* to currency crises. Second, if the central bank attempts to fix the exchange rate and, at the same time, to act as a lender of last resort, there could be a currency crisis but not a banking crisis. In other words, the lender of last resort policy determines *only* whether a crisis materializes as a general bank failure or as a collapse of the fixed exchange rate peg. Third, foreign currency denominated bank deposits prevent the central bank from serving as a lender of last resort. In general, among other objectives, their model evaluates how a banking crisis generated by a coordination failure will result in a banking sector collapse or a currency crisis. However, they cannot capture a circular link between a currency crisis and a banking crisis because they do not model the government budget constraint and the existence of explicit or implicit government bailouts even without the figure of a lender of last resort.

Other models do not explore differences among fixed exchange rate regimes but highlight a circular link between a currency crisis and a banking crisis. For example, Burnside, Eichenbaum and Rebelo (2001a, 2001b, and 2002) and Velasco (1987) stress how the cost of bailing out the financial sector will trigger the necessary gov-

ernment deficit to activate a mechanism of losing reserves similar to Krugman (1979). Nevertheless, the idea of a banking sector is only introduced as a way of generating current or future deficits -at least partly seigniorage financed- that will produce a currency crisis, but without explicitly modeling depositors' decisions. Goldfajn and Valdes (1997) and Goldstein (2004)'s models capture a circular link between a banking crises and a currency crisis in which they place more emphasis on the depositors' roles and on the government losses of foreign reserves due to a banking crisis. However, it is not possible to reduce the government fiscal problems from a banking crisis just to the government loss of foreign reserves. Under some fixed exchange rates regimes (e.g. currency boards) the government cannot use foreign reserves to bail out the banking sector. In general, under fixed exchange rate regimes in emerging countries, bailing out implies either using fiscal surpluses or issuing new debt or abandoning the monetary regime.

I develop a model which takes into account the government fiscal budget, fundamentals of the banking sector, and the circular link generated by the impact of a fiscal banking sector bailout on the government budget and the reaction of depositors to the potential impact of a devaluation on their payoffs. The government fiscal budget is introduced as a constraint on a government loss function taken from second generation-currency-crisis models [e.g. Sachs, Tornell and Velasco (1996a)]. The banking sector is modeled similarly to Diamond and Dybvig (1983). However, I follow the Global Game literature started by Carlsson and van Damme (1993) and Morris and Shin (1998) who noted that the existence of non-common knowledge can generate a unique equilibrium in models of strategic complementarities.[4] Unlike multiple equilibria models, the existence of a unique equilibrium provides a basis for explor-

[4]It is worthwhile to highlight that Goldstein (2004) is also based on concepts taken from the Global Games literature. His model emphasizes the strategic complementarities between depositors and speculators in explaning twin crises -adding speculators, increases the potential government loss of foreign reserves. See Goldstein and Pauzner (2004) and Rochet and Vives (2002) for banking crises models without common knowledge.

ing the correlation between the underlying fundamentals and the resultant economic outcomes. The model highlights the self-fulfilling characteristic of the twin crises, and the significant role of banking fundamentals in explaining a currency crisis. The model can also explain a currency crisis even with more solid fiscal fundamentals than Sachs, Tornell and Velasco's (1996a) model. The introduction of the banking sector and the government bailout are responsible for this outcome.

Using different model parameters such as the degree of government fiscal commitment, exit cost, reserve levels, and the currency mismatch exposure, I am able to differentiate between soft pegs (e.g. crawling pegs and basket pegs) and hard pegs (e.g. currency board and dollarization). The model provides support for the intuition that dollarization and (to a lesser extent) currency boards offer some protection against currency crises -in the sense that they may generally tolerate worse fiscal fundamentals without a currency crisis than is the case under soft pegs. Nevertheless, these two hard peg regimes may further increase the degree of currency mismatch in the banks' balance sheets. Domestic borrowers and banks usually feel protected by an implicit government guarantee of their foreign currency liabilities in the event that they are made insolvent by a devaluation. Therefore, this phenomenon might raise the possibility of twin crises due to worse banking fundamentals. This result highlights the fact that including a banking crisis is sometimes essential to understanding a currency crisis under hard pegs which are often considered to be currency-crisis-proof.

Finally, I derive policy implications including: First, regulations that require banks to match or hedge the exchange rate risk of their assets and liabilities may not be enough to avoid a crisis (e.g. rules such as the volume of foreign-currency denominated assets has to be at least equal to the volume of foreign-currency denominated liabilities). In a devaluation scenario, foreign-currency denominated loans taken by the non-tradable sector will produce an indirect exchange rate risk. Regulations such

as the Basel Committee 1996 Amendment that leave the banks themselves to take this risk into account might not perform well under fixed exchange rates regimes due to moral hazard problems. Second, the levels of fiscal fundamentals that are commonly considered safe for developed countries with access to international finance markets (e.g. the levels of public debt and deficit in the Maastricht Treaty) may be too high for emerging countries, which have implemented fixed exchange rate regimes and do not always have access to international finance markets. Last, but not least, a government should be extremely careful with measures that can alter the credibility of a fixed exchange rate regime through changes in the agents' information structure.

The rest of the chapter consists of four sections. First, a unique-equilibrium model of twin crises is developed, which can explain the possibility of fixed exchange rate abandonment even when deposits are foreign currency denominated. Second, an analysis of the differences among fixed exchange rates regimes within the framework of the model is performed. Third, the consequences and implications of introducing multiple equilibria either in the currency crisis or in the banking crisis side of the model are analyzed. Fourth, conclusions and policy implications are drawn from the model.

2.2 The Model

I consider an economy that is populated by a government, Diamond-Dybvig's consumers, and a banking sector. Only the government and the consumers play an active role in this economy. A three-period economy is assumed in the model. During the initial period (t=0) -the planning period- decisions about bank deposits are taken. Also in this period, the government's initial debt for the next period is defined. In the first period (t=1) -the short run, the consumers decide whether or not to withdraw their deposits. After that the government decides how to balance the fiscal budget. In the second period (t=2) -the long run, all investment projects in the economy will

mature and all deposits will be withdrawn. The time line of events can be seen in figure 2.2.[5]

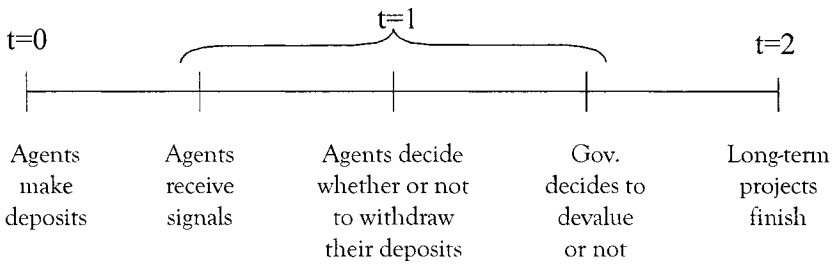

Figure 2.2. Time Line

From the time line can be infered that the depositors will try to anticipate the government action at the moment that they have to decide whether or not to withdraw early. However, the government takes its decision once the government has seen the depositors' actions. I begin by specifying the government's problem, and then the consumers and the setup of the banking sector.

2.2.1 The Government

The government minimizes its loss function subject to a budget constraint. The government loss function is:

$$L = \alpha\varepsilon^2 + x^2 + wc, \tag{2.1}$$

where ε is the devaluation rate, x is the (policy determined) government primary surplus -taxes minus expenditures, c is the government cost of devaluation (e.g. loss of credibility), w is a dummy variable that takes the value one when there is a devaluation and zero otherwise, and α is a positive constant.

[5] As other currency crises models [e.g. Sachs, Tornell and Velasco (1996b)], the intertemporal aspects of both the consumer behavior (e.g. the consumer-saving choices) and the government behavior (public debt management) are disregarded.

The government budget constraint at t=1 is:

$$\theta + D = x + \varphi\left(\varepsilon - \varepsilon_{\text{exp}}\right), \tag{2.2}$$

where ε_{exp} is the expected devaluation rate, ε is the devaluation rate, and θ denotes fiscal fundamentals such as the debt related payment that the government has to pay at t=1 for the inherited real stock of *net* commitments of the consolidated government (including the Central Bank). $\varphi\left(\varepsilon - \varepsilon_{\text{exp}}\right)$ can be thought of as seigniorage revenues. An increase in the expected devaluation rate (ε_{exp}) will decrease domestic currency demand, hence it will reduce the seigniorage revenues at a given devaluation rate (ε).[6] It is worthwhile to highlight that the only modification to the Sachs, Tornell and Velasco (1996a) budget constraint is the explicit presence of a government bailout cost (D), which is equal to:

$$D = dn^{\#} \tag{2.3}$$

where $n^{\#}$ is the number of patient depositors who withdraw their deposits early at t=1 and d is the (exogenous) proportion of depositors' payoff that the government bails out. The bailout is total if $d = 1$. In other words, the government guarantees all bank obligations. The bailout is partial if $0 < d < 1$. Consequently, the bailout is null if $d = 0$. Since a scenario without (explicit or implicit) bailout is very improbable due to the very high cost of a complete early-shutdown of a modern financial sector, I assume that $0 < d \leq 1$.

---

[6] As many other models in the literature have done, I assume that the only inflation-related source of revenues for the government is printing money. The fact that fully anticipated devaluation yields no revenue can be thought of as a normalization, such as in Sachs, Tornell and Velasco (1996a) and Velasco (1996). In praxis, the government can access different sources of resources *once* it abandons the fixed exchange rate regime. These include deflating the real value of outstanding non-indexed debt, reducing the real value of government outlays that are set in domestic currency (e.g. civil servant wages, social securities payments, and non-tradables expenditures in health and education), and the possibility of introducing new taxes to the sectors that would benefit from the abandonment of the fixed exchange rate regime (e.g. taxing exports). The conclusions will be robust to the introduction of these factors.

In this context, the government has three options to balance a tight budget in its optimization problem at t=1: an increase in the government primary surplus, seigniorage obtained through a devaluation (and consequently the abandonment of the fixed exchange rate regime), and a combination of the previous measures. Given the model's parameter values which all agents know, the government will decide to devalue or not after observing $n^{\#}$ (hence, the size of D), the size of devaluation expectations ε_{exp}, and the value of the fiscal fundamentals θ.

Defining E_0 as the nominal exchange rate at t=0 and E_1 as the nominal exchange rate at the end of t=1 and thereafter, the devaluation rate is $\varepsilon = \ln(E_1) - \ln(E_0)$. In the case of devaluation, after solving the first order conditions of the minimization problem, the government will fix E_1 such that the optimal devaluation rate is:

$$\varepsilon = \frac{\varphi}{\alpha + \varphi^2}(\theta + \varphi\varepsilon_{\text{exp}} + D) \tag{2.4}$$

Taking these factors into account the government will devalue if its loss function evaluated at the optimal devaluation rate is lower than its loss function evaluated while maintaining the fixed exchange rate. Using the corresponding loss function equations:

$$\alpha\varepsilon^2 + (\theta + \varphi\varepsilon_{\text{exp}} - \varphi\varepsilon + D)^2 + c < (\theta + \varphi\varepsilon_{\text{exp}} + D)^2 \tag{2.5}$$

Plugging equation (2.4) into equation (2.5):

$$\alpha\left(\frac{\varphi}{\alpha + \varphi^2}(\theta + \varphi\varepsilon_{\text{exp}} + D)\right)^2 + \left(\theta + \varphi\varepsilon_{\text{exp}} - \varphi\left(\frac{\varphi}{\alpha + \varphi^2}(\theta + \varphi\varepsilon_{\text{exp}} + D)\right) + D\right)^2 +$$

$$+c < (\theta + \varphi\varepsilon_{\text{exp}} + D)^2 \tag{2.6}$$

Solving equation (2.6) for θ:

$$\theta > k - \varphi\varepsilon_{\exp} - D \tag{2.7}$$

where $k = \frac{c^{\frac{1}{2}}\sqrt{\alpha+\varphi^2}}{\varphi}$. Thus, the government will devalue when θ is greater than $k - \varphi\varepsilon_{\exp} - D$.

It is worthwhile to highlight that in a *Non Banking Crisis* scenario -when $D = 0$- the government will devalue only if:

$$\theta > k - \varphi\varepsilon_{\exp} \tag{2.8}$$

Therefore, it can be deduced from the above equations that the probability that the government will devalue is a function of the size of fiscal fundamentals θ, the devaluation expectations and the cost to the government of a banking crisis. Figure 2.3 shows the different decision cut-off points in the government maximization problem.

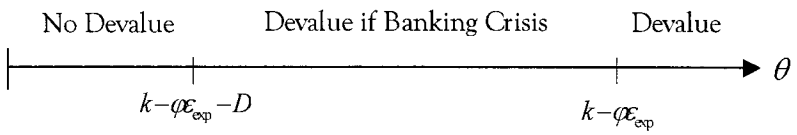

Figure 2.3. Government Cut-Off Points

Three sections can be distinguished in figure 2.3. First, a section where the government will not devalue because the fiscal fundamentals, θ, are very good. The government can afford a fiscal bailout independently of the number of patients depositors' early-withdrawals $n^{\#}$. Second, a section with fiscal fundamentals that are so bad that the government will devalue in any scenario (i.e. with or without a banking crisis). In this section, the government cannot manage to pay for its own expenditures without seigniorage. Last, but not least, an intermediate section where the government will not devalue if the bailout cost is zero, otherwise, the government will have to devalue in order to afford the bailout. The length of this intermediate section is en-

dogenous in the model since it depends on the size of the bailout, i.e., on the value of the endogenous parameter $n^{\#}$. Hence, the larger the number of early-withdrawals $n^{\#}$, the lower the level of fiscal fundamentals needed to force a government devaluation.[7]

In summary, the government's action regarding the devaluation rate (ε) is to set either $\varepsilon = 0$ or $\varepsilon = \frac{\varphi}{\alpha+\varphi^2}(\theta + \varphi\varepsilon_{\exp} + D)$ (from equation 2.4) once it observes the value of θ, $n^{\#}$, and $\varepsilon_{\exp}$ at the end of t=1. It is worth remembering that the value of the other parameters and the model structure are known by *all* agents.

2.2.2 The Consumers

Following Diamond and Dybvig (1983), the consumers (also the only depositors in the model) play an active role in the model. There are a large number of agents who are ex-ante identical at period t=0.[8] Each consumer receives its payments (e.g. wages, income, etc.) as the equivalent to *one* unit of foreign currency at t=0. A consumer' utility function is a function of consumption only. At t=0, each consumer has to decide how she will save for future consumption either in period t=1 or t=2. A consumer can hold foreign/domestic currency or she can deposit foreign currency in the banking sector,[9] but she needs to exchange foreign currency for domestic currency in order to buy goods. Each consumer can exchange currency at the banks (sell or buy foreign currency). The banks offer this service at the fixed exchange rate on behalf of the central bank .

---

[7] At this stage, the government sections are still a function of the endogenous expectations of devaluation. Remember that the government knows the value of the devaluation expectations at the time when it decides whether or not to devalue. I will solve the value of the devaluation expectations in section 2.5.2, once consumers and other considerations are introduced.

[8] In equilibrium the number of agents must ensure that depositors assume that their individual impact on aggregate outcomes is negligible. This is a simplification assumption in the exposition of the model. See Frankel et al (2003) and Morris and Shin (2003) for a finite number of players.

[9] The expected long-term return of the money in the bank is greater than 1 at t=0 (e.g. the prior probability of bank failure is small enough). In the model, the bank accepts only foreign-currency deposits. This assumption is used in order to cover the most dificult alternative in the currency denomination of the banking sector balance sheet under a potential government devaluation of the domestic currency. In section 2.3.1, footnote 13 shows how other alternatives about the currency denomination of the banking sector balance sheet can be also interpreted in the model.

Each consumer knows that she faces an uninsurable risk of becoming type 1 (with probability λ) or type 2 (with probability $1-\lambda$) at t=1. The consumers who will become type 1 want to consume only at t=1 (e.g. they become impatient). The consumers who will become type 2 are more patient and want to consume only at t=2. Each consumers' individual chance of becoming type 1 or 2 is equal and independent.

At the beginning of t=1, each consumer observes *privately* his own type, and the exact value of the other model's parameters with the exception of the fiscal fundamentals θ.[10] They receive a signal θ_i of the fiscal fundamentals, where $\theta_i = \theta + \sigma\eta_i$, $\sigma > 0$ is a constant and the individual specific noise η_i is distributed according to smooth symmetric density $f(\cdot)$ with mean zero. The cumulative distribution function for $f(\cdot)$ is denoted as $F(\cdot)$. I assume that η_i is i.d.d. accross depositors. Each consumer has an improper prior belief about θ over the real line, which allows to concentrate on the updated belief of the consumers conditional on their signal.

To summarize; on the one hand, a proportion λ of the consumers become impatient and withdraw early. On the other hand, a proportion $1-\lambda$ become patient consumers. The actions of these patient consumers will be the focus of the attention. They have two options at t=1: they can decide to withdraw their bank deposits early (and hold cash that will be used at t=2), or otherwise, they can renew their deposits and withdraw them at t=2 once they need to consume. Denoting the proportion of patient depositors that withdraw early as n and setting the total number of patient depositors equal to 1, then, n is equal to $n^{\#}$.

---

[10] The fact that the consumers imperfectly "observe" only the fiscal fundamental variable θ is a simplification taken with the objective of easily comparing our result with Sachs, Tornell and Velasco (1996a). Recall that θ is the debt related payment that the government has to pay at t=1 for the inherited real stock of *net* commitments of the consolidated government. Thus, it includes a variable which is very difficult to forecast or to interpret. This is the new debt that the government could issue (implicitly assumed as exogenous and as determined by the international financial market) at t=1. Additionally, episodes when the agents do not believe in the official debt statistics (e.g. Korea in 1997) can be included.

2.2.3 The Banking Sector

The banking sector has a passive role in the model. The banking sector issues a demand deposit contract when a consumer deposits an unit of *foreign currency* at t=0. The demand deposit contract gives each agent a right to withdraw 1 unit of foreign currency at t=1. The consumers who do not withdraw at t=1, get the pro-rata share of the bank's assets at t=2 because the banks are mutually owned and liquidated in period t=2.

2.2.3.1 Consumers' Payoff in Domestic Currency

This subsection will show the specific characteristics of the investment project and how these characteristics will affect each patient depositor's payoff and behavior. Throughout the analysis, it is important to highlight that the existence of pass-through in the model is assumed. A devaluation will produce an increase in the domestic-currency price of some goods (e.g. tradable goods). Holding domestic currency or domestic-currency related assets as a reserve of value could diminish consumption power after a devaluation. In other words, depositors will try to avoid loosing wealth in foreign currency units because this could mean a lower level of consumption at t=2 when there is a devaluation at the end of t=1.

Since the impatient depositors are certainly going to withdraw at t=1, the focus lays on the behavior of patient depositors only. The banking sector invests in a *domestic long-term* but *high-return* project. As in Goldstein (2004), I assume that the strategic complementarities among the depositors is generated by one long-run productive technology with increasing returns to scale in aggregate investment.[11]

[11] In the literature [e.g. Diamond and Dybvig (1983)], the strategic complementarities among depositors generally come from the short-run lack of liquidity in the investment. However, this will complicate the model significantly. The increasing return to scale assumption is not unrealistic among emerging countries.

Moreover, I will assume a specific type of increasing return to scale and bailout impact on depositors' payoff in order to show the interaction of both concepts.

For each unit invested in the project at t=0, the project generates one unit at t=1 (i.e. there are not liquidation cost). At t=2, without taking into account -for the moment- the bailout impact, the aggregate domestic-currency return of the project (Π) is given by the following production function:

$$\Pi = [1 - \sqrt{1 - K_2}]\Pi^* \tag{2.9}$$

where K_2 is the proportion of patient depositors' resources which remained invested in the project until t=2 (e.g., for the moment, $K_2 = 1 - n$), and Π^* is the project's domestic-currency return when the increasing returns to scale are fully present -in other words, Π^* is the project return when there are no early withdrawals ($n = 0$). It is worthwhile to highlight that $[1 - \sqrt{1 - K_2}]$ captures the increasing returns to scale of each consumer over the domestic-currency payoff [i.e. the greater the proportion of agents who withdraw early (n), the lower is Π]

Now, the impact of the government bailout in the project return needs to be included. First, given that the government bailout was equal to $dn^{\#}$, $K_2 = 1 - n + dn$. Second, I will assume that not all the government bailout cost is going to be directly received by the depositors (e.g. administrative costs during the bailout process such as identification of depositors and certification of their claims, etc.).[12] I assume that the net impact of the government bailout is inversely related to n, hence $K_2 = 1 - n + dn\,(1 - n)$. Plugging in this expression into equation (2.9):

$$\Pi = [1 - \sqrt{[1 - d(1 - n)]n}]\Pi^* \tag{2.10}$$

[12]Empirically, after a banking crisis, depositors often experience (at least) liquidity losses due to delays in accessing their deposits (e.g. freezed deposits as in Argentina in 2002 and 1989 or in USA in 1893 and 1907). The length of these delays are usually related to the size of the banking crisis.

Each patient depositor payoff can be obtained from dividing equation (2.10) by the number of patient depositors:

$$\pi = \frac{[1 - \sqrt{[1 - d(1-n)]n}]}{1-n}\Pi^* \tag{2.11}$$

Figure 2.4 depicts equation (2.11) at different values of the government bailout (d), the proportion of patient depositors who withdraw early (n), $\Pi^* = 1.5$ and $\Pi^* = 2$. On the one hand, Figure 2.4 shows that the greater is n, the lower is π independently of Π^* and for almost all d -the only exception is a total government bailout ($d = 1$). This feature captures the assumed strategic complementarities among the depositors generated by the increasing returns to scale of each depositor over the domestic-currency payoff. On the other hand, the effect of the government bailout on each patient depositor's payoff can also been appreciated in Figure 2.4. Here, it is worthwhile noting the effect derived by the assumption that not all the government bailout cost is going to be captured directly by the depositors. Otherwise, since the government is bailing out at least a part of the early liquidations, there will be a proportion of agents that withdraw early (n) when increases in this proportion will increase the individual domestic currency return of the agents that do not withdraw early because the size of the bailout component is very important and it is divided between less agents. Moreover, without this assumption, $\pi \to \infty$ as $n \to 1$. Under the assumption, for example, in the extreme total bailout scenario ($d = 1$), patient depositors are going to receive Π^*. Finally, two more points in figure 2.4 are interesting to highlight. First, the greater is d, the bigger is π. Second, the line without a government bailout ($d = 0$) in Case A goes below 1 (payoff obtained by depositors when they withdraw early) when n is big enough. In this scenario, the depositors know that, for a big enough n, the payoff at t=2 of the project could be smaller than the withdrawal payoff at t=2. This is not the case when $\Pi^* = 2$ (see Case B).

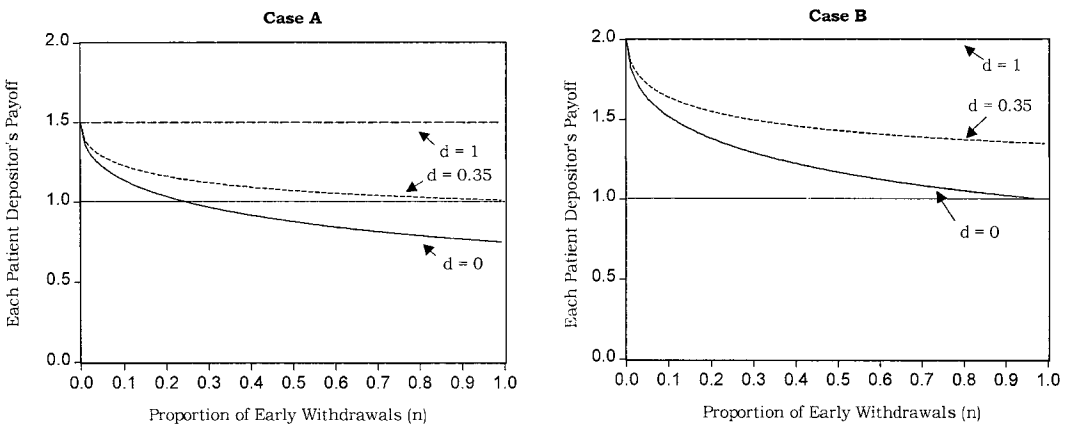

Figure 2.4. Strategic Complementarities Among Depositors

2.2.3.2 Consumers' Payoff in Foreign Currency

As a final point, it is necessary to include the impact of a devaluation on depositors' payoffs. The depositors compare their different returns in terms of foreign currency. Each patient depositor foreign-currency return at maturity (t=2) is equal to:

$$\pi_{US\$} = \frac{\left[1 - \sqrt{[1 - d(1-n)]n}\right] \Pi^*}{(1-n)} \frac{1}{e^{\nu\varepsilon + \ln E_0}} \tag{2.12}$$

where ν shows the international tradable degree of the investment project. Three different cases can be distinguished. First, the project produces only non-tradable goods if $\nu = 1$. Thus, $e^{\nu\varepsilon + \ln E_0} = e^{\varepsilon + \ln E_0} = E_1$. The impact of the devaluation on the foreign-currency return is directly related to the change in the nominal exchange rate. Second, the project is completely internationally tradable if $\nu = 0$. In this case a devaluation will not affect the return of the project in foreign currency terms (e.g. $\frac{\partial \pi_{US\$}}{\partial \varepsilon} = 0$). This case could correspond with a project which is producing goods that can be perfectly exported (e.g. commodities). Note that even if the good is domestically sold, there would be an increase in the domestic price of the good proportional to the devaluation rate. Third, there is an intermediate scenario when $0 < \nu < 1$. A devaluation will affect the foreign-currency denomination of the

project's payoff not only as a function of the change in the nominal exchange rate but also as a function of the project's tradable degree (ν).[13]

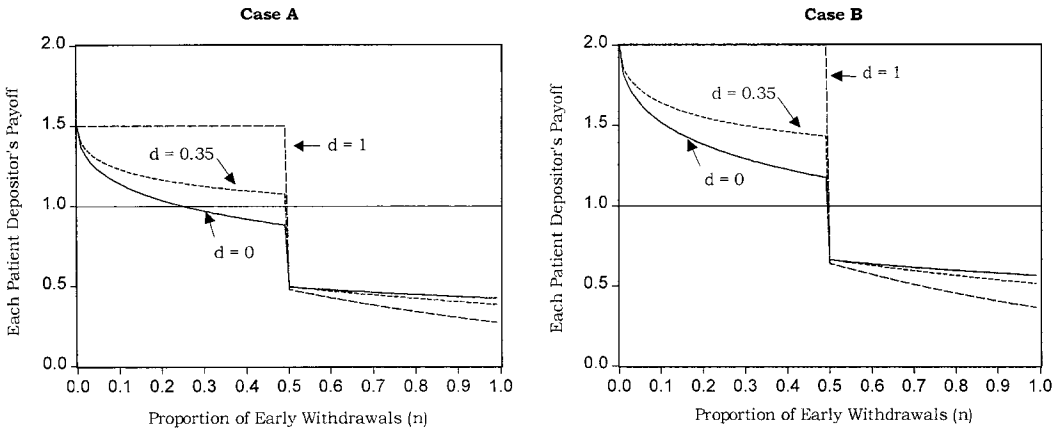

Figure 2.5. Devaluations and Strategic Complementarities Among Depositors

Figure 2.5 shows the same characteristics as figure 2.4, but it is assumed for illustrational purposes that there is a devaluation when $n = 0.5$ and $\nu = 0.5$. The depositors know that their payoffs are also a function of ε and ν. Thus, they will try to anticipate the effect of a government devaluation on their payoffs. A patient depositor might choose to withdraw early and hold foreign currency notes until t=2 if she expected a return lower than 1.[14] Since the objective is to study the links between currency crises and banking crises, I assume that $0 < \nu \leq 1$. Otherwise, a devaluation will not have an effect on the foreign-currency return of the project. The link from a currency crisis to a banking crisis is closed.

---

[13]It is also posible to interpret ν as reflecting a potential banks' balance sheet currency mistmach. For example, the case when $\nu = 1$ could capture either the scenario when the banking sector has received *foreign-currency* denominated deposits and it has given *domestic* currency denominated loans, or the case when the banking sector has received *domestic-currency* denominated deposits and it has given domestic or foreign currency denominated loans. A devaluation of the domestic currency will affect the depositors' payoff in a one to one correspondence with the change of the exchange rate.

[14]The assumption that none of the returns paid at t=1 are a function of the nominal exchange rate is due to the timing of decisions in the model. Before the government decides to devalue, the bank will receive the early liquidation of capital invested in the long-term project.

2.2.4 Model Equilibrium

This subsection explains how the model achieves a unique equilibrium despite the presence of strategic complementarities.[15] The existence of an unique equilibrium in the model is important because it allows the study of the interactions between a banking crisis and a currency crisis.

2.2.4.1 Unique Equilibrium

The existence of a unique equilibrium in the model -following the Global Game literature- is mainly the outcome of two assumptions. First, the assumption that there is a signaling structure about θ. Hence, the realization of θ will *not* be common knowledge, even if uncertainty about the fiscal fundamentals is marginally small ($\sigma \rightarrow 0$). Upon receiving her signal, each consumer can guess the value of θ, and the distribution of the signals reaching the other consumers, as well as their estimate of θ. However, each consumer cannot assume that the other consumers know what she knows and agree with her guesses. Unlike common knowledge, each consumer relies on her own information to form her beliefs. Moreover, it is worthwhile to highlight that *not only* it is possible to interpret this assumption as if each signal is private information available to each individual, *but also* that each agent's signal represents each agent's private opinion (e.g. slightly different interpretations) regarding information that could be common knowledge.

Second, an additional assumption in the production function is needed in order that a banking crisis in the model is *not* driven by a coordination failure among depositors [e.g. in the sense of Diamond and Dybvig (1983)] independent of devaluation expectations' considerations. In the model, there are two regions of the fiscal fundamentals where the depositors are going to have a dominant strategy. On the one hand, depositors will always wait until the long term when the level of fiscal

[15]The multiple equilibria scenarios are briefly analyzed in section 4.

fundamentals is below a level $\underline{\theta}$. The consumers foreign-currency payoff at t=2 will not be lower than 1 for $\theta \leq \underline{\theta}$. This is possible assuming a minimum value of Π^* given d.[16] For example, if $d = 0$ I assume that $\Pi^* \geq 2$. In this case, the only possibility that the consumer's foreign-currency payoff at t=2 might be lower than 1 is due to a devaluation (see figure 2.4). On the one hand, depositors will always run on the bank when the level of fiscal fundamentals is above a level $\overline{\theta}$, no matter what they believe other depositors are going to do. Independently of any agent's action, the size of the devaluation, taking into account only the effect of θ, will be big enough to produce a foreign-currency payoff at t=2 lower than 1.

Given the previous considerations and the model structure, the model satisfies the unique equilibrium strategy detailed in proposition 1.

Proposition 1: *The model has a unique equilibrium in which patient consumers do not run on the bank if they observe a signal below θ^* and run if they observe a signal above θ^*.*

Proof: See Chapter 2's appendix. I use Morris and Shin (2003, section 2.2) in order to prove the existence of unique equilibrium. The key idea of their proof is that observing θ_i gives no information to a depositor on her ranking within the population. Thus, she will have like a uniform belief over the proportion of players who will observe higher signals.

2.2.4.2 Determination of The Threshold Strategy

In this symetric global game context, each patient consumer (who receives a signal θ_i) would have a threshold strategy θ^* where she must be indifferent between running

[16] Other authors (e.g. Goldstein 2004) use a different set of simplification assumptions instead of fixed but high returns. First, they assume that the deposit contract promise a stochastic return in the long term, which is related with the noisy parameter of the model (e.g. θ in our model). Second, they assume that there exist a set of θ, which satisfies the unique equilibrium regions. My assumption is equivalent and easier to implement in the model. See also the uniform limit dominance lemma of the appendix

on the bank at t=1 -getting a payoff equal to 1 unit of foreign currency and using it at t=2- and waiting until the long-term and receiving the correspondent expected payoff of the investment project. Given that a patient depositor, observing the signal θ_i, puts density $\frac{1}{\sigma} f\left(\frac{\theta_i - \theta}{\sigma}\right)$ on state θ,[17] these facts yield that θ^* must satisfy the following zero-profit condition over θ:

$$\int_{-\infty}^{\infty} \left[\widehat{\pi}\left(n\left(\theta, \theta^*\right), \varepsilon\left(\theta, n\left(\theta, \theta^*\right)\right)\right) - 1\right] \frac{1}{\sigma} f\left(\frac{\theta^* - \theta}{\sigma}\right) d\theta = 0, \tag{2.13}$$

where $\widehat{\pi}(.)$ is the patient depositor's expected return of the project at t=2 as a function of the expected devaluation (ε) and the proportion of patient depositors running on the bank (n) which are a function of the fiscal fundamentals.[18] The fact that the depositor's strategy is to run on the bank at threshold signals below θ^* and not to run at threshold signals above θ^* is captured by $n\left(\theta, \theta^*\right)$ which shows the proportion of patient consumers that run on the bank at each level of θ. Moreover, a depositor knows that the probability that any particular depositor receives a signal above the threshold, in the state θ, is

$$prob\left(\theta_i \geqslant \theta^* \mid \theta\right) = 1 - F\left(\frac{\theta^* - \theta}{\sigma}\right) \tag{2.14}$$

Then, given that the noise terms $\{\eta_i\}$ are i.i.d. accross depositors, the proportion of patient depositors that will withdraw at t=1 is equal to

$$n\left(\theta, \theta^*\right) = 1 - F\left(\frac{\theta^* - \theta}{\sigma}\right) \tag{2.15}$$

Therefore, using equation (2.15) and changing the variable of integration of equation (2.13), an implicit definition of θ^* can be we obtained:

---

[17] Even though the uniform prior on the real line is improper, the conditional probabilities are well defined. See Hartigan (1983).

[18] Equation (2.12) shows that each consumer foreign currency payoff is a function of exogenous parameters -which are known by the agents- and the two endogenous model parameters n and ε which are also a function of θ.

$$\int_0^1 \left[\widehat{\pi}\left(n, \varepsilon\left(\theta^* + \sigma F^{-1}\left(1-n\right), n\right)\right) - 1\right] dn = 0 \tag{2.16}$$

2.2.5 Analysis of the Equilibrium under the Limit Uniqueness Case

This subsection shows simple comparative static exercises highlighting the links between a banking crisis and a currency crisis. The model emphasizes the impact of a banking crisis on the government decision when the fiscal fundamentals are in the intermediate government cut-off section.

These simple comparative exercises are possible under the limit uniqueness case when $\sigma \rightarrow 0$, and so $\theta_i \rightarrow \theta$.[19] I begin by individually analyzing the depositors and the government decision cut-off points under the limit uniqueness case, and then, they will be studied together.

2.2.5.1 Depositors' Decision Cut-Off Points

Figure 2.6 shows the range of fundamentals where there will be a banking crisis or not. Since $\theta_i \rightarrow \theta$, in equilibrium, only impatient consumers withdraw early if $\theta < \theta^*$. Thus, $n = 0$.[20] When $\theta \geq \theta^*$, all the depositors withdraw early, or, in other words, $n = 1$. It is worth highlighting that although the model has a unique equilibrium, when the fiscal fundamentals are neither $\theta \leq \underline{\theta}$ nor $\theta \geq \overline{\theta}$, it retains the self-fulfilling characteristics of a bank panic because individual depositors only withdraw because they expect others to do so. On the one hand, if the fiscal fundamentals are $\theta \geq \overline{\theta}$ there will be a banking crisis because the depositors will withdraw early and independently of the action of other depositors. The devaluation rate for $\theta \geq \overline{\theta}$ is big enough to

[19] It is worthwhile to highlight that the assumption of a uniform improper prior belief over θ is less necesary in the limit uniqueness case. The result can be use to identify the limiting behavior independently of the prior belief (Morris and Shin 2003). Nevertheless, a uniform prior over θ serves as a good approximation in generating the conditional beliefs of the agents when the signals received by the agents are very precise relative to the information contained in the prior (Corsetti et al 2003).

[20] When $\theta = \theta^*$ patients depositors are indiferent about whether to withdraw early or not. We are assuming that when $\theta = \theta^*$ all depositors withdraw early.

guarantee that the foreign currency return is less than one, independently of the number of early withdrawals. On the other hand, if the fiscal fundamentals are $\theta \leq \underline{\theta}$ there will be no banking crisis again independently of the action of other depositors.

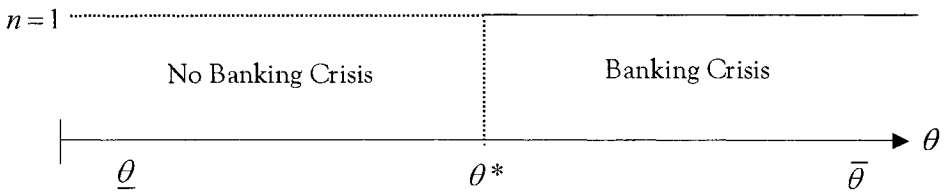

Figure 2.6. Unique Banking Game Equilibrium

The following two propositions study the impact on θ^* of changes in the project's tradable degree (ν) and the project's domestic-currency return Π^*. They show that the possibility of a banking crisis is higher the larger is ν or the smaller is Π^*.

Proposition 2: θ^* is decreasing in ν.

Proof: $\frac{\partial \widehat{\pi}(n,\theta)}{\partial \nu} = -\frac{\{1-\sqrt{[1-d(1-n)]n}\}\Pi^*}{(1-n)} \frac{\varepsilon}{e^{\nu\varepsilon+\ln E_0}} < 0$ if $\varepsilon > 0$ and only equal to zero when $\varepsilon = 0$. Therefore, the value of θ^* that satisfies equations (2.13) and (2.16) must be greater given an increase in ν. QED.

Proposition 3: θ^* is increasing in Π^*.[21]

Proof: $\frac{\partial \widehat{\pi}(n,\theta)}{\partial \Pi^*} = \frac{\{1-\sqrt{[1-d(1-n)]n}\}}{(1-n)e^{\nu\varepsilon+\ln E_0}} > 0$. Therefore, the value of θ^* that satisfies equations (2.13) and (2.16) must be smaller given an increase in Π^*. QED.

2.2.5.2 Government's Decision Cut-Off Points

Besides allowing simple comparative statics, the limit uniqueness case simplifies the analysis because it implies that all consumers will take into account, at the margin, the same θ when they build their expectations. Hence, it is easier to compute the

[21] As long as Π^* verifies the assumption for obtaining perfect strategic complementarities among the depositors. Lower values of Π^* outside our assumption will produce multiple equilibria. See section 4.2.

expectation of devaluation in the government decision cut-off points. The devaluation expectation ($\varepsilon_{\exp}$) is the average devaluation expectation estimated by the set of rational consumers given their knowledge of the problem and the incomplete information structure. At the margin, each individual has the same devaluation expectations.

By construction, each agents' $E(\theta|\theta_i) = \theta$. Additionally, each agent has $E[D(n)|\theta_i] = D$. Once each agent receives her very precise signal, at the margin, they expect that either all patient depositors will run or not [see equation (2.15) with $\sigma \rightarrow 0$]. Therefore, using the rational expectation criterion $E(\varepsilon) = \varepsilon_{\exp}$ on equation (2.4), equation (2.17) is obtained.

$$\varepsilon_{\exp} = \frac{\varphi}{\alpha}(\theta + D) \tag{2.17}$$

Plugging equation (2.17) into equations (2.7) and (2.8), the following constraints are obtained:

$$\theta > \frac{\alpha}{\alpha + \varphi^2} k \tag{2.18}$$

$$\theta > \frac{\alpha}{\alpha + \varphi^2} k - D \tag{2.19}$$

Using equations (2.18) and (2.19), the limits of the government decision cut-off points are showned in Figure 2.7.

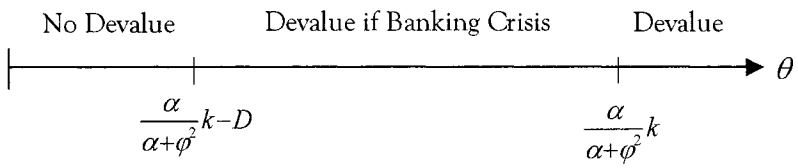

Figure 2.7. Government's Decision Cut-Off Points under Limit Uniqueness

Two important factors about the government decision cut-off points are studied in the following propositions. These propositions will be very useful in the next section when the cut-off points of the depositors and the government are combined.

Proposition 4: The higher is α or c, the higher is the value of the fiscal fundamentals needed to force a devaluation.

Proof: $\frac{\partial k}{\partial \alpha} = \frac{\partial\left(\frac{\sqrt{c}\sqrt{\alpha+\varphi^2}}{\varphi}\right)}{\partial \alpha} = \frac{\sqrt{c}}{2\varphi\sqrt{\alpha+\varphi^2}} > 0$, $\frac{\partial k}{\partial c} = \frac{\partial\left(\frac{\sqrt{c}\sqrt{\alpha+\varphi^2}}{\varphi}\right)}{\partial c} = \frac{\sqrt{\alpha+\varphi^2}}{2\varphi\sqrt{c}} > 0$, and $\frac{\partial\left(\frac{\alpha}{\alpha+\varphi^2}\right)}{\partial \alpha} = \frac{\varphi^2}{(\alpha+\varphi^2)^2} > 0$. Hence, the higher is α or c, more to the left is the intermediate government cut-off section.

Proposition 5: The higher is the government bailout, the higher is the exchange rate at t=1 if there is a devaluation.

Proof: By construction $\varepsilon = \ln(E_1) - \ln(E_0)$, hence $E_1 = e^{\varepsilon + \ln E_0}$. Thus, $\frac{\partial E_1}{\partial D} = \frac{\partial E_1}{\partial \varepsilon}\frac{\partial \varepsilon}{\partial D}$. Since $\frac{\partial E_1}{\partial \varepsilon} = e^{\varepsilon+\ln E_0} > 0$ and $\frac{\partial \varepsilon}{\partial D} = \frac{\varphi}{\alpha} > 0$, then $\frac{\partial E_1}{\partial D} > 0$.

2.2.5.3 Depositors And Government's Cut-Off Points Together

There are two possibilities where θ^* can be located in the government cut-off sections. The threshold strategy θ^* can be located in the intermediate government cut-off section or in the devaluation section. The threshold θ^* cannot be in the *non*-devaluation section because there is no possibility of devaluation in that subset of government fiscal fundamentals. The foreign currency consumers payoff on the project are bigger than 1.

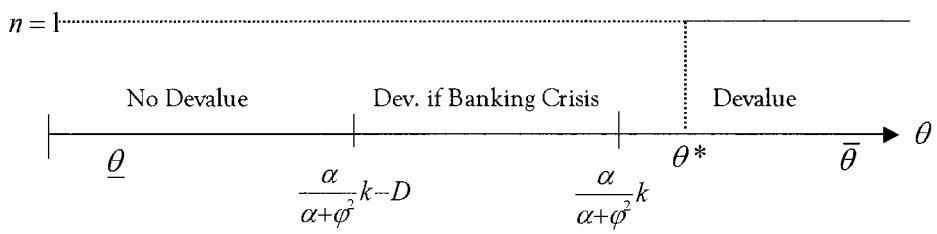

Figure 2.8. Government's Cut Off Sections and Banking Game

Figure 2.8 shows the case where θ^* is in the devaluation cut-off section of the government. In this case, the government will devalue independently of the existence of a banking crisis. If the fiscal fundamentals are to the right of θ^*, all depositors withdraw early ($n = 1$). In the opposite case, if the fiscal fundamentals are to the left of θ^*, only impatient depositors withdraw early ($n = 0$). The intermediate government cut-off section does not play any role in the outcome.[22] Although the devaluation rate will be bigger under a banking crisis due to the bailout cost (see Proposition 5), the currency crisis is not triggered by the bailout cost of a potential banking crisis.

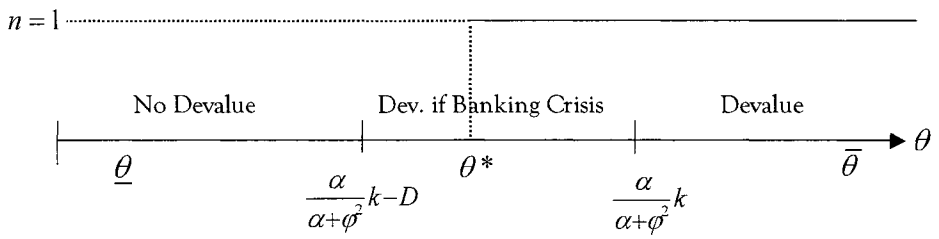

Figure 2.9. Government's Cut Off Sections and Banking Game (2nd Case)

Figure 2.9 shows the case where θ^* is in the government intermediate cut-off section. This case is more interesting since it can reflect the interaction between a currency crisis and a banking crisis. Here, the bailout cost of a banking crisis can trigger a currency crisis. If $\theta < \theta^*$ there is no banking crisis, and hence, there is no currency crisis. On the contrary, if $\theta \geq \theta^*$ there is a banking crisis. Thus, there is a currency crisis due to the fiscal bailout cost. The government does not have enough resources and/or the willingness to increase taxes or to reduce expenditures in order to be able to afford the bailout cost without devaluing the domestic currency.

[22]The size of the intermediate cut-off section depicted in the graph is done only for illustration purposes. The size of the region is endogenous, and only impatients depositors withdraw early when $\theta < \theta^*$.

Two factors can contribute to the setting of the threshold strategy in the intermediate government cut-off section. On the one hand, the lower is the strength of the banking sector, the lower is θ^*. The strength of the banking sector is captured in the model by the size of the returns of the banking sector (e.g. the size of Π^*) and the degree of project tradability (ν). Due to Propositions 2 and 3 it is known that the bigger is ν or the smaller is Π^*, the lower is θ^*. On the other hand, the value of α and c determine the position of the government intermediate cut-off section. From Proposition 4, it is known that the higher is α or c, the higher is the value of the fiscal fundamentals needed to force a devaluation. In other words, the higher is α or c, the more the intermediate government cut-off section moves to the right. The intuition behind those concepts is the following: Higher levels of c mean higher costs for abandoning the fixed exchange rate regime, therefore the worse must be the necessary fiscal fundamentals in order to prompt a currency crisis. The coefficient α in the government loss function [equation (2.1)] can be interpreted as an indicator of the government's fiscal responsibility in the following sense: the government is more likely to adjust taxes and/or expenditures in order to satisfy the budget constraint without having to exit the fixed exchange regime. Thus, the lower the value of α, the less fiscally responsible a government will be.

It is worthwhile to note that the level of fiscal fundamentals needed to achieve a currency crisis are lower (more solid) than in Sachs, Tornell and Velasco (1996a) model of currency crisis. The intermediate government cut-off section developed in this chapter is to the left of their first section where currency crises are possible (their section is between $\frac{\varphi}{\alpha+\varphi^2}k$ and k). Therefore, the model can explain currency crises in the presence of relatively better fundamentals. This is an important contribution if it is taken into account the fact that the fiscal fundamentals levels such as debt ratio

to GDP were considered acceptable for most economists before many currency crises (e.g. Mexico 1994, Argentina 2001).[23]

2.3 Implications For Fixed Exchange Rate Regimes

Although there is not a unique classification of exchange rate regimes, the literature generally divides fixed exchange rate regimes into two groups: soft pegs and hard pegs.[24] Under the soft pegs denomination, there are usually included target zone or band regimes, crawling pegs, basket pegs and adjustable pegs. Soft pegs are different to floating regimes because soft pegs have an explicit target around which the central bank intervenes. Hard pegs usually include currency boards, dollarization and monetary union regimes. The divisory line between soft pegs and hard pegs is that the latter regime goes beyond a declared policy to an institutional commitment that both constrains and enables monetary policy to be devoted to the sole goal of defending the exchange rate parity.

The objective of this section is to discuss how the model offers some explanations about currency crisis under not only soft pegs, but also two important hard pegs: currency boards and dollarization.[25] I will briefly analyze the different degrees of fiscal commitment, exit cost, currency mismatch exposure and reserve levels among fixed exchange regimes.

---

[23]For example, Paul Krugman wrote in the New York Times (07/18/2001): "...there's Argentina...We're talking about a government whose debt really isn't very large compared with the size of its national economy, and whose fairly modest budget deficit is entirely the product of an economic slump...".

[24]See Fischer (2001) and Frankel (2003).

[25]It is not possible to analize an unilateral abandoment of a currency union in this model framework because the model does not include supra-national government levels. Among other factors, it would be necesary to explicity include the existence of a supra-national fiscal system of transfers and emergency compensatory transfers. Nevertheless, it is worth to note that we can analize the possibility of a currency crisis for the currency area as a unit of government. For example, even though the Communauté Financière de l'Afrique (CFA) devalued against the French franc in 1994 after facing bad external shocks, they have retained their currency union among themselves.

2.3.1 Degree of Fiscal Responsibility

By definition, hard pegs have an institutional monetary commitment in defending the exchange rate parity. On the one hand, currency board rules prohibit the central bank or currency board authority from financing the government. On the other hand, dollarization leads to the loss of a domestic currency, and hence, the possibility of financing the government deficit through the central bank. Therefore, in general, it can be assumed that the degree of fiscal responsibility (α) is higher under hard pegs than under soft pegs. The government will be forced to adjust taxes and/or expenditures in order to satisfy the budget constraint without having to exit the hard peg regime. In terms of the model, the intermediate government cut-off section of hard pegs would be to the right of that of soft pegs. This case can be seen in figure 2.10.

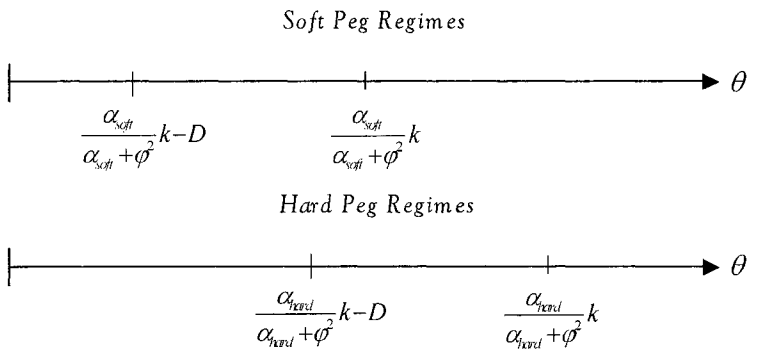

Figure 2.10. Degree of Fiscal Responsability within Soft and Hard Peg Regimes

Figure 2.10 shows not only that the level of fiscal fundamentals, keeping other factor constant, need to be worse under a soft peg than under a hard peg in order to detonate a currency crisis, but also that there might be currency crises under hard pegs. Two questions are immediately introduced. First, is a currency crisis possible

under currency boards? In the model notation, is $\alpha = \infty$ under currency boards?[26] Argentina's last crisis indicates that it is plausible to consider the probability of currency crises (or that $\alpha < \infty$) within currency boards.[27]

Second, is a currency crisis possible under dollarization? Although a dollarization process can be seen as a process of no return, it might be possible to re-introduce the national currency. As in the case of a currency board, the government might have to change some laws in order to re-introduce the national currency. However, an additional question is presented in this case: Will the people use the national currency again? Can the government generate seigniorage revenues from it? There is no contemporary answer to this question.[28] The only countries that have introduced new currencies in recent decades are countries that had abandoned other currencies in the aftermath of newly gained national independence (e.g. the countries of the former Soviet Unions). Moreover, these countries have almost always replaced a weak and inconvertible currency. A departure from dollarization would imply replacing a strong currency such as the US dollar or the Euro for a weaker currency. The main exception to replacing a strong currency by a weaker one is Slovakia after the breakup of the Czechoslovakia Republic in 1993. However, in the Slovakian case, the idea of currency as an expression of sovereignty might have played an important role. Is it possible to *re-introduce* a national currency without having sovereignty as an important support-

---

[26]It is worth to note than if $\alpha \rightarrow \infty$, neither the intermidiate government cut-off section nor the government devaluation section exist because $\lim_{\alpha\rightarrow\infty}\left[\frac{\alpha}{\alpha+\varphi^2}k\right] = \left[\lim_{\alpha\rightarrow\infty}\frac{\alpha}{\alpha+\varphi^2}\right]\left[\lim_{\alpha\rightarrow\infty}\left(\frac{\sqrt{c}\sqrt{\alpha+\varphi^2}}{\varphi}\right)\right] = \infty$.

[27]Within a currency board, α could be though of as a function not only of the executive branch trade off between printing money and adjusting the primary surplus, but also of the legislative branch. In this sense, it is reasonable to assume that there exists some level of α where the majority of the legislative branch will follow the executive initiative of changing the law. At some stage, the cost of raising taxes or decreasing expenditures could be politically and socially unfeasible for the government as a whole.

[28]There are 16 dollarized independent countries: Andorra, Kiribati, Liechtenstein, Ecuador, El Salvador, East Timor, Kosovo, Marshall Islands, Micronesia, Monaco, Nauru, Palau, Panama, San Marino, Tuvalu, and Vatican City.

ing argument? What happened in some Argentinean provinces during the last crisis can shed some light on this question. By law, the Argentinean states cannot issue currency. Nevertheless, months before the Argentinean abandonment of the currency board, several states under very difficult fiscal problems started to print bonds with the shape of a bill-note. Even if these quasi-currencies were worth less than the official domestic currency (e.g. 85% of the bond face value, which was denominated in the official domestic currency), they were accepted for most types of transactions. This experience shows that the people may start using a weaker currency during a crisis. Hence, it is very likely that a government could reintroduce the domestic currency when it decides to abandon an unilateral dollarization regime. Although it would be more difficult to re-introduce a national currency than to abandon a currency board, it is again reasonable to assume that $\alpha < \infty$.

2.3.2 Exit Cost

In the model, the exit cost (c) has been identified as the government's loss of credibility due to its devaluation of the domestic currency. The analysis of c among fixed exchange rate regimes is very similar to the degree of fiscal responsibility section. It is reasonable to assume that c is generally higher within currency board and dollarization regimes than under soft pegs. On the one hand, with the introduction of a currency board, the government surrenders the power of implementing a domestic monetary policy. The government almost directly imports the monetary policy of a foreign currency. On the other hand, the government can go a step further by implementing dollarization. It openly recognizes that it is not even convenient to have a national currency. How affected will the credibility of institutions be when the government abandons one of these hard pegs? The loss of credibility could be very high. The emerging economies that adopted currency boards and dollarization have usually failed when using more discretionary exchange rate regimes. The abandon-

ment of a hard peg shows that even importing credibility from foreign institutions is not a durable regime. As the government and the consumers recognize the hard peg's exit cost, it is expected that the fiscal fundamentals would have to be worse during a crisis within a currency board or a dollarization regime than under soft pegs, which do not have institutional commitments to defend the monetary regime. Figure 2.10 also illustrates these characteristics. The higher is c, the more to the right is the intermediate government cut-off section (i.e. recall Proposition 4).

2.3.3 Reserve Levels

The international reserves hold by the central bank are reflected also in θ. The higher the international reserves, the lower is θ. Which fixed exchange rate regime has more international reserves? There is no general answer to this question. By definition, a currency board must back the monetary base with international reserves. Although soft pegs do not require any reserve level by definition, there are countries that hold reserves in excess even of the monetary base (e.g. Chile, Mexico, etc.). Even dollarized countries such as Ecuador have some reserves, which are not designed to back an inexistent national currency but the banking system.

2.3.4 Currency Mismatch Exposure

After the Asian crisis, many authors argued that the level of currency mismatch is endogenous to the exchange rate regime. For example, Fischer (2001) argues that the belief that the exchange rate will not change removes the need to hedge, and reduces perceptions of the risk of borrowing in foreign currency. Burnside, Eichenbaum and Rebelo (2002) conjecture that domestic borrowers feel protected by an implicit guarantee of their foreign currency liabilities if they are made insolvent by a devaluation. This fact has important implications for the model. The higher is ν, the lower is the threshold strategy θ^*. In other words, there could be greater probability of a banking

crisis, and if a banking crisis does happen in the intermediate government cut-off section there will also be a currency crisis.[29]

Following these arguments, it is clear that there would be some type of currency mismatch not only in soft pegs but also in currency boards. Moreover, due to the institutional commitment, it is reasonable to think that the degree of currency mismatch would be higher under a currency board than under soft pegs. Nevertheless, the case of dollarization is not clear. Is there a currency mismatch under dollarization? The answer is not straightforward. All sectors in a dollarized economy do their transactions in foreign currency. Even the borrowers in the non-tradable sector earn foreign currency. Hence, in principle, there is no currency mismatch throughout the entire economy. Would this fact be true under any scenario? I have already argued that it would be possible to re-introduce the national currency or quasi-currencies when the government is facing fiscal difficulties. In this scenario, the non-tradable sector would end up receiving most of the new currency. Therefore, the currency mismatch would be clear once the government choose to abandon dollarization.

The fact that both currency board and dollarization might increase the degree of currency mismatch highlights the link between a banking crisis and a currency crisis. Although these two hard pegs can be seen as currency-crisis-proof, the degree of currency mismatch in the banking sector might trigger a currency crisis even without very bad fiscal fundamentals.

---

[29]It is worthwhile to remember that hard pegs, at the same time, through the increase of fiscal responsability and exit cost may increase the threshold strategy θ^*. The lower is the probability of devaluation, the higher is θ^* (i.e. the shift toward the right of the intermediate goverment cut-off section captures part of this phenomenon since θ^* cannot be in the non-devaluation section). Therefore, the final location of the threshold strategy θ^* under hard pegs is a function of the relative strengh of the increase in the currency mismatch and the lower probability of devaluation derived from the increase in α and c. Measuring these forces is out of the scope of this paper.

2.4 Multiple Equilibria

Finally, it is convenient to take into account what the consequences of multiple equilibria are. As it was depicted in Figure 1 (upper boxes), there are two ways of introducing multiple equilibria -the coordination failure equilibrium is the bad equilibrium of this set- within twin crises: either in the currency crisis side (through devaluation expectations) or in the banking crisis side (through banking panic runs).

2.4.1 Currency Crisis with Multiple Equilibria

The model predicts that a currency crisis will certainly happen to the right of the intermediate government cut-off section (i.e. to the right of $\frac{\varphi}{\alpha+\varphi^2}k$). Nevertheless, in Sachs, Tornell and Velasco (1996a), a currency crisis will not necessarily happen between $\frac{\varphi}{\alpha+\varphi^2}k$ and k (inside their multiple equilibria section). The assumption that the fiscal fundamentals were imperfectly perceived in the model is the main reason which explain this difference. This assumption does not allow agents' actions and beliefs to be perfectly coordinated in a way that invites multiplicity of equilibria. There is non-common knowledge.

Some policy implications can be extracted from such differences. How could the expectation of devaluation be equal to zero for a bigger level of fiscal fundamentals in the model? The devaluation expectations could be equal to zero until $k = \theta$ *if all* agents interpretations of θ are the same (e.g. there is a mechanism that coordinates agents' interpretations and expectations). This could be the case when all the agents believe in the credibility of the exchange rate regime. There would not be different interpretations regarding the value of θ. There would be no doubt about the level of net commitments. The level of debt services and, more important, the possibility of introducing new debt in the financial market are common knowledge. In other words, if all agents have coordinated interpretations about the fiscal fundamentals there is no-crisis not only in the former intermediate government cut-off section but also

between $\frac{\varphi}{\alpha+\varphi^2}k$ and k. The introduction of multiple equilibria does not significantly alter the logic of the model because the depositors' payoffs are still a function of the exchange rate. If all agents believe that there is no possibility of devaluation, there is no possibility of a banking crisis.

In general, I can speculate that hard pegs, especially dollarization, could benefit more than soft pegs from obtaining the good multiple equilibrium. Within a dollarization scenario, it is more difficult to think about devaluation when a national currency is not being used. Nevertheless, it can not be said whether or when a currency crisis will happen. Some changes in the economic environment might suddenly change agents' expectations and damage the "expectations' coordination mechanism". For example, the assassination of the Mexican president candidate or the introduction of the euro in the Argentinean currency board system played an important role in agents' expectations. These types of episodes can change devaluation expectations and the common knowledge status of some variables such as θ.

2.4.2 Banking Crisis with Multiple Equilibria

The banking crises in the model are driven by the risk of a devaluation on the depositors' payoffs because my objective is to study the circular links between banking crises and currency crises. In order to obtain a unique equilibrium in the banking game, I assumed that the domestic currency denominated return on the investing project was high enough. The strategic complementarities among depositors are driven by aggregate scale economies in the project and not by an early liquidation cost in the project. In other words, I assumed that the banking sector was solvent and liquid under a no-devaluation scenario. If the domestic currency denominated return of the project is below the assumed level or if there is an early liquidation cost in the project, the door is opened to having multiple equilibria in the banking sector in the sense of Diamond and Dybvig (1983). In this case, there could be a banking crisis

even in the no-devaluation section of the government.[30] A banking crisis does not trigger a currency crisis in this section. However, if the banking crisis happens when the fiscal fundamentals are in the intermediate government cut-off section, a banking crisis will trigger a currency crisis even without a currency mismatch throughout the economy. The currency crisis will be the outcome of a bad coordination equilibrium in the banking sector.

The possibility of multiple equilibria in the banking sector is usually used as a justification for the existence of a lender of last resort. In advanced economies, the monetary authority can issue liquidity to bail out the banking system but this extra liquidity is expected to be soaked up by open market operations in the near future, so that bank bailouts can stabilize the banking system with little if any inflationary consequences. In emerging economies, the scope for accommodation of a financial crisis by a central bank printing money alone is limited. The injection of liquidity into the banking system to keep it from defaulting on depositors may lead only to greater pressure on foreign reserves or the exchange rate.[31]

Hard pegs such as currency boards and dollarization do not have a lender of last resort by definition. Bailing out even an illiquid but solvent banking sector implies either using fiscal surpluses or issuing new debt or abandoning the hard peg. The option of bailing out through only fiscal surpluses is sometimes irrealistic due to the size of the bailouts. Since emerging countries do not always have the possibility of issuing new debt in difficult times, some authors [e.g. Jeanne and Wyplosz (2001)] have suggested the necessity of a international lender of last resort. This international lender of last resort would only intervene in illiquid but solvent banking sector sce-

---

[30] It will be necessary to impose more structure in our model in order to determine the exact size of the government cut-off sections. Recall that they are also a function of the devaluation expectations, which are a function of the expected bailout size. Nevertheless, even assuming that the probability of devaluation is one and the bailout cost is the maximum possible ($n = 1$) given d, there exists a non-devaluation section.

[31] See Calvo (2000) for more about the lender of last resort in emerging economies.

narios. The problem is not only potential agency problems between the international lender of last resort and the government - these two agencies might have different objectives, see Tirole (2000)- , but also how to identify the illiquid but solvent scenarios. A banking system can be solvent under the currency board rules but not in the post crisis scenario.

Although soft pegs can have the possibility of a central bank acting as a lender of last resort, this capability is limited even if the deposits are domestic currency denominated, and the analysis follows the one made for hard pegs.

2.5 Conclusions and Policy Implications

This chapter highlights an important circular relationship between a banking crisis and a currency crisis. This circular link is driven by the cost to the government budget of a banking sector bailout and the reaction of depositors to the potential impact of a devaluation on the banking sector balance sheet. The model captures the self-fulfilling characteristics of this circular relationship with the introduction of the intermediate-government-decision cut-off section. This section notably increases the possibility of a fixed exchange rate regime abandonment independently of the type of regime (soft pegs or hard pegs). In the model, a currency crisis is possible for a better level of fiscal fundamentals than in other models which do not take into account the interaction between a banking crisis and a currency crisis.

The analysis of the different models' parameters among fixed-exchange-rate regimes showed that currency board and dollarization regimes usually need worse fundamentals in order to explain a currency crisis because, keeping other factors constant, the degree of fiscal responsability and the exit cost are generally higher under these two regimes than under soft pegs. Nevertheless, currency board and dollarization regimes might increase the currency mismatch of the banking sector. Therefore, the model highlights how this phenomenon might raise the possibilities of twin crises due to

worse banking fundamentals. This result emphasizes the fact that including a banking crisis is some times essential in understanding a currency crisis under hard pegs which are sometimes considered to be currency-crisis-proof.

Some interesting *policy implications* can be derived from the model. First, the model highlights that a regulation that requires banks to match or hedge the exchange rate risk of their assets and their liabilities is not enough to avoid currency risk. The regulation should also consider the assets' characteristics (e.g. the exchange rate risk hold by borrowers). A domestic agent with a non-tradable project may default on a foreign-currency denominated debt on a devaluation scenario. The 1996 Basel Committee's "Amendment to the Capital Accord to Incorporate Market Risk" tries to capture this indirect exchange rate risk factor by using banks' own proprietary in-house models. However, this is probably not very effective under fixed exchange rate regimes (specially currency boards and dollarization) within emerging countries due to moral hazard factors. The banks know that the government might bailout them if their problems are caused by the government devaluation. A devaluation might hit all banks simultaneously. It could be very difficult (and costly) for a particular financial institution to avoid problems in a devaluation scenario. Hence, there are no individual incentives to avoid this type of systemic indirect exchange rate risk. Moreover, the government financial regulators might also find it difficult to address this problem without jeopardizing the credibility on the fixed exchange rate regime.

Second, a government should be extremely careful with measures that can alter the credibility of a fixed exchange rate regime. I have shown in the model how the credibility of a fixed exchange rate regime could be related with common knowledge about θ and devaluation expectations equal to zero for a longer range of parameters. Any government measure that could alter the information structure about θ can have very serious consequences. For example, the introduction of the Euro in the Argentine currency board in 2001 did not produce any benefit, but made evident to everybody

that there were some big problems within the currency board. This probably changed the agents' information structure.[32]

Third, the model highlights the important role of the supervision of the banking sector. The better the banking sector fundamentals, the lower the possibility of a twin banking-currency crises.

Fourth, the very limited (or null) scope for a lender of last resort within fixed exchange rate regimes increases the bailout effect in the government budget. Contingent international credit lines can be an option for financing partial bailouts of the financial system. The possibility to borrow internationally even during crises will improve fiscal government fundamentals, hence, it will decrease the probability of a fixed exchange rate abandonment.

Finally, the levels of fiscal fundamentals that are commonly considered safe for developed countries with access to international finance markets (e.g. the levels of public debt and deficit in the Maastricht Treaty) might be too high for developing countries, which have implemented fixed exchange rate regimes (specially hard pegs) and do not always have access to international finance markets.

[32]It is worthwhile to highlight that there are other episodes, which are outside government control, that could alter the agents' information structure. For example, a crisis in another country (even in a country without trade and financial links) could alert the financial agents and change their behavior. This change in the behavior of financial agents' is usually called 'contagion' in the literature.

CHAPTER 3

EMPIRICAL STUDY OF DEPOSITORS' BEHAVIOR

3.1 Introduction

Understanding the determinants of depositors' behavior is essential to understanding not only banking crises but also twin crises given the important interactions between currency and banking crises.

Although there is no generally accepted empirical definition of a banking crisis in the literature [see Caprio and Klingebiel (1996)], a banking crisis is usually associated with a generalized bank insolvency resulting from one of two main causes. On the one hand, banking sector insolvency might derive from poor banking lending decisions due to adverse selection or moral hazard problems. On the other hand, solvency crises can originate from a liquidity shock such as a bank run on deposits or a sharp decline in the ability of banks to borrow from abroad. Under liquidity problems, the banking system is forced either to liquidate assets early or to reduce the size of their loan portfolio by failing to renew credits, which will ultimately affect the quality of the banking-sector loan portfolio due to the effects on economic activity. Banking crises originating in poor banking lending decisions most often materialize after liquidity shocks, especially bank runs on deposits, since deposits are usually the main funding source for the banking system. This is the main source of the intrinsic relationship between banking crises and (systemic) bank runs.

The objective of this chapter is the empirical study of the determinants of depositors' behavior, focusing attention on two main issues. First, an empirical analysis is carried out in order to discover whether depositors' withdrawal decisions are, as

assumed in the theoretical model presented in chapter 2, a function of their devaluation expectations as well as the degree of currency mismatch, incorporated directly or indirectly (e.g. through currency mismatch among borrowers) in the banking-sector balance sheets. These two assumptions are very important because they can explain why depositors sometimes withdraw not only domestic currency denominated deposits but also foreign-currency denominated deposits when they are concerned about the continuity of a fixed-exchange rate regime. Second, attention is focused on one of the most common economic prescriptions for avoiding bank runs within fixed-exchange-rate regime economies: the (large) presence of foreign banks within the banking sector. The presence of foreign-owned banks is largely discussed in the literature [e.g. Fisher (2001), Peek and Rosengren (2000), etc.] as a way of mitigating the limited existence of a lender of last resort within fixed-exchange rate regimes. Foreign banks' access to their parent bank's capital and liquidity is sometime considered a strong enough factor to convince depositors to not withdraw their deposits from the banking sector. Depositors' behavior towards foreign banks will be reviewed during each bank-run episode. Moreover, the distinction between foreign-owned subsidiaries and foreign branches is also taken into account. In theory, foreign branches offer more protection than foreign-owned subsidiaries since a parent bank, in the case of foreign-owned subsidiaries, is under no legal obligation to honor their liabilities and its potential losses are limited to the capital invested and the costs of closing its operations.[1]

In order to analyze the determinants of depositors' behavior, the Argentinean banking sector during the period December 1994 - December 2001 is analyzed. I have chosen the Argentinean banking sector in that period for the following reasons: First, Argentina had a bi-monetary banking system under a currency board during the

[1] As was mentioned in Chapter 1, Chapter 4 offers a study of the difference between foreign branches and foreign-owned subsidiaries from the foreign banks points of view.

seven years of our sample. Depositors were able to choose between domestic currency (Peso) and US dollar denominated instruments. This is important because it will allow us to test depositors' reactions in two different currencies; therefore, any relative difference in the importance of devaluation expectations and currency mismatch factors in both currencies could be captured. Second, the Argentinean banking sector not only experienced two systemic bank runs during the sample period but also a number of other episodes where depositors changed the currency composition of their deposits (e.g. from pesos to dollar-denominated deposits). Third, it was possible to compile a rich Argentinean dataset which enabled us to accomplish our objective of studying the above mentioned important issues regarding depositors' behavioral decisions. The dataset includes monthly statistics (some series that are not publicly available) such as bank-level data, not only of each bank's balance sheet, but also of their loans performance classification.

Many empirical papers have studied depositors' reactions to weak banking fundamentals and some macroeconomic variables. While a large part of the literature has focused on the U.S. experience (e.g. Gorton 1988, Goldberg and Hudgins 1996, Calomiris and Mason 1994, etc), some others have studied bank runs in developing countries. More specifically, there are studies about the Argentinean banking sector, which concentrate on the analysis of the 1995 and 2001 systemic banking crises. In the first group, Schumacher (2000) and Martinez-Peria and Schmukler (2001) explore the 1995 crisis. Schumacher (2000) analyzes how deposits across banks are affected by each individual bank's probability of failure. She finds that the 1995 systemic bank run was an episode caused by informed depositors that were concerned with the ability of specific banks to survive during the crisis. Martinez-Peria and Schmukler (2001) studies the existence of market discipline (i.e. the ability of depositors to penalize banks for bad or risky performance by withdrawing their deposits or by requiring higher interest rates). They find that market discipline existed even among

small depositors. In the second group, Levy-Yeyati, Martinez-Peria and Schmukler (2004) is worthwhile to highlight. They find that market discipline is quite robust once systemic risks, such as currency risk and government default risk, are factored in during the 2001 crisis.

Nevertheless, there is no comprehensive study, either at the aggregate banking sector level or at a bank-data level, of the entire period Dec 1994 – Dec 2001 in Argentina. Furthermore, these papers (with the exception of the Levy-Yeyati et al 2004) do not analyze the importance of devaluation expectations in affecting the depositors' reactions in both peso and dollar-denominated deposits, nor do they include banking sector variables reflecting the degree of currency mismatch.

The study of the Argentinean banking sector suggests that devaluation expectations have been important for depositors when making their withdrawal decisions regarding both peso and dollar-denominated deposits. I found that high levels of devaluation expectations induce withdrawals of deposits in both currencies. On the contrary, moderate levels of devaluation expectations increase the amount of dollar-denominated deposits. During various episodes when devaluation expectations were not very high, depositors reacted to an increase in the level of devaluation expectations by switching from peso to dollar-denominated deposits.

Regarding currency mismatch exposure, evidence suggests the presence of a currency mismatch among borrowers since the tradable sector in the economy was not the only recipient of the dollar-denominated loans. These currency mismatch problems are even greater at the end of the period under study, when the tradable sector accounted, at most, for only 20 percent of the total dollar-denominated loans. Nevertheless, there is not conclusive evidence about the relationship between depositors' withdrawal decisions and the levels of currency mismatch exposure.

Finally, even after controlling for bank fundamentals and bank size, the evidence for a potential positive role for foreign banks in avoiding bank runs seems to be also

inconclusive in the Argentinean case. On the one hand, foreign banks, especially foreign branches, gained deposits during the first systemic bank run and in all bank runs on peso-denominated deposits. On the other hand, foreign branches are the type of banks which, proportionally, lost more deposits during the bank run on dollar-denominated deposits and during the last systemic bank run.

The structure of this chapter is as follows: the Argentinean currency board and banking sector during the period Dec 1994 - Dec 2001 are briefly described in the second section. The bank run episodes are also identified in the same section. A study of the relevance of devaluation expectations, and currency mismatch variables within the determinants of the depositors' behavior is performed in the third section. Section 4, offers the individual study of the different bank-runs episodes and the depositors' attitudes towards foreign banks. The last section of this chapter contains the conclusions.

3.2 Argentina During Dec 1994 – Dec 2001

3.2.1 The Currency Board

The currency board was introduced in April 1991, with the purpose of putting an end to an era of hyperinflation and government fiscal mismanagement. It established the full convertibility of the domestic currency into US dollars and it legally precluded the creation of pesos not backed by international reserves, except within a very limited range.[2]

The currency board not only achieved a very successful price stabilization but also become an institutional axis that gave incentives for important transformations in fiscal government procedures and in the regulation of the banking sector and labor markets.

[2]Only up to 20% of the international reserves could be constituted by public-traded dollar-denominated Argentinean government securities, which should be valued at market prices.

The currency board was officially abandoned at the beginning of 2002, after a long systemic bank run and following political turmoil. This bank run lead to the imposition of limits on cash withdrawals from bank accounts in December 2001 and the consequent disruption of the payment system.

3.2.2 The Argentinean Banking System

The Argentinean banking sector has undergone numerous transformations not only in the number of institutions but also in the relative market share of the private and public sector. As can be observed in Table 3.1, the total number of institutions has decreased by about half, from 166 to 84 institutions during a 7 year time period. The decrease in the number of private domestic institutions (especially cooperative banks) as well as the decrease in the number of public institutions explains the substantial drop in the total number of banks.[3] On the other side, the number of foreign-owned institutions has increased from 32 banks in December 1994 to 38 banks in December 2001. This increase is mainly due to the rise in the number of foreign-owned subsidiaries. The number of foreign branches has remained approximately constant during the period. Regarding assets participation, Table 3.1 shows a substantial increase in foreign banks, which controlled approximately one half of the total banking system assets in the last years of the sample.

Most of the changes and reforms experienced by the banking sector happened after the 1995 banking crisis. The improvement in regulation and the subsequent reforms resulted in Argentina, by late 1998, being ranked second (after Singapore, tied with Hong Kong, and ahead of Chile) in terms of the quality of its regulatory environment, according to the CAMELOT rating system developed by the World Bank.[4]

---

[3]There were 38 cooperative banks in December of 1994 and only 2 in December 2001. The greater contraction in the number of cooperative banks happened after the 1995 banking crises. At the end of December of 1995, there were only 10 cooperative banks.

[4]The CAMELOT index combines rankings for different elements: (C) for capital requirements; (A) for loan-loss provisioning and definition of non-performing loans; (M) for management as mea-

3.2.3 Bank Runs during Dec 1994 - Dec 2001

This chapter focuses on the study of time deposits made by residents in the country that do not belong to the public and financial sector. These time deposits have a minimum deposit duration of a month.[5] This alternative was chosen because it will capture depositors' expectations better than including checking and saving deposits which have more seasonal components given their frequent use in transactions.[6] Moreover, by considering time-deposits only, each depositor takes a decision whether or not to withdraw their deposit in every period of this monthly study.

The month of December 2001 is not included in the analysis because the Argentinean Central Bank imposed limits on cash withdrawals from bank accounts at the beginning of that month. Hence, withdrawals in this month will not totally reflect the depositors' wishes.

Table 3.2 presents the different bank-run episodes. Eight bank-run episodes have been identified, two of which have systemic bank-run characteristics. A systemic bank run is defined as an episode in which there is an important fall in the total amount of deposits (more than one standard deviation) together with simultaneous bank runs in both peso and dollar-denominated deposits. A peso-deposit (dollar-deposit) bank run is defined as a period in which the percentage change in peso-denominated (dollar-denominated) deposits drops more than a standard deviation of the monthly series measuring the percentage change in peso-denominated (dollar-denominated) deposit.[7]

---

sured by high-quality foreign bank presence; (L) liquidity; (O) for operating environment as measured by definition and enforcement of property and creditor rights and (T) for transparency as measured by banks being rated by international agencies and by an index of corruption. See The World Bank 'Argentina. Financial Sector Review'; Report 17864-AR; September 28, 1998.

[5]Most of the deposits were for about 30 to 35 days.

[6]It is also worthwhile to highlight that checking and saving deposits do not have as high level of dollarization as time deposits. The reason is that in Argentina case, at a difference with other Latin American countries, the US dollar is not use as a unit of transaction [IDB (2005)].

[7]More specifically, a peso-deposit bank run is defined as a period in which the percentage change in peso-denominated deposits drops more than 5.22 points. A dollar-deposit bank run is defined as a period when the percentage change in dollar- denominated deposits drops more than 2.78 points.

During the two systemic bank runs, Table 3.2 shows that the decrease in total deposits was about 20 percent, with a similar increase in the dollarization of deposits. The picture is dramatically different during peso-deposit bank runs. Only during the Aug 98 – Sep 98 peso-deposit bank run was there a decline in the total level of deposits, and it was less than one percent. A bank run of particular note occurred prior to January 2000. This was a dollar-deposit bank run and not a peso-deposit bank run. The decrease in peso deposits was about 1.6 percent. In contrast the drop in dollar deposits was 3.6 percent. Depositors' fears about the Y2K affect on the banking sector were mostly translated into a dollar-deposit bank run. Further description and more details about each bank run episode can be found in the appendix.

3.3 Devaluation Expectations and Currency Mismatch Exposure

This section analyzes whether or not devaluation expectations and currency mismatch were factors taken into account by depositors when they decided whether or not to withdraw their money from the banking sector. Since the nature of the question involves the banking sector as a unit, as in the model of chapter 2, aggregate level data is used.

3.3.1 Variables

The variables used to measure devaluation expectations and currency mismatch are:

Devaluation expectations:

A systemic bank run is defined as a period in which the total percentage change in total deposits drops more than 2.95 points and there is a simultaneous bank run in peso and dollar denominated deposits.

The most suitable variable to measure the depositors' devaluation expectations is the difference between peso and dollar deposit interest rates.[8] More specifically, I use the difference between monthly weighted average interest rates on peso and dollar denominated time deposits at a 30 to 35-day term. Figure 3.1 displays the behavior of devaluation expectations together with the monthly change in peso and dollar-denominated deposits.

Currency Mismatch Exposure:

The main purpose of this variable is to capture the currency mismatch measurement included in the model developed in chapter 2.[9] Currency mismatch in the model explained the rationality of withdrawing dollar-denominated deposits. Depositors fearing a devaluation could withdraw even dollar-denominated deposits if a devaluation could affect the banks' balance sheets through the existence of a currency mismatch. There are two types of currency mismatch: currency mismatch within the banking sector's balance sheet or currency mismatch among the borrowers.

On the one hand, the currency mismatch within the banking sector' balance sheet refers to the potential difference between the amount of dollar-denominated deposits and dollar-denominated loans. There was no currency mismatch within the banking sector at an aggregate level in the Argentinean banking sector during the period under study. Dollar denominated liabilities represented, on average, 90 percent of the banking-sector's dollar-denominated assets. At bank-level and across time, only around 18 percent of the 9441 observations show dollar denominated liabilities greater

---

[8] Another very interesting measure of devaluation expectations is the measurement obtained from the exchange rate contained in the 12-month forward contracts (NFD) relative to the spot exchange rate. Nevertheless, we could not use this measurement because data about forward contracts are available only for the last years of our sample.

[9] As it was presented in Chapter 2, equation (2.12), a devaluation will affect the foreign-currency denomination of the project's payoff not only as a function of the change in the nominal exchange rate but also as a function of the currency mismatch or the project's tradable degree (ν)".

than dollar-denominated assets. Moreover, in most of these cases the currency mismatch levels were lower than 10 percent.

On the other hand, the currency mismatch among borrowers refers to the dollar-denominated loans given to the non-tradable sector. The non-tradable sector, with peso-denominated inflows, will have difficulty repaying dollar-denominated loans in a devaluation scenario. Although, given the data available, it is impossible to capture the exact amount of the dollar denominated loans to the non-tradable sector, it is reasonable to assume that all loans absorbed by the tradable sector are denominated in dollars, with the remaining dollar loans being picked up by the non-tradable sector. This measure offers an idea of the minimum level of currency mismatch. Figure 3.2 shows this estimation. The level of currency mismatch in the banking sector is above 50 percent and it has notably increased during the last years.

Given that the distribution of loans across the different sectors in the Argentinean economy is available only quarterly, two reasonable approximations for the level of currency mismatch are used. First, using bank-level data, the total dollar-denominated loans given as mortgages, car loans, personal loans, credit car loans as well as dollar-denominated loans given to the public and financial sector is estimated. This amount divided by the dollar-denominated loans is called "Currency Mismatch Exposure A" variable.[10] Second, following Levi-Yeyati et al (2004), the ratio of dollar loans over bank capital is used and it is called "Currency Mismatch Exposure B". This latter measurement is an indirect indicator of currency mismatch. It gives an idea about the proportion of dollar-denominated debt which could be covered by bank capital if they turned non-performing.

[10]The total amount of dollar-denominated loans, which was used in the denominator of the variable "Currency Mismatch Exposure A", is the gross amount of dollar-denominated loans without discounting banks provisions and other considerations. Desegregated data about banks' provisions (e.g. the amount that banks write off from their assets given that they assign very low probability of recovering the loans)was not available by type of loans.

At an aggregate level, the variable "Currency Mismatch Exposure A" started slightly below 50 percent and it increased at the end of the period when the government debt with the banking sector increased. The aggregate banking sector mean for this variable is 55 percent with a standard deviation of 7 percent. Figure 3.3 displays the behavior over time of this currency mismatch variable together with the change in both peso and dollar-denominated deposits. It is worthwhile to highlight that the currency mismatch series does not have much time series variation. In the bank-level data there is a lot of heterogeneity, with some banks having 100 percent currency mismatch exposure and others without any currency mismatch exposure. At an aggregate level, although the variable "Currency Mismatch Exposure B" is less smooth than the alternative variable "A", it also has an upward trend and it does not display significant time series variation. The aggregate banking sector mean for "Currency Mismatch Exposure B" is 285 percent with a standard deviation of 29 percent. Figure 3.4 displays the behavior over time of the Currency Mismatch Exposure B variable over time. At bank-level data, there also is a lot of heterogeneity, with some banks' ratios above 500 percent and others with ratios close to zero.

3.3.2 Empirical Methodology

The basic regression model used during the analysis is:

$$\begin{aligned} \triangle \log Deposits_t &= \alpha + \beta_1 CurrencyMismatch_{t-2} + \\ &+ \beta_2 D\,\text{eval}\,uationExpect_t + \gamma_1 t + \gamma_2 t^2 + \varepsilon_t \end{aligned} \tag{3.1}$$

Given that balance sheets, income statements, and a detailed description of loan quality for each bank were released monthly with a lag of approximately two months, two lags in the currency mismatch exposure variable is used.[11] Also, a quadratic trend

[11] It is also worthwhile to highlight that the lag structure also help to reduce any potential endogeneity problems.

is included in the regressions in order to control for factors that can be explained by a simple trend.

3.3.3 Results

Models 1 and 3 in both Tables 3.3 and 3.4 show that devaluation expectations are significant and with the negative expected sign in both peso and dollar deposit regressions. The higher are the devaluation expectations, the higher is the drop in peso and dollar-denominated deposits.[12] The results obtained with the currency mismatch variables are not as clear as with devaluation expectations. The "Currency Mismatch Exposure A" variable sometimes has the expected negative coefficient but is not significant in either peso or dollar deposit regressions. Using "Currency Mismatch Exposure B" variable the results are similar, they are not reported here for reasons of brevity.[13]

Visual inspection of Figures 3.1, 3.3 and 3.4 shows the same results found in the regression study. Devaluation expectations appear to have an important role in explaining the evolution of both peso and dollar-denominated deposits, and this appears not to be the case with the currency mismatch exposure variables. Nevertheless, a more detailed analysis of Figure 3.1 shows that the negative relationship between devaluation expectations and the percentage change in both peso and dollar-denominated deposits holds very well for high levels of devaluation expectations, but not always for low levels of devaluation expectations. This point can be easily observed in Figures

[12]It is worthwhile to highlight that in models 1 and 3, as it was assumed in the theoretical model of chapter 2, a one percent increase in devaluation expectations causes a larger decrease in peso deposits than in dollar-denominated deposits. This is consistent with the Chapter 2 model implication that a devaluation will have a bigger effect on peso deposits because it will affect the real value of the depositors' savings not only indirectly through a potential currency mismatch within the banks balance sheets, but also directly in terms of dollars.

[13]The devaluation expectations results are robust to the introduction of variables such as country risk, government fiscal surplus, non-performing loans and other bank fundamentals variables (see variable list in the second appendix). On the contrary, both currency mismatch exposure measurements are not different from zero once we include those variables in the regressions. The same conclusions are obtained in the robust regressions with or without the trend. The trend only affects the significance level of the currency mismatch variables in the basic models.

3.5 and 3.6. Figure 3.5, which displays the scatter-plot of the percentage change of peso-denominated deposits and the level of devaluation expectations, does not show a negative trend for low values of devaluation expectations. More interestingly, Figure 3.6, which instead takes into account the percentage change of dollar-denominated deposits, seems to have a positive trend for low levels of devaluation expectations.

With the purpose of taking into account this non-linearity, Models 4 in tables 3.3 and 3.4 allow more flexibility in the effect of devaluation expectations at different levels. An interaction variable called "High Expectations" is introduced. This variable is the result of a dummy variable, equal to one when devaluation expectations are higher than 2.5 percent, times devaluation expectations.[14] This variable shows that low levels of devaluation expectations are not necessarily correlated with deposit withdrawals. When the interaction variable is used in peso-deposit regressions, the coefficient of devaluation expectations is not statistically different from zero. This is the result of different episodes that can be observed in Figures 3.1 and 3.5. On the one hand, there are episodes such as the peso-deposit bank runs in Jun 1996-Aug 1996 and Oct 1997-Nov1997 when higher levels of devaluation expectations, but still below the 2.5 percent level, coincide with drops in peso-denominated deposits. For example, on the other hand, there are totally different circumstances such as the Brazilian crisis in January 1999. At that time, there was a peak in devaluation expectations (also below the 2.5 percent level) which was associated with an increase in peso-denominated deposits. According to news reports from that time, depositors took advantage of the volatility and higher nominal interest rates in peso and dollar-denominated deposits.[15]

---

[14]The sample average for devaluation expectations is 2.41, hence, we decided to use 2.5 as the cutoff point. The results obtain are robust to changes in the cutoff point for values above and below the sample average.

[15]On 21/01/1999, the newspaper La Nacion, in the article called "Una Crisis que no Pego en la City Porteña" (A crisis that was not felt in the Buenos Aires banking sector), quoted a banking

On the contrary, in the dollar-denominated deposit regressions, at low levels of devaluation expectations, an increase in devaluation expectations seems to increase the level of dollar deposits. In this case, the coefficient of devaluation expectations is positive and significant. This can be supported not only by circumstances such as the Brazilian crisis in January 1999, but also by the fact that depositors often switched to dollar-denominated deposits from peso-denominated deposits when they had some doubts, but not overwhelming ones about the continuity of the currency board. The peso-deposit bank runs identified in Table 3.2 are clear evidence of such circumstances.

The negative sign and significance of the variable "high devaluation expectations" shows the link between high devaluation expectation and deposit withdrawals. In both peso and dollar-denominated deposits, at high levels of devaluation expectations, an increase in the level of devaluation expectations induces a decrease in both peso and dollar-denominated deposits.[16]

Finally, another factor that needs to be taken into account is the interaction between devaluation expectations and currency mismatch. In the model of Chapter 2, high levels of devaluation expectations combined with insignificant levels of currency mismatch do not compromise banks' solvency. Hence, it is the interaction between devaluation expectations and currency mismatch exposure that matters in depositors' withdrawal decisions. Models 5 in both tables 3.3 and 3.4 introduce this interaction between devaluation expectations and currency mismatch through the use of interaction terms between these two variables. While, unexpectedly, in both peso and

---

analyst saying that "Investors have learnt from the past and they know that uncertainty, during the currency board, means an increase in interest rates which they should be use to make profits".

[16] It is worthwhile to note that the coefficients of the interaction variables are greater than the coefficients of the devaluation expectation variable. Hence, the partial effect of an increase in devaluation expectations has a negative impact in both peso and dollar-denominated deposits. Additionally, it is also worthwhile to highlight that the p values of the F joint tests of the interaction variable and devaluation expectation variable are all significant at the 1 percent level.

dollar-deposit regressions, the interaction terms have positive signs, the coefficients are small and they do not sustantially modify the effect of devaluation expectations.[17]

3.4 Bank-Run Episodes and Foreign Banks.

Depositors' decisions are limited not only to deciding whether or not to maintain their deposits within the banking sector, they also have to decide in which bank to deposit their savings. Banks are not necessarily homogeneous. Banks not only have different balance sheet indicators and portfolio quality levels but also they have different owners.

This section focuses on one of the most common economic prescriptions for avoiding bank runs in fixed-exchange-rate economies: the presence of foreign banks within the banking sector. First, the bank-run episodes are reviewed by grouping the banks according to their owners' type. Second, a bank-level analysis using different measures of solvency, liquidity, portfolio quality and currency mismatch as well as controlling by their owner's type is performed.

3.4.1 Controlling By Ownership Group

Figure 3.7 shows the percentage change in peso-denominated, dollar-denominated and total bank deposits grouped by their type of owner.[18] It is clear that foreign-owned banks, and especially foreign branches, have gained both peso and dollar-denominated deposits during many bank-run episodes. The only exceptions are the last two bank-run episodes. The increase in both peso and dollar-denominated de-

[17] The partial effect of an increase in devaluation expectations has a negative impact on both peso and dollar-denominated deposits, for all possible values of the "Currency Mismatch Exposure A" variable (e.g. from 46.93 to 69.98). This is not the case for the partial effect of an increase in "Currency Mismatch Exposure variable A".

[18] The figures presented in figure 7 are corrected from mergers and acquisitions among banks belonging to different ownership groups during each bank run episode. For example, during the Aug 1998 – Sep 1998 peso-deposit bank run, we do not take into account the deposits of BankBoston (a foreign branch) which acquired, in Aug 1998, a subsidiary belonging to Deutsche Bank.

posits in foreign branches during the Dec 94-Apr 95 systemic bank run, while all other types of banks were losing deposits, looks very striking.

These favorable attitudes towards foreign banks that depositors had during most bank runs, coincides with the views and policy recommendations of many economists regarding the benefits of the presence of major foreign banks within the banking sector. A traditional advantage, mentioned in the literature [e.g. Fischer (2001), Peek and Rosengren (2000), etc.], of the presence of major foreign banks is their potential role in avoiding bank runs. Foreign banks' access to their parent bank's capital and liquidity is sometimes considered a strong enough factor to convince depositors not to withdraw their deposits from the banking sector.[19]

Moreover, the more favorable attitudes of depositors towards foreign branches rather than foreign subsidiaries also support an interesting legal difference between foreign-owned subsidiaries and foreign branches. In most countries (including Argentina), branches are not legally separate entities from their parents and parent banks are responsible for the liabilities of the branches, if the latter cannot meet their obligations with their assets or if capital injections are required.[20] In contrast, subsidiaries are stand-alone entities, separate from the parent, so that the parent bank is under no legal obligation to honor their liabilities and its potential losses are limited to the capital invested and the costs of closing the operations. Argentinean depositors seem to have recognized this legal difference during all but the last two bank-run episodes.

---

[19]Other reasons why foreign banks are usually perceived to be safer than domestic institutions are the volume and diversification of their operations and because they are subject to double supervision (e.g. Host and Home country of the foreign bank).

[20]There is only one exception that could limit the exposure of parent banks from their overseas branches. This exception is usually called ring fencing provisions. Such provisions generally establish that parent banks are not required to repay the obligations of a foreign branch if the branch faces repayment problems due to extreme circumstances such as war or civil conflict and due to certain actions by the host government (e.g., exchange controls, expropriations, etc.). We are going to study further the importance of such provisions in the next chapter.

Nevertheless, before trying to analyze further the different depositors' attitudes during the last two bank-run episodes, a further bank-level analysis is needed. Depositors' attitudes towards foreign banks, and in particular towards foreign branches, may have been the consequence of differences in bank fundamentals and not of differences in types of owners. Some authors have found differences in bank fundamentals between foreign and domestic banks in developing countries. For example, Claessens et al (2000) find that foreign banks have higher profits than domestic banks.

3.4.2 Controlling By Bank-Level Characteristics and Ownership

In order to compare deposit behavior across banks during each bank-run episode, the following cross-section regression model is used for each bank-run episode:

$$\triangle \log Deposits_j = \alpha + \beta_1 OwershipDummies_j + \beta_2 AvgBankFundamentals_j + \varepsilon_j \quad (3.2)$$

where $\triangle \log Deposits_j$ is the percentage change in the deposits of bank j during the bank-run episode; $OwnershipDummies$ are dummies controlling for the different types of owners (domestic private banks is the dummy omitted in the regression), and the $AvgBankFundundamentals$ are the mean values of the bank fundamentals known (two lags) by depositors during the bank-run episode. $AvgBankFundundamentals$ variables are included only in the regressions called robust.[21] The total number of banks used in each bank-run episode is also corrected for the presence of mergers and acquisitions. It is worthwhile to highlight that only bank specific variables are included in these estimations because fiscal and devaluation expectations variables vary only over time and not across individuals.

Given that small banks, in terms of deposits, have greater variance in the percentage change of their deposits during a bank-run episode (e.g. small increases and

[21] Besides the bank-level fundamentals describe in the second appendix, we also include the logarithm of bank assets in the robust regressions. If larger banks are perceived as being more solid, we expect this variable to positively affect the change in bank deposits.

decreases in the amount of deposits, relative to the banking sector deposits, produce a large percentage change in their deposits), I do not use ordinary least squares but weighted least squares. The weight used is the average total amount of deposit in each bank during each bank run. In this sense, this procedure not only reduces a known source of heteroscedasticity, but also it increases the weight of banks with a high level of deposits. The analysis in the previous subsection and in Figure 3.7 is mostly driven by banks with high level of deposits.

The regression results are reported in Table 3.5 for the systemic bank runs and in Table 3.6 for the other bank runs.[22] In these tables, although the significance of the ownership dummies decreases, as expected, after controlling for differences in bank fundamentals and bank size, some ownership dummies are still significant in the robust regressions. Moreover, the signs of the coefficients seem to agree with the analysis performed using Figure 3.7 even after controlling by banks' fundamentals. For example, on the one hand, foreign branches seem to have been considered safer (i.e. in the sense that there is an increase in the level of deposits during the bank runs) relative to private domestic banks, which are the omitted group, during the first systemic bank run in dollar-denominated deposits. On the other hand, foreign branches suffered greater withdrawals during the last systemic bank run in dollar-denominated deposits.

The fact that deposits in foreign banks, especially in foreign branches, exhibit such different behavior during the last systemic bank run is very interesting and at the

[22] Table 6 has a more reduce format (only the robust models) than one used in Table 5 in order to achive a more concise exposition. In the same sense, the presentation of both Table 5 and 6 omit to report the bank fundamentals and bank size variables in the robust regressions because they are many times no significant (including currency mismatch exposure variables) and they are not the main purpose of this section. In general, there is no clear evidence of market discipline (i.e. evidence that depositors are reallocating their deposit funds from weak to strong banks) in our cross-section regressions even during the systemic bank runs. The reason why our study, as difference of Schumacher (2000), Martinez-Peria and Schmukler (2001) and Levi-Yeyati et al (2004), does not find the existence of market discipline is probably due to the fact that we are using the average values of bank fundamentals during each bank-run episode.

same time puzzling. Without explaining the origin of this different behavior, some authors such as Edwards (2002) and Frankel (2003) have used this evidence to support the idea that even a banking system dominated by major foreign banks may still be subject to a run on deposits. Although I do not have a definite answer capable of explaining this recent attitude of depositors towards foreign banks, especially foreign branches, two important points should be highlighted. First, foreign banks had a smaller share of total banking sector assets and deposits during the first bank runs than during the last systemic bank run. Hence, during the first bank runs, more depositors who wanted to remain in the banking sector may have switched from other bank types to foreign banks in order to take advantage of the foreign banks' access to their parent bank's capital and liquidity than during the last systemic bank run. This fact can contribute to diminishing the apparent difference in depositors' attitudes towards foreign banks between the first and last systemic bank runs, but it cannot explain why depositors withdrew proportionally more deposits from foreign branches than from other types of banks during the last systemic bank run. Second, and probably more importantly, the increasing fears of a major devaluation which was going to lead to many bank failures, and consequently, an increase in the possibility of government intervention with measures such as deposit confiscation, could have played a role during the last systemic bank run.[23] This case could have especially damaged the depositors' attitude towards foreign branches because they are usually protected by ring fencing provisions. Such provisions generally establish that parent banks are not required to repay the obligations of a foreign branch if the branch faces repayment problems due to extreme circumstances such as war or civil conflict and due to certain actions by the host government (e.g. exchange controls, expropriations, etc.).

[23] Many depositors probably remembered the action of the government during a bank run in 1989. The government compulsory exchanged government bonds for bank deposits.

3.5 Conclusions

In this chapter, I have uncovered evidence that supports, in general, the chapter 2 assumption regarding the importance of devaluation expectations in determining depositors' withdrawal decisions. More specifically, there is evidence that high levels of devaluation expectations induce withdrawals of both peso and dollar-denominated deposits. Also, there is evidence that moderate levels of devaluation expectations may cause increases in the amount of dollar-denominated deposits. This last finding implies that the analysis in chapter 2 is only valid for high levels of devaluation expectations in a banking sector in which both peso and dollar-denominated deposits are allowed. Nevertheless, this fact does not limit the objective of the model presented in chapter 2 (i.e. the study of twin crises) because banking crises are related to systemic bank-run periods in which there were high levels of devaluation expectations.

On the topic of currency mismatch exposure, the existence of considerable currency mismatch within the Argentinean banking sector has been established. However, there is no conclusive evidence, neither at the aggregate nor at bank-level data, regarding the response of depositors to different degrees of currency mismatch exposure. At the aggregate level, the aggregate currency mismatch series do not have the power of statistically resolving the question due to their lack of time variation. At the bank-level, the failure to find significant results, in contrast to Levy-Yeyati et al (2004), could be originated by the use of bank fundamentals' averages during each bank-run episode. Additionally, two different explanations are possible. First, I did not capture the actual variable of currency mismatch that depositors are reacting to. Second, depositors may respond to devaluation expectations since they could be discounting the effect of a devaluation on banks' balance sheets whatever is the precise degree of currency mismatch (i.e. in this case I am implicitly assuming that depositors know the existence of a positive and significant level of currency mismatch). The

latter seems more plausible given how difficult it is to get an approximation of the currency mismatch among borrowers in the non-tradable sector.

The existence of dollar-denominated deposits introduces a new degree of consideration into the regulatory aspects of a banking system. If governments allow dollar-denominated deposits, depositors seem to be more willing to stay within the banking sector when the devaluation expectations are moderate. Nevertheless, allowing dollar-denominated deposits may increase the currency mismatch problems since banks may have to increase the proportion of dollar-denominated loans. In this sense, the documented presence of currency mismatch among borrowers in the non-tradable Argentinean sector suggests that governments in fixed-exchange-rate economies should introduce tougher loan classification criteria and higher loan-loss provisioning rules for loans to the non-tradable sector in order to internalize their risk within banks' balance sheets.

Finally, I find evidence of depositors' attitudes towards foreign banks that cannot be fully explained by differences in either bank fundamentals or size. Additionally, there is no conclusive evidence about the sign of these depositors' attitudes, and, hence, no definite support regarding one of the most common prescriptions in order to avoid bank runs in fixed-exchange-rate economies. In the study of the Argentinean banking sector for the period December 1994 – December 2001, there were both favorable and non-favorable depositors' attitudes towards foreign banks even after controlling for banks' fundamentals and size.

Figure 3.1. Devaluation Expectations and Percentage Change in Peso and Dollar Denominated Deposits

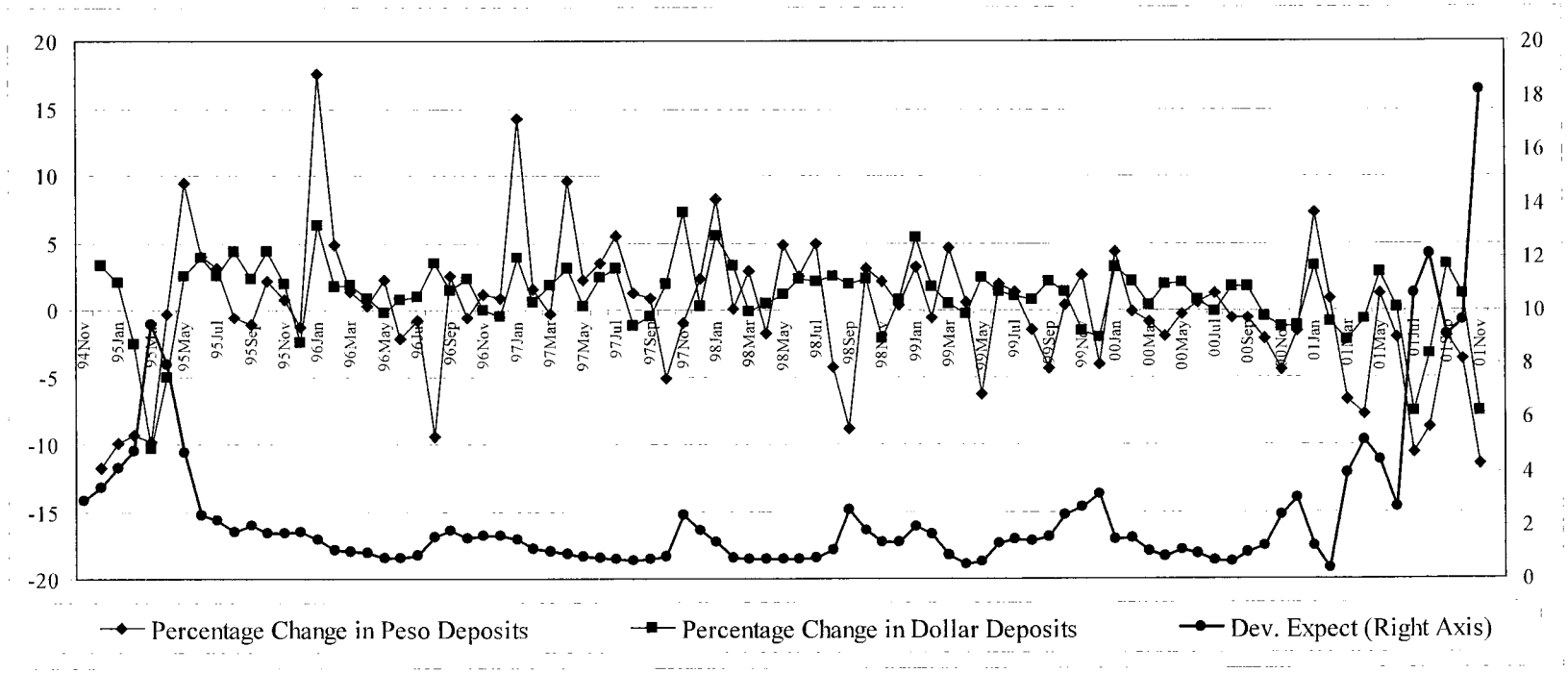

Figure 3.2. Evidence about Currency Mismatch Exposure among Borrowers

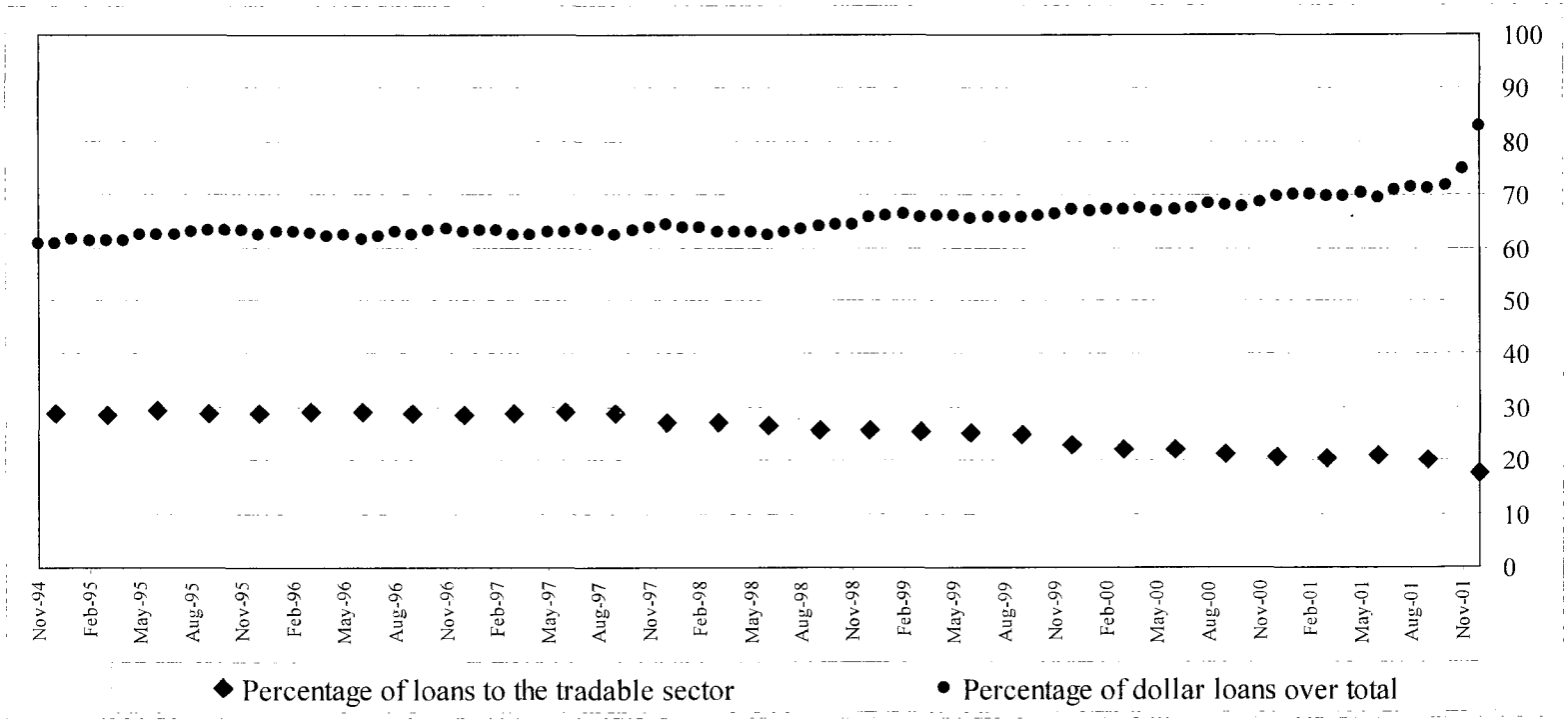

Figure 3.3. Currency Mismatch Exposure A and Percentage Change in Peso and Dollar Denominated Deposits

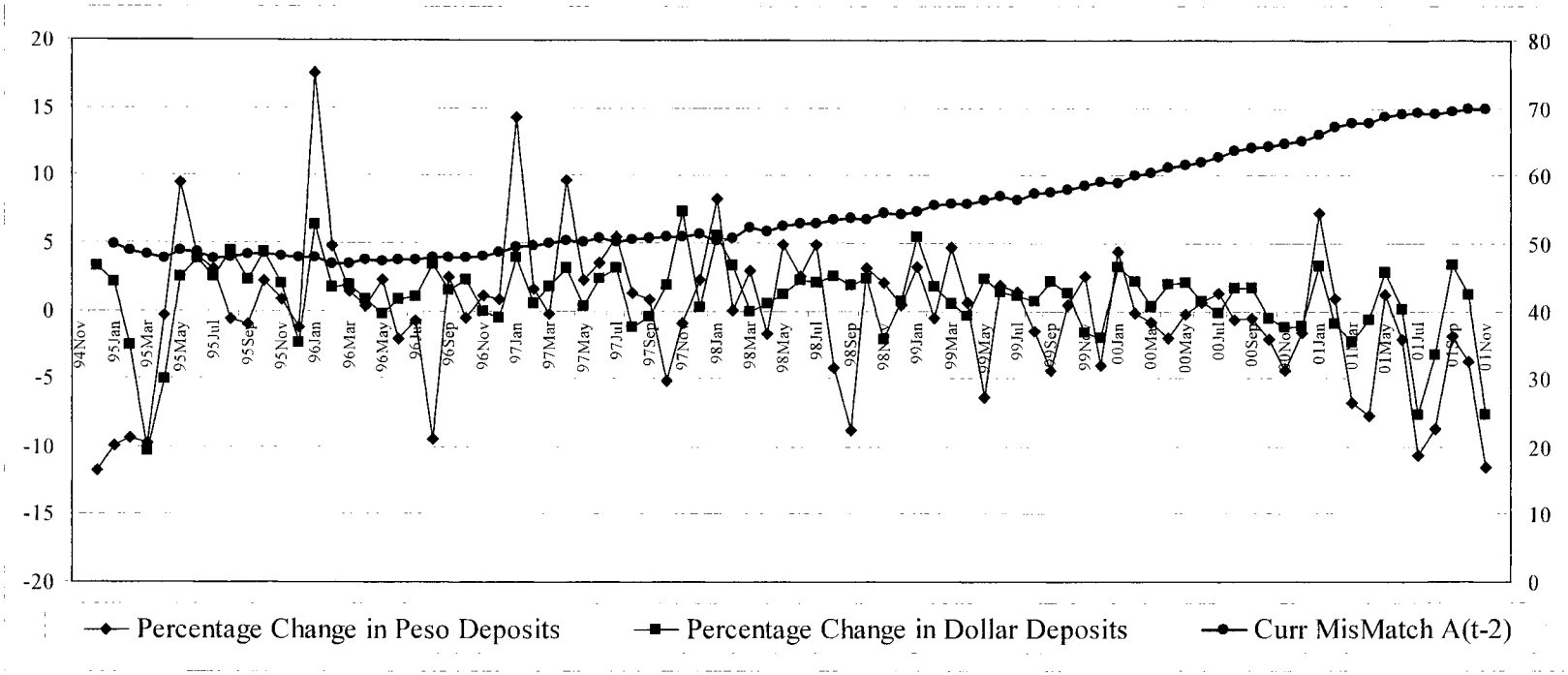

Figure 3.4. Currency Mismatch Exposure B and Percentage Change in Peso and Dollar Denominated Deposits

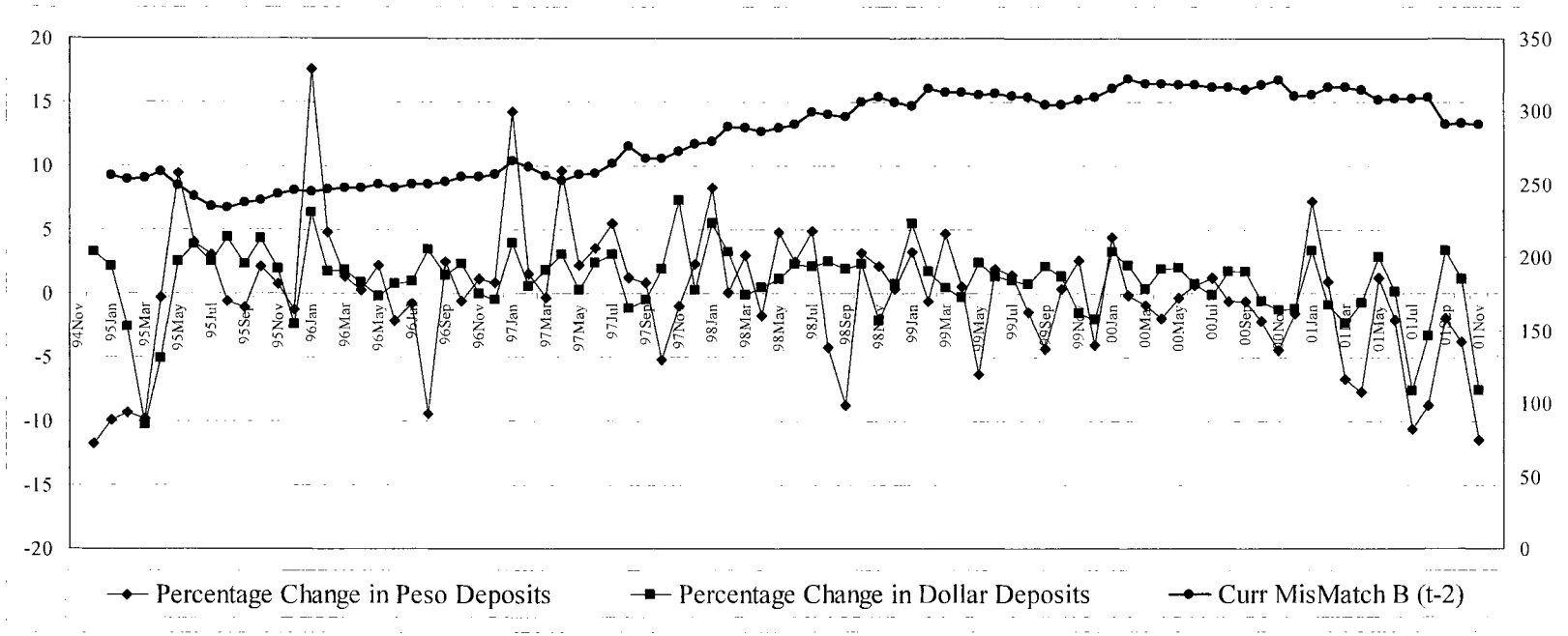

Figure 3.5. Non-linearities in Peso-Denominated Deposits

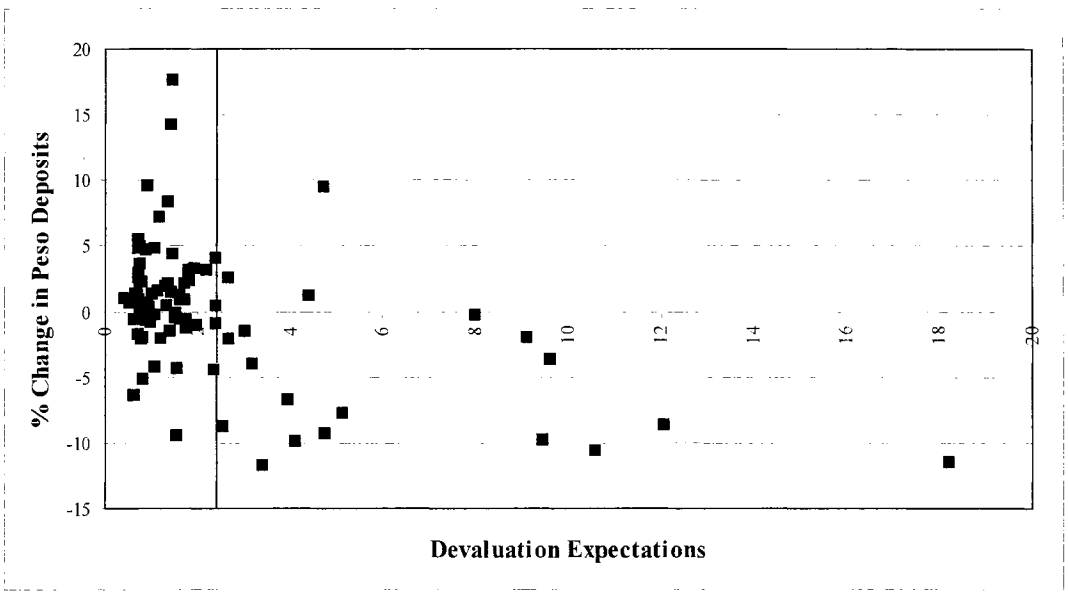

Figure 3.6. Non-linearities in Dollar-Denominated Deposits

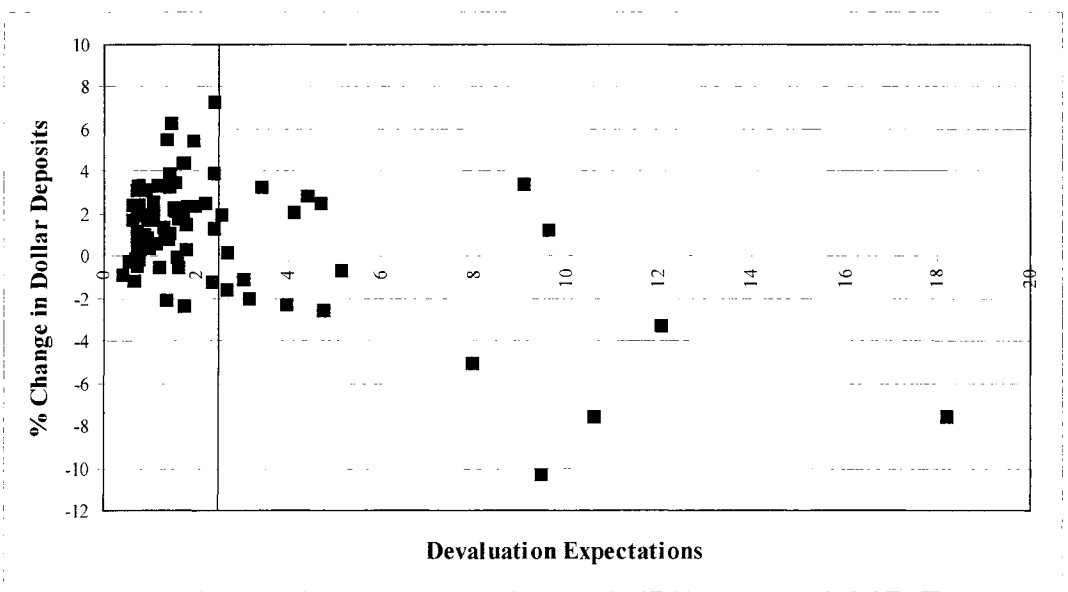

Figure 3.7. Time Deposit Evolution During Bank Runs (in percentage terms)

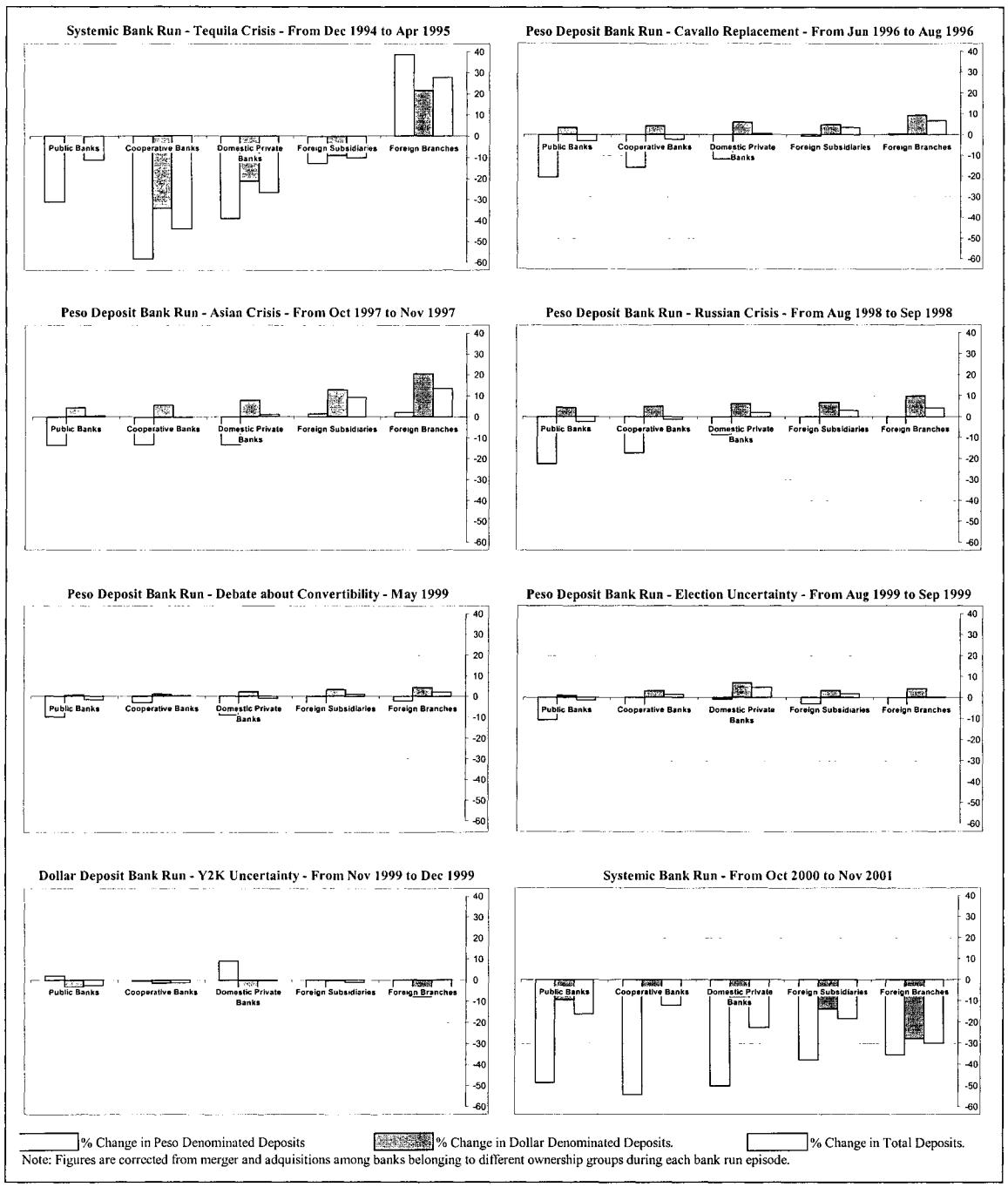

Table 3.1. Argentinean Banking Sector from Dec 1994 to Dec 2001

Year	Total Number of Banks	Public Banks		Private Domestic Banks		Foreign Banks	
		Number	Assets[a]	Number	Assets[a]	Number	Assets[a]
Dec-94	166	32	42%	102	42%	32	16%
Dec-95	126	29	40%	65	38%	32	22%
Dec-96	120	21	35%	67	38%	32	27%
Dec-97	110	17	28%	50	26%	43	46%
Dec-98	104	14	28%	47	23%	43	49%
Dec-99	92	12	28%	40	22%	40	50%
Dec-00	87	11	26%	36	22%	40	52%
Dec-01	84	11	32%	35	21%	38	47%

Note: [a)] Percentage of assets over total Banking System Assets
Source: Own estimations on data from the Argentinean Central Bank

Table 3.2. Bank Run Episodes

Date	% Change in Total Deposits	% Change in Peso Deposits	% Change in Dollar Deposits	*% Change in dollarization of deposits*	*Peso-Deposit Bank Run*[a]	*Dollar-Deposit Bank Run*[b]	*Systemic Bank Run*[c]	*Brief Descriptions of mayor events during the beginning of the period*
Dec 94 - Apr 95	-20.05	-35.21	-12.52	9.23	Yes	Yes	Yes	Mexico devalued its currency in Dec 20, 1994
Jun 96 -Aug 96	0.28	-12.01	5.35	4.98	Yes	No	No	Cavallo is fired Jul 26, 1995 (Strong rumors started in June)
Oct 97 - Nov 97	4.61	-6.09	9.31	4.49	Yes	No	No	First Currency Attack on the Hong kong dollar in Oct23, 1997.
Aug 98 - Sep 98	-0.51	-12.65	4.48	5.06	Yes	No	No	Russia declared default and devalued its currency in Aug 17, 1998
May-99	0.07	-6.34	2.39	2.19	Yes	No	No	Debate about the convenience of the currency board. Financial time article and Soros opinion against.
Aug 99 - Sep 99	0.75	-5.77	2.92	2.08	Yes	No	No	Doubts about Presidential Candidates' commitments to the currency board before October elections
Nov 99 - Dec 99	-3.10	-1.56	-3.56	-0.49	No	Yes	No	Uncertainty about Y2K impact on the banking sector
Oct 00 - Nov 01	-20.02	-41.94	-13.99	7.58	Yes	Yes	Yes	Vice-president resigned showing the government political weakness (Oct 6, 2000)

Notes: [a)] A peso-deposit bank run is defined as a period in which the percentage change in peso-denominated deposits drops more than a standard deviation of the monthly series measuring the percentage change in peso-denominated deposits (5.22 points). [b)] A dollar-deposit bank run is defined as a period in which the percentage change in dollar- denominated deposits drops more than a standard deviation of monthly series measuring the percentage change in dollar-denominated deposit (2.78 points). [c)] A systemic bank run is defined as a period in which total the percentage change in total deposits drops more than a standard deviation of the monthly series measuring the percentage change in deposit (2.95 points) and there are simultaneous bank runs in peso and dollar-denominated deposits.

Table 3.3. Regressions of Peso-Denominated Deposits

Variables	Model 1	Model 2	Model 3	Model 4	Model 5
Devaluation Expectations	-0.72 (0.11) ***		-0.78 (0.18) ***	0.34 (0.61)	-2.18 (0.70) ***
Currency Mismatch Exposure A (t-2)		0.52 (0.81)	-0.58 (1.22)	-0.30 (1.16)	-0.36 (1.26)
HIGH Dev. Expectations				-1.02 (0.54) *	
(Currency Mismatch [t-2] * Dev. Expectations) [a)]					0.02 (0.01) *
Number of Obs	83	83	83	83	83
R^2 Adjusted	0.23	0.15	0.23	0.23	0.23
Durbin-Watson	1.68	1.64	1.69	1.70	1.71
F (Inter., Dev Exp), P-value [b)]				0.00	0.00
F (Inter., Curr Mis), P-value [c)]					0.06

Note: This table reports aggregate regressions for the period Jan 1995 - Nov 2001. A constant and a quadratic trend are estimated but not reported. Newey-West Robust Standard Errors (12 lags) are in parentheses. *, **, *** mean significance at 10, 5 and 1 percent, respectively. a) It reflects the interaction between "Devaluation Expectations" and a dummy variable which is positive for levels of Devaluation Expectations greater than 2.5; b)"F (Inter., Dev Exp), P-value" displays the p-value of the F joint test of the variables "High Devaluation Expectations" and "Devaluation Expectations" in model 4, and the variables "(Currency Mismatch [t-2] * Dev. Expectations)" and "Devaluation Expectations" in model 5; c) "F (Inter., Curr Mis), P-value" displays the p-value of the F joint test of the variable "Currency Mismatch Exposure A" and "(Currency Mismatch [t-2] * Dev. Expectations)".

Table 3.4. Regressions of Dollar-Denominated Deposits

Variables	Model 1	Model 2	Model 3	Model 4	Model 5
Devaluation Expectations	-0.57 (0.20) ***		-0.63 (0.19) ***	0.74 (0.41) *	-2.79 (1.13) **
Currency Mismatch Exposure A (t-2)		0.37 (0.38)	-0.52 (0.56)	-0.17 (0.55)	-0.17 (0.67)
HIGH Dev. Expectations				-1.25 (0.39) ***	
(Currency Mismatch [t-2] * Dev. Expectations) [a)]					0.03 (0.02) **
Number of Obs	83	83	83	83	83
R^2 Adjusted	0.30	0.13	0.30	0.36	0.36
Durbin-Watson	1.68	1.68	1.69	1.80	1.83
F (Inter., Dev Exp), P-value				0.00	0.00
F (Inter., Curr Mis), P-value					0.06

Note: This table reports aggregate regressions for the period Jan 1995 - Nov 2001. A constant and a quadratic trend are estimated but not reported. Newey-West Robust Standard Errors (12 lags) are in parentheses. *, **, *** mean significance at 10, 5 and 1 percent, respectively. a) It reflects the interaction between "Devaluation Expectations" and a dummy variable which is positive for levels of Devaluation Expectations greater than 2.5; b)"F (Inter., Dev Exp), P-value" displays the p-value of the F joint test of the variables "High Devaluation Expectations" and "Devaluation Expectations" in model 4, and the variables "(Currency Mismatch [t-2] * Dev. Expectations)" and "Devaluation Expectations" in model 5; c) "F (Inter., Curr Mis), P-value" displays the p-value of the F joint test of the variable "Currency Mismatch Exposure A" and "(Currency Mismatch [t-2] * Dev. Expectations)".

Table 3.5. Systemic Bank Run Episodes

Variables	*Period: Dec 94 - Apr 95*				*Period: Oct 00 - Nov 01*			
	Peso	Robust Peso	Dollar	Robust Dollar	Peso	Robust Peso	Dollar	Robust Dollar
Foreign Subsidiary	12.2	9.5	9.5	8.6	5.9	1.2	-3.7	-3.2
	(11.2)	(14 7)	(7.1)	(9.9)	(9.7)	(6.3)	(6 7)	(8.4)
Foreign Branch	114.4	106.8	80.3	78.9	17.3	6.6	-19.7	-21.2
	(67.5) *	(71.2)	(40 5) **	(44 3) *	(7.9) **	(11.7)	(6 1) ***	(11.5) *
Public Bank	-1.5	-5.5	15.8	0.9	-1 5	-11.8	0.8	-19.0
	(32.3)	(32.3)	(6.8) **	(12.4)	(8.6)	(12.1)	(12.9)	(12.4)
Domestic Coop	-35.7	-26 8	-15.6	-7 3	-3 1	-8.4	4.7	1.7
	(9.4) ***	(16.9)	(6.2) **	(8.4)	(6.8)	(9.5)	(3.6)	(11.7)
Number of Obs	140	140	147	147	68	68	71	71
R-Square	0.18	0.19	0 06	0 07	0.14	0.37	0.14	0.44

Note. This table reports WLS among the two systemic bank run episodes. The weight measure used is each bank total deposit average during each bank run episode . Robust Standard Errors are in parentheses *, **, *** mean significance at 10, 5 and 1 percent, respectively A constant is estimated but not reported in all regressions Bank fundamentals variables are included but not reported in the robust peso and dollar-deposit regressions (for the list of bank fundamentals see the Appendix C)

Table 3.6. Non-Systemic Bank Run Episodes

Variables	*Period: Jun 96 - Aug 96*		*Period: Oct 97-Nov 97*		*Period: Aug 98 - Sep 98*	
	Robust Peso	Robust Dollar	Robust Peso	Robust Dollar	Robust Peso	Robust Dollar
Foreign Subsidiary	2.56	7.83	-4.64	3.57	-4.21	0.70
	(10.06)	(11.67)	(32.53)	(4.30)	(5.46)	(15.61)
Foreign Branch	11.96	6.73	31.73	12.31	-8.93	60.49
	(8.74)	(9.81)	(54.22)	(8.80)	(6.15)	(34.68) *
Public Bank	-3.04	-3.94	102.55	-2.33	-4.30	-22.06
	(7.81)	(10.33)	(92.95)	(9.99)	(10.06)	(28.10)
Domestic Coop	-1.77	5.33	3.46	3.86	2.23	-19.96
	(6.72)	(8.23)	(26.37)	(4.08)	(6.46)	(17.87)
Number of Obs	104	110	102	106	93	96
R-Square	0.33	0.03	0.01	0.25	0.32	0.41

Note: This table reports WLS among non-systemic bank run episodes. The weight measure used is each bank total deposit average during each bank run episode . Robust Standard Errors are in parentheses. *, **, *** mean significance at 10, 5 and 1 percent, respectively. A constant and bank fundamentals variables are estimated but not reported (for the list of bank fundamentals see the Appendix C)

Table 3.6. (Continuation) Non-Systemic Bank Run Episodes

Variables	*Period: May 99*		*Period: Aug 99 - Sep 99*		*Period: Nov 99 - Dec 99*	
	Robust Peso	Robust Dollar	Robust Peso	Robust Dollar	Robust Peso	Robust Dollar
Foreign Subsidiary	3.28	11.42	-0.18	-1.83	-7.07	7.29
	(4.64)	(12.34)	(2.98)	(2.00)	(4.50)	(2.56) ***
Foreign Branch	1.92	-0.56	-3.94	1.88	-14.29	-1.27
	(4.96)	(7.58)	(5.09)	(4.16)	(7.37) *	(5.02)
Public Bank	5.54	40.39	-0.10	-14.01	0.93	2.39
	(9.70)	(33.01)	(7.80)	(8.73)	(8.24)	(8.15)
Domestic Coop	10.40	18.26	3.91	-3.17	-9.36	2.05
	(4.58) **	(20.16)	(4.43)	(4.15)	(7.17)	(3.26)
Number of Obs	88	92	84	88	78	82
R-Square	0.340	0.147	0.393	0.105	0.342	0.200

Note: This table reports WLS among non-systemic bank run episodes. The weight measure used is each bank total deposit average during each bank run episode . Robust Standard Errors are below each estimation. *, **, *** mean significance at 10, 5 and 1 percent, respectively. A constant and bank fundamentals variables are estimated but not reported (for the list of bank fundamentals see the Appendix C)

CHAPTER 4

FOREIGN BANKS - BRANCHES OR SUBSIDIARIES?

4.1 Introduction[1]

Over the last two decades, many countries liberalized bank activities that traditionally had been heavily regulated and protected from competition. As part of this process, foreign banks, which had previously played only a marginal role, have established a substantial presence in the banking systems of several middle-income and developing countries. In this chapter, using a newly put together database on the activities of the top 100 international banks worldwide, the factors that affect the organizational form under which banks choose to operate in foreign markets are studied. As was discussed in chapter 3, international banks can operate (receiving also local deposits) either as foreign-owned subsidiaries or as foreign branches in host-countries.

Besides liabilities issues, there are at least two other sets of reasons why policy makers, bank users, and bankers should care about how foreign banks operate in host markets. First, the organizational form of foreign banks may affect the competitive structure of the local banking systems. Foreign subsidiaries with extensive networks are in direct competition with local commercial banks for retail clients. Single-branch foreign banks concentrate, instead, on segments such as wholesale and investment banking, which are typically undeveloped in the host countries. Second, the regulatory challenges presented by independently capitalized stand-alone subsidiaries are different from those presented by foreign branches.

---

[1]Chapter 4 is based on "How Banks Go Abroad: Branches or Subsidiaries" by Cerutti, E., G. Dell'Ariccia and S. Martinez-Peria, 2005, mimeo.

We build an empirical model that allows banks' organizational choice to depend on parent bank characteristics, home-country regulations, the desired level of penetration in the host market (as proxied by affiliate bank characteristics) and host-country factors. In particular, we allow the parent bank's size, business orientation (wholesale versus retail), degree of international presence, and past expansion strategies to affect their choice of organizational form in a given host country. We measure the desired level of penetration in the host market by controlling for the affiliate size and business orientation. Also, we examine how host factors such as legal restrictions on foreign bank operations, entry requirements, and taxation levels influence foreign banks' mode of operation

Finally, an important issue that we examine is whether differences in the legal treatment of a parent bank's responsibility vis-à-vis the liabilities of its overseas branches and subsidiaries play a role in the choice of organizational form. Legally, branches are not separate entities from their parents and parent banks are responsible for the liabilities of the branches, if the latter cannot meet their obligations with their assets or if capital injections are required. In contrast, subsidiaries are stand-alone entities, separate from the parent, so that the parent bank is under no legal obligation to honor their liabilities and its potential losses are limited to the capital invested and the costs of closing the operations. If these differences play an important role in banks' decisions, branches would tend to be the preferred organizational form in host countries characterized by relatively higher economic and political risks.

The question is empirically relevant, especially considering that in practice the distinction between branches and subsidiaries in times of crisis may be much more blurred than what theory predicts. In fact, although there have been many cases where parents assisted their branches and allowed their subsidiaries to fail, special contractual arrangements and reputational considerations have also determined whether a parent bank stood by its foreign operations. On the one hand, ring-fencing provi-

sions may limit the losses faced by parent banks when their branches are in trouble. Such provisions generally establish that parent banks are not required to repay the obligations of a foreign branch if the branch faces repayment problems due to extreme circumstances (such as war or civil conflict) or due to certain actions by the host government (e.g., exchange controls, expropriations, etc.). In recent years, a number of banking groups have adopted ring fencing provisions.[2] On the other hand, concerns about loss of reputation have in certain instances lead parent banks to rescue and recapitalize subsidiaries even if they were not legally forced to do so.[3]

To estimate our model we build a large dataset on the foreign activities and general characteristics of the largest 100 banks in the world. We focus on their operations in Latin America and Eastern Europe, the two regions that have witnessed the largest increase in foreign bank participation over the last decade. In both regions, current levels of foreign bank participation exceeds 50 % of banking system assets in many countries.

Our findings confirm some of our expectations, but also pose new questions, and challenge some established views. First, regulation and institutional factors appear to have an important effect. Foreign banks are less likely to operate as branches in countries that limit their activities and where regulation makes it difficult to establish

---

[2] In the case of US bank branches section 25C of the Federal Reserve Act establishes that "a member bank shall not be required to repay any deposit made at a foreign branch of the bank if the branch cannot repay the deposit due to an act of war, insurrection, or civil strife or (2) an action by a foreign government or instrumentality (whether de jure or de facto) in the country in which the branch is located, unless the member bank has expressly agreed in writing to repay the deposit under those circumstances". Another example of ring fencing provisions are the clauses included in the International Swaps and Derivatives Association (ISDA) Master Agreement. These Ring-Fencing Provisions stipulate that the headquarters will bear no responsibility for transactions made at overseas branches in the case of exchange controls or expropriation (see ISDA (2003), Section 10 (a) Ring-Fencing Agreements).

[3] For example, HSCB injected more than US$600 millions into its Argentine subsidiary following the crisis in that country (Economist Intelligence Unit Wre, December 16, 2003). Similarly, Portugal's Banco Espiritu Santo injected more capital into its Brazilian subsidiary Banco Boavista Interatlantico, after the latter had to make good on the losses sustained by its mutual funds following the Real's devaluation of January 1999. ABN Amro and KBC promised to make good on any losses to clients arising from an alleged fraud at their Hungarian subsidiary K&H equities (The Economist, September 2003).

new banks. Branches are, instead, more common in host countries with high corporate taxes (possibly because of the greater ease allowed by this structure in shifting profits across borders) and in poor countries perhaps because of fewer market opportunities.

Second, our results suggest that different organizational forms are associated with different degrees of penetration in the host market. Branches are more likely when foreign operations are smaller in size and do not have a retail orientation.

Third, host-country risk matters. Branches are less common in countries with highly risky macroeconomic environments, where parent banks seem to prefer the shield of "hard" limited liability provided by subsidiaries to the "soft" protection of ring-fencing. However, when it comes to risks stemming from possible government intervention and other major political events parent banks are more likely to operate as branches. This is not necessarily surprising. In view of legal provisions that shield parent banks from the liabilities of their foreign branches in events such as wars, insurrections, or arbitrary actions by foreign governments, banks are actually more exposed as subsidiaries, which typically have higher capital and reserve requirements and larger investments in local fixed assets than as branches.

The literature on the choice of banks' organizational form is scant. Our paper relates to early studies on the operations of international banks during the 1970s-1980s (see Goldberg and Saunders 1980; 1981a,b; Goldberg and Johnson 1990; Miller and Parkhe 1998, among others). However, these studies looked at the determinants of each type of organizational form in isolation and did not take into account banks' decision to enter a given market.

A larger literature has examined related aspects of the rising foreign bank presence in developing countries.[4] Several authors have analyzed the factors driving the decision of international banks to establish operations overseas and their choice of

[4]See Clarke et al. (2003) for a review of this literature.

location during the 1990s (see, for example, Claessens et al. 2000, Foccarelli and Pozzolo 2000, Moshirian 2001, Buch and DeLong 2001, Buch 2000, Galindo, Micco and Serra 2002, Buch 2003, Buch and Lipponer 2004, Wezel 2004). Also, many studies have focused on the implications of foreign bank presence in developing countries. For example, Claessens et al. (2000), Barajas et al. (2000), Denizer (2000), and Martinez Peria and Mody (2004) study the effects on competition and efficiency in the banking sector. Dages et al. (2000), Peek and Rosengren (2000), and de Haas and Levyveld (2002, 2004) compare the lending behavior of foreign and domestic banks during crises. Berger et al. (2001), Mian (2004), and Clarke et al. (2005) study the consequences on access to finance and cherry picking.

The remainder of this chapter is organized as follows. Section 2 discusses the dataset collected on the activities of the top 100 banks and their operations in Eastern Europe and Latin America. Section 3 presents the empirical methodology pursued in the paper to examine the determinants of foreign banks' choice of organizational form. Section 4 unveils the empirical results. Section 5 concludes.

4.2 Data

To examine the choice of organizational form by international banks across countries, we assembled an extensive and original database on the operations of the 100th largest banks in the world (according to the size of their global assets as of December 2002).[5] In particular, we focus on their presence in Latin America and Eastern Europe.[6]

---

[5]Among the top 100 banks, we did not include banks which were owned (50% or more of the shares) by another large bank. For example, Bank Austria Creditanstalt AG and Credit Lyonnais SA were not included in the top 100 list because their main shareholders as of 2002 were Bayerisque Hypo-un Vereisbank AG and Credit Agricole S, both in the top 100 list. The shareholder data structure was obtained from Bankscope.

[6]In Latin America, we examine international bank operations in Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Mexico, Peru, and Uruguay. In Eastern Europe, we focus on Bulgaria, Croa-

Table 4.1 lists the top 100 international commercial banks, specifies their country of origin, and indicates the type of operations -branch or subsidiary- (if any) that these banks have in Latin America and Eastern Europe.[7] Also, to establish the degree to which each bank has international operations, we report the number of countries where each bank is present. On average the top 100 banks have operations in more than 15 countries worldwide. Dutch banks have the highest country average, with operations in more than 38 countries. Also, a clear regional pattern emerges from this table. US and Spanish banks are dominant in the Latin American region. German and Italian banks are the key players in Eastern and Central Europe.

The operations of these 100 banks capture most of the foreign bank activity in the host countries in question in Latin America and Eastern Europe (Table 4.2). We define a foreign subsidiary as a bank with a foreign shareholder who owns at least 50% of the shares. On the other hand, a branch is 100 percent owned by its foreign parent bank. We eliminated Colombia from our sample because Colombian legislation does not allow for the entry of foreign bank branches. Only foreign bank subsidiaries, locally incorporated, are permitted.

Foreign owned banks represent about 50 percent of the total number of banks in Latin America and Eastern and Central Europe. Those included in our sample capture more than 80 percent of the assets controlled by all foreign banks, on average, across countries. Hungary, Peru and Bolivia are the exception, where the foreign banks in our sample account for less than 60 percent of the assets of the foreign banks in the system, mainly because their biggest foreign banks are owned by border

---

tia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovenia, Slovak Republic, and Turkey.

[7]Branches operating in a country as a branch of a TOP 100 subsidiary incorporated in a developing country were coded as a subsidiary. The Top 100 bank is under no legal obligation to honor those branches liabilities in excess of their developing country subsidiary.

countries' banks not among the world's top 100 banks.[8] Overall, we capture 247 out of 387 foreign controlled institution or about 65 percent of the foreign operations in the countries in our sample.

Regarding the choice of organizational form, there seems to be a strong preference for subsidiaries (Table 4.2), which 65% of the number of foreign bank operations in Latin America, for 82% of those in Eastern Europe.

The operations of the top 100 banks by country of origin (or home country) are shown in Table 4.3. It is clear that US, German, and Japanese banks are dominant both in terms of assets and number of institutions. There are 20 US banks, 16 German banks, and 11 Japanese banks in the top 100 list. Regarding our sample of host countries, we can observe that US and German banks have operations in 15 out of the 20 host countries in our study. Italian and Dutch banks operate in 14 and 12 countries, respectively. The actual number of branches and subsidiaries in each host country can also be observed in this table. US banks have 26 subsidiaries and 24 branches, followed by German banks with 42 subsidiaries and 6 branches.

Home- and host-country laws and regulations governing the activities of the affiliates of parent banks are likely to affect banks' choice of organizational form. A dummy summarizing home-country regulations regarding the operations of their bank affiliates overseas is shown in the last column of Table 4.3. A value of 1 is associated with countries that place additional restrictions on opening branches relative to subsidiaries. For example, Canadian and Italian banks cannot open a branch without the previous approval of the home regulator.[9] Also, the Spanish regulator can refuse the application for opening a branch based on a wider set of criteria (e.g. legal or other

[8]Peru's low share data is more subtle and it is due to the importance of Banco de Credito del Peru and Interbank's shareholders which are companies from Bermuda and Bahamas respectively.

[9]Italian legislation does not include EU Member States on this issue.

type of obstacles that prevent or hamper the control and inspection of the branch by the home regulator) than in the case of opening a subsidiary.

A summary of the regulatory treatment of branches versus subsidiaries by host regulators is shown in Table 4.4. Since the distinctions on host-country requirements for foreign branch and subsidiaries are generally more detailed than for home-country requirements, the Host Country Regulation Index is subdivided into four subcategories. These categories are: Written Statements, Restrictions on Activities, Responsibilities Undertaken, and Other Restrictions. A value of one is associated with each category, where the host country establishes more requirements for opening a foreign branch than for a foreign controlled subsidiary. The most common additional requirements are: the approval of the home-country foreign bank regulator, restrictions for some type of operations (e.g. mortgage transactions) or for operating with host-country residents, and a statement of the applicant foreign bank that it will satisfy all claims of the branch that may arise.

Among the host countries in our sample, regulations for Croatia, Hungary, and Poland discriminate the most against foreign branches. Most notably, the first two countries place restrictions on the type of activities that branches can undertake relative to subsidiaries. With the exception of Mexico, such restrictions appear to be uncommon in Latin America.

4.3 Empirical Methodology

We model a bank's choice of organizational form according to equation (4.1) below:

$$\begin{aligned} OrganizationalChoice_{i,j,k} &= \alpha + \beta_1 ParentBankCharacteristics + \\ &+ \beta_2 HomeCountry\,\mathrm{Re}gulations + \beta_3 AffiliateBankCharacteristics + \\ &+ \beta_4 HostCountryFactors_j + \varepsilon_i \end{aligned} \tag{4.1}$$

where $OrganizationalChoice_{i,j,k}$ is a dummy equal to 1 if parent bank i from home country j has a branch in host country k, and 0 if it operates a subsidiary in that country.

Among the *parent bank characteristics* we control for size, business orientation and international strategy of each parent bank. *Parent bank size* refers to the log of the total parent bank assets. This data comes from Bankscope. *Parent bank retail business orientation* is a dummy that equals one if the bank has a retail orientation and zero if the bank is primarily engaged in wholesale or investment bank activities. The sources of this classification are Bankscope and the home banks' web pages. *Parent bank internationalization strategy* refers to the ratio of branches to total foreign operations that the parent owns. This variable helps determine whether the parent has a clear preference for one type of organizational form or the other. Bankers' Almanac is the source used to construct this variable.

Home country regulations refers to the restrictions placed by the home regulator on parent banks' organizational choice. In particular, it measures restrictions on opening branches relative to subsidiaries. This dummy was constructed on the basis of the information gathered from laws and regulations in the parent countries. More details on this dummy can be seen in Table 4.3.

We also control for several characteristics of the affiliate bank. *Affiliate bank size* refers to the size of the local affiliate in the host country, as measured by the number of employees.[10] This data comes mainly from Bankscope and Bankers' Almanac. *Affiliate bank business orientation* is a dummy equal to 1 if the affiliate bank has a retail business orientation. The dummy is zero in the case of trade finance and corporative and investment banks. This data come from Bankscope, Bankers' Almanac and individual banks' webpages. We also include a dummy for whether the bank is a

[10] We use size as measured by employees because data on assets for branches was lacking in many cases given that balance sheets are typically consolidated at the parent level.

greenfield operation (0) or the result of an acquisition (1). Finally, we control for the year in which the affiliate was established. The information used to construct both of these variables was obtained from numerous sources such as central banks, banks WebPages, Bankers' Almanac and Bankscope.

Host country factors include measures of banking regulations, corporate taxation, country size, level of development and risk. Among the banking regulations, *Host country bank entry requirements* is an index that takes values from 0 to 8 depending on the number of legal submissions required to obtain a license to operate as a bank in the host country. These requirements may include none, all or some of the following: (1) draft by laws, (2) intended organizational chart, (3) first 3-year financial projections, (4) financial information on main potential shareholders, (5) background/experience of future directors, (6) background experience of future managers, (7) sources of funds to capitalize new bank and (8) intended differentiation of new bank from others. This index is constructed using the data collected and methodology proposed by Barth, Caprio, and Levine (2001).

Host country restrictions on bank activities is also an index developed by Barth et al. (2001). This index that ranges between 1 to 16 tries to capture the extent to which banks can engage in (a) the business of securities underwriting, brokering, dealing, and all aspects of the mutual fund industry, (b) insurance underwriting and selling, (c) real estate investment, development and management, and (d) whether banks can own non-financial firms. For each of these subcategories a value between 1 and 4 is assigned depending on whether the activity is unrestricted (1), permitted (2), restricted (3), or prohibited (4).

Host country regulations on foreign bank branches refers to an index that captures the degree to which the host country restricts the operation of foreign banks as branches in the country, relative to its treatment of foreign subsidiaries. This variable

was constructed on the basis of 2002 bank regulations and legislation in each of the twenty host countries. Details on this index are shown on Table 4.4.

Host country corporate taxes refers to the top corporate tax rate in the host country as reported by the Heritage Foundation Index of Economic Freedom. *Host country size* is measured by the log of constant dollar GDP in the host country. This variable is intended to capture the scope for scale economies in the country. *Host country GDP per capita*, measured as the dollar GDP per capita, is included in order to capture the degree of economic development in the host country. This variable may also help to measure business opportunities in the host country. Data for both of these variables comes from the World Development Indicators produced by the World Bank.

Host country risk refers to four different types of host-country risk indexes reported by the International Country Risk Guide (ICRG). These variables are *Economic Risk, Political Risk, Investment Profile Risk*, and *Country Risk* (composite index). We change the sign on these variables so that higher values indicate greater potential risk. More specifically, the *ICRG Economic Risk* assesses a country's economic strength or weakness as a function of variables such as the country's GDP per capita, real GDP growth, annual inflation rate, budget balance, and current account balance.[11] The *ICRG Political Risk* rating provides a means of assessing the political stability of a country through various political and social variables such as measures of government stability, socioeconomic conditions, internal conflict, external conflict, law and order, investment profile, etc. Investment Profile Risk, a subcomponent of Political Risk, takes into account contract viability, profits repatriation, payments delays measurements. Finally, the *ICRG Country Risk* is a composite index that in-

[11] Although the ICRG Economic Risk index includes the host-country GDP Per Capita as a subcomponent, the correlation coefficient between the ICRG Economic Risk index and host-country GDP Per Capita variables is very low in our sample.

cludes both economic and political risk variables and other variables such as exchange rate stability and total foreign debt as percent of GDP.

The choice of organizational form explained by equation (4.1) can only be observed for a given host country once the parent bank decides to establish operations in that country. Thus, in estimating equation (4.1) there might be a selection bias, unless we also consider how parent banks make decisions on where to establish foreign operations. We take this into account by estimating equation (4.2) below:

$$\begin{aligned} ForeignBank\,\mathrm{Pr}esence_{i,j,k} &= \alpha + \beta_1 ParentBankCharacteristics + \\ &+ \beta_2 HomeCountryRegulations + \beta_3 AffiliateBankCharacteristics + \\ &+ \beta_4 HostCountryFactors + \beta_5 Home - HostProximity + \varepsilon_j \end{aligned} \tag{4.2}$$

where $ForeignBank\,\mathrm{Pr}esence_{i,j,k}$ is a dummy equal to 1 if parent bank i from home country j has any kind of operations in host country k, and 0 if it does not have a presence in the host country. Most variables included in equation (4.2) have been defined above, with the following three exceptions. First, within the parent bank characteristics, *Parent Bank Worldwide Activity* takes into account the number of countries where each parent bank has activities worldwide (data source: Bankers' Almanac). Second, among the regulatory variables, *Host Country (inward) Foreign Investment Regulation* and *Home Country (outward) Foreign Investment Regulation* capture government controls on inward and outward direct investment in banking, respectively. Both variables are constructed as a five year average (2002-1998) from original IMF data.[12] Finally *Home-Host Proximity* is a matrix of variables that capture the degree of economic, cultural, and institutional affinity between the home and host countries. In particular, it includes separate dummies for whether the host and home country share (i) a common language and (ii) a common legal origin. Also, the matrix includes the share of bilateral trade between countries and a measure of

[12]The original IMF data are dummies which equal 1 in those years when the countries had controls.

geographical distance measured in miles. We also included a dummy for whether the home and host were in a colonial relationship or colonized by the same country. All these variables come from the CIA Fact Book.

4.4 Results

Table 4.5 reports the results for the probit estimation of equation 1.[13] We present six alternative specifications including different proxies for political and economic risk. All regressions are estimated with robust standard errors allowing for the possibility that observations for the same parent bank may not be independent (i.e., we allow for clustered standard errors).

Most coefficients are significant and have the expected sign. Since results are robust across specifications, in what follows we focus on our baseline regression labeled model (4).

The results can be summarized as follows. First, regulation matters. The variables describing host- and home-country restrictions on foreign branches both have the right negative sign and are significant in all specification (often at the 1 percent level), indicating that the more restrictions on branches the lower the probability that banks will choose this organizational form.. Host-country bank entry requirements, which capture the number of procedures required to license a bank, also have a negative, although less consistently significant, effect on the establishment of branches. One possible explanation for this result is that while branches are typically denovo operations, banks can circumvent entry requirements by setting up subsidiaries through the purchase of domestic banks. Consistent with this interpretation, we find that the acquisition dummy is always significant and has a negative sign. Host-country

[13]Note the sample size, which captures the number of bank affiliates (both branches and subsidiaries) drops to 240 observations instead of 247 as shown in table 2, because of missing data for 5 Brazilian banks (all investment banks), one Mexican Bank, and one Polish bank.

restrictions on bank activities do not seem, instead, to have a significant impact on how foreign banks choose to enter. This is not necessarily surprising since these restrictions typically apply to both locally- and foreign-incorporated banks.

Second, taxation matters. The coefficient of the host-country top corporate tax rate is positive and highly significant in all regressions. Thus, branches -having an advantage in shifting profits across border- are more likely in countries with relatively higher corporate taxes.

Third, risk matters. Differences in the parent bank's responsibility for the liabilities of branches and subsidiaries play an important role in the choice of organizational form. Under normal circumstances, parents face full responsibility vis-à-vis the liabilities of branches, but their exposure is limited to the loss of the equity invested in the case of subsidiaries. Consistent with these differences in the legal treatment, we find that banks prefer to operate as branches in host-countries characterized by relatively low economic risk. The coefficient of the proxy for economic risk is negative and significant, suggesting that, in countries with a highly risky macroeconomic environment, parent banks seem to prefer the shield of "hard" limited liability provided by subsidiaries to the "soft" protection of ring-fencing. However, the coefficients on the political risk proxy and on the measure of investment risk (capturing risk to the viability of contracts, the risk of expropriation, and potential obstacles to the repatriation of profits), are instead positive and significant, although to a lesser extent. This suggests that when it comes to risks stemming from possible government intervention and other major political events (such as civil unrest or wars) parent banks prefer to operate as branches, since the latter are often protected against such events by ring fencing provisions. In other words,[14] in view of legal provisions that shield parent banks from the liabilities of their foreign branches in events such as

[14]The opposite sign associated with economic and political risk explains why the ICRG country composite risk index in Regression (1) is not significant.

wars, insurrections, or actions by foreign governments, banks are in such occasions less exposed as branches than as subsidiaries, which typically have higher capital and reserve requirements and larger investments in local fixed assets.

Fourth, size matters. Our results suggest that different organizational forms are associated with different degrees of penetration in a foreign market on the part of the parent bank. Branches are more likely when foreign operations are smaller in size. The link between the degree of penetration and a lower probability of being a branch is reinforced by the negative and significant coefficient of the dummy indicating that the affiliate is a retail bank. The coefficient of affiliate year-of-entry is positive and significant, suggesting that there has been a recent trend by foreign banks to increasingly penetrate emerging markets by operating as subsidiaries.

A related finding is that branches are less likely in relatively richer countries: the host-country's per capita income has a negative and significant coefficient. This may in part reflect the fact that subsidiaries are often the result of crisis-related acquisitions which are more likely to occur in poorer countries. However, this cannot be the entire story as major crises have occurred also in relatively richer emerging market economies. One additional explanation may be that foreign banks enter as subsidiaries in markets where they believe there is ample room for expansion, and these are typically poorer economies where the local banks are less developed and capitalized, and hence easier to compete against.

Finally, one additional result worth noting is that parent banks seem to specialize, at least to some extent, in one organizational form or the other, beyond what is explained by their home-country regulation. Indeed, the worldwide ratio of branches-to-subsidiaries at the parent bank is positive and highly significant. One possible explanation for this finding is that the two organizational forms require different expertise and corporate governance design at the parent level. However, the coefficients of the dummy indicating that the parent institution is a retail bank and that of its

size are not significant, suggesting that the specialization and overall size of the parent bank itself are not important when it comes to the organizational form of its foreign operations. Possibly, the reason why parent size seems not to matter can be ascribed to the fact that all parent banks in our sample are pretty large, with assets ranging from 1,097,190 millions (Citigroup Inc) to 94,325 millions (Bank of China, Hong Kong) Limited.

In Table 4.6, we measure the economic impact of a change in our explanatory variables by considering what happens to the predicted probability of the affiliate being a branch when each right hand side variable increases from its sample average by one standard deviation (for the dummy variables we consider a change from 0 to 1). Among the taxation and regulatory variables, corporate taxes and restrictions on foreign branches in the host country have the largest impact: one standard deviation increase (decrease) from the average in corporate taxes (restrictions on branches) increases the likelihood of choosing to operate as a branch by about 3.5 percentage points (equivalent to 8 percent of the standard deviation of the dependent variable). The economic effect of the other regulatory variables is around 1.5 percentage points. Among the bank-specific factors, the affiliate bank size has the largest impact, almost 6 percentage points. Year of entry and the acquisition dummy are also important with impacts around 4.5 percentage points. Finally, the relative importance of country risk is comparable to that of regulation, with impacts at about 4.3 and 3.2 percentage points for the political risk and the economic risk measures, respectively.

Results for the Heckman probit estimation are shown in Tables 4.7 and 4.8. Table 4.7 shows the first stage of the Heckman estimation where we model the decision of banks to enter a given host country. Our estimations yield results consistent with many of the previous studies on this issue, but also offer some new insights. In particular, we show that banks are less likely to enter countries where political risk is high. Also, once we control for the market opportunities in the host country, economic

risk does not seem to matter if we do not control for political risk and it is positive when we control for the latter. We interpret the positive coefficient on economic risk to be associated with the fact that much of the recent foreign bank entry has occurred following economic crises in the host countries, since these events provide opportunities for "good deals" in terms of acquiring local banks. Finally, like previous studies we find that regulation and taxation have a negative impact on entry, while economic and cultural proximity to the host promote entry.

Table 4.8 shows the results for second stage in the Heckman model, i.e., the likelihood of a parent bank choosing to operate as a branch. These results are very similar (and almost identical in terms of significance) to those for the simple probit model without controlling for sample selection. Therefore, for the sake of brevity, they are not discussed here.

4.5 Conclusions

Our study of the determinants of the organizational choice of foreign banks yielded three main findings. First, there is evidence that political and economic risk matters for how banks enter new markets, suggesting that the different degree of parent bank responsibility vis-à-vis the liabilities of branches and subsidiaries plays an important role in the decision. Second, different organizational forms correspond to different degrees of penetration by a parent bank to a foreign market. Third, institutional factors such as host- and home-country regulation are also important in determining the organizational choice of local operations.

From a policy perspective the results point to two main conclusions. First, since risk matters, parent banks should be expected to behave differently vis-à-vis branches and subsidiaries in times of economic and political crisis. Second, since regulatory variables have non-marginal effects on the form of foreign bank entry, governments can design regulation to favor one structure rather than another. Policy makers

concerned with the behavior of foreign banks during periods of financial distress may want to favor branches to tap into the deep pockets of their parents. However, the results indicate that subsidiaries are more likely to enter retail market and establish large local networks. Hence, a trade-off emerges. While favoring branches may be optimal from the point of view of systemic risk management, regulation discouraging foreign banks from establishing local subsidiaries may limit the benefits of foreign entry. We leave the analysis of this trade-off to future research.

Table 4.1. Top 100 International Commercial Banks and Their Operations in Eastern Europe and Latin America, 2002

Ranking by Assets	Parent Bank Names	Parent Country	Number of Host Countries where Banks Operate	Argentina	Bolivia	Brazil	Bulgaria	Chile	Colombia	Croatia	Czech-Rep	Ecuador	Estonia	Hungary	Latvia	Lithuania	Mexico	Peru	Poland	Slovakia	Slovenia	Turkey	Uruguay
1	Citigroup Inc	US	78	B	B	B, S	B	B	S		S	B		S			S	B	S	S		B	B
2	Mizuho Financial Group	JP	25																				
3	UBS AG	CH	28			S																	
4	Sumitomo Mitsui	JP	16			S																	
5	Deutsche Bank AG	DE	48	S		S		S			B			S			B		S (2)				S(2)[a]
6	Mitsubishi Tokyo Fin Group	JP	33	B		S		B									B		S				
7	J P Morgan Chase & Co	US	50	B		B, S		B									B					B	
8	HSBC Holdings Plc	UK	63	S		S (2)		B			B					S [a]	S (2)					S	S
9	ING Groep NV	NL	37	B		B	B				B			S			B		S	B		B	
10	BNP Paribas	FR	48	B,S		S	S							S				S	S				S
11	Credit Suisse Group	CH	33			S (2)											B					B	
12	Bank Of America	US	30	B		S											B		S				
13	Royal Bank of Scotland	UK	19																				
14	UFJ Holdings Inc	JP	17																				
15	Barclays Holding Plc	UK	41			S																	
16	Credit Agricole CA	FR	47			S					S			S					S (2)	S		B,S	S (2)
17	ABN AMRO Bank	NL	59	B		S (2)		S	S		B						B		S			B	B
18	Indus & Com Bank of China	CN	8																				
19	HBOS Plc	UK	9																				
20	Bayerische Hypo Vereinsbank A	DE	25	S			S			S (2)	S (2)			S	S	B			S (3)	S	S		
21	Morgan Stanley	US	24			S																	
22	Societe Generale	FR	46	S		S	S				S								B	S	S	B	
23	Norinchukin Bank (The)	JP	3																				
24	Fortis	BE	22																S				
25	Merrill Lynch & Co , Inc	US	9			S													S				S
26	Commerzbank AG	DE	22								B			S					S (2)				
27	General Electric Capital Corp	US	13	S		S					S			S			S		S				
28	Bank of CN	CN	20																				
29	Dresdner Bank AG	DE	26			B,S		S		S	S						S		S				
30	Rabobank Group	NL	19			S													S				
31	China Construction Bank	CN	4																				
32	Dexia	BE	13																	S			
33	Agricultural Bank of China	CN	2																				
34	NRW BANK (WestLB)	DE	18			S								S					S			B	
35	Goldman Sachs Group, Inc	US	6			S																	
36	Wells Fargo & Company	US	8																				
37	DZ Bank AG	DE	13											S					S				
38	Wachovia Corporation	US	5																				
39	Resona Holdings, Inc	JP	6																				
40	Bayerische Landesbank	DE	5							S				S									
41	Lloyds TSB Bank Plc	UK	23	B		B, S			S			B											B
42	Santander Central Hisp Group	ES	24	S	S	S (4)		S	S								S (2)	S					S
43	Landesbank Baden-Wuertt	DE	6																				
44	KfW Group	DE	0																				
45	Prudential Financial Inc	US	1																				
46	Banca Intesa SpA	IT	19	S		S (3)		B	S	S (4)	S [a]			S				S		S (2)			B
47	Banco Bilbao Vizcaya Arg	ES	21	S		S (3)		S	S								S (2)	S					S
48	Abbey National Plc	UK	1																				
49	Bank One Corporation	US	8														B						
50	Washington Mutual Inc	US	0																				

Note. This Table contains information about the top 100 commercial banks, classified by assets, in 2002. B stands for Branch. S stands for Subsidiary. S(#) indicates the number of subsidiaries in the country. Centries Codes used: AT = Austria, AU = Australia, BE = Belgium, CA = Canada, CH = Switzeland, CN = China, DE = Germany, DK = Denmark, ES = Spain, FR = France, HK = Hong Kong, IE = Ireland, IT = Italy, KP = Korea, JP = Japan, NL = Netherlands, SE = Sweden, UK = United Kingdom, US =USA. [a] One branch operating in the country was coded as a subsidiary because it was a branch of a TOP 100 subsidiary operating in a developing country.

Sources: Bankscope, National Central Banks, and Bankers Almanac

Table 4.1. (Continuation) Top 100 International Commercial Banks and Their Operations in Eastern Europe and Latin America, 2002

Ranking by Assets	Parent Bank Names	Parent Country	Number of Host Countries where Banks Operate	Argentina	Bolivia	Brazil	Bulgaria	Chile	Colombia	Croatia	Czech-Rep	Ecuador	Estonia	Hungary	Latvia	Lithuania	Mexico	Peru	Poland	Slovakia	Slovenia	Turkey	Uruguay
51	Almanij	BE	24	B							S (2)			S					S	S(2)[a]			
52	Credit Mut. Centre Est Europe	FR	10																				
53	CDC Ixis	FR	0																				
54	Nordea Bank AB	SE	14										B		B	B			S				
55	Lehman Brothers Holdings Inc	US	16																				
56	Danske Bank A/S	DK	8																S				
57	Eurohypo AG	DE	8																				
58	Royal Bank of CA RBC	CA	10																				
59	UniCredito Italiano SpA	IT	19				S			S (3)	S								S	S		S	
60	Shinkin Central Bank	JP	2																				
61	San Paolo IMI	IT	18											S							S		
62	HSH Nordbank AG	DE	8																				
63	National AU Bank	AU	9																				
64	NORD/LB	DE	11												S	S			S				
65	Fleet National Bank	US	12	B		B, S		B	S								B	B					B, S
66	Bear Stearns Companies Inc	US	4																				
67	Bank of Nova Scotia (The)	CA	30					S									S						
68	Bankgesellschaft Berlin AG	DE	5																S				
69	US Bancorp	US	0																				
70	Nomura Holdings Inc	JP	7																				
71	Toronto Dominion Bank	CA	7																				
72	Canadian Imperial Ba of Com	CA	12																				
73	Banque de Montreal	CA	6																				
74	Kookmin Bank	KP	5																				
75	American Express Company	US	28	S		S (2)											B						S
76	CNCEP	FR	1																				
77	Landesbank Hessen-HELABA	DE	4																				
78	Deutsche Postbank AG	DE	2																				
79	Depfa Bank Plc	IE	5																				
80	Capitalia SpA	IT	12																			B	
81	Sumitomo Trust & Bank Co	JP	5																				
82	Nat'l Agricultural Coop Fed	KP	0																				
83	Svenska Handelsbanken	SE	2																S				
84	Natexis Banques Populaires	FR	12																				
85	Banca Monte dei Paschi Siena	IT	9																				
86	Skandinaviska Enskilda Banken	SE	12										S		S	S							
87	Commonwealth Bank of AU	AU	9																				
88	Erste Bank der Oesterreichischen	AT	8							S (2)	S (2)			S						S			
89	Chuo Mitsui Trust & Bank Co	JP	0																				
90	National City Corporation	US	2																				
91	SunTrust Banks, Inc	US	1																				
92	BHW Holdings AG	DE	0																				
93	Standard Chartered Plc	UK	43						S									B					
94	LA CAIXA (Barcelona)	ES	2																				
95	Shoko Chukin Bank, Ltd	JP	0																				
96	Foereningssparbanken	SE	8										S		S	S							
97	State Bank of India	IN	14																				
98	Westpac Banking Corporation	AU	11																				
99	Woori Financial Holdings Co.	KP	10																				
100	Bank of China (HK) Limited	HK	2																				

Note: This Table contains information about the top 100 commercial banks, classified by assets, in 2002. B stands for Branch, S stands for Subsidiary; S(#) indicates the number of subsidiaries in the country. Countries Codes used: AT = Austria, AU = Australia, BE = Belgium, CA = Canada, CH = Switzeland, CN = China, DE = Germany, DK = Denmark, ES = Spain, FR = France, HK = Hong Kong, IE = Ireland, IT = Italy, KP = Korea, JP = Japan, NL = Netherlands, SE = Sweden; UK = United Kingdom, US =USA. [a] One branch operating in the country was coded as subsidiary because it was a branch of a TOP 100 subsidiary incorporated in a developing country.

Sources: Bankscope, National Central Banks, and Bankers Almanac

Table 4.2. Foreign Bank Presence in Eastern Europe and Latin America

Countries	Number of Banks	Number of Banks under Foreign Control[a)]	Number of Foreign Subsidiaries	Number of Foreign Branches	Number of TOP 100 Subsidiaries[b)]	Number of TOP 100 Branches[c)]	TOP 100 Foreign Banks' Asset Share Within Foreign Controled Banks[d)]
Argentina	79	30	15	15	10	10	89.99%
Bolivia	12	5	2	3	1	1	58.79%
Brazil	193	73	64	9	38	6	91.14%
Bulgaria	34	21	15	6	4	2	40.61%
Chile	25	14	6	8	6	6	97.70%
Croatia	46	21	21	0	13	0	75.16%
Czech Republic	37	26	17	9	13	5	84.74%
Ecuador	22	2	0	2	0	2	100.00%
Estonia	7	4	3	1	2	1	92.30%
Hungary	39	25	25	0	15	0	60.56%
Latvia	23	9	8	1	4	1	87.55%
Lithuania	13	8	5	3	4	2	92.78%
Mexico	33	21	11	10	10	10	99.72%
Peru	15	12	9	3	4	3	52.43%
Polande)	59	45	44	1	29	1	79.25%
Slovak Republic	20	17	15	2	11	1	75.16%
Slovenia	22	7	6	1	3	0	77.86%
Turkey	54	19	8	11	4	9	94.35%
Uruguay	41	28	18	10	11	5	77.17%
TOTAL	**774**	**387**	**292**	**95**	**182**	**65**	-

Notes: [a)] Foreign banks with at least 50% of the bank capital; [b)] Number of subsidiaries under foreign banks' control whose parent banks were within the top 100 worldwide banks, classified by assets at 2002; [c)] Number of foreign branches whose parent banks were within the top 100 worldwide banks, classified by assets at 2002 - 4 branches in the sample of Top 100 subsidiaries incorporated in a developing country were classified as subsidiaries; [d)] Czech Republic, Estonia, Latvia, Poland, Slovak Republic and Uruguay's figures are underestimated due to missing asset data. Bulgaria's low share is due to the important participation of banks from Greece and Hungary which are not classified within the TOP 100. Peru's low share data is due to the importance of Banco de Credito del Peru and Interbank's shareholders which are companies from Bermuda and Bahamas respectively. Bolivia's low share figure is due to the importance of Banco de Credito de Bolivia whose main shareholder is Banco de Credito del Peru; and [e)] It does not include 605 cooperatives banks (They represent 6.5% of total assets)
Sources: National Central Banks, Bankers Almanac, Bankscope, and Others.

Table 4.3. Top 100 Parent Bank Activities by Country of Origin (Home) and Home Country Regulations on Overseas Activities

Countries	Number of Top 100 Banks by Assets in 2002	Assets' Share Among Top 100 Banks	Number of Top 100 Banks with Operations in Sample of Host Countries	Number of Host Countries with Operations	Number of Subsidiaries in Sample of Host Countries	Number of Branches in Sample of Host Countries	Home Country Branch/Sub Regulation Index
Australia	3	1.26%	0	0	0	0	0
Austria	1	0.37%	1	4	6	0	0
Belgium	3	3.32%	3	5	8	1	0
Canada	5	2.70%	1	2	2	0	1[(a)]
China	4	5.10%	0	0	0	0	0*
Denmark	1	0.72%	1	1	1	0	0
France	7	7.90%	3	11	22	4	0
Germany	16	14.97%	8	15	42	6	1[(b)]
Hong Kong	1	0.28%	0	0	0	0	0
India	1	0.31%	0	0	0	0	1[(c)]
Ireland	1	0.45%	0	0	0	0	0
Italy	5	2.94%	4	14	23	3	1[(d)]
Japan	11	14.55%	2	5	3	3	0
Korea	3	1.16%	0	0	0	0	0
Netherlands	3	5.06%	3	12	8	12	0
Spain	3	2.14%	2	8	20	0	1[(e)]
Sweden	4	1.88%	4	4	8	3	0
Switzerland	2	4.50%	2	3	3	2	0
United Kingdom	6	9.81%	4	11	10	7	0
United States	20	20.57%	10	15	26	24	0
Total	**100**	**100.00%**	**48**	**20**	**182**	**65**	-

Notes The Home Country Branch/Sub Legislation Index is equal to zero if the legal requirements for a branch are the same as for a subsidiary. Instead, it is equal to one if there are more requirements for a branch than for a subsidiary The references to each case with 1 can be found below Note that none of the host countries in the sample were EU members in 2002

(a) No bank shall have any branch, other than a representative office, outside Canada, without the approval of the Minister, whose approval may be subject to such terms and conditions as the Minister considers appropriate (Banking Act, art 422)

(b) An institution shall report immediately to the Federal Banking Supervisory Office and the Deutsche Bundesbank, the establishment, relocation and closure of a branch in a non-EEA state (Banking Act, art 24 (7))

(c) Overseas Branches should not rely substantially on borrowed funds for asset expansion above the tolerance level (Instruction of RBI for Banks &Banking Operations. Chapter 17, paragraph 17 1 (viii)) Numerous ceilings to individual borrowers and the exposure of branches overseas (Instruction of RBI for Banks &Banking Operations. Chapter 17, paragraph 17.3). In depth and detailed "reviews" of the working of the overseas branches in each country at reasonable intervals of not more than a year and put the reviews for the consideration of the Top management and the Board of Directors (Instruction of RBI for Banks &Banking Operations Chapter 17, paragraph 17 11 (v))

(d) Italian banks may establish branches in a non-member state, subject to authorization by the Bank of Italy Italian banks may establish branches in Italy and in other member states (Banking Act, art 15(2))

(e) If it is intended to open the branch in a non-EU Member State, the Banco de España can refuse the application on the basis of, and in addition to the foregoing reasons, the fact that it considers that the activity of the branch is not going to be subject to effective control by the supervisory authorities of the host country, or that there exists legal or some other kind of obstacles that prevent or hamper control and inspection of the branch by the Banco de España (Real Decreto 1245/1995, art 13)

* China Banking Regulatory Commission (CBRC) was officially launched on April 28, 2003 Before it was regulated by the PBOC (People's Bank of China). The main banks are state banks. No legislation was found for that period

Source: Parent Countries' Banking Sector Regulations, National Central Banks, Bankers Almanac, and Bankscope

Table 4.4. Host Country Regulation on the Organizational Choice of Foreign Banks: Branch vs. Subsidiary Index

Countries	Written Statements	Restriction on Activities	Responsibilities Undertaken	Other Restrictions	*Host Country Regulation Index*
Argentina	0	0	0	0	**0**
Bolivia	1[a]	0	0	0	**1**
Brazil	0	0	0	0	**0**
Bulgaria	1[b]	0	0	0	**1**
Chile	0	0	0	0	**0**
Croatia	1[c]	1[d]	1[e]	0	**3**
Czech Republic	0	0	0	0	**0**
Ecuador	0	0	0	0	**0**
Estonia	0	0	0	0	**0**
Hungary	0	1[f]	0	1[g]	**2**
Latvia	0	0	0	0	**0**
Lithuania	0	0	0	0	**0**
Mexico	0	1[h]	0	0	**1**
Peru	0	0	0	0	**0**
Poland	0	0	1[i]	1[j]	**2**
Slovak Republic	0	1[k]	0	0	**1**
Slovenia	0	0	0	0	**0**
Turkey	0	0	0	0	**0**
Uruguay	0	0	0	0	**0**

Notes: This table explains how the Host Country Legislation Index was built. The index was developed using four subcategories: Required Written Statements, Restrictions on Activities, Responsibilities Undertaken and Other Restrictions. Each category is equal to zero if the legal requirements for a branch are the same as for a subsidiary. It is equal to one if there are more requirements for a branch than for a subsidiary. The references to each case with 1 can be found below.

(a) Written approval of bank supervisory body of country of domicile required to open a bank branch (Law of Financial Institutions, art 17 (1))

(b) Written approval of bank supervisory body of country of domicile required for opening a bank branch (Law of Banks, art 12). Also written statement of the bank's supervisory body agreeing exchange of information and prompt notification of news to the Bulgarian authorities (Regulation 2, section II).

(c) (Among others) An opinion or approval of the supervisory authority of a bank of a Member State or the supervisory authority of a foreign bank on a bank that intends to establish a bank in the Republic of Croatia. (Banking Law, art 35)

(d) A branch office of Foreign banks shall not perform the activities determined by the provisions of Articles 35, 36 and 37 of the Banking Act (e.g. receive deposits, etc). Special conditions for operating a branch office of foreign banks shall be regulated by Croatia National Bank (Banking Act, art 21)

(e) A branch may conduct operations within the Republic of Croatia pursuant to the authorization of the founder bank and with the implicit responsibility of the founder bank for all obligations undertaken in the Republic of Croatia in relation to the operations of the branch. (Banking Law, art 51)

(f) Unless otherwise provided for by an international agreement, the Government may, based on a law or an authorization granted by law, prescribe by decree that only economic organizations with business offices registered in Hungary or organizations under full or majority ownership of domestic residents may be entitled to perform certain activities. (Branch Act, section 8)

(g) A branch office may be entered in the company registration records if an international agreement concluded with the country, or international organization, where the registered office, in which the foreign company is located, allows the foreign company to establish a branch office in Hungary. (Branch Act, section 5) From 1 January 1998, The Branch Act recognizes and authorizes for the first time the "branch" as a legal form of establishment in Hungary.

(h) The Secretariat of Finance and Public Credit may authorize the establishment in the Republic of branches of pre-eminent foreign banks, whose borrowing and lending operations may be conducted only with residents outside Mexico. (Law of Credit Institutions, art 7)

(i) The application shall have appended thereto an undertaking from the applicant foreign bank that it will satisfy all claims on the branch that may arise from its relations with other organizations. (Banking act, art40 (3))

(j) The Commission for Banking Supervision stated in a debate that the most appropiate form of foreign organization in the baking business in Poland would be a joint-stock bank (source: The Polish Banking System in the Nineties, National Bank of Poland, December 2001) The authorization of the Commission for Banking Supervision is a requirement for the establishment of a branch of a foreign bank (Banking Act, art 40)

(k) A branch of a foreign bank may only be permited mortgage transactions if the foreign bank applying for the license has a license to perform mortgage transactions in the home country...(Banking Act, art 8(9))

Source: Host Countries' Banking Sector Regulations

Table 4.5. Probit Estimation of the Likelihood that a Foreign Bank Operates as a Branch

Independent Variables	*Dependent variable: Branch=1 ; Sudsidiary=0*					
	Model (1)	*Model (2)*	*Model (3)*	*Model (4)*	*Model (5)*	*Model (6)*
Parent Bank Internationalization Strategy	3.22 (1.24) ***	3.23 (1.29) **	3.24 (1.20) ***	3.24 (1.27) **	3.39 (1.34) **	3.39 (1.31) ***
Parent Bank Size	-0.39 (0.24)	-0.43 (0.24) *	-0.29 (0.23)	-0.31 (0.26)	-0.40 (0.25)	-0.31 (0.30)
Parent Bank Retail Business Orientation	0.70 (0.52)	0.79 (0.52)	0.49 (0.53)	0.45 (0.55)	0.68 (0.52)	0.47 (0.54)
Home Country Regulations on Overseas Branches	-0.74 (0.30) **	-0.75 (0.29) **	-0.81 (0.30) ***	-0.85 (0.30) ***	-0.71 (0.29) **	-0.77 (0.30) **
Affiliate Bank Size	-0.25 (0.15) *	-0.27 (0.16)	-0.28 (0.15) *	-0.31 (0.17) *	-0.30 (0.16) *	-0.31 (0.16) **
Affiliate Bank Business Orientation	-0.85 (0.35) **	-0.88 (0.34) ***	-0.88 (0.34) ***	-0.96 (0.32) ***	-0.82 (0.33) **	-0.84 (0.32) ***
Year of Entry	-0.03 (0.01) ***	-0.03 (0.01) ***	-0.03 (0.01) ***	-0.04 (0.01) ***	-0.03 (0.01) ***	-0.03 (0.01) ***
Acquisition Dummy	-1.53 (0.32) ***	-1.52 (0.36) ***	-1.87 (0.42) ***	-1.93 (0.46) ***	-1.79 (0.46) ***	-2.12 (0.58) ***
Host Country Regulations on Foreign Branches	-0.84 (0.32) ***	-0.44 (0.25) *	-1.37 (0.33) ***	-0.72 (0.29) **	-0.62 (0.20) ***	-1.14 (0.42) ***
Host Country Bank Entry Requirements	-0.28 (0.19)	-0.22 (0.19)	-0.40 (0.19) **	-0.34 (0.21)	-0.36 (0.21) *	-0.48 (0.22) **
Host Country Restrictions on Bank Activities	0.12 (0.12)	0.20 (0.12) *	0.01 (0.10)	0.13 (0.12)	0.17 (0.12)	0.05 (0.13)
Host Country Corporate Taxes	0.07 (0.02) ***	0.06 (0.02) ***	0.10 (0.03) ***	0.09 (0.02) ***	0.09 (0.03) ***	0.12 (0.03) ***
Host Country Size	-0.03 (0.14)	-0.15 (0.13)	0.09 (0.10)	-0.09 (0.10)	-0.16 (0.11)	-0.03 (0.12)
Host Country GDP per Capita	-0.48 (0.13) ***	-0.39 (0.13) ***	-0.53 (0.14) ***	-0.30 (0.13) **	-0.59 (0.13) ***	-0.62 (0.14) ***
ICRG Country Risk (Composite index)	0.00 (0.04)					
ICRG Political Risk		0.05 (0.04)		0.12 (0.04) ***		
ICRG Economical Risk			-0.12 (0.06) **	-0.22 (0.07) ***		-0.11 (0.06) *
ICRG Investment Risk					0.27 (0.12) **	0.25 (0.14) *
Latin America Dummy	0.12 (0.36)	0.05 (0.36)	-0.12 (0.39)	-0.58 (0.43)	0.30 (0.40)	0.02 (0.45)
Number of Observations	240	240	240	240	240	240
Pseudo R-squared	0.58	0.58	0.59	0.61	0.59	0.60
Wald chi2	114.67	116.90	108.49	194.96	121.21	126.48
P-value of Wald chi2	0.00	0.00	0.00	0.00	0.00	0.00

This table reports probit regressions with standard error adjusted for clustering on each parent bank. A constant is estimated but not reported. Robust Standard Errors are in parentheses. *, **, *** mean significance at ten, five and one percent, respectively.

Table 4.6. Impact of the Determinants of the Likelihood of a Foreign Bank Operating as a Branch

Variables	Marginal Effects	Standard Desviation	Impact Effects on the Probability of Beign a Branch (in % terms)
Parent Bank Internationalization Strategy	0.163	0.172	2.805
Parent Bank Size	-0.015	0.596	-0.920
Parent Bank Retail Business Orientation	0.015	0.243	0.375
Home Country Regulations on Overseas Branches	-0.038	0.486	-1.854
Affiliate Bank Size	-0.015	3.888	-5.996
Affiliate Bank Business Orientation	-0.063	0.493	-3.124
Year of Entry	-0.002	24.774	-4.368
Acquisition Dummy	-0.097	0.487	-4.728
Host Country Regulations on Foreign Branches	-0.036	0.948	-3.453
Host Country Bank Entry Requirements	-0.017	0.916	-1.560
Host Country Restrictions on Bank Activities	0.007	1.962	1.321
Host Country Corporate Taxes	0.005	7.683	3.461
Host Country Size	-0.005	1.391	-0.637
Host Country GDP per Capita	-0.015	1.719	-2.605
ICRG Political Risk	-0.006	6.975	-4.319
ICRG Economical Risk	0.011	2.879	3.174
Latin America Dummy	-0.030	0.501	-1.505

Note: The marginal effect of dummy variables is considered from a change from 0 to 1

Table 4.7. First Stage Heckman Probit Estimations of the Likelihood that a Foreign Bank Operates in a Given Host

Independent Variables	*Dependent variable: Entry=1 ; Non-Entry=0*					
	Model (1)	*Model (2)*	*Model (3)*	*Model (4)*	*Model (5)*	*Model (6)*
Parent Bank Worldwide Activity	0.04 (0.01) ***	0.04 (0.01) ***	0.04 (0.01) ***	0.04 (0.01) ***	0.04 (0.01) ***	0.04 (0.01) ***
Parent Bank Size	0.13 (0.15)	0.13 (0.15)	0.13 (0.15)	0.14 (0.15)	0.13 (0.15)	0.14 (0.15)
Parent Bank Retail Orientation	0.14 (0.34)	0.13 (0.34)	0.14 (0.34)	0.15 (0.34)	0.14 (0.34)	0.14 (0.34)
Home Country (outward) Foreign Investment Regulation	0.18 (0.34)	0.18 (0.34)	0.18 (0.33)	0.20 (0.34)	0.19 (0.34)	0.18 (0.33)
Host Country (inward) Foreign Investment Regulation	-0.31 (0.08) ***	-0.27 (0.08) ***	-0.33 (0.08) ***	-0.29 (0.07) ***	-0.30 (0.08) ***	-0.32 (0.09) ***
Host Country Bank Entry Requirements	-0.09 (0.04) **	-0.08 (0.04) **	-0.09 (0.04) **	-0.10 (0.07) **	-0.09 (0.04) **	-0.10 (0.04) **
Host Country Restrictions on Bank Activities	-0.04 (0.02) **	-0.05 (0.02) **	-0.05 (0.02) **	-0.08 (0.02) ***	-0.04 (0.02) *	-0.04 (0.02) *
Host Country Corporate Taxes	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01) *	-0.01 (0.01)	-0.01 (0.01)
Host Country Size	0.28 (0.05) ***	0.29 (0.05) ***	0.27 (0.05) ***	0.25 (0.04) ***	0.28 (0.05) ***	0.27 (0.05) ***
Host Country GDP per Capita	0.06 (0.01) ***	0.05 (0.01) ***	0.07 (0.01) ***	0.04 (0.01) ***	0.06 (0.01) ***	0.07 (0.02) ***
ICRG Country Risk (Composite index)	0.00 (0.01)					
ICRG Political Risk		-0.01 (0.01) **		-0.03 (0.01) ***		
ICRG Economical Risk			0.02 (0.01)	0.06 (0.02) **		0.01 (0.02)
ICRG Investment Risk					0.03 (0.03)	0.02 (0.04)
Bilateral Trade	54.20 (14.33) ***	49.46 (14.59) ***	56.04 (13.95) ***	48.85 (14.64) ***	57.75 (15.59) ***	58.10 (15.51) ***
Colony	0.38 (0.20) *	0.43 (0.20) **	0.43 (0.19) **	0.67 (0.18) ***	0.35 (0.20) *	0.40 (0.21) *
Bilateral Distance	-0.21 (0.04) ***	-0.21 (0.04) ***	-0.21 (0.04) ***	-0.22 (0.04) ***	-0.20 (0.04) ***	-0.21 (0.04) ***
Common Language	1.09 (0.49) **	1.05 (0.48) **	1.06 (0.48) **	0.85 (0.45) *	1.13 (0.48) **	1.09 (0.48) **
Common Legal Origin	0.18 (0.14)	0.20 (0.14)	0.18 (0.14)	0.19 (0.14)	0.18 (0.13)	0.17 (0.14)
Latin America Dummy	0.69 (0.23) ***	0.78 (0.24) ***	0.73 (0.25) ***	1.03 (0.28) ***	0.66 (0.25) ***	0.70 (0.28) **
Wald test of indep. eqns. (rho = 0): chi2(1) =	0.06	0.09	0.05	0.35	0.34	0.24
Prob > chi2	0.81	0.76	0.83	0.55	0.56	0.63
Number of observation	1933	1933	1933	1933	1933	1933
Censored observations	1693	1693	1693	1693	1693	1693
Uncensored observations	240	240	240	240	240	240

This table reports the first stage of Heckman probit regressions with standard error adjusted for clustering on each parent bank A constant is estimated but not reported. Robust Standard Errors are in parentheses *, **, *** mean significance at ten, five and one percent, respectively.

Table 4.8. Second Stage Heckman Probit Estimations of the Likelihood that a Foreign Bank Operates as a Branch

Independent Variables	*Dependent variable: Branch=1 ; Sudsidiary=0*					
	Model (1)	*Model (2)*	*Model (3)*	*Model (4)*	*Model (5)*	*Model (6)*
Parent Bank Internationalization Strategy	3.22 (1.25) ***	3.22 (1.30) **	3.24 (1.21) ***	3.21 (1.27) **	3.37 (1.34) **	3.38 (1.32) ***
Parent Bank Size	-0.41 (0.28)	-0.47 (0.28)	-0.31 (0.26)	-0.37 (0.28)	-0.46 (0.29)	-0.35 (0.29)
Parent Bank Retail Bussines Orientation	0.68 -0.52	0.75 -0.52	-0.81 -0.52	0.40 -0.55	0.62 -0.52	0.44 -0.53
Home Country Regulations on Overseas Branches	-0.74 (0.30) **	-0.74 (0.30) **	-0.81 (0.30) ***	-0.83 (0.30) ***	-0.70 0.30 **	-0.76 (0.31) **
Affiliate Bank Size	-0.26 (0.15) *	-0.27 (0.17) *	-0.28 (0.15) *	-0.31 (0.17) *	-0.30 (0.16) *	-0.32 (0.16) **
Affiliate Bank Bussines Orientation	-0.85 (0.35) **	-0.88 (0.34) ***	-0.88 (0.34) ***	-0.98 (0.32) ***	-0.83 (0.33) **	-0.85 (0.33) ***
Year of Entry	-0.03 0.01 ***	-0.03 0.01 ***	-0.03 0.01 ***	-0.04 0.01 ***	-0.03 0.01 ***	-0.03 0.01 ***
Acquisition Dummy	-1.53 (0.32) ***	-1.52 (0.36) ***	-1.87 (0.42) ***	-1.91 (0.48) ***	-1.79 (0.47) ***	-2.12 (0.59) ***
Host Country Regulations on Foreign Branches	-0.83 (0.32) ***	-0.44 (0.25) *	-1.37 (0.33) ***	-0.71 (0.30) **	-0.61 (0.20) ***	-1.12 (0.44) ***
Host Country Bank Entry Requirements	-0.27 (0.18)	-0.22 (0.18)	-0.40 (0.19) **	-0.32 (0.21)	-0.35 (0.21) *	-0.47 (0.22) **
Host Country Restrictions on Bank Activities	0.12 (0.11)	0.20 (0.11) *	0.01 (0.10)	0.14 (0.12)	0.16 (0.12)	0.05 (0.13)
Host Country Corporate Taxes	0.07 (0.02) ***	0.06 (0.02) ***	0.10 (0.03) ***	0.09 (0.02) ***	0.09 (0.03) ***	0.12 (0.03) ***
Host Country Size	-0.05 (0.17)	-0.17 (0.15)	0.08 (0.12)	-0.12 (0.12)	-0.20 (0.14)	-0.06 (0.14)
Host Country GDP per Capita	-0.48 (0.13) ***	-0.38 (0.13) ***	-0.53 (0.14) ***	-0.29 (0.13) **	-0.59 (0.13) ***	-0.62 (0.14) ***
ICRG Country Risk (Composite index)	0.00 (0.04)					
ICRG Political Risk		0.05 (0.04)		0.13 (0.04) ***		
ICRG Economical Risk			-0.12 (0.06) **	-0.22 (0.07) ***		-0.11 (0.07) *
ICRG Investment Risk					0.28 (0.12) **	0.26 (0.14) *
Latin America Dummy	0.13 (0.36)	0.06 (0.36)	-0.12 (0.39)	-0.58 (0.43)	0.33 (0.40)	0.05 (0.46)

This table reports the second stage of Heckman probit regressions with standard error adjusted for clustering on each parent bank. A constant is estimated but not reported. Robust Standard Errors are in parentheses. *, **, *** mean significance at ten, five and one percent, respectively. See first stage estimation for more details

CHAPTER 5

CONCLUSIONS

This dissertation highlights the importance of studying banking and currency crises together. It shows theoretically how the introduction of a self-fulfilling circular link, which is driven by the cost to the government budget of a banking sector bailout and the reaction of depositors to the potential impact of a devaluation on the banking sector balance sheet, can increase the possibility of abandonment of a fixed exchange rate regime. In the model, a currency crisis is possible for a better level of fiscal fundamentals than in other models which do not take into account the interaction between a banking crisis and a currency crisis. The model also supports the intuition that hard pegs might offer more protection than soft pegs against currency crises in terms of fiscal fundamentals, but they might increase the possibility of twin crises due to worse banking fundamentals (e.g. higher currency mismatch levels).

This dissertation also provides empirical evidence that supports one of the key assumptions used in the theoretical model. Depositors' withdrawal decisions are a function of depositors' devaluation expectations. During banking crises, the higher the devaluation expectations, the greater are the withdrawals of deposits. Regarding the currency mismatch the empirical evidence is not as clear. I documented the existence of a large currency mismatch among the Argentinean non-tradable sector during the period under study, which the model implies could be important. However, there is no conclusive evidence in the Argentinean case, neither at the aggregate nor at the bank-level, regarding the response of depositors to different levels of currency mismatch exposure. Probably, the reason why devaluation expectations matters is the

existence of currency mismatch. But variation in currency mismatch is not sufficient to test this aspect of the model. Future research using other countries with different level of currency mismatch and different exchange rate regimes could provide valuable insight regarding depositors' reactions to different levels of currency mismatch, and, hence, to the model's prediction that hard pegs might increase the possibility of twin crises due to higher currency mismatch levels.

Finally, I examine the effects of a significant presence of foreign banks within the banking sector, one of the most common prescriptions in order to avoid bank runs in economies with fixed-exchange-rate regimes. There is no conclusive evidence that would always support the idea of favorable depositors' attitudes towards foreign banks during the Argentinean bank runs that were studied. The results suggest that foreign banks, especially foreign branches, gained proportionally more deposits during most bank runs but not all. Some positive and negative significant signs of the foreign branches' dummies were still present even after I controlled for differences in bank fundamentals and bank size, although to a lesser extent. The evidence of favorable attitudes towards foreign branches supports the view that depositors might have also been considering other factors beside bank fundamentals such as foreign branches' access to their parent bank's capital and liquidity. The evidence, regarding negative sign of the foreign branches' dummy during the last systemic bank run, might point to increases in the depositors' government intervention fears, and, hence the action of ring fencing provisions. Moreover, from the parent banks' point of view, Chapter 4 finds similar evidence. Foreign banks prefer to operate as subsidiaries in host countries characterized by relatively high economic risk, and they prefer to operate as branches when it comes to risks stemming from possible government intervention and other major political events (such as civil unrest or wars) since the branches are often protected against such events by ring fencing provisions.

APPENDIX A

PROOF OF PROPOSITION 1 OF CHAPTER 2

A strategy in an incomplete information game form of the model is a function $s : \Pi \rightarrow \{0, 1\}$, where $s(\theta_i)$ is the action (i.e. withdraw early or not) chosen if a player observes signal θ_i. We are interested in strategy profiles, $(s_i)_{i\epsilon[0,1]}$, that form a Bayesian Nash equilibrium of the incomplete model game.

The game described in the model satisfies the following lemmas required in the two-actions symmetric Global Game literature [e.g. Morris and Shin (2003) and Frankel et al (2003)] in order to achieve a unique equilibrium:

Lemma 1 - Action Monotonicity: $\widehat{\pi}(n, \theta)$ is non-increasing in n.

Proof: It was established that the consumer's domestic currency payoff at t=2 is strictly decreasing if $0 \leq d < 1$ (i.e. there exists strategic complementarities among depositors) or constant if $d = 1$. Moreover, the devaluation effect is also a function of n. From equation (2.4) we know that $\frac{\partial \varepsilon}{\partial n} \geq 0$. Therefore, the *consumer's foreign-currency payoff* at t=2 is $\frac{\partial \widehat{\pi}(n,\theta)}{\partial n} \leq 0$ independent of the size of the bailout.

Lemma 2 - State Monotonicity: $\widehat{\pi}(n, \theta)$ is non-increasing in θ.

Proof: from equation (2.4) $\frac{\partial \varepsilon}{\partial \theta} \geq 0$ and from equation (2.12) $\frac{\partial \widehat{\pi}(n,\theta)}{\partial \varepsilon} < 0$. Hence, $\frac{\partial \widehat{\pi}(n,\theta)}{\partial \theta} = \frac{\partial \widehat{\pi}(n,\theta)}{\partial \varepsilon} \frac{\partial \varepsilon}{\partial \theta} + \frac{\partial \widehat{\pi}(n,\theta)}{\partial n} \frac{\partial n}{\partial \varepsilon} \frac{\partial \varepsilon}{\partial \theta} \leq 0$.

Lemma 3 - Uniform Limit Dominance: there exists thresholds $\underline{\theta}$, $\overline{\theta}$ (where $\underline{\theta} < \overline{\theta}$),and $\delta > 0$ such that:

$$\widehat{\pi}(n,\theta) - 1 \leq -\delta \text{ for each } \theta \geq \overline{\theta} \text{ and for each } n \tag{A.1}$$

$$\widehat{\pi}(n,\theta) - 1 > \delta \text{ for each } \theta \leq \underline{\theta} \text{ and for each } n \tag{A.2}$$

Proof: On the one hand, equation (A.1) implies that the depositors will always run on the bank (e.g. a dominant action) when the level of fiscal fundamentals is above $\overline{\theta}$, no matter what they believe other depositors are going to do. We know that there will be a devaluation for θ above the government intermediate cut-off section of fiscal fundamentals. Hence, it is easy to justify the idea that there will be a level of fiscal fundamentals from which the return of the project will be less than one unit of foreign currency. On the other hand, equation (A.2) implies that the depositors will always wait until the long term when the level of fiscal fundamentals is below $\underline{\theta}$. This property is satisfied in our model because we assume a minimum value of Π^* given d. It is worthwhile noting that there will not be a devaluation for θ to the left of the government intermediate cut-off section.[1]

Lemma 4 - Strict Laplacian State Monotonicity: the threshold strategy θ^* is the unique solution to the following equation:

$$\int_0^1 \left[\widehat{\pi}\left(n, \varepsilon\left(\theta^* + \sigma F^{-1}(1-n), n\right)\right) - 1\right] dn = 0 \tag{A.1}$$

Proof: Let start by defining some notation. Let us define $\varepsilon^i_{\exp}$ as the agent i's devaluation expectations. Through equations (2.4) and (2.7), it is known that:

$$\varepsilon^i_{\exp} \begin{cases} 0 & if \quad \theta < k - \varphi\varepsilon_{\exp} - D \\ E\{\frac{\varphi}{\alpha+\varphi^2}(\theta + \varphi\varepsilon_{\exp} + D)\,|\theta_i\} & if \quad \theta \geq k - \varphi\varepsilon_{\exp} - D \end{cases} \tag{A.2}$$

[1] The total bailout cost for the government is limited from above because the maximum bailout that the government has to pay is given by d and $n = 1$.

where ε_{exp} is the average expectation of devaluation observed by the government (e.g. $\varepsilon_{\text{exp}} = \int_0^1 \varepsilon^i_{\text{exp}}\, di$). Since for each agent i participation in the aggregate is marginal, and due to the fact that all agents have to rely on their own information to form their beliefs about signals reaching the other agents (their signal does not give them information on their signal's ranking within the population of signals), the conditional expectation of ε_{exp} by agent i is a function of n and θ.

Additionally, it is known that each agent's devaluation expectation is non-decreasing in θ due to a direct effect and also indirect effects through D and ε_{exp}. In general, we can say that the size of the devaluation expectations is a function of n and θ. In equation A.1 notation, we have that $\varepsilon(\theta, n)$, where $\frac{\partial \varepsilon(n,\theta)}{\partial n} \geq 0$ and $\frac{\partial \varepsilon(n,\theta)}{\partial \theta} \geq 0$.

The expected *consumers' foreign-currency payoff* at t=2 is a function of n and θ as can be observed in equation A.3:

$$\widehat{\pi}(n,\theta) = \frac{\{1 - \sqrt{[1-d(1-n)]n}\}\Pi^*}{(1-n)\, e^{\upsilon \varepsilon_{\text{exp}} + \ln E_0}} \tag{A.3}$$

On the one hand, it is known that $\widehat{\pi}(n,\theta)$ is non-decreasing in θ (from Lemma 2). On the other hand, it is known that $\widehat{\pi}(n,\theta)$ is strictly decreasing in n through both the expected devaluation effect and the increasing return to scale.[2]

Finally, from the Uniform Limit Dominance assumption, it is known that there exists thresholds $\underline{\theta}$, $\overline{\theta}$ (where $\underline{\theta} < \overline{\theta}$),and $\delta > 0$ such that:

$$\frac{\left[1 - \sqrt{[1-d(1-n)]n}\right]\Pi^*}{(1-n)\, e^{\nu\varepsilon + \ln E_0}} - 1 \leq -\delta \text{ for each } \theta \geq \overline{\theta} \text{ and for each } n \tag{A.4}$$

[2]If $d = 1$ there is not perfect strategic complementatities among depositors (e.g. $\widehat{\Pi}(\theta, n)$ is not stricly decreasing in n). Nevertheless, $\widehat{\Pi}(\theta, n) - 1$ will cross cero only if there is a devaluation. So $\frac{\partial \theta}{\partial n} > 0$, and them $\frac{\partial \widehat{\Pi}(\theta,n)}{\partial n} < 0$).

$$\frac{\left[1-\sqrt{[1-d(1-n)]n}\right]\Pi^*}{(1-n)\,e^{\nu\varepsilon+\ln E_0}}-1>\delta \text{ for each } \theta\leq\underline{\theta} \text{ and for each } n \qquad \text{(A.5)}$$

Therefore, there must exist a unique θ^*, such as $\underline{\theta}<\theta^*<\overline{\theta}$ and that satisfies equation A.1

In summary, the global game defined in our model satisfies the uniqueness conditions on a continuum of players, two actions symmetric game Morris and Shin (2003, section 2.2). As a result, there exists a unique θ^*, for which patient consumers will not run on the bank if they observe a signal below θ^* and they will run if they observe a signal above θ^*. It is worthwhile to highlight that these authors show not merely that the model has a unique Bayesian equilibrium, but that the strategy profile associated with the unique equilibrium survives iterated deletion of strictly dominated strategies. QED.

APPENDIX B

DESCRIPTION OF CHAPTER 3'S BANK-RUN EPISODES

B.1 Dec 1994 – Apr 1995: Systemic Bank Run (Tequila Crisis)

On December 20th, 1994, Mexico devalued its currency. Investors and the public at large feared that a devaluation of Argentina's domestic currency would follow the Mexican devaluation. This sense of uncertainty was soon reinforced by the upcoming Argentine presidential elections of May 14th, 1995.

It is possible to divide this systemic bank run into two phases. The First Phase took place during December 1994 and January 1995. Through the first phase, depositors mostly ran on peso-denominated deposits. Dollar-denominated deposits increased but not enough to compensate the important fall in peso-denominated deposits. The second phase of the Tequila systemic bank run occurred from February to April 1995. Both peso and dollar-denominated deposits decreased sharply during this period. It is worthwhile to highlight that both peso and dollar-denominated deposits increased in foreign branches during both the first and the second phases of this systemic bank run.

Although 9 banks closed their doors (5 banks were suspended by the Central Bank and 4 were absorbed by other banks), they represented less than 1.60 percent of the total assets of the banking sector.

B.2 Jun 1996 – Aug 1996: Peso-Deposit Bank Run (Cavallo Resignation)

Domingo Cavallo, the finance minister who designed the currency board was laid off on July 26th, 1996. Strong rumors about his resignation started in June. Economic agents were initially concerned about the viability of the currency board without its creator.

Although the banking sector did not lose deposits during this period, the fall in peso-denominated deposits was above 12 percent. Consequently, deposit dollarization increased by around 5 percent. At the end of August 1996, dollar-denominated deposits represented 74 percent of total deposits.

In the aggregate, foreign banks gained deposits, especially foreign branches which gained both peso and dollar-denominated deposits. Only 3 banks were absorbed – there were no Central Bank suspensions– during the period and they represented less than one half percent of the total assets of the banking sector.

B.3 Oct 1997 – Nov 1997: Peso-Deposit Bank Run (Asian Crises)

Although the Asian crisis started in July 1997 after the currency devaluation implemented by Thailand, Malaysia, and Indonesia, the first consequence that can be observed in Argentina was after the First Attack on the Hong Kong dollar on October 23rd. Hong Kong had implemented a currency board similar to the Argentinean one, hence economic agents worried again about the sustainability of the Argentinean system.

The peso-deposit bank run produced a 6 percent fall in peso-denominated deposits but the total level of deposits increase by about 5 percent. At the end of November 1997, dollar deposits represented 72 percent of total deposits. During this period, in

the aggregate groups, foreign-owned subsidiaries and foreign branches gained both peso and dollar-denominated deposits.

Two banks were suspended (and then revoked) by the Central Bank. Nevertheless, they represented less than a quarter percentage point of the total banking sector's assets.

B.4 Aug 1998 – Sep 1998: Peso-Deposit Bank Run (Russian Default)

Russia defaulted on its debt and devalued its currency on August 17th, 1998. This increased concern about the debt and currency sustainability of numerous emerging markets, including Argentina. The analysis of newspaper articles shows that economic agents were also worried about the fate of Brazil immediately after the Russian default. Agents were expecting more negative effects if a crisis started in Brazil, Argentina's main trading-partner.[1]

The fall in peso-denominated deposits was important, 12 percent, in only two months. Although the increase in dollar-denominated deposits was not enough to offset completely the drop in peso-denominated deposits, the decrease in total deposits was only one half percentage point. This is the only peso-deposit bank run episode in our study when there was a decrease in total deposits within the banking sector.

During this peso-deposit bank run, the Central Bank suspended Mayo Coop Bank which had about one percent of the banking sector's assets. In terms of assets, this was the most important suspension during the bank-run episodes under study.

---

[1] Newspaper La Nacion, October 18, 1998.

B.5 May 1999: Peso-Deposit Bank Run (Debate about the convenience of the Currency Board)

The Recession, the impact of the Brazilian devaluation on Argentina, and Brazil's less than traumatic transition after the devaluation increased the debate about the future of the convertibility. A Financial Times article and George Soros's opinion about the future of the currency board also increased the debate. The uncertainty decreased after the IMF and others endorsed the currency board and the government expressed its preference for going to full dollarization instead of devaluing the peso.

Although this peso-deposit bank run only lasted one month, the fall in peso-denominated deposits was important (6.3 percent). The increase in dollar-denominated deposit completely offset the drop in peso-denominated deposits. All banks grouped by ownership lost peso-denominated deposit and they gained dollar-denominated deposits. Only Public banks and Domestic private banks decrease they level of total deposit in May 1999.

No banks closed its doors during this peso-deposit bank run.

B.6 Aug 1999 – Sep 1999: Peso-Deposit Bank Run (Uncertainty before Presidential Elections)

The presidential elections were held on October 20th, 1999. Months before the election, the commitment of the two main presidential runners to the currency board was not clear. The uncertainty decreased after the favorite candidate in the polls (subsequently elected president) pledged the continuation of the currency board during the last weeks prior to the election.

This peso-deposit bank run is similar to the one identified in May 1999. We do not classify them as only one period because there was a solid increase in both peso and dollar-denominated deposits during the months of June and July 1999. Moreover, newspaper articles mainly highlighted the uncertainty about frontrunner presidential

candidates' commitments towards the currency board during August and September 1999, and not in May 1999.

The fall of peso-denominated deposits was 5.8 percent. There was no decrease in total deposits, which increased by 0.8 percent due to the 2.9 percent increase in dollar-denominated deposits. All banks grouped by ownership lost peso-denominated deposit and they gained dollar-denominated deposits. Only Public banks decreased their level of total deposits during this peso-deposit bank run.

Two banks –due to absorptions by other banks- left the banking sector during this period. They represented only a quarter percentage point of the total assets of the banking sector.

B.7 Nov 1999 – Dec 1999: Dollar-Deposit Bank Run (Uncertainty due to Y2K)

Newspaper articles during these months mainly highlighted some investors'concerns about the level of preparation that the Argentinean financial sector had undertaken to face the Y2K problem. According to news reports, many depositors either withdrew their deposits from the banking sector or changed them for more liquid instruments (e.g. checking accounts).[2]

This is the only dollar-deposit bank run that there is in the sample which has not happened together with a systemic bank run. Dollar-denominated deposits dropped 3.56 percent, while peso-denominated deposits fell only 1.6 percent. It also worthwhile to highlight that foreign branches were by far the bank group that lost most deposits, both peso and dollar-denominated deposits.

Three banks were absorbed during the dollar-deposit bank run. They represented 0.84 percent of the banking sector's total assets.

---

[2]See "El Efecto 2000" and "Las tasas de interes, en niveles de crisis" published by newspaper La Nacion on December 24 and November 11 respectively.

B.8 Oct 2000 – Nov 2001: Systemic Bank Run (End of Currency Board)

Before October 2000, there was some uncertainty regarding the sustainability of the currency board due to the government's weak fiscal performance and the long economic recession (the decline in the economic aggregate indicators started about late 1998). Nevertheless, an important additional ingredient was added in October which increased the levels of uncertainty even more. On October 6th, 2000, the vice-president (and head of one of the two main coalition parties in the government) resigned.

The drop in both peso and dollar-denominated deposits was important during the period, 42 and 20 percent respectively. Although foreign branches did not lose as many peso-denominated deposits as other bank groups, they lost much more dollar-denominated deposits (e.g. around 28 percent), which resulted in a 30 percent drop in total deposits.

This long period is not homogeneous. Nevertheless, I have classified it as only one period because the sources of uncertainty are the same through the period. This bank run can be sub-divided into five phases.

Phase I – From October 2000 to January 2001

The vice-president's resignation together with the weak fiscal position of the government increased doubts about the continuity of the currency board. The level of uncertainty finally decreased after the government reached an agreement with the IMF on December 19th, 2000. The size of the international aid program was around 40 billion in total, with most parts conditional on the fulfillment of some fiscal goals and other conditions.

All groups of banks by ownership lost peso and dollar-denominated deposits from October to December. Even though the fall in peso and dollar-denominated deposits were different by groups, the total fall in deposits was around 4 percent for all bank

groups. The picture was different in January. On the aggregate, the banking system increased peso and dollar-denominated deposits about 7 percent and 3 percent respectively. The increase on total deposits was around 4 percent. Hence, the banking system recovered the deposits lost during the previous months. Public and Coop banks received the greatest increase on deposits.

Three banks closed during this period, two of them were suspended by the Central Banks. They represented around 0.3 percent of the banking system assets.

Phase II – From February 2001 to May 2001

Even though, at the beginning, the agreement with the IMF was considered sturdy, the weak political base of the government and the crisis in Turkey (Turkey devalued its currency on February 22nd, 2001) triggered a new increased in uncertainty. Moreover, two finance ministers resigned during March.[3] Cavallo was named finance minister on March 20. The public in general welcomed Cavallo's appointment but some of his first measures produced some uncertainty e.g. the removal of the president of the Central Bank who was considered a strong supporter of the currency board, and of the idea of introducing the Euro within the currency board. The debt-swap program implemented by Cavallo during May was in some ways successful and it seemed to decrease the fiscal problems of the government.

The banking sector lost around 6 percent of the deposits during February to April. The fall in peso and dollar-denominated deposits was 13 and 4 percent respectively. Domestic private banks were particularly affected. They lost more than 10 percent of their deposits. There was a recovery in level of the banking sector deposits in May, but it was not enough to offset the drop in deposits during the previous months. In contrast to other bank groups, foreign branches lost deposits during May due to a

[3]Lopez-Murphy was the finance minister who was designated after the resignation of Machinea. Lopez-Murphy lasted only two weeks as finance minister, and he resigned due to differences with the President.

big drop in peso-denominated deposits which was not offset by the modest increase in dollar-denominated deposits.

Only one small foreign branch was suspended by the Central Bank during this period. It represented about 0.01 percent of the banking sector's assets.

Phase III – From June 2001 to August 2001

The ultimate modification of the Currency Board by the Congress on June 20 triggered a new increase in uncertainty and in devaluation expectations. The Congress approved the introduction of the Euro once the Euro and the US dollar reached parity (the value of the Euro was below the US dollar at that moment). This change in the Currency Board, although it did not have any immediate impact on the old rules, signaled to the public how easy it was to change the currency board rules.[4] The introduction of many quasi-currencies also made public the severe fiscal problems of both the federal government and the provincial governments.

The drop in the banking sector's deposits was very large: around 20 and 10 percent of peso and dollar denominated deposits. Public banks were the group most affected. They lost around 40 and 14 percent of their peso and dollar-denominated deposits respectively.

The Central Bank suspended one coop bank during this period, which had only about 0.02 of the banking system assets.

Phase IV – From September 2001 to October 2001

A new agreement was reached with the IMF on August 26. This international support together with measures designed to reduce the fiscal deficit (including a 13 percent cut on public employees and retirees wages) seemed to have slightly decreased the uncertainty and devaluation expectations' levels. However, the political uncer-

[1]The introduction of the Euro in the Currency Board did not happen because Argentina abandoned the Currency Board before the Euro and the US Dollar reached parity.

tainty did not decrease due to national elections and state governors' opposition to following the federal government fiscal adjustments.

On the aggregate, the banking sector gained deposits (3 percent) during these two months due to the 4.6 percent increase in dollar-denominated deposits. The variation in peso-denominated deposits was negative (-5.6 percent). Foreign branches were not only the only group that lost both peso and dollar-denominated deposits, but were the only group that experienced a decrease in the total level of deposits. In contrast, public banks increased their level of deposits in both peso and dollar-denominated deposits.

Only one bank, Chase Manhattan, closed its doors due to the previous merger of its parent bank with JP Morgan which also was present in Argentina.

Phase V – November 2001

The international organizations did not approve of the fiscal indicators presented by the government (i.e. they were below the goals previously established), and also they were not satisfied with the lack of progress in reaching an agreement between the federal and state governments. This closed the doors for international financial assistance. The levels of uncertainty and devaluation expectation increased exponentially.

The drops in peso and dollar-denominated deposits were around 11 and 8 percent respectively. All bank groups suffered a fall in both types of deposits. Proportionally, domestic private banks were the group more affected in both peso and dollar-denominated deposits.

APPENDIX C

ROBUSTNESS VARIABLES USED IN SECTIONS 3 AND 4 OF CHAPTER 3

The following variables were used in the robustness tests:

• Capital to asset ratio captures the banking system capital adequacy. This variable is used with two lags.

• Non-performing loans to total loans captures the banking system asset quality. This variable is used with two lags.

• Return on assets ratio measures the banking system profitability. This variable is used with two lags.

• Banking system cash to asset ratio captures the banking system liquidity. This variable is used with two lags.

• The government exposure variable measures the banking system exposure to government bonds and loans over total assets. This variable is used with two lags.

• Country risk measures the spread between the Argentinean Brady FRB bond (dollar denominated and floating interest rate) over comparable U.S. bonds. This variable is not used in section 4.

• Government fiscal surplus variable is built on the federal government fiscal surplus (without taking into account income derived from privatizations). This variable is used with one lag in order to take into account the delay in the publication of fiscal figures. This variable is not used in section 4.

BIBLIOGRAPHY

[1] Barajas, A., Steiner, R., Salazar N., (2000): "The Impact of Liberalization and Foreign Investment in Colombia's Financial Sector". Journal of Development Economics, v63, n1, pp. 157-96.

[2] Barth, J., Caprio, G. and Levine, R., (2001): "The Regulation and Supervision of Banks around the World: A New Database". Policy Research Working Paper No. 2588. World Bank: Washington, D.C.

[3] Berger, A., Klapper L., and Udell G., (2001): "The ability of banks to lend to informationally opaque small businesses". Journal of Banking and Finance, 25 (12): pp. 2127-2167.

[4] Brymant, J., (1980): "A Model of Reserves, Bank Runs, and Deposit Insurance". Journal of Banking and Finance, 335-344.

[5] Buch, C. and DeLong, G., (2001): "Cross-Border Bank Mergers: What Lures the Rare Animal?" Kiel Institute of World Economics Working Paper No. 1070.

[6] Buch, C. and Lipponer, A., (2004): "FDI Versus Cross-border Financial Services: The Globalization of German Banks". Deutsche Bundesbank Discussion Paper - Series 1 05/2004.

[7] Buch, C., (2000): "Why Do Banks Go Abroad? Evidence from German Banks". Financial Markets, Institutions, and Instruments, 9, pp. 33-67.

[8] Buch, C., (2003): "Information or Regulation: What Drives the International Activities of Commercial Banks?" Journal of Money, Credit and Banking, 35(6), pp. 851-869.

[9] Burnside, C., M. Eichenbaum and S. Rebelo, (2001a): "Hedging and Financial Fragility in Fixe Exchange Rate Regimes". European Economic Review, 45, 1151-1193.

[10] Burnside, C., M. Eichenbaum and S. Rebelo, (2001b): "On the Fiscal Implication of Twin Crises". NBER Working Paper 8277 and forthcoming in M. Dooley and J. Frankel (eds.) Managing Currency Crises in Emerging Markets, Chicago University Press. .

[11] Calomiris, C and J. Mason, (1997): "Contagion and Bank Failures During the Great Depressions: The June 1932 Chicago Banking Panic". American Economic Review, 87, pp.863-83.

[12] Calvo, G., (2000): "Notes in price Stickiness: With Special Reference to Liability Dolarization and Credibility". Manuscript, December.

[13] Calvo, G., (2001): "Capital Markets and the Exchange Rate". Journal of Money, Credit, and Banking, Vol. 33, No 2, pp 312-334.

[14] Caprio, Jr. G. and D. Klingebiel, (1996): "Bank Insolvencies: Cross Country Experience". Policy Research Paper 1620, World Bank.

[15] Carlsson, H. and E. van Damme, (1993): "Global Games and Equilibrium selection". Econometrica, 61(5), pp. 989-1018.

[16] Chang, R. and A. Velasco, (2000): "Financial Fragility and the Exchange Rate Regime". Journal of Economic Theory, 92, pp 1-34.

[17] Chang, R. and A. Velasco, (2001): "A Model of Financial Crises in Emerging Markets". Quarterly Journal of Economics, 111, pp 489-517.

[18] Cho, K., Krishnan, S., Nigh, D., (1987): "The State of Foreign Banking Presence in the United States". International Journal of Bank Marketing, 5, pp. 59–75.

[19] Claessens, S., Demirgüç-Kunt, A., Huizinga, H., (2000): "How Does Foreign Entry Affect Domestic Banking Markets?" Journal of Banking and Finance v25., n5, 891-911.

[20] Clarke, G., Cull, R., Martinez Peria, M. and Sánchez, S., (2003): "Foreign bank entry: Experience, implications for developing countries, and agenda for further research". World Bank Research Observer, 18 (1), pp. 25-40.

[21] Clarke, G., Cull, R., Martinez Peria, M., and Sánchez, S., (2005): "Bank lending to small businesses in Latin America: Does bank origin matter?" Journal of Money, Credit, and Banking, 37(1), pp. 83-118.

[22] Corsetti, G., A. Dasputa, S. Morris and H.S. Shin, (2003): "Does One Soros Make a Difference? A Theory of Currency Crises with Large and Small Traders". Review of Economic Studies,.

[23] Crystal, J., Dages, B. G., Goldberg, L. B., (2001): "Does Foreign Ownership Contribute to Sounder Banks in Emerging Markets? The Latin American Experience", in Litan, R., Masson, P., Pomerleano, M. (Eds.), Open Doors: Foreign Participation in Financial Systems in Developing Countries. Brookings Press, Washington, D.C., pp. 217-266.

[24] Dages, B. G., Goldberg, L. B., Kinney, D., (2000): "Foreign and Domestic Bank Participation in Emerging Markets: Lessons from Mexico and Argentina". Federal Reserve Bank of New York Economic Policy Review, 17-36.

[25] Denizer, C., (2000): "Foreign Entry in Turkey's Banking Sector, 1980–1997", in Claessens, S., Jansen, M. (Eds.), The Internationalization of Financial Services: Issues and Lessons for Developing Countries. Kluwer Academic, Boston, pp. 389-406.

[26] Diamond, D. and P. Dybvig, (1983): "Bank Runs, Deposit Insurance, and Liquidity". Journal of Political Economy, vol. 91, no. 3, 401-419.

[27] Edwards, S., (2002): "The Great Exchange Rate Debate after Argentina". NBER Working Paper 9257, October 2002.

[28] Fisher, A., Molyneux, P., (1996): "A Note on the Determinants of Foreign Bank Activity in London between 1980 and 1989". Applied Financial Economics, 6, pp. 271–77.

[29] Fisher, S., (2001): "Exchange Rates Regimes: Is the Bipolar View Correct?" Journal of Economic Perspectives, 2001, vol. 15, issue 2, pages 3-24

[30] Flood, R.P. and P.M. Garber, (1984): "Collapsing Exchange Rate Regimes – Another Linear Examples". Journal of International Economics, 17, pp. 1-13.

[31] Focarelli, D. and Pozzolo, A., (2000): "The Determinants of Cross-Border Bank Shareholdings: An Analysis with Bank-Level Data from OECD Countries" Banca D'Italia. Tema di Discussione. Number 381.

[32] Frankel, D.; S. Morris and A. Pauzner, (2003): "Equilibrium Selection in Global Games with Strategic Complementarities". forthcoming in the Journal of Economic Theory.

[33] Frankel, J., (2003):"Experience of and Lessons from Exchange Rate Regimes in Emerging Economies," written for the Asian Development Bank, in a study coordinated by Takatoshi Ito and Yung Chul Park. Forthcoming in Monetary and Financial Cooperation in East Asia, Macmillan Press. Also KSG Working Papers Series No. RWP03-011.

[34] Gale, D. and X. Vives, (2002): "Dollarization, Bailouts and the Stability of the Banking System". Quarterly Journal of Economics, Volume CXVII, 467-502.

[35] Galindo, A., Micco A., and Serra, C., 2003. Better the Devil That You Know: Evidence on Entry Costs Faced By Foreign Banks, Inter.-American Development Bank Working Paper No. 477.

[36] Glick, R. and M. Hutchison (1999): "Banking and Currency Crises: How Common Are Twins?" Unpublished manuscript, Federal Reserve Bank of San Francisco and University of California, Santa Cruz.

[37] Goldberg, L. and S. Hudgins, (1996): "Response of Uninsured Depositors to Impending S&L Failures: Evidence of Depositors Discipline". Quarterly Review of Economics and Finance, 36:3, pp. 311-325.

[38] Goldberg, L. B., (2001): "When is U.S. Bank Lending to Emerging Markets Volatile?" Federal Reserve Bank of New York, Mimeo.

[39] Goldberg, L. G., Grosse, R., (1994): "Location Choice of Foreign Banks in the United States". Journal of Economics and Business, 46, pp. 367–79.

[40] Goldberg, L. G., Johnson, D., (1990): "The Determinants of U.S. Banking Activity Abroad". Journal of International Money and Finance, 9, pp. 123–37.

[41] Goldberg, L. G., Saunders, A., (1981a): "The Determinants of Foreign Banking Activity in the United States". Journal of Banking and Finance, 5, pp. 17–32.

[42] Goldberg, L. G., Saunders, A., (1981b): (The Growth of Organizational Forms of Foreign Banks in the U.S.: A Note". Journal of Money, Credit, and Banking, 13, pp. 365–74.

[43] Goldberg, L.G., Saunders, A., (1980): "The Causes of U.S. Bank Expansion Overseas: The Case of Great Britain". Journal of Money, Credit, and Banking, 12, pp. 630–43.

[44] Goldfajn, I. and R. O. Valdes, (1997): "Capital Flows and the Twin Crises: The Role of Liquidity". Working Paper 97-87, International Monetary Fund.

[45] Goldstein, I. and A. Pauzner, (2004): "Demand Deposit Contracts and the Probabilities of Bank Runs". Journal of Finance, forthcoming.

[46] Goldstein, I., (2004): "Strategic Complementarities and the Twin Crises". Economic Journal, forthcoming.

[47] Gorton, G., (1988): "Banking Panics and Business Cycles". Oxford Economic Papers, 40, pp. 751-81.

[48] Haas, de, R. and van Lelyveld, I., (2002): "Foreign Bank Penetration and Private Sector Credit in Central and Eastern Europe". De Nederlandsche Bank Staff Reports No. 91.

[49] Haas, de, R. and van Lelyveld, I., (2004): "Foreign Banks and Credit Stability in Central and Eastern Europe: A Panel Data Analysis". De Nederlandsche Bank Staff Reports No. 109.

[50] Inter-American Development Bank (IDB), (2005): "Unlocking Credit, The Quest for Deep and Stable Bank Lending". Johns Hopkins University Press, Baltimore.

[51] Ize, A., and E. Levy Yeyati, (2005): "Financial Dollarization". Journal of International Economics 59, pp. 323–347.

[52] Jeanne, O. and C. Wyplosz (2001): "The International Lender of Last Resort: How Large is Enough?" NBER Working Paper 8381.

[53] Kaminsky, G. and C. Reinhart, (1999): "Twin Crises: The Causes of Banking and Balance of Payments Problems". American Economic Review, vol. 89 No.4, 473-500.

[54] Krugman, P., (1979): "A Model of Balance-of-Payments Crises". Journal of Money, Credit and Banking, vol. 11, no. 3(August), 311-325.

[55] Levy-Yeyati, E., Martinez-Peria, M. S. and S. Schmukler, (2004): "Market Discipline under Systemic Risk: Evidence from Bank Runs in Emerging Economies". World Bank, mimeo.

[56] Martinez Peria, M. and Mody, A., (2004): "How Foreign Participation and Market Concentration Impact Bank Spreads: Evidence from Latin America". Journal of Money, Credit, and Banking, 36(3), pp. 511-539.

[57] Martinez-Peria, M. S. and S. Schmukler, (2001): "Do Depositors Punish Banks for 'Bad' Behavior? Market Discipline, Deposit Insurance, and Banking Crises". Journal of Finance, 56:3, pp. 1029-1051.

[58] McKinnon, R., (1982): "The Order of Economic Liberalization: Lessons from Chile and Argentina." Carnegie-Rochester Conference Series on Public Policy 17, North-Holland Publishing Company.

[59] Mian, A., (2004): "Distance Constraints: The Limits of Foreign Lending in Poor Economies". Journal of Finance, forthcoming.

[60] Miller, S., and Parkhe, A., (1998): "Patterns in the Expansion of U.S. Banks' Foreign Operations". Journal of International Business Studies, 29 (2), pp. 359–90.

[61] Morris, S. and H. S. Shin, (1998): "Unique Equilibrium in a Model of Self-Fulfilling Currency Attacks". American Economic Review, 88, pp. 587-597.

[62] Morris, S. and H. S. Shin, (2003): "Global Games: Theory and Applications". forthcoming in the Conference Volume of the Eighth World Congress of the Econometric Society.

[63] Moshirian, F., (2001): "International Investment in Financial Services". Journal of Banking and Finance, 25, pp. 317-337.

[64] Nigh, D., Cho, K., Krishnan, S., (1986): "The Role of Location-Related Factors in U.S. Banking Involvement Abroad: An Empirical Analysis". Journal of International Business Studies, 17, pp. 59–72.

[65] Obstfeld, M., (1994): "The Logic of Currency Crisis". Cahiers Economiques et Monetaries, 43, 189-213.

[66] Obstfeld, M., (1996): "Models of Currency Crises with Self-Fulfilling Features". European Economic Review, 40 (April), 1037-1048.

[67] Palmer, D. E., (2000): "U.S. Bank Exposure to Emerging-Market Countries during Recent Financial Crises". Federal Reserve Bulletin, February, 81-96.

[68] Peek, J., and E.S. Rosengren (2000). "Implications of the Globalization of the Banking Sector: The Latin American Experience". New England Economic Review, Federal Reserve Bank de Boston, Sept./Oct.

[69] Postlewaite, A., and X. Vives (1987). "Banks Runs as an Equilibrium Phenomenon". Journal of Political Economy, 95, pp. 485-491.

[70] Rochet, J.-C. and X. Vives, (2002): "Coordination Faillures and the Lender of Last Resort: Was Bagehot Right After All?". HWWA Discussion Paper 184.

[71] Sachs, J., A. Tornell and A. Velasco, (1996a): "The Mexican Peso Crisis: Sudden Death or Death Foretold?". Journal International Economics, 41, pp. 265-283.

[72] Sachs, J., A. Tornell, and A. Velasco (1996b), "Financial Crises in Emerging Markets: The Lessons from 1995," Brookings Papers on Economic Activity 1, pp. 147-212.

[73] Schumacher, L., (2000): "Bank Runs and Currency Runs in a System without a Safety Net: Argentina and the 'Tequila' Shock". Journal of Monetary Economics, 46, pp. 257-277.

[74] Tirole, J., (2002): "Financial crises, Liquidity Provision and the International Financial System." Princeton University Press.

[75] Velasco, A., (1987): "Financial Crises and balance of Payments Crises". Journal of Development Economics, 27, pp 263-283.

[76] Velasco, A., (1996): "Fixed Exchange Rates: Credibility, Flexibility, and Multiplicity". European Economic Review, 40 (April), pp. 1023-1035.

[77] Wezel, T., (2004): "Foreign Bank Entry into Emerging Economies: An Empirical Assessment of the Determinants and Risks Predicated on German FDI Data". Deutsche Bundesbank Discussion Paper - Series 1 01/2004.

CURRICULUM VITAE

Eugenio Cerutti was born in Cordoba, Argentina on August 31st, 1975. He obtained an B.A./M.A. in economics from the Universidad Nacional de Cordoba in Cordoba, Argentina in 1999. In 2000 he entered the Johns Hopkins University in Baltimore, MD where he completed a Master of Arts degree in 2003 and Doctor of Philosophy in October 2005. He is presently employed by the International Monetary Fund, Washington DC.