Topic 6 : Theory of Financial Intermediation

Federal Reserve Bank of Richmond *Economic Quarterly*, Volume 82/3 Summer 1996, pp 51 -66

EE431: 2/2018

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Contents

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 Short-coming 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 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

3.2 Financial Intermediation as Delegated Monitoring

- more recent evidence $\Rightarrow$ abundant literature on loan announcement and stock price relationship
- 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?

  $=$ ———— = ... = 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 ,
  - $V = \begin{cases} H = \text{high outcome} = 140 & \text{success with probability (1-}\pi\text{) = 0.8,} \\ L = \text{low outcome} = 100 & \text{failure with probability } (\pi) = 0.2. \end{cases}$
- 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

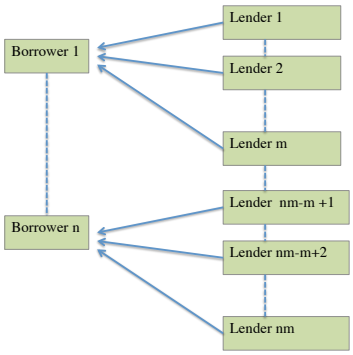
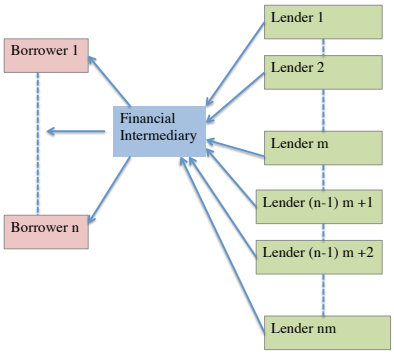


Figure 2. Intermediated Finance as delegated monitoring



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

3.2.2 Punishment : Optimal Unmonitored Debt Contract

- 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 less 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

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

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

- "Liquidation is a sanction that the banker tries to avoid. For simplicity and for symmetry with the assumption made about liquidation of borrowers' projects, I assume that liquidation of the bank is only a sanction and yield no cash to small depositors or to the banker. There are several vawys to interpret this high cost of bank liquidation. One intepretation is that when too little is paid to the depositors, the assets of the bank's borrowers are liquidated to make sure that the banker and borrowers have not colluded to take funds owed to depositors. Another interpretation is that liquidating the bank's asset consumes all of the assets. In addition, because the banker gets zero when there is a default on deposits, a banker who anticipates that the bank is about to fail will reduce any discretionary component of monitoring. The reduced monitoring will decrease the value of bank assests. The assumption that borrower and lenders get zero serves as a simple short hand for those more complicated aspects of the cost of bank liquidation."

- Note: **Topic 6. Financial Intermediation**
- **Can the face value of a monitored debt below 131.25?**
  - **From the example**,
    - we **assume** that with **the same loan rate (31.25%)** as an unmonitored debt (a loan contract with punishment but without monitoring), lenders can receive more returns.
    - This is because the benefits from reducing dead weight loss is higher than monitoring cost.
    - There is **a welfare improvement**.
    - Since we assume the same loan rate (31.25%), **borrower's welfare is the same. Lender's welfare can be improved.**
    - Lenders are now able to receive ..... at **the maximum.**
    - Deposit rate must lie between ..... and ..... ; depending on the degree of competition in banking system.
  - If we **assume** that **the lenders receive the same interest rate** as an unmonitored debt**, which is .....%** [each lender recieve .....]
    - What is **the minimum** loan rate?
    - We need to receive expected payoff net of monitoring cost of at least ..... per one borrower.
    - Expected payoff net of monitoring cost per one borrower is .....
    - Solving for the new face value per one borrower :
      $[..... \times (0.2) + ... \times (0.8)] - ..... \geq .....$

      $f \geq .....$
    - The minimum possible loan rate is ..... .
    - Loan rate is greater than or equal to ..... ; depending on the degree of competition in banking system.
    - Since we assume the same (expected) rate of return for lenders (5%), **lender's welfare is the same. Borrower's welfare can be improved.**
- There are many possible equilibria; depending on the degree of competition, especially in the banking sector.
- For simplicity, we consider just these two cases.

3.2.4 Delegated Monitoring without diversification does not succeed.

- Suppose that the bankers monitors a single loan (runs a one-loan bank) on the behalf of the small lenders, and does not diversify across loans.
- Is there any benefits from economies of scale?
- Is there any benefits from diversification?
- Does it work?
- $f = 131.25$ million dollars.
- With monitoring, the total expected loan repayment from a borrower is equal to $(1 - \pi)131.25 + \pi(100) = 105 + 20 = 125$ million dollars.
- Net of monitoring cost, the bank will receive = ...
- The bank can pay depositors at most ..... (expected value)
- Deposits are asymptotically riskless?
- If the one-loan bank promises its depositor to repay 5% deposit rate, can the one-loan bank able to repay for sure?
- If the one-loan bank promises its depositor to repay 23.5% deposit rate, can the one-loan bank able to repay for sure?
- The one-loan bank will fail whenever its borrower fails.
- Duplicated monitoring to the bank is too costly, If the bank fails, we need to force the bank into liquidation.
- Lender will receive $1+r_d$ with probability ..... and receive ..... with probability .....
- The one-loan bank will be liquidated just as often as the borrower.
- With the same loan rate, this is worse. The bank has to pay monitoring cost.
- Delegated monitoring without diversification will not succeed.

3.2.5 Can the banker use diversification to reduce delegation costs?

- Suppose the banker monitored not one loan but a portfolio of two loans.
- Consider a **two-loan bank**.
- The two-loan bank's portfolio is not riskless but better diversified than individual lender's.

Payment	Probabilty	Probability that payment is $\geq$ this value	Explanation
$2f$			bot pay f
$f + 100$			one pays f and one pay 100
200			both pay 100

- Let B is face value of deposits per one loan.
- The bank receives deposits for 200 and promiste to repay ..... in total (for all 200 depositors).
- Assuming that liquidatingthe bank yields nothing to depositors or to the banker, similar to the liquidation of borrowing firms.
- If the bank must be liquidated when it collects f from one borrower and 100 from the other, it will be liquidated whenever at least one-loan defaults.
- [Alternatively, if the bank can and will pau its deposits when one loan defaults, it will default only when both loans default.]
- To examine when payment of all deposits is possible when just one loans defaults, the total payment received by all 200 depositors will be 2B with probability ..... and ..... with probabilty .....
- This implies that

  $0.96(2B)$ = ...

  B = ...

- Equivalently

- Consider an economy with ..... identical entrepreneurs (firms).
- Each has no initial capital funds, needs ..... =..... units of capital funds to implement the investment project.
- Lenders are ..... each has ..... unit of capital fund, need at least ..... rate of return (exogeneously determined).
- # of lenders = ... so that Demand for funds = Supply of funds.
- Borrowers implement a risky project costs 100.
  - $V = \begin{cases} H = ... \\ \\ L = ... \end{cases}$
- Expected payoff = 0.8(.....) + 0.2 (.....) = 132
- Describe aysmmetric information and moral hazard problem in the model
  - Is an entrepreneur willing to speak the truth about the outcome of the project?
  - To cope with the problem
    1. Punishiment
    2. Monitoring
  - Financial System : Direct finance and Indirect Finance

1. **Punishment**
   - Describe : liquidation policy
   - $100 < f \leq 140$; ..... repayment if the project fails and ..... if the project succeeds.
   - calculate optimal unmonitored debt contract.

   - Deadweight loss liquidation cost [neither borrower nor lender receive it].
     expected DW = ... per one borrower.
     Aggregate DW = ...

2. **Monitoring**

- monitor cost K per one borrower
- direct finance : hard to cooperate
  - monitoring cost = ... per one borrower
- indirect finance : delegate monitoring trask to "a bank" , a coalition of lenders.
  - monitoring cost = ... per one borrower
- efficiency of monitoring :
  - expected payoff on an unmonitored debt (per one borrower) = ...
  - expected payoff on a monitored debt (per one borrower) = ...
  - Monitoring activity is efficient when .....
- Can we trust the bank? Continue on page 14