The Short-Termism Trap: Catering to Informed Investors under Stock-Based CEO Compensation

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Short-termism

- Corporate short-termism–companies systematically take too short a view and do not invest enough for the long term–has been criticized often, and is widely believed (e.g., McKinsey study)
- One common view is that CEOs of publicly listed companies have short-term pressure from the financial markets

Stock-based compensation

Does stock-based compensation promote long-term value of firms?

- Stock prices are informative about firms' future value
- Properly designed stock-based compensation can mitigate agency problems (e.g., Holmstrom and Tirole, 1993)
- Thus, it allows firms to pursue longer-term projects

This is a bright side of stock-based compensation

Competition for informed trading

This paper: a dark (GE) side of stock-based compensation

- Stock prices are more useful if they are informative (e.g. because of an agency problem)
- Firms must attract informed trading to benefit more from prices
- But, informed investors capital is limited (Dow and Han, 2018; Dow, Han and Sangiorgi, 2021)
- Competition for informed trading leads to corporate decisions that are privately optimal but socially inefficient

Preview of Results

Information-based channel for corporate short-termism. Mechanism:

- Investors with limited capital have incentives to produce and trade on information with a shorter horizon
  - Long-term information is slow to be incorporated into prices
- Firms react to this by shortening project maturities
  - This behaviour is privately optimal
  - But, there is a negative externality on other firms
- Competition for informed trading results in excessive short-termism (compared to a second-best (constrained-efficient) benchmark)
- This short-termism trap can destroy large amounts of shareholder value: Potentially up to 100% of the benefits of stock market listing

Literature on corporate short-termism

- Narayanan (1985); Stein (1989)
  - Managerial short-termism arises against the wishes of shareholders
- Optimal incentive scheme in Bolton, Scheinkman, and Xiong (2006)
  - But, market pricing is inefficient
- Short-termism emerges as a coordination failure in Piccolo (2022)
- Short-termism emerges as second-best outcome in Edmans, Gabaix, Sadzik, and Sannikov (2012), Varas (2018), Takor (2021), in Hackbarth, Rivera, and Wong (2021)
- Socially excessive (not second-best) short-termism
  - Milbradt and Oehmke (2015). Long-term projects are more costly to finance, so LT types pretend they are ST types (maturity rat race)
  - Thanassoulis (2013), Chemla, Rivera, and Shi (2021). Firms compete for managers and short-termism transmits through the labour market
  - No equity market in these models, not an information story

Literature on benefits of stock prices in motivating managers in an agency framework

- Seminal paper: Holmstrom and Tirole (1993)
- Baiman and Verrecchia (1995), Dow and Gorton (1997), Kang and Liu (2010), Strobl (2014), Lin, Liu, and Sun (2019), Piccolo (2022)

These papers show the benefits of stock-based compensation
We also use an agency framework, but:

1. Project maturity choice is a key variable
2. We study the effects of competition among firms for informed trading

Roadmap

1. Setup
   - Corporate sector
   - Financial sector
2. Optimal choices
   - Price efficiency
   - Contracts
   - Maturity choice
3. Equilibrium
   - Properties
   - Benchmarks
   - Comparative statics
4. Extensions & robustness
5. Conclusions

Setup

Three-period economy ($t = 0, 1, 2$) with:

(1) A corporate sector
- M firm-manager pairs

(2) Financial markets
- Continuum (unit mass) of informed investors
- Market makers
- Noise traders

Firms

- M firms; each firm starts at $t = 0$ with a project
- Its owners choose the project duration and the management contract (alternatively, the manager chooses the project duration)
- Project duration: probability τ it will liquidate late at $t = 2$ (otherwise it liquidates early at $t = 1$)
- At liquidation, firm n's output is

$$V^n \equiv f(\tau^n) + R^n, \text{ where } R^n = \begin{cases} \Delta V & \text{if the project is successful } (S) \\ 0 & \text{otherwise } (F) \end{cases}$$

- $f(\cdot)$ is increasing: long-term projects are more efficient
- Payoffs are independent across firms

Managers

- Firms need a manager to run the project
- Manager's effort choice $e \in \{L, H\}$ is private information
- Success probability

$$\rho(e^n) = \begin{cases} \rho_H & \text{if } e^n = H \\ \rho_L & \text{if } e^n = L \end{cases}, \text{ where } \rho_H > \rho_L$$

Each manager:

- has utility

$$u\left(w^n\right) - \mathbb{1}_{\{e^n = H\}} K$$

- is subject to limited liability and an outside option
- exits the economy in $t = 1$ with probability $\delta \in [0, 1]$
  - alternative interpretation: noisy long-term performance ▸ details

Stock markets

- A subset of $N \leq M$ of firms (indexed by $n \in \mathcal{N}$) are listed (endogenous)
- Each listed firm's stock (a claim on the project payoff) is traded at $t = 0, 1$ (after projects have been chosen) among:
  - A risk-neutral market maker
  - Noise traders. Order flow in firm n: $Z^n \sim U[-\bar{z}, \bar{z}]$
  - A mass μ^n of informed traders (endogenous)

Informed Investors

Each informed investor:

- is risk-neutral
- can produce information about one firm
- can hold at most one unit of one stock (either long or short)
- must exit the economy in $t = 1$ with probability $\gamma \in (0, 1)$

Information

- Investors who investigate firm n receive signal $s^n \in \{G, B\}$
- Signals are informative about managerial effort:

$$\sigma_G \equiv pr\left(s^n = G \,|e^n = H\right)$$
$$\sigma_B \equiv pr\left(s^n = G \,|e^n = L\right)$$

  where $\sigma_G > \sigma_B$

Informed investors optimally trade at $t = 0$ ▸ Strategies: details

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Stock prices and information revelation

In $t = 0$, the price of stock n is either fully-revealing or non-revealing

▸ Price: details

Lemma

If μ^n mass of informed traders trade stock n, the price of stock n in the initial period, $t = 0$, is fully revealing with probability

$$\lambda^n = \frac{\mu^n}{\bar{z}}$$

Trading at $t = 1$ is uninteresting: noise traders reverse their positions with probability γ at $t = 1$ (no new information)

Financial Market Equilibrium

- Investors' expected trading gains should be the same for all stocks:

$$(1-\lambda^n)(1-\gamma\tau^n) = (1-\lambda^m)(1-\gamma\tau^m), \quad \text{for all } n, m \in \mathcal{N} \tag{1}$$

  - Mispricing-duration tradeoff: if $\tau^m > \tau^n$, then $\lambda^m < \lambda^n$
- Because there is one unit mass of informed investors,

$$\sum_{n=1}^{N} \lambda^n = \frac{1}{\bar{z}} \tag{2}$$

Proposition

- *Given $\{\tau^n\}_{n\in\mathcal{N}}$, there is a unique $\{\lambda^n\}_{n\in\mathcal{N}}$ that satisfies Eqs. (1)-(2)*
- *λ^n is decreasing in τ^n and increasing in τ^m for all $m \in \mathcal{N} \setminus \{n\}$*

When a firm decreases its τ, it has negative externality on other firms

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Listed firms' optimal managerial compensation

- Listed firms implement high managerial effort
- States relevant for the contract:
  - (i) price reveals the good signal ($\omega = G$)
  - (ii) price reveals the bad signal ($\omega = B$)
  - (iii) price is non-revealing and the manager stays until success ($\omega = S$)
  - (iv) price is non-revealing and the manager stays until failure ($\omega = F$)
  - (v) price is non-revealing and the manager exits before outcome ($\omega = \emptyset$)
- An optimal contract minimizes the shareholders' wage bill

$$\mathcal{W}^n(\tau^n) \equiv \min_{\{w_G^n, w_B^n, w_S^n, w_F^n, w_\emptyset^n\}} E\left[\tilde{w}^n\right],$$

subject to the manager's PC, IC, and limited liability

Listed firms' optimal managerial compensation (cont'd)

Proposition

The unique optimal contract is such that:

(i) $w_B^{*n} = w_F^{*n} = w_\emptyset^{*n} = 0$ *and* $w_G^{*n} > w_S^{*n} > 0$

(ii) *The wage bill* $\mathcal{W}^n$ *is increasing and convex in* τ^n

Intuition:

- Wage bill is decreasing in price efficiency
- Price efficiency is decreasing in project duration
- Therefore, long-term projects carry a higher agency cost

Listed firms' maturity choice

- Trade-off between production efficiency and agency cost
- Firm n's optimization problem:

$$\max_{\tau^n \in [0,1]} \mathcal{V}^n(\tau^n) - \mathcal{W}^n(\tau^n) \tag{3}$$

  - $\mathcal{V}^n(\tau^n)$ is the expected project's payoff given $e = H$
  - $\mathcal{W}^n(\tau^n)$ is the wage bill under the optimal contract
- Given other firms' $\{\tau^m\}_{m \in \mathcal{N} \setminus \{n\}}$, there is a unique solution τ^{*n} to (3)
- Shareholder value for firm n:

$$S^{*n} \equiv f(\tau^{*n}) + \rho_H \Delta V - [\lambda^n \sigma_G w_G^{*n} + (1 - \lambda^n)(1 - \delta \tau^{*n}) \rho_H w_S^{*n}]$$

Listed firms' maturity choice (cont'd)

How does a firm's maturity choice affect other firms?

Proposition

Maturity choices are strategic complements: $\frac{\partial \tau^{*n}}{\partial \tau^m} > 0$ *for all* $m \in \mathcal{N} \setminus \{n\}$

- When a firm shortens its τ, it increases its λ at the cost of others
- Other firms' agency cost goes up
- Other firms also shorten their τ to regain price informativeness

Unlisted Firms and the Listing Decision

- In equilibrium, all managers of unlisted firms exert low effort and choose long-term projects ($\tau = 1$)
- Therefore, shareholder value for unlisted firms is

$$S^U \equiv f(1) + \rho_L \Delta V.$$

- The listing choice is based on the comparison between S^{*n} and S^U
- Listing is optimal if $S^{*n} \geq S^U$, and not listing is optimal if $S^U \geq S^{*n}$

Equilibrium

Definition

An equilibrium consists of a number N of listed firms, project maturity choices $\{\tau^n\}_{n\in\mathcal{N}}$, price informativeness $\{\lambda^n\}_{n\in\mathcal{N}}$, and compensation contracts $\{w^n\}_{n\in\mathcal{N}}$ s.t.,

1. Each τ^n maximizes firm value in Eq. (3) given $\{\tau^m\}_{m\in\mathcal{N}\setminus\{n\}}$
2. $\{\lambda^n\}_{n\in\mathcal{N}}$ satisfy investors' indifference condition Eq. (1) and the informational resource constraint Eq. (2)
3. Each $\tilde{w}^n$ minimizes the expected cost of managerial compensation
4. Firms' listing decisions are optimal

Equilibrium (cont'd)

Theorem

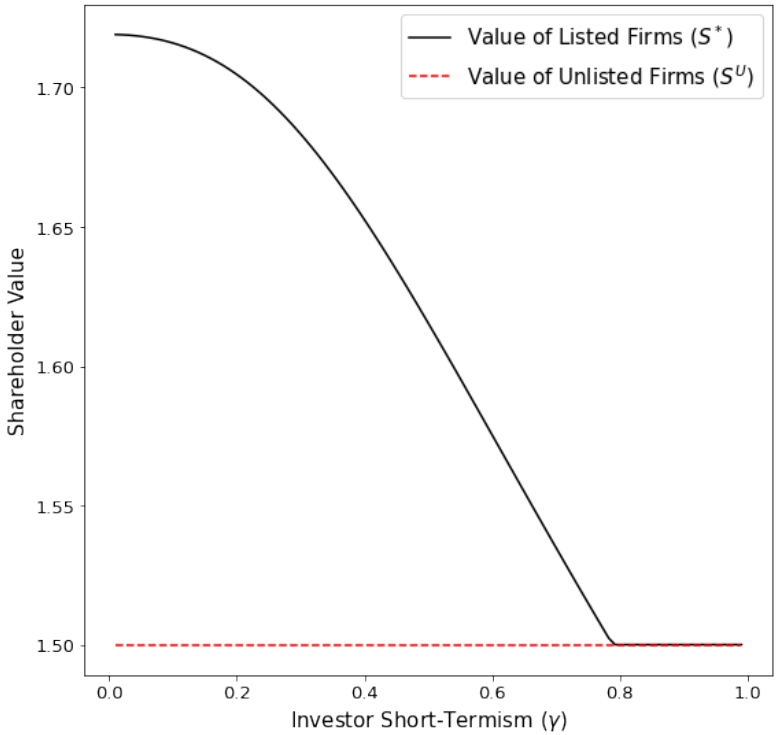
- *There exists a unique equilibrium*
- *There is a critical value γ^* for investor short-termism such that all firms list if $\gamma \leq \gamma^*$, whereas some firms remain unlisted otherwise*
- *The equilibrium project maturity choice for listed firms is symmetric and interior*

In equilibrium,

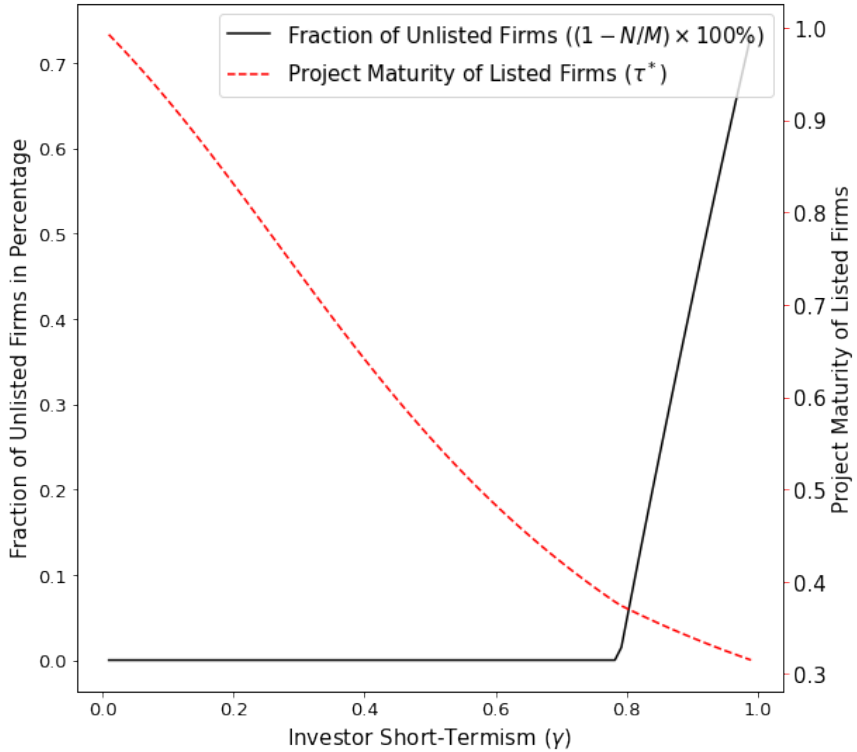
$$\lambda^n = \frac{1}{N\bar{z}} \quad \text{for all } n \in \mathcal{N}$$

- Price efficiency is the same regardless of equilibrium τ
- Competition for informed trading leads to a loss in shareholder value

Impact of Investor Short-Termism on Equilibrium Shareholder Value and Listing Decisions



(a) Shareholder Value



(b) Project Maturity and % of Unlisted Firms

Impact of Investor Short-Termism on Equilibrium Shareholder Value and Listing Decisions (cont'd)

- $S^* - S^U$ measures the value of informative stock prices at equilibrium
- The short-termism trap can destroy this value: S^* falls as γ increases
  - heightened competition for price informativeness
- Once $\gamma > \gamma^*$, some firms choose to remain unlisted, $S^* = S^U$
  - the short-termism trap nullifies the value of market monitoring
- Firms subjected to intense investor pressure choose excessively short-term projects; this offsets the benefits from an informative price

Benchmarks

We study two benchmark cases:

(i) Effort without price

(ii) Coordinated Project Maturity Choice:

$$\max_{\tau^s \in [0,1]} \sum_{n=1}^{N} [\mathcal{V}^n(\tau^s) - \mathcal{W}^n(\tau^s)]$$

Theorem

(i) *The coordinated benchmark has the longest project maturity and largest shareholder value*

(ii) *Equilibrium may have shorter project maturity than the effort without price benchmark*

Equilibrium is constrained inefficient and may have shorter-term projects than if there were no stock market

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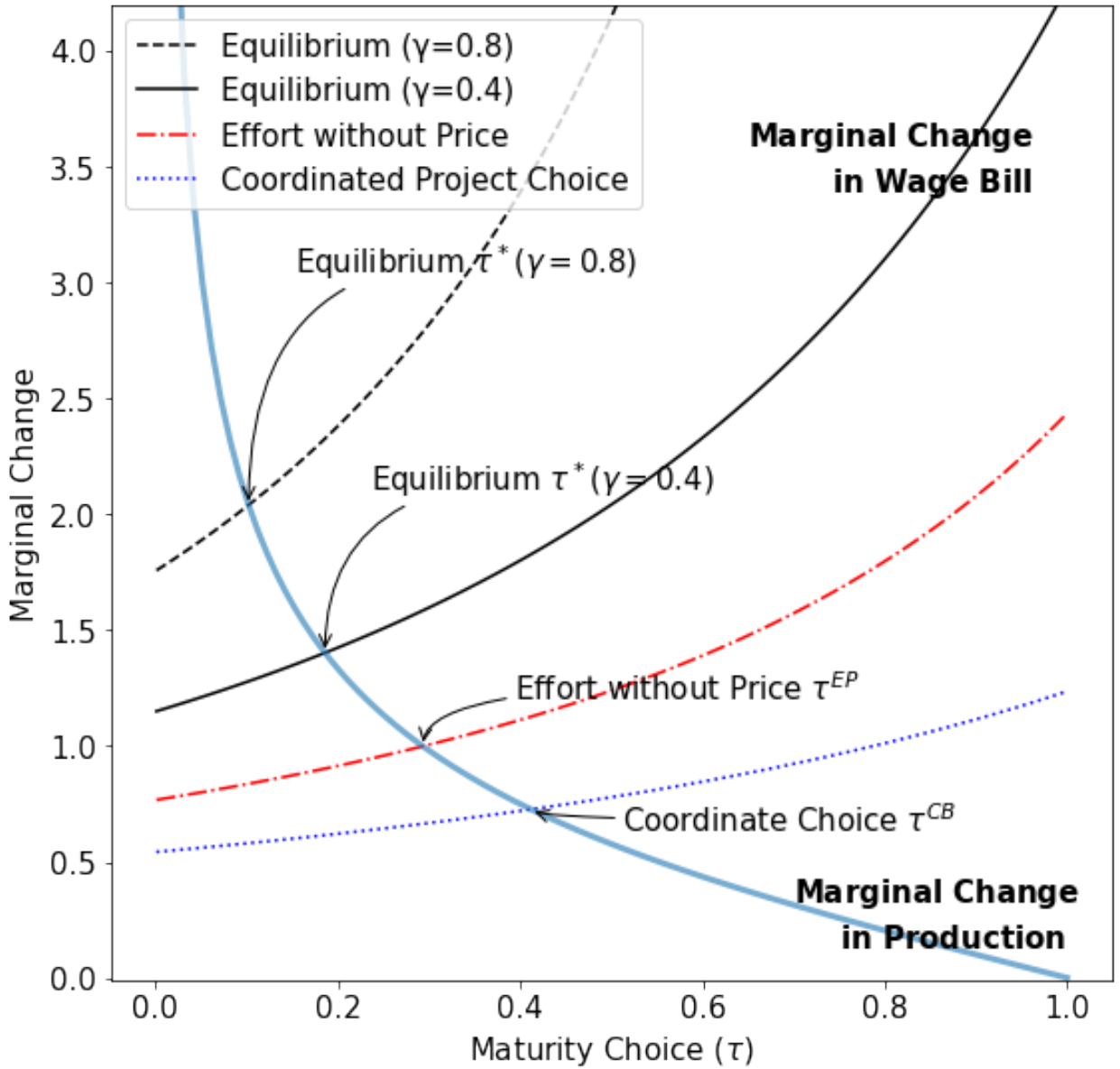
Equilibrium maturity choice vs. different benchmarks



Comparative statics

Proposition

1. *(Competition) Fixing $M\bar{z}$, higher competition (larger M) induces more short-termism and lower shareholder value*
2. *(Investor short-termism) An increase in investor myopia (larger γ) induces more short-termism and lower shareholder value*
3. *(Agency problem) An increase in managers' impatience or effort cost induces more short-termism and lower shareholder value*

- In (1) and (2), competition for informed trading is more intense
- In Dow, Han, and Sangiorgi (2021) γ depends on market conditions, so shocks that originate in the financial market transmit to firms
- (3) also holds in the second best, but there is an amplification effect (strategic complementarities)

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Symmetric equilibrium with long-term investors

Question: Does an increase in long-term investing curb short-termism?

- A fraction μ of "long-term investors" stay until $t = 2$
- A fraction $1 - \mu$ "short-term investors" exit in $t = 1$ with prob. γ

Proposition

(i) *For $\mu \leq \mu^* < 1/N$, the equilibrium is identical to the case without long-term investors*

(ii) *For $\mu \geq 1 - 1/N$, equilibrium is identical to case with exogenous informed trading*

(iii) *For $\mu \in [1/N, 1 - 1/N)$, there is no symmetric equilibrium*

- Long-term investors have no impact if their mass is small

Clientele equilibrium

Proposition

- *For* $1-(N-1)\,\bar{z} < \mu < 1-\frac{1}{N}$ *there exists a clientele equilibrium in which a fraction* α_S *choose maturity* τ_S *and a fraction* $1-\alpha_S$ *of firms choose maturity* τ_L*, where* $\tau^* < \tau_S < \tau_L < \tau^{CB}$
- *Short-term investors invest in short-term firms and long-term investors invest in long-term firms*

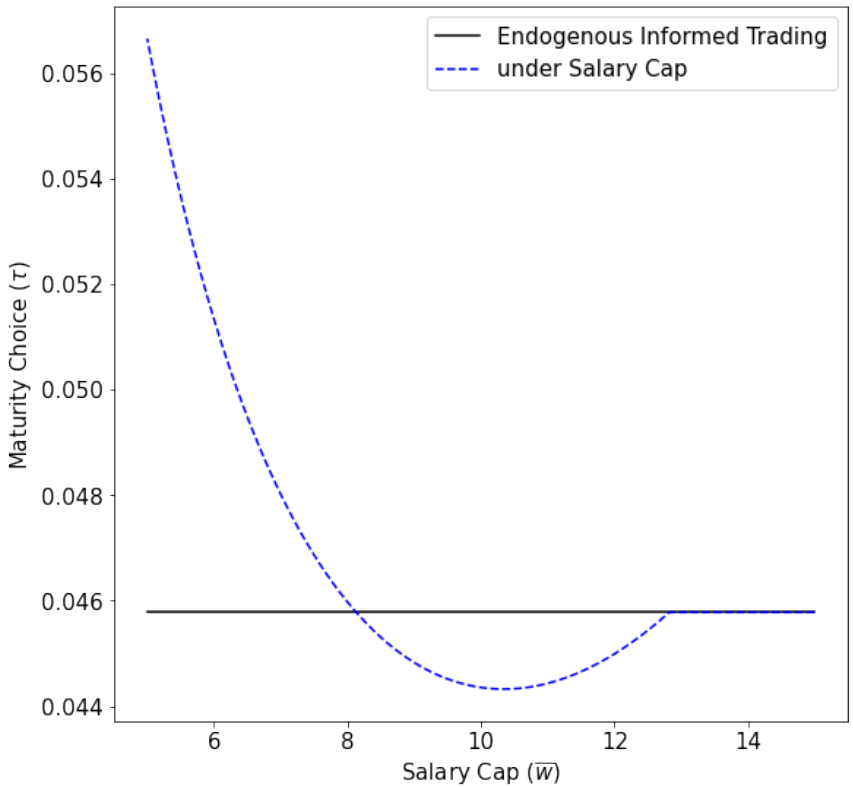
- Ex-ante identical firms become ex-post heterogeneous
- Long-term firms are more productive but have less informative prices

Salary cap

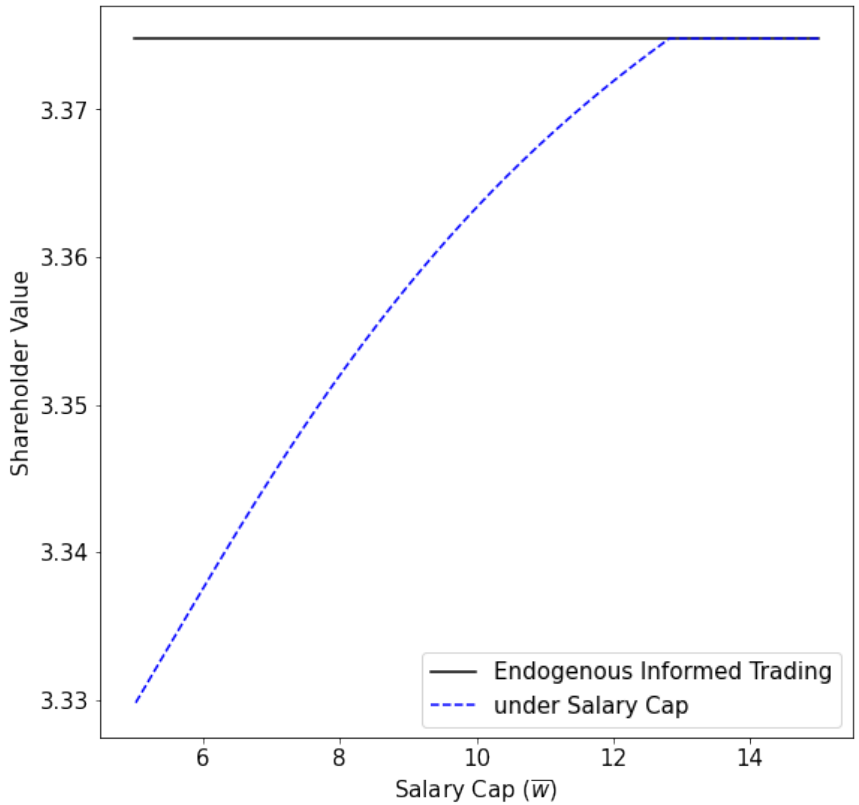
Question: Does a salary cap mitigate short-termism?

Augment the contracting problem by the constraint that

$$w_G^n, w_B^n, w_S^n, w_F^n, w_\emptyset^n \leq \bar{w}.$$



(a) Maturity Choice



(b) Shareholder Value

Conclusion

- Competition for investor "attention" (limited capital, not bounded rationality) leads to excessive short-termism that destroys firm value
  - Up to 100% of the benefits of stock market listing
- Informed investors' "short term" preferences transmit to firms

Equilibrium in the financial market: investor trading

Given informed investor i's choice to produce information on stock n, we can represent the maximization problem as follows:

$$J_0^n \equiv \max_{x_i^n(0)\in\{-1,0,1\}} -E[P^n(0)|s^n]x_i^n(0)+\gamma\Gamma^n(s^n)x_i^n(0)+(1-\gamma)\mathrm{E}[J_1^n(x_i^n(0),P^n(0))|s^n],$$

where

$$\Gamma^n(s^n) \equiv (1-\tau^n)\mathrm{E}[V^n|s^n]+\tau^n\mathrm{E}[P^n(1)|s^n],$$

and

$$\begin{aligned} J_1^n(x_i^n,P^n(0)) \equiv{}& \mathrm{E}[V^n|s^n]x_i^n \\ &+\tau^n(1-|x_i^n|)\max_{x_i^n(1)\in\{-1,0,1\}} \mathrm{E}[(V^n-P^n(1))|s^n,P^n(0)]x_i^n(1). \end{aligned}$$

back

Equilibrium in the financial market: prices

Lemma

If μ^n mass of informed traders trade on private information on stock n, the price of stock n in $t = 0$ is

$$P^n = \begin{cases} P_L^n & \text{if } -\mu^n - \bar{z} \leq X^n(0) < \mu^n - \bar{z} \\ P_\emptyset^n & \text{if } \mu^n - \bar{z} \leq X^n(0) \leq -\mu^n + \bar{z} \\ P_H^n & \text{if } -\mu^n + \bar{z} < X^n(0) \leq \mu^n + \bar{z} \end{cases}$$

where

$$P_L^n = f(\tau^n) + \nu_B \Delta V, \quad P_\emptyset^n = f(\tau^n) + \rho_H \Delta V, \quad P_H^n = f(\tau^n) + \nu_G \Delta V.$$

back

Robustness

1. Long-term outcomes are less informative about effort

- Long-term projects are influenced by additional external factors
- Thus, late project outcome is less correlated with managerial effort: Assume late project is successful with probability $\rho(e^n)(1-\beta)$
- The optimal contract is equivalent to the baseline model with the parameter $\hat{\delta} = \delta + \beta(1-\delta)$ replacing δ

▸ back

Robustness (cont'd)

2. Long-term outcomes more valuable to investors

- Assume the liquidating dividend equals to

$$V^n \equiv f(\tau^n) + R^n \quad \text{where} \quad R^n = \begin{cases} \Delta V(1 + \alpha \mathbf{1}_l) & \text{if success} \\ 0 & \text{otherwise} \end{cases},$$

where $\alpha \geq 0$, and $\mathbf{1}_l$ equals one iff the project pays off late

- The indifference condition becomes

$$(1 - \lambda^n)(1 - \tau^n \kappa(\gamma, \alpha)) = (1 - \lambda^m)(1 - \tau^m \kappa(\gamma, \alpha)),$$

where

$$\kappa(\gamma, \alpha) = \gamma - \alpha(1 - \gamma)$$

and $\kappa(\gamma, \alpha) > 0$ if and only if $\gamma > \frac{\alpha}{1+\alpha}$

Evidence on stock price short-termism

Empirical evidence consistent with long-term information not fully incorporated into prices and delivering abnormal long-term returns:

- high R&D expenditures (Lev and Sougiannis (1996))
- advertising expenditures (Chan, Lakonishok, and Sougiannis (2001))
- patent citations (Deng, Lev, and Narin (1999))
- software development costs (Aboody and Lev (1998)),
- employee satisfaction indexes (Edmans (2011))

Dow, J., J. Han, and F. Sangiorgi, 2021, "Hysteresis in Price Efficiency and the Economics of Slow-Moving Capital," *The Review of Financial Studies*, 34, 2857–2909.