Feedback Effects, Market Valuations, and Real Efficiency

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Motivation

Secondary financial markets appear to have "real" effects

- Corporate decision makers and capital providers learn from prices, thereby allocating the resources more efficiently
  - Various contexts: M&As and production quantity
  - Policy implications: promoting active investing and lowering information costs (e.g., Subrahmanyam & Titman, 1999)
- This seems natural in contexts requiring immediate decisions. But how about decisions involving long-term commitments?
  - E.g., strategic planning and market positioning of firms
  - Relevance for explaining the relationship between financial development and economic efficiency

Motivation

Counterargument: myopic corporate behaviors

- "Short-termism" may happen when short-term prices incorrectly reflect the long-term consequences of certain types of actions
- The literature identifies various types of potential incentive distortion:
  - Earnings manipulation (e.g., Stein, 1989)
  - Inefficient investments (e.g., Aghion & Stein, 2008; Bolton, Scheinkman & Xiong, 2006)

Motivation

This paper examines the long-term consequences of feedback effects between real and financial sectors in terms of market valuations and efficiency

- The interaction between real and financial sectors leads to an overvaluation of equity
- Combined with the short-term incentive for decision makers, this causes inefficiencies in long-term investments
    - As a result, the real economy doesn't necessarily benefit from the informational role of secondary financial markets

Situation and research question

A model of real and financial sectors distinguishing between short- and long-term real investments

- The model considers a single firm whose shares are held by an initial DM
- The initial DM first chooses between two alternative long-term projects, only one of which gives rise to interim information for the firm later
- Then financial market opens and the initial DM exits
- The late DM determines the amount of short-term investments on the chosen project

Situation and research question

Initial DM's choice between two long-term projects

- Scenario 1: The late DM holds information about the productivity of project, which leads to better decison making.
- Scenario 2: The late DM doesn't have any direct information. Instead, she learns from the price.

How does the short-term incentive for the initial DM affect his project choice?

- Imagine that an entrepreneur builds a startup firm and is concerned about the possibility of an IPO in the future
- Core operations vs. pet projects

Main results

Scenario 1: Interim information for firm

- No learning from the price
- The financial price is unbiased about the firm's profit from operations

Scenario 2: No interim information for firm

- Learning from the price
- The financial price is higher on average than the firm's profit from operations
  - This results from the interaction between the price and short-term investments, combined with informed speculators' risk aversion

Main results

Combining these results together, we can identify a type of myopic behavior of the initial DM

- Learning from price causes the firm's shares to be overpriced. This incentivizes the initial DM to choose the less efficient long-term project.

Empirical and policy implications:

- Empirical findings regarding the contribution of price learning to the economy-wide efficiency
- Various aspects of the development of financial markets
- Possible remedies: (i) committing against learning; (ii) large population of uninformed speculators

Literature

Feedback effects between real and financial sectors

- Various features unusual in standard frameworks on financial markets: equilibrium multiplicity, information disclosure, price manipulation, etc.
- DM's price-based intervention may weaken the information from the price (e.g., Bond, Goldstein & Prescott, 2017; Boleslavsky, Kelly & Taylor, 2017)
- Asymmetry in trading behavior (Boleslavsky, Kelly & Taylor, 2017; Edmans, Goldstein & Jiang, 2015)

Corporate short-termism

- Stein (1989): signal-jamming such as earnings manipulation
- Aghion and Stein (2008): strategic focus between sales growth and per-unit growth margins
- Bolton, Sceinkman, and Xiong (2006): CEO's short-term incentive arising from shareholders' incentive to boost short-term prices

Model

A firm has access to the following production technology for project $d \in \{A, B\}$:

$$\pi_d = a_d \left(\theta + \epsilon\right) - \frac{1}{2} a_d^2,$$

where

- θ and ϵ are the forecastable and unforecastable parts of productivity factors, respectively;
- a_d is the amount of investment on the project.

Model

The order of game:

- At $t = 0$, an initial DM chooses $d \in \{A, B\}$
- At $t = 1$, the financial market opens. The initial DM exits by selling the shares.
- At $t = 2$, there are two different scenarios:
    - In the case of project A, a late DM holds θ, which is used to decide a_A;
    - In the case of project B, the late DM only knows the financial price to decide a_B.
- At $t = 3$, the firm generates cash flows π_d and all agents get paid

Model: productivity of projects

The project value $\theta > 0$ follows a power function distribution

$$f(\theta) = C\theta^{-\lambda}, \text{ where } \lambda \in (1, 3) \text{ and } C > 0.$$

- Theoretical and empirical support (e.g., Axtell, 2001; Gabaix, 1999; Gabaix & Landier, 2008)
- Regarded as approximating well-defined fat-tail distributions (checked later)

On the other hand, the unforecastable part ϵ follows $N(0, \sigma_\epsilon^2)$.

- Plays the role of preventing infinite trading in the financial market

Model: financial sector

At $t = 1$, a continuum of informed speculators $i \in [0, 1]$ and noise traders participate in the financial market

- For each project d, informed speculators know θ and submit $x_{id}(\theta, p_d)$ to maximize

$$U_{id} = -\frac{1}{\varphi} \exp\left[-\varphi \left\{x_{id}\left(\pi_d - p_d\right)\right\}\right].$$

- Noise trade is ω, which is a random variable whose support is $\{\omega_1, \cdots, \omega_J\}$ with probabilities $q_1, \cdots, q_J$, respectively. Also, $E[\omega] = 0$.
- The initial DM's shares are negligible.

Model: feedback effects

Two scenarios at $t = 2$:

- Project A: The late DM knows θ, which is used to decide the short-term investment a_A. No need for price learning.
- Project B: No information about θ. Thus, the late DM learns from the price to decide the short-term investment a_B.

How can we interpret these projects?

- Firms may lack experiences and historical data when starting new businesses (e.g., dot-com bubble).
- Note that the relative informativeness between firms and markets may depend on the nature of projects.

Model: equilibrium definitions

Definition 1. An equilibrium consists of $d \in \{A, B\}$, $(x^*_{iA}(\theta, p_A), x^*_{iB}(\theta, p_B))$, $(p_A(\theta, \omega), p_B(\theta, \omega))$, and $(a^*_A(\theta, p_A), a^*_B(p_B))$ such that the following conditions are satisfied:

1. The long-term project $d \in \{A, B\}$ maximizes the expectation of the price conditional on *every realization of project value* θ;
2. Demands $x^*_{id}(\theta, p_d)$ maximize U_{id} at $t = 3$. Also, the price p_d clears the market, i.e. $\int_{i\in[0,1]} x^*_{id} di + \omega = 0$;
3. At $t = 2$, the amount of short-term investments a^*_d maximizes $E[\pi_d|\mathcal{I}_d]$, where $\mathcal{I}_A = \{\theta, p_A\}$ and $\mathcal{I}_B = \{p_B\}$.

Equilibrium for project A

In the case of project A, there is interim information about θ for the late DM deciding the amount of short-term investments a_A at $t = 2$. Therefore, she chooses $a_A = \theta$ so that the firm's profit is given by

$$\pi_A = a_A(\theta + \epsilon) - \frac{a_A^2}{2} = \frac{\theta^2}{2} + \theta\epsilon.$$

On the other hand, the market-clearing condition yields

$$p_A = E[\pi_A|\theta] + \varphi\omega Var[\pi_A|\theta].$$

Equilibrium for project A

Proposition 1. The equilibrium price p_A is given by

$$p_A = \underbrace{\frac{\theta^2}{2}}_{E[\pi_A|\theta]} + \underbrace{\varphi\sigma_\epsilon^2\theta^2\omega}_{\varphi\omega Var[\pi_A|\theta]} = \left(\frac{1}{2} + \varphi\sigma_\epsilon^2\omega\right)\theta^2.$$

Corollary 1. The expected price $E[p_A|\theta]$ is equal to the firm's expected profit $E[\pi_A|\theta]$, where the expectations are conditional on the project value θ.

Equilibrium for project B

In the case of project B, there is *no* interim information about θ for the late DM at $t = 2$. Therefore, she decides the amount of short-term investments a_B based on p_B. With conjectured investment strategy $a_B^*(p_B)$, the firm's profit is given by

$$\pi_B = a_B^*(\theta + \epsilon) - \frac{1}{2}\left(a_B^*\right)^2,$$

which determines the price p_B as follows:

$$p_B = \underbrace{a_B^*\theta - \frac{1}{2}\left(a_B^*\right)^2}_{E[\pi_B|\theta, p_B]} + \underbrace{\varphi\sigma_\epsilon^2\left(a_B^*\right)^2\omega}_{\varphi\omega Var[\pi_B|\theta, p_B]}.$$

Equilibrium for project B

What form of signal about θ can be extracted from p_B? Define

$$\hat{p} := \frac{p_B + \frac{1}{2}\left(a_B^*\right)^2}{a_B^*} = \theta + \varphi\sigma_\epsilon^2 a_B^* \omega$$

and conjecture that $a_B^* = \alpha\hat{p}$ possibly with $\alpha = \alpha(\hat{p})$. The remaining task is to calculate $E[\theta|\hat{p}]$ and match this with the initial conjecture $\alpha\hat{p}$. By a special property of power function distribution, α turns out to be constant.

Equilibrium for project B

Proposition 2. There is at least one equilibrium where

$$a_B = \frac{\alpha\theta}{1 - \varphi\sigma_\epsilon^2\alpha\omega} \text{ and } p_B = \left(\alpha - \frac{1}{2}\alpha^2\right)\left(\frac{\theta}{1 - \varphi\sigma_\epsilon^2\alpha\omega}\right)^2,$$

where coefficient α is determined by

$$\alpha \sum_{j=1}^{J} \left(1 - \varphi\sigma_\epsilon^2\alpha\omega_j\right)^{-\lambda} q_j = \sum_{j=1}^{J} \left(1 - \varphi\sigma_\epsilon^2\alpha\omega_j\right)^{1-\lambda} q_j.$$

Corollary 2. The expected price $E[p_B|\theta]$ is higher than the firm's expected profit $E[\pi_B|\theta]$, where the expectations are conditional on the project value θ.

Equilibrium for project B

Why $E[p_B|\theta] > E[\pi_B|\theta]$? Recall that

$$p_B = \underbrace{a_B^*\theta - \frac{1}{2}\left(a_B^*\right)^2}_{E\left[\pi_B^*|\theta,p_B\right]} + \underbrace{\varphi\sigma_\epsilon^2\left(a_B^*\right)^2\omega}_{\varphi\omega Var[\pi_B^*|\theta,p_B]} .$$

- As $\omega = 0$, the price is identical to $E[\pi_B^*|\theta, p_B]$.
- As ω is random, the price goes up on average.
  - As $\omega > 0$, the price goes up. Informed speculators trade against it, but they trade less as they expect $a_B \uparrow$, which means more risk. Thus, larger impact of $\omega \uparrow$ on the price.
  - As $\omega < 0$, the price goes down. Informed speculators trade against it, and they trade even more as they expect $a_B \downarrow$, which means less risk. Thus, smaller impact of $\omega \downarrow$ on the price.

Project choice

Now that we have solved for two scenarios, we turn to the determination of projects by the initial DM.

- The initial DM cares about the price at the subsequent period
- He chooses a project if the project is superior than the other for every realization of project value θ

Project choice

Proposition 3. Project A delivers a larger expected profit than project B, i.e. $E[\pi_A|\theta] > E[\pi_B|\theta]$ for every $\theta > 0$. Nevertheless, project B is chosen at $t = 0$ in equilibrium if and only if

$$\left(\alpha - \frac{1}{2}\alpha^2\right) \sum_{j=1}^{J} \frac{q_j}{(1 - \varphi\sigma_\epsilon^2\alpha\omega_j)^2} > \frac{1}{2}.$$

This is the case when either of the following conditions hold:

1. λ is sufficiently close to 2;
2. The variance of noise trade ω is sufficiently large;
3. The variance of noise trade ω is sufficiently small.

Project choice

The dilemma facing the initial DM:

- Project A: $E[p_A|\theta] = E[\pi_A|\theta]$;
- Project B: $E[p_B|\theta] > E[\pi_B|\theta]$.

Despite less efficiency (i.e., $E[\pi_A|\theta] > E[\pi_B|\theta]$), the initial DM may choose project B due to his benefit from overvaluation. This occurs under various conditions:

- $\lambda = 2$ is close to the estimated distribution of firm size (Axtell, 2001);
- As noise trading is very large, the loss of efficiency from project B is especially large.

Power function distribution

We may consider whether the main results can carry over to well-defined distributions of project value θ. Formally, we set the distribution of θ as

$$g(\theta) = L(\theta)\theta^{-\lambda},$$

where $g'(\theta) < 0$ and $L(\theta)$ goes to a constant $\bar{L} > 0$ as $\theta \to \infty$.

- E.g., $\Pr(\theta) = \frac{\lambda-1}{k}\left(\frac{\theta}{k} + 1\right)^{-\lambda}$ for constant $k > 0$

Definition 2. The initial DM chooses $d \in \{A, B\}$ whenever it maximizes $E[p_d]$ under the truncated distribution of θ given by

$$\hat{g}(\theta) \propto 1_{(\underline{M},\bar{M})}(\theta)g(\theta) \text{ for small } \underline{M} \text{ and large } \bar{M}.$$

Power function distribution

Proposition 4. All main results carry over to the case where θ follows $g(\theta) = L(\theta)\theta^{-\lambda}$ as follows:

- In case where project A (B) is chosen at $t = 0$, there is a unique equilibrium (at least one equilibrium) as in Proposition 1 (2). For large θ, the equilibrium price p_A (p_B) approaches that in Proposition 1 (2).
- The initial DM's project choice at $t = 0$ is identical to that described in Proposition 3. All other statements in Proposition 3 continue to hold as well.

Other assumptions

- Competitiveness in the financial market
  - Under imperfect competition, strategic interaction between investors and the firm may cause a similar effect (Boleslavsky, Kelly & Taylor, 2017; Edmans, Goldstein & Jiang, 2015)
- Noise trade
  - It could be interpreted as a group of traders with systematically biased beliefs, who are unlikely to be "rational" enough to respond to changes in the risk of firm value

Learning from stock prices

Empirical evidence

- Firms behave as if they recognize the informativeness of stock price (e.g., Chen, Goldstein & Jiang, 2007; Luo, 2005)
- Mixed findings on the contribution of learning from stock price to the real productivity (e.g., David, Hopenhyn & Venkateswaran, 2016)

Implications of the main results

- Even if firms recognize the informativeness of stock price, they might not benefit from learning from stock price when their real decisions feature long-term commitments, rather than allowing for immediate feedbacks from price.
- Another related possibility is committing against learning from stock price (e.g., remaining private).

Development of financial markets

Subrahmanyam and Titman (1999) analyze the choice between private and public financing of firms.

- Going public exhibits positive externalities by increasing the size and informational efficiency of stock markets.
- This leads to a path dependency in the development of financial markets due to equlibrium multiplicity, justifying the policy of promoting active investing and lowering information costs.

The main results suggest that various aspects of financial market development may have rather different impacts on real efficiency.

- Reduction in noise trade
- Reduction in the potential costs of initial shareholders' selling-out

Possible remedies for inefficiency

Possible remedies?

- Commitment against learning from prices
  - A caveat is that initial shareholders may not have incentive to do so, as long as they could sell their shares at boosted prices
- A large population of uninformed speculators in the financial market
  - They will sell the asset in response to overvaluation of equity. As their trading is intensive, the price approaches the firm's expected profit.
  - They could be more easily interpreted as professional market makers rather than retail investors