JACOBS LEVY EQUITY MANAGEMENT CENTER
FOR QUANTITATIVE FINANCIAL RESEARCH

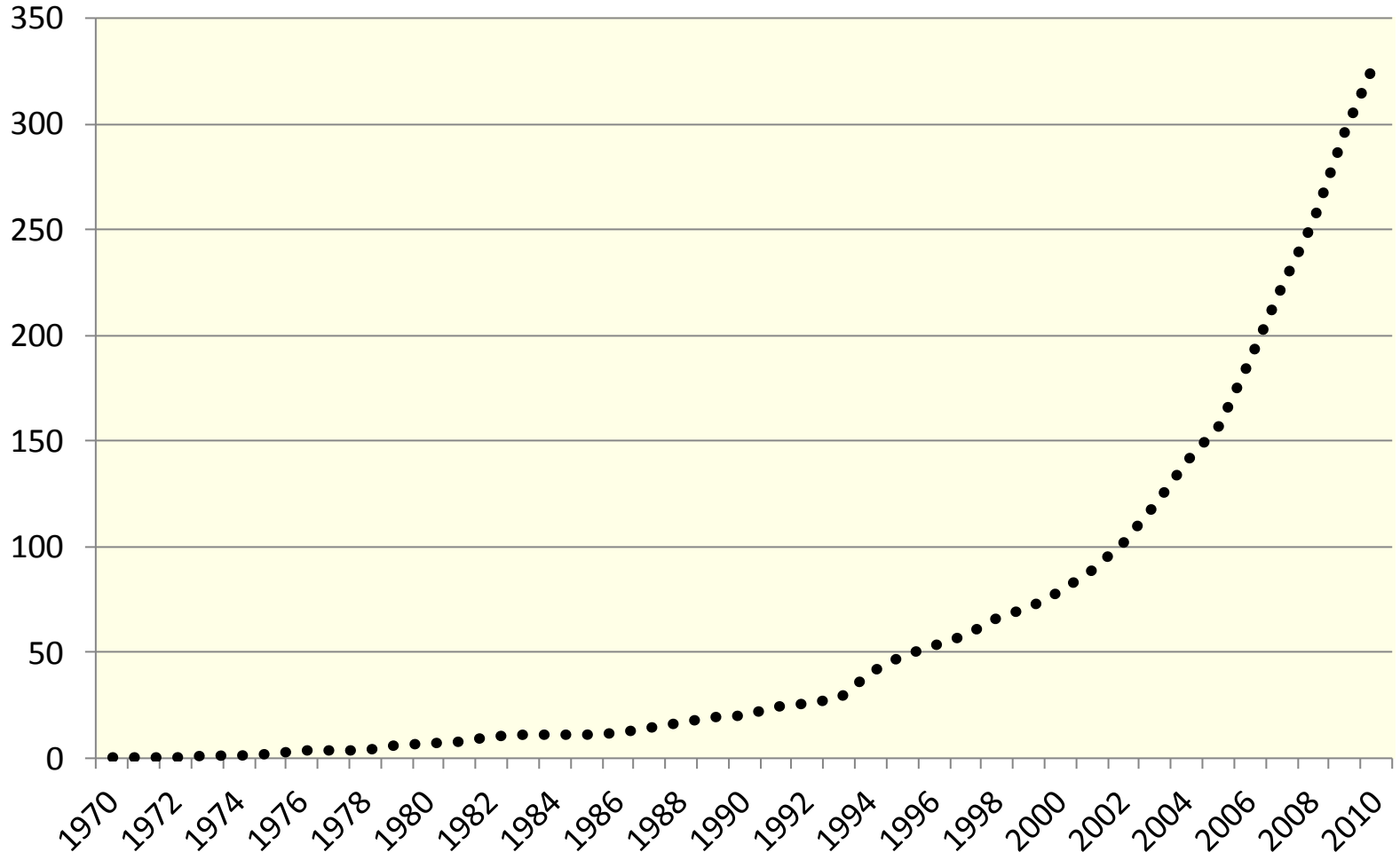
The Remarkable Multidimensionality in the Cross-Section of Expected U.S. Stock Returns

Jeremiah Green
Assistant Professor
Smeal College of Business, Pennsylvania State University

Paper with John Hand and Frank Zhang

Friday, April 25, 2014

NUMBER OF RETURN PREDICTIVE SIGNALS (*Source: Green, Hand, and Zhang (2013)- Review of Accounting Studies*)



BACKGROUND

Why the search for new signals (RPS) that (incrementally) predict returns?

Academics: Breaking down a fortress wall (and they were getting published)
Practitioners: Competition to provide abnormal returns

What do we (the world) do with the new signals?

Do we incrementally include each signal when evaluating new signals? (Practice-yes?, Academics-in general hasn't really happened)

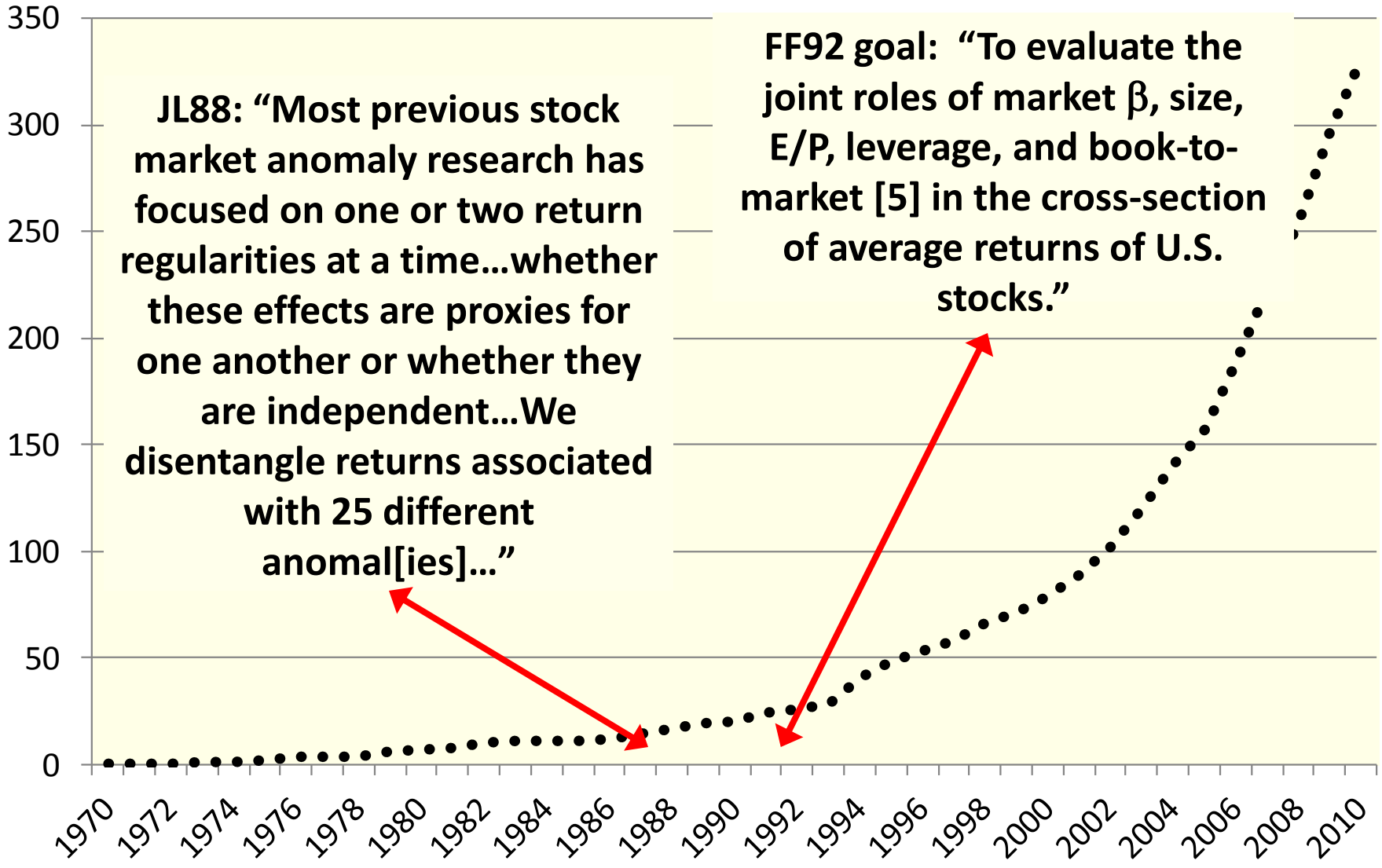
Signal recalculated	All papers
Beta [RMKT]	70%
Firm size [SMB]	77%
Book-to-market [HML]	66%
Momentum [MOM]	45%
Other	12%
None	9%

THE PRIMARY ISSUE

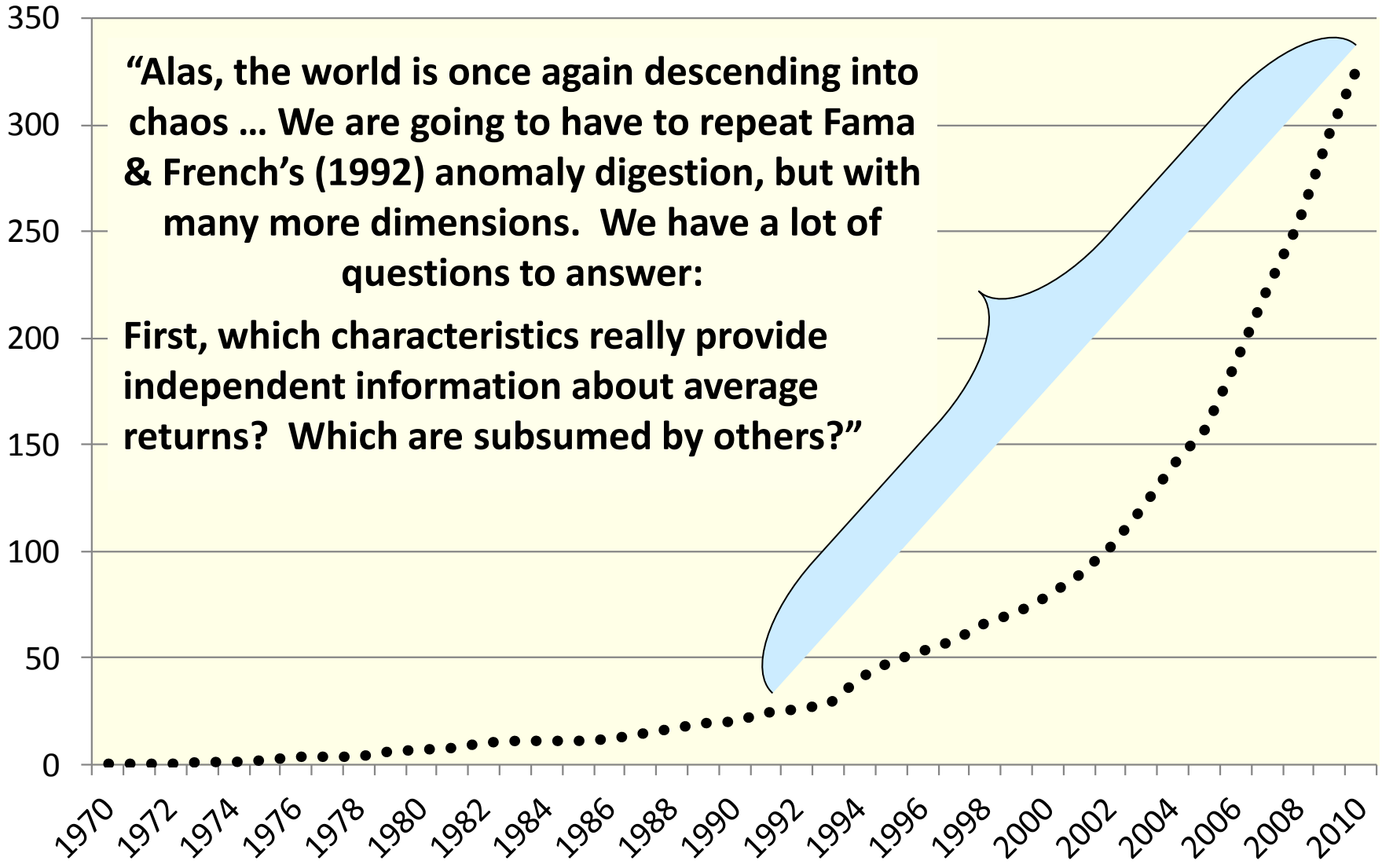
Periodic question is whether these signals measure the same thing:

Are the signals the same?

Which are incremental?


JL88: "Most previous stock market anomaly research has focused on one or two return regularities at a time…whether these effects are proxies for one another or whether they are independent…We disentangle returns associated with 25 different anomal[ies]…"
FF92 goal: "To evaluate the joint roles of market β, size, E/P, leverage, and book-to-market [5] in the cross-section of average returns of U.S. stocks."
350
300
250
200
150
100
50
0
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010

A CALL FOR ASKING THE QUESTION (AGAIN)



SOME IMPORTANT CONCERNS

In sample over-fitting (the RPS discovered in same data)
Over-fitting-current tests (Lots of RPS, easier to fit noise)
Correlation-Measuring the same thing (Concern and purpose of tests)

What is the concern for all of these?

- Conclude that lots of RPS significant when out-of-sample it won't work

What do we (in this paper) do?

- Only signals studied in prior research
- Latest data (includes some out of sample versus when RPS discovered)
- Consistent definitions (don't vary to try to get best signal definitions)
- Stricter statistical cutoff (Harvey, Liu, and Zhu, 2013)
- Various methodologies

WHAT WE DO

- Start with 100 RPS from CRSP, Compustat, and I/B/E/S 1980-2012
- Missing values set to mean and all variables ranked into deciles (0, .1, .. 1)
- Align in calendar month
- Remove 9 that are highly correlated (around 90%) with other RPS

STOP

What would you expect?

Our informal surveys:

-of academics = a lot of overlap in RPS = 5-10 incremental
-of practitioners = we know a lot, but which?

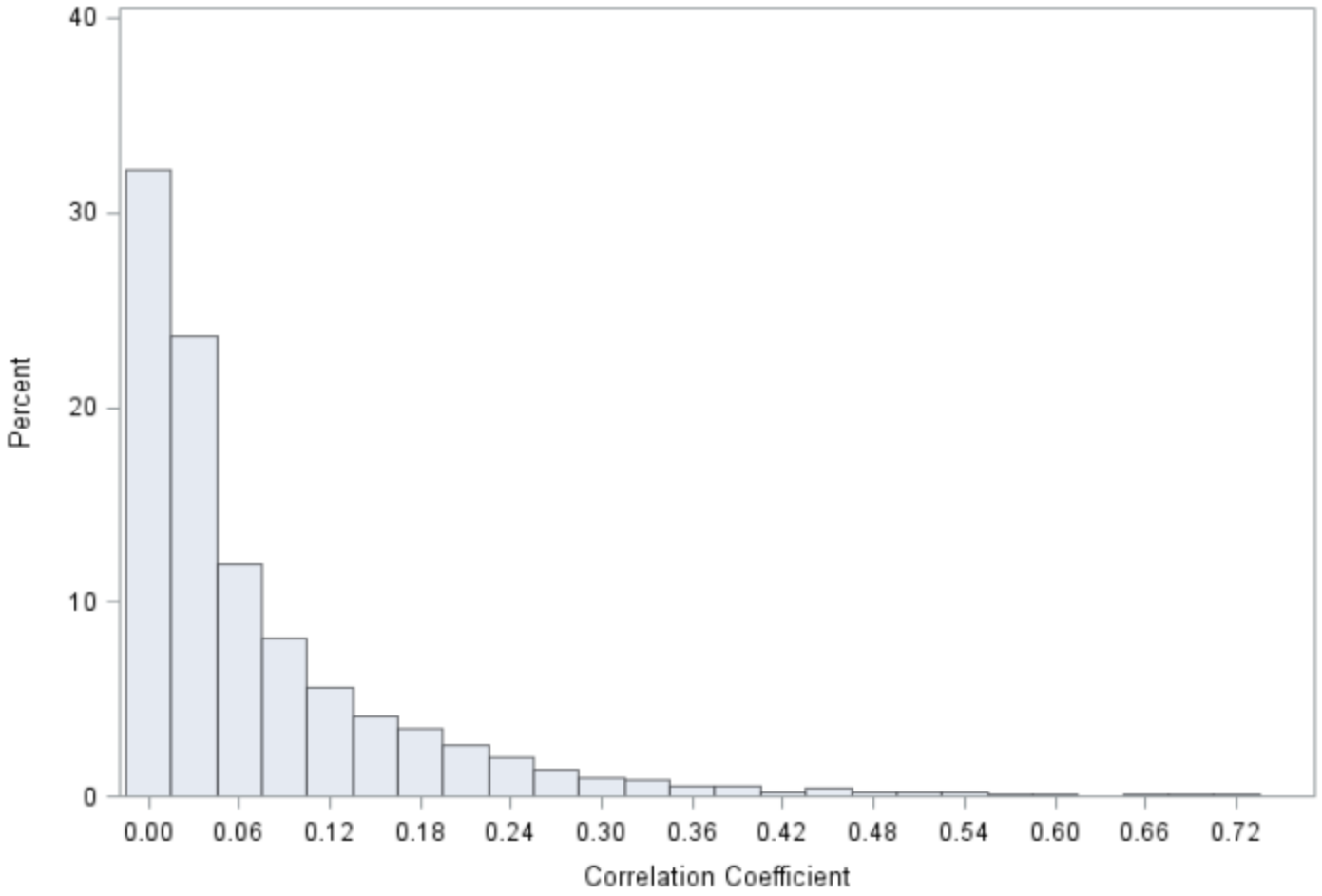
SUMMARY OF RESULTS

- After removing 9, mean absolute correlation among RPS = 8%
- 24 (of 91) are significant with |t-stat| >= 3.0
- 24 may likely be understated
- N RPS larger for small companies, but R-squared larger for large companies
- Returns to multidimensional (pure-JL) are about ½ of the unidimensional (naïve-JL)
- Robust: Factor analysis, Lasso Regression, WLS, pseudo-out-of-sample
- Pseudo out-of-sample Sharpe ratio = 2.6
- An empirically derived 10-RPS model provides a reasonable approximation of the full set

SAMPLE OF RPS

Beta	Change in shares outstanding
Earnings to price	Asset growth
Firm size	3-day return around earnings announcement
dividend to price	new equity issue
Unexpected quarterly earnings	sales to price
Book-to-market	dividend initiation
Forecasted growth in 5-year EPS	sales growth
leverage	Employee growth rate
illiquidity (bid-ask spread)	number of earnings increases
industry momentum	Dispersion in forecasted eps
scaled analyst forecast	R&D to sales
idiosyncratic return volatility	Cash flow volatility
Growth in long term net operating assets	ROA
12 month momentum	Change in tax expense
One month momentum	Gross profitability

ABSOLUTE RPS CROSS-CORRELATIONS



SUMMARY OF PRIMARY REGRESSIONS

	All firms	
	Unidimensional	Multidimensional
# abs{t-stat} ≥ 1.96	48	46
# abs{t-stat} ≥ 3.0	35	24
Mean # obs. per regression	5,032	4,930
Mean adjusted R^2	0.4%	6.0%

Multimensional (by firm size)		
Large-Cap	Mid-Cap	Small-Cap
20	29	34
6	20	21
910	1,911	1,931
17.0%	9.0%	4.0%

SOME DETAILS

RPS	Pred. sign	MALSRet	t-stat.	MALSRet	t-stat.
beta	+	-3.8%	-0.7	1.7%	0.7
betasq	+	-4.0%	-0.8		
ep	+	6.5%	1.2	6.2%	4.3
mve	-	-6.5%	-1.6	-9.0%	-1.7
dy	+	0.9%	0.2	-1.9%	-1.7
sue	+	20.3%	15.8	11.2%	14.2
chfeps	+	7.3%	6.0	1.8%	2.3
bm	+	15.1%	4.5	8.2%	4.4
mom36m	-	8.6%	5.2	0.9%	2.3
fgr5yr	-	-0.9%	-0.2	-5.1%	-4.8

LARGEST

10 largest multidimensional t-stats.						
#	RPS	Pred. sign	MALSRet	t-stat.	MALSRet	t-stat.
1	*sue*	+	20.3%	15.8	11.2%	14.2
2	*ear*	+	16.5%	16.6	9.3%	13.7
3	*sfe*	+	-8.1%	-1.7	-14.5%	-12.6
4	*turn*	+	21.9%	9.1	23.4%	10.0
5	*dolvol*	-	1.0%	1.5	-9.1%	-9.3
6	*rsup*	+	7.9%	3.8	6.7%	7.5
7	*roaq*	+	13.2%	3.3	9.6%	7.1
8	*retvol*	-	-5.7%	-1.0	-11.6%	-6.6
9	*indmom*	+	25.8%	7.3	7.2%	6.3
10	*aeavol*	+	8.0%	7.0	3.0%	5.7
15	*bm*	+	15.1%	4.5	8.2%	4.4
52	*mve*	-	-6.5%	-1.6	-9.0%	-1.7
70	*mom12m*	+	9.8%	6.1	0.7%	0.7

LARGEST BY SIZE

Large-Cap		Mid-Cap		Small-Cap	
20		29		34	
6		20		21	
910		1,911		1,931	
17.0%		9.0%		4.0%	
10 largest multidimensional t-stats.					
RPS	t-stat.	RPS	t-stat.	RPS	t-stat.
sfe	-10.1	*retvol*	-10.5	*sue*	14.2
cash	5.0	*sfe*	-9.7	*ear*	11.2
retvol	-4.4	*ear*	9.1	*turn*	9.4
indmom	4.0	*turn*	7.8	*mve*	-7.0
ep	3.1	*dolvol*	-6.9	*rsup*	6.5
bm	3.0	*roaq*	6.5	*dolvol*	-6.3
		rsup	6.0	*sfe*	-6.2
		sue	5.4	*stdcf*	-6.2
		indmom	5.0	*ep*	5.7
		cash	4.8	*rd_mve*	5.2
bm	3.0	*bm*	2.0	*bm*	2.0
mve	-1.7	*mve*	-0.9	*mve*	-7.0
mom12m	-0.4	*mom12m*	0.4	*mom12m*	0.4

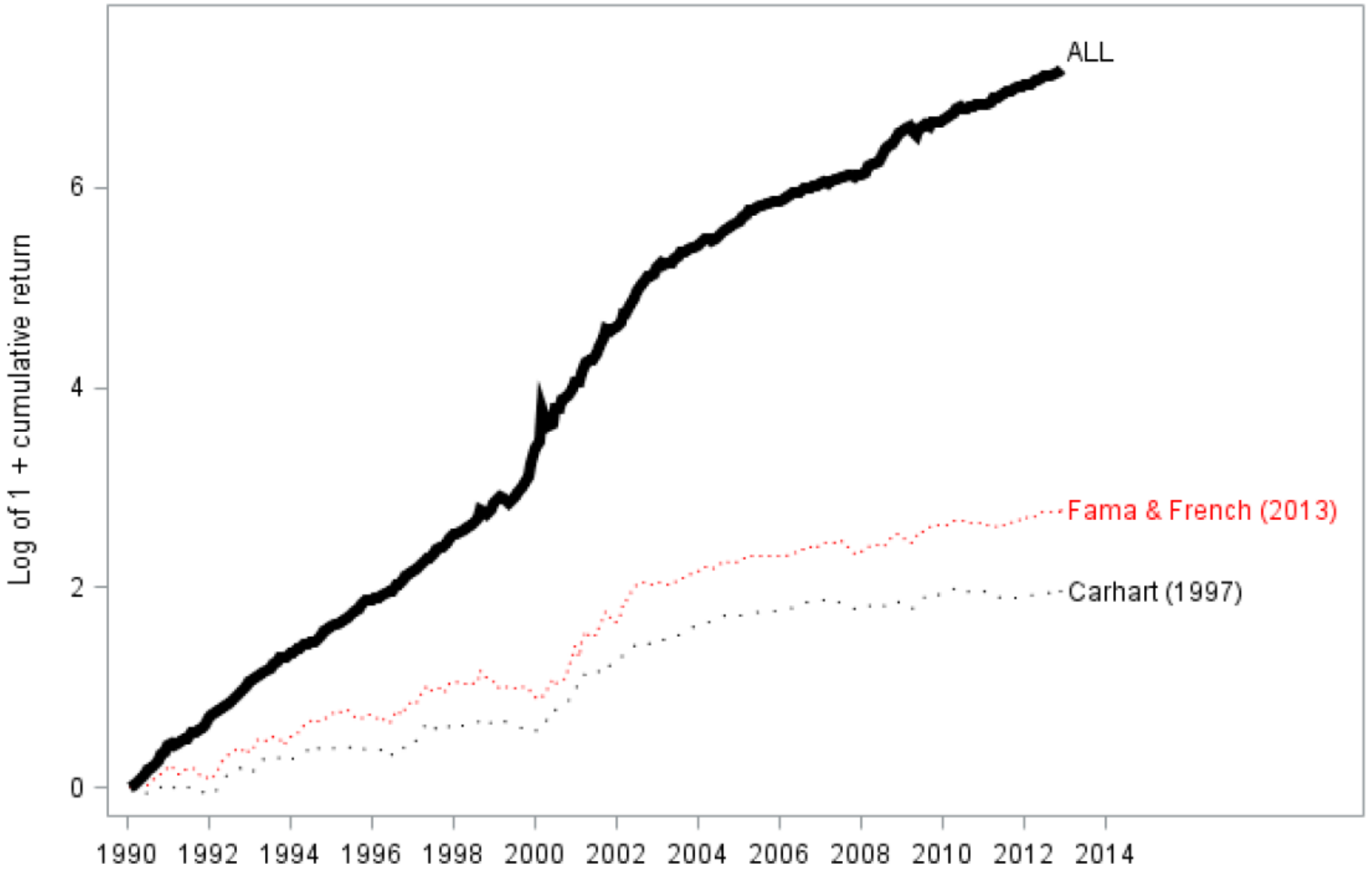
ATTENUATION—REGRESS MULTI ON UNIDIMENSIONAL

MALSRets	All firms	Large-Cap	Mid-Cap	Small-Cap
Intercept	0.2%	0.1%	0.2%	-0.3%
t-stat (null = 0)	(0.4)	(0.3)	(0.5)	(-0.5)
Slope	0.41	0.39	0.36	0.51
t-stat (null = 0)	(7.8)	(5.7)	(7.2)	(8.9)
t-stat [null = 1]	[11.0]	[8.8]	[12.7]	[8.4]
Adj. R-sq.	40%	26%	36%	47%

PSEUDO OUT-OF-SAMPLE

Multidimensioned set of RPS	Statistics on monthly out of sample hedge returns							
	t-stat.	Min.	10th pctile	50th pctile	Mean	90th pctile	Max.	Annualized Sharpe
Carhart (1997): *mve, bm, mom12m*	4.8	-7.0%	-2.3%	0.4%	0.8%	4.2%	9.0%	0.99
Fama & French (2013): *mve, bm, roic, agr, mom12m*	5.2	-9.2%	-2.7%	0.7%	1.1%	4.9%	15.5%	1.08
ALL: All RPS (n = 91)	12.4	-11.8%	0.0%	2.1%	2.7%	6.3%	37.1%	2.58

PSEUDO OUT-OF-SAMPLE LN CUMULATIVE RETURNS



REDUCED MODEL

Asset growth
Book-to-market
Dollar trading volume
Quarterly earnings announcement returns
Forecasted annual earnings
Scaled unexpected earnings

Quarterly ROA
12-month industry returns
36 month momentum
Monthly share turnover

	Statistics on monthly out of sample hedge returns							
Multidimensioned set of RPS	t-stat.	Min.	10th pctile	50th pctile	Mean	90th pctile	Max.	Annualized Sharpe
ALL: All RPS (n = 91)	12.4	-11.8%	0.0%	2.1%	2.7%	6.3%	37.1%	2.58
TEN: Distilled 10 RPS model	14.1	-4.1%	0.2%	2.2%	2.5%	5.0%	32.0%	2.94

PSEUDO OUT-OF-SAMPLE LN CUMULATIVE RETURNS