

Lecture Notes

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

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FIN 8250, Autumn 2021
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Introduction

Contribution

The q -factor model, which consists of the market factor, a size factor, an investment factor, and a profitability factor, largely summarizes the cross-sectional variation of average stock returns

Introduction

The q -factor model

$$E[R^i - R^f] = \beta_{\text{MKT}}^i E[\text{MKT}] + \beta_{\text{ME}}^i E[R_{\text{ME}}] + \beta_{\text{I/A}}^i E[R_{\text{I/A}}] + \beta_{\text{ROE}}^i E[R_{\text{ROE}}]$$

- $E[\text{MKT}], E[R_{\text{ME}}], E[R_{\text{I/A}}]$, and $E[R_{\text{ROE}}]$: The market, size, investment, and ROE factor premiums, respectively
- $\beta_{\text{MKT}}^i, \beta_{\text{ME}}^i, \beta_{\text{I/A}}^i$, and β_{ROE}^i : Factor loadings

Introduction

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Introduction

Properties of the q -factors, 1/1972–12/2012

	\bar{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

Introduction

Overview

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 outperforms the Fama-French 3-factor and Carhart 4-factor models:

- The average magnitude of high-minus-low alphas: 0.20% in q , 0.33% in Carhart, and 0.55% 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

1 Mechanism

2 Factors

3 Testing Portfolios

4 Factor Regressions

5 Sharpe Ratios

Outline

1 Mechanism

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Mechanism

An economic model of investment-based asset pricing

Two periods, 0 and 1

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

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

Mechanism

An economic model

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:

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

Mechanism

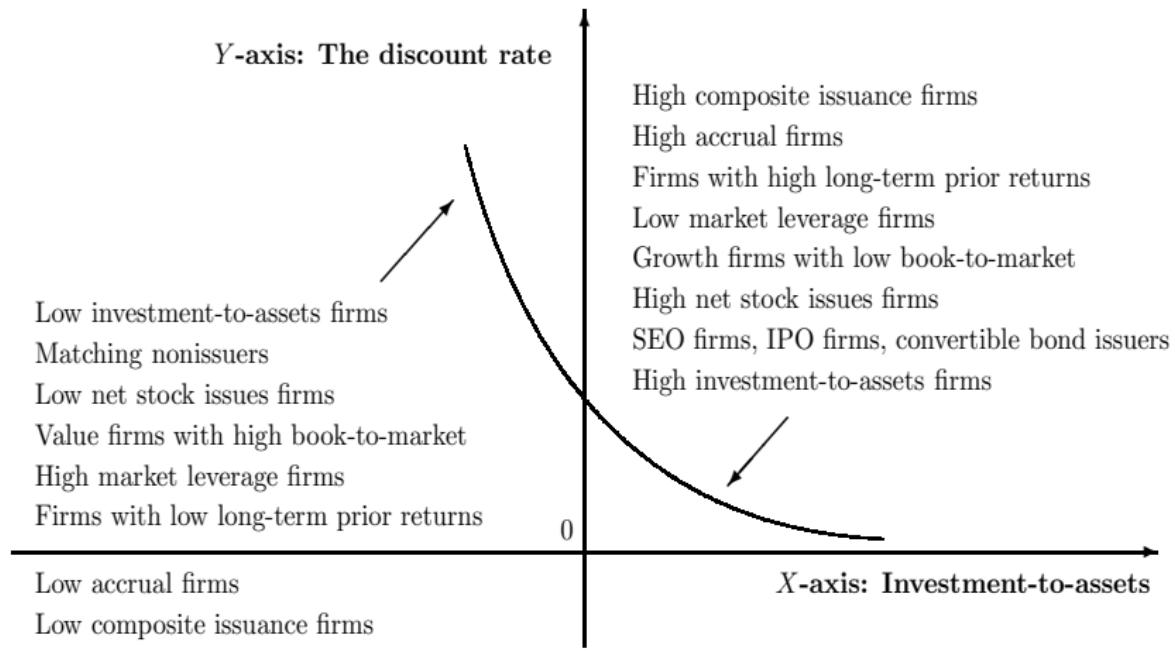
A two-period investment-based asset pricing model

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

- 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

Mechanism

The investment factor



Mechanism

The ROE factor

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

Mechanism

Implementation, covariances vs. characteristics

The investment model is based on characteristics

We implement a linear factor model:

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

The q -factor model as a linear approximation of the nonlinear investment return

Outline

1 Mechanism

2 Factors

3 Testing Portfolios

4 Factor Regressions

5 Sharpe Ratios

Factors

Construction, variable definition

Construct $R_{ME,t}$, $R_{I/A,t}$, and $R_{ROE,t}$ with a triple 2-by-3-by-3 sort on size, investment, and ROE

Variable definition:

- 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

Factors

Construction, procedure

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 theory

Joint sorts on I/A and ROE also consistent with theory

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Testing Portfolios

Design follows Fama and French (1996)

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)

Testing Portfolios

Six categories of anomalies, momentum

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

SUE-1, earnings surprise
(1-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)
RE-1, revisions in analysts' earnings
forecasts (1-month holding period),
Chan, Jegadeesh, and Lakonishok (1996)
R6-1, price momentum (6-month prior
returns, 1-month holding period),
Jegadeesh and Titman (1993)
R11-1, price momentum, (11-month
prior returns, 1-month holding period),
Fama and French (1996)

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

Testing Portfolios

Six categories of anomalies, value versus growth

Panel B: Value versus growth

B/M, book-to-market equity,

Rosenberg, Reid, and Lanstein (1985)

Rev, reversal, De Bondt and Thaler (1985)

EF/P, analysts' earnings forecasts-to-price,

Elgers, Lo, and Pfeiffer (2001)

D/P, dividend yield,

Litzenberger and Ramaswamy (1979)

NO/P, net payout yield, Boudoukh,

Michaely, Richardson, and Roberts (2007)

LTG, long-term growth forecasts

of analysts, La Porta (1996)

A/ME, market leverage,

Bhandari (1988)

E/P, earnings-to-price, Basu (1983)

CF/P, cash flow-to-price,

Lakonishok, Shleifer, and Vishny (1994)

O/P, payout yield, Boudoukh, Michaely,

Richardson, and Roberts (2007)

SG, sales growth,

Lakonishok, Shleifer, and Vishny (1994)

Dur, equity duration,

Dechow, Sloan, and Soliman (2004)

Testing Portfolios

Six categories of anomalies, investment

Panel C: Investment

ACI, abnormal corporate investment,
Titman, Wei, and Xie (2004)

NOA, net operating assets, Hirshleifer,
Hou, Teoh, and Zhang (2004)

IG, investment growth,
Xing (2008)

CEI, composite issuance,
Daniel and Titman (2006)

IvG, inventory growth,
Belo and Lin (2011)

OA, operating accruals, Sloan (1996)

POA, percent operating accruals, Hafzalla,
Lundholm, and Van Winkle (2011)

I/A, investment-to-assets,
Cooper, Gulen, and Schill (2008)
ΔPI/A, changes in PPE
plus changes in inventory scaled by assets,
Lyandres, Sun, and Zhang (2008)

NSI, net stock issues,
Pontiff and Woodgate (2008)

NXF, net external financing,
Bradshaw, Richardson, and Sloan (2006)

IvC, inventory changes,
Thomas and Zhang (2002)

TA, total accruals, Richardson, Sloan,
Soliman, and Tuna (2005)

PTA, percent total accruals, Hafzalla,
Lundholm, and Van Winkle (2011)

Testing Portfolios

Six categories of anomalies, profitability

Panel D: Profitability

ROE, return on equity,

Haugen and Baker (1996)

RNA, return on net operating assets,
Soliman (2008)

ATO, asset turnover,
Soliman (2008)

GP/A, gross profits-to-assets,
Novy-Marx (2013)

TES, tax expense surprise,
Thomas and Zhang (2011)

RS, revenue surprise,
Jegadeesh and Livnat (2006)

FP, failure probability,

Campbell, Hilscher, and Szilagyi (2008)

ROA, return on assets,

Balakrishnan, Bartov, and Faurel (2010)

PM, profit margin, Soliman (2008)

CTO, capital turnover,

Haugen and Baker (1996)

F, *F*-score,

Piotroski (2000)

TI/BI, taxable income-to-book income,
Green, Hand, and Zhang (2013)

NEI, number of consecutive quarters
with earnings increases,
Barth, Elliott, and Finn (1999)

O, *O*-score, Dichev (1998)

Testing Portfolios

Six categories of anomalies, intangibles

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)

Testing Portfolios

Six categories of anomalies, trading frictions

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)

Testing Portfolios

Insignificant anomalies

	R6-1	A/ME	Rev	EF/P	D/P	O/P	SG	LTG	ACI	NXF
\bar{R}	0.48	0.43	-0.39	0.45	0.27	0.35	-0.27	0.01	-0.27	-0.30
$t_{\bar{R}}$	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
\bar{R}	-0.19	0.13	0.10	0.22	0.20	0.37	0.32	0.13	0.29	-0.08
$t_{\bar{R}}$	-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
\bar{R}	0.18	0.01	0.32	-0.25	0.03	-0.18	-0.24	-0.54	-0.37	-0.31
$t_{\bar{R}}$	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		
\bar{R}	-0.13	0.07	-0.31	-0.33	-0.12	-0.00	-0.26	0.27		
$t_{\bar{R}}$	-0.36	0.30	-1.39	-1.24	-0.43	-0.01	-1.30	1.14		

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Factor Regressions

Alphas, significant momentum anomalies

	SUE-1	SUE-6	Abr-1	Abr-6	RE-1	RE-6	R6-6	R11-1	I-Mom	$ \bar{\alpha} $
\bar{R}	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
$t_{\bar{R}}$	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	
$ \alpha_{FF} $	0.17	0.13	0.16	0.11	0.27	0.23	0.19	0.26	0.15	0.19
$ \alpha_C $	0.11	0.09	0.12	0.08	0.11	0.09	0.10	0.13	0.06	0.10
$ \alpha_q $	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

q-factor loadings and *q*-characteristics, momentum

	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
$\beta_{\text{I/A}}$	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
$t_{\beta_{\text{MKT}}}$	-1.82	-1.53	-1.31	-1.20	-0.76	-1.24	-1.17	-1.43	-1.72
$t_{\beta_{\text{ME}}}$	1.94	1.27	0.67	1.82	-1.42	-1.98	1.43	1.74	1.86
$t_{\beta_{\text{I/A}}}$	0.18	-0.97	-1.25	-2.24	0.25	-0.82	-0.27	0.12	-0.13
$t_{\beta_{\text{ROE}}}$	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
$t_{\text{I/A}}$	-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

Alphas, significant value versus growth anomalies

	B/M	E/P	CF/P	NO/P	Dur	$ \bar{\alpha} $
\bar{R}	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
$t_{\bar{R}}$	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	
$ \alpha_{FF} $	0.07	0.10	0.08	0.17	0.11	0.11
$ \alpha_C $	0.06	0.09	0.07	0.15	0.08	0.09
$ \alpha_q $	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

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

	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
$\beta_{\text{I/A}}$	1.45	0.99	1.01	1.03	-0.85
β_{ROE}	-0.51	-0.09	-0.24	0.02	0.24
$t_{\beta_{\text{MKT}}}$	-0.59	-2.02	-2.41	-3.86	1.67
$t_{\beta_{\text{ME}}}$	5.37	1.90	1.66	-4.40	-1.61
$t_{\beta_{\text{I/A}}}$	12.74	5.76	6.79	10.25	-5.69
$t_{\beta_{\text{ROE}}}$	-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
$t_{\text{I/A}}$	-17.06	-1.20	-5.47	-13.81	2.73
t_{ROE}	-29.57	1.30	-4.83	7.27	2.22

Factor Regressions

Alphas, significant investment anomalies

	I/A	NOA	Δ PI/A	IG	NSI	CEI	IvG	IvC	OA	POA	PTA	$ \bar{\alpha} $
\bar{R}	-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
$t_{\bar{R}}$	-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	
$ \alpha_{FF} $	0.12	0.17	0.13	0.13	0.18	0.15	0.11	0.12	0.13	0.11	0.11	0.13
$ \alpha_C $	0.10	0.14	0.12	0.11	0.15	0.15	0.10	0.10	0.12	0.11	0.10	0.12
$ \alpha_q $	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

q-factor loadings and *q*-characteristics, investment

	I/A	NOA	Δ 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

Alphas, significant profitability anomalies

	ROE	ROA	GP/A	NEI	FP	$ \bar{\alpha} $
\bar{R}	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
$t_{\bar{R}}$	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	
$ \alpha_{FF} $	0.24	0.23	0.14	0.23	0.23	0.21
$ \alpha_C $	0.15	0.14	0.14	0.15	0.12	0.14
$ \alpha_q $	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

q -factor loadings and q -characteristics, profitability

	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
$\beta_{I/A}$	0.10	-0.10	-0.24	-0.30	0.17
β_{ROE}	1.50	1.31	0.52	0.63	-1.61
$t_{\beta_{MKT}}$	-2.57	-4.48	1.20	0.88	6.46
$t_{\beta_{ME}}$	-6.56	-6.41	0.51	-2.53	2.45
$t_{\beta_{I/A}}$	1.05	-1.23	-2.35	-3.78	0.63
$t_{\beta_{ROE}}$	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
$t_{I/A}$	4.16	6.88	-2.05	11.45	-4.18
t_{ROE}	29.02	27.97	23.88	27.36	-25.56

Factor Regressions

Alphas, significant intangibles and trading frictions anomalies

	OC/A	Ad/M	RD/M	OL	Svol	$ \bar{\alpha} $
\bar{R}	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
$t_{\bar{R}}$	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	
$ \alpha_{FF} $	0.15	0.13	0.17	0.11	0.19	0.15
$ \alpha_C $	0.13	0.18	0.21	0.12	0.16	0.16
$ \alpha_q $	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	

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

Alphas, 25 size and book-to-market portfolios

	Low	2	3	4	High	H-L		Low	2	3	4	High	H-L
	\bar{R}							α_{FF} ($ \alpha_{FF} = 0.10$)					
S	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
B	0.40	0.54	0.54	0.61	0.56	0.16		0.16	0.11	0.09	0.00	-0.16	-0.32
	$t_{\bar{R}}$							t_{FF} ($p_{FF} = 0.00$)					
S	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
B	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

Alphas, 25 size and book-to-market portfolios

	Low	2	3	4	High	H-L		Low	2	3	4	High	H-L	
	α_c ($ \alpha_c = 0.11$)							α_q ($ \alpha_q = 0.11$)						
S	-0.48	0.03	0.12	0.18	0.22	0.70		-0.25	0.27	0.31	0.30	0.32	0.57	
2	-0.18	0.03	0.09	0.10	0.04	0.22		-0.14	0.02	0.03	0.07	0.10	0.24	
3	-0.04	0.04	0.09	0.03	0.16	0.20		-0.01	-0.03	-0.04	-0.01	0.14	0.15	
4	0.15	-0.01	0.07	0.03	0.09	-0.06		0.18	-0.14	-0.01	0.02	0.06	-0.12	
B	0.17	0.07	0.07	-0.03	-0.13	-0.31		0.10	-0.04	0.06	-0.01	-0.04	-0.13	
	t_c ($p_c = 0.00$)							t_q ($p_q = 0.00$)						
S	-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	
B	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

1 Mechanism

2 Factors

3 Testing Portfolios

4 Factor Regressions

5 Sharpe Ratios

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

Conclusion

Hou, Xue, and Zhang (2015)

The q -factor model goes a long way in summarizing the cross-sectional variation of average stock returns