

A wide-angle photograph of a city skyline viewed from across a body of water. In the foreground, there's a dark, rippling surface of water. A low, dark brown horizontal bar is positioned at the bottom left, containing white text. The middle ground features a row of multi-story brick buildings with dark roofs, some with gabled structures. Behind these, a dense cluster of modern skyscrapers with various architectural styles, including glass facades and unique shapes, rises against a clear blue sky. A construction crane is visible on the right side of the skyline.

Andreas Krause

Chapter 3
Selling information

Outline

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

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

Opportunity to sell information

Opportunity to sell information

- ▶ Investment banks have **superior information** on investment opportunities

Opportunity to sell information

- ▶ Investment banks have superior information on investment opportunities
- ▶ They could use this information for their **own investments**

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

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

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

Signals

- ▶ Informed investment banks receive an imperfect signal on the return:
- ▶ $R = s + \varepsilon$

Signals

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

Signals

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

Signals

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

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

Investments

- ▶ Investment banks invest into risk-free **government securities**
- ▶ The final value is $W_1 = (1 + r)G$

Investments

- ▶ Investment banks invest into risk-free **government securities** and the **risky asset**
- ▶ The final value is $W_1 = (1 + r)G + (1 + R)V$

Investments

- ▶ Investment banks invest into risk-free government securities and the risky asset
- ▶ The final value is $W_1 = (1 + r)G + (1 + R)V = (1 + r)W_0 + (R - r)V$

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 $U_B = E[W_1] - \frac{1}{2}zVar[W_1]$

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 $U_B = E[W_1] - \frac{1}{2}zVar[W_1]$

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

Optimal investment without selling information

Optimal investment without selling information

- ▶ If investment banks are uninformed, they observe **no signal**

Optimal investment without selling information

- ▶ If investment banks are uninformed, they observe no signal
- ▶ Then $E[R] = \mu$

Optimal investment without selling information

- ▶ If investment banks are uninformed, they observe no signal
- ▶ Then $E[R] = \mu$ and $Var[R] = \sigma_R^2$

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 $E[W_1] = (1 + r)W_0 + (\mu - r)V$

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 $Var[W_1] = \sigma_R^2 V^2$

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
$$\frac{\partial U_B}{\partial V} = (\mu - r) - z\sigma_R^2 V = 0$$

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 $V^* = \frac{\mu-r}{z\sigma_R^2}$

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 $U_B^* = (1+r)W_0 + \frac{(\mu-r)^2}{2z\sigma_R^2}$

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

Preventing uninformed selling of information

- ▶ Investment banks can **claim** they have received a signal

Preventing uninformed selling of information

- ▶ Investment banks can claim they have received a signal , **even if this is not true**

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

- ▶ $\hat{U}_B =$ $+$ P

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**
- ▶ $\hat{U}_B = (1 + r) W_0 + (\mu - r) V + P - \frac{1}{2} z \sigma_R^2 V^2$

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

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 $\hat{U}_B \leq U_B^*$

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 $P \leq P^* = \frac{(\mu - r)^2}{2z\sigma_R^2} - (\mu - r) V + \frac{1}{2} z \sigma_R^2 V^2$

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 ($V > 0$)

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

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 $\frac{\partial P^*}{\partial z} = -\frac{(\mu-r)^2}{2z^2\sigma_R^2} + \frac{1}{2}\sigma_R^2 V^2 = 0$

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 $\frac{\partial P^*}{\partial z} = -\frac{(\mu-r)^2}{2z^2\sigma_R^2} + \frac{1}{2}\sigma_R^2V^2 = 0$
- ▶ Giving $z^2 = \frac{(\mu-r)^2}{\sigma_R^4V^2}$

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 $\frac{\partial P^*}{\partial z} = -\frac{(\mu-r)^2}{2z^2\sigma_R^2} + \frac{1}{2}\sigma_R^2V^2 = 0$
- ▶ Giving $z^2 = \frac{(\mu-r)^2}{\sigma_R^4V^2}$
- ▶ Assume that $\mu > r$, then if $V > 0$, we have $z = \frac{\mu-r}{\sigma_R^2V}$

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 $\frac{\partial P^*}{\partial z} = -\frac{(\mu-r)^2}{2z^2\sigma_R^2} + \frac{1}{2}\sigma_R^2V^2 = 0$
- ▶ Giving $z^2 = \frac{(\mu-r)^2}{\sigma_R^4V^2}$
- ▶ Assume that $\mu > r$, then if $V > 0$, we have $z = \frac{\mu-r}{\sigma_R^2V}$
- ▶ From this we get $P^* = 0$

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 $\frac{\partial P^*}{\partial z} = -\frac{(\mu-r)^2}{2z^2\sigma_R^2} + \frac{1}{2}\sigma_R^2V^2 = 0$
- ▶ Giving $z^2 = \frac{(\mu-r)^2}{\sigma_R^4V^2}$
- ▶ Assume that $\mu > r$, then if $V > 0$, we have $z = \frac{\mu-r}{\sigma_R^2V}$
- ▶ From this we get $P^* = 0$
- ▶ If $V > 0$ the investment bank would **always sell information** it does not have

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 $\frac{\partial P^*}{\partial z} = -\frac{(\mu-r)^2}{2z^2\sigma_R^2} + \frac{1}{2}\sigma_R^2V^2 = 0$
- ▶ Giving $z^2 = \frac{(\mu-r)^2}{\sigma_R^4V^2}$
- ▶ Assume that $\mu > r$, then if $V > 0$, we have $z = \frac{\mu-r}{\sigma_R^2V}$
- ▶ 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 ($V < 0$)

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

► If $V < 0$, then $z = -\frac{\mu-r}{\sigma_R^2 V}$

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

► If $V < 0$, then $z = -\frac{\mu-r}{\sigma_R^2 V}$ and $P^* = -2(\mu-r)V > 0$

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**

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^***

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

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

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
- ▶ $\hat{V}^* = -\frac{\mu-r}{z\sigma_R^2}$

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 $P^* = 2\frac{(\mu-r)^2}{z\sigma_R^2}$

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

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

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

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

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

Optimal investment without selling information

Optimal investment without selling information

- ▶ If investment banks are informed, they observe their signal

Optimal investment without selling information

- ▶ If investment banks are informed, they observe their **signal**
- ▶ Then $E[R] = s$

Optimal investment without selling information

- ▶ If investment banks are informed, they observe their signal
- ▶ Then $E[R] = s$ and $Var[R] = \sigma_\varepsilon^2$

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 $E[W_1|s] = (1+r)W_0 + (s-r)V$

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 $Var[W_1|s] = \sigma_\varepsilon^2 V^2$

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
$$\frac{\partial U_B}{\partial V} = (s-r) - z\sigma_\varepsilon^2 V = 0$$

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 $V^{**} = \frac{s-r}{z\sigma_\varepsilon^2}$

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 $U_B^{**} = (1+r)W_0 + \frac{(s-r)^2}{2z\sigma_\varepsilon^2}$

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

Selling information

- ▶ Utility when selling information is enhanced by the price obtained

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^*

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

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 $V^{**} < 0$

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 $s < r$

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**

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

Reasons for only selling negative information

- ▶ **Positive information** makes a **long position** optimal for informed and uninformed banks

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

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

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**

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

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

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

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

Investor decisions

Investor decisions

- ▶ **Uninformed investors** are similar to uninformed banks

Investor decisions

- ▶ **Uninformed investors** are similar to uninformed banks
- ▶ Their expected utility is given by $U_D^* = (1 + r) W_0 + \frac{(\mu - r)^2}{2z\sigma_R^2}$

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

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 $\hat{U}_D^* = (1 + r) W_0 + \frac{(s - r)^2}{2z\sigma_\epsilon^2}$

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 $\hat{U}_D^* = (1 + r) W_0 + \frac{(s - r)^2}{2z\sigma_\varepsilon^2} - \frac{P^*}{N}$

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

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

Becoming informed

- ▶ Investors become informed if $\hat{U}_D^* \geq U_D^*$

Becoming informed

- ▶ Investors become informed if $\hat{U}_D^* \geq U_D^*$
- ▶ This becomes $(s - r)^2 \geq \frac{\sigma_\varepsilon^2}{\sigma_R^2} \left((\mu - r)^2 + \frac{2z\sigma_R^2 P^*}{N} \right)$

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

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
- ▶ $s \leq r - \frac{\sigma_\varepsilon}{\sigma_R} \sqrt{(\mu - r)^2 + \frac{2z\sigma_R^2 P^*}{N}} < r$

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**

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

Information content needed

- ▶ The **maximum price** possible is P^* to prevent uninformed investment banks selling information

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

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**

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

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

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

Only negative information is sold

Only negative information is sold

- ▶ Only **negative information** can be sold,

Only negative information is sold

- ▶ Only negative information can be sold, as **positive information** can be **copied** by uninformed investment banks

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

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

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

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

Market implications

- ▶ **Negative information** is valuable as it will be based on **actual information**

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

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

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



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

Picture credits:

Cover: The wub, CC BY-SA 4.0 <https://creativecommons.org/licenses/by-sa/4.0>, via Wikimedia Commons, https://commons.wikimedia.org/wiki/File:Canary_Wharf_from_Greenwich_riverside_2022-03-18.jpg

Back: Seb Tyler, CC BY 3.0 <https://creativecommons.org/licenses/by/3.0>, via Wikimedia Commons, https://commons.wikimedia.org/wiki/File:Canary_Wharf_Panorama_Night.jpg

Andreas Krause
Department of Economics
University of Bath
Claverton Down
Bath BA2 7AY
United Kingdom

E-mail: mnsak@bath.ac.uk