Whoever Has Will Be Given More: Information Sharing in Financial Markets

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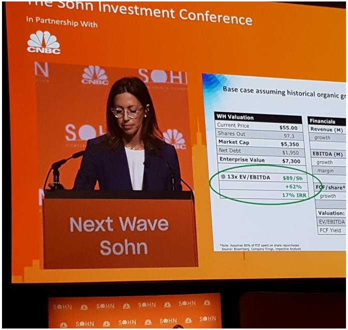
Investor conferences

- Why investors share information?
- Who will share with whom? Should they share information?
- What are the implications for markets and profits?

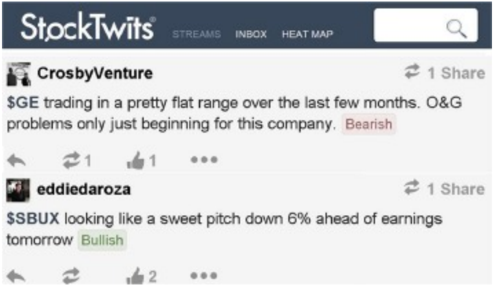


The rise of investment conferences in the Street

Social trading

Social trading

- Normal folks also like sharing their investment ideas.
- Are they informed? Or just noise (barking dogs)?
- For hedge funds that seek after the social media sentiment, are they becoming better off?



What do we do?

Provide one rational theory of information sharing:

1. The coarsely informed investors have a strategic motive to share their info: "trading against error" effect
   - Unique info flow: less informed $\Rightarrow$ more informed
2. After info sharing,
   - the sender is better off but the receiver is worse off
   - liquidity $\downarrow$, price efficiency $\uparrow$, and trading volume $\uparrow$
3. This theory
   (1) explains why so many folks are willing to talk about their investment ideas (barking dogs)
   (2) justifies the predictive power of online messages
   (3) sheds new light on the nascent sentiment trading strategy
   (4) offers a new perspective of info networks in financial markets

Literature

1. Info sharing
   - Manipulation: Benabou and Laroque (1992)
   - Price correction acceleration: Ljungqqvist and Qian (2016), Kovbasyuk and Pagano (2015), Liu (2017), Schmidt (2019)
   - Commitment to aggressive trading: Indjejikian, Lu and Yang (2014)
   - Advantage over uninformed followers: Van Bommel (2003)
   - "Talk for her book": Pasquariello and Wang (2016)
   - Disagreement: Balasubramaniam (2020)

Our explanation: info flows from the less informed to the more informed

2. Info transmission/disclsoure: Admati and Pfleiderer (1986, 1988), Fishman and Hagerty (1995)

3. Noise/supply info in financial markets:
   - Ganguli and Yang (2009)
   - Farboodi and Veldkamp (2020): trading against dumb money

Our focus: noise in investor's info/sentiment

Model setup: Key departures

Two key departures from Kyle (1985)

1. Two rational investors with info of different precision;
2. Info can be shared between them.

$t = 0$

Investors make info-sharing decisions.

$t = 1$

- Investors observe their private information and, if any, the shared information.
- Investors and noise traders submit order flows, and market makers set the price.

$t = 2$

The value of the asset is realized, and all agents consume.

Model setup: Specifics

- A risky asset with date-2 value $\tilde{v} \sim N(0,1)$.
- Two risk-neutral rational investors
  - H observes $\tilde{v}$ and L observes $\tilde{y} = \tilde{v} + \tilde{e}$, with $\tilde{e} \sim N(0, \rho^{-1})$
  - At $t = 0$, info-sharing decisions:

$$\begin{aligned} \text{H shares} \quad & \tilde{s}_H = \tilde{v} + \tilde{\varepsilon}_H, \text{ with } \tilde{\varepsilon}_H \sim N(0, {\tau_H}^{-1}) \\ \text{L shares} \quad & \tilde{s}_L = \tilde{y} + \tilde{\varepsilon}_L, \text{ with } \tilde{\varepsilon}_L \sim N(0, {\tau_L}^{-1}) \end{aligned}$$

  - Investor i places order $\tilde{x}_i$ to maximize $E[\tilde{x}_i(\tilde{v} - \tilde{p})|\mathcal{F}_i]$, where $\mathcal{F}_H = \{\tilde{v}, \tilde{s}_H, \tilde{s}_L\}$ and $\mathcal{F}_L = \{\tilde{y}, \tilde{s}_H, \tilde{s}_L\}$
- Trading. Noise traders $\tilde{u} \sim N(0, \sigma_u^2)$ and market makers set pricing rule

$$\tilde{p} = E\left(\tilde{v}|\tilde{\omega}\right), \text{ with } \tilde{\omega} = \tilde{x}_H + \tilde{x}_L + \tilde{u}$$

Interpreting information sharing

- L has countably infinite data points:

$$\tilde{\delta}_{L,j} = \tilde{v} + \tilde{e} + \tilde{\xi}_{L,j},\ \mathit{for}\ j = 1, 2, \ldots$$

  - $\tilde{\xi}_{L,j} \sim N\left(0, \frac{1}{A_L}\right)$ ($A_L \approx 0$), iid
  - $\tilde{e}$: error specific to L's data source
  - In aggregate, L knows information

$$\tilde{y} \equiv \lim_{J\to\infty} \frac{1}{J} \sum_{j=1}^{J} \tilde{\delta}_{L,j} = \tilde{v} + \tilde{e}$$

- If L shares T_L data points with H, then these shared data points are equivalent to:

$$\tilde{s}_L \equiv \frac{1}{T_L} \sum_{j=1}^{T_L} \tilde{\delta}_{L,j} = \underbrace{\tilde{v} + \tilde{e}}_{\equiv \tilde{y}} + \underbrace{\frac{1}{T_L} \sum_{j=1}^{T_L} \tilde{\xi}_{L,j}}_{\equiv \tilde{\varepsilon}_L \sim N\left(0, \frac{1}{A_L T_L}\right)}$$

- Define $\tau_L \equiv A_L T_L \in \{0, A_L, 2A_L, 3A_L, \ldots\}$.

Trading equilibrium

1. Trading on $t = 1$ for a given (τ_H, τ_L).
   - Consider a linear pricing rule $\tilde{p} = \lambda\tilde{\omega}$ and linear trading strategies

$$\tilde{x}_H = \underbrace{\alpha_v}_{>0}\tilde{v} + \underbrace{\alpha_H}_{<0}\tilde{s}_H + \underbrace{\alpha_L}_{<0,\text{ trading against error } \tilde{e}}\tilde{s}_L,$$

$$\tilde{x}_L = \underbrace{\beta_y}_{>0}\tilde{y} + \underbrace{\beta_H}_{>0}\tilde{s}_H + \underbrace{\beta_L}_{>0}\tilde{s}_L.$$

H trades against L's shared info!

1. L trades based on

$$\tilde{y} = \underbrace{\tilde{v}}_{\text{correct}} + \underbrace{\tilde{e}}_{\text{incorrect}}$$

2. With $\tilde{s}_L$, H can infer

$$E[\tilde{e}|\tilde{v}, \tilde{s}_L] = \frac{\tau_L}{\rho + \tau_L}(\tilde{s}_L - \tilde{v})$$

The higher τ_L, the more accurate the inference.

Info sharing equilibrium

1. Trading on $t = 1$ for a given (τ_H, τ_L).
   - Consider a linear pricing rule $\tilde{p} = \lambda\tilde{\omega}$ and linear trading strategies

$$\tilde{x}_H = \underbrace{\alpha_v}_{>0} \tilde{v} + \underbrace{\alpha_H}_{<0} \tilde{s}_H + \underbrace{\alpha_L}_{<0\text{, trading against error } \tilde{e}} \tilde{s}_L,$$

$$\tilde{x}_L = \underbrace{\beta_y}_{>0} \tilde{y} + \underbrace{\beta_H}_{>0} \tilde{s}_H + \underbrace{\beta_L}_{>0} \tilde{s}_L.$$

2. Info sharing on $t = 0$.
   - In eqm, $\tau_H^* = 0$ and $\tau_L^* = +\infty$ so that

$$\tilde{x}_H = \alpha_v^* \tilde{v} + \alpha_L^* \tilde{y} \text{ and } \tilde{x}_L = (\beta_y^* + \beta_L^*) \tilde{y}$$

   - Why does L share her info?
   - Why doesn't H share his info?

Why does L share info? ($\tau_L = \infty$)

$$\max_{x_L} E\left[x_L\left(\tilde{v} - \lambda(x_L + \overbrace{\underset{>0}{\alpha_v}\tilde{v} + \underset{<0}{\alpha_L}\tilde{s}_L}^{x_H})\right) |\tilde{y}, \tilde{s}_L\right]$$

Info-sharing decisions:

$$\frac{d\pi_L}{d\tau_L} = \underbrace{\frac{\partial \pi_L}{\partial \alpha_L}\frac{\partial \alpha_L}{\partial \tau_L}}_{\text{trading-against-error effect}>0} + \underbrace{\frac{\partial \pi_L}{\partial \alpha_v}\frac{\partial \alpha_v}{\partial \tau_L}}_{\text{competition}<0}$$

$$+ \underbrace{\frac{\partial \pi_L}{\partial \lambda}\frac{\partial \lambda}{\partial \tau_L}}_{\text{liquidity }<0} + \underbrace{\frac{\partial \pi_L}{\partial \tau_L}}_{<0} > 0$$

Why doesn't H share info? ($\tau_H = 0$)

$$\max_{x_H} E\left[x_H\left(\tilde{v} - \lambda\big(x_H + \overbrace{\underset{>0}{\beta_y}\tilde{y} + \underset{>0}{\beta_H}\tilde{s}_H + \underset{>0}{\beta_L}\tilde{s}_L}^{x_L}\big)\right)\Big|\tilde{v}, \tilde{s}_H, \tilde{s}_L\right]$$

Info-sharing decisions:

$$\frac{d\pi_H}{d\tau_H} = \underbrace{\frac{\partial \pi_H}{\partial \beta_H}\frac{\partial \beta_H}{\partial \tau_H}}_{\text{information leakage } <0} + \underbrace{\frac{\partial \pi_H}{\partial \beta_y}\frac{\partial \beta_y}{\partial \tau_H}}_{>0} + \underbrace{\frac{\partial \pi_H}{\partial \beta_L}\frac{\partial \beta_L}{\partial \tau_H}}_{>0}$$

$$+ \underbrace{\frac{\partial \pi_H}{\partial \lambda}\frac{\partial \lambda}{\partial \tau_H}}_{\text{liquidity}>0} + \underbrace{\frac{\partial \pi_H}{\partial \tau_H}}_{<0} < 0$$

Investors' profits

Proposition

Compared with the no-info-sharing benchmark, with info sharing

- *Profits:* $\pi_L^* > \pi_L^0$, $\pi_H^* < \pi_H^0$, *and* $\pi_H^* + \pi_L^* > \pi_H^0 + \pi_L^0$.

- Trading strategy:

$$\text{w/o info sharing} : \tilde{x}_H = \alpha_v^0 \tilde{v}, \;\; \tilde{x}_L = \beta_y^0 \tilde{y}$$

$$\text{w/ info sharing} : \tilde{x}_H = \alpha_v^* \tilde{v} + \alpha_L^* \tilde{y}, \;\; \tilde{x}_L = (\beta_y^* + \beta_L^*) \tilde{y}$$

  Intuition:

  (1) Trading against $\tilde{e}$: $\alpha_L^* < 0$
  (2) Competition: $\beta_y^* + \beta_L^* > \beta_y^0$ and $\alpha_v^* + \alpha_L^* < \alpha_v^0$
  (3) Liquidity effect: $\lambda^* > \lambda^0$

- Example: if $\rho = 1$ and $\sigma_u = 1$, via info sharing, $\pi_L \uparrow 32.7\%$, $\pi_H \downarrow 4.1\%$, and $\pi_H + \pi_L \uparrow 2.6\%$ (noise traders are harmed)

Market quality

Proposition

Compared with the no-info-sharing benchmark, with info sharing

- *Market quality: liquidity $\downarrow$, price efficiency $\uparrow$, and total trading volume $\uparrow$.*

H trading against error $\Rightarrow$ Less error in the aggregate order flow

1. Market liquidity: $\lambda^* > \lambda^0$
2. Price efficiency $Var^{-1}(\tilde{v}|\tilde{p})$: $m^* > m^0$
3. Trading volume: $TV^* > TV^0$

$$TV = \frac{1}{2}\left(\underbrace{E[|\tilde{x}_H|]}_{\downarrow} + \underbrace{E[|\tilde{x}_L|]}_{\uparrow} + \underbrace{E[|\tilde{\omega}|]}_{\uparrow} + E[|\tilde{u}|]\right) \quad \uparrow$$

Four extensions

1. H is not perfectly informed
2. L and multiple H-investors
3. L needs to incur a cost to acquire info
4. Public shared info

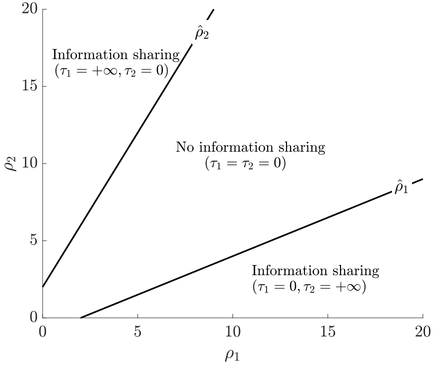
Extension 1: Imperfectly informed H investor

- Investor i's info

$$\tilde{y}_i = \tilde{v} + \tilde{e}_i, \;\; \tilde{e}_i \sim N(0, \rho_i^{-1}) \text{ and } \rho_i \in (0, +\infty].$$

information sharing

$$\tilde{s}_i = \tilde{y}_i + \tilde{\varepsilon}_i, \text{ where } \tilde{\varepsilon}_i \sim N(0, \tau_i^{-1}) \text{ and } \tau_i \in [0, +\infty].$$



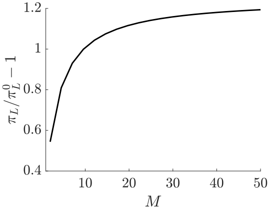
Extension 2: Multiple H-investors

- M insiders $(H_1, ..., H_M)$ observe $\tilde{v}$ and L observes $\tilde{y}$
- Assume Hs do not share (numerically verified), and if L wants to share, she shares "as is"
- Insiders can commit not to receiving the shared info

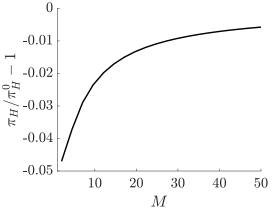
Proposition

(i) *When $M \geq 3$, ~~every insider commits not to receiving L's shared information~~.*

(ii) *(Prisoner's dilemma) $\exists M > \hat{M}$ such that the following equilibrium always exists: all Hs choose to trade against L's shared information.*

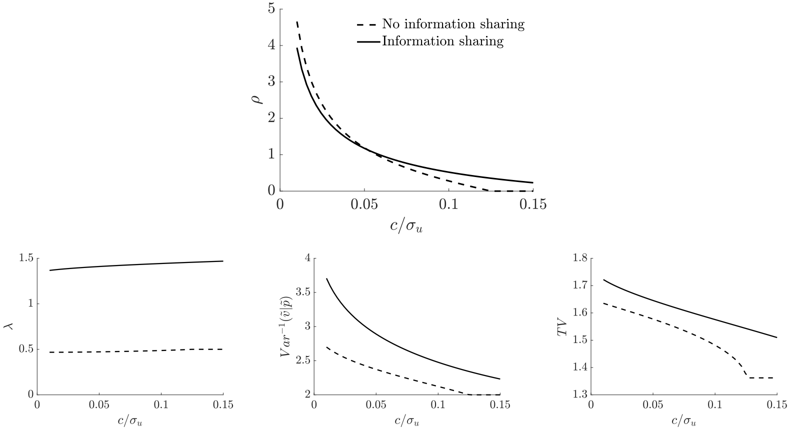


L's profit change



An insider's profit change

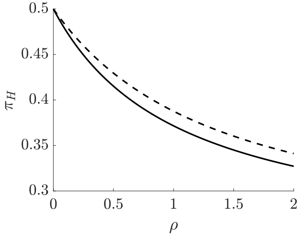
Extension 3: Costly info acq for L: $c \cdot \rho$



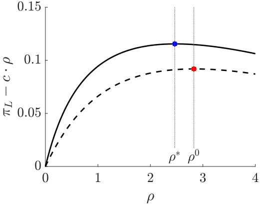
Info acq trade-off

- $(-)$ With info sharing permitted, L trade aggressively despite noisy info
- $(+)$ With higher profits, L can afford more info acq

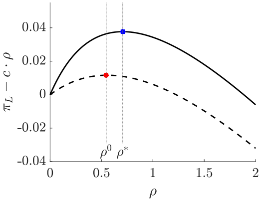
Extension 3: Costly info acq for L: $c \cdot \rho$



H's profits



L's net profits ($c = 0.02$)

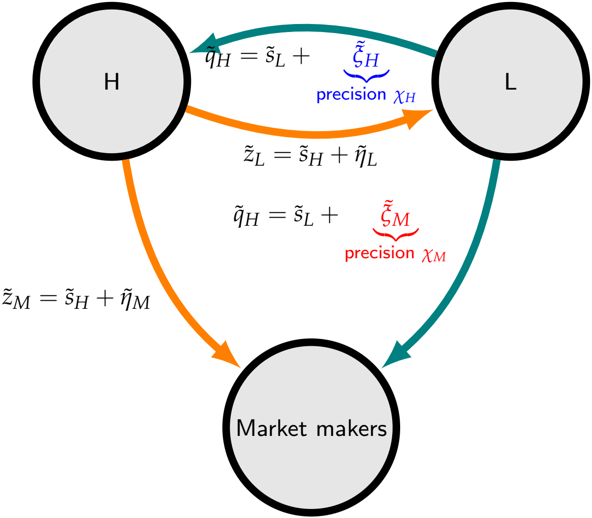


L's net profits ($c = 0.08$)

Extension 4: Public shared information

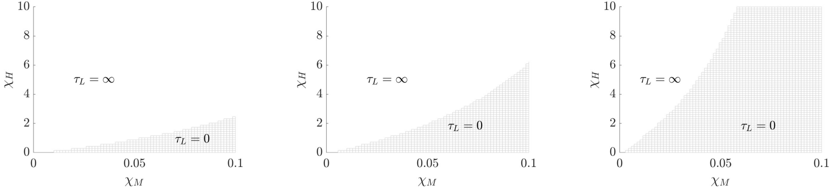
- Info may be leaked during the communication process.
- Assume if L wants to share, she shares it “as is”

H sends: $\tilde{s}_H = \tilde{v} + \tilde{\varepsilon}_H$ and L sends: $\tilde{s}_L = \tilde{y} + \tilde{\varepsilon}_L$



Extension 4: Public shared information

- H does not share info
- L shares info as follows:
  - χ_H: H's ability to read L's info;
  - χ_M: market makers' ability to read L's info



(a) $\rho = 3$ (b) $\rho = 5$ (c) $\rho = 10$

Figure: Public shared information ($\sigma_u = 1, \kappa_L = \chi_H, \kappa_M = \chi_M$)

Application 1: Information network

- Info network (Shiller and Pound, 1986; Hong et al, 2005; Luo 2018)
- Fundamental questions:
  (1) Why do investors share valuable info?
  (2) Who shares with whom?
- One explanation for increasingly popular investment conferences (Luo, 2018): prisoner's dilemma

Application 2: Twitter

- Why does a barking dog bark? Investment opinions on social media
- Mapping to our model
  (1) L: representative Tweet writers; H: hedge funds
  (2) MM has low ability to read the public info
- So, social media investment opinions can be truthful but noisy
  - This helps explain the widespread info sharing phenomenon
  - This helps explain why investor opinions transmitted through social media can predict future stock returns (Chen et al, 2014)
- Lessons for sentiment trading strategy: subscribe to Dataminr iff you are not well informed

Conclusion

1. A coarsely informed investor has a strategic incentive to share her info with the well informed.
2. After info sharing, info sharer is better off but info receiver is worse off. Noise traders are worse off.
3. Market liquidity decreases, price efficiency increases, and total trading volume increases.
4. Trading on the shared info can be a prisoner's dilemma for the well informed.