



**JACOBS LEVY EQUITY
MANAGEMENT CENTER**
for Quantitative Financial Research

Anomaly Time

PRESENTER

Matthew Ringgenberg, University of Utah

Coauthors: Boone Bowles, Adam Reed, Jake Thornock

Big Picture: *Many* anomalies in the literature. Are they real?

There are now over 400 documented anomalies....

McLean and Pontiff's (2016) -- 93 (now 140 anomalies)

Hou, Xue, and Zhang (2017) -- 447 anomalies

Kakushadze and Serur (2018) -- 151 (18 asset classes)

...all apparent violations of market efficiency

Existing thoughts: Anomalies are real vs. they are spurious

- McLean and Pontiff (2016)

Anomalies are “real”...but arbitrageurs eliminated them

“If return predictability reflects mispricing and publication leads sophisticated investors to learn about and trade against the mispricing, then we expect the returns associated with a predictor should disappear or at least decay after the paper is published.”

- Harvey, Liu, and Zhu (2016) & Hou, Xue, and Zhang (2017)

Anomalies are not real...they are spurious due to data mining

“...most claimed research findings in financial economics are likely false.”

“The anomalies literature is infested with widespread p-hacking.”

Big Picture: Our key idea is based on information releases

In this paper, we put forward a different explanation that answers whether anomalies are real or spurious. We ask:

- *To what extent are anomalies driven by information?*
 - Difficult question because information is constantly evolving
- We need ***distinct*** and ***measurable*** information releases, and value-relevant information
 - We use a novel database that contains precise information release dates. We find anomaly returns are larger if you condition on the precise information release. ***ANOMALIES ARE REAL!***

Main Results: If you consider info timing, anomalies are real

1. Anomaly returns are “real”, and returns to anomaly portfolios are primarily earned in the weeks immediately following the release of key information
 - A. Moreover, anomaly returns have moved earlier in time
 - i. Explains why they seem to have disappeared recently
2. Returns to trading quickly are large
 - A. Daily vs. annual rebalancing leads to increase of ~7% per annum
3. Hedge funds that react faster to new information earn higher alphas

Outline

- Intro & Motivation
- Background, Approach, & Examples
- Results – Several Empirical Tests:
 1. Event Time Approach
 2. Annual v. Daily Rebalancing
 3. Fast Minus Slow and Hedge Fund Performance
 4. Robustness
- Conclusion

Many anomalies. How do we measure them?

- Academic literature has identified more than 100 anomalies
- Convention in the literature: examine returns to anomaly strategies using annual rebalancing (typically in June)

“To ensure that the accounting variables are known before the returns they are used to explain, we match the accounting data for all fiscal year-ends in calendar year $t-1$ with the returns for July of year t to June of $t+1$.” -- Fama and French (1992)

- This ensures that strategies do not have a look ahead bias, but also means that key conditioning information is stale
- We develop a strategy to see if anomalies are real by more precisely measuring the release of key information

Anomaly Selection and Measurement

- We need to identify a subset of anomalies with clear information release dates
- Approach:
 - Start with Pontiff and McLean (2016) - 93 anomalies
 - However, for the majority of these anomalies, at least some of the underlying data is constantly changing
 - For Example, Pontiff and McLean's (2016) #1: E/P (Basu 1977)
 - E is fixed but P is constantly changing
 - Restrict set to anomalies with clear information release dates

We use 9 anomalies based on accounting data with clear release dates

- Accruals (Sloan AR 1996)
- Asset Growth (Cooper, 2008)
- Gross Profitability (Novy-Marx JFE 2013)
- Inventory Growth (Thomas and Zhang RAS 2002)
- Net Working Capital (Soliman AR 2008)
- Operating Leverage (Novy-Marx ROF 2010)
- Profit Margin (Soliman AR 2008)
- Return on Equity (Haugen and Baker JFE 1998)
- Sustainable Growth (Lockwood and Prombutr JFR 2010)

All 9 anomalies are based on accounting data that change at ***distinct*** and ***measurable***, points in time

We use the “Snapshot” database to find precise information release dates

- We use the *Snapshot* database to pinpoint the precise date each information signal first becomes publicly available
 - Could be the EA or 10K date
 - E.g., Snapshot allows us to measure a stock’s asset growth as soon as assets are known to the public

Benefit of Snapshot Data		
	% of Annual Earnings Announcements that Reported Total Assets	Average Number of Days Between Earnings Announcement and 10-K Filing
Entire Period	53	23
Early (1997-99)	18	38
Middle (2000-07)	37	27
Late (2008-17)	93	11

Example of Snapshot importance: GulfMark Offshore, Inc.

GulfMark Offshore, Inc.

2004 data

- Earnings Announcement Date = February 26, 2004
 - Did NOT contain balance sheet data
- 10-K Date = March 15, 2004
 - Contained all financial statement data

2018 data

- Earnings Announcement Date = March 29, 2018
 - Contained all financial statement data
- 10-K Date = April 2, 2018 (also contained all financial data)

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We start with event time analyses that use Snapshot

Step 1: For each anomaly and stock, identify information release dates

- Snapshot identifies the first date at which all financial information is known with certainty, whether that be the EA date or the 10-K date

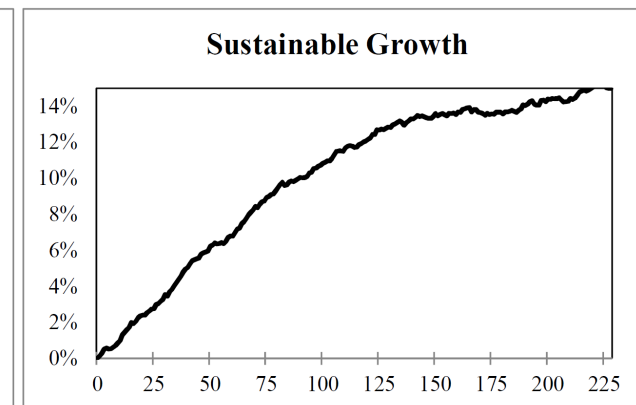
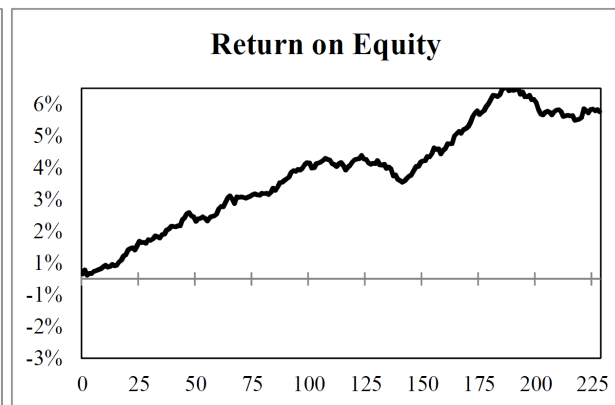
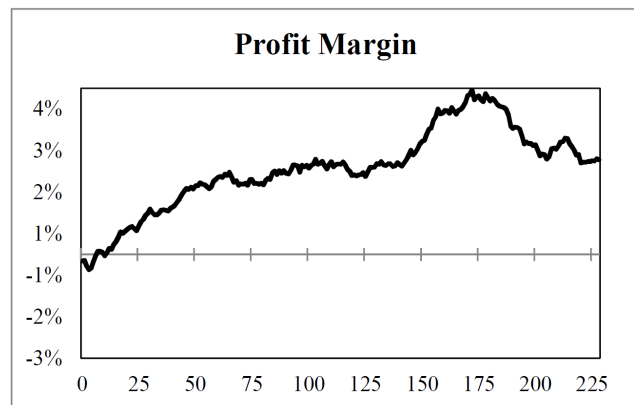
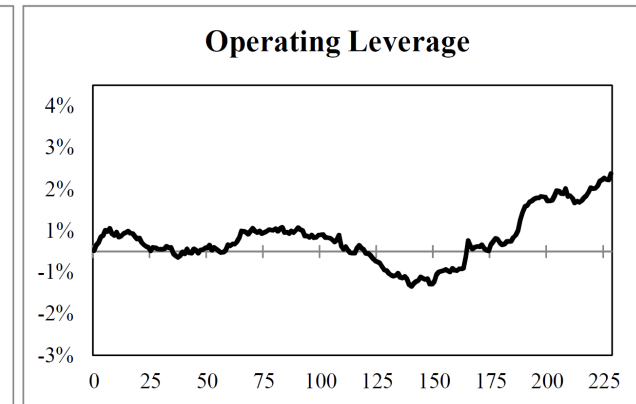
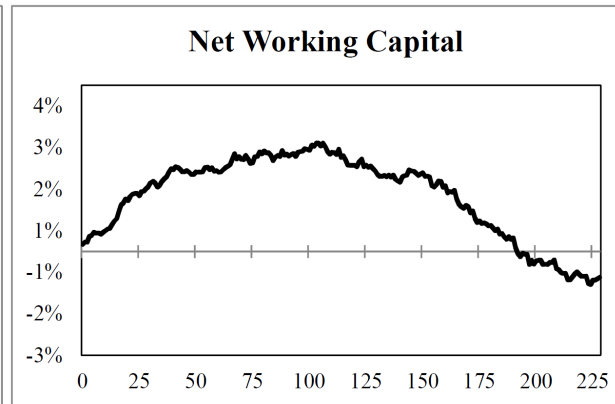
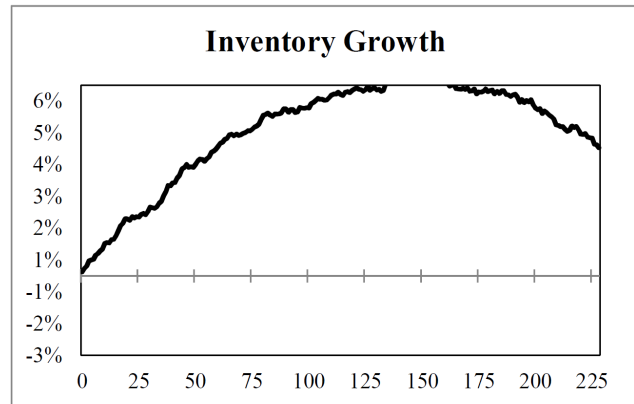
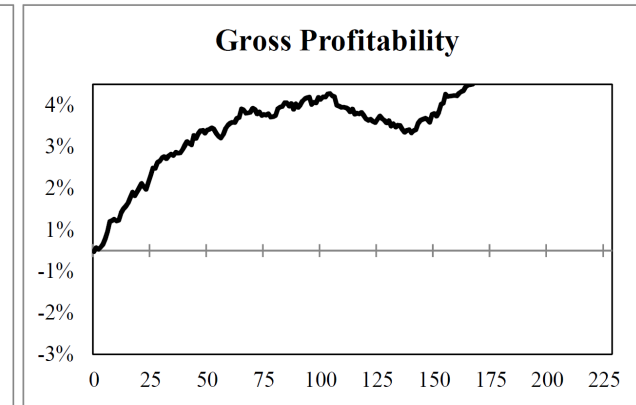
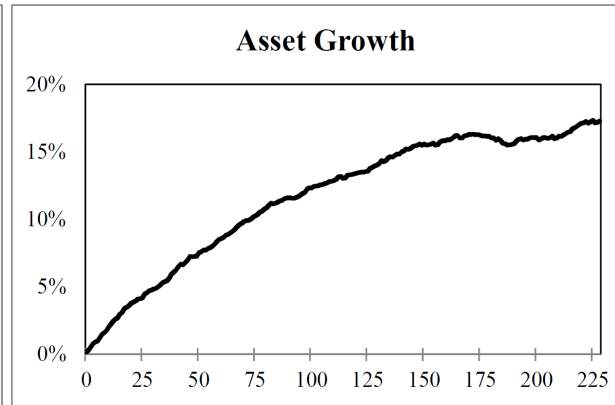
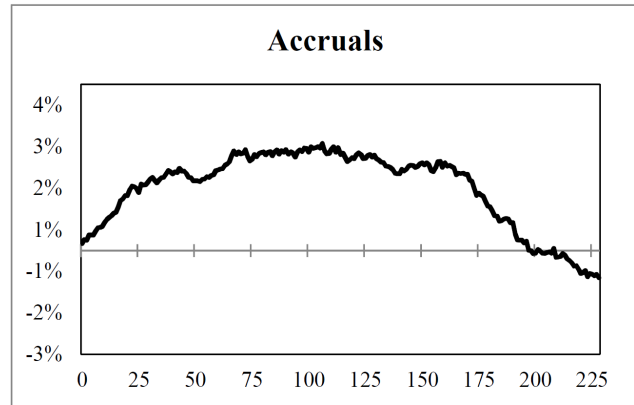
Step 2: Measure and Rank Anomaly Variable

- Calculate anomaly variable (e.g., asset growth) from information revealed in the financial statements and rank the universe of stocks on the anomaly variable
- If a stock warrants inclusion to the long or short legs of the anomaly portfolio, then buy or sell starting at the end of the day following the information release

Step 3: Hold positions for one year (or until next info release date)

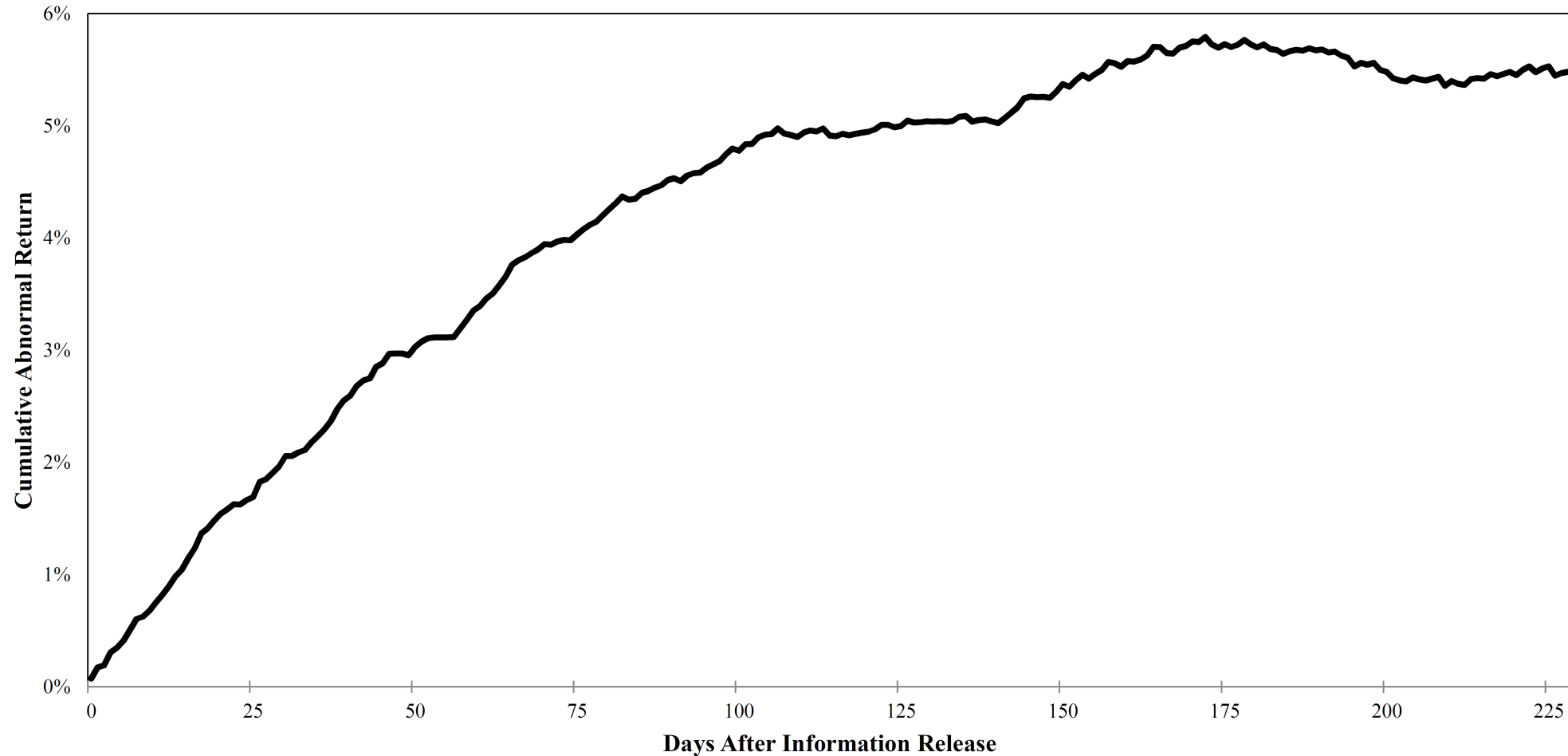
Step 4: Line up returns in event time and examine performance

Event Time results show returns concentrated in first few months



Event Time results show returns concentrated in first few months

- We also construct a “Super Anomaly” portfolio = equal-weighted combo of all 9 individual portfolios. Results show clearly that information release date matters!



Event Time results show returns concentrated in first few months

- Most anomalies “work” in the first 30 days after information release
- Super Portfolio is an equally-weighted portfolio of all 9 anomalies
 - Super anomaly earns FF3 alpha of 1% in first month!
- Less return earned after 120 days and after a full year
 - 2% alpha in first half-year and year
 - Decay is fast after first few months

Anomaly	Compound Returns Earned After Release of Financial Information		
	(1)	(2)	(3)
	30 Days	120 Days	240 Days
Super (p-value)	0.98 (.000)	2.13 (.000)	1.97 (.000)
Accruals	0.79 (.000)	0.65 (.085)	-0.55 (.306)
Asset Growth	2.29 (.000)	5.56 (.000)	6.13 (.000)
Gross Profitability	1.04 (.000)	1.60 (.000)	1.42 (.006)
Inventory Growth	1.10 (.000)	2.78 (.000)	1.88 (.000)
Net Working Capital	0.76 (.000)	0.73 (.048)	-0.10 (.854)
Operating Leverage	0.05 (.731)	0.01 (.985)	0.41 (.415)
Profit Margin	0.36 (.038)	0.66 (.066)	0.05 (.919)
ROE	0.66 (.000)	1.39 (.000)	2.07 (.000)
Sustainable Growth	1.59 (.000)	5.07 (.000)	5.72 (.000)

Event Time results show returns concentrated in first few months

- **When** are the returns earned?
 - Annualized return to super anomaly in the first 30 days is 7.87%.
- Less return earned after 120 days and after a full year
 - 3.31% annualized return earned from day 31 to day 120
 - 0.37% annualized return earned from day 121 to day 240
- Returns decay over time
- Consistent with information (i.e., not risk or data mining)

Anomaly	Average Annualized Return Earned Over Span of Days		
	(4)	(5)	(6)
	1 - 30 Days	31 - 120 Days	121 - 240 Days
Super	7.87	3.31	0.37
(p-value)	(.000)	(.000)	(.328)
Accruals	6.30	-0.60	-2.57
	(.000)	(.496)	(.003)
Asset Growth	18.28	9.53	2.45
	(.000)	(.000)	(.005)
Gross Profitability	8.29	1.86	1.24
	(.000)	(.031)	(.117)
Inventory Growth	8.76	4.47	-1.35
	(.000)	(.000)	(.081)
Net Working Capital	6.10	-0.10	-2.53
	(.000)	(.910)	(.005)
Operating Leverage	0.43	-0.05	1.59
	(.731)	(.948)	(.049)
Profit Margin	2.89	0.96	0.01
	(.038)	(.240)	(.986)
ROE	5.26	2.71	1.75
	(.000)	(.002)	(.041)
Sustainable Growth	12.71	9.61	2.43
	(.000)	(.000)	(.007)

Event Time results are impressive. But how large is the magnitude?

- Event time results consistently show that anomalies are real
 - But how large is the magnitude?
- We next examine a trading strategy using data and rankings as soon as they are available (daily rebalanced calendar time approach)

Example: Asset Growth (Cooper *et al* (2008)):

1. Calculate Asset Growth = $(AT_t - AT_{t-1}) / AT_{t-1}$ using snapshot data
2. Every day, rank sample according to Asset Growth
3. Form Portfolios
 - Bottom 10%, long leg
 - Top 10%, short leg
4. Stock remains in portfolio as long as rank still warrants it

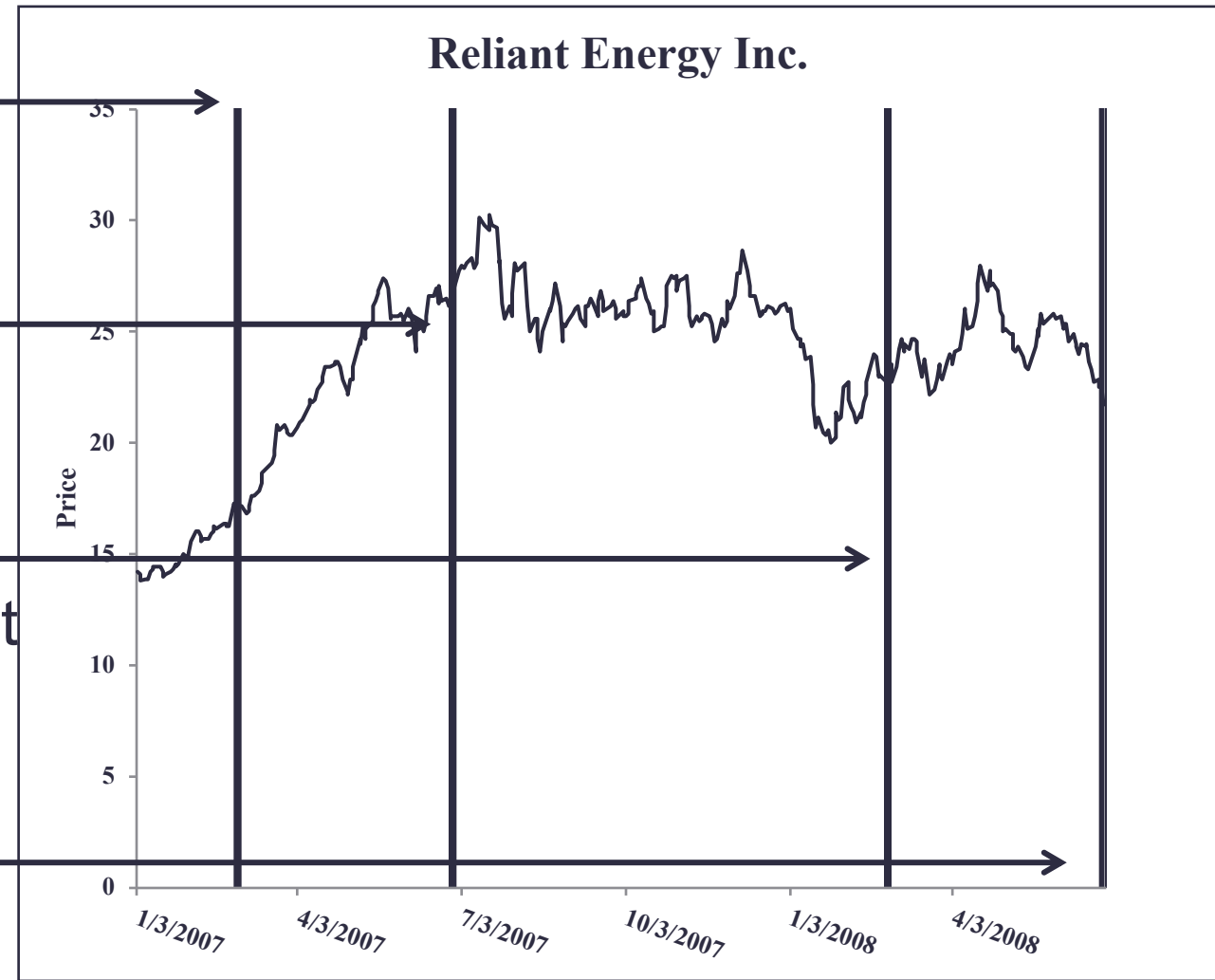
Example of Calendar Time Approach: Reliant Energy Inc.

- 10-K filed on Feb. 28, 2007
 - Reliant enters long leg of daily rebalanced portfolio
- End of June 2007
 - Reliant enters long leg of annually rebalanced portfolio
- 10-K filed on Feb. 26, 2008
 - Reliant remains in long leg of daily rebalanced portfolio
 - Note that if asset growth for Reliant were higher then Reliant would have left the portfolio
- End of June 2008
 - Reliant remains in long leg of annually rebalanced portfolio

Reliant Energy Inc.	Filed 10-K Feb. 28, 2007	Annual Rebalancing June 29, 2007	Filed 10-K Feb. 26, 2008	Annual Rebalancing June 30, 2008
Asset Growth	-0.221	-0.221	-0.105	-0.105
Percentile	2nd	2nd	7th	9th
Position	Enters Long	Enters Long	Remains Long	Remains Long
1 year Return			44.63%	-21.08%
Asset Growth Stats				
Mean	0.169	0.193	0.198	0.203
Median	0.086	0.098	0.100	0.098
5th percentile	-0.145	-0.116	-0.107	-0.131
10th percentile	-0.070	-0.054	-0.051	-0.056
90th percentile	0.471	0.509	0.527	0.509
95th percentile	0.728	0.845	0.858	0.840

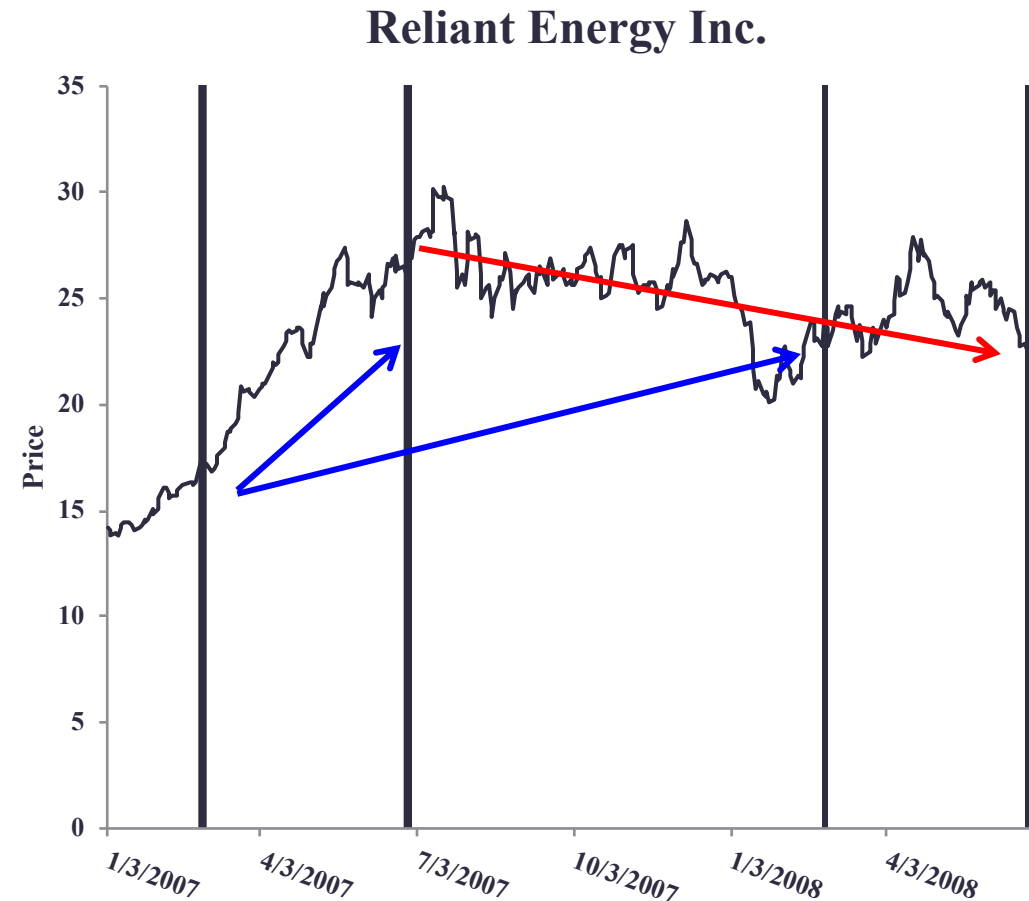
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 - Note that if asset growth for Reliant were higher then Reliant would have left the portfolio.
- End of June 2008
 - Reliant remains in long leg of annually rebalanced portfolio



Example of Calendar Time Approach: Reliant Energy Inc.

- Reliant earns a return of 59.09% in the 85 days between the 10-K filing and the annual rebalancing at the end of June.
- Reliant earns a return of 44.63% over the full year between 10-K filings.
- Reliant loses 21.08% over the full year from June to June.



Annual rebalancing shows anomalies are gone (were they ever real?)

Annual Rebalancing

- Most anomalies don't show significant returns in our sample
- Consistent with:
 - Green, Hand, and Zhang (2017)
 - McLean and Pontiff (2016)
 - Hou, Xue, and Zhang (2017)
- Begs the question: were anomalies ever there in the first place? Were they just accidents in the data (or even data mined?)

Anomaly	Average Daily Returns		
	(1)	(2)	(3)
	Daily Return in Basis Points	Return in Annualized Percent	p-value
Super	0.60	1.44	.159
Accruals	-1.61	-3.87	.004
Asset Growth	1.85	4.43	.013
Gross Profitability	1.46	3.51	.139
Inventory Growth	-1.34	-3.22	.024
Net Working Capital	-1.98	-4.76	.000
Operating Leverage	0.69	1.66	.491
Profit Margin	0.59	1.42	.412
ROE	1.34	3.22	.113
Sustainable Growth	1.58	3.80	.020

What happens if we rebalance as information first arrives?

Original/Annual Rebalancing is a replication of anomalies from the original papers

Anomaly variable measurement and ranking is done once per year, on June 30th, using information from most recent annual financial statements

We find little evidence of asset pricing anomalies

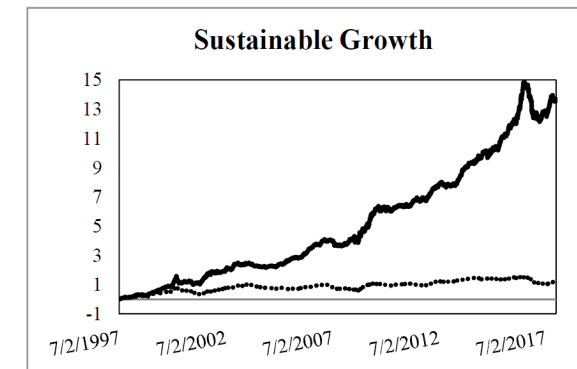
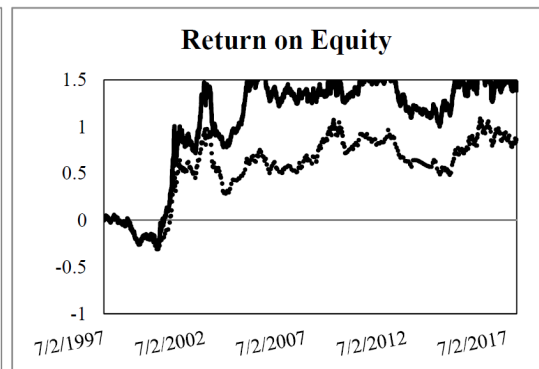
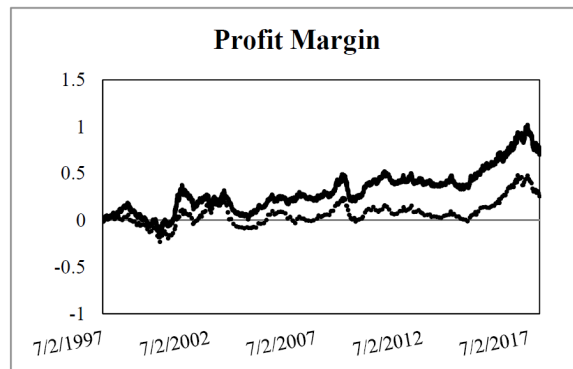
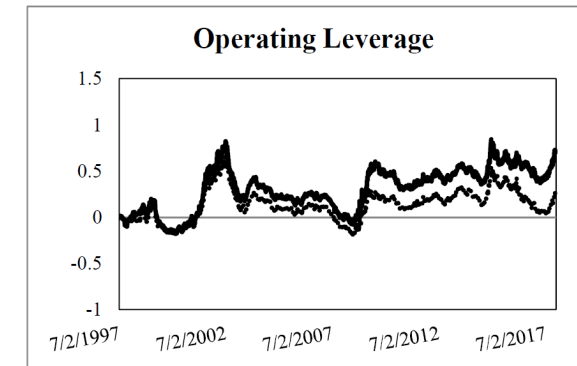
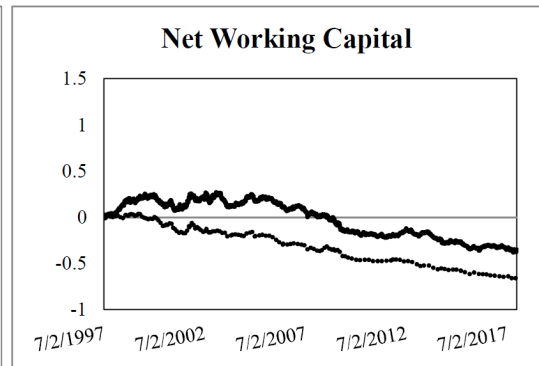
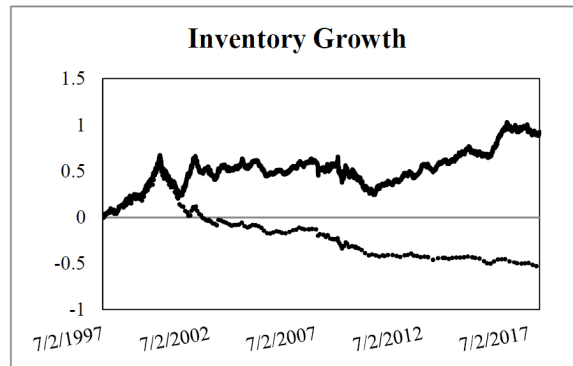
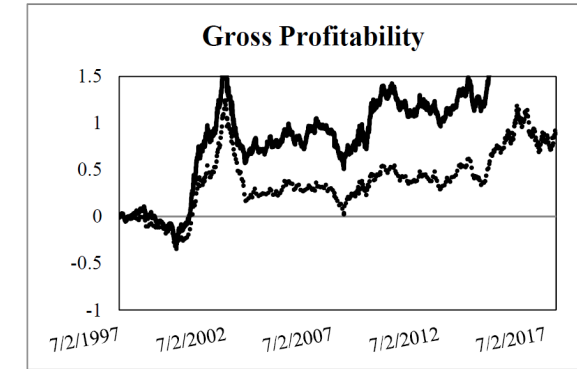
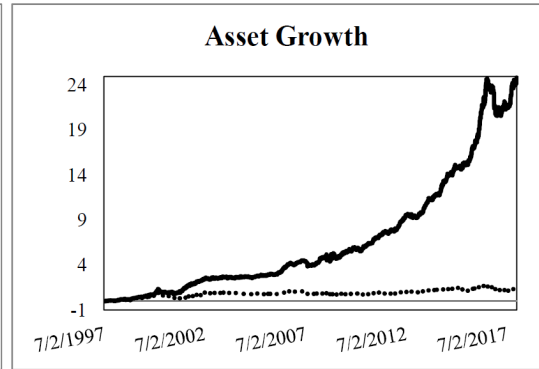
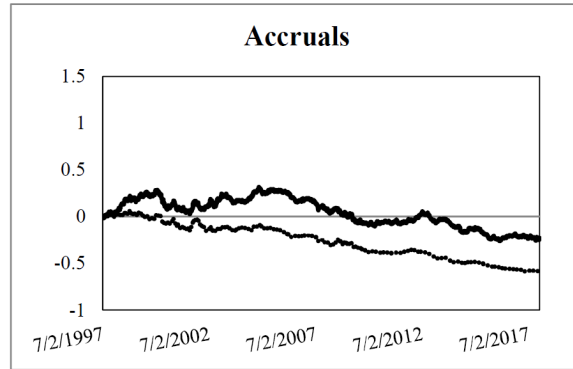
Implementable/Daily Version is the daily rebalancing strategy

Anomaly variable measurement and ranking is done daily upon the release of any annual financial data that affects anomaly calculation

Stocks are moved into or out of the anomaly portfolio legs daily based on new rankings

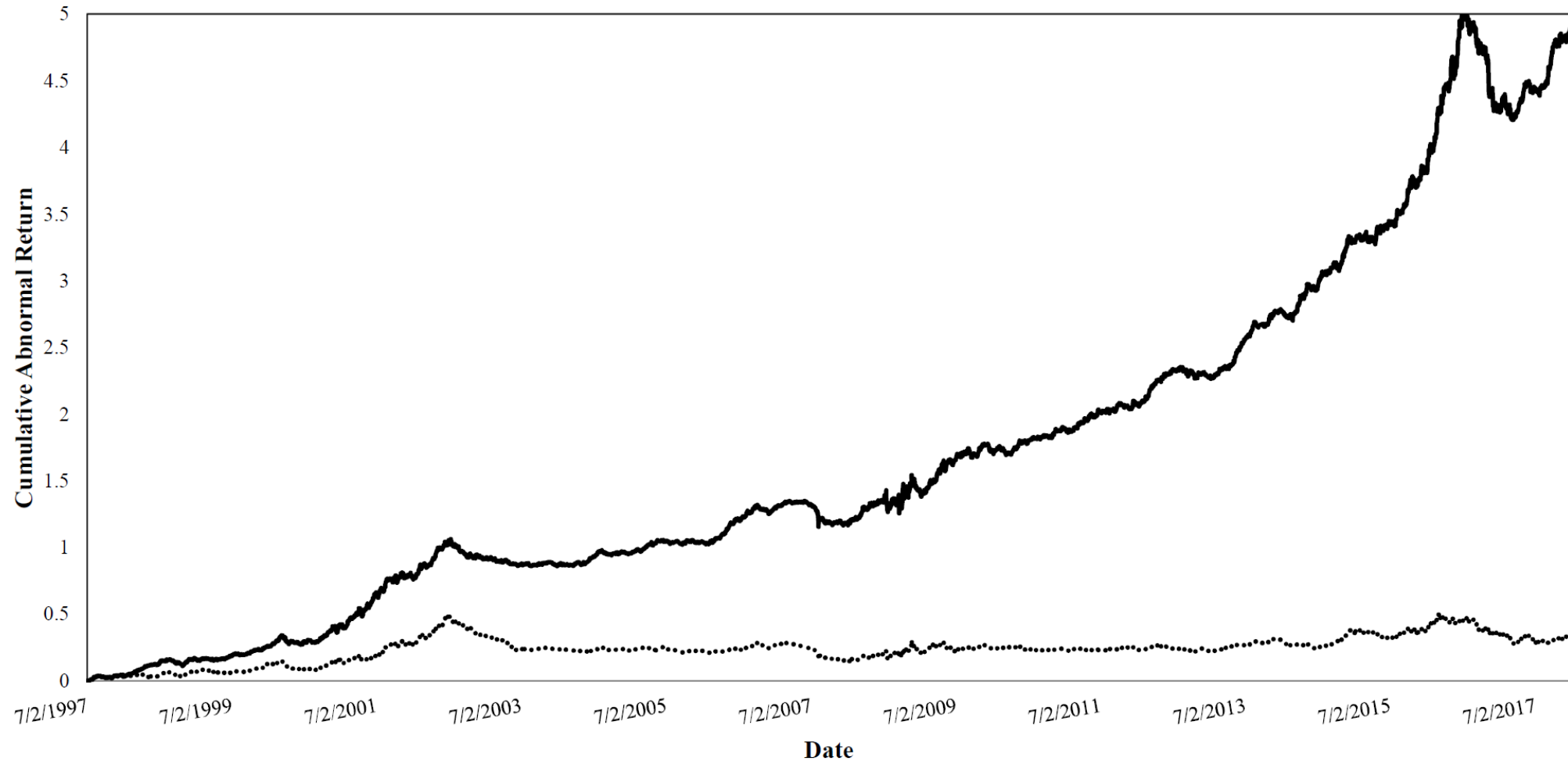
We find strong evidence that anomalies are real!

Calendar Time results show rebalancing for new information is valuable



Calendar Time results show rebalancing for new information is valuable

- “Super Anomaly” portfolio shows clearly that, on average, rebalancing as information arrives leads to a dramatic improvement → Anomalies are real!



Calendar Time Approach: Annual vs. Daily Rebalancing

Annual vs. Daily

- Daily rebalancing gives higher returns...
- Overall, the super anomaly portfolio shows a difference of 6.92% annually!

Anomaly	Annualized Average Daily Returns in Percent			
	(1)	(2)	(3)	(4)
	Annual Rebalancing	Daily Rebalancing	Difference (2 - 1)	Difference (p-value)
Super	1.44	8.37	6.92	.000
Accruals	-3.87	-1.02	2.85	.129
Asset Growth	4.43	15.48	11.05	.000
Gross Profitability	3.51	6.17	2.66	.432
Inventory Growth	-3.22	3.26	6.48	.001
Net Working Capital	-4.76	-1.85	2.92	.113
Operating Leverage	1.66	3.08	1.42	.675
Profit Margin	1.42	2.83	1.41	.566
ROE	3.22	4.53	1.31	.652
Sustainable Growth	3.80	12.78	8.97	.000

The rewards to speed: examining Hedge Fund performance

- Our results suggest anomalies are real, not spurious, and the key is speed
- How valuable is speed?
- To answer this, we examine hedge fund performance
- We can't see individual trades by funds, so we *infer* their speed
 - We define the return difference between the daily updating portfolios and the annually updating portfolios as Fast Minus Slow, or “FMS”
 - FMS mimics the experience of a trader who is long the daily rebalancing hedge portfolios for an anomaly (or super) and is short the annually rebalanced hedge portfolio
 - We then examine how correlated each fund's performance is with FMS

Faster hedge funds do better in the future

Panel Analysis

$$Performance_{i,t+1:t+12} = \alpha + \beta Speed_{i,t} + \epsilon_{i,t+1:t+12}$$

- Fund speed is positively associated with future fund performance
- Using fixed effects models, within fund variation in speed is also associated with higher performance
- An average fund increasing its speed by one std. dev. should expect a 40 basis point increase in its future abnormal returns

	Performance and Speed		
	(1)	(2)	(3)
	Performance	Performance	Performance
Speed	0.6321***	0.8848***	0.8318***
(s.e.)	(0.1392)	(0.1501)	(0.1869)
Fund FE	No	Yes	Yes
Month-Year FE	No	No	Yes
Clustered Std. Errors	Yes	Yes	Yes
R-squared	0.002	0.163	0.327
Within R-squared	0.002	0.003	0.002
No. of Funds	2,744	2,744	2,744
No. of Months	192	192	192
Observations	218,737	218,737	218,737

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Robustness: we examine several other tests in the paper

We have several additional tests in the paper:

- Returns have been earned faster in more recent sample periods
- Results are not driven by general news, only news about the strategy itself
- Results are robust across micro cap, small cap, and large cap stocks
- Results are strongest when arbitrage risk is high as measured by Wurgler and Zhuravskaya (2002)
- Returns decay faster when arbitrage risk is low
 - Again, suggests anomalies are real, not data mined
- Transaction costs for daily strategy not significantly higher than annual strategy
 - Currently doing more to verify this
 - Also examining strategy capacity

Conclusion: Anomalies are real (if you are fast enough)

- Returns to anomaly portfolios are primarily earned in the weeks immediately following the release of information
 - This is true in both event time and calendar time approaches
- Hedge funds that react faster to new information earn higher alpha
- Taking all the evidence together, the implication is clear:
 - **Anomaly returns are not compensation for bearing systematic risk**
 - **Anomaly returns are not spurious**
 - ***Anomaly returns are due to delayed reactions to key portfolio information***