Topic 6 : The Theory of Financial Intermediation

EE431/438

Peter D. Spencer, Chapter 8 (available at the reserve section of the library, HG173 .S637)
Douglas W. Diamond, Financial Intermediation as Delegated Monitoring: A Simple Example. Federal Reserve Bank of Richmond *Economic Quarterly*, Volume 82/3 Summer 1996, pp 51 -66

2014

Outline

1. Introduction
2. Shortcomings of direct finance
3. How banks help to resolve the problem?
    1. Confidentiality and The Banking Relationship
    2. Role of Diversification in Banking : Financial Intermediation as Delegated Monitoring, Diamond(1996)

1. Introduction

- Direct Finance : lenders contract borrowers directly.
- Indirect finance : lenders first lend to banks who then lend to borrowers.
- Having an intermediary is costly. Why do we need a financial intermediary?
- Financial market : asymmetric information
- What is the financial technology that gives the banks the ability to serve as middleman?
- To answer the question, we study how banks solve the asymmetric information problem in the financial market
  - confidentiality and the banking relationship
  - a simplified version of the model in Financial Intermediation and Delegated Monitoring (Diamond 1984)

2. Shortcomings of direct finance

- Think about a simple world where N investors have excess funds to jointly provide financing to a borrower's project
- Before making a decision to fund the project, the investors should be convinced to the value/quality of the project
- Otherwise, the cost of funding would be high : "adverse selection" problem
- Credit rating agency help mitigating the information problem
- Reveal the information $\Rightarrow$ "Tranparency"

“Information dilution” problem

- However, information revealed may benefit their rivals.
- Knowledge-based industries try to remain private as long as they can ; i.e. pharmaceutical industries etc.
- Company’s signalling by buying share back may not be effective
- What are the other problems?

“Control dilution” problem

- There will be so many shareholders and creditors.
- Equity issues reduce the borrower’s managerial control.
- It also causes **“Principal-Agent”** problem and **“Moral Hazard”** problem
- If each investor’s funds are so small, no investor has the incentive to monitor entrepreneur because the cost is likely more than the benefit (which is sharing among N investors)
- There will be no monitoring activities. This is the well-known **“free-rider problem”.**

3. How banks help to resolve the problem?

- How banks help to resolve the problem?
  1. Confidentiality and the banking relationship : banking relationship is highly confidential
  2. Economies of scale and diversification : cost of screening and monitoring the borrowers is reduced due to large scale of lending, risk is also reduced due to portfolio diversification

3.1 Confidentiality and the banking relationship

- Banks are given access to insight information which allows them to finance a company privately without revealing its trade secrets to the market or their rivals
- A business which its stock are undervalued by the market : raising funds through direct financing is too costly (signaling is not a good option since it may not be effective or it might benefit their rivals)
- Businesses usually trust a bank, they are willing to reveal their trade secrets to a bank.
- By law, financial institutions can do only financial businesses.

- COMMERCIAL BANKING ACT

Section 9 bis17. Inaddition to undertaking the business of commercial banking,a commercial bank may carry on any business which is connected with or incidental to commercial banking business or any business traditionally regarded as commercial banking practice, such as, the collecting of money against bills, giving of aval to bills, acceptance of bills, issuing letters of credit, or giving guarantees or, if permission is obtained from the Bank of Thailand, any other business of a similar nature; but it shall not carry on any other trade or business. (Source: www.bot.or.th)

- They keep their's customer's secrets and establish the "**long term customer relationship**".
- This benefits the banks by reducing asymmetric information problem through **"economy of scope"**.
- The company's bank account provides an excellent indicator of cashflow and fiancial viability.
- By doing both deposits and loans services, the cost of screening and monitoring reduces.
- When a company is given a large sum of bank loans, this signals that the company has a growth potential and hence mitigating the security mispricing problem.
- **The bank's signalling** is effective.

- Evidence for the signalling role of the banks (Peter D. Spencer pp 162 - 163)
    - James (1987) : effect of annoucements of bank loans to US firms on their share prices
        - annoucement $\Rightarrow$ share price $\uparrow$ 1.5%
        - this result is contradict to studies of public bonds issues : public bonds issues $\Rightarrow$share price $\downarrow$
    - Lummer and McConnell (1989)
        - announcement to new borrowers $\Rightarrow$ effect on share price is insignificant
        - favourable revisions to existing borrowers $\Rightarrow$ a positive effect on share price (and vise versa)
    - This explains why even large company with AAA ratings borrow from banks as well as the bond market
    - UK and Europe : formal loan annoucement is less common $\Rightarrow$ hard to test the existence of the effect
- more recent evidence $\Rightarrow$ abundant literature on loan announcement and stock price relationship

3.2 Financial Intermediation as Delegated Monitoring

- Asymmetric information between lenders and borrowers $\Rightarrow$ moral hazard and adverse selection problem
- monitoring can improve efficiency
- "monitoring" means
  - screening : we need to know about the borrower's business in order to determine its potential profitability, in the context of adverse selection
  - preventing : observing the borrower in order to ensure that the borrower will invest the funds in the investment project as promised
  - punishing or auditing : to punsih the borrowers who fails to meet the contractual obligation. It is sometimes costly to verifythe borrower's performance. Though the project succeeds, the borrower may declare that the project fails and may default on the loan. This is the context of "costly state verification"
- Financial intermediation: benefits of economies of scale and benefits of diversification.
- Diamond(1996) (a simplified version of Diamond (1984))

3.2.1 Basic Model Settings

- Consider a borrower who needs to raise a large quantity of capital.
- All lenders and borrowers are risk neutral, but borrowers have no capital.
- Each lender's capital to invest is small relative to the amoung needed to fund each borrower's investment.
- The borrower needs to raise 100 million dollars while each investor has 1 million dollars to invest.
- How many investors each borrower need to borrow from?

$= \frac{\quad}{\quad}$ = ... = *m* investors per one borrower.

- It is assumed that *m* is large.

- The borrower needs to raise \$100 million and each investors requires an expect return of $r = 5\%$ (repayment of \$1.05 million each).
- Each borrower's project's realized value is a random variable with realization denoted by V
  - For example, the project costs \$100 million ,
  - $V =$ $$\begin{cases} H = \text{high outcome} = 140 & \text{success with probability } (1\text{-}\pi) = 0.8, \\ L = \text{low outcome} = 100 & \text{failure with probability } (\pi) = 0.2. \end{cases}$$
- The realization of V is freely observed by the borrower alone. The other cannot observe the total output of the project without paying a cost.
- Witout monitoring, the borrower can appropriate the return to himself, since no one else observe the project's sucess.
- Asymmetric Information $\Rightarrow$costly state verification $\Rightarrow$ moral hazard problem

- Is a borrower willing to speak the truth about the outcome of his/her project?
- Suppose the borrower promises to repay \$131.25 M.
  - When $V = 140$ M.,
    - if the borrower speaks the truth, he/she needs to pay = ... to the lenders. The enterpreneur retains ....
    - if the borrower underreport his/her output - suppose the borrower reports the output of 131.25, he/she will have to pay .... and the borrower retains ....
    - ~ - suppose the borrower reports the output of 110 M., he/she will have to pay .... and retains ....
    - ~ -suppose the borrower reports the output of 100 M. , he/she will have to pay .... and retains ....
- What output the borrower report?

- The smallest possible value of outcome. This is also true for when $V = 100$ M..
- No matter what the true value of the output, the best response of the borrower is to report the smallest possible value.
- The borrower has an incentive to report the outcome of zero, no matter what the true outcome is.
- If there is no cost to the borrower of understating the amount, the borrower always does.
- Even if the investors knows the true value of the output, the borrower obtain it first and thus controls it, the lenders will not be paid unless the borrowers suffers some consequence of not paying.

- Two ways to cope with the problem, (1) punishment (or force into liquidation) and (2) monitoring .
- Consider two financing options.

Figure 1: Direct Finance: Each lender monitors its borrower

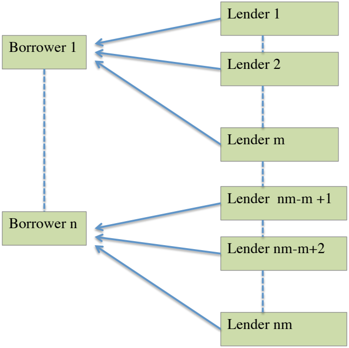
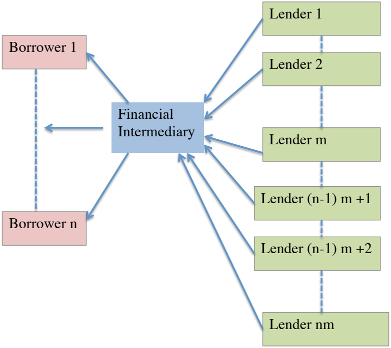


Figure 2. Intermediated Finance as delegated monitoring



- What is the financial techonology that gives the banks the ability to serve as middleman?

- One way to prevent this moral hazard behaviour to happen is to impose some kinds of ***"punishment***". The loan contract includes the punishment.

"What Can the Lender Do IF the Borrower Claims a Low Amount? The lender would like to impose a penalty for low payments to give incentives for higher payments. There are two intrepretations. The lender can liquidate the project of the borrower pays too little, preventing the borrower from absconding with it, or the lender can impose a nonmenetary penalty on the borrower. Bankruptcy in the world today is some combinaton of these two actions. In ancient history, the nonmonetary penalties were very common, i.e., debtors's prison and physical penalties. Such sanction are now illegal, but the loss of reputation of a borrower of a bankrupt firm is similar to a sanction." Diamond (1996)

- How to design the punishment so that the borrowers will avoid the cost of liquidation by paying back the debt?
- Assume that liquidating gives no proceeds to the lenders and the borrower.
- The result is similar when “liquidation yields a positive amount that is much lass than the value of the unliquidated asset.”
- The borrower will be forced liquidation if he/she pay lower than a specified amount, f.
- If the payment, f is paid, the borrower can avoid liquidation.
- The lender then liquidates for all lower payments.
- Suppose that the lenders do not liquidate if $f = 100$ M. is paid (1 M. each).
  - If the borrower has at least 100 M. but he/she pays less than 100M., what will happen?
  - Then, whenever the borrower has at least 100 M., he/she will avoid liquidation by paying .... and keep the remainder for himself/herself.

- The borrower will pay the .... (lowest/highest) amount that avoids liquidation and keep the rest for himslef.
- The payment will never exceeds that lowest amount, f.
- This debt contract has a face value of f. f includes the promised principal and interest.
- $m = 100$. Each investor has \$1. to lend.
- $V = \begin{cases} \$140 & \text{million with probability } 0.8, \\ \$100 & \text{million with probability } 0.2. \end{cases}$
- f denote total loan repayment(principal + interest) promised by each firm.
- Assumed that each investor requires an expected return of at least r(%). Suppose $r = 5\%$ (exogenously given).
- Then, each lender need a repayment of at least .... = $(1 + r)$. (Total payment is at least \$ 105 million = \$ 1.05 M. each $\times 100$ lenders per one borrower)

- What should be the value of f ? (the payment, f if paid to all lenders, the borrower can avoid liquidation)
- Suppose f = 100 Million dollars.
  - When $V = 100$ M., the borrower will pay .... (paying less would result in liquidation).
  - When $V = 140$ M., the borrower will pay .... and keep the rest.
  - The expected return to the 100 lenders is equal to .... = ... which is .... 105 M.. The rate of returns from lending is ..... the required rate.
- Suppose f = 110 million dollars.
  - When $V = 100$ M., the borrower will pay ....
  - When $V = 140$M., the borrower will pay .... and keep the rest.
  - The expected return to the 100 lenders is equal to .... = ... which is .... 105 M.. The rate of returns from lending is ..... the required rate.

- Any f between 100 M. and 140 M. forces the borrower into liquidation when the project returns 100 M. and is paid in full when the project returns 140 M..
- This gives the lender an expected return of ...., because nothing is received when liquidation.
- Solving for the minimum value of f , f = ...

Let $V = \begin{cases} H & \text{million with probability (1-}\pi\text{),} \\ L & \text{million with probability } \pi. \end{cases}$

The lender would receive expected payment of

$(1-\pi)f + \pi(0) = (1-\pi)f \geq (1+r) \times$ principal amount.

The minimum value of $f = \dfrac{(1+r) \times \text{the principal amount}}{(1-\pi)}$

- Suppose f = 131.25 M.
  - When $V = 100$ M., the borrower can pay .... f. The borrower will be forced liquidation. *
  - When $V = 140$ M., the borrower will pay .... and keep the rest.
  - The expected return to the 100 lenders is equal to .... = ... which is .... 105 M.. The rate of returns from lending is ..... the required rate.
- *The best interpretation is that the borrower will choose to pay 0 when $V = 100$ M. because it is the best choice when liquidation is generalized to allow the borrower to keep a positive fraction of retained cash.This leads the lenders to liquidate and receive zero, which occurs with probability 0.2.

- After we impose the punishment system, whenever the borrower has enough money to repay the debt, they will always repay.
- Once we impose "the punishment", the truth about their project's outcome will be revealed.
- When a borrower is forced into liquidiation, nobody gets anything $\rightarrow$ deadweight loss.
- From the example, let $f = 131.25$.M.
- The lender would get .... when $V = 140$ M., and .... when $V = 100$ M.
- We have to punish a borrower with probability ....
- The remaining value of a failed project is gone by bankruptcy process.
- The expected deadweight liquidation cost is equal to $0.2 \times$ .... (per one borrower).
- Without monitoring, the unmonitored debt contract has positive expected deadweight liquidation cost.

- There are n borrowers in the economy.
- Suppose n is large enough to apply law of large number.
- How much is the total deadweight liquidation cost in the economy?

- This cost is the same for both direct finance and indirect finance.

- The expected deadweight loss liquidation cost per borrower is equal to πL.
- The total deadweight loss liquidation cost = $n \times \pi L$.

3.2.3 Monitoring

- Suppose that it is possible for the lender to monitor the value of the borrower's operation.
- Monitoring cost is paid ex ante : lenders must learn in advance about the borrower's business to properly interpret any data about the project returns. The lenders then can verify the true outcome of the project.
- Monitoring $\rightarrow$ the lender knows the true outcome of the project.
- Then, instead of liquidating when the borrower fails to repay f, the lender who monitors can use the threat of liquidation and offer to refrain from liquidation as long as the borrower repays as much as possible.
- Borrower can avoid liquidation by repaying as much as possible.
- With monitoring, we do not have to force liquidation when a project fails. There is no deadweight liquidation cost.

- Monitoring a borrower cost $K = 1.5$ million dollars.
- $m = 100$.
- 100 investors per one borrower.
- There are so many investors, it is hard to cooperate. If investors do not delegate monitoring job to an agent, all investors have to monitor their own borrower.
- Duplicated monitoring costs = ... = ... (per one borrower).
- Duplicated monitoring is prohibitively expensive.
- Therefore, if there is no way to delegate monitoring, the projects will be financed by unmonitored debt. There will be no monitoring activity if the economy relies on direct financing.

- Suppose that small lenders can delegate monitoring job to an agent (let's call him or her "the banker").
- Then, all investors deposit their money to the bank.
- The bank is the sole lender to the borrowers.
- The bank monitors the borrowers on the behalf of the lenders.
- The cost of delegated monitoring becomes .... (per one borrower).

[Recall: Monitoring a borrower cost $K = 1.5$ million dollars.]

- This cost of monitoring the borrower is much lower than cost of duplicated monitoring, which is $mK = 100 \times 1.5 = 150$ million dollars.

- If there were a single lender or if we can delegate monitoring job to the bank, the cost of monitoring the value of one borrower's project is equal to K.
- Delegated monitoring costs K.
- Duplicated monitoring by m lenders would cost mK.
- Total monitoring cost is lower for a single lender due to ***economies of scale***.

- Is monitoring costly efficient?
- Punishment (liquidation policy) costs a deadweight loss liquidation cost of $\pi L = 0.2 \times 100 = 20$ million dollars per one borrower.
- Monitoring costs only 1.5 million dollars per one borrower.
- With monitoring there is no deadweight loss liquidation cost but we have to pay monitoring cost.
- Therefore, when the benefit gained from reducing deadweight loss is higher than the cost of monitoring, monitoring is more cost efficient.

Monitoring is cost efficient than punishment when
$K < \pi L$

- Can we trust the bank?
- Assuming that the bank's performance is its own private information, the bank has an incentive to underreport its outcome or the bank may not monitor the borrowers.
- We may need to pay a "delegation costs " of D to monitor the monitor.
- Duplicated monitoring of the bank by each investors would clearly be inefficient.
- Imposed a liquidation policy.
- $f = 131.25$ million dollars.
- With monitoring, the total expected loan repayment from a borrower is equal to $(1 - \pi) \times 131.25 + \pi(100) = 105 + 20 = 125$.M

$$\text{Let } V = \begin{cases} H = 140 & \text{million with probability } 0.8\text{=(1-}\pi\text{)}, \\ L = 100 & \text{million with probability } 0.2\text{= } \pi. \end{cases}$$

- The bank lends to n borrowers. If n is large enough, the bank will receive 125 $\times$ n for sure (1.25 per one borrower).

- The bank's net income from lending = 125n - monitoring cost = 125n - 1.5n = 123.5n million dollars for sure.
- From the example, the bank can pay at most .... for each depositor which is .... than 105. As long as, the deposit rate, r_d, ... $\leq r_d \leq$ ...., the bank will be able to repay the depositor the promised amount with certainty.
- ($m = 100$. One hundred investors per one borrower.)
- Depositors are always satisfied if the bank can pay at least 5% deposit rate.
- Deposits are asymptotically riskless because of diversification.
- asymtotic : approaching a given value when the sample is large enough.
- At the same loan rate 31.25%, depositors could get a higher return with lower risk.
- Intermediated finance could bring about a welfare improvement.

- The bank may promise its depositor less than that amount and retains the rest for its own.
- If the bank underreports its income and refuse to pay the amount promised to its depositors, the bank will be forced into liquidation. The bank will get nothing.
- Thus, the bank has no incentive to underreport its income. The bank will never default.
- There will be no punishment to the bank because the bank will never default. (We never have to force a bank into liquidation.)
- We never have to pay any delegation cost.
- This is called the benefit from ***portfolio diversification***.
- All depositors get their deposit repayment in full amount as promised in the deposit contract.
- (For direct finance case, not all the lenders get their loan repayment in full amount. How many lenders get their loan repayment back in full amount as promised in the loan contract?)

Direct Financing	Intermediated Financing
punishment (liquidation policy) involves deadweight loss liquidation cost the (expected) deadweight loss liquidation cost = πL per one borrower	
duplicated **monitoring** is costly, inefficient [duplicated monitoring cost = mK per one borrower]	delegated **monitoring** is cost efficient [monitoring cost = K per one borrower]

- When $K < \pi L$, delegated monitoring is efficient*.
- Financial intermediation plays an important role in the economy (reducing the cost associated with asymetric information problem).
- There is no delegation cost because of the role of diversification.
- What is the financial techonology that gives the banks the ability to serve as middleman?

- Delegated monitoring without diversification does not succeed.
    - One-loan bank, a a banker montiors a single loan. The one-loan bank will fail whenever its borrower fails.
    - The one-loan bank will default and be liquidiated just as often as borrowers.
    - The bank in the model has to lend to many borrowers. It is assumed that the law of large number can be applied.
- Diamond (1996) provide numerical examples to Diamond's (1984) model.
    - Diamond(1996) provide a numerical example where diversification reduces the level of risk in the bank's portfolio.
    - However, the risk does not go down to zero. Deposits are not risk-free. (Anyway, it is less riskier than direct financing.)
    - This case is more realistic.
    - A student may read page 60 -63 in Diamond(1996) (not required). Questions are always welcome.

- Several criticisms have been expressed regarding Diamond's theory.
- There are many interesting contribution that builds on Diamond's (1984) model. (If you are interested, see Chapter 2 in "Microeconomics of Banking" by Freixas and Rochet (2000). Note that the material is not required.)
- Lenders should charge high interest rate to high risk customers, low interest rate to low risk customer. (Topic 5 : Credit risk management)
- Banks are in a better position than individual savers. They can analyse credit risk better than individual savers.
- See an evidence from the real world next page.

Table 12. Pricing differences of good and bad risks

	LR	Pricing		
		Overall	**Defaulted**	**Non-Defaulted**
2003	4.0%	4.84	7.74	4.10
2004	4.6%	5.23	7.48	4.76
2005	2.7%	6.30	8.62	5.93
2006	2.4%	7.35	9.01	7.13
2007 H1	3.9%	6.67	8.69	6.39

Source: authors' calculation

Source: BOT Symposium 2007, Structural Analysis on Bank's Corporate Loan Portfolio (Nakornthub et. al.)

Summary

- The moral hazard problem exists because the realization of outcome of the project is freely observed by the borrower alone. The other cannot observe the total output of the project without paying a cost.
- Then, the borrower has an incentive to misreport its outcome.
- There are two methods to cope with the moral hazard problem; punishment (liquidation) and monitoring.
- Given that

$$V = \begin{cases} H = \text{high outcome} & \text{success with probability } (1-\pi) = 0.8, \\ L = \text{low outcome} & \text{failure with probability } \pi = 0.2. \end{cases}$$

- Punishment : We punish any borrowers who default (are unable to pay f). he truths about the project's outcome will be revealed. The expected deadweigh loss liquidation cost of punishing one borrower is equal to πL. Some borrowers will not be able to payback their debt and hence they will be punished. $n\pi L$ is the total deadweight loss liquidation cost of the economy. n is the total number of borrowers.
- Optimal face value of unmonitored debt =
$$f = \frac{(1 + r)(\text{principal amount})}{(1 - \pi)}.$$
- Monitoring : The cost of monitoring one borrower is equal to K. The lenders paid K and then they can verify the true outcome of the borrower's project.
- As long as $K < \pi L$. Monitoring is cost effiecient.
- Direct Finance: Duplicated monitoring
- Indirect Finance : Delegated monitoring, benefit from economies of scale and diversification

- However, the bank also have an incentive to misreport or not to monitor at all.
- Bank's performance and its activities are its own private information.
- We may impose punishment system to prevent the bank from moral hazard behaviour. We will punish (force liquidiation) the bank who fails to pay back its depositors.
- The bank also gains benefits from diversification. Their income is certain due to the fact that they lend to many borrowers.
- The bank will never default.
- Thus, there is no cost of punishing the bank because the bank will never default.

Note 1

- Monitoring a borrower cost $K = 1.5$ million dollars.
- If you have \$100 million to lend to a borrower, which option will you choose; monitored debt, unmonitored debt with liquidation policy?
- For all values of $100 < f < 140$,
  - expected payment from unmonitored debt = $0.8 \times$ ...... $+ 0.2 \times$ ....
  - and expected net payment from monitored debt = $0.8 \times$ .... $+ 0.2 \times$ ...... $-$ monitoring cost $= 0.8f + 0.2(100) - 1.5$.
  - expected repayment from unmonitored debt ...... monitored debt.
  - Thus, monitoring is cost efficient when $K < \pi L$.

Note 2

- The bank can also drive the cost of capital down. Given deposit rate of 5%.
- $0.8F + 0.2(100) - 1.5 = 105$, $F = 108.125$.
- Interest rate on loans is now equal to 8.125%.
- Therefore, the minimum loan rate for monitored debt is equal to 8.125% which is much less than 31.25% for the unmonitored debt.