Investment-Based Expected Stock Returns

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October 2, 2009

Theme

Investment-based expected stock returns

We derive and test q-theory implications for the cross-section of returns

Motivation

Many characteristics-return relations in capital markets research

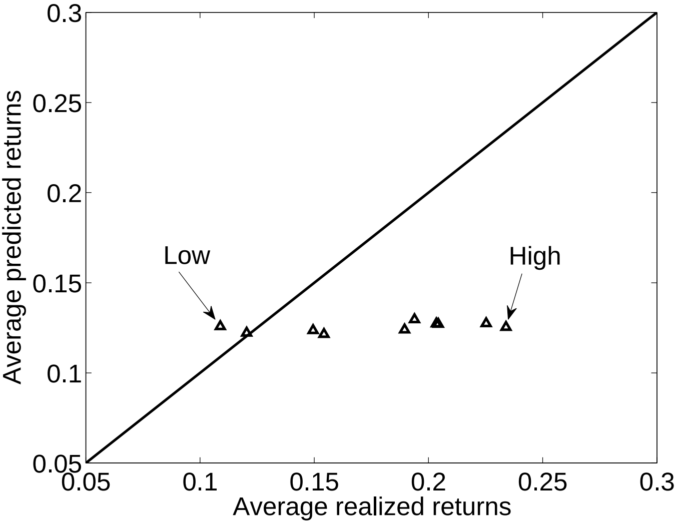
$$\overbrace{r_{jt+1}}^{\textbf{Realized returns}} = \underbrace{E_t[r_{jt+1}]}_{\textbf{Expected returns}} + \overbrace{\epsilon_{jt+1}}^{\textbf{Abnormal returns}}$$

Outline

Outline

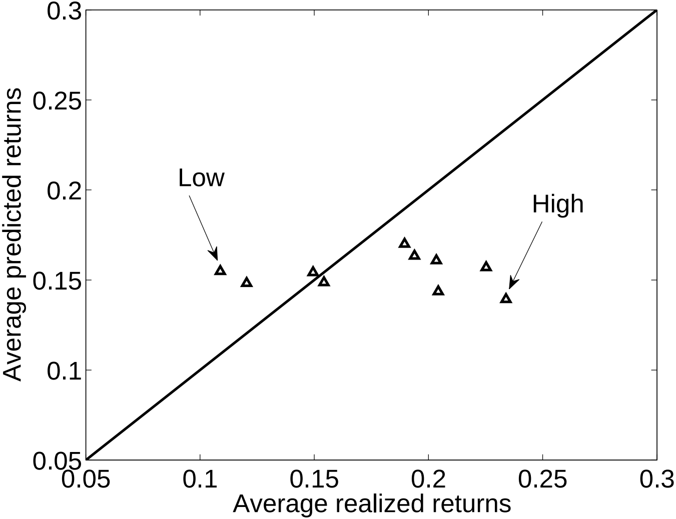
Key Results

Average predicted vs. realized returns, ten SUE portfolios, the CAPM



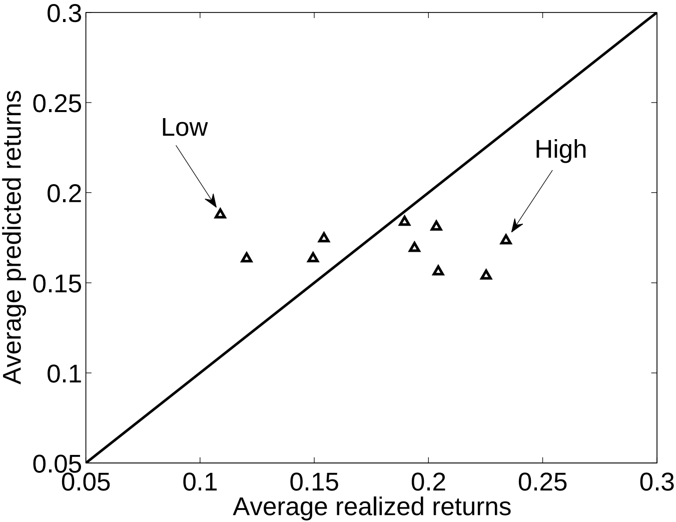
Key Results

Average predicted vs. realized returns, ten SUE portfolios, the Fama-French model



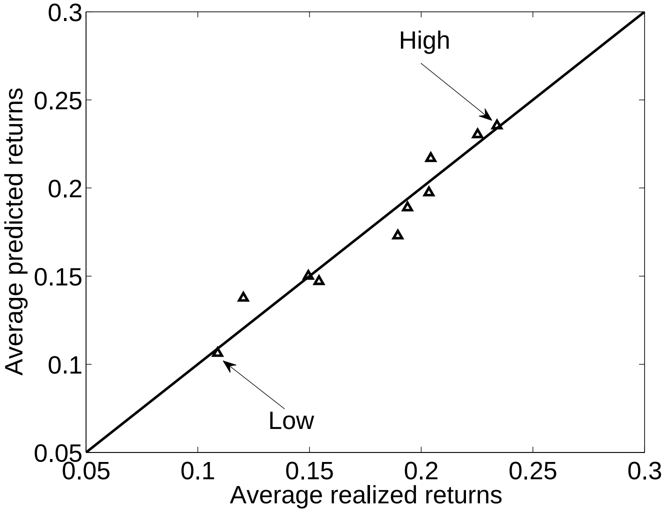
Key Results

Average predicted vs. realized returns, ten SUE portfolios, the consumption-CAPM



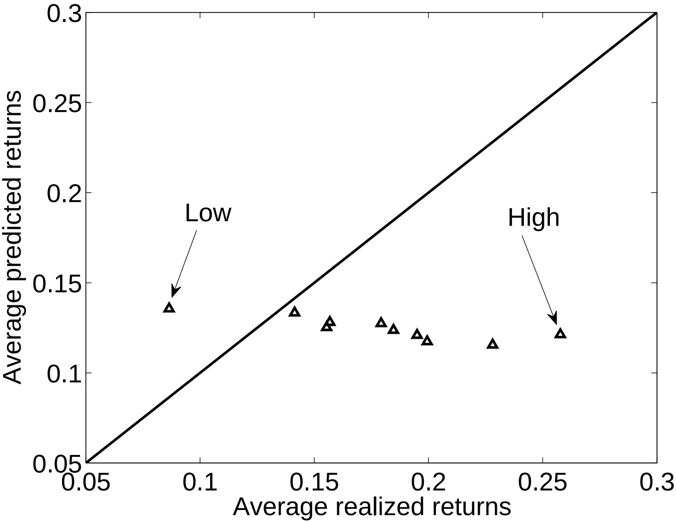
Key Results

Average predicted vs. realized returns, ten SUE portfolios, the *q*-theory model



Key Results

Average predicted vs. realized returns, ten B/M portfolios, the CAPM



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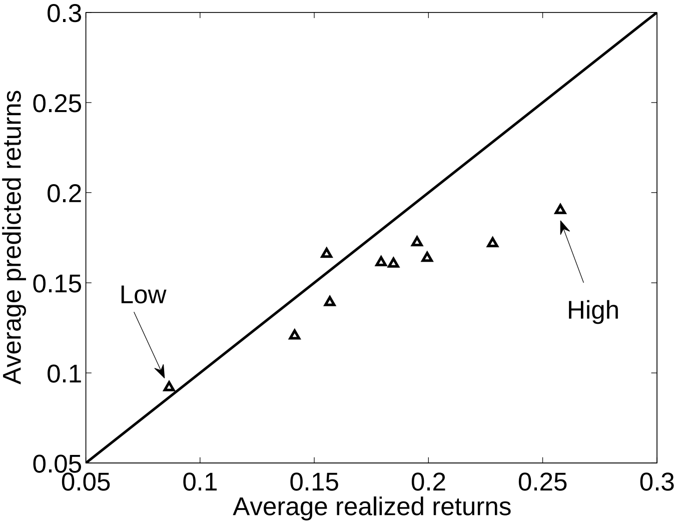
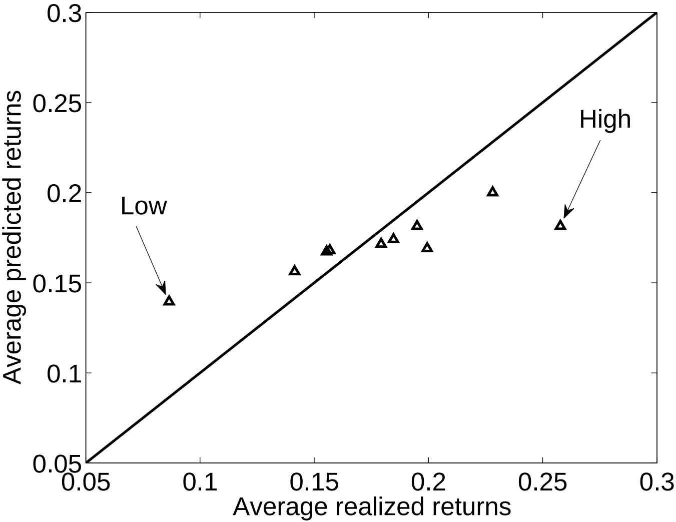
Average predicted vs. realized returns, ten B/M portfolios, the Fama-French model



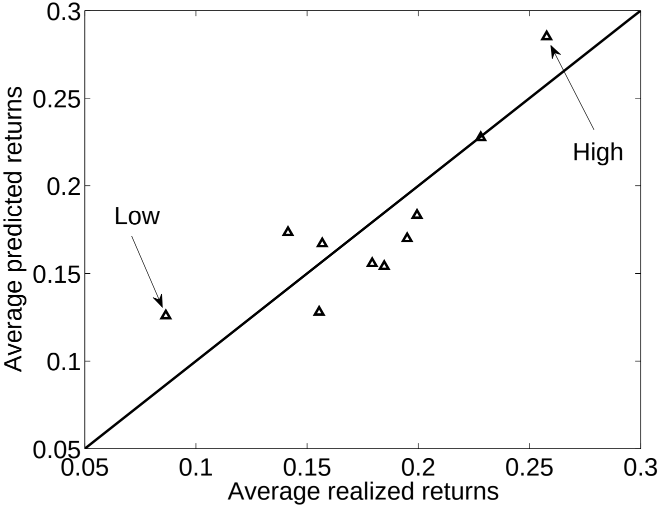
Key Results

Average predicted vs. realized returns, ten B/M portfolios, the consumption-CAPM



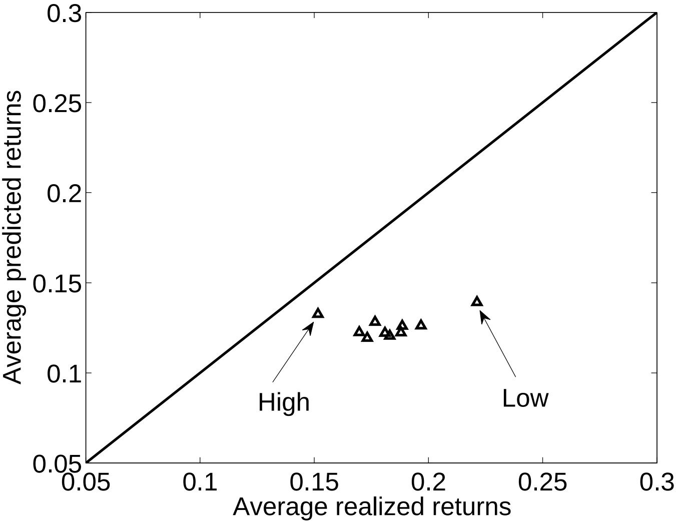
Key Results

Average predicted vs. realized returns, ten B/M portfolios, the *q*-theory model



Key Results

Average predicted vs. realized returns, ten CI portfolios, the CAPM



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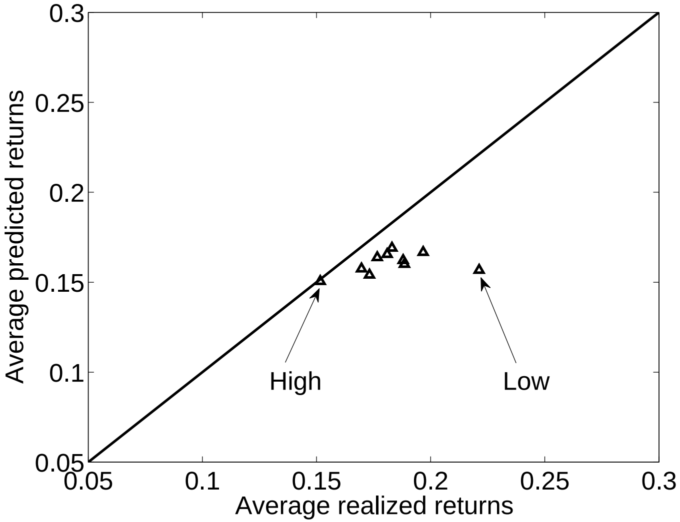

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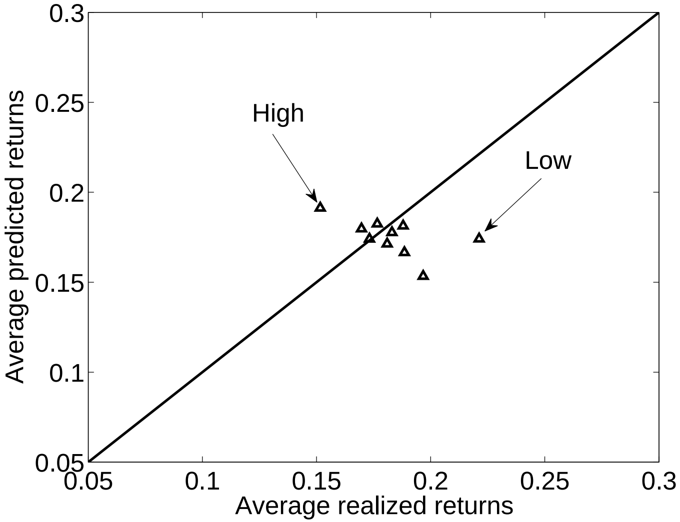

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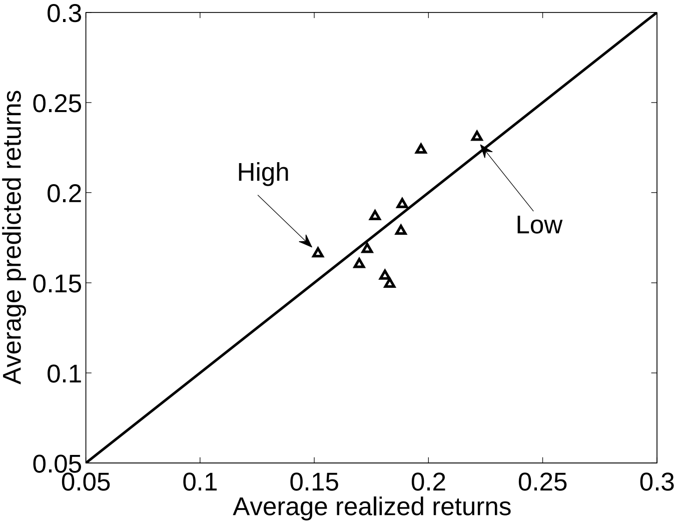
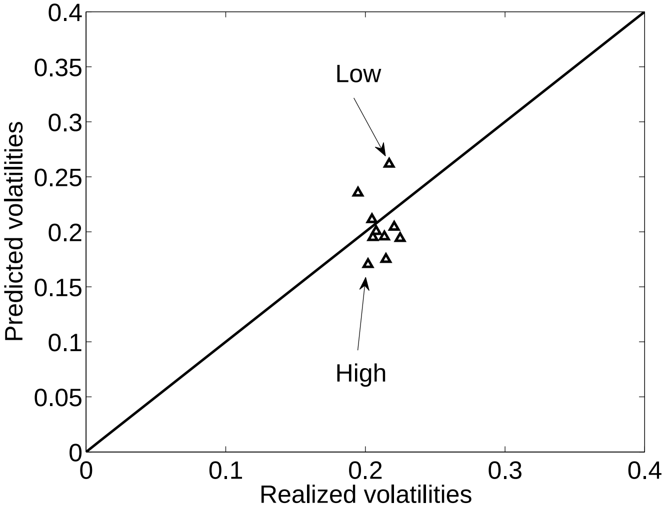
Average predicted vs. realized returns, ten CI portfolios, the *q*-theory model



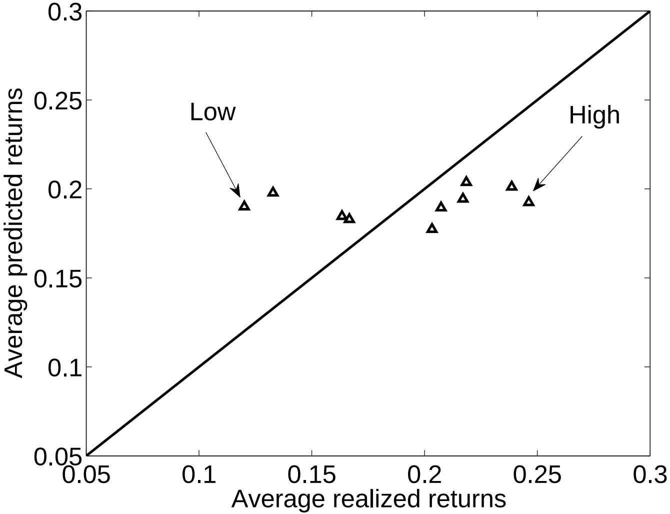
Key Results

Predicted vs. realized stock return volatilities, the q-theory model



Key Results

Average predicted vs. realized returns, the *q*-theory model



Outline

The Model

The neoclassical *q*-theory framework à la Hayashi (1982) and Cochrane (1991)

Operating profits, $\Pi(K_{it}, X_{it})$, with

$$\frac{\partial \Pi(K_{it}, X_{it})}{\partial K_{it}} = \alpha \frac{Y_{it}}{K_{it}} \quad \text{with } Y_{it} = \text{Sales}$$

Capital evolves as:

$$K_{it+1} = I_{it} + (1 - \delta_{it}) K_{it}$$

Convex adjustment costs:

$$\Phi(I_{it}, K_{it}) = \frac{a}{2} \left(\frac{I_{it}}{K_{it}} \right)^2 K_{it}$$

The Model

Equity-value maximization

One-period debt, B_{it+1}, with corporate bond return r^B_{it+1}

Payout, D_{it}, defined as:

$$(1-\tau_t)[\Pi(K_{it}, X_{it}) - \Phi(I_{it}, K_{it})] - I_{it} + B_{it+1} - r^B_{it} B_{it} + \tau_t \delta_{it} K_{it} + \tau_t (r^B_{it} - 1) B_{it}$$

The cum-dividend market value of the equity:

$$V_{it} \equiv \max_{\{I_{it+s}, K_{it+s+1}, B_{it+s+1}\}_{s=0}^{\infty}} E_t \left[\sum_{s=0}^{\infty} M_{t+s} D_{it+s} \right]$$

in which M_{t+1} is the stochastic discount factor, correlated with X_{it+1}

The Model

Proposition 1

$E_t[M_{t+1} r^I_{it+1}] = 1$, in which r^I_{it+1} is the investment return:

$$r^I_{it+1} \equiv \frac{\overbrace{\left[\begin{array}{c} \underbrace{(1-\tau_{t+1})\left[\alpha\frac{Y_{it+1}}{K_{it+1}} + \frac{a}{2}\left(\frac{I_{it+1}}{K_{it+1}}\right)^2\right]}_{\text{Marginal product plus economy of scale (net of taxes)}} \\ +\tau_{t+1}\delta_{it+1} + \underbrace{(1-\delta_{it+1})\left[1+(1-\tau_{t+1})a\left(\frac{I_{it+1}}{K_{it+1}}\right)\right]}_{\text{Expected continuation value}} \end{array}\right]}^{\text{Marginal benefit of investment at time } t+1}}{\underbrace{1+(1-\tau_t)\left(\frac{I_{it}}{K_{it}}\right)}_{\text{Marginal cost of investment at time } t}}$$

The Model

Proposition 1

Define $r^{Ba}_{it+1} = (1-\tau_{t+1})r^{B}_{it+1} + \tau_{t+1}$, then $E_t\left[M_{t+1}r^{Ba}_{it+1}\right] = 1$

Define $P_{it} \equiv V_{it} - D_{it}$ and the stock return $r^{S}_{it+1} \equiv (P_{it+1} + D_{it+1})/P_{it}$. Under constant returns to scale, the investment return is the weighted average of stock and after-tax bond returns:

$$r^{I}_{it+1} = w_{it}r^{Ba}_{it+1} + (1-w_{it})r^{S}_{it+1} \;\Rightarrow\; r^{S}_{it+1} = r^{Iw}_{it+1} \equiv \frac{r^{I}_{it+1} - w_{it}r^{Ba}_{it+1}}{1-w_{it}}$$

in which w_{it} is market leverage, $w_{it} \equiv B_{it+1}/(P_{it} + B_{it+1})$

Outline

Framework

GMM moment conditions

Do expected stock returns equal expected levered investment returns?

$$E\left[r^S_{it+1} - r^{Iw}_{it+1}\right] = 0$$

Do stock return variances equal levered investment return variances?

$$E\left[\left(r^S_{it+1} - E\left[r^S_{it+1}\right]\right)^2 - \left(r^{Iw}_{it+1} - E\left[r^{Iw}_{it+1}\right]\right)^2\right] = 0$$

Data

Testing portfolios

Three sets of testing portfolios

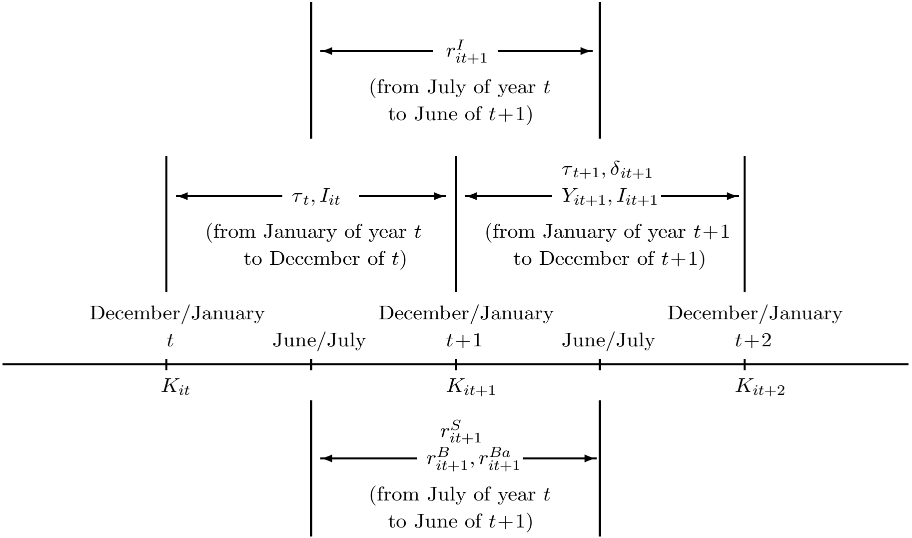
- Ten Standardized Unexpected Earnings (SUE) portfolios of Chan, Jegadeesh, and Lakonishok (1996)
- Ten book-to-market portfolios as in Fama and French (1993)
- Ten "abnormal" investment portfolios of Titman, Wei, and Xie (2004)

Why portfolios?

- Representing regularities of returns as in Fama and French (1993)
- Smoothing lumpy investment as in Thomas (2002)

Data

Timing



r^I_{it+1}
(from July of year t to June of $t+1$)
τ_t, I_{it}
(from January of year t to December of t)
$\tau_{t+1}, \delta_{it+1}$
Y_{it+1}, I_{it+1}
(from January of year $t+1$ to December of $t+1$)
December/January t
June/July
December/January $t+1$
June/July
December/January $t+2$
K_{it}
K_{it+1}
K_{it+2}
r^S_{it+1}
$r^B_{it+1}, r^{Ba}_{it+1}$
(from July of year t to June of $t+1$)

Data

Measurement

- K_{it}: gross property, plant, and equipment
- I_{it}: capital expenditure minus sales of property, plant, and equipment
- Y_{it}: sales
- B_{it}: total long-term debt
- P_{it}: market value of common equity
- δ_{it}: the amount of depreciation divided by capital
- r^B_{it+1}: impute bond ratings, assign corporate bond returns of a given rating to all firms with the same rating
- τ_t: statutory tax rate of corporate income

Matching Expected Returns

Point estimates and tests of overidentification

	SUE	B/M	CI
a	7.68	22.34	0.97
[ste]	[1.72]	[25.47]	[0.29]
α	0.32	0.50	0.21
[ste]	[0.03]	[0.31]	[0.02]
χ^2	4.37	5.99	6.52
d.f.	8	8	8
p	0.82	0.65	0.59
a.a.p.e.	0.74	2.32	1.51

Matching Expected Returns

Euler equation errors, ten SUE portfolios

	Low	5	High	H−L	[$t_{\text{H}-\text{L}}$]
	Panel A: Ten SUE portfolios				
e_i	−1.69	6.56	10.86	12.55	[5.53]
e_i^{FF}	−4.59	1.96	9.47	14.06	[5.31]
e_i^{C}	−8.07	−0.04	5.31	13.38	[1.35]
e_i^{q}	0.26	1.66	−0.15	−0.40	[−0.41]

Matching Expected Returns

Euler equation errors, ten B/M portfolios

	Low	5	High	H−L	$[t_{\text{H}-\text{L}}]$
	Panel B: Ten B/M portfolios				
e_i	−4.91	5.19	13.65	18.56	[2.51]
e_i^{FF}	−0.54	1.80	6.76	7.30	[3.25]
e_i^{C}	−5.43	0.27	6.88	12.31	[0.26]
e_i^{q}	−3.94	2.35	−2.73	1.21	[0.79]

Matching Expected Returns

Euler equation errors, ten CI portfolios

	Low	5	High	H−L	$[t_{\mathrm{H-L}}]$
	Panel C: Ten CI portfolios				
e_i	8.21	5.89	1.91	−6.30	[−3.88]
e_i^{FF}	6.45	1.54	0.11	−6.34	[−3.99]
e_i^{C}	4.03	0.46	−4.35	−8.38	[−1.35]
e_i^{q}	−0.97	2.72	−1.45	−0.49	[−0.41]

Matching Expected Returns

Economic determinants of expected stock returns

$$r^I_{it+1} \equiv \frac{(1-\tau_{t+1})\left[\alpha\frac{Y_{it+1}}{K_{it+1}} + \frac{a}{2}\left(\frac{I_{it+1}}{K_{it+1}}\right)^2\right] + \tau_{t+1}\delta_{it+1} + (1-\delta_{it+1})\left[1+(1-\tau_{t+1})a\left(\frac{I_{it+1}}{K_{it+1}}\right)\right]}{1+(1-\tau_t)a\left(\frac{I_{it}}{K_{it}}\right)}$$

$$r^{Iw}_{it+1} \equiv \frac{r^I_{it+1} - w_{it} r^{Ba}_{it+1}}{1-w_{it}}$$

Determinants: $Y_{it+1}/K_{it+1}, I_{it+1}/I_{it}, \delta_{it+1}$, and I_{it}/K_{it}, also w_{it} and r^B_{it+1}

Matching Expected Returns

Characteristics, ten SUE portfolios

	Low	5	High	H−L	$[t_{\text{H}-\text{L}}]$
I_{it}/K_{it}	0.12	0.11	0.12	0.00	[0.70]
$(I_{it+1}/K_{it+1})/(I_{it}/K_{it})$	0.89	1.00	1.06	0.17	[4.06]
Y_{it+1}/K_{it+1}	1.52	1.50	1.83	0.31	[5.16]
δ_{it+1}	0.08	0.08	0.08	0.00	[0.63]
w_{it}	0.30	0.28	0.21	−0.10	[−5.83]
r^B_{it+1}	9.44	9.76	9.38	−0.06	[−0.27]

Matching Expected Returns

Expected returns accounting, ten SUE portfolios

	Low	5	High	H−L
$\overline{I_{it}/K_{it}}$	−2.48	4.45	−4.26	−1.78
$\overline{q_{it+1}/q_{it}}$	−5.23	1.76	3.62	8.85
$\overline{Y_{it+1}/K_{it+1}}$	−0.78	0.39	3.53	4.31
$\overline{w}_{it}$	0.13	1.89	−1.46	−1.58

Matching Expected Returns

Characteristics, ten B/M portfolios

	Low	5	High	H−L	$[t_{\text{H}-\text{L}}]$
I_{it}/K_{it}	0.18	0.11	0.08	−0.10	[−7.95]
$(I_{it+1}/K_{it+1})/(I_{it}/K_{it})$	0.98	1.00	1.02	0.04	[0.68]
Y_{it+1}/K_{it+1}	1.95	1.45	1.38	−0.57	[−6.77]
δ_{it+1}	0.10	0.07	0.07	−0.03	[−5.01]
w_{it}	0.08	0.27	0.53	0.44	[12.44]
r^B_{it+1}	8.17	8.09	8.52	0.35	[1.05]

Matching Expected Returns

Expected returns accounting, ten B/M portfolios

	Low	5	High	H−L
$\overline{I_{it}/K_{it}}$	−42.06	4.69	48.17	90.23
$\overline{q_{it+1}/q_{it}}$	−1.92	2.11	−4.06	−2.14
$\overline{Y_{it+1}/K_{it+1}}$	0.16	0.92	−6.33	−6.49
$\overline{w}_{it}$	−6.00	2.19	5.58	11.58

Matching Expected Returns

Characteristics, ten CI portfolios

	Low	5	High	H−L	$[t_{\text{H}-\text{L}}]$
I_{it}/K_{it}	0.09	0.11	0.16	0.07	[11.06]
$(I_{it+1}/K_{it+1})/(I_{it}/K_{it})$	1.25	1.04	0.81	−0.44	[−7.23]
Y_{it+1}/K_{it+1}	1.84	1.58	1.89	0.05	[0.38]
δ_{it+1}	0.08	0.07	0.08	0.00	[−0.46]
w_{it}	0.35	0.25	0.28	−0.07	[−2.59]
r^B_{it+1}	8.47	8.27	8.44	−0.03	[−0.15]

Matching Expected Returns

Expected returns accounting, ten CI portfolios

	Low	5	High	H−L
$\overline{I_{it}/K_{it}}$	2.86	3.50	−5.67	−8.53
$\overline{q_{it+1}/q_{it}}$	0.73	2.97	−3.87	−4.60
$\overline{Y_{it+1}/K_{it+1}}$	0.57	−0.44	0.09	−0.48
$\overline{w}_{it}$	1.80	2.61	−0.91	−2.71

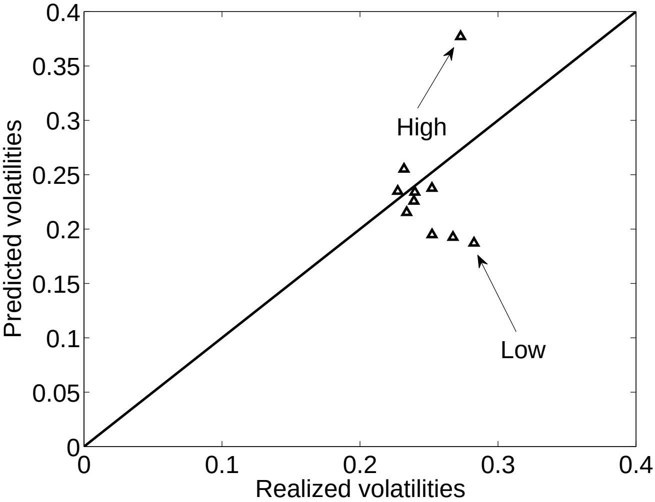
Matching Expected Returns and Variances

Point estimates and tests of overidentification

	SUE	B/M	CI
a	28.88	11.48	16.23
[ste]	[16.25]	[4.75]	[5.53]
α	0.61	0.35	0.36
[ste]	[0.27]	[0.07]	[0.08]
$\chi^2_{(2)}$	5.14	6.18	6.05
d.f.(2)	8	8	8
$p(2)$	0.74	0.63	0.64
a.a.p.e.(2)	0.03	0.04	0.02
$\chi^2_{(1)}$	5.22	4.38	4.81
d.f.(1)	8	8	8
$p(1)$	0.73	0.82	0.78
a.a.p.e.(1)	3.45	2.58	2.22
χ^2	5.45	6.17	6.62
d.f.	18	18	18
p	1.00	1.00	0.99

Matching Expected Returns and Variances

Predicted vs. realized stock return volatilities, ten B/M portfolios, the *q*-theory model



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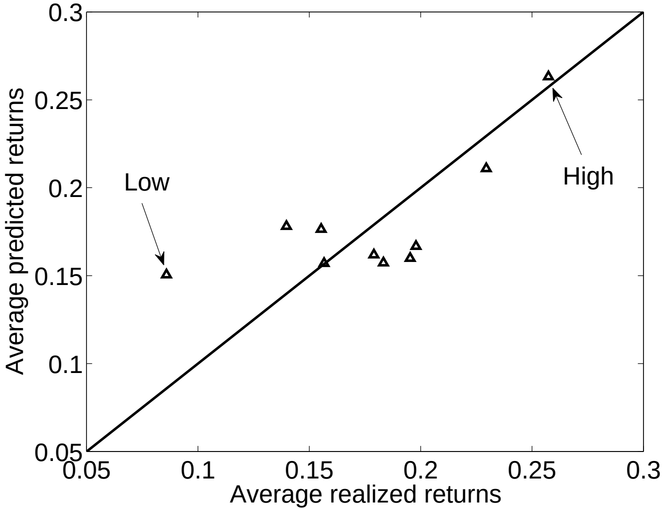
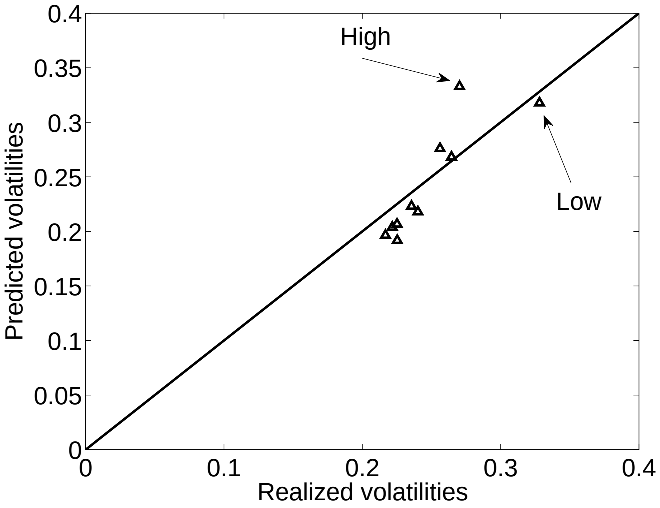
Average predicted vs. realized returns, ten B/M portfolios, the *q*-theory model



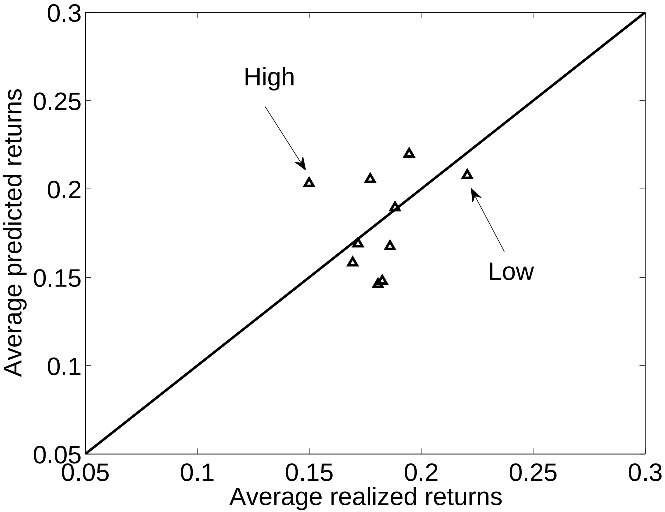
Matching Expected Returns and Variances

Predicted vs. realized stock return volatilities, ten CI portfolios, the q-theory model



Matching Expected Returns and Variances

Average predicted vs. realized returns, ten CI portfolios, the *q*-theory model



Conclusion

Summary, interpretation, and future work

Summary: derive and test the q-theory model for cross-sectional returns

Interpretation: portfolios of firms do a good job in aligning their investment policies with costs of equity capital, and this alignment drives many characteristics-return relations

Future work: more realistic ingredients (decreasing returns, time-to-build, investment lags, financing constraints, labor, fixed costs) and more stylized facts in cross-sectional returns (momentum, asset growth, accruals, distress, M&As, net equity issues, governance, also corporate bond returns)