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Information acquisition and market efficiency
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Noisy information

- In order for prices to reflect available information, investors need to obtain such information
- This information needs then to be included into the asset price
- Information is generally not perfect, but will be subject to errors, called noise

Knowledge with information

- Information on the asset value consists of a signal, which is subject to noise
- $V = s + \varepsilon$
- The noise is unbiased and has a variance
- $\mathsf{E}[\varepsilon] = 0$, $\mathsf{Var}[\varepsilon] = \sigma_\varepsilon^2$
- Informed investors infer the asset value to be the signal, but this has some uncertainty due to the noise

$\Rightarrow$ $\mathsf{E}[V|s] = s$, $\mathsf{Var}[V|s] = \sigma_\varepsilon^2$

- Uninformed investors only know the average asset value and face larger uncertainty
- $\mathsf{E}[s] = \mathsf{E}[V] = V^*$, $\mathsf{Var}[V] = \sigma_V^2 = \sigma_s^2 + \sigma_\varepsilon^2$

Demand by informed investors

- The profits an investor makes is the difference between the inferred value and price paid for each unit
- Risk averse investors dislike the risks arising from these profits, measured by its variance
- $U_I = (\mathsf{E}[V|s] - P) Q_I - \frac{1}{2} z Q_I^2 \mathsf{Var}[V - P|s]$
- The optimal investment is then given if $\frac{\partial U_I}{\partial Q_I} = 0$

$\Rightarrow Q_I = \frac{\mathsf{E}[V|s] - P}{z \mathsf{Var}[V|s]}$

$\Rightarrow U_I = \frac{(s-P)^2}{2z\sigma_\varepsilon^2}$

Acquiring information in an efficient market

- Acquiring information is costly and the decision to acquire information is made before receiving it
- Information will only be acquired if this is profitable
- $\mathsf{E}[U_I] = \mathsf{E}\left[\frac{(s-P)^2}{2z\sigma_\varepsilon^2}\right] - C \geq 0$
- If prices are efficient and reflect all available information, we have $P = s$

$\Rightarrow \mathsf{E}[U_I] = -C < 0$

$\Rightarrow$ Information acquisition is not profitable if markets are efficient

Demand by uninformed investors

- The profits an investor makes is the difference between the inferred value and price paid for each unit
- Risk averse investors dislike the risks arising from these profits, measured by its variance
- $U_U = (\mathsf{E}[V] - P) Q_U - \frac{1}{2} z Q_I^2 \mathsf{Var}[V - P]$
- The optimal investment is then given if $\frac{\partial U_U}{\partial Q_U} = 0$

$\Rightarrow Q_U = \frac{\mathsf{E}[V] - P}{z \mathsf{Var}[V]}$

$\Rightarrow U_U = \frac{(V^* - P)^2}{2 z \sigma_V^2}$

Becoming informed

- We have $\mathrm{E}\left[(s-P)^2\right] = (V^*-P)^2 + \sigma_s^2$
- It is more profitable becoming informed if $\mathrm{E}\left[U_I\right] \geq U_U$

$\Rightarrow C \leq \frac{(V^*-P)^2 \sigma_S^2}{2z\sigma_\varepsilon^2 \sigma_V^2}$

- If information costs are sufficiently low, then investors prefer becoming informed

Equilibrium information acquisition

- If information costs are low, it is profitable to become informed
- If markets are efficient, informed investors cannot recover their information costs

$\Rightarrow$ Becoming informed is not profitable

- Without informed investors, markets cannot reveal information

$\Rightarrow$ If information is costly, markets cannot be fully efficient

Summary

- If markets are efficient, informed investors cannot make any trading profits
- This prevents investors from recovering any information costs, and they will not acquire any information
- In the absence of information, markets cannot be efficient

$\Rightarrow$ Fully efficient markets cannot exist

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