"How does Stock Market Affect Corporate Investment?"

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How does Stock Market Affect Corporate Investment?

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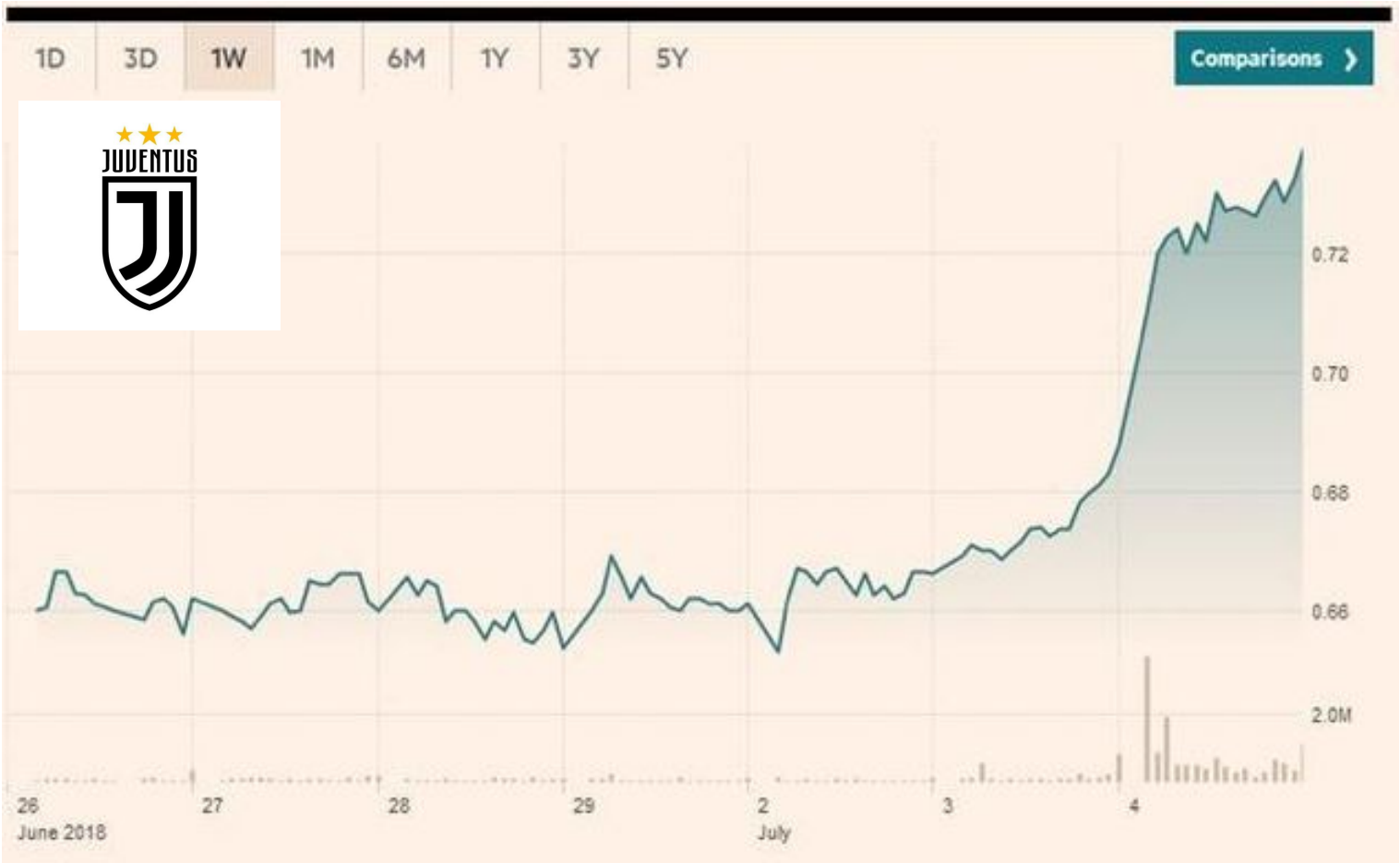
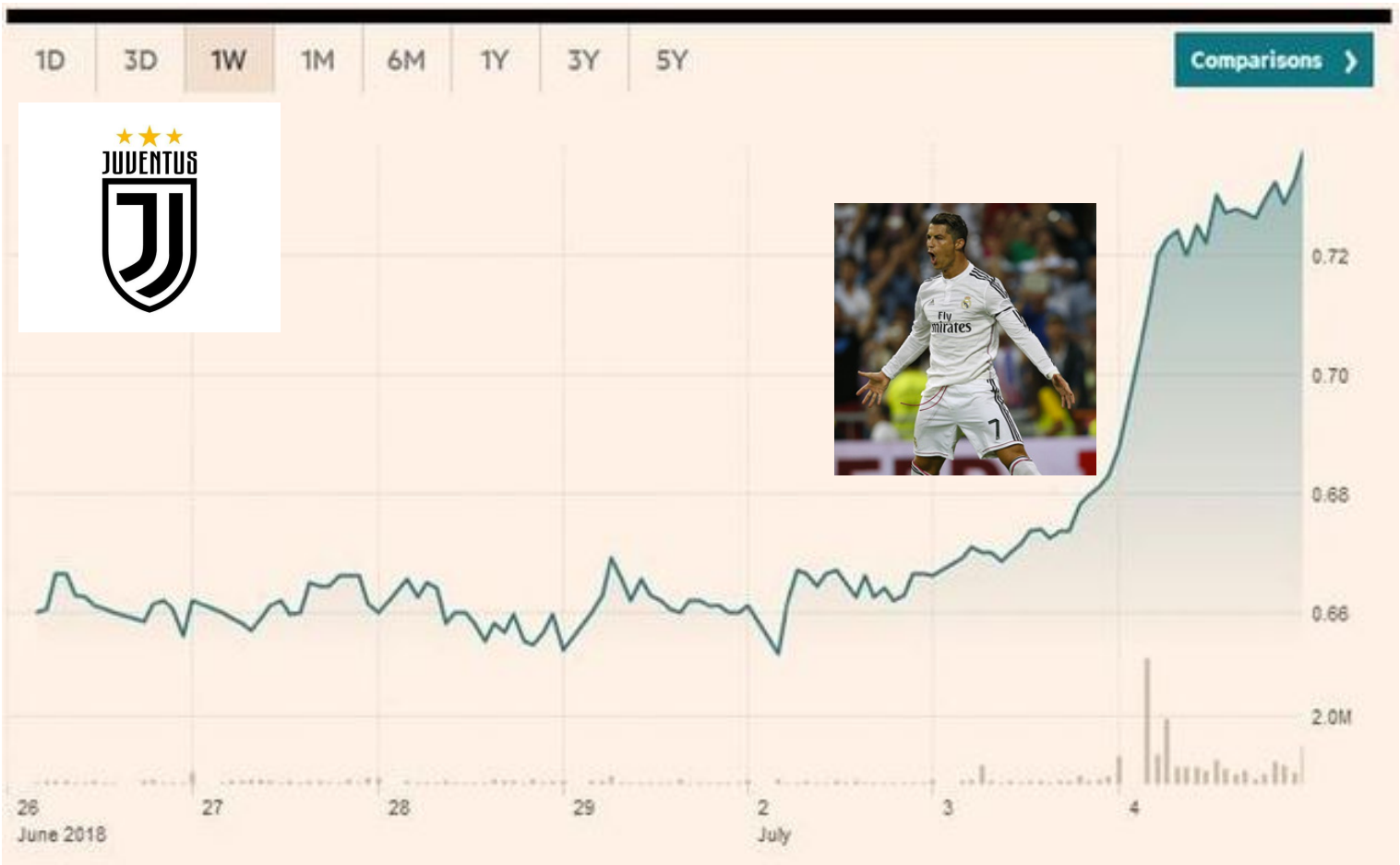
Investment and Stock Price



Investment and Stock Price



Investment Sensitivity to Price

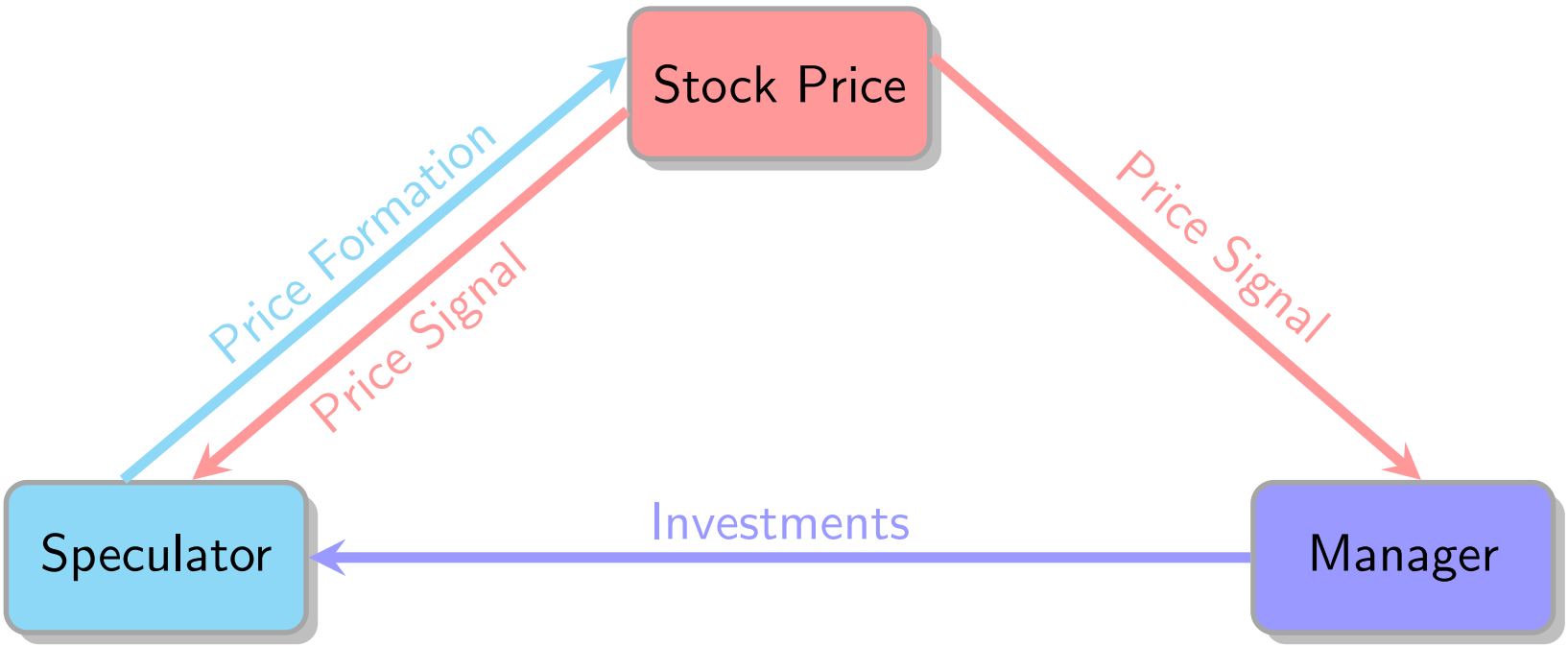
Strong positive correlation between investment and stock price

- Recent empirical evidence in Bond, Edmans, and Goldstein (2012)
- In short, *investment-price sensitivity*

No agreement on the reason

- *Correlated information channel* due to correlation between
  - Managerial information: determining investment
  - Speculator private information: determining price
- *Managerial learning channel*

Informational Feedback Loop



A General Model

Managerial learning has been studied theoretically in various specific settings.

- Special payoff functions
- Binary random economic fundamentals
- Binary choices

We know less about general properties of informational feedback.

1. Tractable model with general functional form, continuous economic fundamentals, and continuous choices
2. How does stock market affect corporate investments?
3. New identifications for test of managerial learning hypothesis

New Insights

Consider an exogenous shock in financial market.

- Shock affects *investment-price sensitivity* through price signal only.
- $\textit{Investment-price sensitivity} = \dfrac{\text{Shock effect on investment}}{\text{Shock effect on price}}$.
  - Shock effect on investment represents managerial learning.
  - Shock effect on price arises from speculator learning.
    - Belief updating
    - Anticipating managerial learning

Race between managerial learning and speculator learning

- Determines how price informativeness affects corporate investments and *investment-price sensitivity*

Preview of Results

1. Price informativeness is the product of
   - Precision of speculator private signal
   - Precision of random supply shock

2. Different precisions have heterogeneous effects on investment-price sensitivity.

	investment-price sensitivity	
	global monotonicity	asymptotic
speculator signal	decreasing	significant
supply shock	increasing then decreasing	trivial

3. Direct effects of price informativeness on investment
   - Not through affecting investment-price sensitivity

Empirical Implications

Two new identifications for managerial learning hypothesis.

1. Different noise precisions affect investment-price sensitivity differently.
2. Noise precisions have direct effects on corporate investments.

A Feedback Model: Manager

Manager optimization

$$\max_{I \in [I_L, I_H]} \mathbb{E}\left[\pi(v, I) - \Delta(I) | P\right]$$

- $\pi(v, I)$: firm value depends on fundamental v and investment I
- $\Delta(I)$: manager's private cost
- The manager can observe stock price P
  - Shutting down correlated information channel

A Feedback Model: Financial Market

A continuum of risk-neutral speculators with measure 1. Each speculator i

$$\max_{d_i \in [-1,1]} \mathbb{E}\left[(\pi(v, I) - P)\, d_i | s_i, P\right]$$

- $s_i = v + \epsilon_i$ is speculator i's private signal
- **Private signal noise**: $\epsilon_i \sim \mathcal{N}(0, \gamma^{-1})$
- Submit a demand scheme

Random supply $S(\xi) = 1 - 2\Phi(\xi)$

- **Random supply noise**: $\xi \sim \mathcal{N}(0, \beta^{-1})$

Equilibrium Behavior

Manager's investment decision

- Belief updating: $v|P \sim \mathcal{N}\left(\mu_{v|P}, \sigma^2_{v|P}\right)$
- Maximization: $\mathbb{E}\left[\pi\left(v, I\right) - \Delta(I)|P\right] \equiv \Pi\left(I, \mu_{v|P}, \sigma_{v|P}\right) - \Delta(I)$
- Equilibrium investment: $I^*(\mu_{v|P}, \sigma_{v|P})$

Each speculator i

$$d(s_i, P) = \begin{cases} 1, & \text{if } s_i > g(P) \\ \in [-1, 1], & \text{if } s_i = g(P) \\ -1, & \text{if } s_i < g(P) \end{cases}$$

Price Formation

Market clearing implies $g(P) = v + \xi/\sqrt{\gamma}$.

- Define $z = g(P)$ as the price signal
- $z|v \sim \mathcal{N}\left(v, (\gamma\beta)^{-1}\right)$
- $g(P)$ **is not linear**

Marginal speculator

- Private signal realization $=$ price signal realization
- $v|s_i = z, z \sim \mathcal{N}\left(\mu_{v|s_i=z,z}, \sigma^2_{v|s_i=z,z}\right)$,
- Indifference:

$$P = \mathbb{E}\left[\pi(v, I^*)|s_i = z, z\right] = \Pi\left(I^*, \mu_{v|s_i=z,z}, \sigma_{v|s_i=z,z}\right)$$

Decomposing Investment-price Sensitivity

Consider a change of random supply shock $\Delta\xi$.

- Affects investment and speculator payoff through price signal only (Δz)

Decomposition of *investment-price sensitivity*

$$\textit{Investment-price sensitivity} = \frac{\Delta I}{\Delta P} = \frac{\Delta I/\Delta z}{\Delta P/\Delta z}$$

- $\Delta I/\Delta z$: managerial learning
- $\Delta P/\Delta z$: (marginal) speculator learning

Importantly,

- P is not linear in z, so speculator learning is not constant.

Learning effects

Manager and speculators observe same signal realization but learn differently.

- *Managerial learning* $\Delta I^* / \Delta z$:

$$\frac{\Delta I^*}{\Delta z} = \frac{\partial I^*}{\partial \mu_{v|z}} \frac{\partial \mu_{v|z}}{\partial z},$$

  where $\mu_{v|z} = \frac{\eta v_0 + \gamma \beta z}{\eta + \gamma \beta}$;

- *Marginal speculator learning* $\Delta P / \Delta z$:
  - *Belief updating*

$$\frac{\partial \Pi\left(I^*, \mu, \sigma\right)}{\partial \mu} \frac{\partial \mu_{v|s_i=z,z}}{\partial z},$$

    where $\mu_{v|s_i=z,z} = \frac{\eta v_0 + \gamma z + \gamma \beta z}{\eta + \gamma + \gamma \beta}$.
  - *Anticipation effect:*

$$\frac{\partial \Pi\left(I^*, \mu, \sigma\right)}{\partial I^*} \frac{\Delta I^*}{\Delta z}$$

Almost Uninformative Stock Price

Price signal z

$$z|v \sim \mathcal{N}\left(v, (\gamma\beta)^{-1}\right)$$

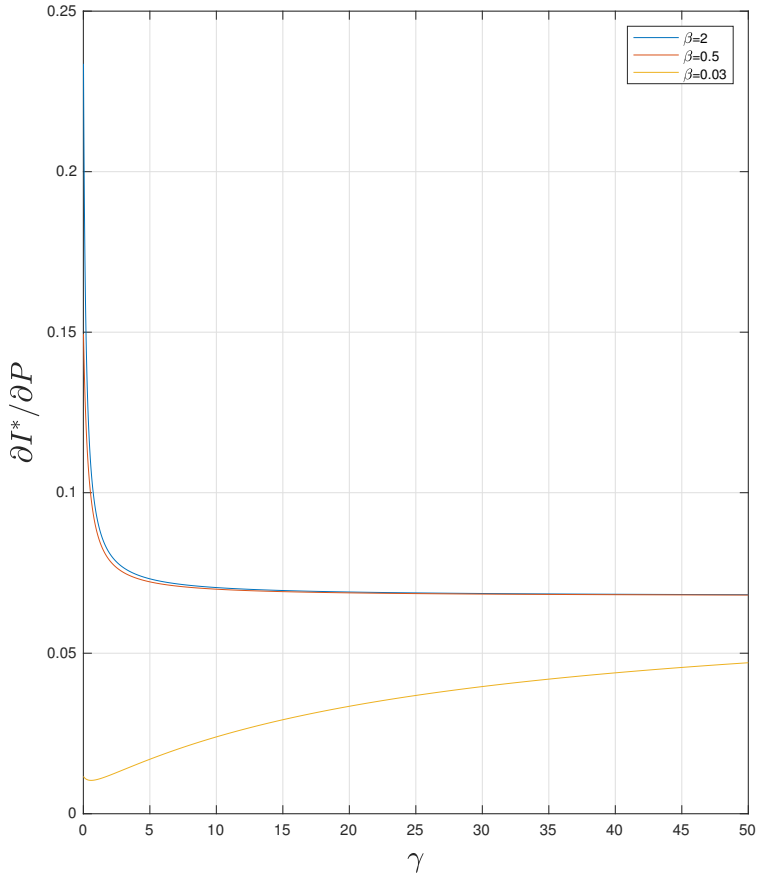
Price is almost uninformative if either $\gamma \to 0$ or $\beta \to 0$.

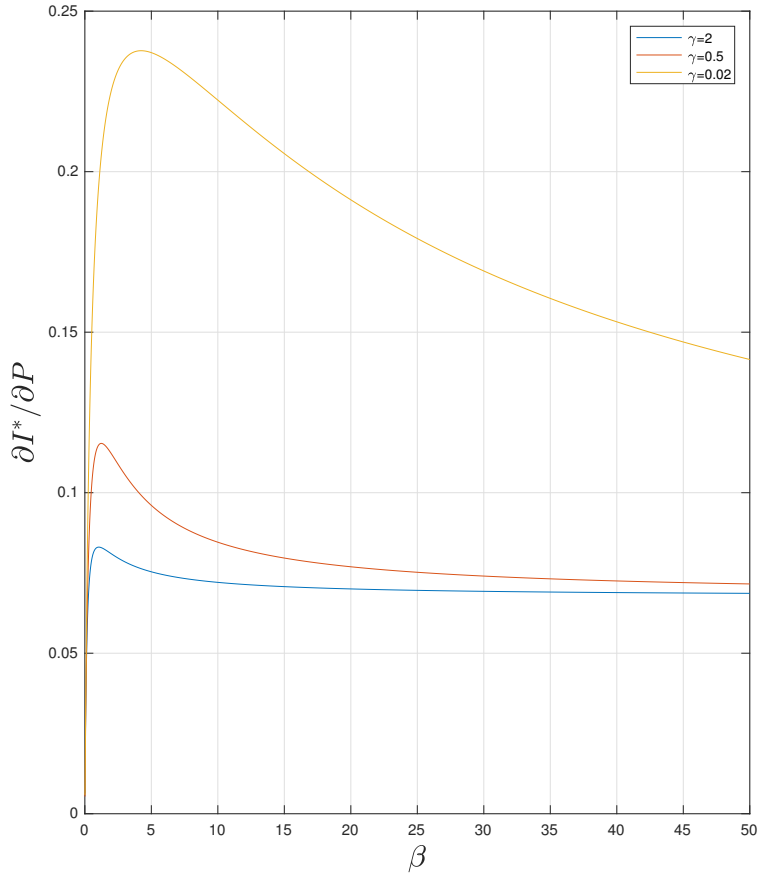
	$\gamma \to 0$	$\beta \to 0$
Price signal z	noise	noise
Private signal $s_i = z$	noise	informative
Manager Learning	trivial: $\frac{\gamma\beta}{\eta+\gamma\beta} \to 0$	trivial: $\frac{\gamma\beta}{\eta+\gamma\beta} \to 0$
Speculator Learning	trivial: $\frac{\gamma+\gamma\beta}{\eta+\gamma+\gamma\beta} \to 0$	non-trivial: $\frac{\gamma+\gamma\beta}{\eta+\gamma+\gamma\beta} \to \frac{\gamma}{\eta+\gamma}$
Investment-price sensitivity	$\frac{\Delta I}{\Delta P} \to c > 0$	$\frac{\Delta I}{\Delta P} \to 0$

Heterogeneous Global Monotonicity

Investment-price sensitivity may not be strictly increasing in either γ or β.

- The effects of γ and β differ.





An increase in γ

When speculator private signals are more precise

- Managerial learning is stronger.
  - Price signal is more informative.
- Speculator learning is even stronger.
  - More informative private signal $\Rightarrow$ Stronger belief updating
  - Anticipation effect is at least as strong as managerial learning.

$$\textit{Investment-price sensitivity} = \frac{\text{Managerial learning}}{\text{Anticipation} + \text{Belief updating}}$$

- Denominator grows faster $\Rightarrow$ *Investment-price sensitivity* decreases.

An increase in β

When random supply shock is less noise

- Managerial learning is stronger.
  - Price signal is more informative.
- Speculator learning becomes stronger.
  - For small β, belief updating is mainly based on private signal.
  - For large β, belief updating is mainly based on price signal.
  - Anticipation effect is as strong as managerial learning.

$$\textit{Investment-price sensitivity} = \frac{\text{Managerial learning}}{\text{Anticipation} + \text{Belief updating}}$$

- First increases then decreases

Direct Effects

Price informativeness affects investments directly (not through affecting investment-price sensitivity).

$$\frac{\partial \Pi\left(I, \mu_{v|P}, \sigma_{v|P}\right)}{\partial I} - \frac{\partial \Delta(I)}{\partial I} = 0.$$

- Increase in price informativeness weakens the role of prior.
- Price informativeness affects $\sigma_{v|P}$.

Conclusion

From theoretical aspect

- A tractable general equilibrium model about informational feedback
- Characterize generally how price informativeness affects investments and investment-price sensitivity

From empirical aspect: two new identifications for managerial learning hypothesis

- Different noise precisions affect investment-price sensitivity differently.
- Price informativeness affects investments directly.