A Neoclassical Interpretation of Momentum

Laura Xiaolei Liu[1] Lu Zhang[2]

[1]Hong Kong University of Science and Technology

[2]The Ohio State University
and NBER

The *Q* Group
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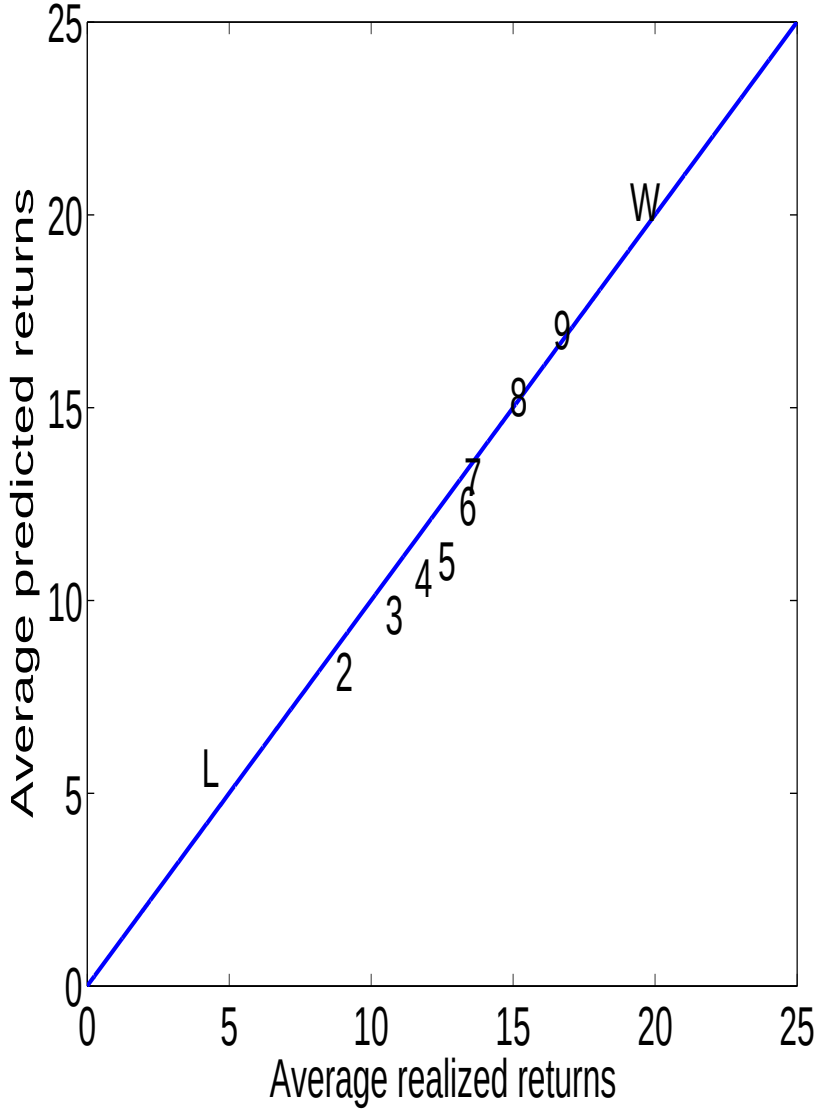
Theme

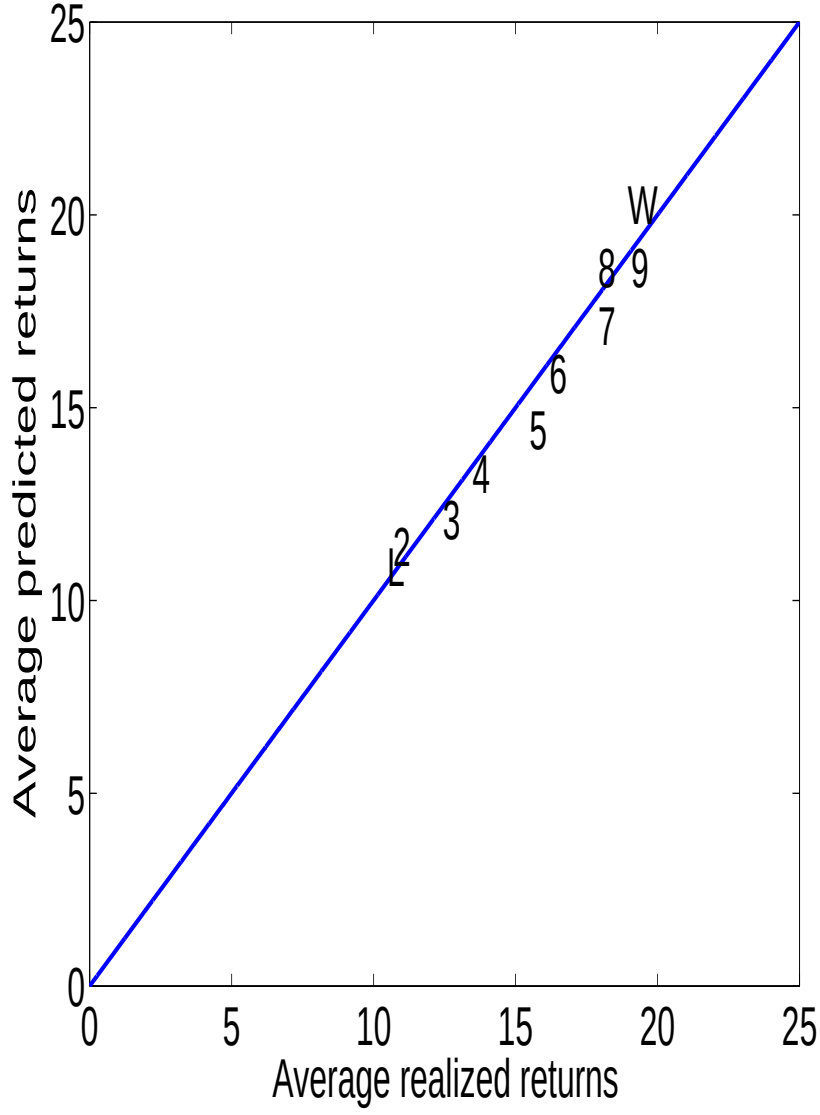
An economic interpretation of momentum based on the neoclassical q-theory of investment

Practical implication: Momentum might be riskier than you thought

Key Result

Price and earnings momentum





Outline

Outline

The Q Model

A microfoundation for the WACC approach to capital budgeting

$$r^{I}_{it+1} \equiv \frac{\overbrace{\left[\underbrace{(1-\tau_{t+1})\left[\kappa\frac{Y_{it+1}}{K_{it+1}}+\frac{a}{2}\left(\frac{I_{it+1}}{K_{it+1}}\right)^{2}\right]}_{\text{Marginal product plus economy of scale (net of taxes)}} +\tau_{t+1}\delta_{it+1}+\underbrace{(1-\delta_{it+1})\left[1+(1-\tau_{t+1})a\left(\frac{I_{it+1}}{K_{it+1}}\right)\right]}_{\text{Expected continuation value}}\right]}^{\text{Marginal benefits of investment at time } t+1}}{\underbrace{1+(1-\tau_{t})a\left(\frac{I_{it}}{K_{it}}\right)}_{\text{Marginal costs of investment at time } t}}$$

$$\underbrace{w_{it}r^{Ba}_{it+1}+(1-w_{it})r^{S}_{it+1}}_{\text{The weighted average cost of capital}} = r^{I}_{it+1}$$

The Q Model

Expected stock returns = expected levered investment returns?

$$E\left[r^{S}_{it+1} - \underbrace{\frac{r^{I}_{it+1}(a,\kappa) - w_{it}\, r^{Ba}_{it+1}}{1 - w_{it}}}_{r^{Iw}_{it+1}}\right] = 0,$$

with the model error, α^{q}_{i}, as the sample average of the difference

Construct a χ^2 test per Hansen (1982) based on these alphas

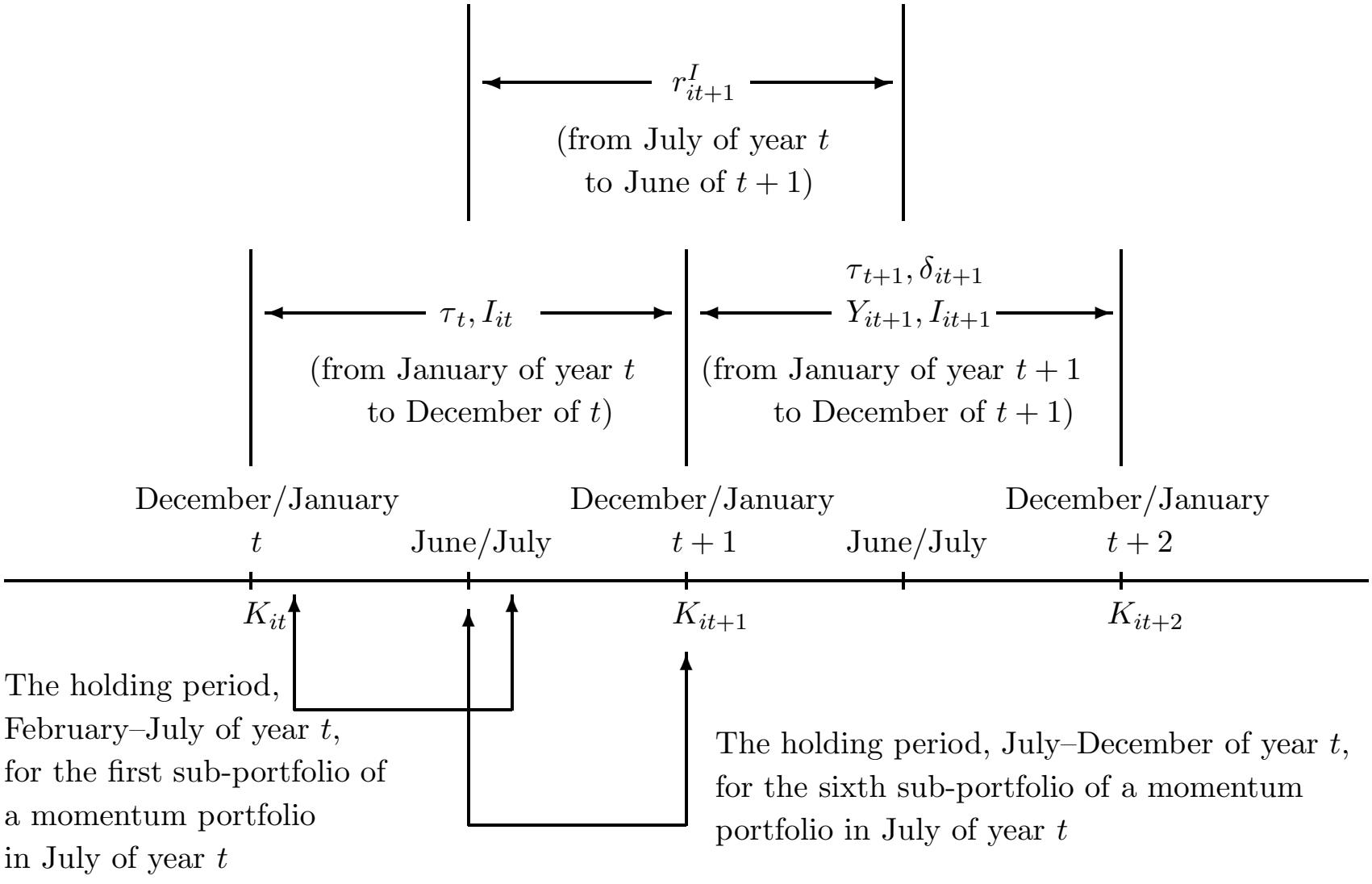
The Q Model

Measurement, 1963–2012

- K_{it}: Net property, plant, and equipment (PPE)
- I_{it}: Capital expenditure minus sales of PPE
- Y_{it}: Sales
- B_{it}: Long-term debt plus short-term debt
- P_{it}: The market value of common equity
- δ_{it}: The amount of depreciation divided by capital
- r^B_{it+1}: Imputed bond ratings, assigning corporate bond returns of a given rating to all firms with the same rating
- τ_t: Statutory tax rate of corporate income

The Q Model

Timing alignment, firms with December fiscal yearend



Outline

Average Momentum Profits

Point estimates

	Price momentum	Earnings momentum
a	2.52	5.41
[se]	[0.94]	[2.51]
κ	0.12	0.17
[se]	[0.02]	[0.03]

Average Momentum Profits

Deciles, alphas and overall model performance

	L	5	W	W−L	mae	[p-val]
			Price momentum			
$\bar{r}^S$	4.04	12.36	19.13	15.09		
α^q	−1.61	1.32	−1.21	0.40	0.83	[0.04]
$[t]$	−0.39	0.44	−0.29	0.12		
			Earnings momentum			
$\bar{r}^S$	10.48	15.48	18.95	8.47		
α^q	−0.39	1.05	−1.31	−0.92	0.63	[0.09]
$[t]$	−0.09	0.25	−0.37	−0.36		

Average Momentum Profits

Comparative statics

$$r^{S}_{it+1} = \overbrace{\frac{\overbrace{(1-\tau_{t+1})\left[\kappa\frac{Y_{it+1}}{K_{it+1}} + \frac{a}{2}\left(\frac{I_{it+1}}{K_{it+1}}\right)^2\right] + \tau_{t+1}\delta_{it+1} + (1-\delta_{it+1})\left[1+(1-\tau_{t+1})a\left(\frac{I_{it+1}}{K_{it+1}}\right)\right]}^{\text{The investment return, } r^{I}_{it+1}}}{1+(1-\tau_t)a\left(\frac{I_{it}}{K_{it}}\right)} - w_{it}r^{Ba}_{it+1}}{1-w_{it}}}^{\text{The levered investment return, } r^{Iw}_{it+1}}$$

Components of expected stock returns:
I_{it}/K_{it}, Y_{it+1}/K_{it+1}, $(I_{it+1}/K_{it+1})/(I_{it}/K_{it})$, and w_{it}

Average Momentum Profits

Expected return components

	Loser	5	Winner	W−L	[t]
			Price momentum		
I_{it}/K_{it}	0.22	0.19	0.25	0.04	[3.6]
$(I_{it+1}/K_{it+1})/(I_{it}/K_{it})$	0.83	0.99	1.15	0.32	[15.4]
Y_{it+1}/K_{it+1}	3.16	3.00	4.10	0.94	[5.6]
w_{it}	0.34	0.25	0.22	−0.12	[−7.2]
			Earnings momentum		
I_{it}/K_{it}	0.19	0.19	0.20	0.01	[2.2]
$(I_{it+1}/K_{it+1})/(I_{it}/K_{it})$	0.95	1.00	1.05	0.10	[5.0]
Y_{it+1}/K_{it+1}	3.01	3.06	3.53	0.52	[3.7]
w_{it}	0.29	0.28	0.20	−0.09	[−7.5]

Average Momentum Profits

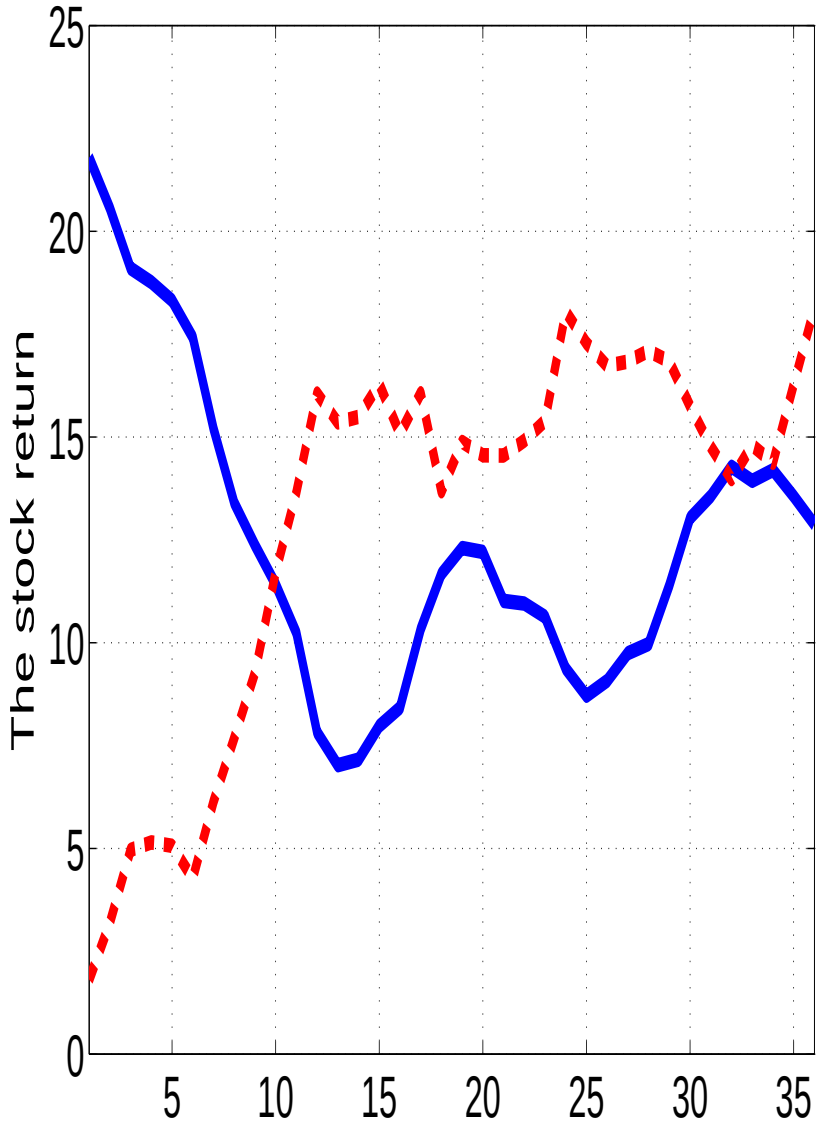
Comparative statics

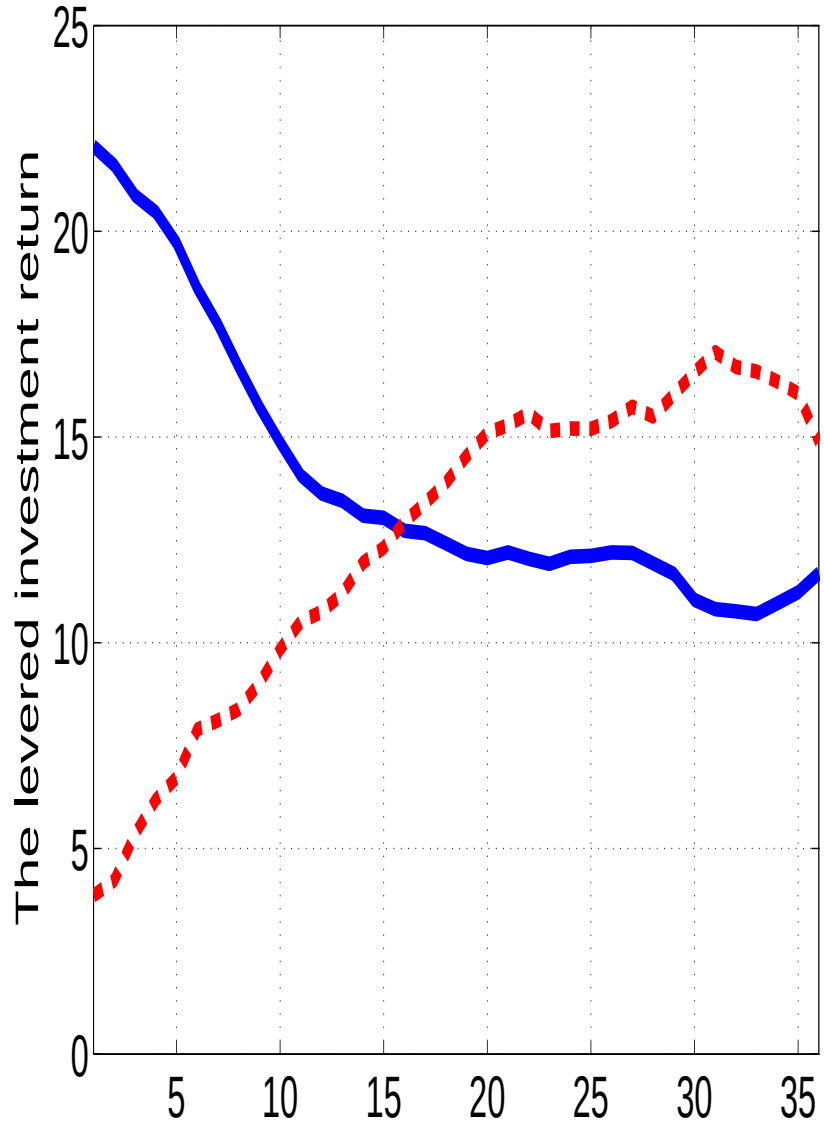
	Loser	5	Winner	W−L
		Price momentum		
$\overline{I_{it}/K_{it}}$	−2.58	3.77	−7.23	−4.65
$\overline{q_{it+1}/q_{it}}$	−7.26	1.00	2.66	9.92
$\overline{Y_{it+1}/K_{it+1}}$	−2.59	−0.56	4.13	6.73
$\overline{w}_{it}$	−1.39	1.22	−1.48	−0.09
		Earnings momentum		
$\overline{I_{it}/K_{it}}$	0.62	2.89	−4.54	−5.16
$\overline{q_{it+1}/q_{it}}$	−3.20	0.88	0.88	4.07
$\overline{Y_{it+1}/K_{it+1}}$	−1.65	0.24	1.71	3.36
$\overline{w}_{it}$	−0.57	1.20	−2.52	−1.95

Outline

Reversal

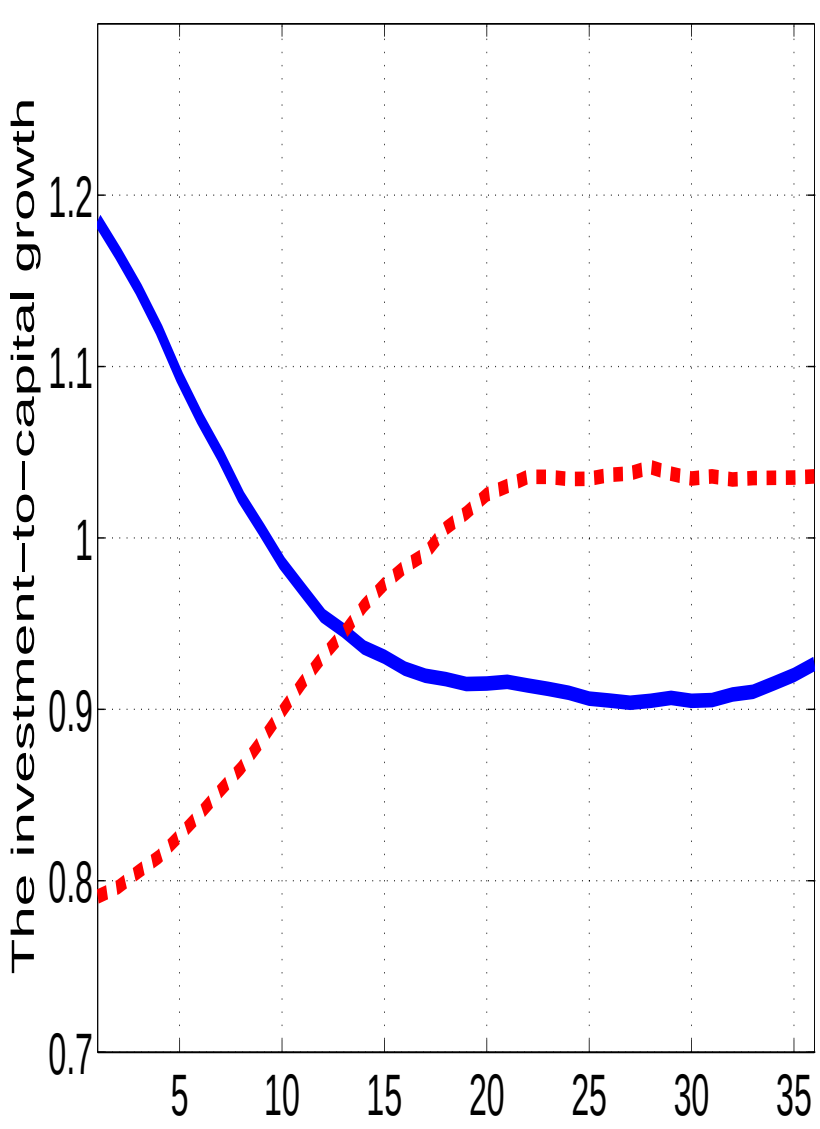
Price momentum, r^{s}_{it+1} and r^{lw}_{it+1}

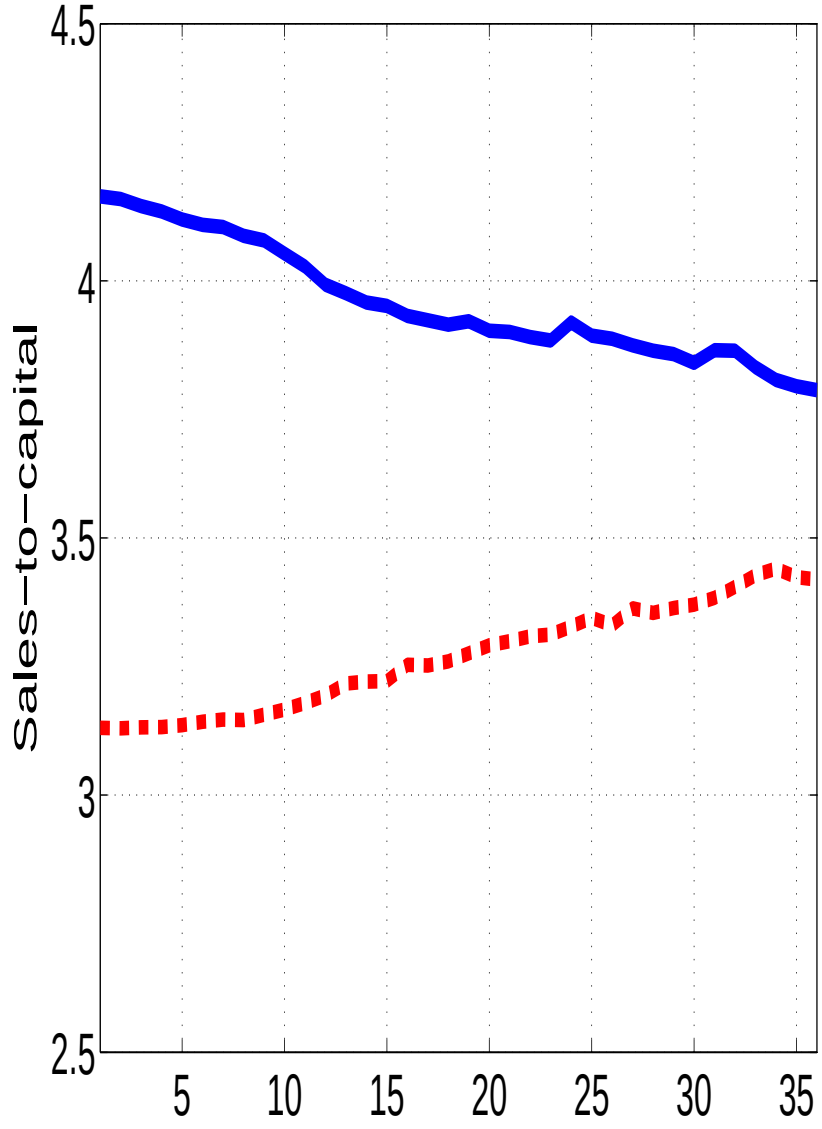




Reversal

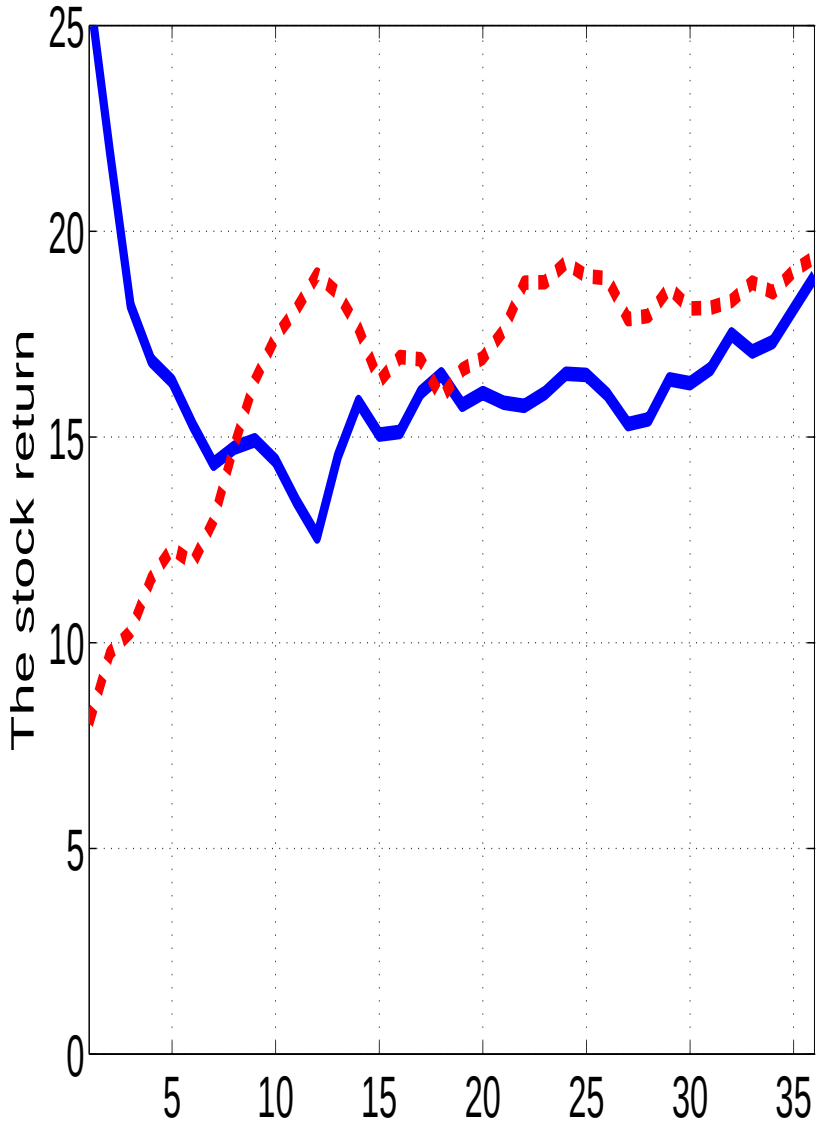
Price momentum, $(I_{it+1}/K_{it+1})/(I_{it}/K_{it})$ and Y_{it+1}/K_{it+1}

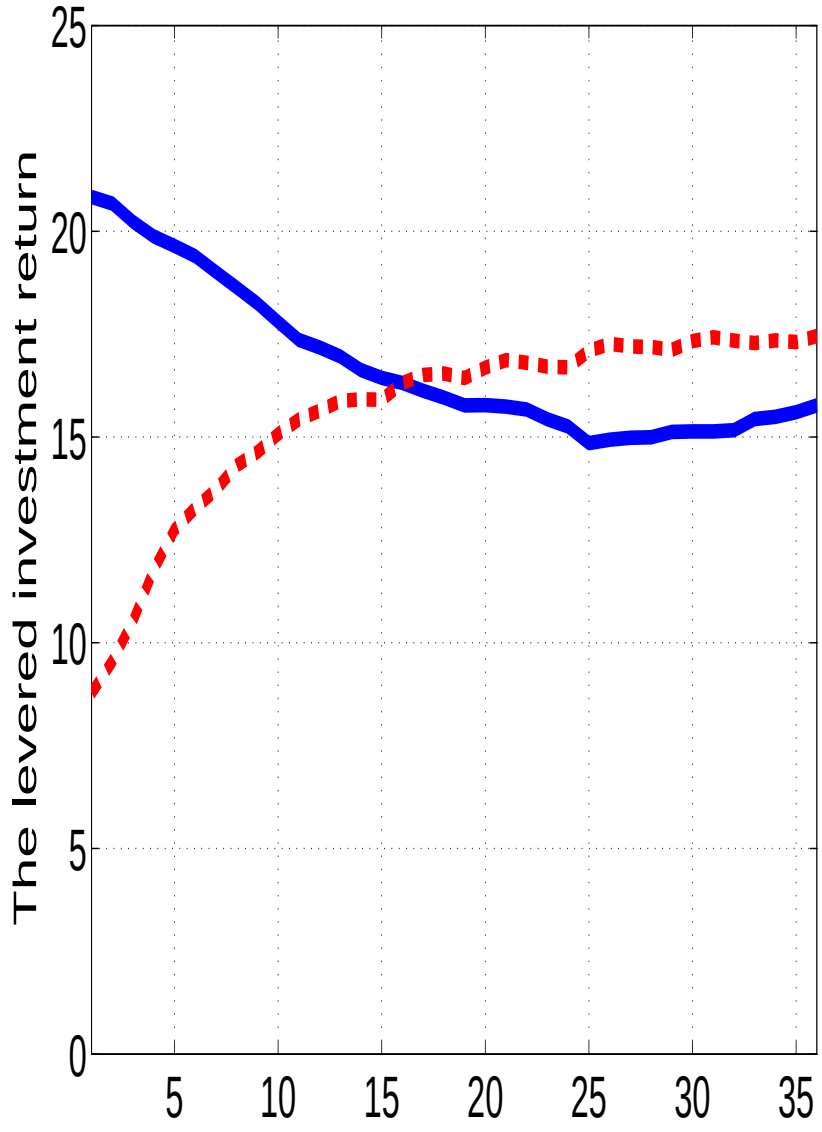




Reversal

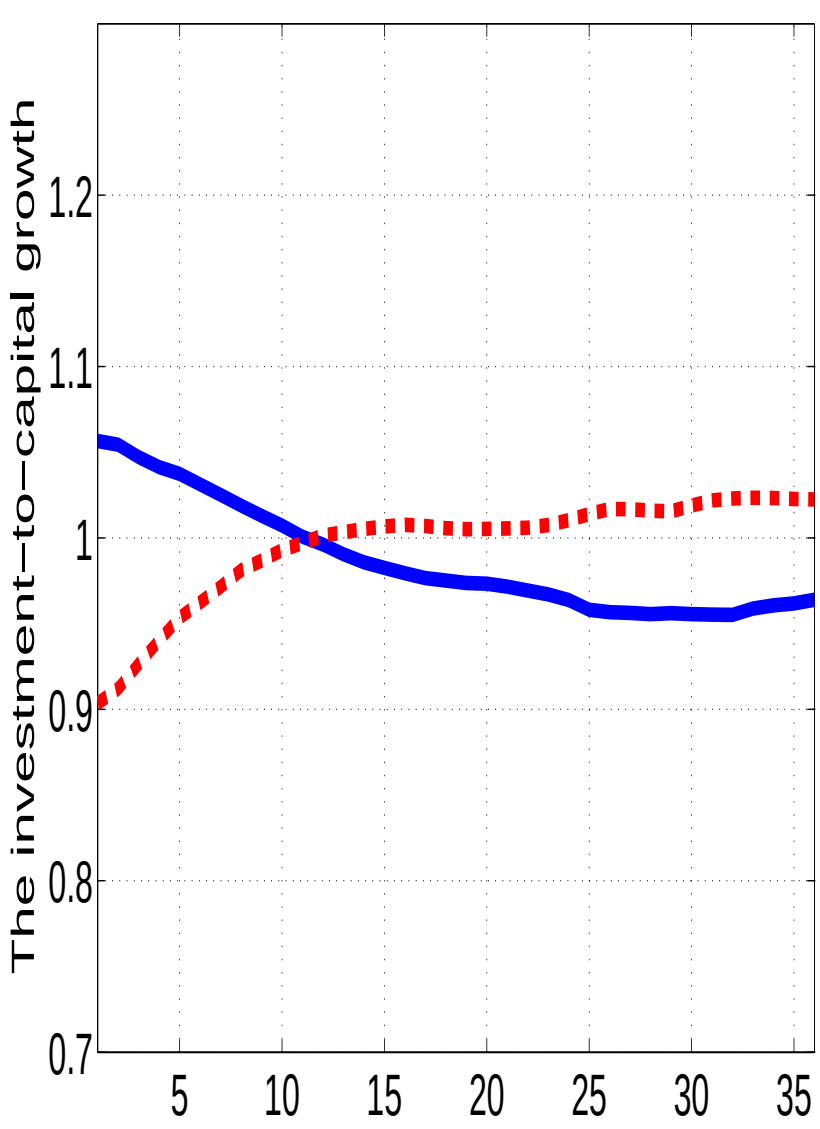
Earnings momentum, r^{s}_{it+1} and r^{lw}_{it+1}

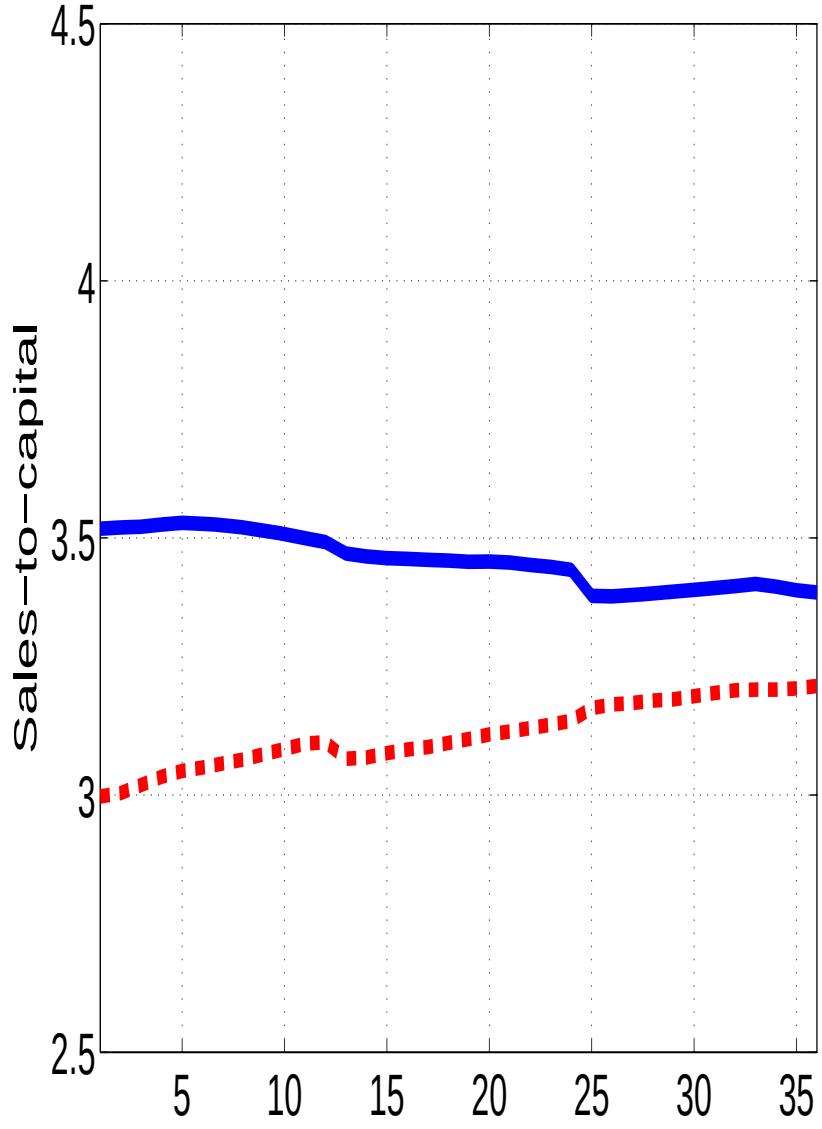




Reversal

Earnings momentum, $(I_{it+1}/K_{it+1})/(I_{it}/K_{it})$ and Y_{it+1}/K_{it+1}





Outline

Long-run Risks

Long-run risks in the stock return

Bansal, Dittmar, and Lundblad (2005) show that aggregate consumption risks in cash flows help explain momentum profits:

$$g_{i,t} = \gamma_i \left(\frac{1}{8} \sum_{k=1}^{8} g_{c,t-k} \right) + u_{i,t}$$

- $g_{i,t}$: demeaned log real dividend growth of momentum decile i
- $g_{c,t}$: demeaned log real growth rate of aggregate consumption
- γ_i: cash flow exposure to long-run consumption growth

Long-run Risks

Long-run risks in the investment return

Define the cash flow in the investment return as:

$$D^{\star}_{it+1} = (1 - \tau_{t+1}) \left[\kappa \frac{Y_{it+1}}{K_{it+1}} + \frac{a}{2} \left(\frac{I_{it+1}}{K_{it+1}} \right)^2 \right] + \tau_{t+1} \delta_{it+1}$$

Let $g^{\star}_{i,t}$: demeaned log real growth of $D^{\star}_{it+1}$ for momentum decile i:

$$g^{\star}_{i,t} = \gamma^{\star}_{i} \left(\frac{1}{8} \sum_{k=1}^{8} g_{c,t-k} \right) + u_{i,t}$$

- $\gamma^{\star}_{i}$: cash flow exposure to long-run consumption growth

Long-run Risks

Evidence

	Price momentum				Earnings momentum			
	γ_i	[se]	$\gamma_i^\star$	[se]	γ_i	[se]	$\gamma_i^\star$	[se]
L	−3.09	[4.41]	4.21	[2.09]	−1.27	[2.51]	6.77	[2.06]
5	0.18	[1.27]	5.52	[1.20]	1.21	[2.20]	5.82	[1.49]
W	14.94	[9.04]	15.95	[2.87]	3.70	[1.94]	9.02	[1.64]
W−L	19.28	[11.66]	11.74	[2.78]	4.97	[3.43]	2.26	[1.67]

Outline

Market States and Momentum

Cooper, Gutierrez, and Hameed (2004), UP (DOWN) defined as the market returns nonnegative (negative) over the prior year

State	Price momentum Profits	[t]		Earnings momentum Profits	[t]	
DOWN	2.21	[0.62]	r^S	1.31	[0.40]	r^S
UP	9.89	[5.04]	r^S	5.04	[6.73]	r^S
DOWN	9.19	[4.50]	r^{lw}	4.50	[2.46]	r^{lw}
UP	6.87	[4.64]	r^{lw}	4.64	[6.51]	r^{lw}

Outline

Interaction

GMM tests, price momentum

	Size	Age	Trading volume	Credit ratings	Stock return volatility	Book-to-market
a	2.33	2.37	2.76	1.97	3.17	3.44
[se]	0.70	0.95	0.93	0.83	0.82	0.89
κ	0.09	0.12	0.12	0.12	0.12	0.13
[se]	0.01	0.01	0.01	0.01	0.02	0.01
p-val	0.00	0.00	0.00	0.00	0.00	0.00
mae	3.66	1.29	1.67	1.68	1.92	3.10

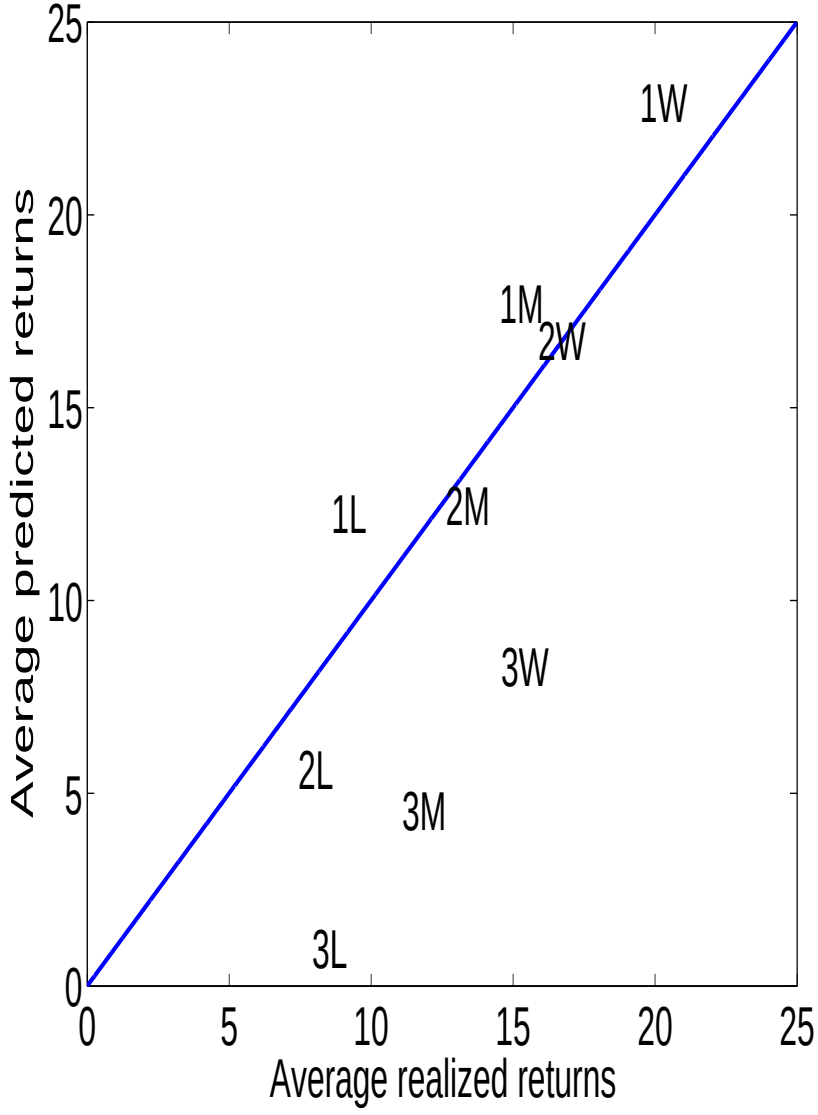
Interaction

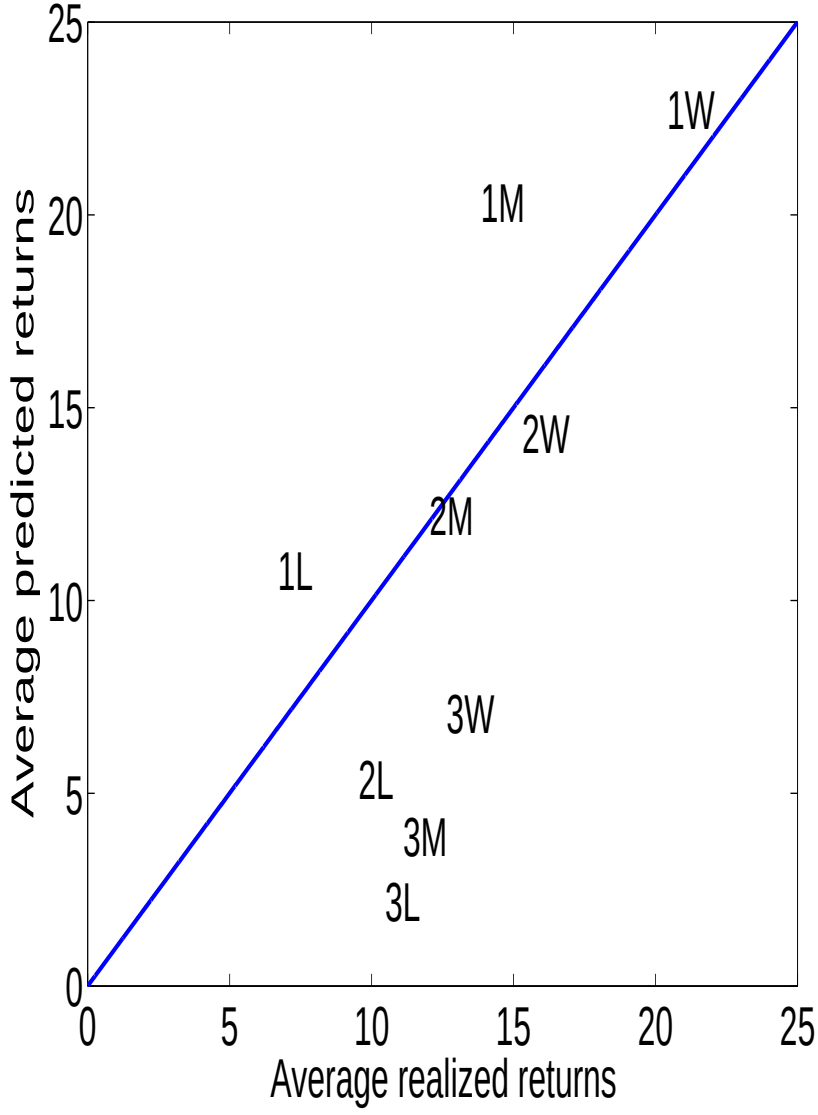
GMM tests, earnings momentum

	Size	Age	Trading volume	Credit ratings	Stock return volatility	Book-to-market
a	2.74	2.75	2.56	1.14	2.74	7.20
[se]	0.60	1.55	1.32	0.72	0.76	2.36
κ	0.09	0.12	0.12	0.11	0.12	0.16
[se]	0.01	0.02	0.02	0.01	0.02	0.02
p-val	0.00	0.27	0.00	0.00	0.00	0.01
mae	4.37	1.08	2.30	1.35	1.95	2.88

Interaction

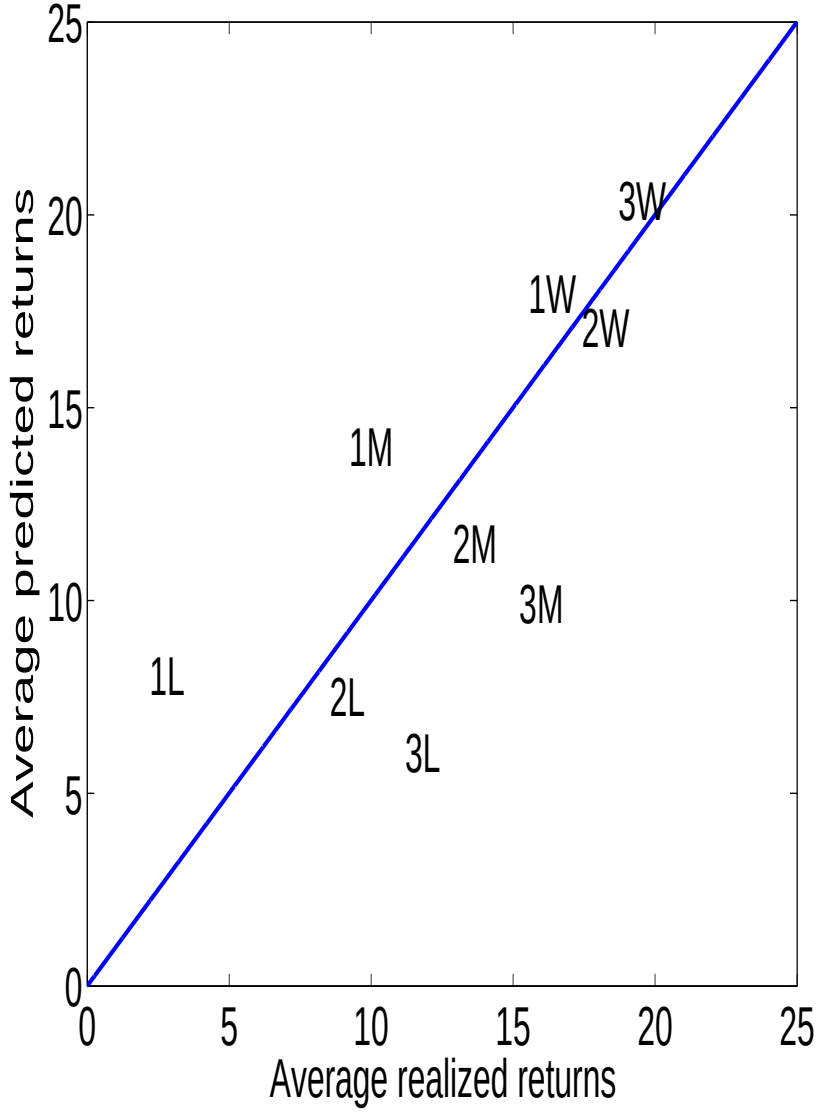
Size and price (earnings) momentum

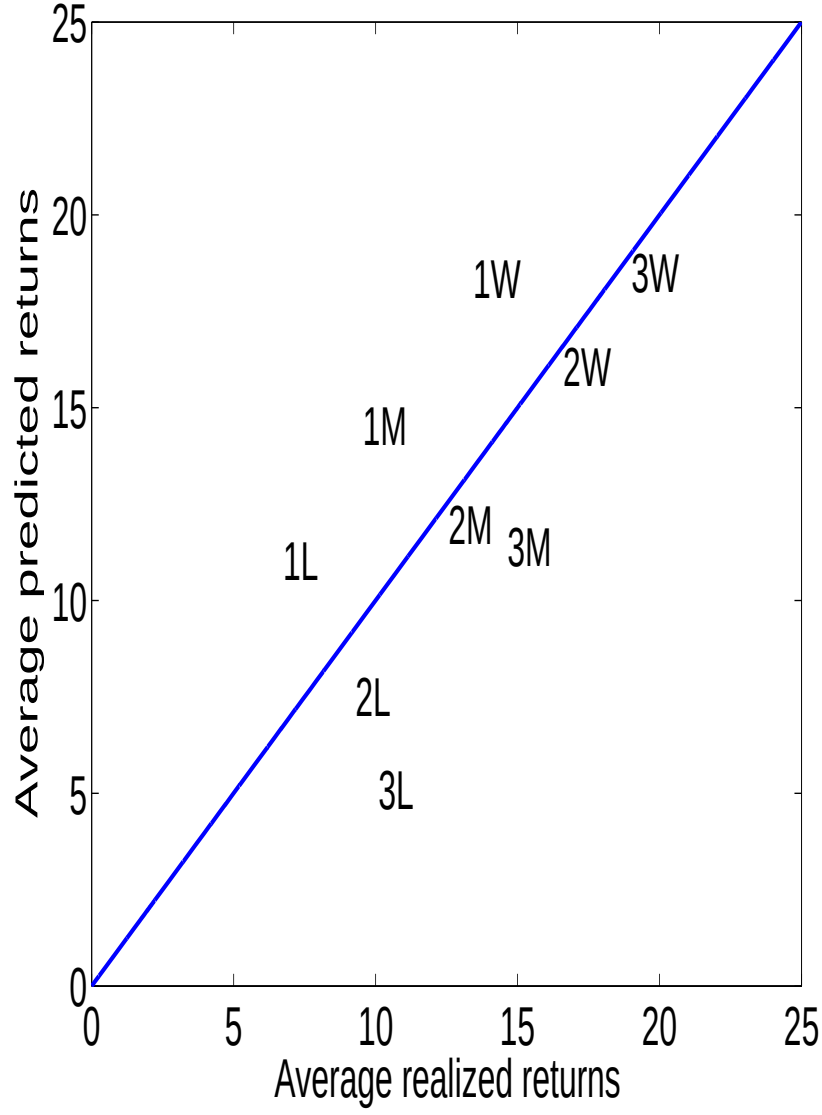




Interaction

Book-to-market and price (earnings) momentum





Outline

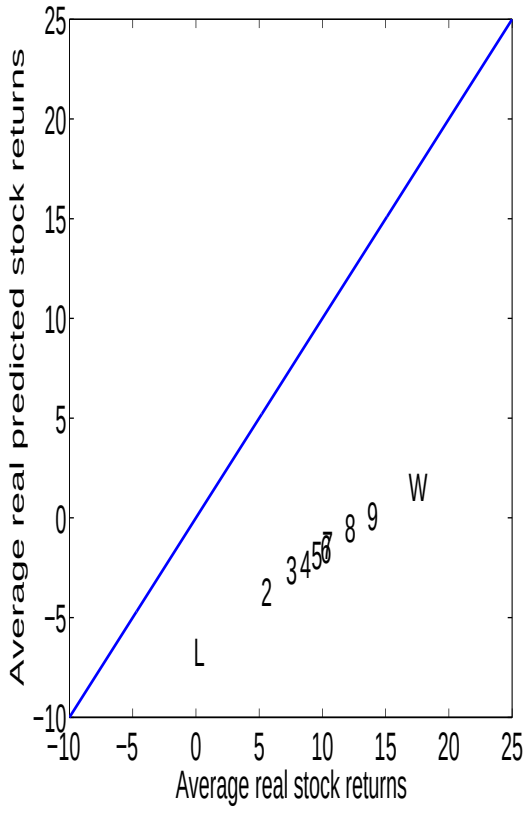
Testing the consumption CAPM and the Q model jointly:

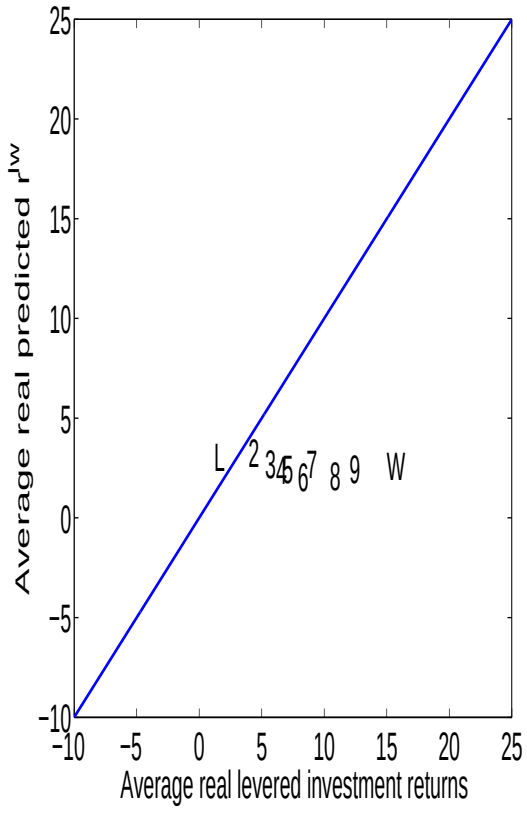
$$\begin{aligned} E[M_{t+1}(r^S_{it+1} - r^f_{t+1})] &= 0, \\ E[M_{t+1}(r^f_{t+1}/i_{t+1})] &= 1, \\ E[M_{t+1}(r^{lw}_{it+1} - r^f_{t+1})] &= 0, \\ E[r^S_{it+1} - r^{lw}_{it+1}] &= 0. \end{aligned}$$

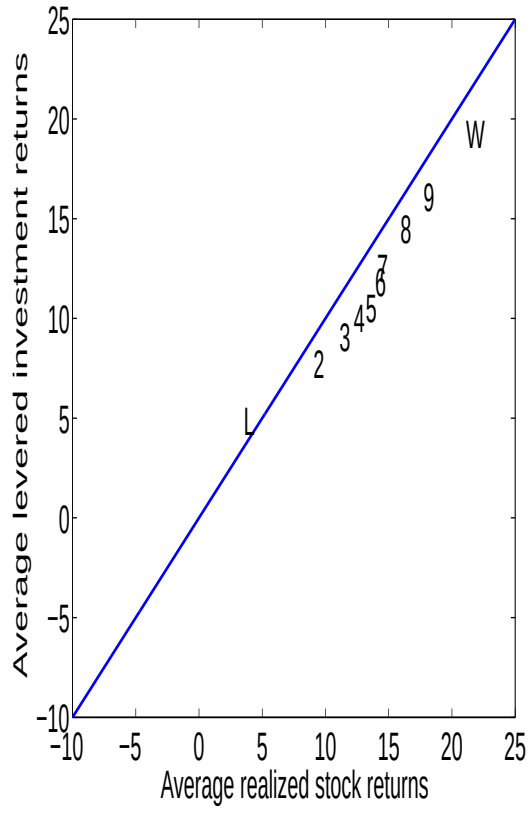
$M_{t+1} = \rho\,(C_{t+1}/C_t)^{-\gamma}$. Annual data

Risk Analysis

R^6: CCAPM with r^S, CCAPM with r^{lw}, Q-moment

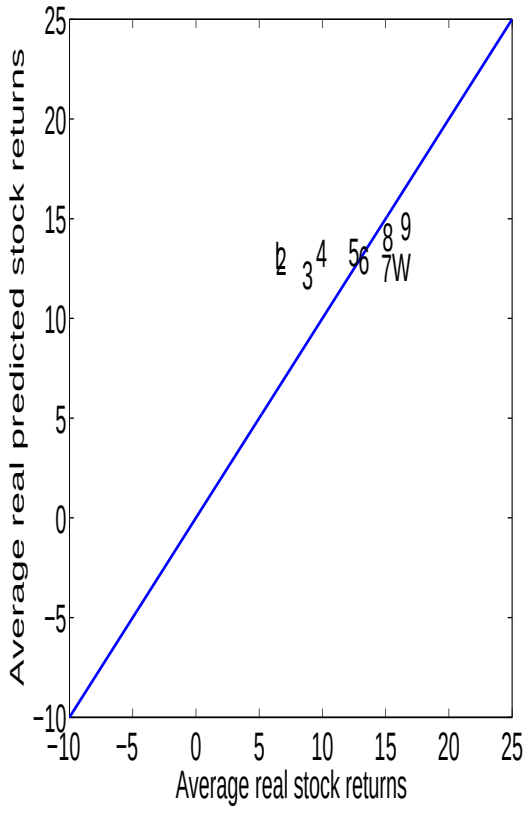


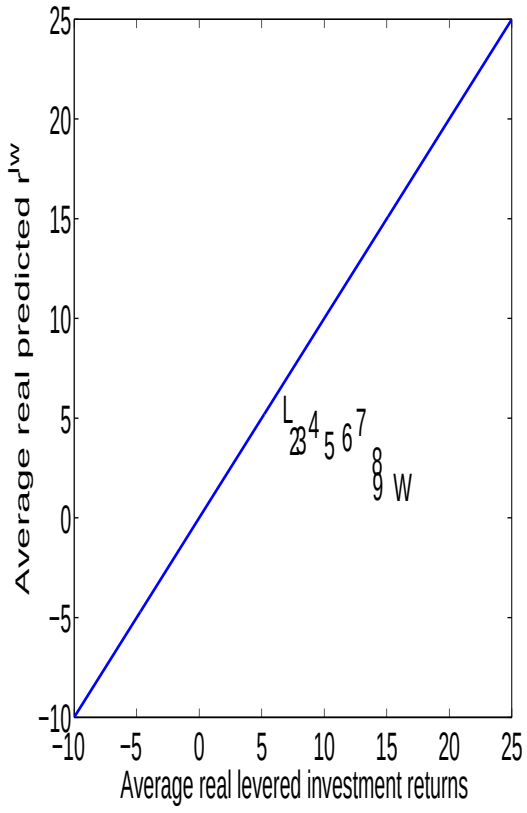


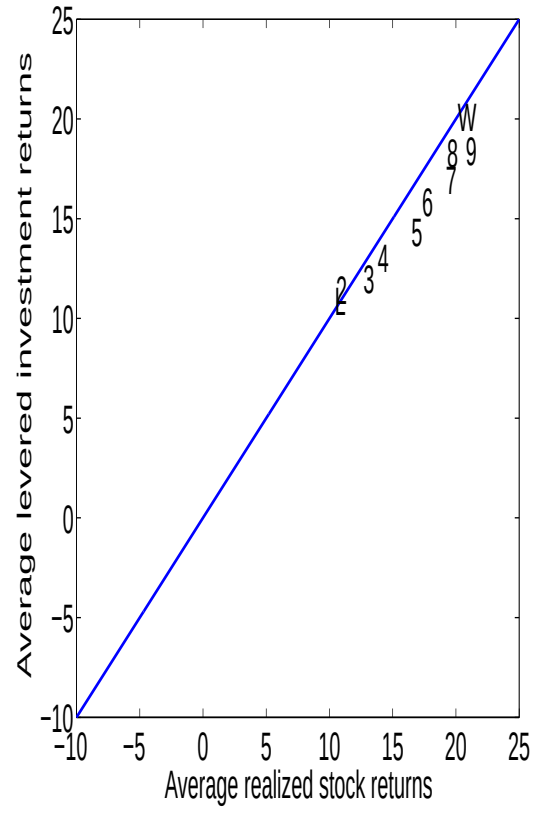


Risk Analysis

SUE: CCAPM with r^S, CCAPM with r^{lw}, Q-moment







Conclusion

Summary and future work

The Q model broadly consistent with many aspects of momentum:

- Managers align investment properly with costs of capital
- Momentum per se might not imply investor irrationality

Several directions in the future:

- Value and momentum jointly, industry-specific parameters
- Value and momentum in currencies, International Q model
- Recent developments in CCAPM in the joint model