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Chapter 3

Selling information

Outline

- Problem and model assumptions
- Uninformed investment banks
- Informed investment banks
- Purchase of information
- Summary

Opportunity to sell information

- Investment banks have superior information on investment opportunities
- They could use this information for their own investments
- Additionally, they could sell the information to clients
- Information cannot be verified ex-ante, customers would want a verification mechanism to ensure it exists

Signals

- Informed investment banks receive an imperfect signal on the return:
- $R = s + \varepsilon$
- For uninformed investment banks it is $E[s] = \mu$, $Var[s] = \sigma_S^2$
- $E[\varepsilon] = 0$, $Var[\varepsilon] = \sigma_\varepsilon^2$
- $Var[R] = \sigma_R^2 = \sigma_S^2 + \sigma_\varepsilon^2$

Investments

- Investment banks invest into risk-free government securities and the risky asset
- The final value is $W_1 = (1+r)\,G + (1+R)\,V = (1+r)\,W_0 + (R-r)\,V$
- Expected utility is then given by $U_B = E[W_1] - \frac{1}{2} z Var[W_1]$

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Optimal investment without selling information

- If investment banks are uninformed, they observe no signal
- Then $E[R] = \mu$ and $Var[R] = \sigma_R^2$
- This gives $E[W_1] = (1+r)W_0 + (\mu - r)V$ and $Var[W_1] = \sigma_R^2 V^2$
- Maximizing expected utility for the optimal investment V we get $\frac{\partial U_B}{\partial V} = (\mu - r) - z\sigma_R^2 V = 0$
- Solving for $V^* = \frac{\mu - r}{z\sigma_R^2}$
- Expected utility is then $U_B^* = (1+r)W_0 + \frac{(\mu - r)^2}{2z\sigma_R^2}$

Preventing uninformed selling of information

- Investment banks can claim they have received a signal, even if this is not true
- Investment banks will charge a price for this information and obtain this revenue in addition to the utility from investment
- $\hat{U}_B = (1+r)\,W_0 + (\mu - r)\,V + P - \frac{1}{2} z \sigma_R^2 V^2$
- Investment into the risky asset might change if selling information
- The investment bank will refrain from selling information it does not hold if $\hat{U}_B \leq U_B^*$
- This solves for $P \leq P^* = \frac{(\mu-r)^2}{2z\sigma_R^2} - (\mu - r)\,V + \frac{1}{2} z \sigma_R^2 V^2$

Selling news for long positions ($V > 0$)

- The risk aversion of investment banks is unknown, so the constraint on P must hold for all values
- The smallest possible price P is given from $\frac{\partial P^*}{\partial z} = -\frac{(\mu-r)^2}{2z^2\sigma_R^2} + \frac{1}{2}\sigma_R^2 V^2 = 0$
- Giving $z^2 = \frac{(\mu-r)^2}{\sigma_R^4 V^2}$
- Assume that $\mu > r$, then if $V > 0$, we have $z = \frac{\mu-r}{\sigma_R^2 V}$
- From this we get $P^* = 0$
- If $V > 0$ the investment bank would always sell information it does not have

Selling news for short positions ($V < 0$)

- If $V < 0$, then $z = -\frac{\mu - r}{\sigma_R^2 V}$ and $P^* = -2(\mu - r)V > 0$ and the investment bank would want to sell the information if the price is high enough
- As banks seek to maximize their utility they will sell information at the highest price P^*
- Inserting this into the expected utility $\hat{U}_B$ and maximizing this expression using $\frac{\partial \hat{U}_B}{\partial V} = 0$, we get
- $\hat{V}^* = -\frac{\mu - r}{z\sigma_R^2}$
- This then gives $P^* = 2\frac{(\mu - r)^2}{z\sigma_R^2}$

Preventing the sale of information that does not exist

- If $V > 0$ for an uninformed investment bank, information should not be sold as it can be from informed or uninformed investment banks
- If $V < 0$ for an uninformed investment bank, information may be sold if the price is below P^* as in this case it is from the informed investment bank

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Optimal investment without selling information

- If investment banks are informed, they observe their signal
- Then $E[R] = s$ and $Var[R] = \sigma_\varepsilon^2$
- This gives $E[W_1|s] = (1+r)W_0 + (s-r)V$ and $Var[W_1|s] = \sigma_\varepsilon^2 V^2$
- Maximizing expected utility for the optimal investment V we get $\frac{\partial U_B}{\partial V} = (s-r) - z\sigma_\varepsilon^2 V = 0$
- Solving for $V^{**} = \frac{s-r}{z\sigma_\varepsilon^2}$
- Expected utility is then $U_B^{**} = (1+r)W_0 + \frac{(s-r)^2}{2z\sigma_\varepsilon^2}$

Selling information

- Utility when selling information is enhanced by the price obtained
- The price does not depend on the investment V, this includes the maximum price P^*
- Informed investment banks would always sell their information
- To distinguish themselves from uninformed investment banks, they would sell only if $V^{**} < 0$
- This implies $s < r$
- Information can only be sold if it is sufficiently negative

Reasons for only selling negative information

- Positive information makes a long position optimal for informed and uninformed banks, this means they cannot be distinguished well
- Negative information makes a short position optimal for informed and a long position for uninformed banks, this means they can be easily distinguished
- Adjustment of security holding for the uninformed investment bank is too large to sell negative information they do not hold
- Purchasers use the investment position of the investment bank as a guide to identify informed and uninformed investment banks

Investor decisions

- Uninformed investors are similar to uninformed banks
- Their expected utility is given by $U_D^* = (1+r)\,W_0 + \frac{(\mu - r)^2}{2z\sigma_R^2}$
- Informed investors are similar to informed banks
- Their expected utility is given by $\hat{U}_D^* = (1+r)\,W_0 + \frac{(s-r)^2}{2z\sigma_\varepsilon^2} - \frac{P^*}{N}$
- We assume that the costs of information P^* is shared among N investors

Becoming informed

- Investors become informed if $\hat{U}_D^* \geq U_D^*$
- This becomes $(s-r)^2 \geq \frac{\sigma_\varepsilon^2}{\sigma_R^2}\left((\mu-r)^2 + \frac{2z\sigma_R^2 P^*}{N}\right)$
- We need $s < r$ to have information being offered, this means
- $s \leq r - \frac{\sigma_\varepsilon}{\sigma_R}\sqrt{(\mu-r)^2 + \frac{2z\sigma_R^2 P^*}{N}} < r$
- Information is only bought if it is sufficiently negative

Information content needed

- The maximum price possible is P^* to prevent uninformed investment banks selling information
- The lower the price the less negative the signal needs to be to be profitable
- Even at $P = 0$ the information needs to be sufficiently negative
- The information needs to deviate from their current knowledge sufficiently to justify the costs

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Only negative information is sold

- Only negative information can be sold, as positive information can be copied by uninformed investment banks
- To verify the existence of information, purchasers can observe the investments of investment banks
- Selling negative information without having it, requires a too large adjustment of the investments, given the price they are charging
- To justify the price of information, it needs to be sufficiently negative to be of value to investors

Market implications

- Negative information is valuable as it will be based on actual information
- Positive information can be from informed or uninformed investment banks and much less valuable
- Investors should react stronger to negative information than positive information

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