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Alice's Adventures in Factorland: Three Mistakes that Plague Factor Investing

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Factor Investing/Smart Beta

Factor investing is about allocating portfolio weights to known “factors”

- Embraced by some of the world’s largest institutional investors
- Retail investors also have access to hundreds of factor products

Factor investing/smart beta index funds have many benefits

- Exposure to well-studied sources of return
- Typically low fees
- Transparency

What is there not to like about factor investing?

Reality of Factor Investing

Factor investing has failed to live up to many of its promises. It's success is compromised by three risks often underappreciated by investors:

1. Exaggerated expectation about factor performance due to:
 - Data mining
 - Crowding and rising valuations
 - Ignorance of trading costs and implementability
2. Factors sometimes experience drawdowns that far exceed expectations
3. Diversification vanishes as correlations sometimes soar

Exaggerated Expectations

Factor Performance in the Long Run, United States, July 1963–June 2018

Factor	Year of Discovery	Average Return	Average Volatility	t-stat
Market	1964	4.20	10.00	3.11
Value	1990	4.15	10.00	3.07
Size	1975	2.53	10.00	1.87
Operating profitability	2013	3.70	10.00	2.74
Investment	2003	4.32	10.00	3.20
Momentum	1989	5.48	10.00	4.06
Low beta	1966	0.16	10.00	0.12

Note: All factors are scaled to 10% volatility. Factor portfolios are equally weighted and also scaled to 10% volatility.
Source: Research Affiliates, LLC, using data from CRSP/Compustat.

Factor Performance in the Long Run, United States, July 1963–June 2018

Factor	Year of Discovery	Average Return	Average Volatility	<i>t</i> -stat	CAPM Alpha	CAPM Alpha <i>t</i> -stat	CAPM Beta
Market	1964	4.20	10.00	3.11			
Value	1990	4.15	10.00	3.07	5.24	3.99	-0.26
Size	1975	2.53	10.00	1.87	1.32	1.02	0.29
Operating profitability	2013	3.70	10.00	2.74	4.74	3.60	-0.25
Investment	2003	4.32	10.00	3.20	5.80	4.56	-0.35
Momentum	1989	5.48	10.00	4.06	6.06	4.50	-0.14
Low beta	1966	0.16	10.00	0.12	3.18	3.36	-0.72

Note: All factors are scaled to 10% volatility. Factor portfolios are equally weighted and also scaled to 10% volatility.
Source: Research Affiliates, LLC, using data from CRSP/Compustat.

Factor Performance in the Long Run, United States, July 1963–June 2018

Factor	Year of Discovery	Average Return	Average Volatility	t-stat	CAPM Alpha	CAPM Alpha t-stat	CAPM Beta
Market	1964	4.20	10.00	3.11			
Value	1990	4.15	10.00	3.07	5.24	3.99	-0.26
Size	1975	2.53	10.00	1.87	1.32	1.02	0.29
Operating profitability	2013	3.70	10.00	2.74	4.74	3.60	-0.25
Investment	2003	4.32	10.00	3.20	5.80	4.56	-0.35
Momentum	1989	5.48	10.00	4.06	6.06	4.50	-0.14
Low beta	1966	0.16	10.00	0.12	3.18	3.36	-0.72
Idiosyncratic volatility	2000	1.62	10.00	1.20	4.34	4.18	-0.65
Short-term reversals	1987	5.34	10.00	3.96	4.13	3.17	0.29
Illiquidity	1997	3.01	10.00	2.23	3.96	2.99	-0.23
Accruals	1991	4.31	10.00	3.20	4.93	3.67	-0.15
Cash flow to price	1990	4.82	10.00	3.57	6.34	5.01	-0.36
Earnings to price	1971	3.76	10.00	2.78	5.49	4.44	-0.41
Long-term reversals	1982	3.43	10.00	2.55	3.50	2.57	-0.02
Net share issues	2003	5.28	10.00	3.91	6.97	5.60	-0.40

Note: All factors are scaled to 10% volatility. Factor portfolios are equally weighted and also scaled to 10% volatility.
Source: Research Affiliates, LLC, using data from CRSP/Compustat.

Factor Performance in the Long Run, United States, July 1963–June 2018

Factor	Year of Discovery	Average Return	Average Volatility	t-stat	CAPM Alpha	CAPM Alpha t-stat	CAPM Beta	CAPM Beta t-stat
Market	1964	4.20	10.00	3.11				
Value	1990	4.15	10.00	3.07	5.24	3.99	-0.26	-6.90
Size	1975	2.53	10.00	1.87	1.32	1.02	0.29	7.69
Operating profitability	2013	3.70	10.00	2.74	4.74	3.60	-0.25	-6.57
Investment	2003	4.32	10.00	3.20	5.80	4.56	-0.35	-9.69
Momentum	1989	5.48	10.00	4.06	6.06	4.50	-0.14	-3.57
Low beta	1966	0.16	10.00	0.12	3.18	3.36	-0.72	-26.46
Idiosyncratic volatility	2000	1.62	10.00	1.20	4.34	4.18	-0.65	-21.73
Short-term reversals	1987	5.34	10.00	3.96	4.13	3.17	0.29	7.70
Illiquidity	1997	3.01	10.00	2.23	3.96	2.99	-0.23	-5.99
Accruals	1991	4.31	10.00	3.20	4.93	3.67	-0.15	-3.81
Cash flow to price	1990	4.82	10.00	3.57	6.34	5.01	-0.36	-9.98
Earnings to price	1971	3.76	10.00	2.78	5.49	4.44	-0.41	-11.65
Long-term reversals	1982	3.43	10.00	2.55	3.50	2.57	-0.02	-0.39
Net share issues	2003	5.28	10.00	3.91	6.97	5.60	-0.40	-11.26
Average of factors 1–6		3.39	10.00	2.51	4.39	3.50	-0.24	-7.58
Average of factors 7–14		3.95	10.00	2.92	4.96	3.95	-0.24	-7.14
Average of other factors		3.58	10.00	2.64	4.44	3.48	-0.20	-5.89

Note: All factors are scaled to 10% volatility. Factor portfolios are equally weighted and also scaled to 10% volatility.
Source: Research Affiliates, LLC, using data from CRSP/Compustat.

Factor Performance in the Long Run, United States, July 1963–June 2018

Factor			Year of Discovery	Average Return	Average Volatility	t-stat	CAPM Alpha	CAPM Alpha t-stat	CAPM Beta
Average of factors 1–6				3.39	10.00	2.51	4.39	3.50	-0.24
Average of factors 7–14				3.95	10.00	2.92	4.96	3.95	-0.24
Average of other factors				3.58	10.00	2.64	4.44	3.48	-0.20
Portfolios of factors	No rebalancing, no vol. scaling	1–6		3.61	5.17	5.18	4.44	6.82	-0.20
		7–14		3.91	5.20	5.57	4.67	7.04	-0.18
		Other		5.14	4.79	7.94	6.14	10.89	-0.24
	Monthly rebalancing, no vol. scaling	1–6		3.39	4.60	5.47	4.39	8.22	-0.24
		7–14		3.95	5.42	5.40	4.96	7.51	-0.24
		Other		3.57	3.47	7.62	4.42	11.53	-0.20
	Monthly rebalancing, 10% vol. scaled	1–6		7.38	10.00	5.47	9.55	8.22	-0.52
		7–14		7.28	10.00	5.40	9.15	7.51	-0.44
		Other		10.28	10.00	7.62	12.73	11.53	-0.58

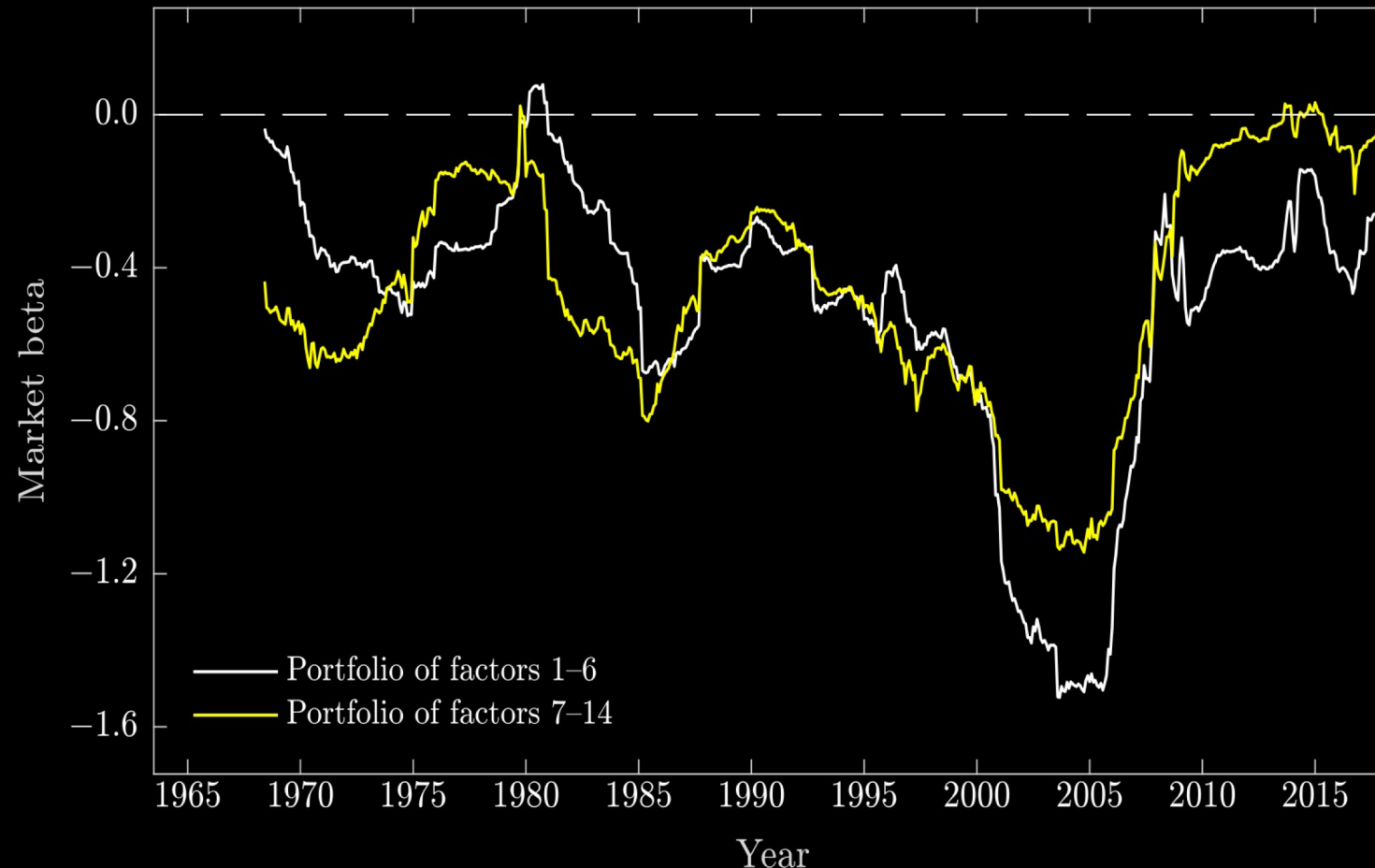
Note: All factors are scaled to 10% volatility. Factor portfolios are equally weighted and also scaled to 10% volatility.
Source: Research Affiliates, LLC, using data from CRSP/Compustat.

Factor Performance Over Market Cycles, United States, July 1963–June 2018

Factor	Market Return		
	Up	Neutral	Down
Market	4.3%	0.3%	-4.9%
Value	-0.8%	0.4%	1.8%
Size	0.8%	0.4%	-1.6%
Operating profitability	-0.5%	0.2%	1.9%
Investment	-0.8%	0.3%	2.5%
Momentum	-0.6%	0.7%	0.7%
Low beta	-3.0%	0.1%	3.8%
Idiosyncratic volatility	-2.4%	0.1%	3.8%
Short-term reversals	1.9%	0.4%	-1.1%
Illiquidity	-0.9%	0.4%	1.3%
Accruals	-0.2%	0.4%	0.7%
Cash flow to price	-1.1%	0.4%	2.4%
Earnings to price	-1.3%	0.3%	2.7%
Long-term reversals	0.5%	0.2%	0.8%
Net share issues	-1.1%	0.4%	2.8%
Average of factors 1–6	-0.8%	0.3%	1.5%
Average of factors 7–14	-0.6%	0.3%	1.7%
Average of other factors	-0.5%	0.3%	1.5%
Portfolio of factors 1–6	-1.8%	0.7%	3.3%
Portfolio of factors 7–14	-1.1%	0.6%	3.1%
Portfolio of other factors	-1.3%	0.8%	4.3%

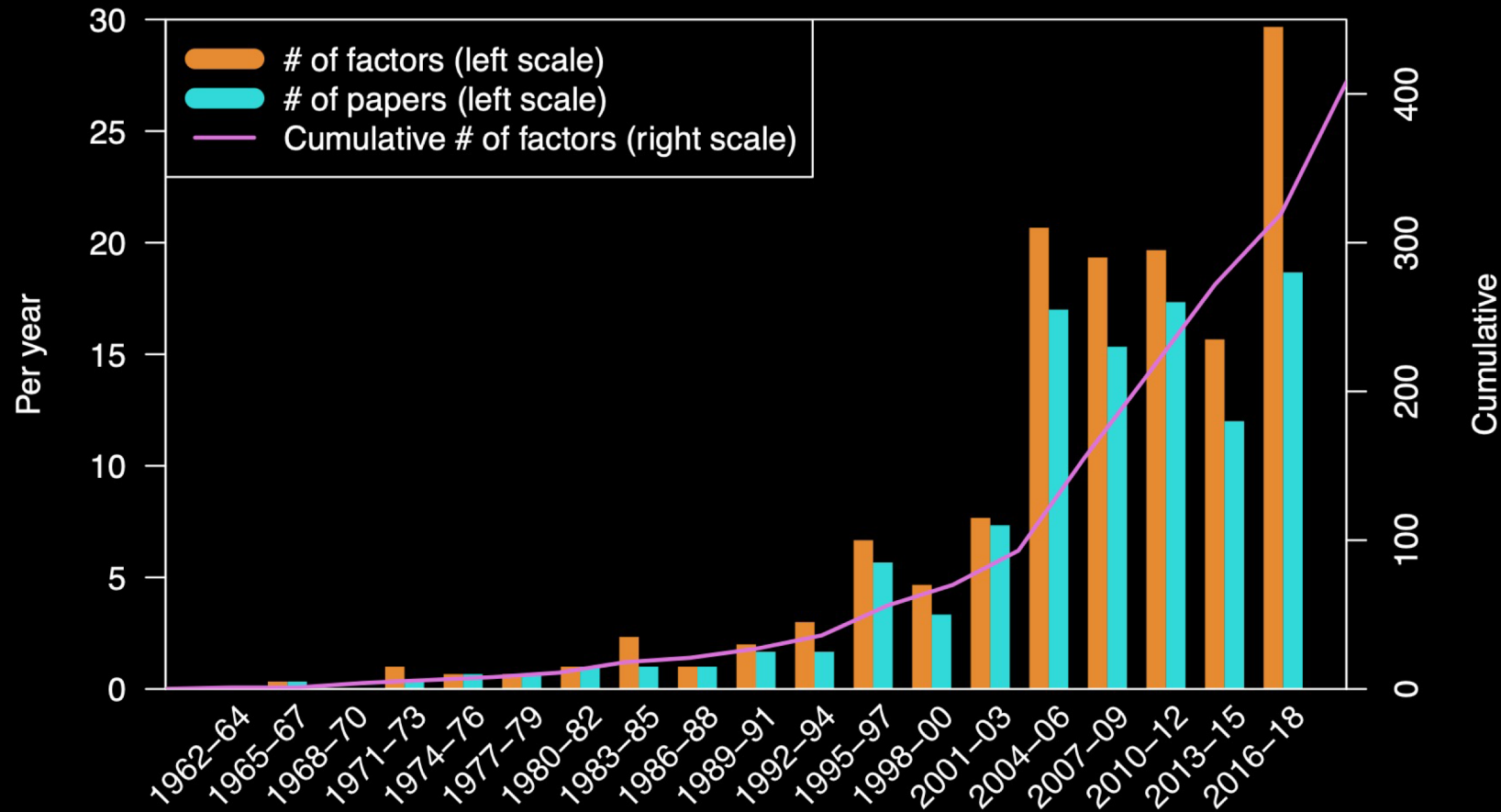
Note: We mark with bold the values where corresponding t -statistics exceed three in absolute value. All factors are scaled to 10% volatility. Factor portfolios are equally weighted and also scaled to 10% volatility.
Source: Research Affiliates, LLC, using data from CRSP/Compustat.

Five-Year Factor Return Market Betas, United States, July 1963–June 2018



Note: All factors are scaled to 10% volatility. Factor portfolios are equally weighted and also scaled to 10% volatility.
Source: Research Affiliates, LLC, using data from CRSP/Compustat.

Factors and Publication Years, Limited to Top-Tier Academic Journals



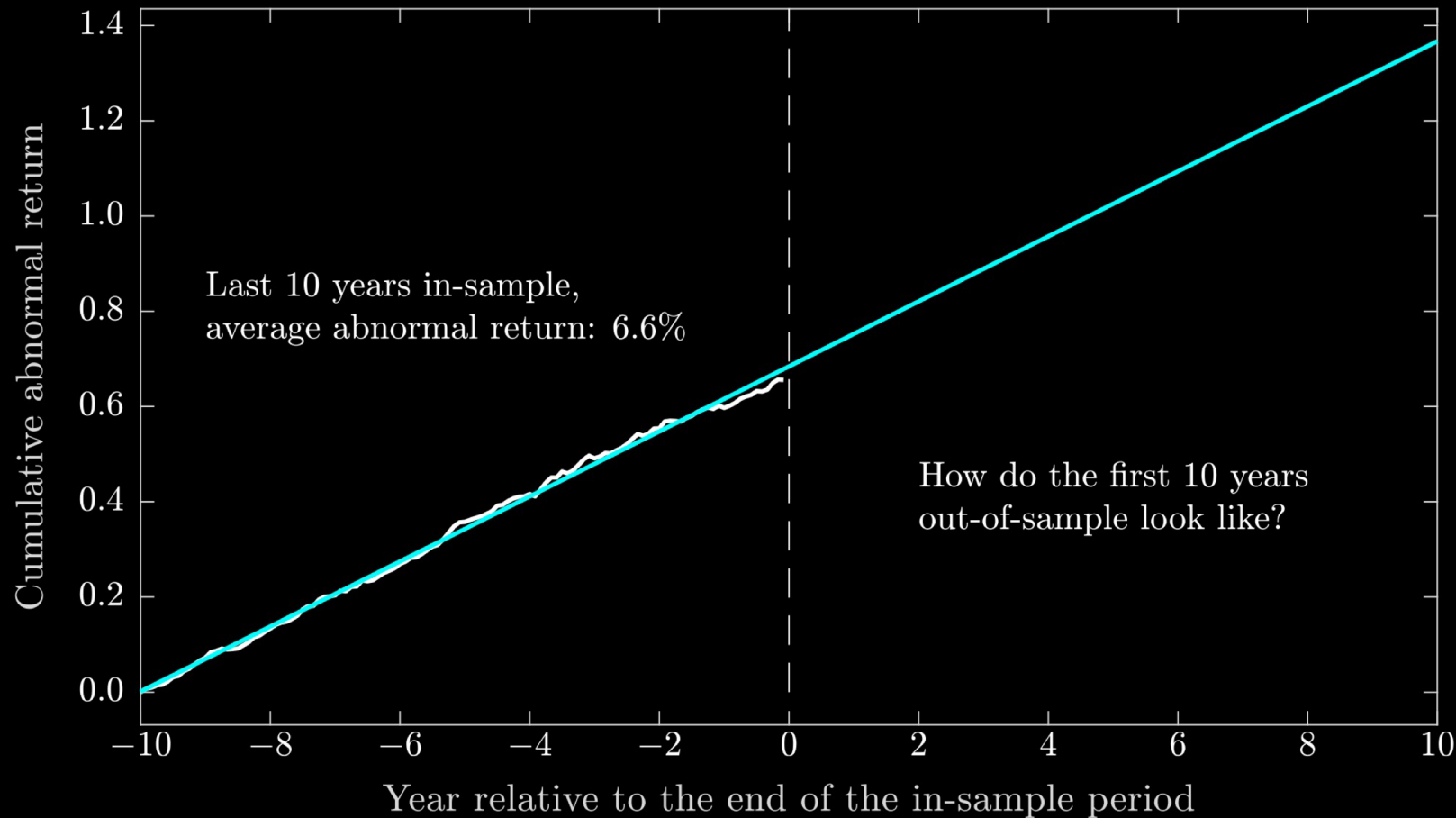
Note: Journals published through December 2018. Data collection in January 2019.
Source: Harvey and Liu (2019).

In-Sample Factor Performance Sets a High Bar

How about performance out of sample?

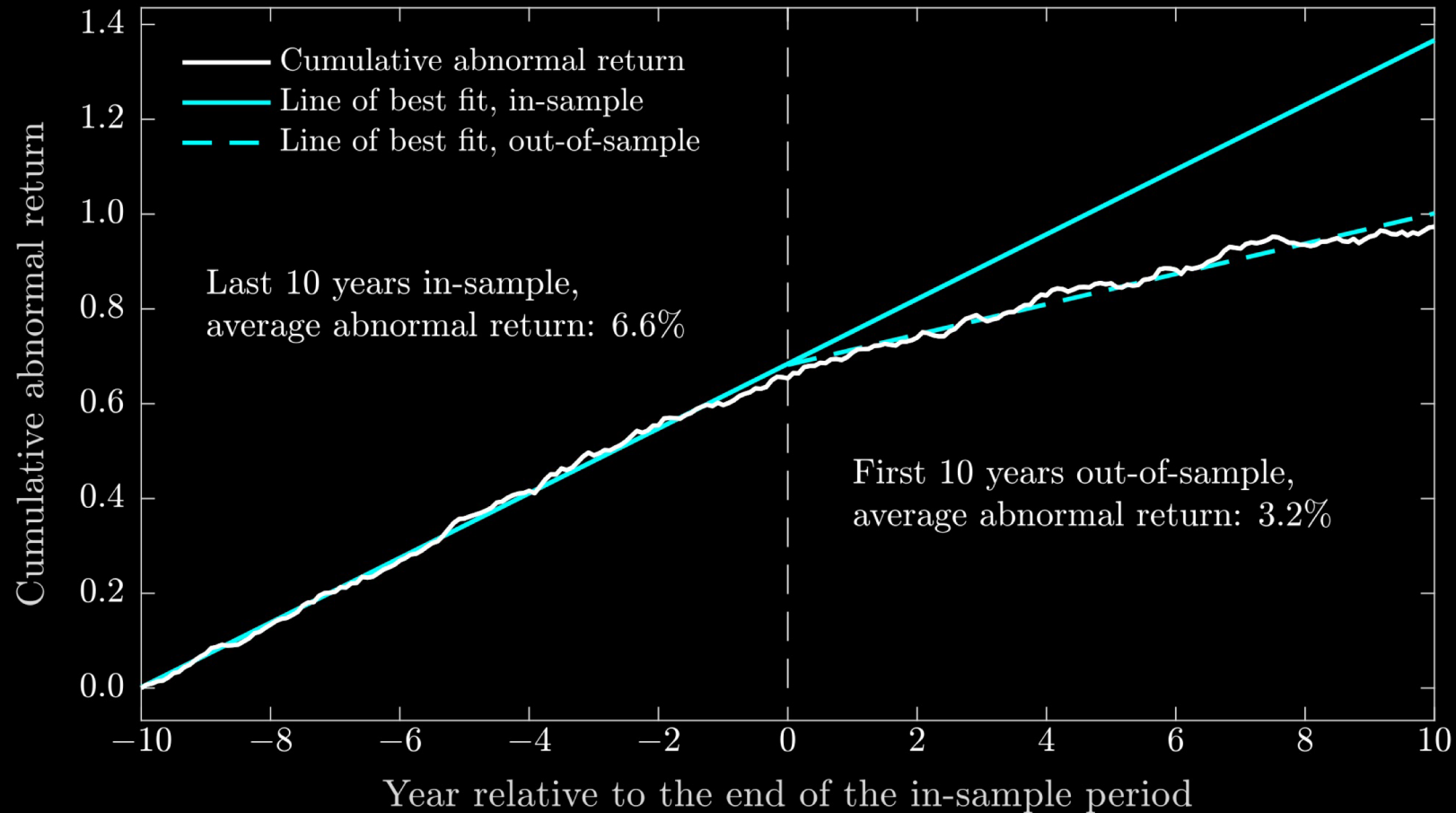
- Let's take the first generally accepted article (top journals only) that identifies each factor.
- Let's estimate CAPM regressions to extract factors' "residual returns"
- Let's average the residuals, across multiple factors, for each of the final 120 months (10 years) of the in-sample period.
- Let's then average the returns for each of the first 120 months after the last month of the in-sample period.

Cumulative Factor Performance Before and After Publication



Source: Research Affiliates, LLC, using data from CRSP/Compustat from July 1963–June 2018.

Cumulative Factor Performance Before and After Publication



Source: Research Affiliates, LLC, using data from CRSP/Compustat from July 1963–June 2018.

In-Sample Factor Performance Sets a High Bar

How about performance out of sample?

- How do the first 10 years of out-of-sample returns compare with the last 10 years of in-sample returns? **Not very pretty.**

This could be for many reasons

- The factor was a product of aggressive data mining, not scientific method, and was never as powerful as it seemed.
- The factor was lucky during the in-sample period, or unlucky during the out-of-sample period.
- The trades became crowded, so the factor was arbitrated away.

Recent Average Annual Factor Returns, United States, July 2003–June 2018

Factor	Year of Discovery	Average Return	Average Volatility	t-stat	CAPM Alpha	CAPM Alpha t-stat	CAPM Beta
Market	1964	6.76	10.00	2.61			
Value	1990	0.15	10.00	0.06	-1.61	-0.63	0.26
Size	1975	2.66	10.00	1.03	0.33	0.13	0.34
Operating profitability	2013	4.97	10.00	1.92	8.17	3.51	-0.47
Investment	2003	0.34	10.00	0.13	-0.14	-0.05	0.07
Momentum	1989	0.77	10.00	0.30	2.92	1.17	-0.32
Low beta	1966	-1.71	10.00	-0.66	3.08	1.65	-0.71

Note: All factors are scaled to 10% volatility. Factor portfolios are equally weighted and also scaled to 10% volatility.
Source: Research Affiliates, LLC, using data from CRSP/Compustat.

Recent Average Annual Factor Returns, United States, July 2003–June 2018

Factor	Year of Discovery	Average Return	Average Volatility	t-stat	CAPM Alpha	CAPM Alpha t-stat	CAPM Beta
Market	1964	6.76	10.00	2.61			
Value	1990	0.15	10.00	0.06	-1.61	-0.63	0.26
Size	1975	2.66	10.00	1.03	0.33	0.13	0.34
Operating profitability	2013	4.97	10.00	1.92	8.17	3.51	-0.47
Investment	2003	0.34	10.00	0.13	-0.14	-0.05	0.07
Momentum	1989	0.77	10.00	0.30	2.92	1.17	-0.32
Low beta	1966	-1.71	10.00	-0.66	3.08	1.65	-0.71
Idiosyncratic volatility	2000	-0.48	10.00	-0.19	4.09	2.10	-0.68
Short-term reversals	1987	0.69	10.00	0.27	-2.12	-0.88	0.42
Illiquidity	1997	4.23	10.00	1.63	4.47	1.70	-0.04
Accruals	1991	2.17	10.00	0.84	0.86	0.33	0.19
Cash flow to price	1990	3.45	10.00	1.33	3.85	1.46	-0.06
Earnings to price	1971	0.69	10.00	0.27	2.75	1.10	-0.31
Long-term reversals	1982	-2.01	10.00	-0.78	-4.14	-1.65	0.31
Net share issues	2003	0.65	10.00	0.25	3.34	1.38	-0.40

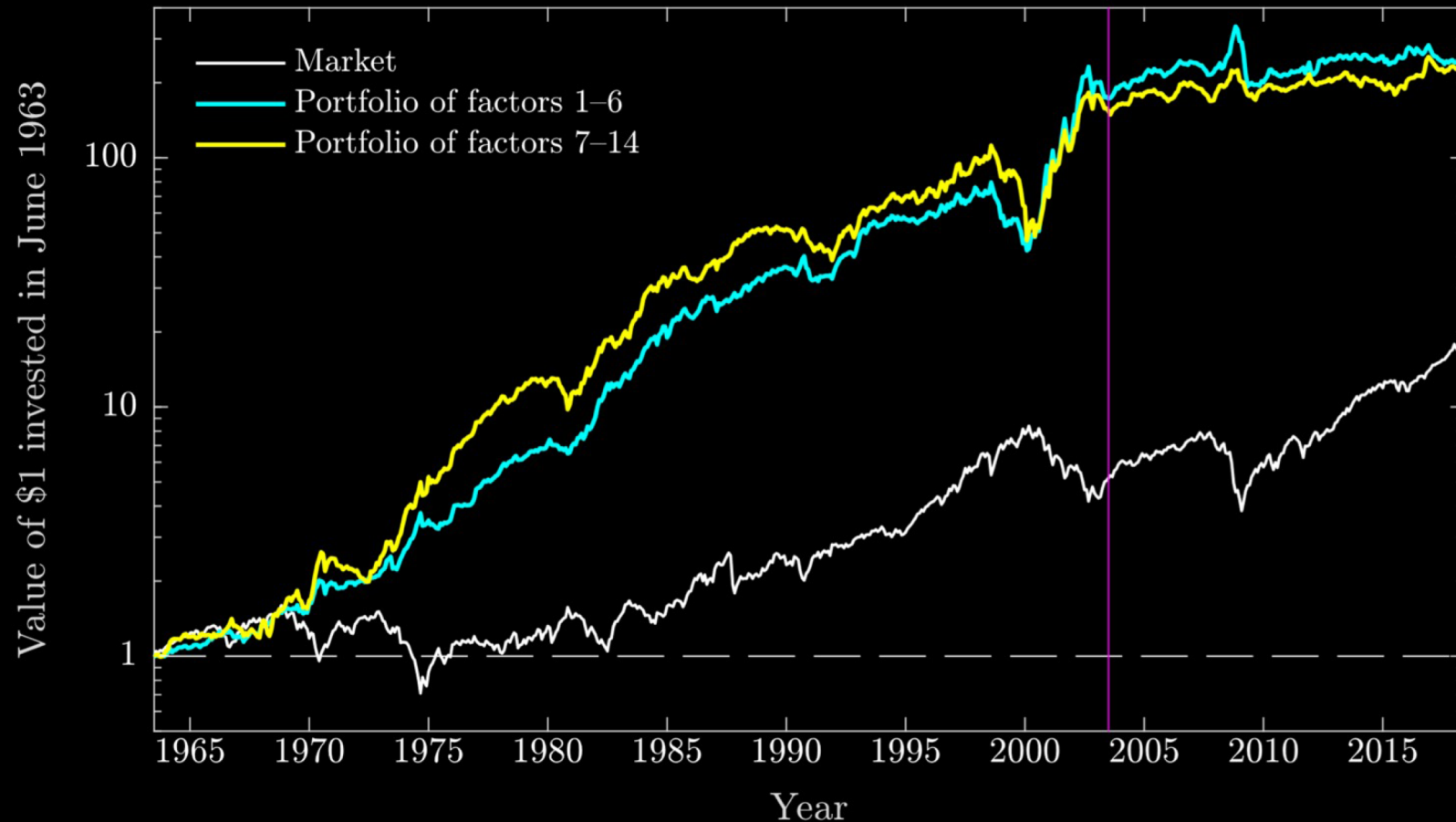
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Source: Research Affiliates, LLC, using data from CRSP/Compustat.

Recent Average Annual Factor Returns, United States, July 2003–June 2018

Factor			Year of Discovery	Average Return	Average Volatility	t-stat	CAPM Alpha	CAPM Alpha t-stat	CAPM Beta
Average of factors 1–6				1.20	10.00	0.463	2.12	0.96	-0.137
Average of factors 7–14				1.17	10.00	0.453	1.64	0.69	-0.069
Average of other factors				1.64	10.00	0.63	2.86	1.23	-0.18
Portfolios of factors	No rebalancing, no vol. scaling	1–6		1.12	3.97	1.09	1.98	1.99	-0.13
		7–14		1.04	4.31	0.93	1.49	1.32	-0.07
		Other		1.70	3.34	1.96	3.02	4.23	-0.20
	Monthly rebalancing, no vol. scaling	1–6		1.20	3.86	1.20	2.12	2.23	-0.14
		7–14		1.17	4.07	1.11	1.64	1.55	-0.07
		Other		1.64	3.11	2.04	2.86	4.27	-0.18
	Monthly rebalancing, 10% vol. scaled	1–6		3.10	10.00	1.20	5.50	2.23	-0.36
		7–14		2.89	10.00	1.11	4.03	1.55	-0.17
		Other		5.29	10.00	2.04	9.20	4.27	-0.58

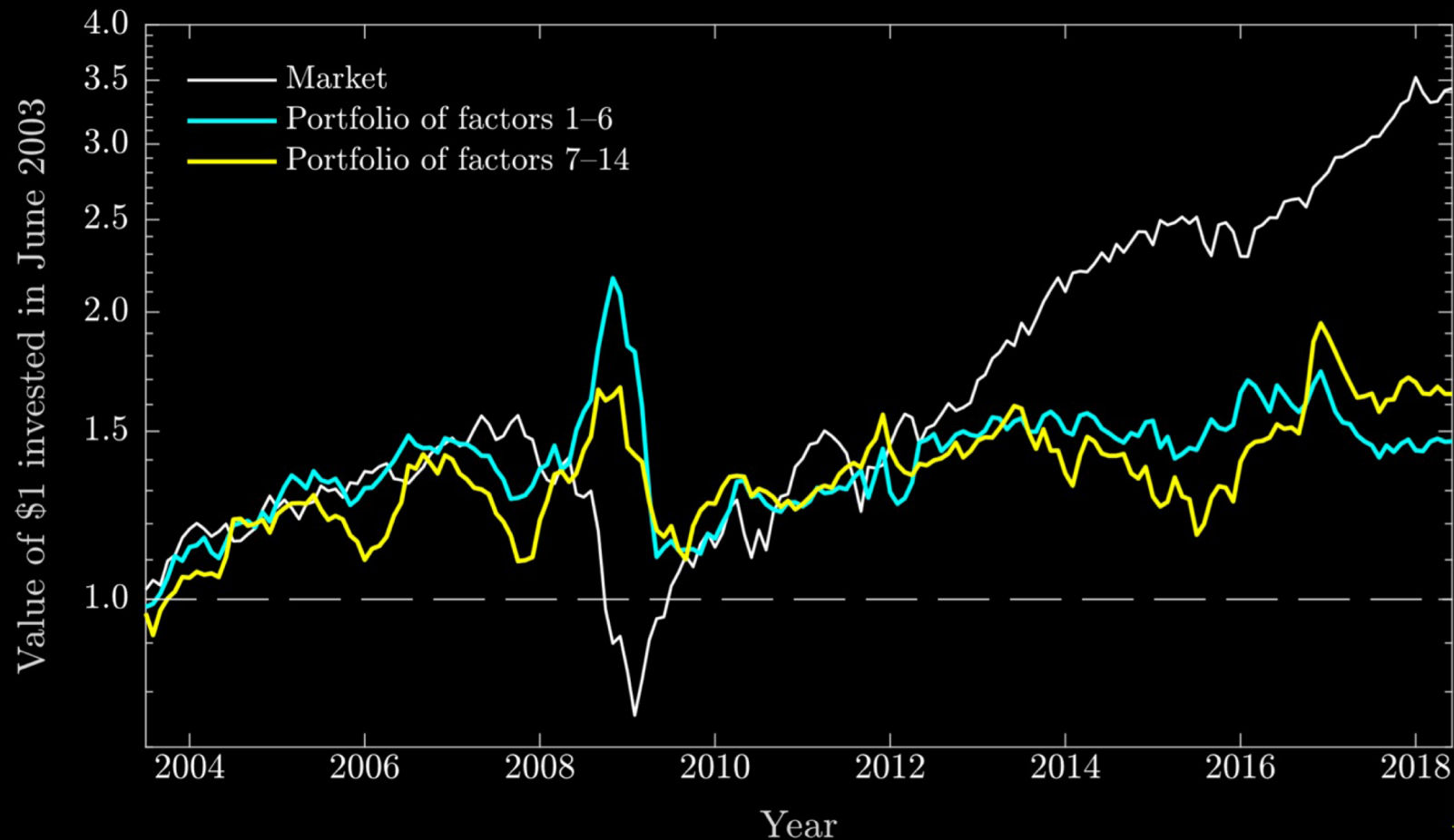
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Source: Research Affiliates, LLC, using data from CRSP/Compustat.

Factor Performance in the Long Run, United States, July 1963–June 2018



Source: Research Affiliates, LLC, using data from CRSP/Compustat.

Recent Average Annual Factor Returns, United States, July 2003–June 2018



Source: Research Affiliates, LLC, using data from CRSP/Compustat.

Out-of-Sample Performance Was Disappointing

Post-publication factor premia are less than half of in-sample premia

In-sample premia are arguably higher due to:

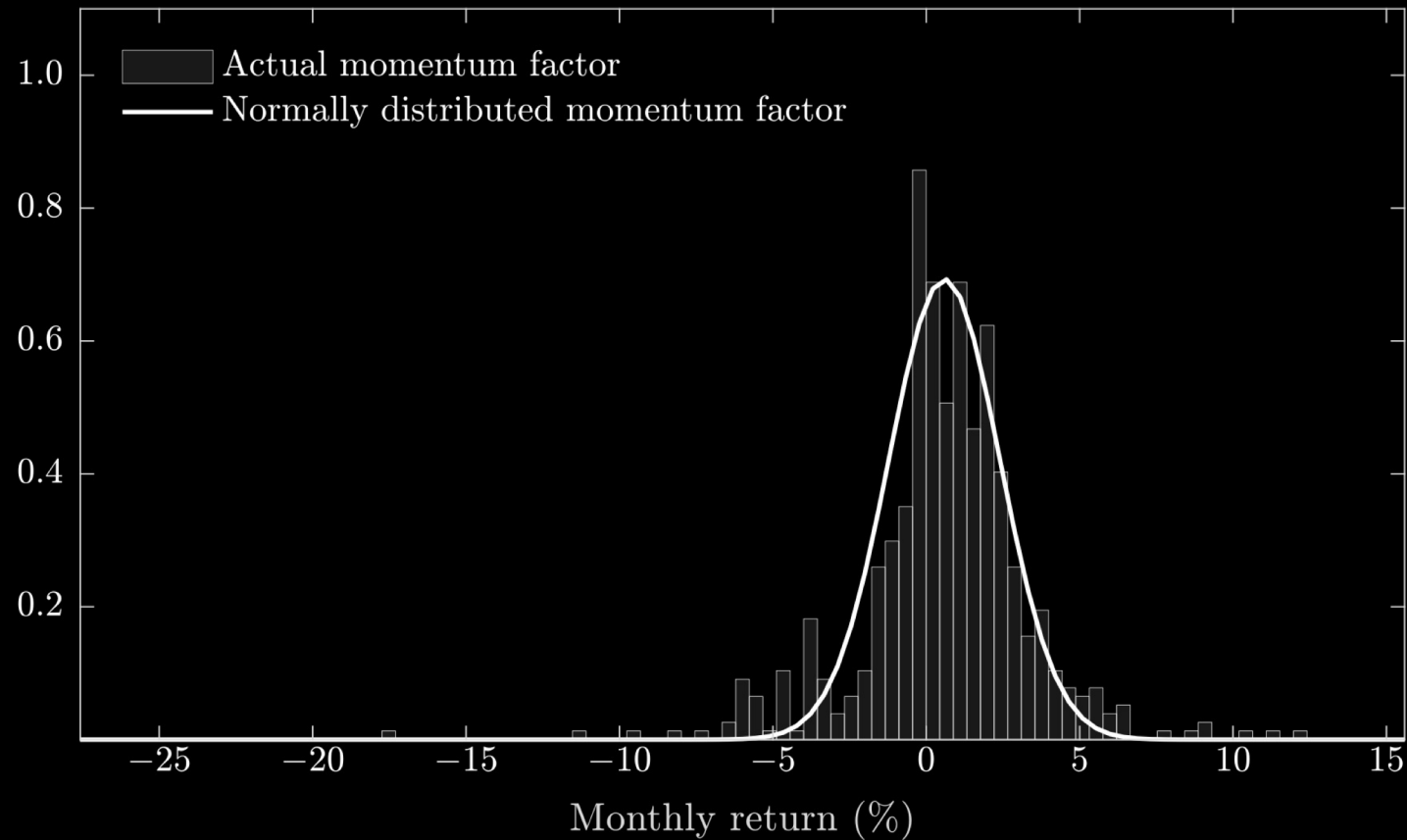
- Data mining
- Lucky outliers
- Post-discovery crowding and high valuations

Factor performance fell short of expectations in the last 15 years

- Are the factors broken or is it bad luck?

Factors Are Prone to Crashes

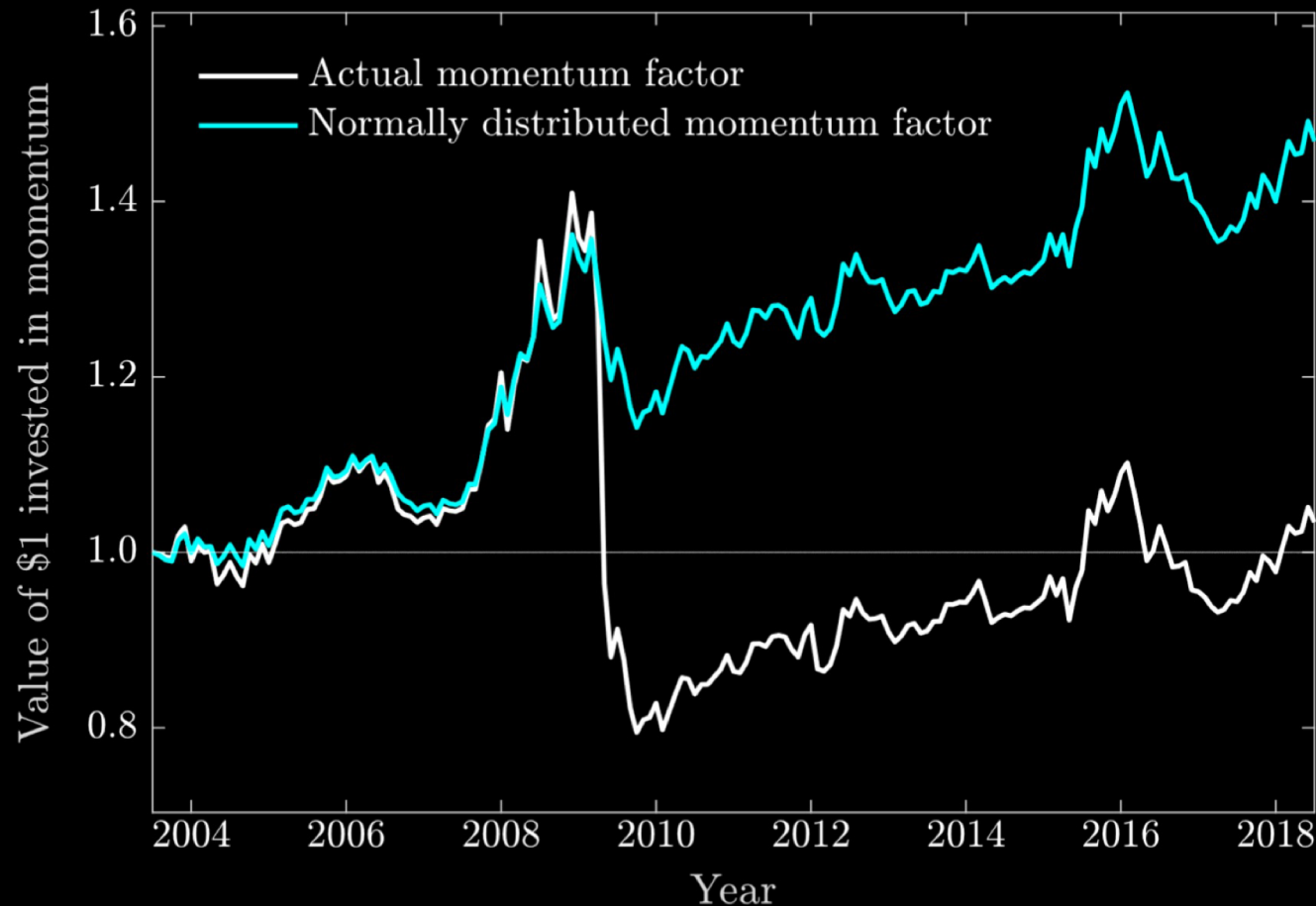
“Normally Distributed Momentum”



This is the monthly momentum return distribution from July 1963 through February 2009

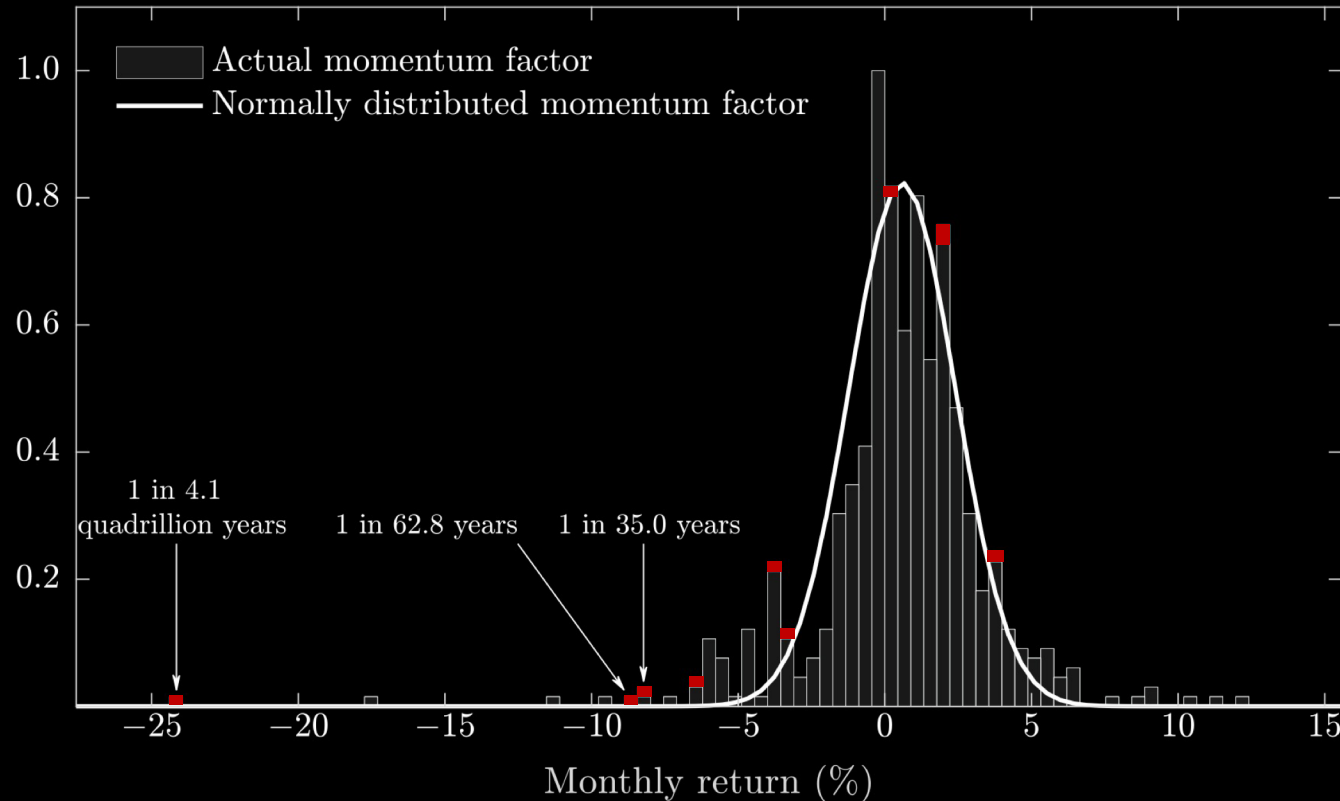
Source: Research Affiliates, LLC, using data from CRSP/Compustat.

Momentum Crash: Actual vs. Hypothetical, United States, July 2003–June 2018



Source: Research Affiliates, LLC, using data from CRSP/Compustat.

“Normally Distributed Momentum”



The red bars denote the monthly momentum returns from March 2009 through December 2009

Source: Research Affiliates, LLC, using data from CRSP/Compustat.

Non-Normality of Monthly Factor Returns, United States, July 1963–June 2018

Factor	Average Annualized Return	Skewness	Excess Kurtosis	Worst Monthly Return	Frequency (in Years) of Expected Worst Realized Monthly Return, Assuming Normal Return Distribution
Market	4.20%	-0.54	2.03	-15.3%	1 in 1.6 million
Value	4.15%	0.11	2.05	-11.5%	1 in 2,522
Size	2.53%	0.46	5.54	-16.2%	1 in 8.9 million
Operating profitability	3.70%	-0.25	12.64	-24.3%	1 in 4.7 quadrillion (10^{15})
Investment	4.32%	0.20	0.79	-9.2%	1 in 109
Momentum	5.48%	-1.41	11.38	-24.3%	1 in 4.1 quadrillion (10^{15})
Low beta	0.16%	-0.39	3.33	-17.1%	1 in 49.8 million
Idiosyncratic volatility	1.62%	-0.32	4.39	-16.4%	1 in 12.3 million
Short-term reversals	5.34%	0.37	5.82	-13.5%	1 in 58,097
Illiquidity	3.01%	-0.58	5.11	-17.1%	1 in 55.8 million
Accruals	4.31%	-0.11	0.97	-10.0%	1 in 320
Cash flow to price	4.82%	-0.35	5.81	-18.9%	1 in 2.5 billion (10^9)
Earnings to price	3.76%	-0.32	5.94	-19.5%	1 in 10.5 billion (10^9)
Long-term reversals	3.43%	0.65	2.62	-9.1%	1 in 106
Net share issues	5.28%	-0.40	9.85	-23.4%	1 in 357.5 trillion (10^{12})
Average of other factors	3.58%	0.03	4.19	-14.4%	
Portfolio of factors 1–6	7.38%	0.46	8.12	-16.1%	1 in 6.5 million
Portfolio of factors 7–14	7.28%	0.12	5.04	-17.6%	1 in 147.6 million
Portfolio of other factors	10.28%	0.63	4.93	-13.3%	1 in 38,989

Note: All factors are scaled to 10% volatility. Factor portfolios are equally weighted and also scaled to 10% volatility.
Source: Research Affiliates, LLC, using data from CRSP/Compustat.

Individual Factors Are Prone to Crashes

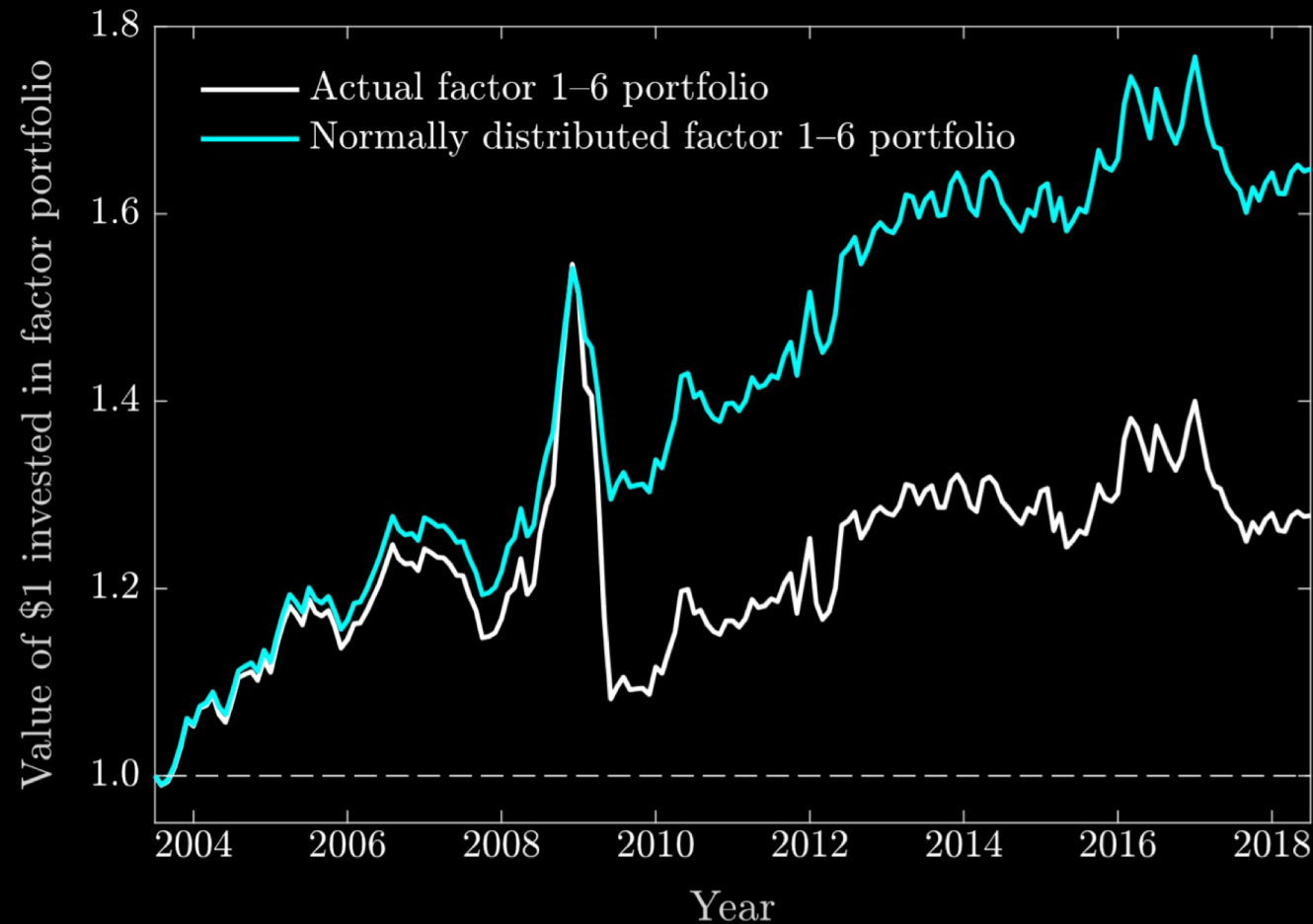
All factors are prone to severe outlier returns

- This property is called “excess kurtosis”

Several factors such as momentum and liquidity are negatively skewed which makes them prone to crashes

Diversification Falls Short of Expectation

Factor Portfolio Crash: Actual vs. Hypothetical, United States, July 2003–June 2018



Source: Research Affiliates, LLC, using data from CRSP/Compustat.

Worst Drawdowns in Portfolios of Factors, United States, July 1963–June 2018

EXHIBIT 11

Estimated Probabilities of Underperformance in Portfolios of Factors, United States, July 1963–June 2018

Factors	Worst Realized Drawdown		Worst Simulated Drawdown and [% of Samples That Were Worse Than Actual]			
			Simulation Assuming Normality	Bootstrap (Resampling Returns from Realized History)		
				Independent	1-m Blocks, Preserving x-Factor Correlation	12-m Blocks, Preserving x-Factor and Time-Series Correlation
1–6	–33.4%	Return	–21.5%	–21.9%	–25.8%	–30.4%
		[prob]	[2.7%]	[3.7%]	[12.4%]	[29.1%]
7–14	–42.9%	Return	–13.3%	–13.5%	–26.4%	–32.5%
		[prob]	[0.0%]	[0.0%]	[2.2%]	[11.6%]
Other Factors	–22.8%	Return	–6.9%	–6.5%	–20.3%	–23.2%
		[prob]	[0.0%]	[0.0%]	[26.1%]	[44.3%]

Notes: All factors are scaled to 10% volatility. Factor portfolios are equally weighted and also scaled to 10% volatility.

Source: Research Affiliates, LLC, using data from CRSP/Compustat.

Note: All factors are scaled to 10% volatility. Factor portfolios are equally weighted and also scaled to 10% volatility.
Source: Research Affiliates, LLC, using data from CRSP/Compustat.

Diversification Can Vanish

Factors tend to crash in correlated manner

Factor auto-correlation and cross-factor autocorrelation exacerbates factor portfolio drawdowns

**Are Factors Broken?
Or Riskier than We Thought?
Or Did Data Mining Find Illusory
Factors that Were Merely
Lucky In-Sample?**

Recent Poor Single Factor Performance, United States, July 1963–June 2018

Factor	% of samples that were worse than actual				
	Average Return		Simulation Assuming Normality	Bootstrap (Resampling Returns from Realized History)	
	1963:7–2003:6	2003:7–2018:6		1m Blocks	12m Blocks
Market	3.4%	6.8%	98.3%	98.3%	98.8%

Note: All factors are scaled to 10% volatility in both the 1963:7-2003:6 and the 2003:7-2018:6 sub-samples.
Source: Research Affiliates, LLC, using data from CRSP/Compustat.

Recent Poor Single Factor Performance, United States, July 1963–June 2018

Factor	Average Return		Simulation Assuming Normality	% of samples that were worse than actual	
	1963:7–2003:6	2003:7–2018:6		Bootstrap (Resampling Returns from Realized History)	
				1m Blocks	12m Blocks
Market	3.4%	6.8%	98.3%	98.3%	98.8%
Value	5.4%	0.2%	2.3%	2.2%	4.5%
Size	2.5%	2.7%	48.2%	48.0%	48.2%
Operating profitability	3.4%	5.0%	47.3%	47.1%	44.2%
Investment	5.4%	0.3%	2.8%	2.8%	3.7%
Momentum	7.4%	0.8%	0.3%	0.4%	0.0%
Low beta	0.8%	-1.7%	5.6%	5.6%	4.6%

Note: All factors are scaled to 10% volatility in both the 1963:7-2003:6 and the 2003:7-2018:6 sub-samples.
Source: Research Affiliates, LLC, using data from CRSP/Compustat.

Recent Poor Single Factor Performance, United States, July 1963–June 2018

Factor	% of samples that were worse than actual				
	Average Return		Simulation Assuming Normality	Bootstrap (Resampling Returns from Realized History)	
	1963:7–2003:6	2003:7–2018:6		1m Blocks	12m Blocks
Market	3.4%	6.8%	98.3%	98.3%	98.8%
Value	5.4%	0.2%	2.3%	2.2%	4.5%
Size	2.5%	2.7%	48.2%	48.0%	48.2%
Operating profitability	3.4%	5.0%	47.3%	47.1%	44.2%
Investment	5.4%	0.3%	2.8%	2.8%	3.7%
Momentum	7.4%	0.8%	0.3%	0.4%	0.0%
Low beta	0.8%	-1.7%	5.6%	5.6%	4.6%
Idiosyncratic volatility	2.3%	-0.5%	8.0%	8.3%	7.4%
Short-term reversals	6.9%	0.7%	0.7%	0.7%	0.4%
Illiquidity	2.5%	4.2%	92.6%	92.6%	91.7%
Accruals	5.0%	2.2%	8.3%	8.4%	12.3%
Cash flow to price	5.2%	3.4%	15.9%	16.2%	18.0%
Earnings to price	4.6%	0.7%	6.2%	6.5%	9.5%
Long-term reversals	5.4%	-2.0%	0.4%	0.3%	1.1%
Net share issues	6.6%	0.7%	1.2%	1.5%	1.1%
Joint probability			0.0%	1.7%	2.6%

Note: All factors are scaled to 10% volatility in both the 1963:7-2003:6 and the 2003:7-2018:6 sub-samples.
Source: Research Affiliates, LLC, using data from CRSP/Compustat.

Recent Poor Factor Portfolio Performance, United States, July 1963–June 2018

Factors	Worst Simulated Drawdown and [% of samples that were worse than actual]					
	Realized Return, Annualized		Simulation Assuming Normality	Bootstrap (Resampling Returns from Realized History)		
				Independent	1m Blocks, Preserving x-Factor Correlation	12m Blocks, Preserving x-Factor and Time-Series Correlation
1–6	1.9%	Return [p-value]	9.3% [0.0%]	9.4% [0.1%]	9.4% [0.3%]	9.8% [0.3%]
7–14	1.9%	Return [p-value]	9.2% [0.0%]	9.3% [0.0%]	9.3% [0.5%]	9.5% [1.1%]
Other factors	4.2%	Return [p-value]	12.5% [0.0%]	12.6% [0.0%]	12.5% [0.1%]	12.9% [0.1%]

Note: All factors are scaled to 10% volatility. Factor portfolios are equally weighted and also scaled to 10% volatility.
Source: Research Affiliates, LLC, using data from CRSP/Compustat.

So, Are Factors Broken? Or Was it Bad Luck?

Factor performance fell short of expectations in the last 15 years

The poor performance of many factors is difficult to explain by bad luck alone

- Was this an exceptional period?
- At the same time as the factors fell short of our expectations, the market exceeded them by almost the same margin

Poor factor performance likely a combination of bad luck (“unusual time period”) and structural reasons:

- Data mining in the pre-2003 sample
- Post-discovery crowding and rising valuations

Bottom Line

Poor factor recent performance \neq factor investing is broken

Instead, it is a call to be more realistic

What can we do?

- Curb your expectations
- Prepare for large drawdowns and disappearing diversification benefits
- Pay attention to implementation shortfall

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