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Chapter 16.1

# Optimal remuneration

# Outline

# Bankers and traders

- Bankers assess securities and loans and monitor them, thereby adding value to the through increased value or higher likelihood of being repaid
- Traders assess the value of the securities and loans provided by other banks with an aim to benefit from trading these
- Remuneration of bankers and traders should be based on the value they add to the bank employing them
- Bankers add social value, while traders do not add social value, they only re-distribute value
- How is remuneration determined for these two types of employees?

# Loan repayments

- Banks have given a loan $L$ with interest $r_L$
- Probability that the loan is repaid is either $\pi_H^i$ or $\pi_L^i = \delta\pi_H^i$
- State $H$ occurs with probability $p$, but this probability for an individual loan is not known to other banks, only thr bank originating the loan
- The other banks receive a signal about the state and this is correct with probability $\rho_i$

# Loans with low and high signals

- A bank does not know the probability with which the loans of another bank is repaid, but from expectations $E_i\left[\pi_s^j\right]$
- Bank $i$ will assess a loan given by bank $j$ if given a signal $L$ as
- $P_L^{ij} = \rho_i E_i\left[\pi_L^j\right](1+r_L)\,L + (1-\rho_i)\,E_i\left[\pi_H^j\right](1+r_L)\,L$
- The signal $L$ can be correct or incorrect, and gives the inference of the high or low probability of default
- For the high signal we get similarly
- $P_H^{ij} = \rho_i E_i\left[\pi_H^j\right](1+r_L)\,L + (1-\rho_i)\,E_i\left[\pi_L^j\right](1+r_L)\,L$

# Seller accepting low offers

- If $\rho_i > \frac{1}{2}$, then $P_L^{ij} < P_H^{ij}$
- A bank can always offer to sell at $P_L^{ij}$ and the loan will be purchased, if the banks wants to sell at $P_H^{ij}$, then the buyer needs to have the high signal
- We need $P_L^{ij} > pP_H^{ij}$ for the seller to accept the low offer
- This gives $\rho_i \leq \frac{1-p\delta}{(1-\delta)(1-p)}$
- Adverse selection must not be too high for the seller willing to accept low offers

# Liquidity shock

- A bank faces a liquidity shortage with probability $\lambda$ and has to sell loans
- A bank not facing a liquidity shortage has excess liquidity and would buy these loans
- Banks employ bankers, who can affect the probability of loans being repaid, $\pi_j^i$
- Banks employ traders, who obtain signals with precision $\rho_i$

# Bank profits

- Banks facing a liquidity shortage, sell the loan for what the other bank thinks it is worth, $P_L^{ji}$
- Banks not facing a liquidity shortage, retain their loan
- and purchase at a price $P_L^{ij}$ the loan of the other bank
- They pay depositors and their bankers and traders
- $$\begin{aligned}\Pi_B^i = \lambda P_L^{ji} + (1-\lambda)\Big(&p\pi_H^i\left(1+r_L\right)L + (1-p)\,\pi_L^i\left(1+r_L\right)L \\ &+ \left(pE_i\left[\pi_H^j\right]\left(1+r_L\right)L + (1-p)\,E_i\left[\pi_L^j\right]\left(1+r_L\right)L - P_L^{ij}\right)\Big) \\ &-(1+r_D)\,D - w_T N_T^i - w_B N_B^i\end{aligned}$$

# Price of the loan the other bank pays

- The price paid will be determined by the inference the bank has on the quality of the signal by the other bank
- $P_L^{ji} = E_i\left[\rho_j\right]\pi_L^i\left(1+r_L\right)L + \left(1-E_i\left[\rho_j\right]\right)\pi_H^i\left(1+r_L\right)L$
- Probability of loans being repaid and the quality of the signal are not given but banks will optimize them

# Hiring more bankers and traders

- Hiring more bankers increases the likelihood of loans being repaid: $\frac{\partial \pi_s^i}{\partial N_B^i} > 0$
- Hiring more traders increases the precision of the signal: $\frac{\partial \rho_i}{\partial N_T^i} > 0$
- The total number of bankers and traders is limited to $N_k$ each
- If a bank hires $N_k^i$ bankers or traders, the remaining banks share $N_k^j = \frac{N_k - N_k^i}{N-1}$

# Influence of bankers and traders

- Influence of bankers on loan repayments of other banks:
  $$\frac{\partial \pi_H^j}{\partial N_B^i} = \frac{\partial \pi_H^j}{\partial N_B^j} \frac{\partial N_B^j}{\partial N_B^i} = -\frac{1}{N-1} \frac{\partial \pi_H^j}{\partial N_B^j} < 0$$
- Influence of traders on signal precision of other banks:
  $$\frac{\partial \rho_j}{\partial N_T^i} = \frac{\partial \rho_j}{\partial N_T^j} \frac{\partial N_T^j}{\partial N_T^i} = -\frac{1}{N-1} \frac{\partial \rho_j}{\partial N_T^j} < 0$$
- As the number of bankers and traders is limited, hiring more will reduce the number available to other banks and thus reduce their probability of loan repayment or signal precision

# Number of bankers and traders

- Ignoring the effect hiring a banker has on the ability of other banks, the optimal number of bankers and traders to hire is given from $\frac{\partial \Pi_B^i}{\partial N_T^i} = \frac{\partial \Pi_B^i}{\partial N_B^i} = 0$
- All banks are alike, hence banks will infer that they behave like them: $E_i\left[\pi_H^j\right] = \pi_H^i$ and $E_i\left[\rho_j\right] = \rho_i$
- Traders: $w_T^* = (1-\lambda)(1-\delta)\pi_H^i(1+r_L)L\frac{\partial \rho_i}{\partial N_T^i}$
- Bankers: $w_B^* = (V + (1-\delta)\lambda(1-\rho_i-p)(1+r_L)L)\frac{\partial \pi_H^i}{\partial N_B^i}$

# Equilibrium wages

- A Pareto optimal allocation of resources within banks requires that the marginal products of bankers and traders are identical
- The marginal product of a banker or trader is its wage
- This implies that $w_T^* = w_B^* = w^*$
- The wages are adjusted by hiring the requisite number of bankers and traders to adjust $\frac{\partial \rho_i}{\partial N_T^i}$ and $\frac{\partial \pi_H^i}{\partial N_B^i}$ accordingly

# Optimal wages with impact on other banks

- The bank will now take into account the effect its hiring of a banker or trader has on the ability of the other bank to do likewise
- The optimal number of bankers and traders to hire is given from $\frac{\partial \Pi_B^i}{\partial N_T^i} = \frac{\partial \Pi_B^i}{\partial N_B^i} = 0$
- Traders: $w_T^{**} = (1-\delta)\left((1-\lambda) + \frac{\lambda}{N-1}\right)(1+r_L)\,L\frac{\partial \rho_i}{\partial N_T^i}$
- Bankers: $w_B^{**} = \frac{\partial \pi_H^i}{\partial N_B^i}\left(V + \left(\lambda + \frac{1-\lambda}{N-1}\right)(1-\delta)(1-\rho_i - p)(1+r_L)\,L\right)$

# Traders are paid more than bankers

- Comparing with the efficient wage, we get $w_T^{**} > w^* > w_B^{**}$
- Traders are paid more than bankers
- Traders are paid more than their marginal product, they are overpaid
- Bankers are paid less than their marginal product, they are underpaid

# Overpaid traders

- Traders contribute to bank profits by evaluating loans the bank buys
- Hiring traders contributes also to the bank achieving a higher sales price for their loans

$\Rightarrow$ Denying other banks a trader, reduces the precision of their signal

$\Rightarrow$ As $\frac{\partial P_L^{ij}}{\partial \rho_i} < 0$, the sale price of the loan increases

- Traders indirectly contribute more than their marginal product from signal precision to the profits of the bank

# Underpaid bankers

- Bankers increase the value of the loan the bank holds through higher probabilities of repayment
- This also increases the value of the loan to any purchaser as loans are sold at a discount, increasing the loss to the selling bank
- This causes an externality and the banker contributes less than its marginal product from increasing the probability of repayment

# Private benefits

- Traders create profits by buying loans at a higher discount and preventing other banks to purchasing loans at a high discount
- They benefit banks in two ways, making their remuneration high
- Bankers create value to the bank by reducing the default rate of loans, this also benefits the purchaser of a loan as it will be paid at a higher discount
- They create an externality that reduces bank profits, making their remuneration low

# Social benefits

- Bankers produce social value by reducing defaults
- Traders produce no social surplus as they only redistribute value between banks
- The activity increasing welfare is paid less than the activity adding no welfare
- It is privately rational to reward traders more highly

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