q^5

Stress-testing Factor Models

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Bernstein Quantitative Finance Conference
October 4, 2018

Augmenting the q-factor model with an expected growth factor to form the q^5 model:

$$\begin{aligned} E[R_i - R_f] &= \beta^i_{\mathrm{MKT}}\, E[\mathrm{MKT}] + \beta^i_{\mathrm{Me}}\, E[R_{\mathrm{Me}}] \\ &\quad + \beta^i_{\mathrm{I/A}}\, E[R_{\mathrm{I/A}}] + \beta^i_{\mathrm{Roe}}\, E[R_{\mathrm{Roe}}] + \beta^i_{\mathrm{Eg}}\, E[R_{\mathrm{Eg}}] \end{aligned}$$

Stress-testing factor models with a large set of 158 anomalies:

- The q^5 model improves on the q-factor model substantially
- The q-factor model already compares well with the Fama-French 6-factor model

Outline

Outline

$$E[R_i - R_f] = \beta^i_{\text{MKT}} \, E[\text{MKT}] + \beta^i_{\text{Me}} \, E[R_{\text{Me}}] + \beta^i_{\text{I/A}} \, E[R_{\text{I/A}}] + \beta^i_{\text{Roe}} \, E[R_{\text{Roe}}]$$

- MKT, R_{Me}, $R_{\text{I/A}}$, and R_{Roe} are the market, size, investment, and profitability (return on equity, Roe) factors, respectively
- β^i_{MKT}, β^i_{Me}, $\beta^i_{\text{I/A}}$, and β^i_{Roe} are factor loadings

The q-factor model largely summarizes the cross section of average stock returns, capturing most (but not all) anomalies that plague the Fama-French 3-factor model and Carhart 4-factor model

The Fama-French 5-factor model:

$$E[r_{it} - r_{ft}] = b_i\, E[\mathrm{MKT}_t] + s_i\, E[\mathrm{SMB}_t] + h_i\, E[\mathrm{HML}_t] + r_i\, E[\mathrm{RMW}_t] + c_i\, E[\mathrm{CMA}_t]$$

- $\mathrm{MKT}_t, \mathrm{SMB}_t, \mathrm{HML}_t, \mathrm{RMW}_t$, and CMA_t are the market, size, value, profitability, and investment factors, respectively
- b_i, s_i, h_i, r_i, and c_i are factor loadings

Fama and French (2018) add UMD to form the 6-factor model

Background

The q-factor model predates the Fama-French 5-factor model by 3–6 years

Neoclassical factors	July 2007
An equilibrium three-factor model	January 2009
Production-based factors	April 2009
A better three-factor model that explains more anomalies	June 2009
An alternative three-factor model	April 2010, April 2011
Digesting anomalies: An investment approach	October 2012, August 2014
Fama and French (2013): A four-factor model for the size, value, and profitability patterns in stock returns	June 2013
Fama and French (2014): A five-factor asset pricing model	November 2013, September 2014

Spanning tests in Hou et al. (2018, "Which factors?"), 1/1967–12/2016

	$\overline{R}$	α	β_{MKT}	β_{SMB}	β_{HML}	β_{RMW}	β_{CMA}	β_{UMD}
R_{Me}	0.31	0.05	0.01	0.97	0.03	−0.03	0.02	
	(2.43)	(1.58)	(0.72)	(64.99)	(1.63)	(−0.98)	(0.72)	
		0.03	0.01	0.97	0.05	−0.04	0.01	0.03
		(0.90)	(1.21)	(68.50)	(2.81)	(−1.34)	(0.34)	(2.57)
$R_{\text{I/A}}$	0.41	0.12	0.01	−0.04	0.03	0.06	0.82	
	(4.92)	(3.48)	(0.80)	(−3.08)	(1.32)	(2.46)	(31.26)	
		0.11	0.01	−0.05	0.04	0.06	0.81	0.01
		(3.15)	(0.97)	(−3.06)	(1.79)	(2.21)	(33.12)	(0.77)
R_{Roe}	0.55	0.47	−0.03	−0.12	−0.24	0.70	0.10	
	(5.25)	(5.91)	(−1.18)	(−2.98)	(−3.72)	12.80	1.03	
		0.30	0.00	−0.12	−0.10	0.65	−0.01	0.24
		(4.50)	0.03	(−3.74)	(−2.02)	(14.77)	(−0.21)	(9.94)

Spanning tests in Hou et al. (2018, "Which factors?"), 1/1967–12/2016

	$\overline{R}$	α_q	β_{MKT}	β_{ME}	$\beta_{\text{I/A}}$	β_{ROE}
SMB	0.25	0.04	−0.01	0.94	−0.08	−0.09
	(1.92)	(1.32)	(−0.66)	(54.18)	(−4.21)	(−5.84)
HML	0.37	0.07	−0.04	0.02	1.01	−0.19
	(2.71)	(0.63)	(−1.01)	(0.31)	(12.18)	(−2.65)
RMW	0.26	0.01	−0.03	−0.12	0.03	0.54
	(2.53)	(0.11)	(−1.21)	(−1.70)	(0.35)	(8.53)
CMA	0.33	−0.00	−0.04	0.04	0.96	−0.10
	(3.51)	(−0.13)	(−3.74)	(1.90)	(34.93)	(−3.48)
UMD	0.64	0.11	−0.08	0.24	−0.00	0.91
	(3.60)	(0.49)	(−1.24)	(1.73)	(−0.02)	(5.88)

The q-factors subsume RMW, CMA, and UMD in the Fama-French 6-factor model, which in turn cannot subsume the q-factors

Spanning tests replicated, but not reported by Barillas and Shanken (2017, 2018): Slide 6 in Shanken's discussion on "A comparison of new factor models" in February 2015

Empirical Results: Barillas-Shanken (2015b)

We develop a Bayesian test for comparing models

q-model prob = 97%, FF5 3%

Asness and Frazzini (2013) argue for a **better value factor** than HML

FF (1993) update portfolios once a year using prices lagged 6 months; ignores recent return

Updating monthly with the most recent stock price gives a factor HML^m with higher mean and more negatively correlated with momentum

Question: does q-model explain HML^m ?

Answer: HML^m alpha on q-factors is 5.3% (t = 3.3)

Also, UMD alpha on q-factors + HML^m is 6.5% (t = 4.0)

We explore a 6-factor model **M** = {Mkt, SMB, HML^m, ROE, I/A, UMD}

In the multiperiod investment framework (Cochrane 1991):

$$r_{it+1} = \frac{X_{it+1} + (a/2)\left(I_{it+1}/A_{it+1}\right)^2 + (1-\delta)\left[1 + a\left(I_{it+1}/A_{it+1}\right)\right]}{1 + a\left(I_{it}/A_{it}\right)}$$

The "capital gain" roughly proportional to investment-to-assets growth, $\left(I_{it+1}/A_{it+1}\right)/\left(I_{it}/A_{it}\right)$

Intuition analogous with the profitability-expected return relation

Upgrade the q-factor model with an expected growth factor

Outline

Forecast $\mathrm{d}^{\tau}\mathrm{I/A}$, τ-year ahead investment-to-assets changes, via monthly cross-sectional regressions

Motivating predictors based on a priori conceptual arguments:

- Tobin's q: Erickson and Whited (2000)
- Cash flows: Fazzari, Hubbard, and Petersen (1988)
- Change in return on equity: Liu, Whited, and Zhang (2009)

Cash flows: Internal funds available for investments

Accounting conservatism: Cash flows better than earnings in capturing expected growth due to intangibles (Ball, Gerakos, Linnainmaa, and Nikolaev 2016)

- Total revenue minus cost of goods sold, minus SG&A, plus R&D, minus change in accounts receivable, minus change in inventory, minus change in prepaid expenses, plus change in deferred revenue, plus change in trade accounts payable, and plus change in accrued expenses, all scaled by book assets

dRoe: Capturing short-term dynamics of investment growth

τ	$\log(q)$	Cop	dRoe	R^2	Pearson	Rank
1	−0.03	0.53	0.80	6.64	0.14	0.21
	(−5.86)	(12.82)	(7.75)		[0.00]	[0.00]
2	−0.08	0.72	0.93	8.88	0.16	0.23
	(−10.09)	(12.58)	(10.25)		[0.00]	[0.00]
3	−0.09	0.76	0.74	9.18	0.16	0.22
	(−12.14)	(12.20)	(8.62)		[0.00]	[0.00]

Relatively reliable out-of-sample correlation with subsequent, realized investment-to-assets changes

Modeling the Expected Growth

An expected growth factor, R_{Eg}, monthly 2×3 sorts on size and $E_t[\mathrm{d}^1\mathrm{I/A}]$

$\overline{R}_{\mathrm{Eg}}$	α	β_{Mkt}	β_{Me}	$\beta_{\mathrm{I/A}}$	β_{Roe}	R^2	
0.82	0.63	−0.10	−0.09	0.25	0.30	0.48	
(9.81)	(9.11)	(−6.17)	(−3.47)	(6.26)	(9.43)		
	α	β_{Mkt}	β_{Me}	$\beta_{\mathrm{I/A}}$	β_{Roe}	$\beta_{\log(q)}$	R^2
	0.63	−0.11	−0.09	0.27	0.30	−0.02	0.48
	(9.15)	(−6.20)	(−3.54)	(6.00)	(9.05)	(−0.50)	
	α	β_{Mkt}	β_{Me}	$\beta_{\mathrm{I/A}}$	β_{Roe}	β_{Cop}	R^2
	0.36	−0.03	−0.02	0.32	0.15	0.57	0.66
	(6.09)	(−1.84)	(−0.70)	(10.36)	(5.07)	(10.41)	
	α	β_{Mkt}	β_{Me}	$\beta_{\mathrm{I/A}}$	β_{Roe}	β_{dRoe}	R^2
	0.59	−0.11	−0.09	0.22	0.23	0.15	0.49
	(8.06)	(−6.44)	(−3.86)	(4.81)	(5.20)	(2.43)	

Outline

8 competing factor models:

- The q-factor model, the q^5 model
- The Fama-French 5-factor model, the 6-factor model, the alternative 6-factor model with RMWc
- The Stambaugh-Yuan 4-factor model
- The Barillas-Shanken 6-factor model, including MKT, SMB, $R_{\mathrm{I/A}}$, R_{Roe}, the Asness-Frazzini monthly formed HML, UMD
- The Daniel-Hirshleifer-Sun 3-factor model

Use the replicated Stambaugh-Yuan and Daniel-Hirshleifer-Sun models via the standard approach (Hou et al. 2018, "Which factors?")

158 anomalies with NYSE breakpoints and value-weighted returns significant at the 5% level (Hou, Xue, and Zhang 2018, “Replicating anomalies”)

- Momentum: 36
- Value-versus-growth: 29
- Investment: 28
- Profitability: 35
- Intangibles: 26
- Trading frictions: 4

Sue1	Earnings surprise (1-month holding period), Foster, Olsen, and Shevlin (1984)	Abr1	Cumulative abnormal returns around earnings announcements (1-month holding period), Chan, Jegadeesh, and Lakonishok (1996)
Abr6	Cumulative abnormal returns around earnings announcements (6-month holding period), Chan, Jegadeesh, and Lakonishok (1996)	Abr12	Cumulative abnormal returns around earnings announcements (12-month holding period), Chan, Jegadeesh, and Lakonishok (1996)
Re1	Revisions in analysts' forecasts (1-month holding period), Chan, Jegadeesh, and Lakonishok (1996)	Re6	Revisions in analysts' forecasts (6-month holding period), Chan, Jegadeesh, and Lakonishok (1996)
$R^6 1$	Price momentum (6-month prior returns, 1-month holding period), Jegadeesh and Titman (1993)	$R^6 6$	Price momentum (6-month prior returns, 6-month holding period), Jegadeesh and Titman (1993)
$R^6 12$	Price momentum (6-month prior returns, 12-month holding period), Jegadeesh and Titman (1993)	$R^{11} 1$	Price momentum (11-month prior returns, 1-month holding period), Fama and French (1996)

$R^{11}6$	Price momentum, (11-month prior returns, 6-month holding period), Fama and French (1996)	Im1	Industry momentum, (1-month holding period), Moskowitz and Grinblatt (1999)
Im6	Industry momentum (6-month holding period), Moskowitz and Grinblatt (1999)	Im12	Industry momentum (12-month holding period), Moskowitz and Grinblatt (1999)
Rs1	Revenue surprise (1-month holding period), Jegadeesh and Livnat (2006)	dEf1	Analysts' forecast change (1-month hold period), Hawkins, Chamberlin, and Daniel (1984)
dEf6	Analysts' forecast change (6-month hold period), Hawkins, Chamberlin, and Daniel (1984)	dEf12	Analysts' forecast change (12-month hold period), Hawkins, Chamberlin, and Daniel (1984)
Nei1	# of consecutive quarters with earnings increases (1-month holding period), Barth, Elliott, and Finn (1999)	52w6	52-week high (6-month holding period), George and Hwang (2004)
$\epsilon^6 6$	Six-month residual momentum (6-month holding period), Blitz, Huij, and Martens (2011)	$\epsilon^6 12$	Six-month residual momentum (12-month holding period), Blitz, Huij, and Martens (2011)

$\epsilon^{11}1$	11-month residual momentum, 1-month, Blitz, Huij, and Martens (2011)
$\epsilon^{11}12$	11-month residual momentum, 12-month, Blitz, Huij, and Martens (2011)
Ilr1	Industry lead-lag effect in prior returns, 1-month, Hou (2007)
Ilr12	Industry lead-lag effect in prior returns, 12-month, Hou (2007)
Cm1	Customer momentum, 1-month Cohen and Frazzini (2008)
Sim1	Supplier industries momentum, 1-month, Menzly and Ozbas (2010)
Cim6	Customer industries momentum, 6-month, Menzly and Ozbas (2010)
$\epsilon^{11}6$	11-month residual momentum, 6-month, Blitz, Huij, and Martens (2011)
Sm1	Segment momentum 1-month, Cohen and Lou (2012)
Ilr6	Industry lead-lag effect in prior returns, 6-month, Hou (2007)
Ile1	Industry lead-lag effect in earnings news, 1-month, Hou (2007)
Cm12	Customer momentum, 12-month Cohen and Frazzini (2008)
Cim1	Customer industries momentum, 1-month, Menzly and Ozbas (2010)
Cim12	Customer industries momentum, 12-month, Menzly and Ozbas (2010)

Bm	Book-to-market equity, Rosenberg, Reid, and Lanstein (1985)	Bmj	Book-to-June-end market equity, Asness and Frazzini (2013)
Bm^q12	Quarterly book-to-market equity (12-month holding period)	Rev6	Reversal (6-month holding period), De Bondt and Thaler (1985)
Rev12	Reversal (12-month holding period) De Bondt and Thaler (1985)	Ep	Earnings-to-price, Basu (1983)
Ep^q1	Quarterly earnings-to-price (1-month holding period)	Ep^q6	Quarterly earnings-to-price (6-month holding period)
Ep^q12	Quarterly earnings-to-price (12-month holding period)	Cp	Cash flow-to-price, Lakonishok, Shleifer, and Vishny (1994)
Cp^q1	Quarterly cash flow-to-price (1-month holding period)	Cp^q6	Quarterly cash flow-to-price (6-month holding period)
Cp^q12	Quarterly cash flow-to-price (12-month holding period)	Nop	Net payout yield, Boudoukh, Michaely, Richardson, and Roberts (2007)
Em	Enterprise multiple, Loughran and Wellman (2011)	Em^q1	Quarterly enterprise multiple (1-month holding period)

$\text{Em}^{q}6$	Quarterly enterprise multiple (6-month holding period)
Sp	Sales-to-price, Barbee, Mukherji, and Raines (1996)
$\text{Sp}^{q}6$	Quarterly sales-to-price (6-month holding period)
Ocp	Operating cash flow-to-price, Desai, Rajgopal, and Venkatachalam (2004)
Ir	Intangible return, Daniel and Titman (2006)
Vfp	Analysts-based intrinsic value-to-market, Frankel and Lee (1998)
Dur	Equity duration, Dechow, Sloan, and Soliman (2004)

$\text{Em}^{q}12$	Quarterly enterprise multiple (12-month holding period)
$\text{Sp}^{q}1$	Quarterly sales-to-price (1-month holding period)
$\text{Sp}^{q}12$	Quarterly sales-to-price (12-month holding period)
$\text{Ocp}^{q}1$	Operating cash flow-to-price (1-month holding period)
Vhp	Intrinsic value-to-market, Frankel and Lee (1998)
Ebp	Enterprise book-to-price, Penman, Richardson, and Tuna (2007)

Aci	Abnormal corporate investment, Titman, Wei, and Xie (2004)	I/A	Investment-to-assets, Cooper, Gulen, and Schill (2008)
Ia^q6	Quarterly investment-to-assets (6-month holding period)	Ia^q12	Quarterly investment-to-assets (12-month holding period)
dPia	(Changes in PPE and inventory)/assets, Lyandres, Sun, and Zhang (2008)	Noa	Net operating assets, Hirshleifer, Hou, Teoh, and Zhang (2004)
dNoa	Changes in net operating assets, Hirshleifer, Hou, Teoh, and Zhang (2004)	dLno	Change in long-term net operating assets, Fairfield, Whisenant, and Yohn (2003)
Ig	Investment growth, Xing (2008)	2Ig	Two-year investment growth, Anderson and Garcia-Feijoo (2006)
Nsi	Net stock issues, Pontiff and Woodgate (2008)	dIi	% change in investment− % change in industry investment, Abarbanell and Bushee (1998)
Cei	Composite equity issuance, Daniel and Titman (2006)	Ivg	Inventory growth, Belo and Lin (2011)

- **Ivc** Inventory changes, Thomas and Zhang (2002)
- **dWc** Change in net non-cash working capital, Richardson, Sloan, Soliman, and Tuna (2005)
- **dNco** Change in net non-current operating assets, Richardson, Sloan, Soliman, and Tuna (2005)
- **dFin** Change in net financial assets, Richardson, Sloan, Soliman, and Tuna (2005)
- **dBe** Change in common equity, Richardson, Sloan, Soliman, and Tuna (2005)
- **Poa** Percent operating accruals, Hafzalla, Lundholm, and Van Winkle (2011)
- **Pda** Percent discretionary accruals
- **Oa** Operating accruals, Sloan (1996)
- **dCoa** Change in current operating assets, Richardson, Sloan, Soliman, and Tuna (2005)
- **dNca** Change in non-current operating assets, Richardson, Sloan, Soliman, and Tuna (2005)
- **dFnl** Change in financial liabilities, Richardson, Sloan, Soliman, and Tuna (2005)
- **Dac** Discretionary accruals, Xie (2001)
- **Pta** Percent total accruals, Hafzalla, Lundholm, and Van Winkle (2011)
- **Ndf** Net debt finance, Bradshaw, Richardson, and Sloan (2006)

Roe1	Return on equity, 1-month, Hou, Xue, and Zhang (2015)	Roe6	Return on equity, 6-month, Hou, Xue, and Zhang (2015)
dRoe1	Change in Roe, 1-month horizon	dRoe6	Change in Roe, 6-month horizon
dRoe12	Change in Roe, 12-month horizon	Roa1	Return on assets, 1-month horizon, Balakrishnan, Bartov, and Faurel (2010)
dRoa1	Change in Roa, 1-month horizon	dRoa6	Change in Roa, 6-month horizon
Rna^q1	Return on net operating assets, 1-month horizon	Rna^q6	Return on net operating assets, 6-month horizon
Ato^q1	Quarterly asset turnover, 1-month horizon	Ato^q6	Quarterly asset turnover, 6-month horizon
Ato^q12	Quarterly asset turnover, 12-month horizon	Cto^q1	Quarterly capital turnover, 1-month horizon
Cto^q6	Quarterly capital turnover, 6-month horizon	Cto^q12	Quarterly capital turnover, 12-month horizon
Gpa	Gross profits-to-assets, Novy-Marx (2013)	Gla^q1	Gross profits-to-lagged assets, 1-month horizon

Stress Tests

Testing deciles, profitability (35)

Gla^{q}6	Gross profits-to-lagged assets, 6-month horizon
Ole^{q}1	Operating profits-to-lagged equity, 1-month horizon
Opa	Operating profits-to-assets, Ball, Gerakos, Linnainmaa, and Nikolaev (2015)
Ola^{q}6	Operating profits-to-lagged assets, 6-month horizon
Cop	Cash-based operating profitability, Ball, Gerakos, Linnainmaa, and Nikolaev (2016)
Cla^{q}1	Cash-based operating profits-to-lagged assets, 1-month horizon
Cla^{q}12	Cash-based operating profits-to-lagged assets, 12-month horizon
F^{q}6	Quarterly F-score, 6-month horizon
Fp^{q}6	Failure probability, 6-month horizon, Campbell, Hilscher, and Szilagyi (2008)
Gla^{q}12	Gross profits-to-lagged assets, 12-month horizon
Ole^{q}6	Operating profits-to-lagged equity , 6-month horizon
Ola^{q}1	Operating profits-to-lagged assets, 1-month horizon
Ola^{q}12	Operating profits-to-lagged assets, 12-month horizon
Cla	Cash-based operating profits-to-lagged assets
Cla^{q}6	Cash-based operating profits-to-lagged assets, 6-month horizon
F^{q}1	Quarterly F-score, 1-month horizon
F^{q}12	Quarterly F-score, 12-month horizon

Oca	Organizational capital-to-assets, Eisfeldt and Papanikolaou (2013)	Ioca	Industry-adjusted organizational capital-to-assets, Eisfeldt and Papanikolaou (2013)
Adm	Advertising expense-to-market, Chan, Lakonishok, and Sougiannis (2001)	Rdm	R&D-to-market, Chan, Lakonishok, and Sougiannis (2001)
Rdm^{q}1	Quarterly R&D-to-market, 1-month horizon	Rdm^{q}6	Quarterly R&D-to-market, 6-month horizon
Rdm^{q}12	Quarterly R&D-to-market, 12-month horizon	Ol	Operating leverage, Novy-Marx (2011)
Ol^{q}1	Quarterly operating leverage, 1-month horizon	Ol^{q}6	Quarterly operating leverage, 6-month horizon
Ol^{q}12	Quarterly operating leverage, 12-month horizon	Hs	Industry concentration (sales), Hou and Robinson (2006)
Etr	Effective tax rate, Abarbanell and Bushee (1998)	Rer	Real estate ratio, Tuzel (2010)
Eprd	Earnings predictability, Francis, Lafond, Olsson, and Schipper (2004)	Etl	Earnings timeliness, Francis, Lafond, Olsson, and Schipper (2004)

Alm^q1	Asset liquidity (market assets), 1-month horizon	Alm^q6	Asset liquidity (market assets), 6-month horizon
Alm^q12	Asset liquidity (market assets), 12-month horizon	R_a^1	12-month-lagged return, Heston and Sadka (2008)
$R_a^{[2,5]}$	Years 2–5 lagged returns, annual Heston and Sadka (2008)	$R_n^{[2,5]}$	Years 2–5 lagged returns, nonannual Heston and Sadka (2008)
$R_a^{[6,10]}$	Years 6–10 lagged returns, annual Heston and Sadka (2008)	$R_n^{[6,10]}$	Years 6–10 lagged returns, nonannual Heston and Sadka (2008)
$R_a^{[11,15]}$	Years 11–15 lagged returns, annual Heston and Sadka (2008)	$R_a^{[16,20]}$	Years 16–20 lagged returns, annual Heston and Sadka (2008)

Trading frictions (4)

Sv1	Systematic volatility risk, 1-month horizon, Ang, Hodrick, Xing, and Zhang (2006)	Dtv12	Dollar trading volume, 12-month horizon, Brennan, Chordia, and Subrahmanyam (1998)
Isff1	Idiosyncratic skewness per the 3-factor model, 1-month horizon	Isq1	Idiosyncratic skewness per the q-factor model, 1-month horizon

	$\overline{\lvert\alpha_{\text{H-L}}\rvert}$	$\#_{\lvert t\rvert\geq1.96}$	$\#_{\lvert t\rvert\geq3}$	$\overline{\lvert\alpha\rvert}$	$\#_{p<5\%}$
			All (158)		
q	0.25	46	17	0.11	98
q^5	0.18	19	4	0.10	58
FF5	0.38	89	61	0.12	113
FF6	0.28	67	33	0.11	95
FF6c	0.25	55	21	0.10	68
BS6	0.28	61	34	0.14	147
SY4	0.27	57	25	0.10	87
DHS	0.42	83	45	0.15	108

	$\overline{\lvert\alpha_{\mathrm{H-L}}\rvert}$	$\#_{\lvert t\rvert\geq 1.96}$	$\#_{\lvert t\rvert\geq 3}$	$\overline{\lvert\alpha\rvert}$	$\#_{p<5\%}$
	Momentum (36)				
q	0.26	8	1	0.10	23
q^5	0.19	6	1	0.09	12
FF5	0.64	34	27	0.16	34
FF6	0.29	18	8	0.10	25
FF6c	0.27	16	5	0.10	18
BS6	0.25	12	5	0.13	33
SY4	0.34	21	7	0.10	22
DHS	0.26	12	2	0.15	26

	$\overline{\lvert\alpha_{\mathrm{H-L}}\rvert}$	$\#_{\lvert t\rvert\geq 1.96}$	$\#_{\lvert t\rvert\geq 3}$	$\overline{\lvert\alpha\rvert}$	$\#_{p<5\%}$
	Value-versus-growth (29)				
q	0.20	4	0	0.11	17
q^5	0.19	4	0	0.13	15
FF5	0.14	1	0	0.08	9
FF6	0.16	4	1	0.09	11
FF6c	0.15	4	0	0.09	8
BS6	0.24	11	5	0.13	26
SY4	0.20	6	2	0.11	15
DHS	0.81	29	26	0.23	29

	$\overline{\lvert\alpha_{\mathrm{H-L}}\rvert}$	$\#_{\lvert t\rvert\geq 1.96}$	$\#_{\lvert t\rvert\geq 3}$	$\overline{\lvert\alpha\rvert}$	$\#_{p<5\%}$
	Investment (28)				
q	0.20	9	4	0.10	17
q^5	0.10	0	0	0.08	7
FF5	0.23	11	6	0.09	17
FF6	0.21	10	5	0.09	17
FF6c	0.18	7	1	0.08	7
BS6	0.20	7	4	0.11	26
SY4	0.17	5	3	0.08	17
DHS	0.33	19	2	0.10	21

	$\overline{\lvert\alpha_{\text{H-L}}\rvert}$	$\#_{\lvert t\rvert\geq 1.96}$	$\#_{\lvert t\rvert\geq 3}$	$\overline{\lvert\alpha\rvert}$	$\#_{p<5\%}$
	Profitability (35)				
q	0.23	12	4	0.10	19
q^5	0.14	2	0	0.09	12
FF5	0.45	28	21	0.12	30
FF6	0.32	22	11	0.10	21
FF6c	0.26	14	6	0.10	17
BS6	0.28	16	11	0.13	34
SY4	0.29	15	7	0.09	21
DHS	0.19	6	1	0.09	12

	$\overline{\lvert\alpha_{\mathrm{H-L}}\rvert}$	$\#_{\lvert t\rvert\geq 1.96}$	$\#_{\lvert t\rvert\geq 3}$	$\overline{\lvert\alpha\rvert}$	$\#_{p<5\%}$
			Intangibles (26)		
q	0.41	11	8	0.17	19
q^5	0.31	7	3	0.13	10
FF5	0.41	13	6	0.15	20
FF6	0.42	11	8	0.16	18
FF6c	0.43	12	9	0.16	17
BS6	0.42	13	7	0.19	25
SY4	0.33	8	6	0.14	10
DHS	0.59	14	12	0.19	17

	$\overline{\vert\alpha_{\mathrm{H-L}}\vert}$	$\#_{\vert t\vert \geq 1.96}$	$\#_{\vert t\vert \geq 3}$	$\overline{\vert\alpha\vert}$	$\#_{p<5\%}$
	Trading frictions (4)				
q	0.23	2	0	0.09	3
q^5	0.17	0	0	0.08	2
FF5	0.22	2	1	0.08	3
FF6	0.20	2	0	0.08	3
FF6c	0.19	2	0	0.07	1
BS6	0.21	2	2	0.10	3
SY4	0.19	2	0	0.08	2
DHS	0.43	3	2	0.16	3

The q^5 model is the best performing model

The q-factor model already compares well with the Fama-French 6-factor model, with a lower number of high-minus-low alphas but a higher number of GRS rejections

The Fama-French 5-factor model, the Barillas-Shanken model, and the Daniel-Hirshleifer-Sun model all perform poorly

	Sue1	$R^6 6$	Bm	Nop	Nsi	Oa	dFin	Dac	Cop	Rdm
$\overline{R}$	0.46	0.82	0.54	0.63	−0.64	−0.27	0.28	−0.39	0.63	0.70
$t_{\overline{R}}$	3.48	3.50	2.61	3.40	−4.46	−2.19	2.39	−2.95	3.57	2.75
α_q	0.06	0.25	0.15	0.35	−0.29	−0.56	0.43	−0.67	0.69	0.72
α_{q^5}	−0.04	−0.16	0.08	0.20	−0.12	−0.23	0.12	−0.28	0.10	0.25
t_q	0.46	0.83	0.99	2.42	−2.32	−4.10	3.00	−4.73	5.04	3.11
t_{q^5}	−0.30	−0.60	0.51	1.33	−0.89	−1.51	0.81	−1.91	0.89	1.13
α_{FF5}	0.52	1.00	−0.10	0.22	−0.30	−0.52	0.50	−0.64	0.82	0.57
α_{FF6}	0.30	0.18	−0.08	0.24	−0.28	−0.47	0.48	−0.63	0.73	0.60
α_{FF6c}	0.25	0.16	−0.08	0.16	−0.20	−0.31	0.36	−0.53	0.51	0.76
t_{FF5}	3.92	3.65	−0.88	1.83	−2.58	−4.20	4.17	−4.90	6.53	2.55
t_{FF6}	2.54	1.77	−0.70	1.92	−2.39	−3.42	3.86	−4.55	6.15	2.77
t_{FF6c}	2.10	1.44	−0.63	1.22	−1.60	−2.04	2.65	−3.63	4.28	3.34

The q^5 model substantially improves the q-factor model, which already compares well with the Fama-French 6-factor model