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

October 2012

Outline

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 intermdiary?
- 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 an entrepreneur E'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 entrepreneur’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 E 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”.**

- Some ways to solve the problems:
  - venture capitalist (providing finance and getting involve in management) can solve “information dilution” but not “control dilution”
  - equity participation contract : motive to overstate profits
- Capital market need a strong legal and accounting system to overcome these problems
- If the legal and accounting system is not strong enough, intermediaries like banks may have the advantage
- literature on bank-based versus market-based financial system

Table 8.1 : Key features of banking and capital markets (pp 160, Peter D. Spencer)

	Capital Market	Banking Market
Tranparency	Open	Confidential
Typical investors	Small	Large
Contracts	Equity and bond	Loan and deposit

3. How banks help to resolve the problem?

- How banks help to resolve the problem? Two schools of thoughts
  1. Confidentiality and the banking relationship : banking relationship is highly confidential
  2. Economies of scale and economies of scope : 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 : a share buyback, 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.

- 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 while the company's signalling may not.

- Banks usually lend on fix. Potential upside gains accrue to shareholders and should be reflected in higher share prices.
- Banks may require the company to finance their new project partly by new equity issuance and partly by bank loans. Why?
- "**equity cushion**" preventing banks from downside risk
- "This allows the bank and the company to turn the financial free-rider problem to their advantage"

- 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 bank loan 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.

Consider an economy where

- All lenders and borrowers (entrepreneurs) are risk neutral
- There are n identical borrowers, each borrower needs to raise a large quantity of capital, m.
- Borrowers have no capital. Their wealth is initially equal to zero.
- Each lender's capital to invest, assumed to be equal to one, is small relative to the amount needed to fund the borrower's investment. (for example, $m = 100$)
- There are $N =$ ..... = ... lenders so that the supply of capital funds is just exactly equal to the demand for capital funds.
- Each borrower endowed with technology to implement the investment project. Each entrepreneur owns a firm.

- Each entrepreneur's project's realized value is a random variable with realization denoted by $\widetilde{Y}$; for example, $\widetilde{Y} = \begin{cases} Y_{HIGH} & \text{with probability } 1\text{-}\pi, \\ Y_{LOW} & \text{with probability } \pi. \end{cases}$
  - The distribution of $\widetilde{Y}$ is known to all borrowers and lenders
  - Project returns are identically and independently distributed.
  - For example, $m = 100$, $\widetilde{Y} = \begin{cases} 140 & \text{with probability } 0.8, \\ 100 & \text{with probability } 0.2. \end{cases}$
- Let L denote total loan repayment(principal + interest) promised by each firm. $L \geq m$. For example, $L = 131.25$ (given), the loan rate is 31.25%.
- Asymmetric Information : the realization of $\widetilde{Y}$ is freely observed by the entrepreneur alone. The other cannot observe the total output of the project without paying a cost. $\Rightarrow$ moral hazard problem $\Rightarrow$ cost associated with the problem (explain in details next page)

- Is an entrepreneur willing to speak the truth about the outcome of his/her project?
  - $Y_{HIGH} = 140$, with prob. 0.8. $Y_{LOW} = 100$, with prob. 0.2.
  - Actual repayment, denoted by X, depends on the outcome of the project reported by the entrepreneur.
  - X is not necessarily equal to $L = 131.25$. For example, when the entrepreneur defaults.
  - When $\widetilde{Y} = 140$,
    - if the entrepreneur speaks the truth, he/she needs to pay X = ... to the lenders. The enterpreneur retains ..... .
    - if the entrepreneur underreport his/her output - suppose the entrepreneur reports the output of 131.25, he/she will have to pay $X =$ ..... and the entrepreneur retains .....
    - ~ - suppose the entrepreneur reports the output of 110, he/she will have to pay $X =$ ..... and retains .....
    - ~ -suppose the entrepreneur reports the output of 100, he/she will have to pay $X =$ ..... and retains .....

- What output the entrepreneur report?
- The smallest possible value of outcome. This is also true for when $\widetilde{Y} = Y_{LOW}$.
- No matter what the true value of the output, the best response of the entrepreneur is to report the smallest possible value.
- If there is no cost to the entrepreneur of understating the amount, the entrepreneur always does.
- Even if the lenders knows the true value of the output, the entrepreneur obtain it first and thus controls it, the lenders will not be paid unless the entrepreneurs suffers some consequence of not paying.

- Two ways to cope with the problem, (1) monitoring and (2) punishment (or force into liquidation).
- There are two system which the economy can choose to finance the investment projects.

Figure 1: Direct Finance: Each lender monitors its borrower

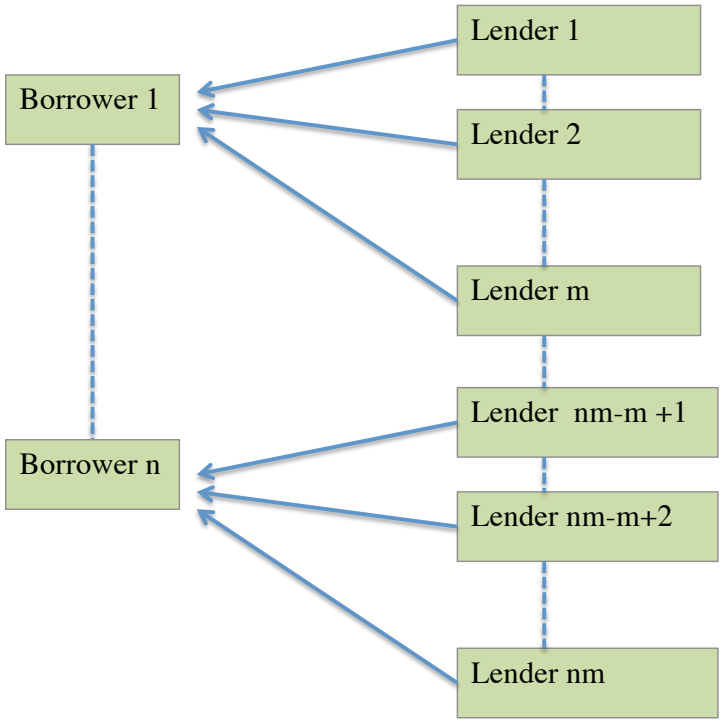
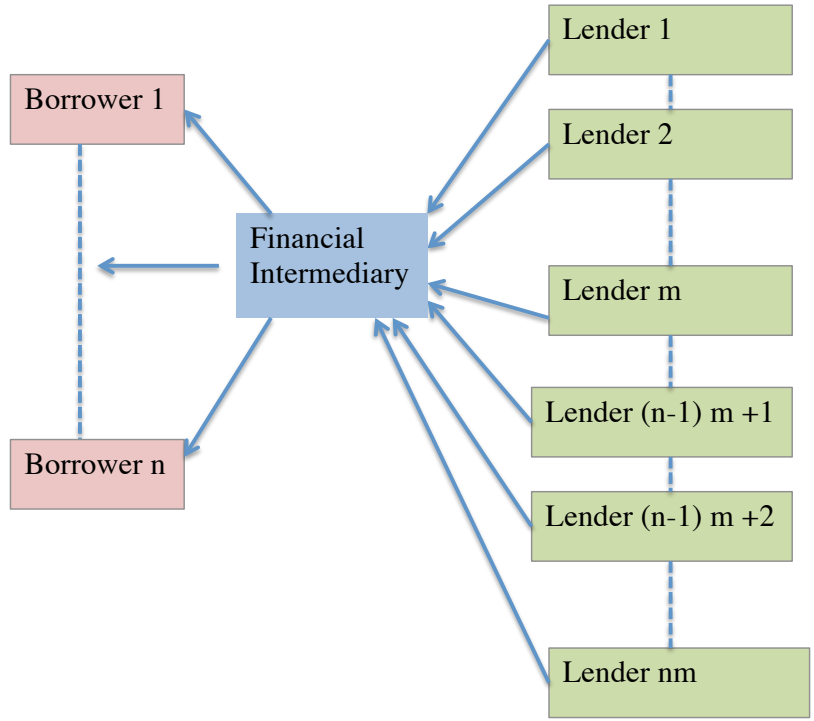


Figure 2. Intermediated Finance as delegated monitoring



3.2.1 Punishment

- The entrepreneur has an incentive to report the outcome of zero, no matter what the true outcome is.
- 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)

- Assume that liquidating gives no proceeds to the lenders and the borrower.
- How to design the punishment so that the borrowers will avoid the cost of liquidation by paying back the debt?
- The borrower will be forced liquidation if he/she pay lower than a specified amount.
- Suppose that the lenders do not liquidate if 100 is paid (1 each).
  - If the entrepreneur has at least 100 but he/she pays less than 100, what will happen?
  - Then, whenever the borrower has at least 100, he/she will avoid liquidation by paying 100 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.
- Let L denote total loan repayment(principal + interest) promised by each firm.
- The payment, L if paid to all lenders, the borrower can avoid liquidation.

- $m = 100$, each lender has 1 of capital fund to lend.
- $\widetilde{Y} = \begin{cases} 140 & \text{with probability } 0.8, \\ 100 & \text{with probability } 0.2. \end{cases}$
- L denote total loan repayment(principal + interest) promised by each firm. In other words, L is the face value of the debt contract between the entrepreneur and the lender (or the bank).
- Assumed that each lender 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 = 1.05 each $\times$100 lenders)
- What should be the value of L ?
- (the payment, L if paid to all lenders, the borrower can avoid liquidation.)

- Suppose L = 100.
  - When $Y = 100$, the entrpreneur will pay ..... (paying less would result in liquidation).
  - When $Y = 140$, the entrepreneur will pay ..... and keep the rest.
  - The expected return to the 100 lenders is equal to ..... = ... which is ..... 105. The rate of returns from lending is ..... the required rate.
- Any L between 100 and 140 forces the borrower into liquidation when the project returns 100 and is paid in full when the project returns 140.
- This gives the lender an expected return of ....., because nothing is received when liquidation.
- Solving for the minimum value of L , L = ...

- Suppose L = 131.25
  - When $Y = 100$, the entrpreneur can pay ..... L. The entrepreneur will be forced liquidation. *
  - When $Y = 140$, the entrepreneur will pay ..... and keep the rest.
  - The expected return to the 100 lenders is equal to ..... = ... which is ..... 105. The rate of returns from lending is ..... the required rate.
- * The best interpretation is that the borrower will choose to pay 0 when $Y = 100$ 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 entrepreneur 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. .
- We have to punish some entrepreneurs (force liquidation) and pay the punishment cost.
  - How many entrepreneurs we have to punish?
- Here, assuming that the cost of punishment is equal to P per one borrower.
- π is the probability of borrower default. In this case $\pi = 0.2$.
- Total punishment cost = the number of borrowers to be punished $\times$ punishment cost per one borrower = ...
- This cost is the same for both direct finance and indirect finance.

3.2.2 Monitoring

- K is the cost of montoring a borrower's project. Let $K = 0.2$.
- 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.
- If there were one large single lender lends to one borrower, then monitoring would cost K.
- Recall that $m = 100$, each lender has 1 of capital fund to lend.
- Monitoring Cost : Direct Finance
  - There are so many lenders, it is hard to cooperate.
  - Duplicated monitoring by each of m lenders would cost .....

- Monitoring Cost : Indirect Finance (Intermediated financing)
  - All lenders deposit their money to the bank.
  - The bank is the sole lender to the firms (entrepreneurs).
  - The bank monitors the borrowers on the behalf of the lenders.
  - The lenders delegate the monitoring task to one agent, the bank.
  - Delegating monitoring to the bank avoids duplication, then total monitoring cost is equal to ..... (cost of monitoring one borrower $\times$ the number of borrowers in the economy).

Method	Direct financing	Intermediated financing
Monitoring		
Punishment		

- Total monitoring cost is lower for intermediated financing due to ***economies of scale***.
- 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.
- We may need to pay a cost to monitor the bank.
- There is a cost of monitoring the bank. Direct monitoring of the bank by each lender would clearly be inefficient.
- Therefore, we consider "punishment" to the defaulted bank. Let C_n is the cost of punishing the bank.
- However, it will be shown later that after we impose such a punishment, the bank will never default.
- Therefore, there is no cost to punish the defaulted bank eventually. C_n is never paid.

- nL is the total loan repayment promised to the bank. The actual repayment the bank received is less than nL because some borrowers will fail to repay.
- If the bank fails, we have to liquidate the bank and to liquidate the bank costs C_n.
- Let Y_i is the actual realization value of borrower i's project. X_i is the actual repayment the bank recieve from borrower i.
- With monitoring, $X_i = \min(L, Y_i)$. $E(X_i) = E[\min(L, Y_i)] < L$. For example. Let $m = 100$ =1 million. L= 131.25 (i.e. loan rate is 31.25% - assumed exogenously given).

$$\widetilde{Y} = \begin{cases} 140 & \text{with probability } 0.8, \\ 100 & \text{with probability } 0.2. \end{cases}.$$

If $Y_i = 140$, $X_i =$ .....

If $Y_i = 100$, $X_i =$ .....

Then, $E(X_i) = 131.25 * 0.8 + 100 * 0.2 =$ ..... < 131.25.

- $E(X_i) - K \geq 1 + r$; Assumed that each lender requires an expected return of at least r (exogenously given). Suppose r = 5% = 0.05, then each lender need a repayment of at least 1.05.
- From the example, $E(X_i) - K =$ ..... or ..... each which is $> 1 + r = 1.05$. Depositors are satisfied. 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.
- Delegated monitoring without diversification does not succeed.
  - One-loan bank, a banker montiors a single loans. 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.

- Bank's total income from lending is equal to $\sum_{i=1}^{n} X_i$.
- $\frac{\sum_{i=1}^{n} E(X_i)}{n} = E(X_i)$ when n is sufficiently large.
- Thus, the bank's total income from lending is equal to $\sum_{i=1}^{n} X_i = nE(X_i)$ = ...n. (for certain)
- The bank's total income from lending net of monitoring cost is equal to $nE(X_i)$ − monitoring cost = $nE(X_i)$ − nK =.....n.
- As long as the bank can promise its depositors ex ante at most (in total amount) $nE(X_i) - nk$= ..... (or ..... for each depositor), the bank will have enough money to repay their depositors.

- 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.
- 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 backin full amount as promised in the loan contract?)
- 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 cost to punish the bank.

Method	Direct financing	Intermediated financing
Monitoring	$nmK = NK$	nK
Punishment	$nP\pi$	$nP\pi$

- $nK < nmK$ due to economies of scale
- There is no cost of punishing the bank. Both monitoring and punishment help revealing the truth about the outcome of the project.
- Indirect Financing: $K < P\pi$. Then, monitoring is more cost effective than punishment. The bank will never default because of the benefit from diversification. There is no cost to punish the bank.
- Direct financing: if m is very large, $mK > P\pi$ (monitoring is costly) and punishment is more cost effective.

- 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.

Summary

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

Method	Direct financing	Intermediated financing
Monitoring	$nmK = NK$	nK
Punishment	$nP\pi$	$nP\pi$

- Punishment : We punish any borrowers who default (are unable to pay L). The cost of punishing one borrower is equal to P. The truths about the project's outcome will be revealed. Some borrowers will not be able to payback their debt and hence they will be punished. πn is the number of borrowers who will be punished. (π is the probability that a borrower will default)

- 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.
- Direct Finance: Duplicated monitoring
- Indirect Finance : Bank as delegated monitoring, economies of scale.
- However, the bank also have an incentive to misreport.
- 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.

- Credit Risk Management of Financial Institutions :
  - the bank should charge high(low) interest rate to high(low) risk customers
  - if the bank cannot separate high risk from low risk customers, it cannot price its financial products correctly
  - then, the bank will make a loss on its lending business
  - “Adverse Selection Problem” : screening, credit analysis, long-term customer relationship
  - Bank can do “credit analysis” “screening” jobs better and at a lower cost than individual borrowers. They are expertise in finanancial businesses and they can establish customer relationship. They also gain benefits from economies of scale and economies of scope.

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.)