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.
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 \( \Pi = \text{dividend} \)
    \[
    \Pi(\theta, k) = R(\theta) \cdot k - C(k), \quad \theta \sim N(0, \lambda^{-1})
    \]
  - manager undertakes investment choice: \( k \geq 0 \)

- \( t = 2 \): (financial market)
  - initial shareholders: sell fraction \( \alpha \) of shares
  - informed traders: observe \( x_i \sim N(\theta, \beta^{-1}) \); purchase \( d_i(x, P) \in (0, \alpha) \)
  - Noise traders: demand \( \alpha \Phi(u); \quad u \sim N(0, \delta^{-1}) \)
  - market clears at \( P = P(\theta, u) \)

- \( t = 3 \): (payoffs)
  - dividend realized; agents paid
Equilibrium characterization

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

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

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

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

3. Market clearing (info aggregation):

$$\alpha = \int d(x_i, P) d\Phi(\sqrt{\beta}(x - \theta)) + \alpha \Phi(u)$$

$$\Rightarrow \hat{x}(P) = \theta + 1/\sqrt{\beta} \cdot u \equiv z$$

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

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

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

- Information aggregation wedge:
  \[
  \Omega(z) \equiv P(z) - V(z) = k \cdot \{ \mathbb{E}[R(\theta)|x = z, z] - \mathbb{E}[R(\theta)|x = z] \}
  \]
  - depends on realization of \( z \)
  - magnitude scales up with manager's investment choice \( k \)
Posterior beliefs: no shocks

- Posterior of mean and mg trader coincide
Posterior beliefs: $\Delta u = +1 \text{ s.d.}$

$\Phi(\Delta u) = 0.841$

Common expectations effect

Threshold trader’s posterior:
$$E[\theta | x = z, z] = z x (\beta + \beta \delta)/(\lambda + \beta \delta)$$

Market-clearing effect

Threshold trader’s posterior:
$$E[\theta | x = z, z] = z x (\beta + \beta \delta)/(\lambda + \beta \delta)$$

$\rightarrow (+)$ Noisy demand shock: prices increase – higher signal $z$

$\rightarrow$ All traders’ posteriors increase due to higher $z$: common expectations effect

$\rightarrow$ But to accommodate $\Delta u$, posterior of mg trader must increase more: market clearing effect
Posterior beliefs: $\Delta \theta = -1 \text{ s.d.}$

$\Phi(u) = 0.5$

- Informed traders posteriors: $E[\theta | x, z] \sim N(z \beta \delta / (\lambda + \beta + \beta \delta), D)$
- Common expectations effect
- Threshold trader’s posterior: $E[\theta | x = z, z] = z \times (\beta + \beta \delta) / (\lambda + \beta + \beta \delta)$
- Market-clearing effect

$\rightarrow$ (−) Fundamentals shock: prices fall – higher signal $z$

$\rightarrow$ All traders’ posteriors fall due to lower $z$: common expectations effect

$\rightarrow$ 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

$$\mathbb{E}[\Omega(z)] = k \cdot \int_{0}^{\infty} (R' (\theta) - R' (-\theta)) (\Phi(\sqrt{\lambda} \cdot \theta) - \Phi(\sqrt{\lambda_P} \cdot \theta)) d\theta.$$

- 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: $\mathbb{E}[\Omega(\cdot)] = 0$

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

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

(iv) for given $k$, $|\mathbb{E}[\Omega(\cdot)]|$ increasing in info frictions $\lambda_P^{-1}$
$t = 1$: 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.:

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

- 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: $\hat{k}$

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

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. $\lambda_P^{-1}$: if $R(\cdot)$ has upside/downside risk, $|\hat{k}/k^* - 1|$ increasing in $\lambda_P^{-1}$
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 \( \mathbb{E}\{\mathbb{E}[R(\theta)|x = z, z]\} = \mathbb{E}[R(\theta)] \), or when \( \gamma \rightarrow \infty \)

- (ii) Bounded losses on downside: if \( \mathbb{E}\{\mathbb{E}[R(\theta)|x = z, z]\} < \mathbb{E}[R(\theta)] \), then \( \Delta < 1 \)

- (iii) Unbounded losses on upside: if \( \mathbb{E}\{\mathbb{E}[R(\theta)|x = z, z]\} > \mathbb{E}[R(\theta)] \), then \( \Delta \rightarrow \infty \) if
  - \( \mathbb{E}\{\mathbb{E}[R(\theta)|x = z, z]\}/\mathbb{E}[R(\theta)] \rightarrow \infty \), or
  - \( \gamma \rightarrow 0 \)

- (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 \( \theta \): \( \theta \sim N\left(\frac{\kappa}{\lambda + \kappa} y, (\lambda + \kappa)^{-1}\right) \)

Proposition: market reaction to public disclosures

- (i) \( \lambda_P(\kappa) \) is increasing in \( \kappa \), 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 \( \delta \) is sufficiently low.

→ News not effective at reducing initial shareholders’ uncertainty over market price.

→ Noisy news exacerbate gap between uncertainty about fundamentals and uncertainty about market price.
Underreaction to public information

\[ \lambda + k \]

\[ \lambda_p(k) \]

\[ \beta + \beta \delta \]

\[ \lambda + k \]
Distorting the response to public news

Proposition (in progress):

- (i) Noisy News may reduce welfare.
  
  → news about fundamentals may increase uncertainty about market prices.
  
  → 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
  - Moderately bad news actually reduce the (objective) default probability
- With info frictions, market uncertainty is reduced less:
  - Moderately bad news increase the (market) default probability
  - 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
  
  → Moderately good news actually reduce the (objective) probability of success

- With info frictions, market uncertainty is reduced less:
  
  → Moderately good news increase the (market) success probability
  
  → 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
  
  → *Endogenous* element of upside risk!
Distorting the response to market signals

Let $\hat{z}$ be such that $\mathbb{E}(R(\theta)|x = z, z) \gtrless \mathbb{E}(R(\theta)|z)$, for $z \gtrless \hat{z}$. 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 $\mathbb{E}(\Omega(z, k(z))) = \mathbb{E}(\Omega(z, \mathbb{E}(k(z)))) + \text{Cov}\{k(z); \mathbb{E}(R(\theta)|x = z, z) - \mathbb{E}(R(\theta)|z)\}$

- 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**
Proposition: Market noise creates investment volatility

- (i) Excess investment sensitivity:
  The investment distortion $|\hat{k}(z)/k^*(z) - 1|$ increases in $\alpha$, 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 $(\psi(R), \psi(\bar{R}))$ contains all efficient $k$’s (for some $\theta$)

- 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: $W(\Pi) = \max\{W, \omega \Pi\}$

- (ii) Any $k \in (\psi(R), k^*)$ 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
    - Bar out anything other than restricted stock
  - Investment size caps
    - Aim at limiting distortions, taking financial market as given
    - Must trade off losses from flexible (info-contingent) investment
  - Financial transactions tax
    - Tax $\tau(z) = 1 - \frac{V(z; k)}{P(z; k)} = \Omega(z; k)$: implements efficient investment
    - 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 $\bar{P} = \bar{R} \cdot \hat{k} - C(\hat{k})$.
  - 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 $>\text{expected dividend returns}$).
  → 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.