MISPRICING FACTORS

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Factor Origins

- Factors: the $f_{j,t}$'s in

$$r_{i,t} = a_i + \sum_{j=1}^{K} \beta_{ij} f_{j,t} + \epsilon_{i,t}$$

- Originated *without* prior evidence of role in average return
  - market, consumption, output, volatility, liquidity, inflation, etc.
  - factors extracted using principal components or factor analysis
- Originated *with* prior evidence of role in average return
  - size, value, momentum
  - investment, profitability
- Factors based on the second approach are more popular
  - they explain expected returns better
  - "theory is flexible" (SG)
- We also pursue the second approach
  - exploiting more of the evidence
  - maintaining parsimony—key virtue of factor models

Motivation: Anomalies and Mispricing

- Anomalies
  - Mispricing effects (large literature)
  - Systematic components (e.g., investor sentiment)
- Recent evidence examining multiple anomalies:
  - Sentiment predicts anomaly long-short profits
  - Short-leg returns are especially low following high sentiment
  - Short-leg returns are stronger among stocks less easily shorted
  - IVOL is positively (negatively) related to long-leg (short-leg) alphas
  - Short-leg negative IVOL effect is stronger
    - among stocks less easily shorted
    - following high sentiment
  - Following publication of an anomaly
    - greater trading activity in its portfolios
    - lower profits

E.g., Baker and Wurgler (2006), Stambaugh, Yu, and Yuan (2012, 2015), Drechsler and Drechsler (2014), McLean and Pontiff (2015)

Factors: Our Approach

- Our factors aggregate information in 11 prominent anomalies
  - same set used in Stambaugh, Yu, and Yuan (2012, 2014, 2015)
  - alleviate data-mining concerns
  - examine model performance on wide range of other anomalies
- Objective: capture systematic components of mispricing
- Factor models can capture systematic risk or mispricing
- Parsimonious alternative to popular single-anomaly factors
- Four-factor model:
  - market
  - size (*SMB*)
  - two "mispricing factors" (*MGMT* and *PERF*)
- Three-factor model:
  - market
  - size (*SMB*)
  - one mispricing factors (*UMO*)

Main Results

- Our four-factor model
  - accommodates a wide range of anomalies better than notable 4- and 5-factor alternatives.
  - is heavily favored in Bayesian factor-model comparisons
- Our version of *SMB* implies a substantially larger size premium.
  - constructed to minimize the effects of mispricing
  - our *SMB* averages 46 bps (per month)
  - versus 25 bps for the Fama-French three-factor *SMB*
- Our 3-factor model also performs well, especially in the Bayesian model comparisons.
- Shared limitation of the factor models we consider:
  - cannot accommodate IVOL-related alpha
  - evident when controlling for overpricing vs. underpricing
  - otherwise can appear as successfully handling IVOL
  - effect of arbitrage risk enters depends on mispricing direction

Constructing the Mispricing Factors

- Universe: NYSE/AMEX/NASDAQ stocks, price $\geq$ \$5
- Correlations of 11 anomaly long-short return residuals in regression

$$R_{it} = \alpha_i + \beta_i MKT_t + s_i SMB_t + \epsilon_{it}$$

- Two clusters - Ahn, Conrad, Dittmar (2009) procedure

First Cluster	*Second Cluster*
Net stock issues	Distress
Composite equity issues	O-score
Accruals	Momentum
Net operating assets	Gross profitability
Asset growth	Return on assets
Investment-to-assets	

- First cluster, *MGMT*: management-related
- Second cluster, *PERF*: performance-related

Constructing the Mispricing Factors

- Average each stock's anomaly percentiles within each cluster $\longrightarrow$ mispricing measures $P1$ and $P2$
- Separate small and large stocks, using median NYSE size
- Within each size group, form two value-weighted portfolios:
  - stocks with $P1$ below 20th NYSE/AMEX/NASDAQ pctile
  - stocks with $P1$ above 80th NYSE/AMEX/NASDAQ pctile
- *MGMT*: average low-$P1$ return minus average high-$P1$ return
- *PERF*: same procedure using $P2$

Size Factor

- Our *SMB*:
  - use only the stocks not used in the mispricing factors
  - return difference between value-weighted portfolios of
    - small stocks not in the four extreme $P1$ and $P2$ portfolios
    - large stocks not in the four extreme $P1$ and $P2$ portfolios
- Alternative (more familiar) procedure:
  - use all stocks
  - return difference between value-weighted portfolios of
    - average of all six small-stock $P1$ and $P2$ portfolios
    - average of all six large-stock $P1$ and $P2$ portfolios
  - mispricing effects unlikely to average out
    - arbitrage asymmetry $\Rightarrow$ over-pricing more severe
    - especially for small stocks
  - result: downward bias in size premium
- Important for size premium
- Not important for our model's ability to explain anomalies

Comparing Size Premia

- Size premia, bps per month, 1967–2013

	Average	t-statistic
1. Our *SMB*	46.0	3.76
2. Alternative *SMB*	27.5	2.30
3. FF-3 *SMB*	24.7	1.86
1 minus 2	18.4	3.99
1 minus 3	21.3	4.19

- Is book/market affected by mispricing? (e.g., Lakonishok, Shleifer, Vishny (1994))
- Size matters after controlling for mispricing

  . . . or, "if you control your junk" (Asness et al. (2015))

Factors: Monthly Statistics

Factor	Mean(%)	Std. Dev.(%)	Correlations			
			MGMT	*PERF*	*SMB*	*MKT*
MGMT	0.62	2.93	1	0.00	-0.30	-0.55
PERF	0.70	3.83	0.00	1	-0.06	-0.25
SMB	0.46	2.90	-0.30	-0.06	1	0.26
MKT	0.51	4.60	-0.55	-0.25	0.26	1

Factors: Monthly Statistics, 1/1967–6/1990

Factor	Mean(%)	Std. Dev.(%)	Correlations			
			MGMT	*PERF*	*SMB*	*MKT*
MGMT	0.69	2.76	1.00	-0.23	-0.32	-0.63
PERF	0.68	3.01	-0.23	1.00	-0.07	0.01
SMB	0.54	3.02	-0.32	-0.07	1.00	0.32
MKT	0.39	4.79	-0.63	0.01	0.32	1.00

Factors: Monthly Statistics, 7/1990–12/2013

			Correlations			
Factor	Mean(%)	Std. Dev.(%)	*MGMT*	*PERF*	*SMB*	*MKT*
MGMT	0.55	3.10	1.00	0.13	-0.28	-0.49
PERF	0.72	4.50	0.13	1.00	-0.05	-0.45
SMB	0.38	2.78	-0.28	-0.05	1.00	0.18
MKT	0.63	4.40	-0.49	-0.45	0.18	1.00

Factor Loadings of Anomaly Strategies, Long–Short

	β_{MGMT}	β_{PERF}	t_{MGMT}	t_{PERF}
First Cluster (used to construct mispricing factor MGMT)				
Net stock issues	0.63	0.22	17.21	8.85
Composite equity issues	0.85	0.05	18.12	1.72
Accruals	0.38	0.02	6.09	0.48
Net operating assets	0.46	-0.01	8.54	-0.28
Asset growth	0.94	-0.02	15.99	-0.54
Investment-to-assets	0.64	-0.09	11.83	-2.61
Average	0.65	0.03	12.96	1.27
Second Cluster (used to construct mispricing factor PERF)				
Distress	0.31	1.17	3.96	24.10
O-score	-0.09	0.23	-1.39	5.02
Momentum	0.25	1.21	1.71	12.15
Gross profitability	-0.32	0.66	-6.08	18.04
Return on assets	0.06	0.66	0.95	13.21
Average	0.04	0.79	-0.17	14.50

Factor Loadings of Anomaly Strategies, Long Legs

	β_{MGMT}	β_{PERF}	t_{MGMT}	t_{PERF}
First Cluster (used to construct mispricing factor MGMT)				
Net stock issues	0.31	0.06	14.29	4.18
Composite equity issues	0.48	-0.06	11.13	-2.31
Accruals	-0.22	0.08	-4.64	2.37
Net operating assets	0.09	-0.08	2.49	-2.92
Asset growth	0.34	-0.01	6.99	-0.18
Investment-to-assets	0.17	0.02	5.52	0.83
Average	0.20	0.00	5.96	0.33
Second Cluster (used to construct mispricing factor PERF)				
Distress	0.04	0.39	0.78	12.27
O-score	-0.32	0.14	-6.62	4.26
Momentum	-0.18	0.46	-2.40	9.48
Gross profitability	-0.01	0.24	-0.29	7.14
Return on assets	-0.25	0.27	-7.25	10.94
Average	-0.14	0.30	-3.16	8.82

Factor Loadings of Anomaly Strategies, Short Legs

	β_{MGMT}	β_{PERF}	t_{MGMT}	t_{PERF}
First Cluster (used to construct mispricing factor MGMT)				
Net stock issues	-0.32	-0.16	-8.82	-6.62
Composite equity issues	-0.37	-0.11	-11.80	-5.11
Accruals	-0.61	0.06	-16.11	2.43
Net operating assets	-0.37	-0.07	-11.45	-2.80
Asset growth	-0.60	0.01	-20.20	0.77
Investment-to-assets	-0.47	0.11	-9.14	3.21
Average	-0.46	-0.03	-12.92	-1.35
Second Cluster (used to construct mispricing factor PERF)				
Distress	-0.27	-0.78	-4.67	-23.10
O-score	-0.23	-0.10	-5.14	-3.05
Momentum	-0.43	-0.75	-4.91	-12.39
Gross profitability	0.31	-0.42	5.94	-13.00
Return on assets	-0.32	-0.39	-5.06	-8.69
Average	-0.19	-0.49	-2.77	-12.05

Investor Sentiment and the Factors

$$R_t = a + bS_{t-1} + u_t,$$

	Long Leg		Short Leg		Long−Short	
Factor	$\hat{b}$	t-stat.	$\hat{b}$	t-stat.	$\hat{b}$	t-stat.
MKT	-	-	-	-	-0.32	-1.37
SMB	-0.49	-1.72	-0.27	-1.17	-0.22	-1.60
MGMT	-0.22	-0.98	-0.66	-2.06	0.44	2.81
PERF	-0.31	-1.29	-0.67	-2.05	0.36	2.02

	$\hat{b}$	t-stat.
1. Our *SMB*	-0.22	-1.60
2. FF-3 *SMB*	-0.32	-2.27
2 minus 1	-0.10	-1.68

Comparing Models' Abilities to Accommodate Anomalies

- The primary models we compare

  FF-3: three-factor model of Fama and French (1993)
  FF-5: five-factor model of Fama and French (2015)
  q-4: "*q*-factor" model of Hou, Xue, and Zhang (2015a)
  M-4: four-factor mispricing-factor model introduced here

- All use factors formed on stock characteristics that initially gained attention as anomalies.
- Previous studies investigate the abilities of the first three to accommodate a range of anomalies.

Anomaly Alphas Under Different Factor Models

Anomaly	Unadjusted	FF-3	FF-5	q-4	M-4
Net stock issues	0.56	0.66	0.32	0.37	0.06
Composite equity issues	0.58	0.54	0.34	0.51	0.07
Accruals	0.43	0.51	0.56	0.65	0.31
Net operating assets	0.53	0.53	0.50	0.43	0.22
Asset growth	0.52	0.32	0.06	0.08	-0.22
Investment-to-assets	0.53	0.42	0.35	0.32	0.06
Distress	0.44	1.21	0.62	0.20	-0.16
O-score	0.05	0.49	0.45	0.47	0.35
Momentum	1.26	1.59	1.35	0.48	0.12
Gross profitability	0.28	0.69	0.35	0.39	0.11
Return on assets	0.58	0.91	0.43	0.10	0.27
Book-to-market	0.43	-0.20	-0.14	-0.03	-0.17

Anomaly Alphas Under Different Factor Models

(t-statistics)

Anomaly	Unadjusted	FF-3	FF-5	q-4	M-4
Net stock issues	4.77	6.60	3.42	3.54	0.71
Composite equity issues	3.88	4.93	2.94	4.10	0.70
Accruals	2.95	3.61	3.94	4.30	2.08
Net operating assets	4.32	4.10	3.63	3.03	1.70
Asset growth	3.69	2.83	0.58	0.72	-1.96
Investment-to-assets	4.28	3.48	3.04	2.72	0.54
Distress	1.54	5.03	2.29	0.78	-1.03
O-score	0.30	4.28	3.92	3.89	2.42
Momentum	4.58	5.70	4.12	1.40	0.47
Gross profitability	1.79	5.22	2.78	2.50	0.92
Return on assets	3.18	5.52	3.13	0.85	1.90
Book-to-market	2.39	-1.99	-1.33	-0.19	-1.10

Summary of Models' Abilities to Explain Anomalies

(12 anomalies, value-weighted, NYSE deciles)

Measure	Unadjusted	FF-3	FF-5	q-4	M-4
Average $\|\alpha\|$	0.52	0.67	0.45	0.34	0.18
Average $\|t\|$	3.14	4.44	2.93	2.34	1.29
GRS_{10}	6.89	10.10	6.71	5.99	1.84
p_{10}	3×10^{-10}	1×10^{-15}	7×10^{-10}	1×10^{-8}	0.05
GRS_{12}	6.16	7.71	4.17	3.95	1.88
p_{12}	5×10^{-10}	4×10^{-13}	3×10^{-6}	8×10^{-6}	0.03
No. of $min\|\alpha\|$	-	0	1	2	9

Summary of Models' Abilities to Explain Anomalies

(73 anomalies, value-weighted, NYSE deciles)

Measure	Unadjusted	FF-3	FF-5	q-4	M-4
Average $\lvert\alpha\rvert$	0.39	0.44	0.30	0.20	0.18
Average $\lvert t\rvert$	2.14	2.74	1.77	1.15	0.99
GRS_{51}	2.74	2.60	1.91	1.68	1.28
p_{51}	9×10^{-9}	7×10^{-8}	3×10^{-4}	3×10^{-3}	0.10
GRS_{72}	2.23	2.10	1.79	1.78	1.54
p_{72}	2×10^{-6}	1×10^{-5}	5×10^{-4}	6×10^{-4}	8×10^{-3}
No. of $min\lvert\alpha\rvert$	-	7	10	19	37

Summary of Models' Abilities to Explain Anomalies

(73 anomalies, equally weighted, NYSE/AMEX/NASDAQ deciles)

Measure	Unadjusted	FF-3	FF-5	q-4	M-4
Average $\|\alpha\|$	0.50	0.53	0.35	0.23	0.22
Average $\|t\|$	3.02	3.72	2.41	1.44	1.38
GRS_{51}	5.85	6.31	5.15	4.19	4.17
p_{51}	3×10^{-27}	6×10^{-30}	4×10^{-23}	2×10^{-17}	3×10^{-17}
GRS_{72}	2.95	3.25	2.64	2.41	2.68
p_{72}	1×10^{-10}	3×10^{-12}	1×10^{-8}	2×10^{-7}	6×10^{-9}
No. of $min\|\alpha\|$	-	7	11	23	32

Summary of Models' Abilities to Explain Anomalies Less Correlated with Factors in Models q-4 and M-4

(57 anomalies, value-weighted, NYSE deciles)

Measure	Unadjusted	FF-3	FF-5	q-4	M-4
Average $\|\alpha\|$	0.37	0.39	0.27	0.19	0.17
Average $\|t\|$	2.14	2.60	1.71	1.15	0.97
GRS_{41}	3.01	2.81	1.95	1.63	1.26
p_{41}	7×10^{-9}	6×10^{-8}	6×10^{-4}	9×10^{-3}	0.13
GRS_{56}	2.29	2.16	1.73	1.64	1.53
p_{56}	6×10^{-6}	3×10^{-5}	2×10^{-3}	5×10^{-3}	0.01
No. of $min\|\alpha\|$	-	4	7	15	31
No. of $min\|\alpha\|$, q-4 vs. M-4	-	-	-	21	36

Summary of Models' Abilities to Explain Anomalies Less Correlated with Factors in Models q-4 and M-4

(54 anomalies, equally weighted, NYSE/AMEX/NASDAQ deciles)

Measure	Unadjusted	FF-3	FF-5	q-4	M-4
Average $\|\alpha\|$	0.45	0.46	0.32	0.25	0.23
Average $\|t\|$	2.94	3.53	2.41	1.61	1.47
GRS_{40}	6.38	7.03	5.78	4.69	4.55
p_{40}	7×10^{-26}	5×10^{-29}	8×10^{-23}	3×10^{-17}	2×10^{-16}
GRS_{53}	3.36	4.07	3.12	2.82	3.03
p_{53}	4×10^{-11}	1×10^{-14}	7×10^{-10}	2×10^{-8}	2×10^{-9}
No. of $min\|\alpha\|$	-	6	9	16	23
No. of $min\|\alpha\|$, q-4 vs. M-4	-	-	-	21	33

Models' Abilities to Explain Each Other's Factors

Factors in FF-5

	Alpha (t-statistic) computed with respect to model	
Factors	q-4	M-4
HML	0.04	-0.03
	(0.43)	(-0.28)
RMW	0.04	0.11
	(0.55)	(1.35)
CMA	0.02	-0.03
	(0.47)	(-0.56)

Models' Abilities to Explain Each Other's Factors

Factors in q-4

Factors	Alpha (t-statistic) computed with respect to model	
	FF-5	M-4
I/A	0.12	0.09
	(3.48)	(1.57)
ROE	0.45	0.36
	(5.53)	(4.00)

Models' Abilities to Explain Each Other's Factors

Factors in M-4

Factors	Alpha (t-statistic) computed with respect to model	
	FF-5	q-4
MGMT	0.33	0.36
	(4.93)	(4.54)
PERF	0.64	0.35
	(4.17)	(2.24)

Models' Abilities to Explain Each Other's Factors

GRS F-statistic (p-value)

	Alphas computed with respect to model		
Factors	FF-5	q-4	M-4
HML, *RMW*, *CMA*	-	0.23 (0.87)	0.65 (0.58)
I/A, *ROE*	19.06 (10×10^{-9})	-	9.12 (1×10^{-4})
MGMT, *PERF*	25.35 (3×10^{-11})	15.66 (2×10^{-7})	-

Bayesian Model Comparison

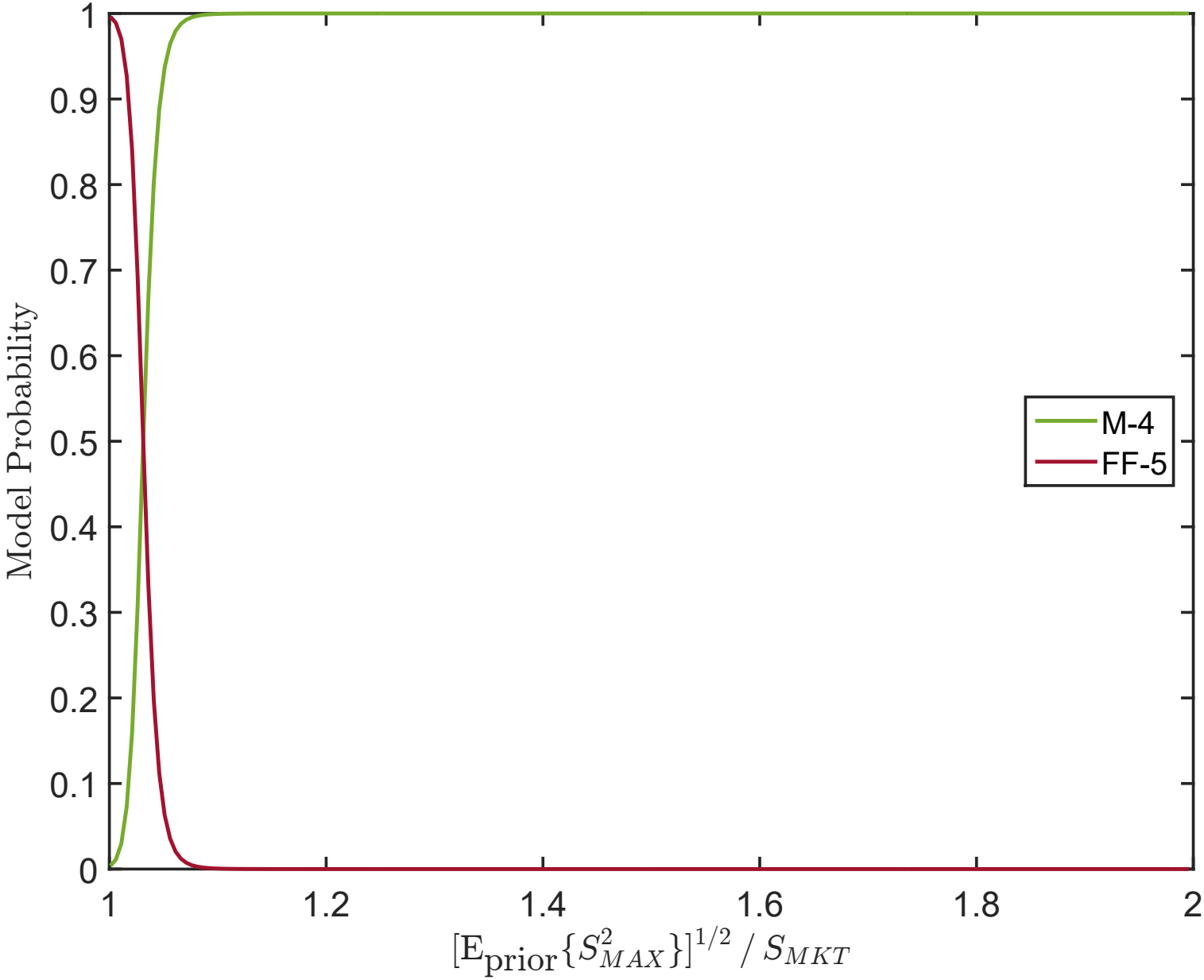
- Compare models: M_1, M_2
- Prior model probabilities: $p(M_1)$, $p(M_2)$ (sum to 1)
- Conditional on the data, D, posterior probability of model i:

$$p(M_i|D) = \frac{p(M_i) \cdot ML_i}{p(M_1) \cdot ML_1 + p(M_2) \cdot ML_2},$$

with marginal likelihood given by

$$ML_i = \int_{\theta_i} p(\theta_i) p(D|\theta_i) d\theta_i$$

- $p(D|\theta_i)$: likelihood function for model i
- $p(\theta_i)$: prior distribution for model i's parameters
  - informative about factors' maximum Sharpe ratio
  - specify $[\mathrm{E}_{\mathrm{prior}}\{S^2_{MAX}\}]^{1/2} \,/\, S_{MKT}$
- Non-factor "test assets" irrelevant (Barillas & Shanken, 2015)


Model Probability
1
0.9
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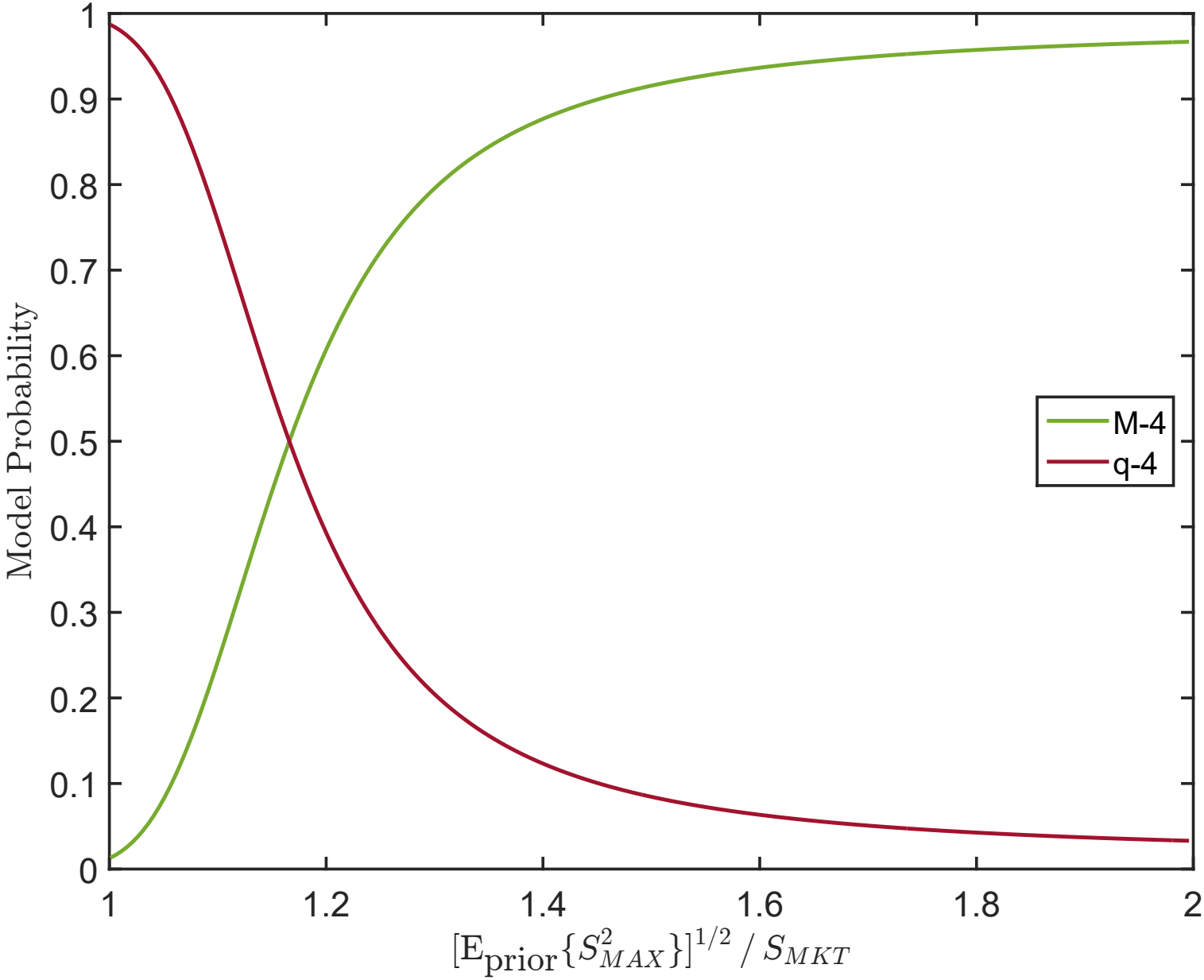
M-4
FF-5


Model Probability
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1.4
1.6
1.8
2
$[\mathrm{E}_{\mathrm{prior}}\{S^2_{MAX}\}]^{1/2} \,/\, S_{MKT}$
M-4
q-4

Percent of Return Variance Explained by Factor Models

No. of Assets	Description	Factor Model						
		MKT	*MKT* & *SMB*	FF-3	FF-5	q-4	M-4	M-3
30	Industry Portfolios	59.5	61.1	63.5	66.1	63.6	63.3	62.0
25	Size-B/M Portfolios	74.9	85.3	91.6	92.1	88.4	88.1	85.7
25	Size-Mispricing Portfolios	81.2	89.8	90.8	91.9	91.2	92.3	93.1
25	Size-Beta Portfolios	75.6	86.0	88.8	89.8	88.1	87.7	87.2
25	Size-Volatility Portfolios	75.3	83.2	87.1	89.4	86.4	86.6	85.8

Alternative Three-Factor Model

- Compute composite mispricing measure by averaging a stock's percentiles for all 11 anomalies
- Otherwise form single mispricing factor (and size factor) in same manner as before
- Three factors:
  - market
  - size (SMB)
  - mispricing (UMO)
- Essentially replace HML with a composite mispricing factor

Comparison of Three-Factor Models

(12 anomalies, value-weighted, NYSE deciles)

	FF-3	M-3
Average $\lvert\alpha\rvert$	0.67	0.28
Average $\lvert t\rvert$	4.44	1.78
GRS_{10}	10.10	2.50
p_{10}	1×10^{-15}	0.006
GRS_{12}	7.71	3.03
p_{12}	4×10^{-13}	4×10^{-4}
No. of min $\lvert\alpha\rvert$	1	11

Comparison of Three-Factor Models

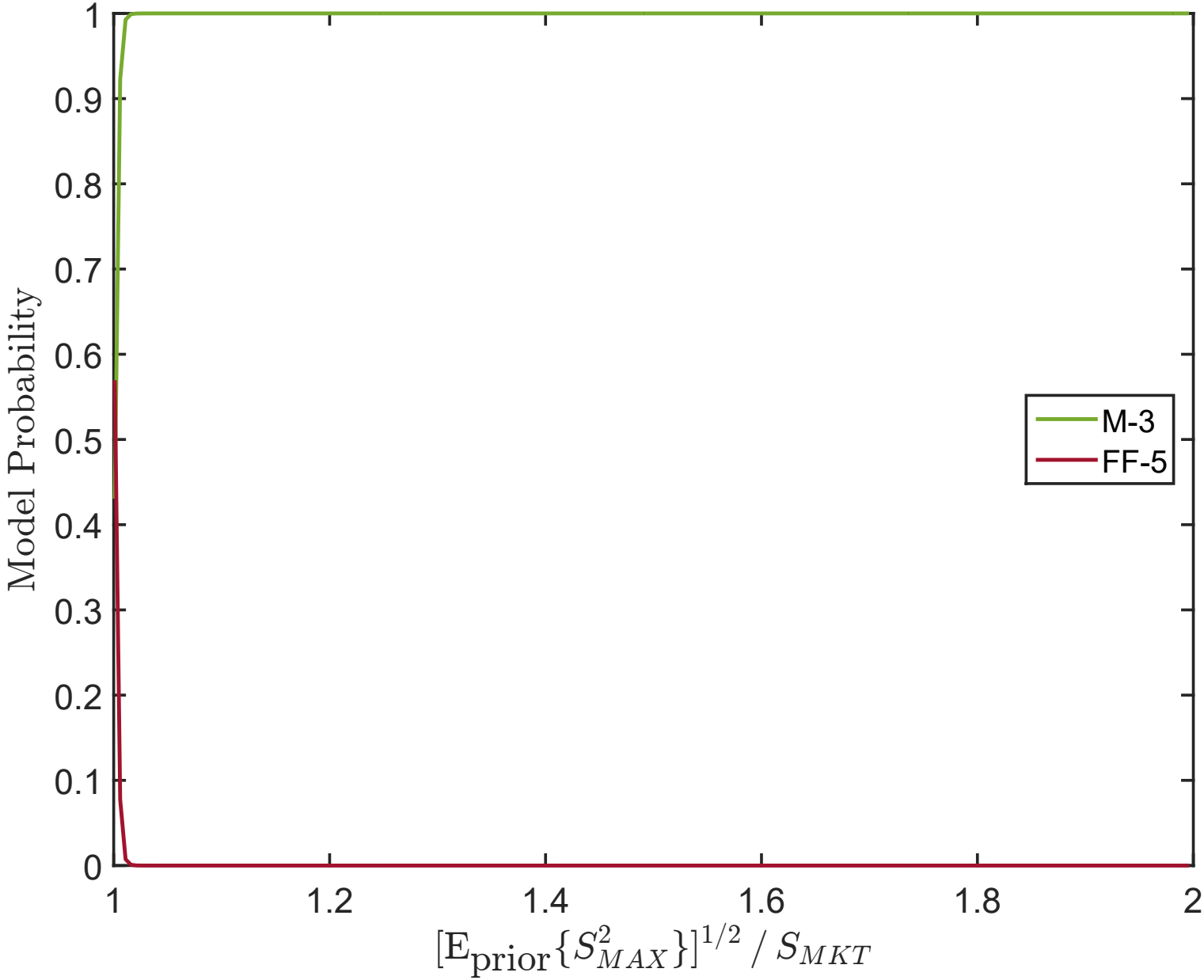
(73 Anomalies, value-weighted, NYSE deciles)

	FF-3	M-3
Average $\lvert\alpha\rvert$	0.44	0.24
Average $\lvert t\rvert$	2.74	1.17
GRS_{51}	2.60	1.46
p_{51}	7×10^{-8}	0.02
GRS_{72}	2.10	1.67
p_{72}	1×10^{-5}	2×10^{-3}
No. of min $\lvert\alpha\rvert$	18	55

Comparison of Three-Factor Models

(73 Anomalies, equally weighted, NYSE/AMEX/NASDAQ deciles)

	FF-3	M-3
Average $\lvert\alpha\rvert$	0.53	0.30
Average $\lvert t\rvert$	3.72	1.61
GRS_{51}	6.31	4.09
p_{51}	6×10^{-30}	10×10^{-17}
GRS_{72}	3.25	2.48
p_{72}	3×10^{-12}	9×10^{-8}
No. of min $\lvert\alpha\rvert$	15	58


1
0.9
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0.5
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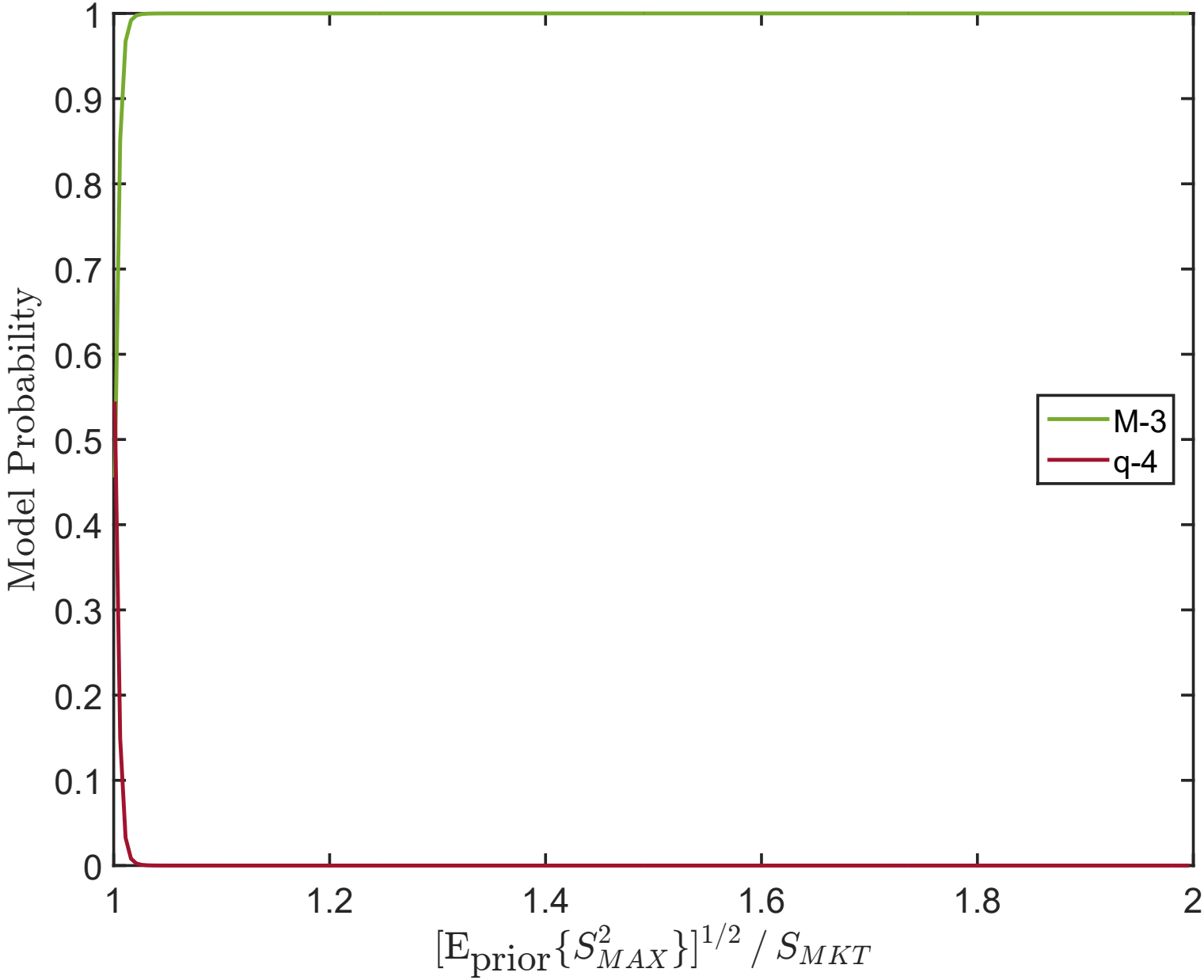
0.3
0.2
0.1
0
Model Probability
1
1.2
1.4
1.6
1.8
2
$[\mathrm{E}_{\mathrm{prior}}\{S^2_{MAX}\}]^{1/2} \,/\, S_{MKT}$
M-3
FF-5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0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Model Probability
1
1.2
1.4
1.6
1.8
2
$[\mathrm{E}_{\mathrm{prior}}\{S^2_{MAX}\}]^{1/2} \,/\, S_{MKT}$
M-3
q-4

Arbitrage Risk and Factor Models

- Idiosyncratic volatility represents arbitrage risk (e.g., Pontiff (2006))
- Effects alpha in different directions, depending on overpricing versus underpricing
- Stronger expected effect among overpriced stocks, given less capital willing/able to short
- Consistent with empirical evidence (Stambaugh, Yu, and Yuan (2015))
- Here we sort, independently, into quintiles of
  - the composite mispricing measure
  - IVOL: std. dev. of daily 3-factor residuals over past month
- Form value-weighted portfolios
- Compare alphas under different factor models

Idiosyncratic Volatility Effects
FF-3 Alpha

	Highest IVOL	Next 20%	Next 20%	Next 20%	Lowest IVOL	Highest -Lowest
Most Overpriced (top 20%)	-1.87 (-12.04)	-0.92 (-6.89)	-0.77 (-5.42)	-0.51 (-4.13)	-0.23 (-1.85)	-1.64 (-8.46)
Middle 20%	-0.22 (-1.43)	-0.18 (-1.51)	-0.01 (-0.09)	-0.25 (-2.47)	0.06 (0.65)	-0.28 (-1.42)
Most Underpriced (bottom 20%)	0.45 (2.86)	0.61 (4.56)	0.50 (4.95)	0.35 (4.3)	0.15 (2.18)	0.30 (1.70)
All Stocks	-0.72 (-6.52)	-0.12 (-1.61)	-0.02 (-0.38)	0.02 (0.46)	0.10 (2.31)	-0.81 (-6.04)

Idiosyncratic Volatility Effects
FF-5 Alpha

	Highest IVOL	Next 20%	Next 20%	Next 20%	Lowest IVOL	Highest -Lowest
Most Overpriced (top 20%)	-1.40 (-8.71)	-0.65 (-4.63)	-0.55 (-3.85)	-0.47 (-3.54)	-0.17 (-1.27)	-1.23 (-6.15)
Middle 20%	0.09 (0.56)	-0.07 (-0.56)	0.01 (0.10)	-0.28 (-2.43)	-0.06 (-0.71)	0.15 (0.78)
Most Underpriced (bottom 20%)	0.57 (3.44)	0.61 (4.03)	0.39 (3.75)	0.17 (1.99)	-0.07 (-1.02)	0.64 (3.61)
All Stocks	-0.36 (-3.55)	0.01 (0.19)	-0.01 (-0.11)	-0.08 (-1.44)	-0.03 (-0.70)	-0.33 (-2.69)

Idiosyncratic Volatility Effects

q-4 Alpha

	Highest IVOL	Next 20%	Next 20%	Next 20%	Lowest IVOL	Highest -Lowest
Most Overpriced (top 20%)	-1.25 (-7.57)	-0.44 (-3.11)	-0.55 (-3.38)	-0.45 (-2.8)	-0.14 (-0.85)	-1.11 (-4.88)
Middle 20%	0.12 (0.67)	0.01 (0.07)	0.09 (0.65)	-0.35 (-2.68)	-0.05 (-0.45)	0.16 (0.73)
Most Underpriced (bottom 20%)	0.47 (2.43)	0.59 (3.56)	0.32 (2.93)	0.07 (0.84)	-0.14 (-1.65)	0.61 (2.96)
All Stocks	-0.28 (-2.40)	0.09 (1.13)	0.01 (0.13)	-0.13 (-2.00)	-0.05 (-1.05)	-0.23 (-1.58)

Idiosyncratic Volatility Effects

M-4 Alpha

	Highest IVOL	Next 20%	Next 20%	Next 20%	Lowest IVOL	Highest -Lowest
Most Overpriced (top 20%)	-0.96 (-6.33)	-0.20 (-1.61)	-0.16 (-1.05)	-0.11 (-0.88)	0.08 (0.57)	-1.04 (-4.40)
Middle 20%	0.06 (0.34)	0.02 (0.14)	0.12 (1.04)	-0.25 (-2.03)	-0.01 (-0.13)	0.08 (0.33)
Most Underpriced (bottom 20%)	0.36 (2.08)	0.28 (1.93)	0.23 (2.16)	0.00 (-0.05)	-0.26 (-3.66)	0.62 (3.17)
All Stocks	-0.21 (-1.75)	0.13 (1.60)	0.08 (1.22)	-0.06 (-0.91)	-0.09 (-1.80)	-0.12 (-0.79)

Conclusions

- Our four-factor model accommodates anomalies better than notable four- and five-factor alternatives.
- Our size factor, constructed to be less affected by mispricing, implies a size premium nearly twice the usual estimate.
- Our three-factor model substantially outperforms the popular three-factor model of Fama and French (1993).
- Both of our models far well in Bayesian model comparisons.
- All of the factor models considered share a limitation in accommodating arbitrage risk (IVOL).