A Reality Check on Hedge Fund Returns*

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abstract

In this article we examine the backfill bias or instant history bias for hedge funds using additional information from the Tass database. This is information about the exact date a hedge fund starts to reporting to Tass. Using this information we are able to reveal the length of the instant histories. We find these to be just over 3 years on average. This number is far greater than previously documented. More than half of the recorded returns in the database are backfilled. The magnitude of the overall backfill bias is about 4 percent per annum on average. Again this number exceeds all previous estimates of the backfill bias we are aware of. We elaborate further across different time periods styles. Next, we eliminate backfilled returns and use survivorship free data to create a universe in which we could investment in real time. We introduce an investor who invests an equal amount in each fund that is in the universe. Conditional on this investment strategy our results indicate that the backfill bias is underestimated, and has a substantial downward effect on the returns across most hedge fund styles and is consistent over time for the whole sample. We have no reasons to believe that our conclusions are limited to the Tass database.

JEL Classification: G10; G11; G23; G29

Keywords: Backfill bias; Hedge funds; Performance Persistence; Self-selection bias.

1 Introduction

The *backfill* or *instant-history bias* appears when hedge funds with good track records decide to report, and data providers backfill their files to show this track record. Recently, several studies appeared which try to estimate the size of the backfill bias. There is evidence that the size of the backfill bias is substantial. Consequently, performance numbers of hedge funds are in general upward biased. Therefore a good notion of the size of this bias is important for asset allocation decisions to hedge funds.

In this paper instead of estimating the backfill bias we exactly determine the backfill bias. We do this for the Tass hedge funds database[1]. The edge in our research is that to calculate this bias we used the exact date the funds decide to report to Tass. With this information we can determine for each fund the time periods that are backfilled. Subsequently, we can remove the backfilled returns from our data set in order to obtain a data set that is free of backfill bias.

We will use our backfill bias free data set to investigate the following. A hedge fund manager is not required to report and is free to set up as many hedge funds as he likes. Our hypothesis is that a hedge fund manager will not report the performance over the first periods to a database vendor instantaneously. Instead, a hedge fund manager will report afterwards, and only if funds performed well. There is an analogy to the story about the investment newsletter. An investment firm sends investment newsletters to 1024 people. The first half receives a buy recommendation, and the second half a sell recommendation. Suppose the buy recommendation proves to be right. A week later

[1] For information see: www.tassresearch.com

the 512 people that received the buy recommendation, now receive a new letter: half of them a new buy and half of them a sell recommendation. 256 people will get a correct recommendation again. When we select and divide the groups who got the correct recommendations further till we get 64 people, the remaining 64 people have received correct recommendations four times in a row without one failure in four weeks. An investment firm with such track record has a good position to acquire new customers. The only drawback are the people who have got the wrong recommendation, they are less likely to become customers. Imagine now, that the investment firm is sending the four correct recommendations with falsified time stamps, directly to 1024 people who are returning from their 5 weeks holidays. Instead of 64 out of 1024, the investment firm has made a good impression to 1024 out of 1024 potential customers. Database vendors have backfilled hedge funds in their databases. Tass provided us the fund-specific entry dates, so in the analogy we know when the investment newsletters were mailed. The fact that hedge funds are not allowed to advertise publicly, but use database listings as an important marketing vehicle, deepens the above analogy.

Using basic statistical techniques and the fund-specific entry dates we reveal the backfill bias in the Tass database. Our data set ranges from 1996 to 2002. The average length of the backfill period in this sample is about 34 months, which is higher than reported earlier. An investment strategy, which is based on investing in a fund only if the fund is not in its backfill period, is a more realistic investment strategy than investing in backfilled periods. We introduce an investor who invests at every point in time an equal amount of money in each fund that is at that particular time listed in the Tass database. Doing so, we basically construct a non-backfilled equally

weighted hedge fund index return series. Conditional on this investment strategy our results indicate the following. On average the non-backfilled index series has a 4% lower return per annum than the backfilled series., When we compare our results with results of Fung & Hsieh (2000), who estimate the backfill bias in the Tass database to be 1.4% annually, we conclude the backfill bias to be severely underestimated. Our results are consistent for most styles and over different periods. To examine whether the results are stable trough time we break the available data period in subsets of one year. For an investor who tracks the funds in the Tass database we show that returns are significantly lower. Agarwal & Naik (2000) reported persistence in quarterly returns of hedge funds. Brown, Goetzmann & Ibbotson (1999) and Kat & Menexe (2003) found little or no evidence of persistence in mean returns of hedge funds. We find no persistence between the returns of the backfilled and the non-backfilled period.

Funds have an incentive to hide bad performance both before going to report and after leaving the database due to termination. Database vendors are not able to obtain all returns from terminating funds. Therefore we construct three scenario tests to show how additional negative performance could influence returns. Our analysis may have a large impact on asset allocation decisions to hedge funds, because our returns are substantially lower than those reported earlier.

The plan of the paper is as follows. Section 1 describes biases in hedge funds data. In section 2 we discuss and analyze the length of the instant histories in different time periods. Section 3 examines the influence of three liquidation scenarios on returns. Section 4 concludes.

2 Biases in hedge fund data

Because hedge funds are not obliged to report, information is scattered over different databases. The total base capital under management in the hedge fund industry is estimated to be over US$ 600 billion according to Hedgeworld and Tremont[2].

The data used to determine hedge fund returns is far from perfect. Whereas, mutual funds are required to report their daily net asset value (NAV) by law, this is not the case for hedge funds. Therefore data problems are much more likely to occur. Knowledge about the way the data is gathered gives insight in the potential biases in the data and the limitations of usage of the data. Besides that, new and terminating hedge funds effect the structure of the database. The use of derivatives and leverage by hedge funds increases the risk of termination compared to mutual funds. The fact that reporting is voluntarily and the data collection processes by data vendors gives rise to the variety of biases in hedge fund data. Therefore Fung & Hsieh (2000) distinguish between *natural* and *spurious biases*. Natural biases arise from the birth, growth and death processes of hedge funds, while spurious biases arise from sampling from an unobservable universe of hedge funds and the way data vendors collect hedge fund information as discussed above. Natural biases are for example survivorship and self-selection biases. Other biases originate from the drive of hedge fund managers to present good performance combined with the opportunity to influence the return figures. Furthermore the way research is carried out on these databases may cause biases. One can think for example of regression analysis, which requires funds with a

[2]see http://www.hedgeworld.com/news/read_news.cgi?section=what&story=what13327.html

minimum number of periods to analyze, which will result in neglect of funds with small return histories. The different subsets of funds and return histories that are taken into account, may influence returns upward or downward. *Survivorship biases* stems from analyzing surviving funds only. Survivorship biases are defined differently by various authors:

(i) survivorship bias is comparing a sample containing defunct funds with a sample that does not contain defunct funds.

(ii) survivorship bias is comparing a sample containing all funds with a sample that does not contain defunct funds.

(iii) survivorship bias originates from defunct funds, failing to report their last returns. This bias is also called *liquidation bias*.

Reaching maximum capacity and protecting a successful strategy are other reasons to stop reporting. From earlier research we have an indication of the magnitude of these survivorship related biases. From the mutual fund literature it is known that considering only the non-defunct funds can overstate mutual fund performance. Grinblatt & Titman (1989), Brown, Goetzmann, Ibbotson & Ross (1992), and Malkiel (1995) estimate this yearly survivorship bias to in the range of 0.5% to 1.4%. Several researchers have investigated this survivorship bias for hedge funds and the results vary. Brown et al. (1999) report a bias of 3% and a 20% drop-out rate for offshore hedge funds per year. Fung & Hsieh (2000) use the Tass database and calculate the annual survivorship bias to be 3% with a 15% drop out rate[3]. Liang (2000) examines this survivorship bias

[3]Fama & French (1993) specifies a Chow test for structural change in the median monthly returns series, where funds are aligned in event time, with the event being the first month of listing in the

in hedge fund returns by comparing the Tass and the HFR database. He finds that the survivorship bias exceeds 2% per year in the Tass database, while the HFR database survivorship bias equals 0.6%, which is consistent with the higher drop out rate in the Tass database. Ackermann, McEnally & Ravenscraft (1999) suggest that two biases, the survivorship bias and the self-selection bias, offset each other.

Due to voluntary reporting, funds may decide not to report or to stop reporting to databases. This is called the *self-selection bias*. The under- and outperforming funds may decide not to report anymore for different reasons. The underperforming funds could hide bad results in order to avoid investors withdrawing their money. Outperforming funds could protect their winning strategies, and stop the inflow of new capital by stopping to report and closing the fund. Hedge funds may decide to get a good track record before they start to report. This also results in a self-selection bias that is more difficult to estimate. There are three possible development paths for these funds. First, they can become so successful that they have no incentive to report because they acquired enough capital. Second, they become successful and reporting to databases will have benefits for them, e.g. reaching more investors and increasing capital. The last possibility is an unsuccessful fund that terminates without ever reporting.

The backfill or instant history bias appears when hedge funds with (good) track records decide to report and data providers backfill their files to show this track record. Fama & French (1993) calls these records *instant histories*. The backfill bias is a self-selection bias. Good track records in comparison to the hedge fund universe lead to

Tass database.

overestimating hedge fund performance, while bad track records are not backfilled or the funds with bad track records terminate and never report. The backfill bias on equity market data is commonly calculated by an indirect approach. This indirect approach is eliminating the first two years of reported data; see e.g. Fama & French (1993). Brown, Goetzmann & Park (1998) use the method of Park to estimate an instant history of 15 months for the Tass database. Ackermann et al. (1999), Fung & Hsieh (2000), and Edwards & Caglayan (2001) addressed the backfill bias for hedge funds in different periods for different databases, and all used indirect approaches. Ackermann et al. (1999) eliminate two years and found an average annual bias of 0.5% for the MAR and HFR database[4] funds with different sample periods ending in 1995. Fung & Hsieh (2000) calculated the backfill bias for the Tass database over the period 1994 to 1998. They eliminated the first 12 months of returns, because they found a median 343 days incubation period. The lasting mean performance was 1.4% lower over the period 1994–1998. So, they estimated the backfill bias to be 1.4% for the Tass database over the period 1994–1998. Edwards & Caglayan (2001) use the same indirect approach of eliminating 12 months of returns from the MAR database to correct for the backfill bias. They find that the average annual returns of hedge funds in the first year are 1.17% higher than the annual returns in subsequent years. In contrast with other researchers we use a direct method of examining the backfill bias. Instead of eliminating the same average or median incubation period for all funds, the direct method eliminates the individual incubation period per fund. The information that we use in this paper is information from Tass. Tass provided us the dates for which the

[4]hedge fund databases are described in section 4.

funds started reporting to the database. We eliminate the returns for each fund before the reporting date.

3 Scenarios

Note that a fund that terminated without ever reporting to a database is not taken into analysis. The fact that we have no data about not reported returns, leads us do our analysis on conditionally on the available universe. Investing in the complete hedge funds universe is impossible. Laws prohibiting marketing of hedge funds and the freedom to refrain from reporting by hedge funds, leave us unknown about the complete set of hedge funds. An investor cannot invest in a hedge fund, which existence is not known to him. Therefore we introduce an investor who invests an equal amount in all hedge funds that report in a database at every point in time. Using the non-backfilled returns we can assess the returns as they actually were available to the investor. The investor is basically an index investor, where the index is equally weighted and index membership is determined by reporting to the database. This is a real time and implementable investment strategy that only invests in all hedge funds that are in a specific point in time in the Tass database. To determine 'known' hedge funds we use the Tass database. A hedge fund is added to the Tass database when the hedge fund manager decides to report. We assume that at this specific point in time our investor is able to invest in the added hedge fund[5]. The database contains prior returns of the

[5]We assume a hedge fund to be open for investors when added to the database. Reporting to a database seems illogical to us, if the benefits of acquiring new investments are excluded.

fund, which are not investable during this period, while he was unaware of the existence of the fund. Our investor holds an equally weighted portfolio of all hedge funds that are in the database at a given moment, except for the hedge funds that are in their backfill period. The portfolios are rebalanced every month. We include all stopped-reporting or 'graveyard' funds, which have been recorded by Tass since January 1994. This makes our data sample a so-called survivorship free sample, and does not demand from our investor the foresight to know which funds are going to leave the database (look ahead bias). The survivorship bias, which consists of termination, liquidation and self-selection biases, is therefore partly neutralized. Partly because returns from funds that leave the database are incorporated till they leave. However, lockup periods and fund liquidations can prevent an investor to withdraw his investments after the fund has left the database. Liquidation and time biases still exist. In order to give insight in the possible magnitude of liquidation and time biases we set up several scenarios. The first scenario is based on findings of Ackermann et al. (1999), who found a negligible impact of liquidation and time biases[6]. In this scenario we assume the extra return to be zero. The second and third scenarios are based on information from Tass employees[7], who are – not withstanding their systematic efforts – unable

[6] Ackermann et al. (1999) used information from HFR. HFR polled terminating funds and were able to recover all returns through the instant of redemption for all of their terminating funds. Overall, the average loss in fund value beyond the information contained in the database is only 0.7% and average delay is 18 days.

[7] oral communication to the authors

to obtain the last not reported return histories from all terminating funds. Funds leaving the database exhibit indirect reporting. Rather than reporting directly we observe many non-terminated hedge funds delay their reporting several months. In this manner poor performing funds could choose to cancel reporting totally if poor performance persists. We assume that terminating funds are not willing to cooperate due to serious negative performance after leaving the database. From many terminated large hedge funds it is known that they could not return the total principal investments. Long Term Capital Management is a famous example, this fund lost 92% of capital from October 1997 to October 1998 and did not report to databases. The fear of a collapse of the financial system urged the Federal Reserve Bank to take action, and through this action, returns are known for this not reporting fund. Therefore we respectively add an extra negative return in the month they stop reporting of 50% and 100% in the second and third scenario. The survivorship bias assessed by comparing a sample including defunct funds with a sample excluding defunct funds changes when considering only non-backfilled returns. Dropout or attrition rates increase due to smaller periods of returns histories. All our results are conditional on the investment strategy outlined above.

4 Data

The hedge fund industry is growing at a fast pace, growth in assets under management is estimated to be 40% per annum. Database vendors have enlarged their databases also. Large shifts in styles have taken place in recent history, e.g. the focus on large

global macro directional funds has shifted to relative value funds. The clientele is changing also: wealthy individuals were the investors of the first hour, while nowadays even conservative institutions are interested. The growth and change of the hedge fund industry, lead to the existence of different hedge fund tracking databases. The most well known are the Tremont Tass database, the hedge fund research database (HFR), the Vanhedge database and the managed accounts reports (MAR) hedge database. The HFR database contains over 1400 funds in January 2001 while the Tass database contains 3606 funds in December 2002. The HFR database contains funds that stopped reporting, the so-called 'graveyard' funds. The Tass database contains more graveyard funds (1386 in December 2002). Different data collection methodology of the Tass and the HFR indices results in further varying performance; see Fung & Hsieh (2001). We chose the Tass database for our analysis. Compared to traditional asset managers, hedge funds charge aggressive fees this is typically 1 or 2% of assets under management, and 20% of cumulative profits on a yearly basis. The returns we use are net of fees except for a few hedge funds for which Tass did not receive the returns net of fees. Both onshore and offshore hedge funds are used in our analysis. A offshore hedge fund differs from a onshore hedge fund, in that it is registered in a tax-haven. The dominant motivation for the existence of offshore hedge funds is to minimize tax liabilities to non-U.S. citizens. Most hedge funds report in U.S. dollars. We converted returns reported in other currencies to U.S. dollars. We select the monthly reporting funds for which we have information on the first reporting dates, and eliminate the quarterly reporting funds. This brings our sample down to 3580 funds. First records for the reporting dates are kept from January 1994. Information prior to January 1994 in the Tass

database is too sporadic to provide meaningful results. Due to the small number of funds, which have returns after their reporting date in 1994 and 1995, constructed indices without backfilled returns have a very small basis compared to the backfilled indices. In 1996, however it is possible to construct indices without backfilling for the majority of hedge fund styles with a reasonable basis, so we perform our analysis on the period January 1996 to December 2002. In order to assess differences of the backfill bias through time we break the total period up in subsets of years ranging from 1996 to 2002. To test the consistency of our findings by style, we break the funds sample returns further up in 10 hedge fund styles. To determine which style a hedge fund has, we use the category label assigned by Tass. Non-reporting funds can have several reasons to stop reporting. We assume funds that drop from the database due to merging in another entity, no longer reporting to tass, or closed to new investments not to have additional negative performance. Liquidation, fund dormant, and not being able to contact the manager, are reasons for us to assume additional (negative) performance. So funds that stop reporting due to the latter reasons are incorporated in the liquidation scenario analysis. The salient features of the raw data are in Table 1[8]. We observe that Convertible Arbitrage, Event Driven, Fixed Income Arbitrage and Emerging Markets behave quite similarly. These styles show both substantial negative skewness and excess kurtosis of the return distribution. Together with Equity Market Neutral they also share the property of high positive autocorrelation of the returns.

[8]Note that the statistics are calculated on the styles and not on the individual returns. So we first formed an equally weighted style index and then calculated the time series standard deviation, skewness, etc from the style index return series.

	Mean	Stdev.	Skew	XKurt	25% Q	75% Q	Max Drawd	Acf 1
Convertible Arbitrage	1.02	1.06	-0.97	2.90	0.59	1.56	-3.41	0.43
Long/Short Equity Hedge	1.30	3.25	0.20	0.94	-1.01	3.32	-8.84	0.18
Event Driven	0.91	1.54	-1.73	7.82	0.17	1.88	-7.26	0.34
Fund of Funds	0.67	1.65	0.33	1.11	-0.33	1.54	-4.38	0.13
Fixed Income Arbitrage	0.78	1.10	-3.45	17.61	0.33	1.38	-6.09	0.44
Managed Futures	0.70	2.80	0.20	-0.29	-1.18	2.63	-5.00	-0.06
Global Macro	0.67	1.64	0.80	0.62	-0.57	1.56	-3.51	0.00
Unknown	0.95	1.81	-0.22	0.05	-0.17	2.20	-4.82	-0.05
Emerging Markets	0.84	4.95	-1.04	3.66	-1.92	3.96	-21.61	0.28
Equity Market Neutral	0.87	0.79	0.14	-0.19	0.27	1.49	-0.79	0.36
Dedicated Short Bias	0.67	6.31	0.47	0.50	-3.57	5.33	-11.79	0.06
All funds	0.91	1.88	0.21	0.89	-0.46	2.25	-5.20	0.15

Table 1: Salient features of monthly returns to hedge funds over 1996-2002 per style.

These features are reported earlier in the hedge fund literature. We can also deduce relatively high Sharpe ratios for these styles. This has also been noted earlier.

Given the methodology used by the different data vendors we have no reasons to believe that our conclusions are limited to the Tass database.

5 Empirical findings

Given the short returns history (1994–2002) we employ it is impossible to assess backfill biases caused by incubation periods larger than 9 years. This seems to be no problem when looking at the distribution of the incubation periods of all backfilled funds, see figure 1. The average length and median of instant histories we calculated is respectively about 34 and 23 months. The median indicates that the majority of backfilled funds has an incubation period greater than 22 months. An average length of 34 months is substantially larger than estimates and calculations by others. Brown et al. (1998) estimated 15 months for Tass hedge fund database. Fung & Hsieh (2000) found a median of 343 days of hedge fund incubation period and eliminated 12 months of returns per fund to obtain a backfill free database. In equity market papers (e.g. Fama & French (1993)) it is common to eliminate 24 months. Ackermann et al. (1999) eliminate therefore 24 months. Edwards & Caglayan (2001) eliminate 12 months of returns following Fung & Hsieh (2000).

While backfilled returns from funds that start reporting in the future are not in the database yet, we expect less backfilled funds at the end of our data set. Indeed, the percentage of backfilled funds is decreasing per year from 69% in 1996 to 13% in 2002;

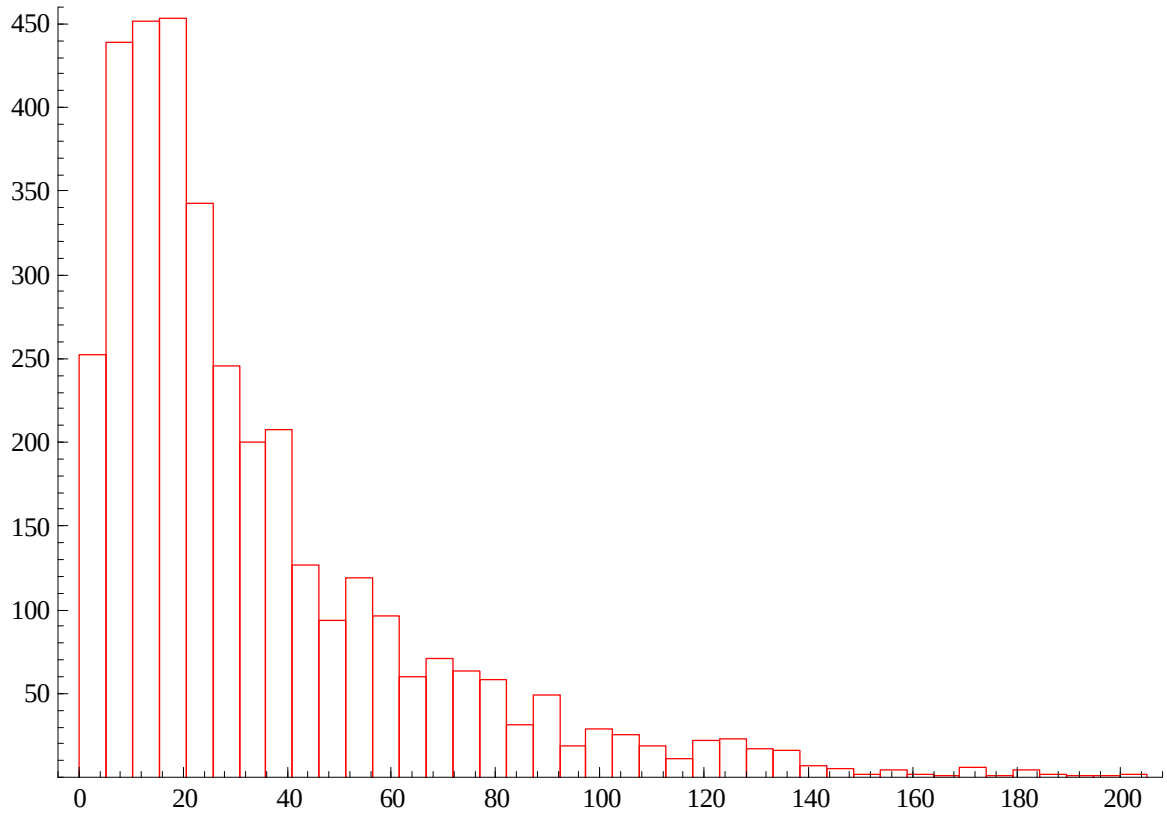

Figure 1: Distribution of incubation periods in months of 3580 funds in the period 1994 to 2002.

	1996	1997	1998	1999	2000	2001	2002	Total
Convertible Arbitrage	73	65	65	60	58	38	15	52
Long/Short Equity Hedge	79	75	65	58	58	44	10	57
Event Driven	80	76	60	52	50	36	11	53
Fund of Funds	65	51	49	44	45	43	20	46
Fixed Income Arbitrage	69	60	50	52	53	40	14	48
Managed Futures	48	37	34	31	31	23	10	32
Global Macro	59	47	45	37	39	35	11	40
Unknown	84	64	62	67	69	56	23	58
Emerging Markets	77	59	49	38	38	27	5	44
Equity Market Neutral	83	72	69	60	64	41	15	53
Dedicated Short Bias	73	76	67	62	59	36	10	55
All funds	69	61	55	49	51	40	13	50

Table 2: Percentage of backfilled funds per style over the years 1996 to 2002

see table 2. For two styles, Managed Futures and to a lesser extent Global Macro, the percentage of backfilled funds seems substantially less than for the other styles. Of all returns in the database more than half are backfilled. Funds have on average longer track records than direct reporting records. Funds leaving the database also show indirect reporting. Rather than reporting directly we observe many non-terminated hedge funds delay their reporting several months. Because information about dates of data-entries from returns after the first data entry are not kept, it is impossible to calculate this type of self-selection bias of funds temporally leaving the database and coming back with backfilled returns when it suits.

In table 3 the backfill bias is presented per style and per year. Our expectations

are confirmed by the results. Backfill biases broken down by period and style remain positive except for dedicated short. Only three styles have a bias below 2 percent per annum. Few funds relative to other styles could induce less significant results. The fund of funds class is considered to be less influenced by biases, see Fung & Hsieh (2000). The backfill bias for fund of funds is with 2.27% indeed lower than average. However, 2.27% annual return, but remains highly significant with a t-value of 3.86. The bias of convertible arbitrage is 2.19% and significant. Convertible arbitrage is the only style that keeps its double digit average return after eliminating the backfilled returns. Long/short Equity Hedge is the largest style with 683 non-backfilled funds. It has high returns and also a high backfill bias of approximately 6.34%. For dedicated short bias, managed futures, global macro and the 'unknown' category the annual return is well below the risk free rate of approximately 5%[9] during this period. All years have a positive sign for the backfill bias. The bias is relative small in the years 2001 and 2002. The low percentage of backfilled funds in 2001 and especially 2002 is an explanation for this fact. The backfilling of 2002 will probably happen 2003 and further into the future. In 1999 record performance for convertible arbitrage, fund of funds and emerging markets were combined with negative biases. Assuming that reporting hedge fund managers have more capital under management than managers that are still building their track record, the question arises whether easy markets lead reporting hedge fund managers to increase leverage since this enlarges their performance fee.

Table 4 shows the paired difference t-tests for the backfill bias during the years 1996

[9] On average 4.9% for 3 months LIBOR over the period 1996-2002.

	1996	1997	1998	1999	2000	2001	2002	Total
Convertible Arbitrage	1.39	2.46	5.15	-1.72	4.07	3.18	0.75	2.19
Long/Short Equity Hedge	7.97	5.92	7.74	6.78	9.01	5.99	1.03	6.34
Event Driven	2.73	2.15	5.26	2.19	3.40	0.16	1.28	2.45
Fund of Funds	3.15	3.61	2.53	1.82	3.51	0.70	0.54	2.27
Fixed Income Arbitrage	5.40	4.19	8.83	3.51	4.91	0.04	0.27	3.89
Managed Futures	3.54	0.23	4.04	3.19	2.71	1.94	-0.09	2.23
Global Macro	3.25	4.28	3.87	1.50	4.21	3.99	0.79	3.13
Unknown	11.05	3.28	10.20	4.18	9.55	0.65	1.34	5.75
Emerging Markets	2.98	8.88	5.69	-0.55	6.82	3.55	1.54	4.16
Equity Market Neutral	0.29	6.19	5.91	1.50	3.63	-0.08	0.74	2.60
Dedicated Short Bias	-5.21	4.23	0.89	1.89	-2.15	4.23	-1.93	0.29
All funds	5.55	5.07	5.88	4.36	6.09	2.66	0.84	4.35

Table 3: Backfill bias per style over the years 1996 to 2002. The backfill bias is expressed as the annual difference between the backfilled and non-backfilled index in percentages of returns.

	1996	1997	1998	1999	2000	2001	2002	Total
Convertible Arbitrage	0.83	1.24	2.01	-1.31	3.66	3.32	2.53	3.44
Long/Short Equity Hedge	4.17	3.63	4.89	6.34	5.01	3.40	3.51	9.99
Event Driven	2.28	2.52	2.74	2.76	2.78	0.35	3.91	5.57
Fund of Funds	1.30	1.80	1.70	1.79	2.35	0.91	2.18	3.86
Fixed Income Arbitrage	3.17	2.77	3.65	2.01	2.35	0.03	0.85	5.48
Managed Futures	1.63	0.23	1.65	1.83	2.61	3.18	-0.11	3.66
Global Macro	0.98	1.42	2.45	0.82	1.79	1.66	1.54	3.54
Unknown	1.13	1.05	2.29	0.92	2.71	0.11	1.26	2.81
Emerging Markets	0.78	3.86	2.49	-0.26	6.45	2.24	3.10	4.67
Equity Market Neutral	0.11	2.93	3.39	1.93	2.10	-0.08	2.56	3.86
Dedicated Short Bias	-0.72	0.60	0.12	0.24	-0.12	1.23	-1.11	0.09
All funds	2.57	2.80	4.36	3.93	5.16	4.79	3.57	7.96

Table 4: t-values of the paired difference t-tests on 12 months biases per style per year

to 2002 per style. The significance of the backfill bias varies per style and year. The bias over all funds and years is significant at all usually employed significance levels, except for the year 2002 and the style dedicated short. Relatively few funds and returns in the backfill-excluded samples in these periods could let to an increase of the role of fund specific volatility relative to the backfill included samples. The low number of funds from the category dedicated short or other can also induce more fund specific volatility in the constructed indices. The fund specific volatility in indices could cause lower paired difference tests. Highly significant biases are found for all styles except Dedicated Short.

In scenario 2 and 3 we add respectively an additional negative return of 50 and

	1996	1997	1998	1999	2000	2001	2002	Total
Convertible Arbitrage	15.04	14.39	5.08	17.44	12.89	10.45	10.12	12.20
Long/Short Equity Hedge	21.71	20.62	14.68	40.34	9.54	1.34	-2.66	15.01
Event Driven	18.14	17.93	2.70	19.14	9.68	7.26	1.10	10.83
Fund of Funds	11.83	10.59	1.39	20.49	5.41	2.06	3.18	7.83
Fixed Income Arbitrage	18.56	12.05	-5.06	12.83	5.52	11.28	9.76	9.26
Managed Futures	8.47	11.44	11.39	1.44	8.51	0.44	14.23	7.98
Global Macro	14.13	15.25	4.26	4.78	3.23	5.17	8.30	7.87
Unknown	11.57	10.01	12.69	24.43	10.28	5.44	3.82	11.16
Emerging Markets	25.36	16.99	-32.97	41.22	-8.57	11.90	7.16	8.52
Equity Market Neutral	17.23	13.84	11.25	8.61	14.26	3.97	3.53	10.37
Dedicated Short Bias	-2.40	8.95	-3.86	-13.72	19.27	8.31	23.87	5.71
All funds	15.95	15.52	4.94	24.37	7.56	3.96	2.98	10.73

Table 5: Backfilled returns per style per year from scenario 1, that is terminated funds have no additional negative returns outside the database.

	1996	1997	1998	1999	2000	2001	2002	Total
Convertible Arbitrage	13.65	11.93	-0.07	19.16	8.82	7.27	9.37	10.01
Long/Short Equity Hedge	13.74	14.70	6.94	33.56	0.53	-4.65	-3.69	8.67
Event Driven	15.42	15.78	-2.56	16.95	6.28	7.10	-0.18	8.38
Fund of Funds	8.68	6.98	-1.14	18.67	1.89	1.36	2.64	5.57
Fixed Income Arbitrage	13.16	7.86	-13.89	9.32	0.61	11.24	9.48	5.37
Managed Futures	4.94	11.21	7.35	-1.76	5.80	-1.50	14.32	5.75
Global Macro	10.89	10.97	0.40	3.28	-0.99	1.18	7.51	4.74
Unknown	0.52	6.73	2.49	20.25	0.73	4.80	2.48	5.41
Emerging Markets	22.38	8.11	-38.66	41.77	-15.39	8.36	5.62	4.36
Equity Market Neutral	16.94	7.65	5.34	7.11	10.63	4.05	2.78	7.78
Dedicated Short Bias	2.81	4.72	-4.75	-15.61	21.42	4.07	25.80	5.42
All funds	10.40	10.45	-0.95	20.01	1.47	1.30	2.13	6.38

Table 6: Non-backfilled returns per style per year from scenario 1: terminated funds have no additional negative returns outside the database.

	1996	1997	1998	1999	2000	2001	2002	Total
Convertible Arbitrage	15.52	15.84	7.71	16.09	15.90	15.76	12.82	14.23
Long/Short Equity Hedge	23.84	22.63	18.98	45.27	15.89	7.17	5.28	19.80
Event Driven	18.82	18.59	6.50	21.17	13.21	7.85	11.88	13.99
Fund of Funds	13.12	13.95	4.00	22.73	9.55	2.61	4.54	10.05
Fixed Income Arbitrage	21.05	14.88	3.34	15.84	9.31	12.78	11.03	12.60
Managed Futures	12.64	11.71	19.22	8.50	14.42	7.82	12.07	12.33
Global Macro	16.00	19.80	8.84	7.61	9.70	17.73	8.58	12.60
Other	13.26	12.19	18.42	26.66	14.53	7.05	11.98	14.86
Emerging Markets	26.47	23.25	-27.23	39.73	2.21	20.93	31.62	16.53
Equity Market Neutral	17.32	16.19	13.86	9.53	16.30	3.11	9.06	12.19
Dedicated Short Bias	-5.11	10.41	-3.93	-12.84	13.87	18.61	2.38	3.29
Total	18.27	18.80	9.83	28.81	13.37	7.70	7.91	14.94

Table 7: Only backfilled returns per style per year.

	1996	1997	1998	1999	2000	2001	2002	Total
Convertible Arbitrage	1.87	3.91	7.78	-3.07	7.08	8.49	3.45	4.22
Long/Short Equity Hedge	10.10	7.94	12.04	11.71	15.36	11.81	8.97	11.13
Event Driven	3.40	2.81	9.06	4.22	6.93	0.75	12.06	5.62
Fund of Funds	4.43	6.97	5.14	4.06	7.66	1.25	1.90	4.48
Fixed Income Arbitrage	7.89	7.03	17.23	6.52	8.70	1.54	1.55	7.23
Managed Futures	7.70	0.50	11.87	10.25	8.62	9.32	-2.25	6.58
Global Macro	5.11	8.83	8.45	4.33	10.68	16.55	1.07	7.86
Other	12.74	5.47	15.93	6.41	13.80	2.26	9.50	9.45
Emerging Markets	4.09	15.14	11.43	-2.04	17.61	12.57	26.00	12.17
Equity Market Neutral	0.38	8.54	8.52	2.42	5.67	-0.94	6.28	4.41
Dedicated Short Bias	-7.92	5.69	0.82	2.77	-7.55	14.53	-23.42	-2.13
Total	7.87	8.35	10.78	8.80	11.89	6.40	5.78	8.55

Table 8: Backfill bias calculated as the difference between indices constructed with only backfilled and indices with only "live-reporting" returns per style per year.

100 percent. Tables containing backfill and liquidation biases, t-statistics, backfilled returns, and backfill eliminated returns for scenarios 2 and 3 are placed at the end of this paper. Scenarios 2 and 3 in which terminating funds get an additional negative return deliver higher and more significant biases. The negative return is added to the last reporting date of terminating funds. The last returns of terminating funds are mostly not in backfill periods, because it makes no sense reporting returns at a point in time, where the fund is not investable anymore. There are some exceptions, a few funds started reporting during the same month they terminated. The backfill period is assumed to include the month, in which the fund is going to report, while the investor is not able to invest for that whole month in the fund. The return over all periods and styles for backfilled samples drops from 10.73% in the first scenario (no additional returns) to respectively 7.43% and 3.95% percent for scenario 2 and 3. Biases increase from 4.35% (first scenario) to 7.24% and 10.13% percent for scenario 2 and 3. This leads overall backfill eliminated performance drop from 6.38% (first scenario) to 0.11% and -6.18% percent for the two scenarios. It also has substantial effects on skewness and kurtosis. As we are adding large negative outlier in the left tail of the distribution, the skewness will become more negative and the kurtosis increases.

All in all, our most conservative estimate of the backfill bias is 4.35% per month. This number is statistically significant. In money terms this is also a significant amount. Given the estimated US$ 600 billion capital under management in the hedge fund industry as quoted earlier. This would amount to an economically significant loss of return of US$ 26.1 billion per year.

6 Conclusions

In this paper we first analyzed the length of instant histories. The average length of instant histories we calculated is approximately 37 months. This is substantially larger than estimates and calculations of other researchers. More than 50% of all returns in the database are backfilled returns. Funds on average have longer track records than direct reporting records. The hedge funds instant histories are longer compared to equity funds. This indicates the importance of track records in the hedge fund industry. Funds leaving the database, also exhibit indirect reporting. Rather than reporting directly we observe many non-terminated hedge funds delay their reporting several months. This implies liquidation or self-selection biases. Because information about dates of data-entries from returns after the first data entry are not kept, it is impossible to calculate this type of self-selection bias of funds temporally leaving the database and coming back with backfilled returns when it suits. Therefore our assessment of the backfill bias is on the conservative side.

The backfill bias over the total period and all funds is about 4 percentage annual return. The results are consistent over the different years. The decrease in magnitude of the backfill bias in 2001 is consistent with the lower percentage of backfilled fund returns in this period. Results over the years 1996 to 2000 are significant for all funds. From the years 1996 and 1997 less than 40 percent of the returns is a non-backfilled return. Together with relatively few funds, this could give rise to more fund specific volatility in the constructed indices.

Biases are highly significant for all styles except Dedicated Short. Scarcity of data

could cause these results. The style category Dedicated Short consist of less than 11 hedge funds in the non-backfilled index during every period.

Fund of funds are often considered the most bias free styles of hedge funds. However, fund of funds still exhibit a significant backfill bias of 2.27 percent per annum, which is a substantial amount of their average backfilled annual return (7.83).

Incorporating return scenarios after leaving the database for terminating funds, the backfill bias increases significantly. In the scenario of minus 50% additional return five styles are able to show positive performance. Convertible arbitrage, long short equity hedge, event driven, and equity market neutral deliver returns of respectively 3.5, 2.9, 5.5, and 3.6 percent. The performance of funds of funds is not significantly different from zero. In the scenario of minus 100% additional return only the event driven style is able to deliver a low positive return, which still remains below the risk free rate.

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Tables

	1996	1997	1998	1999	2000	2001	2002	Total
Convertible Arbitrage	10.78	6.98	10.64	1.68	4.83	5.78	0.89	5.95
Long/Short Equity Hedge	13.83	9.81	12.39	9.35	11.54	7.64	1.21	9.38
Event Driven	6.25	1.60	5.91	4.90	5.17	1.12	1.00	3.70
Fund of Funds	6.01	6.43	6.05	3.93	6.22	3.24	0.95	4.69
Fixed Income Arbitrage	11.39	7.05	18.47	9.21	8.81	1.30	0.58	8.16
Managed Futures	7.29	2.94	7.32	6.36	5.47	3.05	0.29	4.68
Global Macro	2.29	7.82	6.72	4.40	9.36	3.55	1.05	5.04
Unknown	21.46	7.39	16.84	7.52	13.37	1.26	1.60	9.93
Emerging Markets	7.76	11.27	9.25	2.33	9.62	4.46	1.62	6.65
Equity Market Neutral	0.29	6.19	8.99	8.81	9.01	-1.09	1.08	4.76
Dedicated Short Bias	4.25	18.56	0.89	5.48	-0.88	12.29	-1.92	5.57
All funds	10.44	8.38	9.96	7.57	9.11	4.16	1.06	7.24

Table 9: Backfill and liquidation bias per style over the years 1996 to 2002. The bias is expressed as the annual difference between the backfilled and non-backfilled index in percentages of returns. Terminated funds have an extra last return of minus 50%

	1996	1997	1998	1999	2000	2001	2002	Total
Convertible Arbitrage	1.40	2.07	2.06	0.69	3.62	3.09	2.98	3.87
Long/Short Equity Hedge	7.19	4.94	7.09	6.47	4.94	3.94	4.06	11.84
Event Driven	2.17	1.40	2.84	3.91	3.04	2.06	2.01	5.57
Fund of Funds	2.51	2.74	3.21	4.73	4.98	2.91	3.95	7.26
Fixed Income Arbitrage	2.75	2.41	6.09	3.03	3.22	0.71	1.46	6.66
Managed Futures	2.86	2.86	2.85	3.28	5.47	4.38	0.35	6.76
Global Macro	0.76	2.54	3.73	1.72	3.36	1.28	1.80	5.05
Unknown	1.69	1.50	2.23	1.36	2.22	0.21	1.44	3.60
Emerging Markets	1.92	5.00	3.84	1.01	7.68	2.76	3.14	7.02
Equity Market Neutral	0.11	2.93	3.12	2.19	4.47	-0.83	3.14	4.64
Dedicated Short Bias	0.38	1.57	0.12	0.58	-0.05	2.75	-1.11	1.42
All funds	4.81	4.89	6.68	6.57	7.48	6.43	4.25	11.62

Table 10: t-values of the paired difference t-tests on 12 months biases per style per year for scenario 2.

	1996	1997	1998	1999	2000	2001	2002	Total
Convertible Arbitrage	8.97	11.49	2.18	15.58	11.32	7.43	9.21	9.45
Long/Short Equity Hedge	19.37	18.62	11.88	38.28	6.81	-3.24	-4.95	12.32
Event Driven	17.18	17.38	2.21	16.09	7.46	5.09	-0.67	9.23
Fund of Funds	9.20	7.02	-2.28	17.81	2.03	-1.30	1.38	4.82
Fixed Income Arbitrage	15.88	8.67	-14.55	7.87	1.35	7.35	7.96	4.90
Managed Futures	-0.53	6.11	4.98	-5.61	1.37	-4.04	10.61	1.83
Global Macro	4.89	11.32	0.38	-1.59	-8.41	0.53	6.98	2.00
Unknown	8.91	4.89	7.67	22.99	6.73	4.60	2.98	8.38
Emerging Markets	23.76	14.63	-39.94	36.30	-13.94	7.75	5.38	4.62
Equity Market Neutral	17.23	13.84	9.88	3.92	9.78	1.94	2.02	8.36
Dedicated Short Bias	-6.79	5.19	-3.86	-16.08	17.05	-4.30	20.78	1.65
All funds	12.05	12.64	1.14	20.91	3.71	0.14	0.97	7.34

Table 11: Backfilled returns per style per year from scenario 2, that is terminated funds have a 50% negative return after leaving the database.

	1996	1997	1998	1999	2000	2001	2002	Total
Convertible Arbitrage	-1.80	4.50	-8.46	13.90	6.49	1.65	8.32	3.50
Long/Short Equity Hedge	5.54	8.81	-0.51	28.93	-4.73	-10.87	-6.16	2.94
Event Driven	10.93	15.78	-3.71	11.19	2.29	3.98	-1.66	5.52
Fund of Funds	3.19	0.59	-8.33	13.88	-4.18	-4.53	0.43	0.13
Fixed Income Arbitrage	4.49	1.62	-33.02	-1.34	-7.47	6.06	7.37	-3.26
Managed Futures	-7.82	3.17	-2.34	-11.97	-4.10	-7.09	10.32	-2.85
Global Macro	2.60	3.50	-6.34	-5.98	-17.77	-3.03	5.94	-3.04
Unknown	-12.54	-2.50	-9.17	15.48	-6.64	3.34	1.38	-1.55
Emerging Markets	16.01	3.36	-49.19	33.98	-23.56	3.29	3.76	-2.03
Equity Market Neutral	16.94	7.65	0.89	-4.89	0.78	3.03	0.94	3.60
Dedicated Short Bias	-11.05	-13.37	-4.75	-21.56	17.93	-16.58	22.70	-3.92
All funds	1.60	4.26	-8.82	13.33	-5.40	-4.02	-0.09	0.11

Table 12: Non-backfilled returns per style per year from scenario 2: terminated funds have a 50% negative return after leaving the database.

	1996	1997	1998	1999	2000	2001	2002	Total
Convertible Arbitrage	21.18	11.64	16.35	5.13	5.63	8.43	1.02	9.95
Long/Short Equity Hedge	19.76	13.72	17.05	11.93	14.08	9.29	1.39	12.44
Event Driven	9.87	1.04	6.57	7.64	6.95	2.08	0.71	4.98
Fund of Funds	8.90	9.27	9.61	6.05	8.94	5.80	1.35	7.14
Fixed Income Arbitrage	17.55	10.00	28.25	14.99	12.83	2.58	0.90	12.53
Managed Futures	11.07	5.68	10.63	9.59	8.24	4.18	0.67	7.17
Global Macro	1.48	11.40	9.60	7.35	14.59	3.13	1.31	7.00
Unknown	33.60	11.74	24.04	11.05	17.66	1.89	1.87	14.60
Emerging Markets	12.60	13.69	12.93	5.26	12.44	5.38	1.70	9.19
Equity Market Neutral	0.29	6.19	12.14	16.45	14.47	-2.09	1.42	7.01
Dedicated Short Bias	15.57	36.43	0.89	9.37	0.46	21.41	-1.92	11.87
All funds	15.34	11.71	14.05	10.79	12.14	5.65	1.27	10.13

Table 13: Backfill and liquidation bias per style over the years 1996 to 2002. The bias is expressed as the annual difference between the backfilled and non-backfilled index in percentages of returns. Terminated funds have an extra last return of minus 100%

	1996	1997	1998	1999	2000	2001	2002	Total
Convertible Arbitrage	2.83	8.56	-0.75	13.71	9.73	4.39	8.30	6.67
Long/Short Equity Hedge	17.03	16.63	9.07	36.21	4.07	-7.82	-7.24	9.62
Event Driven	16.22	16.82	1.71	13.03	5.22	2.93	-2.44	7.62
Fund of Funds	6.56	3.43	-5.96	15.12	-1.35	-4.67	-0.43	1.80
Fixed Income Arbitrage	13.18	5.27	-24.09	2.88	-2.85	3.41	6.15	0.51
Managed Futures	-9.55	0.75	-1.45	-12.70	-5.79	-8.53	6.98	-4.34
Global Macro	-4.44	7.37	-3.52	-8.00	-20.11	-4.16	5.66	-3.91
Unknown	6.19	-0.35	2.55	21.54	3.11	3.75	2.14	5.54
Emerging Markets	22.15	12.27	-46.99	31.35	-19.33	3.59	3.59	0.69
Equity Market Neutral	17.23	13.84	8.49	-0.82	5.28	-0.09	0.50	6.33
Dedicated Short Bias	-11.37	1.31	-3.86	-18.50	14.78	-17.48	17.60	-2.58
All funds	8.14	9.76	-2.66	17.44	-0.14	-3.69	-1.04	3.95

Table 14: Backfilled returns per style per year from scenario 3, that is terminated funds have a 100% negative return after leaving the database.

	1996	1997	1998	1999	2000	2001	2002	Total
Convertible Arbitrage	1.44	2.12	2.04	1.29	3.09	2.78	2.95	3.67
Long/Short Equity Hedge	6.12	5.26	7.00	5.90	4.81	4.31	4.48	11.42
Event Driven	1.92	0.67	2.85	3.55	2.90	2.40	0.80	4.81
Fund of Funds	3.14	3.16	3.67	5.94	6.55	3.15	4.63	8.54
Fixed Income Arbitrage	2.51	2.03	6.19	3.23	2.89	0.93	1.64	6.45
Managed Futures	3.47	3.44	3.71	3.81	6.88	4.86	0.79	8.21
Global Macro	0.34	3.21	4.04	2.07	3.54	0.90	1.92	5.09
Unknown	1.66	1.60	2.05	1.43	1.73	0.31	1.54	3.49
Emerging Markets	2.39	5.09	3.54	1.77	6.83	2.90	3.15	7.39
Equity Market Neutral	0.11	2.93	2.64	2.14	4.21	-1.12	3.07	4.25
Dedicated Short Bias	0.86	1.49	0.12	0.81	0.03	2.73	-1.11	2.11
All funds	6.26	6.53	7.77	7.91	8.79	7.00	4.74	13.11

Table 15: t-values of the paired difference t-tests on 12 months biases per style per year for scenario 3.

	1996	1997	1998	1999	2000	2001	2002	Total
Convertible Arbitrage	-18.35	-3.09	-17.10	8.57	4.10	-4.05	7.28	-3.28
Long/Short Equity Hedge	-2.73	2.91	-7.98	24.28	-10.01	-17.11	-8.62	-2.82
Event Driven	6.35	15.78	-4.87	5.39	-1.73	0.85	-3.15	2.64
Fund of Funds	-2.34	-5.84	-15.56	9.07	-10.29	-10.47	-1.78	-5.34
Fixed Income Arbitrage	-4.37	-4.72	-52.34	-12.11	-15.68	0.83	5.25	-12.01
Managed Futures	-20.62	-4.94	-12.07	-22.28	-14.04	-12.70	6.31	-11.51
Global Macro	-5.92	-4.03	-13.12	-15.35	-34.69	-7.28	4.35	-10.92
Unknown	-27.41	-12.09	-21.50	10.48	-14.55	1.86	0.27	-9.06
Emerging Markets	9.55	-1.42	-59.92	26.09	-31.77	-1.79	1.89	-8.49
Equity Market Neutral	16.94	7.65	-3.65	-17.27	-9.20	2.01	-0.92	-0.68
Dedicated Short Bias	-26.94	-35.12	-4.75	-27.86	14.32	-38.89	19.51	-14.45
All funds	-7.21	-1.94	-16.72	6.65	-12.27	-9.34	-2.31	-6.18

Table 16: Non-backfilled returns per style per year from scenario 3: terminated funds have a 100% negative return after leaving the database.