Lecture Notes

Hou, Xue, and Zhang (2015, Review of Financial Studies)
Digesting Anomalies: An Investment Approach

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A q-factor model consisting of the market factor, a size factor, an investment factor, and a profitability factor largely summarizes the cross section of average stock returns

$$r_t^i - r_t^f = \alpha_q^i + \beta_{\text{MKT}}^i \, \text{MKT}_t + \beta_{\text{ME}}^i \, r_{\text{ME},t} + \beta_{\text{I/A}}^i \, r_{\text{I/A},t} + \beta_{\text{ROE}}^i \, r_{\text{ROE},t} + \epsilon^i$$

- MKT_t, $r_{\text{ME},t}$, $r_{\text{I/A},t}$, and $r_{\text{ROE},t}$ are the market, size, investment, and *ROE* factors, respectively
- β_{MKT}^i, β_{ME}^i, $\beta_{\text{I/A}}^i$, and β_{ROE}^i are factor loadings

	$\overline{R}$	α	β_{MKT}	β_{SMB}	β_{HML}	β_{UMD}
r_{ME}	0.31	0.23	0.17			
	(2.12)	0.04	0.02	0.99	0.17	
		0.01	0.02	0.99	0.19	0.03
$r_{\text{I/A}}$	0.45	0.52	−0.15			
	(4.95)	0.33	−0.06	−0.02	0.39	
		0.28	−0.05	−0.02	0.41	0.05
r_{ROE}	0.58	0.63	−0.11			
	(4.81)	0.77	−0.09	−0.33	−0.20	
		0.50	−0.03	−0.33	−0.10	0.28

	$r_{\text{I/A}}$	r_{ROE}	MKT	SMB	HML	UMD
r_{ME}	−0.11	−0.31	0.25	0.95	−0.07	0.01
$r_{\text{I/A}}$		0.06	−0.36	−0.22	0.69	0.05
r_{ROE}			−0.19	−0.38	−0.09	0.50

About one half of nearly 80 anomalies are insignificant with NYSE breakpoints and value-weighted decile returns

In "explaining" 35 significant anomalies, the q-factor model performs well relative to the Fama-French and Carhart models:

- The average magnitude of high-minus-low alphas: .20% in q, .33% in Carhart, and .55% in Fama-French
- The number of significant high-minus-low alphas: 5 in q, 19 in Carhart, and 27 in Fama-French
- The number of rejections by the GRS test: 20 in q, 24 in Carhart, and 28 in Fama-French

Outline

Outline

Two periods, 0 and 1

Heterogenous firms, indexed by $i = 1, \ldots, N$

Firm i's operating profits in dates 0 and 1, $\Pi_{i0}A_{i0}$ and $\Pi_{i1}A_{i1}$:

- A_{i0} and A_{i1}: Productive assets

$$A_{i1} = I_{i0}$$

  in which I_{i0} is investment (the depreciation rate is 100%)

- Π_{i0} and Π_{i1}: Profitability (ROE)

M_1: Stochastic discount factor

Firm i's value-maximization problem:

$$P_{i0} + D_{i0} \equiv \max_{\{I_{i0}\}} \Pi_{i0} A_{i0} - I_{i0} - \frac{a}{2}\left(\frac{I_{i0}}{A_{i0}}\right)^2 A_{i0} + E_0[M_1 \Pi_{i1} A_{i1}]$$

The first principle for investment:

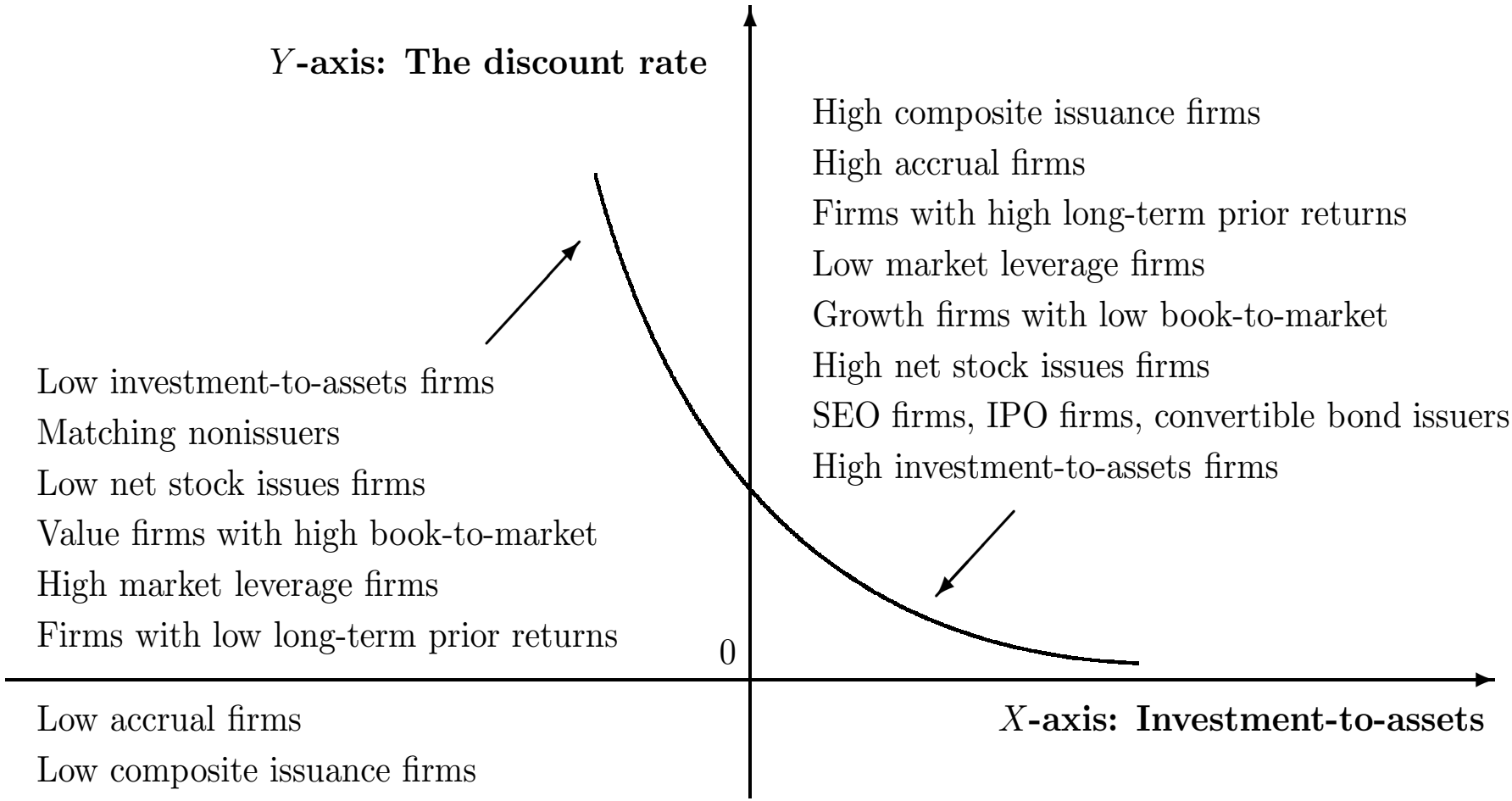
$$1 + a\frac{I_{i0}}{A_{i0}} = E_0[M_1 \Pi_{i1}]$$

A more familiar form from the corporate finance perspective:

$$r_{i1}^S = \frac{P_{i1} + D_{i1}}{P_{i0}} = \frac{\Pi_{i1} A_{i1}}{E_0[M_1 \Pi_{i1} A_{i1}]} = \frac{\Pi_{i1}}{E_0[M_1 \Pi_{i1}]} = \frac{\Pi_{i1}}{1 + a(I_{i0}/A_{i0})}$$

$$E_0[r_{i1}^S] = \frac{E_0[\Pi_{i1}]}{1 + a(I_{i0}/A_{i0})}$$

- All else equal, high investment stocks should earn lower expected returns than low investment stocks
- All else equal, high expected profitability stocks should earn higher expected returns than low expected profitability stocks


Y-axis: The discount rate
High composite issuance firms
High accrual firms
Firms with high long-term prior returns
Low market leverage firms
Growth firms with low book-to-market
High net stock issues firms
SEO firms, IPO firms, convertible bond issuers
High investment-to-assets firms
Low investment-to-assets firms
Matching nonissuers
Low net stock issues firms
Value firms with high book-to-market
High market leverage firms
Firms with low long-term prior returns
0
Low accrual firms
Low composite issuance firms
X-axis: Investment-to-assets

High ROE relative to low investment means high discount rates:

- Suppose the discount rates were low
- Combined with high ROE, low discount rates would imply high net present values of new projects (and high investment)
- So discount rates must be high to counteract high ROE to induce low investment

Price and earnings momentum winners and low distress firms tend to have higher ROE and earn higher expected returns

The investment-based model is a characteristics-based model

We implement a linear factor model:

- Returns are better measured than accounting variables, also with higher frequency
- Estimating the economic model directly involves specification errors in the production and investment technologies, aggregation, etc., absent from the factor model

Outline

Construct $r_{\text{ME},t}$, $r_{\text{I/A},t}$, and $r_{\text{ROE},t}$ with a triple two-by-three-by-three sort on size, investment, and ROE

Variable definitions:

- Size: Stock price times shares outstanding from CRSP
- Investment, I/A: Annual changes in total assets (item AT) divided by lagged total assets
- ROE: Income before extraordinary items (item IBQ) divided by one-quarter-lagged book equity

NYSE breakpoints: 50-50 for size, 30-40-30 for investment, and 30-40-30 for ROE

Timing:

- Annual sort in June on the market equity at the June end
- Annual sort in June of year t on I/A for the fiscal year ending in calendar year $t-1$
- Monthly sort at the beginning of each month on ROE with the most recently announced quarterly earnings

Timing is consistent with the economic model

Use an extensive array of anomaly portfolios (nearly 80), scope comparable with the largest in the literature

- Green, Hand, and Zhang (2013)
- Harvey, Liu, and Zhu (2013)
- McLean and Pontiff (2013)

NYSE breakpoints and value-weighted decile returns to alleviate the impact of microcaps

- Fama and French (2008)

Factors/Testing Portfolios

Six categories of anomalies, 80 in total

Panel A: Momentum (plus six momentum-reversal variables)

SUE-1, earnings surprise (1-month holding period), Foster, Olsen, and Shevlin (1984)	SUE-6, earnings surprise (6-month holding period), Foster, Olsen, and Shevlin (1984)
Abr-1, cumulative abnormal stock returns around earnings announcements (1-month holding period), Chan, Jegadeesh, and Lakonishok (1996)	Abr-6, cumulative abnormal stock returns around earnings announcements (6-month holding period), Chan, Jegadeesh, and Lakonishok (1996)
RE-1, revisions in analysts' earnings forecasts (1-month holding period), Chan, Jegadeesh, and Lakonishok (1996)	RE-6, revisions in analysts' earnings forecasts (6-month holding period), Chan, Jegadeesh, and Lakonishok (1996)
R6-1, price momentum (6-month prior returns, 1-month holding period), Jegadeesh and Titman (1993)	R6-6, price momentum (6-month prior returns, 6-month holding period), Jegadeesh and Titman (1993)
R11-1, price momentum, (11-month prior returns, 1-month holding period), Fama and French (1996)	I-Mom, industry momentum, Moskowitz and Grinblatt (1999)

Factors/Testing Portfolios

Six categories of anomalies, 80 in total

Panel B: Value versus growth

B/M, book-to-market equity, Rosenberg, Reid, and Lanstein (1985)	A/ME, market leverage, Bhandari (1988)
Rev, reversal, De Bondt and Thaler (1985)	E/P, earnings-to-price, Basu (1983)
EF/P, analysts' earnings forecasts-to-price, Elgers, Lo, and Pfeiffer (2001)	CF/P, cash flow-to-price, Lakonishok, Shleifer, and Vishny (1994)
D/P, dividend yield, Litzenberger and Ramaswamy (1979)	O/P, payout yield, Boudoukh, Michaely, Richardson, and Roberts (2007)
NO/P, net payout yield, Boudoukh, Michaely, Richardson, and Roberts (2007)	SG, sales growth, Lakonishok, Shleifer, and Vishny (1994)
LTG, long-term growth forecasts of analysts, La Porta (1996)	Dur, equity duration, Dechow, Sloan, and Soliman (2004)

Factors/Testing Portfolios

Six categories of anomalies, 80 in total

Panel C: Investment

ACI, abnormal corporate investment, Titman, Wei, and Xie (2004)	I/A, investment-to-assets, Cooper, Gulen, and Schill (2008)
NOA, net operating assets, Hirshleifer, Hou, Teoh, and Zhang (2004)	△PI/A, changes in PPE plus changes in inventory scaled by assets, Lyandres, Sun, and Zhang (2008)
IG, investment growth, Xing (2008)	NSI, net stock issues, Pontiff and Woodgate (2008)
CEI, composite issuance, Daniel and Titman (2006)	NXF, net external financing, Bradshaw, Richardson, and Sloan (2006)
IvG, inventory growth, Belo and Lin (2011)	IvC, inventory changes, Thomas and Zhang (2002)
OA, operating accruals, Sloan (1996)	TA, total accruals, Richardson, Sloan, Soliman, and Tuna (2005)
POA, percent operating accruals, Hafzalla, Lundholm, and Van Winkle (2011)	PTA, percent total accruals, Hafzalla, Lundholm, and Van Winkle (2011)

Factors/Testing Portfolios

Six categories of anomalies, 80 in total

Panel D: Profitability

ROE, return on equity, Haugen and Baker (1996)	ROA, return on assets, Balakrishnan, Bartov, and Faurel (2010)
RNA, return on net operating assets, Soliman (2008)	PM, profit margin, Soliman (2008)
ATO, asset turnover, Soliman (2008)	CTO, capital turnover, Haugen and Baker (1996)
GP/A, gross profits-to-assets, Novy-Marx (2013)	*F*, *F*-score, Piotroski (2000)
TES, tax expense surprise, Thomas and Zhang (2011)	TI/BI, taxable income-to-book income, Green, Hand, and Zhang (2013)
RS, revenue surprise, Jegadeesh and Livnat (2006)	NEI, number of consecutive quarters with earnings increases, Barth, Elliott, and Finn (1999)
FP, failure probability, Campbell, Hilscher, and Szilagyi (2008)	*O*, *O*-score, Dichev (1998)

Factors/Testing Portfolios

Six categories of anomalies, 80 in total

Panel E: Intangibles and other characteristics

OC/A, organizational capital-to-assets, Eisfeldt and Papanikolaou (2013)

Ad/M, advertisement expense-to-market, Chan, Lakonishok, and Sougiannis (2001)

RD/M, R&D-to-market, Chan, Lakonishok, and Sougiannis (2001)

H/N, hiring rate, Belo, Lin, and Bazdresch (2014)

G, corporate governance, Gompers, Ishii, and Metrick (2003)

Ind, industries, Fama and French (1997)

BC/A, brand capital-to-assets, Belo, Lin, and Vitorino (2014)

RD/S, R&D-to-sales, Chan, Lakonishok, and Sougiannis (2001)

RC/A, R&D capital-to-assets, Li (2011)

OL, operating leverage, Novy-Marx (2011)

AccQ, accrual quality, Francis, Lafond, Olsson, and Schipper (2005)

Factors/Testing Portfolios

Six categories of anomalies, 80 in total

Panel F: Trading frictions

ME, the market equity,
Banz (1981)
Tvol, total volatility,
Ang, Hodrick, Xing, and Zhang (2006)
MDR, maximum daily return,
Bali, Cakici, and Whitelaw (2011)
D-β, Dimson's beta, Dimson (1979)
Disp, dispersion of analysts' earnings forecasts,
Diether, Malloy, and Scherbina (2002)
1/P, 1/share price,
Miller and Scholes (1982)
Illiq, Absolute return-to-volume,
Amihud (2002)

Ivol, idiosyncratic volatility,
Ang, Hodrick, Xing, and Zhang (2006)
Svol, systematic volatility,
Ang, Hodrick, Xing, and Zhang (2006)
β, market beta,
Frazzini and Pedersen (2014)
S-Rev, short-term reversal, Jegadeesh (1990)
Turn, share turnover,
Datar, Naik, and Radcliffe (1998)

Dvol, dollar trading volume,
Brennan, Chordia, and Subrahmanyam (1998)

Factors/Testing Portfolios

Insignificant anomalies in the broad cross section

	R6-1	A/ME	Rev	EF/P	D/P	O/P	SG	LTG	ACI	NXF
m	0.48	0.43	−0.39	0.45	0.27	0.35	−0.27	0.01	−0.27	−0.30
t_m	1.43	1.82	−1.57	1.73	0.94	1.53	−1.34	0.02	−1.70	−1.55
	TA	RNA	PM	ATO	CTO	F	TES	TI/BI	RS	O
m	−0.19	0.13	0.10	0.22	0.20	0.37	0.32	0.13	0.29	−0.08
t_m	−1.31	0.61	0.40	1.11	1.11	1.28	1.92	0.86	1.82	−0.37
	BC/A	RD/S	RC/A	H/N	G	AccQ	ME	Ivol	Tvol	MDR
m	0.18	0.01	0.32	−0.25	0.03	−0.18	−0.24	−0.54	−0.37	−0.31
t_m	0.73	0.06	1.27	−1.47	0.09	−0.79	−0.90	−1.56	−0.95	−0.94
	β	D-β	S-Rev	Disp	Turn	1/P	Dvol	Illiq		
m	−0.13	0.07	−0.31	−0.33	−0.12	−0.00	−0.26	0.27		
t_m	−0.36	0.30	−1.39	−1.24	−0.43	−0.01	−1.30	1.14		

Outline

Factor Regressions

Significant anomalies in the momentum category

	SUE-1	SUE-6	Abr-1	Abr-6	RE-1	RE-6	R6-6	R11-1	I-Mom	|ave|
m	0.45	0.24	0.73	0.30	0.89	0.60	0.85	1.18	0.51	
α_{FF}	0.55	0.39	0.84	0.38	1.20	0.94	1.12	1.52	0.68	0.85
α_C	0.34	0.18	0.62	0.19	0.56	0.37	0.06	0.09	−0.18	0.29
α_q	0.16	0.02	0.64	0.26	0.12	0.03	0.24	0.24	0.00	0.19
t_m	3.59	2.17	5.50	3.11	3.43	2.58	3.17	3.52	2.33	
t_{FF}	4.50	3.62	5.93	3.89	4.81	4.52	4.47	4.99	3.25	
t_C	2.62	1.69	4.37	2.06	2.56	2.15	0.51	0.67	−1.11	
t_q	1.12	0.18	4.07	2.18	0.43	0.14	0.71	0.54	0.01	
$\overline{\lvert\alpha_{FF}\rvert}$	0.17	0.13	0.16	0.11	0.27	0.23	0.19	0.26	0.15	0.19
$\overline{\lvert\alpha_C\rvert}$	0.11	0.09	0.12	0.08	0.11	0.09	0.10	0.13	0.06	0.10
$\overline{\lvert\alpha_q\rvert}$	0.05	0.07	0.13	0.07	0.10	0.11	0.08	0.13	0.13	0.10
p_{FF}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	
p_C	0.00	0.00	0.00	0.01	0.16	0.12	0.00	0.00	0.45	
p_q	0.42	0.04	0.00	0.02	0.46	0.08	0.00	0.01	0.03	

Factor Regressions

Significant anomalies in the value minus growth category

	B/M	E/P	CF/P	NO/P	Dur	|ave|
m	0.70	0.59	0.52	0.66	−0.54	
α_{FF}	0.01	0.05	0.01	0.52	−0.06	0.13
α_C	−0.01	0.01	−0.06	0.49	−0.08	0.13
α_q	0.21	0.17	0.22	0.36	−0.27	0.25
t_m	2.88	2.63	2.44	3.23	−2.59	
t_{FF}	0.04	0.34	0.08	3.51	−0.44	
t_C	−0.06	0.03	−0.40	3.33	−0.56	
t_q	1.15	0.76	1.04	2.38	−1.32	
$\overline{\lvert\alpha_{FF}\rvert}$	0.07	0.10	0.08	0.17	0.11	0.11
$\overline{\lvert\alpha_C\rvert}$	0.06	0.09	0.07	0.15	0.08	0.09
$\overline{\lvert\alpha_q\rvert}$	0.08	0.10	0.14	0.12	0.08	0.10
p_{FF}	0.19	0.18	0.43	0.00	0.15	
p_C	0.29	0.38	0.37	0.00	0.41	
p_q	0.35	0.13	0.02	0.00	0.72	

Factor Regressions

Significant anomalies in the investment category

	I/A	NOA	△PI/A	IG	NSI	CEI	IvG	IvC	OA	POA	PTA	|ave|
m	−0.42	−0.38	−0.51	−0.41	−0.68	−0.57	−0.41	−0.45	−0.30	−0.46	−0.40	
α_{FF}	−0.15	−0.52	−0.41	−0.26	−0.64	−0.50	−0.29	−0.38	−0.37	−0.32	−0.29	0.38
α_C	−0.09	−0.41	−0.36	−0.20	−0.54	−0.40	−0.19	−0.30	−0.33	−0.25	−0.27	0.30
α_q	0.14	−0.38	−0.26	0.05	−0.26	−0.22	−0.03	−0.28	−0.56	−0.12	−0.10	0.22
t_m	−2.45	−2.55	−3.43	−2.93	−4.13	−2.96	−2.77	−3.05	−2.32	−3.02	−2.57	
t_{FF}	−1.09	−3.30	−2.93	−1.99	−4.28	−3.72	−2.10	−2.61	−2.84	−2.42	−2.06	
t_C	−0.61	−2.69	−2.48	−1.51	−3.58	−2.93	−1.34	−1.97	−2.32	−1.88	−1.82	
t_q	1.08	−1.90	−1.85	0.39	−1.75	−1.50	−0.20	−1.84	−3.90	−0.87	−0.67	
$\overline{\lvert\alpha_{FF}\rvert}$	0.12	0.17	0.13	0.13	0.18	0.15	0.11	0.12	0.13	0.11	0.11	0.13
$\overline{\lvert\alpha_C\rvert}$	0.10	0.14	0.12	0.11	0.15	0.15	0.10	0.10	0.12	0.11	0.10	0.12
$\overline{\lvert\alpha_q\rvert}$	0.09	0.12	0.14	0.09	0.11	0.12	0.11	0.08	0.15	0.12	0.08	0.11
p_{FF}	0.01	0.00	0.00	0.00	0.00	0.00	0.03	0.01	0.00	0.00	0.01	
p_C	0.02	0.00	0.01	0.00	0.00	0.00	0.11	0.04	0.00	0.01	0.02	
p_q	0.01	0.00	0.00	0.01	0.02	0.01	0.08	0.56	0.00	0.00	0.11	

Factor Regressions

Significant anomalies in the profitability category

	ROE	ROA	GP/A	NEI	FP	|ave|
m	0.80	0.62	0.34	0.39	−0.67	
α_{FF}	1.17	1.00	0.50	0.63	−1.44	0.95
α_C	0.85	0.67	0.45	0.43	−0.67	0.61
α_q	0.05	0.09	0.11	0.18	−0.17	0.12
t_m	3.11	2.70	2.18	3.31	−1.98	
t_{FF}	5.43	5.40	3.25	6.03	−6.44	
t_C	4.03	3.59	2.85	3.73	−3.79	
t_q	0.37	0.72	0.71	1.68	−0.57	
$\overline{\lvert\alpha_{FF}\rvert}$	0.24	0.23	0.14	0.23	0.23	0.21
$\overline{\lvert\alpha_C\rvert}$	0.15	0.14	0.14	0.15	0.12	0.14
$\overline{\lvert\alpha_q\rvert}$	0.09	0.07	0.11	0.09	0.13	0.10
p_{FF}	0.00	0.00	0.01	0.00	0.00	
p_C	0.00	0.04	0.01	0.00	0.00	
p_q	0.05	0.75	0.38	0.05	0.00	

Factor Regressions

Significant anomalies in the intangibles and trading frictions categories

	OC/A	Ad/M	RD/M	OL	Svol	|ave|
m	0.56	0.79	0.63	0.39	−0.60	
α_{FF}	0.61	0.15	0.22	0.37	−0.66	0.40
α_C	0.40	0.32	0.31	0.33	−0.62	0.40
α_q	0.09	0.11	0.60	−0.05	−0.37	0.24
t_m	4.07	2.96	2.31	2.06	−2.57	
t_{FF}	4.52	0.79	0.93	1.91	−2.88	
t_C	2.97	1.37	1.40	1.76	−2.59	
t_q	0.66	0.39	2.40	−0.27	−1.42	
$\overline{\lvert\alpha_{FF}\rvert}$	0.15	0.13	0.17	0.11	0.19	0.15
$\overline{\lvert\alpha_C\rvert}$	0.13	0.18	0.21	0.12	0.16	0.16
$\overline{\lvert\alpha_q\rvert}$	0.11	0.11	0.27	0.12	0.11	0.14
p_{FF}	0.00	0.18	0.02	0.07	0.01	
p_C	0.00	0.07	0.01	0.06	0.06	
p_q	0.02	0.07	0.00	0.09	0.20	

Overall, except for the operating accrual anomaly and the R&D-to-market anomaly, the q-factor model performs as well as, and in most cases outperforms the Fama-French and Carhart models across major categories of anomalies:

- The q-factor model beats the Carhart model and by a bigger margin the Fama-French model in the momentum category
- The q-factor model also outperforms in the investment category and dominates in the profitability category
- The models are comparable in the value versus growth category
- The size factor plays only a limited role in the q-factor model

Outline

Factor Regressions

q-factor loadings and q-characteristics, the momentum category

	SUE-1	SUE-6	Abr-1	Abr-6	RE-1	RE-6	R6-6	R11-1	I-Mom
β_{MKT}	−0.08	−0.06	−0.06	−0.03	−0.05	−0.07	−0.09	−0.14	−0.11
β_{ME}	0.10	0.09	0.07	0.09	−0.15	−0.19	0.27	0.40	0.31
$\beta_{I/A}$	0.02	−0.11	−0.13	−0.16	0.04	−0.12	−0.07	0.04	−0.03
β_{ROE}	0.48	0.45	0.28	0.18	1.33	1.12	1.02	1.48	0.82
$t_{\beta_{MKT}}$	−1.82	−1.53	−1.31	−1.20	−0.76	−1.24	−1.17	−1.43	−1.72
$t_{\beta_{ME}}$	1.94	1.27	0.67	1.82	−1.42	−1.98	1.43	1.74	1.86
$t_{\beta_{I/A}}$	0.18	−0.97	−1.25	−2.24	0.25	−0.82	−0.27	0.12	−0.13
$t_{\beta_{ROE}}$	5.75	5.95	3.26	2.94	10.09	9.96	5.31	5.67	4.90
ME	0.69	0.75	−0.01	0.03	0.77	0.87	0.40	0.52	0.62
I/A	−1.46	−0.96	−1.37	−1.13	−0.80	0.72	−4.07	−3.83	−1.18
ROE	5.80	3.38	1.59	1.49	6.58	6.47	4.14	5.34	1.61
t_{ME}	4.91	5.38	−0.29	1.31	8.75	9.65	4.92	4.95	3.67
$t_{I/A}$	−3.30	−2.57	−2.36	−2.58	−1.22	1.13	−5.54	−4.66	−1.79
t_{ROE}	16.46	19.07	13.38	15.47	29.77	27.86	16.00	17.06	10.24

Factor Regressions

q-factor loadings and q-characteristics, the value versus growth category

	B/M	E/P	CF/P	NO/P	Dur
β_{MKT}	−0.03	−0.12	−0.15	−0.18	0.11
β_{ME}	0.46	0.25	0.19	−0.32	−0.23
$\beta_{I/A}$	1.45	0.99	1.01	1.03	−0.85
β_{ROE}	−0.51	−0.09	−0.24	0.02	0.24
$t_{\beta_{MKT}}$	−0.59	−2.02	−2.41	−3.86	1.67
$t_{\beta_{ME}}$	5.37	1.90	1.66	−4.40	−1.61
$t_{\beta_{I/A}}$	12.74	5.76	6.79	10.25	−5.69
$t_{\beta_{ROE}}$	−5.98	−0.66	−1.78	0.19	1.87
ME	−2.46	−0.73	−0.89	1.23	0.41
I/A	−9.70	−1.11	−5.63	−14.43	3.95
ROE	−5.68	0.21	−0.72	1.18	0.49
t_{ME}	−10.31	−4.09	−4.57	7.74	5.23
$t_{I/A}$	−17.06	−1.20	−5.47	−13.81	2.73
t_{ROE}	−29.57	1.30	−4.83	7.27	2.22

Factor Regressions

q-factor loadings and q-characteristics, the investment category

	I/A	NOA	△PI/A	IG	NSI	CEI	IvG	IvC	OA	POA	PTA
β_{MKT}	0.02	−0.02	0.05	−0.02	0.04	0.24	−0.03	0.04	0.03	−0.01	0.06
β_{ME}	−0.11	0.06	−0.05	−0.11	0.17	0.26	0.12	0.00	0.28	0.15	0.21
$\beta_{I/A}$	−1.37	−0.01	−0.77	−0.82	−0.68	−1.06	−0.96	−0.65	−0.02	−0.90	−0.90
β_{ROE}	0.15	−0.01	0.16	−0.07	−0.32	−0.12	0.05	0.18	0.29	0.05	0.04
$t_{\beta_{MKT}}$	0.62	−0.55	1.33	−0.71	0.99	6.27	−0.77	1.01	0.80	−0.19	1.50
$t_{\beta_{ME}}$	−1.81	0.54	−0.94	−1.95	2.24	3.79	2.85	−0.07	4.41	3.20	3.28
$t_{\beta_{I/A}}$	−15.50	−0.04	−6.98	−10.91	−6.14	−13.11	−11.81	−5.49	−0.21	−9.61	−8.72
$t_{\beta_{ROE}}$	2.29	−0.12	1.93	−1.06	−4.07	−1.42	0.56	1.95	4.59	1.04	0.55
ME	0.88	0.07	0.63	0.22	−1.37	−1.79	0.26	0.19	−0.24	−0.36	−0.36
I/A	83.89	55.72	61.16	34.03	27.04	14.80	37.85	44.80	10.15	11.12	16.14
ROE	1.63	−1.24	0.84	0.50	−1.71	−1.41	0.42	1.07	0.88	1.02	0.36
t_{ME}	7.75	1.71	7.56	6.16	−6.44	−7.77	4.27	4.86	−5.13	−9.39	−6.76
$t_{I/A}$	32.74	18.28	30.77	22.38	13.85	14.37	23.42	34.89	5.19	7.90	12.93
t_{ROE}	10.00	−7.89	5.10	3.24	−11.87	−9.07	3.31	8.13	5.06	7.42	2.56

Factor Regressions

q-factor loadings and q-characteristics, the profitability category

	ROE	ROA	GP/A	NEI	FP
β_{MKT}	−0.10	−0.14	0.05	0.02	0.44
β_{ME}	−0.41	−0.38	0.03	−0.10	0.43
$\beta_{\text{I/A}}$	0.10	−0.10	−0.24	−0.30	0.17
β_{ROE}	1.50	1.31	0.52	0.63	−1.61
$t_{\beta_{\text{MKT}}}$	−2.57	−4.48	1.20	0.88	6.46
$t_{\beta_{\text{ME}}}$	−6.56	−6.41	0.51	−2.53	2.45
$t_{\beta_{\text{I/A}}}$	1.05	−1.23	−2.35	−3.78	0.63
$t_{\beta_{\text{ROE}}}$	20.71	16.86	7.08	10.83	−8.79
ME	2.81	2.66	0.39	2.34	−3.09
I/A	3.56	5.32	−1.29	5.35	−3.91
ROE	16.95	14.71	3.94	4.32	−8.74
t_{ME}	10.56	10.50	10.84	11.58	−10.76
$t_{\text{I/A}}$	4.16	6.88	−2.05	11.45	−4.18
t_{ROE}	29.02	27.97	23.88	27.36	−25.56

Factor Regressions

q-factor loadings and q-characteristics, intangibles and trading frictions

	OC/A	Ad/M	RD/M	OL	Svol
β_{MKT}	−0.13	0.04	0.16	−0.06	0.04
β_{ME}	0.25	0.50	0.66	0.26	0.31
$\beta_{I/A}$	0.35	1.42	0.21	0.16	−0.21
β_{ROE}	0.51	−0.27	−0.58	0.54	−0.43
$t_{\beta_{MKT}}$	−3.74	0.50	2.51	−1.22	0.53
$t_{\beta_{ME}}$	5.69	2.85	6.75	2.63	2.30
$t_{\beta_{I/A}}$	3.52	6.03	1.21	1.34	−1.30
$t_{\beta_{ROE}}$	7.12	−1.37	−4.10	4.85	−3.54
ME	−1.31	−1.34	−4.39	−1.31	−0.19
I/A	−13.77	−10.71	−3.22	−5.71	0.66
ROE	1.52	−3.33	−2.80	1.86	−0.64
t_{ME}	−9.44	−9.83	−9.47	−8.43	−3.95
$t_{I/A}$	−11.38	−12.17	−2.54	−4.70	1.37
t_{ROE}	7.97	−12.60	−9.21	11.42	−4.03

Factor Regressions

25 size and book-to-market portfolios

	Low	2	3	4	High	H−L	Low	2	3	4	High	H−L
	m						α_{FF} ($\overline{\lvert\alpha_{FF}\rvert} = 0.10$)					
Small	0.08	0.72	0.84	0.95	1.11	1.02	−0.54	0.02	0.13	0.18	0.16	0.70
2	0.32	0.69	0.86	0.87	0.99	0.67	−0.21	0.00	0.09	0.07	0.04	0.25
3	0.38	0.71	0.77	0.77	1.02	0.65	−0.09	0.04	0.03	0.00	0.13	0.22
4	0.52	0.59	0.73	0.74	0.84	0.32	0.14	−0.02	0.03	0.00	0.02	−0.12
Big	0.40	0.54	0.54	0.61	0.56	0.16	0.16	0.11	0.09	0.00	−0.16	−0.32
	t_m						t_{FF} ($p_{FF} = 0.00$)					
Small	0.20	2.02	2.57	3.07	3.30	4.59	−4.84	0.23	1.58	2.53	1.97	5.66
2	0.90	2.20	3.03	3.29	3.31	2.93	−2.59	0.01	1.36	0.92	0.45	2.19
3	1.15	2.49	3.03	3.05	3.93	2.76	−1.21	0.52	0.35	0.02	1.28	1.70
4	1.73	2.35	2.91	3.08	3.24	1.43	1.74	−0.23	0.27	0.03	0.17	−0.87
Big	1.70	2.53	2.71	3.04	2.43	0.79	2.66	1.29	0.92	−0.02	−1.31	−2.32

Factor Regressions

25 size and book-to-market portfolios

	Low	2	3	4	High	H−L	Low	2	3	4	High	H−L
	α_C ($\overline{\lvert\alpha_C\rvert} = 0.11$)						α_q ($\overline{\lvert\alpha_q\rvert} = 0.11$)					
Small	−0.48	0.03	0.12	0.18	0.22	0.70	−0.25	0.27	0.31	0.30	0.32	0.57
2	−0.18	0.03	0.09	0.10	0.04	0.22	−0.14	0.02	0.03	0.07	0.10	0.24
3	−0.04	0.04	0.09	0.03	0.16	0.20	−0.01	−0.03	−0.04	−0.01	0.14	0.15
4	0.15	−0.01	0.07	0.03	0.09	−0.06	0.18	−0.14	−0.01	0.02	0.06	−0.12
Big	0.17	0.07	0.07	−0.03	−0.13	−0.31	0.10	−0.04	0.06	−0.01	−0.04	−0.13
	t_C ($p_C = 0.00$)						t_q ($p_q = 0.00$)					
Small	−4.00	0.36	1.58	2.59	2.53	5.72	−1.48	2.24	3.09	3.68	2.72	2.91
2	−2.28	0.37	1.34	1.40	0.44	1.88	−1.21	0.29	0.37	0.67	0.89	1.25
3	−0.50	0.53	0.93	0.28	1.40	1.43	−0.09	−0.30	−0.37	−0.05	1.16	0.92
4	1.87	−0.16	0.74	0.24	0.75	−0.42	1.50	−1.58	−0.06	0.21	0.44	−0.61
Big	2.89	0.91	0.70	−0.36	−1.02	−2.12	1.32	−0.49	0.65	−0.06	−0.23	−0.70

Outline

Sharpe Ratios

Factors

Sharpe ratios							Maximum Sharpe ratios			
MKT	SMB	HML	UMD	r_{ME}	$r_{I/A}$	r_{ROE}	CAPM	FF	Carhart	q
0.10	0.06	0.13	0.16	0.10	0.24	0.22	0.10	0.21	0.30	0.43

Sharpe Ratios

Testing portfolios

	SUE-1	SUE-6	Abr-1	Abr-6	RE-1	RE-6	R6-6	R11-1	I-Mom
S_{H-L}	0.14	0.09	0.23	0.15	0.16	0.13	0.15	0.16	0.10
S_m	0.27	0.26	0.28	0.23	0.25	0.21	0.31	0.28	0.20

	B/M	E/P	CF/P	NO/P	Dur
S_{H-L}	0.14	0.12	0.11	0.16	0.12
S_m	0.21	0.24	0.21	0.30	0.24

	I/A	NOA	△PI/A	IG	NSI	CEI	IvG	IvC	OA	POA	PTA
S_{H-L}	0.11	0.12	0.17	0.14	0.21	0.14	0.13	0.14	0.10	0.15	0.12
S_m	0.24	0.29	0.25	0.26	0.30	0.32	0.23	0.25	0.25	0.23	0.23

	ROE	ROA	GP/A	NEI	FP
S_{H-L}	0.15	0.13	0.10	0.14	0.10
S_m	0.24	0.21	0.18	0.26	0.28

	OC/A	Ad/M	RD/M	OL	Svol	all
S_{H-L}	0.18	0.14	0.12	0.10	0.14	0.48
S_m	0.26	0.23	0.21	0.17	0.29	1.60

The q-factor model largely summarizes the cross section of average stock returns, capturing most (but not all) anomalies that bedevil the Fama-French model

A parsimonious empirical model for estimating expected returns, silent about the rational asset pricing versus mispricing debate:

- Rational asset pricing: q-factors constructed on economic fundamentals; comovement indicated in Sharpe ratios; covariation (betas) between anomalies and q-factors
- Mispricing: simultaneous impact on stocks with similar investment (and similar ROE); high Sharpe ratios