Corporate Discount Rates

Niels Joachim Gormsen and Kilian Huber

University of Chicago
Stylized view in economics

- Firms’ required returns to investment, known as **discount rates**, determined by cost of capital (COC) in fin. markets
- Fin. prices directly impact investment
Stylized view in economics

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This paper
Introduction

Stylized view in economics

• Firms’ required returns to investment, known as discount rates, determined by cost of capital (COC) in fin. markets
• Fin. prices directly impact investment

This paper

• Measures wedges btw. discount rates and cost of capital
• Implications for relation btw. financial shocks and investment
• Since 2000: Growing wedges account for US “missing investment”
Framework

Textbook approach to investment

1. Firms invest in projects for which \( \text{expected return} > \delta \), where \( \delta \) = discount rate (required return)

2. \( \delta \) should be the “cost of capital” of project (\( r \))
   - No risk: \( r = \) risk-free interest rate
   - With risk: \( r = \) weighted cost of debt and equity (Modigliani and Miller 1958)

Textbook approach leads to a stylized view

- \( r = \delta \)
- Shocks to interest rates and fin. prices have powerful effects on firms
- Dominant view in macro-finance
Framework

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Stylized view: \( r = \delta \)

Challenges to stylized view
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Challenges to stylized view

1. \( r \) unobserved and difficult to estimate (Fama and French 1997):

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r^{\text{perceived}} = r + \nu
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Framework

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1. \( r \) unobserved and difficult to estimate (Fama and French 1997):

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2. Managers may incorporate other factors into \( \delta \) (e.g., risk perceptions, constraints, signaling):

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\delta = r_{\text{perceived}} + \kappa
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Any relation btw. \( \Delta r \) and \( \Delta \delta \)?
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\delta = r_{\text{perceived}} + \kappa
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Any relation btw. \( \Delta r \) and \( \Delta \delta \)?

Implications for stylized view and investment?
Framework

Stylized view: \( r = \delta \)

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1. \( r \) unobserved and difficult to estimate (Fama and French 1997):
   \[ r_{\text{perceived}} = r + \nu \]

2. Managers may incorporate other factors into \( \delta \) (e.g., risk perceptions, constraints, signaling):
   \[ \delta = r_{\text{perceived}} + \kappa \]

Plan today

1. Measurement of \( r_{\text{perceived}} \) and \( \delta \)
2. Facts about \( r_{\text{perceived}}, \delta, \) and \( \kappa \)
3. Implications for investment
4. Determinants of \( \kappa \)
Data from Corporate Conference Calls
Example Nasdaq 100 and S&P 500 firm Intuit, Q1-2014:

”We continued to take a disciplined approach to capital management, investing in opportunities that yield 15%-plus. Our weighted average cost of capital is about 9 or 9.5%. Our IRR hurdle is a 15% rate of return.”
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”We continued to take a disciplined approach to capital management, investing in opportunities that yield 15%-plus. Our weighted average cost of capital is about 9 or 9.5%. Our IRR hurdle is a 15% rate of return.”

- Perceived cost of capital: 9.25%
- Discount rate: 15%
- In practical usage, hurdle = minimum required IRR = discount rate (Jagannathan et al. 2017)
Constructing the Dataset

Approach

• Access all call transcripts on Thomson One for 2002-2021 (Frankel et al. 1999, Hassan et al. 2019)
• Identify paragraphs containing at least 1 of 20 keywords, 74k in total
• Manually enter relevant figures from all paragraphs with RA team
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  - 5-6 undergraduates UChicago
  - Training sessions and weekly meetings
  - Most cases done twice, outliers checked by authors
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High bar on terminology
- Required, realized, or expected returns? ⇒ Collect all three separately
- Unrelated or hypothetical returns? ⇒ Only record explicit managerial statements about investment rules
- Multiple discount rates? ⇒ Record most representative for the firm
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Repeated, high-stakes interactions

Verify: Cost of debt accurate, discount rates predict investment, discount rates predict future returns
Features of the New Dataset

2,500 listed firms, 20 countries
- Many large firms, e.g., AT&T, Exxon, Home Depot, Intel, JPMorgan, Nestle, UnitedHealth
- Representative, except larger firms
- Included firms account for 50% of aggr. investment since 2000
- No evidence that firms experience unusual shocks when included
- Data under costofcapital.org
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Observe firm names, match real outcomes

Allows for dynamic analyses within firms (unbalanced panel 2002-21)
Firms Included in the Sample

Skewed towards large firms
- ~3% unconditional probability of being in sample
- ~50% probability of inclusion for top 100 firms

Characteristics of included firms in cross-sectional percentiles

<table>
<thead>
<tr>
<th></th>
<th>Discount rates</th>
<th>Perceived cost of capital</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mean</td>
<td>min</td>
</tr>
<tr>
<td>Market value</td>
<td>83.1</td>
<td>3.0</td>
</tr>
<tr>
<td>Return on equity</td>
<td>59.8</td>
<td>0.8</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>Physical capital to assets</td>
<td>59.0</td>
<td>2.2</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>
<tr>
<td>Leverage</td>
<td>60.4</td>
<td>1.2</td>
</tr>
</tbody>
</table>

Average percentile relative to all firms in Compustat in same year and country
Little evidence that firms experience shocks when included

<table>
<thead>
<tr>
<th></th>
<th>Discount rate included</th>
<th>Perc. COC included</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Z-score (bankruptcy risk)</strong></td>
<td>0.00081 (0.0018)</td>
<td>0.00047 (0.0015)</td>
</tr>
<tr>
<td><strong>Return on equity</strong></td>
<td>0.00096 (0.0013)</td>
<td>0.0011 (0.0012)</td>
</tr>
<tr>
<td><strong>Book-to-market</strong></td>
<td>0.00046 (0.0018)</td>
<td>0.0013 (0.0014)</td>
</tr>
<tr>
<td><strong>Investment rate</strong></td>
<td>-0.0016 (0.0012)</td>
<td>0.00043 (0.0011)</td>
</tr>
<tr>
<td><strong>Financial constraints</strong></td>
<td>0.0016 (0.0027)</td>
<td>0.0037 (0.0039)</td>
</tr>
<tr>
<td><strong>Leverage</strong></td>
<td>-0.00091 (0.0023)</td>
<td>0.00066 (0.0020)</td>
</tr>
</tbody>
</table>

| **Observations**   | 228,501 | 235,329 | 228,501 | 235,329 |
| **FE**             | Firm/year | Firm/year | Firm/year | Firm/year |
| **Within R²**      | 2.6e-06 | 0.000020 | 9.1e-07 | 0.000036 |

Regressors in percentile ranks relative to all firms in Compustat in same year and country
High discount rates consistent with previous surveys (Poterba and Summers 1995; Graham and Harvey 2001; Jagannathan et al. 2016)

New dataset allows us to test comovement within firms and link to investment
Levels of Discount Rates

Puzzle in literature: high level of reported discount rates

Conference calls provide context
  • Many discount rates do not account for all overhead
  • Discount rates accounting for overhead are lower

<table>
<thead>
<tr>
<th></th>
<th>Discount Rate Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Discount rate (mean of full sample)</td>
<td>15.7</td>
</tr>
<tr>
<td>2</td>
<td>Discount rate (mean of observations accounting for all overhead)</td>
<td>11.4</td>
</tr>
<tr>
<td>3</td>
<td>Return on invested capital (Compustat)</td>
<td>13.5</td>
</tr>
<tr>
<td>4</td>
<td>Total overhead over invested capital (Compustat)</td>
<td>30.7</td>
</tr>
<tr>
<td>5</td>
<td>Perceived cost of capital (mean of full sample)</td>
<td>8.4</td>
</tr>
</tbody>
</table>

Today: focus on within-firm analyses, where levels are largely irrelevant

We control for levels when relevant
COC, Discount Rates, and Time-Varying Wedges
## Time Variation: Financial COC → Perceived COC

<table>
<thead>
<tr>
<th>Sample</th>
<th>(1) U.S. only</th>
<th>(2) Global</th>
</tr>
</thead>
<tbody>
<tr>
<td>Country-level earnings yield, $t$</td>
<td>0.51***</td>
<td>0.58***</td>
</tr>
<tr>
<td></td>
<td>(0.11)</td>
<td>(0.20)</td>
</tr>
<tr>
<td>Long-term interest rate, $t$</td>
<td>0.27***</td>
<td>0.31***</td>
</tr>
<tr>
<td></td>
<td>(0.079)</td>
<td>(0.063)</td>
</tr>
<tr>
<td>Observations</td>
<td>1,543</td>
<td>1,543</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2,625</td>
</tr>
<tr>
<td>FE</td>
<td>None</td>
<td>Firm</td>
</tr>
<tr>
<td>R²</td>
<td>0.050</td>
<td>0.88</td>
</tr>
</tbody>
</table>

- U.S. earnings yield = 1/CAPE
- Outside U.S.: constructed similarly
- Long-term interest rate = rate on long-term government debt
Time Variation: Financial COC → Perceived COC

<table>
<thead>
<tr>
<th>Sample</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Perceived CoC&lt;sub&gt;t&lt;/sub&gt;</td>
<td></td>
<td></td>
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<td>(0.12)</td>
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Cross-Section: Perceived COC and Factors

Leverage

Perceived cost of capital

Low leverage Neutral High leverage

Beta

Perceived cost of capital

Low beta Neutral High beta

Size

Perceived cost of capital

Nano Micro Small Large Mega

Value

Perceived cost of capital

Growth Neutral Value

Consistent with Modigliani and Miller (1958) and Fama and French (1993)
A Recently Incorporated Factor: Green Versus Brown

- Sort firms into green and brown using MSCI data
- Green firms perceive significantly lower CoC since 2015
- Holds conditional on Fama-French factors
“Mistakes” in the Perceived Cost of Capital

Perceived cost of capital ≠ discount rates in financial markets:
- “Excess volatility:” 70% of variation in perc. CoC not justified by future returns
- “Missing volatility:” 75% of variation in “objective” factor premia not in perc. CoC

Additional results in Gormsen and Huber (2023)
- Implications for production-based asset pricing
- Rejection of Investment CAPM by Hou et al. (2015)
Perceived COC $\rightarrow$ Discount Rates
Perceived COC $\rightarrow$ Discount Rates

Estimated slope: 0.37 (0.11)
\[ p(\text{slope}=0): 0.001 \]
\[ p(\text{slope}=1): 0.000 \]

COC $\downarrow$ by 1 ppt. $\rightarrow$ discount rate $\downarrow$ by 0.3 ppt (with firm and year FE)
Perceived COC → Discount Rate
### Perceived COC → Discount Rate

<table>
<thead>
<tr>
<th></th>
<th>Discount Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived COC</td>
<td>0.43*** 0.37***</td>
</tr>
<tr>
<td></td>
<td>(0.12) (0.11)</td>
</tr>
<tr>
<td>Perceived COC (predicted)</td>
<td>0.36** 0.26*</td>
</tr>
<tr>
<td></td>
<td>(0.16) (0.14)</td>
</tr>
<tr>
<td>Observations</td>
<td>257 257 1,820 1,820</td>
</tr>
<tr>
<td>FE</td>
<td>Firm Firm/Year Firm Firm/Year</td>
</tr>
<tr>
<td>P(slope = 1)</td>
<td>3.1e-06 6.1e-08 0.000084 3.0e-07</td>
</tr>
<tr>
<td>Within R²</td>
<td>0.37 0.20 0.03 0.0065</td>
</tr>
</tbody>
</table>

- Lasso: predict perceived COC in 1st stage, mitigates attenuation bias
- Reject stylized coefficient of 1 (and 0)
- Partial incorporation of perceived COC into discount rates
Unchanged Discount Rates

Fraction of firms with unchanged cost of capital and discount rates over time

Years after first observation

Share with unchanged discount rate
Share with unchanged perceived cost of capital
Examples of Firm Behavior

Attention to COC
Premier, CFO, Q1-2017: “We obviously, with changing markets, always reassess what our weighted average cost of capital is and whether that return hurdle needs to change.”

Partial incorporation
Spectra Energy, CFO, Q3-2014: “We didn’t lower our hurdle rates all the way down with long-term rates. We are still looking at returns of, say 10%, on average for our projects.”

No change
Ball Corporation, CFO, Q3-2015: “The discount rate has been 9% for a long time. In fact, our weighted average cost of capital is less than 6% now, so people have said: why don’t you lower the hurdle rate?”
Within-Firm, Average Discount Rate Wedge in the US

Large magnitudes: QE1 reduced corp. bond yields by 0-0.5 ppt (Krishnamurthy and Vissing-Jørgensen 2011). Natural real rate down by 1 ppt since 2002 (Bauer and Rudebusch 2020).

Post-2010 increase driven by falling COC
Discount Rates and Investment
Measured Discount Rates Predict Aggregate US Investment

[Graph showing the relationship between net investment rate and discount rate from 2002 to 2018.]
### Discount Rate → Investment

<table>
<thead>
<tr>
<th></th>
<th>Estimate 1</th>
<th>Estimate 2</th>
<th>Estimate 3</th>
<th>Estimate 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net investment rate</td>
<td>-0.93***</td>
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<td>-0.79***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.28)</td>
<td>(0.27)</td>
<td>(0.30)</td>
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<tr>
<td>Discount rate wedge</td>
<td>-0.91***</td>
<td></td>
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<td></td>
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<td>-0.70</td>
<td>1.48</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.02)</td>
<td>(1.56)</td>
<td></td>
<td></td>
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<tr>
<td>Financial COC (firm level)</td>
<td>-0.70</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>(1.01)</td>
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<td></td>
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<tr>
<td>Tobin's Q</td>
<td>0.26*</td>
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<td>(0.11)</td>
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<tr>
<td>Observations</td>
<td>1,381</td>
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<td>1,237</td>
</tr>
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**FE Firm Firm/year Firm/year Firm/year**

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<tr>
<th></th>
<th>R²</th>
</tr>
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<tbody>
<tr>
<td>Within R2</td>
<td>0.036</td>
</tr>
<tr>
<td></td>
<td>0.035</td>
</tr>
<tr>
<td></td>
<td>0.035</td>
</tr>
<tr>
<td></td>
<td>0.024</td>
</tr>
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**Standard Q-model (Philippon 2009)** slope = -1

Measured discount rates capture component of investment demand.
## Discount Rate → Investment

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</tr>
<tr>
<td></td>
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</tr>
<tr>
<td>Within $R^2$</td>
<td>0.036</td>
</tr>
<tr>
<td></td>
<td>0.035</td>
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<td></td>
<td>0.035</td>
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Standard Q-model (Philippon 2009) slope = -1

Measured discount rates capture component of investment demand
Heterogeneity in Investment Regressions

- Slope in investment regressions robust across subsamples
- Results do not appear driven by constrained or otherwise special firms
“Missing Investment”
“Missing Investment”

Low US investment puzzling in light of stylized view and Q-theory

- Stock/bond prices up, int. rates down → financial COC down → Tobin’s Q up
- Theory: investment should rise until Tobin’s Q = 1
“Missing Investment”

Low US investment puzzling in light of stylized view and Q-theory

- Stock/bond prices up, int. rates down $\rightarrow$ financial COC down $\rightarrow$ Tobin’s Q up
- Theory: investment should rise until Tobin’s Q = 1
- Reality: low investment, even incl. intangibles (Crouzet et al. 2022)
Adjusted Q

Modifying Q to allow for discount rate wedges
Adjusted Q

Modifying Q to allow for discount rate wedges

\[
\text{Firms} \quad \max_{I_t} \quad \sum_{t=0}^{\infty} \frac{\Pi_t(k_t) - I_t - \Phi(I_t, k_t, \xi)}{(1 + r_{\text{fin.}} + \nu + \kappa)^t},
\]

s.t. \quad k_{t+1} = I_t + (1 - \xi)k_t,

• \( r_{\text{fin.}} + \nu + \kappa = \) discount rate

• Tobin’s Q and stylized view: \( \nu + \kappa = 0 \), i.e., firms calculate \( r_{\text{fin.}} \) perfectly and set \( \delta = r_{\text{fin.}} \).

• \( I_t = \) capital investment at time \( t \)

• \( \Pi_t(k_t) = \) profits earned at \( t \)

• \( \Phi(I_t, k_t, \xi) = \) adjustment costs (quadratic in net inv.)

• Profit and cost functions homogeneous of degree one
Optimal Investment

\[
\frac{I_t}{k_t} - \xi \approx \left[ Q_t^{Adjusted} - 1 \right] \times \frac{1}{\phi}
\]

Adjusted Q uses observed discount rates

\[
Q_t^{Adjusted} = Q_t^{Tobin} \times \frac{1}{(\psi + \kappa) \times \text{Dur} + 1}
\]

Intuition:
- Wedges imply that firms and fin. markets use different discount rates
- The further away cash flows (high Dur), the more important wedges
Measuring Adjusted Q

- We measure adjusted Q using new data
- Focus on $\kappa$—wedges actively chosen by firms
Measuring Adjusted Q

- We measure adjusted Q using new data
- Focus on $\kappa$—wedges actively chosen by firms
- Recall: large time variation in avg. $\kappa$
Measuring Adjusted Q

- Adjusted Q more consistent with level and dynamics of investment
- Wedges large enough to account for low investment without relying on mismeasurement or low marginal returns
Adjusted Q Accounts for Low Investment

Method of Gutiérrez and Philippon (2017)

- Estimate relation btw. Tobin’s Q and aggr. investment for 1990-2002
- Predict investment for 2002-2019
- Deviation from prediction is “missing investment,” > 20% of capital
Firm-Level Changes in Tobins’ Q and Wedges

Firms that increased their wedges have disproportionately contributed to the rise in aggregate Tobin’s Q

<table>
<thead>
<tr>
<th>Tobin’s Q</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Discount rate wedge κ</td>
<td>0.20***</td>
</tr>
<tr>
<td></td>
<td>(0.078)</td>
</tr>
<tr>
<td>Discount rate and COC wedge κ+υ</td>
<td>0.17***</td>
</tr>
<tr>
<td></td>
<td>(0.058)</td>
</tr>
<tr>
<td>Observations</td>
<td>685</td>
</tr>
<tr>
<td>FE</td>
<td>Firm</td>
</tr>
<tr>
<td>Within R²</td>
<td>0.015</td>
</tr>
<tr>
<td></td>
<td>0.012</td>
</tr>
</tbody>
</table>
General lesson: wedges decouple investment from fin. prices
Investment and the Financial COC

General lesson: wedges decouple investment from fin. prices

In a standard Q-model (Philippon 2009), a 1 ppt. shock to financial COC changes investment rate by:

- 2 with zero discount rate wedge
- 0.2 with observed average wedge
- Not 0!
Investment and the Financial COC

General lesson: wedges decouple investment from fin. prices

In a standard Q-model (Philippon 2009), a 1 ppt. shock to financial COC changes investment rate by:

- 2 with zero discount rate wedge
- 0.2 with observed average wedge
- Not 0!

Channels: (1) partial transmission, (2) wedges shorten cash flow duration

Relevant for calibration of investment models and for understanding real impact of fin. shocks
Drivers of Discount Rate Wedges
Theories

Take first steps toward understanding drivers

1) Risk and real options
• When investment is irreversible and risky, investment is postponed (Abel and Eberly 1996, McDonald 2000, Bloom 2009)
• High wedges approximate optimal timing

2) Constraints
• Firms cannot take on all projects due to financial, organizational, or managerial constraints (Jagannathan et al. 2016)

3) Market power
• Market power makes it less costly to maintain wedges
• Potential benefits of higher wedge
• Signals prudence (Jensen 1986)
• Buffers against MPK
Theories

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     • Buffers against MPK < COC
     • 59% of managers believe that wedges add value
Drivers of Discount Rate Wedge $\kappa$

Theories based on

Measure

Cross-sectional $b$

Accounts for time var.
Drivers of Discount Rate Wedge $\kappa$

Theories based on

Mkt. power

Measure

Cross-sectional $b$

Accounts for time var.
Drivers of Discount Rate Wedge $\kappa$

<table>
<thead>
<tr>
<th>Measure</th>
<th>Cross-sectional $b$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accounts for time var.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Theories based on</th>
<th>Mkt. power</th>
<th>Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$0.9^{**}$</td>
<td>$1.2^{**}$</td>
</tr>
</tbody>
</table>

Cross-sectional regression with standardized regressors:

$$\kappa_i(t) = a + b_1 \text{Mkt. power}_{i,2002} + b_2 \text{Risk}_{i,2002} + b_3 \text{Cons.}_{i,2002} + \text{year}_t + \text{country}_i + \varepsilon_{i,t}$$
Drivers of Discount Rate Wedge $\kappa$

<table>
<thead>
<tr>
<th>Theories based on</th>
<th>Mkt. power</th>
<th>Risk</th>
<th>Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cross-sectional $b$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accounts for time var.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Drivers of Discount Rate Wedge $\kappa$

<table>
<thead>
<tr>
<th>Measure</th>
<th>Theories based on</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mkt. power</td>
</tr>
<tr>
<td></td>
<td>Acct. markup</td>
</tr>
</tbody>
</table>

Cross-sectional $b$

Accounts for time var.

Cross-sectional regression with standardized regressors:

$$\kappa_t^i = a + b_1 \text{Mkt. power}_{2002}^i + b_2 \text{Risk}_{2002}^i + b_3 \text{Cons.}_{2002}^i + \text{year}_t + \text{country}_i + \epsilon_t^i$$
### Drivers of Discount Rate Wedge $\kappa$

<table>
<thead>
<tr>
<th>Measure</th>
<th>Theories based on</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mkt. power</td>
</tr>
<tr>
<td>Cross-sectional $b$</td>
<td>Acct. markup 0.9**</td>
</tr>
</tbody>
</table>

Accounts for time var.

Cross-sectional regression with standardized regressors:

$$\kappa^i_t = a + b_1 \text{Mkt. power}^{i2002} + b_2 \text{Risk}^{i2002} + b_3 \text{Cons.}^{i2002} + \text{year}_t + \text{country}^i + \epsilon^i_t$$
## Drivers of Discount Rate Wedge $\kappa$

<table>
<thead>
<tr>
<th>Measure</th>
<th>Mkt. power</th>
<th>Risk</th>
<th>Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cross-sectional $b$</td>
<td>Acct. markup</td>
<td>Stock volatility</td>
<td>Fin. cons.</td>
</tr>
<tr>
<td></td>
<td>0.9**</td>
<td>1.2**</td>
<td>0.7*</td>
</tr>
</tbody>
</table>

Accounts for time var.
### Drivers of Discount Rate Wedge $\kappa$

<table>
<thead>
<tr>
<th>Measure</th>
<th>Theories based on</th>
<th>Mkt. power</th>
<th>Risk</th>
<th>Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acct. markup</td>
<td></td>
<td></td>
<td>Stock volatility</td>
<td>Fin. cons.</td>
</tr>
<tr>
<td>Cross-sectional $b$</td>
<td>0.9**</td>
<td>1.2**</td>
<td>0.7*</td>
<td></td>
</tr>
<tr>
<td>Accounts for time var.</td>
<td>Yes, secular trend</td>
<td>Yes, short-run fluctuations</td>
<td>Weakly</td>
<td></td>
</tr>
</tbody>
</table>
Average markup in 2000-02, measured using accounting approach (Baqee and Farhi 2020), robust to De Loecker et al. (2020) and user-cost approaches
## Competition and the Secular Decline in Cost of Capital

<table>
<thead>
<tr>
<th></th>
<th>Discount rate ($\delta$)</th>
<th>Disc. rate wedge ($\kappa$)</th>
<th>Both wedges ($\kappa + \upsilon$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mkt. P. (2002)*</td>
<td>0.13**</td>
<td>0.12**</td>
<td>0.12**</td>
</tr>
<tr>
<td>Year</td>
<td>(0.069)</td>
<td>(0.062)</td>
<td>(0.063)</td>
</tr>
<tr>
<td>Mkt. P. (2002)*</td>
<td></td>
<td>-0.45**</td>
<td>-0.37**</td>
</tr>
<tr>
<td>Avg. perc. COC</td>
<td></td>
<td>(0.19)</td>
<td>(0.17)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.16)</td>
</tr>
<tr>
<td>Observations</td>
<td>949</td>
<td>949</td>
<td>949</td>
</tr>
<tr>
<td>FE</td>
<td>Firm</td>
<td>Firm</td>
<td>Firm</td>
</tr>
<tr>
<td>Within $R^2$</td>
<td>0.12</td>
<td>0.045</td>
<td>0.053</td>
</tr>
</tbody>
</table>

Std. dev. increase in market power has raised discount rates by 2.5 ppt between 2002 and 2021.

Competition determines to what extent firms follow stylized view.
Conclusion

1. New panel dataset of perceived COC, discount rates, and investment

2. New facts on dynamics
   - Financial COC $\Rightarrow$ perceived COC $\approx 0.7$
   - Perceived COC $\Rightarrow$ discount rate $\approx 0.3$
   - Discount rate wedge has increased by 2.5 pp. since 2002

3. Discount rates and investment:
   - Discount rates predict investment
   - Increase in discount rate wedges accounts for recent “missing investment”

4. Drivers
   - Market power limits transmission of COC into discount rates
   - Risk important for short-run fluctuations


## Disciplined, value-focused capital allocation

<table>
<thead>
<tr>
<th>$ billion</th>
<th>Cash Capex</th>
<th>Cash Capex after power dilutions</th>
<th>FCF</th>
<th>IRR hurdle rates</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2022</td>
<td>2023</td>
<td>24-25</td>
<td>24-25</td>
</tr>
<tr>
<td>IG</td>
<td>4</td>
<td>~5</td>
<td>~5</td>
<td>~5</td>
</tr>
<tr>
<td>UP</td>
<td>8</td>
<td>~8</td>
<td>~8</td>
<td>~8</td>
</tr>
<tr>
<td>IGU</td>
<td>12</td>
<td>~13</td>
<td>~13</td>
<td>~13</td>
</tr>
<tr>
<td>MKT</td>
<td>5</td>
<td>~6^</td>
<td>~3</td>
<td>~3</td>
</tr>
<tr>
<td>C&amp;P</td>
<td>4</td>
<td>3-4</td>
<td>3-4</td>
<td>3-4</td>
</tr>
<tr>
<td>R&amp;ES</td>
<td>3</td>
<td>2-4</td>
<td>4-5</td>
<td>(1-2)</td>
</tr>
<tr>
<td>DSR</td>
<td>12</td>
<td>11-14</td>
<td>10-12</td>
<td>9-10</td>
</tr>
<tr>
<td>Total</td>
<td>25</td>
<td>23-27</td>
<td>22-25</td>
<td>21-23</td>
</tr>
</tbody>
</table>

^1 For price assumptions see appendix  ^2 includes acquisition of Nature Energy (nearly $2 billion)

Capital Markets Day 2023 | June 14
## Realized Returns

<table>
<thead>
<tr>
<th></th>
<th>(1) Realized IRR (same quarter)</th>
<th>(2) Future realized IRR</th>
<th>(3) Future realized IRR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discount rate</td>
<td>0.91***</td>
<td>0.74***</td>
<td>0.79**</td>
</tr>
<tr>
<td></td>
<td>(0.14)</td>
<td>(0.096)</td>
<td>(0.38)</td>
</tr>
<tr>
<td>Observations</td>
<td>122</td>
<td>276</td>
<td>276</td>
</tr>
<tr>
<td>FE</td>
<td>None</td>
<td>None</td>
<td>Firm</td>
</tr>
<tr>
<td>R²</td>
<td>0.30</td>
<td>0.22</td>
<td>0.94</td>
</tr>
</tbody>
</table>

- Compares realized returns (from calls) to hurdle rates
- Realized returns higher for firms with higher hurdles
- Holds within firm
Market Power and Discount Rates

Two-period model

$$V_1(\nu + \kappa, k) = \max_k k^{1-\theta} - k(r_{\text{fin.}} + \nu + \kappa).$$

Cost of higher wedge

- Positive wedge lowers firm value: $$\frac{\partial V_1(\nu + \kappa, k^*)}{\partial (\nu + \kappa)} < 0,$$ but by less for firm with more market power $$\theta$$: $$\frac{\partial^2 V_1(\nu + \kappa, k^*)}{\partial (\nu + \kappa) \partial \theta} > 0$$
- Intuition: higher wedge has an offsetting, positive effect on revenue (through price) for firm with more market power
- Firm with more market power maintains wedge at lower cost

Benefits of higher wedge

- Signal prudence (Jensen 1986)
- Buffer against MPK $<$ COC
- 59% of managers believe that wedges add value