Risk-taking, Rent-seeking, and CEO compensation when Financial Markets are Noisy

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Motivation

Conventional wisdom on firm investment, managerial incentives, and financial markets

1. Shareholder Value Maximization:
   - Optimal firm decisions should focus on maximizing stock market valuation
2. Pay-for-Performance Contracts:
   - Align manager incentives by tying compensation to share price performance
3. Efficient Markets Hypothesis:
   - Shareholder, manager incentives aligned with social welfare when $P(z;k) = V(z;k)$
   - No need for, but possibly harm from, regulatory or market interventions

This paper: *explore impact of shareholder value maximization and performance pay when financial markets are not efficient*

Motivation

This paper: revisit "conventional wisdom" when EMH fails

- Stage 1: initial shareholders sign contract with CEO, CEO takes investment decision
- Stage 2: initial shareholders sell fraction of shares in financial market with *noisy info aggregation*
- Analyze impact of market frictions on contract design and investment decisions

Key insights/results

1. **Market friction**:
   - Distorts price response to new information
   - Generates rent-seeking motive for initial shareholders
2. **Pay-for-performance contracts**: Serve rent-seeking purposes of incumbent shareholders (in particular, stock options!)
3. **Scope for welfare-improving interventions**: Regulation of executive pay, transaction taxes, size caps, information policies, asset purchase programs, etc.

Literature

1. **Information aggregation and real investment**
   - Leland (JPE 92); Dow and Gorton (JF 97); Subrahmanyam and Titman (JF 99); Dow and Rahi (JB 03); Chen, Goldstein and Jiang (RFS 07); Goldstein and Guembel (REStud 08); Roll, Schwartz and Subrahmanyam (JFE 09).
2. **Managerial compensation and investment efficiency**
   - Stein (QJE 89); Bebchuk and Fried (JEP 03); Bolton, Scheinkman, and Xiong (RES 06); Benmelech, Kandel and Veronesi (QJE 10).

Roadmap

1. Baseline Model
2. Investment with financial market frictions
3. Distorted reaction to information
4. Compensation design
5. Discussion: Regulation and intervention

Baseline Model

Setup

- $t = 1$: (compensation design and investment)
  - unit measure of (risk-neutral) shareholders hire (risk-neutral) manager
  - set pay scheme $W(\Pi)$; where $\Pi =$ dividend

$$\Pi(\theta, k) = R(\theta) \cdot k - C(k), \quad \theta \sim N(0, \lambda^{-1})$$

  - manager undertakes investment choice: $k \geq 0$
- $t = 2$: (financial market)
  - initial shareholders: sell fraction α of shares
  - informed traders: observe $x_i \sim N(\theta, \beta^{-1})$; purchase $d_i(x, P) \in (0, \alpha)$
  - Noise traders: demand $\alpha\Phi(u)$; $u \sim N(0, \delta^{-1})$
  - market clears at $P = P(\theta, u)$
- $t = 3$: (payoffs)
  - dividend realized; agents paid

$t = 2$: financial market

Equilibrium characterization

1. Demand strategy: threshold $\hat{\mathbf{x}}(\mathbf{P})$

$$\mathbf{d}(\mathbf{x}, \mathbf{P}) = \begin{cases} \alpha & \text{if } \mathbf{x_i} \geq \hat{\mathbf{x}}(\mathbf{P}) \\ \mathbf{0} & \text{if } \mathbf{x_i} < \hat{\mathbf{x}}(\mathbf{P}) \end{cases}$$

2. Price $=$ dividend expectation of *marginal* trader ($x_i = \hat{\mathbf{x}}(\mathbf{P})$)

$$\mathbf{P} \quad = \quad \mathbb{E}[\Pi(\theta, k) | x_i = \hat{\mathbf{x}}(\mathbf{P}), \mathbf{P}]$$

3. Market clearing (info aggregation):

$$\begin{aligned} \alpha \quad &= \quad \int \mathbf{d}(\mathbf{x_i}, \mathbf{P}) d\Phi(\sqrt{\beta}(x - \theta)) + \alpha \Phi(u) \\ \Rightarrow \hat{\mathbf{x}}(\mathbf{P}) \quad &= \quad \theta + 1/\sqrt{\beta} \cdot u \equiv \mathbf{z} \end{aligned}$$

$\rightarrow$ $\mathbf{P}$ *info equivalent* to $\hat{\mathbf{x}}(\mathbf{P}) = \mathbf{z}$: endogenous signal (precision $\beta\delta$)

Information Aggregation Wedge

- $\mathbf{V}(\mathbf{z}) \equiv \mathbb{E}[R(\theta)|\mathbf{z}] \cdot k - C(k)$
  - Expected dividend, conditional on **public signal** $\mathbf{z}$ only
  - Bayesian weight γ_V on signal $\mathbf{z}$

- $\mathbf{P}(\mathbf{z}) = \mathbb{E}[R(\theta)|\mathbf{x} = \mathbf{z}, \mathbf{z}] \cdot k - C(k)$
  - Threshold trader conditions on **public signal** $\mathbf{z}$; **private signal** $\mathbf{x_i} = \mathbf{z}$
  - Bayesian weight $\gamma_P > \gamma_V$ on signal $\mathbf{z}$
  - Price conveys information, but must also **clear the market**

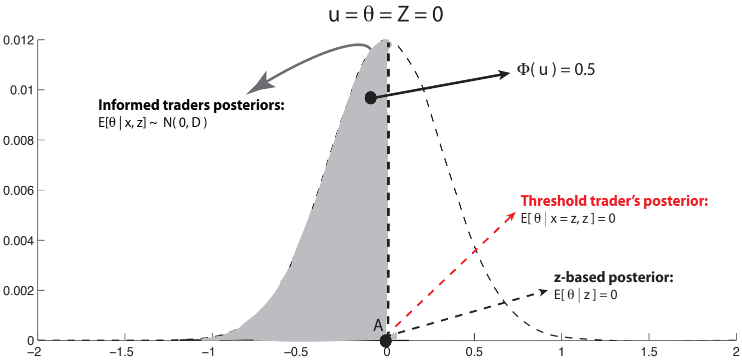
- **Information aggregation wedge:**

$$\mathbf{\Omega}(\mathbf{z}) \equiv \mathbf{P}(\mathbf{z}) - \mathbf{V}(\mathbf{z}) = k \cdot \{ \, \mathbb{E}[R(\theta)|\mathbf{x} = \mathbf{z}, \mathbf{z}] - \mathbb{E}[R(\theta)|\mathbf{x} = \mathbf{z}] \, \}$$

$\rightarrow$ depends on realization of $\mathbf{z}$

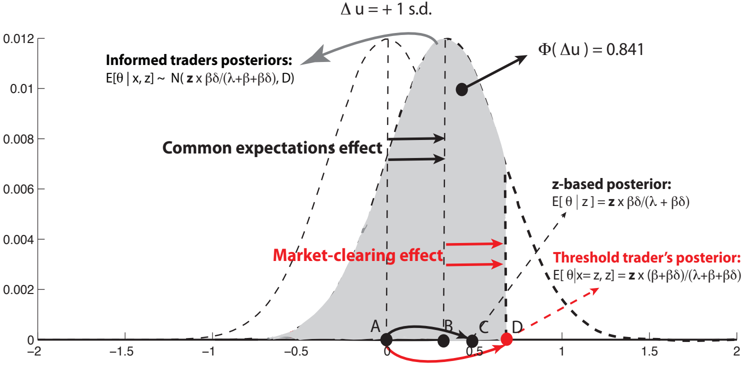
$\rightarrow$ magnitude **scales up** with manager's investment choice k

Posterior beliefs: no shocks



$\rightarrow$ Posterior of mean and mg trader coincide

Posterior beliefs: $\Delta u = +1\ s.d.$

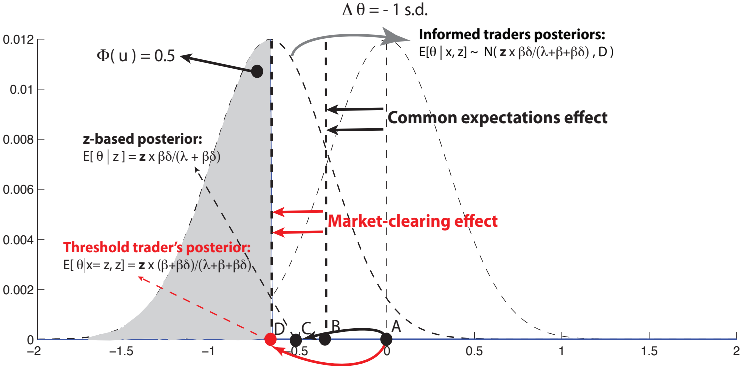


→ (+) Noisy demand shock: prices increase – higher signal z

→ All traders' posteriors increase due to higher z: **common expectations effect**

→ But to accommodate Δu, posterior of mg trader must increase more: **market clearing effect**

Posterior beliefs: $\Delta\theta = -1\ s.d.$



→ (−) Fundamentals shock: prices fall – higher signal z

→ All traders' posteriors fall due to lower z: **common expectations effect**

→ But since private signals are lower, informed traders' demands drop even more: **market clearing effect**

Unconditional Wedge

Lemma (unconditional wedge): for any $k \geq 0$, the unconditional wedge is given by

$$\mathbb{E}[\boldsymbol{\Omega}(\mathbf{z})] = k \cdot \int_0^\infty (R'(\theta) - R'(-\theta))(\Phi(\sqrt{\lambda} \cdot \theta) - \Phi(\sqrt{\lambda_P} \cdot \theta))d\theta.$$

- 1st component: **shape** of $R(\theta)$ (cash flow risks)
- 2nd component: **informational frictions** $\lambda_P^{-1} > \lambda^{-1}$
  - Precision of private vs. public info

Theorem: unconditional wedge and cash-flow risks

(i) If $R(\cdot)$ has *symmetric risk*: $\mathbb{E}[\boldsymbol{\Omega}(\cdot)] = 0$

(ii) If $R(\cdot)$ has *upside risk*: $\mathbb{E}[\boldsymbol{\Omega}(\cdot)] > 0$

(iii) If $R(\cdot)$ has *downside risk*: $\mathbb{E}[\boldsymbol{\Omega}(\cdot)] < 0$

(iv) for given k, $|\mathbb{E}[\boldsymbol{\Omega}(\cdot)]|$ increasing in info frictions λ_P^{-1}

$t = 1$: compensation design and investment

- Incumbent shareholders:
  - choose *implementable triplet* $\{k, W(\Pi), P\}$ to max

$$\mathbb{E}\{\alpha P(\theta, u; k) + (1-\alpha)\Pi(\theta; k) - W(\Pi(\theta; k))\}$$

s.t. :

$$k \in \text{argmax } \mathbb{E}[W(\Pi(\theta; k))], \quad \text{and} \quad \mathbb{E}[W(\Pi(\theta; k))] \geq \bar{w}$$

- Implementation: 2-steps
  - Step 1: find investment level that maximizes incumbent shareholders' value (disregarding ICC)
  - Step 2: characterize compensation scheme that implements optimal investment level

Investing with financial market frictions

Over- and under-investment

- Efficient investment (dividend-maximizing): k^*

$$C'(k^*) = \mathbb{E}[R(\theta)]$$

- Optimal investment for incumbent shareholders: $\hat{k}$

$$C'(\hat{k}) = \alpha \cdot \mathbb{E}\{\mathbb{E}[R(\theta)|\mathbf{x} = \mathbf{z}, \mathbf{z}]\} + (1-\alpha) \cdot \mathbb{E}[R(\theta)]$$

Proposition: over- and under-investment

- (i) Sign:
  - if $R(\cdot)$ has symmetric risk, $\hat{k} = k^*$
  - if $R(\cdot)$ has upside risk, $\hat{k} > k^*$
  - if $R(\cdot)$ has downside risk, $\hat{k} < k^*$
- (ii) Comp statics w.r.t. λ_P^{-1}: if $R(\cdot)$ has upside/downside risk, $|\hat{k}/k^* - 1|$ increasing in λ_P^{-1}

Efficiency losses

- Efficiency benchmark: $\Delta \equiv 1 - \hat{V}/V^*$, with

$$V^* \equiv \mathbb{E}[R(\theta)] \cdot k^* - C(k^*), \quad \text{and} \quad \hat{V} \equiv \mathbb{E}[R(\theta)] \cdot \hat{k} - C(\hat{k})$$

- Let $C(k) = k^{1+\gamma}/(1+\gamma)$

Proposition: efficiency losses

- (i) Comp statics: $\Delta = 0$ iff $\mathbb{E}\{\mathbb{E}[R(\theta)|\mathbf{x} = \mathbf{z}, \mathbf{z}]\} = \mathbb{E}[R(\theta)]$, or when $\gamma \to \infty$
- (ii) Bounded losses on downside: if $\mathbb{E}\{\mathbb{E}[R(\theta)|\mathbf{x} = \mathbf{z}, \mathbf{z}]\} < \mathbb{E}[R(\theta)]$, then $\Delta < 1$
- (iii) Unbounded losses on upside: if $\mathbb{E}\{\mathbb{E}[R(\theta)|\mathbf{x} = \mathbf{z}, \mathbf{z}]\} > \mathbb{E}[R(\theta)]$, then $\Delta \to \infty$ if
  - $\mathbb{E}\{\mathbb{E}[R(\theta)|\mathbf{x} = \mathbf{z}, \mathbf{z}]\}/\mathbb{E}[R(\theta)] \to \infty$, or
  - $\gamma \to 0$
- (iv) Negative expected dividends: implemented $\hat{k}$ leads to $\mathbb{E}(\Pi(\theta)) < 0$ whenever:

$$\alpha \left(\frac{\mathbb{E}\{\mathbb{E}(R(\theta)|x = z, z)\}}{\mathbb{E}(R(\theta))} - 1 \right) > \gamma$$

Distorted reaction to information

Distorting the response to public news

- Public signal at $t = 1$: $y \sim N(\theta, \kappa^{-1})$
- Posterior of θ: $\theta \sim N\left(\frac{\kappa}{\lambda+\kappa}y, (\lambda+\kappa)^{-1}\right)$

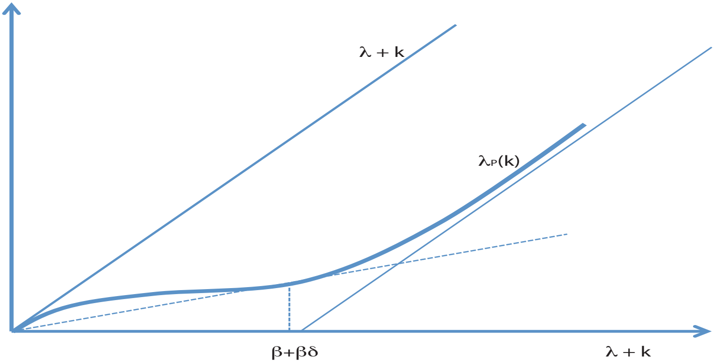
Proposition: market reaction to public disclosures

- (i) $\lambda_P(\kappa)$ is increasing in κ, but $\lambda_P'(\kappa) < 1$.
- (ii) $\lambda_P(\kappa) / (\lambda + \kappa)$ is decreasing iff $\lambda + \kappa \leq \beta + \beta\delta$
- (iv) $\lambda_P(\kappa) / (\lambda + \kappa)$ may be arbitrarily small, when δ is sufficiently low.

$\rightarrow$ News not effective at reducing initial shareholders' uncertainty over market price.

$\rightarrow$ Noisy news exacerbate gap between uncertainty about fundamentals and uncertainty about market price.

Underreaction to public information



Distorting the response to public news

Proposition (in progress):

- (i) Noisy News may reduce welfare.

$\rightarrow$ news about fundamentals may increase uncertainty about market prices.

$\rightarrow$ requires risk that news shift in perception of upside vs. downside risk.

Distorting the response to public news

Case 1: moderately bad news and unjustified fears

- Assume $R(\theta) = 1$, if $\theta > \bar{\theta}$, 0 otherwise
- Downside risk example: $\hat{\theta} < 0 \rightarrow$ emerging market bond (low ex-ante default prob)

Proposition: moderately bad news cause unjustified fears and investment panics

- (i) If $\bar{\theta} << 0$, $C'(\hat{k}(y))/C'(k^*(y))$ reaches global minimum at $\hat{y} < 0$
- (ii) For an interval of signals, $\hat{k}(y) < \hat{k} < k^* < k^*(y)$

Intuition:

- With no info frictions: lower y reduces posterior, but uncertainty is also reduced
  - $\rightarrow$ Moderately bad news actually **reduce** the (objective) default probability
- With info frictions, market uncertainty is reduced less:
  - $\rightarrow$ Moderately bad news **increase** the (market) default probability
  - $\rightarrow$ In anticipation, investment is reduced

Distorting the response to public news

Case 2: moderately good news and irrational exuberance

- Assume $R(\theta) = 1$, if $\theta > \bar{\theta}$, 0 otherwise
- Upside risk example: $\hat{\theta} > 0 \rightarrow$ technological breakthrough (low ex-ante success prob)

Proposition: moderately good news cause exuberance and investment booms

Intuition:

- With no info frictions: higher y reduces posterior, but uncertainty is also reduced
  - $\rightarrow$ Moderately good news actually **reduce** the (objective) probability of success
- With info frictions, market uncertainty is reduced less:
  - $\rightarrow$ Moderately good news **increase** the (market) success probability
  - $\rightarrow$ In anticipation, investment is higher

Distorting the response to market signals

- Assume now investment is undertaken conditional on z
- Because investors can infer $k(z)$, equilibrium characterization is as before (except for minor monotonicity requirements)
- $\hat{k}(z)$ now satisfies:

$$C'\left(\hat{k}(z)\right) = \alpha(\mathbb{E}(R(\theta)|x = z, z)) + (1 - \alpha)(\mathbb{E}(R(\theta)|z))$$

- Relative to $k^*(z)$, $\hat{k}(z)$ is more aligned with market's expectations of returns

  $\rightarrow$ *Endogenous* element of upside risk!

Distorting the response to market signals

Let $\hat{z}$ be such that $\mathbb{E}(R(\theta)|x = z, z) \gtreqless \mathbb{E}(R(\theta)|z)$, for $z \gtreqless \hat{z}$. Then

Proposition: Info Feedback creates endogenous upside risk and increases rents

- (i) **Increased Shareholder Rents:** For any strictly increasing investment function $k(z)$, $\mathbb{E}(\Omega(z, k(z))) > \mathbb{E}(\Omega(z, k(\hat{z}))$.
- (ii) **Endogenous upside risk:** $\mathbb{E}(\Omega(z, k(z))) > 0$ if either $\mathbb{E}(R(\theta)|x = z, z) \geq \mathbb{E}(R(\theta)|z)$, or $\mathbb{E}(R(\theta)|x = z, z) \leq \mathbb{E}(R(\theta)|z)$ and $inf_z k'(z)/k(z)$ is sufficiently large.
- (iii) **Unbounded Rents:** If $inf_z k'(z)/k(z) \to \infty$, then $\mathbb{E}(\Omega(z, k(z))) \to \infty$, for any $R(\cdot)$.

Intuition: we can write $\mathbb{E}(\Omega(z, k(z))) = \mathbb{E}(\Omega(z, \mathbb{E}(k(z)))) + Cov\{k(z); \mathbb{E}(R(\theta)|x = z, z) - \mathbb{E}(R(\theta)|z)\}$

- First term: expected wedge when $k(z)$ set at its unconditional value
- Second term: endogenous feedback from prices to investment $\to$ enhances upside risk!

$\to$ Moreover, when $k(z)$ aligned with incumbent shareholders: **excessive investment volatility**

Distorting the response to market signals

Proposition: Market noise creates investment volatility

- (i) **Excess investment sensitivity:**

  The investment distortion $|\hat{k}(z)/k^*(z) - 1|$ increases in α, and increases in z whenever $\mathbb{E}(R(\theta)|x = z, z)/\mathbb{E}(R(\theta)|z)$ is increasing in z.

- (ii) **Fundamentals vs. market noise:**

  If market noise is sufficiently important, investment volatility is high, but correlation with future returns is low.

- (iii) **Unbounded rents and welfare losses:**

  If the market friction is sufficiently important, or $\gamma \to 0$, $\mathbb{E}(\Omega(z, k(z)))$ is unboundedly large, but $\mathbb{E}(V(z); k(z))$ lower than with pre-determined investment $\hat{k}$.

Compensation design

Implementing (almost) arbitrary levels of investment

- Let $\underline{R} = lim_{\theta \to -\infty} R(\theta)$, $\bar{R} = lim_{\theta \to \infty} R(\theta)$.
- Interval $(\psi(\underline{R}), \psi(\bar{R}))$ contains all efficient k's (for some θ)
- Benchmarks: k^* obtained with $W = \omega \cdot \Pi$.

Proposition:

(Almost) anything is implementable with equity, stock options, caps, and floors

- (i) Any $k \in (k^*, \psi(\bar{R}))$ can be implemented with **equity** and **floors**: $W(\Pi) = max\{\underline{W}, \omega\Pi\}$
- (ii)Any $k \in (\psi(\underline{R}), k^*)$ can be implemented with **equity** and **caps**: $W(\Pi) = max\{\hat{W}, \omega\Pi\}$

Takeaway: Implementing k^* requires ruling out pretty much all forms of compensation!

(except for restricted equity)

Discussion: Regulation and intervention

Regulation and intervention

- Regulation interventions and tax policy
  - Regulation of executive pay

    $\rightarrow$ Bar out anything other than restricted stock
  - Investment size caps

    $\rightarrow$ aim at limiting distortions, taking financial market as given

    $\rightarrow$ must trade off loses from flexible (info-contingent) investment
  - Financial transactions tax
    - Tax $\tau(z) = 1 - V(z;k)/P(z;k) = \Omega(z;k)$: implements efficient investment

    $\rightarrow$ In practice, would require great deal of info: not realistic

Market Interventions

- Alternative Policy instruments: Market Interventions (TARP, OMT)
  - Focus on return $R(\theta)$ that is dominated by downside risks
  - Policy maker announces to buy shares at a pre-determined price $\bar{P} = \bar{R} \cdot \hat{k} - C\left(\hat{k}\right)$.
  - Under eff. markets: policy subsidizes initial shareholders, generates upwards distortion of investment.

  Proposition: market interventions. If $R(\theta)$ dominated by downside risk:
  - (i) Support price policy is welfare-improving.
  - (ii) But expected fiscal cost is strictly positive (i.e. support price $>$ expected dividend returns).

  $\rightarrow$ Lemons Problem (buying from informed traders) dominates arbitrage gain of under-priced securities.
- Efficient Tax-neutral intervention: price-support policy, plus transaction/dividend tax
  - Not distribution-neutral: policy shifts rents from initial to final shareholders.
  - Remark: for upside risk, could think about costly interventions to limit over-pricing, "prick bubble" by implementing price ceilings.

Conclusions

- Proposed theory of incentive and investment distortions due to info frictions
  - Friction leads to systematic over- or under-pricing,
  - Rent-seeking motive for initial shareholders (conflict of interest w. final shareholders).
  - Initial shareholders' concern about equity value leads to systematic distortion in response to new information.
- Distortions implemented through performance pay contracts (e.g. stock options).
  - Distortions, welfare losses large for investment in upside risks, near constant returns to scale.
  - Scope for welfare-improving regulation and market interventions (with re-distributive effects).
  - Restrictions on executive pay as key element for optimal regulation.