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ABSTRACT

Public Disclosure and Bank Failures*

This paper analyses the impact of public disclosure of banks' risk exposure on banks' risk taking incentives and its implications in terms of soundness of the banking system. We find that, when banks have a complete control over the volatility of their loan portfolio, public disclosure reduces the probability of banking crises. When asset risk is driven largely by exogenous factors beyond the control of bank managers, however, information disclosure may increase banking sector fragility, as the potential gains from a safer choice of assets is offset by the negative feed-back, arising from a positive correlation between asset risk and the deposit rate demanded by informed depositors.

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NON-TECHNICAL SUMMARY

The argument that, in the absence of an explicit or implicit deposit insurance scheme, public disclosure of information about banks' risk exposure may induce depositors to monitor banks' performances, thus reducing risk taking incentives in credit markets, has received renewed attention lately. Following the leading example of New Zealand, where bank surveillance by the government has been replaced by full information disclosure and a heavier reliance on market discipline exerted by informed depositors, many other countries are in the process of implementing mechanisms of information dissemination (for example, through the creation of credit rating agencies and the mandatory issue of subordinated debt) that allows the market to assess and price banks' risk. Whereas full reliance on these type of mechanisms is still regarded as a complement rather than a substitute for bank supervision, bank supervisors' views have been recently moving towards a greater emphasis on market discipline and public disclosure.

Intuitively appealing as this argument may be, however, one has to bear in mind that the disciplining effect of information disclosure is limited to the fraction of portfolio risk that the bank can actually assess and manage. Indeed, even for a large diversified bank, the risk component beyond its control is likely to be substantial. Under such circumstances, in the presence of idiosyncratic shocks that alter relative risk levels, public disclosure may induce massive runs from one bank to the other, introducing a negative feed-back, as the cost of new funding increases for banks in distress. Likewise, information transparency may render the banking system more sensitive to systemic shocks, as banks' fragility is amplified by depositors, who demand a higher deposit rate to compensate for a higher probability of default.

Taking all the above into account, in order to assess the convenience and the extent to which reliance on information disclosure may limit risk taking behaviour and the vulnerability of the banking sector, it is necessary to analyse matters carefully, such as the conditions under which bank information is disclosed to the public, what information is available for disclosure, who are the recipients of this information and the form in which the information is disseminated. As a first step in this direction, this paper focuses on the trade-off between a safer behaviour on the part of banks, as a result of the incentives created by informed depositors that demand deposit rates commensurate to the bank's risk exposure, and the increased vulnerability of the banking sector arising from the sensitivity of deposit rates to shocks that

alter credit risk levels. The paper makes use of a simple model in which a monopolistic bank receives funds from uninsured depositors and invests them in risky entrepreneurial projects. Within this framework, we examine two polar scenarios: in the first one, the riskiness of the bank's portfolio is chosen by the bank; in the second, risk levels are given exogenously. For each of these two scenarios, we discuss the case in which the bank's risk exposure is common knowledge (disclosure), and the case in which it is the bank's private information (non-disclosure). Finally, we compute and compare the probability of systemic banking crises under disclosure and non-disclosure, under the two scenarios.

Our main finding is the following. When the riskiness of the bank's loan portfolio is chosen by the bank, disclosure of information reduces risk taking incentives and thus the probability of bank failures. Therefore, the initial intuition is correct, as long as the bank is able to respond to depositors' demands by lowering its risk exposure. When risk is given exogenously, however, disclosing the bank's portfolio information increases the probability of bank failure in cases in which the risk level of the domestic banking system fluctuates within a wide range. This is because, under disclosure, deposit rates react to changes in risk levels, and the negative impact on the probability of failure arising from higher deposit rates in high risk states of nature dominates the positive impact from lower rates in low risk states. Non-disclosure, in this context, has the same effect as an insurance scheme, through which banks pay a premium during risky states to avoid higher funding costs in safe states. The result suggests that in developing economies, where wide exogenous fluctuations and inadequate hedging instruments restrict the scope for reducing lending risk, full disclosure of information may indeed accentuate the fragility of the banking sector. Under such circumstances, a more suitable way of insuring banks against negative shocks needs to be found, to secure the benefits of public disclosure, while avoiding its pitfalls.

1. Introduction

The aim of this paper is to examine the impact of public disclosure of information about banks' risk exposure on the probability of bank failures. Although recent literature has addressed the problem of information exchange among banks[1], to our knowledge no attempt has yet been made to rigorously analyze the consequences of public disclosure on bank soundness. This paper is intended as a first step to fill such a gap.

The idea that, in the absence of an explicit or implicit deposit insurance scheme (DIS), public disclosure of information about banks' balance sheets may induce depositors to monitor banks' performances, and thus reduce risk taking incentives in credit markets, has been receiving renewed attention lately.[2] As a leading example, the Reserve Bank of New Zealand recently stopped conducting on-site examinations of banks while, at the same time, it introduced the requirement of quarterly disclosure statements with detailed information about asset quality, provisioning, bank's market risk and exposures, etc. Although the New Zealand's approach is often regarded by central bankers, and specialists in general, as too radical[3], it is undeniable that there is a consensus among supervisory authorities about the importance of enhancing the dissemination of financial information[4].

Intuitively, one would expect that informed investors would exert a tighter control on commercial banks, penalizing risk taking behaviors by demanding returns on deposits commensurate to the bank's risk exposure. The impact of information disclosure would then depend on the existence of an uninsured fraction of deposits, and therefore would be sizeable when the DIS is limited to small sums.

[1] See, e.g., Pagano and Jappelli (1993) and Padilla and Pagano (1996).

[2] A notorious example of this view can be found in the new "free banking" literature that advocates full disclosure, elimination of bank regulations and deposit insurance schemes, and reliance on creditors' monitoring of banks. See, e.g., Dowd (1996).

[3] Morover, many argue that since five of the seven New Zealand largest banks are foreign owned, the country is free-riding on banking supervision. For a discussion of the New Zealand case, see "More work for the invisible hand", *Euromoney,* August 1995, pp. 81-84.

[4] The current wisdom is well summarized by the Chairman of the Basle Committee of Banking Supervisors, who recently stated that: "In the past, bank supervisors did not place a great deal of emphasis on the issue of transparency and disclosure. This attitude has changed. We do not share the extreme view that a fully-informed market can provide discipline to the point of making supervision unnecessary, but we do think that market-imposed discipline is desirable and requires adequate disclosure", see BIS (1996).

However, this disciplining effect is limited to the fraction of portfolio risk that the bank can assess and manage. Even for large diversified banks, the risk component beyond their control is substantial, particularly in volatile economies or when sophisticated financial instruments are involved. Under such circumstances, public disclosure may induce massive runs from one bank to the other, as idiosyncratic factors alter relative risk levels, thus inducing a negative feed-back as the cost of new funding increases for banks in distress. Likewise, information transparency may render the banking system more sensitive to systemic shocks, with important economic consequences, e.g., an increase in the cyclical variability of interest rates and credit supply.

Taking all the above into account, should bank information be disclosed to the public and, if so, to what extent, how and to whom? In order to start answering these questions, we develop a model in which a monopolistic bank receives funds from depositors and invests them in risky entrepreneurial projects. Within this framework, we examine two polar cases: in the first one, the riskiness of the bank's portfolio is chosen by the bank, in the second one, risk is chosen by nature. In both scenarios, we discuss the case in which the bank's risk exposure is common knowledge (disclosure), and the case in which it is the bank's private information (non disclosure). Finally, we compute and compare the probability of bank failure under the two regimes.

Our main finding is the following. When the riskiness of the bank's loan portfolio is chosen by the bank, disclosure of information reduces risk taking incentives and thus the probability of bank failures. However, when risk is chosen by nature, disclosing the bank's portfolio information increases the probability of bank failure in cases in which the risk level of the domestic banking system fluctuates within a wide range. This is due to the fact that, under disclosure, deposit rates react to changes in risk levels. In particular, for wide fluctuations, the negative feed-back on the probability of bank failures arising from higher deposit rates in high risk states of nature dominates the positive feed-back from lower rates in low risk states. Under such circumstances, it is optimal for the bank to distribute the cost of risk evenly across periods, but such an arrangement is time inconsistent under disclosure.

Our work is related to Matutes and Vives (1995) who study the link between competition for deposits and risk taking in the banking sector, considering both the case in which banks' portfolio decisions are known by depositors (the case of disclosure, in our terminology) and the case in which they are not (non disclosure). However, since they do not consider situations in which risk is exogenous, they disregard the possible trade-off of information disclosure. Moreover, since they abstract from failure costs born by banks, they conclude that when the banks' risk choice is observable, any asset risk choice is compatible with equilibrium, while when the risk of the banks' portfolio is not observable, banks have incentives in undertaking maximum risk. In our framework, since the bank maximizes its charter value (i.e. the discounted sum of current and future profits), there is a loss associated with failure that works as a disincentive for the bank to engage in high risk. Accordingly, we find that, under non disclosure, only a bank with a low charter value would find it optimal to engage in high risk activities. Moreover, low risk is always optimal in the case of disclosure. This is in line with the empirical evidence, as in Keeley (1990) and particularly in Demsetz et al. (1996) who find a significantly negative correlation between charter values and assets risk for a sample of US banks during the period 1986-94.[5]

The plan of the paper is as follows. Section 2 presents the main ingredients of the model. Section 3 examines the case in which the bank chooses portfolio risk, and computes and compares the probabilities of bank failure with and without disclosure, while section 4 does the same for the case in which risk is chosen by nature. Section 5 provides comments and concluding remarks.

2. The Model

We consider an economy where n (large) identical depositors, each of them endowed with $1/n$ units of cash, decide whether to invest in a foreign risk free asset or to deposit their cash holdings in a domestic bank. Domestic deposits are uninsured. Depositors are risk neutral, and supply funds to the bank if the expected gross return to their deposits is larger (or equal) than the gross returns R^* offered by the foreign risk free asset. Without loss of generality, we make the normalization $R^* = 1$. Furthermore, we define $\phi^e(r,.)$ as the depositors' (common) assessment of the expected returns of a unit of cash deposited in the bank, given their information on the bank's risk profile, with r denoting the (gross) deposit

[5] Suarez (1994) presents a model in which a monopolistic bank chooses between low and high risk, depending on the relative magnitude of its charter value. However, the paper assumes full deposit insurance and therefore it does not discuss the consequences of public disclosure.

rate. Accordingly, the aggregate deposit supply schedule S is given by:

$$\begin{aligned} S = 1, \quad \text{if} \quad \phi^e(r,.) \geq 1; \\ S = 0, \quad \text{if} \quad \phi^e(r,.) < 1. \end{aligned} \tag{2.1}$$

The bank is risk neutral, it invests deposits in risky entrepreneurial projects and maximizes the sum of discounted profits (its charter value, from now on). In what follows, we consider both the case in which the risk profile of investments is chosen by the bank and the case in which it is determined exogenously by nature. In both scenarios, we discuss the situation in which the volatility of the investments is known by depositors (disclosure) and the case in which it is not (non disclosure). The timing of the game we study is the following: (i) the bank (nature) chooses the risk of the loan portfolio, (ii) the bank sets the deposit rate, (iii) depositors decide whether to deposit in the bank, on the basis of the deposit rate and the available information set, (iv) the bank invests the funds it receives, (v) finally, at the end of the period, loans are reimbursed to the bank and payments to depositors are made. If the bank cannot cover deposits in full at the end of the period, it is audited, liquidated, and the available funds are distributed proportionately among depositors.[6]

3. The Bank Chooses Risk

Let us suppose that the bank can choose its loan portfolio among a continuum of portfolios R_j, offering the same expected returns $\overline{R} > 1$, but having different variance. More precisely, we assume that R_j is uniformly distributed over the interval $[\overline{R} - \gamma_j/2; \overline{R} + \gamma_j/2]$, and that γ_j belongs to the interval $[0, 2R]$.[7] Accordingly, by choosing its loan portfolio R_j, the bank chooses its level of asset risk, but not the expected return. The bank offers a standard debt contract that pays a sum r per unit of deposit at maturity, subject to the availability of funds.[8] Since

[6]We assume that the bank does not adjust its risk position after deposits are made. It should be clear that if this were not the case, depositors would behave as in the non disclosure scenario.

[7]The upper bound of γ_j is such that it insures non-negative (gross) returns on investments.

[8]Note that, because of limited liability, payments to depositors are limited to the bank's equity capital (assumed to be equal to zero without loss of generality), plus whatever funds can be recouped from the bank's investments. Hence, for a given deposit rate, expected current profits are increasing in risk, as higher risk (modeled as a mean preserving spread of the distribution of project returns) raises profits in good times ($R_j > r$), without affecting the outcome in bad times.

deposits are not insured, if the receipts from loan repayments, that are equal to the realization of R_j times the deposit supply, are not enough to cover deposits, each unit of deposit is paid $R_j < r$. Deposits pay zero (alternatively, they cannot be withdrawn) before maturity. Furthermore, we assume that the distribution of portfolio returns is common knowledge.

3.1. Disclosure

Assume that, when deciding whether to deposit in the bank or to invest in the risk free asset, depositors know the risk level γ chosen by the bank[9]. If this is the case, depositors' (common) assessment of the expected returns $\phi^e(r, .)$ equals the actual expected return $\phi(r, \gamma)$, i.e.,

$$\phi^e(r, .) = \phi(r, \gamma) = r \int_{\max\{r, \overline{R}-\gamma/2\}}^{\overline{R}+\gamma/2} f(R)dR + \max\left\{0, \int_{\overline{R}-\gamma/2}^{r} Rf(R)dR\right\}. \quad (3.1)$$

The first term in (3.1) denotes the depositors' expected returns when the bank pays deposits in full, times the probability that the bank does not go bankrupt, while the second term denotes the expected returns in the case of bankruptcy, times the probability of bankruptcy. Since R is uniformly distributed over the interval $[\overline{R} - \gamma/2; \overline{R} + \gamma/2]$, (3.1) can be rewritten as

$$\phi(r, \gamma) = \frac{r}{\gamma} \int_{\max\{r, \overline{R}-\gamma/2\}}^{\overline{R}+\gamma/2} dR + \frac{1}{\gamma} \max\left\{0, \int_{\overline{R}-\gamma/2}^{r} Rd(R)\right\}. \quad (3.2)$$

Let us now consider the bank's problem. The bank maximizes its charter value which is the discounted sum of its expected stream of profits. The solution of the bank's maximization problem can be expressed as

$$\begin{gathered} V_t = \max_{\{r,\gamma\}_t^\infty} \{\pi_t(.) + \delta p_t(.)\pi(.)_{t+1} + \delta^2 p_t p_{t+1}\pi(.)_{t+2} + ...\} \\ \text{s.t. } \pi_t(.) \geq 0, \text{ for all } t, \end{gathered} \quad (3.3)$$

[9] From now on, we drop the subindex j for notational simplicity.

where V_t is the bank's charter value at time t, $\pi_t(.)$ denotes the bank's expected profits, given by

$$\pi_t(r_t,\gamma_t) = S\int_{\max\{r_t,\overline{R}-\gamma_t/2\}}^{\overline{R}+\gamma_t/2}(R-r_t)f(R)dR = \frac{S}{\gamma_t}\int_{\max\{r_t,\overline{R}-\gamma_t/2\}}^{\overline{R}+\gamma_t/2}(R-r_t)dR, \quad (3.4)$$

$p_t(.)$ is the probability of not going bankrupt in period t, i.e.,

$$p_t(.) \equiv p(r_t,\gamma_t) = \frac{1}{\gamma_t}\int_{\max\{r_t,\overline{R}-\gamma_t/2\}}^{\overline{R}+\gamma_t/2} dR, \quad (3.5)$$

and $\delta \in [0,1]$ is a discount factor, representing the rate at which the bank's owner discounts future profits

Note that, from (3.3)-(3.5), the bank's choice does not depend on past history. Therefore, the problem is stationary and can be characterized in the following recursive form:

$$\begin{aligned} V =& \max_{\gamma,r}\ \{\pi(r,\gamma)+p(r,\gamma)\delta V_{+1}\} = V_{+1}, \\ & \text{s.t. } \pi(r,\gamma)\geq 0, \text{ for all } t, \end{aligned} \quad (3.6)$$

where V, and V_{+1}, denote the bank's value at the beginning of the current and the following period. Solving (3.6) we obtain the optimal pair (r^*,γ^*), and replacing them back into (3.6) we have the following expression for the bank's charter value:

$$V = \frac{\pi(r^*,\gamma^*)}{1-\delta p(r^*,\gamma^*)}. \quad (3.7)$$

In turn, using (3.4) and (3.5),

$$V = \max\{0, \frac{(\overline{R}+\gamma^*/2-\max\{r^*,\overline{R}-\gamma^*/2\})^2}{2[\gamma^*-\delta[(\overline{R}+\gamma^*/2)-\max\{r^*,\overline{R}-\gamma^*/2\}]]}\}. \quad (3.8)$$

Depositors accept any rate r such that their expected return is greater than that of the risk-free alternative, i.e. r has to satisfy $\phi(r,\gamma^*) \geq 1$. The following lemma shows that, in order to maximize its charter value, the bank always quotes the lowest deposit rate for which there is a positive supply of funds.[10]

Lemma 3.1. *The optimal deposit rate $r^*(\gamma)$ satisfies $\phi(\gamma, r^*) = 1$.*

Proof:

First note that $sgn\left|\frac{\partial\pi(.)}{\partial r}\right| = sgn\left|\frac{\partial p(.)}{\partial r}\right| \leq 0$, so that from (3.6), for deposit rates consistent with a positive supply of funds, it is optimal for the bank to offer the minimal interest, that satisfies $\phi(r,\gamma) = 1$. In what follows, we will denote this rate $\widehat{r}(\gamma)$.

Two cases should be considered:

(i) If $\gamma \in [0, 2(\overline{R} - r)]$, the bank's investment is risk free so that $\widehat{r}(\gamma) = 1$, $\phi[\widehat{r}(\gamma), \gamma] = 1$;

(ii) If $\gamma \in]2(\overline{R} - r), 2R]$, the bank's portfolio is risky and, from (3.2) and after some algebra, it follows that $\phi[\widehat{r}(\gamma), \gamma] = 1$ implies

$$1 < \widehat{r}(\gamma) = \overline{R} + \frac{\gamma}{2} - \sqrt{2\gamma(\overline{R}-1)} < \overline{R} + \frac{\gamma}{2}.$$

Since in both cases the bank gets non-negative profits, $\widehat{r}(\gamma)$ is optimal, i.e. $\widehat{r}(\gamma) = r^*(\gamma)$.□

Summarizing, the equilibrium deposit rate $r^*(\gamma)$ is given by[11]

$$\begin{array}{ll} r^*(\gamma) = 1, & \text{iff} \quad \gamma \in [0, 2(\overline{R}-1)]; \\ r^*(\gamma) = R + \frac{\gamma}{2} - \sqrt{2\gamma(\overline{R}-1)}, & \text{iff} \quad \gamma \in]2(\overline{R}-1), 2R]. \end{array} \tag{3.9}$$

[10] Our results carries on in the case in which deposit supply rises as the interest rate increases. But, since the introduction of an elastic deposit supply schedule would substantially complicate the algebra without providing additional insights, we decided to stick to our simpler framework.

[11] The reader can verify that $\widehat{r}(\gamma)$ is continuous in γ.

Lemma 3.2. *Current bank profits do not depend on the bank's risk profile:* $\frac{\partial(\pi(\widehat{r}(\gamma),\gamma))}{\partial\gamma} = 0$.

Proof:

Substituting the equilibrium interest rate in (3.4), it is easy to check that

$$\pi(r^*(\gamma), \gamma) = \overline{R} - 1, \forall\gamma \in [0, 2R].\square \tag{3.10}$$

Lemma 1 is reminiscent of Matutes and Vives' (1995) result that profits are independent of the asset risk position of a bank, so that the bank is indifferent between any candidate risk choice $\gamma \in [0, 2R]$. However, in our setting, the bank does not maximize its current profits but its charter value, and the indeterminacy is eliminated, as the following proposition demonstrates.

Proposition 3.3. *If the riskiness of the bank's loan portfolio is chosen by the bank and is observable to depositors, the bank always chooses a risk-free portfolio.*

Proof:

From (3.6) and Lemma 1, it is immediate to see that the charter value of the bank is maximized at $p = 1$, which in turn implies that the bank chooses $\gamma \in [0, 2(\overline{R} - 1)]$.[12] $\square$

According to Proposition 1, when depositors observe the bank's loan portfolio choice, they force the bank to behave safely by demanding a deposit rate that perfectly compensates for any risk the bank incurs, thus extracting all the potential benefits that the bank could make by increasing its risk exposure. Since the probability of being liquidated because of bankruptcy increases with risk, the bank is better off choosing the safest alternative.

[12] The bank is indifferent between any γ within the interval, since for all these choices the deposit is safe, $\widehat{r} = 1$, and $V = \frac{\overline{R}-1}{1-\delta}$.

3.2. Non Disclosure

In the above section, we have shown that if information about the riskiness of the bank's portfolio is disclosed to the public, the bank always chooses a risk free portfolio. We now consider the other polar case, in which depositors are not informed about the attendant portfolio risk. In order to compare this situation with the previous one, we still suppose that all other information is common knowledge, i.e., depositors know the distribution of portfolios and the characteristics of the bank, namely the discount factor δ. In such a set-up, depositors, being able to infer the bank's risk choice, form "rational" priors about the riskiness of the bank's portfolio, and supply funds in accordance. Formally:

Proposition 3.4. *If the riskiness of the bank's loan portfolio is chosen by the bank and it is non-observable to depositors, the bank chooses a risk free portfolio if* $\delta \geq \frac{1}{2\bar{R}-1}$, *and chooses the riskiest portfolio* ($\gamma = \overline{\gamma} = 2\overline{R}$) *otherwise. Depositors' expected returns are the same in both cases.*

Proof:

In Appendix

3.3. Comparison

According to Proposition 2, if the riskiness of the portfolio is not disclosed to depositors, the bank chooses a risk free portfolio only when the discount factor is sufficiently large, i.e., $\delta \geq \frac{1}{2\bar{R}-1}$. This result may be interpreted in two ways. On the one hand, the discount rate δ may be understood as a measure of the banker's conservatism. Accordingly, for given values of r, and $\bar{R}$, a conservative banker that assigns a high weight to future profits will tend to prefer safer investment. In this sense, δ is a measure of the subjective cost assigned by the owner to the failure of its bank, cost that determines the trade-off between current and future profits.

On the other hand, Proposition 2 may be read as a condition on $\bar{R}$. Thus, for a given δ, sufficiently high investment returns, i.e., $\bar{R} > \frac{2+\delta}{2\delta}$, are associated with safer investments. This comes from the fact that, as $\bar{R}$ increases, the gains in terms of current profits arising from an increase in risk ($\frac{\partial \pi}{\partial \gamma}$), decrease, while the costs in terms of expected future profits due to a higher probability of failure increase.[13]

[13]The reader can easily check that, for $r > \bar{R} - \frac{\gamma}{2}$, $\frac{\partial \pi}{\partial \gamma} > 0$, $\frac{\partial^2 \pi}{\partial \gamma \partial \bar{R}} < 0$, $\frac{\partial p}{\partial \gamma} < 0$, and $\frac{\partial^2 p}{\partial \gamma \partial \bar{R}} < 0$.

Hence, the incentive to deviate from any candidate equilibrium investing in riskier projects decreases with the investment's expected returns.

Note that, while depositors are as well off in both cases, the bank is worse off under non disclosure when $\delta < \frac{1}{2R-1}$. The bank cannot choose the risk free portfolio and pay the corresponding interest rate because it cannot credibly commit itself to do that. This is the reason why, if $\delta < \frac{1}{2R-1}$, the bank's charter value is lower, and the probability of banking failure higher, under non disclosure than under disclosure. Formally:

Proposition 3.5. *If the bank chooses its portfolio risk, for $\delta < \frac{1}{2R-1}$, a disclosure policy reduces the risk of bank failure; for $\delta \geq \frac{1}{2R-1}$, the probability is the same under both policies.*

Within our framework, the ex-ante depositors' surplus only depends on the returns offered by the risk free asset. Moreover, since all investment projects have the same expected returns, the only component of total welfare that is affected by public disclosure is the bank's value, which decreases as the probability of bankruptcy increases. Hence, we have that:

Corollary 3.6. *If the bank chooses its portfolio risk, and $\delta < \frac{1}{2R-1}$, a disclosure policy is welfare optimal.*

4. Nature Chooses Risk

In the previous section, we assumed that the bank had full command over the risk level of its investment portfolio. However, the bank's ability to choose its risk position is likely to be hindered by the existence of factors beyond its control that affect the evolution of the risk level of its assets. In this section, we study how the previous results change when the bank has limited scope for risk management, by focusing on the extreme case in which the bank's risk profile evolves according to exogenous factors. In particular, we assume that, before deposits are made, nature chooses the risk level γ, which remains constant over the deposit period. The following lemma characterizes the bank's optimal strategy.

Lemma 4.1. *If the riskiness of the bank's loans portfolio is chosen by nature, the bank maximizes its charter value by setting $r = \min\{\arg\min_r \phi^e(r) = 1, \overline{R} + \gamma/2\}$.*

Proof:

In Appendix

For expositional simplicity, from now on, we assume that nature chooses γ from two values, $\underline{\gamma}$ and $\overline{\gamma}$, $\underline{\gamma} < \overline{\gamma}$, which we will denote the "safe" and the "risky" state, respectively. Moreover, we assume that $\overline{\gamma} > 2(\overline{R} - 1)$[14] and $\Pr(\gamma = \underline{\gamma}) = \frac{1}{2}$.

4.1. Disclosure

If information about the riskiness of the bank's portfolio is disclosed, the analysis is similar to that under disclosure in section 2, with the exception that the type of equilibrium is determined by the current state of nature. The equilibrium deposit rates, $r(\underline{\gamma})$ and $r(\overline{\gamma})$, respectively, can be computed form (3.9).

Notice that, in this case, there is clearly no way in which depositors can use the information on risk to discipline the risk management behavior of the bank: the market adjusts to risk changes through the deposit rate in order to leave depositors indifferent between the domestic and the foreign assets.

4.2. Non Disclosure

Since the bank's current profits are decreasing in the deposit rate, if there is no risk information disclosure, any deposit rate offered by the bank in the "safe" state can be matched by the bank in the "risky" state. Therefore, there is no separating equilibrium in which the bank is active (i.e., captures a positive supply of funds) in both states of nature, and the deposit rate is high in the "risky" state and low in the "safe" state.[15] Thus, two possible candidate equilibria for this game exist: a pooling equilibrium in which the bank offers the same rate irrespective of the current state of nature, and a "lemon" equilibrium in which the bank posts a (high) rate in the "risky" state of nature, and does not operate in the "safe" state. Note that this problem is equivalent to one with two types of banks. The risky type always mimics the safe type, and therefore no separation is possible. The safe type, however, follows the risky type as long as the deposit rate does not exceed the maximum return that it can obtain from its investment,

[14] Note that for smaller values of $\overline{\gamma}$, the deposit does not involve any risk and the problem becomes trivial.

[15] The proof is straightforward and hence it is omitted here.

$\overline{R} + \frac{\underline{\gamma}}{2}$. If that is not the case, it stays out of the market, thereby revealing the active bank's type.

Accordingly, a pooling equilibrium exists only if there is a deposit rate $r < \overline{R} + \frac{\underline{\gamma}}{2}$ such that

$$\phi^e(\tilde{r}) = \frac{1}{2}\left[\phi(\underline{\gamma}, r) + \phi(\overline{\gamma}, r)\right] \geq 1, \tag{4.1}$$

in which case the pooling equilibrium deposit rate is the solution to

$$\frac{1}{2}\left[\phi(\underline{\gamma}, r) + \phi(\overline{\gamma}, r)\right] = 1. \tag{4.2}$$

The following proposition shows that there is a unique equilibrium for all possible combination of parameter values, and describes its characteristics.

Proposition 4.2. *(i) If $\underline{\gamma} \in [0, 2\sqrt{4(\overline{R}-1)\overline{\gamma} + 2\overline{\gamma}^2} - 3\overline{\gamma}]$ the unique equilibrium is such that, for any state of nature, the bank offers the deposit rate*

$$\tilde{r} = \overline{R} + \frac{3\overline{\gamma}}{2} - \sqrt{4(\overline{R}-1)\overline{\gamma} + 2\overline{\gamma}^2}, \tag{4.3}$$

and depositors deposit only in the domestic bank.

(ii) If $\underline{\gamma} \in [2\sqrt{4(\overline{R}-1)\overline{\gamma} + 2\overline{\gamma}^2} - 3\overline{\gamma}, 2\overline{R}]$, and $\underline{\gamma} > \overline{\gamma} - 4\sqrt{\overline{\gamma}(\overline{R}-1)}$, the unique equilibrium is such that, for any state of nature, the bank offers the deposit rate

$$\tilde{r} = \overline{R} + \frac{\underline{\gamma}\overline{\gamma} - \sqrt{\underline{\gamma}\overline{\gamma}[-(\frac{\overline{\gamma}-\underline{\gamma}}{2})^2 + 4(\overline{R}-1)(\underline{\gamma}+\overline{\gamma})]}}{(\underline{\gamma}+\overline{\gamma})}, \tag{4.4}$$

and depositors deposit only in the domestic bank.

(iii) If $\underline{\gamma} \in [2\sqrt{4(\overline{R}-1)\overline{\gamma} + 2\overline{\gamma}^2} - 3\overline{\gamma}, 2\overline{R}]$ and $\underline{\gamma} < \overline{\gamma} - 4\sqrt{\overline{\gamma}(\overline{R}-1)}$, the unique equilibrium is such that: a) in 'the 'risky" state, the bank offers the deposit rate

$$\tilde{r} = \overline{R} + \frac{\overline{\gamma}}{2} - \sqrt{2\overline{\gamma}(\overline{R}-1)}, \tag{4.5}$$

and depositors deposit only in the domestic bank, and b) in the "safe" state, the bank does not operate in the domestic market and depositors invest in foreign risk free asset.

Proof:

(i) Note that if

$$0 \leq \underline{\gamma} \leq 2(\overline{R} - \tilde{r}) \tag{4.6}$$

depositors bear no risk in the "safe" state, and (4.2) simplifies to

$$\phi^e(\tilde{r}) = \frac{1}{2}\left[\tilde{r} + \phi(\overline{\gamma}, \tilde{r})\right] = 1, \tag{4.7}$$

which implicitly define $\tilde{r}$ in (4.3). It is easy to check, using (4.3), that (4.6) holds if, and only if,

$$0 \leq \underline{\gamma} \leq 2\sqrt{4(\overline{R}-1)\overline{\gamma} + 2\overline{\gamma}^2} - 3\overline{\gamma}. \tag{4.8}$$

Finally, since

$$\tilde{r} < \overline{R} - \frac{\underline{\gamma}}{2} < \overline{R} + \frac{\underline{\gamma}}{2},$$

the bank has positive profits in both states of nature, and no "lemon" equilibrium exists.

(ii) If

$$\underline{\gamma} \in]2(\overline{R} - \tilde{r}), 2\overline{R}], \tag{4.9}$$

from (4.2) the equilibrium deposit rate is given by (4.4).[16] It is immediate to check, using (4.4), that the condition (4.9) is equivalent to

$$2\sqrt{4(\overline{R}-1)\overline{\gamma} + 2\overline{\gamma}^2} - 3\overline{\gamma} < \underline{\gamma} < 2\overline{R}.$$

For the existence of a pooling equilibrium in which the bank offers the deposit rate $\tilde{r}$, we need

[16]It is easy to check that (4.9) insures that $\tilde{r}$ in (4.4) is a real number.

$$\tilde{r} < \overline{R} + \frac{\gamma}{2},$$

which, using (4.4), simplifies to

$$\underline{\gamma} > \overline{\gamma} - 4\sqrt{\overline{\gamma}(\overline{R} - 1)}. \tag{4.10}$$

(iii) If (4.10) is not satisfied, there is no deposit rate such that the bank makes positive profits in both states of nature. Therefore, the bank operates only when $\gamma = \overline{\gamma}$, thus revealing the state to depositors and offering depositors $r(\overline{\gamma})$, as defined by (4.5) □

Notice that, for all $\underline{\gamma} > 0$, conditions (4.8) and (4.10) collapse to

$$\overline{R} > \overline{R}^c \equiv 1 + \frac{1}{16\overline{\gamma}}, \tag{4.11}$$

in which case, we are either in case (i) or case (ii) of the previous proposition. As result, we can state the following:

Remark 1. *If $\overline{R} > \overline{R}^c$, there are no "lemon" equilibria.*

4.3. Comparison

As we did in section 3, in this section we compare the probability of bank failure under the disclosure and non disclosure policies. We show that, contrary to the result in the previous section, in this case there are situations in which disclosure raises the ex-ante probability of bank failures. The intuition for this is simple. Suppose risk is distributed in such a way that, at the pooling rate demanded by uninformed depositors, the probability of failure is zero in "safe" states. If we now move to the a disclosure policy, the equilibrium deposit rate will be lower than the pooling rate in "safe" states (therefore leaving the probability of failure unaffected) and higher in "risky" states (therefore increasing the probability of failure in "risky" states). The ex-ante probability of failure will be clearly higher under the new policy. Thus, lack of information, leading to a pooling deposit rate that is strictly between those in the disclosure scenario, partially eliminates the negative feed-back from interest rates to asset risk in "risky" states of nature, and it does so without affecting bank soundness in "safe" states.

In general, disclosure may increase or decrease the chances of bankruptcy, depending on the range within which the risk level fluctuates. More precisely, we have:

Proposition 4.3. *For any $\overline{\gamma} \in [2(\overline{R}-1), 2\overline{R}]$, there is a value of $\underline{\gamma}$, $\underline{\gamma}^c \in [2(\overline{R}-\overline{r}), 2(\overline{R}-1)]$ such that for $\underline{\gamma} < \underline{\gamma}^c$, the probability that the bank fails is higher in the case of full information disclosure, and for $\underline{\gamma} > \underline{\gamma}^c$, the opposite is true, where*

$$\underline{\gamma}^c = -a + \sqrt{a^2 + \left[16(\overline{R}-1)\overline{\gamma} - \overline{\gamma}^2\right]}, \tag{4.12}$$

and

$$a = 4\left[\frac{\overline{\gamma}}{4} + \sqrt{2\overline{\gamma}(\overline{R}-1)} - (\overline{R}-1)\right].$$

Proof:

See Appendix.

By the same argument used for Corollary 1, it follows that:

Corollary 4.4. *Public disclosure is welfare optimal if, and only if, $\underline{\gamma} > \underline{\gamma}^c$.*

Figure 1 illustrates the different cases as a function of $\underline{\gamma}$ and $\overline{R}$, for $\overline{\gamma} = 2\overline{R}$.[17] In region 0, the difference between domestic returns to investment and the risk-free rate is too small for the bank to make profits in "safe" states, while paying the premium demanded by uninformed depositors to compensate for the possibility of a "risky" state. Therefore, under non disclosure, only "lemon" equilibria exist: the bank operates in risky states, and depositors assign a high risk level to any operating bank. Under these circumstances, disclosure is obviously optimal, as it allows the bank to operate in both the states of nature.[18]

[17] The results are qualitatively the same for any choice of $\overline{\gamma}$.

[18] Note that, again, depositors are indifferent between any policy, since their expected return is always equal to the risk-free rate. The bank, however, by not playing, looses whatever profits it could extract during good times.

The case discussed at the beginning of the section belongs to region 1, where the bank makes profits in both states of nature, and $\underline{\gamma}$ is small enough to make deposits at a rate $\tilde{r}$ riskless in the "safe" state. Public disclosure only raises the probability of failure in the "risky" state, thus increasing the ex-ante probability of failure and lowering welfare.

Region 2 comprises the intermediate cases. In the "safe" state, deposits are riskless at $r = 1$, but risky at $\tilde{r} > 1$. The critical point $\underline{\gamma}^c$ belongs to this region. For $\underline{\gamma} < \underline{\gamma}^c$, i.e., for wide fluctuations in the attendant risk level, non disclosure reduces the probability of bank failures. The opposite is always the case when $\underline{\gamma} > \underline{\gamma}^c$, as is in region 3, where deposits are risky in both states of nature.

Figure 2 shows the profile of Δ, the difference between the probability of failure under non disclosure and disclosure, as a function of $\underline{\gamma}$, for $\overline{R} = \overline{R}^c$ ($= \frac{8}{7}$), 1.2, and 1.5, and $\overline{\gamma} = 2\overline{R}$. At $\overline{R} = \overline{R}^c$, region 1 collapses to a point, and Δ rises sharply from zero, at $\underline{\gamma} = 0$, to about 25% within region 2. At $\overline{R} = 1.2$ and 1.5, Δ is constant and negative within region 1 and increases within region 2, crossing the horizontal axis at $\underline{\gamma}^c$. In all three cases, Δ declines in region 3 to approach zero asymptotically at $\underline{\gamma} = \overline{\gamma}$.

5. Discussion and Conclusions

In this paper we studied the impact on the probability of bank failures of disclosing bank information to the public. Our main findings are the following.

First, in order for disclosure to play a disciplining role in the bank's risk taking decisions, the bank has to be able to choose its portfolio risk.[19] If that is the case, we showed that the penalty imposed by informed depositors by demanding a deposit rate commensurate to the associated risk, may induce the bank to adopt a low risk strategy, depending on the cost implied by the loss of its charter value in case of liquidation. Alternatively, if risk is largely exogenous, there are cases in which disclosure can indeed increase the probability of bank failures. Those cases correspond broadly to volatile environments with high expected returns to domestic investment, where risk in the banking sector tends to fluctuate within a wide range of values.

[19]This rather obvious point is rarely mentioned in the controversy surrounding the "free banking" view.

The main intuition behind the last result is that, when risk is exogenous, disclosure no longer affects risk taking behavior but still induces a negative feedback on the probability of bank failure by allowing deposit rates to adjust. Thus, the bank is "taxed" during hard times and "rewarded" during good times. While the bank may prefer a more even distribution of the burden, e.g. by subsidizing depositors in good times to ensure lower funding cost in bad times, there is no way depositors can commit to not charge the bank a higher rate once risk is up. In those cases, non disclosure, by eliminating the state-dependent tax, improves the bank's chances of survival.

One should be careful in drawing policy conclusions from the highly stylized framework used in the paper. Whereas informed depositors can influence the bank's risk-taking decisions, public disclosure may have a perverse effect if risk shifts are exogenous. Reality seems to be between these two polar scenarios. In principle, one could conclude that, in those cases, government "insurance" against the occurrence of negative exogenous shocks (e.g., through the provision of emergency credit) would allow the system to benefit from information disclosure avoiding its pitfalls, but the distinction between what is exogenous and what is the result of banks' excessive risk taking is likely to be problematic. In addition, our assumption that risk is perfectly measurable (i.e., that *true* risk may be completely revealed to the public) is rather heroic. In practice, risk measurement is subject to a substantial error margin, which makes risk management a highly qualitative task, and information disclosure potentially misleading.

The model presented in the paper provides some testable implications. In section 3, we noted that informed depositors can influence the bank's risk level when its charter value is high enough. Therefore, a negative correlation between charter value and risk should be expected. Implicit in the analysis of section 4 is the idea that, when risk has a significant exogenous component, public information increases the volatility of deposit rates over time. Finally, when risk information is public (i.e., when it is supplied to the public in such a way that it can be digested and used by unsophisticated depositors), deposit rates should reflect differences in risk levels across banks. Moreover, for a given distribution of risk ratings, the more information is provided, the higher the dispersion of deposit rates. Therefore, the analysis of deposit rates vis-à-vis bank credit ratings would provide a first check on how well the market uses the information provided and on whether risk information has any effect on depositors' behavior.[20]

The model is open to several extensions. First, the assumption of a monopolistic bank can be relaxed. This would allow comparison between systemic and idiosyncratic risk, and would provide interesting insights on how different disclosure policies may affect competitive behavior. Second, the introduction of deposit demand elasticity (e.g. through risk averse depositors or horizontal product differentiation) would introduce deposit supply volatility as an additional dimension over which to analyze the benefits and pitfalls of information disclosure. Finally, the analysis of the case in which only a noisy signal of the risk level is observed may shed light on how the possibility of unwarranted bank distress as a result of misperceptions affects the conclusions drawn here.

[20] In a more general setting that incorporates deposit supply elasticity, both deposit rates and supply should be more volatile in the presence of informed depositors.

6. Appendix

Proof of Proposition 2

(i) Assume a candidate equilibrium deposit rate r. Taking derivatives with respect to γ, of the maximand in (3.6), and using (3.4) and (3.5), the first and second order conditions for the existence of a solution $\gamma \in [\underline{\gamma}, \overline{\gamma}]$ are

$$\frac{1}{2\gamma^2}\left[(\gamma/2)^2 - a\right] = 0 \tag{6.1}$$

and

$$\frac{a}{\gamma^3} < 0, \tag{6.2}$$

respectively, where

$$a \equiv (\overline{R} - r)^2 + 2\delta V_{+1}(\overline{R} - r). \tag{6.3}$$

Two cases arise. If $a > 0$, (6.2) is always positive, and only corner solutions are possible in equilibrium, i.e. $\gamma \in \{\underline{\gamma}, \overline{\gamma}\}$. If $a < 0$, then (6.1) is always positive and the only possible solution is $\gamma = \overline{\gamma}$. It follows that, for any given deposit rate r, no $\gamma \in]\underline{\gamma}, \overline{\gamma}[$ can be an equilibrium.

(ii) Define r^s as the deposit rate that satisfies

$$V(r, \overline{\gamma}) = V(r, \gamma^F), \tag{6.4}$$

where $\gamma^F = 2(R - r)$ is the higher γ such that the bank's portfolio is risk free.

Using (3.8), it is easy to check from (6.4) that

$$r^s = \frac{2\delta\overline{R}}{1+\delta} \leq \overline{R}. \tag{6.5}$$

which, in turn, implies that

$$r < r^s \iff V(r, \gamma^F) > V(r, \bar{\gamma}). \tag{6.6}$$

(iii) Then, for $r < r^s \le \overline{R}$, from (6.3) we know that $a > 0$. Moreover, from (6.6) we know that in this case, the bank chooses the minimum risk portfolio. If $r > r^s$, a may be positive or negative. However, in both cases the bank chooses the maximum variance portfolio.

(iv) Thus, since depositors know δ, they are able to infer the bank's portfolio choice from the posted deposit rate, and the aggregate deposit supply is then given by

$$\begin{array}{lll} S = 1, & \text{if} & r \in [1, r^s]; \\ S = 0, & \text{if} & r \in]r^s, r(\bar{\gamma})[; \\ S = 1, & \text{if} & r \ge r(\bar{\gamma}); \end{array} \tag{6.7}$$

with $r(\bar{\gamma}) = 2(\overline{R} - \sqrt{\overline{R}(\overline{R} - 1)})$, from (3.9).

(v) Finally, notice that interest rates within $]1, r^s]$ are never offered by the bank, because it can always lower the cost of funds without losing deposits, by offering a lower deposit rate. Moreover, for rates within $]r^s, r(\bar{\gamma})[$, the supply of funds (and therefore, profits) are zero. Hence, only 1 and $r(\bar{\gamma})$ can be equilibrium rates. The interval $[1, r^s]$ is non empty if, and only if, $\delta \ge \frac{1}{2\overline{R}-1}$. This together with the fact that $V(1, \gamma^F) > V(r(\bar{\gamma}), \bar{\gamma})$, as from Proposition 1, completes the proof.□

Proof of Lemma 3

The bank's value function is :

$$\begin{array}{c} V(\gamma) = \max\limits_{r} \{\pi(\gamma, r) + \delta p(\gamma, r) V^e\}, \\ \text{s.t. } \pi(.) \ge 0, \text{ for all } t, \end{array} \tag{6.8}$$

where, taking expectations of both sides of (6.8) over γ,

$$V^e = \int_\gamma V(\gamma)dH(\gamma)$$

$$= \int_\gamma \pi(\gamma)dH(\gamma) + \delta V^e \int_\gamma p(\gamma)dH(\gamma),$$

from which

$$V^e = \frac{\int_\gamma \pi(\gamma)dH(\gamma)}{1 - \delta \int_\gamma p(\gamma)dH(\gamma)} > 0.$$

Therefore, V^e is independent of the choice of deposit rate in the current period. The fact that $sgn\left|\frac{\partial\pi(.)}{\partial r}\right| = sgn\left|\frac{\partial p(.)}{\partial r}\right|$, and $r > \overline{R} + \gamma/2 \Rightarrow \pi(\gamma, r) < 0$ completes the proof.□

Proof of Proposition 5

We fix $\overline{\gamma}$ at any arbitrary value within $[2(\overline{R} - 1), 2\overline{R}]$ and compute the probabilities of bank failure with and without disclosure, p_d and p_nd, respectively, for different values of $\underline{\gamma}$.

Case 1: $\underline{\gamma} \in [0, 2\sqrt{4(\overline{R} - 1)\overline{\gamma} + 2\overline{\gamma}^2} - 3\overline{\gamma}]$.

As from Proposition 4, this interval corresponds to values of $\underline{\gamma}$ between 0 and $2(\overline{R} - \tilde{r})$, in the "safe" state the deposits are safe both with and without disclosure. Therefore, the ex ante probabilities of failure in each state are:

$$p_d = \frac{1}{2}[p_d(\underline{\gamma}) + p_d(\overline{\gamma})] = \frac{-\overline{R} + \overline{\gamma}/2 + r(\overline{\gamma})}{2\overline{\gamma}}, \tag{6.9}$$

$$p_{nd} = \frac{1}{2}[p_{nd}(\underline{\gamma}) + p_{nd}(\overline{\gamma})] = \frac{-\overline{R} + \overline{\gamma}/2 + \tilde{r}}{2\overline{\gamma}}. \tag{6.10}$$

Thus,

$$\Delta \equiv p_{nd} - p_d = \frac{\tilde{r} - r(\overline{\gamma})}{2\overline{\gamma}}. \tag{6.11}$$

Taking derivatives of (3.2) with respect to r,

$$\frac{\phi(\overline{\gamma}, r)}{\partial r} = \frac{1}{\overline{\gamma}}(\overline{R} + \overline{\gamma}/2 - r) > 0, \tag{6.12}$$

for $r < \overline{R} + \overline{\gamma}/2$. Therefore, (3.9) and (6.12) imply.

$$\phi(\overline{\gamma}, 1) < 1. \tag{6.13}$$

From (6.13) and (6.12), and (4.7), $\phi^e(\tilde{r}) = 1 \Rightarrow \tilde{r} > 1$. This, combined with (4.7), in turn implies that $\phi(\overline{\gamma}, \tilde{r}) < \phi[\overline{\gamma}, r(\overline{\gamma})] = 1$, and $r(\overline{\gamma}) > \tilde{r}$. Hence, $\Delta < 0$, i.e., the probability of failure is larger when there is disclosure.

Case 2: $\underline{\gamma} \in [2(\overline{R} - 1), 2\overline{R}]$.

In this case, deposits bear some risk in all states of nature, with or without disclosure and

$$\Delta = \frac{1}{2\underline{\gamma}\overline{\gamma}} \left[\left(\underline{\gamma} + \overline{\gamma}\right) \tilde{r} - \left(r(\underline{\gamma})\overline{\gamma} + r(\overline{\gamma})\overline{\gamma} \right) \right] \tag{6.14}$$

Using (3.9) and (4.4),

$$r(\underline{\gamma})\overline{\gamma} + r(\overline{\gamma})\overline{\gamma} = \overline{R}\left(\overline{\gamma} + \underline{\gamma}\right) + \underline{\gamma}\overline{\gamma} - \left(\overline{\gamma}\sqrt{\underline{\gamma}} + \underline{\gamma}\sqrt{\overline{\gamma}}\right)\sqrt{2(\overline{R} - 1)} \tag{6.15}$$

and

$$\left(\underline{\gamma} + \overline{\gamma}\right)\tilde{r} = \overline{R}\left(\underline{\gamma} + \overline{\gamma}\right) + \underline{\gamma}\overline{\gamma} - \sqrt{\underline{\gamma}\overline{\gamma}[-(\frac{\overline{\gamma} - \underline{\gamma}}{2})^2 + 4(\overline{R} - 1)(\underline{\gamma} + \overline{\gamma})]}. \tag{6.16}$$

Substituting (6.15) and (6.16) into (6.14), and after some algebra

$$\Delta \geq 0 \Leftrightarrow \sqrt{2(\overline{R} - 1)} \leq \frac{\left(\sqrt{\overline{\gamma}} + \sqrt{\underline{\gamma}}\right)}{2} \tag{6.17}$$

which is always true, since $\overline{\gamma} \geq \underline{\gamma} \geq 2(\overline{R} - 1)$.

Case 3: $\underline{\gamma} \in [2\sqrt{4(\overline{R} - 1)\overline{\gamma} + 2\overline{\gamma}^2} - 3\overline{\gamma}, 2(\overline{R} - 1)]$

This case includes intermediate values of $\underline{\gamma}$ within the interval $[2(\overline{R} - \tilde{r}), 2(\overline{R} - 1)]$. Deposits are risky except in the "safe" state and with disclosure (without disclosure, as the equilibrium deposit rate is higher, there is a positive probability of bank failure). The difference between probabilities of failure with and without disclosure is

$$\Delta = \frac{\overline{\gamma}\left(-\overline{R}+\underline{\gamma}/2\right)+\left(\overline{\gamma}+\underline{\gamma}\right)\tilde{r}-r(\overline{\gamma})\underline{\gamma}}{2\underline{\gamma}\overline{\gamma}}. \tag{6.18}$$

From Case 1, we know that, at $\underline{\gamma} = 2(\overline{R}-\tilde{r})$, $\Delta < 0$, whereas, from condition (6.17), we know that at $\underline{\gamma} = 2(\overline{R}-1)$, $\Delta > 0$. Therefore, since Δ is continuous in $\underline{\gamma}$, it has to be equal to zero for at least one value of $\underline{\gamma}$ within the interval $[2(\overline{R}-\tilde{r}), 2(\overline{R}-1)]$. Define this value as γ^c. Substituting (3.9) and (6.15) into (6.18), $\Delta = 0$ implies

$$\underline{\gamma}\overline{\gamma} + \sqrt{2\overline{\gamma}(\overline{R}-1)}\underline{\gamma} = \sqrt{\underline{\gamma}\overline{\gamma}[-(\frac{\overline{\gamma}-\underline{\gamma}}{2})^2+4(\overline{R}-1)(\underline{\gamma}+\overline{\gamma})]}, \tag{6.19}$$

or, raising to the square and rearranging,

$$\underline{\gamma}^2 + 8\underline{\gamma}\left[\frac{\overline{\gamma}}{4}+\sqrt{2\overline{\gamma}(\overline{R}-1)}-(\overline{R}-1)\right]+\overline{\gamma}^2-16(\overline{R}-1)\overline{\gamma}=0. \tag{6.20}$$

Solving for $\underline{\gamma}$, we have that the only non-negative solution to (6.20) is

$$\gamma^c = -a+\sqrt{a^2+\left[16(\overline{R}-1)\overline{\gamma}-\overline{\gamma}^2\right]}, \tag{6.21}$$

where

$$a = 4\left[\frac{\overline{\gamma}}{4}+\sqrt{2\overline{\gamma}(\overline{R}-1)}-(\overline{R}-1)\right].$$

It is easy to check that $\gamma > \gamma^c \Rightarrow \Delta > 0$.□

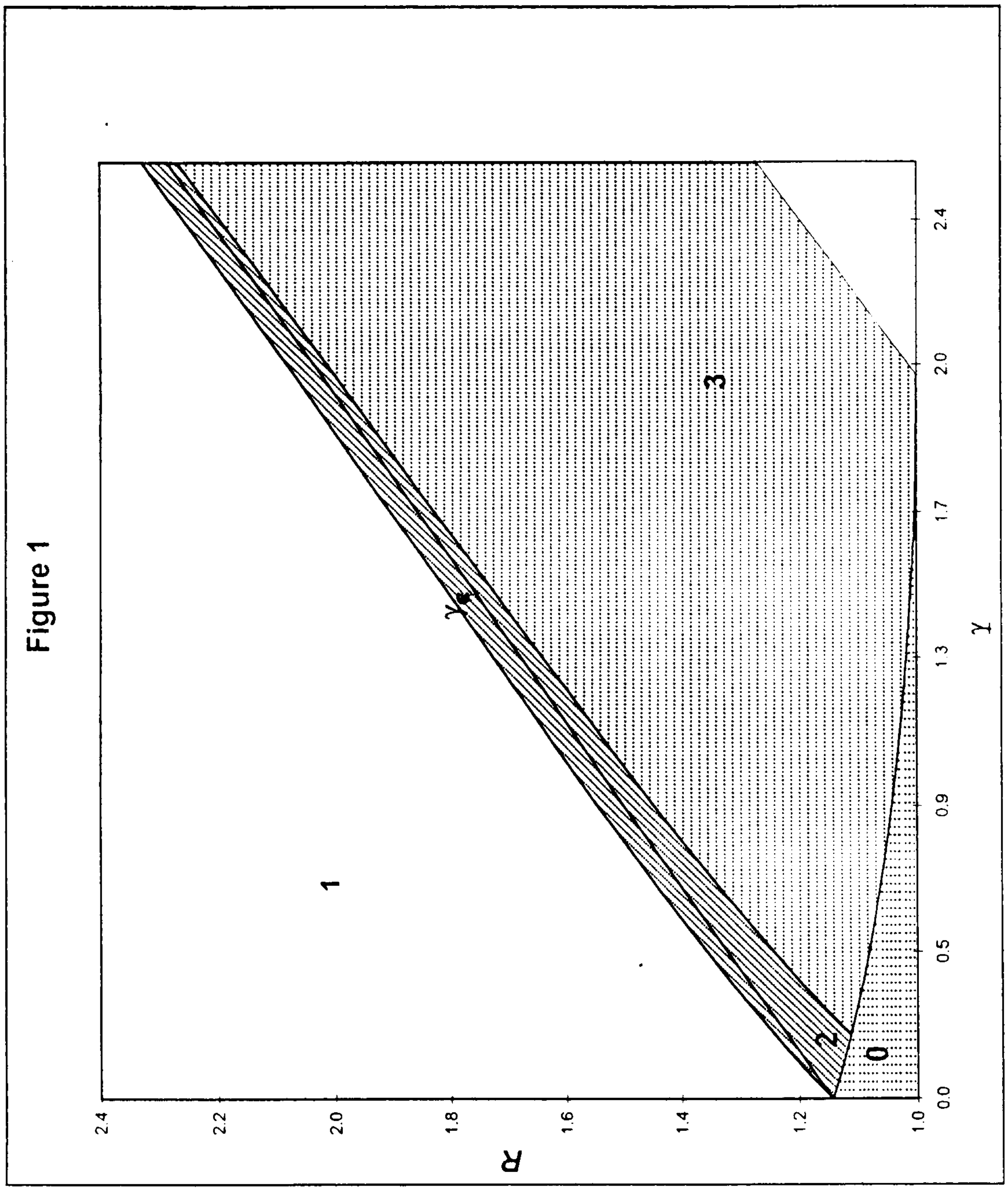
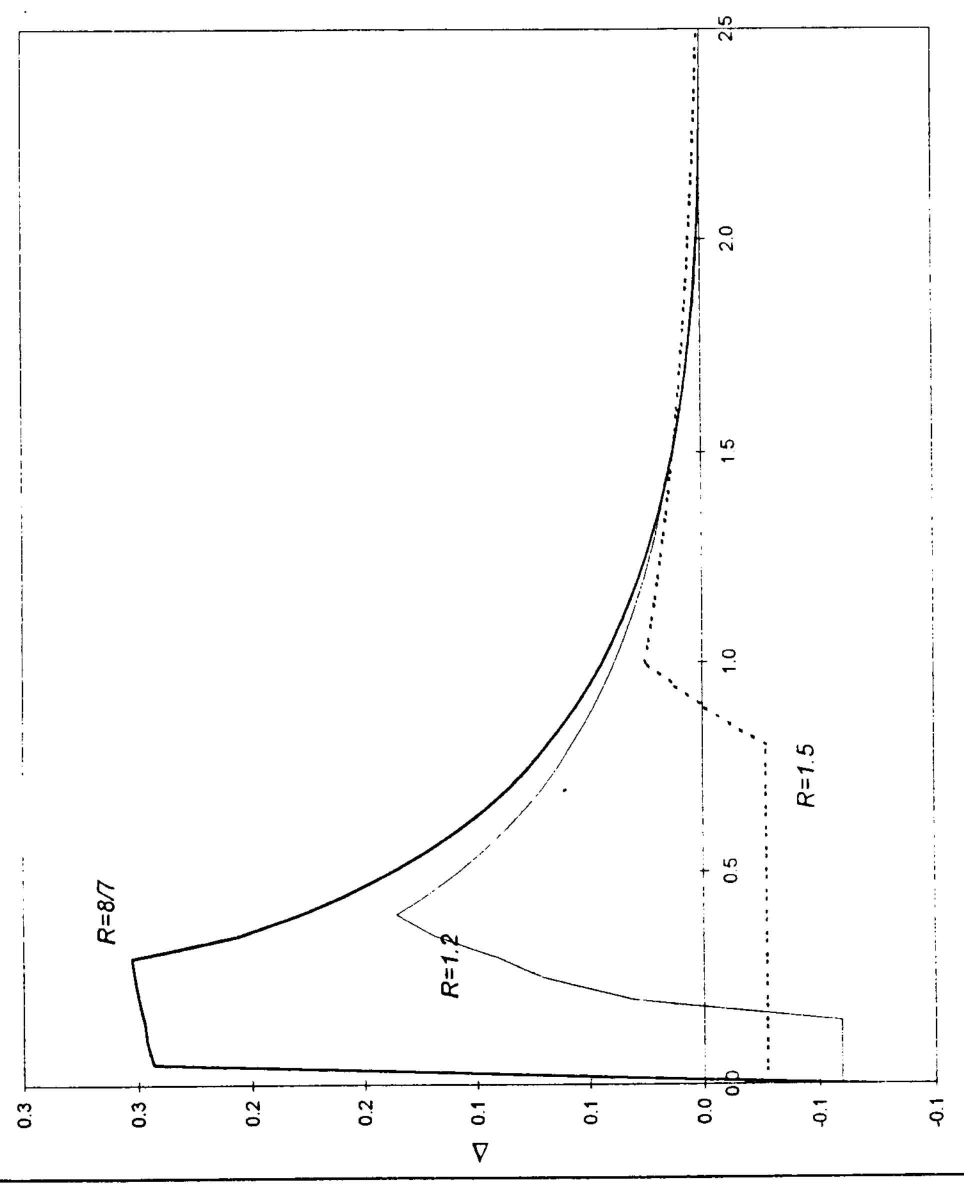


Figure 1

Figure 2



7. References

References

[1] BIS (1996), "Dott. Padoa-Schioppa Examines Developments in the Field of Banking Supervision", *BIS Review*, No. 74.

[2] Demsetz, R., Saidenberg, M. and P. Strahan (1996), "Banks with Something to Lose: The Disciplinary Role of Franchise Value", *Federal Reserve Bank of New York Policy Review*, October: 1-14.

[3] Dowd, K. (1996), "The Case for Financial Laissez Faire", *Economic Journal*, Vol. 106: 679-87.

[4] Keley, M. (1990), "Deposit Insurance, Risk, and Market Power in Banking", *American Economic Review*, Vol. 80, No. 5: 1183-1200.

[5] Matutes, C. and X. Vives (1995), "Imperfect Competition, Risk Taking, and Regulation in Banking", *CEPR Discussion Paper* No. 1177.

[6] Pagano, M. and T. Jappelli (1993), "Information Sharing in Credit Markets", *Journal of Finance*, Vol. 48, No. 5: 1693-1718.

[7] Padilla, J. and M. Pagano (1996), "Endogenous Communication Among Lenders and Enterpreneurial Incentives", *CEPR Discussion Paper* No.1295.

[8] Suarez, J. (1994), "Closure Rules, Market Power and Risk-Taking in a Dynamic Model of Bank Behaviour", *LSE Financial Market Group Discussion Paper*, No. 196.