(In)efficiency in Information Acquisition and Aggregation through Prices

Alessandro Pavan, Savitar Sundaresan, Xavier Vives

Motivation

- **(In)efficiency in financial trading**
  - limit orders
  - private information
- **Endogeneity of traders' private information**
  - information collection/acquisition
  - attention
- **Sand in wheels of financial markets**
  - Tobin tax
  - various other policy proposals
- **Reduction in cost of information**
  - internet, big data, high-frequency trading
  - *beneficial to society*?

This Paper

- Model to investigate interaction
  - (in)efficiency in trading
  - (in)efficiency in information collection prior to trading
- Policy interventions

Findings

- **Exogenous** private information
  - Inefficiency in trading
    - pecuniary externality
    - information externality
  - both inefficiencies corrected with (non-linear) taxes/subsides contingent on
    - price of financial asset
    - individual volume of trade

Findings

- **Endogenous** private information
  - *over-investment* in information acquisition
    - excessive sensitivity of eq. limit orders to private information
    - downward-sloping efficient schedules
    - pecuniary externality prevails over info externality
  - *under-investment* in information acquisition
    - inefficiently low sensitivity of eq. limit orders to private information
    - upward-sloping efficient schedules
    - info externality prevails over pecuniary externality
- No policy measurable in price and individual volume of trade inducing efficiency in both info acquisition and trading
- Efficiency in both info acquisition and trading by conditioning policy on
  - aggregate volume of trade
  - expenditure on info acquisition (when verifiable)

Literature – Incomplete

- **(In)efficiency in usage of info when info exogenous**
  - Vives (1988), Angeletos and Pavan (2007), Amador and Weill (2012), Myatt and Wallace (2012), Vives (2019),...
    - Contribution: endogeneity of info
- **Information acquisition in financial markets**
  - Grossman and Stiglitz (1980), Diamond and Verrecchia (1981), Verrecchia (1982), Peress (2010), Manzano and Vives (2011), Vives (2014), Kacperczyk, Van Nieuwerburgh, and Veldkamp (2016), Davila and Parlatore (2019),...
    - Contribution: welfare analysis
- **(in)efficiency in info acquisition**
  - Colombo, Femminis and Pavan (2014), Angeletos, Iovino, and La'O (2020),...
    - Contribution: aggregation
- **Reduction in cost of info and effect on financial mkts**
  - Peress (2005), Farboodi et al (2018), Azamsa (2019), Kacperczyk, Nosal and Stevens (2019), Malikov (2019), Mihet (2018),...

Plan

1. Introduction
2. **Model**
3. (In)efficiency in trading
4. (In)efficiency in info acquisition
5. Conclusions

Model

Model

- Unit-mass continuum of traders with payoff

$$\pi_i = \left(\underbrace{\theta}_{\text{common value}} - \underbrace{p}_{\text{price}} \right) \underbrace{x_i}_{\text{demand of } i} - \underbrace{\lambda \frac{x_i^2}{2}}_{\text{trading cost}}$$

- Representative liquidity supplier with payoff

$$\Pi = \left(p - \underbrace{(\alpha - u)}_{\text{opportunity cost}} \right) \underbrace{\tilde{x}}_{\text{aggregate supply}} - \underbrace{\beta \frac{\tilde{x}^2}{2}}_{\text{trading cost}}$$

Information and schedules

- Each trader observes private signal

$$s_i = \theta + f(\underbrace{y_i}_{\text{effort}})\,(\underbrace{\eta}_{\text{common}} + \underbrace{e_i}_{\text{idiosyncratic}})$$

  with $f' < 0$

- Attention/information collection: $y_i \in \mathbb{R}_+$
  - cost $\mathcal{C}(y_i)$, with $\mathcal{C}', \mathcal{C}'' > 0$
- Trader i's schedule

$$x_i = a s_i + \hat{b} - \hat{c} p$$

- Liquidity supplier's (inverse) supply

$$p = \alpha - u + \beta \tilde{x}$$

- $(\theta, u, \eta, (e_i)_{i \in [0,1]})$ independent, jointly Normal

Timing

- $t = 0$: traders choose y_i
- $t = 1$: traders observe s_i, representative supplier observes u
- $t = 2$: limit orders
- $t = 3$: mkt clears
- $t = 4$: payoffs

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(In)efficiency in Trading

Equilibrium Use of Information

Proposition 1

Unique symmetric equilibrium. Sensitivity of eq. demand schedules to private information:

$$a^* = \frac{1}{\lambda} \frac{\tau_\epsilon y \tau_\eta \left(y\tau_\eta - \tau_\omega(a^*) \right)}{y^2\tau_\eta^2(\tau_\omega(a^*) + \tau_\epsilon + \tau_\theta) - \tau_\omega(a^*)\tau_\epsilon \left(\tau_\theta + 2y\tau_\eta \right)}$$

where

$$\tau_\omega(a^*) \equiv \frac{\beta^2 a^{*2} y \tau_u \tau_\eta}{(\beta^2 a^{*2} \tau_u + y\tau_\eta)}$$

is precision of endogenous signal

$$z \equiv \theta + f(y)\eta - \frac{u}{\beta a^*}$$

contained in eq. price.

(Decentralized) Efficient Use of Information

- Team Problem
  - planner controls traders' limit orders but cannot transfer info from one trader to another
  - chooses schedules $x_i = as_i + \hat{b} - \hat{c}p$ to max total welfare

$$W \equiv \int_0^1 \left(\theta x_i - \frac{\lambda}{2} x_i^2\right) di + \left(u - \alpha - \beta \frac{\tilde{x}}{2}\right) \tilde{x}.$$

Efficient Use of Information

Proposition 2

Team problem has unique solution. Efficient sensitivity of traders' demand schedules to private information:

$$a^T = \frac{1}{\lambda} \frac{\tau_\epsilon y \tau_\eta (y\tau_\eta - \tau_\omega(a^T))}{y^2\tau_\eta^2 (\tau_\omega(a^T) + \tau_\epsilon + \tau_\theta) - \tau_\omega(a^T)\tau_\epsilon (\tau_\theta + 2y\tau_\eta) + \Xi(a^T) + \Delta(a^T)}$$

Given a^T, $\hat{c}^T$ and $\hat{b}^T$ given by same functions as in eq.

- $\Xi(a)>0$: **pecuniary externality**
  - traders do not internalize co-movement of trades with aggregate shocks
- $\Delta(a) < 0$: **information externality**
  - traders do not internalize informational content of prices

Efficient Use of Information

- Efficient schedules $x_i = a^T s_i + \hat{b}^T - \hat{c}^T p$
  - **downward-sloping** when pecuniary externality prevails:

$$\hat{c}^T > 0 \;\Leftrightarrow\; \Xi(a^T) + \Delta(a^T) > 0$$

  - **upward-sloping** when info externality prevails

$$\hat{c}^T < 0 \;\Leftrightarrow\; \Xi(a^T) + \Delta(a^T) < 0$$

Policy

Proposition 3

Efficient trading can be induced through combination of **linear-quadratic tax** on individual volume of trade along with **ad-valorem subsidy/tax** linear in price

$$T(x_i, p) = \frac{\delta}{2} x_i^2 - t_0 x_i + p t_p x_i$$

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Info acquisition

Inefficiency in Info Acquisition

Proposition 4

Let y^T denote socially optimal quality of private information. Suppose traders constrained to submit efficient demand schedules (for y^T). When efficient demands are downward-sloping, traders over-invest in info acquisition. Opposite true when efficient demand schedules upward-sloping.

Impossibility result

Proposition 5

There exists no policy $T(x_i, p)$ inducing efficiency in both info acquisition and trading

- Any policy inducing efficiency in trading creates wedge between private and social (marginal) value info.

Possibility result #1

Proposition 6

Efficiency in both info acquisition and trading induced by conditioning marginal tax rates on **aggregate volume of trade**

$$T^*(x_i, \tilde{x}, p) = \frac{\delta}{2} x_i^2 - t_0 x_i + p t_p x_i + \left(t_{\tilde{x}}^* \tilde{x}\right) x_i$$

- Contingency on aggregate volume of trade: extra flexibility in eliminating discrepancy between marginal benefit and marginal cost of expanding trade around efficient level
- Possibility to eliminate wedge between private and social (marginal) benefit of info, without breaking efficiency of trade

Possibility result #2

Proposition 7

Suppose expenditure on info acquisition y_i verifiable. Efficiency in both info acquisition and trade induced by policy

$$T^{tot}(x_i, p, y_i) = \frac{\delta}{2}x_i^2 - t_0 x_i + p t_p x_i - A y_i.$$

- Subsidy on info acquisition ($A > 0$) when agents under-invest
- Tax on info acquisition ($A < 0$) when agents over-invest

Conclusions

- Inefficiency in trading
  - pecuniary externality
  - info externality
- Exogenous (private) information
  - inefficiency corrected with (linear-quadratic) tax on individual volume of trade + ad-valorem tax/subsidy linear in price
- Endogenous (private) information
  - nature of inefficiency in trade $\rightarrow$ inefficiency in info acquisition
  - non-existence of (canonical policies) inducing efficiency in both trading and info acquisition
- Efficiency in both info acquisition and trading possible with taxes contingent
  - aggregate volume of trade
  - verifiable acquisition
- Future work:
  - financial decisions interacting with real decisions
  - multiple assets
  - dynamics

Most Important Slide

THANKS!