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Chapter 15.2

# Remuneration of traders

# Outline

# Traders as employees

- Investment banks' trading desks employ traders, who require remuneration
- Traders can be informed or uninformed, the investment bank will not be able to determine this when employing them
- Investment banks commonly remunerate traders based on their performance rather than on fixed salaries
- This is often seen as an incentive device to exert effort, but also leads to moral hazard in risk-taking
- It might be the most profitable way of paying traders

# Trader types

- Traders are informed with probability $\gamma$
- Informed traders know the change in value of the security, $\Delta V$, uninformed traders know its expected value $E[\Delta V] = 0$ and variance $Var[\Delta V] = \sigma_V^2$
- Noise traders trade for exogenous reasons with expected trading demand $E[U] = 0$ and variance $Var[U] = \sigma_U^2$

# Price setting

- The price is set such that it mirrors the inference of the change in the value, given the demand: $\Delta P = E\left[\Delta V | D\right]$
- The relationship is assumed to be linear: $\Delta P = \lambda D$
- This is a regression of the demand on the price change, the coefficient being $\lambda = \frac{Cov[\Delta V, D]}{Var[D]}$

# Trader profits

- A trader not employed by an investment bank can trade independently and faces a trading fee $f$
- If the trader is uninformed he will not trade as he will not make a profit against informed traders, $Q_U = 0$
- Total demand is then $D = Q_I + U$
- Trading profits: $\Pi_T = E\left[\left(\Delta V - (1+f)\,\Delta P\right) Q_I | \Delta V\right] = \left(\Delta V - (1+f)\,\lambda Q_I\right) Q_I$

# Optimal demand

- Traders will maximize their profits with first order condition $\frac{\partial \Pi_I}{\partial Q_I} = 0$
- Optimal demand: $Q_I = \frac{\Delta V}{2(1+f)\lambda}$
- Profits: $E[\Pi_T] = \frac{\sigma_V^2}{4(1+f)\lambda}$

# Demand for employed traders

- Investment banks will pay enough to induce informed traders to join them: $w = E[\Pi_T]$
- Uninformed traders cannot be identified, hence will also be hired and will trade as to not be detected
- They will assume the change in security value to be $\Delta\hat{V}$
- Traders at the investment bank do not face trading costs, thus $f = 0$
- For informed traders: $Q_I = \frac{\Delta V}{2\lambda}$
- For uniformed traders: $Q_U = \frac{\Delta\hat{V}}{2\lambda}$

# Total demand

- If an informed trader is not employed, he will demand $\hat{Q}_I = \frac{\Delta V}{2(1+f)\lambda}$
- Trading demand arises if the informed trader is employed, or the uninformed trader is employed, with the informed trader acting independently, plus noise traders
- $D = \gamma Q_I + (1-\gamma)\left(Q_U + \hat{Q}_I\right) + U$

# Equilibrium pricing

- Uniformed traders cannot infer security values: $Cov\left[\Delta V, \Delta\hat{V}\right] = 0$ and $Var\left[\Delta V\right] = Var\left[\Delta\hat{V}\right]$
- They will trade randomly giving the impression having received $\Delta\hat{V}$
- This gives $Cov\left[\Delta V, D\right] = \frac{\sigma_V^2(1+\gamma f)}{2(1+f)\lambda}$ and $Var\left[D\right] = \frac{\sigma_V^2(1+\gamma f)^2}{4(1+f)^2\lambda^2} + \frac{(1-\gamma)^2}{4\lambda^2} + \sigma_U^2$
- Solving for $\lambda = \frac{1}{2}\frac{\sigma_V}{\sigma_U}\sqrt{2\frac{1+\gamma f}{1+f} - \left(\frac{1+\gamma f}{1+f}\right)^2 - (1-\gamma)^2}$

# Investment bank profits

- Trading profits are from the profits of informed traders and losses of uniformed traders
- $\Pi = \gamma E\left[\left(\Delta V - \Delta P\right) Q_I | \Delta V\right] + \left(1-\gamma\right) E\left[\left(\Delta V - \Delta P\right) Q_U\right]$
- Profits: $\Pi_B = E\left[\Pi\right] - w = \left(\gamma - \frac{1}{2}\frac{2+f}{1+f}\right) \frac{\sigma_U \sigma_V}{\sqrt{2\frac{1+\gamma f}{1+f} - \left(\frac{1+\gamma f}{1+f}\right)^2 - (1-\gamma)^2}}$

# Operating a trading desk

- Investment banks will only operate a trading desk if $\Pi_B \geq 0$
- This requires $\gamma \geq \frac{1}{2}\frac{2+f}{1+f}$
- We need sufficient informed traders that trade profitably to ensure the losses made by uninformed traders are covered
- For reasonably low trading costs $f$, this threshold is very high

# Total demand

- Investment banks will only pay traders according to the profits they make
- Informed traders will receive a schedule that induces them to join the investment bank
- Uniformed traders will not trade as they make losses
- Total demand is from the informed traders employed by the investment bank, informed traders not employed, and noise traders
- $D = \gamma Q_I + (1 - \gamma)\,\hat{Q}_I + U$

# Trading profits

- We get $Cov\left[\Delta V, D\right] = \sigma_V^2 \frac{1+\gamma f}{2(1+f)\lambda}$ and $Var\left[D\right] = \sigma_V^2 \frac{(1+\gamma f)^2}{4(1+f)^2\lambda^2} + \sigma_U^2$
- Solving for $\lambda = \frac{1}{2}\frac{\sigma_V}{\sigma_U}\frac{\sqrt{(1+\gamma f)(2(1+f)-(1+\gamma f))}}{1+f}$
- Trading profits are from the informed traders employed: $\Pi = \gamma\left(\Delta V - \Delta P\right) Q_I$

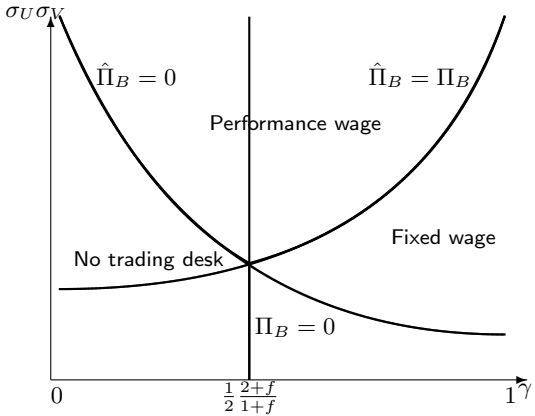
# Investment bank profits

- Performance needs to be evaluated, this costs investment banks $C$
- Investment banks obtain trading profits, pay the wages to informed traders only, and face costs of evaluating trader performance
- Profits: $\hat{\Pi}_B = E[\Pi] - \gamma w - C$
- Investment banks will only operate a trading desk if $\hat{\Pi}_B \geq 0$
- This requires $\sigma_U \sigma_V \geq \frac{2C}{\gamma f} \sqrt{(1+\gamma f)(2(1+f)-(1+\gamma f))}$
- Only if the uncertainty is large enough can informed traders generate enough profits to cover the costs of monitoring

# Performance and fixed wages

- If a trading desk is operated, the bank needs to decide how to pay traders
- They will prefer paying a performance wage if $\hat{\Pi}_B \geq \Pi_B$
- This gives $\sigma_U \sigma_V \geq \dfrac{C}{\frac{\gamma f}{2} \frac{1}{\sqrt{(1+\gamma f)(2(1+f)-(1+\gamma f))}} - \frac{\gamma - \frac{1}{2}\frac{2+f}{1+f}}{\sqrt{2\frac{1+\gamma f}{1+f} - \left(\frac{1+\gamma f}{1+f}\right)^2 - (1-\gamma)^2}}}$
- If many informed traders are present, the costs of fixed wages are low as few uninformed traders are rewarded, making fixed wages more attractive
- If the uncertainty is high, uninformed traders will make more losses, making the performance wage more attractive as then they do not trade and incur no losses

# Equilibrium remuneration contracts for traders



# Impact of informed traders and uncertainty

- For few informed traders, the losses from employing uninformed traders are too high to allow a fixed wage
- For few informed traders, the profits from employing informedtraders are too low to cover monitoring costs in performance wages
- For low uncertainty, the profits made by informed traders are too low to cover the evaluation costs in performance wages
- For many informed traders, the costs of paying uninformed traders is low compared to monitoring costs, making fixed wages more profitable

# Dominance of remuneration forms

- Investment banks will operate trading desks only if there is sufficient uncertainty in the market and they can employ enough informed traders
- Markets with lower uncertainty and easily identified informed traders will see fixed wages being paid, but the threshold is very high
- Highly volatile markets with fewer informed traders will see performance wages dominate
- We will mainly observe performance wages or no trading desk

# Markets with trading desks

- Trading in well-understood securities will be less attractive to investment banks
- If traders can be identified as understanding a market sufficiently well, they will be paid performance wages
- This should be reflected in the importance of bonus payments in the total remuneration of traders

This presentation is based on
Andreas Krause: Theoretical Foundations of Investment Banking, Springer Verlag 2024 

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