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Deposit Insurance, Bank Capital Structures and the Demand for Liquidity

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Deposit Insurance, Bank Capital Structures and the Demand for Liquidity

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Abstract

This paper provides an economic explanation for the extraordinary and historically unprecedented accumulation of liquid assets by the banking system in the aftermath of the Great Depression. At the end of the decade (1938 to 1939) the banking system held over 35 percent of their assets in non-interest bearing cash. Why are these holdings so high and why didn't we observe the same phenomenon in Canada? My theory is that, contrary to what happened in Canada, U.S. banks came out of the Depression severely undercapitalized and they did not immediately replenish the capital account because, at the time, it would have been extremely expensive to do so. In order to calm depositors' fears, bank managers increased the share of liquid assets in their portfolios to reduce their risk exposure on the asset side. In order to shed some light into this observation I construct a banking model that generates some empirically testable implications. The model generates a negative correlation between the equity-to-assets ratio and the liquidity ratio. Using aggregate time-series data (1929-1940), I find that this prediction is borne out in the data. The banking system

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held a higher share of liquid assets during periods of more severe undercapitalization. With Call Report data (1985Q1-1989Q4) on over 10,000 U.S. banks, I test the cross-sectional implications of the model. I perform a pooled time-series, cross-section, fixed-effects regression across different asset size classes and find evidence of the negative correlation suggested by the model. In fact the banks with higher shares of liquidity were the ones with more precarious capital positions. I also do a theoretical experiment on the optimal design of deposit insurance policies. I derive six propositions characterizing bank risk-taking and portfolio composition under three different deposit insurance arrangements: (i) Fixed-rate (FDIC type), (ii) Actuarially fair, and and, *Bank-neutral.* Banks would never hold actuarially fair deposit insurance voluntarily and there is a *moral hazard* problem with fixed-rate deposit insurance. *Bank-neutral* deposit insurance eliminates the *moral hazard* incentive and allows implementation without coercion. It has an imbedded subsidy given by the FDIC but with good counterciclical properties.

1. Introduction

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 excess cash reserves. As meticulously described in his book, Morrison (1966) states that New York banks increased their holdings of excess reserves from less than 1 percent of revised 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 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 came to be known as the "can't push on a string doctrine," defended by Gov. Marriner Eccles in the hearings on the Banking Act of 1935. The liquidity trap hypothesis did not fare well empirically as shown by Horwich (1963), 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 more preference to liquidity immediately after a banking crisis.

During the 1930s banks accumulated substantial amounts of voluntary reserves, but mainly to avoid a recurrence of the liquidity problems that had plagued the U.S. banking system during those years. The liquidity pressures suffered by most banks were predominantly responses to unsubstantiated insolvency rumors about the institution, and not the result of ill advised investment decisions. When faced with some liquidity problems, banks do have some degree of control over their fate. They can self-insure. For instance, by recapitalizing they can implicitly send a strong message to the market and to their depositors saying that solvency is not at risk and that bank runs are not justifiable, since the liquidity problem is ephemeral not permanent.

In the model, we assume that there is no passive attitude from bank managers regarding their holdings of liquid assets. During the 1930s, rather than redundant, banks' excess reserves were desired and were performing an economic function[1]. Holding such amounts of cash was a profit maximizing decision. This assertion can be corroborated by the actions of banks in the 1930s. When in 1936-1937 the Federal Reserve attempted to "dry-out" the level of excess cash in the banking system, by doubling the rate of required reserves, banks responded immediately by accumulating more cash to make up for the funds lost from excess to required reserves. Our model provides an explanation of this observation.

Morrison (1966) reports that, during the early 1930s, in areas plagued with a high incidence of bankruptcies, surviving banks were induced to hold a greater cushion of cash reserves, in relation to their deposits, as a precaution against potential bank runs. Hence, excess reserves performed the function of self-insurance, which at the time was certainly of high value. Furthermore, during the late 1930s short-term interest rates dropped so low that banks may have become indifferent between holding excess cash or short-term Treasury bills, because the return on bills, net of transactions costs, was almost zero. Under these circumstances the opportunity cost of self-insurance (lost revenue from bond

[1]Excess reserves, or short-term secondary reserves, are usually composed of very liquid short-term financial instruments with low or negligible transactions costs.

holdings) was very low. Because insurance through excess reserves was valuable and very cheap, banks held a big fraction of their assets in secondary reserves.

During and even shortly after a severe liquidity crisis, banks fear inordinately large cash outflows and attempt to accumulate sufficient cash to survive expected drains. They fear a bandwagon or domino effect during a crisis. When a given bank has a temporary liquidity problem, word of mouth spreads the bad news, magnifying the original effect, and suddenly a very solid bank can find itself in the ropes. The cost of even a slight liquidity problem can be catastrophic to the bank. Such instances make insurance through cash reserves extremely valuable[2]. A minor liquidity pressure can quickly be transformed into a serious solvency problem. The acuity and importance of this problem was recognized even before the Great Depression. Irving Fisher (1911) said 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, and thus preventing insufficiency of cash from even threatening, . . ., the more the loans in proportion to the cash on hand, the greater the profit but the greater the danger also.*"

Liquidity and solvency problems might seem worlds apart, but during and after a banking crisis they become interrelated. It is this interdependence that I am set to analyze.

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 (by holding a higher percentage of short-term liquid assets, banks also reduce the average risk of their portfolios). The point is that this maneuver will only be necessary if the capital account of the bank is not immediately replenished (or reconstructed) through an injection of new capital, for in this case the safety of deposits will at once be restored. A higher capital ratio positions the bank to better absorb asset value deteriorations without letting that affect the security of deposits. Then, why would banks go in for increased liquidity rather than immediate recapitalization? What factors determines this substitution of liquid assets for capital? It is likely 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), 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 increased liquidity rather than immediate reconstruction. 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 raise the share of cash relative to assets. Notice, that nothing precludes the possibility that higher costs of raising capital can coexist with lower

[2]Once unleashed, sooner or later, a run will cause a bank to fail, regardless of the bank's balance-sheet condition before the run; making the run self-justifiable *ex post*. The psychology of a run or panic stems from the fact that individual depositors have an incentive to run if they believe others will run, independently of the bank's actual condition. The sequential service constraint described by Diamond and Dybvig (1983), puts those at the end of the withdrawal line at risk of losing everything. Hence, runs are a prototypical "market failure" where market forces are unable to achieve the most efficient use of resources.

rates of return on banks' assets, producing a low cost of self-insurance.

Previous studies on the demand for cash reserves concentrate exclusively on the asset side of banks, neglecting the capital account. This paper attempts to bridge the gap by connecting asset and liability decisions in a single integrated model. A distinctive feature of this model is that banks faced with fixed-rate deposit insurance, will not choose to have 100 percent levered capital structures. Since liquid assets (like short-term bonds and cash) generate insurance services, they will be held in equilibrium, and that checks the exploitation of the option value of deposit insurance.

Further, previous banking models were unable to pin down the capital structure, because they ignored the costs of raising equity capital and assumed the absence of market power in the deposits and loans markets, two assumptions clearly refuted by empirical studies. These models also ignored the possibility of voluntary accumulation of reserves, which can be misleading, especially during a crisis like the one in the 1930s.

We subject banks to different deposit insurance arrangements in a simple two-period state preference model in which banks possess some degree of power in the markets where they operate and in which it is costly to raise equity capital. The results are described in a set of six propositions characterizing bank capital structures and asset risk taking under the various insurance schemes. We also use the model to do some comparative static experiments that motivate the empirical section. Using aggregate time series data we can match the model predictions for the 1930s, namely that the banking system should have held a higher percentage of liquid assets during periods of more severe undercapitalization. Also, when an exogenous shock, like a series of bank runs, raises the value of having excess reserves and simultaneously raises the cost of issuing new equity, our model predicts that the ratio of voluntary cash reserves to assets should rise and the ratio of capital to assets should decline. This negative covariance prediction is borne out in the data. Further, cross sectional empirical results demonstrate that in the latter 1980s, better capitalized banks tended to have a lower proportion of liquid assets. As suggested by the theoretical model, we found evidence in a panel of over 10,000 insured banks (from 1984 to 1989) that banks substitute liquid assets for capital, and this is statistically significant across banks of different asset sizes.

This paper is organized as follows. Section 2 presents a case study of the different bank behavior in the U.S. and Canada during the Great Depression. In section 3 we construct a banking model, where banks have monopoly power in the deposit and loan markets, and where there is a cost to raise equity. Section 4 studies the behavior and portfolio composition of banks faced with different kinds of federal deposit insurance schemes. In sections 5 and 6 we put to the test some of the empirical implications of the model. The time-series implications are tested with aggregate data for the 1930s and the cross sectional implications with Call Report data on more than 10,000 insured commercial banks operating in the U.S. from 1984 to 1989. Section 7 concludes.

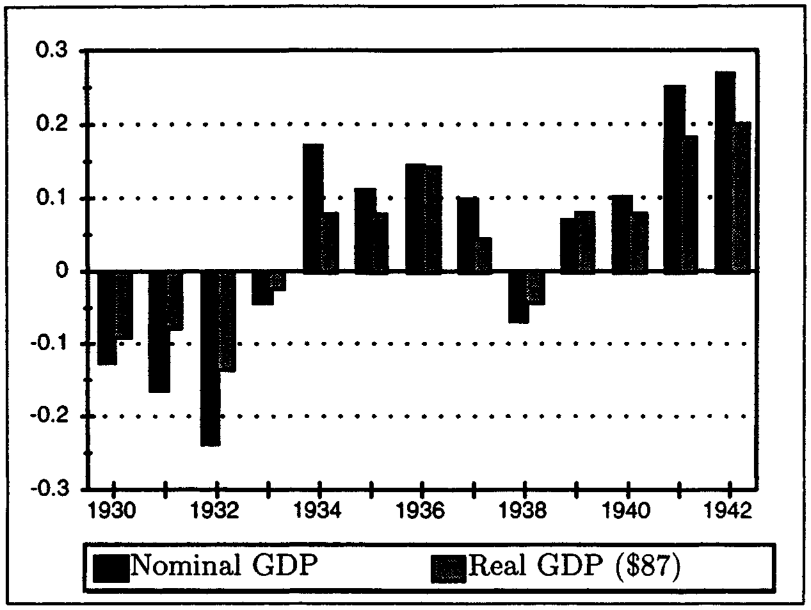

Figure 2.1: Percentual Change of Nominal and Real ($1987) GNP

2. U.S. versus Canada: A Case Study

In the United States, between 1929 and 1933 the money supply contracted substantially, with ensuing deflation and a worsening of the depression (Figures 2.1 and 2.2).

In the 1930s, the amplitude and timing of the business cycles peaks and troughs were almost identical in the United States and in Canada (see figures 2.3 and 2.4). Real GNP declined by 29 percent in both countries between 1929 and 1933 and then rose by 63 percent in the U.S. and 72 percent in Canada, between 1933 and 1940.[3] [4]

What is striking is that the Canadian banking experience was diametrically opposed to the one in the U.S., even though the severity of the recession was almost identical. There were no liquidity problems or bank runs in Canada. Further, there were no massive and widespread bank failures across the country. What was peculiar to the U.S. experience that was not present in Canada?

The Canadian banking system was almost entirely devoid of bank panics and failures. There have only been 32 Canadian bank failures since 1822 and none between 1923 and the mid-1960s. Deposit losses were insignificant, totaling to $20 million in more than one and a half century. Unlike the U.S., Canada experienced no bankruptcies during the 1930s and

[3]Nominal GNP exhibited similar features. It fell by 46 percent in the U.S. and by 43 percent in Canada, from 1929 to 1933; increasing by 80 and 92 percent, respectively, from 1933 to 1940.

Movements in prices and short-term interest rates also show a striking degree of similarity in their time series profiles.

[4]This and subsequent evidence can be found in Morrison (1966), "Liquidity Preferences of Commercial Banks."

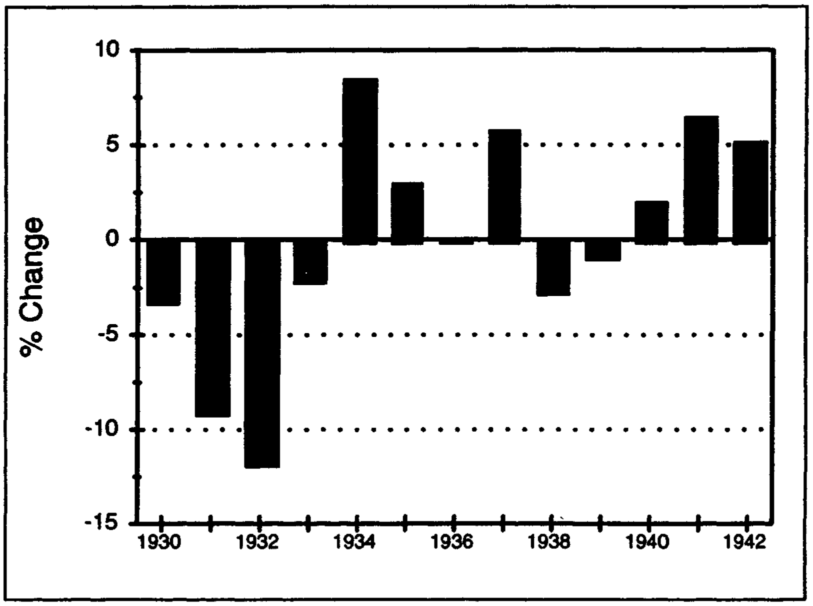

Figure 2.2: GDP Implicit Price Deflator

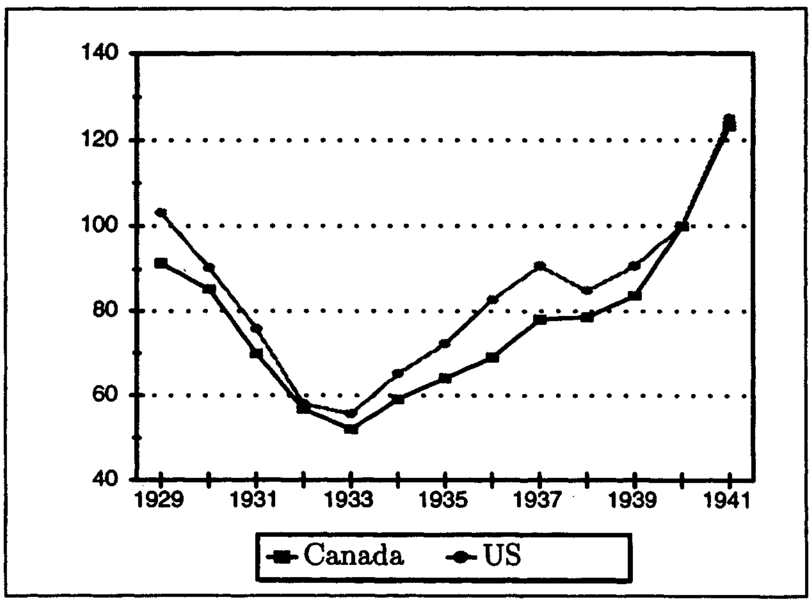

Figure 2.3: Nominal GNP Indexes: Canada and U.S. (1940=100)

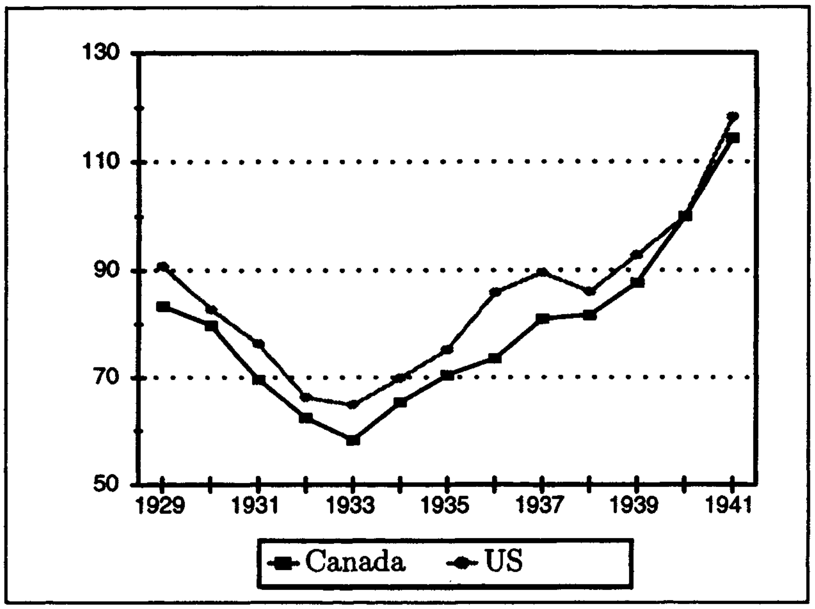

Figure 2.4: Real GNP Indexes: Canada and U.S. (1940=100)

no bank runs, despite going through the same economic vicissitudes. Contrasting with the stability in Canada, in the U.S. there was an epidemic of bank failures from 1930 to 1933. More than 5,000 banks failed from 1930 through 1932, producing losses to depositors of almost $800 million ($6 billion in 1990 dollars). There was another epidemic, even more serious, in 1933, where another 4,000 banks failed, culminating in the banking holiday of 1933 (see figures 2.5 and 2.6). In comparison, 370 banks failed from 1934 to 1941, and 198 from 1942 to 1980. In a word, the banking system was on the verge of collapse. Deposit losses from insolvencies created a chain reaction that spread to other banks and other parts of the economy. That led economists to devote considerable time and resources to understand *systemic risk*, which is defined as the likelihood that trouble in one bank will spill over to other banks or other sectors of the economy. Contagion occurred when a run on a bank spread to another unrelated institution. In this case depositors assumed that the exogenous factor causing problems in one bank was likely to affect all neighboring banks.[5] After the first successful run, fear of insolvency fed on itself creating further runs[6].

The absence of frenzy and freneticism in Canada, presents a stark contrast to the troubling circumstances in the U.S. This naturally leads one to inquire about what is

[5]A revealing example is what happened to banks in the state of Texas in the 1980s, where banks where battered by a sharp downturn in oil prices. Nine out of ten financial institutions needed outside assistance.

[6]Remember, that to perform its intermediary function, banks use liquid and extremely short-term liabilities, such as deposits, to fund highly illiquid, medium- to long-term assets, such as loans, which cannot be sold or recalled quickly without a significant capital loss. The combination of long-term assets with short-term liabilities can be explosive, making banks inherently vulnerable to runs or panic withdrawals of deposits.

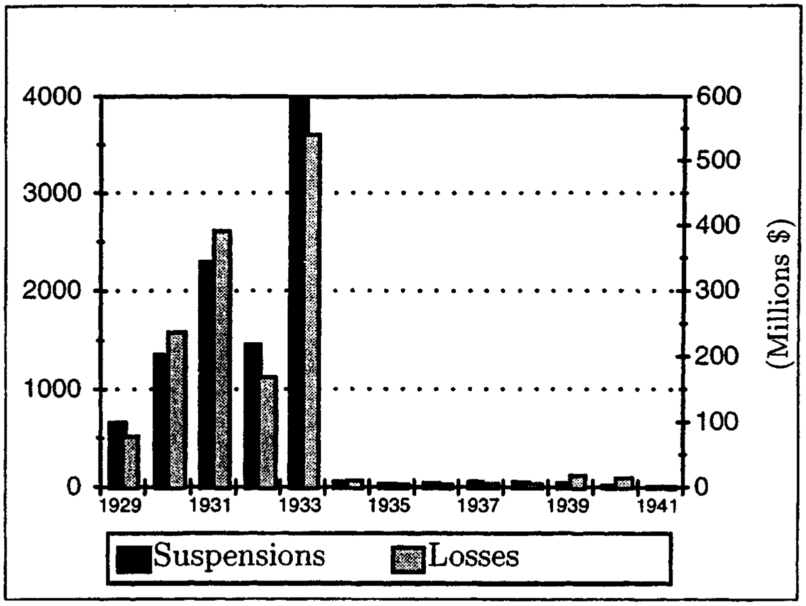

Figure 2.5: Bankruptcies and Depositor Losses in the U.S.

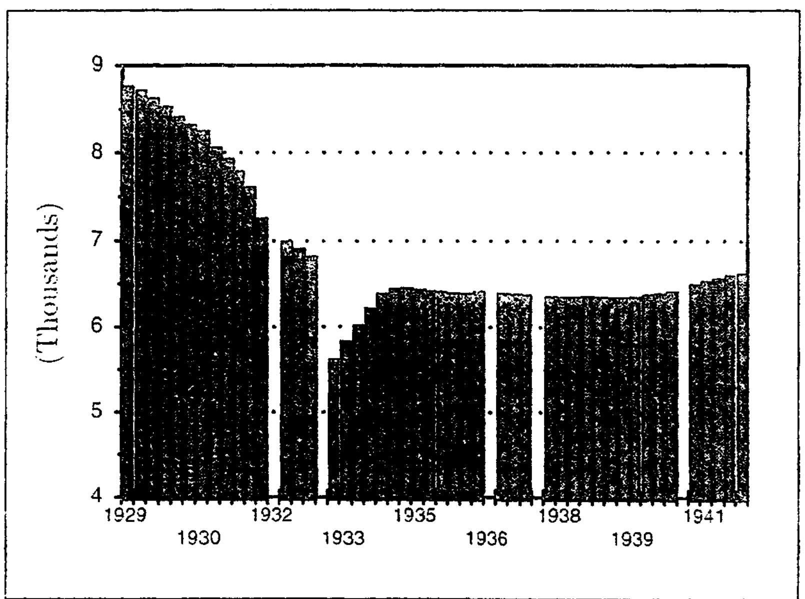

Figure 2.6: Number of Federal Reserve Member Banks

driving such sharp differences in behavior. A potential explanation lies in the different banking structure in the northern neighbor coupled with traditionally higher equity ratios.

During the Great Depression there were fewer than 20 banks in Canada, each of which controlling a vast network of branches extending all across the nation. Branch banking has deep roots in Canada's history, going as far back as the beginning of the nineteenth century. Undoubtedly, it was in large part due to the size and geographical diversification of these banks that Canada experienced few bank failures. Further, the Canadian banking sector followed a continuous trend of consolidation and horizontal integration, where weaker institutions were taken over or merged into stronger ones resulting in the gradual reduction of the number of chartered banks operating in Canada. This phenomenon contributed to the stability and public confidence in the Canadian banking sector (see Morrison (1966)).

In contrast, the U.S. had thousands of small regional and state banks that were severely curtailed in their intentions to expand state or nationwide. Due to this fact, U.S. banks had probably more difficulty in raising funds in times of crisis than their Canadian counterparts. Also, there is some anecdotal evidence that issuing equity was probably more difficult and more expensive in the U.S. unit banking system, especially during times of financial distress. Banking structure by itself goes a long way in explaining the different behavior of U.S. and Canadian banks, and the public reaction during the unsettling circumstances of the 1930s. Obviously, a very different banking structure led to striking differences in portfolio choices, in spite of the parallel evolution of both economies. Canadian chartered banks could take advantage of being present in different, possibly complementary, regions, to shift funds from areas where problems were not present, or were less acute, to areas where their branches were going through rough times.

Several hypothetical explanatory variables for the different banking responses, especially in the accumulation of cash, can be ruled out *a priori*. Business cycles were sufficiently alike to rule out factors related to poor credit demand from playing an important role. If U.S. banks did accumulate cash because there were no good credit opportunities, the same should have been observed in Canada. But much to the contrary, Canadian Banks did not accumulate cash, driving out poor credit opportunities as the driving factor for the increasing shares of cash held by U.S. banks. Also, there were no noticeable disparities between short-term interest rates in both countries even though short-term interest rates did not drop as low in Canada as in the U.S. (Figure 2.7)

Hence, we are left with the hypothesis that the absence of bank runs and subsequent failures, and the stability of reserve requirements allowed Canadian banks to function in an atmosphere of relative calm and confidence, despite a serious economic downturn. In contrast, in the U.S., apart from the bank runs, reserve requirements were doubled in three successive increments between August 15, 1936, and May 1, 1937. Confidence in the Canadian banking system was fostered by the characteristics peculiar to branch banking, which can quickly mobilize funds to meet localized runs on deposits more cheaply and efficiently than can a unit banking. The ability to diversify geographically protected Canadian banks from sectoral or regional economic shocks and insulated them from bank runs. In the U.S., banks have traditionally operated under several costly restrictions on geographic diversification. Among others, these restrictions precluded interstate banking

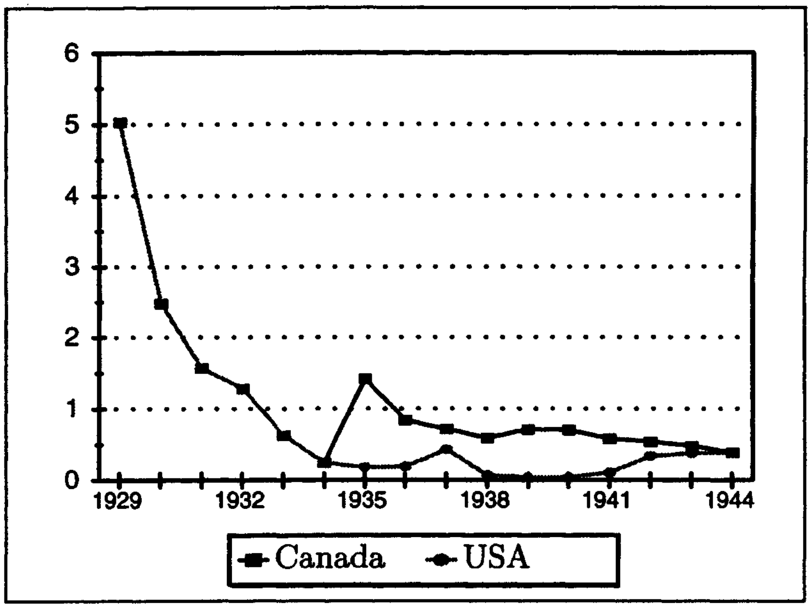

Figure 2.7: Short-term Interest Rates (%): Canada and U.S.

and branching. Even intrastate banking was limited. Critics have often asserted that the constraints to expand efficiently within the U.S. may have been counterproductive, since it may have led banks to look for riskier profit opportunities and less stable funding sources. Furthermore, banks confined to local markets are often more exposed to regional economic cycles. In addition, apart from shielding banks from local risks, branching is often a more efficient form of interstate penetration due to some natural synergies that produce cost savings, such as, consolidated management and data processing. These savings build profit and capital, enhancing the safety and soundness of the banking system.

The only comparable branch bank in the U.S. — Bank of America — had no difficulty in resisting runs, and by the end of the decade had quite negligible amounts of excess reserves[7]. More recent evidence comes from the savings and loan crisis of the 1980s and early 1990s, when thrifts affiliated with geographically diversified holdings failed less often than unaffiliated ones. Usually, the parent holding provided additional capital inflows to their subsidiaries.

Thus, it seems that branch banks are substantially more insulated from the ravages of panics than unit banks. This fact impinges on behavior, justifying the big contrast in the cash position and portfolio choices of Canadian versus U.S. banks in the years that followed the March 1933 bank holiday (see figures 2.8 to 2.12).

My thesis is that, contrary to what happened in Canada, U.S. banks came out of the

[7]Excess reserves as a percentage of deposit liabilities at the Bank of America amounted to:
Dec. 31, 1939: -0.2% of revised deposits (that is, deposits net of required reserves)
Dec. 31, 1940: 2.6% of revised deposits.

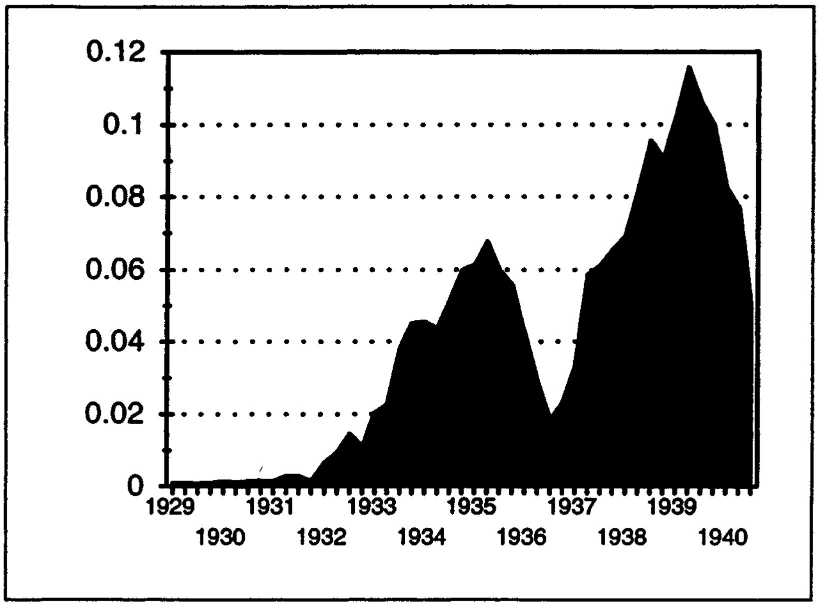

Figure 2.8: Federal Reserve Member Banks Ratio of Excess Reserves to Assets

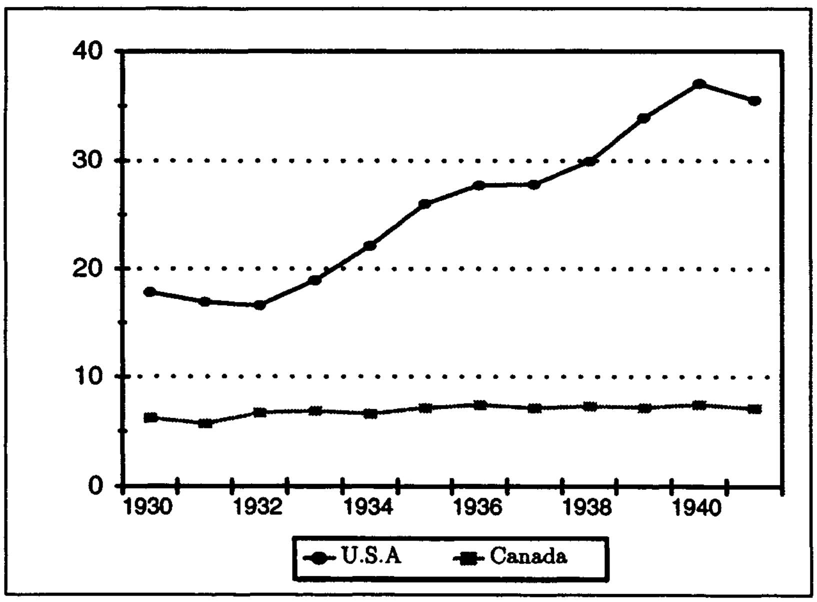

Figure 2.9: U.S. and Canadian Banks Cash to Assets Ratio

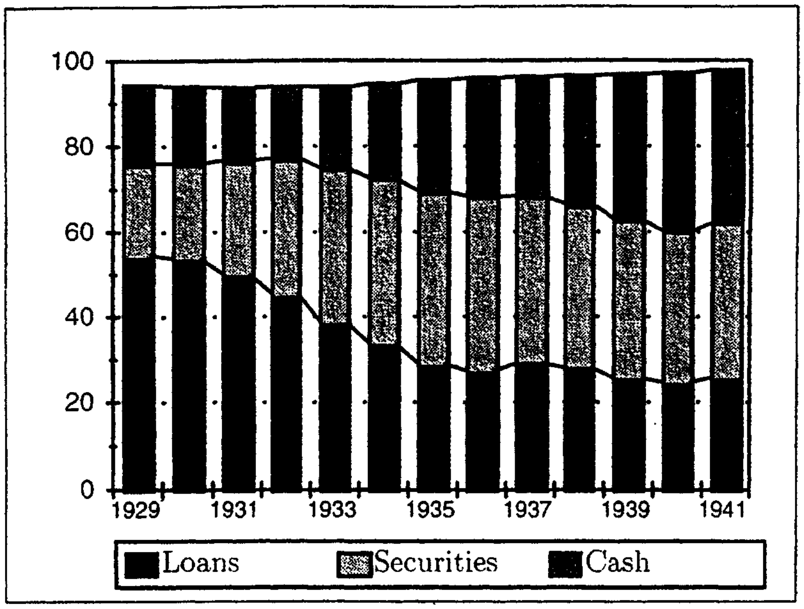

Figure 2.10: U.S. Banks Portfolio Composition: Loans, Securities and Cash to Asset Ratios

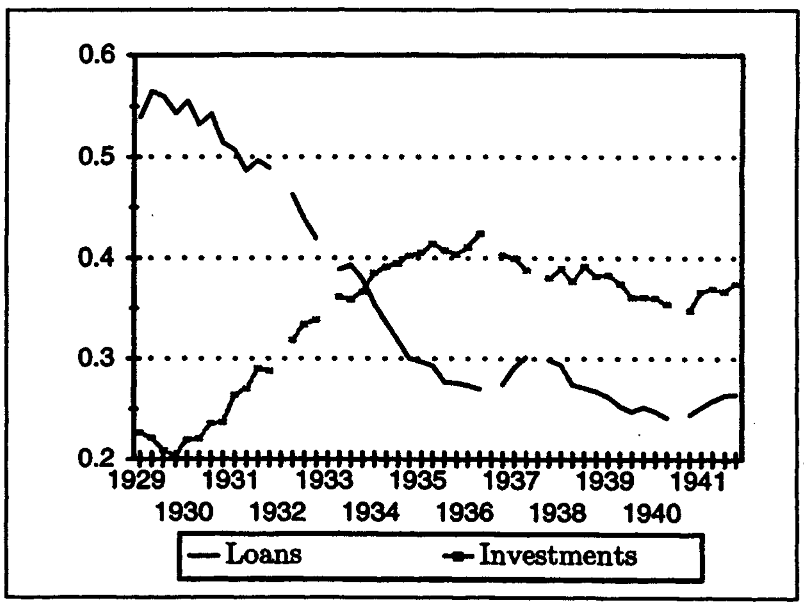

Figure 2.11: U.S. Banks Ratio of Loans and Investments to Assets

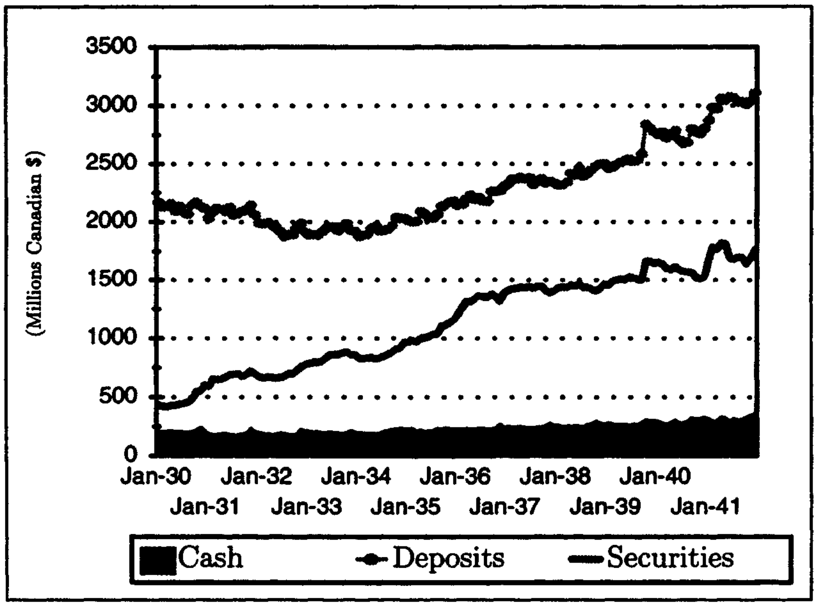

Figure 2.12: Canadian Banks Cash, Deposits and Security Holdings

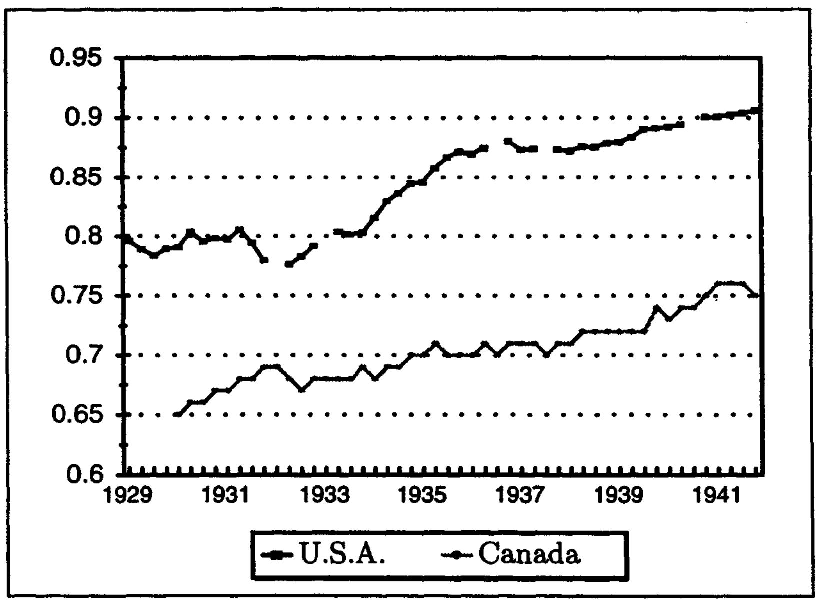

Figure 2.13: Leverage Ratio: Total Deposits over Assets

Depression severely undercapitalized, and they did not immediately replenish the capital account because it was extremely expensive to do so at the time. Since depositors were worried about the safety of their money, bank managers elected to increase the share of liquid assets in order to reduce their vulnerability. Since the Canadian banking system was better capitalized (i.e. less levered: see figure 2.13), more diversified and historically more immune to runs, cash reserves as self-insurance did not have as much value, for Canadian banks as it did for U.S. banks. In the U.S. the equity ratio dropped from an average of 16 percent at the beginning of the decade to less than 8 percent at the end of the decade, an astonishing 50 percent drop. Simultaneously, in the U.S. the share of cash assets surged to more than one third of total assets by the end of the decade, as can be seen from figure 2.9, in sharp contrast with Canada where there is almost no increase in the share of cash held by banks. As pointed out by Vishny and Shleifer (1992), potential buyers of a distressed firm's assets, who usually are in the same industry, might also be experiencing financial distress. U.S. banks could hardly count on anyone to rescue them which made excess reserves an attractive asset to their managers. In addition, raising new equity seemed prohibitively expensive at the time.

3. The Model

3.1. Economic Environment

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.

All relevant economic decisions will be made in period 1. Outcomes are realized 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. By assumption, θ takes values on the unit interval, $\theta \in (0,1)$, according to the cumulative distribution function, $F(\theta)$.

In the present period, banks select their portfolios of earning assets, and decide the optimal capital structure. Then there is a random drawing that determines the actual state of the world. In period 2 banks collect whatever their portfolios are worth and liquidate 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. The random variable affecting outcomes can be motivated as representing all relevant economic variables that impact on the way banks perform. Then, it can be thought of as a multidimensional vector containing variables (like short- and, long-term interest rates, exchange rates, etc.) that influence how the bank fares *ex post.*

3.2. Balance Sheet Variables

3.2.1. Liabilities

There are two sources of funds available to the bank. Funds can be raised by issuing deposit liabilities, D, and equity, E.

Issuing equity is not costless. 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. There is in fact a hidden wealth transfer from existing to new equity holders when new equity is issued. The dilution brought about by new capital infusions can be quite large. Some studies, such as Asquith and Mullins (1986), suggest that for every dollar of new equity issued the market value of existing shares can drop as much as 28 percent. Hence, when faced with an external shock that raises the return and demand of a specific asset, banks may find it cheaper to adjust at other margins[8] than through new capital. Calomiris and Hubbard (1992) documented that during the 1930s firms voluntarily incurred significant tax penalties to avoid dividend payouts when they would have to raise extra funds from outsiders. Therefore, there is compelling empirical evidence that, due to capital market frictions or imperfections, firms are forced to rely primarily on internal financing sources. 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.*"

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.

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 like subordinated notes and debentures (SNBs).

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 the first period. The bank promises depositors 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. By assumption the charge is assessed in the second period. Let deposit services be produced according to a constant returns to scale (CRS) technology, so that, the cost of supplying them increases 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.

[8] For example, by raising more money from deposits, by contracting the volume of all other assets, or both.

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

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

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.

In a deposit market where banks have no market power, competition among banks guarantees that the cost to the bank of having one unit of deposits is equal to 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 return on deposits. Large banks located in big money market centers, where competition is more intense, will probably face a more elastic supply of deposits schedule.

3.2.2. Assets

The funds raised through the deposit and equity markets are allocated among the assets available to the bank. Specifically, the bank is allowed to hold three types of assets: default-free bonds, B, voluntary excess cash reserves, ER, and risky loans, X.

Bonds pay a competitively determined risk-free rate of interest, r.

Cash reserves will be modeled as generating unconditional benefits (independent of θ) to the bank of $1 + e(TR)$, per dollar of total reserves, TR (total reserves are the sum of required reserves plus excess reserves, ER). This benefit, or return, can be motivated by a myriad of reasons. It can be justified on the ground that holding cash reserves produces some liquidity services to the bank and, moreover, it allows the bank to avoid transaction costs associated with buying and selling securities when the bank manages its cash position. Voluntary reserve holdings can also be a source of some intangible benefits to the shareholders. They in fact function as a buffer stock against unexpected adverse reserve outflows[9]. By having a cash cushion, the bank can avoid liquidity or payments 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 by federal regulators.

We model the benefits of total cash reserves as a per-dollar quantity so that it can have the interpretation of a rate of return. In its liquidity and/or self-insurance function we assume that the return is decreasing with quantity. If a bank has already built a large cash buffer stock, one additional dollar in reserves should have an insignificant impact on the solvency prospects of the bank, as compared with the case when the bank is in a precarious cash position. Hence, let:

$$e(TR) > 0, \quad e'(TR) < 0, \quad e''(TR) > 0$$

and,

$$e(0) = \infty, \quad e(\infty) = 0.$$

Bankruptcy usually means that shareholders loose the capital invested in the bank. However, in a regulated banking system, bankruptcy goes beyond that, 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, not to gamble and risk bankruptcy. The hypothetical loss of a valuable charter, in the insolvent states of the world, in fact, creates an extra insolvency cost to shareholders (beyond the usual reorganization and liquidation costs)[10]. Therefore, bank managers may elect to hold additional self-insurance to protect their charter values. That insurance can come from more equity capital, or if new capital is very expensive to raise, they may choose to hold more excess reserves, for example by selling other assets for cash. Notice that in this set-up a bank can reduce the probability of bankruptcy by holding more capital or by reducing asset risk. *Ceteris paribus*, more cash reserves means that the bank is holding a less risky portfolio, therefore reducing the need for a substantial capital cushion to accommodate asset value losses.

In our model, the value of the charter (our link to a multiperiod model) is imbedded in the return to cash reserves, $(1 + e)$. Having more excess cash reserves 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.

The imputed return on reserves, for their insurance value, is a function not only of the economic value that cash reserves are in fact protecting — the charter value — but also of the probability that this insurance will ever be needed. Hence, during a crisis period,

[9]Previous work from the author gives a more comprehensive treatment of these issues.

[10]Notice that this insolvency cost is borne whether the bank benefits from federal deposit insurance or not.

when confidence in the banking system is low, the implicit return on excess reserves is higher, even if the value of the charter remains unaltered, because the probability that excess reserves are going to be of any use is much higher.[11]

It is fair to say that during the 1930s excess reserves were valuable, even after the inception of the Federal Deposit Insurance Corporation (FDIC) in 1933. First, because the FDIC insurance was not complete; more than half of total deposits were uninsured, making banks still vulnerable to run-related insolvency risk. Second, the traumatic events of 1929 through 1933 were still very vivid in both depositors and bankers minds. So, as Morrison (1966) and Friedman and Schwartz (1963) concluded, even after 1933 and until the end of the decade, there was a heightened sense of caution, so a little extra insurance would do no harm, especially when the opportunity cost of doing so, the short-term interest rate, was not very high.

As in the deposit market, banks also have some degree of monopoly power in the loan market, reflecting banks' privileged access to small local borrowers and the value of a close and long-term relationship with some of its borrowers. Once again it should be mentioned that for large banks operating in more competitive environments, like big money market centers, the degree of market power is substantially reduced.

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:

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

Therefore, $\frac{R_L}{1+r}$ represents the market value of the liability assumed by the borrower, per dollar borrowed. In the absence of monopoly power and under risk neutrality, arbitrage conditions guarantee that the expected return is just equal to risk-free interest rate, $\int_0^1 x(\theta)\, dF(\theta) = 1 + r$, producing a demand for deposits infinitely elastic at $1 + r$.

According to the previous description, our bank faces a downward sloping demand curve for loans with the following characteristics:

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

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; 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*.

[11]Notice that we are working with a definition of economic, not accounting, profits. Hence, the return on cash reserves may be intangible, that is, may not be a cash-flow (receipt) but it will certainly be an economic revenue.

Funds raised through the deposit and equity markets are used to fund the purchases of bonds, the holdings of excess reserves and the granting of credit. Furthermore, it is assumed that federal regulatory agencies impose a constant required reserve ratio of α per dollar of deposits, with $0 \leq \alpha \leq 1$. Finally, the bank can purchase deposit insurance from a government agency, such as, the FDIC or the Savings Association Insurance Fund (SAIF). Let the deposit insurance premium be ϕ per dollar of deposits.

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

$$B + X + ER = D(1 - \alpha - \phi) + E(1 - v(E)). \tag{3.1}$$

3.3. Rules of the Game and Profit Function

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

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

out of which it must pay its depositors, paying them δ^* if enough funds are around. Consequently, the state contingent payoff to equity in state θ is represented by:

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

Furthermore, when insolvent the bank faces constant bankruptcy costs of γ, per unit of deposit,[12] with $0 \leq \gamma D \leq x(\theta) X + (1 + r) B + (1 + e)(ER + \alpha D) + \Pi D$ for all θ that imply bankruptcy. 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 impact qualitatively on the results we derive.

Bankruptcy is costly and the cost is unavoidable. Further, 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, $x(\theta) X + (1 + r) B + (1 + e)(ER + \alpha D) + (\Pi - \delta^*) D \geq 0$, 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, in the absence of deposit insurance, depositors get a payoff of (funds available net of bankruptcy costs):

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

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

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:

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

When the bank is solvent, obviously, $\varphi(\theta) = \gamma = 0$.

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

Naturally, the present discounted value of banks expected gains are found by discounting the various cash flows being realized in period 2. 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, buying us in this 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 the cost makes the optimal capital structure determined. Also, the presence of the insolvency 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.

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

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

subject to:

$$\begin{aligned} X + B + ER &= (1 - \alpha - \phi) D + E(1 - v(E)), & (3.2)\\ ER &\geq 0 & (3.3) \end{aligned}$$

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:

$$x(\theta^*) X + (1+r) B + (1+e)(ER + \alpha D) + (\Pi - \delta^*) D = 0. \qquad (3.4)$$

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

$$\varphi(\theta) D = (\delta^* + \gamma - \Pi) D - (1+r) B - (1+e)(ER + \alpha D) - x(\theta) X. \tag{3.5}$$

The expected value of the insurance payment is given by:

$$\begin{aligned} P_o &\equiv \int_0^{\theta^*} \varphi(\theta) D \, dF(\theta) \\ &= [(\delta^* + \gamma - \Pi) D - (1+r) B - (1+e)(ER + \alpha D)] F(\theta^*) \\ &\quad - \int_0^{\theta^*} x(\theta) X \, dF(\theta). \end{aligned} \tag{3.6}$$

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, $\delta^* D$.

3.4. Two-Period versus Multiperiod Analysis:

The third party guarantor of deposits — FDIC — insures a bank for one period. At the end of the period, there is an audit to determine if the bank is solvent. If the answer is yes, the FDIC extends the bank 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 (1978), 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, when they are immediately 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 still go through. 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 you change any of the variables in period 1. A model with some intertemporal connections could be easily 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.

4. Equilibrium Allocations

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

Manipulating the profit function G, using (3.6) and substituting the balance-sheet constraint (3.2) for E, the capital gains function to be maximized becomes:

$$\begin{aligned} G = & \left(\frac{\int_0^1 x(\theta)dF(\theta)}{1+r} - \frac{1}{1-v}\right) X - \left(\frac{v}{1-v}\right) B + \left(\frac{1+e}{1+r} - \frac{1}{1-v}\right)(ER + \alpha D) \\ & + \left(\frac{\Pi - \delta^*}{1+r} + \frac{1-\phi}{1-v} + \frac{\int_0^{\theta^*} (\varphi(\theta) - \gamma) dF(\theta)}{1+r}\right) D. \end{aligned} \tag{4.1}$$

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, $\frac{\partial G}{\partial Y} \leq 0$.

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

In the absence of deposit insurance; $\phi = \varphi(\theta) = 0$. Here, depositors get δ^* when the bank is solvent and, $\delta(\theta) D = x(\theta) X + (1+r) B + (1+e)(ER + \alpha D) + (\Pi - \gamma) D$, when insolvent. Hence, the expected gross return on deposits is simply given by

$$\begin{aligned} R_D &= \int_0^1 \delta(\theta) dF(\theta) = \int_0^{\theta^*} \delta(\theta) dF(\theta) + \int_{\theta^*}^1 \delta^* dF(\theta) \\ &= \frac{\int_0^{\theta^*} x(\theta) X dF(\theta) + [(\Pi-\gamma)D + (1+r)B + (1+e)(ER+\alpha D)] F(\theta^*)}{D} + \delta^* [1 - F(\theta^*)]. \end{aligned} \tag{4.2}$$

The objective function (4.1) simplifies to:

$$\begin{aligned} G = & \left(\frac{\int_0^1 x(\theta)dF(\theta)}{1+r} - \frac{1}{1-v}\right) X - \left(\frac{v}{1-v}\right) B + \left(\frac{1+e}{1+r} - \frac{1}{1-v}\right)(ER + \alpha D) \\ & + \left(\frac{\Pi - R_D}{1+r} + \frac{1}{1-v} - \frac{\gamma F(\theta^*)}{1+r}\right) D \end{aligned} \tag{4.3}$$

Let $m_X^1 \equiv \frac{\int_0^1 x(\theta)dF(\theta)}{1+r} - \frac{1}{1-v}$ and, $m_D^1 \equiv \frac{\Pi - R_D}{1+r} + \frac{1}{1-v} - \frac{\gamma F(\theta^*)}{1+r}$ represent the net margin per dollar invested in loans and deposits, respectively. Notice that the profit function (4.3) decreases with the bankruptcy cost and also with the probability of being bankrupt, $F(\theta^*)$. Hence, decreasing the probability of insolvency increases capital gains.

Bank-Neutral[13] 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 (4.1)), meaning that there is no way bank

[13]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 complete (one hundred percent) coverage.

owners can exploit deposit insurance to their own benefit, at the expense of the insuring agency. With *bank-neutral* deposit 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.

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 FDIC 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 FDIC, 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 (4.3), subject to (3.3), with respect to all the endogenous variables produces the following first order conditions (FOCs)[14]:

$$\begin{aligned}
\frac{\partial G}{\partial B} &= \frac{-v}{1-v} - \frac{\gamma D}{1+r} f(\theta^*) \frac{\partial \theta^*}{\partial B} \\
\frac{\partial G}{\partial ER} &= \left(\frac{1+e}{1+r} - \frac{1}{1-v}\right) + \frac{e'}{1+r} TR - \frac{\gamma D}{1+r} f(\theta^*) \frac{\partial \theta^*}{\partial ER} + \mu \\
\frac{\partial G}{\partial x(\theta)} &= \frac{f(\theta)}{1+r}\left(X + m_X^1 X'\right) - \frac{\gamma D}{1+r} f(\theta^*) \frac{\partial \theta^*}{\partial x(\theta)} \\
\frac{\partial G}{\partial \delta^*} &= \frac{1}{1+r}\left(-D + m_D^1 D_1\right) + \frac{\alpha D_1}{1+r}\left[\left(\frac{1+e}{1+r} - \frac{1}{1-v}\right) + \frac{e'}{1+r} TR\right] - \frac{\gamma D}{1+r} f(\theta^*) \frac{\partial \theta^*}{\partial \delta^*} \\
\frac{\partial G}{\partial f} &= \frac{-1}{1+r}\left(-D + m_D^1 D_1\right) - \frac{\alpha D_1}{1+r}\left[\left(\frac{1+e}{1+r} - \frac{1}{1-v}\right) + \frac{e'}{1+r} TR\right] - \frac{\gamma D}{1+r} f(\theta^*) \frac{\partial \theta^*}{\partial f} \\
\frac{\partial G}{\partial c} &= \frac{1}{1+r}\left(-D + m_D^1 D_2\right) + \frac{\alpha D_2}{1+r}\left[\left(\frac{1+e}{1+r} - \frac{1}{1-v}\right) + \frac{e'}{1+r} TR\right] - \frac{\gamma D}{1+r} f(\theta^*) \frac{\partial \theta^*}{\partial c}
\end{aligned}$$

where $f(\theta)$ is the probability density function of θ and μ is the multiplier associated with constraint (3.3). Assuming an interior solution several Propositions arise:

Proposition 4.1. *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.

[14] For clarity of the presentation we will suppress the argument of the return on total cash reserves, $e(TR)$. But, we should keep in mind that e is a decreasing function of the amount of reserves. Also, e' is the first derivative of e with respect to TR; with, $e' \leq 0$.

Proof. The last term, involving the bankruptcy cost γ, on the right hand side of every equation, vanishes. Further, from the profit function (4.3), 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 or even excess reserves just 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. From the first order conditions with respect to δ^* and ER, we immediately have that the optimal amount of deposits to raise is given by: $D = m_D^1 D_1$. At the optimum, reserves should be held until the marginal benefit of one additional unit, $1 + e + e'TR$, equals their marginal cost, $1 + r$.

From the remaining FOCs, the optimal portfolio is given by the following quantities; starred variables designate optimal quantities.

$$\begin{aligned}
B^* &= \text{indeterminate} \\
D^* &= m_D^1 D_1 \\
ER^* &= \frac{e-r}{-e'(.)} - \alpha D^* = \frac{e-r}{-e'(.)} - \alpha m_D^1 D_1 \\
D_1 &= D_2 \text{ or } c = 0 \\
X^* &= -m_X^1 X'(.)
\end{aligned}$$

The optimal amount of excess reserves reflects not only the return associated with holding them, but also the opportunity cost of the funds invested, r. [15]

In conclusion, with costless equity, banks raise enough funds to fully exploit all the available profit opportunities, whether in 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.

[15]The optimality condition for the demand of excess reserves can also be expressed as: $e(1 - \varepsilon_{e,TR}) = r$. Where, $\varepsilon_{e,TR} = -\frac{\partial e}{\partial TR}\frac{TR}{e}$ is the elasticity of the return with respect to total cash reserves. If the return on reserves were constant (independent of the quantity), then the desired holdings of excess reserves would be:

$$ER^* = \begin{cases} \infty & \text{if } e > r \\ \text{indeterminate} & \text{if } e = r \\ 0 & \text{if } e < r \end{cases}$$

Proposition 4.2. *Bank-neutral deposit insurance with, costly bankruptcy ($\gamma > 0$) but costless equity capital ($v = 0$), 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 (4.3), 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 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 since 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 4.1 also corroborates and extends the results of Dothan and Williams (1980).

Proposition 4.3. *If banks face bank-neutral deposit insurance, costly capital ($v > 0$) but costless bankruptcy ($\gamma = 0$), then:*

(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 assets (less excess reserves and loans).

Proof. From the objective function (4.3), 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: $B^* = 0$. In what concerns cash reserves, an extra dollar in reserves generates a benefit of $\frac{1+e+e'TR}{1+r}$, in present value, but the cost of that extra dollar in terms of funds to be raised is $\frac{1}{1-v}$. Once again equating marginal benefits to marginal costs, we have that the optimal amount of excess reserves is given by (from the FOC with respect to ER)[16]:

$$ER^* = \frac{(1+e)(1-v)-(1+r)}{-e'(1-v)} - \alpha D^*$$

Since funds are now more expensive to get, the optimal level of excess reserves will be lower, when compared with the case of $v = 0$. From the definition of m_X^1 and m_D^1, 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 $1 + r$. Funds being more costly to get implies that bank managers should contract the level of excess reserves (for the same level of the risk-free rate of interest), and also demand a higher payoff from borrowers, implying a contraction of credit, in order to make up for the increased cost of loanable funds. 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:

$$B^{**} = 0$$

$$ER^{**} < ER^*$$

$$D^{**} > D^*$$

$$D_1 = D_2 \text{ or } c = 0$$

$$X^{**} < X^*$$

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 4.4. *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 ($\gamma = 0$).

[16] In terms of elasticities, the optimal amount of cash reserves must satisfy the following condition: $e(1 - \varepsilon_{e,TR}) = \frac{1+r}{1-v} - 1$.

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 excess reserves) and increasing the internal sources of financing (higher capital ratio).

As before, the optimal quantities for all the endogenous variables is 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 excess reserves, and ask for a higher payoff from their borrowers. We can see that the bank adjusts at all the five margins available (3 assets and 2 liabilities), always equating marginal benefits to marginal costs.The optimal quantities (triple starred) compare with the previous ones ($\gamma = 0$), as follows:

$$B^{***} \text{ determinate } \geq B^{**} = 0$$

$$ER^{***} > ER^{**}$$

$$D^{***} < D^{**}$$

$$D_1 = D_2 \text{ or } c = 0$$

$$X^{***} < X^{**}$$

4.2. Capital Structure vs. Excess Reserves

Consider an exogenous shock to excess reserves that increases the benefits generated by them. Imagine, for example, a situation like the one in the 1930s, where a series of bank runs increases the value of excess reserves for self-insurance.

Let the return from excess reserves go from e to e_1, with $e_1 > e$. Further assume that the stochastic variable θ is uniformly distributed over the interval $(0, 1)$, and that the X, D, and e functions are linear.

Just staring at the optimality conditions given by the FOCs, it is trivial to see that the optimal level of excess reserves increases, but the optimal levels of deposits, loans and bonds stay unaltered. Therefore, the increase in the voluntarily held excess reserves is completely financed from the raising of new equity, $\Delta ER = \Delta E$. Then, the ratio of excess reserves to assets, and of capital to assets, increases. Notice that before the shock, optimization of fund raising, requires that at the margin, the bank be indifferent from raising the last dollar from equity or from deposits[17]. Since the supply of deposits is positively sloped, but the supply of equity is horizontal, when more funds are needed to finance extra cash reserves, the bank will not raise more money from deposits, because for that it has to promise them a higher δ^* (or lower fee for deposit services), or more provision of services. Since the cost to raise equity is constant, the extra funds needed will undoubtedly come from the shareholders. Any adjustment in the volume of assets will be accommodated through changes in equity capital, because money raised through deposits is already at its optimal given the cost of $\frac{1}{1-v}$ to raise equity. Notice that from the definition of the net margin on deposits, m_D^1, the optimal level of funds raised from the deposit market is higher, the higher the cost parameter v.

Nevertheless, if one has convexity of the cost to raise new equity, i.e. $v'(E) \geq 0$ and $v''(E) \geq 0$, the reverse might be true. For strong enough convexity, we will have that, in fact the shock makes the ratio of excess reserves to assets higher but decreases the ratio of capital to assets. That happens, because now some of the needed extra funds will come from the deposits market. Further, since at the margin funds are now more expensive, one should expect, at the optimum, to have less funds loaned and invested in bonds, than before the shock. It would not be too difficult to envisage a situation where the exogenous shock simultaneously raises the benefits of excess reserves and increases the cost of issuing new equity, for any level of equity. This fact will reinforce the previous effect.

In conclusion, when the cost of raising new capital increases with quantity, any factor that makes one asset more attractive, will in general, increase the demand for that asset. But increments of the holdings of the more attractive asset will increase the marginal cost for all others. Then since at the margin, the marginal revenue for all other assets is equated to the marginal cost of one additional dollar of funds, that effect, implies a reduction of the demand for all other assets. If in fact during the decade of 1930 the return on liquid assets increased and simultaneously it became more costly to raise equity capital, then we have an empirically testable implication of our model. We should expect the ratio of excess reserves to assets to increase, but the ratio of capital to assets to decrease. We will

[17]When deciding how much money to raise from deposits versus equity, the bank also equates marginal benefits to marginal costs. For example, suppose that $\gamma = 0$. Increasing by one unit the pledged interest rate on deposits, δ^*, generates a direct marginal cost of D, and a marginal benefit of, $D_1 \left(\frac{\Pi-\delta^*}{1+r}\right)$ (i.e., extra funds raised times the net margin), plus the cost saving arising from not having to raise D_1 dollars from equity, which amounts to, $D_1 \frac{1}{1-v}$. Equating the marginal cost to the marginal benefit, implies: $D^* = m_D^1 D_1$, where $m_D^1 = \frac{\Pi-\delta^*}{1+r} - \frac{1}{1-v}$.

test this later.

4.3. Competitively Priced Deposit Insurance

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 (4.1) assumes the following form:

$$\begin{aligned} G = & \left(\frac{\int_0^1 x(\theta) dF(\theta)}{1+r} - \frac{1}{1-v} \right) X - \left(\frac{v}{1-v} \right) B + \left(\frac{1+e}{1+r} - \frac{1}{1-v} \right) (ER + \alpha D) \\ & + \left(\frac{\Pi - \delta^*}{1+r} + \frac{1}{1-v} - \frac{v}{1-v} \frac{\int_0^{\theta^*} \varphi(\theta) dF(\theta)}{1+r} \right) D \end{aligned} \tag{4.4}$$

Substituting the expected insurance payments for the equivalent expression (3.6) the profit function becomes:

$$\begin{aligned} G = & \left[\frac{\int_{\theta^*}^1 x(\theta) dF(\theta)}{1+r} + \frac{1}{1-v} \frac{\int_0^{\theta^*} x(\theta) dF(\theta)}{1+r} - \frac{1}{1-v} \right] X + \left[\frac{\Pi - \delta^*}{1+r} \left(1 + \frac{v}{1-v} F(\theta^*) \right) + \frac{1}{1-v} \right] D \\ & - \frac{v}{1-v} (1 - F(\theta^*)) B + \left[\frac{1+e}{1+r} \left(1 + \frac{v}{1-v} F(\theta^*) \right) - \frac{1}{1-v} \right] (ER + \alpha D) \end{aligned} \tag{4.5}$$

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, $m_D^2 \equiv \frac{\Pi - \delta^*}{1+r} \left(1 + \frac{v}{1-v} F(\theta^*) \right) + \frac{1}{1-v}$, 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 (4.4) 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 from the FDIC, 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 FDIC steps in.

The optimal portfolio is found by differentiating the gains function (4.5), subject to (3.3), with respect to $B, ER, x(\theta), \delta^*, f$ and, c. We have now to distinguish between bankruptcy and non bankruptcy states. The optimality conditions are given by:

$$\frac{\partial G}{\partial B} = -\frac{v}{1-v}\left[1-F\left(\theta^*\right)\right]$$

$$\frac{\partial G}{\partial ER} = -\frac{1}{1-v} + \left(\frac{1+e}{1+r} + \frac{e'(.)}{1+r}TR\right)\left(1+\frac{v}{1-v}F\left(\theta^*\right)\right) + \mu$$

$$\frac{\partial G}{\partial x(\theta)}|_{\theta\geq\theta^*} = \frac{f(\theta)}{1+r}\left(X + m_X^2 X'(.)\right)$$

$$\frac{\partial G}{\partial x(\theta)}|_{\theta<\theta^*} = \frac{f(\theta)}{1+r}\left(\frac{1}{1-v}X + m_X^2 X'(.)\right)$$

$$\frac{\partial G}{\partial \delta^*} = \frac{1}{1+r}\left(-D\left(1+\frac{v}{1-v}F\left(\theta^*\right)\right) + m_D^2 D_1\right) + \frac{\alpha D_1}{1+r}\left[\frac{-1}{1-v} + \left(\frac{1+e}{1+r} + \frac{e'(.)}{1+r}TR\right)\left(1+\frac{v}{1-v}F\left(\theta^*\right)\right)\right]$$

$$\frac{\partial G}{\partial f} = \frac{-1}{1+r}\left(-D\left(1+\frac{v}{1-v}F\left(\theta^*\right)\right) + m_D^2 D_1\right) - \frac{\alpha D_1}{1+r}\left[\frac{-1}{1-v} + \left(\frac{1+e}{1+r} + \frac{e'(.)}{1+r}TR\right)\left(1+\frac{v}{1-v}F\left(\theta^*\right)\right)\right]$$

$$\frac{\partial G}{\partial c} = \frac{1}{1+r}\left(-D\left(1+\frac{v}{1-v}F\left(\theta^*\right)\right) + m_D^2 D_2\right) + \frac{\alpha D_2}{1+r}\left[\frac{-1}{1-v} + \left(\frac{1+e}{1+r} + \frac{e'(.)}{1+r}TR\right)\left(1+\frac{v}{1-v}F\left(\theta^*\right)\right)\right]$$

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 $\frac{v}{1-v}F\left(\theta^*\right)$; 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 4.5. *Competitively priced deposit insurance implies that:*

(i) Banks choose less levered capital structures and a less riskier asset composition by having more cash reserves.

(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, the optimal level of excess reserves is higher and is given by (assuming an interior solution, so that $\mu = 0$)[18]:

$$ER^* = \frac{(1+e)\left[1-v\left(1-F\left(\theta^*\right)\right)\right]-(1+r)}{-e'\left[1-v\left(1-F\left(\theta^*\right)\right)\right]} - \alpha D^*$$

It can also be inferred just from the analysis of the FOCs that δ^* (and consequently deposits) will be smaller, in order to reduce the probability of bankruptcy. The optimal quantity of deposits is given by:

[18] Or equivalently, the optimal level of cash reserves must satisfy the following condition: $e\left(1-\varepsilon_{e,TR}\right) = \frac{1+r}{1-v(1-F(\theta^*))} - 1$

$$D^{*}=\frac{m_{D}^{2}}{1+\frac{v}{1-v}F\left(\theta^{*}\right)}D_{1}$$

The optimal level of deposits is negatively related to the probability of insolvency and decreases with the FDIC 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 (4.4) 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 FDIC, since premiums reflect risk and at an unfavorable rate to the bank. This gives an extra benefit for holding excess cash, 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 $x\left(\theta\right)$).

4.4. Fixed-Rate Deposit Insurance

Consider now the current case in the U.S. where the insurance premium ϕ is not risk-based. The insurance premium is fixed, independently of the expected present value of the deposit insurance liability. Still assuming that the cost of raising equity is independent of the quantity raised, and that with complete coverage there are no bankruptcy costs, the profit function is now:

$$\begin{aligned}G=&\left(\frac{\int_{0}^{1}x(\theta)dF(\theta)}{1+r}-\frac{1}{1-v}\right)X-\left(\frac{v}{1-v}\right)B+\left(\frac{1+e}{1+r}-\frac{1}{1-v}\right)\left(ER+\alpha D\right)\\&+\left(\frac{\Pi-\delta^{*}}{1+r}+\frac{1-\phi}{1-v}+\frac{\int_{0}^{\theta^{*}}\varphi(\theta)dF(\theta)}{1+r}\right)D\end{aligned}\tag{4.6}$$

Simple inspection of the profit function (4.6), is enough to conclude that banks do benefit from fixed-rate deposit insurance. Therefore, they will act accordingly, and exploitation of the FDIC subsidy will be done to the maximum, profitable, extent possible. Now, shareholders benefit from insolvency. The fixed insurance premium ϕ, acts solely as a flat tax on deposits. Bank managers, will compose their portfolios in such a way as to maximize the resource transfer from the insuring agency, to the bank shareholders.

Using equation (3.6), the profit function simplifies to:

$$G=\left(\frac{\int_{\theta^*}^1 x(\theta)dF(\theta)}{1+r}-\frac{1}{1-v}\right)X+\left(\frac{1+e}{1+r}\left(1-F\left(\theta^*\right)\right)-\frac{1}{1-v}\right)\left(ER+\alpha D\right)$$
$$-\left(\frac{v}{1-v}+F\left(\theta^*\right)\right)B+\left(\frac{\Pi-\delta^*}{1+r}\left(1-F\left(\theta^*\right)\right)+\frac{1-\phi}{1-v}\right)D \tag{4.7}$$

Once again the optimal portfolio is determined from the first order necessary and sufficient conditions of (4.7) subject to (3.3). Let $m_D^3=\frac{\Pi-\delta^*}{1+r}\left(1-F\left(\theta^*\right)\right)+\frac{1-\phi}{1-v}$, and $m_X^3=\frac{\int_{\theta^*}^1 x(\theta)dF(\theta)}{1+r}-\frac{1}{1-v}$. The FOCs are the following:

$$\begin{aligned}
\frac{\partial G}{\partial B} &= -\frac{v}{1-v}-F\left(\theta^*\right)\\
\frac{\partial G}{\partial ER} &= \left(\frac{1+e}{1+r}+\frac{e'(.)}{1+r}TR\right)\left(1-F\left(\theta^*\right)\right)-\frac{1}{1-v}+\mu\\
\frac{\partial G}{\partial x(\theta)}\Big|_{\theta<\theta^*} &= \frac{f(\theta)}{1+r}m_X^3X'\left(.\right)\\
\frac{\partial G}{\partial x(\theta)}\Big|_{\theta\geq\theta^*} &= \frac{f(\theta)}{1+r}\left(X+m_X^3X'\left(.\right)\right)\\
\frac{\partial G}{\partial \delta^*} &= \frac{1}{1+r}\left(-D\left(1-F\left(\theta^*\right)\right)+m_D^3D_1\right)+\frac{\alpha D_1}{1+r}\left[\left(\frac{1+e}{1+r}+\frac{e'(.)}{1+r}TR\right)\left(1-F\left(\theta^*\right)\right)-\frac{1}{1-v}\right]\\
\frac{\partial G}{\partial f} &= \frac{-1}{1+r}\left(-D\left(1-F\left(\theta^*\right)\right)+m_D^3D_1\right)-\frac{\alpha D_1}{1+r}\left[\left(\frac{1+e}{1+r}+\frac{e'(.)}{1+r}TR\right)\left(1-F\left(\theta^*\right)\right)-\frac{1}{1-v}\right]\\
\frac{\partial G}{\partial c} &= \frac{1}{1+r}\left(-D\left(1-F\left(\theta^*\right)\right)+m_D^3D_2\right)+\frac{\alpha D_2}{1+r}\left[\left(\frac{1+e}{1+r}+\frac{e'(.)}{1+r}TR\right)\left(1-F\left(\theta^*\right)\right)-\frac{1}{1-v}\right]
\end{aligned}$$

Now, even if it is costless to raise equity ($v=0$), the optimal amount of bond holdings will be zero. The reason why, is that bonds reduce profits by reducing the probability of bankruptcy, and hence the transfers from the FDIC. If $v>0$, there is another reason to avoid holding bonds. For every dollar the bank puts in bonds it directly looses $\frac{-v}{1-v}$, and indirectly, it reduces FDICs transfers for exactly one dollar in the bankruptcy states, in present value terms, therefore, costing the bank $F\left(\theta^*\right)$.

Proposition 4.6. *For a sufficiently small insurance premium, a fixed-rate deposit insurance scheme implies that:*

(i) Banks choose a higher leverage ratio and a riskier asset portfolio (less cash assets) than both bank-neutral or actuarially fair deposit insurance.

(ii) When compared with the bank-neutral arrangement, fixed-rate deposit insurance generates a riskier loan portfolio.

Proof. Assuming an interior solution, the optimal level of excess cash to hold is now given by[19]:

[19] In terms of elasticities the optimal condition can be written as: $e\left(1-\varepsilon_{e,TR}\right)=\frac{1+r}{(1-v)(1-F(\theta^*))}-1$

$$ER^* = \frac{(1+e)(1-v)[1-F(\theta^*)] - (1+r)}{-e'(1-v)[1-F(\theta^*)]} - \alpha D^*,$$

which, for the same probability of bankruptcy, is smaller than the quantity derived under both bank-neutral (or no insurance) or even competitively priced insurance.

In the same line of reasoning, one should expect the bank to increase asset risk and increase leverage until it is profitable to do so, in order to capitalize on the implicit wealth transfer from the insurance fund (profit from the increase in the option value of deposit insurance). In fact that will happen.

From the FOCs the optimal level of deposits will be:

$$D^* = \frac{m_D^3}{1-F(\theta^*)} D_1$$

Deposits will be increasing with the probability of bankruptcy[20]. The optimal probability of insolvency follows directly from the profit function and from the first four equations of the FOCs. Since the FOC for $x(\theta)$, when $\theta < \theta^*$, is always negative, the optimal state contingent loan payoff should be zero in the bankruptcy states. When bankrupt, the bank has no benefit in having positive cash flows. That does not benefit the shareholders, since the FDIC will cover any shortfall, and the premium is invariant. Hence, banks should ask borrowers to pay a lot more when the bank is solvent and nothing when insolvent. When solvent we have, $X^* = -m_X^3 X'(.)$. Also, since $x(\theta) = 0$ for $\theta < \theta^*$, then, $\int_0^1 x(\theta)\, \partial F(\theta) = \int_{\theta^*}^1 x(\theta)\, \partial F(\theta)$, meaning that the bank chooses the same expected rate of return on loans as before $(m_X^3 = m_X^1)$, but the distribution of state contingent payoffs is more spread out, i.e., more risky. ■

Previous models, with just two assets; bonds and loans, generate very strong predictions, when faced with fixed rate deposit insurance. At the limit, banks will be in a corner solution, holding a one hundred percent levered capital structure, and just one solvency state, that happens with infinitesimal probability. In fact, an infinitely large subsidy is possible, which implies that there may be no finite optimal quantity off deposit liabilities (like Kareken and Wallace (1978)). In order to maximize the option value of the deposit insurance, at the limit there will be no solvent states, making $F(\theta^*) \approx 1$. Here, since cash reserves do generate benefits to the bank, even though it reduces the exploitation of the FDIC insurance, the probability of insolvency will be smaller, and deposits will not tend to infinity. Excess reserves, through its insurance function, check the exploitation of the FDIC subsidy, making the banking system more sound. This prediction matches evidence presented by Markus (1984) and Keeley (1990). Even though the fixed rate deposit insurance provides a moral hazard for excessive risk taking, banks don't seem to be exploiting it fully. Banks don't seem to be maximizing the put option value of deposit insurance. In reality, bank capital structures are far less levered than previous models predicted. Markus

[20] For a sufficiently small insurance premium; $\phi < \frac{F(\theta^*)}{1-v(1-F(\theta^*))}$, the optimal level of deposits will be higher with fixed price deposit insurance than with an actuarially fair insurance scheme.

(1984) reports that there is a dichotomy in bank behavior. Some banks are extremely risk averse, and some others are extremely risk taking. This polarization is reflected in the fact that, the riskiest 5 percent of banks account for virtually the entire present value of the FDIC liabilities. The great majority of banks, are in fact, very safe financial institutions. Probably because they have a higher charter value, and want to protect it from insolvency, thereby self insuring considerably. Banks already technically insolvent, on the other hand, try to maximize to the highest extent possible the wealth transfer from the FDIC. Some authors, try to model charter values in an *ad-hoc* way, by just adding a term to the profit function. In this model, the value of charter insurance (loss prevention) is attributed to an asset in the bank portfolio, and furthermore, the return depends also on some other exogenous factors, that might affect the probability of loosing the charter.

5. Time Series Implications of the Model

The present banking model makes no pretense of being a full theory of bank portfolio decision. Its main objective is to provide a framework for the study of the interaction and substitutability between equity capital and excess cash reserves. Previous studies on the demand for excess reserves during the 1930s abstracted from the evolution of the capital account. They may have been complete characterizations of the asset side of bank portfolios, but paid no attention to the liability side composition. The fulcrum of the model time series implications is the interdependence of bank liquidity and bank solvency during and after a banking crisis.

Friedman and Schwartz (1963) demonstrated that during the decade of 1930 there was a shift in the banks desired level of excess reserves. Bank owners were "shocked" into expecting large reserve losses, initially due to the recession and runs on other banks — from 1929 to 1933, — and then, due to the changes in reserve requirements — August 1936 through May 1937. Taking this as unquestionable evidence, and assuming that raising new capital was more expensive during the 1930s (when compared with historical standards), as asserted by some empirical studies mentioned before; our model predicts that banks will adjust to these circumstances by raising the ratio of excess reserves to assets while simultaneously letting the ratio of capital to assets decline.

In order to test and potentially capture this effect we will regress the equity ratio on the excess reserve ratio,[21] after controlling for a bunch of other variables that are also expected to affect the capital ratio.

We will be working with a definition of revised assets (deposits), that is, assets (deposits) net of required reserves, in order to be consistent with equation (3.2) stating the balance-sheet constraint.

In the regression equations to be estimated we will make use of some economic control variables, like real GNP and inflation. Real GNP will capture the exogenous forces contributing to the volume of bank reserves flowing into and out of the bank (unborrowed

[21] We also regressed the capital ratio on the ratio of total reserves to assets. The results were not qualitatively different from the ones reported.

reserves). Hence, we expect that during a depression reserves will be flowing out of the bank, implying that banks desire to hold higher capital ratios.

Several financial control variables will also be used. Among them, the short-term interest rate, or alternatively, the penalty rate on emergency borrowing from the Federal Reserve (or forced sales of earning assets) — the discount rate. The risk-premium on corporate bonds (Moody's Baa-Aaa), which should capture default risk on low grade assets. And finally, an index measuring the evolution of common stock prices.

The data will be quarterly observations for all Federal Reserve member banks ranging from 1927:1 to 1945:4. The independent variable is the ratio of equity to revised assets. We report heteroskedastic consistent standard errors, and use the Newey-West correction for serial correlation. (The Durbin-Watson statistics provided are for the OLS regressions before any correction for heteroskedasticity or serial correlation).

In a multiperiod context, banks accumulate more excess cash today if they have experienced asset losses and anticipate more in the future. These losses impact negatively on the capital account, and may increase the cost of raising equity in the future. In this case it seems that variations in the excess reserves ratio today could signal and explain variability in the capital ratio in the near future. We tested for Granger causality between the excess cash and capital ratios. While not very strong, we found that in the presence of lags of the dependent variable, that the first and second lags of the excess reserves ratio had some explanatory power over the capital asset ratio.

Next we regress the capital ratio on a number of control variables and the current, first and second lag of the excess reserves ratio. The results are reported in Table 1.

The first and second lags of the excess reserve ratio seem to capture future adjustments in the capital account. Nevertheless, in the presence of the second lag, the first lag is not significant at the 5 percent level (see regressions 1 to 3 in Table 1).

After controlling for some other variables it seems that changes in the excess reserve ratio predict (precede) a negative evolution in the capital-asset ratio 2 quarters into the future (regressions 4, 5, and 6). In conclusion, it seems that, for the sample period, all else constant, an increase of 1% in the excess reserve ratio tended to be substituted by a decrease in the equity ratio of around .3% two quarters into the future. In what concerns the two measures of the expected cost of short-term borrowing to meet any immediate liquidity problem – the short-term interest rate and the New York Fed discount rate – they are of the right sign (positive), statistically significant and approximately of the same magnitude. Further an increase in real GNP and/or inflation would make banks more confident about the future prospects, thereby lowering the capital cushioning, because more non-borrowed reserves are flowing into the banking system. The stock market index and the corporate bond spread are not significant in the regressions.

TABLE 1: Dependent variable: All Federal Reserve Member Banks (Equity ÷ Assets) 1927:1 to 1945:4. (T-ratios in parenthesis)						
	R. 1	*R. 2*	*R. 3*	*R. 4*	*R. 5*	*R. 6*
Intercept	15.44	15.43	15.39	19.79	19.81	21.17
	(106.1)	(98.6)	(72.4)	(23.57)	(13.03)	(13.23)
Real GNP ($1985)	...	...	...	-.002	-.001	-.002
				(-2.84)	(-1.18)	(-2.20)
Inflation	...	...	...	-.04	-.06	-.06
				(-2.84)	(-2.54)	(-2.83)
Short-Term Int. Rate	...	...	...	...	...	.38
						(3.69)
N.Y. Fed Disc. Rate	...	...	...	.24	.40	...
				(2.57)	(3.09)	
Corp. Bond Spread	...	...	...	...	-.04	.013
					(-.23)	(.09)
Stock Mkt. Index	...	...	...	...	-.001	-.003
					(-.13)	(-.06)
(Exc. Res. ÷ Assets) $_t$	.06	.20	-.42	-.09	...	...
	(.58)	(2.02)	(-11.9)	(-1.26)		
(Exc. Res. ÷ Assets) $_{t-1}$	-.14	-.64	...	-.06	...	...
	(-.79)	(-6.50)		(-.47)		
(Exc. Res. ÷ Assets) $_{t-2}$	-.38	...	...	-.18	-.32	-.27
	(-3.26)			(-2.07)	(-7.94)	(-6.56)
R-Square	.92	.89	.76	.96	.95	.96
Number of Obs.	55	61	67	55	60	60
Durbin Watson	1.04	1.02	.36	1.64	1.45	2.04

Note: Heteroskedastic consistent std errors. Newey-West correction for serial correlation.

6. Cross Sectional Implications of the Model

We will use disaggregated data from banks balance sheets to provide a test of the model implication that, *ceteris paribus*, better capitalized banks should have lower liquidity ratios, as measured by the cash-to-asset ratio or the cash-plus-securities ratio.

6.1. The Data

The data on banks balance sheets that we use to test the model is taken from the quarterly regulatory Consolidated Reports of Condition and Income (Call Reports) that all federally insured banks must submit to the Federal Reserve.

The sample period ranges from 1985:1 to 1989:4. The sample starts no earlier than 1985, because in 1984 there was a major overhaul in the formats of the reported data. By then, banks were asked to provide more information and more detailed. Further, the way many of the series were constructed was adjusted, making it extremely difficult to construct consistent series pre-1985. The sample period ends in 1989:4, which roughly coincides with the implementation of the Basel Committee on Banking Supervision new capital adequacy guidelines which introduced risk-based capital requirements (RBCR). The onset of the Basle Accord fostered a series of bank portfolio adjustments that might distort our econometric analysis. The new regulations established a framework that made capital requirements more sensitive to the risk profiles of the different assets held in banks portfolios. The main intent was to make riskier assets more costly to hold. Therefore, the Basle Accord directed banks to set aside more equity for loans than for securities, thus reducing the existing disincentive to hold liquid (low risk) assets.

Therefore, the methodological changes in the way the data was collected and compiled and the changes in bank capital regulation provide the natural starting and ending points for the sample. Furthermore, in these 5 years there was no recession or any other macroeconomic disturbances that might have significantly affected the way banks operate in the United States.

The sample consists of more than 10,000 federally insured domestic commercial banks operating continuously from 1984:1 to 1989:4. Banks that have both domestic and foreign offices were deleted from the sample since different regulatory treatment could render the interpretation of their behavior more difficult. In order to construct a balanced panel, the final sample is composed of banks that submitted a Call Report in each one of the 20 quarters. This procedure purges the sample of banks that became insolvent, merged, or got their charters during the sample period. The reasoning behind this procedure is that *de novo* banks and banks that are about to fail or merge might exhibit peculiar behavior and characteristics that could potentially color the empirical results. In addition, banks with capital ratios of less than 3% or above 50% were eliminated[22]. All these eliminations accounted for a small percentage of the sample, and were mainly of small banks (see also Furfine (1995) and Lucas and McDonald (1987)).

The U.S. banking landscape is far from homogeneous. With more than 10,000 commercial banks, and with the largest ones in the sample being more than 5,000 times bigger than some of the smallest, significant heterogeneity across banks is not only a possibility but a reality. To account for this fact, the sample was segmented into 3 asset size classes — Big, Medium, and Small. By doing so we have allowed banks belonging to different

[22]Setting different cutoff levels did not qualitatively alter the results.

classes to have different targets for risk exposure. This partition is also justified on the grounds that banks of different sizes might offer very different products, deal with a complete different set of customers, and have varying degrees of diversification (for additional motivation see Furfine (1995)). It is also true that banks regulatory treatment is asymmetric. For instance, banks with total book assets exceeding $300 million are required to provide more detailed information about their activities, especially in what concerns their off-balance sheet operations. Therefore, regressions will be carried out by size classes. The classes and the number of banks in each category are given in Table 2.

TABLE 2: The Sample

1987:2 Total Book Assets	Number Banks	% of Total
Less than $100 Million	8524	81%
$100 – $300 Million	1467	14%
Over $300 Million	484	5%

A quick overview of the balance sheet data for the 3 size classes is provided in Table 3. The Call Report codes for the variables used is given in Appendix B.

As Table 3 shows, the portfolio composition of banks in different size classes exhibit important differences. Small banks hold substantially more cash and securities (41.5%) than medium or big ones. As one goes from small to big, the liquidity ratio decreases approximately 10 percentage points (41.5% → 30.8%). Further, smaller banks tend to hold a higher percentage of risk-free securities.

Larger banks depend more on loans in their asset portfolios than do smaller banks. Nevertheless, smaller institutions tend to concentrate more on the riskier type, like agricultural loans. Further, out of total loans, a higher percentage of small banks loans are in real estate (45%), and only 21% are in loans to individuals. Bigger banks concentrate more on Commercial and Industrial loans and have almost no agricultural loans.

TABLE 3: Bank Balance Sheet Composition by Size Classes Insured Commercial Banks. 1987:4.			
	Asset Size (Book Value)		
	< \$100m.	\$100–\$300m.	> \$300m.
Assets (\$$10^6$)	39	168	878
Fraction of Total Assets			
Cash	.093	.079	.087
Securities	.322	.272	.221
Risk-Free Securities	.130	.094	.083
Loans	.489	.564	.611
Agricultural Loans	.064	.014	.006
C&I Loans	.102	.147	.168
Real Estate Loans	.220	.270	.255
Loans to Individuals	.103	.120	.150
Rep. Agreem. & Fed. Funds Sold	.055	.046	.044
Deposits	.893	.884	.848
Demand Deposits	.137	.156	.172
Time & Savings Deposits	.756	.728	.676
Uninsured Deposits	.089	.105	.116
Subordinated Debt × 100	.024	.074	.168
Equity	.090	.079	.070
Preferred Stock × 100	.024	.026	.027
Common Stock	.015	.012	.009
Rep. Agreem. & Fed. Funds Purchased	.005	.021	.058
Other Variables			
Return on Loans	.028	.027	.026
Return on Deposits	.013	.013	.012
Net Income ÷ Assets	.001	.002	.002
Net Operating Income ÷ Assets	.003	.004	.004
Loans 90+ Days Late ÷ Loans	.009	.006	.005
Loans not Accruing ÷ Loans	.016	.012	.011
Loan Loss Provision ÷ Loans	.004	.002	.003

The loan portfolio of smaller banks seems to be of lower quality as shown by the 3 measures of loan delinquency. In what concerns the Federal Funds market, smaller banks tend to participate more on the lender side and in a higher proportion than big banks, but do almost no borrowing in this market. Bigger banks participate actively on the buyer and seller side, with special emphasis on the buyer side. This evidence goes with the spirit of our model in that smaller banks have a harder time raising external finance on short notice, contrary to what happens with bigger institutions.

Looking now at the liability composition of banks balance sheets one notices that smaller banks depend more on deposits. The composition of deposits shows that smaller banks have a higher share of Time and Savings deposits but less demand deposits. Hybrid financing forms like Subordinated Debt is almost exclusively an item of very large banks. In what concerns equity capital, smaller banks show better capital ratios and rely more on conventional forms like common stock instead of preferred stock. Uninsured deposits is typically a large bank phenomena, which is understandable if one acknowledges that larger, more diversified banks, pose less risk to uninsured depositors. Hence, in their liability composition large banks make less use of deposit financing and tend to have significantly less equity. This gap is made up by a number of other forms of financing, like borrowings in the Federal Funds market, the use of Subordinated Debt, and large uninsured time deposits and Certificates of Deposit (CD's).

A quick analysis of some performance ratios, shows that bigger banks receive a smaller return on loans, but also pay a smaller return on deposits (see Boyd and Runkle (1993) for corroborating evidence). Smaller banks do seem to have a higher degree of monopoly power over their borrowers, than do big money center banks. Smaller banks have an *ex-post* higher return on loans and also pay a higher return on deposits, hypothetically to compensate depositors for the higher risk involved or for less provision of deposit services than big banks. Finally, the income ratios favor big banks.

6.2. Model Testing

We will now make use of a longitudinal data set, containing a large number of cross-sectional units – banks – observed quarterly during five years. A panel data estimation should corroborate the results found in the previous section with aggregate data for the 1930's, but this kind of empirical exploration is aimed at testing the model predictions at the micro level.

One of the cross-sectional empirical implications of our model is that banks with lower capital ratios can self-insure by holding more liquid assets. Since capital functions as a buffer stock against asset value losses, by holding more liquid assets bank managers can effectively reduce the risk of asset losses in the future and hence the need of equity to absorb them. Therefore, we should expect that banks that have a higher liquidity ratio, measured as the ratio of cash-to-assets or cash-plus-securities to assets, should have lower capital ratios than their better capitalized peers.

We test if this prediction is borne out in the data by running a fixed-effects time series cross section regression on a balanced panel of over 10,000 insured commercial banks. The regression equation to be estimated is of the following form.

$$\left(\frac{Equity}{Assets}\right)_{it} = \alpha_i + \gamma_t + \beta_1 \left(\frac{Liquidity}{Assets}\right)_{i\ t-1} + \sum_{k=2}^{N} \beta_k X_{k\ i\ t-1} + \varepsilon_{i\ t}. \qquad (6.1)$$

Where $X_{k\ i\ t-1}$ is a set of other lagged control variables that might influence the evolution of the capital ratio. 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 in different asset size classes.

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

The fixed effects parameter α_i captures 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. Time effects are captured by γ_t which measures changes in macro variables or changes in regulation that might equally affect all the banks in a given size class. As a proxy for the liquidity ratio we use two specifications. The first one is just the cash-to-asset ratio, and the second one the ratio of cash-plus-securities to assets. The results are qualitatively the same whichever measure one uses, but we only report the coefficient estimates for the second specification of the liquidity ratio.

To control for other effects over banks capital ratios, apart from their liquidity ratios, we include the following exogenous variables:

$Log(Assets)_{t-1}$: For a plethora of 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. By being more diversified the bank reduces its risk exposure, therefore needing a lower equity cushion. Further in practice the regulatory treatment of banking firms has been far from symmetric across sizes. 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, are *de facto* guaranteed. This makes it possible for bigger banks to substitute their own capital for regulators capital. Theoretically we expect a negative coefficient for this variable.

$(Nonperforming\ Loans \div Loans)_{t-1}$: Following the insight of Lucas and McDonald (1992) we expect that for banks with a higher incidence of delinquent loans, the put option value of deposit insurance should be higher. Hence banks with a higher fraction of nonperforming loans should opt to exploit deposit insurance by minimizing their capital ratios, since capital affects negatively the option value of insurance. We use two different measures of nonperforming loans: *Loans 90+ days late and still accruing* and *Loans not accruing.* The results do not change much from one measure to the other.

(*Uninsured Deposits* $\div$ *Assets*)$_{t-1}$: Uninsured deposits are simultaneously an additional source of funds (when compared with the equity issuance alternative), and a source of risk that might have to be hedged through higher capital ratios. Hence, banks that finance themselves more heavily through the issuance of uninsured deposits may show different portfolio choices depending on which margin they weigh more: the increased risk or the substitution for other financing funds.

(*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 capital to protect the rents arising from intermediation. Alternatively, they might view it as a sign that their banking business generates such high margins that the risk of failure is so low that they don't need as much capital cushioning.

(*Net Income* $\div$ *Assets*)$_{t-1}$: With a few rare exceptions banks rely mainly on their internal funds to build the capital account, because banks like other non-financial firms face increasing costs of external finance. This interpretation is analogous to the one in the literature of non-financial firms, where it is found that investment is positively correlated with measures of internal liquidity.

(*Repurchase Agreements and Fed. Funds Purchased* $\div$ *Assets*)$_{t-1}$: This is a way banks have to generate liquidity from the liability side[23]. The informational content of this variable is different from the one provided by the liquidity ratio. It captures the ability of the bank to generate funds at a moments notice. Therefore, banks that rely more on the Federal Funds market on the buy side (typically big banks) do not need to maintain high capital ratios, because should an emergency arise they can quickly mobilize funds by borrowing in the Federal Funds market.

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 control for this and other bank specific effects by estimating a fixed effects model. By doing so we are in fact purging the coefficients from bank specific effects that remain constant over time.

The coefficient estimates of equation (6.1) for different asset size classes are shown in Tables 4 and 5.

[23] I thank Eli Brewer for suggesting this point to me.

TABLE 4: Fixed Effects Estimates of Equation (6.1). Balanced Panel
Dependent Variable (Equity÷Assets)$_t$. Sample: 1985:1–1989:4

Nonperforming Loans=Loans not Accruing	*Big*	*Medium*	*Small*
Log(Assets)$_{t-1}$	-.004	-.009	-.022
	(-11.1)	(-26.03)	(-105)
((Cash+Securities) ÷ Assets)$_{t-1}$	-.005	-.003	-.004
	(-3.24)	(-3.65)	(-9.62)
Intermediation Spread$_{t-1}$	.044	-.083	-.061
	(1.55)	(-3.51)	(-6.35)
(Net Operational Income÷Assets)$_{t-1}$	.450	.462	.485
	(9.82)	(17.38)	(39.11)
(Uninsured Deposits÷Assets)$_{t-1}$	-.014	-.010	.001
	(-6.26)	(-5.94)	(1.37)
(Nonperforming Loans÷Loans)$_{t-1}$	-.049	-.066	-.081
	(-7.49)	(-15.35)	(-51.1)
(Rep. Agre. & Fed. Funds Purchased÷Assets)$_{t-1}$	-.008	-.019	.001
	(-3.57)	(-8.16)	(0.34)
Nonperforming Loans=Loans 90+ d. Late	*Big*	*Medium*	*Small*
Log(Assets)$_{t-1}$	-.004	-.009	-.022
	(-11.40)	(-25.81)	(-105)
((Cash+Securities)÷Assets)$_{t-1}$	-.004	-.004	-.004
	(-3.08)	(-4.18)	(-9.87)
Intermediation Spread$_{t-1}$	.060	-.059	-.022
	(2.10)	(-2.48)	(-2.25)
(Net Operational Income÷Assets)$_{t-1}$	.513	.512	.568
	(11.31)	(19.36)	(45.70)
(Uninsured Deposits÷Assets)$_{t-1}$	-.013	-.008	.004
	(-5.95)	(-4.61)	(4.95)
(Nonperforming Loans÷Loans)$_{t-1}$	.038	-.014	.012
	(2.78)	(-2.02)	(-5.56)
(Rep. Agre. & Fed. Funds Purchased÷Assets)$_{t-1}$	-.007	-.018	.001
	(-3.17)	(-7.89)	(.73)
Adjusted R^2	0.862	0.860	0.867
Number of observations	9196	27873	161937

Notes: OLS estimation. All specifications control for fixed and time-specific effects.
T-ratios in parenthesis. Detailed variable definitions in Appendix B.

TABLE 5: Fixed Effects Estimates of Equation (6.1). Balanced Panel
Dependent Variable (Equity÷Assets)$_t$. Sample: 1985:1–1989:4

Nonperforming Loans=Loans not Accruing	*Big*	*Medium*	*Small*
Log(Assets)$_{t-1}$	-.004	-.009	-.021
	(-11.2)	(-25.7)	(-104)
((Cash+Securities)÷Assets)$_{t-1}$	-.006	-.005	-.006
	(-3.93)	(-5.39)	(-13.31)
Intermediation Spread$_{t-1}$	.089	-.055	-.026
	(3.26)	(-2.39)	(-2.84)
(Net Income÷Assets)$_{t-1}$	.565	.480	.376
	(14.91)	(22.61)	(52.97)
(Uninsured Deposits÷Assets)$_{t-1}$	-.013	-.010	.001
	(-5.85)	(-5.91)	(1.49)
(Nonperforming Loans÷Loans)$_{t-1}$	-.036	-.056	-.074
	(-5.51)	(-12.89)	(-47.06)
(Rep. Agre. & Fed. Funds Purchased÷Assets)$_{t-1}$	-.008	-.019	.001
	(-3.68)	(-8.22)	(0.61)
Nonperforming Loans=Loans 90+ d. Late	*Big*	*Medium*	*Small*
Log(Assets)$_{t-1}$	-.004	-.009	-.022
	(-11.44)	(-25.49)	(-104)
((Cash+Securities)÷Assets)$_{t-1}$	-.006	-.006	-.006
	(-3.82)	(-5.97)	(-14.06)
Intermediation Spread$_{t-1}$	.105	-.034	.015
	(3.90)	(-1.48)	(1.63)
(Net Income÷Assets)$_{t-1}$	.621	.534	.433
	(16.82)	(25.52)	(61.33)
(Uninsured Deposits÷Assets)$_{t-1}$	-.012	-.008	.004
	(-5.52)	(-4.79)	(4.79)
(Nonperforming Loans÷Loans)$_{t-1}$	.044	-.007	-.009
	(3.16)	(-1.05)	(-4.36)
(Rep. Agre. & Fed. Funds Purchased÷Assets)$_{t-1}$	-.008	-.018	.002
	(-3.37)	(-8.00)	(1.00)
Adjusted R^2	0.864	0.861	0.868
Number of observations	9196	27873	161937

Notes: OLS estimation. All specifications control for fixed and time-specific effects.
T-ratios in parenthesis. Detailed variable definitions in Appendix B.

Table 4 presents the coefficient estimates of equation (6.1) where the profitability proxy is given by the *Net Operational Income* ratio. Table 5 presents the estimation results of the same equation but with profitability represented by *Net Income*. Both tables allow for two different measures of nonperforming loans[24]. Our theoretical model generates some cross-sectional testable implications. Among others, it implies that in the production of 'insurance services' equity capital and liquid assets are substitutes. This should imply a negative coefficient for the liquidity ratio, which is given by the ratio of cash-plus-securities to total assets.

Inspecting tables 4 and 5 we verify that, after controlling for some other exogenous variables, this prediction is borne out in the data. All of the four different specifications produce a negative and significant coefficient for the liquidity ratio, as predicted. The coefficient estimate is also very stable across sizes and estimation specifications.

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. This variable is also very significant for all specifications and across all sizes. As expected the coefficient exhibits a negative sign since a bigger bank can naturally diversify more its operations, thereby reducing risk and the necessity of higher capital ratios. Further the coefficient is increasing in absolute terms when we go from big to small banks, which makes economic sense. Since there are decreasing returns to diversification, the same increment in the volume of assets reduces risk in a greater proportion for a small bank than for a bank that is already quite large. Hence, when a small bank grows in size it can cut down more on its capital ratio to maintain the same level of insurance, then can a large bank. The reason is twofold. First, to start with, a large bank has already a lower capital base to cut from than a small bank. Second, the same increment in the volume of assets reduces risk to a lower extent in a large bank than in a small bank, because large banks are already somewhat diversified.

The intermediation spread (return on loans - return on deposits) tries to capture the monopoly rents arising from the 'core' banking activities of loan making and deposit taking. This variable tends to show a positive and significant coefficient for big banks and negative for small and medium ones. Clearly banks of different sizes react differently. Big banks see a large spread as an indication of a valuable charter and hence try to protect it by increasing the capital ratio. This is more so, because big banks tend to have very low, and close to the regulatory minimum, capital ratios. To the contrary medium and small sized banks view an increase in the spread as indication that their 'core' business is relatively profitable and safe, implying that they can reduce their capital ratios without imperilling the continuity of their activity. This variable is not significant for the medium and small categories in the specification that uses the loans 90+ days late and net income variables.

As a proxy for the profitability of banks assets we use two different but related measures. Net Operational Income in table 4 and Net Income in table 5. Net Income is a broader measure, since it includes income from the off-balance sheet operations, and other extraordinary net gains. This variable is highly significant and positive across all size

[24]Loan Loss Provisions was used as a third measure of nonperforming loans. Although the estimation with this specification is not reported the results were qualitatively the same.

categories, especially for small banks. Hence, more profitable banks today tend to have a more solid capital structure one period (one quarter) into the future.

The way banks react to uninsured deposits[25] is rather different across size classes. For big and medium sized banks the coefficient tends to be negative and significant (while decreasing in absolute terms from big to medium, and from medium to small). This is evidence that large banks don't see large uninsured deposits as an additional source of risk, but rather as a good funding alternative to their own capital, for the purchase of assets. For a small bank that is not so. A small bank might view a large deposit as an additional source of risk. If one of these big depositors suddenly decides to withdraw his money, bank managers may have to liquidate a relatively big proportion of their earning assets at substantial capital losses, potentially putting in danger the solvency of the bank. These small banks react to an increase in uninsured deposits by holding higher capital ratios. This is evidence that small banks operate more on the increasing risk margin of uninsured deposits, than on the funding source alternative margin. This behavior leads to a positive and significant coefficient associated with uninsured deposits. This reversal of sign from big to small is robust across specifications and evidence of different behavior of banks pertaining to different size categories.

With rare exceptions, the percentage of nonperforming loans produces a negative and significant coefficient. This is consistent with evidence presented in Lucas and McDonald (1992) and with the spirit of Merton (1977). Banks with bad quality loan portfolios might decide to reduce their capital ratios in order to explore the implicit insurer transfer imbedded in fixed-rate deposit insurance. This is the natural way to increase the option value of deposit insurance as seen in section 3. The exception to this characterization is given by big banks in the specifications that use as a measure of delinquent loans, Loans 90+ Days Late. In these two cases the coefficient is positive suggesting that big, long and well established banks might opt to recapitalize a bit instead of exploiting the option value of deposit insurance. This is also consistent with the dichotomy in bank behavior presented by Markus (1984).

Finally, in what concerns the ability to generate liquidity through the liability side, the coefficient on Repurchase Agreements and Federal Funds Purchased is negative and significant for the big and medium size categories, but insignificant for the small one. That the coefficient for small banks is insignificant comes as no surprise, since small banks barely participate in the Federal Funds market on the buyer side (less than .6 percent of their liabilities). The market makers are medium and especially big banks. For these two categories, the ability to generate funds at a moments notice reduces the need for capital cushioning, justifying the negative coefficient found.

In conclusion, the data is rather supportive of the idea that bank managers, when found in a situation of undercapitalization, do increase liquidity in order to maintain a given level of security. This increase in liquidity is also a way to compensate depositors for the lacking of adequate equity funds in the bank capital structure.

[25]Uninsured deposits is given by the sum of Open Account Time Deposits of $100,000 or More plus Time CD's of $100,000 or More.

6.3. Robustness Checks

It is of some relevance to see that 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, it did not impact significantly on the results using annual dummies instead of a dummy for every quarter. Instead of running individual regressions for every size class, we also run a pooled regression for all the banks, but with size dummies. The results obtained were consistent with the ones reported.

Changing the asset cutoff level in the formation of the size classes (for instance big banks defined as banks with book assets over $1bn) did not change substantially the results achieved. Finally, instead of quarterly data we used annual data, which produced almost identical results.

From all this, we are led to conclude that the coefficient estimates are quite robust to different kinds of specifications.

7. Conclusion

We formally developed a model of bank portfolio choice under different deposit insurance arrangements. The main findings were summarized in a set of six propositions. Namely, it was shown that under a fixed-rate deposit insurance scheme, banks take more risk and choose a more levered capital structure. Nevertheless, they will not be in a corner solution with 100% levered capital structures. Furthermore, banks will never hold actuarially fair deposit insurance on a voluntary basis. Bank managers must be coerced into accepting it. Finally, the model made explicit the intuition that undercapitalized banks try to compensate for the lack of security, by holding a higher percentage of liquid assets.

Panel data estimation of the model implications revealed that the correlation between the equity-to-assets ratio and the liquidity ratio was indeed negative and significant for banks of all sizes. Further, time series estimation for the Great Depression brought into light evidence that the banking system held more excess cash reserves as a fraction of total assets during periods of more severe undercapitalization.

Further research could potentially go in the direction of the analysis of the implications of the risk-based capital requirements on the asset portfolio composition of banks. Also, the model could be used to study the optimal design of deposit insurance schemes from a regulatory point of view. Empirical tests with banking data from countries with no formal deposit insurance scheme would help to evaluate the full extent of banks substitutability of equity for liquid assets.

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. As before banks want to maximize the capital gains function, subject to their balance sheet constraint. 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. If the cost of raising capital increases very sharply, as the asset size increases, the bank will raise an increasing share of the funds from deposits, and less from capital.

A.1. *Bank-Neutral* Deposit Insurance.

In this case, $\phi = (1-v)\frac{\int_0^{\theta^*}\varphi(\theta)dF(\theta)}{1+r}$. The expected return on deposits is still given by (4.2) The objective of the bank is to maximize

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

subject to:

$$X + B + ER \leq (1-\alpha-\phi)D + E(1-v(E)) \text{ and } ER \geq 0$$

Let λ be the multiplier associated with the balance sheet constraint, μ the multiplier associated with the non-negativity constraint on the level of excess reserves 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:

$$\frac{\partial G}{\partial E} = -1+\lambda\left(1-v-Ev'\left(\cdot\right)\right)$$

$$\frac{\partial G}{\partial B} = 1-F\left(\theta^{*}\right)\left[1-\lambda\left(1-v\right)\right]-\lambda\left(1-v\right)\frac{\gamma D}{1+r}f\left(\theta^{*}\right)\frac{\partial\theta^{*}}{\partial B}$$

$$\frac{\partial G}{\partial ER} = \left(\frac{1+e}{1+r}+\frac{e'(.)}{1+r}TR\right)\left(1-F\left(\theta^{*}\right)\left[1-\lambda\left(1-v\right)\right]\right)-\lambda-\lambda\left(1-v\right)\frac{\gamma D}{1+r}f\left(\theta^{*}\right)\frac{\partial\theta^{*}}{\partial ER}+\mu$$

$$\frac{\partial G}{\partial x(\theta)}\Big|_{\theta\geq\theta^{*}} = \frac{f(\theta)}{1+r}\left[X+m_X^4X'\left(.\right)\right]-\lambda\left(1-v\right)\frac{\gamma D}{1+r}f\left(\theta^{*}\right)\frac{\partial\theta^{*}}{\partial x(\theta)}$$

$$\frac{\partial G}{\partial x(\theta)}\Big|_{\theta<\theta^{*}} = \frac{f(\theta)}{1+r}\left[\lambda\left(1-v\right)X+m_X^4X'\left(.\right)\right]-\lambda\left(1-v\right)\frac{\gamma D}{1+r}f\left(\theta^{*}\right)\frac{\partial\theta^{*}}{\partial x(\theta)}$$

$$\begin{aligned}\frac{\partial G}{\partial d^{*}} &= \frac{1}{1+r}\left[\left(-D+\frac{\pi-d^{*}}{1+r}D_1\right)\left(1-F\left(\theta^{*}\right)\left[1-\lambda\left(1-v\right)\right]\right)\right]+\frac{\lambda D_1}{1+r}\left[1-\alpha-\frac{1-v}{1+r}\gamma F\left(\theta^{*}\right)\right]\\ &\quad+\frac{\alpha D_1}{1+r}\left(1-F\left(\theta^{*}\right)\left[1-\lambda\left(1-v\right)\right]\right)\left[\frac{1+e}{1+r}+\frac{e'(.)}{1+r}TR\right]-\lambda\left(1-v\right)\frac{\gamma D}{1+r}f\left(\theta^{*}\right)\frac{\partial\theta^{*}}{\partial d^{*}}\end{aligned}$$

$$\begin{aligned}\frac{\partial G}{\partial f} &= \frac{-1}{1+r}\left[\left(-D+\frac{\pi-d^{*}}{1+r}D_1\right)\left(1-F\left(\theta^{*}\right)\left[1-\lambda\left(1-v\right)\right]\right)\right]-\frac{\lambda D_1}{1+r}\left[1-\alpha-\frac{1-v}{1+r}\gamma F\left(\theta^{*}\right)\right]\\ &\quad-\frac{\alpha D_1}{1+r}\left(1-F\left(\theta^{*}\right)\left[1-\lambda\left(1-v\right)\right]\right)\left[\frac{1+e}{1+r}+\frac{e'(.)}{1+r}TR\right]-\lambda\left(1-v\right)\frac{\gamma D}{1+r}f\left(\theta^{*}\right)\frac{\partial\theta^{*}}{\partial f}\end{aligned}$$

$$\begin{aligned}\frac{\partial G}{\partial c} &= \frac{1}{1+r}\left[\left(-D+\frac{\pi-d^{*}}{1+r}D_2\right)\left(1-F\left(\theta^{*}\right)\left[1-\lambda\left(1-v\right)\right]\right)\right]+\frac{\lambda D_2}{1+r}\left[1-\alpha-\frac{1-v}{1+r}\gamma F\left(\theta^{*}\right)\right]\\ &\quad+\frac{\alpha D_2}{1+r}\left(1-F\left(\theta^{*}\right)\left[1-\lambda\left(1-v\right)\right]\right)\left[\frac{1+e}{1+r}+\frac{e'(.)}{1+r}TR\right]-\lambda\left(1-v\right)\frac{\gamma D}{1+r}f\left(\theta^{*}\right)\frac{\partial\theta^{*}}{\partial c}\end{aligned}$$

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.

A.2. Competitively Priced Deposit Insurance: $\phi = \frac{\int_0^{\theta^{*}}\varphi(\theta)dF(\theta)}{1+r}$.

Once again, shareholders desire to maximize capital gains accruing to the bank, by choice of the seven variables that the bank controls.

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

subject to:

$$X+B+ER\leq\left(1-\alpha-\phi\right)D+E\left(1-v\left(E\right)\right)\text{ and }ER\geq0$$

In the present case the objective function simplifies to:

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

subject to

$$X + B + ER \leq \left(1 - \alpha - \frac{\int_0^{\theta^*} \varphi(\theta)\, dF(\theta)}{1+r}\right) D + E(1 - v(E)) \text{ and } ER \geq 0$$

Differentiating with respect to all the endogenous variables results in the following first order conditions:

$$\begin{aligned}
\tfrac{\partial G}{\partial E} &= -1 + \lambda(1 - v - Ev'(.)) \\
\tfrac{\partial G}{\partial B} &= (1-\lambda)[1 - F(\theta^*)] \\
\tfrac{\partial G}{\partial ER} &= \left(\tfrac{1+e}{1+r} + \tfrac{e'}{1+r}TR\right)[1 - F(\theta^*)(1-\lambda)] - \lambda + \mu \\
\tfrac{\partial G}{\partial x(\theta)}\Big|_{\theta \geq \theta^*} &= \tfrac{f(\theta)}{1+r}\left[X + \left(\tfrac{\int_{\theta^*}^1 x(\theta) dF(\theta)}{1+r} + \lambda \tfrac{\int_0^{\theta^*} x(\theta) dF(\theta)}{1+r} - \lambda\right) X'(\cdot)\right] \\
\tfrac{\partial G}{\partial x(\theta)}\Big|_{\theta < \theta^*} &= \tfrac{f(\theta)}{1+r}\left[\lambda X + \left(\tfrac{\int_{\theta^*}^1 x(\theta) dF(\theta)}{1+r} + \lambda \tfrac{\int_0^{\theta^*} x(\theta) dF(\theta)}{1+r} - \lambda\right) X'(\cdot)\right] \\
\tfrac{\partial G}{\partial d^*} &= \tfrac{1}{1+r}\left[-D[1 - F(\theta^*)(1-\lambda)] + m_D^5 D_1\right] + \tfrac{\alpha D_1}{1+r}\left[\left(\tfrac{1+e}{1+r} + \tfrac{e'}{1+r}TR\right)[1 - F(\theta^*)]\right] \\
\tfrac{\partial G}{\partial f} &= \tfrac{-1}{1+r}\left[-D[1 - F(\theta^*)(1-\lambda)] + m_D^5 D_1\right] - \tfrac{\alpha D_1}{1+r}\left[\left(\tfrac{1+e}{1+r} + \tfrac{e'}{1+r}TR\right)[1 - F(\theta^*)]\right] \\
\tfrac{\partial G}{\partial c} &= \tfrac{1}{1+r}\left[-D[1 - F(\theta^*)(1-\lambda)] + m_D^5 D_2\right] + \tfrac{\alpha D_2}{1+r}\left[\left(\tfrac{1+e}{1+r} + \tfrac{e'}{1+r}ER\right)[1 - F(\theta^*)]\right]
\end{aligned}$$

Where $m_D^5 = (\pi - d^*)[1 - F(\theta^*)(1-\lambda)] + \lambda(1-\alpha)$. If $v = 0$, then $\lambda = 1$, making bond holdings indeterminate. Going bankrupt does not affect profits because insurance is competitively priced (risk-rated insurance premium) and, there are no bankruptcy costs.

A.3. Fixed-Rate Deposit Insurance

Under fixed-rate deposit insurance banks maximize a profit function of the following form:

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

subject to

$$X + B + ER \leq (1 - \alpha - \phi) D + E(1 - v(E)) \text{ and } ER \geq 0$$

The optimality conditions are now given by:

$$
\begin{aligned}
\frac{\partial G}{\partial E} &= -1 + \lambda\left(1 - v - Ev'(.)\right) \\
\frac{\partial G}{\partial B} &= (1-\lambda) - F(\theta^*) \\
\frac{\partial G}{\partial ER} &= \left(\tfrac{1+e}{1+r} + \tfrac{e'}{1+r}TR\right)\left[1 - F(\theta^*)\right] - \lambda + \mu \\
\frac{\partial G}{\partial x(\theta)}\Big|_{\theta \geq \theta^*} &= \tfrac{f(\theta)}{1+r}\left[X + \left(\frac{\int_{\theta^*}^{1} x(\theta)dF(\theta)}{1+r} - \lambda\right)X'(\cdot)\right] \\
\frac{\partial G}{\partial x(\theta)}\Big|_{\theta < \theta^*} &= \tfrac{f(\theta)}{1+r}\left(\frac{\int_{\theta^*}^{1} x(\theta)dF(\theta)}{1+r} - \lambda\right)X'(\cdot) \\
\frac{\partial G}{\partial d^*} &= \tfrac{1}{1+r}\left[-D + m_D^6 D_1\right] + \tfrac{\alpha D_1}{1+r}\left[\left(\tfrac{1+e}{1+r} + \tfrac{e'}{1+r}TR\right)\left[1 - F(\theta^*)\right]\right] \\
\frac{\partial G}{\partial f} &= \tfrac{-1}{1+r}\left[-D + m_D^6 D_1\right] - \tfrac{\alpha D_1}{1+r}\left[\left(\tfrac{1+e}{1+r} + \tfrac{e'}{1+r}TR\right)\left[1 - F(\theta^*)\right]\right] \\
\frac{\partial G}{\partial c} &= \tfrac{1}{1+r}\left[-D + m_D^6 D_2\right] + \tfrac{\alpha D_2}{1+r}\left[\left(\tfrac{1+e}{1+r} + \tfrac{e'}{1+r}TR\right)\left[1 - F(\theta^*)\right]\right]
\end{aligned}
$$

Where $m_D^6 = (\Pi - d^*)\left(1 - F(\theta^*)\right) + \lambda(1 - \alpha - \phi)$.

B. Data Sources and Definitions

All series were constructed from the quarterly Consolidated Reports of Condition and Income for insured commercial banks operating continuously in the United States from 1985:1 to 1989:4.

The series for securities, item RCFD0390, is the sum of the series for U.S. Treasury Securities, U.S. Government Agency and Corporation Obligations, Securities Issued by States and Political Subdivisions in the U.S., Other Domestic Securities, and Foreign Securities.

Uninsured Deposits, item RCON2604, is the sum of Time CD' in Denominations of $100,000 or More (RCON6645) and Open Account Time Deposits in Amount of $100,000 or More (RCON6646).

Equity capital, item RCFD3210, includes Perpetual Preferred Stock, Common Stock, Surplus, Undivided Profits and Capital Reserves, and Cumulative Foreign Currency Translation Adjustments.

All other variables used are defined in the table that follows:

Variable	Call Report Code and Definition	
Assets	RCFD2170	Total Assets - Book Value
Cash	RCFD0010	Cash and Balances Due from Depository Institutions
Securities	RCFD0390	Total Investment Securities - Book Value
Risk-Free Securities	RCFD0400	U.S. Treasury Securities - Book Value
Loans	RCFD2125	Loans and Leases, Net of Unearned Income, Allowance and Reserve
Agricultural Loans	RCFD1590	Loans to Finance Agricultural Production and Other Loans to Farmers
C&I Loans	RCFD1600	Commercial and Industrial Loans
Real Estate Loans	RCFD1410	Loans Secured by Real Estate
Loans to Individuals	RCFD1975	Loans to Individuals for Household, Family and other Personal Expenditures
Repurchase Agreements and Federal Funds Sold	RCFD1350	Federal Funds Sold and Securities Purchased Under Agreement to Resell
Deposits	RCFD2200	Total Deposits
Demand Deposits	RCON2210	Total Demand Deposits
Time & Saving Deposits	RCON2350	Total Time and Savings Deposits
Uninsured Deposits	RCON2604	Time Deposits in Denominations of $100,000 or More
Subordinated Debt	RCFD3200	Subordinated Notes and Debentures
Equity	RCFD3210	Total Equity Capital
Preferred Stock	RCFD3220	Total Preferred Stock
Common Stock	RCFD3230	Common Stock
Repurchase Agreements and Federal Funds Purchased	RCFD2800	Federal Funds Purchased and Securities Sold Under Agreement to Repurchase
Return on Loans	RIAD4010	Total Interest and Fee Income on Loans
Return on Deposits	RIAD4170	Interest on Deposits
Net Income	RIAD4340	Net Income (Loss)
Net Operating Income	RIAD4000- -RIAD4130	Total Interest and Non Interest Income - Total Interest and Non Interest Expense
Loans 90+ Days Late	RCFD1407	Total Loan and Lease Finance Receivables: Past Due 90 Days or More and Still Accruing
Loans not Accruing	RCFD1403	Total Loan and Lease Finance Receivables: Nonaccrual
Loan Loss Provision	RIAD4230	Provision for Loan and Lease Losses

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