Review on An Augmented q-Factor Model with Expected Growth

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Content

Abstract

In the investment theory, firms with high expected investment growth earn higher expected returns than firms with low expected investment growth, holding investment and expected profitability constant.

Building on cross-sectional growth forecasts with Tobin's q. Operating cash flows and change in return on equity as predictors.

We augment the q-factor model with the expected growth factor to form the q5 model.

an expected growth factor earns an average premium of 0.84% per month (t ¼ 10.27) in the 1967–2018 sample.

Review on introduction

if expected investment is high next period relative to current investment, the discount rate must be high to offset the high benefit of investment this period to keep current investment low.

cross-sectional forecasting regressions of investment to-assets changes on current Tobin’s q, operating cash flows, and the change in return on equity.

An independent 2 x 3 sort on size and expected 1-year-ahead investment-to-assets changes yields an expected investment growth factor

We augment the q-factor model with the expected growth factor to form the q5 model and stress-test it along with other recent factor models.

Review on introduction

For testing deciles

For competing factor models

The q-factor model compares with the Fama–French six-factor model

The Stambaugh–Yuan model is comparable with the q-factor model.

Review on introduction

Two major contributions

First, we bring expected growth to the fore of empirical finance.

Second, we conduct a large horse race of factor models. In contrast to small sets of testing portfolios in prior studies, we increase the number of testing anomalies drastically to 150.

Review on Motivating Expected Growth

1. Describes the economic model.

2. Presents its implications on cross-sectional returns.

3. Interprets the factors from the investment theory.

Describes the economic model.

Conceptual Framework:

The household maximizes its expected utility : $E_0[\sum_{t=0}^{\infty} \rho^t U(C_t)]$.

Let $\Pi_{it} = X_{it} A_{it}$ be firm i's time t operating profits,

Review on Constructing the Expected Growth Factor

1. Performing cross-sectional growth forecasts
2. Forming the expected growth factor
3. exploring alternative growth specifications

Performing cross-sectional growth forecasts

Forecasting future investment-to-assets changes.

Forecasting framework is monthly Fama–MacBeth (1973) cross-sectional predictive regressions:

At the beginning of each month t, we measure current investment-to-assets as total assets from the most recent fiscal year ending at least four months ago minus the total assets from one year prior, scaled by the 1-year-prior total assets.

The left-hand side variables in the cross-sectional regressions are investment-to-assets changes denoted as $d^{\tau}I/A$

sample is from July 1963 to December 2018.

Predictors Based on a Priori Conceptual Arguments

Keynes (1936) and Tobin (1969) argue that a firm should invest if its average q exceeds one.

Lucas and Prescott (1971) and Mussa (1977) show that optimality requires the marginal cost of investment to equal marginal q.

Hayashi (1982) shows that under constant returns to scale, marginal q equals (observable) average q.

Fazzari, Hubbard, and Petersen (1988) show that the cash flows effect on investment is especially strong for firms that are more financially constrained.

Ball et al. (2016) document that cash-based profitability outperforms earnings-based profitability in forecasting returns.

in such include Tobin’s q as a predictor, include cash flows on the right-hand side of our forecasting regressions. operating cash flows as a key predictor of future growth.

Measuring Growth Predictors:

Monthly returns are from the Center for Research in Security Prices (CRSP) and accounting information from the CompStat Annual and Quarterly Fundamental Files

We follow Ball et al. (2016) in measuring operating cash flows, denoted Cop as total revenue.

The change in return on equity, dRoe, is Roe minus the 4-quarter-lagged Roe and missing dRoe values are set to zero in the cross-sectional forecasting regressions.

Cross-Sectional Forecasting Regressions:

	Panel A: log(q)				Panel B: Cop			
τ	log(q)	R^2	Pearson	Rank	Cop	R^2	Pearson	Rank
1	0.021	0.01	0.016	0.004	0.418	0.03	0.138	0.176
	(5.12)		[0.00]	[0.33]	(13.38)		[0.00]	[0.00]
2	−0.005	0.01	0.027	0.037	0.457	0.04	0.127	0.153
	(−0.95)		[0.00]	[0.00]	(12.09)		[0.00]	[0.00]
3	−0.019	0.01	0.085	0.098	0.436	0.04	0.115	0.131
	(−3.81)		[0.00]	[0.00]	(10.49)		[0.00]	[0.00]

	Panel C: dRoe				Panel D: log(q), Cop, and dRoe					
τ	dRoe	R^2	Pearson	Rank	log(q)	Cop	dRoe	R^2	Pearson	Rank
1	0.795	0.02	0.068	0.131	−0.029	0.516	0.771	0.06	0.135	0.208
	(7.85)		[0.00]	[0.00]	(−5.63)	(12.75)	(7.62)		[0.00]	[0.00]
2	0.949	0.02	0.068	0.155	−0.073	0.699	0.907	0.09	0.148	0.220
	(9.82)		[0.00]	[0.00]	(−9.76)	(12.34)	(10.07)		[0.00]	[0.00]
3	0.746	0.02	0.055	0.130	−0.093	0.745	0.717	0.09	0.154	0.218
	(8.50)		[0.00]	[0.00]	(−12.39)	(12.17)	(8.60)		[0.00]	[0.00]

Forming the expected growth factor

τ		Low	2	3	4	5	6	7	8	9	High	H–L
Panel A: Average excess returns, $\bar{R}$												
1	$\bar{R}$	−0.12	0.20	0.28	0.42	0.45	0.49	0.56	0.64	0.77	0.95	1.07
	t	−0.40	0.84	1.21	2.00	2.36	2.61	3.00	3.54	4.17	4.69	6.48
2	$\bar{R}$	−0.09	0.23	0.23	0.37	0.44	0.60	0.62	0.80	0.70	1.08	1.17
	t	−0.33	0.98	1.07	1.79	2.29	3.36	3.50	4.23	3.61	5.10	7.14
3	$\bar{R}$	−0.08	0.20	0.30	0.39	0.53	0.51	0.74	0.68	0.81	1.11	1.19
	t	−0.29	0.90	1.41	1.92	2.82	2.79	3.86	3.39	4.19	5.20	7.13
Panel B: The q-factor alphas, α_q												
1	α_q	−0.42	−0.35	−0.23	−0.14	−0.15	−0.02	0.08	0.17	0.29	0.43	0.86
	t	−4.09	−3.45	−2.28	−1.58	−1.80	−0.28	1.05	1.64	3.54	4.31	6.19
2	α_q	−0.36	−0.19	−0.17	−0.19	−0.13	0.06	0.01	0.17	0.29	0.58	0.93
	t	−3.78	−2.43	−1.81	−2.88	−1.81	0.68	0.19	1.88	3.02	4.16	5.53
3	α_q	−0.40	−0.16	−0.21	−0.23	−0.02	−0.11	0.17	0.19	0.30	0.61	1.01
	t	−4.14	−1.84	−2.49	−3.00	−0.21	−1.21	1.88	1.98	3.02	4.40	6.01
Panel C: The expected growth, $E_t[d^{\tau}I/A]$												
1	$E_t[d^{\tau}I/A]$	−15.21	−7.67	−5.61	−4.20	−3.03	−1.97	−0.86	0.47	2.52	7.65	22.87
	t	−36.75	−31.37	−25.19	−20.56	−15.96	−11.01	−5.08	3.01	16.53	37.98	45.21
2	$E_t[d^{\tau}I/A]$	−19.87	−10.18	−7.38	−5.52	−4.03	−2.67	−1.23	0.51	3.13	9.44	29.31
	t	−34.26	−26.34	−21.16	−16.88	−12.97	−8.94	−4.22	1.81	11.30	29.57	45.51
3	$E_t[d^{\tau}I/A]$	−20.42	−11.16	−8.26	−6.33	−4.75	−3.31	−1.77	0.03	2.66	9.06	29.48
	t	−30.59	−23.07	−18.58	−15.04	−11.80	−8.51	−4.70	0.10	7.67	24.92	44.17

τ		Low	2	3	4	5	6	7	8	9	High	H-L
Panel D: Average future realized growth, $d^{\tau}I/A$												
1	$d^{\tau}I/A$	-16.69	-12.30	-4.11	-3.56	-1.10	-0.43	-0.32	0.64	1.57	5.96	22.65
	t	-11.71	-8.36	-7.15	-5.22	-2.24	-0.90	-0.71	1.18	3.59	9.07	14.72
2	$d^{\tau}I/A$	-23.68	-12.64	-6.45	-3.74	-2.25	-1.44	0.10	1.47	1.25	3.14	26.82
	t	-14.38	-12.42	-8.44	-4.60	-3.86	-2.43	0.22	2.72	2.33	4.93	16.10
3	$d^{\tau}I/A$	-23.10	-12.91	-7.00	-3.20	-2.29	-2.90	-1.44	-0.50	0.46	1.31	24.41
	t	-14.70	-13.87	-9.51	-4.72	-3.79	-4.68	-2.96	-0.91	0.76	1.85	15.18

A Common Factor:

Panel A: Properties of the expected growth factor, R_{Eg}

$\bar{R}_{Eg}$	α	β_{Mkt}	β_{Me}	$\beta_{I/A}$	β_{Roe}	R^2
0.84	0.67	−0.11	−0.09	0.21	0.30	0.44
(10.27)	(9.75)	(−6.38)	(−3.56)	(4.86)	(9.13)	

α	β_{Mkt}	β_{Me}	$\beta_{I/A}$	β_{Roe}	$\beta_{\log(q)}$	R^2
0.67	−0.11	−0.09	0.23	0.30	−0.02	0.44
(9.80)	(−6.40)	(−3.61)	(4.72)	(8.83)	(−0.48)	

α	β_{Mkt}	β_{Me}	$\beta_{I/A}$	β_{Roe}	β_{Cop}	R^2
0.37	−0.02	−0.02	0.31	0.14	0.60	0.65
(6.35)	(−1.66)	(−0.54)	(9.51)	(4.37)	(10.63)	

Panel A: Properties of the expected growth factor, R_{Eg}

α	β_{Mkt}	β_{Me}	$\beta_{I/A}$	β_{Roe}	β_{dRoe}	R^2
0.63	−0.11	−0.10	0.18	0.23	0.16	0.46
(8.56)	(−6.62)	(−3.93)	(3.57)	(5.00)	(2.41)	

α	β_{Mkt}	β_{Me}	$\beta_{I/A}$	β_{Roe}	β_{Cop}	β_{dRoe}	R^2
0.33	−0.03	−0.02	0.28	0.07	0.60	0.15	0.66
(5.20)	(−1.88)	(−0.72)	(6.73)	(1.72)	(10.02)	(2.33)	

α	β_{Mkt}	β_{Me}	$\beta_{I/A}$	β_{Roe}	$\beta_{\log(q)}$	β_{Cop}	β_{dRoe}	R^2
0.25	−0.01	−0.01	0.06	0.04	0.22	0.72	0.21	0.70
(4.04)	(−0.86)	(−0.35)	(1.31)	(1.27)	(8.36)	(14.61)	(3.19)	

Panel B: Correlations of R_{Eg} with other factors

R_{Mkt}	R_{Me}	$R_{I/A}$	R_{Roe}	$R_{\log(q)}$	R_{Cop}	R_{dRoe}
−0.458	−0.367	0.342	0.506	0.188	0.710	0.423

Exploring alternative growth specifications

The q5 Model:

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

Limitation : Unlike investment and profitability, expected growth is unobservable. Estimating expected growth requires us to take a stand on its specification and the list of predictors to be included.

Stress-Testing Factor Models

1. Setting up the playing field.

2. discussing the overall performance of different factor model.

3. detail individual regressions for prominent anomalies

Setting up the playing field.

Testing Portfolios:

using the 150 anomalies that are significant at the 5% level with NYSE(NEW YORK STOCK EXCHANGE)breakpoints and value-weighted returns from January 1967 to December 2018

Factor Models:

In addition to the q and q5 models, we examine six other models, including (i) the Fama– French (2015) five-factor model; (ii) the Fama–French (2018) six-factor model with RMW; (iii) the Fama–French alternative six-factor model with RMWc; (iv) the Barillas–Shanken (2018) six-factor model; (v) the Stambaugh–Yuan (2017) four-factor model; and (vi) the Daniel–Hirshleifer–Sun (2019) three-factor model.

The Big Picture of Model Performance

Performance across 150 Anomalies

Panel A: Sharpe ratios for individual factors							
R_{Mkt}	R_{Me}	$R_{\text{I/A}}$	R_{Roe}	R_{Eg}	SMB	HML	CMA
0.112	0.094	0.200	0.218	0.444	0.074	0.112	0.149
RMW	RMWc	UMD	HML^{m}	MGMT	PERF	FIN	PEAD
0.125	0.186	0.151	0.083	0.195	0.163	0.104	0.320
Panel B: Maximum Sharpe ratios for factor models							
q	q^5	FF5	FF6	FF6c	BS6	SY4	DHS
0.416	0.634	0.322	0.365	0.434	0.475	0.412	0.416

Performance across Each Category of Anomalies

Momentum. Value-versus-growth. Investment. Profitability Intangibles and Trading Frictions

Discussing the overall performance of different factor model

To dig deeper, we present individual regressions of the 52 anomalies that the q-factor model cannot explain.

It reports the alphas and t-values for the q-factor model, the q5 model, and the two versions of the Fama–French six-factor model, as well as the q5 loadings for each high-minus-low decile.

All models including the q and q5 models fail to explain the anomaly on cumulative abnormal returns around earnings announcements.