

Life and death of market (in) efficiency

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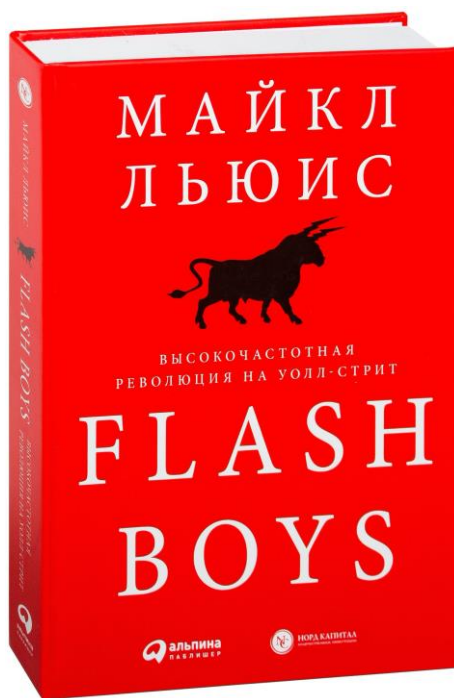
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Perm Winter School 2020

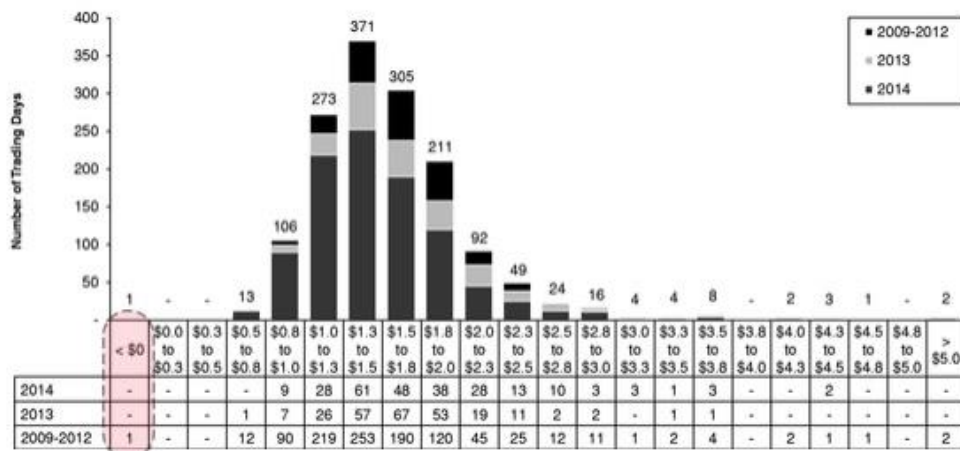
February 02, Perm, Russia



High-frequency trading



Daily Adjusted Net Trading Income Distribution(1)
(in millions)



Virtu GAAP Income Statement

Income Statement (\$mm)	3Q 2018	4Q 2018	1Q 2019 ¹	2Q 2019	3Q 2019
Trading income, net	\$235.7	\$366.2	\$257.5	\$205.9	\$220.1
Commissions, net and technology services	40.3	45.5	75.1	145.1	139.6
Interest and dividends	21.5	26.2	29.1	24.2	23.4
Other	(2.3)	4.3	1.2	3.3	2.2
Total Revenues	\$295.1	\$442.2	\$363.0	\$378.5	\$385.4
Brokerage, exchange and clearance fees	68.6	73.8	64.1	75.9	74.3
Communications and data processing	39.5	38.3	41.8	54.4	59.8
Employee compensation and payroll taxes	44.8	64.8	107.8	83.7	90.6
Payment for order flow	18.3	24.3	23.6	23.6	24.5
Interest and dividends expense	32.6	40.6	45.4	36.8	34.5
Operations and administrative	15.6	13.1	22.1	34.8	28.4
Depreciation and amortization	16.0	13.6	16.5	14.8	17.6
Amortization of purchased intangibles and acquired capitalized software	6.4	6.1	10.9	20.6	18.9
Termination of office leases	1.4	0.1	-	65.2	1.3
Debt issue cost related to debt refinancing and prepayment	3.3	-	9.2	(1.3)	-
Transaction fees and expenses	(0.3)	2.5	15.1	1.8	7.2
Reserve for legal matters	1.6	-	-	-	-
Financing interest expense	17.7	16.3	22.8	34.7	34.2
Total Operating Expenses	\$265.7	\$293.5	\$379.2	\$445.0	\$391.2
Income (Loss) before income taxes	\$29.4	\$148.8	(\$16.2)	(\$66.6)	(\$5.8)
Provision for income taxes (benefit)	13.8	0.8	(2.6)	(11.1)	(0.6)
Net Income (Loss)	\$15.6	\$147.9	(\$13.6)	(\$55.5)	(\$5.2)

Hedge funds

SHORTLISTED
FOR THE FT AND
MCKINSEY BUSINESS
BOOK AWARD

**THE MAN
WHO SOLVED
THE MARKET**

**HOW
JIM SIMONS
LAUNCHED
THE QUANT
REVOLUTION**

Gregory Zuckerman
Author of *THE GREATEST TRADE EVER*

$$E = \frac{1}{2} M g L \dot{\theta}^2; \theta_0 = \frac{2E}{MgL} \sum_{i=1}^N E_i = c^2 r$$

$$\frac{d\theta}{dt} = \left(\frac{g}{L}\right)^{1/4} (\theta_0^2 - \theta^2)^{1/2} \quad \frac{d^2 r}{dt^2} = \frac{d^2 r}{d\phi^2} \Delta r$$

$$\left(\frac{g}{L}\right)^{1/4} dt = \frac{d^2 r}{d\phi^2} \left(\frac{r}{\rho_1}\right)$$

$$W(\phi) = \frac{1}{r(\phi)}$$

$$A_{\text{res}} \sin\left(\frac{\phi}{\theta_0}\right) - A_{\text{sym}} \sin\left(\frac{\phi}{\theta_0}\right)$$

$$b = \sqrt{1 - c^2}$$

$$f = \frac{v}{\lambda} = \frac{c}{\lambda} = \frac{1}{\lambda} \frac{2\pi}{\lambda} N_A = (2\pi F)_A = 2\pi g \sin \theta$$

$$J_A = (F \lambda P)_A = -M L' \dot{\theta} \quad M L' \dot{\theta} = -L M g \sin \theta$$

$$F_A = -C x \quad M_A = C x \quad \ddot{x} + \frac{C}{M} x = 0$$

$$\sin \theta = 0 \quad \ddot{\theta} = -\omega_0^2 \sin(\omega_0 t + \phi)$$

$$\omega_0^2 x = 0 \rightarrow \omega_0 = \left(\frac{C}{M}\right)^{1/2} \quad v_0 = \omega_0 A \cos \phi$$

$$A \sin(\omega_0 t + \frac{1}{2}\pi) = A \cos(\omega_0 t)$$

$$K \frac{1}{2} M \dot{x}^2 = \frac{1}{2} M [\omega_0 A \cos(\omega_0 t + \phi)]^2$$

$$[\dot{x}, \dot{p}] = i \int_{-\infty}^{\infty} \frac{\cos^2(\omega_0 t + \phi)}{2\pi \omega_0} d\omega$$

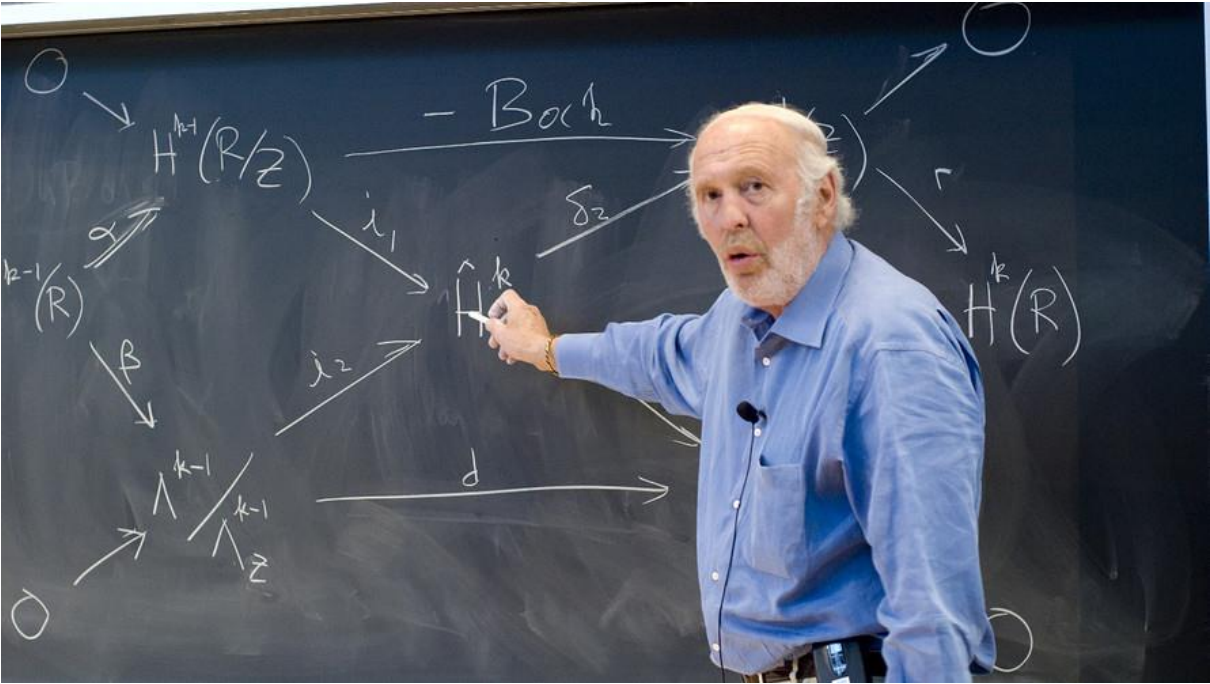
$$E = \langle K \rangle = \langle U \rangle = \frac{1}{2} M \omega_0^2 A^2$$

$$E_0 = E + \frac{1}{2} \epsilon + \frac{1}{2} \epsilon_0$$

$$\frac{d p_x}{d t} = \left(1 - \frac{v^2}{c^2}\right)^{1/2} \frac{\Delta p_x}{\Delta t}$$

$$H|\psi\rangle = E|\psi\rangle \quad \frac{d\psi}{dt} = -\frac{i}{\hbar} H\psi$$

Инвестор	Ключевой фонд	Период	Доходность в годовых*
Джим Саймонс	Medallion Fund	1988 - 2018	39,1%
Джордж Сорос	Quantum Fund	1969 - 2000	32%
Стивен Коэн	SAC	1992 - 2003	30%
Питер Линч	Magellan Fund	1977 - 1990	29%
Уоррен Баффет	Berkshire Hathaway	1965 - 2018	20,5%
Рэй Далио	Pure Alfa	1991 - 2018	12%



	Доходность (Net)	Комиссия за управление	Комиссия за успех	Доходность до комиссий, %	Размер фонда	Доходность, USD
1988	9,0%	5%	20%	16,3%	\$ 20 млн	\$ 3 млн
1989	-4,0%	5%	20%	1,0%	\$ 20 млн	\$ 0
1990	55,0%	5%	20%	77,8%	\$ 30 млн	\$ 23 млн
1991	39,4%	5%	20%	54,3%	\$ 42 млн	\$ 23 млн
1992	33,6%	5%	20%	47,0%	\$ 74 млн	\$ 35 млн
1993	39,1%	5%	20%	53,9%	\$ 122 млн	\$ 66 млн
1994	70,7%	5%	20%	93,4%	\$ 276 млн	\$ 258 млн
1995	38,3%	5%	20%	52,9%	\$ 462 млн	\$ 244 млн
1996	31,5%	5%	20%	44,4%	\$ 637 млн	\$ 283 млн
1997	21,2%	5%	20%	31,5%	\$ 829 млн	\$ 261 млн
1998	41,7%	5%	20%	57,1%	\$ 1.1 млрд	\$ 626 млн
1999	24,5%	5%	20%	35,6%	\$ 1.54 млрд	549 млн
2000	98,5%	5%	20%	128,1%	\$ 1.9 млрд	\$ 2.434 млн
2001	33,0%	5%	36%	56,6%	\$ 3.8 млрд	\$ 2.149 млн
2002	25,8%	5%	44%	51,1%	\$ 5.24 млрд	\$ 2.676 млрд
2003	21,9%	5%	44%	44,1%	\$ 5.09 млрд	\$ 2.245 млрд
2004	24,9%	5%	44%	49,5%	\$ 5.2 млрд	\$ 2.572 млрд
2005	29,5%	5%	44%	57,7%	\$ 5.2 млрд	\$ 2.999 млрд
2006	44,3%	5%	44%	84,1%	\$ 5.2 млрд	\$ 4.374 млрд
2007	73,7%	5%	44%	136,6%	\$ 5.2 млрд	\$ 7.104 млрд
2008	82,4%	5%	44%	152,1%	\$ 5.2 млрд	\$ 7.911 млрд
2009	39,0%	5%	44%	74,6%	\$ 5.2 млрд	\$ 3.881 млрд
2010	29,4%	5%	44%	57,5%	\$ 10 млрд	\$ 5.750 млрд
2011	37,0%	5%	44%	71,1%	\$ 10 млрд	\$ 7.107 млрд
2012	29,0%	5%	44%	56,8%	\$ 10 млрд	\$ 5.679 млрд
2013	46,9%	5%	44%	88,8%	\$ 10 млрд	\$ 8.875 млрд
2014	39,2%	5%	44%	75,0%	\$ 9.5 млрд	\$ 7.125 млрд
2015	36,0%	5%	44%	69,3%	\$ 9.5 млрд	\$ 6.582 млрд
2016	35,6%	5%	44%	68,6%	\$ 9.5 млрд	\$ 6.514 млрд
2017	45,0%	5%	44%	85,4%	\$ 10 млрд	\$ 8.536 млрд
2018	40,0%	5%	44%	76,4%	\$ 10 млрд	\$ 7.643 млрд
	39,1%			66,1%		\$ 104,530,000,000
	Средняя доходность (Net)					

500 000



50



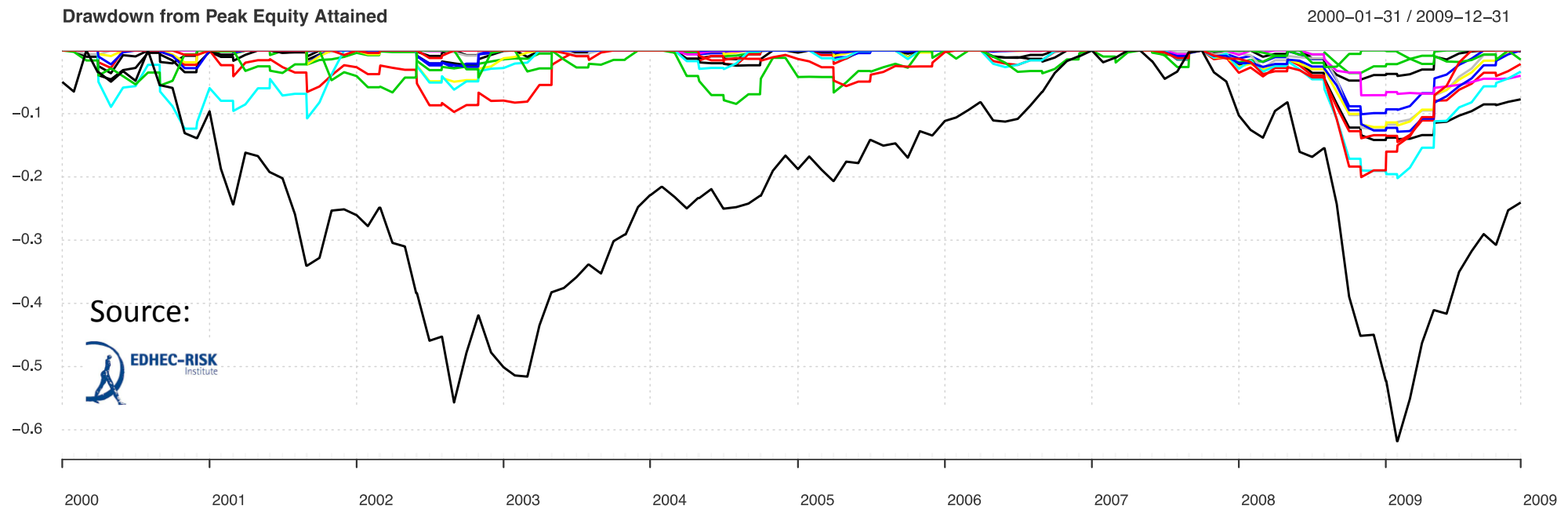
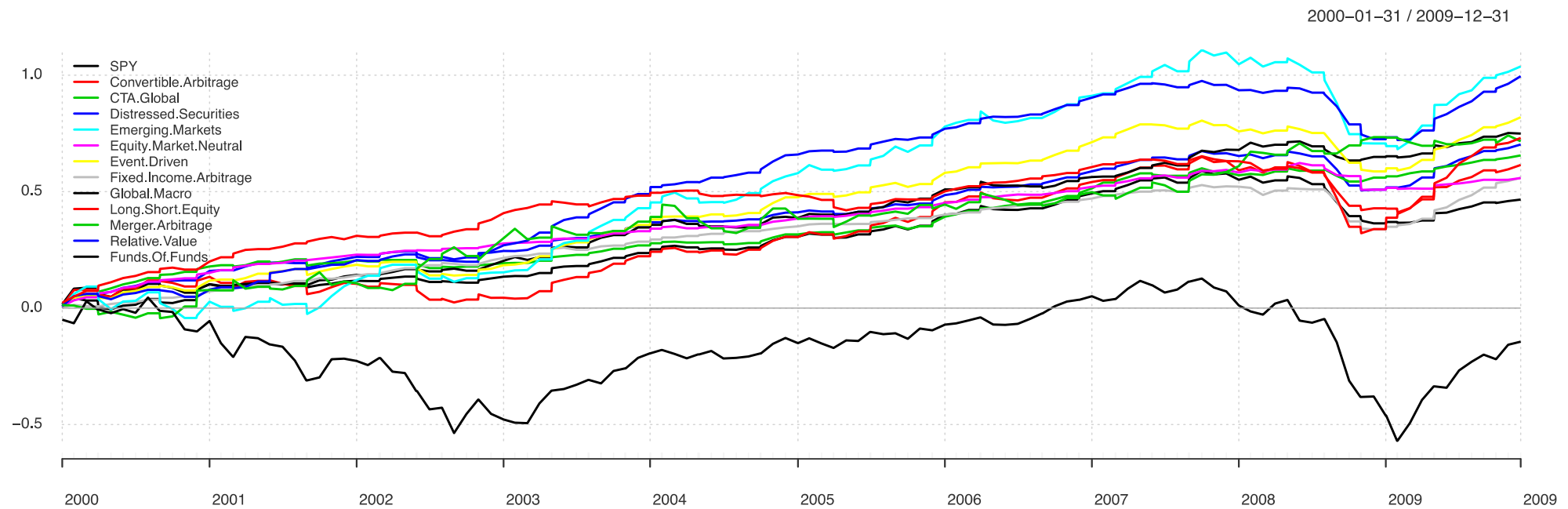
1 Tesla company

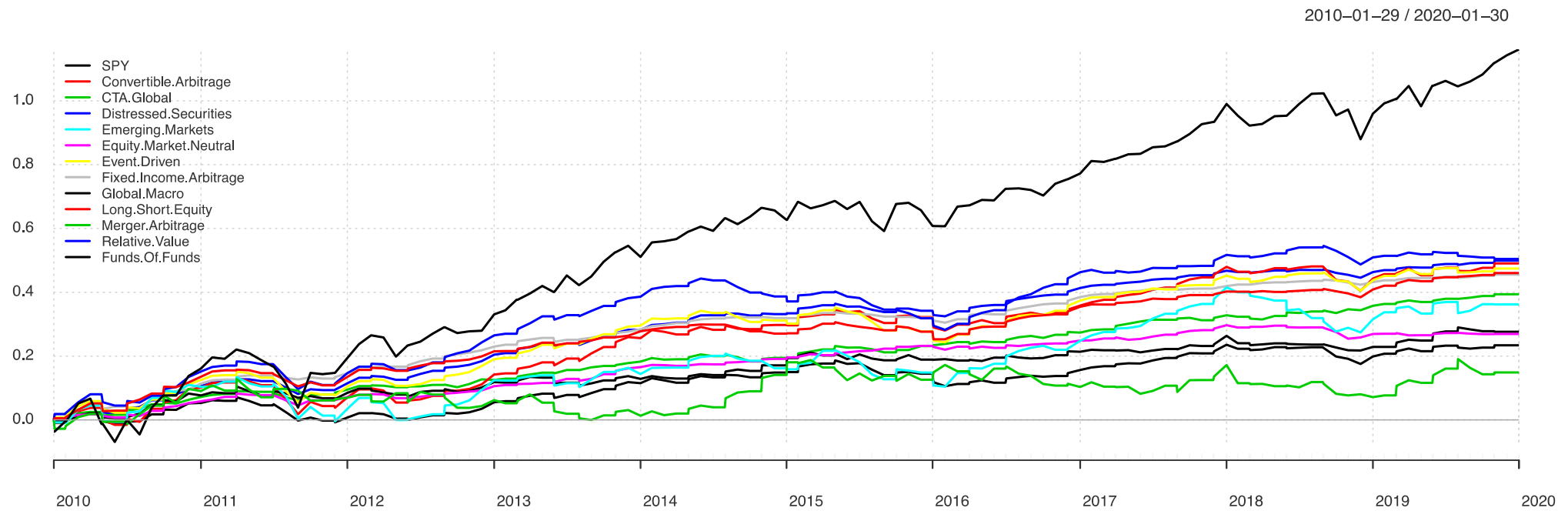


Bitcoin capitalization
In May 2019

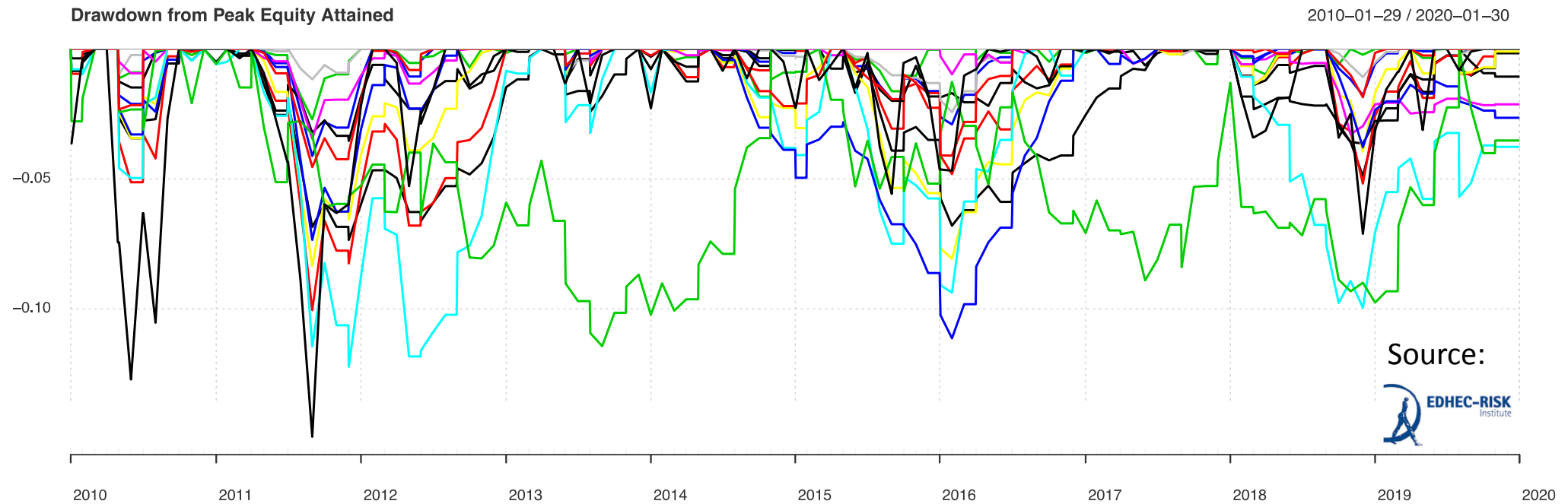


20% capitalization
of Russian market

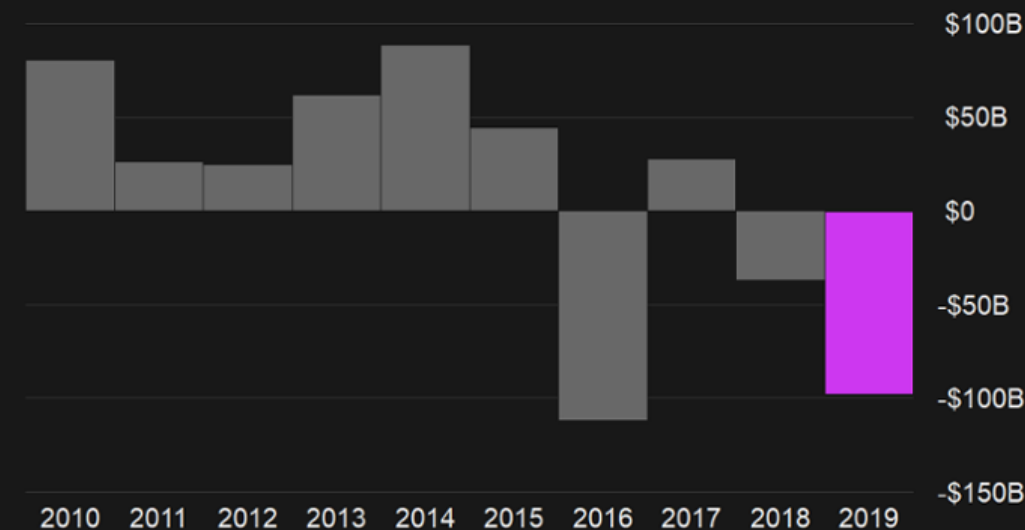




Drawdown from Peak Equity Attained



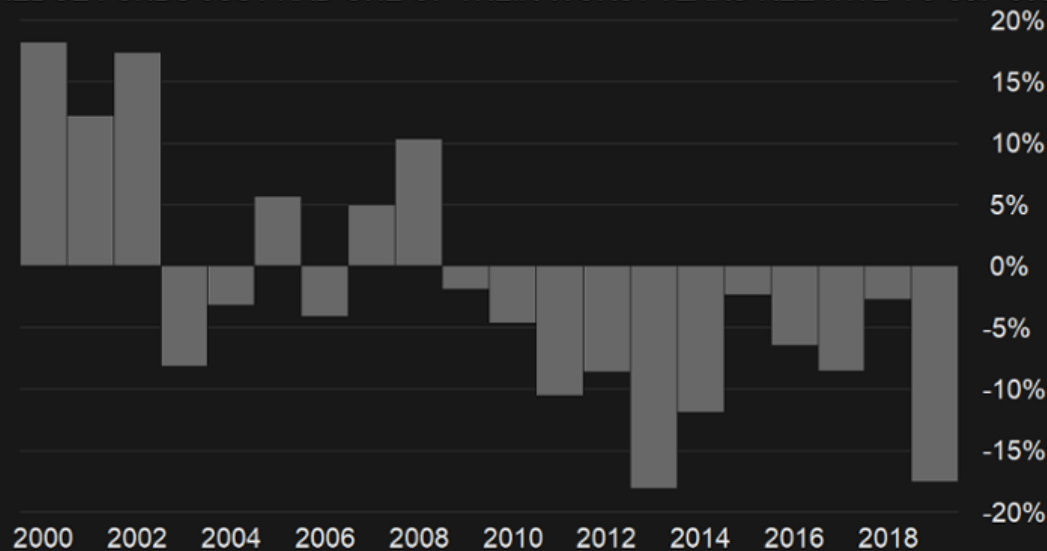
HEDGE FUNDS SEE MOST NET REDEMPTIONS SINCE 2016



SOURCE: EVESTMENT

ANNUAL SCORECARD

HEDGE FUNDS JUST HAD ONE OF THEIR WORST YEARS RELATIVE TO S&P 500

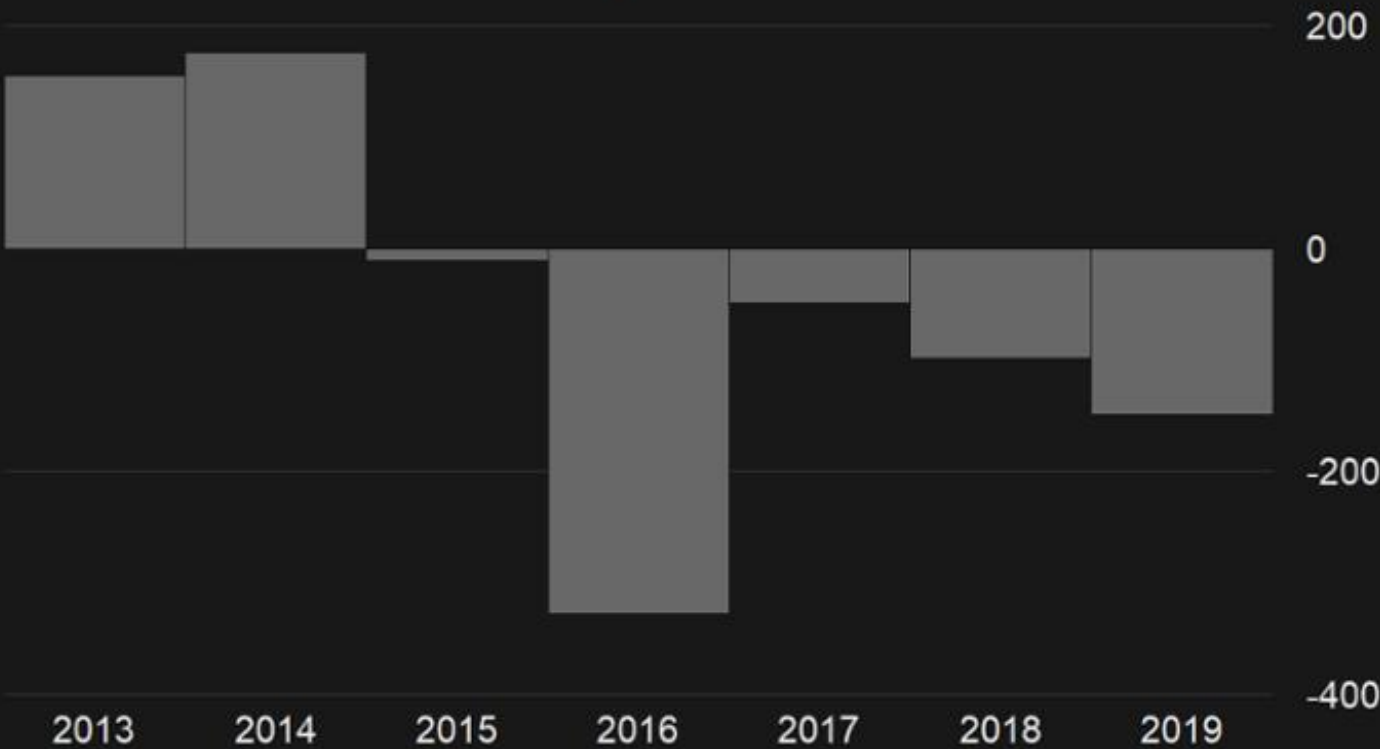


NOTE: SHOWS ANNUAL RETURNS: EQUITY HEDGE FUNDS VS. S&P ON 12/31/19
SOURCES: BLOOMBERG, HEDGE FUND RESEARCH

Igor Tulchinsky's WorldQuant dismissed about 130 employees and is shuttering five offices, said people familiar. The quant fund, which runs more than \$7.5 billion for investors including Millennium, is closing offices in Mexico City; Bangkok; Tallinn, Estonia; Sofia, Bulgaria; and Bucharest. The bulk of the layoffs occurred in recent weeks and were outside of the U.S. The decision came on the back of a year in which returns for the fund, while positive, had waned from recent years.

Cliff Asness's AQR is dismissing between 5% and 10% of its global workforce after its funds underperformed and lost assets last year. It's the second straight year that AQR, which has about 900 employees, is cutting staff. "This continues to be a challenging time for the asset management industry," Suzanne Escousse, AQR's chief marketing officer, said in an email. "After conducting our annual review, we made the difficult decision to reduce headcount to balance the size of our workforce with the current needs of our clients."

GO YOUR OWN WAY NET ANNUAL HEDGE FUND OPENINGS



NOTE: 2019 THROUGH 3Q
SOURCE: HEDGE FUND RESEARCH

RETURNS (%)	2019	DECEMBER
MILLER VALUE PARTNERS 1	119.5	3.3
CAS'S SOSIN PARTNERS	64.5	-1.7
PERSHING SQUARE HOLDINGS	58.1	4.5
HUDSON EXECUTIVE	52.2	N/A
JANA	52.0	N/A
GLENVIEW	51.0	4.4
MELVIN*	47.0	1.0
SOROBAN OPPORTUNITIES	45.0	3.9
BOWIE CAPITAL	39.4	1.8
VOLORIDGE	37.0	N/A
SARISSA	37.0	2.4
CLEARFIELD	35.0	N/A
STATAR	34.3	N/A
TIGER GLOBAL	33.0	-0.2
BLUE HARBOUR	33.0	N/A
MIG MASTER	31.5	0.9
VOLORIDGE TRADING AGGRESSIVE	31.0	N/A
LAND & BUILDINGS	31.0	2.5
SELIGMAN TECH SPECTRUM OFFSHORE	29.6	4.3
KEPOS ALPHA	28.0	4.0
LAKEWOOD	26.0	N/A
SELIGMAN TECH SPECTRUM	25.9	4.3
CASTLERIGG CREDIT OPPORTUNITIES	25.5	6.4
SOMA PARTNERS	22.0	2.6
SACHEM HEAD	22.0	N/A
MUDRICK'S DISTRESSED OPPORTUNITY	22.0	N/A
CAT ROCK	21.0	N/A
EMINENCE PARTNERS	20.8	N/A
CITADEL'S TACTICAL TRADING	20.0	N/A
CAXTON GLOBAL INVESTMENT	19.5	N/A
CITADEL WELLINGTON	19.4	2.3
GRAHAM'S TREND-FOLLOWING MACRO	18.7	N/A
VIKING	18.0	1.1
LIGHT SKY MACRO	18.0	N/A
SENVEST MASTER	18.0	8.2
THIRD POINT OFFSHORE	17.1	2.2
POINT72	16.0	1.5
SCULPTOR MASTER	15.0	2.2
KINGDON'S GLOBAL LONG-SHORT EQUITY	14.5	3.0
SCHONFELD STRATEGIC ADVISORS	14.4	0.8
RENAISSANCE INSTITUTIONAL EQUITIES	14.0	2.0
GREENLIGHT	13.8	-0.3
BRAHMAN PARTNERS II	13.8	1.1
GRAHAM QUANT MACRO	13.2	N/A
BALYASNY ATLAS ENHANCED	12.0	2.0
ELEMENT	12.0	N/A
VOCE	12.0	0.6
D.E. SHAW OCULUS	11.8	N/A
TUDOR BVI GLOBAL	11.1	N/A
D.E. SHAW COMPOSITE	10.5	N/A
COATUE QUALIFIED PARTNERS**	10.0	0.06

Pershing Square portfolio:

Bill Ackman's Portfolio



Bill Ackman Real-Time Picks

Real Time Picks after 2019-09-30 are displayed for Premium Members Only

Bill Ackman Current Holdings

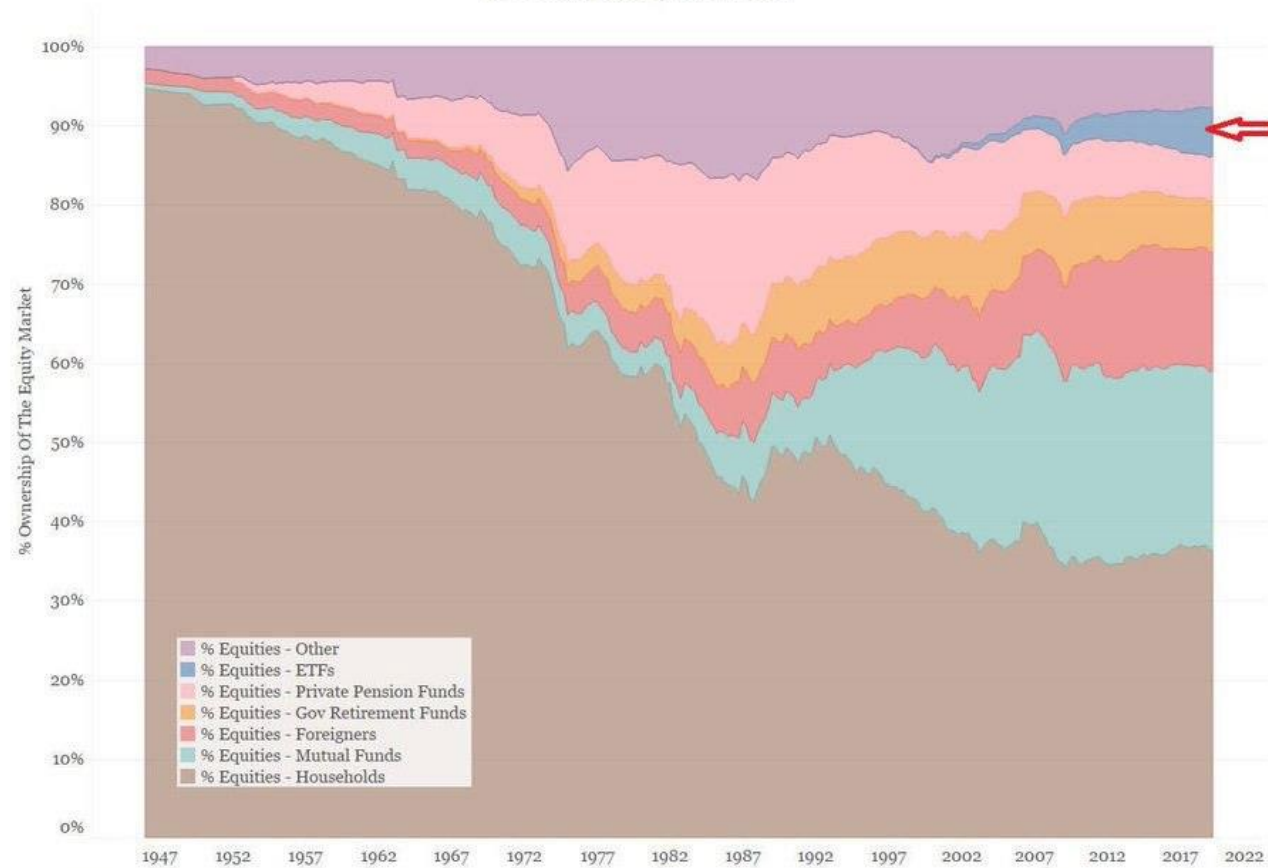
2019-09-30 ▾ Select Sector ▾ Select Country ▾											
Ticker ▾	Company ▾	Industry ▾	Market Cap \$Mil ▾	Shares ▾	Value (\$1000) ▾	Shares Change % ▾	Weighting % ▾	Trade Impact % ▾	% of Shares outstanding ▾	3M Change % ▾	YTD Change % ▾
A	Agilent Technologies Inc	Medical Diagnostics & Research	26,173.28	2,916,103	223,461	New Holding	3.44	+3.44%	0.94	+11.09%	-1.09%
BRK.B	Berkshire Hathaway Inc	Insurance	557,304.82	4,015,594	835,324	+14.31%	12.87	+1.61%	0.16	+6.86%	+0.61%
SBUX	Starbucks Corp	Restaurants	100,750.41	9,313,890	823,534	0%	12.69	0%	0.75	+2.45%	-2.37%
HHC	The Howard Hughes Corp	Real Estate	5,343.11	1,194,793	154,845	0%	2.39	0%	2.77	+11.10%	-2.48%
LOW	Lowe's Companies Inc	Retail - Cyclical	91,762.44	8,613,212	947,109	-3.23%	14.59	-0.43%	1.12	+8.08%	+0.43%
CMG	Chipotle Mexican Grill Inc	Restaurants	24,458.39	1,724,310	1,449,231	-3.28%	22.33	-0.64%	6.20	+13.47%	+5.12%
QSR	Restaurant Brands International Inc	Restaurants	18,490.27	15,084,304	1,073,097	-3.56%	16.54	-0.58%	6	-4.55%	-2.74%
HLT	Hilton Worldwide Holdings Inc	Travel & Leisure	30,775.52	10,556,805	982,944	-3.73%	15.15	-0.60%	3.58	+12.23%	-1.66%
ADP	Automatic Data Processing Inc	Business Services	75,567.16	0	0	Sold Out	0	-9.93%	0	+7.17%	+2.64%

MILLENNIUM	9.8	1.4
GRAHAM'S DISCRETIONARY MACRO	9.5	N/A
KRENSAVAGE PARTNERS	8.6	0.2
VOLEON'S INVESTORS	7.0	N/A
EXODUSPOINT	6.8	0.8
TUDOR'S RIVERBEND CROSSING	6.5	N/A
MOAB PARTNERS	5.6	0.2
MQS OFFSHORE	4.0	-2.6
QIM'S QUANTITATIVE TACTICAL AGGRESSIVE	0.5	-0.3
BRIDGEWATER PURE ALPHA II	-0.5	N/A
ANCHORAGE	-1.5	N/A
LIGHT STREET	-1.8	-4.3
AUTONOMY GLOBAL MACRO	-5.7	8.1

SOURCE: BLOOMBERG NEWS

Where Does All The Money Go !?

Who Owns The Equity Market?

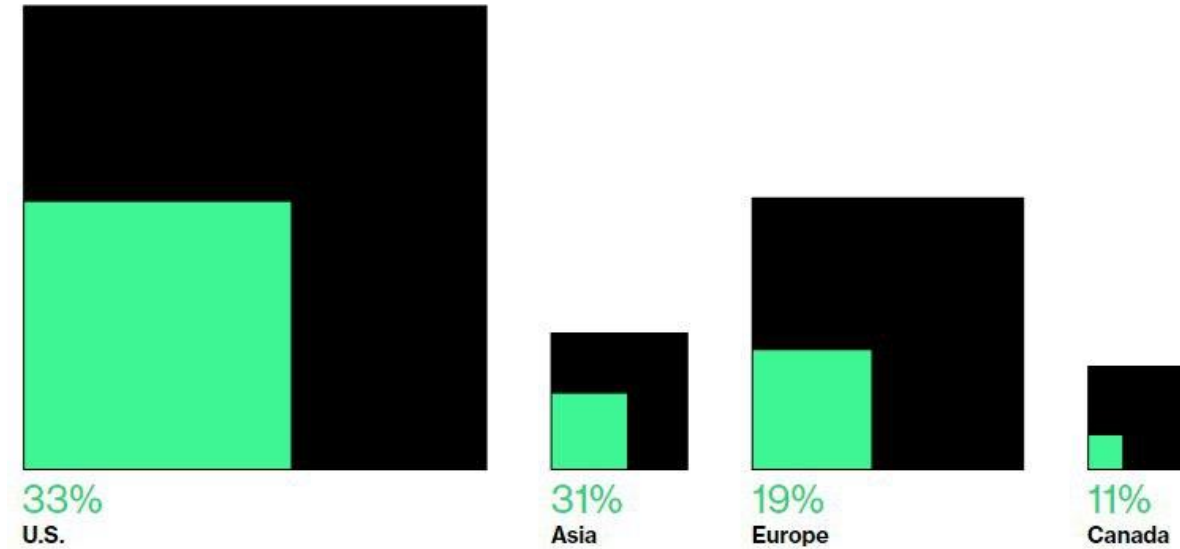


Source: The Federal Reserve

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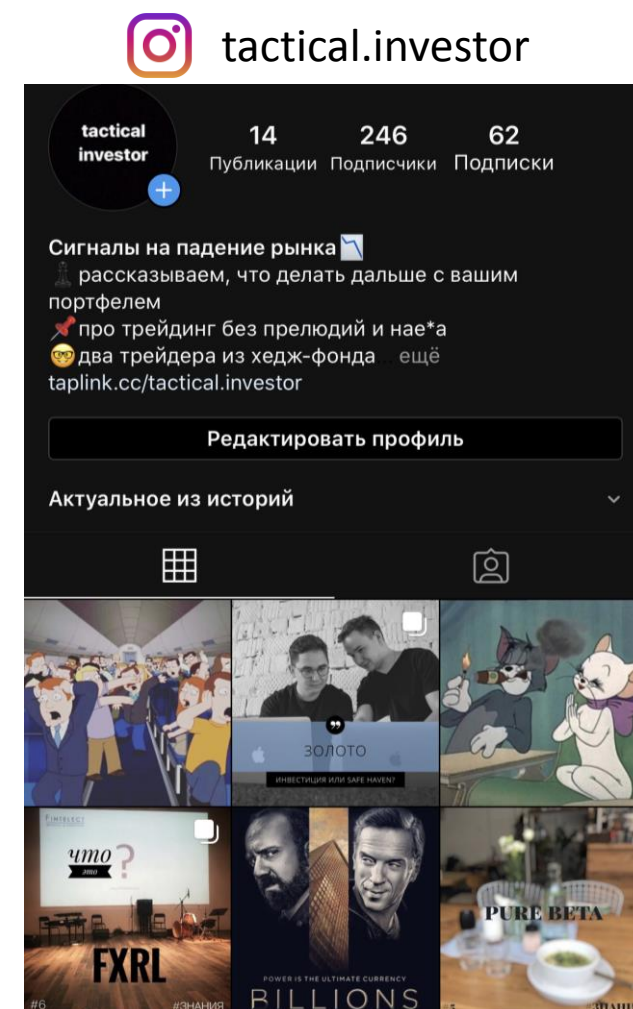
Switching Over

The U.S. had the largest percentage of money in ■ passive funds last year



Note: Boxes are sized by 2018 assets under management in each region. Asia figures include Japan.
Source: Morningstar Inc.

Tactical Investor



Data for analysis

Current Research Returns

In August 2019, we added emerging markets portfolios to the bottom of the page. The global portfolios and factors have been renamed to developed.

	December 2019	Last 3 Months	Last 12 Months
Fama/French 3 Research Factors			
Rm-Rf	2.77	8.98	28.28
SMB	0.69	1.91	-5.92
HML	1.82	-2.28	-12.15
Fama/French 5 Research Factors (2x3)			
Rm-Rf	2.77	8.98	28.28
SMB	0.97	1.79	-6.08
HML	1.82	-2.28	-12.15
RMW	0.23	-0.91	5.24
CMA	1.29	-1.03	-2.81
Fama/French Research Portfolios			
Size and Book-to-Market Portfolios			
Small Value	4.81	9.47	14.10
Small Neutral	4.23	9.95	25.40
Small Growth	2.71	14.15	30.59
Big Value	4.30	10.05	26.36
Big Neutral	2.63	7.85	27.33
Big Growth	2.76	9.93	34.16

Detail for Daily Momentum Factor (Mom)

Daily Returns: November 3, 1926 - December 31, 2019

Construction: We use six value-weight portfolios formed on size and prior (2-12) returns to construct Mom. The portfolios, which are formed daily, are the intersections of 2 portfolios formed on size (market equity, ME) and 3 portfolios formed on prior (2-12) return. The daily size breakpoint is the median NYSE market equity. The daily prior (2-12) return breakpoints are the 30th and 70th NYSE percentiles.

Mom is the average return on the two high prior return portfolios minus the average return on the two low prior return portfolios,

$$Mom = 1/2 (Small\ High + Big\ High) - 1/2 (Small\ Low + Big\ Low).$$

Stocks: The six portfolios used to construct Mom each day include NYSE, AMEX, and NASDAQ stocks with prior return data. To be included in a portfolio for day t (formed at the end of day t-1), a stock must have a price for the end of day t-251 and a good return for t-21. In addition, any missing returns from t-250 to t-22 must be -99.0, CRSP's code for a missing price. Each included stock also must have ME for the end of day t-1.

Detail for Daily Short-Term Reversal Factor (ST_Rev)

Daily Returns: January 26, 1926 - December 31, 2019

Construction: We use six value-weight portfolios formed on size and prior (1-1) returns to construct ST_Rev. The portfolios, which are formed daily, are the intersections of 2 portfolios formed on size (market equity, ME) and 3 portfolios formed on prior (1-1) return. The daily size breakpoint is the median NYSE market equity. The daily prior (1-1) return breakpoints are the 30th and 70th NYSE percentiles.

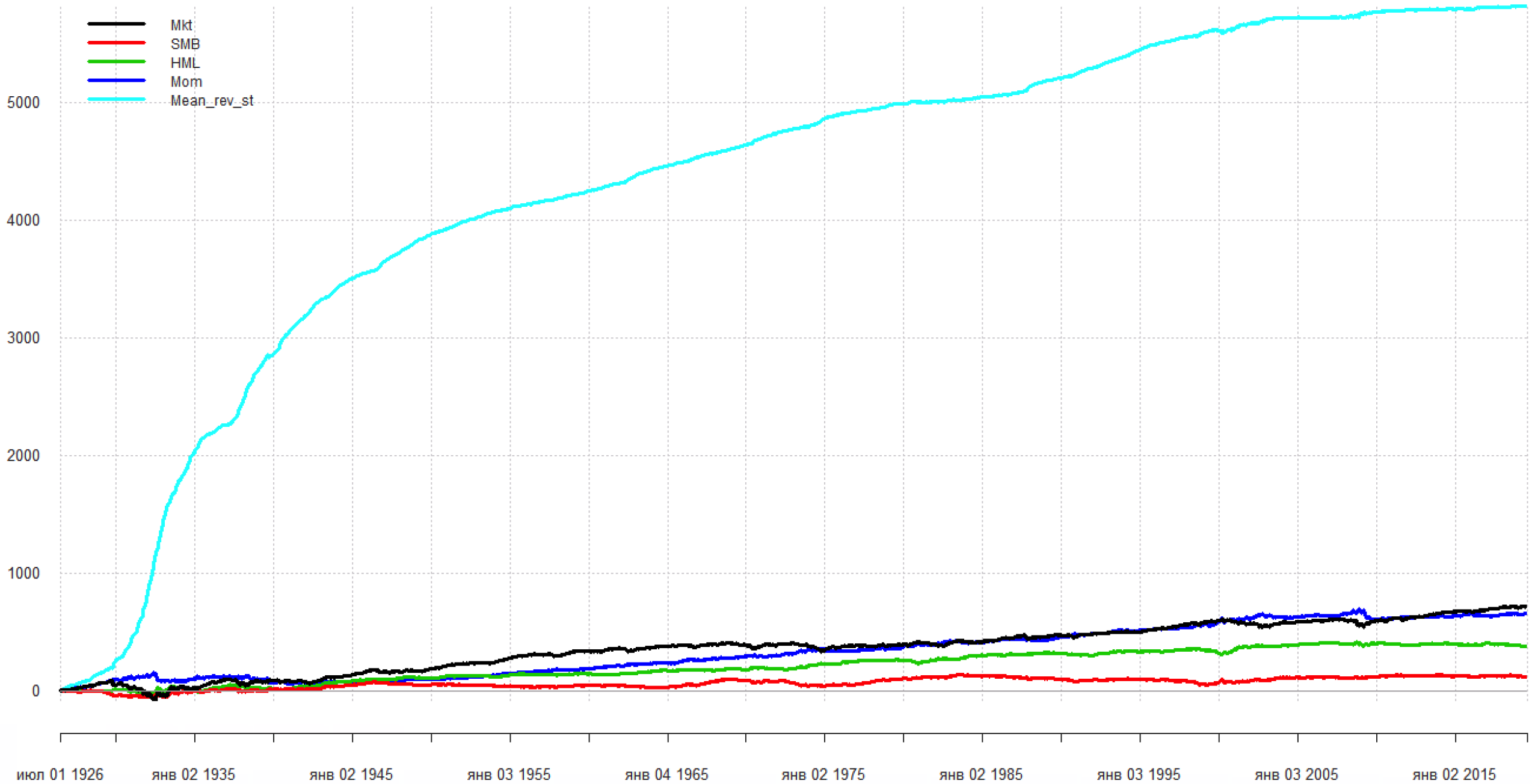
ST_Rev is the average return on the two low prior return portfolios minus the average return on the two high prior return portfolios,

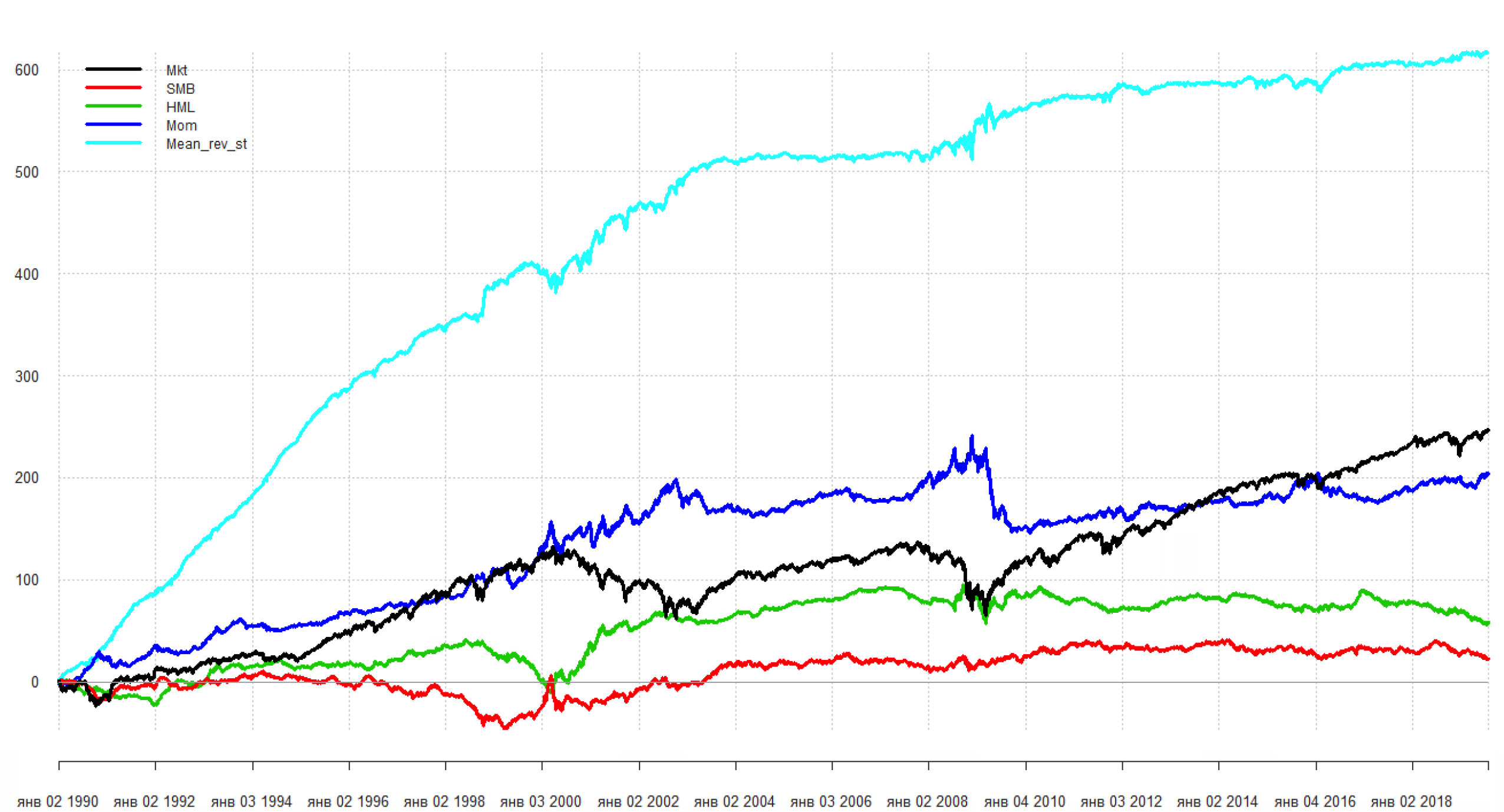
$$ST_Rev = 1/2 (Small\ Low + Big\ Low) - 1/2 (Small\ High + Big\ High).$$

Stocks: The six portfolios used to construct ST_Rev each day include NYSE, AMEX, and NASDAQ stocks with prior return data. To be included in a portfolio for day t (formed at the end of day t-1), a stock must have a price for the end of day t-21 and a good return for t-2. In addition, any missing returns from day t-20 to t-2 must also be -99.0, CRSP's code for a missing price. Each included stock also must have ME for the end of day t-1.



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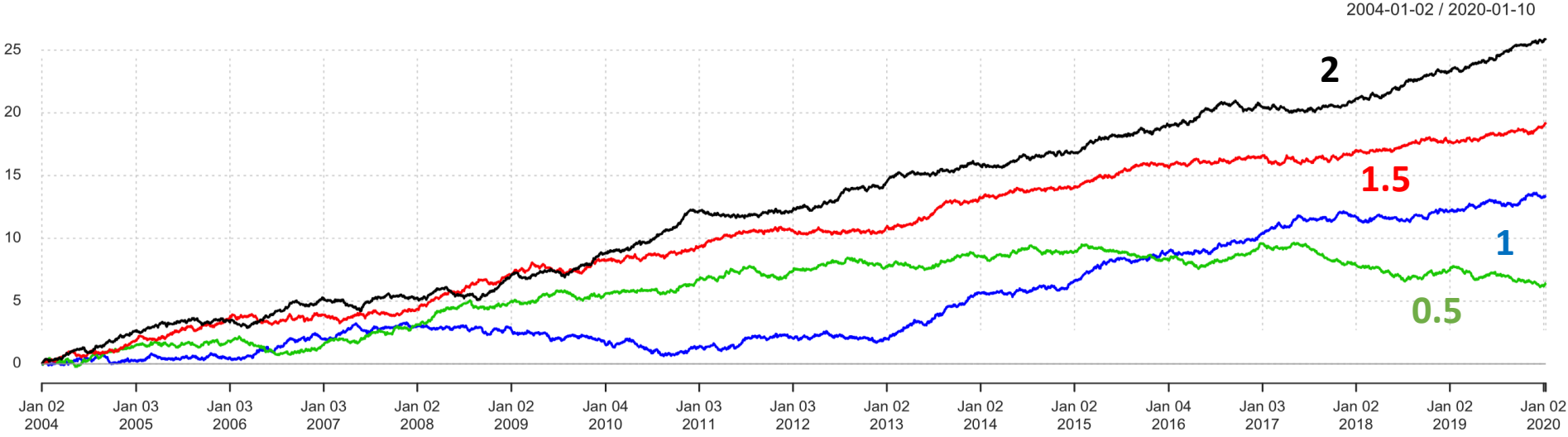




Sharpe ratio

Sharpe ratio = $\frac{R_p - R_f}{\sigma_p}$

R_p asset return
 R_f risk-free rate
 σ_p standard deviation (of asset return)



Performance probability

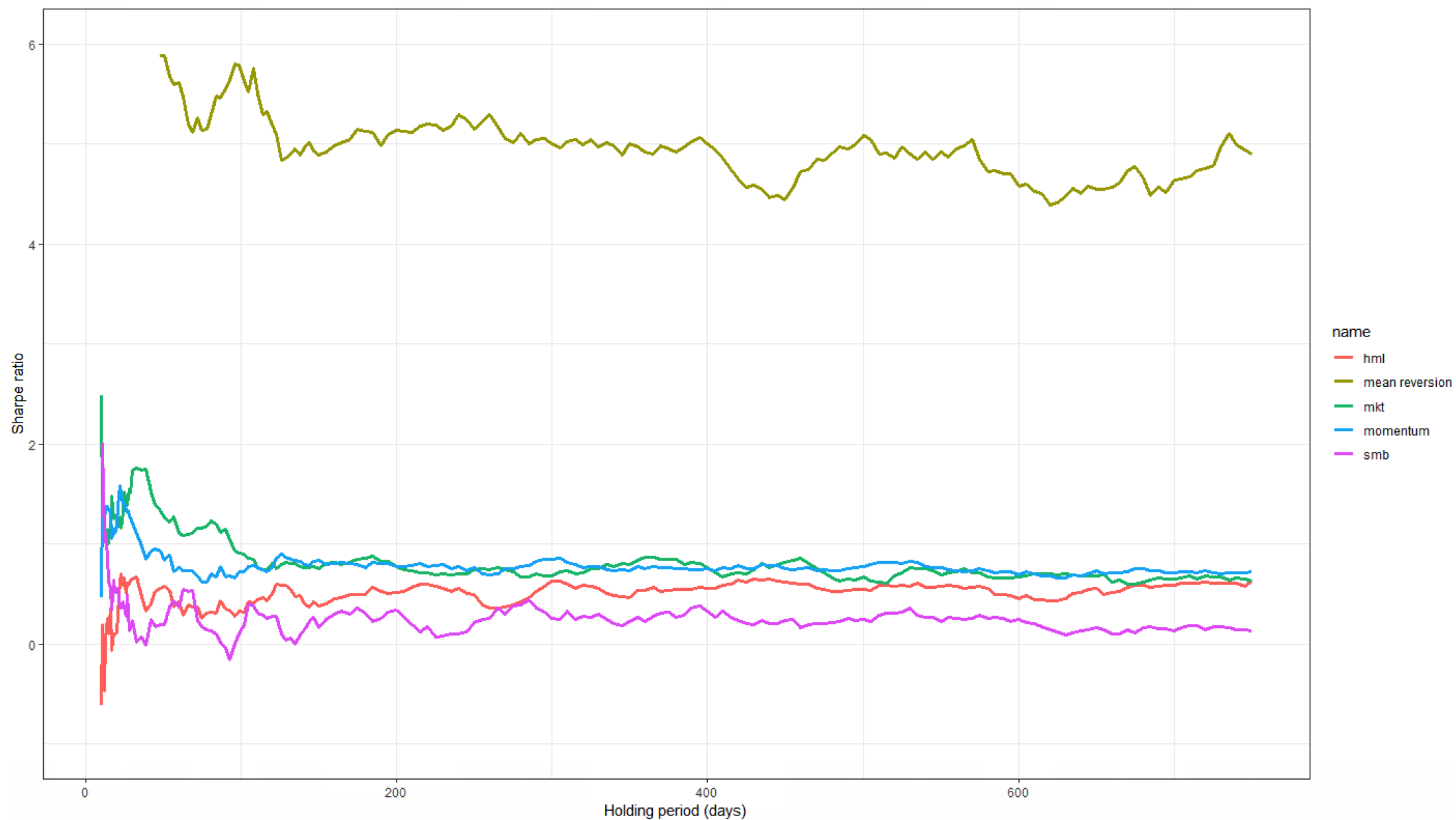
Sharpe ratio

Calculation on Monte-Carlo portfolios
with random start point

Time of holding

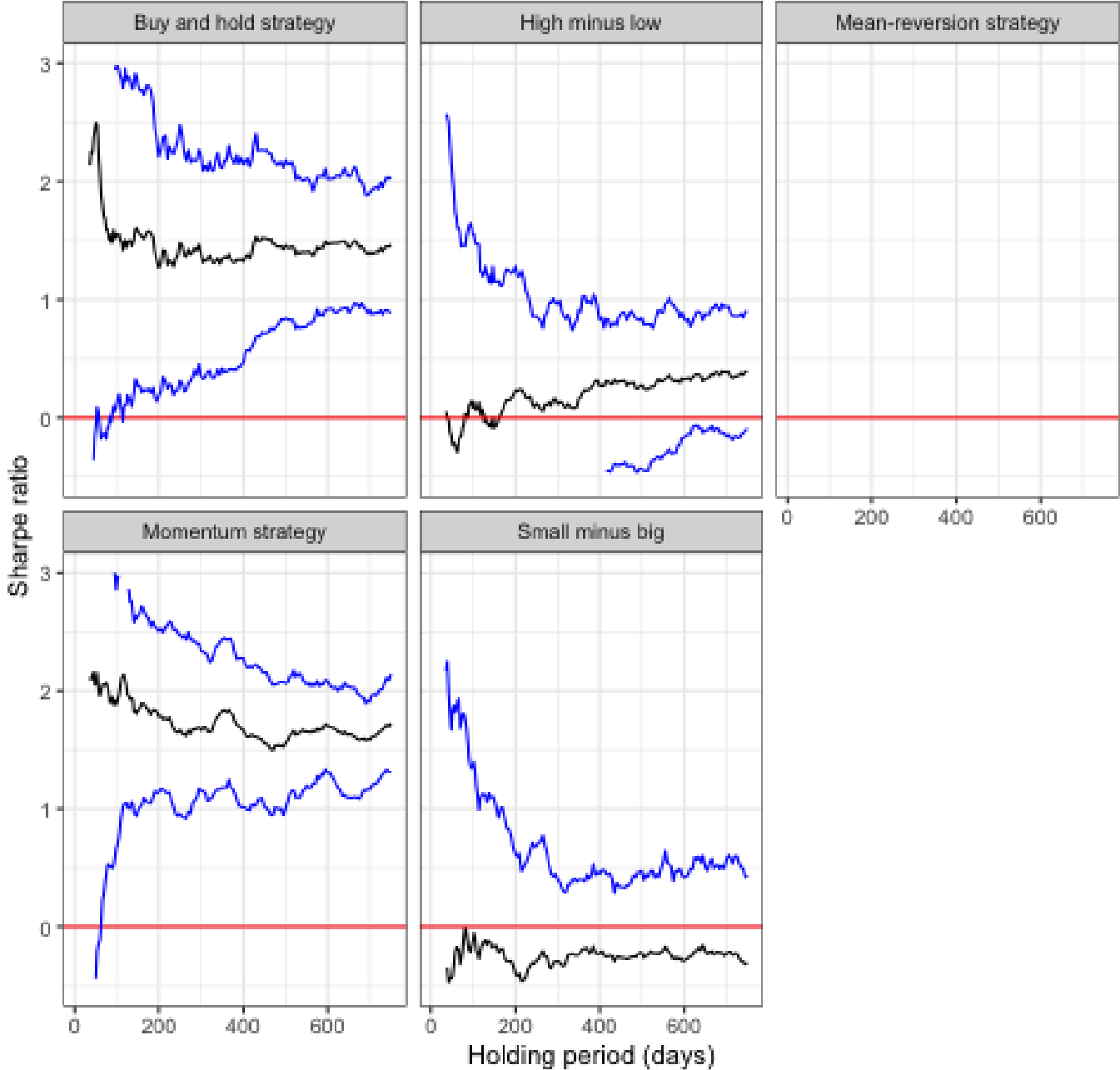


Performance probability 1926-2020

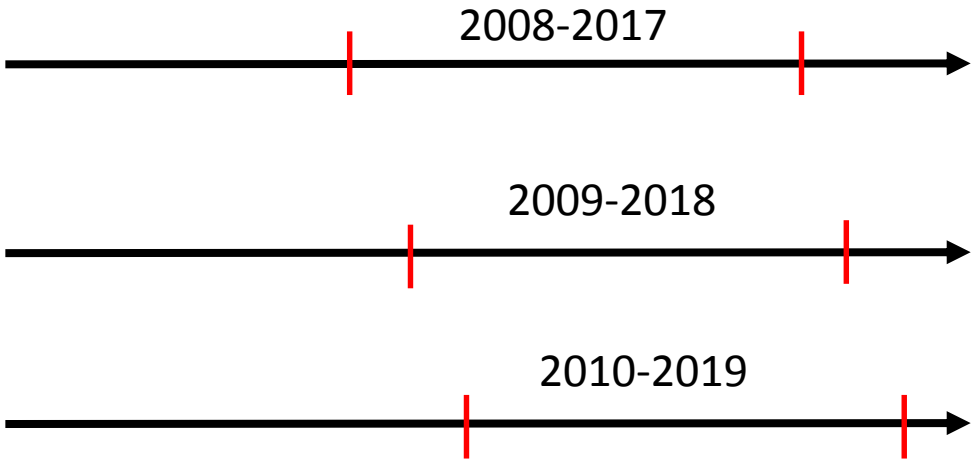


Year: 1961-01-01

Dynamics of performance probability



Rolling window last 10 years for calculation



Does this effect of low interest rates and QE

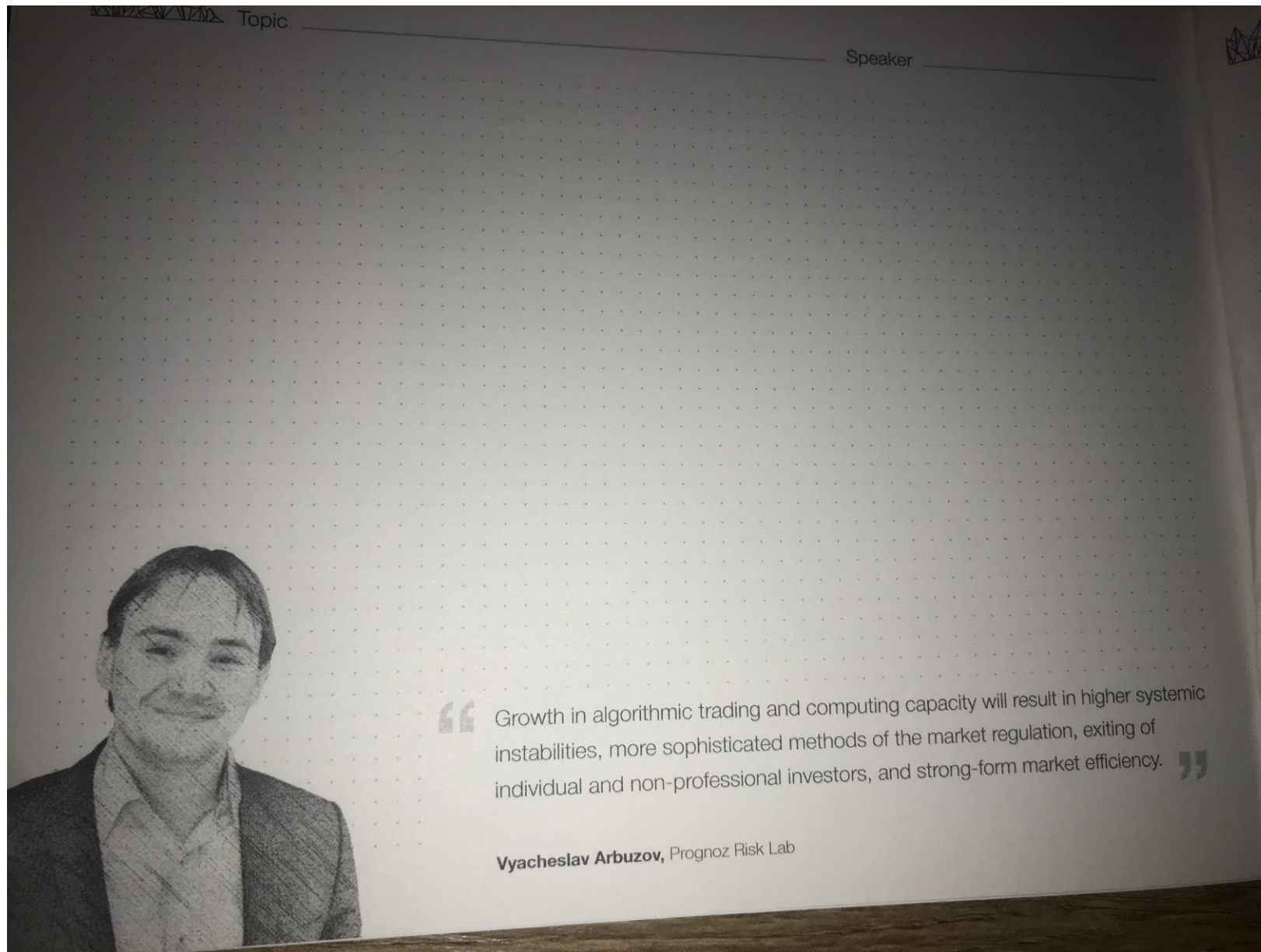
or

effective market reality?

US interest rate



Perm Winter School 2015 sketch book



Thank you

for your attention !