Firms’ Perceived Cost of Capital

Niels Joachim Gormsen and Kilian Huber

University of Chicago Booth School of Business
This Paper

\[ r_{\text{perc.}} = r_{\text{true}} + \nu \]

1. Collect data on \( r_{\text{perc.}} \) from conference calls
2. \( r_{\text{perc.}} \) correctly incorporates:
   - Time variation in expected returns on debt and equity
   - Some traditional cross-sectional factors
3. But \( r_{\text{perc.}} \) is mostly wrong relative to standard models:
   - Only 20% of variation can be justified by \( r_{\text{true}} \)
   - 80% of variation reflects "mistakes" ("excess dispersion")
   - No mistakes in \( r_{\text{perc.}} \) CoD, large mistakes in \( r_{\text{perc.}} \) CoE
4. Mistakes lead to misallocation of capital:
   - Mistakes \( \rightarrow \) misallocation \( \rightarrow \) TFP loss \( \sim 5\% \)
   - Allocation closer to optimal if all firms had same perceived coc
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Mistakes challenge standard theory
- Challenges premise of production-based theory
- Rejection of Investment-CAPM
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Data and Framework
Data from Corporate Conference Calls

- Nestlé, Q4-2006: “We use an average cost of capital of 7.5%.”
- Air Canada, Q3-2017: “... our weighted average cost of capital of 7.6%.”
- Phillips 66, Q2-2022: “... our weighted average cost of capital of 10%.”

Our Approach
- Identify 110k paragraphs containing keywords from 2002-2022
- Manually read and enter numbers with RA team
- Collect numbers related to:
  - Perceived CoC, CoE, and CoD
  - Required returns (discount rates or “hurdle rates”)
  - Realized returns
- Separately collect “project-specific” variables from “representative projects”

Overview of data
- Perc. CoC and required returns for 2,500 firms, 20 countries
- Representative, except larger firms (more on next slide)
- Includes 50 of the 100 largest firms in Compustat (3% of universe)
- Included firms account for > 40% of market value
- Data under costofcapital.org

Verifiable data
- Calls are repeated high-stakes interactions (Hassan et al. 2019)
- Information from conference calls used in security lawsuits
- Extensive data validation in Gormsen and Huber (2023) (details)
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(details)
### Summary Statistics and Representativeness

#### Summary statistics

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>mean</th>
<th>p5</th>
<th>p95</th>
</tr>
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<tbody>
<tr>
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<td>13.0</td>
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<td>15.0</td>
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- Included firms are larger, less constrained, and slightly more profitable than average.
- Gormsen and Huber (2023): Extensive analysis on representativeness.
## Summary Statistics and Representativeness

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### Characteristics (cross-sectional percentiles) of included firms:

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<tr>
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<th>Discount rates</th>
<th>Cost of capital</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mean</td>
<td>min</td>
</tr>
<tr>
<td>Return on equity</td>
<td>59.8</td>
<td>0.8</td>
</tr>
<tr>
<td>Market value</td>
<td>83.1</td>
<td>3.0</td>
</tr>
<tr>
<td>Book-to-market</td>
<td>49.4</td>
<td>0.2</td>
</tr>
<tr>
<td>Investment rate</td>
<td>53.6</td>
<td>0.3</td>
</tr>
<tr>
<td>Z-score (bankruptcy risk)</td>
<td>47.6</td>
<td>0.8</td>
</tr>
<tr>
<td>Financial constraints</td>
<td>20.5</td>
<td>0.0</td>
</tr>
</tbody>
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- Included firms are larger, less constrained, and slightly more profitable than average
- Gormsen and Huber (2023): Extensive analysis on representativeness
## Within-Firm Timing

<table>
<thead>
<tr>
<th></th>
<th>(1) Discount rate observed in quarter</th>
<th>(2) Perc. cost of capital observed in quarter</th>
<th>(3) Perc. cost of equity or debt observed in quarter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z-score (bankruptcy risk)</td>
<td>0.00081 (0.0018)</td>
<td>0.00047 (0.0015)</td>
<td>-0.00068 (0.0022)</td>
</tr>
<tr>
<td>Return on equity</td>
<td>0.00096 (0.0013)</td>
<td>0.0011 (0.0012)</td>
<td>0.0025* (0.0015)</td>
</tr>
<tr>
<td>Book-to-market</td>
<td>0.00046 (0.0018)</td>
<td>0.0013 (0.0014)</td>
<td>-0.0024 (0.0019)</td>
</tr>
<tr>
<td>Investment rate</td>
<td>-0.0016 (0.0012)</td>
<td>0.00043 (0.0011)</td>
<td>-0.000032 (0.0015)</td>
</tr>
<tr>
<td>Financial constraints</td>
<td>0.0016 (0.0027)</td>
<td>0.0037 (0.0039)</td>
<td>0.0016 (0.0040)</td>
</tr>
<tr>
<td>Leverage</td>
<td>-0.00091 (0.0023)</td>
<td>0.00066 (0.0020)</td>
<td>0.0090*** (0.0027)</td>
</tr>
</tbody>
</table>

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</tr>
</thead>
<tbody>
<tr>
<td>FE</td>
<td>2.6e-06</td>
<td>0.000020</td>
<td>9.1e-07</td>
<td>0.000036</td>
<td>1.4e-06</td>
<td>0.00020</td>
</tr>
<tr>
<td>Within R²</td>
<td></td>
<td></td>
<td></td>
<td></td>
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- Timing of inclusion not predictable
- Exception: Firm talks about CoD following increase in leverage (debt issuance)
- Additional analysis in Gormsen and Huber (2023)
Real Effects of the Perceived Cost of Capital

Standard theory: CoC should influence real decisions

- Higher CoC ⇒ higher returns
- Higher CoC ⇒ less investment
- Higher CoC ⇒ less capital deployed

We find consistent evidence
Real Effects of the Perceived Cost of Capital

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- Higher CoC $\Rightarrow$ higher returns
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We find consistent evidence

<table>
<thead>
<tr>
<th></th>
<th>ROIC$_{i,t}$</th>
<th>Capital/labor$_{i,t}$</th>
<th>Long-run investment$_{i,t+5}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perc. CoC$_{i,t}$</td>
<td>0.74**</td>
<td>-17.3***</td>
<td>-0.78**</td>
</tr>
<tr>
<td></td>
<td>(0.31)</td>
<td>(2.91)</td>
<td>(0.36)</td>
</tr>
<tr>
<td>Country-year FE</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Observations</td>
<td>1,979</td>
<td>2,338</td>
<td>1,371</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.036</td>
<td>0.24</td>
<td>0.088</td>
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Notes: **p < 0.01, ***p < 0.001
What is the True Cost of Capital?

\[ r_{\text{perc.}} = r_{\text{true}} + \psi \]
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The true **firm-level** CoC
- CoC for project with **same risk as overall firm**
- Use expected returns on the firm’s debt and equity as CoD and CoE:

$$r_{i,t}^{true} = \omega_t \times (1 - \text{tax}) \times \text{Cost of debt}_t + (1 - \omega_t) \times \text{Cost of equity}_t$$

$$= \omega_t \times (1 - \text{tax}) \times E_t[r_{i}^{\text{debt}}] + (1 - \omega_t) \times E_t[r_{i}^{\text{equity}}]$$
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- This definition leads to maximization of stock prices
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Definition of \( r_{\text{true}} \) generally not depend on market efficiency
- Requires only law of one price (details)
Stylized Drivers of the
Perceived Cost of Capital
Time-Variation in Perceived CoC

US results:

\[ r_{i,t}^{\text{perc.}} = a_0 + 0.59^{***} \times \text{Earnings yield}_t + 0.32^{***} \times \text{Treasury yield}_t + \epsilon_{i,t} \]

Similar results in global sample
Cross-Sectional Variation and Classic Factors

Consistent with Modigliani and Miller (1958) and Fama and French (1993)
A Multivariate Model of the Perceived Cost of Capital

- Lasso selects 11 relevant characteristics for the perc. cost of capital (among 153)
- Slope coefficients for the 11 characteristics (measured in percentiles from 0 to 1):
A Recently Incorporated Factor: Green Versus Brown

“Climate Capitalists” (with Simon Oh) studies CoC for green and brown firms

- Sort firms into green and brown using MSCI data
- Green firms perceive significantly lower CoC since 2015
- Holds conditional on Fama-French factors
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Excess Dispersion in the Perceived CoC
Excess Dispersion

\[ r^{\text{perc.}} = r^{\text{true}} + \nu \]

How much of the variation in \( r^{\text{perc.}} \) comes from \( r^{\text{true}} \) and \( \nu \)?
Excess Dispersion

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How much of the variation in \( r^{\text{perc.}} \) comes from \( r^{\text{true}} \) and \( \upsilon \)?

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Excess Dispersion

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- Summary statistics suggests that \( r_{\text{perc.}} \) is too volatile to be driven by \( r_{\text{true}} \) alone.

- The 10-90 spread in the perc. cost of equity is 8%
- Very rare to find stocks with 8% difference in long-run expected returns
  \( \rightarrow r_{\text{perc.}} \) likely to be driven, at least in part, by errors (\( \nu \))
Variance Decomposition

\[ r_{\text{perc.}} = r_{\text{true}} + u \]
Variance Decomposition

\[ r_{\text{perc.}} = r_{\text{true}} + \nu \]

Standard variance decomposition:

\[
\text{var} \left( r_{i,t}^{\text{perc.}} \right) = \text{cov} \left( r_{i,t}^{\text{perc.}}, r_{i,t}^{\text{true}} \right) + \text{cov} \left( r_{i,t}^{\text{perc.}}, \nu_{i,t} \right).
\]

So,

\[
1 = \frac{\text{cov} \left( r_{i,t}^{\text{true}}, r_{i,t}^{\text{perc.}} \right)}{\text{var} \left( r_{i,t}^{\text{perc.}} \right)} + \frac{\text{cov} \left( \nu_{i,t}, r_{i,t}^{\text{perc.}} \right)}{\text{var} \left( r_{i,t}^{\text{perc.}} \right)}.
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\text{true variation} \quad \text{excess variation}
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We need proxy for \( r^{\text{true}} \):

- Measure leverage and cost of debt using accounting data, tax rate 20%
- Two different methods for true cost of equity
  1. Realized returns
  2. Implied cost of capital

Proxy for true cost of equity based on ex-post realized returns (details):

1. Calculate \( r_{\text{realized}}^{i,t+j} \) by replacing CoE with realized stock returns
2. \( r_{\text{realized}}^{i,t+j} \) is \( r^{\text{true}} \) + an unexpected residual
3. Project \( r_{\text{realized}}^{i,t+j} \) onto \( r^{\text{perc.}} \) to obtain \( \gamma^{\text{true}} \)(and \( \gamma^{\text{excess}} \))
Variance Decomposition

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Standard variance decomposition:

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\]

\( \gamma_{\text{true}} \quad \gamma_{\text{excess}} \)

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\[ \gamma_{\text{true}} \]

\[ \gamma_{\text{excess}} \]

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3. Project \( r_{i,t+j}^{\text{realized}} \) onto \( r_{i,t}^{\text{perc.}} \) to obtain \( \gamma_{\text{true}} \) (and \( \gamma_{\text{excess}} \))
1. Excess Dispersion through Realized Returns

Estimate true cost of equity based on realized returns (details)
1. Excess Dispersion through Realized Returns

Estimate true cost of equity based on realized returns (details)

![Graph showing excess volatility (γ^excess) with different variations and no controls marked as No controls.](image-url)
1. Excess Dispersion through Realized Returns

Estimate true cost of equity based on realized returns (details)

[Graph showing excess volatility (γexcess) for all variation and within country-year, comparing no controls and controlling for risk factors.]
2. Excess Dispersion through Implied Cost of Capital

Estimate true cost of equity based on the “implied cost of capital” (details)
2. Excess Dispersion through Implied Cost of Capital

Estimate true cost of equity based on the “implied cost of capital” (details)

Excess volatility (\(\gamma_{excess}\))

- All variation
- Within country-year

- Implied Cost of Cap
- Realized returns
Excess Dispersion in Perceptions about Equity, not Debt

Estimating the excess dispersion in the perceived cost of equity and debt separately
Excess Dispersion in Perceptions about Equity, not Debt

Estimating the excess dispersion in the perceived cost of equity and debt separately

Cost of equity based on implied cost of capital and cost of debt based on accounting data
Heterogeneity in Excess Dispersion

Excess dispersion similar across firms, with slight variations
Heterogeneity in Excess Dispersion

Excess dispersion similar across firms, with slight variations

![Graph showing excess volatility across different factors like Market value, Book-to-market, Depence on external finance, Issuance, and Market beta. The graph compares values above and below the median.]
Measurement Error Cannot Explain Excess Dispersion

- Excess vol. does not arise because of mismeasurement of tax, $\omega$, or $r_{\text{debt}}$.
- Excess vol. is not a product of CME.
Excess volatility ($\gamma_{\text{excess}}$)

- Excess vol. does not arise because of mismeasurement of tax, $\omega$, or $\rho_{\text{debt}}$
- Excess vol. not a product of CME
Measurement Error Cannot Explain Excess Dispersion

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Capital Misallocation from Excess Dispersion
Excess Dispersion and Misallocation

Standard models: mistakes in perceived cost of capital leads to misallocation of capital

We quantify this effect in the Hsieh and Klenow (2009) model

- In this model, excess dispersion maps directly to TFP loss
- Estimated TFP loss around 5%
Model

Three layers of production:

1. Representative firm produces output good by combining sector output \((Y_s)\) with sector share \(\theta\)

\[
Y = \prod_{s=1}^{S} Y_s^{\theta_s}
\]

2. Sector output is a CES aggregate of firm-level output within sector

\[
Y_s = \left( \frac{\sum_{i=1}^{M_s} Y_{si}^{\frac{\sigma-1}{\sigma}}}{\sum_{i=1}^{M_s}} \right)^{\frac{\sigma}{\sigma-1}}
\]

3. Firms produce using Cobb-Douglas

\[
Y_{si} = A_{si} K_{si}^{\alpha_s} L_{si}^{1-\alpha_s}
\]

- Perceived cost of capital \(r_{si} = (1 + \tau_{si}) \times r_{si}^{\text{true}}\)
- Constant cost of labor (wage)
- \(A_{si}\) and \(r_{si}\) jointly log-normal and \(\tau_{si}\) independent of \(r_{si}^{\text{true}}\) and sector
Solution: Misallocation from Excess Dispersion

Solution

- TFP loss from misallocation:

\[ \log(\text{TFP}) - \log(\text{TFP}^{\tau=0}) = \]

- \( \log(\text{TFP}^{\tau=0}) \) is TFP if \( \tau_i = 0 \forall i \)
Solution: Misallocation from Excess Dispersion

Solution
- TFP loss from misallocation:

\[
\log(TFP) - \log\left(TFP^{\tau=0}\right) = -\frac{\sigma^2}{2} \text{var}\left(\log(1 + \tau_i)\right)
\]

- \log(TFP^{\tau=0}) is TFP if \(\tau_i = 0\) \(\forall i\)
Solution: Misallocation from Excess Dispersion

Solution
- TFP loss from misallocation:

\[
\log(TFP) - \log(TFP^{\tau=0}) = -\frac{\sigma}{2} \text{var} \left( \log(1 + \tau_i) \right)
\]

Results
- Calibrate \( \sigma = 4 \) in baseline (evidence suggest 3 to 10)
Solution: Misallocation from Excess Dispersion

Solution

- TFP loss from misallocation:

\[
\log(TFP) - \log(TFP^{\tau=0}) = -\frac{\sigma}{2} \text{var}(\log(1 + \tau_i))
\]

Results

- Calibrate \( \sigma = 4 \) in baseline (evidence suggest 3 to 10)

<table>
<thead>
<tr>
<th>Impact of excess dispersion on TFP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excess dispersion estimated using realized returns (baseline)</td>
</tr>
<tr>
<td>Excess dispersion estimated using implied cost of capital</td>
</tr>
<tr>
<td>Low elasticity of substitution (( \sigma = 3 ))</td>
</tr>
<tr>
<td>High elasticity of substitution (( \sigma = 5 ))</td>
</tr>
</tbody>
</table>
Accounting for Discount-Rate Dynamics

Gormsen and Huber (2023): Perc. CoC influences discount rates and investment
- Very limited impact of perc. CoC in short run
- Strong impact in the long run

Long-run impact of perc. CoC:
- Perc. CoC strongly related to ROIC, investment, and capital-to-labor
- Perc. CoC is persistent: AR coefficient around 0.6 at 10-year horizon
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Challenges for Standard Theory
Challenges for Standard Theory

Standard theory endows firms with perfect information about their cost of capital
- Innocent assumption in many settings
- But crucial in others...
Challenges for Standard Theory

Standard theory endows firms with perfect information about their cost of capital
- Innocent assumption in many settings
- But crucial in others...

One example: Production-Based Asset Pricing (PBAP)
- PBAP builds on idea that managers have rational expectations about stock returns, hard to reconcile with our findings
- Mistakes in perc. CoC may lead to rejection of PBAP models
- Example: Investment-CAPM
Perceived CoC and the Investment CAPM

Investment CAPM (Hou et al. 2015)

- Theoretical prediction: firms with high past investment have low expected stock returns
- Mechanism: firms have high investment because they have low perceived CoC
- Consistent with data: investment $q$-factor explains future stock returns
Perceived CoC and the Investment CAPM

Investment CAPM (Hou et al. 2015)
- Theoretical prediction: firms with high past investment have low expected stock returns
- Mechanism: firms have high investment because they have low perceived CoC
- Consistent with data: investment $q$-factor explains future stock returns

We reject the mechanism
- Firms with high investment have *high* perceived CoC
- The investment factor is not a product of optimal capital budgeting behavior
- Perc. CoC is higher (not lower) for high investment
- High investment of high-investment firms not driven by low perceived cost of capital
## Testing the Investment CAPM

<table>
<thead>
<tr>
<th>Asset expansion (investment)</th>
<th>All firm/quarters</th>
<th>Firm/quarters with observed perceived cost of capital</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Realized stock returns</td>
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</tr>
<tr>
<td>Asset expansion</td>
<td>-1.43**</td>
<td>-6.58***</td>
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<tr>
<td>(investment)</td>
<td>(0.61)</td>
<td>(1.35)</td>
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</table>

Controls:
- Profits bins
- Beta bins
- Size bins

<table>
<thead>
<tr>
<th>Observations</th>
<th>739,481</th>
<th>723,243</th>
<th>722,926</th>
<th>1,352</th>
<th>1,334</th>
<th>1,334</th>
<th>2,000</th>
<th>1,960</th>
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</tr>
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<tbody>
<tr>
<td>R-squared</td>
<td>0.118</td>
<td>0.158</td>
<td>0.183</td>
<td>0.215</td>
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<td>0.264</td>
<td>0.187</td>
<td>0.217</td>
<td>0.345</td>
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Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
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- Perc. CoC is higher (not lower) for high investment
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<td>(investment)</td>
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<td>-4.60* (2.45)</td>
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<td>-4.61*** (1.19)</td>
<td>-4.40* (2.20)</td>
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- Perc. CoC is higher (not lower) for high investment
- High investment of high-investment firms not driven by low future returns
Conclusions

Economist endow firms with perfect knowledge of CoC
- But CoC hard to estimate → errors likely

New facts on firms perc. CoC
- 20% of variation “correct”
- But 80% of variation represents deviations

Large economic consequences of deviations in perc. CoC
- Deviations → 5% TFP loss
- Capital closer to optimal if all firms used same CoC
- Is current MBA curriculum counterproductive?

Plea: More research on these classical topics
- How should firms estimate their CoC?
- Should firms incorporate uncertainty about CoC in cap. budgeting?
- How do mistakes in perc. CoC hurt stock prices?
Thank You!
References


Market Efficiency and True Cost of Capital

\( r_{\text{true}} \) does not depend on market efficiency in general
- Assume prices driven by “behavioral demand” but law of one price holds
- Firms maximize value by discounting cash flows \((X)\) using the SDF \((M)\):

\[
\max \sum_{i=1}^{\infty} E_t(M_{t+i}X_{t+i})
\]

- Leads to similar rule as WACC formula
- Intuition: expected returns capture required return of marginal arbitrageur

Rule may differ if firms maximize future stock prices
- Firms use expected future SDF to discount cash flows
- Equivalent to using “future expected returns”
- Can explain “missing variation”, but not the large excess dispersion
1. Excess Dispersion through Realized Returns: Details

Estimate true cost of equity based on realized returns:

1. Define realized stock returns for firm $i$ as

\[ r_{i, t+j}^{\text{equity, realized}} = E_t[r_{i,t}^{\text{equity}}] + e_{i,t+j} \]

2. Define,

\[ r_{i, t+j}^{\text{realized}} = \omega_{i,t} \times (1 - \tau) \times r_{i,t}^{\text{debt}} + (1 - \omega_{i,t}) \times r_{i,t+j}^{\text{equity, realized}} \]

3. Then,

\[ r_{i, t+j}^{\text{realized}} = r_{i,t}^{\text{true}} + (1 - \omega_{i,t}) \times e_{i,t+j} \]

\[ \Rightarrow \text{We can recover } \gamma^\text{true} \text{ and } \gamma^\text{excess} \text{ through projection of } r_{i, t+j}^{\text{realized}} \text{ on } r_{i,t}^{\text{perc.}} \]
2. Excess Dispersion through Implied Cost of Capital: Details

Estimate true cost of equity based on the “implied cost of capital” (ICC)
- Standard measure of long-run expected returns
- Backs out expected returns from prices and expected cash flows

ICC is a noisy predictor of expected returns
- Predictive regressions give

\[ R_{i,t+j}^{\text{realized}} = \alpha + 0.5 \times r_{i,t}^{\text{ICC}} + \epsilon_{i,t+j} \]

- I.e., excess dispersion in the ICC
- We can extract \( \gamma^{\text{excess}} \) under the assumption that \( r_{i,t}^{\text{ICC}} = r_{i,t}^{\text{true}} + \text{noise}_{i,t} \)

Go back
Cost of Capital Factor

1. Does the perceived CoC include variation that is not in $\mu$?
   - Alternative approach: factor regression

\begin{tabular}{lcccc}
   & $t$ & $t+1$ & $t$ & $t+1$
\hline
   Constant & 0.41*** & 0.0067 & -0.17 & -0.11
   & (0.0026) & (0.18) & (0.17) & (0.15)
   \hline
   MKT & 0.25*** & 0.16***
   & (0.037) & (0.036)
   \hline
   SMB & 0.27***
   & (0.066)
   \hline
   HML & 0.26***
   & (0.049)
   \hline
   Observations & 216 & 216 & 216 & 216
   \hline
   P(intercept = 0.41) & 0.026
   \hline
   R-squared & 0.000 & 0.000 & 0.173 & 0.355
   \hline
   Standard errors in parentheses, *** $p < 0.01$
\end{tabular}
1. Does the perceived CoC include variation that is not in $\mu$?
   - Alternative approach: factor regression
   - Address using CoC factor (Fama and French 1993-type factor)
   - Use most recently observed perceived CoC (< 10 years old)
   - Factor not strongly associated with returns, but with market, size, and value

<table>
<thead>
<tr>
<th></th>
<th>(1) Perceived. CoC$_t$</th>
<th>(2) Realized return$_{r,t+1}$</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>0.41***</td>
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<td>MKT$_{t,t+1}$</td>
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<td>0.16***</td>
<td></td>
</tr>
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<td></td>
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<td>0.173</td>
<td>0.355</td>
</tr>
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Standard errors in parentheses, *** $p<0.01$
Which Factors Are Reflected in Per. Coc?

- Estimate relation between $\lambda^{\text{implied}}$ and $\lambda^{\text{true}}$ for different groups (Cho and Polk (2019))
- Reasonable relation within “traditional” factors
- Little to no relation for other factors
“As If” Behavior Cannot Save the Investment CAPM

“As if” hypothesis: high investment firms “know” they should require low returns
Test: look at required returns (discount rates/hurdles) from Gormsen and Huber (2023)

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firm required return</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asset expansion</td>
<td>0.012</td>
<td>0.029***</td>
<td>0.012</td>
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<tr>
<td>(investment)</td>
<td>(0.010)</td>
<td>(0.011)</td>
<td>(0.0089)</td>
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<td>Controls:</td>
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<td>Size bins</td>
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<td>Observations</td>
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<tr>
<td>R-squared</td>
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<td>Firm/date</td>
</tr>
</tbody>
</table>

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
- Note: required returns reduce investment once conditioning properly on investment opportunities (e.g., firm FE)
Survey Evidence

Data from surveys:

- **Poterba and Summers (1995):** 1990 Survey of ~ 100 hurdle rates
- **Jagannathan et al. (2016):** 2003 survey of ~ 100 hurdle rates
- **Duke-CFO survey:** ~ 150 hurdle rates and ~ 350 cost of capital (more for non-listed firms)
Predicting Duke-CFO Data

- We estimate predicted value of perc. CoC and discount rates using machine learning.
- Predicted values are unbiased estimates of Duke-CFO variables:

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<tr>
<td>Duke CoC</td>
<td></td>
<td></td>
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<tr>
<td>Predicted perc. CoC</td>
<td>0.74***</td>
<td>0.90***</td>
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<tr>
<td></td>
<td>(0.17)</td>
<td>(0.21)</td>
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<tr>
<td>Predicted discount rate</td>
<td></td>
<td>1.02***</td>
<td>0.98**</td>
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<tr>
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<td>(0.38)</td>
<td>(0.38)</td>
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<tr>
<td>Constant</td>
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<td>0.021</td>
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<td></td>
<td>(0.014)</td>
<td>(0.018)</td>
<td>(0.036)</td>
<td>(0.037)</td>
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<td>92</td>
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<tr>
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<td>FE</td>
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<td>Within $R^2$</td>
<td>0.057</td>
<td>0.057</td>
<td>0.12</td>
<td>0.11</td>
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Standard errors in parentheses

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