Financial Market Feedback

Foundations and New Directions

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Structure

- Overview of feedback from financial markets:
    - Basic premise, evidence, implications
- Implications for disclosure:
    - Interaction between learning and disclosing; Goldstein and Yang (*JFE*, 2019)
- Lessons for commodities futures markets financialization;
    - New avenue of feedback; Goldstein and Yang (WP, 2019)

OVERVIEW

Information in prices

- A basic premise in financial economics: market prices are very informative about assets fundamentals
- They gather information from many different participants, who trade on their own money
- Lots of empirical evidence supporting the idea, e.g., Roll (*AER*, 1984)
- Models of how information gets reflected in the price: Grossman and Stiglitz (*AER*, 1980), Kyle (*Econometrica*, 1985), Glosten and Milgrom (*JFE*, 1985)

The Feedback Effect

- The informativeness of prices is important, since it helps facilitate the efficient allocation of resources:

  An efficient market "has a very desirable feature. In particular, at any point in time market prices of securities provide accurate signals for resource allocation. That is, firms can make production-investment decisions ..." **Fama & Miller (1972)**

- Who learns from the price?
  - Managers, Creditors, Regulators, Customers, Employees, etc.
  - As long as there is *some* information in the price they don't know

Empirical Evidence

- Some Evidence:
  - Luo (*JF*, 2005) – Mergers are more likely to be canceled when prices react more negatively and managers are trying to learn
  - Chen, Goldstein, and Jiang (*RFS*, 2007) and Bakke and Whited (*RFS*, 2010) – Price informativeness affects investment sensitivity to price
  - Edmans, Goldstein, and Jiang (*JF*, 2012) – Non-fundamental shocks to prices affect takeovers
  - Foucault and Fresard (*RFS*, 2012) – Cross listed firms have stronger investment-price sensitivity
  - Foucault and Fresard (*JFE*, 2014) – Learning from peers' stock prices and corporate investment
  - Dessaint, Foucault, Fresard, and Matray (RFS, 2019) – Non-fundamental shocks to stock prices (noise) affect peers' investment

⟶ Financial markets are not a **side show**

Implications for Theory

- A **feedback loop** emerges between market prices and firms' cash flows and fundamentals. Prices reflect *and* affect cash flows:

  "In certain circumstances, financial markets can affect the so-called fundamentals which they are supposed to reflect." **George Soros**

- Traditional models on financial markets do not capture this feedback loop
  - They take firm cash flows as given and study price formation as a result
- The "Feedback Effect" papers break this paradigm and consider the feedback loop between prices and cash flows / fundamentals
  - Modelling can be challenging because of feedback loop

Early Literature Review: Bond, Edmans, and Goldstein (*ARFE*, 2012)

- Review theoretical and empirical literature on the real effect of (secondary) financial markets
- Two channels for real effect (both rely on information):
  - Decision makers on the real side **learn new information** from markets that guides their decisions
  - Compensation contracts for real decision makers are tied to market prices (due to their informativeness) and affect their **incentives**

- Highlight two implications for theoretical research:
  - Incorporating the feedback effect into models of trading in financial markets fundamentally **changes predictions on price formation** in financial markets (with implications for firm cash flows)
    - Giving rise to phenomena that otherwise look puzzling
  - Different notions of efficiency
    - **Forecasting Price Efficiency (FPE)**
    - **Revelatory Price Efficiency (RPE)**
    - Former is often emphasized (Market Efficiency), but latter really matters (Real Efficiency)

FEEDBACK AND DISCLOSURE

Good Disclosure, Bad Disclosure (Goldstein and Yang, *JFE* 2019)

Implications for Disclosure

- Literature in accounting and finance studies the implications of disclosure of public information (See recent survey by Goldstein and Yang (*ARFE*, 2017))
  - Disclosure can improve **liquidity** and **market efficiency**
  - But, it can **crowd out** private information, which might generate the opposite effect
  - Ultimately, one should care about real efficiency
  - For this, it is important to consider the interaction between disclosure and feedback effects

Good Disclosure, Bad Disclosure: Goldstein and Yang (*JFE*, 2019)

- The paper studies the real-efficiency implications of public disclosure in a model with feedback effect
- The model differentiates between **different types of information** and shows that implications can be different depending on what is being disclosed, how precise the disclosure is, how efficient the market is, etc.
- Note earlier work exploring the relation between feedback and disclosure, e.g., Gao and Liang (*JAR*, 2013) and Bond and Goldstein (*JF*, 2015)

Model Setup (slightly adjusted)

- A firm has access to an investment technology that needs to be financed by capital providers
- A financial asset whose payoff is tied to the technology's cash flow is traded in the financial market by speculators
- Agents (speculators, capital providers) have access to two types of information: Private information and public disclosure
- Timeline
  - t = 0: Speculators trade and the asset is priced
  - t = 1: Capital providers decide how much capital to provide
  - t = 2: Cash flow is realized; all agents receive their payoffs

Technology and Investment

- The payoff from the investment is $\tilde{A}\tilde{F}k_j$, where k_j is the amount of investment financed by a capital provider; $\tilde{A} \geq 0$ and $\tilde{F} \geq 0$ are mutually independent shocks
- Capital provider must incur a cost $c(k_j)=\frac{1}{2}ck_j^{\ 2}$ when investing, and then receive a fraction β of the payoff
- Prior distributions:
  - $\tilde{f} = ln(\tilde{F})$ is normal with mean 0 and variance $\sigma_f^2 \equiv 1/\tau_f$
  - $\tilde{a} = ln(\tilde{A})$ is normal with mean 0 and variance $\sigma_a^2 \equiv 1/\tau_a$

Financial Market

- A continuum of risk neutral speculators indexed by $i \in [0,1]$ trade a security, whose payoff is cash flow from the investment $(1-\beta)\int \tilde{A}\tilde{F}k_j$
- Speculator *i* can buy or short up to a unit of the asset: $d(i) \in [-1,1]$
- Noisy supply in the financial market with underlying normally-distributed shock $\tilde{\xi}$ with precision τ_ξ
- Price *P* is set by market clearing condition, so that speculators' demand is equal to noisy supply:
    - Speculators do not condition on price, but noise is sensitive to price

Information

- Speculators observe private noisy signals about fundamental shocks:
  - $\tilde{x}_i = \tilde{a} + \tilde{\varepsilon}_{x,i}$, where $\tilde{\varepsilon}_{x,i}$ is normally distributed with precision: τ_x
  - $\tilde{y}_i = \tilde{f} + \tilde{\varepsilon}_{y,i}$, where $\tilde{\varepsilon}_{y,i}$ is normally distributed with precision: τ_y
- Capital providers know $\tilde{a}$; they want to learn $\tilde{f}$
  - They partly rely on the information in the price P
- Public disclosure about shocks available to all: $\tilde{\omega} = \mu_a \tilde{a} + \mu_f \tilde{f} + \tilde{\varepsilon}_\omega$
  - $\tilde{\varepsilon}_\omega$ is normally distributed with precision τ_ω

Trading Equilibrium

- A linear monotone equilibrium where speculators buy one unit when a linear combination of their signal is above a threshold, and sell one unit otherwise; i.e., they buy if and only if:

$$\tilde{x}_i + \phi_y \tilde{y}_i + \phi_\omega \tilde{\omega} > g$$

  - The constants ϕ_y, ϕ_ω, and g are determined in equilibrium which is pinned down by the "guess and verify" approach
  - The value of ϕ_y is key to the equilibrium: It is the extent to which speculators put weight on what capital providers want to learn

Disclosure and Real Efficiency

- How does quality of disclosure τ_ω affect the real efficiency
  - Real efficiency is defined as the expected surplus from real investment: $RE = E\left[\int \tilde{A}\tilde{F}k_j - C\left(k_j\right)\right]$
- Real efficiency boils down to the quality of information available to capital providers about $\tilde{f}$:
  - $RE \propto \frac{1}{Var(\tilde{f}|\tilde{a},\tilde{P},\tilde{\omega})}$.

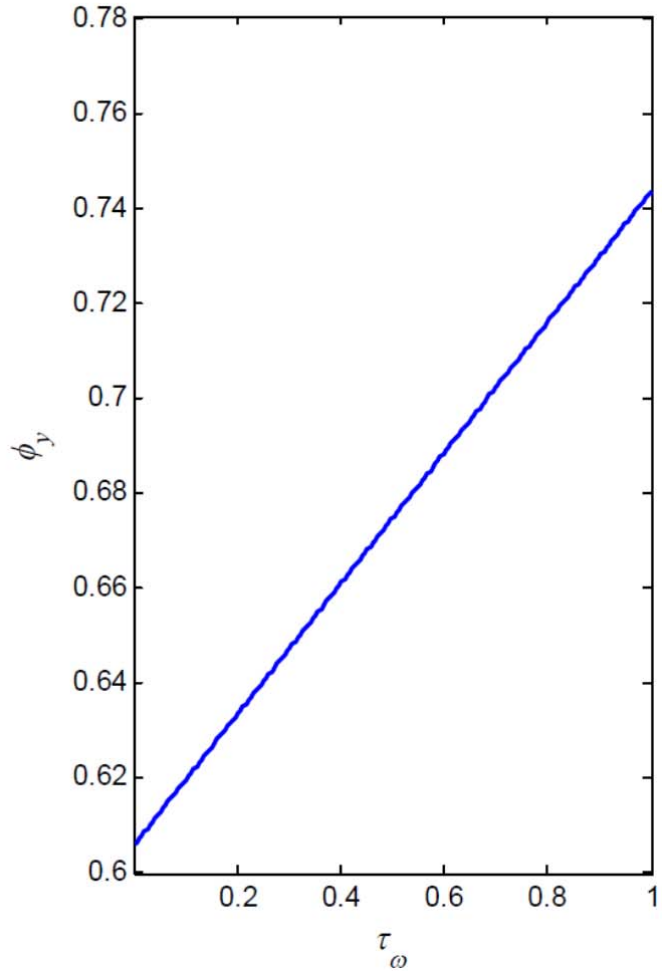
Direct and Indirect Effect of Disclosure

- **Direct effect:** More disclosure entails higher precision of information about $\tilde{f}$

- **Indirect effect:** More disclosure changes the precision of the price signal about $\tilde{f}$, denoted as τ_p
  - Precision of the price signal about $\tilde{f}$ is determined by ϕ_y, which is the weight speculators put on their signal about $\tilde{f}$ when they trade
  - This effect can be positive or negative

Public Signal is Mostly about *A*

- Indirect effect is positive:
  - When public signal provides more precise information about $\tilde{a}$, speculators put more weight on their information about $\tilde{f}$
  - Price provides more precise signal about $\tilde{f}$
  - This is amplified via feedback effect; real value is affected more by $\tilde{f}$, encouraging speculators to put even more weight on this signal
- Both direct and indirect effects are positive; disclosure clearly improves real efficiency (see picture on next slide)


0.78
0.76
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0.72
0.7
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0.62
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ϕ_y
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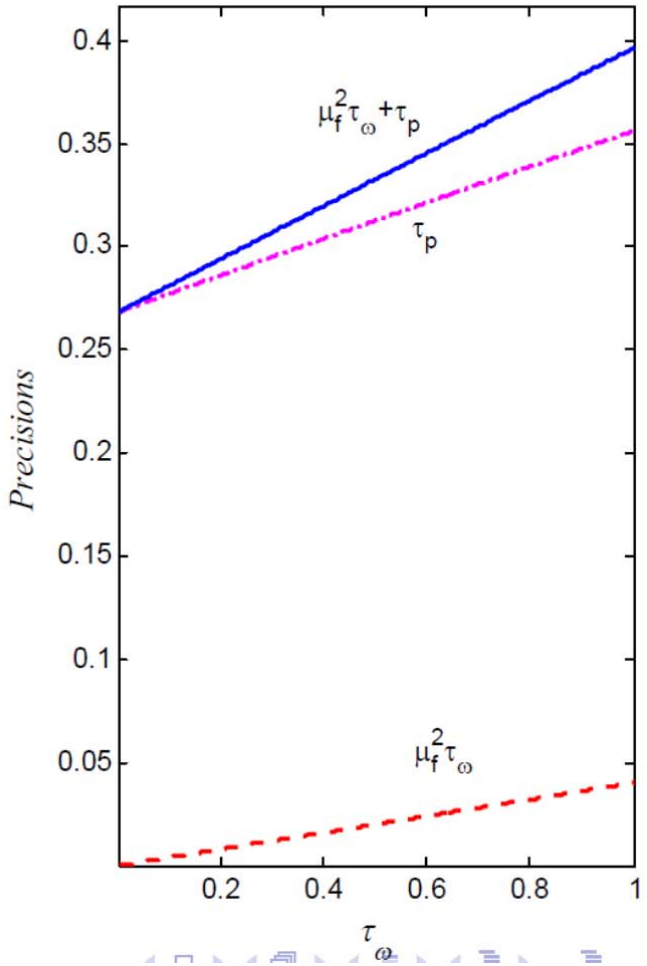
0.6
0.8
1
τ_ω


0.4
0.35
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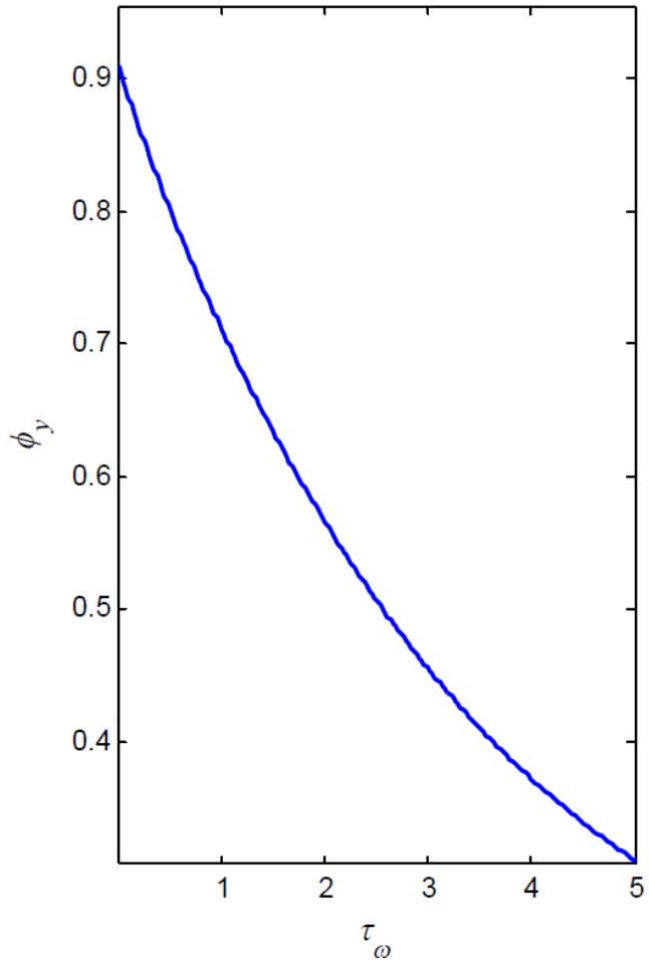
Precisions
$\mu_f^2\tau_\omega+\tau_p$
τ_p
$\mu_f^2\tau_\omega$
0.2
0.4
0.6
0.8
1
τ_ω

Public Signal is Mostly about *F*

- Indirect effect is negative:
  - When public signal provides more precise information about $\tilde{f}$, speculators put less weight on their information about $\tilde{f}$
  - Price provides less precise signal about $\tilde{f}$
  - This is amplified via feedback effect
- Direct and indirect effects are opposite
- Indirect effect dominates when market is efficient; high τ_ξ (see picture)


0.9
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ϕ_y
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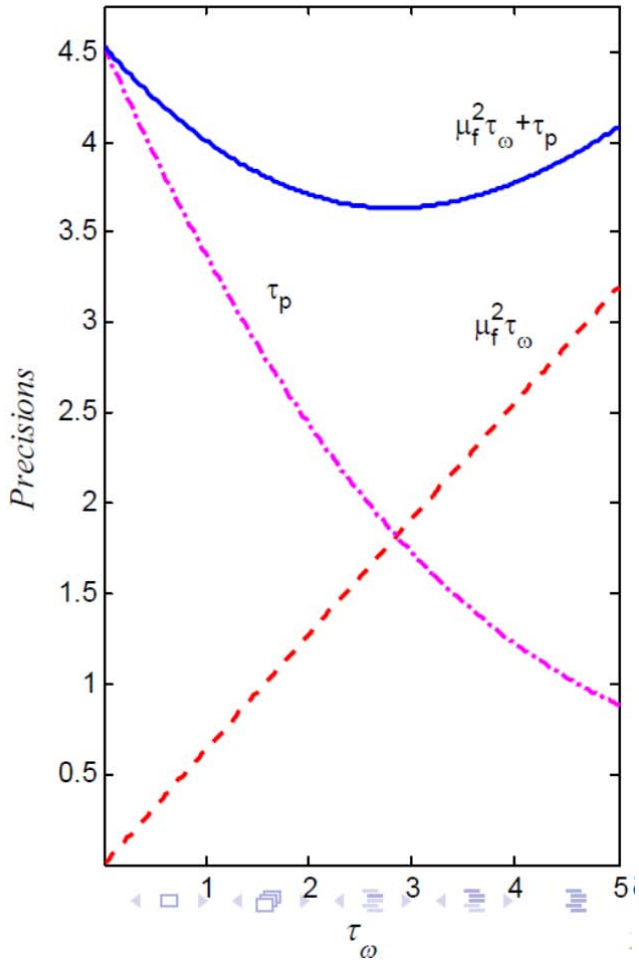
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Precisions
$\mu_f^2\tau_\omega+\tau_p$
τ_p
$\mu_f^2\tau_\omega$
1
2
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τ_ω

Some Implications

- It is important to pay attention to **multiple dimensions of information** and consider **what disclosure is about** when evaluating its desirability
- There is a clear **benefit in providing public information about what decision makers already know**, as it pushes the market to focus on the information that decision makers care to learn
- **Providing public information about something decision makers wish to learn might backfire** when the market works efficiently and the public disclosure is not super precise

Example

- Capital providers finance a firm's investment in a new line of products
  - They have information about the **quality of the technology** and the products (easy to verify from the firm), but not about the **competition the firm faces with other firms**
  - Information about the competitive landscape can be aggregated by financial markets (this information tends to benefit from aggregation)
  - Public disclosure emerges from credit rating agencies or mandatory disclosure requirements from firms

- Having public disclosure focused on the quality of technology and products is always beneficial
- However, providing public disclosure on competition with other firms might not be desirable if the market is efficient and the public disclosure is of low precision (likely when aggregation is beneficial)

- Result provides rationale for accounting metrics that are based on **backward looking information** and not **forward looking assessments**
- Note difference between cases where information is disclosed by a third party (discussed in the model) and where it is disclosed by the decision maker (no direct effect)

FEEDBACK FROM COMMODITIES FUTURES MARKETS

Commodity Financialization and Information Transmission (Goldstein and Yang, *WP* 2019)

Commodities Futures Financialization

- Commodity futures became popular among financial investors over the last two decades
  - Phenomenon known as **commodities financialization**: Cheng and Xiong (*ARFE*, 2014)
- Economists and regulators are concerned about whether and how financialization has affected the functioning of futures and spot markets
  - What happened to market quality (**spot and futures market**)?
  - What are the **real effects**?

Informational Role of Commodities Futures Markets

- Information incorporated in trading in futures markets may be key for **investment/production** decisions in commodities

  "*futures prices provide a wealth of valuable information for those who produce, store, and use commodities...The big benefit from futures markets is the side effect: the fact that participants in the futures markets can make production, storage, and processing decisions by looking at the pattern of futures prices, even if they don't take positions in that market."* **Black (1976)**

- What would be the consequences of financialization analyzed through the lens of the **informational channel**?

Commodity Financialization and Information Transmission: Goldstein and Yang (WP, 2019)

- We develop an asymmetric information model where financial traders, commodity producers, and noise traders trade futures contracts
  - Financial traders inject new **information** and **noise** into the futures market
  - **Price informativeness** can either increase or decrease with commodity financialization
- Commodity producers are affected by futures price in deciding on commodity production
  - **Real effects** of commodity financialization; natural framework for feedback

Model Setup

- Two dates: *t = 0* (futures market), *t = 1* (spot market)
- **Date-1 spot market**
  - Symmetric information; endogenous spot price $\tilde{v}$
  - Exogenous linear commodity demand
  - Endogenous commodity supply from commodity producers
- **Date-0 futures market**
  - Asymmetric information; endogenous futures price $\tilde{p}$
  - Players: commodity producers (mass 1), financial traders (mass μ), and noise traders; μ parameterizes commodity financialization

Commodity Demand and Supply

- At date 1, the commodity demand is $\boldsymbol{y = \tilde{\theta} + \tilde{\delta} - \tilde{v}}$
  - o $\boldsymbol{\tilde{\theta} + \tilde{\delta}}$ captures demand shocks
  - o $\boldsymbol{\tilde{\theta} \backsim N\left(\bar{\theta}, \tau_{\theta}^{-1}\right)}$ is forecastable and $\boldsymbol{\tilde{\delta} \backsim N\left(0, \tau_{\delta}^{-1}\right)}$ is unforecastable
- At date 0, a continuum [0,1] of commodity producers choose production $\boldsymbol{x_i}$ and position in futures market $\boldsymbol{d_i}$ to maximize expected CARA utility
  - o Their final wealth is: $\boldsymbol{W_i = \tilde{v}x_i - \left(cx_i + \frac{1}{2}x_i^2\right) + (\tilde{v} - \tilde{p})d_i}$
  - o Their information is the futures price $\boldsymbol{\tilde{p}}$ and a private signal $\boldsymbol{\tilde{s_i} = \tilde{\theta} + \tilde{\varepsilon_i}}$, where $\boldsymbol{\tilde{\varepsilon_i} \backsim N\left(0, \tau_{\varepsilon}^{-1}\right)}$

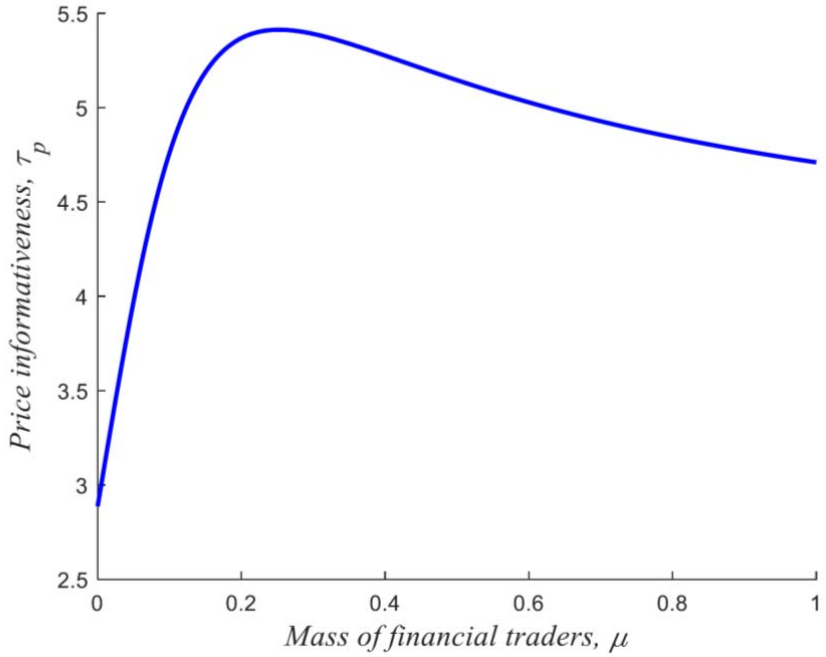
- Their production and trading decisions are:
  - **Production**: $\boldsymbol{x_i = \tilde{p} - c}$
  - **Futures exposure**: $\boldsymbol{d_i = \frac{E(\tilde{v}) - \tilde{p}}{\kappa Var(\tilde{v})} - (\tilde{p} - c)}$
    - First component is **speculation** and second component is **hedging**
- Equilibrium in spot market:
  - Supply $(\tilde{p} - c)$ equals demand $(\tilde{\theta} + \tilde{\delta} - \tilde{v})$
  - Spot price $\tilde{v} = \tilde{\theta} + \tilde{\delta} + c - \tilde{p}$
- Clear **supply channel** by which futures price affects spot price and the real economy

Financial Traders

- A mass $\boldsymbol{\mu}$ of identical financial traders who trade futures both for **speculation** and for **hedging** to maximize expected CARA utility
- They know the demand shock $\widetilde{\boldsymbol{\theta}} \rightarrow$ speculation
- They invest in another market with net return of $\widetilde{\boldsymbol{\alpha}} + \widetilde{\boldsymbol{\eta}}$
  - $\widetilde{\boldsymbol{\alpha}} \backsim \boldsymbol{N}\left(\mathbf{0}, \boldsymbol{\tau}_{\boldsymbol{\alpha}}^{-\mathbf{1}}\right)$ is forecastable and $\widetilde{\boldsymbol{\eta}} \backsim \boldsymbol{N}\left(\mathbf{0}, \boldsymbol{\tau}_{\boldsymbol{\eta}}^{-\mathbf{1}}\right)$ is unforecastable
  - $\boldsymbol{Corr}\left(\widetilde{\boldsymbol{\delta}}, \widetilde{\boldsymbol{\eta}}\right) = \boldsymbol{\rho} \in (-\mathbf{1}, \mathbf{1}) \rightarrow$ hedging
- In the financial market, there are also noise traders: $\tilde{\boldsymbol{\xi}} \backsim \boldsymbol{N}\left(\bar{\boldsymbol{\xi}}, \boldsymbol{\tau}_{\boldsymbol{\xi}}^{-\mathbf{1}}\right)$
- Price is obtained by market clearing; linear function of $\widetilde{\boldsymbol{\theta}}$, $\widetilde{\boldsymbol{\alpha}}$, $\tilde{\boldsymbol{\xi}}$

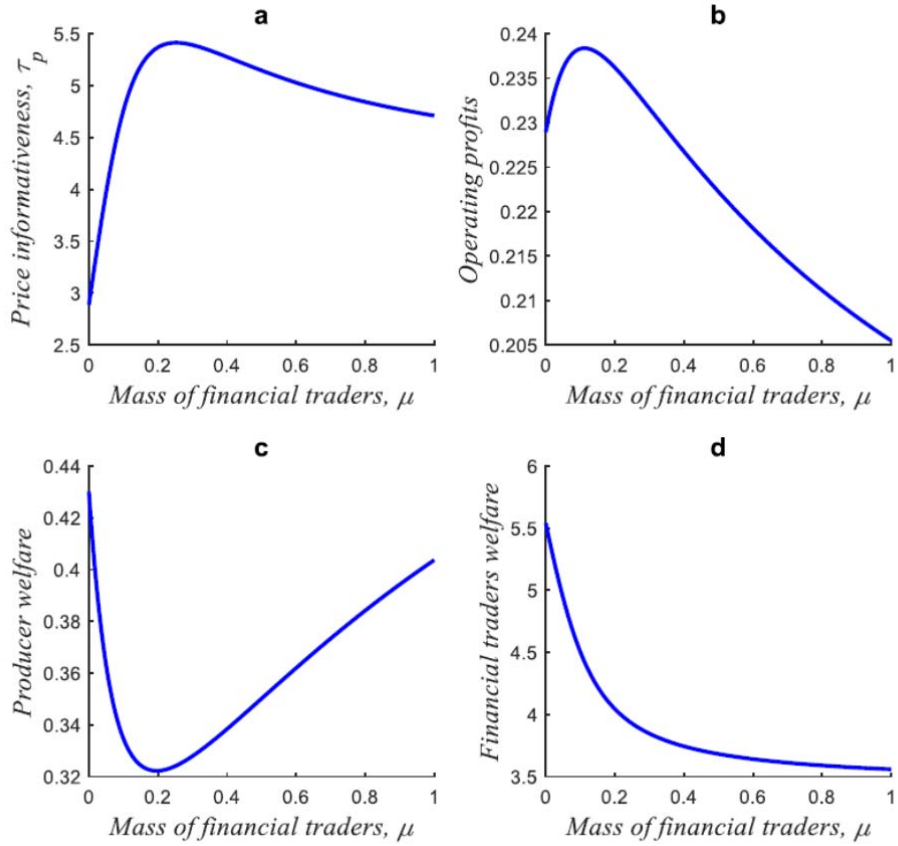
Financialization and Price Informativeness

- How does an increase in **financialization μ** affect the **informativeness** of the price about the fundamental $\tilde{\theta}$?



- Financial traders bring both **"noise"** ($\tilde{\alpha}$) and **information** ($\tilde{\theta}$) to the price
  - **Second effect dominates** only when their **mass is relatively small**
  - Initially their presence is effective to overcome noise trading ($\tilde{\xi}$), but as they become more prominent in the market, the additional factors they bring ($\tilde{\alpha}$) also become more prominent and mask $\tilde{\theta}$
- **Empirical literature** provides conflicting results
  - Raman, Robe and Yadav (2017) vs. Brogaard, Ringgenberg and Sovich (2017)
  - Our model can **reconcile** them and emphasizes the importance of how **advanced the process of financialization** is

Real Effect of Financialization



Implications for Real Effects:

- On the one hand, **greater informativeness translates into greater operating profits for the producers**
  - This is in the spirit of the empirical evidence in Brogaard, Ringgenberg and Sovich (2017)
- But, there are other things operating in the opposite direction:
  - **Greater informativeness hurts trading gains and reduces risk sharing opportunities** for producers in futures market
- As a result, it turns out that the overall real efficiency is affected in the **opposite direction when producers are active in futures market**

- An extension of the model shows that greater informativeness translates to greater real efficiency for producers who are **not active in the futures market**
- Hence, interpretation of empirical evidence requires more thought; while operating profits improve for all producers when informativeness increases, welfare results depend on participation in futures markets
- There are additional complications in the context of commodities futures markets on top of the usual feedback effect models
    - Combination of **primary** (price has direct effect on production) and **secondary** (price has an informational effect) financial markets effects

CONCLUSION

- Feedback effects are a natural consequence of informative financial markets
- There is evidence supporting their presence in the data and they generate important implications for theories of financial markets
- I presented recent research developing new implications for disclosure of information and for the effect of commodities futures markets
- There are ample opportunities for future research:
  - Establishing empirical evidence more firmly or directly
  - Exploring other implications of interactions between financial markets and the real economy