

# On Diamond (1984): Intermediaries as delegated monitors

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Theory of Banking

a.a. 2016-2017

*"Why do investors first lend to banks who then lend to borrowers, instead of lending directly?" D. Diamond (1996)*

- Diamond (1984) is a model which investigates:
  - the key role of debt contract in bank lending;
  - the financial technology which gives banks the ability to serve as intermediaries;
  - the importance of diversification within financial intermediaries.

## Introduction/2

- Asset services are those provided to the issuers of the assets held by the intermediary, e.g. bank borrowers.
- Relative to an intermediary that provides no asset services, one who provides asset services will concentrate its portfolio on assets that are held at a comparative advantage. Reduced monitoring costs are a source of this comparative advantage.
- Financial intermediaries are special in Diamond (1984) for the composition of the asset side of their balance sheet.

- Monitoring in broad sense means:
  - *screening* project a priori in a context of adverse selection → ex-ante monitoring
  - *preventing* opportunistic behavior of a borrower during the realization of a project (moral hazard) → interim monitoring
  - *punishing or auditing* a borrower who fails to meet contractual obligations → ex-post monitoring
- Diamond (1984) is a model in which monitoring happens ex-post.

## Delegated monitoring theory/1

- Financial intermediaries should be delegated the monitoring activity, because they may have a comparative advantage in those monitoring activities relative to small individual investors.
- Monitoring the monitor!
- Necessary conditions for this theory to work are:
  - Economies of scale in monitoring: a bank finances many investment projects;
  - Small capacity of investors relative to the size of the investment project: each project needs the funds of several investors;
  - Low cost of delegation: the cost of monitoring the monitor (bank) must be lower than the gains from economies of scale generated by the bank.

## Delegated monitoring theory/2

- Consider an economy in which there are  $n$  identical risk-neutral firms, who seek to finance projects
- Initial investment is normalized to 1
- Returns of investment are uncertain, represented by random variables that are identically and independently distributed
- Cashflow  $\tilde{y}$  of the investment is unobservable to lenders

## Delegated monitoring theory/3

- Investors are small relative to the project size
  - Each investor owns only  $\frac{1}{m} < 1 \rightarrow m$  investors are needed to finance one project
- Monitoring
  - Investors are able to observe the realized cash-flow by paying a monitoring cost  $K$

## Delegated monitoring theory/4

- Since the project outcome is private information of the entrepreneur, he decides and distributes dividends to the investors.
- Investors can only observe the received dividends.
- The entrepreneur keeps whatever left.
- Thus, the entrepreneur has an incentive to understate the realization of the investment project.

This incentive must be taken care of.



## Delegated monitoring theory/5

- Three possible ways of taking care of entrepreneur's incentives to misbehave:
  - + investor relies on optimal debt contract with no monitoring;
  - + investor decides to monitor individually (direct monitoring);
  - + monitoring is delegated to a "third" agent, i.e. a bank (delegated monitoring).
- The least costly among these three will be chosen.

## Optimal contract without monitoring/1

- The contract can only be written on observable variables.
- It includes a non-monetary penalty (reputation loss) that protects investors in those cases in which the entrepreneur does not meet contractual obligations.
- Let the non-monetary penalty  $\phi$  be a function of the dividend  $z$  distributed to investors, i.e.  $\phi(z)$ .
- $\phi(\cdot)$  negatively affect the payoff of the entrepreneur, which is given by:

$$E_{z \in [0, \tilde{y}]} (\tilde{y} - z - \phi(z))$$

## On the non-monetary penalty/1

- Let  $h$  be the lowest repayment that the investor requires to participate in the investment project.
  - If  $h \leq z$ , then the entrepreneur pays no penalty;
  - If  $h > z$ , then the entrepreneur pays a penalty since he is not complying with his contractual obligations; and the penalty  $\phi(z) = h - z$ .
- In the optimal contract  $\phi^*(z) = \max(h - z, 0)$

## Optimal contract without monitoring/2

- The entrepreneur will maximize:

$$E_{z \in [0, \tilde{y}]} (\tilde{y} - z - \phi(z))$$

- subject to the constraints that

$$\phi^*(z) = \max(h - z, 0)$$

$$\{P(\tilde{y} > h) \cdot h\} + \{P(\tilde{y} < h) \cdot E[\tilde{y}|y < h]\} \geq R$$

where  $R$  is the per-project return that each investor demands.

- Within the set of possible investment returns,  $h$  is the lowest possible value that satisfies the investor's participation constraint as an equality.

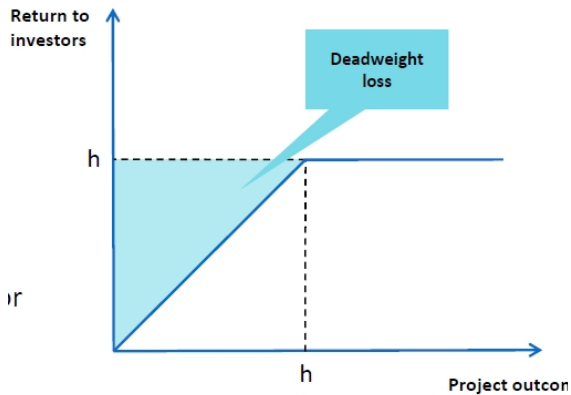
## Optimal contract without monitoring/3

- The entrepreneur's optimal payout will have the following structure:

$$D^* = \begin{cases} y & \text{if } y < h \\ h & \text{if } y \geq h \end{cases}$$

- Hence, the optimal contract is a standard debt contract with face value  $h$ .
- The non-monetary penalty forces the entrepreneur to pay back the investor whenever possible.
- The non-monetary penalty is a disutility for the entrepreneur which does not make the investor better off.

## Optimal debt contract



## The monitoring technology

- Monitoring allows the investor to observe the project returns, when they realize.
- Assumptions:
  - each investor can spend  $K > 0$  resources to observe the realization of an investment project,  $y$ ;
  - monitoring decision is taken at time  $t = 0$ , investor commits to the decision she takes;
  - investment is profitable, i.e.  $E[\tilde{y}] > K + R$ ;
  - if an investor monitors, the realization  $y$  is not observed by other investors, i.e. private nature of information.

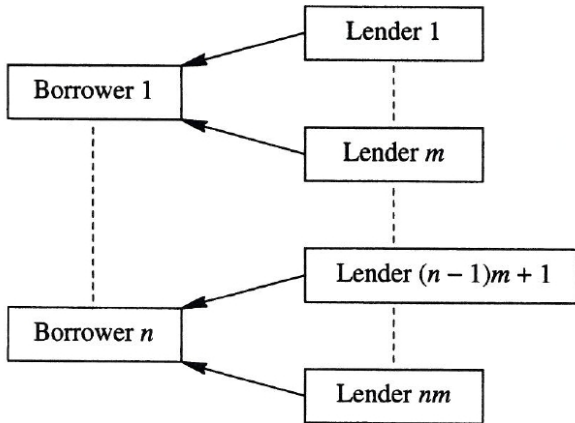
## Direct lending with monitoring/1

- Each investor monitors the firm he has financed
- If there are  $n$  firms that are all financed,
  - $m > 1$  financiers for every firm,
  - and monitoring an individual firm costs  $K$

then, direct monitoring implies a total monitoring cost equal to  $mnK$ .



## Direct lending with monitoring/2



Monitoring

## Direct lending with monitoring/3

- For every firm, direct monitoring is preferred to debt contract if the cost of direct individual monitoring is lower than the expected cost of using a debt contract with no monitoring. That is,

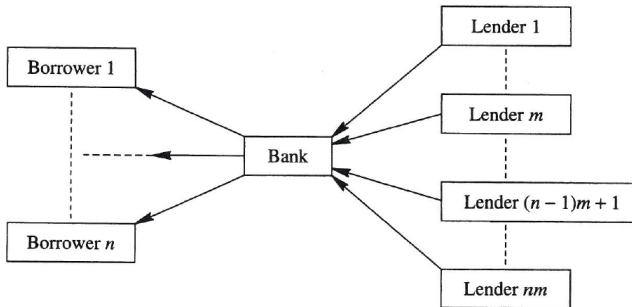
$$mK \leq E_{z \in [0, \bar{y}]}[\phi^*(z)]$$

- Notice that this inequality is less likely with large  $m$ .

## Delegated monitoring/1

- Assume there exists a financial intermediary, i.e. bank, such that:
  - the bank is risk neutral and has no initial wealth;
  - the bank collects deposits from investors and invests them in the firms' projects;
  - the bank has access to the same monitoring technology of the investors, i.e. it costs  $K > 0$  to monitor each investment project;
  - depositors do not monitor the bank, thus she must be given incentives to repay the depositors.

## Delegated monitoring/2



## Delegated monitoring/3

- The bank is delegated the monitoring activity on investment projects.
- The total monitoring cost reduces to  $nK < nmK$  when  $m > 1$ .
- This delegation is costly from the lenders' point of view. Let  $D$  denote the delegation cost to monitor one firm.

## Delegated monitoring/4

- Delegated monitoring is viable when the per-project total cost of relying on a bank ( $K + D$ ) is lower than the minimum between the cost of using a debt contract  $E_{z \in [0, \tilde{y}]}[\phi^*(z)]$  (measured by the expected value of the non-pecuniary penalty) and the cost of direct individual monitoring  $mK$ :

$$K + D \leq \min \left\{ E_{z \in [0, \tilde{y}]}[\phi^*(z)], mK \right\}$$

where  $D$  is the per-project cost of delegation.

- We have to determine  $D$ .

## Delegated monitoring/5

- If all depositors monitor the bank  $\rightarrow$  total cost for the economy is too high:  $mnK + nK > mnK$
- Direct monitoring on the bank is not desirable.
- The optimal contract between depositors and the bank is a debt contract with non-monetary penalties.
- The debt contract has the following features:
  - rate on the deposit contract is  $R_D$ , i.e. for a deposit of  $1/m$  the bank repays  $\frac{R_D}{m}$ ;
  - if the bank announces a cashflow that is not enough to repay all depositors, i.e.  $Z_n = \sum_{i=1}^n z_i = \sum_{i=1}^n \tilde{y}_i - nK < nR_D$ , she is liquidated.

## Delegated monitoring/6

- Depositors have several alternatives with different returns:
  - the debt contract with a return  $R_D$ ;
  - the appropriation of intermediary's cash-flow in case of bankruptcy,  $\frac{Z_n}{n} = \frac{\sum_{i=1}^n \tilde{y}_i - nK}{n}$ ;
  - an outside option yielding a safe return  $R$ , for example a government bond.



## Delegated monitoring/7

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  - an outside option yielding a safe return  $R$ , for example a government bond.
- The participation constraint of the individual depositor can be written as:

$$E\left(\min\left\{\frac{Z_n}{n}, R_D\right\}\right) = R \quad (1)$$

## Delegated monitoring/8

- The cost of delegation is equal to the non-pecuniary penalty paid by the intermediary in case of bankruptcy:

$$D = E \left( \max \left\{ \frac{nR_D + nK - \sum_{i=1}^n \tilde{y}_i}{n}, 0 \right\} \right) \quad (2)$$

- Diamond (1984) proves that the expected bankruptcy cost approaches zero as the number of firms  $n$  increases.
- In other words, the cost of delegating the monitoring to the bank reduces as there are enough investment projects for the bank to achieve extensive diversification.

## Delegated monitoring/9

- Assume that  $K < D_1 \rightarrow$  the bank will choose to monitor her borrowers instead of signing debt contracts.
- Delegated monitoring dominates direct monitoring if  $K + D < mK$ .

*Proposition* If monitoring is efficient ( $K < D_1$ ), investors are small ( $m > 1$ ), and investment is profitable ( $E(\tilde{y}) > R + K$ ), then financial intermediation with delegated monitoring dominates direct lending as  $n$  gets large enough.

## Delegated monitoring: comments/1

- Diamond (1984) discusses the key role of debt contracts in bank finance and the importance of diversification within financial intermediaries.
- A financial intermediary can reduce the deadweight loss caused by asymmetric information, by means of monitoring activity and diversification.