THE GEORGE WASHINGTON UNIVERSITY

WASHINGTON, DC

Working Paper

August 15, 2014

Bank Disclosure and Managerial Incentives

Korok Ray[1], Assistant Professor of Accounting

The George Washington University – School of Business

korok@gwu.edu

The George Washington University Regulatory Studies Center[2]

Abstract

I propose a microeconomic model of a bank that acts as a financial intermediary engaging in maturity transformation, borrowing short-term debt from a market of investors to fund a long term loan to a firm. The bank installs a manager who exerts costly effort to reduce the credit risk of the loan portfolio. Disclosing this credit risk to the market increases the manager's incentives for risk management. The market rewards the manager's early efforts to manage risk with a lower future cost of debt. When paid on bank equity, the manager is induced to better manage risk. Disclosure therefore helps resolve the moral hazard problem inside banks.

[1] Korok Ray is an economist on the faculty of the George Washington University School of Business,. His academic research primarily focuses on compensation in corporate governance, though he has also written on regulation and venture capital.

[2] This working paper reflects the views of the author and does not represent an official position of the GW Regulatory Studies Center or the George Washington University. The Center's policy on research integrity is available at http://research.columbian.gwu.edu/regulatorystudies/research/integrity.

Bank Disclosure and Managerial Incentives*

Korok Ray
George Washington University – School of Business
korok@gwu.edu

Thursday 14th August, 2014

Abstract

I propose a microeconomic model of a bank that acts as a financial intermediary engaging in maturity transformation, borrowing short-term debt from a market of investors to fund a long term loan to a firm. The bank installs a manager who exerts costly effort to reduce the credit risk of the loan portfolio. Disclosing this credit risk to the market increases the manager's incentives for risk management. The market rewards the manager's early efforts to manage risk with a lower future cost of debt. When paid on bank equity, the manager is induced to better manage risk. Disclosure therefore helps resolve the moral hazard problem inside banks.

1 Introduction

Ever since the brief financial crisis in 2008, there has been renewed interest in the proper regulation of banks. Much of the interest in the policy community has resulted in stricter rules through the landmark Dodd-Frank Act. This, among other aims, grants banking regulators more discretion and authority. Yet alongside this debate on banking regulation has been a parallel acknowledgement that managerial incentives were misaligned

*I'd like to thank Susan Dudley, Lee Pinkowitz, Kai Du, and seminar participants at Georgetown University for helpful comments. Julia Morriss and John Cannavo provided outstanding research assistance. The George Washington University Regulatory Studies Center provided generous financial support.

within these banks, which led to some problems to fester in mortgage origination, securitization, and proprietary training. This paper shows that an alternative channel to regulation, disclosure of financial information, is an e ective means of realigning managerial incentives with shareholders. As such, disclosure is a mechanism to discipline managerial behavior, and an alternative to direct regulation of the banking sector.

The literature has long known that disclosure has both cost and benefits, but these models are rarely tailored to the specific environment of banks. Here, I propose a microeconomic model of the main production function of a bank, which is engaging in maturity transformation, borrowing short-term debt from investors to fund long term loans to firms. On top of this core activity, I layer an agency problem with a bank manager who exerts costly e ort to reduce the credit risk of the loan. The bank cannot contract on e ort, so instead compensates the manager on output, bank capital. Outside investors lend to the bank every period and provide the funds necessary to make longer term loans to the firm.

Because of maturity transformation, the model takes place over two stages, which is necessary to distinguish between short term liabilities and long term assets. In the benchmark regime without disclosure, the investor sees nothing after the early stage, and therefore sets its lending rate in expectation at the beginning of the game. But if the bank discloses credit risk after stage one, the investor can then condition its second stage interest rate on this disclosure. This allows the investor to discipline the manager through the later stage interest rate. Knowing this, the manager will exert extra care in stage one to mitigate credit risk, in order to achieve a lower cost of funds in stage two. Because he is compensated on equity, he cares about the cost of funds for the bank. Disclosure is the channel through which the investor can discipline the bank.

Since the landmark study of Diamond and Dybvig (1983), economists have conceived of bank regulation in terms of bank runs. As a solution to this market failure, there exists a role for the government to insure bank deposits, which currently operates in the U.S. through the Federal Deposit Insurance Corporation. But insuring deposits does not resolve the internal agency problem within the bank. At the same time, disclosure opens the way for investors to discipline the manager's action. Disclosure is a tool for the investor, and it o ers a vehicle for market regulation, as opposed to government regulation. In this sense, disclosure is a substitute instrument, and an alternative approach to manage the systemic risk of banks.

This paper ties together three separate literatures: banking, managerial compensation, and accounting disclosure. Most of the existing work in compensation operates within the agency framework, but the production function of the firm is general and it does not specifically address the unique nature of banks. Diamond (1984), Holmstrom and Tirole (1997), and Pyle (1971) are classic results in banking theory, but the focus there is not on managerial incentives to minimize credit risk. Beyer, et al (2010), Dye (2001), and Verrecchia (2001) o er comprehensive surveys of the disclosure literature, but once again, this literature operates primarily for general firms without considering the unique aspects of banking. By modeling the production function of the bank directly and the manager's risk management e orts, I can obtain a more precise and direct result of disclosure as it pertains to banks specifically.

I first consider the benchmark model without disclosure, establish the first best, and then show what happens when the bank discloses credit risk in the market. The main result explains how equilibrium managerial e ort responds to this disclosure. Section 4 concludes.

1.1 The State of Disclosure Requirements for Banks

To begin, let's first take stock of the disclosure requirements for financial institutions since the financial crisis. In what follows, I refer to financial institutions as "banks," even though technically, banks are a subset of financial institutions.

The Financial Accounting Standards Board (FASB) provides rules for all companies, and its rules are embedded within the standard accounting regulations. Certain accounting rules apply to all companies, but specifically pertain to banks. Banks are special in that several federal agencies regulate them. To a greater and lesser extent, these agencies have broadly shifted toward more disclosure since the financial crisis. In October 2012, the Enhanced Disclosure Task Force (EDTF) issued the Enhancing the Risk Disclosures of Banks report to the FASB that o ered many suggestions for improving financial disclosure (EDTF ERDB 2013). According to EDTF, disclosure should: be clear, balanced, and understandable; be comprehensive and include all of the bank's key activities and risks; present relevant information; reflect how the bank manages its risks; be consistent over time; be comparable among banks; and be provided on a timely basis.

EDTF goes on to o er recommendations for improving and enhancing risk disclosure. These include describing the risk culture and key risks that the bank takes as a result of its activities, and increased compliance with Basel standards. As of an August 2013 progress report to FASB, EDTF estimates that participating banks used 50 percent of the recommendations and hoped to reach 72 percent by the end of 2013 (EDTF PRFSB 2013). These are not strict rules to follow, but broader guidelines intended to enhance risk disclosure.

Apart from accounting standards, several other agencies, including the Fed, the FDIC, and the OCC have issued new disclosure requirements for financial institutions. In December 2013, the Fed issued a final rule, effective in April 2014, that addressed disclosures related to risk (FRS 2014). Banks need to provide "timely quantitative market risk disclosures" every quarter and give qualitative disclosures annually. Any changes in material portfolios would require public disclosure. Additionally, the Fed's rule calls for implementation of Basel III disclosure requirements by April 2014 (though there is yet to be a comprehensive review determining if this was successful). Basel III Disclosure requirements, which the Basel Committee estimated to be implemented by June 2013, designed a common template for disclosure, provided some reconciliation for disclosure under current financial statement requirements, and pushed for an approach that any accounting standard could adopt (BCBS 2012). Despite developing a common template, the requirements did not dictate exactly what needed to be disclosed or how to disclose it. It offered guidelines that would provide opportunity for greater disclosure, while still allowing for innovation in how disclosure is provided.

In January 2014, the FDIC, together with the Fed and the OCC, issued final its 2013 interim rule concerning disclosure requirements, with no substantive changes (FDIC 2014). This rule applies to banks with 50 billion dollars in assets or more, pursuant to Dodd-Frank section 165. It includes many disclosure requirements, such as requiring each bank to have a formal disclosure policy approved by its board of directors. Quantitative disclosures are required every quarter and qualitative risk-management can be disclosed annually, but any significant changes should be reported as they occur. The disclosures should be made publicly available for the prior three years. If the risk disclosure information is proprietary or confidential, the bank does not have to disclose it, but does need to give a reason. This does not exempt banks from disclosing information required by accounting standards. The rule's public disclosure requirements include information on capital structure, capital adequacy, the capital conversation buffer, credit risk, securitization, equities, and interest rate risk for non-trading activities.

As this analysis shows, regulations across multiple federal agencies, such as the FED, FDIC, and FASB, all want more disclosure. There are two noteworthy features of these rules. First, there is little explicit reasoning in the rules themselves for why disclosure should take place. Presumably, there is a general dissatisfaction with the opacity of the existing financial statements of banks, and regulators believe the market should know more. Second, the nature of the disclosure requirements is not a set of strict rules, but rather guidelines and suggestions. This means the regulators are moving tentatively, and perhaps may reflect some underlying uncertainty, hesitation, or lack of agreement on why more disclosure make sense.

This paper seeks to address these twin issues. First, I show there is a clear reason for more disclosure - namely better management of risk-taking managers. Second, the message is not one of loose moral suasion, but rather strong requirement toward more disclosure. In this sense, the paper addresses directly the current regulatory environment, and provides both theoretical foundation and a prescription for how to regulate going forward.

2 The Benchmark Model: No Disclosure

To fix ideas, first consider the benchmark model without disclosure. There are four players in this game: an investor, a bank, a manager, and a firm. The bank borrows from the investor at rate r_t in each of the two periods for $t = 1, 2$. This market for short term debt is competitive. The bank then lends to the firm at rate $r > r_t$. This is the standard business model of the bank: the bank lends out at a higher rate than it borrows, making a return on the spread. On top of this, the bank engages in maturity transformation, o ering short term liquidity to investors, while providing long term lending for production (to the firm). Figure 1 shows a schematic diagram of the loan structure. The bank acts as a financial intermediary, borrowing from an investor and making loans to a firm.

Let A_t be the bank's assets at period t, L_t its liabilities at period t, and $K_t = A_t - L_t$ be its equity, or bank capital. All parties are risk neutral. There is an agency problem inside the bank. A manager o ers his skills and human capital to the loan, while the bank owns the manager's output and provides incentives to the manager through output-contingent contracts. The manager exerts (unobservable) e ort e_t at cost $C(e_t) = 0.5ce_t^2$. The bank pays the manager on output, which here is captured by book value

Figure 1: Flow of funds between the firm, bank, and investor.

of equity (bank capital).[1] Such long term contracts ensure incentive alignment between the manager and the bank, inducing the manager to maximize long term book value.

In each period, the manager exerts costly e ort to improve the quality of the firm's asset. Since the sole asset of the bank is a long term loan, the manager's e ort reduces the credit risk of the loan. In particular, the probability that the firm will repay its loan is

$$p = \theta + e_1 + e_2 \tag{1}$$

where $\theta \sim f(\theta)$ is the intrinsic credit risk of the firm, and e_t is the manager's e ort in period t. Thus, credit risk has two components: the inherent risk of the firm (θ), and the risk management activities of the manager (e_t). Now, θ captures both moral hazard and adverse selection problems within the firm, which are not explicit here.[2] Managerial e ort e_t captures all the bank's activities pertaining to improving credit risk, such as risk management, mechanisms to ensure repayment, servicing the loan, handling borrower inquiries, and so forth. Indeed, these e orts represent the reason why the firm cannot borrow directly from the investor; the manager at the bank handles and manages the loan, o ering services that the investor cannot. The timing of the game runs as follows.

[1] In practice, banks pay on market value, not book value, of equity. However, that would require modeling a stock market, which would dramatically increase the complexity of the model, and distract from the focus on the debt markets and maturity transformation. I assume markets are efficient, and so, market value tracks book value, leading to similar qualitative results for the sake of incentives.

[2] The majority of the theoretical banking literature examines adverse selection and moral hazard problems pertaining to the firm (the borrower). The focus here is on moral hazard problems inside the bank (the lender). See the introduction for some references to this voluminous literature.

1. The bank begins with an initial stock of capital K_1.

2. The bank hires a manager and o ers a contract (s, b), where s is the manager's salary (cash) compensation, and b is a bonus paid on bank capital K at the end of the game. The manager has an outside option $\bar{u}$.

3. The bank obtains funds in the short term debt market. The bank borrows (liabilities) L_1 from a risk neutral investor at rate r_1, due after one period.

4. The bank meets a firm with intrinsic credit risk θ. The investor does not observe θ, but everyone else does (the bank, the manager, the firm).

5. The bank lends $A_1 = L_1 + K_1$ to the firm at rate r per period. This loan is due at the end of period two.

6. The manager exerts e ort e_1 at cost $C(e_1)$ to improve the quality of the bank's asset, and therefore decrease its credit risk.

7. At the start of period two, the bank rolls over its short term debt. It borrows $L_2 = (1 + r_1)L_1$ at rate r_2, due at the end of period two. The bank uses this new debt L_2 to pay o the old debt L_1. The assets of the bank are now $A_2 = A_1$, the liabilities are $L_2 = (1 + r_1)L_1$, and bank capital is $K_2 = A_2 - L_2 = K_1 - r_1L_1$.

8. The manager exerts e ort e_2 at cost $C(e_2)$ to continue to reduce credit risk.

9. Nature resolves the uncertainty on credit risk. Either the firm defaults on its loan, or it pays o the loan. The firm repays the loan with probability $p = \theta + e_1 + e_2$.

10. The bank pays o its debt to the investor, using the funds earned from the repayment of its loan to the firm.

11. The bank calculates bank capital and pays the manager a bonus based on bank capital.

Figure 2 shows the timing of the game and the abbreviated actions of the relevant players. Each of the two periods contains several stages, which detail the sequential evolution of the game. To solve the subgame-perfect Nash Equilibrium, it is necessary to work backwards. The main event determining the course of the game is the credit risk given by p. This credit risk is a function of the firm's type θ and the manager's e ort e_t.

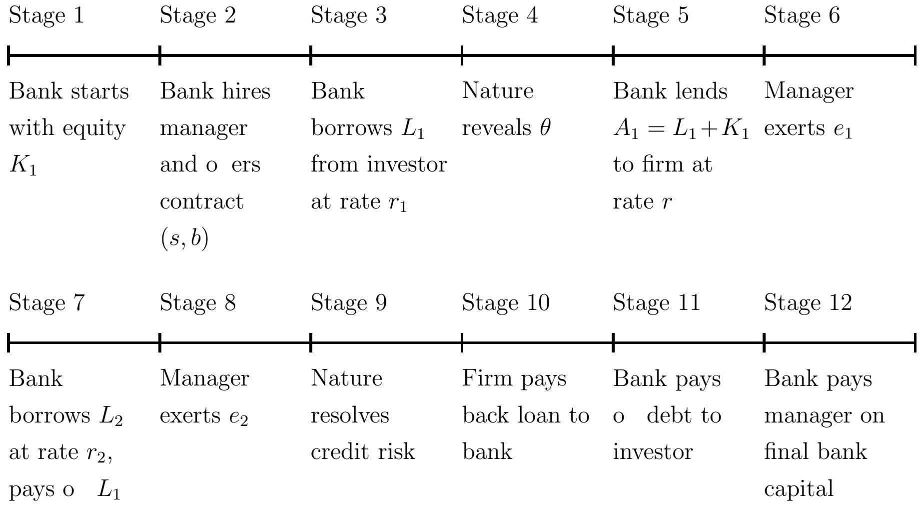

Figure 2: Timeline of game without disclosure.

2.1 Final Bank Capital

In the last period, the bank pays the manager on final bank capital. This bank capital will depend on whether the firm defaults on its loan. Therefore, final capital is a random variable prior to the resolution of credit risk.

The bank's assets in period two are $(1 + r)^2 A_1$ if the firm pays back its loan. The bank earns interest r on the loan of size A_1 for each of the two periods. If the firm defaults, the bank's assets are zero. At the end of period two, the bank's liabilities are $(1 + r_2)L_2$, where L_2 is the loan from the investor at the beginning of period 2. The liabilities of the bank are not stochastic, since they do not depend on repayment of the loan to the firm.

If the firm defaults, capital is $K = -(1 + r_2)L_2 < 0$. If the firm does not default, capital is $K = (1+r)^2 A_1 - (1+r_2)L_2 > 0$, since $r > r_t$ and $A_1 > L_1$. Therefore, the bank defaults if and only if the firm defaults. This equivalence will simplify the calculation of the rate at which the investor lends to the bank, since the credit risk of the bank as a whole is identical to the credit risk of its sole asset, the loan to the firm. Final bank equity is therefore a random variable depending on the resolution of credit risk, and its expectation is:

$$E(K) = p(1 + r)^2 A_1 - (1 + r_2)(1 + r_1)L_1.$$

2.2 Manager's Problem in Period Two

The manager takes as given his contract (s, b), where the bonus is paid on final bank capital. Rolling the game backward, the manager exerts e ort to maximize his compensation on expected capital, which is

$$E[K] = p(\theta, e_1, e_2)(1 + r)^2 A_1 - (1 + r_2)(1 + r_1)L_1 \tag{2}$$

The bank knows θ, and so computes expected capital conditional on θ. The manager is paid a cash salary plus a bonus on expected capital, and so, in period two he solves

$$\max_{e_2} s + bE[K] - C(e_2) \tag{3}$$

Recall that he takes r_t as well as e_1 as given when he chooses e_2. The first order condition gives the manager's second period incentive constraint:

$$e_2^* = \frac{b}{c}(1 + r)^2 A_1. \tag{4}$$

As usual, e ort rises in the manager's bonus, and falls in his cost of e ort parameter. In addition, the manager exerts more e ort under higher interest rate r and a larger loan size, A_1. Increases in both these parameters increase the unconditional value of the asset, which tracks the manager's marginal return to e ort (the change in expected value given a marginal change in e ort). A larger loan size or a higher interest rate increases the "prize" from repayment, and this induces the manager to exert e ort to secure this prize (and hence reduce credit risk).

As argued above, the probability that the bank does not default is the probability that the firm does not default on its loan to the bank. This probability is a linear combination of the firm's inherent credit risk θ, and the manager's e ort e_t. Without disclosure, the investor knows nothing about θ, and by the linearity of the probability function, evaluates the probability at $\bar{\theta} = E[\theta]$. Finally, the investor relies on the standard Nash assumption that the players of the game know the equilibrium, and hence imputes equilibrium e ort to calculate the probability of repayment. The investor operates in a competitive market, and therefore will select a second period loan L_2 that earns him zero expected profit (zero NPV):

$$p(e_1^*, e_2^*, \bar{\theta})(1 + r_2)L_2 - L_2 = 0 \tag{5}$$

Solving this yields the investor's equilibrium interest rate

$$r_2^* = (\bar{\theta} + e_1^* + e_2^*)^{-1} - 1 \tag{6}$$

Importantly, the investor's interest rate relies on the only information it has: average θ and equilibrium e orts.

2.3 Behavior in Period One

Continuing to roll the game backwards, at the end of period one, the manager exerts e ort e_1. Because of his long term contract, he is paid on final bank capital. As before, expected bank capital is the probability of repayment times the unconditional asset value minus the value of the bank's liabilities to its investor:

$$E[K] = p(\theta, e_1, e_2^*)(1 + r)^2 A_1 - (1 + r_2^*)(1 + r_1)L_1 \tag{7}$$

The manager maximizes his compensation less his cost of e ort. So he solves

$$\max_{e_1} s + bE[K] - C(e_1) - C(e_2^*) \tag{8}$$

Taking the first order condition with respect to e_1 gives

$$C'({e^*}_1) = \frac{\partial p}{\partial e_1} b(1 + r)^2 A_1 \tag{9}$$

Observe that e_1 lowers credit risk by increasing p. Importantly, the manager's actions a ect the assets of the bank, but not its liabilities. Its liabilities depend on r_2, which is a function not of actual e ort e_2, but only equilibrium e ort e_2^*. Rewriting this first order constraint gives the manager's equilibrium e ort choice

$$e_1^* = \frac{b}{c}(1 + r)^2 A_1 = e_2^*. \tag{10}$$

Thus, e ort is identical across periods. As it should be, as no information is revealed between periods, so the periods are identical.

As before, the investor calculates the probability that the bank will repay its loan, which is identical to the probability that the firm repays its loan to the bank. The investor calculates this information based on the information he has: expected θ and equilibrium e ort. The competitive investor again chooses the interest rate such that his expected profits are zero,

$$p(e_1^*, e_2^*, \bar{\theta})(1 + r_1)L_1 - L_1 = 0 \tag{11}$$

Rearranging this gives the investor's choice of equilibrium interest rate

$$r_1^* = (\bar{\theta} + e_1^* + e_2^*)^{-1} - 1 = r_2^* \tag{12}$$

Notice that this is identical to the rate in period two. Because of no disclosure between periods, the periods are identical, and hence the investor faces the same problem in periods one and two. We collect these results into our first proposition.

Proposition 1 *In the no-disclosure regime, the manager exerts equal e ort in both periods* ($e_1^* = e_2^*$)*, and the investor sets the same interest rate in both periods* ($r_1^* = r_2^*$)*.*

3 Disclosure of Credit Risk

Now suppose the bank discloses credit risk to the market. Credit risk is given by the probability of default $p = \theta + e_1 + e_2$. Observe that credit risk is a function, both of the intrinsic characteristic of the firm θ, as well as the e ort of the manager. Because the manager exerts his e ort sequentially over time, credit risk therefore evolves over time. As the manager works to ensure repayment in the second period, credit risk will not be identical across periods.

Suppose the bank discloses credit risk after the manager exerts his e ort, both in periods one and two.[3] At the end of period one, the bank discloses the credit risk of the loan, given all information available at that point:

$$d_1 = \theta + e_1 \tag{13}$$

At this point, the bank manager has already invested resources into the loan, and it is difficult for the bank to disentangle θ from e_1. For example, the manager has already run credit risk models and estimated the probability of repayment, which itself requires e ort and resources. The bank has its own estimate of the credit risk of the loan, which we assume is verifiable by a third party. An outside party can audit the bank's credit risk

[3] The bank could also disclose credit risk prior to the manager's e ort (disclosing θ), but this would clearly not a ect managerial incentives at all. Hence, we do not consider such disclosure, though including it would not change the model in any qualitative way.

modeling to discover the bank's own estimate of credit risk.[4] The bank formulates its own estimate of credit risk and discloses this to the market, rather than simply revealing θ to the market.

In period two, after the manager exerts e ort to improve the quality of the loan, the bank then makes the disclosure d_2 to the market:

$$d_2 = \theta + e_1 + e_2 \tag{14}$$

As before, the bank discloses the aggregate term d_2 and not its separate components for similar reasons argued earlier. The timeline of the game is the same as before, with the additional disclosures in period one and period two. Figure 3 portrays the timeline of this new game.

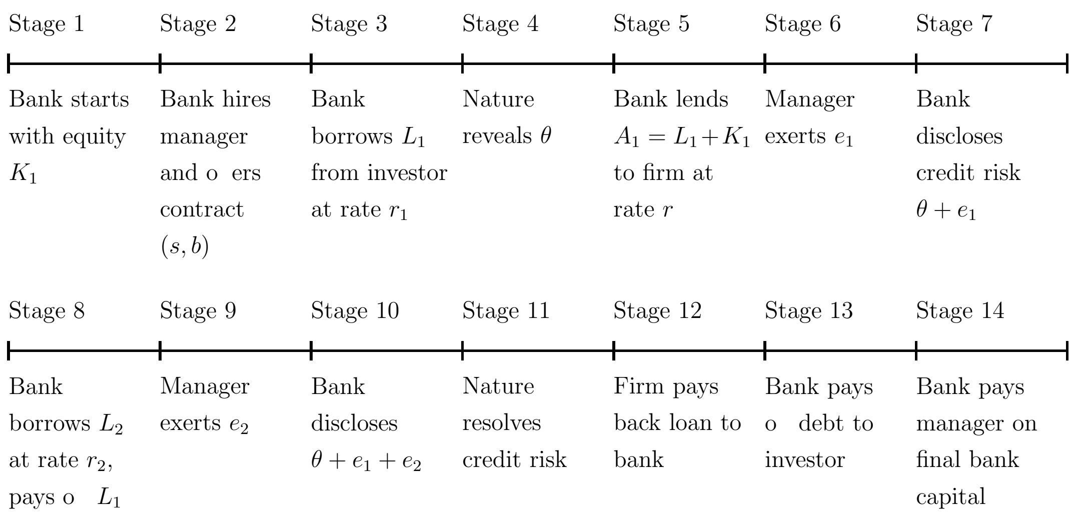

Figure 3: Timeline of game with disclosure.

The analysis precedes as before, working backwards from the last stage. The probability that the bank defaults is identical to the probability that the firm defaults on its loan in period two. The investor in period two will select his interest rate such that his expected profits are zero, since the investor's market is competitive.

[4] Allowing separate disclosure of θ and e_1 would unravel the moral hazard problem. If the bank discloses e_1, then e ort becomes observable, and therefore contractable, disallowing the need for output-contingent contracts. Disclosing θ alone does not convey the true credit risk of the loan, because it ignores the bank manager's e ort to ensure repayment.

$$p(e_1, \hat{e_2}, \theta)(1 + r_2)L_2 - L_2 = 0 \tag{15}$$

Observe that the investor maintains the standard Nash assumption that he knows the equilibrium $\hat{e_2}$.[5] But in period two, he also knows the disclosure $d_1 = \theta + e_1$. Therefore, his imputed probability of default is a function of d_1, which itself is based on the actual e ort of the manager e_1, rather than simply his equilibrium e ort $\hat{e_1}$. Solving for the interest rate that sets the investor's expected profits to zero,

$$\hat{r_2} = (\theta + e_1 + \hat{e_2})^{-1} - 1 \tag{16}$$

Thus, the investor's second period interest rate is a function of both equilibrium e ort $\hat{e_2}$ as well as the first stage disclosure $d_1 = \theta + e_1$. And because the disclosure is a function of the manager's actual e ort choice, this means that $\hat{r_2}$ is also a function of e_1. The disclosure thus links the two periods together, since the price of debt in the second stage (r_2) is directly a function of first stage e ort. In particular, as the manager exerts more e ort in the early stage, the investor sets a lower interest rate. Intuitively, the manager works hard to lower the credit risk of the loan, and this is disclosed to the market. With the disclosure, the investor observes a lower credit risk, and then charges a smaller risk premium (a lower interest rate) in the second period. The investor rewards the manager for working hard in the first stage by providing a lower cost of funds in the second stage. Solving the manager's first period problem gives the main result:

Proposition 2 *Disclosing credit risk increases managerial e ort, inducing more e ort early on* ($\hat{e_1} > \hat{e_2}$).

Proof The expectation of bank capital at the end of the game is

$$E[K] = p(e_1, e_2, \theta)(1 + r)^2 A_1 - (1 + r_2(e_1))(1 + r_1)L_1 \tag{17}$$

The manager is paid a salary and a bonus on expected bank capital, so in period one he solves

$$\max_{e_1} s + bE[K] - C(e_1) - C(\hat{e}_2) \tag{18}$$

[5] Use $\hat{e}_t$ to denote equilibrium e ort in the disclosure regime, to distinguish from e_t^*, the equilibrium e ort in the no-disclosure regime.

The FOC gives

$$\frac{\partial p}{\partial e_1} b(1+r)^2 A_1 - b\left(\frac{\partial r_2}{\partial e_1}\right)(1+r_1)L_1 = C(e_1) \tag{19}$$

This occurs because r_2 is now a function of e_1. Now $p = \theta + e_1 + e_2$ and $r_2 = (d_1 + \hat{e_2})^{-1} - 1 = (\theta + e_1 + \hat{e_2})^{-1} - 1$, so rewriting,

$$b(1+r)^2 A_1 + \frac{b(1+r_1)L_1}{\theta + e_1 + \hat{e_2}} = ce_1 \tag{20}$$

Collecting terms and solving for equilibrium e ort,

$$\hat{e_1} = \hat{e_2} + \frac{b(1+r_1)L_1}{\theta + \hat{e_1} + \hat{e_2}} > \hat{e_2}. \tag{21}$$

The inequality follows because all terms in the fraction on the left-hand side are positive.

Note that the proposition establishes a relationship between e ort across stages, but not between the disclosure regime and the non-disclosure regime. In general, we cannot compare these two e ort levels because the existence of disclosure fundamentally changes the game and thereby the payo s to all relevant parties. More specifically, disclosure allows the investor to adjust the interest rate after the intermediate stage and thereby alter first stage e ort. Without disclosure, e ort in stage one is not a function of this interest rate, and so these two terms are not comparable.

We can compare this result to Ray (2007), which finds the opposite result in a different context. There, an agent works over time on a long project and the principal can disclose performance of that project after the first stage. Ray (2007) finds e ort increases in the later stage. This result differs from the one here because of the nature of the production function. In Ray (2007), the firm does not collect output from production until the end of the game. At that point, there may be complementarity across stages if the agent works harder in the later stage, because the marginal return from clearing his performance target is higher. Here, we do not have performance targets, but rather performance pay that decreases in the cost of funds. Disclosure in this game operates through the channel of the outside investor; in Ray (2007), it is information that is useful for the agent's own decision-making.

Note that I do not solve for the optimal contract. In so far that it induces the behavior of the manager, the optimal contract by itself is not of deep concern. The large and voluminous literature on optimal contracts has thoroughly explored this issue and my focus here is on behavior for any given contract parameter.

4 Conclusion

Since the recent global financial crisis, there has been a tectonic shift in the policy world towards more onerous regulation of the banking sector, primarily, though not exclusively, through the Dodd-Frank Act. Bank regulators not only have more power given to them through Congress, but also from the increase in power of the Federal Reserve and the other major banking regulators in the U.S (OCC, FDIC, etc.). At the same time, there has been widespread acknowledgement that incentives were at the core of the problem leading up to the financial crisis, but little actual research on what those underlying incentive problems were and how they may be resolved.

A bank exists to engage in maturity transformation: borrowing short and lending long. A bank manager is necessary to improve credit risk on its loan portfolio because of internal agency problems. However, various contractual constraints internally prevent the writing of an efficient contract. So there still exists a problem inside the bank, where the manager does not have the same incentives as the shareholders. Disclosure of credit risk to the financial markets can resolve this residual agency problem because it o ers a channel through which the external investor can discipline the internal manager. The investor lends to the bank each period, and can therefore condition its second stage interest rate on information from the first stage, if it is available. Knowing this, the manager will work harder early on in order to secure a better cost of funds in the later stage. He does this because he is paid on output; his pay for performance contract, while imperfect, is nonetheless vital to induce him to work more.

Future research can extend the work here by modeling a richer structure inside the bank. Recall that the Dodd-Frank Act included the Volcker rule that removed proprietary trading from banks, the trading activities in which investment banks traded their own capital for profit. Many believed this form of trading created risk for the bank as a whole and led to much of the problems in the financial crisis. With the Volcker rule in place, this begs the question of how the new equilibrium behavior of banks will change. Furthermore, it is worthwhile to understand how financial disclosure interacts with the actions of bank regulators who conduct their analysis, often behind closed doors. That remains an interesting topic for future research.

5 References

1. Allen, Franklin. "Credit Rating and Payment Incentives." Review of Economic Studies 50.4 (1983).

2. Basel Committee on Banking Supervision. Composition of Capital Disclosure Requirements. Basel Committee on Banking Supervision, 2012. Web. 10 July 2014.

3. Bolton, Patrick, and David Scharfstein. "A Theory of Predation Based on Agency Problems in Financial Contracting." The American Economic Review 80.1 (1990).

4. Beyer, Anne, Daniel A Cohen, Thomas Z. Lys, and Beverly R. Walther. "The nancial reporting environment: Review of the recent literature." Journal of Accounting and Economics 50 (2010): 296 343

5. Diamond, Douglas W. "Financial Intermediation and Delegated Monitoring." Review of Economic Studies (1984).

6. Diamond, Douglas W. "Monitoring and Reputation: The Choice Between Bank Loans and Directly Placed Debt." Journal of Political Economy 99.4 (1991).

7. Diamond, Douglas W., and Philip H. Dybvig. "Bank Runs, Deposit Insurance, and Liquidity." Journal of Political Economy 91.3 (1983): 401.

8. Dye, Ronald A. "An Evaluation of "Essays on Disclosure" and the Disclosure Literature in Accounting." Journal of Accounting and Economics 32.1 (2001)

9. Enhanced Disclosures Task Force (EDTF). Enhancing the Risk Disclosures of Banks. Enhanced Disclosures Task Force (EDTF), 2012. Web. 10 July 2014.

10. Enhanced Disclosures Task Force (EDTF). Progress Report to Financial Stability Board. Enhanced Disclosures Task Force (EDTF), 2013. Web. 10 July 2014.

11. Federal Deposit Insurance Corporation. Regulatory Capital Rules, Final Rule. 79 Federal Register 71, 2014. Web. 10 July 2014.

12. Federal Reserve System. Risk-Based Capital Guidelines; Market Risk Final Rule. 78 Federal Register 243, 2013. Web. 10 July 2014.

13. Gorton, Gary, and James Kahn. "The Design of Bank Loan Contracts, Collateral, and Renegotiations." National Bureau of Economic Research (1993).

14. Hart, Oliver, and Dwight Ja ee. "On the Application of Portfolio Theory to Depository Financial Intermediaries." Review of Economic Studies 41.1 (1974).

15. Ho, Thomas, and Anthony Saunders. "The Determinants of Bank Interest Margins: Theory and Empirical Evidence." The Journal of Financial and Quantitative Analysis 16.4 (1981).

16. Holmstrom, Bengt, and Jean Tirole. "Financial Intermediation, Loanable Funds, and the Real Sector." The Quarterly Journal of Economics 112.3 (1997).

17. Koehn, Michael, and Anthony Santomero. "Regulation of Bank Capital and Portfolio Risk." The Journal of Finance 35.5 (1980).

18. Lintner, John. "The Valuation of Risk Assets and the Selection of Risky Investments in Stock Portfolios and Capital Budgets." The Review of Economics and Statistics 47.1 (1965).

19. Merton, Robert. "On the Pricing of Corporate Debt: The Risk Structure of Interest Rates." Journal of Finance 29.2 (1974).

20. Pyle, David. "On the Theory of Financial Intermediation." The Journal of Finance 26.3 (1971).

21. Ray, Korok. "Performance Evaluations and Efficient Sorting." Journal of Accounting Research 45 (2007).

22. Rochet, Jean-Charles. "Capital Requirements and The Behaviour of Commercial Bank." European Economic Review 36.5 (1992).

23. Sharpe, William. "Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk." The Journal of Finance 19.3 (1964).

24. Townsend, Robert. "Optimal Contracts and Competitive Markets with Costly State Verification." Journal of Economic Theory 21.2 (1979).

25. Verrecchia, Robert E. "Essays on Disclosure." Journal of Accounting and Economics 32 (2001): 97 - 180.