Bank Monitoring and Role of Diversification

Matej Marinč[*]

November 16, 2008

[*]University of Ljubljana, Kardeljeva ploščad 17, 1000 Ljubljana, Slovenia, *e-mail*: matej.marinc@ef.uni-lj.si, and Amsterdam Center for Law & Economics (ACLE), University of Amsterdam, Roetersstraat 11, 1018WB Amsterdam, The Netherlands, *e-mail*: m.marinc@uva.nl.

Bank Monitoring and Role of Diversification

Abstract

I present a framework of banking in which banks' main role is to monitor their borrowers. Within this framework I analyze the benefits of diversification and the threats of systemic risk and inter-bank competition. Diversification improves banks' monitoring incentives. High systemic risk not only hampers banks' monitoring incentives, but also makes diversification less effective. I also show that competition lowers monitoring incentives. I match the insights of the analysis with the abundant literature on the role of banks on the asset-side and provide some implications for recent developments in banking.

1 Introduction

The banking industry is going through a dramatic transformation. Banks have been growing geographically, expanding across national and regional borders. In addition, banks are becoming involved in many different activities. They have combined various lending products with trading and financial market operations. This paper asks two questions in particular: i) How does diversification affect bank lending operations? and ii) How does the potential presence of a financial crisis affect the effectiveness of diversification? The importance of these issues is unquestionable. The subprime crisis that hit the financial sector in 2007–2008 appears to have had a major impact on the structure of the banking industry. Banks are increasingly forced to reevaluate their diversification strategies: do they want to choose a broad position or should they focus in their activities and remain geographically contained? Moreover, the regulators have to ask whether they want to encourage bank diversification or try to limit it.

I analyze these issues in a framework of banking, in which banks' main role is to monitor their projects (i.e., their borrowers). Monitoring improves the return of a bank's projects and also contains their diversifiable risk. This captures the role that banks play in relationship banking: banks invest in borrower-specific knowledge that might be beneficial to their borrowers; see Boot and Thakor (2000) and Ongena and Smith (2000) for reviews of relationship banking. However, bank projects are also subject to an undiversifiable systemic risk: if a systemic shock occurs, all projects simultaneously fail. A systemic shock may be caused by a financial crises in which suddenly bank assets are found to be worthless or the shock to the real economy that forces many firms in default.

In this model, banks have incentives to shift risk and may stop monitoring their projects if monitoring is too costly. Without monitoring banks partially transfer the risk to depositors and the deposit insurer but keep the potential profits.

Following Diamond (1984) I show that diversification limits the potential for the risk-shifting behavior of banks and commits banks to monitoring. More specifically, diversification limits the probability of large losses but increases the probability of small losses of

bank projects. This puts bank capital at risk instead of deposits and the deposit insurer and makes bank monitoring more valuable for bank owners.

I show that the presence of a systemic shock lowers banks' monitoring incentives. That is, in an environment with a high systemic risk, banks expect low profits and monitoring costs are relatively high. Hence, banks have higher problems in committing to monitoring. In addition, high systemic risk also makes diversification less effective because the bank is hit equally hard by a systemic shock regardless of how well diversified it is. I also show that increasing inter-bank competition – that is, opening up locally segmented markets to cross-market competition – lowers banks' monitoring incentives.

The regulatory and strategic implications are immediate. If a banking system is stable, the systemic risk is low, diversification is effective, and it may be an optimal mechanism for banks to commit to monitoring their borrowers. However, diversification may be less valuable for banks in times of financial turmoil when systemic risk is high. In such an environment, banks may have higher incentives to refocus on their core activities and on their core geographical markets.

My analysis also follows Bhattacharya, Boot, and Thakor (1998) in showing that regulators should avoid directly limiting diversification. However, the regulators have to reevaluate the benefits of diversification carefully, especially as systemic risk increases. The presence of high systemic risk may limit the benefits of diversification: In this light, one can understand regulatory actions in the U.S. after the Great Depression, in which regulators limited the scope and geographical scale of banks. As a response to the Great Depression, the U.S. implemented the Glass-Steagall Act, which enforced tight control over banking activities. The Glass-Steagall Act separated the activities of commercial banks and securities firms.[1] U.S. banks were also geographically restricted; for example, by limitations on opening branches in different U.S. states (the McFadden Act).

However, in the 1990s those regulatory barriers were removed. The Riegle-Neal Act of 1994 removed most barriers to interstate branching. The Gramm-Leach-Bliley Act of 1999

---

[1]The U.S. also imposed Regulation Q to restrict the level of competition with the aim of increasing bank stability.

lifted restrictions on the activities banks could undertake (i.e., combining securities and insurance with commercial banking). In doing so it allowed for the creation of a financial services holding company. Using the results of my analysis, one could argue that a perceived lower level of systemic risk increased the benefits of diversification and that removing barriers to diversification might be optimal. The current financial crises, however, may again raise thoughts about the benefits of diversification. As a response to high systemic risk, banks may again become more geographically contained and refocus on their core activities. The regulatory approval for takeovers of banks in trouble by their safer competitors may therefore be optimal only in the short term. In the long term, the benefits of giant financial institutions such as diversification may not overcome potential costs.[2]

I also survey some core results of the modern banking literature (following several surveys; e.g., Bhattacharya, Boot, and Thakor (1998) and Gorton and Winton (2003)). I review the role that banks perform on their asset side and why bank diversification is important. In particular, I stress the information-acquisition and asset-transformation function of banks. I also discuss the marginal contribution of this analysis with respect to the existing literature on banking.

This paper is organized as follows. Section 2 builds a model and analyzes the impact of diversification on bank monitoring, including the effects of systemic risk and inter-bank competition. Section 3 discusses the financial intermediation literature on bank monitoring. Section 4 concludes the paper.

2   Model Specification and Main Analysis

This section first builds a model of bank monitoring. Subsequently, it analyzes banks' incentives to monitor their projects. It focuses on the benefits of bank diversification and on the threats of inter-bank competition and systemic risk.

---

[2]Huge financial institutions may spark regulatory capture or overly lax bailout policies (see Boot, Greenbaum, and Thakor (1993)).

2.1 Model specification

Preferences and timeline: There is universal risk neutrality, with r_F representing the riskless interest factor (one plus the interest rate). The model has three dates, $t = 0$, 1, and 2. At $t = 0$, a bank raises \$1 of funds from depositors and capital providers and makes investments in N projects. At $t = 1$, the bank may invest in monitoring technology. Payoffs are realized at $t = 2$. Figure 1 summarizes the sequence of events.

FIGURE 1 COMES APPROXIMATELY HERE

Bank funding: The bank collects the proportion k of the total funds needed from the providers of bank capital at a cost r_E per unit and the proportion $[1 - k]$ from depositors. Deposits are insured, hence depositors are willing to supply their funds at the risk-free interest rate r_F. The deposit insurance premium is fixed, and to simplify matters we assume that this premium is included in the gross costs of deposits. Hence, the cost of deposits is $r_D > r_F$. Capital is more costly than deposits; that is, $r_E > r_D$.[3]

Bank projects: Bank projects are subject to a systemic shock. That is, with probability $[1-p]$ a bank is hit by a systemic shock such that all of its projects fail and yield zero return. With probability p, there is no systemic shock. In this case, returns of the projects depend on the bank's monitoring technology: monitoring improves the quality of bank projects such that they yield a return R_G per \$1 dollar of investment; if not monitored, the projects become bad. The return R of a bad project per \$1 of investment is distributed by a normal distribution $f(R, R_B, \sigma)$ with a mean R_B and a standard deviation σ. The returns of bad projects are independent. However, monitoring is costly; the bank invests in monitoring technology at a cost c_M.

I assume that the expected return of a good project net of monitoring costs is higher than the cost of capital, whereas the expected return of a bad project is even lower than the

---

[3]See Holmstrom and Tirole (1997) and Diamond and Rajan (2000) for explicit models of why the cost of capital might be higher than the cost of deposits. Note that this assumption bypasses the question of *how* capital is raised, including potential adverse selection problems, as in Myers and Majluf (1984), or moral hazard problems, as in Thakor (1990).

cost of deposits; that is,

$$pR_G - c_M > r_E > r_D > pR_B. \tag{1}$$

2.2 Preliminary discussion: Monitoring incentives

I first analyze the incentives of a bank to monitor its borrower. That is, I compute the profit of the bank conditional on monitoring and compare it with what the bank earns without monitoring.

If the bank monitors, its expected profit is as follows. The bank incurs monitoring cost c_M and has to repay capital providers in total kr_E. The bank succeeds if there is no systemic shock, which happens with probability p. In this case, the bank obtains return R_G but has to repay its depositors $[1-k]r_D$. Hence, the profit of the bank conditional on monitoring is

$$\Pi_M = p\{R_G - r_D[1-k]\} - c_M - kr_E. \tag{2}$$

If the bank does not monitor, it saves the cost of monitoring. The bank has to provide a return to its capital providers in total kr_E. However, now its projects are bad and the bank may fail even if there is no systemic shock. That is, the returns of a bad project may be lower than the promised repayment $r_D[1-k]$ to depositors. Conditional on no systemic shock, the underlying return of a bad project is distributed according to a normal distribution $f(R, R_B, \sigma)$ with a mean R_B and a standard deviation σ. The bad projects are independent, hence the total return of N bad projects is distributed according to a normal distribution $f(R, R_B, \sigma_N)$ with the same mean R_B but lower standard deviation

$$\sigma_N = \frac{\sigma}{\sqrt{N}}. \tag{3}$$

Conditional on no monitoring, the bank's profit is

$$\Pi_{NM} = p \int_{r_D[1-k]}^{\infty} \{R - r_D[1-k]\} f(R, R_B, \sigma_N) \mathrm{d}R - kr_E. \tag{4}$$

A bank has an incentive to monitor if its profit in the case of monitoring exceeds the

profit without monitoring. That is, $\Pi_M > \Pi_{NM}$. Using (2) and (4), one obtains

$$p\{R_G - r_D[1-k]\} - c_M > p \int_{r_D[1-k]}^{\infty} \{R - r_D[1-k]\} f(R, R_B, \sigma_N) \mathrm{d}R. \qquad (5)$$

Hence, the bank can commit to monitoring only if

$$c_M \le \bar{c}_M, \text{ where } \bar{c}_M \equiv p\Big\{R_G - r_D[1-k] - \int_{r_D[1-k]}^{\infty} \{R - r_D[1-k]\} f(R, R_B, \sigma_N) \mathrm{d}R\Big\}. \qquad (6)$$

The condition in (6) shows that the bank can only commit to monitoring for a low cost of monitoring. If projects demand high costs of monitoring (i.e., $c_M > \bar{c}_M$), banks cannot commit to monitoring even though monitoring is welfare optimal (as the condition in (1) shows). This is because of the standard risk shifting problem, in which the bank shifts the risk to the deposit insurer (see Merton (1977)). The regulator then should impose regulation that would either improve the monitoring incentives of a bank or simply prohibit banks from undertaking activities that are too prone to risk shifting (in terms of the model, projects with $c_M > \bar{c}_M$).

I follow the banking literature and present how banks commit to monitoring through diversification. Financing several projects at the same time allows the bank to better commit to monitoring.

2.3 Diversification and systemic risk

One of the main characteristics of financial intermediaries is that they raise funds from many depositors and lend to many borrowers. In the following simplified framework I analyze how diversification affects a bank's incentives to monitor its projects. A key result is that a diversified bank can more easily commit to monitoring.

Proposition 1. *Diversification enables the bank to finance projects that demand costly monitoring; that is, $\bar{c}_M$ is increasing in N.*

The intuition for Proposition 1 is the following. Diversification has no impact on project returns in the case of bank monitoring. In the absence of monitoring, however, diversification

6

lowers the dispersion of project returns. This then contains the level of risk-shifting of a bank. In particular, a diversified bank must internalize a larger part of potential loss instead of depositors (and the deposit insurer). Hence, the bank is incentivized more to monitor its projects.

The following corollary replicates the result by Diamond (1984) (see Section 3.2 for further discussion).

Corollary 1. *Completely diversified bank (with $N \to \infty$) can commit to monitoring.*

Proposition 1 and Corollary 1 have the following empirical implication. They predict that a better diversified bank might be willing to finance small and more opaque borrowers – borrowers that demand higher monitoring. Large banks seem to be better at building a superior information system and using it to gather information through transaction technologies such as factoring, leasing, and small business credit scoring (see Berger, Rosen, and Udell (2007) and Berger and Udell (2006). In this case, the cost of monitoring is independent of the number of projects of the bank and the results of this analysis apply. However, empirical evidence on this aspect is less conclusive for small banks. Small banks may still keep a competitive edge with large banks because they seem to be better at gathering soft information through relationship lending (see Stein (2002) and Berger et al. (2005)). This shows that diversification is not the only factor that influences bank monitoring. The type of lending technology may matter as well when lending to small and opaque borrowers.

Now I analyze how the presence of systemic risk affects banks' monitoring incentives and the benefits of diversification.

Proposition 2. *As systemic risk increases, banks have lower monitoring incentives.*

Higher systemic risk lowers bank profits both in the case of monitoring and in the case of no monitoring, but it does not affect the cost of monitoring. Proportionally, monitoring costs become a bigger part of bank profits. This lowers the benefits of monitoring with respect to its cost and banks are less incentivized to monitoring.

Proposition 3. *As systemic risk increases, diversification becomes less effective.*

Proposition 3 shows the following. Diversification is effective because it limits the risk-shifting behavior of the bank. However, high systemic risk lowers bank profits. Hence, prudent behavior in which a bank monitors its projects becomes less profitable in comparison to risky behavior with no monitoring.

Proposition 2 and Proposition 3 draw some implications for the current developments in banking. The regulators may have underestimated the interconnectedness of the banking systems around the world. Perceived systemic risk in banking nowadays seems to be much higher than before the subprime crisis. Proposition 2 shows that banks are more prone to risk taking in a banking system with high systemic risk. This should keep the regulators alert. Moreover, Proposition 3 shows that diversification may be less effective in committing banks to monitoring if the systemic risk is high. Allowing banks to diversify is less important from the perspective of the prudential regulation. To increase stability of the banking system, the regulator has to strengthen other regulatory mechanisms; for example, stricter regulatory oversight, prohibition of certain risky activities, tighter capital requirements, and so on.

Proposition 3 also gives implications for banks' strategic behavior. Diversification may be more important for banks if they operate in a stable environment with low systemic risk. Diversification then is beneficial because it allows banks to commit to more monitoring. Banks may follow broader strategies such as entering many different markets and undertaking different lending and investment activities. In times of a higher systemic shock, however, banks may be more inclined to refocus on their core market and on their core activities (see Boot and Marinč (2008) for the review of the ongoing strategic repositioning in the banking industry).

2.4   Diversification and inter-bank competition

Now I can extend the analysis a bit further to give predictions on how increased competition for deposits would change the monitoring incentives of a bank. If competition for deposits increases, a bank may have to offer depositors a higher deposit rate. A simple way to analyze the effects of higher competition for deposits is to observe the effect of an increase in r_D.

Corollary 2. *An increase in inter-bank competition (via higher r_D) lowers the monitoring incentives of a bank.*

Corollary 2 replicates the analysis of Keeley (1990). As competition for deposits increases, the bank expects to earn lower rents in the case of monitoring. The bank may then stop monitoring to save on the cost of monitoring, knowing that depositors (and the deposit insurer) carry the burden of higher risk.

The following corollary connects the effects of diversification and competition.

Corollary 3. *Competition makes diversification more effective for banks with high levels of capital but less effective for banks with low levels of capital.*

Corollary 3 stems from the following observation. Diversification is effective because it limits the size of risk shifting of a bank. That is, a diversified bank is more frequently exposed to a small shock, which puts bank capital at risk rather than bank depositors or the deposit insurer. Competition even exacerbates this effect. Hence, a diversified, well-capitalized bank is more inclined not to take risk and to monitor its projects. However, diversification is less effective if the bank has too little capital at stake and competition increases. In this case, bank capital is depleted even by a small shock and diversification no longer protects depositors and the deposit insurer. Hence, diversification does not prevent risk shifting and even a diversified bank can no longer commit to monitoring for high levels of inter-bank competition.

The implications of Corollary 2 and Corollary 3 are immediate. Competition may undermine a bank's incentive to monitor. Diversification then helps because it mitigates moral hazard. However, for banks with low levels of capital, competition makes diversification less effective. This complements the analysis of Boot and Marinč (2007) who show that high inter-bank competition makes capital regulation less effective especially for weak banks. Besanko and Thakor (1993) argue that higher competition may induce banks to select a risky, less diversified portfolio. Winton (1997) analyzes different causality between diversification and competition. He shows that bank owners have fewer incentives to engage in competition if a bigger bank also becomes more diversified. In particular, engaging in competition brings

an additional market share and additional diversification, which mostly benefits debtholders but not bank owners.

I have presented a simplified model to explain the bank's role in monitoring. Banks that pool many projects together and thus diversify are better at committing to monitoring their projects. In the next section I review the literature on banks' existence and I link it to the main insights from my simple model of bank monitoring. Central to this literature is that bank monitoring contains information asymmetries between firms and investors.

3   The Role of Banks in Monitoring

I now highlight and discuss the key conclusions of the literature on the existence of financial intermediaries and the benefits of diversification. A bank's role in monitoring and screening borrowers is central to this literature. Monitoring serves to lower informational asymmetries between investors and borrowers. In particular, following Freixas and Rochet (1999), bank monitoring can be seen as information gathering as in Leland and Pyle (1977), Ramakrishnan and Thakor (1984), and Allen (1990). In this case, banks act on behalf of investors to acquire information about borrowers. Banks either observe the quality of the borrower or verify the cash flows of the borrower (see Townsend (1979) and Krasa and Villamil (1992)). In addition, monitoring might denote an action of a bank against a deviating borrower as in Diamond (1984). In Holmstrom and Tirole (1997), bank monitoring contains opportunistic behavior. Townsend (1979) focuses on the role of banks and other monitors in auditing borrowers.

Several empirical studies provide evidence on the positive impact that a bank relationship might have on a borrower. James (1987) identifies a positive stock price response to the announcement of a new bank credit arrangement. Building on this, Lummer and McConnell (1989) distinguish between new bank loans and renewals, and show that renewals have a positive announcement effect but new bank loans do not. Several other studies, however, show no significant difference between initiations of loans and loan renewals (see Slovin, Johnson, and Glascock (1992), Best and Zhang (1993), and Billett, Flannery, and Garfinkel

(1995)).[4]

I proceed as follows. I first relate the analysis to the financial intermediation literature that points to the value of diversification in reducing monitoring costs (Leland and Pyle (1977) and Ramakrishnan and Thakor (1984)). Second, I explain the role of financial intermediaries in qualitative asset transformation.

3.1 Information acquisition: Intermediaries as information sellers

I now review the contributions that focus on the view of banks as information producers and discuss why diversification may improve information production. In this view, agents endogenously join together and form a bank because this allows for more efficient information production than each individual agent could achieve on his own.

Broadly speaking, one could argue that banks mediate information asymmetries between firms and investors. Normally, firms have more information about the prospects of their projects than investors. Especially if investors are small, they have little incentive to incur monitoring costs in order to lower information asymmetries. Banks, however, pool a large number of investors together and as such could be delegated information producers. The cost advantages that banks possibly achieve in information acquisition stem not only from pooling together funds from small investors (some type of scale economies), but also could be skill related (e.g., benefits of specialization). In addition, banks could possibly reuse information across time and across different borrowers better than individual agents could (see Chan, Greenbaum, and Thakor (1986)).

Leland and Pyle (1977) were the first to rationalize banks as mediators of information asymmetries. They applied insights from the (then) emerging field of information economics to financial intermediation; see Akerlof (1970), Spence (1973), and Rothschild and Stiglitz (1976). In their analysis, entrepreneurs differ in the profitability of their projects. Risk-averse entrepreneurs prefer borrowing funds to self investing; however, borrowing might be

---

[4]More recent evidence suggests that the importance of bank loan agreements is declining (see André, Mathieu, and Zhang (2001) and Fields et al. (2006)). However, loan agreements seem to keep their value for small firms, for poorly performing firms, in times of greater economic uncertainty, and in banking systems with high-quality lenders (see also Boscaljon and Ho (2005)).

limited due to information asymmetries. In particular, because investors cannot determine the profitability of entrepreneurs, they charge entrepreneurs a high lemon cost of financing. That is, charging the actuarially fair average cost is not sustainable because this would induce an adverse selection problem with only risky entrepreneurs raising funds at this average rate. Leland and Pyle (1977) argue that the "good" entrepreneurs choose to (partially) self finance to separate themselves from bad risks. Building on this, Leland and Pyle (1977) suggest that good entrepreneurs may form a coalition to lower the costs of such separation. Diamond (1984) expands this reasoning by showing that potential diversification in the coalition could lower the costs of this separation even further.

Ramakrishnan and Thakor (1984) explain the information-acquisition function of a financial intermediary. They focus on the incentive contract between an investor as a risk-averse principal and risk-averse agents that form the financial intermediary and gather information about the prospects of borrowers; that is, they screen firms. Ramakrishnan and Thakor (1984) show that diversification among information-producing agents may help reduce the agency problem between the principal and information-producing agents. As long as the projects of the firms are uncorrelated and agents can observe their respective efforts (no moral hazard between agents), the formation of a coalition lowers the agency cost per agent.

Ramakrishnan and Thakor (1984) argue that two conditions must be satisfied for financial intermediation (i.e., the formation of a coalition of information-producing agents) to occur. First, the projects should be diversifiable (i.e., the correlation should not be too high). Second, sufficiently many projects should exist; that is, sufficient diversification should be possible. In this case, the total agency costs of the financial intermediary become small compared to the sum of total agency costs of individual entrepreneurs.[5] In my analysis, Proposition 2 and Proposition 3 complement Ramakrishnan and Thakor (1984) by confirming that the presence of systemic risk limits bank monitoring incentives.

Allen (1990) shows that a financial intermediary might be better at selling information

---

[5]Both Diamond (1984) and Ramakrishnan and Thakor (1984) predict that banks would be of infinite size. In reality, several small banks exist as well. Millon and Thakor (1985) show that the underlying assumption of Ramakrishnan and Thakor's model is that agents costlessly observe the efforts of other agents in the coalition. If the efforts in the coalition are observable only at a cost, several finite financial institutions may appear.

than an individual agent. This is because agents on their own may be forced to leave some rents in order to commit to truthful reporting of information. A coalition of agents in a financial intermediary can better commit to truthful reporting and hence extract additional rents from information selling.

The financial intermediary as described above could be viewed as a pure brokerage institution that produces information for resale. Examples are analysts providing financial advice on investments and credit-rating agencies that screen and certify firms, and bond issues.

In summary, agents that produce and resell information may have incentives to form coalitions. I have reviewed several contributions that discuss such endogenous formation of diversified financial intermediaries and their role as information producers. The scope of these papers is quite broad and may be applied to many different types of financial interme-diaries. In fact, with the increasing importance of fee business in banking, such brokerage rather than the asset-transformation role is gaining importance. However, depository finan-cial institutions involving asset transformation are (still) of considerable importance. The next section focuses on such institutions and, in particular, on the asset-transformation role that they perform.

3.2   Asset transformation

Banks not only produce information, but they also act as asset transformers. They provide for transformation of maturity, liquidity, and risk between their assets and liabilities. In particular, banks fund risky borrowers with low-risk deposits. Analyzing this asset transfor-mation role also illuminates why debt contracts may be an optimal contract between banks and depositors and between banks and borrowers.

Diamond (1984) provides the following explanation of the asset transformation role of banks. Without banks, depositors could lend funds directly to borrowers. When doing so, depositors should monitor borrowers to guarantee repayments of the loans. This, however, may result in several inefficiencies. First, monitoring may be duplicated. Second, depositors may freeride on each other, such that in the end nobody monitors. A bank that gathers

funds from depositors and lends them to borrowers resolves these monitoring problems. Although the bank still has to monitor borrowers, Diamond (1984) shows that depositors do not need to monitor a well-diversified bank. He shows that writing a standard debt contract between depositors and a well-diversified bank may guarantee bank monitoring. With this he elegantly solves the problem of who monitors the bank – in his view, nobody needs to monitor a well-diversified bank.

The rationale for why diversification guarantees bank monitoring is the following. Diamond (1984) adds the possibility of non-pecuniary punishment to the standard debt contract between depositors and the bank.[6] In particular, if the bank breaches its contractual obligations and fails to repay depositors, it is punished. Punishment may be an instrument that helps induce the bank to always monitor the borrowers. A dark side of punishment is that an (undiversified) bank may fail even if it monitors the borrower. In this case, punishment is costly for a bank. However, in his model a well-diversified bank that monitors will never fail and costly punishment will never be realized. The sole threat of punishment is enough to incentivize a well-diversified bank to monitor. Hence, punishment is a costless device to induce a well-diversified bank to monitor.

Despite its unquestionable importance, Diamond's analysis has some shortcomings. In particular, the existence of non-pecuniary punishments seems to be unrealistic. Although a literal interpretation is far-fetched – banks neither physically punish their defaulted borrowers nor put them in jail – a more realistic interpretation such as the loss of reputation as a mechanism of non-pecuniary punishment also has some difficulties. In particular, investors can hardly fine-tune the loss of reputation to the final outcome of the returns of the bank. However, this is necessary to commit the bank to truthfully report its returns while minimizing the cost of punishment. My analysis circumvents these shortcomings by limiting the decision of a bank only to a decision about monitoring its projects. In my case, the banker can no longer just grab the money from the bank and misreport his earnings. He only can stop monitoring the bank projects, and this increases their risk. This seems to be a more

---

[6]In Diamond (1984), the punishment is a non-pecuniary penalty such as the loss of reputation or physical punishment.

realistic assumption knowing that financial frauds (such as earnings manipulations) are less frequent than excessive risky behavior of a banker.

Several other contributions complement Diamond (1984) and further justify the existence of a debt contract. Townsend (1979) and Gale and Hellwig (1985) use a costly state verification approach to justify the existence of the standard debt contract. If it is costly to monitor the performance of borrowers, banks design their lending contracts to minimize monitoring costs. Townsend (1979) and Gale and Hellwig (1985) show that conditioning monitoring on default is an optimal strategy. This leads to a debt contract in which equal payments are made in non-default. A few assumptions are that banks are limited to deterministic monitoring and borrowers are risk neutral. In other words, they show that a standard debt contract minimizes the monitoring cost. In addition, the bank should monitor more if the firm performs badly.

Another rationale for the use of debt contracts is given by Gorton and Pennacchi (1990). In Gorton and Pennacchi's study, the role of a financial intermediary is to design securities that split the cash flows of the underlying assets into securities of different informational content. In their setting, debt contracts are used to protect uninformed traders on the capital markets. They show that firms optimally divide their cash flows into two securities: equity and debt. Uninformed traders protect themselves by buying a security with low informational content; that is, debt security. In contrast, informed traders buy an equity contract that contains a lot of information about firm profitability. This is reminiscent of later work on optimal security design by Boot and Thakor (1997) and DeMarzo and Duffie (1999).

To summarize, financial intermediation occurs because markets may be unable to resolve information asymmetries. The various contributions discussed above consider various types of informational frictions and present rationales for why diversification is important in different forms of financial intermediaries such as banks, investment banks, credit-rating agencies, and mutual funds. I also add to this abundant literature on bank monitoring with some of the insights of my analysis.

4 Conclusion

This paper builds a simple model that serves to analyze the effects of diversification on bank monitoring. More specifically, banks may have incentives to stop monitoring their projects and become riskier because their risk is transferred to depositors or the deposit insurer. Diversification limits the prospects of bank risk-taking and induces banks to monitor.

I show that diversification, however, is less effective in the presence of high systemic risk. As systemic risk increases, banks' expected profits decrease and risky bank behavior becomes more attractive. Diversification cannot limit the loss if systemic shock occurs; hence, diversification is less effective in inducing banks to behave prudently – to monitor their projects – if a systemic shock is high.

The analysis offers the following regulatory implications. Generally, the regulators should endorse bank diversification because it improves bank monitoring incentives (see Proposition 1). Diversification is the most effective in times of low systemic risk. However, diversification has its limits. In times of the financial crisis, when systemic risk is high and when bank monitoring is needed the most, diversification may no longer be effective in committing banks to monitoring (see Proposition 3). As a systemic risk increases, the regulators should cautiously supervise banks even if they are well diversified. Such banks may be the least prepared for high levels of systemic risk. Despite being well diversified, they may still engage in risky behavior.

5 Appendix

Proof of Proposition 1

Profits of a bank conditional on no monitoring (substitute $R_1 = \frac{R - R_B}{\sigma_N}$ into (4)) are

$$\Pi_B = p \int_{\frac{r_D[1-k] - R_B}{\sigma_N}}^{\infty} \{\sigma_N R_1 + R_B - r_D[1-k]\} f(R_1, 0, 1) \mathrm{d}R_1. \tag{7}$$

Differentiate (7) w.r.t. σ_N to obtain

$$\frac{\partial \Pi_B}{\partial \sigma_N} = p \int_{\frac{r_D[1-k]-R_B}{\sigma_N}}^{\infty} R_1 f(R_1, 0, 1) dR_1, \tag{8}$$

which is positive. Hence, increasing the number of projects N, which decreases σ_N, also lowers profits of a bad bank and leads to higher $\bar{c}_M$. ■

Proof of Corollary 1

Use (6) to compute the convergence of $\bar{c}_M$ if $N \to \infty$.

$$\bar{c}_M(N \to \infty) = \lim_{\sigma_N \to 0} \bar{c}_M = \begin{cases} p[R_G - R_B] & \text{for } R_B > r_D[1-k], \\ p\{R_G - r_D[1-k]\} & \text{for } R_B \le r_D[1-k]. \end{cases} \tag{9}$$

The condition in (1) guarantees that $c_M < \bar{c}_M(N \to \infty)$. ■

Proof of Corollary 2

Differentiate (6) w.r.t. r_D to obtain

$$\frac{\partial \bar{c}_M}{\partial r_D} = -p[1-k] + p \int_{r_D[1-k]}^{\infty} [1-k] f(R, R_B, \sigma_N) dR, \tag{10}$$

which is negative. ■

Proof of Corollary 3

Differentiate (8) w.r.t. r_D to obtain

$$\frac{\partial^2 \bar{c}_M}{\partial r_D \partial \sigma_N} = -\frac{\partial^2 \Pi_B}{\partial r_D \partial \sigma_N} = \frac{r_D[1-k] - R_B}{\sigma_N^2} p[1-k] f(\frac{r_D[1-k] - R_B}{\sigma_N}, 0, 1). \tag{11}$$

Because $\sigma_N = \frac{\sigma}{\sqrt{N}}$, we have $\frac{\partial^2 \bar{c}_M}{\partial r_D \partial N} > 0$ for $r_D[1-k] < R_B$ and $\frac{\partial^2 \bar{c}_M}{\partial r_D \partial N} \le 0$ for $r_D[1-k] \ge R_B$. ■

Proof of Proposition 2

Differentiate (6) w.r.t. p to obtain

$$\frac{\partial \bar{c}_M}{\partial p} = R_G - r_D[1-k] - \int_{r_D[1-k]}^{\infty} \{R - r_D[1-k]\} f(R, R_B, \sigma_N) \mathrm{d}R. \tag{12}$$

This is positive as long as banking is viable; that is, as long as $\bar{c}_M > 0$. ∎

Proof of Proposition 3

Differentiate (8) w.r.t. p to obtain

$$\frac{\partial^2 \bar{c}_M}{\partial p \partial \sigma_N} = p \int_{\frac{r_D[1-k]-R_B}{\sigma_N}}^{\infty} R_1 f(R_1, 0, 1) \mathrm{d}R_1, \tag{13}$$

which is positive. ∎

References

Akerlof, G. A., 1970, "The Market for "Lemons:" Quality Uncertainty and the Market Mechanism," *Quarterly Journal of Economics*, 84(3), 488–500.

Allen, F., 1990, "The Market for Information and the Origin of Financial Intermediation," *Journal of Financial Intermediation*, 1(1), 3–30.

André, P., R. Mathieu, and P. Zhang, 2001, "A Note on: Capital Adequacy and the Information Content of Term Loans and Lines of Credit," *Journal of Banking & Finance*, 25, 431–444.

Berger, A. N., N. H. Miller, M. A. Petersen, R. G. Rajan, and J. C. Stein, 2005, "Does Function Follow Organizational Form? Evidence from the Lending Practices of Large and Small Banks," *Journal of Financial Economics*, 76(2), 237–269.

Berger, A. N., R. J. Rosen, and G. F. Udell, 2007, "Does Market Size Structure Affect Competition? The Case of Small Business Lending," *Journal of Banking & Finance*, 31(1), 11–33.

Berger, A. N., and G. F. Udell, 2006, "A More Complete Conceptual Framework for Financing of Small and Medium Enterprises," *Journal of Banking & Finance*, 30(11), 2945–2966.

Besanko, D., and A. V. Thakor, 1993, "Relationship Banking, Deposit Insurance and Bank Portfolio Choice," in *Capital Markets and Financial Intermediation*, ed. by C. Mayer, and X. Vives. Cambridge University Press, Cambridge, pp. 292–319.

Best, R., and H. Zhang, 1993, "Alternative Information Sources and the Information Content of Bank Loans," *Journal of Finance*, 48(4), 1507–1522.

Bhattacharya, S., A. W. A. Boot, and A. V. Thakor, 1998, "The Economics of Bank Regulation," *Journal of Money, Credit, and Banking*, 30(4), 745–770.

Billett, M. T., M. J. Flannery, and J. A. Garfinkel, 1995, "The Effect of Lender Identity on a Borrowing Firm's Equity Return," *Journal of Finance*, 50(2), 699–718.

Boot, A. W. A., S. I. Greenbaum, and A. V. Thakor, 1993, "Reputation and Discretion in Financial Contracting," *American Economic Review*, 83(5), 1165–1183.

Boot, A. W. A., and M. Marinč, 2007, "Competition and Entry in Banking: Implications for Capital Regulation," ACLE Working Paper.

———, 2008, "The Evolving Landscape of Banking," *Industrial and Corporate Change*, 17(6), 1173–1203.

Boot, A. W. A., and A. V. Thakor, 1997, "Financial System Architecture," *The Review of Financial Studies*, 10(3), 693–733.

———, 2000, "Can Relationship Banking Survive Competition?," *Journal of Finance*, 55(2), 679–713.

Boscaljon, B., and C.-C. Ho, 2005, "Information Content of Bank Loan Announcements to Asian Corporations during Periods of Economic Uncertainty," *Journal of Banking & Finance*, 29(2), 369–389.

Chan, Y.-S., S. I. Greenbaum, and A. V. Thakor, 1986, "Information Reusability, Competition and Bank Asset Quality," *Journal of Banking & Finance*, 10(2), 243–253.

DeMarzo, P. M., and D. Duffie, 1999, "A Liquidity-Based Model of Security Design," *Econometrica*, 67(1), 65–100.

Diamond, D. W., 1984, "Financial Intermediation and Delegated Monitoring," *Review of Economic Studies*, 51(3), 393–414.

Diamond, D. W., and R. G. Rajan, 2000, "A Theory of Bank Capital," *Journal of Finance*, 55(6), 2431–2464.

Fields, L. P., D. R. Fraser, T. L. Berry, and S. Byers, 2006, "Do Bank Loan Relationships Still Matter?," *Journal of Money, Credit, and Banking*, 38(5), 1195–1209.

Freixas, X., and J.-C. Rochet, 1999, *Microeconomics of banking*. Massachusetts Institute of Technology, Cambridge, MA, Fourth printing, 1999.

Gale, D., and M. Hellwig, 1985, "Incentive-Compatible Debt Contracts: The One-Period Problem," *Review of Economic Studies*, 52(4), 647–663.

Gorton, G. B., and G. G. Pennacchi, 1990, "Financial Intermediaries and Liquidity Creation," *Journal of Finance*, 45(1), 49–71.

Gorton, G. B., and A. Winton, 2003, "Financial Intermediation," in *Handbook of the Economics of Finance*. North-Holland, Amsterdam, pp. 431–552.

Holmstrom, B., and J. Tirole, 1997, "Financial Intermediation, Loanable Funds, and the Real Sector," *Quarterly Journal of Economics*, 112(3), 663–691.

James, C., 1987, "Some evidence on the uniqueness of bank loans," *Journal of Financial Economics*, 19(2), 217–235.

Keeley, M. C., 1990, "Deposit Insurance, Risk, and Market Power in Banking," *American Economic Review*, 80(5), 1183–1200.

Krasa, S., and A. P. Villamil, 1992, "Monitoring the Monitor: An Incentive Structure for a Financial Intermediary," *Journal of Economic Theory*, 57(1), 197–221.

Leland, H., and D. Pyle, 1977, "Informational Asymmetries, Financial Structure, and Financial Intermediation," *Journal of Finance*, 32(2), 371–387.

Lummer, S., and J. McConnell, 1989, "Further Evidence on the Bank Lending Process and the Capital Market Responses to Bank Loan Agreements," *Journal of Financial Economics*, 25(1), 99–122.

Merton, R. C., 1977, "An Analytic Derivation of the Cost of Deposit Insurance and Loan Guarantees: An Application of Modern Option Pricing Theory," *Journal of Banking & Finance*, 1(1), 3–11.

Millon, M. H., and A. V. Thakor, 1985, "Moral Hazard and Information Sharing: A Model of Financial Information Gathering Agencies," *Journal of Finance*, 40(5), 1403–1422.

Myers, S. C., and N. S. Majluf, 1984, "Corporate Financing and Investment Decisions When Firms Have Information that Investors Do not Have," *Journal of Financial Economics*, 13(1), 51–76.

Ongena, S., and D. C. Smith, 2000, "Bank Relationships: A Review," in *Performance of Financial Institutions*, ed. by S. A. Zenios, and P. Harker. Cambridge University Press, Cambridge, pp. 221–258.

Ramakrishnan, R., and A. V. Thakor, 1984, "Information Reliability and a Theory of Financial Intermediation," *Review of Economic Studies*, 51(3), 415–432.

Rothschild, M., and J. E. Stiglitz, 1976, "Equilibrium in Competitive Insurance Markets: An Essay on the Economics of Imperfect Information," *The Quarterly Journal of Economics*, 90(4), 630–649.

Slovin, M. B., S. A. Johnson, and J. L. Glascock, 1992, "Firm Size and the Information Content of Bank Loan Announcements," *Journal of Banking & Finance*, 16(6), 1057–1071.

Spence, A. M., 1973, "Job Market Signaling," *The Quarterly Journal of Economics*, 87(3), 355–374.

Stein, J. C., 2002, "Information Production and Capital Allocation: Decentralized versus Hierarchical Firms," *Journal of Finance*, 57(5), 1891–1921.

Thakor, A. V., 1990, "Investment "Myopia" and the Internal Organization of Capital Allocation Decisions," *Journal of Law, Economics and Organization*, 6(1), 129–154.

Townsend, R., 1979, "Optimal Contracts and Competitive Markets with Costly State Verification," *Journal of Economic Theory*, 21(2), 265–293.

Winton, A., 1997, "Competition among Financial Intermediaries When Diversification Matters," *Journal of Financial Intermediation*, 6(4), 307–346.

$t = 0$:

♠ The bank gathers funds from depositors and capital providers and invests in N projects.

$t = 1$:

♠ The bank can invest in monitoring technology.

$t = 2$:

♠ Payoffs are realized.

Figure 1: The basic sequence of events