Firms' Perceived Cost of Capital

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Overview

Data

Measure firms' discount rates (δ) and perceived cost of capital from conference calls

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$$\delta = r^{\text{perc.}}$$

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$$r^{\text{perc.}} = r^{\text{true}} + \upsilon$$

Papers on discount rates

1. Corporate Discount Rates
   $\rightarrow$ Introduces data, studies κ, shows κ accounts for "missing investment"
2. Sticky Discount Rates (with Masao Fukui)
   $\rightarrow$ DSGE model and monetary non-neutrality

Papers on the perceived cost of capital

1. Firms' Perceived Cost of Capital
2. Climate Capitalists (with Simon Oh)

See `costofcapital.org`

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   - time variation in expected returns on debt and equity
   - some traditional cross-sectional factors

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   - Mistakes $\rightarrow$ misallocation $\rightarrow$ TFP loss $\sim 10\%$
   - Allocation closer to optimal if all firms had same perceived coc

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4 Mistakes challenge standard theory
  - Challenges premise of production-based theory
  - Rejection of Investment-CAPM

Data and Framework

Data from Corporate Conference Calls

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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%."*

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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"

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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

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Overview of data

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)

Summary Statistics and Representativeness

Summary statistics

	N	mean	p5	p95
Perceived cost of capital	3,139	8.67	5.30	13.0
Perceived cost of debt	5,165	4.66	1.70	8.90
Perceived cost of equity	485	10.3	5.00	15.0
Discount rate	3,286	15.4	8.00	25.0

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Characteristics (cross-sectional percentiles) of included firms:

	Discount rates			Cost of capital		
	mean	min	max	mean	min	max
Return on equity	59.8	0.8	100.0	58.3	0.2	100.0
Market value	83.1	3.0	100.0	79.4	8.5	100.0
Book-to-market	49.4	0.2	100.0	47.3	0.2	100.0
Investment rate	53.6	0.3	100.0	54.0	1.4	100.0
Z-score (bankruptcy risk)	47.6	0.8	99.0	48.8	2.3	99.0
Financial constraints	20.5	0.0	100.0	23.0	0.0	90.7

- Included firms are larger, less constrained, and slightly more profitable than average
- Gormsen and Huber (2023): Extensive analysis on representativeness
- Gormsen and Huber (2023): Within-firm timing of inclusion not predictable

Within-Firm Timing

What is the True Cost of Capital?

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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:

$$r_{i,t}^{\text{true}} = \omega_t \times (1 - \text{tax}) \times \text{Cost of debt}_t + (1 - \omega_t) \times \text{Cost of equity}_t$$
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Definition of r^{true} generally not depend on market efficiency
- Requires only that law of one price holds (details)

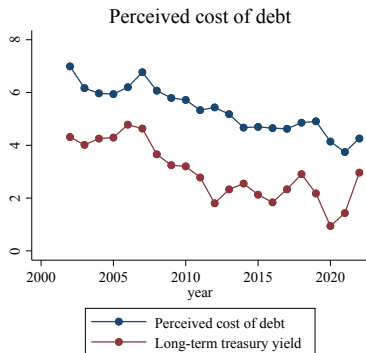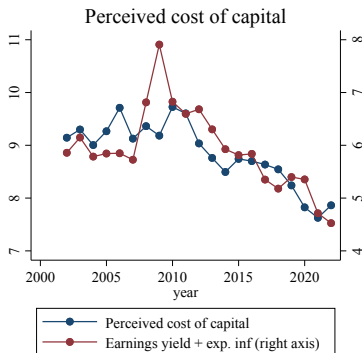# Stylized Drivers of the Perceived Cost of Capital

Time-Variation in Perceived CoC

US results:

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

Perceived cost of capital

Perceived cost of debt

Legend (left panel):
- Perceived cost of capital
- Earnings yield + exp. inf (right axis)

Legend (right panel):
- Perceived cost of debt
- Long-term treasury yield

Similar results in global sample

Cross-Sectional Variation and Classic Factors
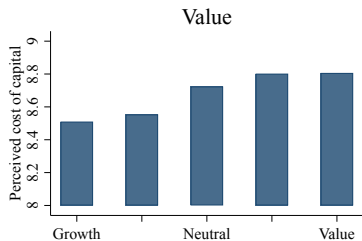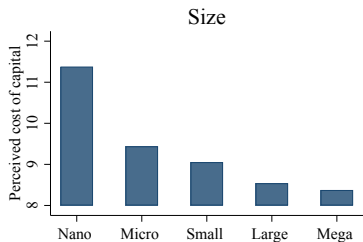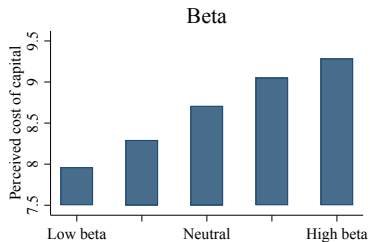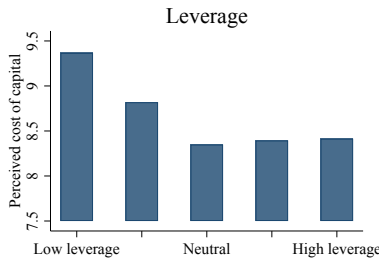
Consistent with Modigliani and Miller (1958) and Fama and French (1993)

A Multivariate Model of the Perceived Cost of Capital

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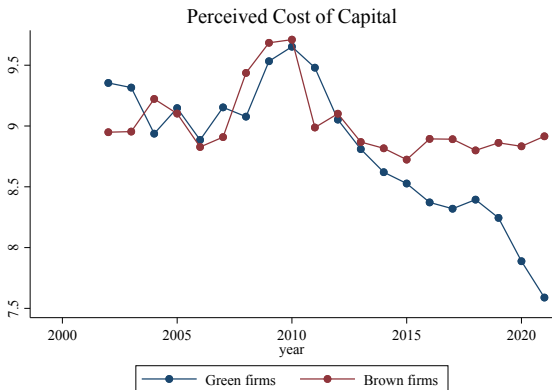- Slope coefficients for the 11 characteristics (measured in percentiles from 0 to 1):
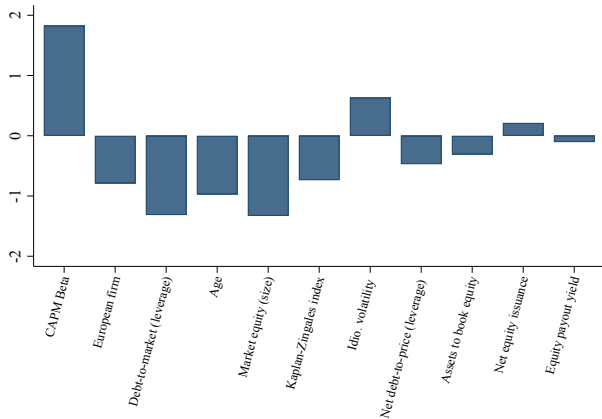
A Recently Incorporated Factor: Green Versus Brown

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Perceived Cost of Capital

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

Excess Volatility in the Perceived CoC

Excess Volatility

$$r^{\text{perc.}} = r^{\text{true}} + \upsilon$$

How much of the variation in $r^{\text{perc.}}$ comes from r^{true} and υ?

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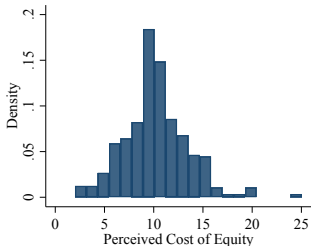How much of the variation in $r^{\text{perc.}}$ comes from r^{true} and υ?

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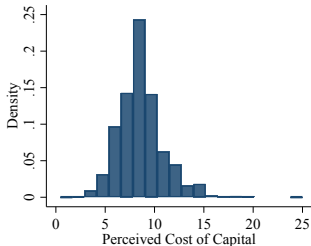
- The 10-90 spread in the perc. cost of equity is 8%
- Very rare to find stocks with 8% difference in long-run expected returns
  $\rightarrow r^{\text{perc.}}$ likely to be driven, at least in part, by errors (υ)

Variance Decomposition

$$r^{\text{perc.}} = r^{\text{true}} + \upsilon$$

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Standard variance decomposition:

$$\text{var}\left(r_{i,t}^{\text{perc.}}\right) = \underbrace{\text{cov}\left(r_{i,t}^{\text{perc.}}, r_{i,t}^{\text{true}}\right)}_{\text{true variation}} + \underbrace{\text{cov}\left(r_{i,t}^{\text{perc.}}, \upsilon_{i,t}\right)}_{\text{excess variation}}.$$

So,

$$1 = \underbrace{\frac{\text{cov}\left(r_{i,t}^{\text{true}}, r_{i,t}^{\text{perc.}}\right)}{\text{var}\left(r_{i,t}^{\text{perc.}}\right)}}_{\gamma^{\text{true}}} + \underbrace{\frac{\text{cov}\left(\upsilon_{i,t}, r_{i,t}^{\text{perc.}}\right)}{\text{var}\left(r_{i,t}^{\text{perc.}}\right)}}_{\gamma^{\text{excess}}}$$

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We need proxy for $r_{i,t}^{\text{true}}$:
- 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

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Proxy for true cost of equity based on *ex-post* realized returns (details):
1. Calculate $r_{i,t+j}^{\text{realized}}$ by replacing CoE with realized stock returns
2. $r_{i,t+j}^{\text{realized}}$ is $r_{i,t}^{\text{true}}$ + an unexpected residual
3. Project $r_{i,t+j}^{\text{realized}}$ onto $r_{i,t}^{\text{perc.}}$ to obtain γ^{true} (and γ^{excess})

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

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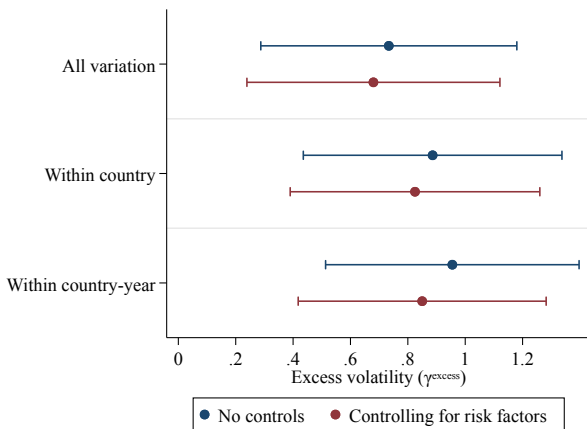
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Excess volatility (γ^{excess})

- No controls
- Controlling for risk factors
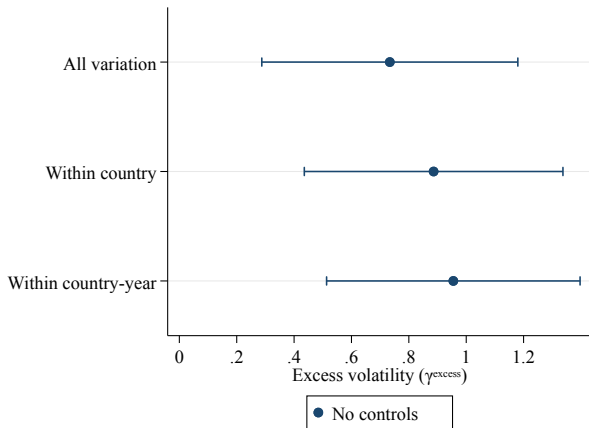
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Estimate true cost of equity based on the "implied cost of capital" (details)
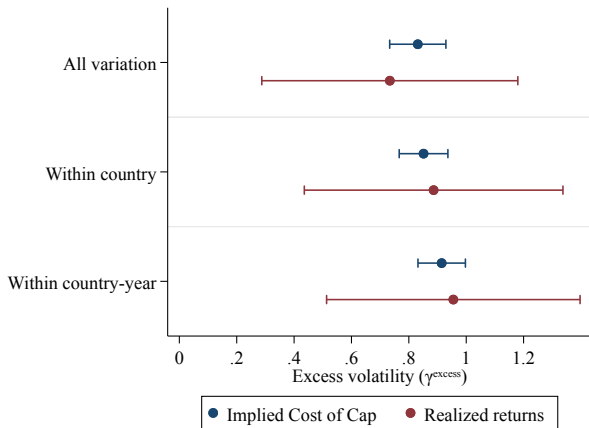
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Excess volatility (γ^{excess})

● Implied Cost of Cap   ● Realized returns

Excess Volatility in Perceptions about Equity, not Debt

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

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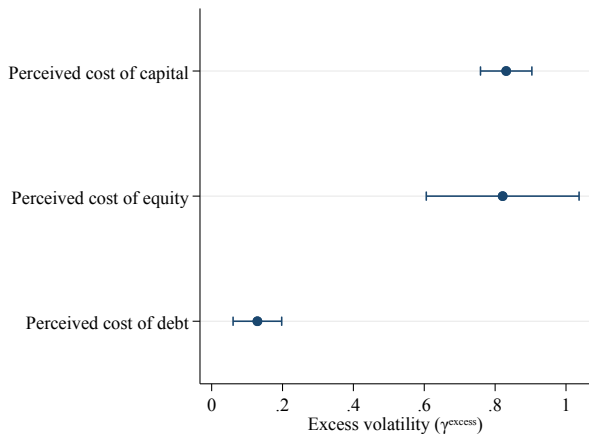
Cost of equity based on implied cost of capital and cost of debt based on accounting data

Measurement Error Cannot Explain Excess Volatility

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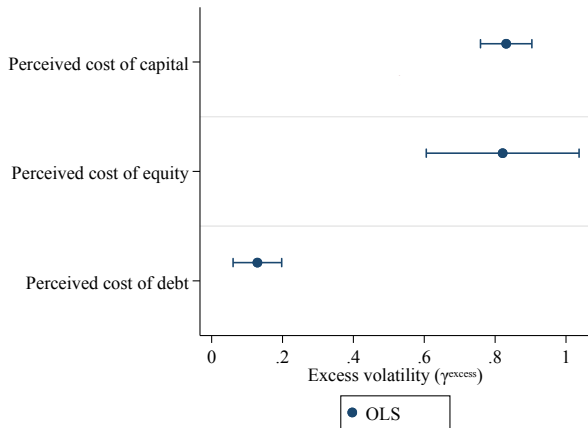
- Excess vol. does not arises because of mismeasurement of tax, ω, or r^{debt}
- Excess vol. not a product of CME

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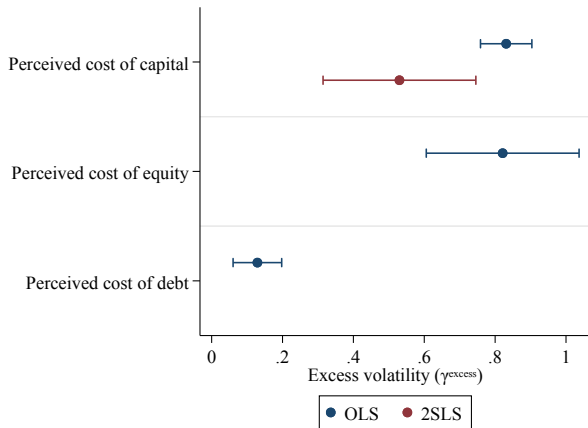
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Capital Misallocation from Excess Volatility

Excess Volatility and Misallocation

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

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

- In this model, excess volatility maps directly to TFP loss
- Estimated TFP loss around 10%

We next discuss what happens if perceived cost of capital $\neq$ discount rates

Model

Three layers of production:

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

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

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

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

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 τ_{si} independent of r_{si}^{true} and sector

Solution: Misallocation from Excess Volatility

Solution

- TFP loss from misallocation:

$$\log\left(\text{TFP}\right) - \log\left(\text{TFP}^{\tau=0}\right) =$$

- $\log\left(\text{TFP}^{\tau=0}\right)$ is TFP if $\tau_i = 0 \forall i$

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Results

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	Percentage change in TFP
All excess volatility	-15.3%
Excess cross-sectional volatility	-13.7%
Excess volatility implied by realized returns	-13.5%
Low elasticity of substitution ($\sigma = 3$)	-9.8%

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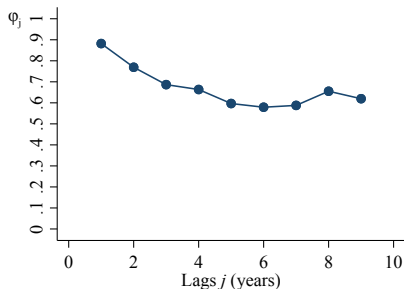- TFP loss with sticky discount rates around 7%

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Incorporating all volatility from discount rate wedges (κ) substantially increases TFP loss

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- Innocent assumption in many settings
- But crucial in others...

One example: Production-Based Asset Pricing (PBAP)

- PBAP buils 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

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- 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

Testing the Investment CAPM
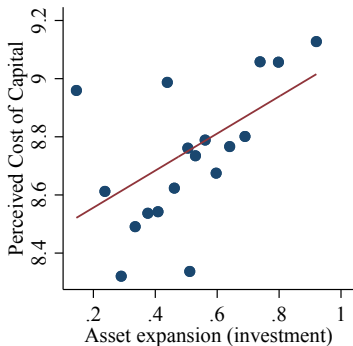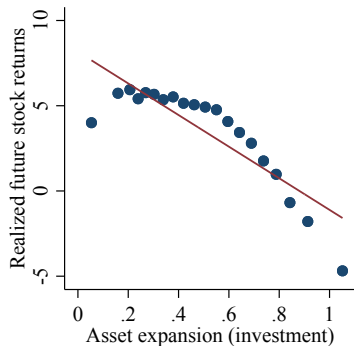
- Perc. CoC is higher (not lower) for high investment

- High investment of high-investment firms not driven by low perceived cost of capital

Testing the Investment CAPM

| | All firm/quarters | | | Firm/quarters with observed perceived cost of capital | | | | | |
	Realized stock returns			Realized stock returns			Perceived cost of capital		
Asset expansion (investment)	-1.43** (0.61)								
Controls: Profits bins Beta bins Size bins									
Observations	739,481	723,243	722,926	1,352	1,334	1,334	2,000	1,960	1,960
R-squared	0.118	0.158	0.183	0.215	0.230	0.264	0.187	0.217	0.345

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Testing the Investment CAPM

	All firm/quarters			Firm/quarters with observed perceived cost of capital					
	Realized stock returns			Realized stock returns			Perceived cost of capital		
Asset expansion	-1.43**	-6.58***	-4.61***						
(investment)	(0.61)	(1.35)	(1.19)						
Controls:									
Profits bins		X	X						
Beta bins			X						
Size bins			X						
Observations	739,481	723,243	722,926	1,352	1,334	1,334	2,000	1,960	1,960
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Testing the Investment CAPM

	All firm/quarters			Firm/quarters with observed perceived cost of capital					
	Realized stock returns			Realized stock returns			Perceived cost of capital		
Asset expansion	-1.43**	-6.58***	-4.61***	-3.01	-4.60*	-4.40*			
(investment)	(0.61)	(1.35)	(1.19)	(2.28)	(2.45)	(2.20)			
Controls:									
Profits bins		X	X		X	X			
Beta bins			X			X			
Size bins			X			X			
Observations	739,481	723,243	722,926	1,352	1,334	1,334	2,000	1,960	1,960
R-squared	0.118	0.158	0.183	0.215	0.230	0.264	0.187	0.217	0.345

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Testing the Investment CAPM

| | All firm/quarters | | | Firm/quarters with observed perceived cost of capital | | | | | |
	Realized stock returns			Realized stock returns			Perceived cost of capital		
Asset expansion	-1.43**	-6.58***	-4.61***	-3.01	-4.60*	-4.40*	0.40	0.57**	0.63***
(investment)	(0.61)	(1.35)	(1.19)	(2.28)	(2.45)	(2.20)	(0.24)	(0.25)	(0.23)
Controls:									
Profits bins		X	X		X	X		X	X
Beta bins			X			X			X
Size bins			X			X			X
Observations	739,481	723,243	722,926	1,352	1,334	1,334	2,000	1,960	1,960
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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 mistakes

Large economic consequences of mistakes in perc. CoC
- Mistakes → 10% 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!

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Market Efficiency and True Cost of Capital

r^{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):

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

- 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 volatility

1. Excess Volatility 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 γ^{true} and γ^{excess} through projection of $r_{i,t+j}^{\text{realized}}$ on $r_{i,t}^{\text{perc.}}$

2. Excess Volatility 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

$$R_{i,t+j}^{\text{realized}} = \alpha + 0.t_{i,t}^{\text{ICC}} + \varepsilon_{i,t+j}$$

- I.e., excess volatility in the ICC
- We can extract γ^{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 μ?
- Alternative approach: factor regression

Cost of Capital Factor

1. Does the perceived CoC include variation that is not in μ?

- 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

	(1)	(2)	(3)	(4)
	Perceived. CoC_t	Realized return$_{t,t+1}$		
Constant	0.41***	0.0067	-0.17	-0.11
	(0.0026)	(0.18)	(0.17)	(0.15)
$MKT_{t,t+1}$			0.25***	0.16***
			(0.037)	(0.036)
$SMB_{t,t+1}$				0.27***
				(0.066)
$HML_{t,t+1}$				0.26***
				(0.049)
Observations	216	216	216	216
P(intercept = 0.41)		0.026		
R-squared	0.000	0.000	0.173	0.355

Standard errors in parentheses, *** $p<0.01$

Which Factors Are Reflected in Per. Coc?
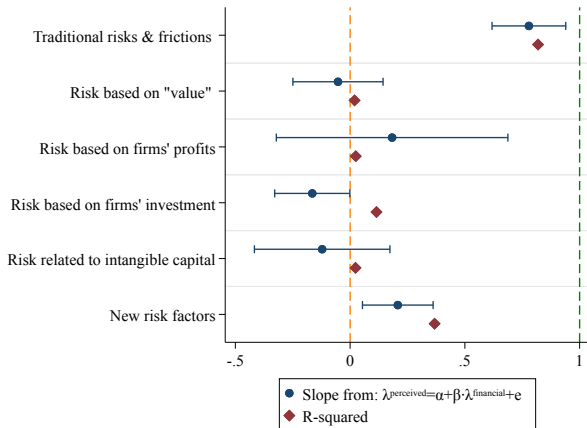
- Estimate relation between $\lambda^{implied}$ and λ^{true} for different groups (Cho and Polk (2019))
- Reasonable relation within "traditional" factors
- Little to no relation for other factors

"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)

	(1)	(2)	(3)
	Firm required return		
Asset expansion	0.012	0.029***	0.012
(investment)	(0.010)	(0.011)	(0.0089)
Controls:			
Profits bins		X	X
Beta bins			X
Size bins			X
Observations	1,896	1,816	1,816
R-squared	0.130	0.198	0.286
FE	Country/date	Country/date	Country/date
Cluster	Firm/date	Firm/date	Firm/date

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)