Disclosure Quality, Cost of Capital, and Investors’ Welfare

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Presentation at
The Wharton School
1. Overview
   - Research Questions
   - Economic Forces and Main Results
   - Related Literatures

2. Model and Equilibrium
   - Events, Utility, Cash Flow Function, and Information
   - The Equilibrium

3. Effects of Disclosure Quality
   - Disclosure Quality and Cost of Capital
   - Disclosure Quality and the Current Owner’s Welfare
   - Disclosure Quality and the New Owner’s Welfare

4. Extensions and Conclusion
When disclosure changes a firm’s real decisions, how does disclosure quality affect cost of capital, current shareholders’ welfare, and new shareholders’ welfare?
Research Questions

- When disclosure changes a firm’s real decisions, how does disclosure quality affect cost of capital, current shareholders’ welfare, and new shareholders’ welfare?

- Under what conditions is cost of capital a sufficient statistic for the welfare of current and/or new shareholders?
Motivation

- Regulators and firms are concerned about the welfare impacts of disclosure quality;

Levitt
"The truth is, high [accounting] standards lower the cost of capital. And that’s a goal we share."

Pingyang Gao (Yale School of Management)
Regulators and firms are concerned about the welfare impacts of disclosure quality;

The research has focused on the relation between disclosure quality and cost of capital;
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There is a gap between the empirical evidence and the theoretical research;
Regulators and firms are concerned about the welfare impacts of disclosure quality;

The research has focused on the relation between disclosure quality and cost of capital;

There is a gap between the empirical evidence and the theoretical research;

What is the relation between cost of capital and investors’ welfare?

Levitt

“The truth is, high [accounting] standards lower the cost of capital. And that’s a goal we share.”
The Investment Effect

\[ \text{Disclosure} \implies \text{Risk of Profitability} \implies \text{Cash flow & Price} \]
Disclosure quality reduces cost of capital if and only if:
the adjustment cost of new investment is sufficiently high,
the prior expected profitability of existing investment is sufficiently low.

The Investment Effect

Disclosure $\implies$ Risk of Profitability $\implies$ Cash flow & Price $\implies$ Investment
Disclosure quality reduces cost of capital if and only if:

- the adjustment cost of new investment is sufficiently high,
- or the prior expected profitability of existing investment is sufficiently low.
Disclosure quality improves current shareholders' welfare if and only if:
- current shareholders are sufficiently risk tolerant,
- or the adjustment cost of new investment is sufficiently low.

\[
\text{The Total Risk} \ (\text{Var}[\tilde{F}])
\]

The Risk Allocation Effect
The Risk Allocation Effect

The Total Risk \( (\operatorname{Var}[\tilde{F}]) \)

Cash Flow Risk \( (E[\operatorname{Var}[\tilde{F} | y]]) \)

Disclosure Quality

0 \( \beta \) \( \infty \)

Disclosure quality improves current shareholders’ welfare if and only if:

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- current shareholders are sufficiently risk tolerant,
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The Risk Allocation Effect

The Total Risk \( \text{Var}[\tilde{F}] \)

- Price Risk \( \text{Var}[E[\tilde{F}|y]] \)
- Cash Flow Risk \( E[\text{Var}[\tilde{F}|y]] \)

Disclosure Quality

\[ 0 \rightarrow \beta \rightarrow \infty \]
The Risk Allocation Effect

The Total Risk (\( \text{Var}[\tilde{F}] \))

\[
\text{Price Risk} (\text{Var}[E[\tilde{F}|y]]) + \text{Cash Flow Risk} (E[\text{Var}[\tilde{F}|y]])
\]

Disclosure quality improves new shareholders’ welfare if and only if:

- the adjustment cost of new investment is sufficiently low,
- or the level of existing investment is sufficiently low.
Three Related Literatures

- The relationship b/w disclosure quality and cost of capital
  - Empirical: e.g., surveyed by Leuz and Wysocki (2007)

- The welfare consequences of disclosure quality
  - Early literature on Hirshleifer effect: e.g., Hirshleifer (1971), and Verrecchia (1982).
  - Three subsequent literatures:
    - private information: e.g., Diamond (1985);
    - imperfect competition: e.g., Kyle (1985);
    - production: e.g., Kunkel (1982), Christensen and Feltham (1988), and Yee (2007).

- The real effect of accounting disclosure in capital market
  - e.g., Kanodia (1980, 2007).
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4. Extensions and Conclusion

Pingyang Gao (Yale School of Management)
**Time Line of Events and Utility Functions**

- **$t = 1$**: The firm discloses a signal according to a stipulated disclosure quality.
- **$t = 2$**: The firm makes new investment and the current owner sells the firm to the new owner.
- **$t = 3$**: Investment pays off; The new owner consumes.

Both the current and new owners have CARA utility functions:

$$U(W_i) = -\exp(-W_i \tau_i), \quad i \in \{c, n\}$$
Time Line of Events and Utility Functions

\begin{itemize}
  \item $t = 1$
  \hspace{1cm}
  \text{The firm discloses a signal according to a stipulated disclosure quality.}

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\end{itemize}

Both the current and new owners have CARA utility functions.

\[ U(W_i) = -\exp\left(-\frac{W_i}{\tau_i}\right), \quad i \in \{c, n\} \]
Cash Flow Function

\[ \tilde{F} = m(\mu_0 + \tilde{\mu}) + k\tilde{\mu} - \frac{Z}{2}k^2 \]
The Cash Flow Function is given by

\[ \tilde{F} = m(\mu_0 + \tilde{\mu}) + k\tilde{\mu} - \frac{z}{2}k^2 \]

- \( m \) Level of existing investment
- \( \mu_0 \) Prior expected profitability
- \( \tilde{\mu} \) Uncertainty about profitability
Cash Flow Function

\[ \tilde{F} = m(\mu_0 + \tilde{\mu}) + k\tilde{\mu} - \frac{z}{2}k^2 \]

- \( m \): Level of existing investment
- \( \mu_0 \): Prior expected profitability
- \( \tilde{\mu} \): Uncertainty about profitability
- \( k \): Level of new investment
- \( z \): Adjustment cost of new investment
The New Owner’s Information

$\tilde{\mu}$: the source of uncertainty
The New Owner’s Information

\( \tilde{\mu} \): the source of uncertainty

- Disclosure is a garbling of \( \tilde{\mu} \)

\[ \tilde{y} = \tilde{\mu} + \tilde{\epsilon}, \quad \tilde{\epsilon} \sim \mathcal{N}(0, \frac{1}{\beta}) \]

\( \beta \) is the disclosure quality.
Lemma 1: the Equilibrium

The new owner’s demand function:

\[ D = \tau_n \frac{E[\tilde{F}|\Omega] - p(\Omega)}{Var[\tilde{F}|\Omega]}, \Omega = (y, k) \]
Lemma 1: the Equilibrium

- The new owner’s demand function:

\[ D = \tau_n \frac{E[\tilde{F}|\Omega] - p(\Omega)}{\text{Var}[\tilde{F}|\Omega]}, \quad \Omega = (y, k) \]

- The price function:

\[ p(\Omega) = E[\tilde{F}|\Omega] - \frac{1}{\tau_n} \text{Var}[\tilde{F}|\Omega] \]
Lemma 1: the Equilibrium

- The new owner’s demand function:
  \[ D = \tau_n \frac{E[\tilde{F} \mid \Omega] - p(\Omega)}{\text{Var}[\tilde{F} \mid \Omega]}, \quad \Omega = (y, k) \]

- The price function:
  \[ p(\Omega) = E[\tilde{F} \mid \Omega] - \frac{1}{\tau_n} \text{Var}[\tilde{F} \mid \Omega] \]

- The firm’s optimal investment function:
  \[ k(y) = \frac{E[\tilde{\mu} \mid y]}{z + \frac{2}{\tau_n} \text{Var}[\tilde{\mu} \mid y]} - \frac{2}{\tau_n} \text{Var}[\tilde{\mu} \mid y] m \]
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4. Extensions and Conclusion
Cost of Capital and the Variance-mean Ratio

\[ E[\tilde{R}] = \frac{E[\tilde{F}] - P}{P} = \frac{1}{\frac{\tau_n}{V_F} - 1} \]
Cost of Capital and the Variance-mean Ratio

\[ E[\tilde{R}] = \frac{E_{\tilde{F}} - P}{P} = \frac{1}{\frac{\tau_n}{V_{\tilde{F}}} - 1} \]

**Lemma 2**

As disclosure quality improves,

- \( E_{\tilde{F}} \) increases monotonically;
- \( V_{\tilde{F}} \) increases if and only if the adjustment cost of new investment is sufficiently low (\( V'_{\tilde{F}} > 0 \iff z < z^* \)).
Proposition 1: Disclosure Quality and Cost of Capital

Disclosure quality increases cost of capital if and only if:

- the adjustment cost is sufficiently low \((z < z^*)\), and
- the prior expected profitability of existing investment is sufficiently high \((\mu_0 > \mu^*_0)\).
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Disclosure quality increases cost of capital if and only if:
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\[
\left(\frac{V_{\tilde{F}}}{E_{\tilde{F}}}\right)_{pe} = \frac{\text{Var}[\tilde{\mu} | y]}{\mu_0}
\]

\[
E_{\tilde{F}} \quad \text{or} \quad V_{\tilde{F}}
\]

The Pure Exchange Economy

Pingyang Gao (Yale School of Management)
Proposition 1: Disclosure Quality and Cost of Capital

Disclosure quality increases cost of capital if and only if:
- the adjustment cost is sufficiently low \( z < z^* \), and
- the prior expected profitability of existing investment is sufficiently high \( \mu_0 > \mu_0^* \).

The Pure Exchange Economy

\[
\left( \frac{V_F}{E_F} \right)_{pe} = \frac{\text{Var}[\tilde{\mu}|y]}{\mu_0}
\]

The CRTS Economy

\[
\left( \frac{V_F}{E_F} \right)_{crt} = \frac{\tau_n}{2 + \frac{m_\mu_0 \tau_n}{V_{crt}}}
\]
Intuition: $E[\tilde{R}]$ Measures Variance-Mean Ratio.

\[
\frac{\partial E[\tilde{R}]}{\partial \beta} = \frac{E_{\tilde{F}} V_{\tilde{F}} \tau_n}{(\tau_n E_{\tilde{F}} - V_{\tilde{F}})^2} \left( \frac{V'_{\tilde{F}}}{V_{\tilde{F}}} - \frac{E'_{\tilde{F}}}{E_{\tilde{F}}} \right)
\]
Intuition: $E[\tilde{R}]$ Measures Variance-Mean Ratio.

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- Increasing variance is a necessary condition;
Intuition: $E[\tilde{R}]$ Measures Variance-Mean Ratio.

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- Increasing variance is a necessary condition;
- $\frac{V'_{\tilde{F}}}{V_{\tilde{F}}}$ and $\frac{E'_{\tilde{F}}}{E_{\tilde{F}}}$ are the “quality-elasticity” of variance and mean, respectively;
Intuition: $E[\tilde{R}]$ Measures Variance-Mean Ratio.

\[
\frac{\partial E[\tilde{R}]}{\partial \beta} = \frac{E_{\tilde{F}} V_{\tilde{F}} \tau_n}{(\tau_n E_{\tilde{F}} - V_{\tilde{F}})^2} \left( \frac{V'_{\tilde{F}}}{V_{\tilde{F}}} - \frac{E'_{\tilde{F}}}{E_{\tilde{F}}} \right)
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- Increasing variance is a necessary condition;
- $\frac{V'_{\tilde{F}}}{V_{\tilde{F}}}$ and $\frac{E'_{\tilde{F}}}{E_{\tilde{F}}}$ are the “quality-elasticity” of variance and mean, respectively;
- $\mu_0$, the prior expected profitability of existing investment, only affects the “quality-elasticity” of mean.
Disclosure quality increases the cost of capital when the adjustment cost of new investment is sufficiently low and the general economic outlook is optimistic;
Empirical Implications: Part 1

- Disclosure quality increases the cost of capital when the adjustment cost of new investment is sufficiently low and the general economic outlook is optimistic;

- Disclosure quality increases the risk of a firm’s cash flow when the adjustment cost of new investment is sufficiently low;
Empirical Implications: Part 1

- Disclosure quality increases the cost of capital when the adjustment cost of new investment is sufficiently low and the general economic outlook is optimistic;

- Disclosure quality increases the risk of a firm’s cash flow when the adjustment cost of new investment is sufficiently low;

- More empirical research on how disclosure quality affects the firm’s investment decisions could facilitate the tests (e.g., Verdi (2006)).
Definition and Results

The current owner’s welfare is her expected utility before disclosure.
Definition and Results

The current owner’s welfare is her expected utility before disclosure.

Proposition 2: Disclosure Quality and Current Owner’s Welfare

Disclosure quality makes the current owner worse off if and only if:

- the current owner is sufficiently risk averse relative to the new owner \(\tau_c < \frac{\tau_n}{2}\), and
- the adjustment cost of new investment is sufficiently high \(z > z_c^*\).
Intuition: Trade-off of the Dual Effects

Welfare of the Risk Allocation Effect

\[ CE_c = P - \frac{1}{2\tau_c} \text{Var}[p(y)] \]

\[ = \mu_0 - \frac{1}{\tau_n} \text{Var}[\tilde{\mu}|y] - \frac{1}{2\tau_c} \text{Var}[E[\tilde{\mu}|y]] \]

Cash Flow Risk

Price Risk

\[ = \mu_0 - \frac{1}{2\tau_c} \frac{1}{\alpha} + \left( \frac{1}{2\tau_c} - \frac{1}{\tau_n} \right) \frac{1}{\alpha + \beta} \]
Intuition: Trade-off of the Dual Effects

### Welfare of the Risk Allocation Effect

\[
CE_c = P - \frac{1}{2\tau_c} \text{Var}[p(y)]
\]

\[
= \mu_0 - \frac{1}{\tau_n} \text{Var}[^\mu|y] - \frac{1}{2\tau_c} \text{Var}[E[^\mu|y]]
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- **Cash Flow Risk**
- **Price Risk**

\[
= \mu_0 - \frac{1}{2\tau_c} \frac{1}{\alpha} + \left( \frac{1}{2\tau_c} - \frac{1}{\tau_n} \right) \frac{1}{\alpha + \beta}
\]

### Welfare of the Investment Effect

\[
E[U(W_c)] = -\frac{1}{\sqrt{1 + \frac{1}{2\tau_c} P}}
\]
Remark 1: Cost of Capital and Welfare

Cost of capital is not a sufficient statistic for the current owner’s welfare.
Remark 1: Cost of Capital and Welfare

Cost of capital is not a sufficient statistic for the current owner’s welfare.

Pure Exchange Economy

$$CE_c = \frac{\mu_0}{1 + E[\tilde{R}]} - \frac{1}{2\tau_c} \text{Var}[p(y)]$$

Disclosure affects welfare through both the level and the volatility of the price.
Remark 1: Cost of Capital and Welfare

Cost of capital is not a sufficient statistic for the current owner’s welfare.

Pure Exchange Economy

\[ CE_c = \frac{\mu_0}{1 + E[\tilde{R}]} - \frac{1}{2\tau_c} \text{Var}[p(y)] \]

Disclosure affects welfare through both the level and the volatility of the price.

Without Existing Investment

\[ P = \frac{E\tilde{F}}{1 + E[\tilde{R}]} \]

Disclosure affects the level of the price through both the cost of capital and the mean of the firm’s cash flow.
Proposition 3: Disclosure Quality and New Owner’s Welfare

As disclosure quality increases, the new owner is worse off if and only if $m$ and $z$ are in the blank area.

\[
\beta < \alpha \\
\beta > \alpha
\]
Conditional on disclosure, the new owner prefers cash flow risk.
Intuition: Cash Flow Risk and Elasticity of Demand

Conditional on disclosure, the new owner prefers cash flow risk.

- Risk aversion induces a downward-sloping demand curve;

\[ D = \tau_n \frac{E[\tilde{F}|y] - p(y)}{\text{Var}[\tilde{F}|y]} \]
Intuition: Cash Flow Risk and Elasticity of Demand

Conditional on disclosure, the new owner prefers cash flow risk.

- Risk aversion induces a downward-sloping demand curve;

$$D = \tau_n \frac{E[\tilde{F}|y] - p(y)}{\text{Var}[\tilde{F}|y]}$$

- The gap between marginal and average utility generates the surplus;
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- The gap between marginal and average utility generates the surplus;
- Cash flow risk (\(\text{Var}[\tilde{F}|y]\)) enlarges the gap;
- Life-cycle reason for sale does not generate the surplus.
Intuition: Cash Flow Risk and Elasticity of Demand

Conditional on disclosure, the new owner prefers cash flow risk.

- Risk aversion induces a downward-sloping demand curve;
  \[ D = \tau_n \frac{E[\tilde{F}|y] - p(y)}{Var[\tilde{F}|y]} \]

- The gap between marginal and average utility generates the surplus;
- Cash flow risk (\(Var[\tilde{F}|y]\)) enlarges the gap;
- Life-cycle reason for sale does not generate the surplus.

Before disclosure, the new owner is also averse to the volatility in his conditional utility.
Remark 2: Cost of Capital and Welfare

Cost of capital is not a sufficient statistic for the new owner’s welfare, either.
Remark 2: Cost of Capital and Welfare

Cost of capital is not a sufficient statistic for the new owner’s welfare, either.

Table 2: Effects of Disclosure Quality on Cost of Capital and Welfare

<table>
<thead>
<tr>
<th>Economies</th>
<th>Cost of Capital</th>
<th>Current Owner’s Welfare</th>
<th>New Owner’s Welfare</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Economy</td>
<td>Increase/Decrease ♥</td>
<td>Increase/Decrease ♣</td>
<td>Increase/Decrease ♠</td>
</tr>
<tr>
<td>Pure Exchange</td>
<td>Decrease</td>
<td>Increase/Decrease</td>
<td>Decrease</td>
</tr>
<tr>
<td>No Endowment</td>
<td>Decrease</td>
<td>Increase</td>
<td>Increase/Decrease</td>
</tr>
<tr>
<td>CRTS</td>
<td>Increase</td>
<td>Increase</td>
<td>Increase</td>
</tr>
</tbody>
</table>

Note: Conditions of ♥, ♣, and ♠ differ from and do not subsume each other.
Empirical Implications: Part 2

- Be careful to infer prescriptive suggestions from the results about the relationship between disclosure quality and cost of capital;
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- Be careful to infer prescriptive suggestions from the results about the relationship between disclosure quality and cost of capital;

- Firms commit to high disclosure quality if the adjustment cost of new investment is sufficiently low or current owners are sufficiently risk tolerant;
Empirical Implications: Part 2

- Be careful to infer prescriptive suggestions from the results about the relationship between disclosure quality and cost of capital;

- Firms commit to high disclosure quality if the adjustment cost of new investment is sufficiently low or current owners are sufficiently risk tolerant;

- Exchanges and legal regimes with differential disclosure requirements could attract distinct clienteles.
The model could survive diversification;
The model could survive diversification;

Other definitions of cost of capital do not affect the main results;
Extensions

- The model could survive diversification;
- Other definitions of cost of capital do not affect the main results;
- The main conclusions still hold if disclosure reduces information asymmetry among new investors.
Disclosure quality could increase cost of capital in the presence of the investment effect;
Conclusion

- Disclosure quality could increase cost of capital in the presence of the investment effect;

- There are plausible conditions under which disclosure quality reduces the welfare of both current and new shareholders;
Conclusion

- Disclosure quality could increase cost of capital in the presence of the investment effect;

- There are plausible conditions under which disclosure quality reduces the welfare of both current and new shareholders;

- Cost of capital is not a sufficient statistic for the welfare of either current or new shareholders in the analysis of the economic consequences of disclosure quality.