Investment-based Costs of Equity

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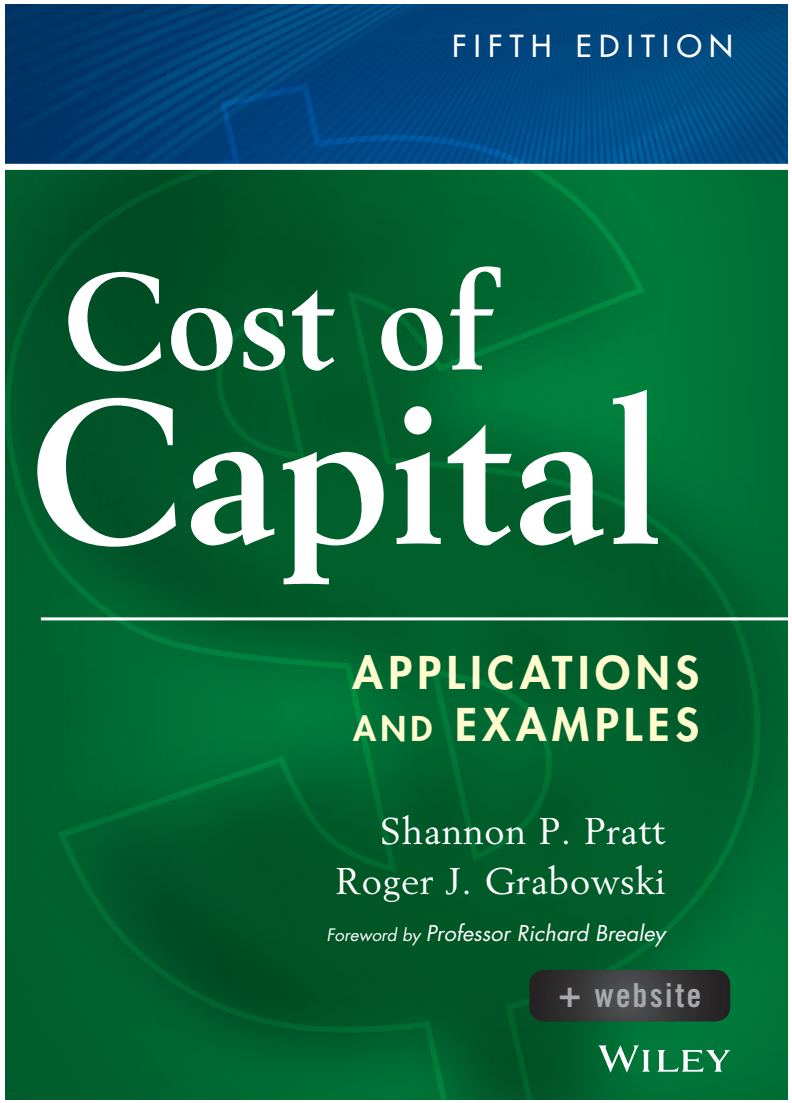


One of the most essential problems in finance

Most applications depend on a cost of equity estimate

Investment management, business valuation, capital budgeting, etc

Trillions of dollars involved

Still a largely open question:

- The imprecision problem (Fama and French 1997)
- The weak association problem for accounting-based implied costs of equity (Easton and Monahan 2005)

The q^5-characteristics model estimates costs of equity as out-of-sample forecasts from cross-sectional predictive regressions

Out-of-sample forecasts combine slopes from prior 120-month rolling windows with the latest available q^5 characteristics

Theme

Evaluation tests establish the q^5-characteristics model as competitive

In portfolio sorts, the q^5-based cost of equity (QCE) strongly associated with future returns (the high-minus-low deciles)

h	1m	12m	36m		1m	12m	36m		1m	12m	36m
QCE	1.53	0.62	0.40	ICE	0.14	0.37	0.22	Q5F	0.19	0.34	0.23
	6.45	2.27	1.77		0.34	1.01	0.76		0.82	1.39	1.12

In cross-sectional regressions, the QCE slopes insignificant from 1

	h	s	ste	$\lvert t_{s=1}\rvert$	h	s	ste	$\lvert t_{s=1}\rvert$	h	s	ste	$\lvert t_{s=1}\rvert$
QCE	1	0.83	0.12	1.43	12	0.57	0.33	1.32	36	0.66	0.29	1.17
ICE	1	0.49	0.18	2.88	12	0.54	0.24	1.93	36	0.35	0.13	4.86
Q5F	1	0.03	0.03	35.00	12	0.01	0.04	23.89	36	0.01	0.02	57.99

Theme

The q^5-characteristics model underperforms the accounting ICE in time series MEV, but competitive in cross-section MEV

	h	$\overline{\text{SVar}}^{\text{TS}}$	Var^{TS}	Cov^{TS}	$\overline{\text{SVar}}^{\text{CX}}$	Var^{CX}	Cov^{CX}
QCE	1	0.0031	0.0081	0.0050	−0.0031	0.0080	0.0111
ICE	1	−0.0176	0.0031	0.0207	−0.0013	0.0045	0.0058
Q5F	1	0.0234	0.0195	−0.0039	0.0302	0.0312	0.0010
QCE	12	−0.1782	0.4756	0.6538	−0.1755	0.5288	0.7043
ICE	12	−2.6801	0.5375	3.2176	−0.5684	0.7965	1.3649
Q5F	12	4.1936	3.4265	−0.7671	5.3185	5.3230	0.0045
QCE	36	−1.7692	2.2386	4.0079	−0.0685	3.1506	3.2191
ICE	36	−10.85	12.31	23.15	5.03	15.16	10.13
Q5F	36	86.68	86.84	0.1576	114.69	117.87	3.1812

Theme

Apply QCE to study firm-, industry-, factor-, and aggregate costs of equity

QCE resolves the imprecision problem

QCE resolves the weak association problem in the cross section

The ICE performance remarkable in the time series

The firm-level QCE distribution weakly left-skewed, whereas the firm-level ICE distribution weakly right-skewed

The term structure of the QCE premiums largely flat, but the term structure of the QCE volatility downward sloping

Outline

Outline

At the beginning of month t, estimate betas from prior 60-month rolling window (30 minimum)

Estimate factor premiums averaged from the expanding window that starts from January 1967

Add back 1-month Treasury bill rate to obtain the cost of equity

Unconditional factor models imply a flat term structure: Raise 1-month forecasts to the power of 12 for 12-month forecasts

The internal rate of return from the residual income model

ICE as the equal-weighted average of four ICE variants:

- Claus and Thomas (2001)
- Gebhardt, Lee, and Swaminathan (2001)
- Easton (2004)
- Ohlson and Juettner-Nauroth (2005)

Estimate earnings forecasts via cross-sectional earnings regressions (Hou, van Dijk, and Zhang 2012)

A flat term structure for ICE (the internal rate of return)

Lewellen (2015): A simple, yet effective, measure of expected returns by combining slopes from prior 120-month rolling windows with the latest available characteristics at the beginning of month t

We implement investment-based cross-sectional forecasts on the q^5 characteristics: size, I/A, ROE, and expected growth (EG)

EG is from cross-sectional forecasts of changes in I/A on the log of Tobin's q, cash-based operating cash flow, and changes in ROE

Winsorize each cross section at the 2.5 and 97.5 percentiles

For 12-month forecasts, regress cumulative returns from month $t-12$ to $t-1$ on prior characteristics known at month $t-12$

The stock return:

$$r_{it+1} = \frac{w_{it}^K r_{it+1}^K + (1 - w_{it}^K) r_{it+1}^W - w_{it}^B r_{it+1}^{Ba}}{1 - w_{it}^B},$$

in which

$$r_{it+1}^K \equiv \frac{\begin{array}{c}(1 - \tau_{t+1}) \left[\gamma_K \frac{Y_{it+1}}{K_{it+1}} + \frac{a}{2} \left(\frac{I_{it+1}}{K_{it+1}} \right)^2 \right] + \tau_{t+1} \delta_{it+1} \\ + (1 - \delta_{it+1}) \left[1 + (1 - \tau_{t+1}) a \left(\frac{I_{it+1}}{K_{it+1}} \right) \right]\end{array}}{1 + (1 - \tau_t) a \left(\frac{I_{it}}{K_{it}} \right)}$$

and

$$r_{it+1}^W \equiv 1 + (1 - \tau_{t+1}) \gamma_W \frac{Y_{it+1}}{W_{it+1}}$$

Forecast I_{it+1}/K_{it+1} on the log of Tobin's q, sales-to-capital, $Y_{it}/(K_{it} + W_{it})$, lagged investment rate, I_{it}/K_{it}

Estimate γ and a via nonlinear cross-sectional regressions of annual returns (with overlapping months) from:

$$r_{it+1} = er(\mathcal{I}_{it}; \gamma, a) + \epsilon_{it+1},$$

$er(\mathcal{I}_{it}; \gamma, a)$ is the expected return from the latest information

For 1-month forecasts, perform nonlinear cross-sectional regressions of subsequent 1-month returns on $er(\mathcal{I}_{it}; \gamma, a)^{1/12}$

Outline

Portfolio sorts: Simplest way to check association with cross-sectional returns

Test slope $= 1$ in cross-sectional predictive regressions (Lewellen 2015): Test for bias (if large-sample average returns are unbiased)

Bias clearly important for business valuation and capital budgeting

For treatment effects (how differences in corporate polices are related differences in CE), the CE bias largely irrelevant

Measurement error variance most relevant for treatment effects

The measurement error: $\omega_{it} = \widehat{er}^h_{it} - er^h_{it}$:

- er^h_{it}: Firm i's true h-month ahead expected return at the beginning of month t
- $\widehat{er}^h_{it}$: An empirical proxy of er^h_{it}

ω_{it} differs from the forecast error, $\widehat{e}_{it+h} \equiv r_{it+h} - \widehat{er}^h_{it}$

Time series and cross-section MEV: Very clever in avoiding the unobservable er_{it}

Time series MEV:

$$\begin{aligned}\overline{\text{SVar}}^{\text{TS}} &= \frac{1}{N}\sum_i \text{SVar}_i^{\text{TS}} \\ \text{SVar}_i^{\text{TS}} &= \text{Var}_i\left(\widehat{er}_{it}^{h}\right) - 2\text{Cov}_i\left(\widehat{er}_{it}^{h}, r_{it+h}\right)\end{aligned}$$

Cross-section MEV:

$$\begin{aligned}\overline{\text{SVar}}^{\text{CX}} &= \frac{1}{T^P - h}\sum_t \text{SVar}_t^{\text{CX}} \\ \text{SVar}_t^{\text{CX}} &= \text{Var}_t\left(\widehat{er}_{it}^{h}\right) - 2\text{Cov}_t\left(\widehat{er}_{it}^{h}, r_{it+h}\right)\end{aligned}$$

Scaled: $\text{Var}(\omega_{it}) = \text{Var}(\widehat{er}_{it}) - 2\text{Cov}(r_{it+1}, \widehat{er}_{it}) + \text{Var}(er_{it})$

h	1	2	3	4	5	6	7	8	9	10	H−L
The q^5 characteristics-based QCE											
1	0.19	0.52	0.86	0.81	0.80	0.97	0.83	1.18	1.39	1.71	1.53
	0.68	2.49	4.38	4.22	4.02	5.23	3.62	5.07	5.77	5.78	6.45
3	0.27	0.61	0.72	0.84	0.95	0.99	0.96	0.94	1.26	1.46	1.20
	0.95	2.83	3.51	4.15	4.73	5.02	4.86	3.92	5.49	5.62	5.40
12	0.51	0.76	0.83	0.89	0.86	0.90	0.94	0.98	1.06	1.13	0.62
	2.06	3.65	4.07	4.35	4.03	4.19	4.03	3.78	3.80	3.31	2.27
24	0.52	0.70	0.80	0.84	0.89	0.90	0.91	0.96	1.02	1.08	0.56
	2.19	3.25	3.81	3.97	4.04	3.78	3.61	3.50	3.37	3.17	2.29
36	0.68	0.80	0.89	0.89	0.95	0.97	0.94	0.95	1.03	1.08	0.40
	3.17	3.90	4.27	4.20	4.26	4.14	3.77	3.55	3.66	3.34	1.77
60	0.75	0.83	0.81	0.82	0.90	0.91	0.96	0.96	1.06	1.02	0.27
	3.54	3.89	3.49	3.39	3.69	3.54	3.65	3.46	3.55	3.16	1.42

h	1	2	3	4	5	6	7	8	9	10	H−L
					The accounting-based ICE						
1	0.69	0.57	0.67	0.74	0.73	0.68	0.71	0.76	0.79	0.84	0.14
	2.40	2.86	3.73	4.33	4.33	3.97	3.57	3.18	2.60	1.69	0.34
3	0.72	0.62	0.66	0.73	0.74	0.67	0.72	0.78	0.86	0.85	0.12
	2.58	3.17	3.61	4.22	4.55	3.76	3.65	3.31	3.09	1.83	0.32
12	0.65	0.64	0.75	0.75	0.81	0.80	0.75	0.80	0.94	1.02	0.37
	2.36	3.32	4.25	4.26	4.86	4.53	3.91	3.31	3.48	2.45	1.01
24	0.64	0.69	0.81	0.81	0.86	0.85	0.85	0.84	0.93	0.93	0.29
	2.39	3.57	4.49	4.66	5.10	4.77	4.55	3.72	3.61	2.38	0.89
36	0.70	0.73	0.81	0.82	0.87	0.88	0.86	0.82	0.92	0.92	0.22
	2.66	3.73	4.41	4.66	5.10	4.88	4.67	3.76	3.51	2.47	0.76
60	0.81	0.80	0.84	0.85	0.90	0.92	0.89	0.85	0.89	1.07	0.26
	3.16	4.22	4.78	4.96	5.19	4.91	4.73	4.06	3.33	2.90	0.96

h	1	2	3	4	5	6	7	8	9	10	H−L
					The Lewellen 7-variable model						
1	0.35	0.66	0.79	0.79	0.80	0.90	0.98	1.11	1.30	1.53	1.18
	1.43	3.44	4.23	4.48	4.34	4.83	4.60	4.65	4.32	3.75	3.33
3	0.32	0.65	0.73	0.84	0.88	0.96	0.92	1.13	1.11	1.31	0.99
	1.34	3.13	3.95	4.73	4.58	4.95	4.44	4.51	3.93	3.42	3.15
12	0.52	0.80	0.86	0.92	0.93	0.88	0.99	1.00	1.04	1.01	0.50
	2.03	4.20	4.76	4.81	4.84	4.25	4.43	3.93	3.26	2.63	1.45
24	0.46	0.78	0.84	0.88	0.82	0.88	0.94	1.03	1.05	1.18	0.73
	1.62	3.94	4.44	4.62	3.98	3.99	3.96	3.69	3.20	2.96	2.08
36	0.60	0.81	0.89	0.96	0.92	0.93	0.98	0.99	1.07	1.14	0.54
	2.25	4.11	4.86	4.95	4.53	4.37	4.29	3.90	3.53	3.14	1.64
60	0.64	0.80	0.88	0.89	0.89	0.91	0.93	0.98	1.03	1.15	0.51
	2.69	3.89	4.20	4.10	3.98	3.90	3.71	3.44	3.12	2.87	1.56

h	1	2	3	4	5	6	7	8	9	10	H−L
					The structural q-model						
1	0.34	0.61	0.68	0.70	0.64	0.83	0.78	0.82	0.86	0.98	0.64
	1.30	2.52	3.28	3.21	3.65	4.76	4.44	4.18	5.00	4.46	2.64
3	0.20	0.64	0.66	0.70	0.65	0.86	0.90	0.79	0.87	0.96	0.76
	0.71	3.31	3.08	3.53	3.40	4.84	4.73	4.18	4.58	4.55	3.28
12	0.35	0.57	0.70	0.75	0.68	0.81	0.87	0.79	0.80	1.10	0.74
	1.30	3.05	3.29	3.65	3.31	4.24	4.53	3.85	3.99	5.49	3.26
24	0.47	0.62	0.68	0.69	0.75	0.76	0.84	0.74	0.87	0.92	0.46
	1.76	3.23	3.12	3.22	3.54	3.82	4.34	3.54	4.10	4.75	2.11
36	0.56	0.73	0.81	0.79	0.81	0.81	0.85	0.82	0.85	0.88	0.32
	2.09	3.94	4.20	3.81	4.04	4.35	4.39	4.20	4.12	4.80	1.50
60	0.62	0.76	0.78	0.82	0.78	0.79	0.83	0.84	0.81	0.83	0.21
	2.36	3.91	3.68	3.83	3.89	3.96	4.28	4.13	3.71	4.30	1.04

	h	s	ste	$\lvert t_{s=1} \rvert$	h	s	ste	$\lvert t_{s=1} \rvert$	h	s	ste	$\lvert t_{s=1} \rvert$
QCE	1	0.83	0.12	1.43	12	0.57	0.33	1.32	36	0.66	0.29	1.17
Lewellen-7	1	0.77	0.11	2.20	12	0.66	0.23	1.49	36	0.74	0.34	0.78
ICE	1	0.49	0.18	2.88	12	0.54	0.24	1.93	36	0.35	0.13	4.86
Structural-q	1	0.07	0.03	36.03	12	0.24	0.14	5.50	36	0.35	0.11	6.22
QCE	3	0.76	0.15	1.60	24	0.72	0.22	1.30	60	0.56	0.26	1.67
Lewellen-7	3	0.73	0.13	2.09	24	0.74	0.23	1.12	60	0.62	0.40	0.96
ICE	3	0.38	0.18	3.47	24	0.49	0.15	3.36	60	0.27	0.15	4.85
Structural-q	3	0.14	0.06	15.53	24	0.31	0.13	5.40	60	0.30	0.09	7.40

	h	$\overline{\text{SVar}}^{\text{TS}}$	Var^{TS}	Cov^{TS}	$\overline{\text{SVar}}^{\text{CX}}$	Var^{CX}	Cov^{CX}
QCE	1	0.0031	0.0081	0.0050	−0.0031	0.0080	0.0111
Lewellen-7	1	0.0002	0.0051	0.0049	−0.0034	0.0062	0.0095
ICE	1	−0.0176	0.0031	0.0207	−0.0013	0.0045	0.0058
Structural-q	1	0.0171	0.0275	0.0104	0.0558	0.0670	0.0112
QCE	3	0.0327	0.0596	0.0269	−0.0225	0.0574	0.0799
Lewellen-7	3	0.0385	0.0436	0.0051	−0.0179	0.0472	0.0650
ICE	3	−0.1539	0.0286	0.1825	−0.0113	0.0416	0.0529
Structural-q	3	−0.0025	0.0499	0.0524	0.1243	0.1790	0.0547
QCE	12	−0.1782	0.4756	0.6538	−0.1755	0.5288	0.7043
Lewellen-7	12	−0.4804	0.4666	0.9470	−0.2158	0.5878	0.8036
ICE	12	−2.6801	0.5375	3.2176	−0.5684	0.7965	1.3649
Structural-q	12	−0.0350	0.2432	0.2782	0.4365	0.8645	0.4280

	h	$\overline{\text{SVar}}^{\text{TS}}$	Var^{TS}	Cov^{TS}	$\overline{\text{SVar}}^{\text{CX}}$	Var^{CX}	Cov^{CX}
QCE	24	−1.6930	1.2691	2.9621	−0.4540	1.6201	2.0741
Lewellen-7	24	−3.4147	1.6007	5.0155	−1.1854	2.1065	3.2919
ICE	24	−8.0229	3.3824	11.41	−0.3978	4.6689	5.0667
Structural-q	24	−0.0003	0.6621	0.6624	0.7641	2.0340	1.2699
QCE	36	−1.7692	2.2386	4.0079	−0.0685	3.1506	3.2191
Lewellen-7	36	−4.7497	3.1905	7.9403	−1.8243	4.4311	6.2554
ICE	36	−10.85	12.31	23.15	5.03	15.16	10.13
Structural-q	36	1.0065	1.1265	0.1200	1.0279	3.2928	2.2648
QCE	60	−8.6963	6.5921	15.29	3.8038	10.09	6.2831
Lewellen-7	60	−15.83	9.6940	25.52	0.4323	14.37	13.93
ICE	60	26.71	105.86	79.15	63.91	108.54	44.62
Structural-q	60	2.6223	2.7788	0.1565	3.0476	8.6056	5.5580

QCE best performer in sorts and cross-sectional regressions

QCE underperforms ICE in time series MEV but competitive (with a somewhat edge) in cross-section MEV

Factor models perform poorly in all metrics, motivating the importance of developing the q^5-characteristics model

The q^5-characteristics model outperforms the structural q-model

In the systems view of the world, explanation differs from prediction

Outline

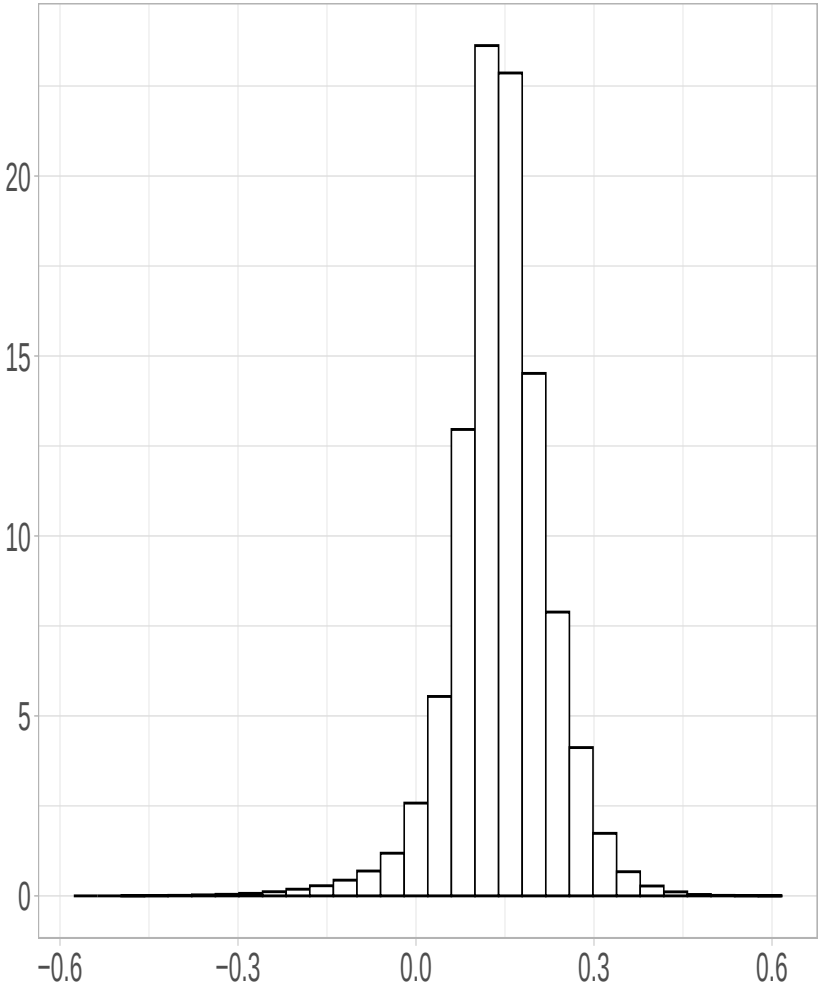
QCE

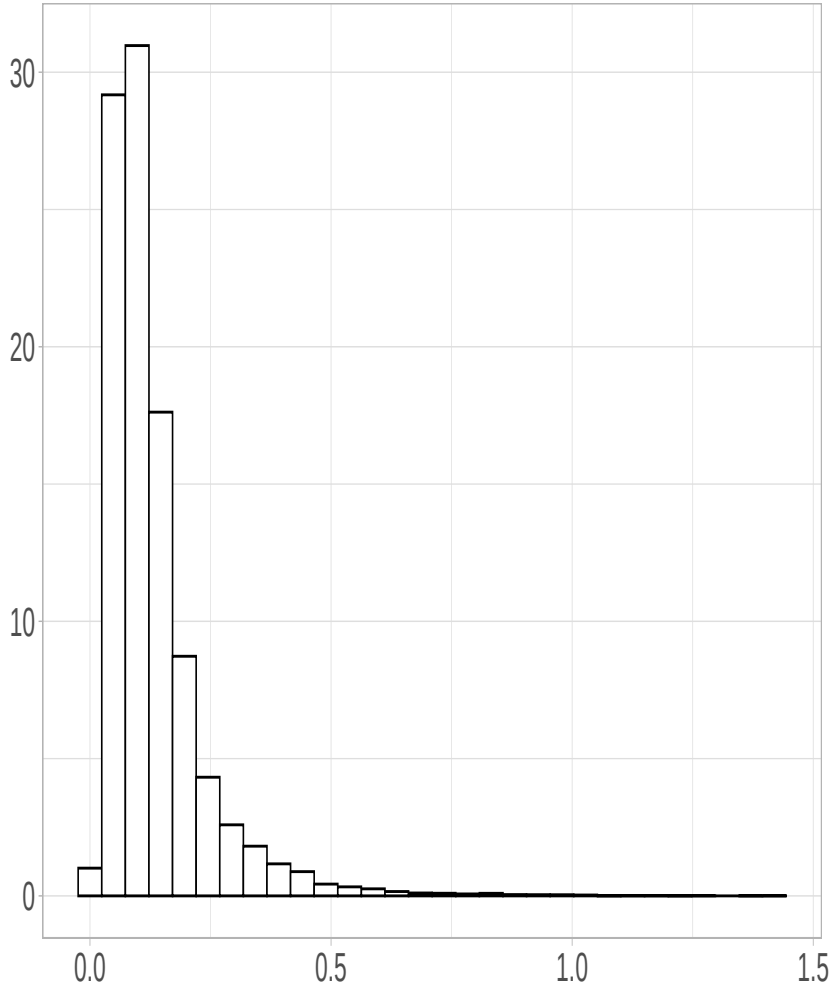
Firm-level costs of equity, January 1977–December 2022

h	Mean	Std	Skew	Kurt	ρ	p5	p25	p50	p75	p95
					QCE					
1	14.31	10.74	−0.63	−0.87	0.723	−5.55	9.37	15.09	20.52	29.85
12	14.08	6.91	−0.77	−0.99	0.775	1.58	10.66	14.62	18.42	23.98
36	13.77	4.33	−0.80	−1.03	0.779	6.01	11.33	14.10	16.66	20.11
					ICE					
12	13.18	9.29	1.89	0.61	0.755	4.79	7.39	10.16	15.08	35.15
					QCE_{12}-minus-ICE					
12	1.53	10.17	−1.45	0.44	0.765	−19.80	−1.59	3.85	7.66	12.83

QCE

Histograms of firm-level costs of equity, 12-month QCE vs. ICE





QCE

Industry costs of equity, January 1977–December 2022: 18 nonfinancial sectors and 57 nonfinancial industries per NAICS

Sector costs of equity:

	QCE_1	QCE_3	QCE_{12}	QCE_{24}	QCE_{36}	QCE_{60}	ICE	Q5F	AR
Mean	9.59	10.36	9.36	9.45	9.87	10.60	8.65	9.76	12.38
Std	4.53	4.23	4.20	3.76	3.29	3.04	2.85	7.53	21.95

Industry costs of equity:

	QCE_1	QCE_3	QCE_{12}	QCE_{24}	QCE_{36}	QCE_{60}	ICE	Q5F	AR
Mean	10.34	10.99	10.02	9.98	10.31	10.94	9.05	9.70	13.17
Std	5.29	4.93	4.47	3.92	3.41	3.11	3.31	9.66	27.13

Average realized returns:

h	1m	3m	12m	24m	36m	60m
I/A	0.33	1.02	2.69	−0.13	−6.05	−19.12
	1.74	1.55	0.69	−0.02	−0.56	−0.66
R^{11}	0.96	2.48	2.86	0.43	7.16	9.95
	3.03	2.31	0.67	0.05	0.97	0.62
ROE	0.82	1.89	3.85	6.44	10.09	18.26
	3.18	2.20	1.08	1.38	1.69	2.01
EG	0.65	1.81	6.78	14.43	23.20	39.70
	3.06	2.61	2.16	2.52	3.07	2.52

QCE:

h	1m	3m	12m	24m	36m	60m
I/A	0.77	2.32	8.26	13.32	16.62	18.59
	13.39	14.42	13.78	12.30	13.88	10.23
R^{11}	0.33	0.86	0.85	0.00	−1.25	−5.72
	5.92	5.63	1.67	0.00	−1.00	−1.86
ROE	1.14	2.86	3.44	3.43	2.59	0.44
	8.33	6.50	2.03	1.61	1.17	0.19
EG	1.27	3.41	6.96	10.92	13.97	17.89
	10.05	7.94	4.88	5.55	5.22	3.60

ICE:

h	1m	3m	12m	24m	36m	60m
I/A	0.25	0.76	3.26	7.12	11.66	23.25
	9.59	9.56	9.43	9.24	9.04	8.61
R^{11}	−0.35	−1.07	−4.58	−10.06	−16.62	−33.69
	−5.82	−5.81	−5.74	−5.64	−5.53	−5.31
ROE	−0.27	−0.83	−3.55	−7.81	−12.90	−26.14
	−7.42	−7.38	−7.21	−6.97	−6.73	−6.25
EG	−0.23	−0.71	−3.00	−6.50	−10.55	−20.69
	−6.60	−6.61	−6.63	−6.64	−6.64	−6.61

h	s	t	R^2	s	t	R^2	s	t	R^2	s	t	R^2
	QCE			ICE			QCE			ICE		
			I/A						R^{11}			
1	1.03	2.27	0.01	1.40	1.34	0.00	−0.36	−0.43	0.00	4.40	2.52	0.03
3	0.88	1.76	0.03	1.35	1.15	0.01	0.84	1.14	0.00	5.33	2.40	0.11
12	0.72	1.11	0.05	1.12	0.68	0.02	2.08	1.43	0.06	4.71	4.15	0.36
24	0.76	1.36	0.06	0.19	0.40	0.00	2.09	1.40	0.06	3.36	3.48	0.37
36	1.28	2.44	0.09	0.11	0.32	0.00	0.93	1.18	0.02	1.86	4.31	0.25
60	−0.27	−0.33	0.00	0.03	0.09	0.00	0.33	0.49	0.01	1.33	3.71	0.21
			ROE						EG			
1	0.35	0.90	0.00	2.61	1.39	0.01	0.18	0.49	0.00	3.97	3.11	0.03
3	0.45	1.08	0.01	2.95	1.55	0.03	0.23	0.73	0.00	3.63	2.98	0.07
12	0.77	1.90	0.06	2.27	1.94	0.07	0.39	0.69	0.02	2.73	3.38	0.13
24	0.75	1.59	0.05	1.72	2.99	0.11	0.19	0.42	0.00	2.29	3.21	0.16
36	0.38	0.63	0.01	1.50	2.81	0.14	−0.11	−0.27	0.00	1.89	2.96	0.14
60	−0.33	−0.93	0.01	0.86	2.65	0.09	−0.35	−0.65	0.01	1.46	2.47	0.12

QCE

The equity premium, January 1977–December 2022

		1m	3m	12m	24m	36m	60m
QCE	Mean	4.78	5.87	3.92	3.71	4.05	4.72
	Std	5.31	4.66	4.47	4.38	4.35	4.07
ICE	Mean	4.34	4.37	3.88	3.60	3.43	3.12
	Std	2.46	2.33	2.37	2.28	2.17	1.97
EAR	Mean	5.26	5.15	4.13	5.97	3.10	3.05
	Std	1.75	1.82	1.94	1.54	2.14	2.03
Rf	Mean	4.25	4.22	4.72	5.00	5.17	5.48
	Std	3.77	3.59	3.84	3.81	3.72	3.58

	QCE					ICE				
h	s	t	R^2	Oos-R^2	$\overline{\text{SVar}}^{\text{TS}}$	s	t	R^2	Oos-R^2	$\overline{\text{SVar}}^{\text{TS}}$
1	0.54	1.07	0.00	0.00	0.00	3.20	3.07	0.02	0.01	−0.00
3	0.47	0.72	0.00	0.01	0.00	2.73	2.34	0.04	0.03	−0.01
12	0.76	0.60	0.04	0.05	−0.10	2.19	1.98	0.10	0.08	−0.19
24	0.82	1.25	0.09	−0.01	−0.48	1.86	1.31	0.15	0.05	−0.63
36	0.51	1.32	0.05	0.05	−0.05	1.82	1.16	0.20	0.21	−1.42
60	−0.02	−0.03	0.00	−0.13	7.31	1.97	1.70	0.30	0.26	−4.80

The q^5-characteristics model estimates costs of equity as out-of-sample forecasts from cross-sectional predictive regressions