Trading Disclosure Requirements and Market Quality Tradeoffs

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Insider Trading and Disclosure

"Section 16(a) is likely to provide significant benefits by making information concerning insiders' transactions in issuer equity securities publicly available substantially sooner than it was before. Making this information available to all investors on a more timely basis should increase market transparency, which will likely enhance market efficiency and liquidity."

—— U.S. Securities and Exchange Commission, File No. S7-31-02.

- Section 16(a) of the Securities Exchange Act of 1934:

  Insider traders (officers and directors) must report to the SEC transactions in equity securities directly with the related issuer within ten days following the end of the month in which the trade had occurred.

- Rationale: to make private information available to all market participants more rapidly, thus increasing price efficiency and market liquidity

- After the introduction of the Sarbanes-Oxley Act (August 2002), the US financial market regulator tightened up this regulation by requiring insiders to report their trades not later than two business days following the transaction.

Purpose: Trading disclosure requirements and market quality

- Economically relevant point
  - Disclosure reports are made immediately available in the marketplace.
- **Rationale**: to achieve market integrity and, then, better investor protection, better price discovery and bounded market volatility.

This paper examines how this transparency affects information efficiency and other attributes of market quality

Lucas Critique

- The inference that a policy decision is independent of fwd looking market players seems suspicious
- A "reform" that introduces mandatory disclosure is likely to alter the traders' decision space.
- Antecedent: Huddart, Hughes, and Levine (2001)
  - Mandatory disclosure leads to improved market quality
  - Consider a market where, in equilibrium, insiders play mixed strategies with the purpose of dissimulating their information
  - Despite dissimulation, disclosure leads to better market efficiency

Our paper

- More realistic market
  - Professional investors also trade—"speculators"
  - They acquire information
  - Their trading decisions may radically change according to the regulatory regime

Conclusions

- Trading disclosure may actually harm market efficiency and have relatively small effects on market liquidity

- At most, mandatory disclosure is neutral regarding market efficiency. Such are the tradeoffs arising while introducing market transparency.

Mechanism

- Professional investors exert competitive pressure on the insider
  - The more information the investors acquire, the more informative the price system—fueled by both the insiders' and the speculators' trading aggressiveness.
- If the information available to speculators was not costly to acquire, a regime of mandatory disclosure would always result in a better market quality.

Information is costly

- Speculators make less profits in a market with mandatory disclosure
  - Insiders' disclosure dilutes some of the information advantage the speculators have vis-à-vis the market makers
  - It is profitable for the speculators to acquire less information than in an otherwise unregulated market.
  - $Information\ crowding\text{-}out + public\ disclosure\ effects$
  - If costs of information acquisition are high enough, information crowding out may dominate over the effects of public disclosure
  - Efficiency of the price system may deteriorate in a regulated market.

Outline of the rest of the talk

Skip literature review in the interest of time

1. Model: private and disclosed information
2. The value of disclosed information
3. Conclusions

1. Model: private and disclosed information

Market

Asset payoff, insider

- Three-period market
- Risky asset pays off a random $\tilde{d} \sim N\left(\bar{d}, \sigma_d^2\right)$ at time-3.
- A risk-neutral insider trader knows realization of $\tilde{d}$ since time-0, and trades x_1 at time-1 and x_2 at time-2.
- Insider must disclose the trade x_1 at the close of the first trading round.
- Noise trading, $z_i \sim N\left(0, \sigma_z^2\right)$ for the $i = 1, 2$.

Speculator

- At time-2, a risk-neutral "speculator" trades based on the information reported by the insider, and additional signals

$$s = \tilde{d} + \epsilon, \quad \epsilon \sim N\left(0, \sigma_\epsilon^2\right).$$

- The insider and the speculator understand their trades have price-impacts

Market maker, linear equilibrium

- A risk-neutral market maker sets prices as

$$p_1 = E(\tilde{d}\,|y_1), \text{ where } y_1 = x_1 + z_1,$$

- After the insider discloses his time-1 trades, x_1, the market maker's update of the asset expected payoff becomes

$$\bar{p}_1 = E(\tilde{d}\,|x_1, y_1) = E(\tilde{d}\,|x_1).$$

- We consider a linear equilibrium, where, at time-1, and for two constants λ_1 and γ,

$$p_1 = \bar{d} + \lambda_1 y_1, \quad \bar{p}_1 = \bar{d} + \gamma x_1,$$

- At time-2, price is $p_2 = E(\tilde{d}\,|x_1, y_2)$, and search for

$$p_2 = \bar{p}_1 + \lambda_2 y_2, \text{ where } y_2 = x_2 + a + z_2,$$

  for some constant λ_2, and where a is the trade of the speculator.

- Initially we take the information choice of the speculator as given and later analyze endogenous information acquisition

Speculator predictive capacity: I

- The assumption that the speculator acquires information makes him informationally superior compared to the market maket
  - Market maker also obviously observes the insider's trade
  - Thus, a private signal (may) incentivize the speculator to trade

Traders' behavior and market maker's updates

- The insider trader understands that his trade disclosed at time-1 is used as a signal by both the market maker and the speculator at time-2.

- With time-1 trade given, the insider's trade at time-2 and the speculator's trade satisfy

$$x_2\left(d, x_1\right) = \arg\max_{x_2} E\left((\tilde{d} - p_2) x_2 \middle| \tilde{d} = d \right)$$

$$a\left(s, x_1\right) = \arg\max_{a} E\left((\tilde{d} - p_2) a \middle| s, x_1 \right).$$

- Each forecasts the forecasting of other—with non-nested information sets

- Turns out the fixed point to this infinite regress problem simplifies in our linear equilibrium

- We show that, in the linear equilibrium,

$$x_2(d, x_1) = \beta_2 (d - \bar{p}_1) \quad \text{and} \quad a(s, x_1) = \beta_{a,2} (s - \bar{p}_1)$$

  for two constants β_2 and $\beta_{a,2}$ to be determined.

- Intuitively, information regarding the insider's trade at time-1 is already embedded into the market maker's update $\bar{p}_1$; this property—semi-strong efficiency—prevents the speculator from extracting any profits based on the insider's disclosure.

Speculator predictive capacity: II

- To illustrate, consider the speculator's forecast of the asset payoff conditional on the insider's disclosure and his private signal, which turns out to be

$$E(\tilde{d}\,|s, x_1) = \bar{p}_1 + \chi_s\,(s - \bar{p}_1)\,,$$

  for some positive χ_s. That is, knowledge of x_1 affects the speculator's expectations on the asset value only up to the market maker's update, $\bar{p}_1$.

- Naturally, the speculator trades at an advantage against the market maker, an advantage captured by the second term

- We term χ_s speculator's "predictive capacity": the higher χ_s, the higher the weight the speculator assigns to his private signal.

Insider's mixed strategy

- At time-1, the insider trades x_1 so as to maximize the time-1 expected profits as well as the expected profits at time-2, $\pi(x_1, d)$, say

$$\max_{x_1} E\left((\tilde{d} - p_1)x_1 + \pi(x_1, \tilde{d}) \middle| \tilde{d} = d \right).$$

We search for a linear equilibrium with mixed trading strategy

$$x_1(d, \eta) = \beta_1 \left(d - \bar{d} \right) + \eta, \quad \eta \sim N\left(0, \sigma_\eta^2\right),$$

where β_1 and σ_η^2 are two constants to be determined.

Equilibrium

- Huddart, Hughes and Levine (2001) (HHL, henceforth): $\sigma_\eta^2 = \beta_1^2 \sigma_d^2$.
- We conjecture that the variance of dissimulation noise satisfies

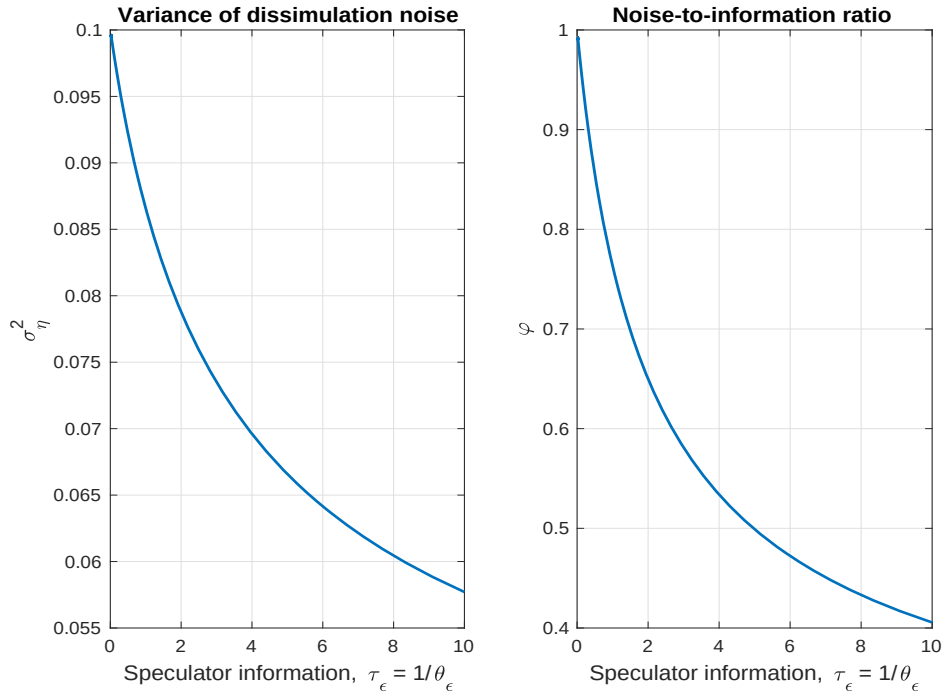
$$\sigma_\eta^2 = \varphi \beta_1^2 \sigma_d^2,$$

  for some constant φ to be determined—"noise-to-information ratio"

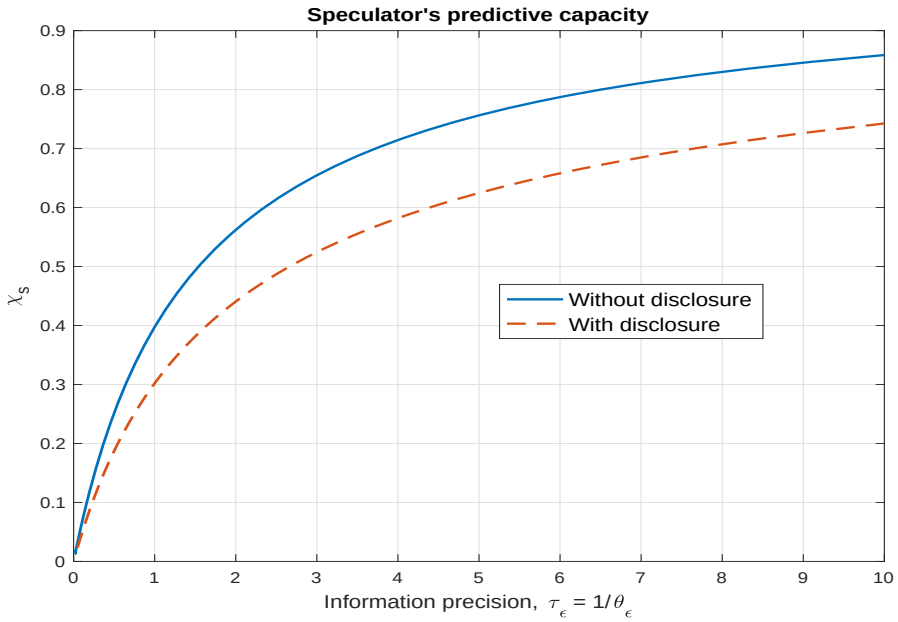
- Define $\theta_X > 0 : \sigma_X^2 = \theta_X \sigma_d^2$, where X may stand for η, ϵ or z.
- Define relative precision of the private information available to the speculator, $\tau_\epsilon \equiv \theta_\epsilon^{-1}$.

Propositions I & II. *There exists a linear equilibrium with mixed strategies,* $\sigma_\eta^2 = \varphi\beta_1^2\sigma_d^2$ *(market with mandatory disclosure) and pure strategies,* $\sigma_\eta^2 = 0$ *(without).*

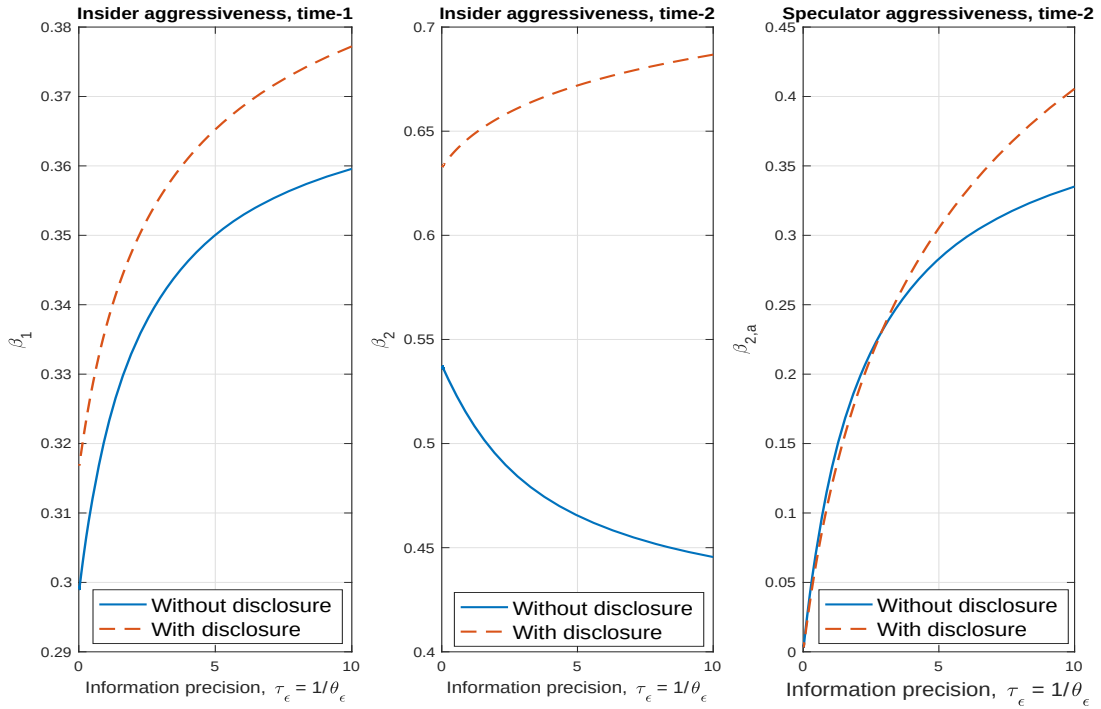
Mixed strategy



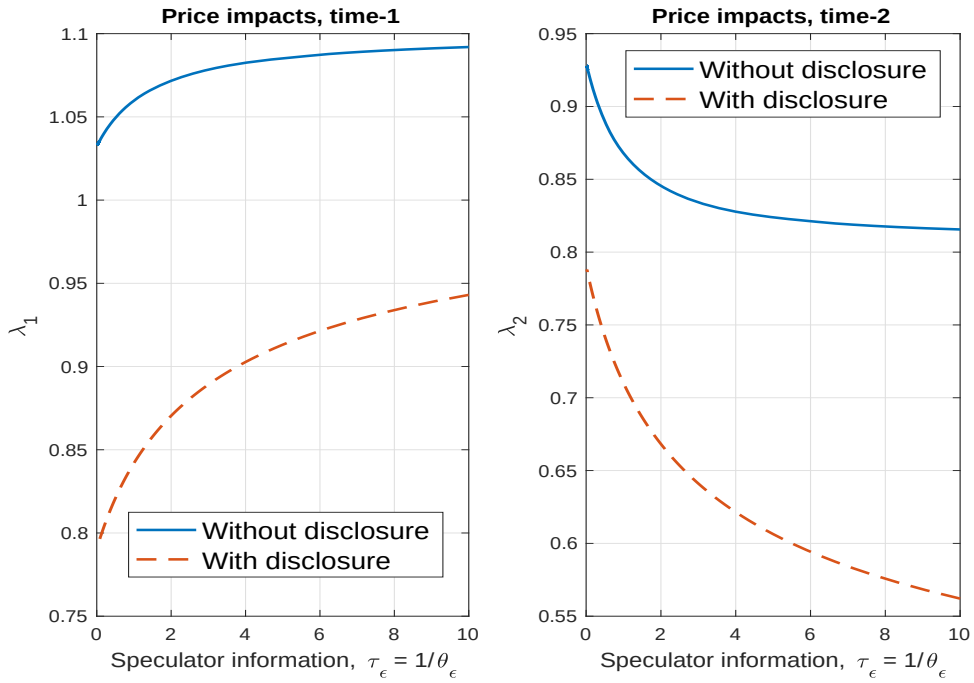
Speculator's predictive capacity



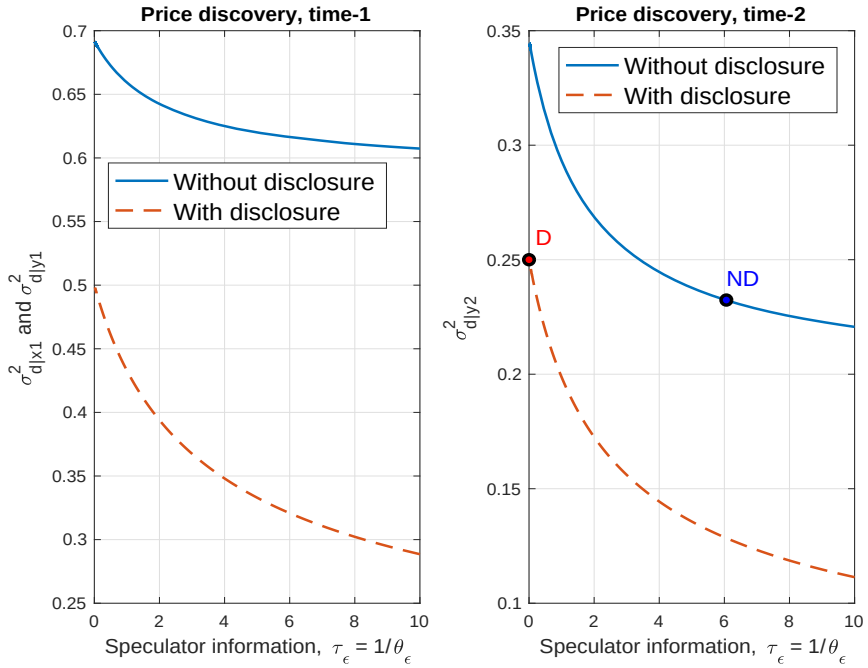
Trading aggressiveness



Liquidity


Price impacts, time-1
1.1
1.05
1
0.95
0.9
0.85
0.8
0.75
λ_1
0
2
4
6
8
10
Speculator information, $\tau_\epsilon = 1/\theta_\epsilon$
Without disclosure
With disclosure
Price impacts, time-2
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0.55
λ_2
0
2
4
6
8
10
Speculator information, $\tau_\epsilon = 1/\theta_\epsilon$
Without disclosure
With disclosure

Price discovery



2. The value of disclosed information

Issues

- Mandatory disclosure spreads information that dilutes the information advantage of the speculator

- If information is costly, the amount of information production may, then, decrease with a "reform" that introduces public disclosure, an *information crowding-out* effect.

- Trade-off
  - Trading disclosure requirements make markets informationally more efficient, for a given level of information production
  - Incentives to acquire information may fall in a market with disclosure requirements.
  - Is information crowding-out even more important in this trade-off?

Gaming

- Note that, now, not only does the speculator need to control his price-impact
  - He also anticipates that the insider and the market maker formulate conjectures regarding his own information choice, because the choice of τ_ϵ contributes to price-impacts
- Insider and market maker conjecture that the speculator acquires information with a given level of precision τ_ϵ.
- Given these conjectures, the speculator considers acquiring information with precision $\hat{\tau}_\epsilon$.

- In equilibrium,
  - (i) the speculator chooses $\hat{\tau}_\epsilon$ to maximize his expected profits
  - (ii) his chosen precision level coincides with the insider and the market maker conjectures

- We consider markets with and without disclosure

Technology

- Costly information acquisition technology to obtain a realization of s drawn with precision τ_ϵ
- To achieve precision τ_ϵ costs $\mathcal{C}(\tau_\epsilon) \equiv \mathrm{CF} + \int_0^{\tau_\epsilon} \mathcal{C}_{mg}(u)\, du$
- $\mathcal{C}(\tau_\epsilon)$ is increasing, continuous, twice differentiable, and non-concave
- Same technology regardless the regulatory regime

Equilibrium information acquisition

Lemma 1. *Insider + market maker conjecture the speculator adopts technology up to precision τ_ϵ. The speculator strategy based on deviating to $\hat{\tau}_\epsilon$ is*

$$\hat{a}\left(s, x_1\right) = \hat{\beta}_{a,2}\left(s - \bar{p}_1\right), \quad \hat{\beta}_{a,2} = \frac{1}{\lambda_2} \frac{\hat{\chi}_s}{4 - \chi_s},$$

where

$$\hat{\chi}_s = \frac{\varphi \hat{\tau}_\epsilon}{1 + \varphi(1 + \hat{\tau}_\epsilon)}, \quad \chi_s = \frac{\varphi \tau_\epsilon}{1 + \varphi(1 + \tau_\epsilon)},$$

and the off-equilibrium speculator's gross expected profits are

$$\pi_{sp}\left(\hat{\tau}_\epsilon, \tau_\epsilon\right) \equiv \frac{\sigma_d^2}{\lambda_2} \frac{\varphi}{1 + \varphi} \frac{1}{\left(4 - \chi_s\right)^2} \hat{\chi}_s.$$

- For any conjecture τ_ϵ, we have that $\pi_{sp}\left(\hat{\tau}_\epsilon, \tau_\epsilon\right)$ is strictly increasing and concave in $\hat{\tau}_\epsilon$
  - under mild regularity conditions on $\mathcal{C}\left(x\right)$, the speculator's problem, $\max_x \left(\pi_{sp}\left(x, \tau_\epsilon\right) - \mathcal{C}'\left(x\right)\right)$, achieves a unique maximum

Proposition III. *Under reg conditions, there exists a unique solution to the speculator information acquisition problem, which is given by*

$$q = \begin{cases} Q(\tau_\epsilon) & \text{if } \pi_{sp}(Q(\tau_\epsilon), \tau_\epsilon) - \mathcal{C}(Q(\tau_\epsilon)) > 0 \\ 0 & \text{otherwise} \end{cases}$$

where $Q(\tau_\epsilon)$ *satisfies the first order conditions*

$$\frac{\partial}{\partial \hat{\tau}_\epsilon} \pi_{sp}(Q(\tau_\epsilon), \tau_\epsilon) = \mathcal{C}'(Q(\tau_\epsilon)).$$

Fixed point in the information acquisition game

- The mappings $Q(\tau_\epsilon)$ are the speculator's optimal response to the market maker and insider conjectures on his own information acquisition decision

- We term $Q(\tau_\epsilon)$ and the ensuing gross profits "off-equilibrium" information strategy and profits

- In equilibrium, these conjectures are correct, in that they coincide with q. Therefore, in equilibrium

$$\tau_\epsilon^* = \begin{cases} Q(\tau_\epsilon^*) & \text{if } \pi_{sp}(Q(\tau_\epsilon^*), \tau_\epsilon^*) - \mathcal{C}(Q(\tau_\epsilon^*)) > 0 \\ 0 & \text{otherwise} \end{cases}$$

  Under mild reg conditions, this equilibrium is unique

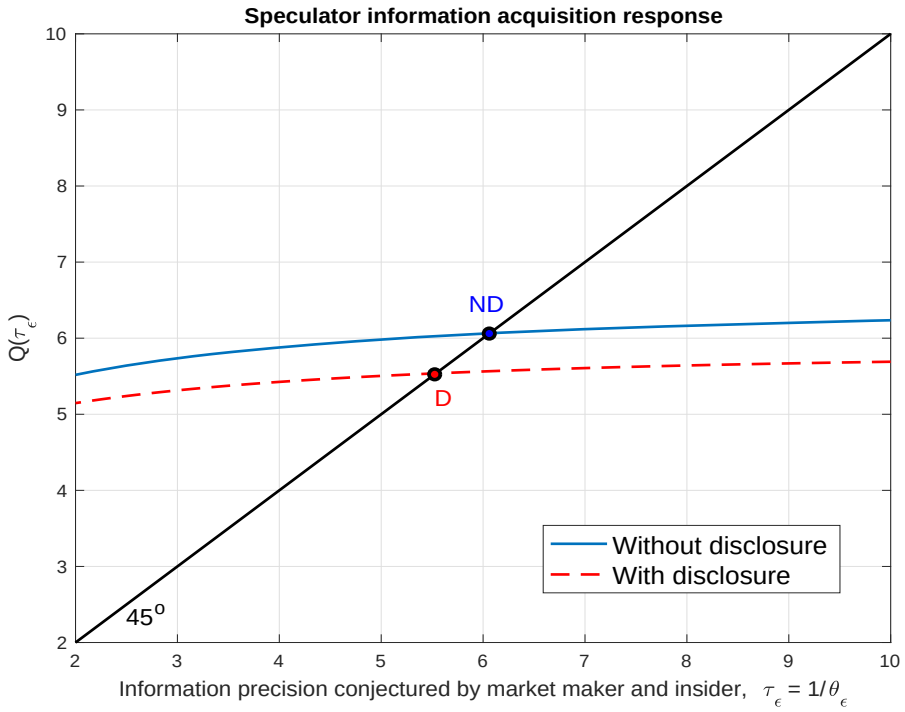
Without mandatory disclosure

Proposition IV. *The equivalent of Proposition III*

Crowding-out and information efficiency

- Constant returns to scale
- Concave production technology (work in progress)

Fixed point in the info acquisition game



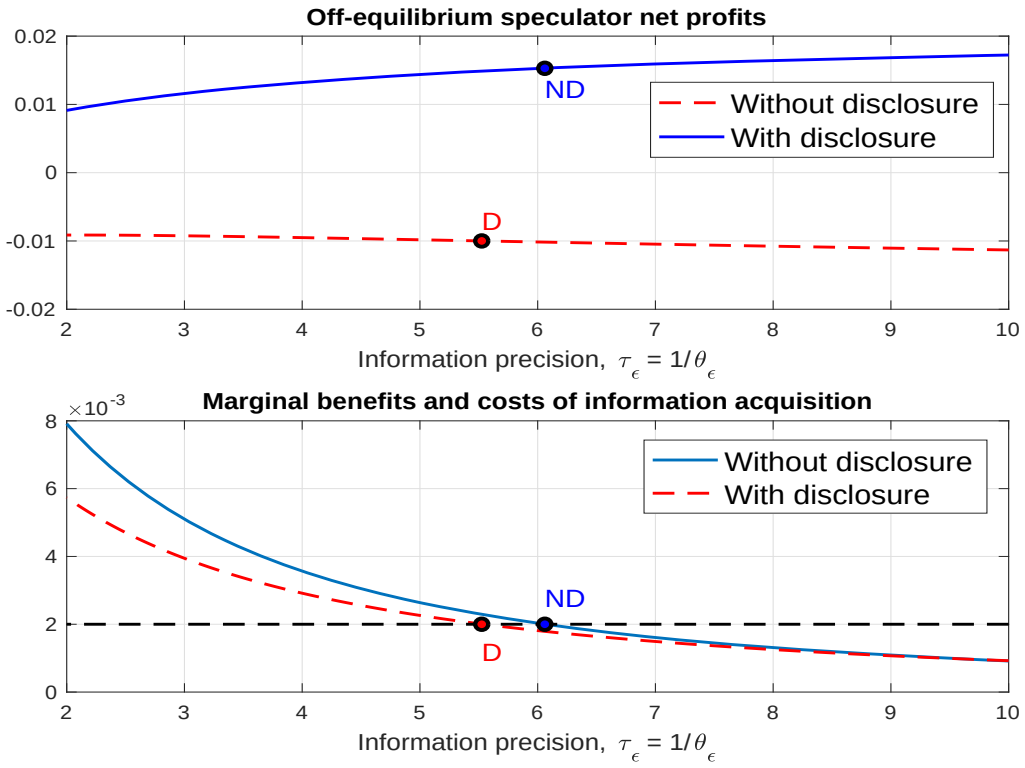
Equilibrium Information production

- Define speculator's off-equilibrium profits

$$\bar{\pi}_{sp}\left(\tau_{\epsilon}\right) \equiv \pi_{sp}\left(Q\left(\tau_{\epsilon}\right), \tau_{\epsilon}\right) - \mathcal{C}\left(Q\left(\tau_{\epsilon}\right)\right).$$

  (i.e., net expected profits when speculator replies to conjectures on τ_{ϵ} with $Q\left(\tau_{\epsilon}\right)$)

- *Equilibrium* net expected profits are $\bar{\pi}_{sp}\left(\tau_{\epsilon}^{*}\right)$, provided $\bar{\pi}_{sp}\left(\tau_{\epsilon}^{*}\right) > 0$, where τ_{ϵ}^{*} are the precisions satisfying the first-order conditions


Off-equilibrium speculator net profits
0.02
0.01
0
-0.01
-0.02
ND
D
Without disclosure
With disclosure
2
3
4
5
6
7
8
9
10
Information precision, $\tau_\epsilon = 1/\theta_\epsilon$
Marginal benefits and costs of information acquisition
$\times 10^{-3}$
8
6
4
2
0
Without disclosure
With disclosure
ND
D
Information precision, $\tau_\epsilon = 1/\theta_\epsilon$

Work in progress

- Additional attributes of market quality
  - Liquidity
  - Volatility
- "Unfair enrichment" of insiders: insiders' profits
- Extension to speculators' Cournot competition

Professional investors subject to Cournot competition

- We consider a market with N symmetrically informated speculators. Each observes/produces a signal

$$s_i = \tilde{d} + \epsilon_i, \quad \epsilon_i \sim N\left(0, \sigma_\epsilon^2\right), \quad i = 1, \cdots, N,$$

  and we assume that the noise components are uncorrelated, $E\left(\epsilon_i \epsilon_j\right)$ for all $i \neq j$.

- We search for a symmetric linear equilibrium where each speculator strategy, a_i say, satisfies

$$a_i = a\left(s_i, x_1\right) = \beta_{a,2}\left(s_i - \bar{p}_1\right), \quad i = 1, \cdots, N.$$

Part of the equilibrium is N^* determined through a zero profit condition.

Conclusions

- Post trade transparency does not help achieve informationally more efficient markets
- Liquidity substantially the same
- Effects are quite strong in the presence of multiple speculators