Traditional and Alternative Risk: An Application to Hedge Fund Returns

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Outline

Motivation

Hedge funds are typically distinguished by the management policies they apply, often regarded as strategies and styles.

We want to investigate how the different policies compare to one another on the performance point of view.
Particularly:

- Given the nature of these vehicles, we are interested in the level of risk taken;
- How did the 2008-2009 crisis affected the different kind of HFs?
- How HFs as an alternative investment compare with a traditional equity investment.

Some Literature on Styles and Strategies

Eichengreen and Mathieson (1998) select 8 categories of hedge funds with 7 differentiated styles plus a fund-of-funds category.
Fung and Hsieh (1997) use a "style" and "location" (that is the asset class where hedge fund invest, for example equity, fixed income, commodities, currencies) taxonomy.
Amenc, Martellini and Vaissié (2003) have proposed a distinction between "return enhancer" and "risk reducer strategies", in the latter active fund managers want to obtain positive excess returns reducing portfolio volatility.
Martin (2001) utilizes a regression analysis to ascertain a link between the performance of the different strategies and the selected economic factors. His results showed that exists a significant correlation when each strategy is pooled as an index.
Browne and Goetzmann (2001) use a cluster analysis algorithm to examine the relationship risk/return of each hedge fund strategy cluster.
Shawky, Dai and Cumming (2012) investigate diversification and performance and find that diversification across styles and location show a significant negative association with hedge fund returns.

Outline

Dataset Description

We scrutinised the commercial data base of a large alternative investment data provider, MondoAlternative.com.
The original data set is comprised of 1100 hedge funds from May 1984 through February 2013, classified by management reported investment strategy.
Most relevant data fields to our analysis are:

- Fund's monthly Net Asset Values (NAVs) gross of fees,
- Reported strategies;
- Fund fees distinguished in management and performance fees.

This is a global HF database, not targeted toward a specific geographic area or purpose.

Overseas Incorporation

For the sake of legal shields and capital gain tax exemption, many funds are incorporated in overseas countries.

	Funds
Cayman Islands	74
Other	44
Luxembourg	34
BVI	33
N. A.	21
Bermuda	21
Switzerland	20

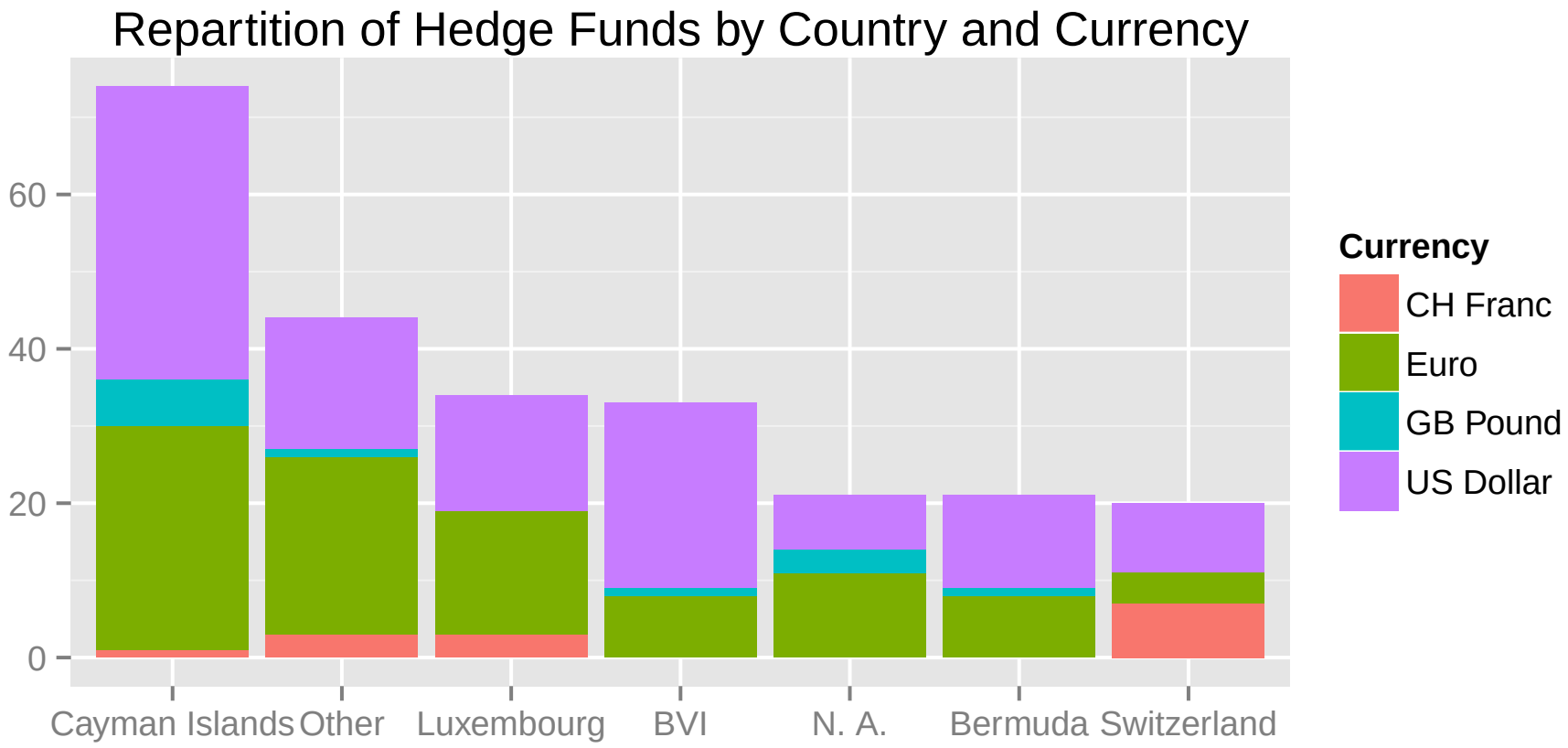
A relatively high percentage of funds do not report the country of incorporation.

Denominations of Currencies

Next chart shows primary currencies of denomination of funds, distributed by country of incorporation.

- Prevailing currencies are Euro and US Dollar
- Despite British Virgin Islands and Cayman Islands are formally British overseas territories, the GB Pound still has a relatively low presence, if compared with Euro or US Dollar.

Currency Denominations (cont'd)

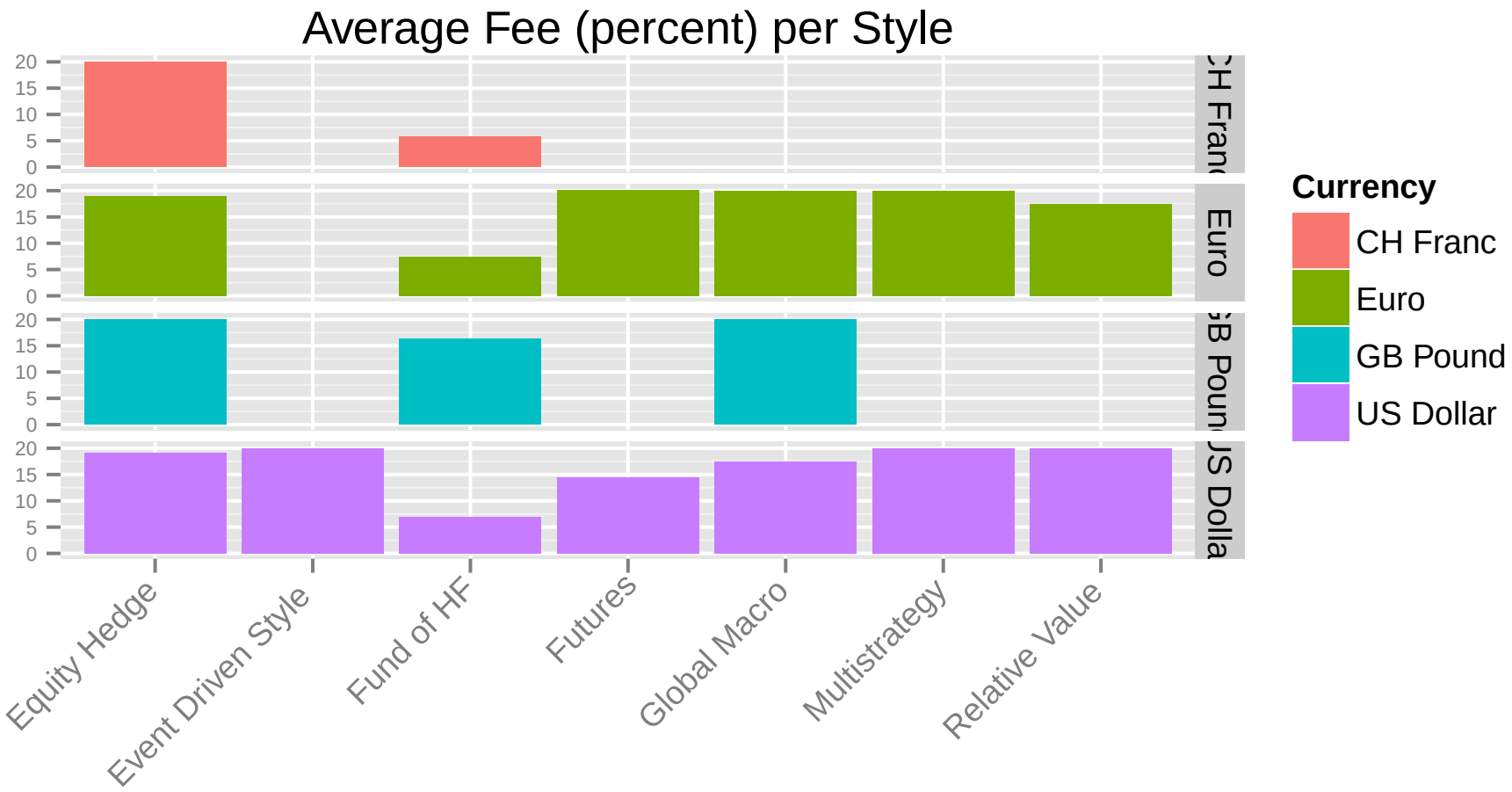


Fee Structures

Next chart shows fee structures distributed by style and currency.

Fees are intended as performance fees, calculated as a percentage of the increase in the gross asset value of the fund.

Fee Structures (cont'd)



Outline

Specific HF data biases and possible solutions

Data biases for HF databases are addressed by Ackerman et al. (1999), Liang (2000), Fung and Hsieh (2000) and Fung and Hsieh (2002).

- Continuous time span. The data set was substantially downsized to obtain comparable time series. Only those funds having a continuous track record from Jan 2005 through Dec 2012 were treated;
- Backfill Bias. Actual used observation where only those starting from Jan 2006.
- Survivorship Bias, by the scope of this analysis, we are interested in those funds actually available to the investors during the whole time covered by our analysis, that is, how they perform provided that they do (see Dor et. al (2012) for similar arguments).

Outlier treatment

Lack of regulations and reporting standards can often involve reporting biases with respect to performances, which suggests using particular care for outlier detection.
Change of scale problems were often detected.

Popular option: extreme Studentised deviation or "three-sigma edit rule"

- Any point more than t standard deviations from the mean of its neighbours is an outlier

$$[\mu - t\sigma, \mu + t\sigma]$$

  The threshold value t is commonly taken to be 3, as for normal data, observing values more than three standard deviations away from the mean is only 0.3% likely.
- Detected outliers are replaced with their reference mean.
- The problem is that mean and SD (especially) are themselves distorted by outliers.

The Hampel Filter

Alternatives to the "local three-sigma" rule
Median absolute deviation:

$$\mathbb{M}_X = \mathbb{m}\left(|X - \mathbb{m}X|\right) \ ,$$

where $\mathbb{m}$ is the median.
Hampel filter (Pearson, 2011)

- It uses the median of neighbouring observations as a reference value, and uses deviation from median (MAD) as an alternative measure of distance
- an outlier is such when lying more than t times the MAD from the median of its neighbours.

Our Hampel Modified Filter

- After detection, the median was replaced with the average observations before and past the outlier.
- The filter was adjusted at the borders of the series, to avoid cutting data.
- The MAD was adjusted by a factor of about 1.5, as it can be shown that for normal data:

$$\sigma_X \approx 1.4826 \mathbb{M}_X$$

Styles and Strategies

Rules for segregating HFs into standardised investment styles are challenging, as there is no formal consensus on the investment approaches.
Data providers tend to design their own classifications

A survey by Alternative Investment Management Association in 2003 evidenced that:

- 50% uses their own style/strategy classification,
- 47% uses one or more outside classification systems,
- and 3% stated that hedge funds could not be classified.

Possible external sources are:

- CS/Tremont (27%),
- Hedge Fund Research (27%),
- MSCI (23%)

Fund strategies

Fund strategies as reported by fund managers and complying with our fund selection criteria.

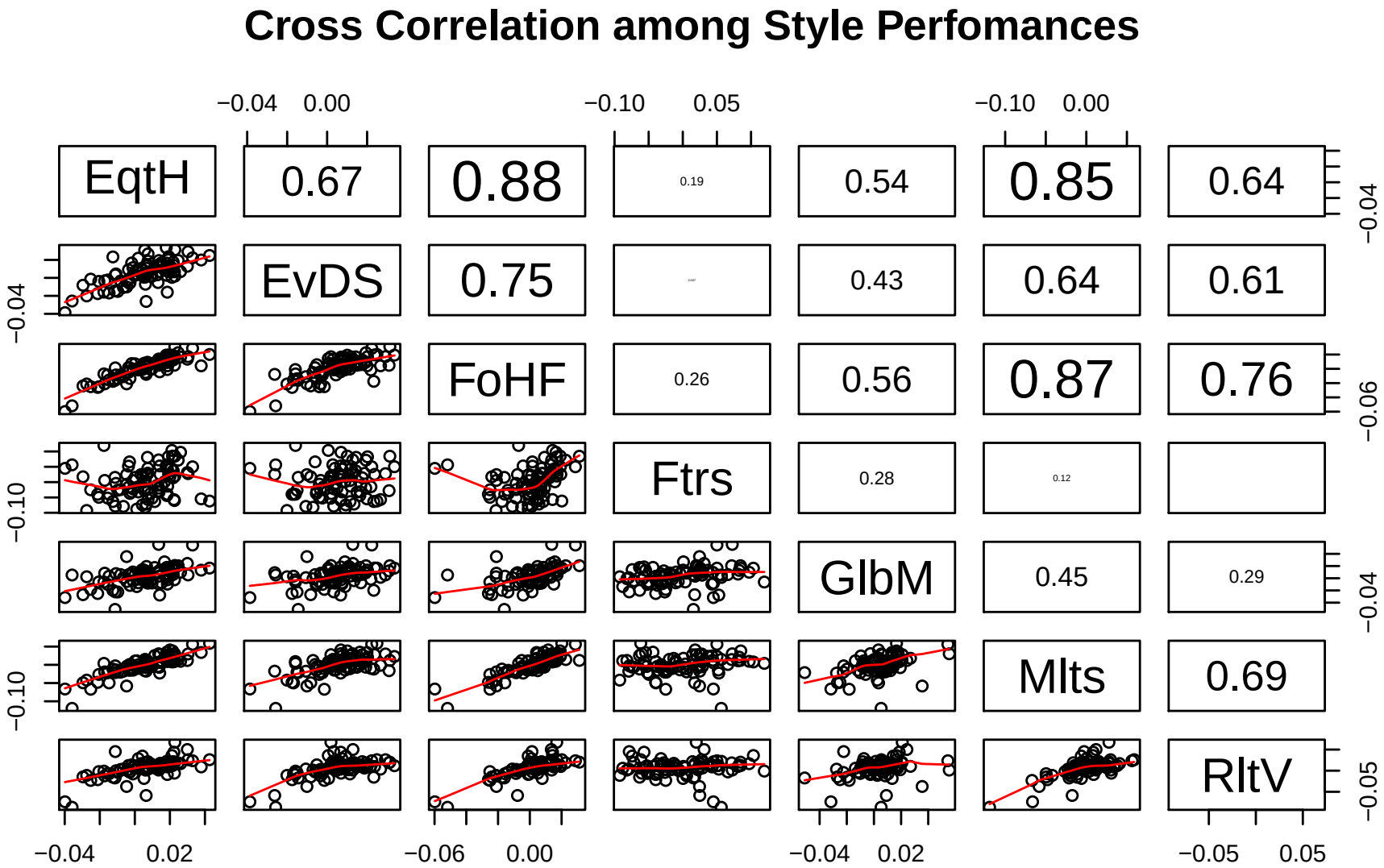
	Strategy
1	Convertible Arbitrage
2	Credit Long/short
3	CTA
4	Emerging Markets
5	Equity Market Neutral
6	Event Driven
7	Fixed Income Arbitrage
8	Fund of funds
9	Fund of funds Mixed
10	Long/short equity
11	Macro
12	Managed Futures
13	Merger Arbitrage
14	Multi Arbitrage
15	Multistrategy

Our tentative classification

	Strategy	Style	Abbrev.
1	Convertible Arbitrage	Relative Value	RltV
2	Credit Long/short	Relative Value	RltV
3	CTA	Futures	Ftrs
4	Distressed Securities	Event Driven Style	EvDS
5	Emerging Markets	Global Macro	GlbM
6	Equity Market Neutral	Relative Value	RltV
7	Event Driven	Event Driven Style	EvDS
8	Fixed Income Arbitrage	Relative Value	RltV
9	Fund of funds	Fund of HF	FoHF
10	Fund of funds Mixed	Fund of HF	FoHF
11	Long/short equity	Equity Hedge	EqtH
12	Macro	Global Macro	GlbM
13	Managed Futures	Futures	Ftrs
14	Merger Arbitrage	Event Driven Style	EvDS
15	Multi Arbitrage	Event Driven Style	EvDS
16	Multistrategy	Multistrategy	Mlts
17	Relative Value Arbitrage	Relative Value	RltV
18	Statistical Arbitrage	Statistical Arbitrage	SttA
20	Volatility Trading	Volatility	Vltl

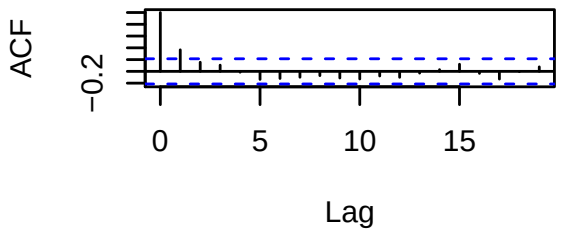
Outline

Graphical Correlation Matrix

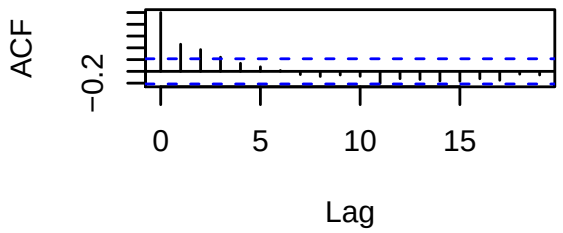


Autocorrelation of Styles

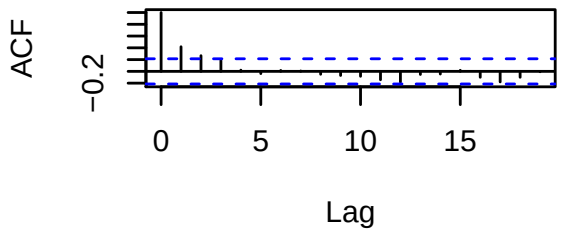
Equity Hedge



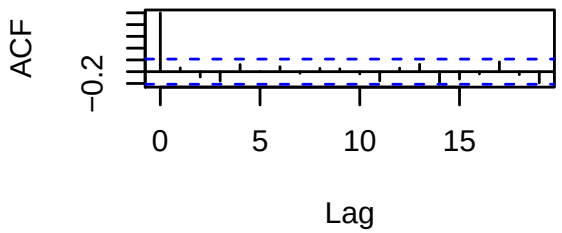
Event Driven Style



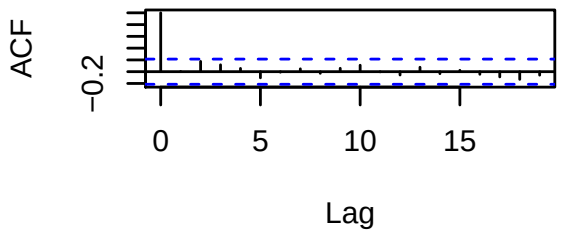
Fund of HF



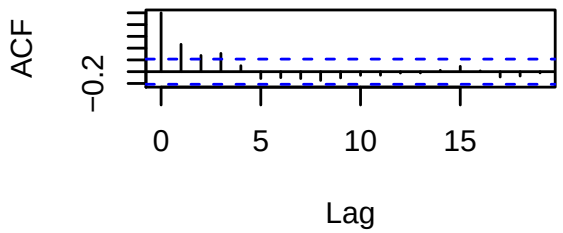
Futures



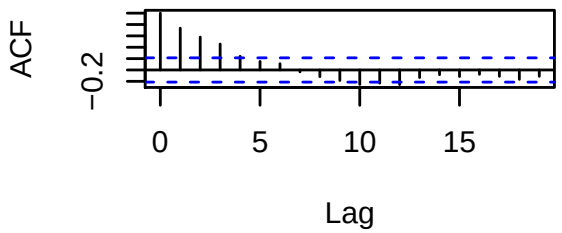
Global Macro



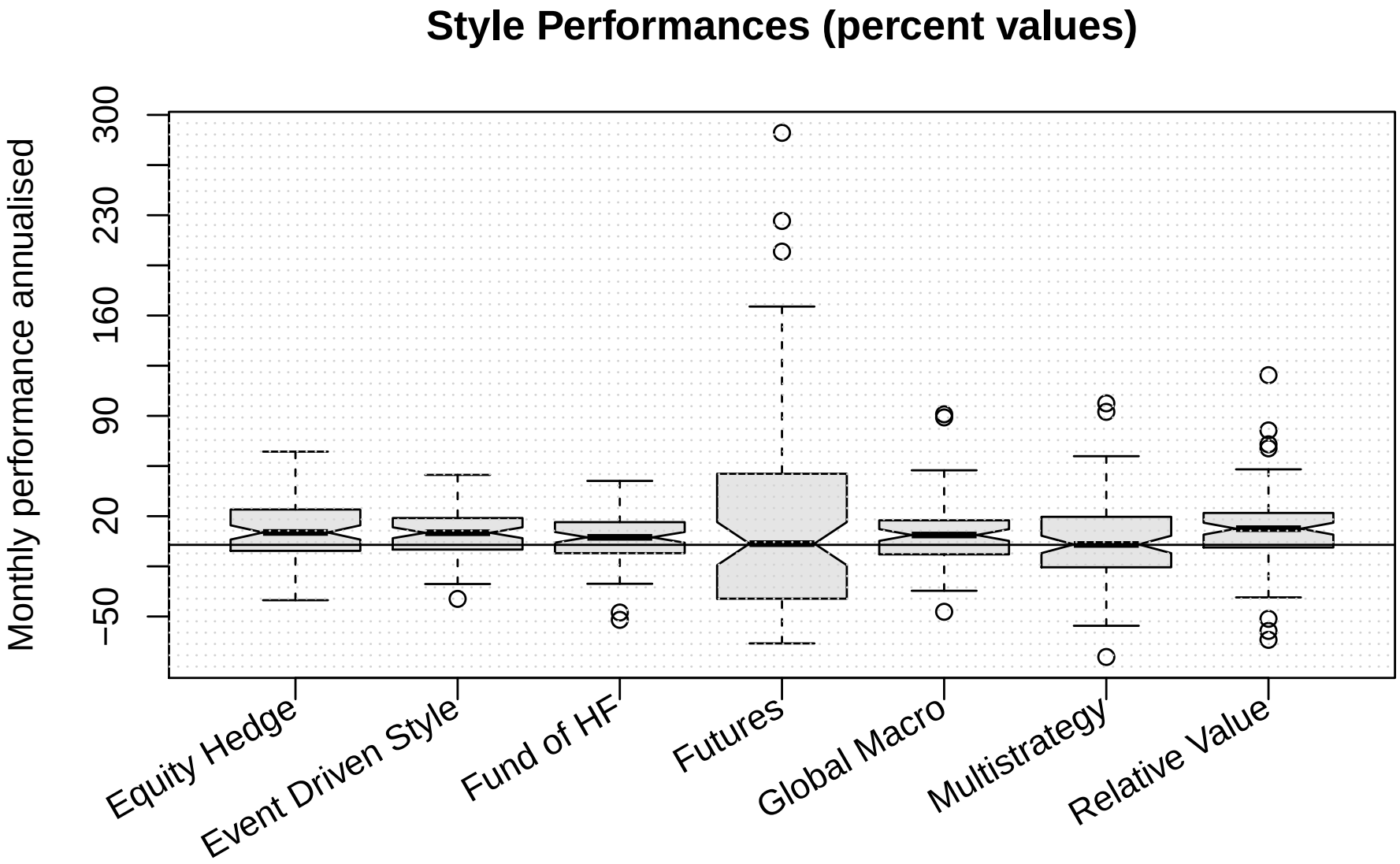
Multistrategy



Relative Value



Notched Boxplots of Performance Variability



Outline

Crisis Window

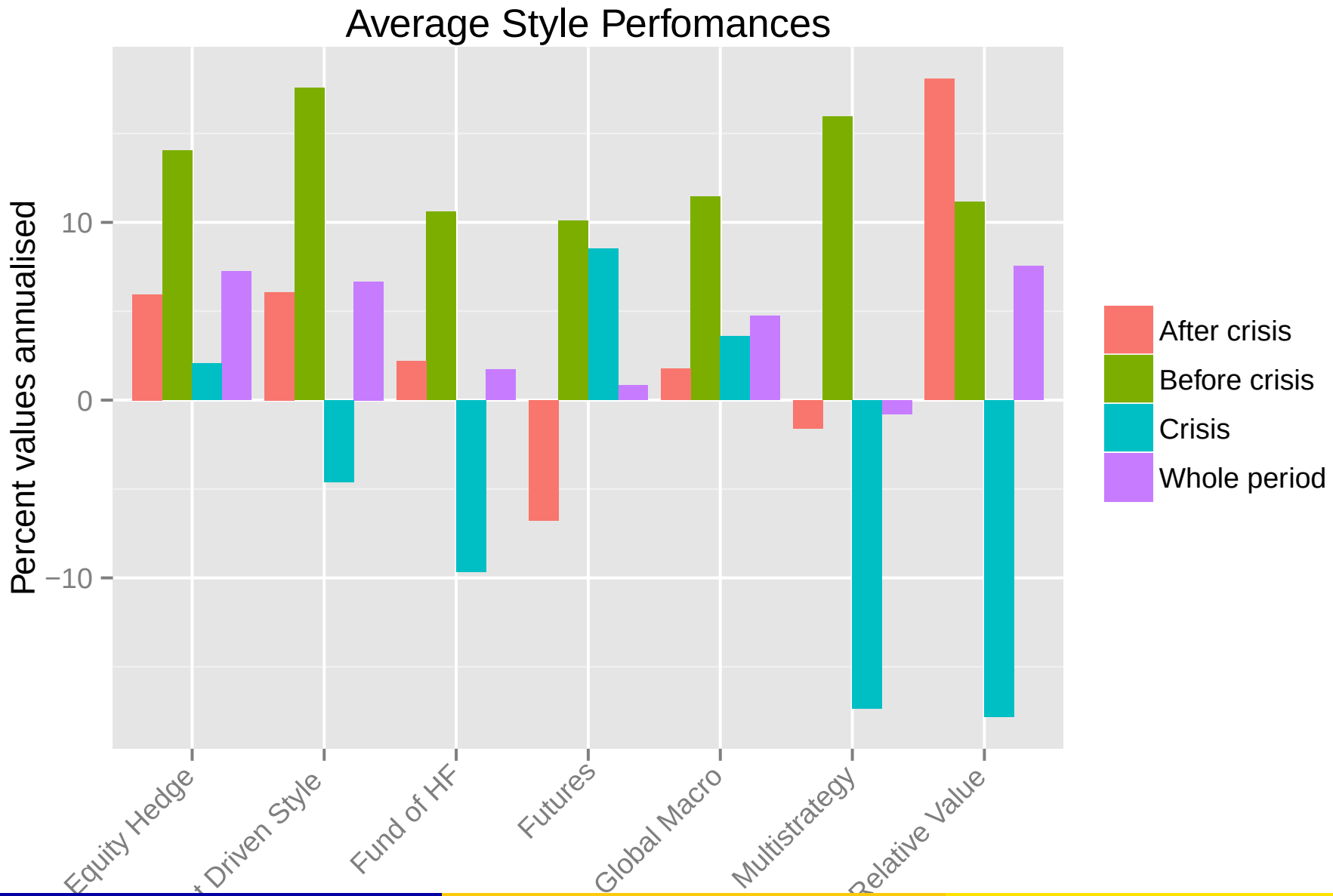
A number of events can be considered as the outbreak of the crisis: most notably the collapse of the investment bank Bear Stearns in March 2008, which triggered a contagion overwhelming several large financial institutions (including Lehman Brothers, Merrill Lynch, Fannie Mae, Freddie Mac, Wachovia, Citigroup).

For a formal, non-subjective, definition it is possible to refer to the Business Cycle Dating Committee of the National Bureau of Economic Research (NBER):

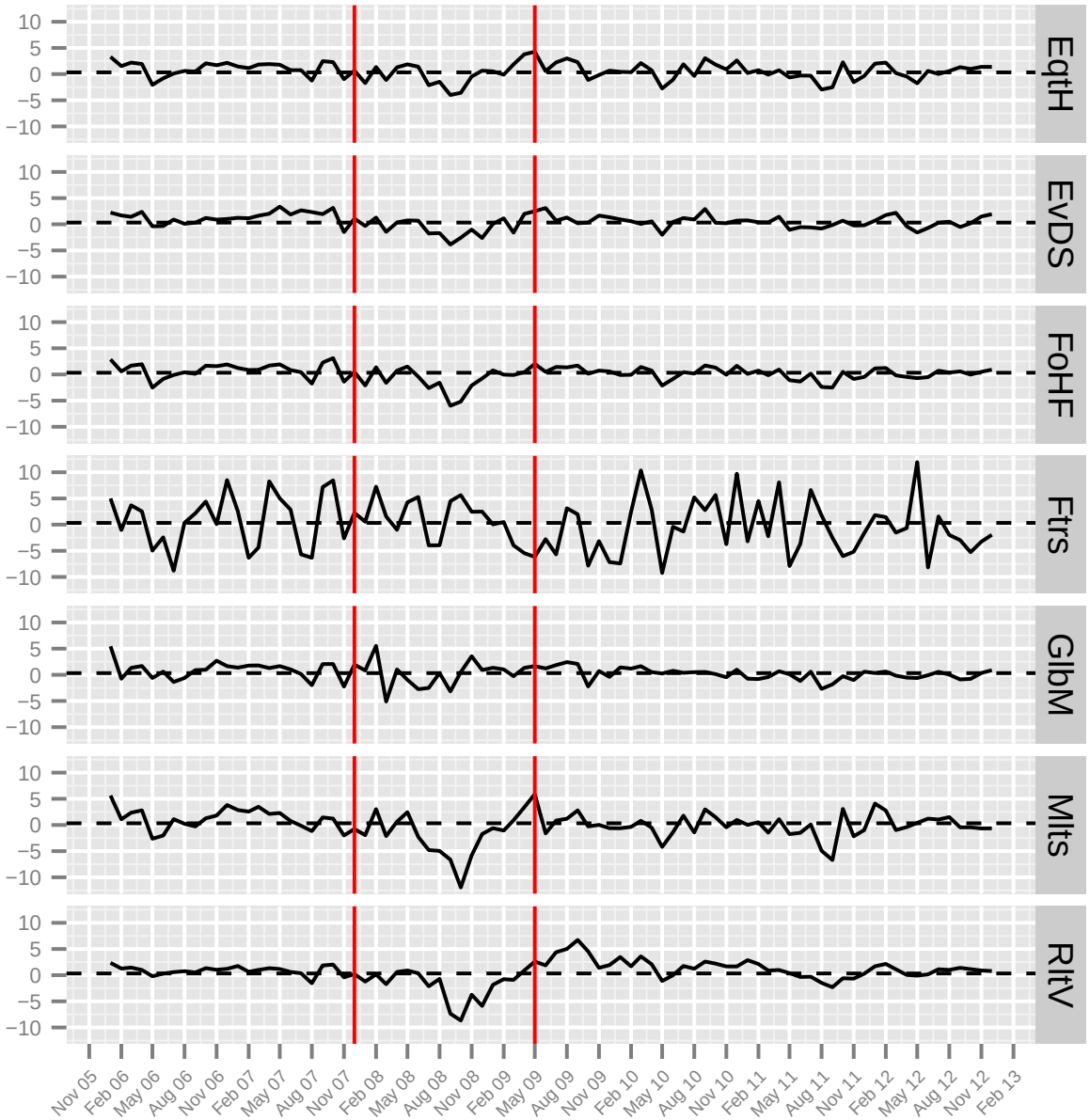
> "A trough in business activity occurred in the U.S. economy in June 2009. The trough marks the end of the recession that began in December 2007 and the beginning of an expansion. The recession lasted 18 months, which makes it the longest of any recession since World War II."
>
> (NBER Meeting, September 20, 2010)

Obviously results are affected by the period chosen and therefore some specific tests were undertaken to assess the impact of differing time spans.

Break-down of Style Performances by Cycles



Styles: Historical Trends



Outline

Measuring the Impact of Strategies and Styles over Performance

How can we check if there are significant differences among groups? Results are randomly drawn or they can be considered the effect of a systematic and disciplined management policy?

- Performance variability among groups can be seen as an effect of the diverse management policies
- The strategy/style factor in terms of return variability was measured by means of F-tests.
- The F-test assumes as null-hypothesis that on average strategies (styles) are indistinguishable.

Aggregating Funds in Strategies

Since every fund has a reported strategy (and only one), let the hedge fund (i,j) denote i-th fund among those reporting the j-th strategy. Therefore $r_{ij}(t)$ denotes the monthly return observed on month t-th (of the time series) for the (i,j) fund. With reference to the time window $T = t_b - t_a$, the average return for the (i,j) fund will be:

$$f_{ij}(t_a, t_b) = F_{ij}(T) = \sum_{h=a}^{b} \frac{r_{ij}(t_h)}{T}$$

In the same period the average for j-the strategy will be:

$$s_j(t_a, t_b) = S_j(T) = \sum_{i=1}^{n_j} \frac{F_{ij}(T)}{n_j}$$

where n_j is the number of funds comprising j-th strategy.

Grouping Effects

The average for all funds, strategies during T are resp.:

$$F(T) = \sum_{i,j=1}^{n_j,N_s} \frac{F_{ij}(T)}{N_F};\ S(T) = \sum_{j=1}^{N_s} \frac{S_j(T)}{N_s}$$

where N_F, N_S are the total number of funds, strategies.

(Obviously $N_F = \sum_{j=1}^{N_s} n_j$.)

The average for all funds during T does not necessarily equal to the average for all strategies unless the latter are are equinumerous, i.e. assuming every $n_j = n$:

$$S(T) = \sum_{j=1}^{N_s} \frac{\sum_{i=1}^{n_j} \frac{F_{ij}(T)}{n}}{N_s} = \sum_{j=1}^{N_s}\sum_{i=1}^{n_j} \frac{F_{ij}(T)}{nN_s} = \sum_{j=1}^{N_s}\sum_{i=1}^{n_j} \frac{F_{ij}(T)}{N_F} =$$

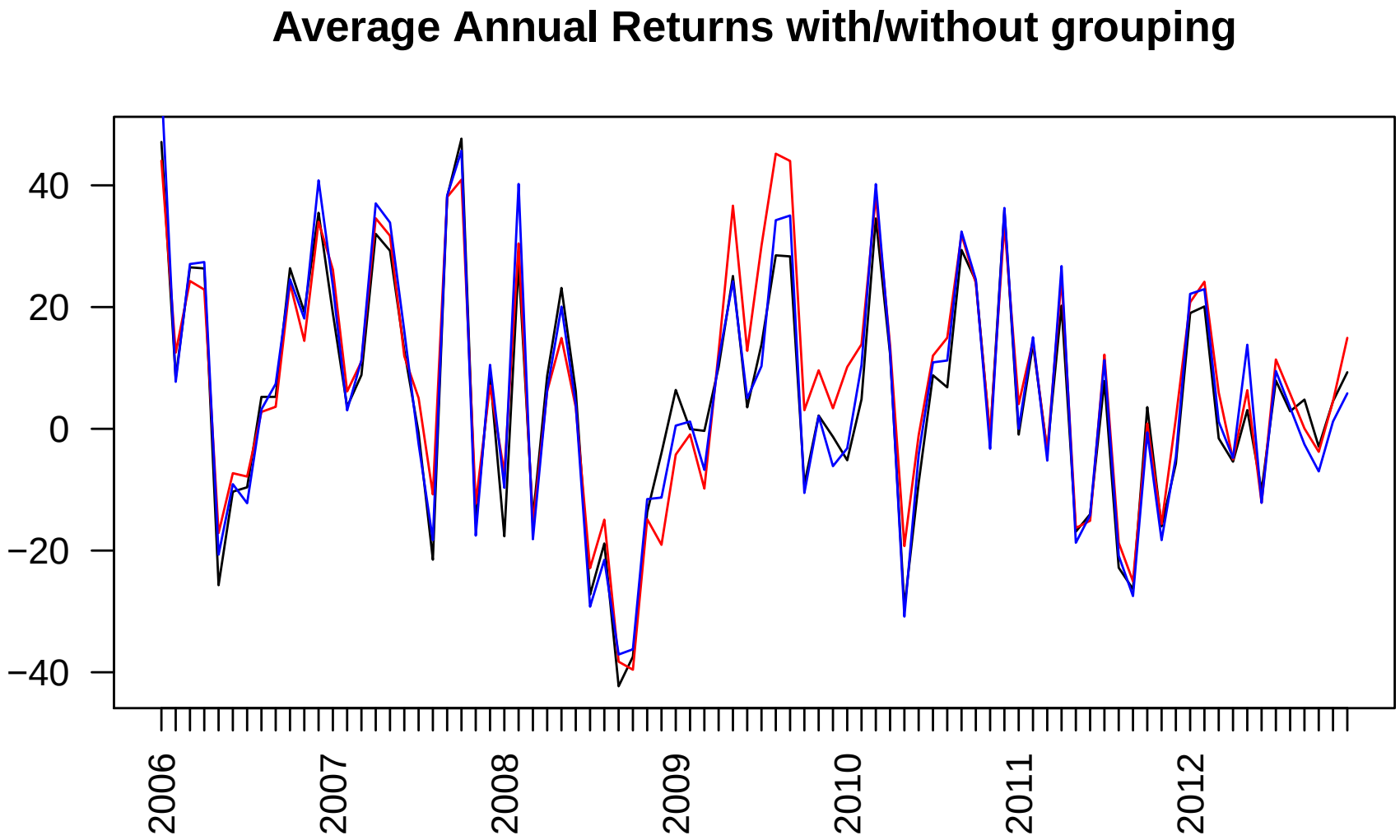
Aggregating Funds in Styles

Given the previous strategy-style mapping, the styles can be thought as a partition of the set of all strategies. If M_k is the set of all strategies mapped to the k-th style, the average return for this style, with reference to the time window $T = t_b - t_a$, is:

$$q_k(t_a, t_b) = Q_k(T) = \sum_{\substack{i=1 \\ j \in M_k}}^{n_j} \frac{F_{ij}(T)}{m_k}$$

where m_k is the number of strategies mapped to the k-th style .
With similar arguments, as for strategies, we can claim that if the style sets, M_k, have the same size, the average returns for all funds during T equals the average among styles.
As the (exact) equinumerosity is not consistent with our data set it makes sense to compare the actual averages.
The plot and the following table show the difference in means are negligible.

Measuring the Grouping Effect



Black no grouping, Red by strategies, Blue by styles.

Measuring the Grouping Effect: Correlation

	Ungrouped	By Strategy	By Style
Ungrouped	1.00	0.95	0.98
By Strategy	0.95	1.00	0.96
By Style	0.98	0.96	1.00

Equality of Variance among Fund Clusters

Assuming that $\bar{s}_j$ is the true mean return of the j-th strategy and $\bar{q}_k$ is the true mean return of the k-th style, we can set the null hypothesis for each test as follows:

$$H_0 : \ \bar{s}_1 = \bar{s}_1 = \ldots = \bar{s}_{n_s}$$

or

$$H_0 : \ \bar{q}_1 = \bar{q}_1 = \ldots = \bar{q}_{n_q}$$

where: n_s (n_q) is the number of strategies (styles).

As usual significance is assessed in terms of p-values, but to further improve on this, a battery of identical tests was run on equally sized random subsamples, to check if similar (p-)values could be obtained.

Strategy Impact

	OMR	MSB	F	Pr(>F)
Jan 2006 - Dec 2012 (84) Whole range	0.0046	0.0007	0.808	0.66066
Dec 2007 - May 2009 (18) Crisis only	-0.0053	0.0042	3.202	0.00011

OMR is the overall mean return (monthly) for the given period. MSB is the mean square between the deviation of the overall return and the single strategies. MSB can be considered as a measure of the performance variability among strategies.

Strategy Impact: simulation I

	OMR	MSB	F	Pr(>F)
Jan 2006 - Jun 2007 (18)	0.0110	0.0003	0.715	0.75909
Feb 2006 - Jul 2007 (18)	0.0095	0.0004	0.866	0.59649
Mar 2006 - Aug 2007 (18)	0.0084	0.0005	0.992	0.46208
Apr 2006 - Sep 2007 (18)	0.0089	0.0005	0.939	0.51691
May 2006 - Oct 2007 (18)	0.0096	0.0006	0.962	0.49254
Jun 2006 - Nov 2007 (18)	0.0098	0.0005	0.881	0.58066
Jul 2006 - Dec 2007 (18)	0.0105	0.0006	1.054	0.40075
Aug 2006 - Jan 2008 (18)	0.0105	0.0007	1.249	0.24028
Sep 2006 - Feb 2008 (18)	0.0117	0.0009	1.551	0.09362
Oct 2006 - Mar 2008 (18)	0.0107	0.0010	1.583	0.08389
Nov 2006 - Apr 2008 (18)	0.0100	0.0009	1.430	0.13897
Dec 2006 - May 2008 (18)	0.0100	0.0009	1.435	0.13679
Jan 2007 - Jun 2008 (18)	0.0088	0.0008	1.391	0.15721
Feb 2007 - Jul 2008 (18)	0.0065	0.0008	1.133	0.32912
Mar 2007 - Aug 2008 (18)	0.0055	0.0008	1.229	0.25428
Apr 2007 - Sep 2008 (18)	0.0028	0.0016	1.864	0.03057
May 2007 - Oct 2008 (18)	-0.0009	0.0027	2.317	0.00512
Jun 2007 - Nov 2008 (18)	-0.0029	0.0033	2.820	0.00061
Jul 2007 - Dec 2008 (18)	-0.0044	0.0044	3.444	0.00004
Aug 2007 - Jan 2009 (18)	-0.0048	0.0050	3.962	0.00000

Strategy Impact: simulation II

	OMR	MSB	F	Pr(>F)
Sep 2007 - Feb 2009 (18)	-0.0043	0.0053	4.465	0.00000
Oct 2007 - Mar 2009 (18)	-0.0063	0.0050	4.292	0.00000
Nov 2007 - Apr 2009 (18)	-0.0074	0.0045	3.872	0.00001
Dec 2007 - May 2009 (18)	-0.0053	0.0042	3.202	0.00011
Jan 2008 - Jun 2009 (18)	-0.0051	0.0038	2.830	0.00058
Feb 2008 - Jul 2009 (18)	-0.0035	0.0031	2.092	0.01271
Mar 2008 - Aug 2009 (18)	-0.0030	0.0025	1.593	0.08118
Apr 2008 - Sep 2009 (18)	-0.0005	0.0019	1.131	0.33088
May 2008 - Oct 2009 (18)	-0.0006	0.0016	0.878	0.58302
Jun 2008 - Nov 2009 (18)	-0.0008	0.0016	0.847	0.61748
Jul 2008 - Dec 2009 (18)	-0.0008	0.0018	0.973	0.48180
Aug 2008 - Jan 2010 (18)	0.0008	0.0020	1.053	0.40160
Sep 2008 - Feb 2010 (18)	0.0022	0.0016	0.881	0.57995
Oct 2008 - Mar 2010 (18)	0.0059	0.0017	0.980	0.47449
Nov 2008 - Apr 2010 (18)	0.0087	0.0026	2.156	0.00985
Dec 2008 - May 2010 (18)	0.0085	0.0033	2.794	0.00068
Jan 2009 - Jun 2010 (18)	0.0094	0.0039	4.077	0.00000
Feb 2009 - Jul 2010 (18)	0.0101	0.0044	5.045	0.00000
Mar 2009 - Aug 2010 (18)	0.0108	0.0044	5.125	0.00000
Apr 2009 - Sep 2010 (18)	0.0126	0.0045	5.497	0.00000

Strategy Impact: simulation III

	OMR	MSB	F	Pr(>F)
May 2009 - Oct 2010 (18)	0.0131	0.0039	4.864	0.00000
Jun 2009 - Nov 2010 (18)	0.0115	0.0038	4.964	0.00000
Jul 2009 - Dec 2010 (18)	0.0123	0.0032	3.952	0.00000
Aug 2009 - Jan 2011 (18)	0.0113	0.0028	3.708	0.00001
Sep 2009 - Feb 2011 (18)	0.0102	0.0024	3.337	0.00006
Oct 2009 - Mar 2011 (18)	0.0083	0.0018	2.772	0.00075
Nov 2009 - Apr 2011 (18)	0.0092	0.0011	1.824	0.03557
Dec 2009 - May 2011 (18)	0.0079	0.0012	1.828	0.03505
Jan 2010 - Jun 2011 (18)	0.0070	0.0011	1.566	0.08895
Feb 2010 - Jul 2011 (18)	0.0071	0.0008	1.258	0.23416
Mar 2010 - Aug 2011 (18)	0.0056	0.0009	1.226	0.25611
Apr 2010 - Sep 2011 (18)	0.0027	0.0006	0.909	0.54957
May 2010 - Oct 2011 (18)	0.0022	0.0004	0.566	0.89030
Jun 2010 - Nov 2011 (18)	0.0024	0.0004	0.667	0.80551
Jul 2010 - Dec 2011 (18)	0.0025	0.0004	0.633	0.83670
Aug 2010 - Jan 2012 (18)	0.0028	0.0004	0.569	0.88796
Sep 2010 - Feb 2012 (18)	0.0032	0.0004	0.516	0.92318
Oct 2010 - Mar 2012 (18)	0.0022	0.0003	0.516	0.92315
Nov 2010 - Apr 2012 (18)	0.0009	0.0003	0.529	0.91484
Dec 2010 - May 2012 (18)	0.0013	0.0003	0.438	0.96099

Strategy Impact: simulation IV

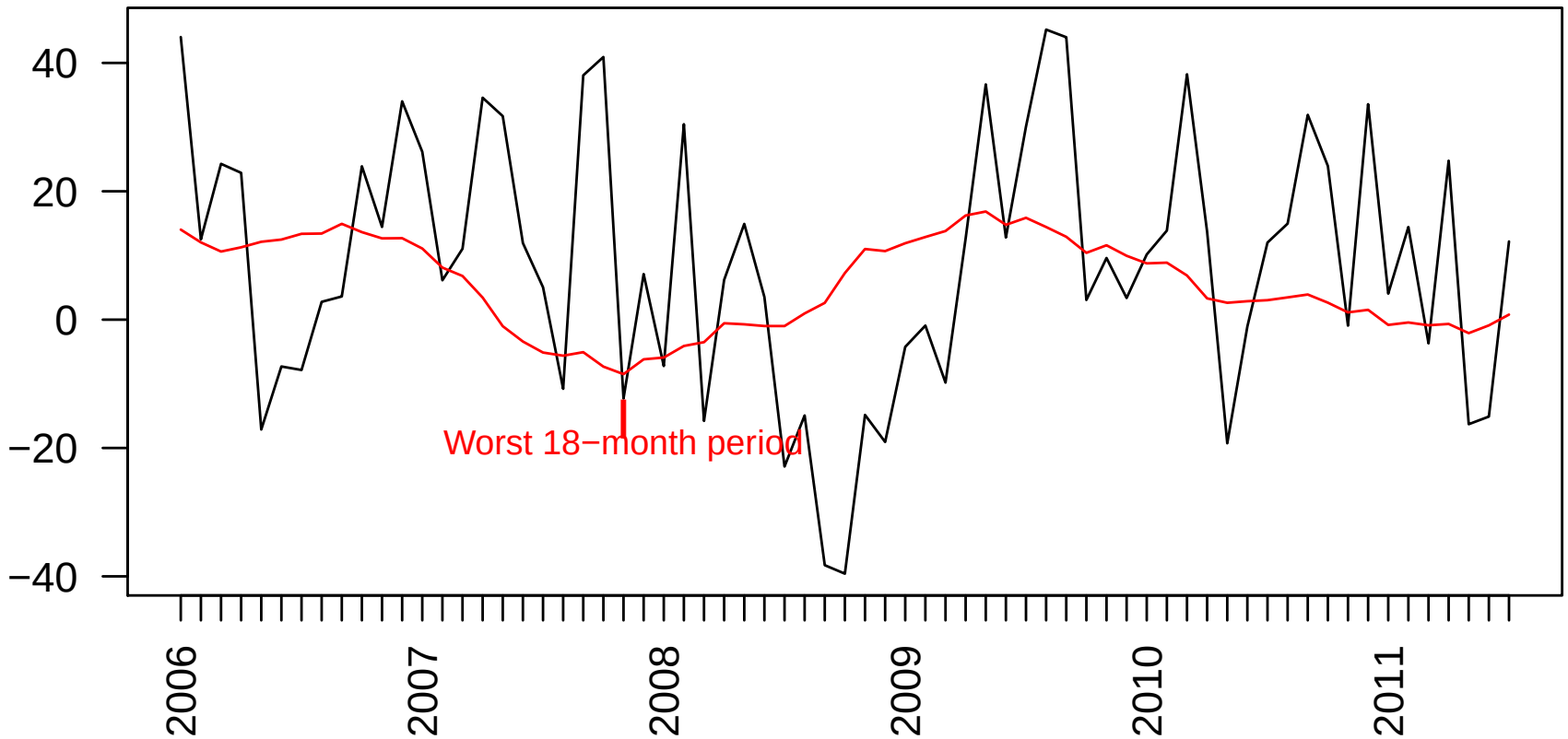
	OMR	MSB	F	Pr(>F)
Jan 2011 - Jun 2012 (18)	-0.0007	0.0003	0.417	0.96874
Feb 2011 - Jul 2012 (18)	-0.0004	0.0002	0.253	0.99742
Mar 2011 - Aug 2012 (18)	-0.0007	0.0001	0.221	0.99879
Apr 2011 - Sep 2012 (18)	-0.0006	0.0002	0.268	0.99649
May 2011 - Oct 2012 (18)	-0.0018	0.0004	0.614	0.85245
Jun 2011 - Nov 2012 (18)	-0.0007	0.0003	0.519	0.92127
Jul 2011 - Dec 2012 (18)	0.0007	0.0003	0.590	0.87229

Style Impact

	OMR	MSB	F	Pr(>F)
Jan 2006 - Dec 2012 (84) Whole range	0.0032	0.0006	0.921	0.47900
Dec 2007 - May 2009 (18) Crisis only	-0.0047	0.0015	1.688	0.12975

Symbols and procedure like in equivalent strategy table.

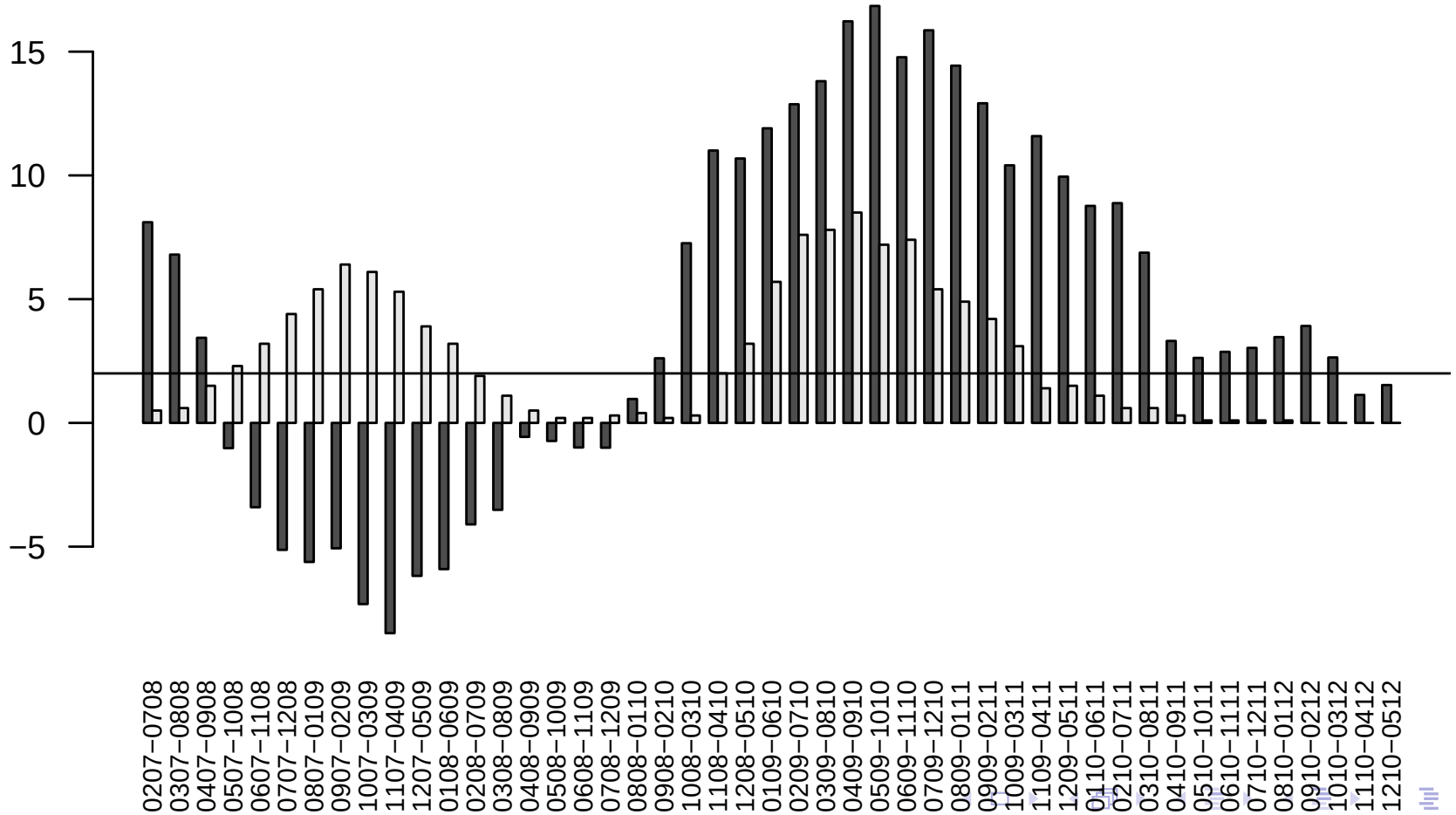
Average and Moving Average Strategy Returns



Black is the average strategy return observed each month.
Red is the mean of the following 18−month observations. Returns are annualised.

Comparing p-values over Different Time Windows

Grayed bars are the $-\log_{10}(\mathtt{p-value})$ of the F-test on related window.

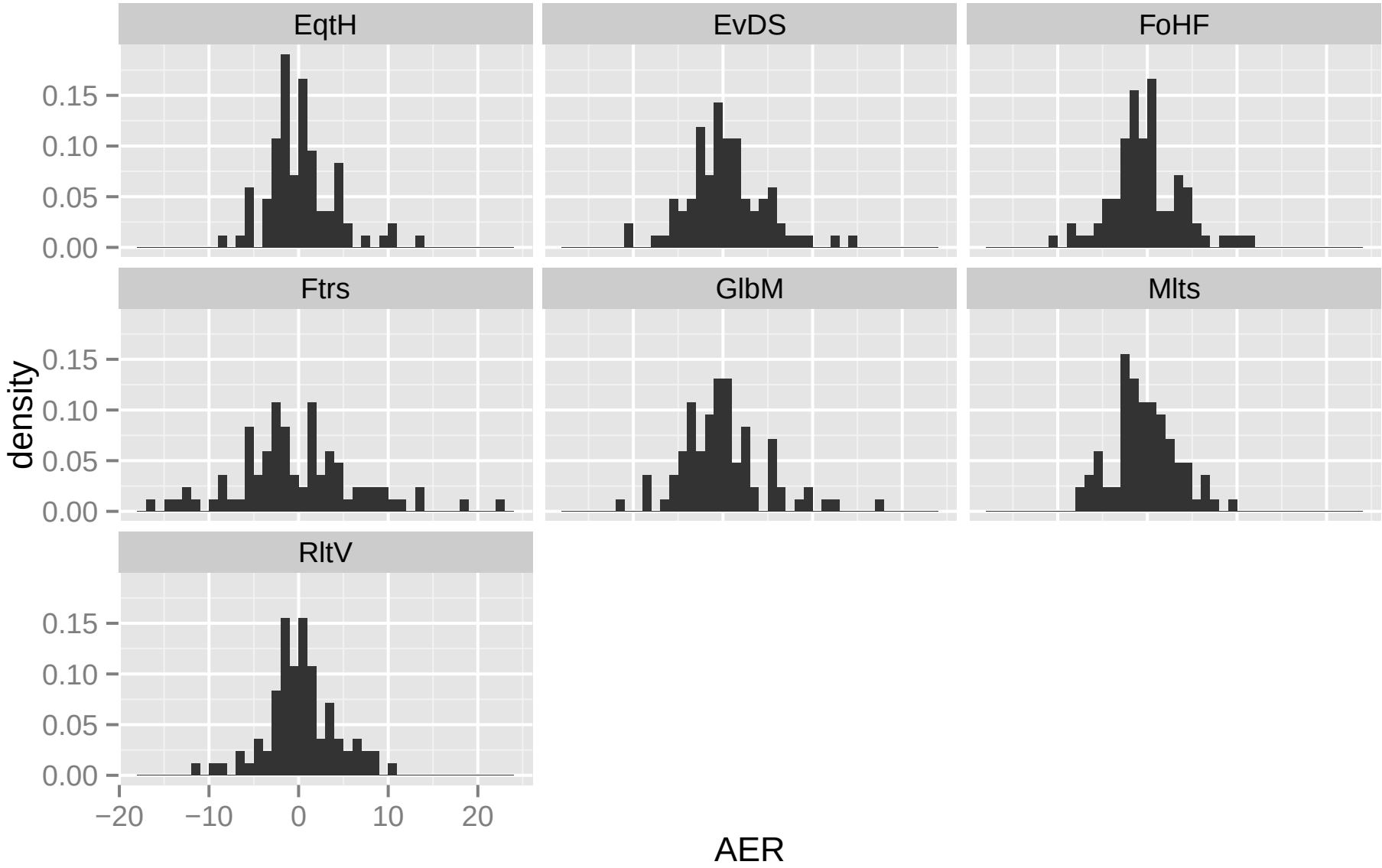


Outline

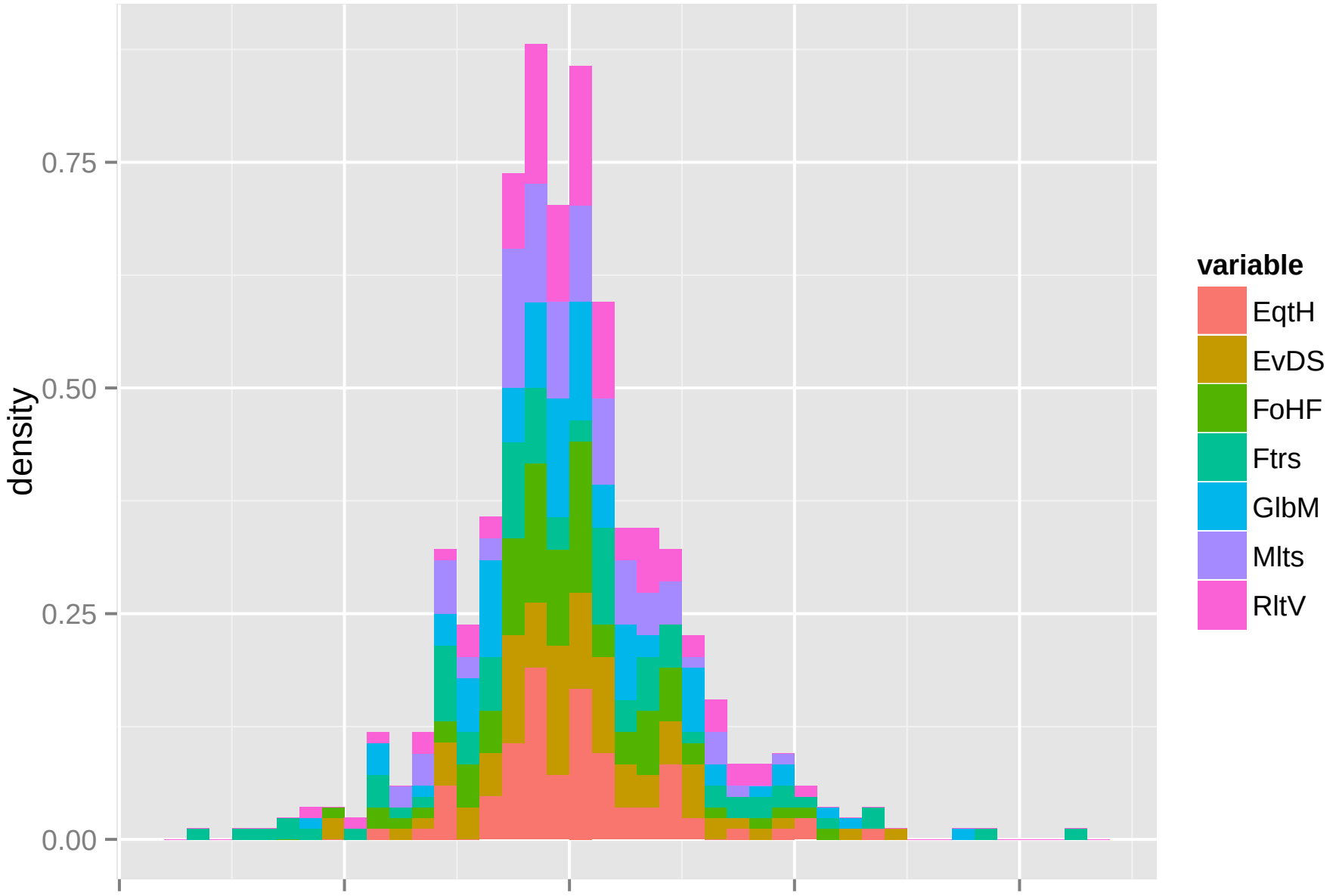
Alternative vs. Traditional Investments

- HFs are assumed to be a form of alternative investment potentially bearing a premium over traditional investments: it makes sense to measure the alternative premium over a traditional investment.
- We define the Alternative Excess Return (AER) of a style as the difference between the return of the style net of the equity market return.
  - To check how significant the alternative premium is, we interpret a positive AER over a negative one as a "success" and therefore we measure the significance of the results with a binomial test.
  - Secondly, with a Student t-test we test for the dimensionality of the AER.

Visual AER Analysis



Visual AER Analysis (cont'd)



Significance of Alternative vs. Traditional Premium

Note that the binomial test depends only on the number of successes (times AER being positive), the t-test depends also on the AER intensity.

	%success	Bin. p-value	Mean AER	t p-value
Relative Value	0.52	0.372	0.0033	0.283
Equity Hedge	0.50	0.543	0.0031	0.289
Event Driven Style	0.49	0.628	0.0026	0.314
Global Macro	0.45	0.837	0.0011	0.421
Fund of HF	0.45	0.837	-0.0013	0.595
Futures	0.45	0.837	-0.0021	0.607
Multistrategy	0.44	0.885	-0.0034	0.713

The premium is proxied with the the extra-return of style returns over the S&P500 index.
The first column is the the realised percent of "success" (AER>0). "Bin. p-value" is the significance of the success in terms of a binomial test. The mean AER is on a monthly basis. "t p-value" is the significance of the mean-AER by a t-test.

Risk-Adjusted AER

AER is weighted with downside risk.

	%success	Bin p-value	M. RA-AER	t p-value
Event Driven Style	0.48	0.707	0.3050	0.013
Equity Hedge	0.46	0.777	0.2626	0.025
Relative Value	0.43	0.922	0.1688	0.092
Global Macro	0.42	0.949	0.1707	0.107
Fund of HF	0.43	0.922	0.0266	0.418
Futures	0.39	0.981	-0.0341	0.593
Multistrategy	0.43	0.922	-0.0693	0.698

Conclusions

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