Lecture Notes

Hou, Xue, and Zhang (2019, Review of Financial Studies): Replicating Anomalies

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[1]Ohio State and NBER

BUSFIN 8250
Autumn 2019, Ohio State

Most anomalies fail to hold up to currently acceptable standards for empirical finance

65% cannot clear the single test hurdle of $|t| \geq 1.96$, with microcaps mitigated with NYSE breakpoints and value-weights

Most (52%) anomalies fail to replicate irrespective of microcaps (NYSE-Amex-NASDAQ breakpoints and equal-weights), if adjusting for multiple testing

Similar results in the original samples: 65.3% versus 56.2%

The biggest casualty in the trading frictions category, with 96% failing the single tests

Replicated anomalies size much smaller than originally reported

Outline

Outline

Lo and MacKinlay 1990, Fama 1998, Conrad, Cooper, and Kaul 2003, Schwert 2003, McLean and Pontiff 2016

Harvey, Liu, and Zhu 2016:

- 27–53% of 296 anomalies are false, adjusting for multi-testing
- Two publication biases: Hard to publish a nonresult, difficult to publish replication studies in finance and economics

Harvey 2017: P-hacking, selecting sample criteria and test specifications until insignificant results become significant

Motivation

Asset management: $5.15 trillion worldwide in ETF/ETPs as of January 2018 per ETFGI

April 6, 2017, 1:02 PM EDT Corrected April 13, 2017, 12:37 PM EDT

Investors Always Think They're Getting Ripped Off. Here's Why They're Right

It's hard to beat the market, but we keep trying—and believing in—new products that promise to outperform.

By Peter Coy

Coy (2017): "Researchers have more knobs to twist in search of a prized 'anomaly...' They can vary the period, the set of securities under consideration, or even the statistical method. Negative findings go in a file drawer; positive ones get submitted to a journal (tenure!) or made into an ETF whose performance we rely on for retirement."

Essay

Why Most Published Research Findings Are False

John P. A. Ioannidis

Summary

There is increasing concern that most current published research findings are false. The probability that a research claim is true may depend on study power and bias, the number of other studies on the same question, and, importantly, the ratio of true to no relationships among the relationships probed in each scientific field. In this framework, a research finding is less likely to be true when the studies conducted in a field are smaller; when effect sizes are smaller; when there is a greater number and lesser preselection of tested relationships; where there is greater flexibility in designs, definitions, outcomes, and analytical modes; when there is greater financial and other interest and prejudice; and when more teams are involved in a scientific field in chase of statistical significance. Simulations show that for most study designs and settings, it is more likely for

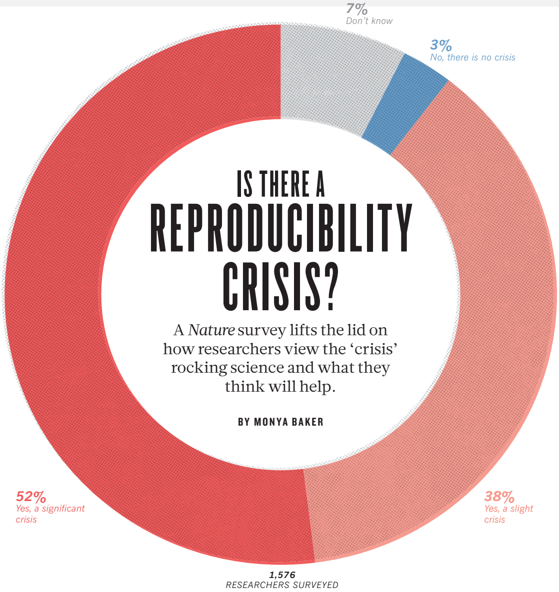
factors that influence this problem and some corollaries thereof.

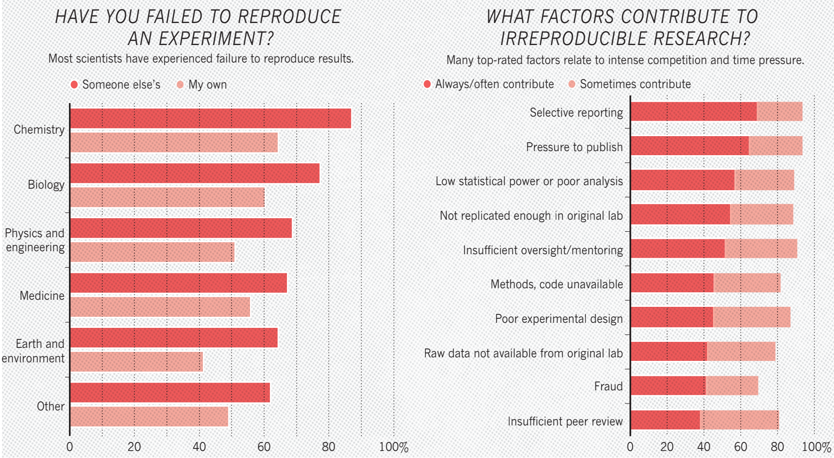
Modeling the Framework for False Positive Findings

Several methodologists have pointed out [9–11] that the high rate of nonreplication (lack of confirmation) of research discoveries is a consequence of the convenient, yet ill-founded strategy of claiming conclusive research findings solely on the basis of a single study assessed by formal statistical significance, typically for a *p*-value less than 0.05. Research is not most appropriately represented and summarized by *p*-values, but, unfortunately, there is a widespread notion that medical research articles

It can be proven that most claimed research findings are false.

is characteristic of the field and can vary a lot depending on whether the field targets highly likely relationships or searches for only one or a few true relationships among thousands and millions of hypotheses that may be postulated. Let us also consider, for computational simplicity, circumscribed fields where either there is only one true relationship (among many that can be hypothesized) or the power is similar to find any of the several existing true relationships. The pre-study probability of a relationship being true is $R/(R + 1)$. The probability of a study finding a true relationship reflects the power $1 - \beta$ (one minus the Type II error rate). The probability of claiming a relationship when none truly exists reflects the Type I error rate, α. Assuming that c relationships are being probed in the field, the expected values of the 2×2 table are given in Table 1. After a research

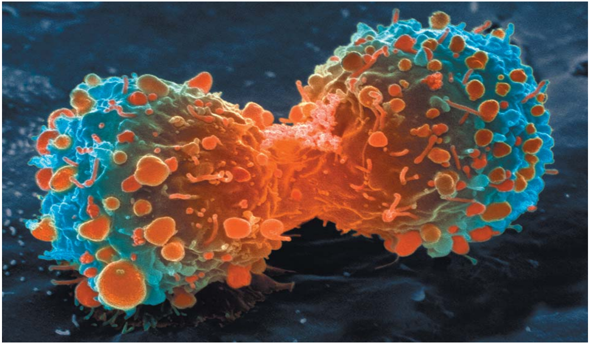

7%
Don't know
3%
No, there is no crisis
IS THERE A
REPRODUCIBILITY
CRISIS?
A *Nature* survey lifts the lid on how researchers view the 'crisis' rocking science and what they think will help.
BY MONYA BAKER
52%
Yes, a significant crisis
38%
Yes, a slight crisis
1,576
RESEARCHERS SURVEYED


HAVE YOU FAILED TO REPRODUCE AN EXPERIMENT?
Most scientists have experienced failure to reproduce results.
Someone else's
My own
Chemistry
Biology
Physics and engineering
Medicine
Earth and environment
Other
0
20
40
60
80
100%
WHAT FACTORS CONTRIBUTE TO IRREPRODUCIBLE RESEARCH?
Many top-rated factors relate to intense competition and time pressure.
Always/often contribute
Sometimes contribute
Selective reporting
Pressure to publish
Low statistical power or poor analysis
Not replicated enough in original lab
Insufficient oversight/mentoring
Methods, code unavailable
Poor experimental design
Raw data not available from original lab
Fraud
Insufficient peer review
0
20
40
60
80
100%

Motivation

Evidence: Begley and Ellis (2012, *Nature*)

S. GSCHMEISSNER/SPL



Many landmark findings in preclinical oncology research are not reproducible, in part because of inadequate cell lines and animal models.

Raise standards for preclinical cancer research

C. Glenn Begley and **Lee M. Ellis** propose how methods, publications and incentives must change if patients are to benefit.

Evidence: Open Science Collaboration (2015, *Science*), 100 psychological studies

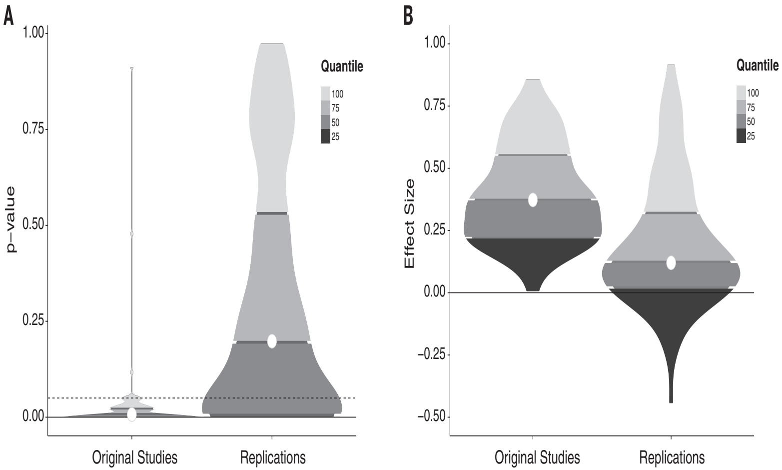


Fig. 1. Density plots of original and replication *P* values and effect sizes. (**A**) *P* values. (**B**) Effect sizes (correlation coefficients). Lowest quantiles for *P* values are not visible because they are clustered near zero.

Studies are more likely false when:

- Samples are smaller
- The effects are smaller
- There are many but fewer theoretically predicted relations
- Flexibility is greater in designs, variable definitions, and specifications
- There are greater financial interest and bias
- More independent teams are involved

Most, if not all, apply to the anomalies literature

Pure replication: To make or do something again in exactly the same way (Merriam Webster Online Dictionary)

Statistical replication: Different sample, but the identical model and underlying population

- "[O]nly marginally relevant for us"

Scientific replication: Different sample, different population, and perhaps similar but not identical model

- "[A]ppears much more suited in type to our methods of research and, indeed, comprises most of what economists view as replication (p. 716, our emphasis)"

Use the same definition in all eight articles on replication:

- Berry, Coffman, Hanley, Gihleb, and Wilson (2017)
- Sukhtankar (2017)
- Hamermesh (2017)
- Coffman, Niederle, and Wilson (2017)
- Duvendack, Palmer-Jones, and Reed (2017)
- Hoffler (2017)
- Anderson and Kichkha (2017)
- Chang and Li (2017)

THE REPLICATION NETWORK

Furthering the Practice of Replication in Economics

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Why Replications?

There is no commonly accepted definition of a replication. TRN defines a replication as any study whose primary purpose is to establish the correctness of a previous study.

There are many gradations of replications, stretching from pure reproduction of key finding(s) of a previous study; to checking the robustness of those findings to changes in data, estimation procedure, model specification, etc. There is subjectivity in deciding when a replication becomes an original study in its own right.

Why replications? They enable researchers to (i) determine the fragility or robustness of previous research findings, and (ii) identify why studies reach different conclusions on the same subject.

Motivation

WSJ/Bloomberg articles featuring our work

THE WALL STREET JOURNAL.

https://www.wsj.com/articles/an-algorithm-an-etf-and-an-academic-study-walk-into-a-bar-1494528113

MARKETS | STREETWISE

An Algorithm, an ETF and an Academic Study Walk Into a Bar

Most of the supposed market anomalies academics have identified don't exist, or are too small to matter

Wall Street license plate souvenirs are displayed near the New York Stock Exchange. PHOTO: BLOOMBERG NEWS

By James Mackintosh

May 11, 2017 2:41 p.m. ET

THE WALL STREET JOURNAL.

https://blogs.wsj.com/moneybeat/2017/05/12/when-researchers-and-investors-walk-into-a-bar-the-investors-get-hammered/

MONEYBEAT | THE INTELLIGENT INVESTOR

When Researchers and Investors Walk Into a Bar, the Investors Get Hammered

Approach all claims of market-beating patterns with extreme skepticism

PHOTO: REUTERS

By

Jason Zweig

May 12, 2017 1:03 pm ET

Motivation

WSJ/Bloomberg articles featuring our work

THE WALL STREET JOURNAL.

https://blogs.wsj.com/experts/2017/11/05/a-reality-check-on-stock-market-anomalies/

THE EXPERTS | WEALTH MANAGEMENT

A Reality Check on Stock-Market ‘Anomalies’

WSJ Wealth Expert Wesley Gray discusses his takeaways on research about anomalies in the market. PHOTO: GETTY IMAGES/ISTOCKPHOTO

By

Wesley Gray

Nov 5, 2017 10:00 pm ET

A New Paper Just Took a Huge Shot at Some of the World's Hottest Investments

By **Eric J Weiner**

May 8, 2017, 3:35 PM EDT

- Researchers find that price aberrations can’t be replicated
- ‘Capital markets are more efficient than previously reported’

Just about every week, some researcher reports finding another statistical quirk in the equity market that might be harvested for a trading edge. Now a new paper <http://www.nber.org/papers/w23394> says most of them don’t work as billed.

Looking at 447 supposedly repeating price patterns identified in the last few decades, academics from Ohio State and the University of Cincinnati contend that more than half are basically figments of their discoverers’ imagination. The study, “Replicating Anomalies” by Kewei Hou, Chen Xue and Lu Zhang, attributed the findings to a statistical sleight of hand known as p-hacking.

While lodged squarely in the academic realm, the paper is a broadside against an area of research that has come to dominate financial economics and underpin both quantitative investing and smart beta exchange-traded funds. It joins a growing body of literature that suggests people looking for money-making opportunities within the market’s chaos often see what they want to see, or confuse profitability with luck.

OPINION | MONEY STUFF

Anomalies, Pitches and Promises

Also a Renaissance lawsuit, VIX, millicorns, unicorns and pie.

By Matt Levine
19 May 9, 2017, 9:28 AM EDT

Anomalies.

The efficient-markets hypothesis -- the idea that there is no predictable way to beat the stock market -- is at the heart of modern academic finance. But the main activity of many finance academics is to find and publish "anomalies," patterns that make stock prices predictable, places where the efficient-markets hypothesis breaks down a little. It is sort of a weird activity, like a physics department whose members all go around looking for cool feathers that don't obey the law of gravity.

Also many of those anomalies might be fake:

> *The anomalies literature is infested with widespread p-hacking. We replicate the entire anomalies literature in finance and accounting by compiling a largest-to-date data library that contains 447 anomaly variables. With microcaps alleviated via New York Stock Exchange breakpoints and value-weighted returns, 286 anomalies (64%) including 95 out of 102 liquidity variables (93%) are insignificant at the conventional 5% level. Imposing the cutoff t-value of three raises the number of insignificance to 380 (85%). Even for the 161 significant anomalies, their*

OPINION | ECONOMICS

Ivory Tower Wonks Help Traders Make a Quick Buck

Profit opportunities exist until researchers publish findings on market inefficiencies. Then they disappear.

By Noah Smith
9 May 11, 2017, 8:00 AM EDT

The route to riches. Photographer: John Greim/LightRocket/Getty Images

We live in an empirical age. P-values, R-squareds, and other statistical terms

Outline

Testing deciles with NYSE breakpoints and value-weights

Univariate Fama-MacBeth with WLS (the market equity as weights)

Fama (1998) and Fama and French (2008)

Many ways of overweighting microcaps:

- NYSE-Amex-NASDAQ breakpoints with equal-weights
- Cross-sectional regressions with OLS

	Number of firms	% of total market cap	Value-weights Average	Value-weights Std	Equal-weights Average	Equal-weights Std	CX std of returns
Market	3,896	100.00	0.91	4.48	1.17	6.27	16.46
Micro	2,365	3.21	1.07	6.89	1.27	7.10	19.26
Small	766	6.71	1.14	6.29	1.15	6.40	11.85
Big	765	90.09	0.91	4.45	1.01	5.06	8.84

Replicating Procedures

Portfolio weights allocated to microcaps (in %)

	All	Mom	VvG	Inv	Prof	Intan	Fric
				Low			
NYSE-VW	7.19	8.00	3.89	7.36	9.46	4.00	10.24
NYSE-EW	55.24	62.23	48.58	68.47	65.48	46.56	51.88
All-VW	10.40	10.76	5.53	9.99	15.04	4.93	15.38
All-EW	57.56	63.86	51.05	71.21	68.86	47.51	54.86
FM-WLS	3.88	4.82	2.37	3.59	5.60	2.43	4.57
FM-OLS	54.31	62.64	46.20	62.08	63.52	46.45	53.11
				High			
NYSE-VW	10.12	3.87	7.38	5.54	5.84	10.29	19.96
NYSE-EW	59.53	47.66	62.87	58.26	53.52	59.00	69.21
All-VW	14.97	4.41	8.93	7.11	8.18	15.98	31.46
All-EW	62.12	48.65	64.16	60.53	54.89	62.41	73.72
FM-WLS	8.22	2.73	4.79	4.93	3.51	7.79	18.52
FM-OLS	60.14	47.72	63.00	59.20	53.47	59.79	70.59

Replicating Procedures

Investment capacity at the end of December 2016 (in $billion)

	All	Mom	VvG	Inv	Prof	Intan	Fric
				Low			
NYSE-VW	2,015.65	1,201.65	2,052.98	1,332.69	1,748.85	2,095.75	2,827.82
NYSE-EW	26.64	1.33	3.00	0.72	4.87	52.32	58.10
ALL-VW	1,892.68	1,067.00	1,306.85	1,081.72	1,162.29	2,284.57	3,234.00
ALL-EW	21.86	1.19	2.73	0.61	4.50	37.65	52.24
FM-WLS	3,367.74	1,975.25	3,939.30	1,659.65	2,066.62	4,018.27	4,765.58
FM-OLS	7.69	1.37	5.57	1.05	7.01	13.69	9.80
				High			
NYSE-VW	1,569.06	1,320.97	900.09	1,702.07	2,402.44	1,499.78	1,533.15
NYSE-EW	11.91	1.97	1.31	1.34	2.15	3.52	44.35
ALL-VW	1,331.77	1,297.23	779.22	964.12	2,140.04	1,225.08	1,340.40
ALL-EW	9.74	1.85	1.19	0.96	2.02	3.73	35.09
FM-WLS	1,219.84	1,821.52	625.06	697.68	1,560.16	1,267.34	1,170.33
FM-OLS	8.25	2.41	1.35	0.95	3.51	3.54	27.21

Outline

Category	Number
Momentum	57
Value-versus-growth	69
Investment	38
Profitability	79
Intangibles	103
Trading frictions	106

Panel A: Momentum (57)

Sue1, Sue6, Sue12	Earnings surprise (1-, 6-, 12-month), Foster, Olsen, and Shevlin (1984)
Abr1, Abr6, Abr12	Cumulative abnormal stock returns around earnings announcements (1-, 6-, 12-month), Chan, Jegadeesh, and Lakonishok (1996)
Re1, Re6, Re12	Revisions in analysts' earnings forecasts (1-, 6-, 12-month), Chan, Jegadeesh, and Lakonishok (1996)
$R^6 1$, $R^6 6$, $R^6 12$	Price momentum (6-month prior returns, 1-, 6-, 12-month), Jegadeesh and Titman (1993)
$R^{11} 1$, $R^{11} 6$, $R^{11} 12$	Price momentum (11-month prior returns, 1-, 6-, 12-month), Fama and French (1996)
Im1, Im6, Im12	Industry momentum (1-, 6-, 12-month), Moskowitz and Grinblatt (1999)
Rs1, Rs6, Rs12	Revenue surprise (1-, 6-, 12-month), Jegadeesh and Livnat (2006)
Tes1, Tes6, Tes12	Tax expense surprise (1-, 6-, 12-month), Thomas and Zhang (2011)
dEf1, dEf6, dEf12	Analysts' forecast change (1-, 6-, 12-month), Hawkins, Chamberlin, and Daniel (1984)
Nei1, Nei6, Nei12	# consecutive quarters with earnings increases (1-, 6-, 12-month), Barth, Elliott, and Finn (1999)

52w1, 52w6, 52w12	52-week high (1-, 6-, and 12-month), George and Hwang (2004)
$\epsilon^{11}1$, $\epsilon^{11}6$, $\epsilon^{11}12$	11-month residual momentum (1-, 6-, 12-month), Blitz, Huij, and Martens (2011)
$\epsilon^{6}1$, $\epsilon^{6}6$, $\epsilon^{6}12$	6-month residual momentum (1-, 6-, 12-month), Blitz, Huij, and Martens (2011)
Sm1, Sm6, Sm12	Segment momentum (1-, 6-, 12-month), Cohen and Lou (2012)
Ilr1, Ilr6, Ilr12	Industry lead-lag effect in prior returns (1-, 6-, 12-month), Hou (2007)
Ile1, Ile6, Ile12	Industry lead-lag effect in earnings surprises (1-, 6-, 12-month), Hou (2007)
Cm1, Cm6, Cm12	Customer momentum (1-, 6-, 12-month), Cohen and Frazzini (2008)
Sim1, Sim6, Sim12	Supplier industries momentum (1-, 6-, 12-month), Menzly and Ozbas (2010)
Cim1, Cim6, Cim12	Customer industries momentum (1-, 6-, 12-month), Menzly and Ozbas (2010)

Panel B: Value-versus-growth (68)

Bm	Book-to-market equity, Rosenberg, Reid, and Lanstein (1985)
Bmj	Book-to-June-end market equity, Asness and Frazzini (2013)
Bm^{q}1, Bm^{q}6, Bm^{q}12	Book-to-current market equity (1-, 6-, 12-month), Asness and Frazzini (2013)
Dm	Debt-to-market, Bhandari (1988)
Dm^{q}1, Dm^{q}6, Dm^{q}12	Debt-to-market (1-, 6-, 12-month)
Am	Assets-to-market, Fama and French (1992)
Am^{q}1, Am^{q}6, Am^{q}12	Assets-to-market (1-, 6-, 12-month)
Rev1, Rev6, Rev12	Reversal (1-, 6-, 12-month), De Bondt and Thaler (1985)
Ep	Earnings-to-price, Basu (1983)
Ep^{q}1, Ep^{q}6, Ep^{q}12	Earnings-to-price (1-, 6-, 12-month)
Efp1, Efp6, Efp12	Analysts' earnings forecasts-to-price (1-, 6-, 12-month), Elgers, Lo, and Pfeiffer (2001)
Cp	Cash flow-to-price, Lakonishok, Shleifer, and Vishny (1994)
Cp^{q}1, Cp^{q}6, Cp^{q}12	Cash flow-to-price (1-, 6-, 12-month)
Dp	Dividend yield, Litzenberger and Ramaswamy (1979)
Dp^{q}1, Dp^{q}6, Dp^{q}12	Dividend yield (1-, 6-, 12-month)

Op	Payout yield, Boudoukh, Michaely, Richardson, and Roberts (2007)
Op^q1, Op^q6, Op^q12	Payout yield (1-, 6-, 12-month)
Nop	Net payout yield, Boudoukh, Michaely, Richardson, and Roberts (2007)
Nop^q1, Nop^q6, Nop^q12	Net payout yield (1-, 6-, 12-month)
Sr	Five-year sales growth rank, Lakonishok, Shleifer, and Vishny (1994)
Sg	Annual sales growth, Lakonishok, Shleifer, and Vishny (1994)
Em	Enterprise multiple, Loughran and Wellman (2011)
Em^q1, Em^q6, Em^q12	Enterprise multiple (1-, 6-, 12-month)
Sp	Sales-to-price, Barbee, Mukherji, and Raines (1996)
Sp^q1, Sp^q6, Sp^q12	Sales-to-price (1-, 6-, 12-month)
Ocp	Operating cash flow-to-price, Desai, Rajgopal, and Venkatachalam (2004)
Ocp^q1, Ocp^q6, Ocp^q12	Operating cash flow-to-price (1-, 6-, 12-month)

Ir	Intangible return, Daniel and Titman (2006)
Vhp	Intrinsic value-to-market, Frankel and Lee (1998)
Vfp	Analysts-based intrinsic value-to-market, Frankel and Lee (1998)
Ebp	Enterprise book-to-price, Penman, Richardson, and Tuna (2007)
Ebp^q1, Ebp^q6, Ebp^q12	Enterprise book-to-price (1-, 6-, 12-month)
Ndp	Net debt-to-price, Penman, Richardson, and Tuna (2007)
Ndp^q1, Ndp^q6, Ndp^q12	Net debt-to-price (1-, 6-, 12-month)
Dur	Equity duration, Dechow, Sloan, and Soliman (2004)
Ltg, Ltg^m1, Ltg^m6, Ltg^m12	Long-term analysts' growth forecasts, La Porta (1996)

Panel C: Investment (38)

Aci	Abnormal corporate investment, Titman, Wei, and Xie (2004)
I/A	Investment-to-assets, Cooper, Gulen, and Schill (2008)
Ia^q1, Ia^q6, Ia^q12	Investment-to-assets (1-, 6-, 12-month)
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, Hou, Xue, and Zhang (2015)
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)
3Ig	Three-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)
Cdi	Composite debt issuance, Lyandres, Sun, and Zhang (2008)
Ivg	Inventory growth, Belo and Lin (2011)

Ivc	Inventory changes, Thomas and Zhang (2002)
Oa	Operating accruals, Sloan (1996)
Ta	Total accruals, Richardson, Sloan, Soliman, and Tuna (RSST, 2005)
dWc	Change in net non-cash working capital, RSST (2005)
dCoa	Change in current operating assets, RSST (2005)
dCol	Change in current operating liabilities, RSST (2005)
dNco	Change in net non-current operating assets, RSST (2005)
dNca	Change in non-current operating assets, RSST (2005)
dNcl	Change in non-current operating liabilities, RSST (2005)
dFin	Change in net financial assets, RSST (2005)
dSti	Change in short-term investments, RSST (2005)
dLti	Change in long-term investments, RSST (2005)
dFnl	Change in financial liabilities, RSST (2005)
dBe	Change in common equity, RSST (2005)
Dac	Discretionary accruals, Xie (2001)
Poa, Pta, Pda	Percent operating, total, discretionary accruals, Hafzalla, Lundholm, and Van Winkle (2011)
Nxf, Nef, Ndf	Net external, equity, debt financing, Bradshaw, Richardson, and Sloan (2006)

Panel D: Profitability (78)

Roe1, Roe6, Roe12	Return on equity (1-, 6-, 12-month), Hou, Xue, and Zhang (2015)
dRoe1, dRoe6, dRoe12	4-quarter Change in Roe (1-, 6-, 12-month)
Roa1, Roa6, Roa12	Return on assets (1-, 6-, 12-month), Balakrishnan, Bartov, and Faurel (2010)
dRoa1, dRoa6, dRoa12	4-quarter Change in Roa (1-, 6-, 12-month)
Rna	Return on net operating assets, Soliman (2008)
Pm	Profit margin, Soliman (2008)
Ato	Asset turnover, Soliman (2008)
Cto	Capital turnover, Haugen and Baker (1996)
Rna^q1, Rna^q6, Rna^q12	Return on net operating assets (1-, 6-, 12-month)
Pm^q1, Pm^q6, Pm^q12	Profit margin (1-, 6-, 12-month)
Ato^q1, Ato^q6, Ato^q12	Asset turnover (1-, 6-, 12-month)
Cto^q1, Cto^q6, Cto^q12	Capital turnover (1-, 6-, 12-month)
Gpa	Gross profits-to-assets, Novy-Marx (2013)
Gla	Gross profits-to-lagged assets

Gla^{q}1, Gla^{q}6, Gla^{q}12	Gross profits-to-lagged assets (1-, 6-, 12-month)
Ope	Operating profits-to-equity, Fama and French (2015)
Ole	Operating profits-to-lagged equity
Ole^{q}1, Ole^{q}6, Ole^{q}12	Operating profits-to-lagged equity (1-, 6-, 12-month)
Opa	Operating profits-to-assets, Ball, Gerakos, Linnainmaa, and Nikolaev (2015)
Ola	Operating profits-to-lagged assets
Ola^{q}1, Ola^{q}6, Ola^{q}12	Operating profits-to-lagged assets (1-, 6-, 12-month)
Cop	Cash-based operating profitability, Ball, Gerakos, Linnainmaa, and Nikolaev (2015b)
Cla	Cash-based operating profits-to-lagged assets
Cla^{q}1, Cla^{q}6, Cla^{q}12	Cash-based operating profits-to-lagged assets (1-, 6-, 12-month)
F	Fundamental (F) score, Piotroski (2000)
F^{q}1, F^{q}6, F^{q}12	Quarterly F-score (1-, 6-, 12-month)
Fp1, Fp6, Fp12	Failure probability (1-, 6-, 12-month), Campbell, Hilscher, and Szilagyi (2008)
O	O-score, Dichev (1998)
O^{q}1, O^{q}6, O^{q}12	Quarterly O-score (1-, 6-, 12-month)

Z	Z-score, Dichev (1998)
Z^q1, Z^q6, Z^q12	Quarterly Z-score (1-, 6-, 12-month)
G	Growth score, Mohanram (2005)
Cr1, Cr6, Cr12	Credit ratings (1-, 6-, 12-month), Avramov, Chordia, Jostova, and Philipov (2009)
Tbi	Taxable income-to-book income, Green, Hand, and Zhang (2013)
Tbi^q1, Tbi^q6, Tbi^q12	Quarterly taxable income-to-book income (1-, 6-, 12-month)
Bl	Book leverage, Fama and French (1992)
Bl^q1, Bl^q6, Bl^q12	Quarterly book leverage (1-, 6-, 12-month)
Sg^q1, Sg^q6, Sg^q12	Quarterly sales growth (1-, 6-, 12-month)

Panel E: Intangibles (103)

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)
gAd	Growth in advertising expense, Lou (2014)
Rdm	R&D-to-market, Chan, Lakonishok, and Sougiannis (2001)
Rdm^q1, Rdm^q6, Rdm^q12	Quarterly R&D-to-market (1-, 6-, 12-month)
Rds	R&D-to-sales, Chan, Lakonishok, and Sougiannis (2001)
Rds^q1, Rds^q6, Rds^q12	Quarterly R&D-to-sales (1-, 6-, 12-month)
Ol	Operating leverage, Novy-Marx (2011)
Ol^q1, Ol^q6, Ol^q12	Quarterly operating leverage (1-, 6-, 12-month)
Hn	Hiring rate, Belo, Lin, and Bazdresch (2014)
Rca	R&D capital-to-assets, Li (2011)
Bca	Brand capital-to-assets, Belo, Lin, and Vitorino (2014)
Aop	Analysts optimism, Frankel and Lee (1998)

Pafe	Predicted analysts forecast error, Frankel and Lee (1998)
Parc	Patent-to-R&D capital, Hirshleifer, Hsu, and Li (2013)
Crd	Citations-to-R&D expense, Hirshleifer, Hsu, and Li (2013)
Hs	Industry concentration (sales), Hou and Robinson (2006)
Ha	Industry concentration (total assets), Hou and Robinson (2006)
He	Industry concentration (book equity), Hou and Robinson (2006)
Age1, Age6, Age12	Firm age (1-, 6-, 12-month), Jiang, Lee, and Zhang (2005)
D1	Price delay based on R^2, Hou and Moskowitz (2005)
D2	Price delay based on slopes, Hou and Moskowitz (2005)
D3	Price delay based on slopes adjusted for standard errors, Hou and Moskowitz (2005)
dSi	% change in sales − % change in inventory, Abarbanell and Bushee (1998)
dSa	% change in sales − % change in accounts receivable, Abarbanell and Bushee (1998)
dGs	% change in gross margin − % change in sales, Abarbanell and Bushee (1998)

dSs	% change in sales − % change in SG&A, Abarbanell and Bushee (1998)
Etr	Effective tax rate, Abarbanell and Bushee (1998)
Lfe	Labor force efficiency, Abarbanell and Bushee (1998)
Ana1, Ana6, Ana12	Analysts coverage (1-, 6-, 12-month), Elgers, Lo, and Pfeiffer (2001)
Tan	Tangibility of assets, Hahn and Lee (2009)
Tan^{q}1, Tan^{q}6, Tan^{q}12	Quarterly tangibility (1-, 6-, 12-month)
Rer	Real estate ratio, Tuzel (2010)
Kz	The Kaplan-Zingales index, Lamont, Polk, and Saa-Requejo (2001)
Kz^{q}1, Kz^{q}6, Kz^{q}12	Quarterly Kaplan-Zingales index (1-, 6-, 12-month)
Ww	The Whited-Wu (2006) index
Ww^{q}1, Ww^{q}6, Ww^{q}12	Quarterly Whited-Wu index (1-, 6-, 12-month)
Sdd	Secured debt-to-total debt, Valta (2016)
Cdd	Convertible debt-to-total debt, Valta (2016)
Vcf1, Vcf6, Vcf12	Cash flow volatility (1-, 6-, 12-month), Huang (2009)
Cta1, Cta6, Cta12	Cash-to-assets (1-, 6-, 12-month), Palazzo (2012)

Gind	Corporate governance, Gompers, Ishii, and Metrick (2003)
Acq, Acq^q1, Acq^q6, Acq^q12	Accrual quality (1-, 6-, 12-month) Francis, Lafond, Olsson, and Schipper (2005)
Eper	Earnings persistence, Francis, Lafond, Olsson, and Schipper (2004)
Eprd	Earnings predictability, Francis, Lafond, Olsson, and Schipper (2004)
Esm	Earnings smoothness, Francis, Lafond, Olsson, and Schipper (2004)
Evr	Value relevance of earnings, Francis, Lafond, Olsson, and Schipper (2004)
Etl	Earnings timeliness, Francis, Lafond, Olsson, and Schipper (2004)
Ecs	Earnings conservatism, Francis, Lafond, Olsson, and Schipper (2004)
Frm	Pension funding rate (scaled by market equity), Franzoni and Martin (2006)
Fra	Pension funding rate (scaled by assets), Franzoni and Martin (2006)

Ala	Asset liquidity (scaled by book assets), Ortiz-Molina and Phillips (2014)
Alm	Asset liquidity (scaled by market assets), Ortiz-Molina and Phillips (2014)
Ala^q1, Ala^q6, Ala^q12	Asset liquidity (book assets) (1-, 6-, 12-month)
Alm^q1, Alm^q6, Alm^q12	Asset liquidity (market assets) (1-, 6-, 12-month)
Dis1, Dis6, Dis12	Dispersion of analysts' earnings forecasts (1-, 6-, 12-month) Diether, Malloy, and Scherbina (2002)
Dlg1, Dlg6, Dlg12	Dispersion in analyst long-term growth forecasts (1-, 6-, 12-month) Anderson, Ghysels, and Juergens (2005)
Dls1, Dls6, Dls12	Disparity between long- and short-term earnings growth forecasts (1-, 6-, 12-month), Da and Warachka (2011)
Ob	Order backlog, Rajgopal, Shevlin, and Venkatachalam (2003)

R_a^1	12-month-lagged return, Heston and Sadka (2008)
R_n^1	Year 1–lagged return, nonannual, 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)
$R_n^{[11,15]}$	Years 11–15 lagged returns, nonannual, Heston and Sadka (2008)
$R_a^{[16,20]}$	Years 16–20 lagged returns, annual, Heston and Sadka (2008)
$R_n^{[16,20]}$	Years 16–20 lagged returns, nonannual, Heston and Sadka (2008)

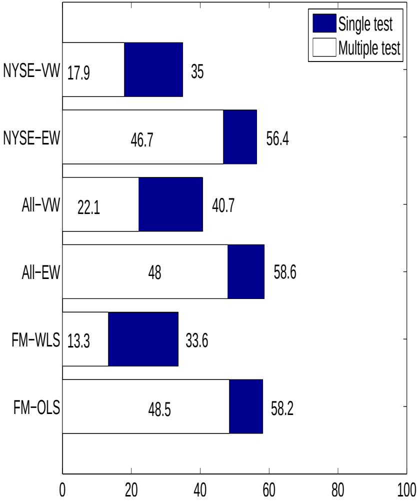
Panel F: Trading frictions (102)

Me	Market equity, Banz (1981)
Iv	Idiosyncratic volatility, Ali, Hwang, and Trombley (2003)
Ivff1, Ivff6, Ivff12	Idiosyncratic volatility per the 3-factor model (1-, 6-, 12-month), Ang, Hodrick, Xing, and Zhang (2006)
Ivc1, Ivc6, Ivc12	Idiosyncratic volatility per the CAPM (1-, 6-, 12-month)
Ivq1, Ivq6, Ivq12	Idiosyncratic volatility per the *q*-factor model (1-, 6-, 12-month)
Tv1, Tv6, Tv12	Total volatility (1-, 6-, 12-month), Ang, Hodrick, Xing, and Zhang (2006)
Sv1, Sv6, Sv12	Systematic volatility (1-, 6-, 12-month), Ang, Hodrick, Xing, and Zhang (2006)
β1, β6, β12	Market beta (1-, 6-, 12-month), Fama and MacBeth (1973)
$\beta^{FP}1$, $\beta^{FP}6$, $\beta^{FP}12$	The Frazzini-Pedersen (2014) beta (1-, 6-, 12-month)
$\beta^{D}1$, $\beta^{D}6$, $\beta^{D}12$	The Dimson (1979) beta (1-, 6-, 12-month)
Srev	Short-term reversal, Jegadeesh (1990)
Tur1, Tur6, Tur12	Share turnover (1-, 6-, 12-month), Datar, Naik, and Radcliffe (1998)
Cvt1, Cvt6, Cvt12	Coefficient of variation for share turnover (1-, 6-, 12-month), Chordia, Subrahmanyam, and Anshuman (2001)

Dtv1, Dtv6, Dtv12	Dollar trading volume (1-, 6-, 12-month), Brennan, Chordia, and Subrahmanyam (1998)
Cvd1, Cvd6, Cvd12	Coefficient of variation for dollar trading volume (1-, 6-, 12-month), Chordia, Subrahmanyam, and Anshuman (2001)
Pps1, Pps6, Pps12	Share price (1-, 6-, 12-month), Miller and Scholes (1982)
Ami1, Ami6, Ami12	Absolute return-to-volume (1-, 6-, 12-month), Amihud (2002)
$Lm^{1}1$, $Lm^{1}6$, $Lm^{1}12$	Prior 1-month turnover-adjusted number of zero daily trading volume (1-, 6-, 12-month), Liu (2006)
$Lm^{6}1$, $Lm^{6}6$, $Lm^{6}12$	Prior 6-month turnover-adjusted number of zero daily trading volume (1-, 6-, 12-month), Liu (2006)
$Lm^{12}1$, $Lm^{12}6$, $Lm^{12}12$	Prior 12-month turnover-adjusted number of zero daily trading volume (1-, 6-, 12-month), Liu (2006)
Mdr1, Mdr6, Mdr12	Maximum daily return (1-, 6-, 12-month), Bali, Cakici, and Whitelaw (2011)
Ts1, Ts6, Ts12	Total skewness (1-, 6-, 12-month), Bali, Engle, and Murray (2015)
Isc1, Isc6, Isc12	Idiosyncratic skewness per the CAPM (1-, 6-, 12-month)
Isff1, Isff6, Isff12	Idiosyncratic skewness per the 3-factor model (1-, 6-, 12-month)
Isq1, Isq6, Isq12	Idiosyncratic skewness per the *q*-factor model (1-, 6-, 12-month)
Cs1, Cs6, Cs12	Coskewness (1-, 6-, 12-month), Harvey and Siddique (2000)

$\beta^{-}1$, $\beta^{-}6$, $\beta^{-}12$	Downside beta (1-, 6-, 12-month), Ang, Chen, and Xing (2006)
Tail1, Tail6, Tail12	Tail risk (1-, 6-, 12-month), Kelly and Jiang (2014)
$\beta^{\text{ret}}1$, $\beta^{\text{ret}}6$, $\beta^{\text{ret}}12$	Liquidity beta (return-return) (1-, 6-, 12-month), Acharya and Pedersen (2005)
$\beta^{\text{lcc}}1$, $\beta^{\text{lcc}}6$, $\beta^{\text{lcc}}12$	Liquidity beta (illiquidity-illiquidity) (1-, 6-, 12-month), Acharya and Pedersen (2005)
$\beta^{\text{lrc}}1$, $\beta^{\text{lrc}}6$, $\beta^{\text{lrc}}12$	Liquidity beta (return-illiquidity) (1-, 6-, 12-month), Acharya and Pedersen (2005)
$\beta^{\text{lcr}}1$, $\beta^{\text{lcr}}6$, $\beta^{\text{lcr}}12$	Liquidity beta (illiquidity-return) (1-, 6-, 12-month), Acharya and Pedersen (2005)
$\beta^{\text{net}}1$, $\beta^{\text{net}}6$, $\beta^{\text{net}}12$	Net liquidity beta (1-, 6-, 12-month), Acharya and Pedersen (2005)
Shl1, Shl6, Shl12	The high-low bid-ask spread estimator (1-, 6-, 12-month), Corwin and Schultz (2012)
Sba1, Sba6, Sba12	Bid-ask spread (1-, 6-, 12-month), Hou and Loh (2015)
$\beta^{\text{Lev}}1$, $\beta^{\text{Lev}}6$, $\beta^{\text{Lev}}12$	Leverage beta (1-, 6-, 12-month), Adrian, Etula, and Muir (2014)
$\beta^{\text{PS}}1$, $\beta^{\text{PS}}6$, $\beta^{\text{PS}}12$	The Pastor-Stambaugh (2003) liquidity beta (1-, 6-, 12-month)
Pin	Prob of information trading, Easley, Hvidkjaer, and O'Hara (2002)

Outline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Multiple test
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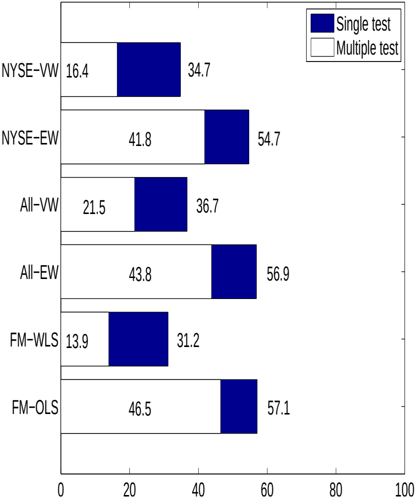
NYSE-EW
All-VW
All-EW
FM-WLS
FM-OLS
17.9
35
46.7
56.4
22.1
40.7
48
58.6
13.3
33.6
48.5
58.2
0
20
40
60
80
100


Single test
Multiple test
NYSE-VW
NYSE-EW
All-VW
All-EW
FM-WLS
FM-OLS
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56.9
13.9
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46.5
57.1
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80
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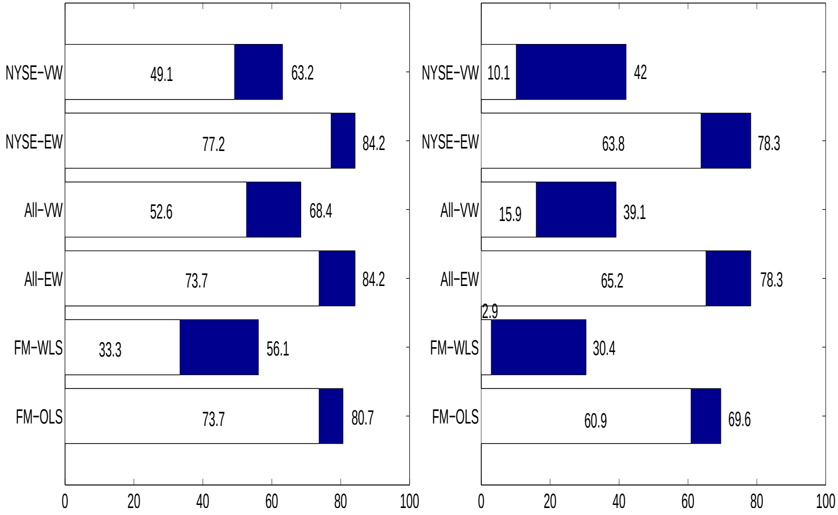
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NYSE-EW
All-VW
All-EW
FM-WLS
FM-OLS
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77.2
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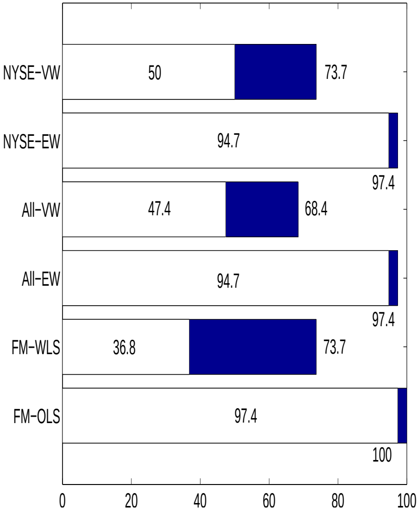
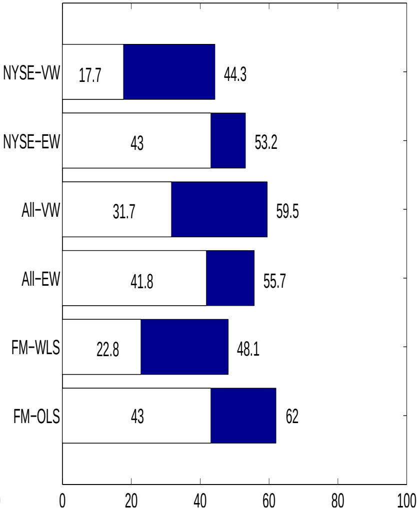
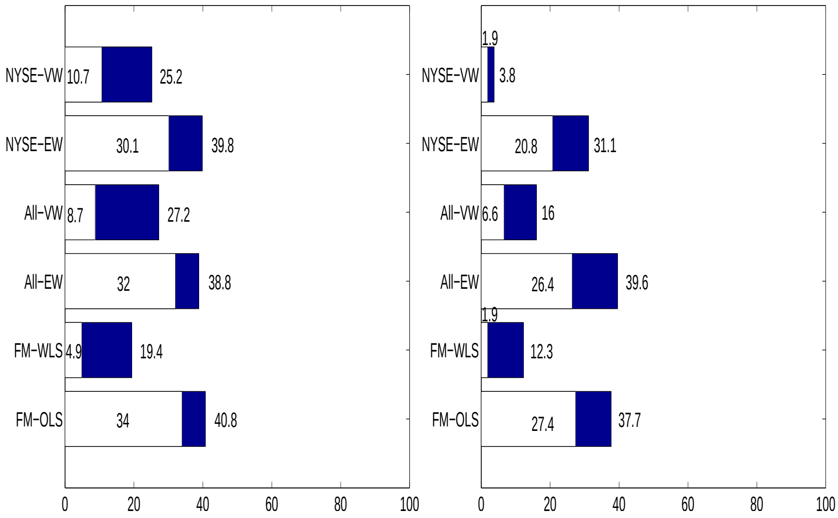
52.6
68.4
73.7
84.2
33.3
56.1
73.7
80.7
0
20
40
60
80
100
NYSE-VW
NYSE-EW
All-VW
All-EW
FM-WLS
FM-OLS
10.1
42
63.8
78.3
15.9
39.1
65.2
78.3
2.9
30.4
60.9
69.6
0
20
40
60
80
100



NYSE-VW
NYSE-EW
All-VW
All-EW
FM-WLS
FM-OLS
50
73.7
94.7
97.4
47.4
68.4
94.7
97.4
36.8
73.7
97.4
100
0
20
40
60
80
100



NYSE-VW
NYSE-EW
All-VW
All-EW
FM-WLS
FM-OLS
17.7
44.3
43
53.2
31.7
59.5
41.8
55.7
22.8
48.1
43
62
0
20
40
60
80
100



NYSE-VW
NYSE-EW
All-VW
All-EW
FM-WLS
FM-OLS
10.7
25.2
30.1
39.8
8.7
27.2
32
38.8
4.9
19.4
34
40.8
0
20
40
60
80
100
1.9
3.8
20.8
31.1
6.6
16
26.4
39.6
1.9
12.3
27.4
37.7

	Sue6	Sue12	$R^{11}12$	Rs6	Rs12	Tes1	Tes6	Tes12	Nei12
$\overline{R}$	0.16	0.08	0.43	0.15	0.07	0.23	0.24	0.16	0.12
$\|t\|$	1.44	0.73	1.93	1.12	0.52	1.41	1.68	1.19	1.11

Chan, Jegadeesh, and Lakonishok (1996): Buy-and-hold Sue return of 1.13% with equal-weights

Jegadeesh and Livnat (2006): Buy-and-hold Rs return of 0.73% with NYSE-Amex-NASDAQ breakpoints and equal-weights

Thomas and Zhang (2011): Buy-and-hold Tes return of 1.3% with NYSE-Amex-NASDAQ breakpoints and equal-weights

Replication Results

Value-versus-growth anomalies not replicated, examples

	Dp^{q}1	Dp^{q}6	Dp^{q}12	Op	Op^{q}1	Op^{q}6	Op^{q}12	Nop^{q}1	Nop^{q}6	Nop^{q}12	Sr	Sg
$\overline{R}$	0.28	0.19	0.21	0.38	0.11	0.11	0.17	0.19	0.25	0.31	−0.19	−0.03
$\|t\|$	1.12	0.80	0.90	1.86	0.49	0.61	0.91	0.86	1.19	1.55	1.08	0.19
	Ocp^{q}12	Ebp^{q}1	Ebp^{q}6	Ebp^{q}12	Ndp	Ndp^{q}1	Ndp^{q}6	Ndp^{q}12	Ltg	Ltg^{m}1	Ltg^{m}6	Ltg^{m}12
$\overline{R}$	0.37	0.25	0.21	0.31	0.28	0.16	0.17	0.26	0.13	0.02	0.01	0.02
$\|t\|$	1.56	0.90	0.84	1.28	1.52	0.66	0.75	1.25	0.38	0.05	0.02	0.07

Lakonishok, Shleifer, and Vishny (1994): −0.61% for Sr with NYSE-Amex breakpoints and equal-weights (no NASDAQ)

La Porta (1996): −20.9% per annum (−1.74% per month)

Penman, Richardson, and Tuna (2007): 0.73% for Ndp with NYSE-Amex-NASDAQ breakpoints and equal-weights

	Ia^q1	3Ig	Cdi	Ta	dCol	dNcl	dSti	dLti	Nxf	Nef
$\overline{R}$	−0.31	−0.16	0.05	−0.22	−0.12	−0.08	0.18	−0.23	−0.29	−0.18
$\lvert t \rvert$	1.74	1.15	0.43	1.63	0.81	0.64	1.22	1.59	1.58	0.96

Richardson, Sloan, Soliman, and Tuna (2005): −1.11% (size-adjusted) for Ta with NYSE-Amex-NASDAQ breakpoints and equal-weights

Bradshaw, Richardson, and Sloan (2006): −1.29% (size-adjusted) for Nxf and −0.93% for Nef with NYSE-Amex-NASDAQ breakpoints and equal-weights

	Pm^{q}6	Pm^{q}12	Gla	Ope	Ole	Ole^{q}12	Ola	F	Fp	Fp^{q}1	Fp^{q}12
$\overline{R}$	0.17	0.17	0.17	0.27	0.11	0.36	0.20	0.29	−0.39	−0.45	−0.36
$\|t\|$	0.87	0.90	1.13	1.34	0.58	1.90	1.11	1.11	1.35	1.38	1.26

	O	O^{q}1	O^{q}6	O^{q}12	Z	Z^{q}1	Z^{q}6	Z^{q}12	G	Cr1	Cr6	Cr12
$\overline{R}$	−0.09	−0.37	−0.23	−0.16	0.01	0.00	−0.03	−0.09	0.24	0.03	−0.01	−0.01
$\|t\|$	0.48	1.66	1.06	0.76	0.06	0.00	0.17	0.46	1.22	0.09	0.03	0.02

Campbell, Hilscher, and Szilagyi (2008): Fp −0.81% in the 1981–2003 sample with NYSE-Amex-NASDAQ breakpoints

- We find +0.69% per month for Fp from 7/1976 to 12/1980

Dichev (1998): −1.17% for the highest-10%-minus-lowest-70% O portfolio with NYSE-Amex-NASDAQ breakpoints and equal-weights

	Variable	Authors	Original estimates	Our estimates	Original methods
Dis	Dispersion of analysts forecasts	Diether, Malloy, Scherbina (2002)	−0.79% (−2.88)	−0.19% (−0.72)	All breakpoints, equal-weights, $5 price screen
Gind	Corporate governance	Gompers, Ishii, Metrick (2003)	−0.71% (−2.73)	0.02% (0.06)	Carhart alpha
Acq	Accruals quality	Francis, LaFond, Olsson, Schipper (2005)		−0.12% (−0.60)	E/P as cost of equity

	Ivv	Ivff1	Ivff6	Ivff12	Ivc1	Ivc6	Ivc12	Ivq1
$\overline{R}$	-0.25	-0.52	-0.32	-0.18	-0.48	-0.31	-0.20	-0.48
$\lvert t \rvert$	1.02	1.71	1.12	0.67	1.52	1.07	0.72	1.59
	Ivq6	Ivq12	Tv1	Tv6	Tv12	Sv1	Sv6	Sv12
$\overline{R}$	-0.31	-0.20	-0.39	-0.24	-0.20	-0.49	-0.18	-0.14
$\lvert t \rvert$	1.10	0.75	1.18	0.77	0.65	2.24	1.27	1.22

15 out of 16 idiosyncratic, total, and systematic volatility measures are insignificant with NYSE breakpoints, similar with equal-weights

Ang, Hodrick, Xing, and Zhang (2006): $-1.06\%, -0.97\%, -1.04\%$ ($t = -3.1, -2.86, -3.9$) for Ivff1, Tv1, and Sv1, respectively, with NYSE-Amex-NASDAQ breakpoints

Replication Results

Traditional liquidity/market microstructure measures decimated: 49 out of 50 (98%) not replicated with value-weights, 100% with $|t|$-cutoff $= 2.78$

	Tur1	Tur6	Tur12	Cvt1	Cvt6	Cvt12	Dtv1	Dtv6	Dtv12	Cvd1	Cvd6	Cvd12
$\overline{R}$	−0.15	−0.16	−0.11	0.12	0.09	0.15	−0.25	−0.34	−0.40	0.08	0.11	0.15
$\lvert t\rvert$	0.61	0.62	0.46	0.82	0.64	1.10	1.37	1.92	2.23	0.57	0.75	1.10

	Pps1	Pps6	Pps12	Ami1	Ami6	Ami12	$\text{Lm}^1 1$	$\text{Lm}^1 6$	$\text{Lm}^1 12$	$\text{Lm}^6 1$	$\text{Lm}^6 6$	$\text{Lm}^6 12$
$\overline{R}$	−0.02	0.05	−0.04	0.25	0.34	0.39	−0.07	0.21	0.21	0.38	0.36	0.31
$\lvert t\rvert$	0.07	0.16	0.14	1.20	1.64	1.91	−0.32	0.96	0.99	1.85	1.74	1.48

	$\text{Lm}^{12} 1$	$\text{Lm}^{12} 6$	$\text{Lm}^{12} 12$	$\beta^{\text{ret}} 1$	$\beta^{\text{ret}} 6$	$\beta^{\text{ret}} 12$	$\beta^{\text{lcc}} 1$	$\beta^{\text{lcc}} 6$	$\beta^{\text{lcc}} 12$	$\beta^{\text{lrc}} 1$	$\beta^{\text{lrc}} 6$	$\beta^{\text{lrc}} 12$
$\overline{R}$	0.39	0.34	0.25	0.00	0.00	−0.03	0.31	0.30	0.29	0.07	0.05	0.07
$\lvert t\rvert$	1.88	1.65	1.19	0.01	0.01	0.09	1.48	1.42	1.46	0.24	0.18	0.28

	$\beta^{\text{lcr}} 1$	$\beta^{\text{lcr}} 6$	$\beta^{\text{lcr}} 12$	$\beta^{\text{net}} 1$	$\beta^{\text{net}} 6$	$\beta^{\text{net}} 12$	Srev	$\beta^{\text{lev}} 1$	$\beta^{\text{lev}} 6$	$\beta^{\text{lev}} 12$	$\beta^{\text{PS}} 1$	$\beta^{\text{PS}} 6$
$\overline{R}$	0.06	−0.02	−0.04	0.09	0.11	0.06	−0.27	0.39	0.26	0.25	0.08	0.11
$\lvert t\rvert$	0.49	0.13	0.32	0.27	0.33	0.20	1.40	1.90	1.31	1.30	0.47	0.74

	$\beta^{\text{PS}} 12$	Pin
$\overline{R}$	0.17	−0.23
$\lvert t\rvert$	1.24	0.91

Cross-sectional regressions:

- Datar, Naik, and Radcliffe (1998, share turnover)
- Chordia, Subrahmanyam, and Anshuman (2001, dollar trading volume and its coefficient of variation)
- Amihud (2002, absolute return-to-volume)
- Acharya and Pedersen (2005, liquidity betas)

Jegadeesh (1990): NYSE-Amex-NASDAQ breakpoints and equal-weights, -1.99% ($t = -12.55$)

Liu (2006): NYSE breakpoints and equal-weights, from 0.18% ($t = 0.93$) to 0.85% ($t = 4.4$), 8 out of 9 measures significant

Adrian, Etula, Muir (2014): Me-Bm-R^{11} portfolios as basis assets

Replication Results

Replicated anomalies: Magnitudes much lower than originally reported

	Anomaly	Original authors	Original estimates	Our estimates	Original methods
Abr6	Abnormal returns around earnings announcements	Chan, Jegadeesh, Lakonishok (1996)	0.98%	0.33% (3.41)	Buy-and-hold, equal-weights
Abr12	Abnormal returns around earnings announcements	Chan, Jegadeesh, Lakonishok (1996)	0.69%	0.23% (2.99)	Buy-and-hold, equal-weights
Re6	Revisions in analysts' earnings forecasts	Chan, Jegadeesh, Lakonishok	1.28%	0.47% (2.24)	Buy-and-hold, equal-weights
Re12	Revisions in analysts' earnings forecasts	Chan, Jegadeesh, Lakonishok	0.81%	0.24% (1.30)	Buy-and-hold, equal-weights

Replicated anomalies: Magnitudes much lower than originally reported

	Anomaly	Original authors	Original estimates	Our estimates	Original methods
$R^6 6$	Prior 6-month returns, 6-month holding period	Jegadeesh, Titman (1993)	1.10% (3.61)	0.82% (3.50)	NYSE-Amex breakpoints, equal-weights
$R^6 12$	Prior 6-month returns, 12-month holding period	Jegadeesh, Titman (1993)	0.90% (3.54)	0.55% (2.91)	NYSE-Amex breakpoints, equal-weights
Cm1	Customer momentum, 1-month holding period	Cohen, Frazzini (2008)	1.58% (3.79)	0.78% (3.85)	All breakpoints, value-weights, $5 price screen

Replicated anomalies: Magnitudes much lower than originally reported

	Anomaly	Original authors	Original estimates	Our estimates	Original methods
Cp	Cash flow-to-price	Lakonishok, Shleifer, Vishny (1994)	0.83%	0.43% (2.14)	NYSE-Amex breakpoints, equal-weights
Ocp	Operating cash flow-to-price	Desai, Rajgopal, Venkatachalam (2004)	1.24% (2.65)	0.70% (3.14)	All breakpoints, equal-weights
I/A	Investment-to-assets	Cooper, Gulen, Schill (2008)	−1.05% (−5.04)	−0.44% (−2.89)	All breakpoints, value-weights
			−1.73% (−8.45)		All breakpoints, equal-weights
Oa	Operating accruals	Sloan (1996)	−0.87% (−4.71)	−0.27% (−2.19)	NYSE-Amex breakpoints, equal-weights, size-adjusted

Replicate the published anomalies literature with 452 variables:

- 65% cannot clear the single test hurdle of $|t| \geq 1.96$, with microcaps mitigated with NYSE breakpoints and value-weights
- Most (52%) anomalies fail to replicate irrespective of microcaps (NYSE-Amex-NASDAQ breakpoints and equal-weights), if adjusting for multiple testing
- Similar results in the original samples: 65.3% versus 56.2%
- The biggest casualty in the trading frictions category, with 96% failing the single tests
- Replicated anomalies size much smaller than originally reported