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INFORMATION REUSABILITY, COMPETITION AND BANK ASSET QUALITY

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This paper explains the recent decline in bank asset quality using the notion of information reusability. Banks are viewed as information processors; they exist because of their advantage in extracting the surplus associated with the reusability of borrower-specific information. It is shown that a bank's incentive to screen loan applicants, and hence maintain the quality of its assets, depends on the surplus this screening can produce, which in turn depends on information reusability. Two recent changes in banks' operating environment are increased competitition and greater temporal volatility in borrower credit risks. The former has directly reduced banks' informational surplus while the latter has impaired information reusability. Hence screening expenditures have been reduced and the diminution of screening has lowered the quality of bank assets. It is also shown that an increase in deposit insurance premia has an effect similar to that of narrowing interest spreads and therefore will result in reduced asset screening and impaired asset quality.

1. Introduction

The recent increase in bank failures is rooted in a decline in the quality of bank assets, but diagnoses of the deterioration in asset quality are disparate. Many explanations seem to characterize banks (and thrifts, too) as passive victims of an increasingly hostile environment. Thus, deregulation has narrowed interest rate spreads and thereby weakened banks' ability to sustain loan losses. Deflation has destroyed asset values in both real estate and agriculture while also undermining foreign debtors' ability to service their liabilities. Sometimes the story is cast in terms of a crisis in government, i.e., spendthrift fiscal policy or politicized and/or irresolute monetary policy. The commonality in all these explanations is their anecdotal quality and the implied innocence of the banks.

We find such explanations unsatisfactory; they are both unscientific and implausible. At best they capture only half the picture. The objective in this paper is to develop a model offering a richer, more satisfying explanation for

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the contemporary deterioration of bank asset quality. Our explanation casts the bank in a more active role and it also subsumes most of the anecdotal explanations.

The bank's role as a processor of financial information is central. This view of banks finds support in recent literature [see Allen (1985), Boyd and Prescott (1985), Campbell and Kracaw (1980), Chan (1983), Diamond (1984), Leland and Pyle (1977), Millon and Thakor (1985), and Ramakrishnan and Thakor (1985)]. Following this literature, we endow the bank with an information processing technology that permits it to screen loan applicants with varying credit risks at a cost advantage relative to individual (non-intermediary) lenders. Borrowers may return for second-period loans. The extent to which the bank can utilize previously generated information in making its second-period loan decisions depends on the reusability of information.

Information reusability, as we use the term, subsumes both information durability and lender solvency. We refer to information about a borrower as being durable if it continues to inform through time, i.e., if its temporal rate of decay is small. For information to be reusable, however, it must be available to a solvent bank as well as being durable, and borrower information is assumed to be non-transferable across banks owing to moral hazard. Hence, the importance of bank solvency. When the bank confronts borrowers described by reusable credit information, it has an advantage. It can either lend to these borrowers at interest rates lower than those that could be offered by alternative lenders, or it can earn an informational surplus by lending at interest rates equal to the borrowers' alternatives. Under the market structure assumed here, the bank pursues the latter option. The informational surplus the bank expects to earn in the second period influences the bank's initial screening expenditure. We show that the larger the anticipated informational surplus, the greater the initial investment in screening. The informational surplus, in turn, is positively related to the reusability of information.

Reusability of information therefore induces more costly screening by the bank and leads to the selection of better quality assets. Recent environmental turbulence has presumably widened intertemporal fluctuations in borrower credit ratings and thus payoff-relevant information about borrowers should have become less durable. Moreover, deregulation has increased competition among banks – both from other banks and from non-bank financial institutions – and this has increased interest rates on bank liabilities and reduced interest rates on loans. The narrowed interest rate spread has increased the bank's risk of ruin, providing yet another reason to reduce screening expenditures. Consequently, ex ante discrimination among borrowers is less discerning and poorer quality loans are more common. A similar point is made in Chan, Greenbaum and Thakor (1985) using a more rudimentary model. The reformulation presented in this paper requires less restrictive assumptions and the notion of information reusability is captured more descriptively.

Although it is not our primary purpose to augment the literature on financial intermediary existence, our analysis sheds new light on the issue. Information reusability provides a potentially powerful motivation for intermediation because an intermediary is better able to reuse information across borrowers whose prospects are correlated through a few systematic factors. Moreover, by dealing with numerous agents the intermediary is more likely to remain a lender, and it is therefore better able to reuse borrower information.

Three sections contain the remaining analysis. In section 2 we develop the model. The main results appear in section 3. Section 4 concludes.

2. The model

Consider a bank that obtains D dollars of one-period deposits at $t=0$. The deposits are completely insured by the FDIC and the deposit interest rate paid on these deposits is the single-period riskless rate, r. The FDIC charges an insurance premium of p per dollar of deposits per period which is paid by each bank at the beginning of each period.[1] Thus, the size of the bank's loan portfolio at $t=0$ is $L_1=D[1-p]$.

The bank faces two types of borrowers, 'good' and 'bad', who are indistinguishable, ex ante. There is a continuum of good borrowers who repay their loans with varying probabilities at $t=1$, but the bad borrowers default with certainty at $t=1$. Although all borrowers display the same characteristics at $t=0$, the bank can employ a screening technology to sort the bad borrowers from the good.[2] How effectively this screening is done is a matter of choice for the bank, and the real-valued scalar α denotes the intensity of screening. It is assumed that the feasible set of values for α is an interval, $A\equiv[0,\bar{\alpha}]$. We represent the cost of this screening by a strictly increasing, strictly convex function, $V(\alpha)$. Screening expenditures are assumed to be financed with bank equity rather than deposits. We also assume that the FDIC cannot observe α or the screening expenditure; otherwise, the FDIC might be able to dictate the choice of α. Regardless of how intensively the bank screens, however, there is always some noise; that is, perfect screening is prohibitively costly. Thus, θ_1, the fraction of first-period borrowers who will repay, is a random variable with a cumulative distribution function, $F(\theta_1,\alpha)$, that is contingent on the bank's choice of screening, α.

[1]We assume a fixed deposit insurance premium in consonance with prevailing practice. See Campbell and Horvitz (1983, Chan and Mak (1985), and Greenbaum and Ricart i Costa (1985), for discussions of risk-sensitive deposit insurance premia.

[2]For an extensive development of costly screening in asymmetrically informed markets, see Stiglitz (1975).

Without screening expenditures, the cumulative distribution of the fraction of borrowers who will repay is $F(\theta_1, 0)$. Since there is a mass point for bad borrowers, $F(0,\alpha)>0$, for all $\alpha \in A$, we have a mixed distribution for θ_1, with a mass point at $\theta_1=0$. Screening reduces the fraction of bad borrowers and increases that of good borrowers. We assume that $F_\alpha(0,\alpha)<0$ for $\alpha \in A$, and $f_\alpha(\theta_1,\alpha)>0$ for $\theta_1 \in (0,1]$ and all $\alpha \in A$.[3]

On every dollar loaned, the principal plus interest is a positive scalar, X_1, which is assumed to be common knowledge and is the same for all borrowers. We shall also assume a sufficiently large positive spread between X_1 and r in order to generate excess profits for the bank. Thus, we have a market structure in which banks are monopolists on the loan side and accept a fixed supply of deposits (per bank) at a market determined interest rate.[4] Some will no doubt object to the assumption that banks can earn monopoly rents on loans. We make the assumption quite deliberately, however. The reason is that we wish to examine the impact of increasing competition on the bank's choice of screening. This would not be possible if our starting point was a perfectly competitive banking system. Thus, X_1 will parameterize the competitiveness of the credit market, and we will later present a comparative statics result involving the impact on α of reducing X_1.[5]

A borrower's type could change through time so that a borrower who repays in the first period could be either good or bad in the second period.[6] Durability of information is taken here to mean the likelihood that a borrower's type will remain unchanged from the first period to the second. More precisely, greater durability of information implies a stochastic increase in the fraction of repaying first-period borrowers who will also repay in the second period. Let θ_2 be the fraction of second-period borrowers who will repay their loans, with $G(\theta_2,\beta)$ representing the cumulative distribution function for θ_2, including $\beta \in [0,1]$ as an information durability parameter. Higher values of β indicate greater durability in the sense of first-order stochastic dominance, i.e., if $\beta_2<\beta_1$, then $G(\theta_2,\beta_2)>G(\theta_2,\beta_1)$ for all θ_2.[7] We assume β is public knowledge. For analytical simplicity, we assume there is no additional screening at $t=1$. Moreover, the bank lends in the second period only to those who were borrowers at $t=0$ and who repaid their first-

[3]Note that these assumptions imply that for any $\alpha_1, \alpha_2 \in A$ with $\alpha_2>\alpha_1$, $F(\theta_1,\alpha_2)$ dominates $F(\theta_1,\alpha_1)$ in the first-order stochastic sense; that is, $F_\alpha(\theta_1,\alpha) \leqq 0 \; \forall \theta_1, \alpha$.

[4]See Stiglitz and Weiss (1981) for a similar credit market structure. Besanko and Thakor (1985) have shown how competition on both sides of the balance sheet can be introduced in such a setting in an adverse selection context.

[5]In a more general model, the banks' interest rates on loans would be endogenized taking into account the competitive market structure and the effect of the loan rates on demand. We use a partial equilibrium framework in order to focus on the issue of information reusability.

[6]A borrower who is bad in the first period is irrelevant for the second period because he/she defaults at $t=1$ and exits the market.

[7]This notion of information durability is more appealing than the one in Chan, Greenbaum and Thakor (1985). The notion here leads to reusability of information about borrowers, whereas the earlier formulation focuses on reusability of the screening technology.

period loans.[8] That is, there are no new borrowers at $t=1$. In a sense, the bank makes two-period commitments at $t=0$ to lend again at $t=1$ to those borrowers who repay. We employ this assumption in order to focus on reusability, and we believe this is achieved most parsimoniously by avoiding the issue of how new credit applicants are screened. Thus, at $t=1$ the bank makes $\theta_1 L_1$ dollars of loans and charges an interest factor of X_2 to the seasoned customers. In general, X_2 will depend on β and the competitive market structure.

The sequence of events can now be summarized as follows. At $t=0$, the bank receives D dollars of deposits. It then chooses a screening intensity, α, which determines (probabilistically) the quality (the mix of good and bad loans) of the bank's loans. At $t=1$, the bank recovers $\theta_1 X_1 L_1$ dollars. If this amount is insufficient to fully repay depositors – that is, $\theta_1 X_1 L_1 < D[1+r]$ – then the FDIC repays depositors, declares the bank insolvent and the process terminates.[9] If, however, $\theta_1 X_1 L_1 \geqq D[1+r]$, then the bank continues in operation for a second period. It is easy to show that

$$\theta_1^* = [X_1(1-p)]^{-1}[1+r], \tag{1}$$

so that the bank is insolvent at $t=1$ if $\theta_1 < \theta_1^*$.

Given the bank's solvency at the end of the first period, it pays its shareholders a dividend of $\theta_1 X_1 L_1 - D[1+r]$. It then extends $\theta_1 L_1$ dollars of second-period loans at an interest factor of X_2 by acquiring $\theta_1 L_1 [1-p]^{-1}$ dollars of deposits. This enables the bank to make the necessary loans after having paid the second-period deposit insurance premium of p per dollar of deposits. The bank's terminal (random) payoff to shareholders can now be written as

$$\max\{0, \theta_1 L_1 \theta_2 X_2 - \theta_1 L_1 [1+r][1-p]^{-1}\}. \tag{2}$$

It can be shown that

$$\theta_2^* = (1+r)[X_2(1-p)]^{-1}, \tag{3}$$

so that the bank is insolvent at $t=2$ if $\theta_2 < \theta_2^*$. The bank's objective is to

[8]In essence, banks perceive the defaulters as unworthy customers because of their low average quality. Note that we do not consider the possibility of banks charging higher loan rates to these customers. Such strategies would be appealing, particularly in an environment with fixed deposit insurance premia.

[9]Insolvency does not always lead to liquidation. It is common for the FDIC and the FSLIC to only change management and ownership of the bank. Campbell (1984) argues that bank failures may serve the useful purpose of permitting regulators to replace inefficient management. In our model, termination of the bank at $t=1$ can be interpreted as termination of those agents – management perhaps – whose welfare is being currently maximized.

choose α to maximize the discounted (expected) present value of the first- and second-period distributions to shareholders net of screening expenditures. That is,

$$\max_{\alpha\in A} J \equiv L_1[1+r]^{-1}\left\{\int_{\theta_1^*}^{1} \Pi_1 \mathrm{d}F(\theta_1,\alpha) + [1+r]^{-1}\int_{\theta_1^*}^{1}\theta_1 \mathrm{d}F(\theta_1,\alpha)\int_{\theta_2^*}^{1}\Pi_2 \mathrm{d}G(\theta_2,\beta)\right\} - V(\alpha), \tag{4}$$

where $\Pi_1 \equiv \theta_1 X_1 - [(1+r)/(1-p)]$, $\Pi_2 \equiv \theta_2 X_2 - [(1+r)/(1-p)]$, and θ_1^* and θ_2^* are defined by eqs. (1) and (3).[10]

Before analyzing the solution to the above maximization program, it is useful to understand why banks exist in our model. Information reusability has a temporal aspect that creates a natural incentive for financial intermediation. To see this, consider an overlapping generations economy in which individual borrowers and lenders who exist at $t=0$ have uncertain lifespans. Each lender has one unit of credit to give and each borrower needs one unit of credit. Each may live for only one period or survive for two.[11] New borrowers and lenders also may enter the credit market at $t=1$. In this setting, if an individual lender and an individual borrower meet at $t=0$ to exchange capital, there is very limited surplus to be extracted from information reusability. Even though information regarding every good borrower may be highly durable, a lender may not find the information reusable for a number of reasons. First, the (good) borrower may die at $t=1$ after repaying the loan. Second, the lender may expire at $t=1$ after repayment from a good borrower. Third, the borrower may have been misidentified at $t=0$ and may default at $t=1$. Because a lender transacts with only one borrower at $t=0$, a default at $t=1$ makes it impossible for the lender to exploit the durability of information about good borrowers in the population. This happens either because first-period default leaves the lender with no credit to extend for the second period, or if the lender has funds available, he is forced to seek a new borrower.

Thus, a bank can better exploit the surplus generated by information reusability because it stays in place for both periods. By bringing together large numbers of borrowers and lenders, the bank substantially reduces the

[10]Note that the assumption of no new borrowers at $t=1$ simplifies the maximization problem substantially since it allows for the separate integration of terms involving θ_1 and θ_2. In our formulation, although p is assumed to be a constant, one can think of the FDIC choosing p to satisfy some criterion. One possible criterion is that the FDIC should break even on average. If we make this assumption, we need to append the breakeven constraint to the maximization problem (4). That is, the FDIC chooses p in such a way that, given the bank's optimal choice of α conditional on that p, the FDIC breaks even. We do not impose the breakeven constraint because we do not wish to contrain the FDIC's choice criterion.

[11]For simplicity, assume that deaths are cross-sectionally uncorrelated.

depletion of informational rents that result from the untimely random departures of individual agents. This adds a scale economy dimension to the reusability argument.

Another factor contributing to financial intermediary existence is the cross-sectional aspect of information reusability. Costly information relating to one borrower is often useful in assessing others.[12] Unlike temporal reusability, cross-sectional reusability is advantageous regardless of future solvency considerations. Hence, cross-sectional durability is the same as cross-sectional reusability, and a financial intermediary dominates direct bilateral credit exchanges between individual agents because it economizes on credit evaluation costs through the cross-sectional reusability of credit information. Cross-sectional reusability provides the rationale for lender specialization in the presence of diversification benefits.

3. Results

We first note that because A is a compact subset of the real line, the objective function in (4) is continuous, and a solution, α^*, does exist. In what follows, we assume that α^* is a unique interior solution, i.e., that the second-order sufficiency conditions are satisfied.[13] We have three main results, all of which are obtained through comparative statics analysis of the optimal solution, α^*.

Defining

$$H \equiv \int_{\theta_2^*}^{1} \Pi_2 \, \mathrm{d}G(\theta_2, \beta),$$

the first-order condition for α^* is given by

$$L_1[1+r]^{-1}\left\{\int_{\theta_1^*}^{1} \Pi_1 f_\alpha \mathrm{d}\theta_1 + [1+r]^{-1}\left[\int_{\theta_1^*}^{1} \theta_1 f_\alpha \mathrm{d}\theta_1\right]\cdot H\right\} = V'(\alpha^*). \tag{5}$$

Partially differentiating (5) with respect to β, r, X_1 and p,

$$\partial\alpha^*/\partial\beta = -L_1[1+r]^{-2}\cdot M\cdot Q/(\partial^2 J/\partial\alpha^2), \tag{6}$$

[12]This aspect of financial information, namely the existence of one or more systematic factors common to all individual borrowers, is exploited by Millon and Thakor (1985) to rationalize financial intermediaries in a setting less restrictive than in Ramakrishnan and Thakor (1985).

[13]A sufficient condition is that $F_{\alpha\alpha} \geq 0$.

$$\partial\alpha^*/\partial r=\{V'(\alpha^*)+L_1\{[1-p]^{-1}[-F_\alpha(\theta_1^*,\alpha^*)+(1+r)^{-1}$$
$$\times\{M\cdot(1-G(\theta_2^*,\beta))+X_1^{-1}H\theta_1^* f_\alpha\}]+[1+r]^{-2}H\cdot M\}\}$$
$$/\{(1+r)\cdot(\partial^2 J/\partial\alpha^2)\}, \tag{7}$$

$$\partial\alpha^*/\partial X_1=\{-L_1[1+r]^{-1}\{[\theta_1^* f_\alpha H/\{X_1^2(1-p)\}^{-1}]+M\}\}/(\partial^2 J/\partial\alpha^2), \tag{8}$$

and

$$\partial\alpha^*/\partial p=\{L_1(1+r)^{-1}(1-p)^{-2}\{-(1+r)F_\alpha(\theta_1^*,\alpha^*)+\theta_1^* f_\alpha\cdot HX_1^{-1}$$
$$+M\cdot(1-G(\theta_2^*,\beta))\}\}/(\partial^2 J/\partial\alpha^2), \tag{9}$$

where

$$M\equiv\int_{\theta_1^*}^{1}\theta_1 f_\alpha \mathrm{d}\theta_1, \qquad Q\equiv\int_{\theta_2^*}^{1}\Pi_2 g_\beta \mathrm{d}\theta_2,$$

$$\frac{\partial^2 J}{\partial\alpha^2}\equiv L_1[1+r]^{-1}\left\{\int_{\theta_1^*}^{1}\Pi_1 f_{\alpha\alpha}\mathrm{d}\theta_1+(1+r)^{-1}H\cdot\int_{\theta_1^*}^{1}\theta_1 f_{\alpha\alpha}\mathrm{d}\theta_1\right\}-V''(\alpha^*).$$

Integrating by parts, it can be shown that

$$Q=-\int_{\theta_2^*}^{1}G_\beta \mathrm{d}\theta_2>0.$$

Since $V'>0$, $M>0$, and $\partial^2 J/\partial\alpha^2<0$ by assumption (cf. footnote 13), we have

$$\partial\alpha^*/\partial\beta>0, \qquad \partial\alpha^*/\partial r<0, \qquad \partial\alpha^*/\partial X_1>0 \quad \text{and} \quad \partial\alpha^*/\partial p<0.$$

Further, we can compute the impact on the probability of bank failures of β, r, X_1 and p,

$$\partial F(\theta_1^*,\alpha^*)/\partial\beta=F_\alpha\cdot[\partial\alpha^*/\partial\beta]<0,$$

$$\partial F(\theta_1^*.\alpha^*)/\partial r=f\cdot[\partial\theta_1^*/\partial r]+F_\alpha\cdot[\partial\alpha^*/\partial r]>0,$$

$$\partial F(\theta_1^*,\alpha^*)/\partial X_1=f\cdot[\partial\theta_1^*/\partial X_1]+F_\alpha\cdot[\partial\alpha^*/\partial X_1]<0, \quad \text{and}$$

$$\partial F(\theta_1^*,\alpha^*)/\partial p=f\cdot[\partial\theta_1^*/\partial p]+F_\alpha\cdot[\partial\alpha^*/\partial p]>0,$$

since $\partial\theta_1^*/\partial r>0$, $\partial\theta_1^*/\partial X_1<0$ and $\partial\theta_1^*/\partial p>0$. These results are stated in the following propositions.

Proposition 1. When the credit risks of borrowers are less likely to change – information is more durable – banks devote more resources to costly screening.

Durability of information enhances its value by providing an increased second-period return to the lender. This enhancement is expressed in terms of the greater correlation between the successful first-period loans and second-period loan outcomes. Thus as β increases, the return to screening expenditures increases, and the bank will spend more on screening, sort loan applicants more successfully, and hold higher quality assets.

Whether or not credit information is durable depends on the environment. Environmental turbulence can be expected to perturb payoff relevant attributes of borrowers, thereby reducing the reliability of historical inference. Our analysis indicates that the reduced information durability implied by environmental turbulence should incline banks to reduce resources devoted to screening and thereby impair asset quality.[14]

Proposition 2. Banks reduce screening expenditures when deposit insurance premia or deposit funding costs increase, or when loan interest rates decrease.

Recent deregulation in banking has reduced barriers to entry increasing competition. This has narrowed interest rate spreads reducing banks' monopoly profits. Therefore, the surplus the bank can earn by identifying good borrowers is diminished and the marginal benefit of screening is reduced. As a consequence, banks optimally expend less in screening. Hence, increased competition in banking, a consequence of deregulation, has diminished banks' incentive to undertake the costly screening of loans needed to sustain asset quality.

An increase in the deposit insurance premium has the same impact on screening as a reduction in interest rate spreads. That is, it will reduce screening expenditures and thereby exacerbate asset quality problems. This result should give pause to those advocating increased risk progressivity of deposit insurance premia as a means of reducing bank risk-taking incentives. The success of such a program may require that the level of premia *not* be increased with the change in the premium structure. But increased risk progressivity at low average levels may be feasible only with draconian penalties for risk taking which would be equivalent to asset proscriptions [see Greenbaum and Ricart i Costa (1985)].

[14]The increased risk-taking propensity of banks discussed here is for a completely different reason from the usual argument based on risk insensitive deposit insurance pricing. That argument asserts that because a bank's equity is a call option on its total assets its value is enhanced by making the bank's assets riskier, especially in a setting in which fully insured depositors do not impose any market penalties for risk taking. In our model, banks do not directly benefit from assuming more risk per se. Rather, they find it beneficial to expend less in risk abatement.

Proposition 3. Reduced durability of information, increased competition or increased deposit insurance premia increase the probability of bank failures because of diminished asset quality.

Note that this is not the traditional argument that competitive pressures weed out the inefficient. There are no cross-sectional efficiency differences among banks in our model. The higher failure probability results from an optimal bank response to environmental innovations leading to the assumption of greater credit risk. Thus, if bank failures result in social cost, the regulator faces a tradeoff between costs and benefits of bank competition.

4. Concluding remarks

This paper has provided an economic rationale for the recent decline in the quality of bank assets. The key idea is that the bank's profit depends on two factors – reusability of information about borrowers and the potential economic rents from lending. Information reusability, in turn, depends on the bank's continued solvency and on the durability of information. We have argued that recent environmental turbulence has impaired information reusability, and deregulation has directly depleted the economic rents from intermediation. Banks have thus found it optimal to devote less reources to screening, have selected poorer quality assets, and have therefore become more prone to failure.[15]

Banks undoubtedly have been victimized by exogenous shocks. But this explanation for bank asset deterioration is dangerously incomplete. It ignores banks' striking adaptive capability. Recent innovations in financial contracts have been both reactive and proactive, and a central part of the banking system's balance sheet dynamic. The optimizing choices of banks in adapting to environmental innovations were at least partly responsible for a higher incidence of financial distress and failure. The view formalized here shifts the policy focus from untoward environmental conditions to the compatibility of incentives between management and ownership on the one hand, and the public guarantors of the financial system's integrity and solvency on the other.

[15]An alternative interpretation is that the recent reduction in banks' informational surplus is akin to a reduction in bankruptcy costs. Gurel and Pyle (1984) suggest that the loss of tax loss carryforwards upon bankruptcy imparts a concavity into the bank's expected profit function and thereby restrains risk seeking. In our model, the informational surplus and intermediation rents play a similar role. The erosion of these rents results in augmented risk taking and consequent quality deterioration.

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