Firms’ Perceived Cost of Capital

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Introduction

Standard definition of cost of capital (CoC):

\[
\text{Firm-level CoC} = \text{expected return on debt and equity} \ (r^{\text{true}})
\]

- Bedrock assumption in macro-finance
- Textbook definition for MBA students
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The perceived cost of capital \( (r^{\text{perc.}}) \) could deviate from \( r^{\text{true}} \)

1. \( r^{\text{true}} \) difficult to estimate (Fama and French 1997)
2. Firms’ may find it optimal to operate with different CoC
   (In general, practice of corporate finance can deviate substantially from theory, Graham 2022)
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This paper

- Measurement of \(r^{\text{perc.}}\).
- \(r^{\text{perc.}}\) deviates fundamentally from \(r^{\text{true}}\)
- Deviations lead to misallocation of capital
Overview

1 Collect data on $r^{perc.}$ from conference calls
   - Unbalanced panel of large firms
   - Included firms cover 40% of assets in Compustat
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   - Time variation in expected returns on debt and equity
   - Some traditional cross-sectional factors
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   - Only 20% of variation can be justified by $r_{\text{true}}$
   - 80% of variation reflects deviations from $r_{\text{true}}$ (“excess dispersion”)
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   - Excess dispersion $\rightarrow$ misallocation $\rightarrow$ TFP loss $\sim 5$
   - Rejection of production-based asset pricing and macro-finance models
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   - Rejection of production-based asset pricing and macro-finance models

5 Discuss potential drivers of excess dispersion
   1. Mistakes in perceptions $\Rightarrow$ we suggest actionable alternatives
   2. Second-best solution to frictions
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 firm-level CoC

Overview of data:
- 3,200 observation of perc. CoC for 1,200 firms in 20 countries
- Representative, except larger firms (more on next slide)
- Firms with perc. CoC account for 40% of assets in developed countries
- 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 paper
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Perceived Cost of Capital Related to Real Outcomes

Standard theory: CoC should influence real decisions
- Higher CoC $\Rightarrow$ higher returns
- Higher CoC $\Rightarrow$ less investment
- Higher CoC $\Rightarrow$ less capital deployed
Perceived Cost of Capital Related to Real Outcomes

Standard theory: CoC should influence real decisions
- Higher CoC ⇒ higher returns
- Higher CoC ⇒ less investment
- Higher CoC ⇒ less capital deployed

We find consistent evidence:

NB: Short-run investment changes not related to shocks to CoC (Gormsen and Huber 2024)
Stylized Drivers of the Perceived Cost of Capital
Time-Variation in the Perceived CoC

US results:

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

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 of green and brown firms
A Recently Incorporated Factor: Green Versus Brown

“Climate Capitalists” (with Simon Oh) studies CoC of 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
Excess Dispersion in the Perceived CoC
Is \( r^{\text{perc.}} = r^{\text{true}} \)?

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

- Recall standard definition: \( r^{\text{true}} = \text{exp. return on debt and equity} \)

- We are interested in two questions

1. Is \( r^{\text{perc.}} = r^{\text{true}} \)?
Is $r_{\text{perc.}} = r_{\text{true}}$?

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- Recall standard definition: $r_{\text{true}} = \text{exp. return on debt and equity}$

- We are interested in two questions
  1. Is $r_{\text{perc.}} = r_{\text{true}}$?
  2. Variance decomposition of $r_{\text{perc.}}$.
Is $r^{\text{perc.}} = r^{\text{true}}$? Methodology

(Example of equity financed firm, so $r_{i,t}^{\text{true}} = E_t[r_i^{\text{equity}}]$)

Estimate

$$E_t[r_i^{\text{equity}}] = \beta_0 + \beta_1 r_{i,t}^{\text{perc.}} + \epsilon_{i,t}. \quad (1)$$

1. If $r_{i,t}^{\text{perc.}} = r_{i,t}^{\text{true}}$ then $\beta = 1$ & $R^2 = 1$
2. If $r_{i,t}^{\text{perc.}}$ is an unbiased estimate of $r_{i,t}^{\text{true}}$ then $\beta = 1$
Is \( r_{i,t}^{\text{perc.}} = r_{i,t}^{\text{true}} \)? Methodology

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\( E_t[r_i^{\text{equity}}] \) unobserved
- Technique relying on realized returns \( r_{i,t}^{\text{realized, equity}} = E_t[r_i^{\text{equity}}] + \varepsilon_{i,t} \)
- Estimate

\[
r_{i,t}^{\text{realized, equity}} = B_0 + B_1 r_{i,t}^{\text{perc.}} + \varepsilon_{i,t}.
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- \( B_1 = \beta_1 \) by definition
Is $r_{i,t}^{\text{perc.}} = r_{i,t}^{\text{true}}$? Methodology

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$E_t[r_i^{\text{equity}}]$ unobserved

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- Estimate

$$r_{i,t}^{\text{realized, equity}} = B_0 + B_1 r_{i,t}^{\text{perc.}} + \varepsilon_{i,t}. \quad (2)$$

- $B_1 = \beta_1$ by definition

Generalize to allow for leverage
Is $r_{\text{perc.}} = r_{\text{true}}$? Results

Estimates of $\beta_1$

- $r_{i,t}^{\text{perc.}}$ is biased estimate of $r_{i,t}^{\text{true}}$.  
- $r_{i,t}^{\text{perc.}} \neq r_{i,t}^{\text{true}}$.  

![Diagram showing all variation and within country-year variation]
Variance Decomposition

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

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

- True dispersion
- Excess dispersion

\[ b_1 = \frac{\% \text{ true dispersion}}{\% \text{ true dispersion}} - 1 \]

We again implement using realized returns
Variance Decomposition

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

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

True dispersion

Excess dispersion

\( \beta_1 \) from previous regression is answer to the variance decomposition

\[ E_t [r_i^{\text{equity}}] = \beta_0 + \beta_1 r_{i,t}^{\text{perc.}} + \epsilon_{i,t}. \] (3)

- \( \beta_1 = \% \) true dispersion
- \( 1 - \beta_1 = \% \) excess dispersion

We again implement using realized returns
Excess Dispersion

Estimate of % excess dispersion \((1 - \beta_1)\)

All variation

Within country-year

Excess dispersion \((1-\beta)\)

No controls
Excess Dispersion

Estimate of % excess dispersion \((1 - \beta_1)\)

- Bias not driven by wrong models alone
- Non-standard terms added by managers matter substantially
Excess Dispersion through Implied Cost of Capital

- Estimate excess dispersion based on the “implied cost of capital”
- Requires $r_{i,t}^{\text{implied}} = r_{i,t}^{\text{true}} + \varepsilon_{i,t+j}$
Excess Dispersion through Implied Cost of Capital

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![Graph showing excess dispersion](image)
Heterogeneity in Excess Dispersion

Excess dispersion similar across firms, with slight variations

- Market value
- Book-to-market
- Dependence on external finance
- Issuance
- Market beta

Excess volatility

Above median
Below median
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

- Excess vol. does not arise because of mismeasurement of tax, \( \omega \), or \( r^\text{debt} \)
- Excess vol. not a product of CME
Capital Misallocation from Excess Dispersion
Excess Dispersion and Misallocation

Perceived cost of capital shapes *long-run* allocation of capital

Standard models: deviations from true CoC lead 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
Excess Dispersion and Misallocation

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<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 between products ($\sigma = 3$)</td>
</tr>
<tr>
<td>High elasticity of substitution between products ($\sigma = 5$)</td>
</tr>
</tbody>
</table>
Potential Drivers of Excess Dispersion
Drivers of Excess Dispersion

1. Excess dispersion from mistakes
   - Mistakes plausible as CoC hard to estimate (Fama and French 1997)
   - Many agents have biased perceptions of expected returns (Greenwood and Shleifer 2014; Nagel and Xu 2022)
   - We produce new methods for estimating CoC without excess dispersion (see also Hommel et al. 2023)

2. Excess dispersion as second-best solution to frictions
   - Signalling, organizational frictions potentially influences optimal choice of CoC
   - Hard to rationalize as deviations from true CoC because deviations lead to misallocation relative to first-best
   - Future work may be able to rationalize excess dispersion
Conclusions

\[ r_{\text{perc.}} \neq r_{\text{true}} \]

Consequences of deviations for economics

- Capital allocated differently than standard models predict
- Should we rethink stylized assumption in macro-finance that \( r_{\text{perc.}} = r_{\text{true}} \)?
- Rejection of production-based asset pricing

Conclusions for corporate finance

- Should we teach CoC differently? (teaching materials on costofcapital.org)
- Future work: can excess dispersion be rationalized?
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 arbitrager

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,

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

$\Rightarrow$ We can recover $\gamma^{\text{true}}$ and $\gamma^{\text{excess}}$ through projection of $r_{i, t+j}^{\text{realized}}$ on $r_{i, t}^{\text{perc.}}$.
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 \( r_{i,t}^{\text{ICC}} = r_{i,t}^{\text{true}} + \text{noise}_{i,t} \)
Cost of Capital Factor

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

<table>
<thead>
<tr>
<th>Coefficient</th>
<th>t-value</th>
<th>p-value</th>
<th>R-squared</th>
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<tbody>
<tr>
<td>Constant</td>
<td>0.41***</td>
<td>0.0067</td>
<td>0.17</td>
</tr>
<tr>
<td>MKT</td>
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<tr>
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Observations: 216

P(intercept = 0.41): 0.026

Standard errors in parentheses, *** p < 0.01
Cost of Capital Factor

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$_{t,t+1}$</th>
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<th>(4)</th>
</tr>
</thead>
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<tr>
<td>Constant</td>
<td>0.41***</td>
<td>0.0067</td>
<td>-0.17</td>
<td>-0.11</td>
</tr>
<tr>
<td></td>
<td>(0.0026)</td>
<td>(0.18)</td>
<td>(0.17)</td>
<td>(0.15)</td>
</tr>
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<td></td>
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<tr>
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<td>0.0067</td>
<td>0.173</td>
<td>0.355</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.000</td>
<td>0.000</td>
<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 (2024))
- Reasonable relation within “traditional” factors
- Little to no relation for other factors
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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<th>(2)</th>
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<th>(4)</th>
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<td>Duke CoC</td>
<td>Duke Discount rates</td>
<td></td>
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<tr>
<td>Predicted perc. CoC</td>
<td>0.74***</td>
<td>0.90***</td>
<td></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>
<td></td>
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<td>(0.38)</td>
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<td>Constant</td>
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<td>(0.037)</td>
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<tr>
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<td>0.057</td>
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<td>0.118</td>
<td>0.136</td>
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<tr>
<td>FE</td>
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<td>Year</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Within $R^2$</td>
<td>0.057</td>
<td>0.057</td>
<td>0.12</td>
<td>0.11</td>
</tr>
</tbody>
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Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1