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THE ECONOMICS OF BANK REGULATION

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Abstract

The object of this paper is to survey and synthesize the literature on the regulation of financial intermediaries, including the theoretical framework and also the applied literature on specific regulations such as deposit insurance, capital controls, line of business restrictions, etc.

Key Words and Phrases
Banking, Deposit Contracts, Insurance, Securitization.

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I. Introduction

The decades of the 1980s and the ongoing 1990s have been witness to exciting developments in banking. On the academic front, the pioneering work of Leland and Pyle [1977], Diamond [1984] and Ramakrishnan and Thakor [1984] on financial intermediary existence, and that of Bryant [1980] and Diamond and Dybvig [1983] on bank runs and deposit insurance generated new interest in micro-economic modelling of the role of financial intermediaries in the economy. The new economics of asymmetric information and contract design played a significant role in these developments and has helped take this literature to the point where many interesting insights have been generated about how banks function and are regulated in the real world. These insights have been augmented by those in the literatures on credit market functioning under asymmetric information (Stiglitz and Weiss [1981], for example), corporate financing and governance (Stiglitz [1985]), and incomplete contracting (Hart [1991]). A survey of the contemporary banking literature is contained in Bhattacharya and Thakor [1993]; Tirole [1994] surveys incomplete contracting.

During this time governmental *regulation of banking* has also been subject to new developments. In the U.S., for example, major banking legislation[1] enacted in the 1930s, and extended through the 1950s and 1970s, has seen several important changes. The large increases in nominal interest rates in the 1970s, together with bank deposit interest rate controls and the emergence of money market funds, resulted in a great deal of "disintermediation". Regulators realized that the erosion in the competitiveness of banks had to be arrested, and thus proceeded to greatly ease constraints on banks in the early 1980s. Interest rate ceilings on bank deposit liabilities (Regulation Q), and narrow portfolio

[1] Important legislation included the Banking (Glass-Steagall) Act of 1933 extended in 1935, and the Bank Holding Act of 1956, amended in 1970.

restrictions (to residential mortgages, often at fixed nominal interest rates over long horizons) on Savings and Loans (S&L's) were eliminated or significantly relaxed. However, the experience with bank deregulation in the 1980s was not entirely pleasant. Many S&L's failed in the late 1980s and early 1990s and, according to the Federal Reserve Bank of Chicago [1990], the liabilities of these institutions may have exceeded their assets by as much as $200 billion, over $2000 per U.S. household. Moreover, rampant financial innovation and the expanding role of financial markets have further reduced the significance of bank regulation in affecting economic activity. This has led to a rethinking of the framework of banking regulation, and implementation of important new regulatory legislation has begun in earnest, with the Federal Deposit Insurance Corporation Improvement Act (1991) in the U.S., the EU's White paper on Intra-European Banking and Harmonization and the International Harmonization of Capital Segments. (The 1988 BIS agreement).

Many issues in bank regulation, newly informed by contemporary developments in banking theory as well as the deregulation experiences of the 1980s, remain unresolved at this point. Included among these are the following:

(a) Is *deposit contracting* (the right to demand withdrawal of contractual claims at any point in time from the issuer) important for investor welfare, on the scale at which it is present in current banking systems? Should such contractual claims be restricted only to financial firms holding extremely low-risk instruments, such as short-term government securities and other instruments? What alternative liability structures for intermediaries can there be, as theoretical possibilities and with implementability being considered?

(b) Should the safety net of *deposit insurance* continue to be provided for such claims, as has been the case in the U.S. since the 1930s? If so, how universal

(across intermediaries) and up to what scale should the coverage be? Should private insurers play a (the major) role in providing such insurance? Should deposit or other non-equity liability holders play a major role in disciplining bank management?

(c) What should be the goal of financial intermediary regulation and how should financial intermediaries with insured liabilities *be regulated*? What should be the role of bank capital controls, deposit interest rate controls, and closure rules for troubled institutions?

(d) What role, if any, should the government play in the *management* of idiosyncratic and systematic *liquidity shocks* experienced by banks? How should the "lender of last resort" role of a Central Bank be organized?

(e) Should *portfolio restrictions* on banks, by line of business lent to or on activities such as underwriting risky securities issues or holding equity investments in firms, be relaxed or made more stringent? Should commercial firms be allowed to own banks (or bank holding companies)? How have countries with different regulatory frameworks in these respects fared in terms of bank risk and efficiency and stability in the financing of commercial and investment activity? What should be regulatory policy towards *interbank competition* in loan markets?

Existing theories of banking (see the Bhattacharya and Thakor [1993] survey), and of corporate governance and capital structure (Hart [1991], Dewatripont and Tirole [1993,1994] are examples), have been only partially successful in providing detailed answers to these questions. In what follows, we first briefly sketch in Section II the salient features of recent banking theories in explaining (i) the asset side functions of intermediaries, (ii)

optimal bank liability contracts, (iii) coordination problems and regulatory interventions suggested by these issues, and (iv) the empirical significance of bank failures and related coordination problems. Section III is devoted to a brief discussion of the key policy issues in bank regulation, and the policy-oriented recommendations for reform. Section IV examines these reform proposals from the standpoint of the academic research on these issues. In particular we examine the role of the following in attenuating deposit-insurance-related moral hazards: (i) cash-asset reserve requirements, (ii) risk-sensitive capital requirements and deposit insurance premia, (iii) partial deposit insurance, (iv) bank closure policy, and (v) portfolio restrictions and universal banking. Section V concludes. The literature on these issues is extensive but there is far from consensus on the conclusions, or even modelling postulates. An important objective of our survey is to highlight the important unresolved questions.

II. Banking Theories

Modern theories of banking, or of financial intermediation in general, in the past two decades have been concerned with explaining (A) why financial intermediaries exist, focusing in particular on the benefits of delegating monitoring for lending and other resolutions to market imperfections, (B) the nature of optimal bank liability contracts, such as deposits, intended to provide insurance for liquidity needs to investors, and (C) the (coordination) problems of imperfect functioning of these contracts, leading to phenomena such as bank runs, and measures to cope with these. In this section, we briefly review the salient features of these theories, and then summarize the empirical evidence on the importance of the theoretical issues in order to provide a perspective for the discussion of more elaborate models of bank regulation in subsequent sections. The most recent theoretical developments

that focus on architecture of financial systems are briefly discussed in the penultimate section.

A. Asset Markets: Unduplicated Monitoring and Diversification

Theorists such as Leland and Pyle [1977], Diamond [1984], Ramakrishnan and Thakor [1984], and Boyd and Prescott [1986] have focused on the following role of intermediaries. These institutions can monitor -- either in the *ex post* sense of verifying cash flows or in the *interim* sense of screening quality -- the attributes of investment projects. Without intermediation, such monitoring would be duplicated by the many investors involved in funding such projects. Alternatively, investors would have been forced to take large (undiversified) stakes (Leland and Pyle (1977)). Markets for information sellers for such monitored knowledge are assumed to function imperfectly, owing to problems of credibility (Ramakrishnan and Thakor (1984)), or the sellers' inability to capture the full returns from monitoring (see Allen [1990]). Furthermore, intermediaries that monitor many projects with imperfectly correlated rates of return achieve diversification, which in turn allows them to credibly communicate the attributes of their diversified portfolios to ultimate investors at lower cost (Diamond (1984)). In symbols, intermediation is efficiency enhancing if per project (or for the average project in the cross-section):

$$[K(n) + S(n)] < \text{Min}[NK, S] \qquad (1)$$

where K is the direct monitoring cost per project, N is the number of investors per project, S is the alternative *indirect* cost of communicating project attributes through signalling or bonding, n is the number of projects per intermediary, K(n) being the resulting monitoring cost per project, and S(n) is the resulting indirect cost of communicating project attributes to ultimate investors for the intermediary agent or coalition.

For example, in Diamond [1984] all agents are *risk-neutral*, project originators have

private information about *ex post* cash flows unless externally monitored, and, in the absence of such monitoring, repayment contracts are *debt contracts* backed up by the threat of "nonpecuniary penalties" equal to the amount of default. These penalties induce thankful communication. Thus, S is the expected value of such nonpecuniary penalties for each borrower, given a contractual repayment level that provides investors with (the alternative) riskless rate of interest, and S(n) is the analogous expected penalty per project for a *single intermediary agent* who monitors n projects, *thus making K(n) = K*. When cash flows across projects are independent or the intermediary's repayment contract adjusts for all systematic risk factors, Diamond shows that $\lim_{n\to\infty} S(n)=0$, whereas S > K by assumption, and hence inequality (1) is satisfied for n large enough, holding constant N > 1. The predictions of the theory are that (a) intermediaries will be very large (no diseconomies of scale), (b) their portfolios will have (almost) zero (non-systematic) risk, and (c) their liabilities will be debt contracts (with repayment levels adjusted for systematic risk factors) which will be honored almost surely.

The model of Leland and Pyle [1977], suitably extended (see Diamond [1984], Appendix), is based on the notion of asymmetric information known to project originators about an interim attribute, such as the mean of normally distributed returns. The indirect communication cost S results from a signal of mean return such as undiversified equity holding in her own project by the originator/entrepreneur; it is the certainty equivalent of the entrepreneur's loss in expected utility relative to that in a first-best (symmetric-information) equilibrium. Alternatively, n such project originators, with imperfectly correlated returns, can monitor one another's projects, take equal holdings in them (with side payments if means are different), and signal to the market with their undiversified holdings in the aggregated firm of projects project, resulting in (certainty-equivalent) signalling cost S(n) per

entrepreneur, given their identical risk averse preferences. In the Leland and Pyle model, S(n) is decreasing in n, but K(n) = n(n-1) K. Thus, the optimal scale of intermediaries is likely to be bounded. In addition, liability contracts for financing/diversification offered by project originators or intermediary coalition partners are *equity contracts*, since ex post cash flows are common knowledge among agents.

Of these two models of intermediation, the Diamond [1984] model has "struck the deeper chord" among many subsequent writers, although its basic structure is not robust to intermediary agents having risk-aversion; see Bhattacharya and Thakor [1993] for details, and comparisons with other models of financial intermediation. There are many reasons for this. For one, many theories of credit market functioning under asymmetric information, such as Stiglitz and Weiss [1981], go against the grain of the Leland-Pyle type of modelling and assume that asymmetric information about interim attributes can not be signalled. In particular, the Leland-Pyle type of signal, or the alternative of using *collateral* in credit markets, are constrained by limited liability (*not* assumed by Leland-Pyle) and availability (see Besanko and Thakor [1987a,b]). As a result, problems of external financing under asymmetric information about project attributes remain unresolved, according to these authors. The resulting lemons problems are supposedly most severe in equity markets, but could lead to phenomena such as credit rationing even in debt markets. The amelioration of such problems could be facilitated by a higher net worth for borrowers (necessitating lower reliance on external funding), or intermediation technologies that allow improved monitoring. Greenwald and Stiglitz [1990] and Bernanke and Gertler [1990] are examples of papers that argue along these lines for credit markets; Myers and Majluf [1984] argued these points earlier with regard to equity markets.

B. Bank Liabilities: Deposit Contracting and Alternatives

Bryant [1980] and Diamond and Dybvig [1983] formalized the liquidity-seeking behavior of individuals and examined its implications for the design of their financing contracts. In the simplest formalization, due to Diamond and Dybvig, ***ex ante*** identical investors have endowments of 1 unit to invest at time 0, and find out at time 1 if they wish to consume then, with utility $U(C_1)$, or if they wish to consume later at time 2, with utility $U(C_2)$; the probabilities of these two events, distributed *independently* across agents, are P and (1-P), respectively.[2] The agents' conditional preferences are extreme: consumption has positive utility either at t=1 *or* t=2. This corner nature of agents' conditional preferences represents the key simplifying and pivotal assumption in Diamond and Dybvig [1983]; see below. Investment technologies for the intermediary include (i) a short-term technology earning gross return of unity, at time 1, and (ii) a long-term technology earning gross rate of return $R > 1$, at time 2, which may be liquidated with return of unity, at time 1. *Intermediaries*, each serving many agents in Bertrand competition over contracts, choose consumption/withdrawal levels $\{C_1 \text{ or } C_2\}$ and investment patterns per capita {L, 1-L} in the short-term and long-term technologies to maximize $[PU(C_1) + (1-P)U(C_2)]$, the representative agent's ex ante expected utility, subject to $PC_1 = L$, $(1-P)C_2 = R(1-L)$. If U(.) has uniformly a relative risk-aversion coefficient greater than unity, then the resulting contract has the "visible" insurance feature:

$$1 < C_1 < C_2 < R. \tag{2}$$

Diamond and Dybvig [1993] *interpret* this $\{C_1, C_2; L\}$ liability-cum-investment

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[2] Presumably, this representation is meant to capture other background risks to endowments, income, health, etc. for which insurance markets do not really exist, for reasons of fixed costs, unobservability of realized state, or (more problematically) moral hazard.

contract as a *deposit contract*, giving investors the unconditional right to withdraw C_1 at time 1 or C_2 at time 2. Given their assumptions, if more than the fraction P of agents tries to withdraw C_1 at time 1, then the promised level of C_2 becomes infeasible. For a sufficiently large fraction f withdrawing early, liquidation f results at time 1. The reason is that after fC_1 is paid off to those who withdraw at time 1, the available payoff per agent at time 2 is $[\frac{(1-fC_1)R}{(1-f)}]$, which is less than C_1 for f large enough. Thus, others are then induced to withdraw as well and a *bank run* materializes.[3]

An alternative implementation of the contract $\{C_1, C_2; L\}$ is for each intermediary to pay a dividend stream {L *and* R(1-L)}, with interim trading of the bond/share by agents who wish to consume earlier. With the ex post corner preferences assumed in the Diamond-Dybvig model, such trading leads to (i) consumption patterns $\{C_1$ or $C_2\}$ for the two types of agents in a Walrasian equilibrium, and (ii) an interest rate (the gross discount rate of time 2 dividends reflected in the time 1 share/bond price) of I, satisfying

$$1 < I = \frac{C_2}{C_1} < R. \qquad (3)$$

This mimics the risk sharing arrangement above. These observations were made in Jacklin [1987] and Bhattacharya and Gale [1987]. Hellwig [1993] obtains analogous results when there is a stochastic (short-term) investment technology between times 1 and 2, with rate of return $\tilde{R}$.

How seriously should this traded-debt-contract alternative to deposits be taken, given coordination problems with the deposit contract such as runs? What are its limitations (i) in

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[3] This setup suggests that the long-term technology usually dominates the short-term technology; i.e., the short-term technology generates 1 at t=0, while the long-term technology generates R>1 at t=2 *or* at t=1. However, we could also have assumed a payoff less than 1 at t=1 if our long-term technology is chosen and early liquidation occurs.

satisfying liquidity (insurance) needs of investors, and (ii) with respect to inducing the optimal investment choices by banks/intermediaries? At the contemporary exposited level of modelling, the following limited answers can be provided. With respect to issue (i), Jacklin [1987] points out that the result that trading achieves allocations that are identical to those in Diamond-Dybvig is an artifact of the extreme preferences in the Diamond-Dybvig model. If liquidity shocks to preferences are less extreme, then the traded debt and non-traded deposit contracts are *not* welfare equivalent. An example of such preferences is obtained by introducing a random variable $\tilde{\rho}$ that results in *ex post* preferences $U(C_1, C_2; \rho)$ that are interior -- say, $[U(C_1) + \rho\, U(C_2)]$, with $U' > 0$, $U'' < 0$, $\lim_{c \to 0} U(C) = \infty$, $0 < \rho < 1$. For example, with ρ taking on 2 values $\rho_1 < \rho_2$, the optimal deposit contract tuples would be $\{C_1 = a\ C_2 = b\}$ or $\{C_1 = c, C_2 = d\}$ with $c > a$ and $b > d$, satisfying

$$\underset{\{a, b, c, d\}}{\text{Max}}\ [PU(a, b; \rho_1) + (1\text{-}P)\, U(c, d; \rho_2] \tag{4a}$$

Subject to

$$L = Pa + (1\text{-}P)c \tag{4b}$$

$$R(1\text{-}L) = Pb + (1\text{-}P)d \tag{4c}$$

$$U(a, b; \rho_1) \geq U(c, d; \rho_1) \tag{4d}$$

$$U(c, d; \rho_2) \geq U(a, b; \rho_2) \tag{4e}$$

The interpretation of this optimization program is straightforward. Note that (4d) and (4e) are incentive compatibility constraints.

The corresponding traded debt contract would pay agents a dividend of $\{L = (Pa + (1\text{-}P)c)\ R(1\text{-}L) = (Pb + (1\text{-}P)d)\}$, relying on interim trade at time 1 by agents with different preference shocks, ρ_1 or ρ_2. Jacklin [1987] shows that the resulting allocation will be *strictly worse* in ex ante welfare compared to the deposit contract. The reason is

simple but subtle: trading obtains the competitive equilibrium from equal endowments, which is coalitionally incentive compatible, whereas the non-traded deposit contract maximizes the ex ante expected utility of agents subject to resource balance and individual incentive compatibility constraints; this is true for any L, including that which optimizes (4a) subject to (4b - e).

How important is this explanation, in rationalizing the extent of deposit contracting that we see in most banking systems? Note that, with interior preferences ex post, the deposit contract does not permit anyone to withdraw at time 1 their whole "wealth" or contractual payment stream, discounted at some appropriate interest rate. In other words, the liquidity-seeking ρ_2 type can at most withdraw $c > L > a$, but not some discounted value of the total stream {c, d}. Yet, what we see in many banking systems is a far less constrained withdrawal right; that is, subject to some early withdrawal penalties, a very large portion of $[c + d/(1+i)]$, where i is some market interest rate, is withdrawable early, without any trade in secondary bond markets.

Do rationales other than preference/liquidity shocks for investors explain the more liberal observed deposit contracting, or "demandable debt"? Calomiris and Kahn [1991] and Peters [1994] have explored the possibility that *early withdrawal rights*, exercised in response to possibly unverifiable private signals, help creditors discipline bank management against temptations to stealing part of R(1-L), or to make inefficient portfolio choices (choosing a highly risky $\tilde{R}$). We examine these explanations in the next section. Yet another explanation can be gleaned from the work of Gorton and Pennacchi [1990]. They suggest that when $\tilde{R}$ is random and some agents have private information about $\tilde{R}$, a traded contract would make payoffs to pure liquidity seekers fluctuate in response to such information. The

bank may then gain by creating securities whose payoffs are riskless, and liquidity-motivated agents' welfare may be further increased by governmental actions such as payoff insurance. However, given the creation of such securities -- the more diversified the intermediary the greater will be the fraction of its asset value that can be devoted to such securities -- the Gorton-Pennacchi line of argument does *not* justify multi-period debt contracts that are demandable; secondary-market trading suffices.

We now return to issue (ii). What are the implications of trading intermediary debt contracts for investment incentives? Bhattacharya and Gale [1987] have made the following observations. The traded discount rate I in the Diamond-Dybvig model satisfies $1 < I < R$ at their optimal allocation. Hence, at time 1, the market value per unit of the long-term investment exceeds 1, whereas a short-term investment yields only 1. By itself this implies nothing for representative intermediaries *if* their bond trading is restricted to investors/depositors of each intermediary separately. However, if intermediaries are *not* representative, at least at the interim stage (time 1) because, for example, the proportion wishing to withdraw early differs across banks, *free trading of bank debt across banks leads to each bank wishing to invest* $L = 0$, since its investors can obtain strictly higher payoffs as a result, i.e., $C_1 = R/I > L/P$ and $C_2 = R > R(1-L)/(1-P)$. Indeed, with such free Walrasian trading of long-term debt across banks at time 1, the only consumption-investment equilibrium is $C_1 = 1$, $C_2 = R$, $L = P$, $I = C_2/C_1 = R$, which is ex ante worse for investors than the outcome without such trade.

Other than as a theoretical curiosity, a structured example of the non-optimality of opening an additional market when the underlying market structure is incomplete owing to the uninsurability of private preference shocks, how important is the Bhattacharya-Gale observation empirically? Does it suggest, for example, a strong reliance on non-traded

deposit contracting, or regulatory controls on liquid asset investments of financial intermediaries if traded debt contracting is allowed? What are its implications for the administration of an *interbank loan market*, to cope with liquidity shocks such as a high proportion of early withdrawals at each bank? The issue is complicated by the fact that in dynamic, intergenerational economies (e.g. Fulghieri and Rovelli [1993], Bhattacharya and Padilla [1994]), the role of short-term assets and new deposits/funds from new generations is sufficient to take care of the liquidity needs of each generation's "early diers".

Examining the issues related to trading of a bank's future payoffs also makes us aware of a central modelling issue related to examinations of bank runs and closure. The Diamond Dybvig assumption that the *liquidation value* of the long-term technology is unity is clearly a non-market assumption. If an individual bank can realize the discounted value of its long-run payoffs (at the rate $I = C_2/C_1$), then coping with a proportion of early withdrawals greater than P is *not* a problem. Hence, the Diamond-Dybvig liquidation value assumption is at best valid at the *aggregate* level of all banks. In real life contexts, to what extent is a bank's asset portfolio value discernible to regulators, other banks and investors? In other words, how broad can securitization markets become? Note that most theories of financial intermediation would predict the presence of significant liquidation costs. In Sharpe [1990] or Rajan [1992], for example, intermediaries obtain finer non-public information about their loans through time (see Lummer and McConnell [1989] and James [1987] for empirical evidence). While this private information permits the bank to extract monopoly rents from its borrowers, it also hampers the manageability of the banks' assets.[4]

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[4] Note that the asset-side theories of intermediation in the spirit of Diamond [1984] provide us little guidance on this important matter, since bank portfolio values are perfectly bonded (through non-pecuniary penalties for the bank agent in Diamond's model).

C. Bank Runs, Suspension of Convertibility, and Deposit Insurance

With deposit contracting for liability holders, the Diamond-Dybvig [1983] model's optimal allocation is subject to an important *coordination failure*. If a sufficiently large proportion of depositors attempts early withdrawal, others attempt to join them. As a result, there are two pure strategy Nash equilibria in the withdrawal game, sketched in the subsection above, among depositors. In the first $1 < C_1 = L/P < C_2 = R(1-L)/(1-P) < R$. In the second, Pareto-inferior Bank Run equilibrium, $C_1 = L/P$ with probability P/L, 0 with probability ([L-P]/L), and $C_2 = 0$.[5]

This observation motivated the Diamond-Dybvig treatment of bank regulation. First, they noted that when preference shocks are i.i.d across many depositors at a bank, so that the realized proportion of early diers is almost surely P, a *precommitment* not to liquidate more than $L = PC_1$ of (short and) long-term investments suffices to eliminate the bank-run equilibrium, since the promised C_2 is always feasible. They use this observation to rationalize the traditional (pre-deposit insurance) measure of suspension of convertibility in U.S. banking.

When preference shocks are not i.i.d. across depositors, or at least admit local correlating factors at a given bank, matters are more problematic. Suspension of withdrawals at $L = PC_1$, when P is the ex ante probability of the partially correlated (across agents) early withdrawal shocks, will imply that some early diers will be unable to withdraw when their realized fraction f exceeds P. Diamond-Dybvig investigate an alternative, and superior,

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[5] There is a third, mixed-strategy (among "late diers") Nash equilibrium with a proportion $f > P$ agents withdrawing early so that

$$C_2 = R\left(\frac{1-f\frac{L}{P}}{(1-f)}\right) = \frac{L}{P} = C_1$$

intervention: that of deposit insurance. Under this mechanism, subject to a sequential service constraint, banks let agents withdraw a predetermined C_1 irrespective of f, but this withdrawal is backed up by governmental funds, with the government taxing withdrawals at rate t, so that $C_1(1-t)$ is the optimal (expected utility maximizing) quantity of withdrawal, given f proportion of early diers. One interpretation, supported by Anderlini [1986], is that this is a *monetary mechanism*. Deposit withdrawal rights are specified in nominal terms, and high early withdrawals beyond some liquid asset holdings of banks are financed by the government printing money. The resulting inflation erodes the real value of such early withdrawals. Anticipating this, and the resulting preservation of banks' long-term investment payoffs, no runs are generated either.

One important criticism of the bank run mechanism modelled by Diamond and Dybvig is that it lacks a trigger mechanism. Bank runs, if they occur, are pure "sunspot" phenomena, uncorrelated with other economic variables. Gorton [1988] argues persuasively that such was *not* the case in U.S. banking history prior to the introduction to deposit insurance. Measures of adverse business activity, such as small business failure rates, were very useful in predicting bank runs. This suggests that *information variables* relating to banks' future asset/loan portfolio returns were likely to have been important in triggering runs by depositors who did not otherwise need to consume early. In symbols, $\tilde{R}$ is risky, and at time 1 some "late diers" have private information about $\tilde{R}$. If, given their realized signal about $\tilde{R}$, these depositors decide that the value of them of their anticipated future contractual (with potential default) return is lower than their current withdrawal rights, they would precipitate a run.

Models of such information-based runs were developed by Bryant [1980], Jacklin and Bhattacharya [1988], Chari and Jagannathan [1988], and Gorton [1988]. The focus of

Bryant's pioneering, but informal, analysis was to note that governmental deposit insurance, backed by intergenerational taxation, could preclude such runs. If, at the aggregate level, the long-term investment technology is *irreversible* at the interim time point 1, then such a bank run simply randomizes the available early consumption from the liquid technology (plus deposits of any new generation's endowment) across "early diers" and informed agents with adverse information about long-term asset returns. The irreversibility of long-term investments precludes Diamond-Dybvig type runs or coordination failures. Jacklin and Bhattacharya [1988], who assumed that the government could not tax other sectors or generations, ruled out such deposit insurance, and examined the alternatives of deposit contracting versus traded debt contracting, as discussed earlier in the context of the Diamond-Dybvig model. They showed that, with low-risk assets, deposit contracting generates higher expected utility since the probability of a run, and the resulting randomization of consumption across liquidity-seekers and informed agents, is lower for such assets. For high-risk assets, however, traded contracts were shown to be ex ante superior, even though the interim price of bank debt is also affected by any information, positive or adverse, held by informed agents regarding the bank's long-run returns prospects.[6]

Chari and Jagannathan [1988] showed that, when there is uncertainty about both asset returns ($\tilde{R}$) *and* the proportion of early withdrawal seekers (f), runs may sometimes occur even though no agent has received any adverse information. The reason is that uninformed agents, who do not wish to consume early, condition their beliefs about the bank's long-term investments payoff on the size of the withdrawal queue at the bank. Even if the queue is long only due to many agents desiring to consume early, uninformed agents may infer sufficiently

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[6] These results were derived for a class of parametric examples in which agents' conditional (on liquidity-shock) intertemporal consumption preferences are strictly interior, satisfying Inada conditions.

adverse information about the return $\tilde{R}$ to precipitate a run. Indeed, if the shocks to returns on the investment technology are correlated across banks (but the liquidity shocks are not), such panic runs may spread across multiple banks.

In this setting, suspension of convertibility can eliminate panic runs, but only at a cost: early diers do not all get their withdrawal when there are many of them, even though there is no adverse shock to the asset return technology, and hence no information-based run by informed agents. Deposit insurance can do better. It not only eliminates information-based runs, thereby eliminating randomization of consumption across liquidity-seekers and informed agents with adverse information, it also eliminates any panic run equilibrium. The following example illustrates.

Example 1: Let $\tilde{R}$ (asset returns) and $\tilde{P}$ (withdrawals) be stochastic, and have the following two-state outcome distributions:

Let $C_1 = 1.2$, $C_2 = 1.4$, and define $L = 0.3$ as the deposit contract. This contract is feasible when $\tilde{R} = 1.5$ and $\tilde{P} = 0.25$. Let 0.15 (.4 - .25) be the proportion of depositors who are (perfectly) informed about the realization of $\tilde{R}$ at time 1.

If realized $P = 0.4$, assuming that the long-term technology could be liquidated with unit payoff at time 1, there would be no Diamond-Dybvig run, since the feasible expected C_2 is

$$C_2 = \frac{(1 - .4 \times 1.2)}{.6}[.9 \times 1.5 + .1 \times 1.1] = \frac{.52[1.46]}{.6} > 1.2$$

Hence, with no private information about $\tilde{R}$, suspension of convertibility at the liquidation

level .4 × 1.2 = .48 would still yield agents a consumption profile {1.2, C_2 > 1.2}.

However, when 0.15 proportion of agents have private information about $\tilde{R}$ and a withdrawal queue size of .4 is observed, uninformed agents attribute *conditional* probabilities .5 to $\tilde{R} = 1.5 \wedge \tilde{R} = 1.1$, making feasible an expected C_2 of

$$C_2 = \frac{(1-.48)}{.6}[.5 \times 1.5 + .5 \times 1.1] = 1.126 < 1.2,$$

making them also join the withdrawal queue. If, on the other hand, suspension of convertibility occurs at a .3 level of liquidation, then the expected C_2 is

$$C_2 = \frac{(1 \times .3)[.5 \times 1.5 + .5 \times 1.1]}{.75} = 1.21$$

so that no such run takes place. However, some "early diers" do not get their withdrawal at time 1.

If deposit insurance backed up the long-term withdrawal claim of $C_2 = 1.4$, then suspension at the R = 0.3 level of liquidation would not be necessary. But the cost of deposit insurance would be that when asset returns turn out to be low, or when there are large early withdrawals leading to liquidation of long-term investments, other sectors would have to be taxed to make up the shortfall. If the insurance regulatory agency knows that $\tilde{R}$ is high, it can augment its policy, as a lender of last resort, by advancing resources to the bank to cover its short-term liquidity needs when withdrawals are high. A more rigorous public finance analysis of the optimal intervention -- the choice between suspension of convertibility and deposit insurance or some combination of the two -- would be of interest. One tradeoff would be their relative costs of deadweight taxation versus randomization in meeting liquidity needs. An adequate model of interim liquidation values for the long-term intermediary asset *portfolio* should form a crucial part of such an analysis.

D. Some Historical Facts and Relative Importance of Phenomena

How important have banks run, and contagion of these runs across banks, been in the era before deposit insurance? What have been the resulting effects on losses for depositors, given their much lower equity capital to assets ratios (average of 7-8% compares to 35-40% for nonfinancial corporations) in the U.S.? What has been the impact of bank failures on any significant scale for credit allocation and economic activity? We briefly review the empirical evidence on these issues, as discussed in Kaufman [1992], Bernanke [1983], Calomiris [1993] and Romer [1993]. This and other evidence should inform any discussion of the desirable extent of safety net provisions for bank liabilities and related regulations on their capital structure and business activities. In particular to determine the relative weights assigned to the goals of efficiency and competitiveness versus safety and stability in bank regulation, and the testability of market versus regulatory discipline. Kaufman's paper makes the following interesting observations:

i. In a study of some 3000 failures of national banks over 1864 to 1936, bank runs accounted for less than 15 percent of all failures;

ii. Although stock returns of banks show greater within-industry correlations than for firms in other industries, abnormal negative returns of *other* banks given failures of a given bank arise only for banks in the same product or market area;

iii. While annual failure rates of U.S. banks over the long-run were *not* significantly higher than for nonfinancial corporations (0.89% versus 0.77%), failure rates of banks are sharply higher during prolonged downturns in business activity (10% between 1930-33: as compared to 1% overall for firms, 3% for manufacturing and mining). These may just reflect the U.S.'s unit

banking structure with many small, locationally and sectorally undiversified banks, which raises failure risks significantly relative to those in other nations.

iv. Average depositor losses in failed banks as a percentage of *all* deposits was only 0.21 over 1865-1933, less than 1 percent even in crisis years, and about 10 percent of the deposits in *failed* national banks over 1865-1930. Between 1950 - 1980, these latter loss rates decreased to 2 percent due to deposit insurance, but have averaged 12 percent over 1981 - 1990. However, adjusting for unearned interest on assets sold later by the FDIC, losses averaged nearly 30 per cent, James [1991] claims. This compares with market based value loss estimates of 62 per cent an average on defaulted bonds of non-bank firms over 1971-91.

On balance, the evidence suggests to us the following conclusions. While the mechanism of runs causing banks in the aggregate to become insolvent because of lack of liquidity has *not* been historically important, the impact of information-based runs leading possibly to suspension of convertibility and regulatory audit of the bank has been important in the pre-insurance era. Without such uninsured depositor-induced discipline leading to reorganization of banks, regulator-induced discipline may not be as effective as one might like; witness the average losses to the FDIC in the volatile but not crisis-stricken U.S. economy of the 1980s that have matched those of a much earlier period characterized by crises, for national banks, namely 1865-1930.[7]

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[7] On the other hand. losses to depositors as a proportion of deposits at failed banks reached nearly 20 percent in 1930-33, a period with which the 1980's are "comparable". Similarly, the market to par value ratios of defaulted corporate debt was in the low 30% range in the 1980s, compared to 61% over 1920-29 for example.

Turning now to medium-run (1-5 years) effects of bank failures on credit markets and aggregate investments, consider the evidence summarized in Calomiris [1993a] for the Great Depression. He argues, as does Bernanke [1983], that the sharp and unanticipated drop of about 40% in nominal prices over 1929-32 in the U.S. caused a "debt deflation" that lowered borrowers' net worths and increased defaults. Both effects, the first through an increase in the lemons premium in credit markets, and the second through banks' lowering their loan-deposit ratios to guard against default or runs, increased the costs of external credit, thus lowering investment and output with some persistence. (U.S. industrial production in real terms declined by 1932 by more than 60 percent relative to the peak of 1929). Moreover, these effects caused bank failures that lowered investment and output even further. Evidence in support of this hypothesis, a modern version of Irving Fisher's classic debt-deflation theory from the 1930's, includes the following. First, the differential between low-(Baa) and high-grade (U.S. government) bond yields increased from less than 200 basis points in 1929 to more than 750 basis points in 1932, the trough of the depression in the U.S., declined to less than 300 basis points by 1934, and was back to 1929 levels by 1937, when U.S. industrial output had also rebounded back to 1929 levels. Surviving banks curtailed their loan to deposit ratios from 0.85 in 1929 to 0.58 in 1933, confirming the debt deflation predictions. The changes in these measures correlated well with the sharp output drop in the U.S. over 1929-32.

However, for Canada which had (and continues to have) a much more concentrated banking system than the U.S., there were far fewer bank failures, and low correlation between its output drop and measures of financial distress, casting doubt on the validity of

the debt deflation theory.[8] Calomiris [1993] argues that this evidence does not disprove the debt-deflation theory, since leverage was much smaller in Canada to start with, e.g., debt service / GNP ratios in the U.S. increased from 9% to 19.8% over 1929-33, versus only from 3.9% to 6.4% in Canada.[9]

While we are skeptical about the medium-run importance of the leverage or debt service/GNP mechanism, we are far from convinced that Canada withstood the deflation period better than the U.S. Notice that (i) the industrial output drop in Canada over 1929-32 was also over 50%, with recovery to 1929 levels only occurring by 1937, and (ii) the share of consumption goods in the drop of production was much greater in the U.S. than in Canada, suggesting severe drops in Canada's level of durable good production and investments; see Romer [1993]. Thus, it is unclear that, within the range of parameters considered, even the largest debt deflation in memory had *very* different output effects, through the cost of capital for investment, in economies differing significantly in their net worth to external financing ratios. For that matter, a country like France, also having a concentrated banking system, did *not* recover its 1929 industrial output level by 1937, and reached its trough only in 1935, compared to 1932 for the U.S.

This is not to deny that unanticipated shocks, particularly large price-level shocks to which nominal debt contracts are not indexed, may cause severe short-term liquidity problems and losses in net worth for commercial borrowers, that in turn may lead to reluctance by banks to lend further in the short run. Central bank intervention to inflate the price level can ease these problems. However, it would be premature to extend this reasoning

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[8] Bank lending was much more important than in the U.S. where the commercial paper market was more important for short-term corporate debt.

[9] Agricultural loans were also sharply higher in the U.S.

to suggest an inherent fragility in banking that warrants an all-embracing safety net. For example, such a safety net may be at odds with prudent risk taking by banks.[10] [11]

III. BANK REGULATION: THE POLICY DEBATE

Federal deposit insurance is said to engender two forms of moral hazard.[12] First, it induces the insured bank to keep a lower level of cash-asset reserves than it would in the absence of deposit insurance, since the deposit insurer is available to absorb liquidity shocks the bank may suffer. Second, it induces the insured bank to invest in riskier assets than it would if it were uninsured. These moral hazards are well known, and there have been numerous suggestions about how to attenuate them, improve intermediation efficiency and limit the deposit-insurance exposure of taxpayers. In this section we review selected proposals made by potentially influential policymakers. The theoretical soundness of these proposals will be examined in the context of the related academic literature in the next section.

The Chicago Fed Letter [July 1990] and the President of the Federal Reserve Bank

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[10] The modelling of financial fragility, as for example in Bernanke and Gertler [1990], amounts to noting that with low endowment and high external borrowing, entrepreneurs will be induced to choose risky projects with lower expected payoffs than alternative riskless ones, that this problem is greater when borrowers' net worth is low, and if project investigation involves a fixed cost then investment may stop if net worth is sufficiently low. Short of such a break down, however, the effect of borrower net worth changes on aggregate investment activity is clearly *ambiguous*.

[11] More recent evidence, such as that of Hoshi, Kashyap and Scharfstein [1990], notes the lesser dependence of investment on internal resources for Japanese firms with a main bank connection. Diamond [1994] shows that this may simply be due to ex ante choices of borrowers, given higher interest and lower default reorganization costs of bank debt.

[12] See Bhattacharya and Thakor [1993]. The seminal work of Merton [1977, 1978] first recognized the isomorphic correspondence between put options and deposit insurance, highlighting the moral hazards created by deposit insurance.

of Richmond, J.A. Broaddus [1994], adequately summarize most of the important issues in the policy debate. Both conclude that fewer restrictions ought to be imposed on banks but that regulatory supervision of banking should be made stricter. The Chicago Fed letter recommends *tough closure policies*, or higher net worth levels at which banks and S & L's are recapitalized, liquidated or merged. It argues that regulatory forbearance that permitted insolvent institutions to continue to operate was mainly responsible for inefficient risk-taking and subsequent taxpayer-financed insurance fund losses in the U.S. in the 1980's. It suggests lowering deposit insurance limits and allowing runs that may be triggered by informed depositors. It is interesting that this market discipline argument does *not* depend on the usual notion that informed depositors may be better informed about banks' assets than regulators, but rather on the supposition that forbearance is less likely with such runs. It argues that enhanced risk-taking opportunities for bank holding companies can only be compatible with such market discipline.

Broaddus [1994] is in agreement. Moreover, he proposes the following additional reforms:

(i) interstate branching to allow greater diversification of regional risks;

(ii) permitting commercial banks to engage in investment banking and securities underwriting, since there is virtually no research to suggest that expanding banking powers this way would create serious conflicts of interest or engender additional risk-taking;

(iii) limiting Federal Reserve Discount Window funding to undercapitalized institutions;

(iv) prescribing a fairly rigid closure policy for the FDIC that limits its discretion in keeping low-net-worth institutions alive;

(v) limiting the scope of the "too big fail" doctrine in banking.

He also strongly believes that scaling back deposit insurance would *not* diminish the ability of the Federal Reserve to stem financial panics since the key deterrent to panics that are unrelated to concerns about the financial health of the banking system *per se* is depositors' belief that the Federal Reserve stands ready and willing to supply liquidity promptly through the discount window and open market operations. In fact, depositor monitoring and the associated threat of runs may well *reduce* risk in banking due to more prudent asset choices by banks.

An even stronger reform proposal was made in 1993 by the *National Commission on Financial Institution* (NCFIRRE), a blue-ribbon commission appointed by Congress to recommend regulatory reform of the depository financial intermediary industry.[13] The principal recommendations of this commission were that separately chartered depository institutions called "monetary service companies" (MSCs) should be the only institutions allowed to offer federally insured deposit accounts. These deposits could be used for transactions purposes and would be completely insured without limit. MSCs would be allowed to invest only in short-term, low-risk debt instruments that are actively traded. MSCs would be subject to federal rules, regulations, and examinations, whereas uninsured banks would have virtually no restrictions imposed on their activities.

The essence of these regulatory proposals appears to be twofold. First, there is a socioeconomic/political benefit to making U.S. banks more profitable. One powerful rationale for this is the evidence in Keeley [1990] that banks with higher Tobin's-q ratios appeared to have taken on less asset risk. Thus, banks with higher future profits and consequently higher charter values pose less asset-substitution moral hazard for the federal

[13] See Greenbaum and Thakor [1995].

deposit insurer. From the regulator's standpoint, one obvious way to increase commercial bank profitability is to permit banks to enter lines of business -- such as investment banking and insurance -- that have been forbidden to them. Second, potentially offsetting this benefit to the deposit insurance fund is the fear that allowing banks to engage in more lines of business would, in principle, expand the scope of the taxpayer-financed safety net. A resolution to this conflict would be to scale back federal deposit insurance and at the same time permit banks wider powers.

Of course, to the extent that *federal* deposit insurance is at the center of the regulatory debate, a natural question to ask is whether private deposit insurance arrangements would suffice. Free-banking advocates, such as Dowd [1994], suggest that there is a rationale for private banking clubs, owing to purposes ranging from (i) serving as a clearinghouse for settling notes and checks among them, (ii) lowering transactions and monitoring costs for interbank borrowing and lending to cope with liquidity shocks, (iii) regulating liquid asset reserves to manage the "externality" of reserves for banks as a whole, (iv) prevent bank runs from becoming panics by engaging in emergency lending *or* by having the club emit a signal that the bank subject to a run is indeed sound. All of these functions, which were often performed in the U.S. free-banking era by clearinghouses or leading banks in major financial centers (such as Suffolk Bank in Boston) require that the club monitor the quality of bank assets, both to ensure their liquidity, and to verify the credit quality of the longer-maturity assets. But individual banks are also each other's *competitors*, and payoff information regarding loans and investments is *proprietary*.[14] Hence, providing such information to competitive banks may lead to high-quality investments being lured away by the competitors.

[14] Models of lending with heterogeneous qualities of borrowers, such as Pagano and Jappelli [1993], often assume that a bank with superior information about its local borrowers earns rents on borrowers with low default risk.

Except for a disinterested central bank, it may be difficult for any private club to commit to keeping such information about asset quality private.

Another important rationale for a governmental role in regulation is, of course, that of large aggregate shocks to asset values to which intermediaries' liability contracts were *not* indexed. Unfortunately, existing models of intermediation neither provide compelling explanations for such non-indexing, nor explain how external information about the quality of an intermediary's portfolio of non-traded investments could deteriorate over time. In other words, an adequate theory of the *dynamics* of intermediation is lacking. As a practical matter though, now that Congress has approved the relaxation of the restrictions on branching and interstate banking in the U.S., the role of aggregate shocks other than nominal (monetary) ones, resulting from technological shifts, business cycles, or shocks in riskier non-bank financial markets, may *not* be all that important in banking, in the sense that large-scale bank failures resulting from such shocks are unlikely.

IV. REFORM PROPOSALS AND THEIR MERITS

The academic literature has examined numerous proposals aimed at ameliorating moral hazards stemming from federal deposit insurance. We consider some of these in this section to provide a foundation with which to assess the policy recommendations of the previous section.

- **Cash-Asset Reserve Requirements:** The point here is that deposit insurance creates incentives for banks to keep lower liquidity levels to cope with deposit withdrawals than they otherwise would, so that legally mandating a minimum level of cash-asset reserves may be a way to deal with this moral hazard.

- **Risk-Sensitive Capital Requirements and Deposit Insurance Premia:** The thrust of this strand of the literature is that by suitably linking capital requirements and deposit insurance premia to bank risk, banks' appetite for risk may be curbed.

- **Partial Deposit Insurance:** If federal deposit insurance were scaled back, uninsured depositors would have a bigger role to play. Would the added market discipline ameliorate deposit-insurance-related moral hazards?

- **Bank Closure Policy:** There are many that believe that delayed closure of troubled banks and thrifts has been a recipe for disaster for the deposit insurance fund. Therefore, limiting regulatory forbearance on the closure issue would limit risk.

- **Portfolio Restrictions and Universal Banking:** Restricting banks' investment opportunities helps to bound their feasible opportunity set and limit taxpayer exposure.

A. Interbank Borrowing-Lending and Reserve Requirements

Bhattacharya and Gale [1987] examine the role of interbank borrowing-lending to cope with bank-specific liquidity shocks.[15] The central feature of the model is a theoretical justification of the *reserve externality argument* of more institutionally oriented traditional banking theorists, such as Dowd [1994], Goodhart [1991], and others. They show that with unconstrained Walrasian access to an interbank borrowing-lending market, each bank underinvests in liquid assets relative to first best. There are two solutions to this problem: if the liquidity of reserve assets is externally verifiable, the optimal level of reserve holdings can simply be mandated; if not, then constraining the amount and terms of interbank borrowing-lending will partially ameliorate the underinvestment problem.[16] This is

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[15] In that model, the effective liquidation value of a bank's long term investments is *not* 1 per unit as in Diamond and Dybvig [1993] but R/I, where I is the equilibrium interest rate.

[16] The caveat is that mandated reserve requirements, in ratio form relative to total deposits, may not be available to meet the liquidity needs because a deposit withdrawal extinguishes reserves, necessitating a new deposit inflow to replace the lost reserves needed to support the remaining old deposits as well as provide the reserves needed to support the new deposits. This issue does not arise in Bhattacharya and Gale [1987] because it is a static model. However, the essence of their argument--that reserve requirements in conjunction with interbank reserves trading could help cushion bank-specific liquidity shocks--could be sustained in a dynamic framework if regulators provided banks sufficient "breathing room" to cope with liquidity shocks.

reminiscent of the reserve externality argument of more institutionally oriented traditional banking theories, such as those found in Dowd [1994] and Goodhart [1991].

Another type of liquidity shock is that emphasized by Chari and Jagannathan [1988]. Because of the possibility of adverse private information about a bank's earnings, even large early deposit withdrawals based solely on the liquidity needs of depositors may lead uninformed depositors to erroneously infer that something is wrong with the bank, and cause a run.

Banking clubs, or clearinghouses, or a central bank, could advance funds to a bank subject to a run *after* verifying that its underlying asset returns prospects do not warrant a run. Such a step would make it unnecessary for the bank, to liquidate its investments early at a loss.[17] On the other hand, if investigation by a clearinghouse/banking authorities reveals that the bank is insolvent--the expected discounted value of future returns is lower than the level of current withdrawal rights of its deposit contracts--then the bank would be "resolved". Such a step would involve (i) placing it in receivership so that excessively risky investment (given its low net worth) in bank equityholders' interest is avoided, and (ii) calculating the amounts that can be paid to depositors given the realizable value of assets, with resale or a merger with another bank.

B. Risk-Based Capital Requirements and Deposit Insurance Premia

The issues of risk-based capital requirements and risk-based deposit insurance premia are formally examined by Chan, Greenbaum and Thakor [1992]. They show that incentive compatibility is sacrificed if the regulator wishes to have a *fairly-priced* (actuarially neutral)

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[17] Such conclusions are a bit heroic because we do *not* have an adequate theory of the functioning of secondary markets for a bank's asset portfolio.

deposit insurance pricing schedule for a competitive banking system. In an informationally rich environment, with either private information and/or moral hazard, it is therefore impossible to implement a fairly-priced and completely risk-sensitive deposit insurance pricing scheme unless banks are permitted access to rents, either through explicit regulatory subsidies or through restricted entry into banking. The authors note the irony in the decision of U.S. bank regulators to move to risk-sensitive schedules for capital requirements and deposit insurance premia at a time when entry restrictions have been substantially eased and regulatory subsidies for banks have been lowered. Berlin, Saunders and Udell [1991] note, however, that the fair pricing of federal deposit insurance may be a goal that public regulators could choose to sacrifice since their paramount concern is with the *safety* of the banking system.[18] Obviously, prudently managed (relatively safe) banks may feel differently.

In a somewhat different setting, Friexas and Gabillon [1994] reach a conclusion qualitatively similar to that in Chan, Greenbaum and Thakor [1992]. In particular, they show that when banks are privately informed about future returns, the optimal regulatory arrangement uses a combination of capital requirements and deposit insurance premia such that banks earn informational rents that are inversely related to their efficiency, and these rents are reflected in the deposit insurance premium schedule.[19]

To summarize, the theories developed thus far suggest an important role for linking

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[18] If contagion effects and credit market breakdowns are important, then banking system safety is a *public good*. Private incentives to preserve this safety may therefore be inadequate.

[19] That is, deposit insurance is not fairly priced. A related paper is Flannery [1991] which shows that when the deposit insurer measures bank risk with error and asset-substitution moral hazard is not an issue, optimal regulation entails a combination of risk-based deposit insurance premia and risk-based capital requirements.

both capital requirements and deposit insurance premia to bank risk; this may resolve private information, moral hazard and private information problems. While the problem of being unable to fairly price deposit insurance remains unresolved, these theories provide some support for the Basle risk-based capital guidelines and the recent move by the FDIC in the U.S. to risk-sensitive deposit insurance premia.

C. Partial Deposit Insurance and Depositor Discipline

The advantage of complete deposit insurance is that runs are eliminated. The disadvantage is that now it is the responsibility of the insuring agency and regulatory bodies to monitor the insured bank's assets, estimate their value relative to the par value of deposits, and to ensure that the bank is adequately capitalized.[20] The purpose of such monitoring is twofold: to minimize losses to the deposit insurance fund, and to prevent low-NPV and excessively risky further investments being undertaken by the bank. In this subsection, we briefly review papers by Peters [1994] and Emmons [1992] that analyze some of these issues.

In their review paper, Berlin, Saunders and Udell [1991] observe that a key issue in deposit insurance reform is the optimal mix of private and public information production and monitoring of banks. Peters [1994] has formalized this notion in a noisy rational expectations model of depositor behavior. He shows that, within the class of demand deposit contracts, the sequentially-service-constrained, *partially* insured demand deposit contract is optimal.

Peters [1994] assumes that the bank has an ex ante choice between two different risky investments, both with lower outcome O and upper outcomes H_1 and H_2, with control rents

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[20] U.S. regulatory authority is fragmented. The Federal Reserve monitors state chartered institutions, the Comptroller of Currency (and the FDIC) monitor national banks, and the FDIC monitors insured state-chartered banks that are *not* members of the Federal Reserve.

C_1 and C_2 for management. The riskier investment has a higher probability of the low outcome. Early liquidation of either investment yields a payoff of 1/2 per unit of investment. Depositors can learn the realization of the investment returns early (while liquidation is still possible at payoff 1/2) by incurring a cost K. In addition, there is a noisy and random level Z of early liquidity-based withdrawals, so that if fraction α of depositors are informed, liquidation demand is $(\alpha + Z)$ if the returns information is adverse, and Z otherwise. Moreover, the uninformed depositors condition their expectations about the bank's asset returns on the size of the withdrawal queue, and choose to withdraw also if their inference is adverse enough. A fraction Φ of deposits is insured. Deposit contracts are subject to a sequential service constraint (SSC), so that informed agents who arrive early manage to obtain their withdrawals even though uninformed agents might not be able to do so. This is needed for the same reasons as in the Calomiris and Kahn [1991] model for rationalizing the SSC, namely to overcome free-rider problems related to the information gathering cost K.

The threat of bank runs, disciplines bank management's asset choice because of *the fact that these runs are sometimes interim inefficient*. In other words, uninformed depositors run when they see a large liquidity-based withdrawal, even though the informed do not have adverse knowledge, so that the expected discounted value of the bank's investments is strictly higher than the liquidation value 1/2.[21] Assuming that the riskier investment strategy by the bank leads to higher control rents for management but lower NPV, Peters [1994] shows the following. There exists an *interior optimal level the fraction of deposits insured* such that it induces a rational expectations equilibrium with the minimal endogenous proportion of depositors becoming informed so as to resolve the asset substitution moral hazard problem.

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[21] Without a run, new deposits arrive so that the scale of the bank is unaffected by pure liquidity withdrawals.

Without any deposit insurance, there is excessive information production by depositors and ex-post inefficient bank runs may arise too often, more than that required to discipline bank management's choice of assets. On the other hand, complete deposit insurance destroys all potentially beneficial information production and monitoring by depositors.

In an ambitious paper, Emmons [1992] attempts to analyze the roles of the *deposit insurer and a lender of last resort* simultaneously, which is desirable given the *ad hoc* assumptions about interim liquidation values made in much of the literature. In this paper, deposit insurance is partial, and the deposit contract is demandable debt with the SSC to sustain depositors' information production incentives. In the event of a bank run, the lender of last resort lends to the bank and helps prevent liquidation of good investments (with an expected payoff greater than the early withdrawal claim), *but* it imposes a cost on bank management by setting the "bailout" loan repayment terms to extract *all* future surplus from the bank.[22] However, to sustain depositors' incentives to monitor and run, the interim lending by the last-resort lender must be randomized, since the benefit from the SSC in inducing monitoring would be lost otherwise.

D. Bank Closure Policy

There have been recent analyses of the incentives of regulators to close banks in a fashion that results in socially optimal portfolio choices by bank management. The advantage of such centralized monitoring and control, as compared to the market discipline achieved through bank runs, could lie in (i) non-duplication of monitoring costs, and (ii) lowering the transactions costs of managing ex post liquidity shocks. The disadvantage might arise from closure decisions that are too lax to discipline the ex ante asset choices of bank management.

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[22] Presumably, it would be much too costly, for other competing lenders to acquire the information needed to provide the same loan.

An important paper on this subject is Campbell, Chan, and Marino [1992] which analyzes regulatory incentives to expend monitoring effort, given regulatory effort aversion. This paper shows that regulatory monitoring and capital requirements are partial substitutes in curbing bank asset risk. Thus, the presence of regulatory effort-aversion moral hazard forces a greater reliance on capital requirements than in the first best.

A subsequent paper by Boot and Thakor [1993] analyzes a model in which regulators' payoffs are based on a reputation for monitoring ability. The underlying problem is the usual one of choice of risky investments by levered bank insiders, but now in *two* separate periods. All deposits are insured. The regulator can either (i) monitor the bank's initial risk choice and ask for a change if the choice is suboptimal, and/or (ii) choose the level of bank capital (realized return on assets minus deposit payoffs) at which to close the bank. Regarding the latter choice, the ex post socially efficient criterion is to close the bank when its second-period capital is low enough that it would choose a negative NPV risky investment in that period. However, beyond this social objective, regulators also care about their reputation for monitoring the first-period risk choice by the bank directly. Boot and Thakor show that, in the reputational sequential equilibrium of the game between the bank and regulator (with his reputational payoffs from a third agent), the regulator's optimal bank closure policy is more lax than the socially optimal policy, which in turn also increases the first-period risk choice by the bank.

The *social efficiency* of closure is analyzed in Acharya and Dreyfus [1989] and Fries, Mella-Barral and Perraudin [1994]. Acharya and Dreyfus derive an optimal closure rule and fair premium rate for bank operating in a competitive environment. While Acharya and Dreyfus focus exclusively on the optimal closure rule that *minimizes* the costs to the government of the guarantor, Fries et al consider a richer environment characterized by

recapitalization possibilities and bankruptcy costs. Their research suggests that "forbearance" might sometimes be optimal, while in Acharya and Dreyfus this would always be suboptimal.

Another noteworthy paper on bank closure policies is Mailath and Mester [1994]. They assume that there is a social opportunity cost of closing a bank, in the form of lost intermediation services for a period, and this cost must be traded off against the influence of closure policies on bank risk taking. There is the usual divergence between the social optimality criterion and that which maximizes the wealth of the levered bank's shareholders when it comes to choosing between a risky and a riskless project. Mailath and Mester note that (i) closure decisions will depend on the regulator's objective, whether it cares about payoffs to all agents or only about the cost of its insurance payments to depositors, and (ii) the subgame-perfect closure decision lacks the simple structure of closing all insolvent banks or letting all solvent banks continue. It would be interesting to compare the welfare properties of the equilibria of their model with one based on runs by uninsured depositors.

More research is needed on regulatory closure decisions versus depositor-induced runs as disciplinary devices for bank management, the imperfections of secondary markets for liquidation of bank loan/asset portfolios, and the role of private interim liquidity provision versus last-resort lending under informational asymmetries. However, we believe that the recent history of bank and thrift failures in the U.S. and elsewhere provides powerful reasons to believe that the time has come to seriously consider an expanded role for monitoring by uninsured depositors.

E. The Role of Bank Charter Value

Higher bank charter values can deter risk taking. Many authors have viewed this as a strategic regulatory instrument and examined its interaction with other instruments.

Much of the results in this literature are qualitative and not precise enough to suggest

quantitative magnitudes for optimal controls. Moreover, they are partial equilibrium in nature. In particular, the endogenization of a credit-cum-deposit market equilibrium among banks, which leads to the determination of profit levels and risk-taking choices by them, is often left incomplete. Complementary literature, which attempts to endogenize these "industrial organization aspects" of banking, includes the work of Matutues and Vives [1994a,b], Genotte [1992], and others.

In Boot and Greenbaum [1993], banks differ in their monitoring ability; cost functions for monitoring at intensity m are V(m) or zero for the two types of banks. Entrepreneurs with loans from banks choose among projects with a two-state return distribution where the bank's monitoring intensity affects the probability distribution of its payoffs. Since the banks loan contract with the entrepreneur has a concave payoff function, banks' expected profits are decreasing in the riskiness of projects i.e., the (probability of reaching the low state). However, banks can control this risk by expending greater monitoring effort.[23] It is assumed that if loans payoffs are low (zero), despite monitoring, then the bank is closed and future rents are lost. In addition to improving these expected future rents, bank monitoring improves its reputation for monitoring with uninsured depositors, which serves to lower the bank's cost of funding in the subsequent period. An increase in either the expected rent (expected payoff on banks' loans less the cost of deposits) or the funding-related reputational benefit increases banks' monitoring efforts. However, unless regulators make an analogous calculation in deciding on deposit insurance premia, the reputational benefit is lost with insured deposits, which is undesirable especially when enhanced competition decreases future

[23] Boot and Greenbaum [1993] argue that their set up, rather than one of choice of asset riskiness by the bank itself, is the appropriate model, since the choice of riskiness of bank loans could be inferred by regulators from the promised interest rate that banks charge on such loans.

rents.[24]

Suares [1994] considers the bank's choice of asset risk from a set with mean returns equalling the riskless rate. The source of the bank's rents is its monopoly power in the deposit market.[25] Assets and deposits are both short-term, with the former having i.i.d. returns over time. The bank is closed as soon as its current period return on assets is lower than the promised (below riskless rate) gross return on deposits; all future rents to its charter (monopoly power) are thus lost. The bank's optimal choice is thus "bang bang"--minimal risk if charter value is high enough, and maximal risk otherwise. Initial capital requirements improve this tradeoff. The minimal charter value that results in a choice of the minimal risk asset by the bank is decreasing in the level (proportionality factor) of the capital requirement. Suares briefly considers the issue of recapitalization[26] by the bank when current cash flows

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[24] Bensaid, Pages and Rochet [1993] examine some issues similar to those in Boot and Greenbaum [1993]. The bank's payoff is affected both by its monitoring effort (unobservable to the regulator) and its privately-known investment quality. They examine a risk averse bank's optimal choices of capital, scale, reserves, and monitoring effort, given the regulator's optimal contract for the bank. They interpret the optimal contract they derive as including a capital requirement.

[25] These presumably result from entry restrictions that impede competition for deposits.

[26] Much of the bank regulation literature mentions but only cursorily analyzes recapitalization. It would be useful to extend this, using approaches analogous to Leland [1993]. In that model he considers the valuation of perpetual coupon debt on a firm with lognormally distributed valuations, when coupon payments must be made by external equity issues (rather than from asset earnings), and in addition there is a mandated floor on firm value such that no external funding of creditors' claims is allowed (the firm is held bankrupt) when firm value hits this floor. Letting t be the tax rate on debt interest deductions (t could be any other proportional advantage to debt), the equity value is then given by

$$E(V) = V - (1-t)\frac{c}{r} + \frac{[(1-t)\frac{c}{r} - F]}{(V/F)^x}$$

where V = asset value, c = coupon rate on debt, t = riskless rate of interest, F is the floor on firm value that is *either* exogenous or endogenously chosen by

are lower than depositors' payments, and shows that this may lead the bank to always prefer the riskiest assets.

To summarize, several themes have emerged in the "bank charter value" literature (see also Dewatripont and Tirole [1993]), but we have not yet reached agreement on methodological premises and policy conclusions. We know that rents are important to generate risk- control or monitoring incentives, but what is the best means of generating such rents (entry restrictions, expanded banking powers, deposit interest rate controls)? Capital requirements may also improve risk-control incentives, but not necessarily; on the other hand, they may not improve bankers' monitoring incentives if "outside" equity is involved.[27] Tough closure rules help control risk, but they may not be consistent with

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equityholders, and $x = 2r/\sigma^2$, where σ^2 is the variability of returns on assets. It is clear that, if we wish to have E(V) unresponsive to σ^2 *per se*, so that value-maximizing asset choices are made by equityholders/mangers, we should set F = (1-t)(c/r), or

$$F^* < F = (1-t)\frac{c}{r} < \frac{c}{r}$$

where F^* is the shareholders' optimal "abandonment point" (refusal to issue more equity),

$$F^* = \frac{(1-t)c}{(r + .5\sigma^2)}$$

Thus the optimal regulation entails a closure rule (given a rent coefficient t or debt that is lost given closure) that neither makes the debt entirely safe, which would generate risk-aversion for equityholders, nor takes it to the point of laissez-faire with respect to voluntary capitalization by (bank) shareholders, which would make them risk-loving. Suitable extensions of this model to banking should be of interest, e.g., the assumption of coupon payout through equity issues only might be reconsidered.

[27] Besanko and Kanatas [1994] show that when the distinction between outside and inside equity is explicitly recognized, increasing capital requirements may reduce the bank's incentive to monitor its borrowers and hence increase risk. Genotte and Pyle

banks' recapitalization incentives. It would be interesting to consider the interaction of these issues in an empirically testable model.

F. Portfolio Restrictions and Universal Banking

Recent literature has also begun to focus on issues related to *banking scope*, i.e., the degree to which banks can (or choose) to engage in different activities. Banking scope clarifies the distinction between *universal banking* and *functionally separated* banking. In a universal banking system, banks perform both investment and commercial banking functions, while in a functionally separated system, these functions are allocated to different institutions.[28] Most European systems -- particularly those in continental Europe -- can be characterized as universal. The U.S. system is best described as functionally separated.[29]

There is an ongoing debate about the desirability of universal banking, particularly in the U.S.. A considerable research effort is now directed at this issue, but the literature

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[1991] also show that there are circumstances in which capital controls do not reduce risk.

[28] We choose not to focus on the issue of equity holdings. While some have emphasized this issue, particularly in the context of German universal banks, it is unclear whether *any* universal bank exists that has voluntarily chosen *to fund* corporations by buying equity. In most universal-banking countries we do not observe pervasive equity holdings at all, and the holdings that are observed are *strategically* motivated. A rationale for the absence of joint equity and debt funding by banks is provided by Dewatripont and Tirole [1993] and Gorton and Kahn [1993]; they show that combined holdings of equity and debt may undermine the disciplinary role of debt and exacerbate problems arising from the softness of bank's budget constraint. A related explanation can be found in banks' comparative advantages in delegated monitoring (see, for example, Diamond [1984]), and in the ability of debt contracts to minimize monitoring costs (see Townsend [1979] and Gale and Hellwig [1985]).

[29] In the U.S., banks representatives being on boards of directors of non-financial firms was forbidden by the Clayton Act of 1914, and underwriting and other investment banking activities were curtailed by the Glass-Steagall Act of 1933. Banks elsewhere, such as in Germany, are often thought of as "universal banks" with greater flexibility in these respects; see below.

is still in its infancy. In the following discussion we review the arguments for and against universal banking.

The principal argument in favor of universal banking appears to be that (artificial) limitations on bank activities constrain potentially optimal configurations that would arise endogenously in a universal banking system. This argument is tantamount to asserting that 'the market' is best equipped to determine the optimal configuration of banks. More specifically, this viewpoint assumes that there are scope economies that are lost by separating commercial and investment banking. Separation impairs the cross-sectional reusability of information between lending and underwriting activities.[30] The information gathered by banks about their borrowers may lead to less adverse selection and hence lower underwriting spreads in issuing securities in the capital market. Empirical evidence in support of this is provided by Calomiris [1993b] who shows that, prior to 1914, small German firms were able to issue equity for less than the cost American corporations paid to issue bonds, even though German banking was no less concentrated. Furthermore, separating lending and securities activities may undermine a bank's incentive to produce information, and would consequently elevate borrowers funding costs. Functionally-separated banking would also lead to lower *intertemporal* reusability of information, which also results in lower relationship-specific investments. In particular, functionally-separated banking does not allow reusability information when a borrower "matures" from dependence on bank loans to financial market funding (see Rajan [1993]).[31]

While better cross-sectional *and* intertemporal reusability of information represents

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[30] See Chan, Greenbaum and Thakor [1986] for a discussion of information reusability.

[31] However, universal banks may even *sub-optimally* elevate the benefits of information-reusability by promoting bank lending *at the expense* of financial market funding (see Boot and Thakor [1995] as discussed below).

an advantage of universal banking, there are also arguments against universal banking, three of which are potentially compelling. First, there could be serious conflicts of interest in permitting banks to underwrite their borrowers' capital market issues. Second, universal banking may adversely affect the development of the capital market. And third, universal banking is likely to create even larger banks that could escalate taxpayer exposure under the "Too Big to Fail" (TBTF) doctrine.

The first possibility has been theoretically modeled by Kanatas and Qi [1994] and Rajan [1993]. The bank may, for example, abuse its deposit insurance umbrella by extending a loan to an uncreditworthy borrower who might otherwise default on a capital market issue earlier underwritten by the bank. Or the bank may misrepresent the financial condition of a borrower whose capital market issue it is underwriting for the purpose of using the proceeds to pay off the bank's loan. However, the empirical evidence in Kroszner and Rajan [1994] suggests that market discipline is likely to be quite effective in preventing abuses. In particular, they found that the default risk in bonds underwritten by banks with securities affiliates was lower than that in bonds underwritten by other banks during the 1920s (prior to the passage of the Glass-Steagall Act).

As for the second argument, Boot and Thakor [1995] develop a model in which the post-lending monitoring incentives of commercial banks and the financial innovation incentives of investment banks are endogenized. They show that a universal bank, which includes as its subsidiaries a commercial and an investment bank, stochastically innovates less than a stand-alone investment bank. This relative retardation of financial innovation leads to a less-developed capital market in a universal banking system than with functionally separated banking system. On the other hand, a universal banking system is characterized by a better attenuation of borrower-specific asset-substitution moral hazards than a

functionally-separated banking system. Thus, the theory points to important tradeoffs in financial system design. Moreover, it provides a perspective on why U.S. capital markets are better developed than those elsewhere.[32]

Finally, the TBTF argument can be understood along the lines of the Boot and Thakor [1993] model discussed earlier. If regulatory reputational concerns result in delayed closures of *commercial* banks with obvious consequences for taxpayer liability, this problem is likely to be exacerbated by two considerations related to *universal* banking. First, the regulator's task of monitoring the insured commercial bank embedded within the universal bank is likely to be more complex than monitoring a stand-alone commercial bank, particularly when issues related to ensuring the integrity of "firewalls" are acknowledged. Second, the sheer size of large universal banks is likely to lead to greater political benefits from a liberal application of the TBTF doctrine, including delaying closures relative to the social optimum. As Boot and Thakor [1993] recognize, this too elevates taxpayers' contingent liability.

V. CONCLUSION

What does all this tell us about how a banking system should be designed and how it should be regulated? This question is not easy to answer since we lack a sufficiently rich understanding of the relative efficiencies of banks and capital markets in processing and aggregating information; see Allen [1993], Bhattacharya and Chiesa [1995], and Boot and Thakor [1995] for initial attempts. However, the literature we have reviewed thus far offers the following conclusions (some tentative):

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[32] Boot and Thakor [1995] show that industry concentration is an important variable in determining the extent to which universal banking impinges on financial innovation. In particular, it is the widely-observed concentration in universal banking that may be responsible for the deleterious effect of universal banking on financial innovation.

(1) If sequentially-service-constrained demandable debt is the instrument by which commercial banks raise funds, then productively disruptive bank runs and panics can arise as Nash equilibrium phenomena, and federal deposit insurance is an important ingredient in coping with these phenomena.

(2) Federal deposit insurance distorts the behavior of insured institutions and engenders forms of moral hazard that elevate bank risk and taxpayer liability.

(3) Risk-sensitive capital requirements and risk-calibrated deposit insurance premia are potentially useful regulatory tools in coping with moral hazard. However, risk measurement and private information problems offer difficult challenges. Consequently, fair pricing of deposit insurance may be elusive unless banks earn rents.

(4) Improving bank closure policy and bringing market discipline to bear by having a larger fraction of deposits left uninsured are potentially effective mechanisms for attenuating deposit-insurance-related moral hazard.

(5) Increasing banks' charter values can also help to dampen the risk-taking propensities of insured banks.

(6) Imposing portfolio restrictions helps to bound the feasible opportunity sets of banks and therefore limits the risky investments that they can make. However, these restrictions may do more harm than good because they reduce profit opportunities for banks and diminish charter values.

(7) Permitting universal banking may improve banks' charter values as well as their ability to cope with borrower moral hazard because it enhances the cross-sectional and intertemporal reusability of information and thus incents banks to make relationship-specific investments. Moreover, while potential conflicts

of interest in universal banking have been discussed a lot, their empirical relevance is suspect. However, the principal drawbacks of universal banking appear to be that it could undermine financial innovation and the development of financial markets, and lead to non-competitive outcomes. On the regulatory front universal banking could invite a more liberal application of the TBTF doctrine, and could therefore increase the liability of federal deposit insurance.

In light of these findings, the NCFIRRE proposal discussed earlier appears to be an attractive alternative to the present system. By stripping away the insured-deposits portion of a bank, *chartering it separately* as a MSC and restricting it to invest in very low-risk assets, we eliminate much of the concern with porous firewalls and expanded taxpayer liability with universal banking. Moreover, by giving the uninsured bank complete freedom in its asset portfolio choices, we shift the function of monitoring and disciplining banks from the regulator to the market, and at the same time improve banks' profit potential. Since these would be independent insured institutions, the TBTF issue for them would be no different from the TBTF issue for General Electric or IBM. These arguments are developed more fully in Boot and Greenbaum [1993].

Recent papers by Peters and Thakor [1995] and Craine [1995] further highlight the incompatibility of insured deposits and bank-asset-choice flexibility. Peters and Thakor start out by assuming that banks provide liquidity services to depositors and also monitor their borrowers' asset choices. They model two forms of moral hazard, one involving the bank choosing riskier borrowers than depositors want, and the other involving borrowers choosing riskier investments than the bank would like. They show that there does not exist a simple resolution to *both* forms of moral hazard. The reason is that monitoring by uninsured

depositors disciplines the bank's choice of risk by creating the possibility of runs, but runs force the bank to liquidate loans before the impact of loan monitoring can be realized. Thus, a higher possibility of runs leads to the bank investing less in monitoring its borrowers' asset choices. The authors conclude that an efficient resolution would be to *separate* the monitoring function of the bank from its liquidity provision function. Thus, we would have one bank creating net liquidity for insured depositors but investing in relatively safe assets that require no bank monitoring, and another bank that raises uninsured deposits to finance riskier assets that require bank monitoring.

Craine [1995] starts with a model in which deposit insurance is an assumed necessity, and goes on to show that it is inefficient to permit banks to finance information-sensitive assets -- those for which the bank's information is proprietary -- with insured transactions deposits, and mispriced deposit insurance leads to an inequitable wealth transfer. Fairly pricing deposit insurance eliminates the wealth transfer, but it does not generate the most efficient allocation. An efficient equilibrium can only be attained with a charter policy that separates the market for insured transactions deposits from private-information financial intermediation.

Much remains to be done. The financial innovation considerations in Boot and Thakor [1995] highlight the important interaction between banking structure and financial markets. Incorporating that interaction into a model in which the need for insured deposits as well as that for bank regulation arise endogenously is likely to require a full-blown analysis of financial system architecture. Conclusive policy prescriptions are probably out of reach until we have such an analysis.

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