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Capital Structures and Portfolio Composition During Banking Crisis: Lessons from Argentina 1995

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Abstract

This paper constructs a theoretical framework that rationalizes banks' short- and long-run adjustment dynamics—in portfolio composition and in the capital structure—following a period of financial distress. The model captures stylized facts about banks' behavior following a shock to the capital base—namely, the rush to liquidity and credit crunch. Bank panel data show that Argentine domestic retail banks underwent a period of adjustment of six quarters following the Mexican devaluation crisis, reducing their risk-exposure since, owing to bank capital scarcity, depositors became less prone to tolerate bank default risk. Foreign-owned banks suffered a milder shock and adjusted immediately.

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SUMMARY

This paper builds on previous banking models in the literature and constructs a general two-period theoretical framework that rationalizes banks' short- and long-run adjustment dynamics—in portfolio composition and in the capital structure—following a period of financial distress. By connecting both asset and liability decisions in a single integrated model, the paper is able to replicate a bank's response to a shock to its capital base—namely, the rush to liquidity and credit crunch.

The model generates empirically testable implications, that we gauge using banking panel data for the Argentine banking system in the aftermath of the 1994 Mexican devaluation. The paper finds empirical support for the model's prediction of a positive covariance between asset risk and banks' own capital. Furthermore, it is found that Argentine domestic retail banks underwent a period of adjustment of six quarters and were required to reduce their risk-exposure in comparison with the precrisis period as depositors became less prone to tolerate bank default risk, owing to bank capital scarcity, and constrained banks to reduce asset risk; in contrast, foreign-owned banks seem to have suffered a milder shock and adjusted immediately.

I. Introduction

This paper develops a theoretical framework that rationalizes the adjustment dynamics—in portfolio composition and in the capital structure—that banking systems undergo following periods of financial distress. The paper builds on previous banking models in the literature and connects both asset and liability decisions in a single integrated model. The theoretical model provides empirically testable implications that we will gauge using banking panel data for Argentine banks from 1993 to 1996. This choice will provide fertile ground for analysis of banking distress since Argentina's banking system was significantly affected by the lack of confidence episode that rippled through many emerging markets, in the aftermath of the December 1994 Mexican crisis. The chronology of the crisis and its main facts are well documented in Schumacher (1996) and several other papers in the banking literature.

The stylized fact that after periods of financial distress banks tend to accumulate liquid assets and retrench their lending activity is not new or even recent. For instance, in the aftermath of the Great Depression and during the entire decade of the 1930s commercial banks in the United States accumulated an unprecedented amount of liquid assets and reduced the share of loans in their portfolios. As described by Morrison (1966) New York banks increased their holdings of excess reserves from less than 1 percent of adjusted deposits (total deposits net of required reserves) in 1929, to a peak of more than 30 percent in 1939. At the time it was said that the reluctance to extend new loans and the huge volume of excess reserves in the banking system could undermine the power of the Federal Reserve to conduct monetary policy, since banks were caught in a liquidity trap. This position, defended by Gov. Marriner Eccles in the hearings on the Banking Act of 1935, came to be known as the "can't push on a string doctrine". The liquidity trap hypothesis did not fare well empirically as shown by Frost (1971) and Brunner and Meltzer (1968). In the quest for an explanation, Friedman and Schwartz (1963) were more successful with the "shock-effect" hypothesis, according to which the demand curve apparently shifted towards increased preference for liquidity immediately after a banking crisis. In the paper we link asset and liability decisions and rationalize the increased preference for liquidity by positing that the demand for liquid assets substitutes for inadequate bank capital and therefore performs the role of self-insurance.

The need and importance of containing asset risk exposure was recognized even before the Great Depression. Irving Fisher (1911) stated that: "*. . . insufficiency of cash is so troublesome a condition—so difficult to escape when it has arrived, and so difficult to forestall when it begins to approach,—a bank must so regulate* [*its portfolio*] *as to keep on hand a sufficient cash reserve, . . ., the more the loans in proportion to the cash on hand, the greater the profit but the greater the danger also.*" Many models and heuristic explanations of banking crisis concentrate exclusively on the asset composition of banks' portfolios, ignoring the interdependence between asset risk and the capital structure. Our contribution is to bridge the gap between asset and liability composition in a single integrated model.

As Lachmann (1937) recognized, the security of bank deposits is usually impaired by the asset losses the bank has sustained. In these circumstances, bank managers may elect to compensate depositors for the diminished safety by increasing liquidity and shedding lending risk. The point is that this maneuver will only be necessary if the capital account is not immediately replenished (or reconstructed) through an injection of new capital, for in this case the safety of deposits would at once be restored. A higher capital ratio enables the bank to better absorb asset value deteriorations and preserve the security of deposits. Then, why would banks opt for increased liquidity (foregoing the quasi-rents from lending) rather than for immediate recapitalization? What factors determine this substitution of liquid assets (or asset risk) for capital? The answer may be that during and immediately after a serious banking crisis the cost of raising equity is very high. Research work, such as Calomiris and Hubbard (1992) and Calomiris and Wilson (1996), provide the empirical support for this assertion. Since the new capital that has to be raised for the sake of reconstruction, will be relatively expensive, shareholders prefer to pay the opportunity cost of increased liquidity rather than the cost of immediate recapitalization. Recapitalization will be postponed to a time when *de novo* capital will be cheaper. In the meantime, depositors must somehow be assured, implying that banks will have to reduce the share of risky assets—since, absent a new capital injection, the risk-constraint imposed by depositors must be satisfied by lower asset risk exposure, that is, higher liquidity ratios.

This paper is organized as follows. In section 2 we construct a banking model, where banks have monopoly power in the deposit and loan markets, and where it is costly to raise equity. In section 3, we solve the model for the equilibrium allocations. In section 4, we introduce adjustment costs and develop a graphical framework. Section 5 illustrates the adjustment dynamics to a capital shock. Section 6 documents the main stages of the adjustment process of the Argentine banking system in the aftermath of the December 1994 Mexican devaluation. In section 7, we put to the test some of the empirical implications of the model using panel data for Argentine banks from 1993 to 1996. Section 8 concludes. Appendix A solves the model for the case of increasing costs of raising bank equity.

II. The Model

Information Set-up

The economic set-up will be a state-preference model with two periods, the current, period 1, and the future, period 2. The economic agents in the model will be risk-neutral, share identical expectations, and live in a world of no taxes.

In period 1, financial contracts are signed, banks select their portfolios of earning assets, and decide the optimal capital structure. In period 2, conditional upon the realization of an exogenous random variable θ, representing all the possible states of the world in the future period, banks collect whatever their portfolios are worth and settle their obligations to the extent that they are able to. The post-state value of the portfolio, and hence the value of the bank, depends on which state of the world has prevailed. By assumption, θ takes values on the unit interval, $\theta \in [0, 1]$, according to the cumulative distribution function, $F(\theta)$. The random variable affecting outcomes can be motivated as representing all relevant economic variables that affect the way banks perform. Then, it can be thought of as a multidimensional vector containing variables that influence how the bank fares *ex post,* such as, short- and long-term interest rates, exchange rates, prudential and regulatory policies, etc.

Balance Sheet Variables

Liabilities

In our set-up banks can raise funds by issuing deposit liabilities, D, and equity, E.

Assumption 1: *Issuing equity is not costless.*

In this framework, banks invest and specialize in an intermediation technology. More specifically, they invest in acquiring expertise in the screening, evaluation, and monitoring of loans. This unique expertise allows them to earn quasi-rents from their activity as delegated monitors in the loan market. Nevertheless, specialization leads to information asymmetries between bankers and their sources of funds which generates costs to secure external financing. After all, banks specialize in holding portfolios of hard-to-value-assets, for which information asymmetries tend to be substantial. This cost can be justified and derived in the context of an adverse selection model, as in Myers and Majluf (1984).

Further, as documented by Baer and McElravey (1993) and Asquith and Mullins (1986), issuing equity can be increasingly costly, making it an expensive way to smooth exogenous shocks to banks portfolio variables. Calomiris and Hubbard (1992) showed that during the 1930s firms voluntarily incurred significant tax penalties to avoid dividend payouts when they would have to raise extra funds from outsiders. In addition, there is compelling corroborating empirical evidence that, due to capital market frictions or imperfections, firms are forced to rely primarily on internal financing sources.

Let $v(E)$ represent the per dollar cost of raising equity capital in the amount E, with:

$$v(E) \geq 0, \quad v'(E) \geq 0, \quad v''(E) \geq 0,$$

where prime and double prime represent the first and the second derivatives of v with respect to E, respectively.[1]

On the market for deposits banks are not perfectly competitive. They face an upward sloping supply function for deposits, reflecting market power. Let $\delta(\theta)$ denote the state contingent gross return on deposits, realized in period 2, per dollar of deposits in period 1. Depositors are promised a gross interest rate of δ^*, independent of the state of nature that will prevail. Whenever possible the bank honors its pledge to pay δ^*. Hence, $\delta(\theta) = \delta^*$ when the bank is solvent, and $\delta(\theta) < \delta^*$ when bankrupt. Therefore, as in Kareken and Wallace (1978), the pledged interest rate is defined as $\delta^* = \max_{\theta} \delta(\theta)$.

Furthermore, as in Dothan and Williams (1980), the bank provides deposit services (check clearing, transactions services, etc.) for which it charges a fixed fee of $f \geq 0$, per dollar of deposits in the first period. Let deposit services be produced according to a constant returns to scale (CRS) technology, so that, supply costs increase linearly with quantity. Let $c \geq 0$ be the cost per dollar of deposits of providing deposit services (due to the CRS assumption c is simultaneously an index of the cost and of the quantity of services provided). Finally, let $\Pi = f - c$ be the profit per dollar deposited that the bank realizes from the provision of services.

Under these qualifications the supply function for deposits can be easily determined. Per dollar deposited, each individual expects to receive a cash payout (net of the fee), and deposits services, with respective present values of:

$$\frac{\int_0^1 \delta(\theta)\, dF(\theta) - f}{1+r}, \text{ and } \frac{c}{1+r},$$

where r is the risk-free rate of interest. Hence, the supply of deposits schedule faced by the bank is given by a two argument function

$$D = D\left(\frac{\int_0^1 \delta(\theta)\, dF(\theta) - f}{1+r}, \frac{c}{1+r}\right)$$

[1]The unobserved per unit cost of raising capital, $v(E)$, can be approximated by the observed Bid-Ask spreads on bank shares in the secondary market. In this model, E, can be interpreted as including the traditional equity items of the balance sheet and also all other securities subordinated to deposits such as subordinated notes and debentures.

with

$$D_1 \equiv \frac{\partial D}{\partial \left(\frac{\int_0^1 \delta(\theta) dF(\theta) - f}{1+r} \right)} > 0, \quad D_2 \equiv \frac{\partial D}{\partial \left(\frac{c}{1+r} \right)} > 0, \quad D\left(-\infty, \frac{c}{1+r} \right) = 0,$$

and where the second argument measures the quantity of deposit services provided by the bank, per dollar deposited[2].

Assets

The funds raised through the deposit and equity markets are allocated among a default-free composite asset denominated here as bonds, B, and risky loans, X.

Bonds pay a competitively determined risk-free rate of interest, r, and, contrary to loans, can be immediately and costlessly liquidated. Since bonds represent a composite of any more-liquid-than-loans asset they are used as a proxy for bank holdings of government securities and required and excess cash reserves.

The liquidity services provided by bond holdings makes them a source of intangible benefits to the shareholders. They function as a buffer stock against unexpected adverse reserve outflows[3]. By having a liquidity cushion, the bank can avoid payment problems. This signals stability, forestalling future bank runs or lack of confidence episodes that can increase the cost of external financing to the bank, that is, higher costs to raise new capital or a higher pledged interest rate to depositors. By doing so the bank is in fact protecting its charter value, and holding at bay possible costly government interventions or even an outright closure of the bank.

In a regulated banking system, bankruptcy goes beyond the loss of shareholders' capital—implying also the loss of the banking charter, whose value is given by the present discounted value of the stream of future monopoly profits. Since the charter is valuable and cannot be sold upon insolvency, bankers have an additional incentive—beyond the impairment of their capital position and the reorganization and liquidation costs—not to gamble and risk bankruptcy. Therefore, bank managers may elect to hold additional self-insurance to protect their charter values. Self-insurance can arise from more equity capital, or if new capital is very expensive to raise, from holdings of liquid assets. Notice

[2] In a deposit market where banks have no market power, competition among banks guarantees that the funding cost to the bank of one unit of deposits equals the benefits that it generates: $\left(1 - \frac{R_D}{1+r}\right) + \frac{f}{1+r} = \frac{c}{1+r}$, where, $R_D \equiv \int_0^1 \delta(\theta)\, dF(\theta)$ is the expected gross cash return on deposits.

[3] Ramos (1996) and Frost (1971) provide a detailed treatment of these issues.

that in this set-up a bank can reduce the probability of bankruptcy by holding more capital or by reducing asset risk. *Ceteris paribus*, a higher asset share of liquid assets implies that the bank is holding a less risky portfolio—reducing the need for a substantial capital cushion to accommodate asset value losses. Having more liquidity enables the bank to self-insure and with a higher probability be solvent at the end of the period, thereby, continuing to have the claim to the present discounted value of future profits.[4]

Assumption 2: *By investing and specializing in a lending technology banks earn quasi-rents from lending.*

The quasi-rents are proprietary to banks and are not available to other non-specialized economic agents. Reflecting banks' privileged access to small local borrowers and the value of a close and long-term relationship with some of its borrowers, banks have a degree of monopoly power in the loan market.

Hence, for loans, as for deposits, banks choose the rate of return (gross return) and the market determines the volume of loans, X. The contractual interest rate set by the bank, obligates the prospective borrower to a vector of state contingent payoffs—interest plus principal—in period 2, $x(\theta)$, per dollar borrowed in period 1. The expected return on loans is equal to:

$$R_L = \int_0^1 x(\theta)\, dF(\theta).$$

where, $\frac{R_L}{1+r}$ represents the market value of the liability assumed by the borrower, per dollar borrowed.[5] Banks face a downward sloping demand curve for loans with the following characteristics:

$$X\left(\frac{R_L}{1+r}\right) \geq 0, \quad X'(\cdot) \leq 0, \quad X(\infty) = 0.$$

[4]The imputed return on liquid assets, for their insurance value, is a function not only of the economic value that cash reserves are protecting—the charter value—but also of the probability that this insurance will ever be needed. Hence, during a crisis period, when confidence in the banking system is low, the implicit return on liquid assets (excess reserves or short-term government securities) is higher, even if the value of the charter remains unaltered, because the probability that liquid reserves are going to be of any use is much higher (see Ramos (1996)).

[5]Large banks located in big money market centers, where competition is more intense, will probably face a more elastic supply of deposits and demand for loans schedule, reflecting reduced market power. In the absence of monopoly power and under risk neutrality, arbitrage conditions guarantee that the expected return equals the risk-free interest rate, $\int_0^1 x(\theta)\, dF(\theta) = 1 + r$, producing a demand for loans infinitely elastic at $1 + r$.

This stylized banking model assumes, without loss of generality, that banks are precluded from holding competitively priced risky securities.

Notice that, even though the state contingent payoffs for both deposits and loans are known to all agents in the model at the outset; still there is uncertainty. That is so, because in period 1, when portfolio decisions are made, it is not known which state of the world will prevail *ex post.* Hence, in this model there is a one-to-one mapping from the share of loans in the portfolio to the total riskiness of the asset portfolio, σ_A. The higher the share of loans in the portfolio the riskier the bank.

Finally, it is assumed that bank regulators impose a constant required reserve ratio of α per dollar of deposits, with $0 \leq \alpha \leq 1$, and that the bank can purchase deposit insurance from a default-free government-backed agency at a premium of ϕ per dollar of deposits.

The balance-sheet identity states that sources of funds must be equal to all uses of funds. Hence, banks must obey the following balance sheet constraint:

$$B + X = D\,(1 - \alpha - \phi) + E\,(1 - v\,(E))\,. \tag{1}$$

Objective Function

Equity is a residual (junior) claim to the assets of the bank. When the bank is solvent, equity holders are entitled to whatever remains after the payment of principal plus interest to depositors. Let $R_E\,(\theta)$ represent shareholders' per-dollar state contingent gross return on equity. When in state of the world θ, the bank has the following resources from its portfolio,

$$x\,(\theta)\,X + (1 + r)\,B + (\Pi + \alpha)\,D,$$

out of which it must pay $\delta^* D$ to depositors, if enough funds are available. Consequently, the state contingent payoff to equity in state θ is represented by:

$$R_E\,(\theta)\,E = \max\left[0,\ x\,(\theta)\,X + (1 + r)\,B + (\Pi + \alpha - \delta^*)\,D\right].$$

Furthermore, when insolvent, the bank faces constant bankruptcy costs of γ per unit of deposit,[6] with $0 \leq \gamma D \leq x\,(\theta)\,X + (1 + r)\,B + (\Pi + \alpha)\,D$ for all θ that imply bankruptcy.

[6] γ is a measure of the resources lost in post-bankruptcy reorganization (or liquidation), legal fees, costs of delay, etc.

Potentially, the bankruptcy cost could also depend on the state of the world, $\gamma(\theta)$, but we will assume not, just for the sake of simplicity and clarity, since it will not affect qualitatively the results we derive. Bankruptcy is costly and the cost is unavoidable.

The claims of deposit owners are subordinated to the bankruptcy cost, but are senior to the claims of any other claimants, in this case, shareholders. If for a given state of the world, $x(\theta) X + (1+r) B + (\Pi + \alpha - \delta^*) D \geq 0$, then, the bank can afford to honor the promised payoff to depositors. So, in these θ states the bank is solvent. If in state θ the bank is insolvent, barring deposit insurance, depositors get a payoff of (funds available net of bankruptcy costs):

$$\delta(\theta) D = x(\theta) X + (1+r) B + (\Pi + \alpha - \gamma) D.$$

When insured, the bank pays the fixed rate insurance premium, ϕ, and, when bankrupt, is entitled to receive the deposit insurance coverage of $\varphi(\theta)$, per dollar of deposits . In this case, $\delta(\theta) = \delta^*$ for all θ, and the insuring agency enacts the necessary transfer of funds to the bank in order to guarantee the pledged payoff to depositors, when the bank is not able to do so *per se.* The vector of state contingent insurance coverage payments is given by:

$$\varphi(\theta) D = \max\left[0,\ (\delta^* + \gamma) D - x(\theta) X - (1+r) B - (\Pi + \alpha) D\right].$$

Banks benefit from limited liability and, by assumption, maximize the present discounted value of expected capital gains (profits) accruing to the shareholders, i.e., $\max G = \left(\frac{\int_0^1 R_E(\theta) dF(\theta)}{1+r} - 1\right) E.$

Hence, the present discounted value of expected profits is the present value of the cash flows arising from the returns on the portfolio of assets net of those from the liabilities issued, minus the amount of equity invested in period 1.

A natural question to ask is what is the introduction of the bankruptcy cost, and of the cost to raise equity, contributing to the model? The existence of the equity cost invalidates the well known corporate finance Modigliani-Miller proposition of indeterminacy of the optimal capital structure in a world of no taxes. The presence of this cost makes the optimal capital structure determined. Also, the presence of the bankruptcy cost is crucial since it gives us the known result of Keeley (1990), Kareken and Wallace (1978), and others, that with costless equity funds and with no deposit insurance, banks will compose their portfolios in such a way as to make sure there are no bankruptcy states. With costless equity and $\gamma = 0$, the number of insolvency states is not determined.

Let $x(\theta)$ be a linear increasing function of θ. The objective of the bank is therefore to:

$$\max_{\{B,x(\theta),\delta^*,f,c\}} G = \frac{\int_{\theta^*}^{1} \left[x(\theta) X + (1+r) B + (\Pi + \alpha - \delta^*) D\right] dF(\theta)}{1+r} - E,$$

subject to:

$$X + B = (1 - \alpha - \phi) D + E (1 - v(E)), \tag{2}$$

where, θ^* is the critical value of θ, at which loan revenues are just enough to make the bank able to pay its depositors the pledged interest rate. Thus:

$$x(\theta^*) X + (1+r) B + (\Pi + \alpha - \delta^*) D = 0. \tag{3}$$

For $\theta \geq \theta^*$, the bank is solvent and $\varphi(\theta) = \gamma = 0$.

For $\theta < \theta^*$, the bank is insolvent, making:

$$\varphi(\theta) D = (\delta^* + \gamma - \Pi - \alpha) D - (1+r) B - x(\theta) X. \tag{4}$$

The expected value of the insurance payment is given by:

$$\begin{aligned} P_o &\equiv \int_0^{\theta^*} \varphi(\theta) D \, dF(\theta) \\ &= \left[(\delta^* + \gamma - \Pi - \alpha) D - (1+r) B\right] F(\theta^*) - \int_0^{\theta^*} x(\theta) X \, dF(\theta). \end{aligned} \tag{5}$$

P_o, is the option value of deposit insurance as defined by Merton (1977). Merton (1977), showed that deposit insurance when viewed as a security, has characteristics that are isomorphic to those of a put option on the value of the bank's assets, at a strike price equal to the promised payoff to depositors, $\delta^* D$.

Two-Period versus Multiperiod Analysis:

The third party guarantor of deposits insures the bank for one period. At the end of the period, there is an audit to determine if the bank is solvent and merits an extension of the insured status for another period. It might seem that the two-period construct is rather limiting, since it abstracts from possible multiperiod interconnections. In fact, that is not so. In a slightly different context, Merton (1977), and Dothan and Williams (1980), construct both two-period and multiperiod models where banks are repeatedly examined, until the first time they are found insolvent and are liquidated. Optimal portfolio decisions, in these more complex models, are qualitatively identical to the ones derived from just a two-period model. Taggart and Greenbaum (1978) develop a three period banking model, and show that the two-period model implications are still valid. That is so because, capital decisions made at the beginning of period 1 do not change deposit withdrawals or second period lending opportunities. Hence, the absence of any intertemporal tie-ins, leaves the optimal second period decisions unchanged, when changing any period 1 variable. A model with some intertemporal connections could easily be developed, adding complexity, but not more insight or interpretation value. For these reasons, and the fact that two-period models seem to be the workhorse and paradigm of the banking literature, we chose to work with a two-period model.

III. Equilibrium Allocations

Let us initially analyze the case of a constant cost v of issuing equity; $v'(E) = 0$. This assumption is relaxed in Appendix A.

Manipulation of the profit function G, using (5) and substituting the balance-sheet constraint (2) for E, the capital gains function to be maximized becomes:

$$\begin{aligned} G = &\left(\frac{\int_0^1 x(\theta)dF(\theta)}{1+r} - \frac{1}{1-v}\right) X - \left(\frac{v}{1-v}\right) B + \\ &+ \left(\frac{\Pi+\alpha-\delta^*}{1+r} + \frac{1-\alpha-\phi}{1-v} + \frac{\int_0^{\theta^*} (\varphi(\theta)-\gamma)dF(\theta)}{1+r}\right) D \end{aligned} \tag{6}$$

Assuming that G is concave in all its arguments and at least twice differentiable, the optimal bank portfolio is found from the usual first order necessary and sufficient conditions (FOCs). At the optimum, every endogenous variable Y must satisfy: $\left(\frac{\partial G}{\partial Y}\right) Y = 0$, $Y \geq 0$, and, $\frac{\partial G}{\partial Y} \leq 0$.

No Deposit Insurance or *Bank-Neutral* Deposit Insurance.

Without deposit insurance $\phi = \varphi(\theta) = 0$. Depositors get δ^* when the bank is solvent and $\delta(\theta) D = x(\theta) X + (1+r) B + (\Pi + \alpha - \gamma) D$, when insolvent. Hence, the expected gross return on deposits is simply given by

$$\begin{aligned} R_D &= \int_0^1 \delta(\theta)\, dF(\theta) = \int_0^{\theta^*} \delta(\theta)\, dF(\theta) + \int_{\theta^*}^1 \delta^* dF(\theta) \\ &= \frac{\int_0^{\theta^*} x(\theta) X dF(\theta) + [(\Pi+\alpha-\gamma)D + (1+r)B] F(\theta^*)}{D} + \delta^* [1 - F(\theta^*)] . \end{aligned} \tag{7}$$

The objective function (6) simplifies to:

$$G = \left(\frac{\int_0^1 x(\theta)\, dF(\theta)}{1+r} - \frac{1}{1-v} \right) X - \left(\frac{v}{1-v} \right) B + \left(\frac{\Pi + \alpha - R_D}{1+r} + \frac{1-\alpha}{1-v} - \frac{\gamma F(\theta^*)}{1+r} \right) D \tag{8}$$

Let $m_X \equiv \frac{\int_0^1 x(\theta) dF(\theta)}{1+r} - \frac{1}{1-v}$ and, $m_D \equiv \frac{\Pi+\alpha-R_D}{1+r} + \frac{1-\alpha}{1-v} - \frac{\gamma F(\theta^*)}{1+r}$ represent the net margin per dollar invested in loans (quasi-rent) and deposits, respectively. Notice that the profit function (8) decreases with the bankruptcy cost and with the probability of bankruptcy, $F(\theta^*)$. Hence, decreasing the probability of insolvency increases capital gains.

Bank-Neutral[7] deposit insurance implies that: $\phi = (1-v) \frac{\int_0^{\theta^*} \varphi(\theta) dF(\theta)}{1+r}$. The insurance premium reflects insolvency risk, but only to a factor of $(1-v)$ percent. Like the case of absence of deposit insurance, this type of insurance does not impact on capital gains (both terms cancel in the capital gains function (6)), meaning that there is no way bank owners can exploit deposit insurance for their own benefit, at the expense of the insuring agency. Contrary to the typical fixed-rate deposit insurance premium, with *bank-neutral* insurance banks cannot maximize the option value of deposit insurance, because the premium reflects both bankruptcy risk and the internal cost of raising equity. Notice that this type of insurance is neutral to the bank but not to the insuring agency, since the premium is smaller than the expected present value of the deposit insurance payments. Therefore, no private arrangement will ever offer this type of insurance.

Bank-neutral priced deposit insurance is irrelevant, because it is redundant to banks, even though the net worth of the insuring agency is negative. It is as if the insuring

[7] I chose the term *bank-neutral* because the bank is indifferent between having this kind of insurance or not. It does not impact on its capital gains. Furthermore, the bank is also indifferent between having partial or full coverage.

agency is subsidizing deposit insurance at precisely the rate of the internal cost of raising capital to the bank. If the premium were to be equal to the expected payoff from the insuring agency, banks would choose to hold no insurance. For them, this would be expensive insurance, since the real cost of the premium is $\phi\frac{1}{1-v}$, which reflects the cost of getting ϕ dollars to pay the insurance premium.

Notice that with *bank-neutral* insurance, $\delta(\theta) = \delta^*$ for all θ. Hence, the expected return on deposits is always $R_D = \delta^*$.

Maximizing the objective function (8), subject to (2), with respect to all the endogenous variables produces the following first order conditions (FOCs):

$$\begin{aligned}
\frac{\partial G}{\partial B} &= \frac{-v}{1-v} - \frac{\gamma D}{1+r} f(\theta^*) \frac{\partial \theta^*}{\partial B} \\
\frac{\partial G}{\partial x(\theta)} &= \frac{f(\theta)}{1+r}(X + m_X X') - \frac{\gamma D}{1+r} f(\theta^*) \frac{\partial \theta^*}{\partial x(\theta)} \\
\frac{\partial G}{\partial \delta^*} &= \frac{1}{1+r}(-D + m_D D_1) - \frac{\gamma D}{1+r} f(\theta^*) \frac{\partial \theta^*}{\partial \delta^*} \\
\frac{\partial G}{\partial f} &= \frac{-1}{1+r}(-D + m_D D_1) - \frac{\gamma D}{1+r} f(\theta^*) \frac{\partial \theta^*}{\partial f} \\
\frac{\partial G}{\partial c} &= \frac{1}{1+r}(-D + m_D D_2) - \frac{\gamma D}{1+r} f(\theta^*) \frac{\partial \theta^*}{\partial c}
\end{aligned}$$

where $f(\theta)$ is the probability density function of θ. Assuming an interior solution several propositions arise:

Proposition 1 *Bank-neutral deposit insurance coupled with costless bankruptcy ($\gamma = 0$) and costless raising of equity capital in any desired amount ($v = 0$), implies that:*

(i) The optimal amount of bond holdings is indeterminate.

(ii) The Modigliani-Miller Proposition of indeterminacy of capital structures holds.

(iii) The probability of bankruptcy is not determined.

Proof. The last term, involving the bankruptcy cost γ, on the right hand side of every equation, vanishes. Further, from the profit function (8), we see that bond holdings do not affect profits. Capital is costless and since bonds pay in present value one dollar, they do not increase or decrease profits. The same would not be true if it were costly to raise equity ($v > 0$). From $\left[\frac{dG}{dB}\right]$, we immediately have that the optimal amount of bond holdings is indeterminate.

It is innocuous, in terms of profits, if the bank is bankrupt or not. Therefore, there is no incentive to hold bonds simply to avoid bankruptcy. Even more, a version of the Modigliani-Miller proposition holds. The capital structure is not determined. Bank managers can just raise more equity, costlessly, to buy bonds, without any effect on profits or bank value. Under these conditions, the number of bankruptcy states (probability of bankruptcy) is not determined. ■

The optimal portfolio, is found from the six FOCs. The optimal amount of deposits to raise is given by: $D = m_D^1 D_1$. From the remaining FOCs, the optimal portfolio is given by the following quantities; starred variables designate optimal quantities.

$$
\begin{aligned}
B^* &= \text{indeterminate} \\
D^* &= m_D D_1 \\
D_1 &= D_2 \text{ or } c = 0 \\
X^* &= -m_X X'(.)
\end{aligned}
$$

In conclusion, with costless equity, banks raise enough funds to exploit all the available profit opportunities, whether on the asset side or the deposit side, always equating the marginal cost of funds to the relevant marginal revenues.

Let's now proceed with the case where bankruptcy is costly; thereby reducing gains. It should be obvious that bank managers will be willing to eliminate insolvency, but only to the extent that it is profitable to do so.

Proposition 2 *Bank-neutral deposit insurance with, costly bankruptcy ($\gamma > 0$) and costless equity capital ($\upsilon = 0$), implies that:*

(i) Banks manage to avoid bankruptcy in every state of the world.

(ii) Bond holdings are indeterminate but with a lower bound.

(iii) The Modigliani-Miller Proposition holds.

Proof. Since raising funds does not entail any cost, bonds do not affect profits directly, as seen above. Nevertheless, the more bonds a bank has the lower the probability of bankruptcy. Since insolvency is costly, it is immediate from $\left[\frac{dG}{dB}\right]$ and from the profit function (8), that the optimal amount of bond holdings should be high enough as to eliminate all the bankruptcy states. Bonds are neutral to profits (directly), but by reducing the probability of costly bankruptcy they become attractive. B^* is still indeterminate, but the range of indeterminacy is now reduced. B^* has a lower bound given by the smallest amount of bond holdings necessary to eliminate bankruptcy altogether. In such instances, the last term of the right hand side of the FOCs vanishes again, and the previous optimal allocations remain optimal. Further, since bond holdings are not determined the Modigliani-Miller Proposition holds again. ■

Under these considerations, deposits, although uninsured, are nevertheless safe, even in a fractional reserve banking system. Deposits are default-free, making deposit insurance unnecessary. This also means, that *bank-neutral* deposit insurance could exist *de jure* but it will never be used *de facto*. Since the expected insurance payment will be zero, the premium will also be zero. *Bank-neutral* deposit insurance is irrelevant, since it is redundant to banks. In this case, bank regulation will be unnecessary—banks will be prudent enough to manage to avoid insolvency. This result is equivalent to the *laissez-faire* equilibrium of Kareken and Wallace (1978) or the Meltzer (1976) variable rate insurance premium. Proposition 4.2 also corroborates and extends the results of Dothan and Williams (1980).

Proposition 3 *Bank-neutral deposit insurance, with costly capital* $(v > 0)$ *but costless bankruptcy* $(\gamma = 0)$*, implies that:*

(i) Optimal bond holdings will be zero, $B^* = 0$.

(ii) When compared with the case of costless equity $(v = 0)$*, banks will choose a more levered capital structure(more deposits and less equity) and contract the volume of loans.*

Proof. From the objective function (8), we can verify that bonds affect profits negatively. A dollar invested in bonds returns a dollar in present value. But, to get a dollar to invest in bonds one needs to raise $\frac{1}{1-v}$ units of capital. Hence, the net benefit from holding bonds is just; $\frac{-v}{1-v}$ $\left(= 1 - \frac{1}{1-v}\right)$. Bankruptcy being costless, implies, from the FOCs, that optimal bond holdings will be zero: $B^* = 0$.

Since funds are now more expensive to get, from the definition of m_X and m_D, and from the FOCs, we immediately get that the amount of deposits will be larger and the amount of loans smaller. ■

These adjustments should have been expected. Now, the bank adjusts at all the margins. Funds are not as cheap as when $v = 0$, therefore, for the same volume of assets, the bank should try to raise more money from the deposit side and less from equity. Further, the relevant opportunity cost of funds is now $\frac{1+r}{1-v}$, instead of just $1 + r$. In order to make up for the increased cost of loanable funds, bank managers will demand a higher payoff from borrowers, implying a contraction of credit. In summary, if one goes from the case of no cost to the case of costly issuance of new equity, banks adjust at several margins, and have a tendency to have more levered capital structures. Other banking models in the literature cannot account for this fact. The optimal portfolio quantities (double star) compare with the previous ones as follows:

$$B^{**} = 0; \quad D^{**} > D^*; \quad D_1 = D_2 \text{ or } c = 0; \quad X^{**} < X^*$$

Hence, the effect of $v > 0$, is to contract all assets and, *ceteris paribus*, to increase leverage. Now, even with $\gamma = 0$, the probability of bankruptcy is determined.

Finally, let us study the more realistic case, where not only are funds costly to get, but also bankruptcy is costly.

Proposition 4 *Bank neutral deposit insurance coupled with costly capital* ($v > 0$) *and bankruptcy* ($\gamma > 0$)*, results in:*

(i) Optimal bond holdings positive and determined.

(ii) A less levered capital structure, than when bankruptcy is not costly ($\gamma = 0$)*.*

Proof. Raising an additional dollar from equity to invest in any of the assets does not cost 1 but $\frac{1}{1-v}$. Hence, directly, bond holdings affect profits negatively. On the other hand, more bonds, as for the same effect, more of any other asset, reduce the probability of bankruptcy, which is beneficial. Maximization of profits requires that this trade-off be optimized. Due to this trade-off, the optimal set of bankruptcy states is determined from the FOCs, and may not be empty. Eliminating all the bankruptcy states, might not be profit maximizing. Remember that with $v > 0$, there is no profit neutral way of reducing the probability of bankruptcy.

The last term of the FOCs does not vanish, implying that bond holdings will be determinate and positive. Since $\frac{\partial \theta^*}{\partial \delta^*}$ is positive, the last term on the right hand side of the $\left[\frac{\partial G}{\partial \delta^*}\right]$ is negative, implying that banks do choose a lower pledged interest rate δ^* and consequently have less deposits than before. ■

The effect of the insolvency cost is to push banks in the direction of increased safety, by choosing less levered capital structures. Therefore, in terms of banking policy regulation, one implication of these models is that in the absence of deposit insurance, one way to foster a safe and sound banking system, is to, somehow, increase the unavoidable penalty associated with insolvency. Then, it would be profit maximizing to avoid those states, by simultaneously reducing risk (less loans and more bonds) and increasing the internal sources of financing (higher capital ratio).

As before, the optimal quantities for all the endogenous variables are obtained from simultaneously solving all the optimality conditions given by the FOCs. Since all assets can contribute to save on bankruptcy costs, banks have an incentive to have more liquid assets, and demand a higher payoff from their borrowers. We can see that the bank adjusts at all the four margins available (2 assets and 2 liabilities), always equating marginal benefits to marginal costs. The optimal quantities (triple starred) compare with the case of $\gamma = 0$, as follows:

$$B^{***} \text{ determinate } \geq B^{**} = 0; \quad D^{***} < D^{**}; \quad D_1 = D_2 \text{ or } c = 0; \quad X^{***} < X^{**}$$

IV. Short- and Long-run Dynamics

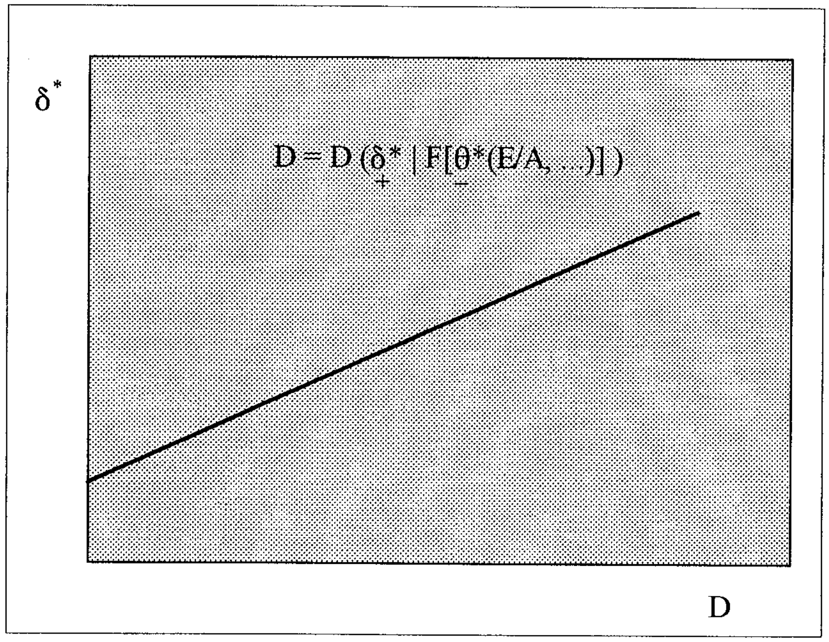
Assumptions 1 and 2 coupled with two empirically validated additional ones will allow us to describe the dynamics of both short- and long-run adjustments to a shock to a bank's capital. The previous working assumptions allowed us to pin down the optimal capital structure and portfolio composition. The next two will shed some light on the way banks adjust to a portfolio shock.

Assumption 3: *Depositors impose a low-risk-tolerance constraint on banks.*

As theoretically elaborated by Gorton and Pennacchi (1990) and Calomiris and Kahn (1990), and empirically corroborated by Calomiris and Wilson (1996), banks do stand to benefit from providing low risk exposure to depositors. These gains come in the form of smaller default-premiums to be paid on the remuneration of deposits, and in the form of a higher volume of deposits flowing into the bank—since depositors have a low tolerance for risk, preferring low-risk instantly-demandable transaction deposits. In addition, a higher probability of default, not only increases the fair default-premium to be paid on banking liabilities, but depositors will also demand an illiquidity-premium—since riskier claims tend to be less liquid. In all, higher deposit risk must be rewarded with higher pledged returns, and in extreme cases could even lead to deposit disintermediation (deposit withdrawals). The supply of deposits schedule faced by the bank depicted in figure 1 is parametric with respect to the probability of default. Higher default-risk will shift the schedule upwards—that is, in order to maintain the same volume of deposits, the bank will have to increase the pledged interest rate, δ^*.

Assumption 4: *Reducing deposit risk—or equivalently, the probability of bank default—is costly.*

Figure 1: Depositors' supply of funds schedule



In our model deposit risk arises from the exposure banks assume in the loan market. To reduce asset risk the bank has to liquidate outstanding loans, many times, before maturity and on short notice. This anticipated liquidation means that banks will not be able to realize the full face value of its loans, not only due to information asymmetries in the loan market (lemons market), but also because fire sales of assets tend to depress prices and put borrowers in financial distress. For instance, Baer and McElravey (1993), report that: "... *Banks do manage their assets as if there are significant costs associated with issuing new equity and selling existing assets.*"

The two new assumptions preclude the possibility of an instantaneous adjustment to the new long-run equilibrium. The model derived in the previous section can be seen as describing the long-run equilibrium of the bank. Given a shock to any of the model's portfolio variables, assumptions 3 and 4, thwart the instantaneous achievement of the new long-run desired equilibrium. These costs generate inertia, sluggishness in the adjustment—leading banks to often being temporarily more exposed than their long-run target (in accordance with assumption 3): but that happens in the best interest of shareholders, since immediate reduction of asset risk can be costly in the short-run (e.g. fire sale of assets).

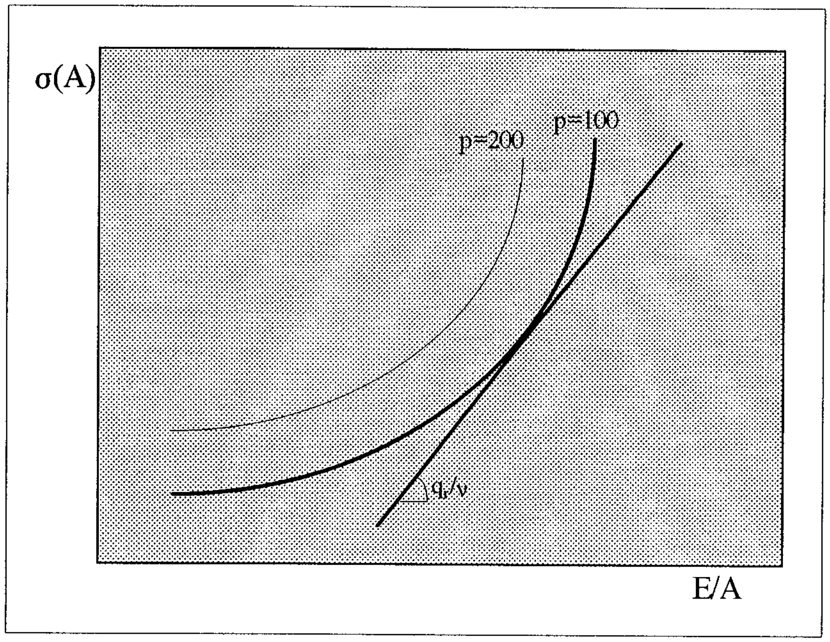
These four simple and realistic assumptions are sufficient to produce a rich array of cross-sectional short- and long-term bank adjustment dynamics in a context of bank maximization, and are able to replicate stylized facts about banks' adjustment during the Great Depression (see Calomiris and Wilson (1996)). In its maximization decision banks not only choose a target for risk exposure (based on the supply of deposits curve that they face and expected depositors' behavior), but also the least expensive way to satisfy it. That is, a given level of risk exposure can be achieved through different combinations of risky assets—loans—and own capital—equity. If the risk exposure is too high—violating the implicit depositors' risk constraint—banks can reduce lending and forego the quasi-rents associated with it and/or can raise additional equity, which entails the cost $v(E)$. By placing both asset and liability decision in a single integrated model, we can clearly put in evidence the trade-off between asset risk, $\sigma(A)$, and the optimal financing structure—equity versus deposit financing.

Given the choice of the target risk exposure, the level of expected quasi-rents to be earned from lending (derived from the loan demand function), and the cost to fund these loans—either the interest on deposits or the cost of raising additional equity—bank managers will optimize and equate all margins choosing the least costly way to achieve the desired exposure, and uniquely determine the optimal portfolio composition.

Let us at this point derive a graphic framework, based on the model, that will help to visualize the path of both the short- and long-term adjustments to a capital shock. Figure 2 depicts two iso-risk curves: the locus of different combinations of asset risk, $\sigma(A)$, and capital-to-asset ratios, $\frac{E}{A}$, that are consistent with a constant level of deposit default premium, p-value. As we move in the northwest direction p-values increase (deposits' default premium in basis points over the risk-free rate). The iso-risk curves are upward sloping since to maintain the same level of deposit risk exposure, higher asset risk exposure must be "hedged" through higher capitalization, that is, a higher capital-to-asset ratio. In a frictionless market, where the Modigliani-Miller theorem of financial structure irrelevance holds, given the choice of the optimal deposit default-risk, any combination of asset risk and capital-to-asset ratio would be equally desirable. In this model, assumptions 1 and 2 allow us to determine a single optimal point on the desired iso-risk curve. Assuming higher asset risk in order to reap the benefits of the quasi-rents associated with lending, will require a higher capital-to-asset ratio, and therefore higher costs of raising equity. On the other hand, to economize on the costs of raising equity the bank will have to curtail lending and forego the quasi-rents so that the target risk exposure is not changed.

Let q_r be the derivative of total quasi-rents with respect to a change in $\sigma(A)$, that is, the marginal cost to the bank, from foregone quasi-rents, of reducing $\sigma(A)$. Further, let ν represent the marginal cost of raising equity, or the adverse-selection cost to be paid in order to increase the capital-to-asset ratio by one unit. Optimality requires that for a given iso-risk curve the optimal point be given by the tangency with a line of slope $\frac{q_r}{\nu}$. A bank able to extract substantial quasi-rents due to its monopoly power in the loan market and with a relatively low external cost of raising equity will therefore choose to operate on a point characterized by higher asset risk and a capital structure that is less

Figure 2: Choice of risk exposure and capital structure

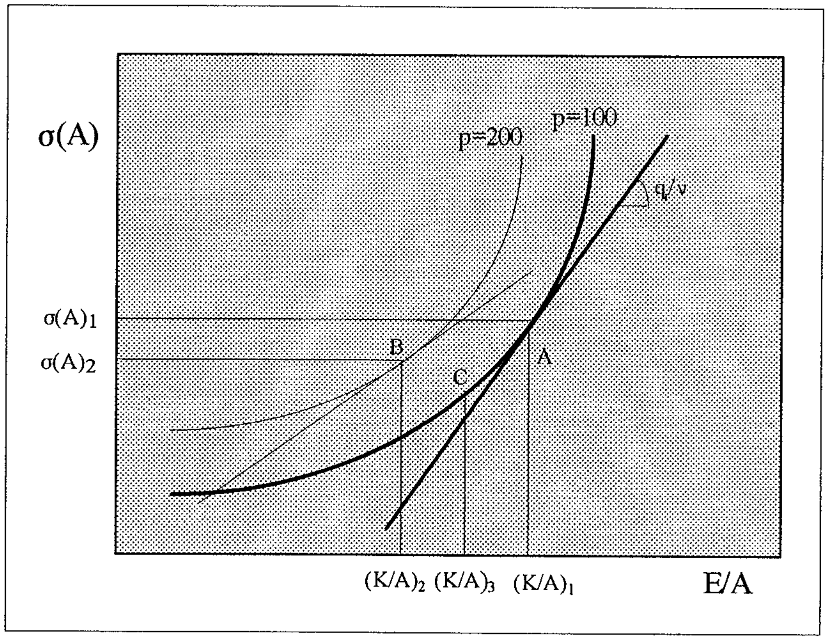


levered—higher ratio of own capital—than a bank that operates in a very competitive environment, where lending quasi-rents are hard to get by, and for whom the cost of raising external finance is high. Depending on the bank-specific relative costs of reducing asset risk and of raising external finance, banks that target the same level of depositors risk exposure will operate in different points of the iso-risk curve. Hence, in equilibrium, a cross-section of banks at a given point in time will reveal bank heterogeneity, with highly capitalized institutions assuming on average more asset risk per unit of p-value. Therefore, an empirically testable implication of our model is that highly capitalized banks should be able to sustain higher asset risk, that is, should hold a higher share of loans in their portfolios and a lower share of liquid assets—cash and short-term bonds—and still satisfy the depositor's risk constraint.

V. The Adjustment Process to a Capital Shock

Given our theoretical model and the assumptions laid-out above, we are now in a position to illustrate the dynamics of a shock to the capital base. Let's assume that asset losses lead a bank to experience a substantial depletion of its capital base. Under these circumstances bank managers can adjust at three different margins: recapitalize the bank, reduce asset risk, and/or accept a higher level of deposit-risk, that is operate on a higher iso-risk curve. Banks will adjust at all the margins taking into account the cost imbedded in each one.

Figure 3: Short-, medium-, and long-term adjustment



Diminishing asset risk will lead to the loss of quasi-rents, m_X, and if done immediately loan liquidation will erode the principal value of the loan portfolio. Increasing capital, will require the payment of the adverse selection cost of raising external finance, v. Finally, accepting higher p-values entails higher costs of deposit-funds, δ^* and running the risk that some depositors might elect to leave the bank. After a period of financial distress, that erodes the capital base of the banking system, it is plausible that the cost of raising external equity will be prohibitively high. Banks will not even try to issue new equity during periods of financial distress because the market simply prices them out.[8] On the other hand, immediate reduction of loans might be extremely costly, if possible at all. Given these facts, in the short-run, it is usually more cost effective to allow p-values to raise—even running the risk of observing some disintermediation—stop the renewal of old loans, and accumulate more liquid assets. This is illustrated in figure 3 by a jump from point A to point B on a higher iso-risk curve. We have shown that, due to capital market imperfections shocks to banks' capital base—or even its deposit base, through a bank run—cannot be frictionlessly offset with other sources of financing, translating into real effects on the lending behavior of banks. In the medium-term[9] banks will continue

[8]This problem is at the genesis of Japan's Ministry of Finance recent creation of the Resolution and Collection Bank (RCB), publicly capitalized with $100bn, with the objective to recapitalize ailing banks. Many Japanese banks have faced sharp erosions of their capital bases because recent stock and real estate market plunges have cut the value of their equity holdings. Public capitalization is called for since—due to market-perceived high risk of banks—even large traditional banks are not able to counter market stigma, and raise new equity in the market independently.

[9]Defined here as the length of time necessary to liquidate enough loans (reduce asset risk) to operate

to liquidate old loans and stop extending new ones—a credit crunch—and will strive to increase the capital-to-asset ratio mainly through retained earnings. This will allow them to move back to the original iso-risk curve—the long-run target for risk-exposure—but at a point with a lower capital ratio and lower asset risk, since it is plausible that the cost of raising equity will still exceed the pre-shock value. In the long run, when the memory of the distress episode fades, if the cost of raising equity returns to pre-crisis levels, one will observe a period of rapid loan growth, accompanied by a shift to less levered capital structures, where banks will again raise fresh capital in the market. This will be shown graphically by a movement from point C to point A. Notice that, these adjustment dynamics are completely driven by capital scarcity. If during the same period of financial distress the creditworthiness of borrowers also deteriorates—reducing quasi-rents—then p-values will not increase as much. The rush to liquidity will be even higher since the opportunity cost of doing so—lost quasi-rents—will be smaller. If post-crisis depositors become more risk-intolerant, it is plausible that the new long-run equilibrium will take place at a lower than the p=100 indifference curve.

VI. The 1995 Argentine Banking Crisis

At the time of the Mexican devaluation the Argentine financial system was characterized by the prevalence of universal banking, the absence of a formal deposit insurance scheme, and high mandated liquidity/reserve and risk-based capital requirements (11.5 percent).[10] High reserve requirements (43% for checking and 3% for term) were motivated by the need to create a pool of liquidity that could be released in case of a systemic run, as a way to smooth credit growth in the presence of substantial capital inflows, and as an incentive for banks to use own capital and reduce leverage (Fernandez and Guidotti 1994).

The iron corset imposed by the currency board adopted in 1991 implied that the central bank had to abdicate from its prerogative to act as a lender of last resort. Notwithstanding these constraints, in order to deal with the crisis, in February 1995, Congress passed an amendment to the Financial Institutions Act of 1991, giving the central bank a broader role in the liquidation of insolvent institutions; without committing fiscal resources. The central bank made use of its new powers five times involving 7 institutions.

on the long-run default-premium iso-risk curve.

[10]This section draws on background information presented in Schumacher (1996) and follows closely the chronology of the crisis presented in the 1995 paper "Managing a Liquidity Shock: Regulating the Financial System in Argentina," issued by the Central Bank of Argentina.

Chronology of the crisis

In December 1994, after strong speculative attacks, Mexico announced the widening of the exchange rate band of the peso, and switched to a floating exchange rate regime. As a result, the peso lost about half of its value against the US dollar in the last ten days of December. The confidence crisis was not circumscribed to Mexico and quickly permeated other emerging markets. For instance, the prices of Argentine Brady's and stocks also plummeted reaching their lowest levels in mid-March. Further, the ensuing capital outflow adversely affected the Argentine financial system. Deposit withdrawals hit initially wholesale banks but quickly extended to the rest of the financial system. Between December 20, 1994, and May 1995 total deposits in the banking system fell by 18.4% (from \$45.4bn to \$37bn) central bank reserves fell 21.1% (from \$17.5bn to \$13.8bn) and M3 contracted by 16.8%. In comparison with the distress period of the Great Depression—from October 1929 to January 1934 when the deposit base shrank by 38.9%—the Argentine panic was short-lived and not as acute. Nevertheless, this represented a big jolt to a system that between December 1991 and December 1993 had registered deposit growth of 350%, reflecting, among other things, the recovery of financial intermediation after many years of high inflation. Moreover, in 1994, despite the rise in international interest rates, the deposit base had expanded by another 50 percent.

It has now become standard to sub-divide the Argentine distress episode in 4 different phases.

Phase I: Portfolio Reallocation (December 20, 1994 to end-February, 1995)

Phase I is characterized by a shift away from peso deposits into assets denominated in US dollars. As of November 1994, 50.6% of the deposit base was denominated in US dollars. From December 20, 1994 to end-January, 1995 there was a marked dollarization of deposits, but in February due to the heightened perception of a possible conversion risk, there was a contraction in both types of deposits.

The net effect was a drop of the deposit base of 7% (\$3.3bn), three quarters of which attributable to the behavior of large term depositors[11]. During phase I, 31% of dollar deposits held by non-residents left the system, M3 contracted by 7.3 percent (\$4bn) and Argentina lost 16.4 percent of its international reserves (\$2.9bn). In addition, interest rates on peso and dollar deposits leapt to around 13% and 7.5%, by end-February, from pre-crisis levels of 9.5 percent and 6.2 percent respectively[12]. In order to arrest the sharp contraction in liquidity the central bank embarked on a process of creation of new

[11] Large deposits, represent accounts with balances over \$100,000.

[12] The heightened perception in peso risk also led the 30-day annualized peso prime-rate to increase from 11.5% to 18.5%, and the equivalent dollar rate to rise from 9% to 12%, increasing the active peso-dollar spread from 2.5% to 6.5%.

liquidity and its redistribution through the system. New liquidity was mainly created by a reduction in reserve requirements, by collateralized loans from the central bank (*redescuentos*), and by repurchase agreements (*pases*) in amounts compatible with the Convertibility Law and with the restrictions imposed by the central bank charter. In addition, penalties for banks that could not meet their reserve requirements were reduced. Further, a line of credit to the state-owned Banco Nación enabled this institution to engage in repos of high quality loans from banks in distress. This mechanism allowed, to some extent, to minimize the losses suffered by banks that had to sell their assets in order to meet liquidity needs. This set of measures were successful in offsetting the outflow of deposits and during the phase I total credit actually went up by $0.3bn.

Table 1: The Evolution of the Crisis: December 1994 to July 1995

	Stock	Flows			
(millions of US$)	Dec 20, 1994	Phase I	Phase II	Phase III	Phase IV
CENTRAL BANK					
Foreign Reserves	17533	-2880	-1892	1068	1278
Monetary liabilities	16725	-2214	-1323	1125	632
Currency	11897	-570	-476	876	150
Held by public	10282	-812	-179	916	-288
Cash in vault	1615	242	-297	-40	438
Reserves at Central Bank	4827	-1643	-847	249	482
BANKING SYSTEM					
Argendollars	2974	-1532	66	-492	608
Loans to the private sector	48221	304	-1424	9	110
Pesos		-829	-583	-62	-116
Dollars		1132	-841	72	227
Total Deposits	45366	-3242	-4170	-948	3357
Peso Deposits	22390	-3133	-1833	126	1664
Dollar Deposits	22976	-109	-2336	-1074	1693
CB repos	298	369	436	15	-431
Rediscounts	59	256	842	439	16
FINANCIAL SYSTEM					
M3	55649	-4055	-4349	-32	3069

Source: Managing a Liquidity Shock: Regulating the Financial System in Argentina, BCRA 1995

Phase II: Deepening of Withdrawals (March)

During March the perception of country risk increased amid fears of corporate defaults on private debt and of an extended Argentine default. In March alone, the 9.9 percent ($4.2bn) contraction of the deposit base exceeded the accumulated loss in phase I. Again, more than half of the contraction can be explained by the behavior of large term depositors. Also, M3 fell by another 7.8% ($4.3bn) and interest rates continued to climb—the rates on peso and dollar deposits increased to 24% and 11%, respectively[13]. The deepening of the crisis led the central bank to allow up to 50% of banks' vault reserves to be counted as part of the reserves requirements. Although the central bank managed to inject $1.3bn of liquidity through repos and central bank loans, that proved insufficient to match the drop in the deposit base and in March banks had to cancel loans worth $1.4bn (3% of outstanding credit). If phase I was mainly associated with the behavior of non-resident depositors, the contraction registered during phase II was to a great extent due to the lagged reaction of domestic depositors.

Phase III: Deceleration of Withdrawals (April to mid-May)

Between April and mid-May there was a noticeable improvement in the performance of all monetary aggregates, mainly due to the understandings reached with multilateral organizations that bolstered the country's foreign reserves and reinforced its policy commitments. Nevertheless, a solid path to recovery had to wait until the resolution of the political uncertainty surrounding the presidential elections, to be held in mid-May, and the non-zero probability of a change in the monetary regime. During this phase the shift towards assets outside the Argentine economy stopped and dollar deposits were reduced to allow for a recovery of the holdings of pesos and peso deposits, that had deteriorated deeply during the previous months. Dollar deposits held by non residents surged 33%, suggesting that the fall in deposits in phase III was much more influenced by the small domestic depositor. Still, total deposits contracted by another 2.5%, M3 remained constant, and the use of liquidity instruments by the central bank was less significant. As an additional tool to appease depositor's concerns, on April 18, 1995, Congress enacted a law creating a privately-funded limited-coverage deposits insurance scheme, and enhanced information disclosure requirements were put in place.

Phase IV (mid-May to end-July)

The aftermath of the elections was characterized by renewed confidence in the ability of Argentine authorities to keep its policy commitments and since mid-May economic agents increased their holdings of domestic assets. Total deposits increased by 9% ($3.4bn) between mid-May and end-July and reserves increased by 9.2%. Interest rates eased during May and June but were still higher than during the pre-shock period.

[13]Interest rates peaked during this phase. The annualized peso and dollar prime rates reached 45% and 30% respectively, and eased up gradually to 28% and 20% respectively by the end-March.

Taxonomy of deposits: Small vs Big, Demand vs Time, and Resident vs Non-resident.

The cumulative effect of phases I to IV on the deposit base was a contraction although dollar deposits were less affected (see table 2).

Table 2: Evolution of Deposits by Type (percentage variation)

	Dec. 20, 1994/July 95	Phase I	Phase II	Phase III	Phase IV
Total deposits	-11.0	-7.1	-9.9	-2.5	9.1
Peso deposits	-14.2	-14.0	-9.5	0.7	9.5
Dollar deposits	-7.9	-.5	-10.2	-5.2	8.7
	Nov. 94/May 95				
Demand deposits	2.0	-4.5	-6.3	14.0	-0.9
Savings accounts	-16.9	-2.3	-5.3	-9.9	-0.5
Term deposits	-22.8	-6.2	-9.9	-8.7	13.0

Source: Managing a Liquidity Shock: Regulating the Financial System, BCRA 1995.

- As of November 1994, the term structure of the deposit base consisted of 62.9 percent on term deposits, 20.2 percent on savings accounts, and the remaining 16.9 percent on demand deposits. Term depositors were the first to react. In April, after the international agreements reached by the government, demand deposits recovered fully, while savings accounts and term deposits were still contracting. Savings account holders seemed to follow the behavior of term depositors with a lag. For the whole period of the crisis, term deposits suffered the highest withdrawals rates, savings accounts holders were less affected, and demand deposits were not affected at all.

- As of November 1994, there were in Argentina around 1.2 million depositors holding term deposit accounts: 80.6% had term deposits of less than \$50,000; 17% deposits between \$50,000 and 100,000; and the remaining 2.4% deposits over \$100,000, but representing 50.8 percent of total term deposits. Large depositors were more risk-sensitive, and probably better informed. The large depositor was the first to perceive the change in the risk environment when the panic began and was also the first to react after March when Argentina reached agreement with the multilateral organizations. Clearly the middle size depositor followed the large depositor with a lag: they began to withdraw only in February and they were still leaving massively the system after March. During the first phase of the panic, 2013 large depositors (on average 10 depositors per bank) were responsible for 96% of the total fall in term deposits (or 74.3% of the fall in all types of deposits).

- As of November 1994, there were \$1.8bn dollars in deposits held by non-residents—3.7% of total deposits and 7.3% of dollar deposits. Over 90% of this amount was concentrated in just 21 banks—Banco Nación had a 18.5% share of dollar deposits of non-residents. Dollar deposits of non-residents fell 31% during the phase I and recovered in phase III, in stark contrast with the evolution of dollar deposits held by residents that grew during phase I and fell during phase III. Foreign depositors were behind the contraction registered during phase I while the behavior of domestic depositors generated the contraction during phase III.

It is worth mentioning that when the confidence shock hit, Argentine banks had: (1) An average risk based capital asset ratio of 18.2% (corresponding to a book capital ratio of 13.4%), to serve as a buffer against asset losses, (2) \$9.4bn in liquid resources—that is, 20% of total deposits were invested in deposits at the central bank. These two facts prevented excessive credit growth during the pre-panic period—when capital inflows and deposit growth was extremely high—and this mass of liquidity was used as much as possible to compensate for the fall in total deposits, minimizing distress sale of loans and thus bank losses. Further, there was in place a system of incentives designed to promote depositors' discipline, as ex-ante weaker banks were seen as less fit to survive the aggregate shock and were punished more heavily by depositors.

As of mid-May, the total loss in deposits was \$8bn, or about 18% of the deposit base. Out of this outflow, \$3.4bn was accommodated by releasing reserve requirements, \$2.3bn with repos and central bank loans, and \$1.1bn with credit contraction. Hence, 42% of the total fall in deposits was compensated by releasing reserve requirements and only 12% with a credit cut—representing 2.4% of total credit outstanding as of December 21, 1994.

VII. Empirical Implications of the Model

The Data

The data on banks balance sheets is taken from the reports of the Argentine Superintendency of Financial Institutions from 1993Q2 to 1996Q4 and encompasses the capital crunch period that followed the Mexican devaluation.

The sample was purged of banks with capital ratios below 2% or above 50%, and of banks with a loan portfolio in excess of 95 percent of total assets[14]. The reasoning

[14] All these eliminations accounted for a small percentage of the sample and setting different cutoff levels did not qualitatively alter the results.

behind this procedure is that these observations are usually from banks that were about to fail and were therefore gambling for resurrection by taking excessive risk, or banks that had recently entered the market and were still adjusting their portfolios to the long-run equilibrium. Since the peculiar behavior and characteristics of these banks could potentially color the empirical results, these observations were excluded.

The regressions were carried out for all banks in the sample, and for sub-samples of foreign, domestic, retail, or wholesale banks. The number of banks in each category is given in Table 3.

TABLE 3: The Sample: 1994Q2 Number of Banks

	Retail (83)	Wholesale (15)
Foreign (13)	11	2
Domestic (85)	72	13

A quick overview of the balance sheet data for the banks in the sample is provided in Tables 4 and 5.

In both pre- and post-crisis periods, foreign banks tended to be bigger than their domestic counterparts. Also, retail banks tended to have more assets under management than wholesale banks. Domestic banks were considerably more affected by the crisis. At the end of 1996 they were still showing a loan portfolio of lower quality, as measured by the ratio of non-performing loans to total loans. In addition, their vulnerability was compounded by the smaller portion of delinquent loans that were provisioned. In the aftermath of the Tequila effect, the observed credit retrenchment resulted in many banks experiencing a reduction of the share of loans in their portfolios, with particular emphasis given to domestic retail banks who suffered a bigger shock to the capital base. Foreign banks rely less on deposit financing, tend to benefit from cheaper funding, and were more successful in controlling loan delinquency—probably by choosing to deal primarily with the best risks in the country. Banks of all categories were successful in streamlining operations and reducing overhead costs following the end-1994 financial crisis.

TABLE 4: Bank Balance Sheet Composition 1994Q2

	All banks	Retail	Wholesale	Foreign	Domestic
Total Assets ($,000)	41,322,212	36,559,945	4,762,267	10,963,738	30,358,474
Average bank size ($,000)	421,655	440,481	317,364	843,364	357,159
Fraction of Total Assets					
Cash	.123	.130	.070	.118	.125
Securities	.041	.038	.068	.052	.038
Loans	.650	.669	.505	.641	.653
Deposits	.579	.602	.402	.553	.588
Equity	.124	.126	.114	.102	.132
Other Variables					
Return on Loans (quarterly)	.048	.048	.051	.035	.052
Return on Deposits (quarterly)	.016	.015	.017	.011	.017
Return on Assets (quarterly)	.003	.003	.000	-.000	.004
Return on Equity (quarterly)	.022	.024	.004	-.002	.029
Non-performing Loans÷ Loans	.085	.085	.090	.079	.087
Overhead ÷ Assets	.022	.023	.012	.019	.023
Loan Loss Provision ÷ Loans	.055	.058	.039	.050	.056

Finally, foreign banks receive a smaller return on loans, but also pay a smaller return on deposits. As shown in Catão (1998) the deterioration of the return on equity of Argentine banks had already started in the year prior to the 1995 financial crisis, posting only a modest rebound in 1996, since the substantial increase in the share of non-performing loans led to an increase in provisioning expenses.

TABLE 5: Bank Balance Sheet Composition 1996Q4

	All banks	Retail	Wholesale	Foreign	Domestic
Total Assets ($,000)	58,162,559	54,317,728	3,844,831	16,473,360	41,689,199
Average bank size ($,000)	969,376	1,207,061	256,322	1,372,780	868,525
Fraction of Total Assets					
Cash	.082	.082	.086	.072	.086
Securities	.089	.088	.103	.104	.083
Loans	.593	.598	.524	.598	.591
Deposits	.542	.546	.481	.535	.544
Equity	.114	.111	.154	.097	.121
Other Variables					
Return on Loans (quarterly)	.043	.043	.044	.040	.044
Return on Deposits (quarterly)	.014	.013	.016	.012	.014
Return on Assets (quarterly)	.003	.003	.003	.001	.004
Return on Equity (quarterly)	.026	.026	.019	.006	.032
Non-performing Loans ÷ Loans	.107	.109	.078	.086	.115
Overhead ÷ Assets	.016	.016	.015	.016	.016
Loan Loss Provision ÷ Loans	.048	.057	.021	.072	.043

Model Testing

Without being a full fledge theory of bank portfolio decision our theoretical model provides a framework for the study of the interaction and complementarity between equity capital and asset risk, and the adjustment dynamics to a capital shock.

We will use a longitudinal data set (108 banks observed during fifteen quarters) of disaggregated data from individual banks balance sheets to provide a test of the model implications. One of the cross-sectional empirical implications of our model is that, since depositors impose a risk-constraint on banks, there is a positive correlation between banks' capital-to-asset ratios and the share of risky assets in their portfolios. Banks with lower capital ratios can self-insure by holding a higher share of liquid assets—that is, by lowering their asset risk. Since capital functions as a buffer stock against asset value losses, by holding less risky assets (loans) bank managers can effectively reduce the risk of asset losses in the future and hence the need of equity to absorb them. Further, when bank capital becomes scarce, in the short-run banks might adjust by allowing p-values to rise, letting the bank be temporarily more exposed than what its long-run equilibrium calls for.

We test if this prediction is borne out in the data by running a fixed-effects time series cross section regression on a panel of 108 banks in operation in 1993Q3. The regression equation to be estimated is of the following form:

$$\sigma(A)_{it} = \alpha_i + \gamma_t + \beta_1 \left(\frac{Equity}{Assets}\right)_{i\,t} + \sum_{k=2}^{N} \beta_k X_{k\ i\ t-1} + \varepsilon_{i\ t} \tag{9}$$

where $X_{k\ i\ t-1}$ is a set of other lagged control variables that might influence the evolution of bank risk taking. It is assumed that the residuals have conditional mean of zero and finite conditional variance, that is:

$$E\left[\varepsilon_{i\ t} \mid \jmath_t\right] = 0, \qquad Var\left[\varepsilon_{i\ t} \mid \jmath_t\right] < \infty.$$

where $\jmath_t$ is the information set at time t (the right hand side explanatory variables are included in the information set $\jmath_t$). Further, the observations are assumed to be uncorrelated across time and across banks.

$$E\left[\varepsilon_{it}\,\varepsilon_{is}\right] = 0 \text{ for } t \neq s \quad \text{and, } E[\varepsilon_{it}\,\varepsilon_{jt}] = 0 \qquad \text{for } i \neq j.$$

The fixed effects parameter α_i should capture the individual bank effects that are constant over the sample period and specific to the particular cross-sectional unit i, for instance, bank i risk propensity or the quality of management. It is known that bank managers have different targets for risk exposure and hence choose very different portfolio compositions. Nevertheless, if their risk preferences are fixed over the sample interval we can purge the coefficients for this and other bank specific effects by estimating a fixed effects model.

Time effects, captured by γ_t, should measure changes in macro variables or in regulation that might equally affect all the banks in the sample. Also, the time dummies will convey information about the short-term adjustment to a capital shock. A positive dummy is an indication that for that period banks were assuming more risk than what was called for by their current capital ratios. Banks are overexposed—since it might be cheaper to allow p-values to increase, than either increase the bank's capital or reduce more the share of loans. As a proxy for asset risk we use several measures: (1) the ratio of total loans to assets, (2) the ratio of non-performing loans to total loans, and (3) the ratio of total assets net of cash and securities to total assets. The results are qualitatively the same whichever measure one uses. We will report the coefficient estimates for asset risk measured by the share of loans.

To control for other effects over the share of loans, apart from the equity ratio, we include the following exogenous variables:

$Log(Assets)_{t-1}$: The Argentine banking landscape is far from homogeneous. With the largest bank in the sample being over 400 times bigger than some of the smallest, significant heterogeneity across banks is not only a possibility but a reality. For very different reasons large and small banks could perform differently. It is well documented that large banks usually have more diversified loan portfolios and deal with a different set of customers and products. By being more diversified the bank reduces its overall risk exposure. Further, in practice the regulatory treatment of banking firms has been far from symmetric across size. Large bank failures are more dreaded than small ones, since large banks are viewed as more likely to generate negative macroeconomic externalities. Under the 'too big to fail' doctrine all liabilities of very large banks, whether formally insured or not, could *de facto be* guaranteed. This makes it possible for bigger banks to substitute their own capital for regulators capital. This variable allows banks of different sizes to have different targets for risk exposure.

$\left(\frac{Equity}{Assets}\right)_t^2$: Since the relation between asset risk and the capital ratio is non-linear a quadratic form as a local approximation of observed behavior is used.

$\left(\frac{Equity}{Assets}\right)_{t-1}$: The lagged capital ratio will allow for a gradual adjustment to the desired level of risk exposure.

$(Return\ on\ Loans)_{t-1}$: This variable should capture the price effect on the demand for loans schedule. A higher return on loans should be associated with a more profitable line of business, that is, with higher quasi-rents arising from granting credit.

$(Ex\text{-}post\ Intermediation\ Spread = Return\ Loans\ -\ Return\ Deposits)_{t-1}$: A higher spread is a sign of a profitable bank, i.e., a bank that has a comfortable operating position. A higher spread might induce banks to hold more loans since the foregone rents of not doing so will be higher. Additionally, high intermediation spreads might be viewed as a signal that the intermediation business generates such high margins that the risk of failure is so low that the bank will be able to sustain higher levels of risky assets without violating the depositors risk-constraint.

To test our prediction we have run a pooled regression with all the banks in the sample and also separate individual regressions for: Domestic, foreign, retail, and wholesale banks. The coefficient estimates of equation (9) for different sub-samples are shown in Tables 6 to 11. After controlling for other exogenous variables, our theoretical conjecture is borne out in the data.

TABLE 6: Fixed Effects Estimates of Equation (9). Full Sample—Pooled regression
Dependent Variable $(\text{Loans} \div \text{Assets})_t$. Sample: 1993Q2–1996Q4

$(\text{Capital} \div \text{Assets})_t$	.34	.62	.82	.82	.82	.82	1.71	1.52	1.51	1.50	1.55
	(5.9)	(8.3)	(12.1)	(12.2)	(12.3)	(12.2)	(11.5)	(10.7)	(10.48)	(10.41)	(10.8)
$(\text{Capital} \div \text{Assets})^2_t$							-2.8	-2.2	-2.2	-2.2	-2.2
							(-9.9)	(-7.8)	(-7.6)	(-7.5)	(-7.4)
$(\text{Capital} \div \text{Assets})_{t-1}$		-.27	-.55	-.55	-.55	-.54					
		(-3.6)	(-8.0)	(-7.9)	(-7.9)	(-6.5)					
$(\text{Loans} \div \text{Assets})_{t-1}$			.44	.44	.44	.44		.36	.36	.36	.39
			(15.5)	(15.6)	(15.6)	(15.4)		(12.8)	(12.9)	(12.9)	(13.7)
$(R_L)_{t-1}$				.15					.06*		
				(2.0)					(0.8)		
Spread_{t-1}					.17	.17				.08*	.07*
					(2.2)	(2.2)				(1.1)	(.92)
Log(Assets)_{t-1}						.002*					0.04
						(.21)					(4.2)
Adjusted R^2	.78	.81	.85	.85	.85	.85	.80	.85	.85	.85	.85
Num. Observations	1201	1077	1077	1077	1077	1077	1201	1077	1077	1077	1077

Notes: OLS estimation. All specifications control for fixed and time-specific effects.
T-ratios in parenthesis. * Not significant at the 5 percent level.

TABLE 7: Constant Cross-sectional Intercept Estimates of Equation (9). Full Sample—Pooled regression
Dependent Variable (Loans÷Assets)$_t$. Sample: 1993Q2–1996Q4

Intercept	.56	.45	.08	.09	.09	.14	.50	.40	.06	.06	.06	.03*
	(34.0)	(26.8)	(7.1)	(7.1)	(7.3)	(5.30)	(22.1)	(18.1)	(4.0)	(4.35)	(4.4)	(.8)
(Capital ÷ Assets)$_t$	.38	.50	.86	.86	.86	.87	.79	.80	.48	.53	.53	.58
	(2.9)	(4.2)	(13.3)	(13.3)	(13.3)	(13.4)	(4.3)	(4.7)	(4.6)	(4.9)	(5.0)	(5.3)
(Capital ÷ Assets)$_t^2$							-1.5	-1.4	-.78	-.87	-.89	-.94
							(-3.9)	(-3.8)	(-3.5)	(-3.8)	(-3.9)	(-4.1)
(Capital ÷ Assets)$_{t-1}$	-.28	-.30	-.79	-.79	-.79	-.83						
	(-2.2)	(-2.6)	(-12.2)	(-12.1)	(-12.2)	(-12.4)						
D$_{retail}$		.13	.03	.03	.03	.03		.12	.03	.03	.03	.03
		(15.3)	(5.4)	(5.5)	(5.6)	(5.8)		(15.7)	(5.6)	(5.9)	(5.8)	(5.6)
D$_{foreign}$		.005*	-.001*	-.003*	-.003*	-.001*		.007*	.00*	.00*	.00*	-.00*
		(.6)	(-.3)	(-.6)	(-.6)	(-.1)		(.9)	(.8)	(.2)	(.3)	(-.0)
(Loans÷Assets)$_{t-1}$			.84	.83	.83	.83			.80	.80	.79	.80
			(49.8)	(49.3)	(48.4)	(48.0)			(45.6)	(45.1)	(44.1)	(44.0)
(R$_L$)$_{t-1}$				-.08*						-.15		
				(-1.3)						(-2.4)		
Spread$_{t-1}$					-.14*	-.15					-.19	-.18
					(-1.9)	(-2.2)					(-2.6)	(-2.5)
Log(Assets)$_{t-1}$						-.004						.003*
						(-2.2)						(1.6)
Adjusted R^2	.14	.30	.80	.80	.79	.79	.13	.28	.76	.76	.76	.76
Num. Observations	1077	1077	1077	1077	1077	1077	1201	1201	1077	1077	1077	1077

Notes: OLS estimation. All specifications control for time-specific effects.
T-ratios in parenthesis. * Not significant at the 5 percent level.

TABLE 8: Fixed Effects Estimates of Equation (9). Sub-Sample: Retail banks.
Dependent Variable $(\text{Loans} \div \text{Assets})_t$. Sample: 1993Q2–1996Q4

$(\text{Capital} \div \text{Assets})_t$	.35	.73	.85	.85	.85	.85	.76	.83	.83	.84	.87
	(5.6)	(8.3)	(10.2)	(10.2)	(10.2)	(10.2)	(4.9)	(5.14)	(5.1)	(5.2)	(5.4)
$(\text{Capital} \div \text{Assets})_t^2$							-.93	-1.1	-1.1	-1.1	-1.1
							(-2.9)	(-3.1)	(-3.1)	(-3.1)	(-3.0)
$(\text{Capital} \div \text{Assets})_{t-1}$		-.51	-.73	-.73	-.73	-.73					
		(-5.7)	(-8.5)	(-8.5)	(-8.5)	(-7.8)					
$(\text{Loans} \div \text{Assets})_{t-1}$			.37	.37	.37	.37		.30	.30	.29	.30
			(11.0)	(10.9)	(10.3)	(10.3)		(8.8)	(8.6)	(8.0)	(7.9)
$(R_L)_{t-1}$				.11*					-.00*		
				(.85)					(-0.0)		
Spread_{t-1}					.07*	.07*				-.09*	-.06*
					(.4)	(.4)				(-.5)	(-.4)
$\text{Log}(\text{Assets})_{t-1}$						-.001*					0.03
						(-.1)					(3.0)
Adjusted R2	.76	.78	.80	.81	.81	.81	.76	.79	.79	.79	.80
Num. Observations	972	877	877	877	877	877	972	877	877	877	877

Notes: OLS estimation. All specifications control for fixed and time-specific effects.
T-ratios in parenthesis. * Not significant at the 5 percent level.

TABLE 9: Constant Cross-sectional Intercept Estimates of Equation (9). Sub-Samples: Retail and wholesale banks. Dependent Variable (Loans÷Assets)$_t$. Sample: 1993Q2–1996Q4

	Retail		Wholesale			Retail					
Intercept	.57	.58	.06*	.08	.12*	.54	.55	.13	.12	.12	.08
	(45.0)	(45.2)	(1.9)	(2.6)	(0.9)	(30.0)	(30.0)	(7.6)	(6.6)	(6.3)	(2.6)
(Capital ÷ Assets)$_t$	.09	.58	.84	.83	.83	.48	.42	.37	.35	.35	.39
	(2.5)	(4.4)	(6.4)	(6.4)	(6.4)	(3.0)	(2.6)	(3.4)	(3.2)	(3.1)	(3.4)
(Capital ÷ Assets)$_t^2$						-.86	-.77	-.73	-.72	-.71	-.75
						(-2.5)	(-2.3)	(-3.0)	(-3.0)	(-2.9)	(-3.1)
(Capital ÷ Assets)$_{t-1}$		-.52	-.64	-.64	-.67						
		(-3.9)	(-4.8)	(-4.9)	(-4.4)						
$D_{foreign}$		-.02	-.02*	-.03*	-.02*		-.02	.00*	.00*	.00*	-.00*
		(-2.6)	(-1.4)	(-1.6)	(-1.5)		(-2.4)	(.8)	(.9)	(.4)	(-.1)
(Loans÷Assets)$_{t-1}$			.88	.87	.87			.75	.75	.75	.76
			(25.0)	(24.6)	(23.8)			(34.5)	(34.5)	(33.4)	(33.4)
$(R_L)_{t-1}$				-.25					.2*		
				(-2.2)					(1.9)		
Spread$_{t-1}$					-.26					.21*	.26*
					(-2.2)					(1.5)	(1.8)
Log(Assets)$_{t-1}$					-.002*						.002*
					(-0.3)						(1.6)
Adjusted R^2	.27	.31	.79	.80	.80	.27	.27	.71	.71	.71	.71
Num. Observations	972	877	200	200	200	972	972	877	877	877	877

Notes: OLS estimation. All specifications control for time-specific effects.
T-ratios in parenthesis. * Not significant at the 5 percent level.

TABLE 10: Fixed Effects Estimates of Equation (9). Sub-Sample: Domestic banks.
Dependent Variable (Loans÷Assets)$_t$. Sample: 1993Q2–1996Q4

(Capital ÷ Assets)$_t$	.27	.76	1.0	1.0	1.0	1.72	1.38	1.37	1.37	1.41
	(4.15)	(8.4)	(12.8)	(12.9)	(13.0)	(10.6)	(8.9)	(8.7)	(8.7)	(9.0)
(Capital ÷ Assets)$_t^2$						-3.2	-2.1	-2.1	-2.1	-2.0
						(-9.7)	(-6.5)	(-6.2)	(-6.1)	(-5.9)
(Capital ÷ Assets)$_{t-1}$		-.50	-.81	-.80	-.85					
		(-5.5)	(-10.0)	(-9.9)	(-9.0)					
(Loans÷Assets)$_{t-1}$			.50	.50	.50		.40	.40	.40	.43
			(16.9)	(16.8)	(16.4)		(13.2)	(13.2)	(13.2)	(13.8)
$(R_L)_{t-1}$				.10*				.02*		
				(1.4)				(.3)		
Spread$_{t-1}$					.13*				.04*	.03*
					(1.7)				(.5)	(.03)
Log(Assets)$_{t-1}$					-.01*					.04
					(-1.0)					(3.7)
Adjusted R^2	.79	.82	.87	.87	.87	.81	.86	.86	.86	.87
Num. Observations	998	896	896	896	896	998	896	896	896	896

Notes: OLS estimation. All specifications control for fixed and time-specific effects.
T-ratios in parenthesis. * Not significant at the 5 percent level.

TABLE 11: Constant Cross-sectional Intercept Estimates of Equation (9). Sub-Sample: Domestic banks.
Dependent Variable (Loans÷Assets)$_t$. Sample: 1993Q2–1996Q4

Intercept	.44	.08	.08	.15	.44	.05	.06	.06	.04*
	(24.9)	(6.3)	(6.5)	(5.4)	(17.5)	(3.3)	(3.7)	(3.7)	(1.4)
(Capital ÷ Assets)$_t$	.48	.98	.99	1.00	1.3	.57	.64	.65	.67
	(3.3)	(12.5)	(12.6)	(12.8)	(6.4)	(4.8)	(5.4)	(5.5)	(5.5)
(Capital ÷ Assets)$_t^2$					-2.7	-1.1	-1.2	-1.2	-1.2
					(-6.1)	(-4.1)	(-4.6)	(-4.7)	(-4.8)
(Capital ÷ Assets)$_{t-1}$	-.37	-.92	-.92	-.97					
	(-2.6)	(-11.8)	(-11.8)	(-12.2)					
D_{retail}	.14	.03	.03	.03		.03	.03	.03	.03
	(16.2)	(4.8)	(4.9)	(5.1)		(5.0)	(5.3)	(5.3)	(5.2)
(Loans÷Assets)$_{t-1}$		.85	.85	.84		.81	.80	.80	.80
		(47.5)	(47.1)	(46.0)		(42.4)	(41.9)	(41.0)	(40.7)
$(R_L)_{t-1}$			-.12*				-.19		
			(-1.9)				(-2.9)		
Spread$_{t-1}$				-.19				-.23	-.23
				(-2.9)				(-3.3)	(-3.1)
Log(Assets)$_{t-1}$				-.004					.001*
				(-2.6)					(0.7)
Adjusted R^2	.35	.82	.82	.82	.17	.79	.79	.80	.80
Num. Observations	998	896	896	896	998	896	896	896	896

Notes: OLS estimation. All specifications control for time-specific effects.
T-ratios in parenthesis. * Not significant at the 5 percent level.

The results obtained are robust and stable across all sub-samples and regression specifications, producing a positive and significant coefficient for bank capital at standard significance levels. Further, retail banks seem to have a higher target for risk exposure than wholesale banks—the dummy variable for retail banks in the pooled specification is positive and significant—, while there is not a statistically significant difference between domestic and foreign banks (see Table 7). The results are particularly robust for domestic retail banks, which comprise most of the sample. The lagged capital ratio and the lagged loan ratio allow for a gradual adjustment of asset risk to a disturbance to the capital base. Fitting quarterly dummies or just a dummy for the pre-crisis period did not significantly alter the reported results. The Hausman specification test favors the fixed-effects specification over random-effects specification.

The control variable $\log(\text{assets})_{t-1}$ tries to capture size effects, or the effects of diversification that come about through the volume of assets is not robust and does not seem to have significance.

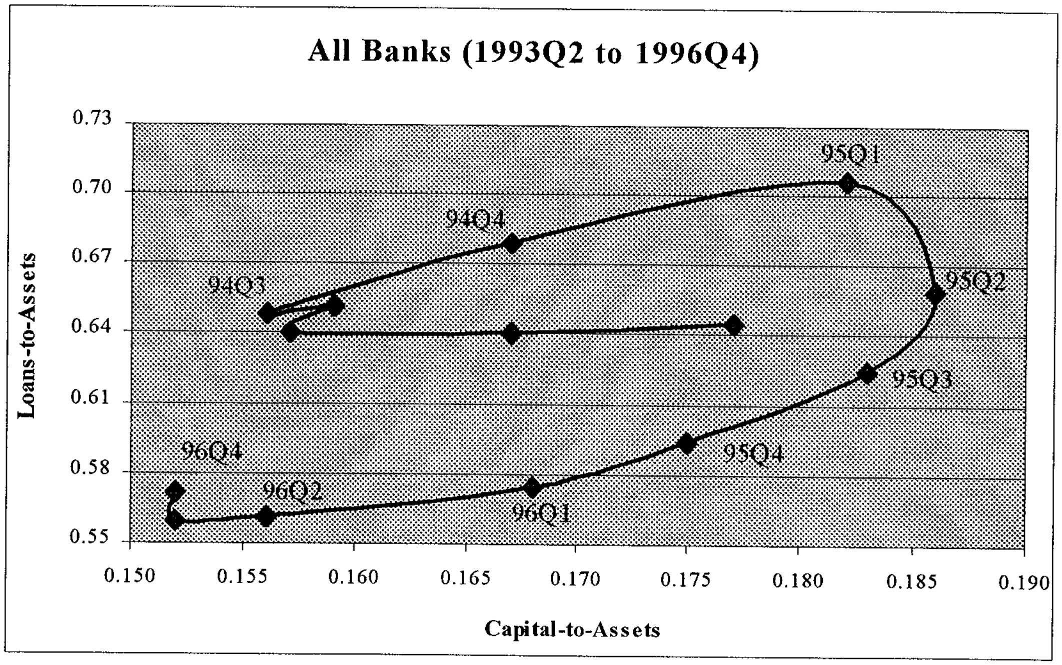
The coefficients on the intermediation spread—which tries to capture the monopoly rents arising from the 'core' banking activities of loan making and deposit taking—and on the ex-post return on loans lack robustness and do not show statistical significance.

Furthermore, the time-dummies are extremely enlightening about the adjustment that the Argentine banking system underwent following the crisis. As shown in table 12, the dummies increase in absolute value until 1995Q1, reach their highest values during the peak of the crisis—1994Q4 to 1995Q2—and then gradually decline over time.

As depicted in figures 4 and 5, the 1995 economic recession and the natural increase in the share of non-performing loans led to a gradual deterioration of banks' capital ratio during the second semester of 1995 and all of 1996. Faced with this depletion, the banking system embarked on a gradual adjustment process of risk reduction by contracting the share of loans in the portfolio. The pre-crisis period, in particular 1994, was characterized, by an expansion of the share of loans in the portfolio accompanied by increases in capitalization. It seems clear from the figures and the coefficients of the time-dummies reported in table 12 that following the panic, at least for the domestic retail banks, depositors became more risk intolerant and pressed banks to operate on a lower default-premium indifference curve—from 1995Q3 on the time-dummies are always smaller in absolute value than the preceding periods and in some instances are even negative. In contrast with 1993 and 1994, from the second half of 1995 on, surviving banks had to offer lower risk exposure to its depositors in order to entice them, since they were still scared and the banking system was still undergoing substantial consolidation, with several mergers and bank failures[15]—this is also shown in figures 4 and 5, where the loan-capital path after 1995Q2

[15]As of September 1996—out of 129 private banks—, 9 had failed, and 30 others had been acquired

Figure 4: Time-series evolution of asset risk and capital ratios for all banks



is always below the pre-crisis path.

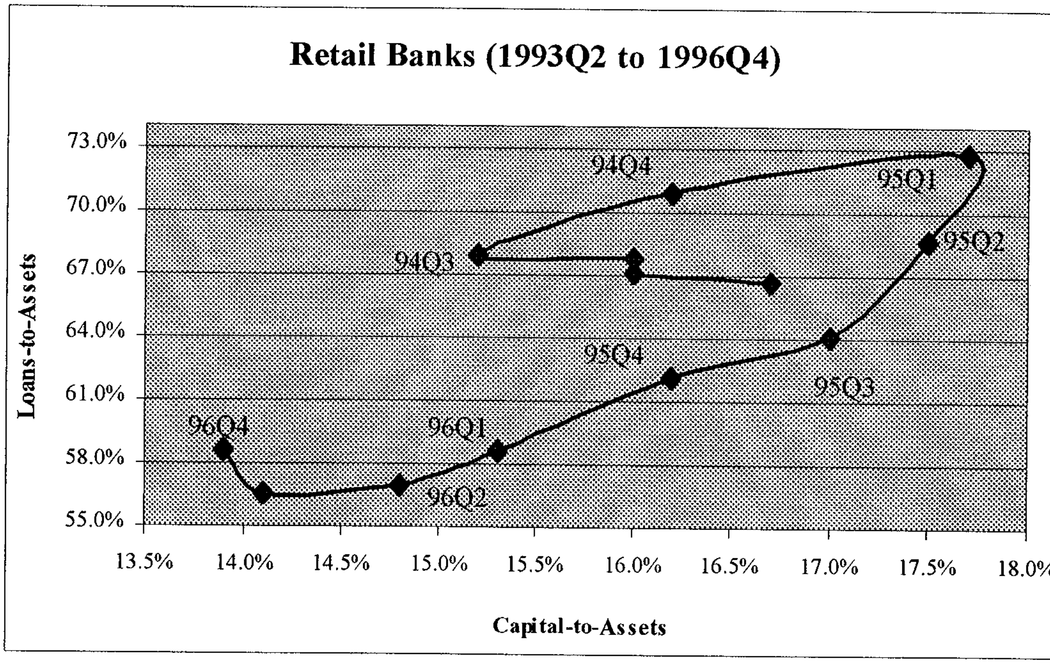
During the panic period—1994Q4 to 1995Q2—the time dummies are positive and reach their highest absolute levels (see table 12), which is prima facie evidence that banks were particularly overexposed during this period, leading to higher passive interest rates and, for many banks, substantial deposit outflows. The six-quarter retrenchment period that followed the panic—1995Q3 to 1996Q4—seems to have ended around the end of 1996, when the system showed the first signs that banks were approaching their pre-crisis equilibrium levels of risk exposure, as depositors were relaxing their risk-constraint.

The pre-crisis increase in the time dummies also corroborates Fernandez and Schumacher (1996) assertion that although the confidence crisis was a major shock to Argentine bank assets, its role was just to expose and exacerbate some worrisome trends that had been developing since late 1993 and 1994—when the 5 year period of declining international interest rates came to an end[16]. Also, the weak deposit base generated by the hyperinflation years rendered capital regulations not binding for many years. All this changed in 1994, when capital ratios became binding (actually rising for some

or merged.

[16]At the beginning of 1994, the U.S. Federal Reserve Board increased the Federal Funds rate, leading to a reduction of funds flowing to argentine financial markets and to a decrease in bonds' prices; adversely affecting many instituions. Wholesale banks were particularly hit.

Figure 5: Time-series evolution of asset risk and capital ratios for retail banks



institutions) and tight new provisioning and delinquency rules (June 1994) impacted on banks capital and brought book capital ratios ever closer the mandated legal minimum requirements.

Calomiris and Wilson (1996) defend that following the 1929-1933 banking distress in the U.S. depositors did not become more risk-intolerant than before. On the contrary, our results for the Argentine crisis, seem to lend support to the view of Friedman and Schwartz (1963), that theorize that following the absence of a lender of last resort intervention by the Fed, banks were made to realize that they were more exposed than previously thought, and depositors turned more risk-intolerant of default risk than they had been previously—forcing banks to operate on a lower indifference curve.

In conclusion, the data are rather supportive of the theoretical conjecture that after a period a financial distress banks optimally choose to be temporarily overexposed in comparison with their long-run target. Bank managers, when found in a situation of undercapitalization, do shed asset risk by reducing the share of risky assets in order to maintain a given level of security. This decrease in risk is the cheapest way to compensate depositors for the lack of adequate equity funds in the bank's capital structure. Further, the empirical evidence suggest that, in particular domestic retail banks, underwent an adjustment period of at least 6 quarters, and that depositors showed evidence of becoming more risk-intolerant in the aftermath of the crisis.

The time dummies for foreign banks (not reported here) show a different picture. There is a slight increase in exposure in 1994Q4 and 1995Q1, but their significance quickly vanishes as banks return to their long-run equilibrium. This is consistent with the fact that foreign banks as a group suffered much lower deposit withdrawal rates, and during some phases of the panic—when there was a clear rush to quality—many actually experienced positive deposit flows.

Table 12: Time dummies for selected regressions in tables 6 to 11

	All banks			Retail banks		Domestic banks	
	(A)	(B)	(C)	(D)	(E)	(F)	(G)
Intercept			.557		.574		.441
γ_{93Q3}	.044	.029		.043	.070	.051	.068
γ_{93Q4}	.040	.030	.071	.054	.078	.047	.069
γ_{94Q1}	.046	.038	.074	.062	.083	.052	.075
γ_{94Q2}	.052	.046	.079	.067	.089	.061	.087
γ_{94Q3}	.051	.046	.076	.071	.082	.055	.078
γ_{94Q4}	.080	.071	.111	.100	.120	.081	.106
γ_{95Q1}	.092	.078	.128	.112	.138	.099	.133
γ_{95Q2}	.055	.047	.082	.079	.097	.063	.091
γ_{95Q3}	.023	.016*	.051	.041	.052	.036	.061
γ_{95Q4}	.010*	.005*	.024*	.027	.032	.010*	.021*
γ_{96Q1}	-.017*	-.021	.004*	-.005*	-.001*	-.020*	-.002*
γ_{96Q2}	-.023	-.026	-.010*	-.020	-.017*	-.021*	-.013*
γ_{96Q3}	-.018*	-.020	-.007*	-.020	-.020*	-.017*	-.011*
γ_{96Q4}	...	...	...	...	...	...	...

Note: (A), (D), and (F) are the time-dummies for the fixed effects regressions of (Loans÷Assets) on (Capital÷Assets). (B) is identical to (A) but also includes $(\text{Capital}\div\text{Assets})_t^2$. (C), (E), and (G) are the time dummies for the constant cross-sectional intercept regressions of (Loans÷Assets) on (Capital÷Assets).
* Not significant at the 5 percent level.

Robustness Checks

The results presented in the previous subsection are robust to slight modifications and extensions. Instead of a fixed-effects model we estimated a random-effects model, where the bank specific constant terms are viewed as randomly distributed across banks. The results were basically unchanged from one specification of the regression equation to the other. The assumption that the observations are uncorrelated across time was also relaxed, by allowing the residual to follow an AR(1) process. Once again the results were qualitatively the same.

The implications of the model were also robust to slight different dummy specifications. For instance, the results did not change significantly by using a dummy for the crisis period—1994Q4 to 1995Q2—instead of a dummy for every quarter, or dummies for the pre-crisis, crisis, and post-crisis periods.

VIII. Conclusion

We developed a general theoretical two-period bank portfolio choice model, from which we derived a graphic representation, along the lines of Calomiris and Wilson (1996). The model implications were tested with Argentine bank balance-sheet data from 1993Q2 to 1996Q4. The pooled time-series cross-section fixed-effects regressions support the model predictions of a positive covariance between asset risk and banks own capital. Furthermore, it is found that Argentine domestic retail banks, underwent a period of adjustment of 6 quarters, following the Mexican devaluation crisis, and reduced their risk-exposure in comparison with the pre-crisis period. This suggests that depositors become less prone to tolerate bank default risk, and constrained banks to reduce their p-values. Foreign banks seem to have suffered a milder shock, and adjusted immediately.

The econometric tests support the model predictions and fit the stylized facts of the Argentine banking system in the aftermath of the crisis. A possible extension would be to perform additional tests using market data. This would allow for the explicit calculation of default-premiums (p-values), from the Black-Scholes contingent claims pricing formula, and to use the market value of equity. However, in the case of Argentina, since the number of publicly traded banks is very small and some have only recently been listed, the reduced number of observations available will constrain the validity of the results. Preliminary tests seem to suggest that the results hold well with market data. Availability of default-premiums would also allow cross sectional testing of deposit outflows, where we can posit that banks with the highest p-values were more affected by deposit withdrawals.

A Convex Cost of Raising Equity: $v'(E)>0, v''(E)>0$

We will now relax the previous assumption, and study the implications of having increasing costs of raising equity. Since the cost v also depends on E, we cannot solve the balance sheet constraint for E, and plug it in the objective function, as we did before.

The assumption of increasing costs, though more realistic, makes the interpretation of the FOCs more cumbersome. The magnitude of the bank adjustments to various shocks, depends on the elasticities of the capital cost, v, with respect to equity, E. The main difference, should be, that when an exogenous shock raises the return of a given asset, bank managers, will try to raise additional funds from both the deposit and equity markets.

Bank-Neutral Deposit Insurance: $\phi = (1-v)\frac{\int_0^{\theta^*}\varphi(\theta)dF(\theta)}{1+r}$

The expected return on deposits is still given by (7). Banks maximize

$$G = \left(\frac{\int_0^1 x(\theta)\,dF(\theta)}{1+r}\right)X + B + \left(\frac{\Pi + \alpha - d^*}{1+r} + \frac{\int_0^{\theta^*}(\varphi(\theta)-\gamma)\,dF(\theta)}{1+r}\right)D - E$$

subject to:

$$X + B \leq (1-\alpha-\phi)\,D + E\,(1 - v(E))$$

Let λ be the multiplier associated with the balance sheet constraint and $m_X^4 = \frac{\int_{\theta^*}^1 x(\theta)dF(\theta)}{1+r} +$

$+\lambda(1-v)\frac{\int_0^{\theta^*} x(\theta)dF(\theta)}{1+r} - \lambda$. Differentiation produces the following first order conditions:

$$
\begin{aligned}
\frac{\partial G}{\partial B} &= 1-F(\theta^*)\left[1-\lambda(1-v)\right]-\lambda(1-v)\tfrac{\gamma D}{1+r}f(\theta^*)\tfrac{\partial\theta^*}{\partial B}\\
\frac{\partial G}{\partial x(\theta)}\big|_{\theta\geq\theta^*} &= \tfrac{f(\theta)}{1+r}\left[X+m_X^4X'(.)\right]-\lambda(1-v)\tfrac{\gamma D}{1+r}f(\theta^*)\tfrac{\partial\theta^*}{\partial x(\theta)}\\
\frac{\partial G}{\partial x(\theta)}\big|_{\theta<\theta^*} &= \tfrac{f(\theta)}{1+r}\left[\lambda(1-v)X+m_X^4X'(.)\right]-\lambda(1-v)\tfrac{\gamma D}{1+r}f(\theta^*)\tfrac{\partial\theta^*}{\partial x(\theta)}\\
\frac{\partial G}{\partial d^*} &= \tfrac{1}{1+r}\left[\left(-D+\tfrac{\pi-d^*}{1+r}D_1\right)\left(1-F(\theta^*)\left[1-\lambda(1-v)\right]\right)\right]+\tfrac{\lambda D_1}{1+r}\left[1-\alpha-\tfrac{1-v}{1+r}\gamma F(\theta^*)\right]\\
&\quad+\tfrac{\alpha D_1}{1+r}\left(1-F(\theta^*)\left[1-\lambda(1-v)\right]\right)\left[\tfrac{1}{1+r}\right]-\lambda(1-v)\tfrac{\gamma D}{1+r}f(\theta^*)\tfrac{\partial\theta^*}{\partial d^*}\\
\frac{\partial G}{\partial f} &= \tfrac{-1}{1+r}\left[\left(-D+\tfrac{\pi-d^*}{1+r}D_1\right)\left(1-F(\theta^*)\left[1-\lambda(1-v)\right]\right)\right]-\tfrac{\lambda D_1}{1+r}\left[1-\alpha-\tfrac{1-v}{1+r}\gamma F(\theta^*)\right]\\
&\quad-\tfrac{\alpha D_1}{1+r}\left(1-F(\theta^*)\left[1-\lambda(1-v)\right]\right)\left[\tfrac{1}{1+r}\right]-\lambda(1-v)\tfrac{\gamma D}{1+r}f(\theta^*)\tfrac{\partial\theta^*}{\partial f}\\
\frac{\partial G}{\partial c} &= \tfrac{1}{1+r}\left[\left(-D+\tfrac{\pi-d^*}{1+r}D_2\right)\left(1-F(\theta^*)\left[1-\lambda(1-v)\right]\right)\right]+\tfrac{\lambda D_2}{1+r}\left[1-\alpha-\tfrac{1-v}{1+r}\gamma F(\theta^*)\right]\\
&\quad+\tfrac{\alpha D_2}{1+r}\left(1-F(\theta^*)\left[1-\lambda(1-v)\right]\right)\left[\tfrac{1}{1+r}\right]-\lambda(1-v)\tfrac{\gamma D}{1+r}f(\theta^*)\tfrac{\partial\theta^*}{\partial c}
\end{aligned}
$$

Notice that when $v'(E)=0$, solving the first equation of the FOCs for λ, and plugging in the remaining equations, we will recover exactly the same set of optimality conditions that we derived before, as expected.

Competitively Priced Deposit Insurance: $\phi=\frac{\int_0^{\theta^*}\varphi(\theta)dF(\theta)}{1+r}$.

We will now proceed to solve for the equilibrium quantities of the endogenous variables, under the assumption that deposit insurance is not subsidized, that is, $\phi=\frac{\int_0^{\theta^*}\varphi(\theta)dF(\theta)}{1+r}$. The insurance premium is actuarially fair, since it is equal to the expected present value of the insurance payments. A higher probability of bankruptcy implies a higher premium. Thus, the period one net-worth of the insuring government agency is zero in expected present value, or in other words, the insurance fund earns the competitive risk-free rate of return. Further, for simplicity, let's assume that with one hundred percent deposit insurance the federal insurance agency is able to guarantee a settlement where the insolvency cost is avoided, making $\gamma=0$.

Under these assumptions the profit function (6) assumes the following form:

$$
G=\left(\frac{\int_0^1 x(\theta)\,dF(\theta)}{1+r}-\frac{1}{1-v}\right)X-\left(\frac{v}{1-v}\right)B+\left(\frac{\Pi+\alpha-\delta^*}{1+r}+\frac{1-\alpha}{1-v}-\frac{v}{1-v}\frac{\int_0^{\theta^*}\varphi(\theta)\,dF(\theta)}{1+r}\right)D \tag{10}
$$

Substituting the expected insurance payments for the equivalent expression (5) the profit function becomes:

$$G = \left[\frac{\int_{\theta^*}^1 x(\theta) dF(\theta)}{1+r} + \frac{1}{1-v} \frac{\int_0^{\theta^*} x(\theta) dF(\theta)}{1+r} - \frac{1}{1-v} \right] X + \left[\frac{\Pi + \alpha - \delta^*}{1+r} \left(1 + \frac{v}{1-v} F(\theta^*) \right) + \frac{1-\alpha}{1-v} \right] D \\ - \frac{v}{1-v} \left(1 - F(\theta^*) \right) B \tag{11}$$

Let $m_X^2 \equiv \frac{\int_{\theta^*}^1 x(\theta) dF(\theta)}{1+r} + \frac{1}{1-v} \frac{\int_0^{\theta^*} x(\theta) dF(\theta)}{1+r} - \frac{1}{1-v}$ and, $m_D^2 \equiv \frac{\Pi + \alpha - \delta^*}{1+r} \left(1 + \frac{v}{1-v} F(\theta^*) \right) + \frac{1-\alpha}{1-v}$, be the net margin per dollar on loans and deposits, respectively.

Even though the deposit insurance premium is actuarially fair, it is not neutral to the bank. From the objective function (10) one notices that banks do loose with bankruptcy, in spite of the fact that deposit insurance is competitively priced. Why? Because of the cost of funds to the bank. The bank expects to collect in insurance transfers, precisely the same amount that it has paid in premiums. But, to the bank, the internal cost of the premium, per dollar of deposits is not ϕ, but $\frac{\phi}{1-v}$, making the insurance transfers less than the real premium paid. Since this type of insurance is not favorable to the bank, they will try to avoid the bankruptcy states because that is when the insurer steps in.

The optimal portfolio is found by differentiating the gains function (11), subject to (2), with respect to $B, x(\theta)$, δ^*, f and, c. We have now to distinguish between bankruptcy and non bankruptcy states. The optimality conditions are given by:

$$\begin{aligned}
\frac{\partial G}{\partial B} &= -\frac{v}{1-v} \left[1 - F(\theta^*) \right] \\
\frac{\partial G}{\partial x(\theta)} |_{\theta \geq \theta^*} &= \frac{f(\theta)}{1+r} \left(X + m_X^2 X'(.) \right) \\
\frac{\partial G}{\partial x(\theta)} |_{\theta < \theta^*} &= \frac{f(\theta)}{1+r} \left(\frac{1}{1-v} X + m_X^2 X'(.) \right) \\
\frac{\partial G}{\partial \delta^*} &= \frac{1}{1+r} \left(-D \left(1 + \frac{v}{1-v} F(\theta^*) \right) + m_D^2 D_1 \right) \\
\frac{\partial G}{\partial f} &= \frac{-1}{1+r} \left(-D \left(1 + \frac{v}{1-v} F(\theta^*) \right) + m_D^2 D_1 \right) \\
\frac{\partial G}{\partial c} &= \frac{1}{1+r} \left(-D \left(1 + \frac{v}{1-v} F(\theta^*) \right) + m_D^2 D_2 \right)
\end{aligned}$$

Notice that, optimal bond holdings will always be zero, even though they reduce the extent and the probability of bankruptcy. This happens because, by investing one additional dollar in bonds reduces banks' profits by $\frac{-v}{1-v}$, but the value of the reduced premium payments is only $\frac{v}{1-v} F(\theta^*)$; reflecting the reduction in bankruptcy insurance transfers. Hence, it will never be profitable to hold any bonds. If $v = 0$, competitively priced deposit insurance does not affect profits. Bond holdings are indeterminate, and bank managers are indifferent to whether deposit insurance is available or not. By themselves, they can replicate any equilibrium with insurance, at no extra cost. The interpretation of the other first order conditions is straightforward.

Proposition 5 *Competitively priced deposit insurance implies that:*

(i) Banks choose less levered capital structures and a less riskier asset composition.

(ii) Actuarially fair deposit insurance must be compulsory, otherwise banks will opt for having no deposit insurance.

Proof. In comparison with the case of *bank-neutral* deposit insurance, δ^* (and consequently deposits) will be smaller, in order to reduce the probability of bankruptcy. The optimal quantity of deposits is given by:

$$D^* = \frac{m_D^2}{1 + \frac{v}{1-v} F(\theta^*)} D_1$$

The optimal level of deposits is negatively related to the probability of insolvency and decreases with the insurance transfers, since higher transfers imply higher premiums. By the same line of reasoning, there is an extra incentive to ask for a higher return on loans in the bankruptcy states, because that is when savings in premiums can be made.

From the profit function (10) it is immediate that insurance reduces capital gains in the amount $\frac{v}{1-v} \frac{\int_0^{\theta^*} \varphi(\theta) dF(\theta)}{1+r}$ per dollar of deposits. Therefore this type of insurance will never be held on a voluntary basis ■

Bank managers want to avoid assistance from the insurance agency, since premiums reflect risk and at an unfavorable rate to the bank. This gives an extra benefit for holding bonds, and all the other assets as well. There is in fact an implicit extra return on all assets, coming from the benefits of lower premium payments.

An interesting implication of this kind of deposit insurance is that the loan contract that the bank writes demands zero payment in the solvent states of the world (this is immediate from the two first order conditions with respect to $x(\theta)$).

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