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Abstract

We study the long-run outcomes associated with hedge funds' compensation structure. Over a 22-year period, the aggregate *effective* incentive fee rate is 2.5 times the average contractual rate (i.e., around 50% instead of 20%). Overall, investors collected 36 cents for every dollar earned on their invested capital (over a risk-free hurdle rate and before adjusting for any risk). In the cross-section of funds, there is a substantial disconnect between lifetime performance and incentive fees earned. These poor outcomes stem from the asymmetry of the performance contract, investors' return-chasing behavior, and underwater fund closures.

Keywords: Hedge Funds, Performance, Asset Management, Incentive Fees
JEL Classification: G11, G23

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1 Introduction

"Performance comes, performance goes. Fees never falter."

Warren Buffett, referring to hedge fund performance[1]

One of the tenets of modern economics is that agency conflicts can be mitigated by implementing compensation contracts that align the agent's interests with those of the principal. Hedge fund fees are considered a prime example of such a pay-for-performance compensation structure, as contract features are appealing to both managers and investors. Managers receive a fraction—often 20%—of the gains earned. And investors are typically protected by provisions meant to ensure they pay incentive fees only on profits that exceed a predefined benchmark, which often includes the previous highest portfolio valuation (high-water mark) and sometimes a hurdle rate.

The consensus among economists is that incentive fees (also known as performance fees) strongly motivate managers to exert high effort.[2] Practitioners also share this view. According to recent surveys of large hedge fund managers (Waterman and Kehoe, 2019) and of large institutional investors (JP Morgan, 2019), respondents in both groups agree that incentive fees are a useful tool to align the interests of managers with those of investors. Further demonstrating investors' preference for performance-based compensation, in recent years, there has been pressure from investors to reduce management fees, usually in exchange for higher incentive fee rates (JP Morgan, 2019; Waterman and Kehoe, 2019).

Academics have studied hedge fund compensation contracts extensively, generally focusing on the tradeoff between the benefit of the increased managerial effort and the drawback of possible risk-shifting due to the asymmetric nature of the contract.[3]

But how do incentive fees fare in practice? We deviate from the literature that explores

[1]Chairman's Letter, Berkshire Hathaway Inc., Annual Report 2017, p. 12.

[2] See, for example, Starks (1987), Elton, Gruber, and Blake (2011), Agarwal, Daniel, and Naik (2009), Aragon and Qian (2009), Panageas and Westerfield (2009), Lan, Wang, and Yang (2013), Lim, Sensoy, and Weisbach (2016), and Mitchell, Muthuraman, and Titman (2019). See also Jesse Eisinger, "Could mutual funds benefit from hedge-fund fee structure?," *The Wall Street Journal*, April 19, 2005.

[3]See Agarwal, Mullally, and Naik (2015) for an extensive review of the literature.

the function of performance contracts in mitigating agency costs. Instead of asking whether the incentive fee contract is optimal *ex-ante*, we focus on the *ex-post* implications of the asymmetry embedded in the contract. Specifically, we measure the long-term outcomes realized over full market cycles. To do so, we analyze the returns and fees earned by nearly 6,000 hedge funds over two decades (1995 to 2016).

Our results indicate that the asymmetry of the incentive fee contract has quantitatively large yet underappreciated implications for the aggregate and cross-sectional relation between hedge fund performance and fees. During the 22-year sample period, investors paid about *half* of their aggregate gross profits as incentive fees—whereas the average contractual incentive fee is below 20%. Moreover, there is a considerable disconnect between returns generated and incentive fees earned across all but the worst-performing 5% of funds. After including management fees, investors collected about 36 cents for each dollar of gross excess return generated by funds on their invested capital. The other 64 cents were paid as management and incentive fees. Adding insult to injury, these results are obtained before adjusting fund returns for risk.

This study has three parts. The first part examines aggregate realized fees. The second part examines the mechanisms contributing to the difference between aggregate realized fees and nominal fees. The final part examines the allocation of fees in the cross-section of funds.

In the first part, we present aggregate estimates of the fees paid by investors over the years.[4] The results are striking. Hedge funds in our sample charge a nominal incentive fee rate of 19.0% of gross profits, on average. In practice, however, investors paid 49.6% of the cumulative gross profits as incentive fees during our sample period. That is, the effective incentive fee rate is 2.62 times higher than the corresponding nominal rate. Adding management fees to the equation, managers collected the lion's share of returns over the years. Total fees paid amount to 63.6% of the cumulative gross returns when including

[4]Similar to other studies, we infer gross returns and fees from reported net returns. Our results are therefore based on estimates. In the last section of the paper, we present extensive sensitivity analyses with respect to the assumptions used to obtain these estimates.

management fees.

The economic significance of these findings is immense. Between 1995 and 2016, investors earned \$228.2bn in aggregate gross profits on their hedge fund investments and paid \$113.3bn as incentive fees. This figure is \$69.8bn larger than the amount they would have paid if the compensation structure had been completely symmetrical.[5] Under simple assumptions, it is possible to extrapolate these figures from the sample considered here to the universe of funds that report to the largest providers of hedge fund data. Comparing the aggregate gross profits and incentive fees estimated for that universe, investors have paid \$193.7bn more than they would have paid if incentive fees had been symmetrical.

Thus, fees impose a meaningful drag on the returns that investors earn on their hedge fund investments. Management fees amount to 1.51% of aggregate AUM per year, while incentive fees amount to an additional 1.93%. Of the latter fees, only 0.74% are "justified" by the amount of aggregate gross profits actually earned by investors, while the remaining 1.19% have been paid for gains that have been offset by losses.

In the second part of our study, we identify the two primary mechanisms that cause the effective level of incentive fees to exceed the nominal level. Both mechanisms exist because of the asymmetric nature of incentive fees and lead to perverse outcomes due to their interaction with fund return volatility and investor behavior.

The first mechanism stems from the fact that investors cannot offset gains and losses across funds. The aggregate profits from a hedge fund portfolio combine the results of winning and losing funds; however, the losses produced by losing funds cannot be used to diminish the incentive fees owed to winning funds. A particularly absurd illustration of this mechanism occurred in 2008. Despite the aggregate loss of \$147.1bn before fees (−26.6%), investors still paid incentive fees of \$4.4bn in that year. Thus, the cross-sectional variation in fund performance causes the aggregate ratio of performance fees-to-profits to be higher

[5] $\$228.2\text{bn} \times (49.6\% - 19.0\%) = \$69.8\text{bn}$. A symmetric incentive fee structure is called a fulcrum fee. See Jason Zweig, "A fee structure for fund managers who put their money where their mouth is," *The Wall Street Journal Blogs: Moneybeat, The Intelligent Investor*, January 11, 2017.

than the nominal performance fee rate. The lack of cross-fund performance netting also gives hedge funds an incentive to offer multiple investment strategies using separate vehicles (i.e., become fund families) rather than consolidating them into a single fund.

The second mechanism is the discontinuation of investment activity following losses. Most hedge funds have a high-water mark provision specifying that investors need to recover any prior loss before they pay incentive fees to the fund.[6] Thus, although investors are not paid "inverse incentive fees" in the case of losses, they are implicitly compensated with "fee credits," i.e., the right to recover prior losses without paying incentive fees. In principle, this should ensure that the long-run ratio of incentive fees to gross profits remains close to the contractual incentive fee rate.

In actuality, however, the protection offered by the high-water mark provision is eroded by the behavior of managers and investors, both of whom tend to discontinue investment following losses.

Specifically, fund managers are substantially more likely to liquidate their funds following large losses than following large gains (see similar results in Brown, Goetzmann, and Park, 2001; Getmansky, Lo, and Mei, 2004; Liang and Park, 2010). When a fund is liquidated following losses, investors automatically lose the opportunity to earn back their losses without paying additional incentive fees. Moreover, if the liquidating fund earned incentive fees at some point in its life, then the act of liquidation leads to the crystallization of "underwater incentive fees," i.e., fees paid for past gross profits that have been offset by subsequent same-fund losses.

Furthermore, hedge fund investors display a strong return-chasing behavior. That is, they tend to invest after good performance and withdraw capital following poor performance at the fund level (Goetzmann, Ingersoll, and Ross, 2003; Getmansky, 2012; Lim et al., 2016) and in the aggregate (Dichev and Yu, 2011). However, some funds experience reversion to the mean in their performance, and others appear to face diminishing returns to scale, as flows are

[6]Some funds in our sample do not offer a high-water mark provision. This is not a first-order driver of our findings. Our key results are virtually unchanged if funds without a high-water mark provision are excluded.

negatively related to future fund performance (Fung, Hsieh, Naik, and Ramadorai, 2008; Teo, 2009; Yin, 2016). Indeed, we confirm that return-chasing investors do not appear to achieve superior performance. On the other hand, return-chasing means that funds experience larger outflows following losses. Therefore, outflows will often occur precisely when investors have accrued fee credits and when previous incentive fees paid have gone underwater.

We quantify the impact of each of these mechanisms. We do so by decomposing the difference between the nominal incentive fee rate and the effective incentive fee rate, i.e., the difference between 19.0% and 49.6%. First, net fund losses lead to an increase in the effective incentive fee rate of over 15%, bringing the incentive fee up to 34.5%. Second, the crystallization of underwater incentive fees due to investor withdrawals and fund liquidations after poor performance further increase the effective rate by 8.4% and 5.4%, respectively. This brings the effective rate up to 48.3%. Finally, underwater incentive fees associated with capital that is still invested with funds as of the end of the sample increase the effective rate by 1.4%, lifting the incentive fee up to 49.6%.

In the third part of the study, we explore the relation between lifetime fund performance and incentive fees in the cross-section of funds. We start by decomposing fund-level incentive fees into two parts: *i*) "justified fees," and *ii*) "residual fees." Justified incentive fees are calculated as fees that would have been paid on the cumulative profits at the end of each fund's life (or the end of the sample). Residual incentive fees arise when funds collect incentive fees on profits but later generate losses that offset the earlier gains. The losses associated with the latter type of fees become irrecoverable once funds liquidate or investors exit—actions that are more likely to take place precisely after poor performance.

Our analysis shows that residual incentive fees are a substantial part of incentive fees. Residual incentive fees average 0.77% per annum across funds (1.19% per annum in aggregate), have little relation with funds' lifetime performance, and are collected by funds across the entire performance spectrum. In fact, residual fees are slightly larger for funds in the domain of losses (negative lifetime gross profits) than for funds in the domain of gains.

One might be tempted to blame the global financial crisis of 2008 for the results; indeed, many hedge funds suffered losses in 2008. However, the mechanisms that push effective incentive fees away from the contractual fee rate are general and independent of any specific period. In down market periods, like the global financial crisis of 2008, the effects that we document are exacerbated (e.g., higher rates of underwater capital withdrawals and fund closures). These episodes, unfortunately, are not uncommon. During our sample period, in addition to the global financial crisis, many hedge funds experienced significant losses in 1998 (LTCM and emerging market currencies crisis), 2000–2002 (dot-com and related turmoil), and 2011 (European debt crisis). As we show, a significant fraction of these losses is never recovered because capital tends to be disinvested when it is underwater. In early 2020 (the COVID-19 crisis, outside our sample period), the media reported large capital withdrawals and a spike in fund closures amid high fund return dispersion.[7]

A large literature examines hedge fund performance. Kosowski, Naik, and Teo (2007) perform a careful analysis of fund returns and document that hedge funds show persistence in performance and estimate an alpha spread of 5.5% between the top- and bottom-decile performers. Dichev and Yu (2011) document that dollar-weighted hedge fund returns are much lower than buy-and-hold returns. Bollen, Joenvaara, and Kauppila (2020) show that the positive contribution of hedge funds as part of a diversified institutional portfolio has diminished significantly over time even under the assumption that investors can identify and invest in top-performing funds using several predictive characteristics. Bhardwaj, Gorton, and Rouwenhorst (2014) paint a similarly bleak picture for commodity trading advisors (CTAs). These studies, however, focus on net-of-fees returns and thus disregard the interplay of the compensation contract, fund performance, and managerial and investor behavior, which is the core of our study. Thus, our paper complements prior research by providing additional insights that help to understand net-of-fees returns.

[7]See, for example, Nishant Kumar and Bei Hu, "Hedge Fund Hotshots Suffer Humbling Losses in Coronavirus Chaos," *Bloomberg*, April 16 2020, and Melissa Karsh, "Hedge Funds Suffer Largest Quarterly Withdrawals Since 2009," *Bloomberg*, April 22, 2020.

Overall, our results show that the hedge fund industry's standard incentive contract has significant yet understudied consequences. The expected incentive fee on a diversified portfolio of hedge funds is materially higher than the contractual fee rate. The main factors that account for this observation are that investors cannot offset gains and losses across funds, and that entry and exit decisions of investors and managers are path-dependent and tend to undermine the effectiveness of high-water mark provisions by destroying fee credits.

Our analysis is informative about the potential effectiveness of alternative compensation contracts. In recent years, investors have raised concerns about the high fees that hedge funds charge. Investors and hedge fund managers have explored "1-and-30" instead of "2-and-20," meaning that weight is shifted away from management fees to incentive fees (JP Morgan, 2019; Waterman and Kehoe, 2019). The aspiration is that this fee structure will lead to a tighter alignment of incentives between managers and investors. Our results suggest two reasons for caution. First, investors end up paying a significantly larger fraction of their profits as incentive fees than what the contract specifies, e.g., the 30% incentive fee rate could be easily doubled ex-post. Second, in the long run, a significant portion of incentive fees will likely be uncorrelated with actual lifetime fund performance, hence looking more like management fees than incentive fees. Therefore, a higher incentive fee rate may have unintended consequences and may lead to unfavorable outcomes for investors.

The paper proceeds as follows. Section 2 discusses data sources and variable construction and describes the sample of funds. Section 3 presents aggregate results for the hedge fund industry. Section 4 examines the main mechanisms contributing to the observed aggregate incentive fee rate. Section 5 analyzes the cross-sectional distribution of fees across funds. Section 6 presents robustness analyses, and Section 7 concludes.

2 Hedge Fund Data and Variable Construction

2.1 Data Sources and Sample

The hedge fund sample used in this study combines data from two major commercial databases: the BarclayHedge database and the Lipper Trading Advisor Selection System database (hereafter TASS). These databases have been confirmed in prior research to have representative coverage of the hedge fund universe.[8] The BarclayHedge and TASS data sets were obtained in April 2018 and June 2018, respectively. Both data sets include a graveyard file that contains the historical performance of funds that dropped from the primary database after 1994.

We apply some standard screens before each observation is included in the primary sample. Only U.S.-dollar funds that report net-of-fees returns are considered. Moreover, observations with missing returns or with missing or stale AUMs are excluded. It appears that the AUM of certain funds is updated only once every quarter. In that case, we do not drop these observations because the analysis of the data is carried out at the quarterly frequency and assumes that assets flow in and out of funds at the end of each quarter. Because the objective of this study is to assess the effectiveness of the typical compensation structure of hedge funds, we only consider funds that have such a compensation structure. Thus, we require non-missing information regarding management fees, incentive fees, and high-water marks. In addition to eliminating backfilled returns, we further mitigate incubation bias and the influence of small and unrepresentative funds by including funds only starting the month after their AUM reaches $5m for the first time (in 2016 dollars). In value-weighted and aggregate results, small funds are automatically given lower weight; thus, the effect of

[8] Joenväärä, Kauppila, Kosowski, and Tolonen (2019) combine and compare seven different hedge fund databases, five of which have been used in previous academic studies. Their analysis shows that the data sets used here (BarclayHedge and TASS, together with Hedge Fund Research) have the most comprehensive information. These data contain a high number of funds, have a graveyard database (starting in 1994), and have better coverage of essential variables such as management fee rates and assets under management (AUM). BarclayHedge and TASS contain data for 58.1% of the total number of funds that report to the seven databases. Moreover, the average fund performance is similar across the different datasets.

the exclusion below \$5m AUM funds is minimal. Moreover, because we eliminate backfilled observations, the potential impact of incubation bias on our results is likely to be small.

We correct the data for known biases in reported performance. Specifically, we take steps to mitigate survivorship bias, backfill bias, and delisting bias. In Section 6, we provide additional details regarding these data corrections and present related robustness tests.

After these initial screens, we combine the BarclayHedge and TASS data and eliminate duplicate fund observations or share classes that exist across the two databases. To do so, we start by fuzzy-matching fund names and fund company names. Then, we calculate the return correlation for each potential duplicate pair and identify it as a duplicate if the correlation is greater or equal to 99%. Finally, for each duplicate case, we keep the one with the longest series of valid returns and AUM data.

2.2 Primary Sample

The final sample starts in the first quarter of 1995 and ends in the last quarter of 2016.[9] In our main empirical analyses, we focus on hedge funds,[10] i.e., we exclude commodity trading advisors (CTAs) and funds-of-hedge-funds (FoFs). Section 6.5, however, presents results obtained when performing the main analyses on the sample of CTAs and FoFs.

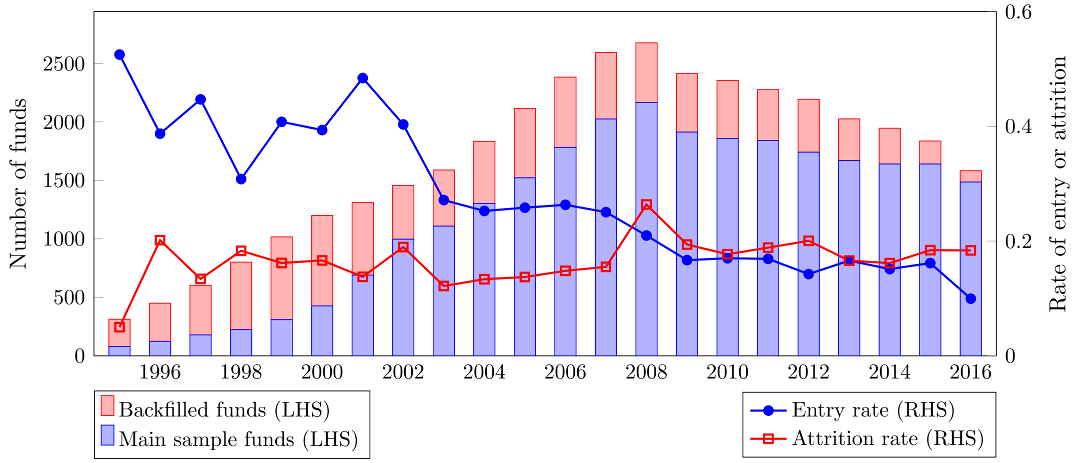
Figure 1 shows the evolution of the hedge fund sample over time. There are 80 funds at the beginning of the sample and about 1,500 funds at the end of the sample period in 2016. As the right axis shows, fund entrance is larger than fund exit in every year until 2008. In every year after 2008, the rate of exit exceeds the rate of entry. As a result, the number of funds in the sample peaks in 2008 at more than 2,100 funds. The chart also shows the number of backfilled funds in each year. As discussed, these funds are excluded from the main sample until the quarter in which they first started reporting their monthly

[9]We do not include observations for the year 2017 because we obtained the "academic" version of the data in early 2018, and some of the data are updated with a time lag.

[10]Following much of the literature, we define hedge funds as those funds whose primary strategy is classified as Relative Value, Event-Driven, Multi-Strategy, Long Only, Long-Short, Short Bias, Sector, Market Neutral, Global Macro, Emerging Markets, and Other. We use these strategy definitions to cluster standard errors in the statistical analyses. Managed Futures funds are considered CTAs and are analyzed separately.

Figure 1. Number of Funds Over Time

This figure shows the number of funds at the beginning of each year of the sample period. The funds are from BarclayHedge and TASS. We follow Jorion and Schwarz (2019) to identify backfilled observations and exclude them from the main sample of funds. The line with round markers and the line with square markers show the fraction of new entrants and delisted funds in each year, respectively.



performance to the data providers.

2.3 Variable Construction

Hedge fund returns are usually reported net of all fees. The advantage of this feature of the data is that it enables one to observe the returns that investors actually earn. This is important because net returns can differ substantially from gross returns, since hedge funds typically charge high fees and have a nonlinear compensation structure. Although basic details about fee levels are usually known, a breakdown of gross returns into net returns and fees is not readily available. To obviate this problem, academic articles have employed an algorithm to impute gross returns from net returns (early implementation was in Agarwal et al., 2009). This method relies on basic information about management and incentive fee levels, high-water mark provisions, and a set of assumptions.

The algorithm has been applied using frequencies that vary from one month to one year. We choose to calculate flows, fees, and gross returns at the quarterly frequency. This choice requires the assumption that all flows in a given quarter take place at the end of that quarter and thus might be slightly less precise than if flows were modeled at the monthly frequency. On the other hand, this choice allows us to include funds whose AUM is updated only once per quarter, thus avoiding selection bias.[11]

The algorithm assumes that all the money invested in a fund when it enters the sample belongs to a single investor. Each quarter, if the fund experiences a net inflow of money, it is assumed that it came from a new investor. If instead there is a net outflow, the money is assumed to be withdrawn by the oldest remaining investor, then the next one, and so on. That is, a first-in-first-out (FIFO) rule is applied to track whether an investor must pay incentive fees in a quarter in which gross profits are positive.[12] The purpose of this algorithm is to account for the fact that, although hedge funds are pools of money, each individual capital commitment made to the fund has its own high-water mark that depends on the net asset value (NAV) at the moment of entry. To be conservative, it is assumed that every hedge fund that has a high-water mark also has a cumulative hurdle rate that has to be met before incentive fees can be collected.

Each quarter, the fund manager accrues incentive fees only if the value of the investor's share is higher than the previous high-water mark plus the hurdle rate plus the management fee. Our data do not specify the crystallization period, i.e., the period over which accrued inventive fees are paid. To be conservative, we assume that all funds have a full clawback clause for incentive fees within each calendar year. However, anecdotal evidence suggests that, historically, funds collected incentive fees more frequently, e.g., semiannually or quarterly. Our estimates should therefore be viewed as a lower bound of the fees collected by hedge funds.

Some academic articles further make assumptions regarding the manager's own invest-

[11] Implementing the algorithm at the quarterly frequency, however, leads to underestimating the amount of money moving in and out of a fund in any given quarter. In order to account for the resulting loss of information, in our algorithm we assume that funds experience a quarterly inflow and outflow of 2.5% of AUM in addition to the observed net flow. In Section 6, we provide additional details and a sensitivity analysis for this choice.

[12] The FIFO rule was applied by Agarwal et al. (2009), Lim et al. (2016), and Cao and Velthuis (2017), among others.

Table 1. Summary Statistics

The table presents summary statistics for the sample used in the study. The sample covers funds in the BarclayHedge and TASS databases from 1995 to 2016. Panel A presents statistics about the number of funds, split by funds that are live at the end of the sample and funds that exited by the end of the sample period. Panel B shows statistics at the fund-quarter level. Backfilled observations are detected using the algorithm of Jorion and Schwarz (2019).

Panel A: Number of Funds

	Total	Live	Graveyard
Number of funds	5,917	1,217	4,700

Panel B: Quarter-Fund Observations

	Fund-qtr observations	Average	Standard deviation	Percentiles 25th	50th	75th	AUM-weighted average
Main Sample							
AUM ($m)	94,306	254.44	794.00	21.04	63.06	192.15	n.a.
Management fee (% AUM)	94,306	1.46%	0.46%	1.00%	1.50%	2.00%	1.51%
Incentive fee (% gains)	94,306	19.36%	3.08%	20.00%	20.00%	20.00%	18.97%
I(High water mark)	94,306	0.89	0.32	1.00	1.00	1.00	0.92
Net excess return (%)	94,306	0.97%	9.74%	−2.08%	1.02%	4.16%	0.77%
Backfilled Observations							
Net excess return (%)	43,721	2.47%	10.58%	−1.20%	1.79%	5.56%	0.96%

ment in the fund and how to model it. Here, the focus is on the average amount of fees paid by all outside investors. Hence, for simplicity and to avoid making additional assumptions, we do not model managerial ownership directly. This choice does not bias the calculation of the ratio of fees to profits for the average outside investor.

Other variables used in the analysis are defined and constructed following the literature. In particular, *Hurdle rate* is defined as the 3-month LIBOR for funds that have a high-water market provision, and zero otherwise (Lim et al., 2016). *Raw returns* are fund returns before all fees. *Gross excess returns* are defined as raw returns minus the hurdle rate (if there is one). *Gross profits*, which are the base for the calculation of the incentive fee, are defined as raw returns in excess of the previous high-water mark (if the fund has a high-water mark provision), minus the hurdle rate and the management fee. *Net returns*, which are reported by the fund directly to the data provider, are the returns earned by investors after management and incentive fees. Finally, *Net excess returns*, are defined as net returns minus the hurdle rate.

Table 1 shows summary statistics for the sample. Using the terminology of hedge fund data vendors, in Panel A we partition the sample into two groups: "live" funds, i.e., those that were still active as of the end of the sample, and "graveyard" funds, i.e., those that stopped reporting during the sample period and have therefore been delisted. Consistent with stylized facts about the high attrition rate of hedge funds, of the 5,917 funds that are in our sample, only 1,217 are live at the end of the sample, with the remaining 80% of funds being in the graveyard.

Panel B reports summary statistics at the fund-quarter level. The sample contains 94,306 fund-quarter observations with an average fund AUM of $254m. The AUM-weighted average (equal-weighted average) quarterly net excess return is 0.77% (0.97%). The table shows that the majority of funds have incentive fees of 20%, and that management fees exhibit relatively less homogeneity. The AUM-weighted average (equal-weighted average) incentive fee and management fee are 18.97% (19.36%) and 1.51% (1.46%), respectively.

Finally, the last row of the table shows that the average backfilled return in our data (2.47% per quarter) is more than twice as high as the average returns after listing (0.97% per quarter). As discussed, these backfilled observations are excluded from the primary sample. In Section 6.4, we report results obtained when backfilled observations are not excluded.

3 Aggregate Results

3.1 Aggregate Hedge Fund Performance and Fees

The distinctive compensation structure of hedge funds is designed to provide managers with powerful incentives to generate high returns. This compensation structure is asymmetric with respect to losses and gains. While a fund collects an incentive fee in periods with gross profits, it does not compensate the investors in periods with losses, nor does the fund return the incentive fees that have been previously collected. For this reason, the portion of an investor's aggregate profits earned across a portfolio of hedge fund investments will tend

Table 2. Hedge Fund Returns, Management Fees, and Incentive Fees, by Year

The table presents information about the aggregate returns generated and fees collected in our sample, at the annual level as well as cumulative over time. The sample covers funds in the BarclayHedge and TASS databases from 1995 to 2016. The table shows the gross excess returns, management fees, the remaining gross profits, and the incentive fees charged on the gross profits. The table also shows the cumulative values for these quantities as of the end of the sample. Please refer to the text for additional details.

Year	#Funds	AUM ($m)	Gross excess return ($m)	Management fees ($m)	Gross profit ($m)	Incentive fees ($m)	Net excess return ($m)
1995	80	6,512	2,271	86	2,185	710	1,475
1996	124	8,751	3,443	113	3,330	826	2,504
1997	179	15,184	3,747	199	3,548	1,048	2,501
1998	224	18,306	−3,258	241	−3,499	234	−3,734
1999	309	19,969	7,497	259	7,238	1,573	5,665
2000	456	35,633	−513	459	−972	919	−1,891
2001	756	67,998	2,478	874	1,604	1,220	383
2002	1,014	99,929	544	1,345	−801	1,219	−2,020
2003	1,080	127,330	23,336	1,788	21,548	4,691	16,858
2004	1,323	215,571	18,732	3,035	15,697	4,128	11,569
2005	1,532	294,675	27,111	4,300	22,810	6,159	16,651
2006	1,786	361,718	40,813	5,365	35,448	8,643	26,805
2007	2,024	473,747	53,166	7,134	46,032	16,183	29,849
2008	2,156	553,077	−147,138	8,391	−155,529	4,445	−159,975
2009	1,905	327,434	74,528	4,998	69,530	10,590	58,940
2010	1,868	364,575	45,113	5,683	39,430	9,069	30,361
2011	1,847	416,398	−5,323	6,370	−11,693	3,688	−15,381
2012	1,744	420,047	34,800	6,509	28,292	6,557	21,735
2013	1,659	452,860	57,157	7,179	49,977	11,756	38,222
2014	1,642	513,432	30,602	8,027	22,575	7,235	15,340
2015	1,645	539,421	19,666	8,320	11,346	6,110	5,236
2016	1,490	536,761	28,074	8,005	20,069	6,275	13,795
Cumulative		5,869,329	316,847	88,680	228,167	113,278	114,889
Per annum (% AUM)			5.40%	1.51%	3.89%	1.93%	1.96%

to exceed the average contractually stated incentive fee level. But just how large is this difference?

To answer this question, we aggregate quarterly returns and fees across all funds and examine these quantities over time. The results are presented in Table 2. Gross excess returns are raw returns before fees minus the hurdle rate, and they range from −26.6% (2008) to 39.3% (1995) of AUM. Over the span of 22 years, the hedge funds in our sample generated cumulative gross excess returns of 5.4% of AUM.[13] Management fees are charged as a percentage of AUM (typically 1% to 2%, see Table 1) and range from \$86m (1995) to \$8.4bn (2008). Gross profits are the gross excess returns minus management fees. In our sample period, annual gross profits range from −\$155.5bn (2008) to \$69.5bn (2009). Incentive fees on gross profits range from \$0.2bn (1998) to \$16.2bn (2007). Net excess returns, which are gross excess returns after all fees, range from −\$160.0bn (2008) to \$58.9bn (2009).

Overall, over our 22-year sample, the population of hedge funds generated a cumulative gross excess return of 5.40% on the invested AUM, and investors received cumulative net excess returns of 1.96%. As hedge funds experience good and bad years, aggregate profits fluctuate substantially. In contrast, accumulated management fees and incentive fees, by definition, never decrease.

The cumulative value of incentive fees paid amounts to 1.93% of AUM per annum. The overall cost of fees is equal to 3.44% of AUM per annum. Thus, over our sample period, investors paid 1.76 dollars in fees for each dollar of net return received (3.44%/1.96% = 1.76). Moreover, the aggregate rate of incentive fees appears much greater than what would be considered "justified" by the aggregate amount of gross profits earned. Gross profits are 3.89% per annum, suggesting that the aggregate annual incentive fee rate should be approximately 3.89% × 19.0% = 0.74%. In contrast, the actual incentive fee rate equals 1.93% of AUM per annum. In Section 4 we discuss the factors that contribute to this difference.

To understand the economic impact of fees on investors' returns, we graphically present how cumulative returns are divided between fund managers and investors over time. In

[13] Note that cumulative measures are equivalent to AUM-weighted average measures. For example, consider the value-weighted average of gross excess returns (G_t, measured in dollars) out of beginning-of-the-period AUM (AUM_t, measured in dollars). We define the ratio for each year as $g_t = \frac{G_t}{AUM_t}$. Then, the value-weighted average across period T, g_T^{VW}, equals the ratio of the cumulative amounts, $\frac{\sum_{t \in T} G_t}{\sum_{t \in T} AUM_t}$:

$$g_T^{VW} = \sum_{t \in T} \left[g_t \frac{AUM_t}{\sum_{t \in T} AUM_t} \right] = \sum_{t \in T} \left[\frac{G_t}{AUM_t} \frac{AUM_t}{\sum_{t \in T} AUM_t} \right] = \sum_{t \in T} \frac{G_t}{\sum_{t \in T} AUM_t} = \frac{\sum_{t \in T} G_t}{\sum_{t \in T} AUM_t}.$$

Figure 2, Panel A, we show the share of gross profits (gross excess returns minus management fees) that are constituted by investors' share and managers' share (i.e., incentive fees). We also plot the AUM-weighted contractual incentive fee as a reference point. In the first half of the sample, the cumulative fee ratio is generally near 30%, but spikes above 50% in 2001 and 2002, and then spikes above 100% in 2008. This reflects the fact that by the end of 2008 the hedge fund industry had generated cumulative gross losses of $1.3bn, yet it had earned cumulative incentive fees of nearly $51.9bn.

Fees as a ratio of profits decrease after 2009, partially because fund returns tend to rebound after periods of crisis, while incentive fees grow significantly less. This happens because right after a crisis, many hedge funds find themselves below the high-water mark, and therefore returns have to be quite substantial before incentive fees can be collected again. Nonetheless, the fraction of incentive fees to gross profits tends to remain persistently higher after periods of crisis than it was before.

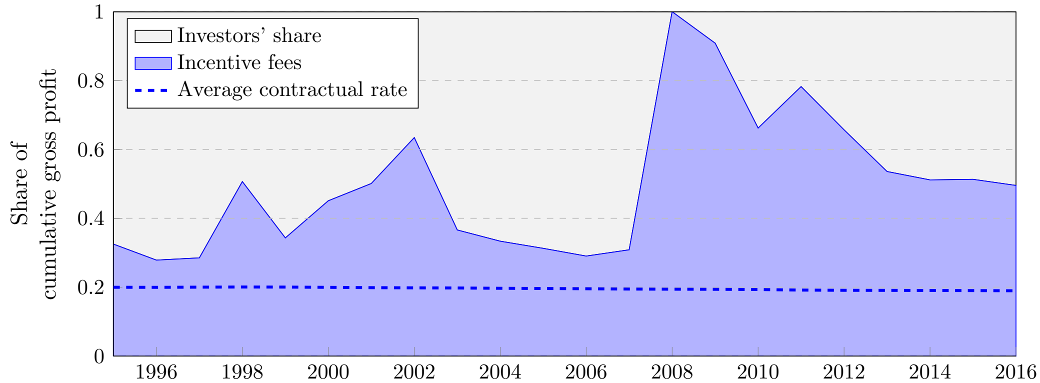
Two mechanisms contribute to a persistently higher cumulative fee ratio. First, investors cannot offset losses in some funds against the gains in others. Hence, they pay incentive fees on gains earned above the high-water mark in some funds but cannot deduct the losses made by other funds. Given that some funds generate gains and others post losses, investors pay incentive fees on the gains, but their wealth increases by gains net of losses (and fees). Second, investor withdrawals and fund exits destroy potential fee credits. The magnitude of this mechanism is exacerbated by the fact that investor withdrawals and fund exits tend to occur after poor aggregate fund performance (and tend to occur for funds that are the worst performers in the cross-section), resulting in the subsequent relatively high returns being experienced by a relatively smaller aggregate AUM relative to the large AUM of the fund industry experiencing losses in the crash.

By the end of the sample, the effective incentive fee rate is 49.6%, which is 2.62 times higher than the average nominal incentive fee. In Section 4, we further discuss these dynamics and estimate their relative importance in explaining why, historically, the effective incentive fee rate has been more than twice as high as the nominal rate.

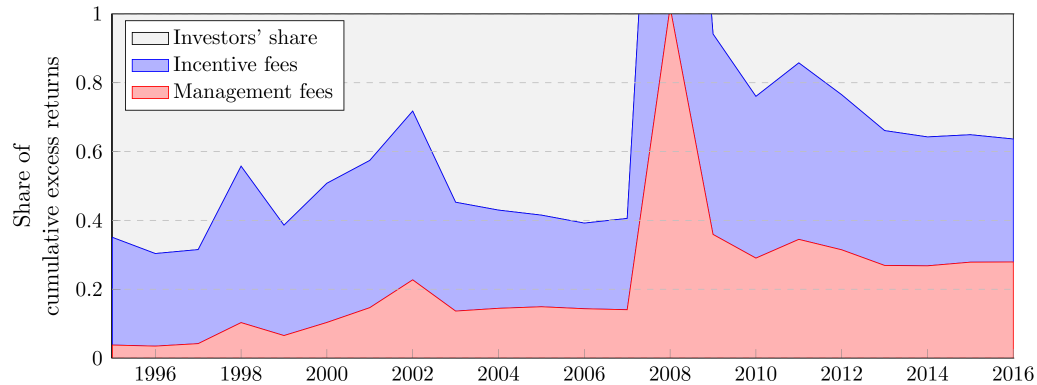
Figure 2. Fees and Investors' Returns Over Time

The figure shows the cumulative fees paid over time by investors to hedge fund managers as a fraction of returns. Panel A shows accumulated incentive fees scaled by accumulated gross profits. The dashed line indicates the AUM-weighted contractual incentive fee rate; this figure remains between 19% and 20% across the sample period. Panel B shows accumulated management fees and incentive fees scaled by accumulated excess returns. In each panel, *investors' share* represents the fraction of returns remaining after subtracting the fees.

Panel A: Gross Profits and Incentive Fees



Panel B: Gross Excess Returns, Management Fees, and Incentive Fees



In Figure 2, Panel B, we show how gross excess returns are divided between the investors' share (i.e., net returns), management fees, and incentive fees. Overall, the effective cumulative fee rate has been trending up over time. In particular, this figure tends to increase sharply during periods of poor fund performance, whether it is specific to the hedge fund sector (third quarter of 1998) or driven by widespread declines in asset prices (2001, 2002, and 2008). The peak of the figure occurs during 2008 and 2009, when cumulative fees composed 259.5% and 94.1% of gross excess returns, respectively. By the end of the sample, cumulative fees account for 63.6% of the gross excess return.[14]

3.2 Economic Interpretation of the Effective Incentive Fee Rate

The results presented above are attributable to the asymmetric nature of hedge fund compensation and to the complex dynamics and path dependence of returns, fund flows, and fund closures. Yet, these findings have a simple economic interpretation. More than half of the profits that the subset of profitable hedge funds have generated have been offset by losses: both by subsequent losses experienced by those funds and by losses of other funds. This means that, at the aggregate portfolio level, investors have paid incentive fees for profits that have not actually been "brought home."

To estimate the dollar amount of fees paid in excess of the nominal fee, consider the penultimate row of Table 2. Over the entire sample, aggregate gross profits amounted to \$228.2bn. If investors had paid the nominal incentive fee rate on these profits, incentive fees would have amounted to approximately \$228.2bn $\times$ 18.97% = \$43.3bn. In contrast, the actual figure was \$113.3bn. That is, compared to a benchmark case in which compensation is fully symmetric, investors paid an additional \$70bn in incentive fees. These calculations reflect the fees paid only to the subset of U.S.-dollar funds covered by BarclayHedge and TASS.

We can attempt to estimate the amount of incentive fees paid in excess of the nominal fee for the entire hedge fund industry. To do so, we extrapolate from our sample to the sample used by Joenväärä et al. (2019), which is, to the best of our knowledge, the most exhaustive hedge fund sample used in an academic study to date.[15] In their study, the

[14]The book "Hedge Fund Mirage" (Lack, 2012) presents a back-of-the-envelope calculation of total fees to gross returns from 1998 to 2010 using the HFRX Global Hedge Fund Index. This exercise may appear similar to Panel B of Figure 2 in our study. The results presented in the book, however, have been criticized by both academics (e.g., see Schneeweis and Kazemi (2012)) and practitioners (see Andrew D. Beer, "A Lack of Rigor in 'The Hedge Fund Mirage'," *AllAboutAlpha.com*, November 15 2012). A crucial criticism is that the HFRX index is not representative and has an abnormally low AUM-weighted internal rate of return due to an unusual computation method.

[15]The back-of-the-envelope calculations reported here are based on the pre-publication version of Joenväärä et al. (2019). At the time of this writing, it appears that the information regarding AUM that we use here has been removed from the version of Joenväärä et al. (2019) that was accepted for publication.

authors include funds from seven separate data providers, including the U.S.-dollar funds from the two data providers studied here, as well as non-U.S. dollar funds. The usual caveat about hedge fund sampling applies, i.e., that both our sample and their sample ignore funds that do not report to any data provider. In an untabulated analysis, we compare the time series of annual aggregate AUM used in our study to the time series of their aggregate AUM. The correlation is greater than 99%. On average, the aggregate AUM in our sample is about 36% of the aggregate AUM presented in their study. Based on their results, we know that fund performance is broadly consistent across the major data providers.

Thus, extrapolating to the larger sample and assuming that the basic relations we find here hold, we can estimate that hedge fund managers collected \$561bn in total fees.[16] Of these fees, \$315bn are incentive fees, \$194bn of which are estimated to be in excess of the contractual rate of 19.0%.[17]

4 Why Are Actual Incentive Fees So High?

Next, we discuss the mechanisms that cause aggregate incentive fees to deviate from the contractually stated nominal fee rate. From the point of view of hedge fund investors, the effective incentive fee rate is equal to the ratio of aggregate incentive fees paid to aggregate gross profits. Conceptually, aggregate gross profits can be decomposed into fund-level profits that have not been offset by subsequent same-fund losses and into net losses (defined as negative gross profits). Similarly, incentive fees can be classified into two categories based

[16]Combining total fees and scaling by the fraction of the universe that is covered by BarclayHedge and TASS: $(\$113.3\text{bn} + \$88.7\text{bn})/36\% = \$561.0\text{bn}$.

[17]$\$113.3\text{bn}/36\% = \$314.6\text{bn}$ and $\$69.7/36\% = \$193.6\text{bn}$.

on whether the gross profits associated with the fees have subsequently been lost. Formally,

$$\begin{aligned}\text{Effective IF} &= \frac{\text{Aggregate IF}}{\text{Aggregate Gross Profits}} \\ &= \frac{\text{IF on Profits Not Lost} + \text{IF on Underwater Profits}}{\text{Gross Profits Not Lost} - \text{Net Losses}}. \end{aligned} \tag{1}$$

We identify two principal reasons why the effective incentive fee rate is strikingly larger than the corresponding nominal rate: losers in the cross-section of funds, and exit decisions of funds and of investors. Both mechanisms influence the effective incentive fee rate because of the asymmetric nature of the compensation contract. The first mechanism increases the effective incentive fee rate by decreasing the denominator in Equation (1). The second mechanism can increase the numerator. Specifically, if capital is disinvested following losses in a fund that in previous years collected incentive fees, then some (or possibly all, in extreme cases) of the incentive fees that have been paid are no longer associated with overall gross profits, yet those fees are still part of the aggregate amount of fees paid. We call these fees "incentive fees on underwater profits."

We start by illustrating these mechanisms in Sections 4.1 and 4.2, respectively. We then present a formal decomposition exercise in Section 4.3. This exercise allows us to determine the relative contribution of each mechanism to our empirical finding that the effective incentive fee rate is estimated to be 49.6%, i.e., approximately 2.6 times higher than the nominal rate of 19.0%.

4.1 Cross-sectional Variation in Performance

One reason why the effective incentive fee rate tends to be high is the lack of "performance netting" across funds. That is, while losses from one fund offset the gains from another fund in the investor's portfolio, fees aggregate across funds, and there are no "inverse incentive fees." Intuitively, this fact alone will affect the aggregate incentive fee level only to the extent that there are funds that generate large losses over the investor's holding period.

To illustrate this point, suppose an investor commits capital to two funds, A and B, both of which charge an incentive fee equal to 20% of gross profits and have a high-water mark provision. Fund A does well, and its net asset value (NAV) per share increases over time; therefore, the fund retains 20% of the profits as part of its compensation. Fund B, on the other hand, performs poorly and its value per share never exceeds the initial value; hence, no incentive fees are paid to the manager. In the investor's portfolio, the losses generated by Fund B offset at least part of the gains earned on Fund Ayet those losses do not decrease the amount of fees paid to Fund A. Therefore, the ratio of aggregate incentive fees to aggregate profits at the portfolio level will be higher than the contractual incentive fee rate of 20%.

In aggregate, the effect of losing funds is large. This should not come as a surprise, however, because hedge funds are characterized by large cross-sectional and time-series variation in performance, and because the number of funds that are liquidated due to poor returns is substantial.

Table 3 helps illustrate the implications of the dispersion in cross-sectional performance on fees and profits. Each year we separate fund investors into those with gains in the year and those with losses in the year. Within the group of fund investors with gains, we further separate observations into those for which the gains have generated at least some incentive fees and those for which no fee is collected because the annual gains were not sufficient to surpass the previous high-water mark and the hurdle rate. In each year, the table reports total gains or losses for each of the three groups. For those fund investor observations that generate fees, it also reports the incentive fees and the ratio of fees to profits by calendar year.

The first set of columns shows that annual incentive fees as a fraction of profits vary

Table 3. Aggregate Gains, Losses, and Incentive Fees, by Year

For each fund in the sample, we keep track of each fund investor's high-water mark (HWM) and annual performance. Then, each year, we sort fund investors into three groups: those with annual gains that pay incentive fees, those with gains that pay no incentive fees (because they are below the HWM and hurdle rate), and those with losses. $\%AUM$ refers to the fraction of the overall aggregate assets under management that belongs to each group each year. Gains indicate positive gross profits, and losses indicate negative gross profits. See the text for additional details.

	Fund investors with gains						Fund investors with losses				
	Pay fees: Investors above HWM + non-HWM funds				No fees: Investors below HWM		No fees: All investors			Aggregate	
		Gains	Incentive fees			Gains			Losses	Aggregate	Fees
Year	%AUM	($m)	$m	%Gains	%AUM	($m)	%AUM	%Funds	($m)	gains ($m)	(%Gains)
1995	82%	2,397	710	29.6%	1%	23	17%	26%	−235	2,185	32.5%
1996	85%	3,344	826	24.7%	3%	118	11%	18%	−131	3,330	24.8%
1997	81%	3,882	1,048	27.0%	2%	105	16%	26%	−439	3,548	29.5%
1998	32%	818	234	28.7%	1%	19	67%	50%	−4,336	−3,499	n.a.
1999	82%	6,871	1,573	22.9%	8%	653	11%	18%	−286	7,238	21.7%
2000	50%	3,616	919	25.4%	2%	135	48%	45%	−4,723	−972	n.a.
2001	60%	5,076	1,220	24.0%	3%	264	36%	40%	−3,736	1,604	76.1%
2002	60%	5,470	1,219	22.3%	2%	200	38%	52%	−6,471	−801	n.a.
2003	87%	22,174	4,691	21.2%	4%	1,000	9%	16%	−1,626	21,548	21.8%
2004	77%	19,476	4,128	21.2%	2%	568	21%	25%	−4,347	15,697	26.3%
2005	73%	27,441	6,159	22.4%	3%	1,029	24%	33%	−5,660	22,810	27.0%
2006	80%	40,530	8,643	21.3%	3%	1,269	18%	23%	−6,351	35,448	24.4%
2007	63%	63,722	16,183	25.4%	3%	2,613	34%	39%	−20,303	46,032	35.2%
2008	19%	17,574	4,445	25.3%	1%	905	80%	83%	−174,009	−155,529	n.a.
2009	62%	62,325	10,590	17.0%	21%	21,424	17%	24%	−14,219	69,530	15.2%
2010	78%	43,573	9,069	20.8%	7%	3,829	15%	22%	−7,971	39,430	23.0%
2011	43%	16,509	3,688	22.3%	2%	647	55%	64%	−28,849	−11,693	n.a.
2012	70%	34,687	6,557	18.9%	9%	4,429	21%	26%	−10,824	28,292	23.2%
2013	82%	57,098	11,756	20.6%	3%	1,838	15%	21%	−8,958	49,977	23.5%
2014	71%	35,022	7,235	20.7%	3%	1,250	27%	40%	−13,697	22,575	32.1%
2015	62%	30,609	6,110	20.0%	3%	1,563	35%	48%	−20,826	11,346	53.9%
2016	62%	35,287	6,275	17.8%	7%	4,071	31%	34%	−19,288	20,069	31.3%
Cumulative		537,499	113,278	21.1%		47,953			−357,284	228,167	49.6%

between 17.0% and 29.6% for funds with gains.[18] Gains accruing to investors who are below

[18] In any given calendar year, the ratio of incentive fees to gross profits can differ from the average incentive fee even within the sample of funds with positive net annual gains for a few reasons. These reasons include the presence of funds with no high-water marks (which is more prevalent at the beginning of the sample), the dispersion in nominal fee rates (i.e., some well-performing funds in the early part of the sample had an incentive fee rate of 25%), and the interaction of within-year swings in performance with inflows and outflows. As the cumulative results presented in the last row indicate, these effects have a small impact once the data are aggregated across years, i.e., the effective incentive fee rate for the subsample of funds with gains and that collect fees is 21.1%, which is not meaningfully higher than the AUM-weighted sample average rate of 19.0%.

the high-water mark help to reduce the ratio of incentive fees to profits, while fund losses contribute to an increase in the ratio of fees to performance.

The annual contribution of cross-sectional losers to the aggregate ratio of fees to profits is often quite large. For example, 40% of funds in 2001 were losers, reflecting 36% of AUM. As a result, while incentive fees paid to winning funds represented 24.0% of the profits generated by those funds in that year, incentive fees represented 76.1% of aggregate annual profits when losing funds are taken into account.

Losses occurring at any given point in time reflect new losses that decrease the overall cumulative profits. To the extent that the losses are subsequently recovered, then cross-sectional losers will have an effect on the ratio of fees to profits in a given year, but will not have an overall effect on cumulative fees-to-profits ratio in the long run. On the other hand, to the extent that these losses are not subsequently recovered, either due to persistent poor performance of the fund or to fund or investor exit, the losses will result in a permanent increase in the cumulative ratio of fees to profits through their effect on decreasing the denominator in Equation (1).

The fact that gains and losses cannot be offset in the cross-section of funds provides management firms with the incentive to offer multiple strategies using different vehicles rather than consolidating two or more strategies into a single vehicle. By keeping strategies in separate vehicles, hedge fund management firms benefit from investors' inability to offset gains and losses. Of course, keeping strategies in separate investment vehicles may also be driven by investor demand.

4.2 Path Dependence of Incentive Fees and Exit Decisions

Incentive fees are calculated and paid to managers at prespecified intervals, usually at the end of each calendar year though sometimes over shorter horizons. This procedure creates path dependence in fee payments. To illustrate this point, consider two funds with flat performance over two years. Fund A had a loss in the first year and a gain in the second year. In contrast, Fund B showed a gain in the first year and a loss in the second. Despite the same two-year performance, investors in Fund B pay incentive fees but investors in Fund A do not. Following the loss in the second year, the investors in Fund B earned a fee credit that they can redeem against future gains, should they occur. If the fund liquidates or investors decide to exit, then the investors in Fund B lose their fee credit, and the incentive fees paid in the past no longer reflect the overall lifetime performance of the fund. In this scenario, the incentive fees paid to Fund B in the first year will become "incentive fees on underwater profits" and will be crystallized by the exit decision, leading to an increase in the effective incentive fee rate by increasing the numerator in Equation (1).

In this section, we analyze how the path dependence in fee calculation interacts with exit decisions by managers as well as entry and exit decisions by investors. Overall, our findings show that the high propensity to disinvest capital following large losses tends to weaken the intended purpose of high-water mark provisions by destroying fee credits and crystallizing underwater incentive fees.

4.2.1 Fund Exit

Funds that consistently perform poorly eventually liquidate and return the remaining capital to investors. By doing so, they effectively crystallize investor losses and any fees paid on past profits that were subsequently lost. Figure 1 shows the evolution in the number of funds in the sample over time. From the inception of the sample until 2008, the rate of new entries outpaced the number of exits, and therefore the number of funds increased. Starting in 2008, this pattern reversed, and the attrition rate exceeded the rate of new entrants in every subsequent year, leading to a decline in the number of funds in the sample since 2008. Importantly, the annual attrition rate was relatively high during the entire sample period, with a low point of 5% and an average of 17%.

Funds that perform poorly are more likely to be liquidated (Brown et al., 2001; Getmansky et al., 2004). It is commonly agreed by practitioners that a drawdown of 25% to

30% from the previous high-water mark leads to a sharp increase in the probability that a fund will be forced to liquidate due to investors' redemption requests (Grossman and Zhou, 1993; Lan et al., 2013). Notice that such a drawdown does not necessarily imply that, at the moment of liquidation, a fund's accumulated profits since inception are negative, because the fund in question might have delivered high returns in the first part of its life. However, a large loss before liquidation will at least partially negate some of a fund's initial profits, on which incentive fees have already been paid.

A number of factors can motivate funds to liquidate. First, it is possible that their investment strategies are no longer expected to be profitable. Second, as funds accumulate losses, it is hard to convince new investors to invest, since investors tend to chase returns on average. Third, the prospect of earning further incentive fees is lower for funds whose investors are below the high-water mark; these funds need to restore investors' capital to its previous high valuation point before they can begin charging new incentive fees.

Consistent with these arguments, funds in our data set are three to four times more likely to exit when they are below the high-water mark. In Panel A of Figure 3, we plot the likelihood of exit as a function of the funds' distance from the high-water mark. Funds above the high-water mark exit at a rate of about 3% per quarter or less. In contrast, funds below the high-water mark are materially more likely to exit. Funds with drawdowns of 5% exit at a rate of 6% per quarter, and funds with drawdowns of 10% or greater exit at a rate of 7% to 9% per quarter.

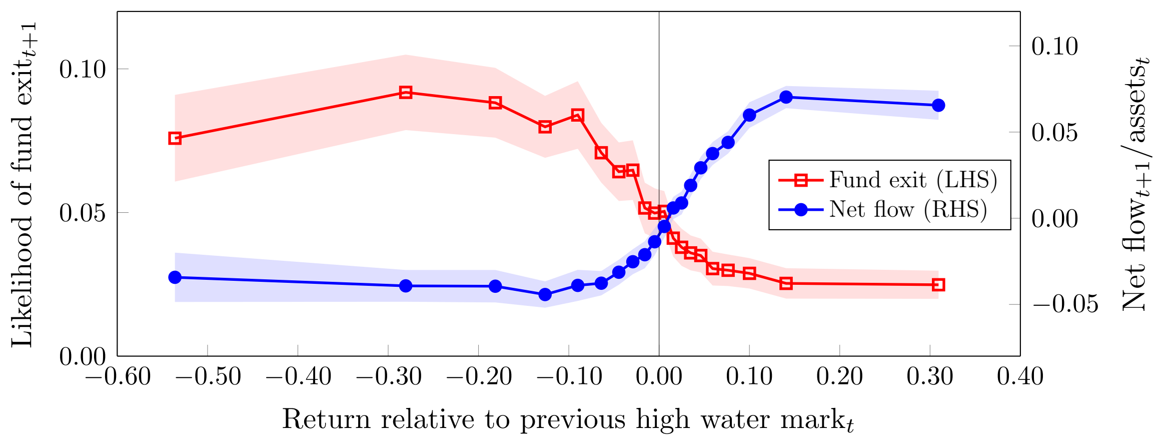
When a fund incurs a loss in value, it has to earn the loss back before it can charge incentive fees. Thus, fund losses generate what we refer to as fee credits.[19] In Table 4, we estimate the amount of fee credits that are lost as a consequence of fund and investors' exits. In the left part of the table we focus on fund exits. We start by reporting the fraction of funds and fraction of beginning-of-year AUM that leaves the sample each year. Then, we calculate the value of assets that are below their investor-specific high-water mark at the

[19]For funds without a high-water-mark provision, fee credits are automatically reset to zero at the beginning of each year.

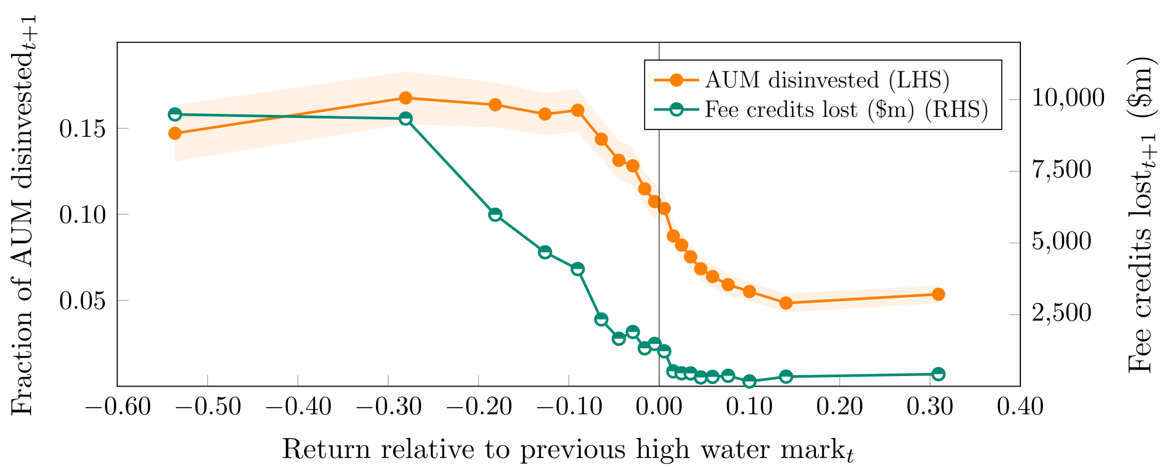
Figure 3. Fund Exit and Investor Flows Around the High Water Mark

Panel A shows the propensity of fund exit (line with square markers) and investors' net flows (line with round markers) in quarter $t+1$ as a function of the fund's value relative to the previous high-water mark as of the end of quarter t. Panel B shows the combined disinvestment of capital from fund exit and investors' capital withdrawals (line with round markers) as well as the dollar amount of incentive fee credits lost due to the disinvestment of capital (line with half-filled round markers). Investors in each fund may have different high-water mark values depending on when they invested in the fund; thus, we calculate the cumulative return with respect to the most recent high-water mark for each investor-fund-quarter observation and then value-weight across investor cohorts within each fund-quarter. The sample is divided into fund-quarter observations above and below the high-water mark (59% and 41% of observations, respectively), and each of the two groups is then divided into 10 bins sorted by cumulative return. The figure includes only funds with high-water-mark provisions. 5% confidence bands are reported based on standard errors clustered at the strategy-quarter level.

Panel A: Fund Exit and Net Flows



Panel B: Combined Disinvestment of Capital and Fee Credits Lost



moment of exit of each fund, and aggregate those figures across funds in each year. Then, fee credits lost are equal to the former value multiplied by each fund's incentive fee rate.

Table 4. Destruction of Fee Credits

This table presents statistics about the fee credits that are lost when funds liquidate or investors withdraw their capital from funds. At the end of each investor-fund-quarter observation, we compute the dollar value of each investor's position that is below the previous high-water mark. Then, for fund exits and investors' outflows, we calculate *Value below HWM*, i.e., the aggregate annual capital below the high-water mark that leaves the sample due to fund exits or investor withdrawals. *Fee credits lost* is calculated as *Value below HWM* times each fund's incentive fee rate. The last column shows the aggregate value of incentive fees paid to funds each year.

	Funds exiting				Investor outflows			
Year	% of funds	% of AUM	Value below HWM ($m)	Fee credits lost ($m)	% of AUM	Value below HWM ($m)	Fee credits lost ($m)	Incentive fees paid ($m)
1995	5.0%	0.5%	14	3	33.1%	112	22	710
1996	20.2%	6.2%	101	20	23.3%	29	6	826
1997	13.4%	3.9%	49	10	24.3%	49	9	1,048
1998	18.3%	8.3%	481	92	24.9%	837	165	234
1999	16.2%	5.7%	137	27	28.1%	850	170	1,573
2000	16.0%	6.5%	1,328	264	24.4%	1,455	285	919
2001	13.4%	7.2%	607	120	17.9%	1,526	295	1,220
2002	19.9%	11.0%	1,483	300	21.7%	2,041	404	1,219
2003	12.4%	6.6%	1,201	241	19.0%	953	189	4,691
2004	13.2%	5.2%	1,408	279	19.6%	1,307	261	4,128
2005	13.6%	6.6%	2,444	493	26.7%	3,328	668	6,159
2006	14.8%	9.4%	2,620	523	19.4%	1,312	264	8,643
2007	15.6%	10.4%	4,475	894	16.8%	5,662	1,131	16,183
2008	26.5%	14.9%	29,037	5,762	27.4%	48,781	9,409	4,445
2009	19.4%	12.2%	25,014	5,015	32.5%	25,404	4,974	10,590
2010	17.7%	13.3%	8,577	1,729	20.9%	6,637	1,297	9,069
2011	18.7%	9.0%	6,749	1,334	18.1%	5,920	1,044	3,688
2012	20.0%	9.7%	9,210	918	23.9%	6,075	1,132	6,557
2013	16.6%	11.7%	4,220	811	20.5%	3,735	698	11,756
2014	16.1%	6.7%	5,181	1,000	20.0%	4,848	895	7,235
2015	18.4%	7.8%	9,748	1,893	19.9%	4,954	902	6,110
2016	18.3%	9.3%	12,819	2,506	20.8%	7,418	1,429	6,275
Cumulative			126,901	24,234		133,231	25,649	113,278

Across the sample, the total amount of fee credits lost due to fund exits is $24.2bn. Hence, investors in those funds could theoretically have earned $126.9bn in gains before having to pay incentive fees. On the contrary, those funds closed and thus their investors lost the right to earn back their losses without paying incentive fees. It is important to note that even if the liquidated funds had remained in business, it is unlikely that the entire amount of fee credits could have been salvaged. Based on the observed distribution of fund performance, it is plausible that many of those funds would have continued to generate mediocre returns.

4.2.2 Investors' Return-Chasing Behavior

It has been widely documented that investors across many asset classes chase returns. Hedge fund investors are not an exception. In Panel A of Figure 3, we confirm known results indicating that net flows in and out of hedge funds are a positive function of past performance (e.g., see Goetzmann et al., 2003; Getmansky, 2012; Lim et al., 2016). On average, funds above the high-water mark tend to receive next-quarter net flows that are about 7 percentage points higher than the net flows received by funds below the high-water mark. Moreover, funds with drawdowns of 10% or more tend to experience quarterly net outflows of capital of about 4% of existing assets.

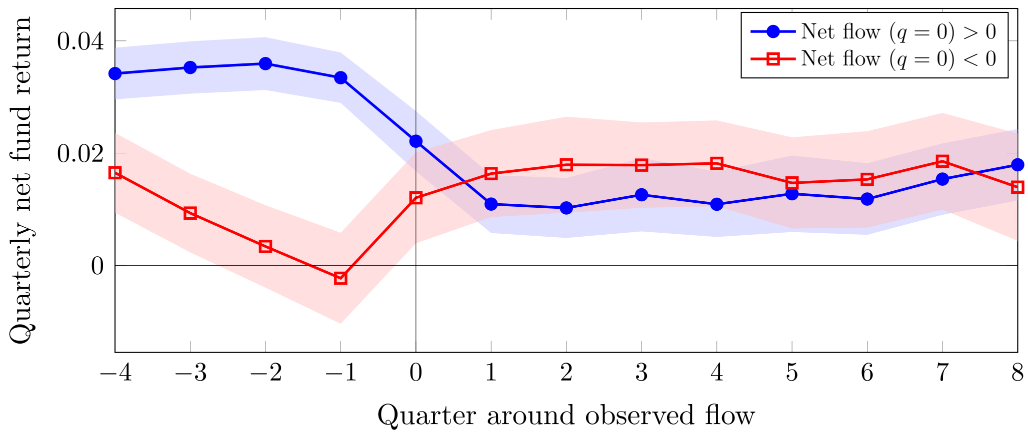
This path-dependent investment behavior suggests that investors' capital withdrawals is likely a large source of fee credit destruction. Thus, just like fund exit, investor exit can exacerbate the ratio of fees paid to profits received.

To see this, consider the hypothetical performance pattern of a fund with volatile returns. A return-chasing investor is likely to invest after observing good performance and to remain in the fund as long as returns are sufficiently high; during this period, the investor pays incentive fees to the manager. Eventually, returns deteriorate and the investor decides to leave the fund. Upon exiting, incentive fees as a percentage of cumulative profits exceed the nominal rate because the recent losses offset some of the earlier profits on which fees have already been paid.

The estimates presented in Table 4 show that exit by investors is an important factor in destroying fee credits. Over the sample period, investors withdrawing money from underwater funds destroyed fee credits amounting to $25.6bn. Considering both fund exits and capital outflows, investors in our sample's hedge funds lost about $49.9bn of fee credits due to the disinvestment of capital after poor fund performance. To provide a benchmark for the magnitude of credit fees lost, consider that the cumulative value of incentive fees paid is $113.3bn. Thus, the value of fee credits destroyed due to capital disinvestment is about 44.0% of the value of incentive fees paid.

Figure 4. Fund Performance Around Investor Flows

The figure shows the average hedge fund performance around net inflow quarters (blue line with round markets) and net outflow quarters (red line with square markers). Each quarterly net return observation is weighted by the absolute magnitude of the inflow or outflow, adjusted for inflation to 2016 dollars. Returns are not cumulative. The 5% confidence bands shown are based on standard errors clustered at the strategy-quarter level.



Panel B of Figure 3 shows the distribution of capital disinvested (as a fraction of lagged AUM) and aggregate fee credits lost due to either investor exit or fund exit as a function of fund performance relative to the previous high-water mark. Consistent with our prior discussion, disinvestment of capital is more prevalent for funds whose value is below the high-water mark. Intuitively, the bulk of fee credits is lost following quarters in which funds are far below the previous high-water mark. For instance, the three left-most groups displayed in the chart represent 12.5% of fund-quarter observations, yet they account for 53.0% of fee credits lost (i.e., approximately $25bn).

In general, divestment decisions could either improve or harm investors' performance relative to a buy-and-hold strategy. For example, if performance is persistent, investors may be able to improve the returns they earn by chasing performance. However, the data do not support this hypothesis. In Figure 4, we explore fund performance around inflows and outflows. In the figure, fund-quarters are sorted into two groups at $q = 0$: fund-quarters that experienced inflows and fund-quarters that experienced outflows. We then calculate and plot the average performance in the preceding and proceeding quarters. Each quarterly net return observation is weighted by the absolute magnitude (in 2016 dollar terms) of the $q = 0$ inflow or outflow.

The pattern shown in Figure 4 confirms that investors chase returns on average. Inflows take place after above-average performance, and outflows happen after below-average performance.

The timing ability of investors, however, appears to be poor. Fund performance reverts immediately after the flows occur: Funds tend to perform slightly better after experiencing net outflows than after net inflows. Hence, on average, investors' flows do not lead to an improvement in the returns they earn. This result is broadly consistent with the findings of Dichev and Yu (2011), who show that dollar-weighted returns are lower than buy-and-hold returns for hedge fund investors. We show that investors' behavior affects not only the returns they earn, but also the fraction of profits that fund managers keep for themselves in the form of fees.

4.3 Putting It All Together: The Effective Fee Rate

Throughout this section, we have discussed how the dispersion of fund performance and the exit behavior of funds and investors contribute to the finding that the effective incentive fee rate significantly exceeds the nominal incentive fee rate. Here, we propose a formal decomposition exercise to quantify the contribution of these different effects. The decomposition exercise follows the intuition provided in Equation (1).

Table 5 presents the results of the analysis. We begin by calculating the fees paid on gross profits that are not subsequently lost due to same-fund losses. We estimate that the aggregate amount of profits not subsequently lost is \$410.9bn and that \$78.6bn in incentive fees has been collected on these profits. Thus, the incentive fee ratio for this subset of profits is 19.1%. This figure is very close to the AUM-weighted average incentive fee rate of 19.0%,

Table 5. Decomposition of Profits and Fees

The table shows the decomposition of aggregate incentive fees and gross profits. The table shows the various components that account for the difference between the contractual incentive fee rate (19.1%) and the actual incentive fee paid (49.6%). All figures presented are cumulative across funds and over time. *Investor-fund profits not lost* refers to gross profits earned at the investor-fund level that had not been destroyed by subsequent same-fund losses as of the end of the sample. *Net losses* refers to all losses (negative gross profits) generated by funds and not subsequently recovered as of the end of the sample. *Underwater investor exits* represents the amount of incentive fees paid on profits that were subsequently lost by investors that were underwater when withdrawing their capital. *Underwater fund exits* represents the amount of incentive fees paid on profits that were subsequently lost by funds that were underwater when exiting the sample. Finally, *Live underwater funds* shows the amount of incentive fees paid to live funds on profits that were subsequently lost and that were still underwater as of the end of the sample.

	Gross profits ($m)	Incentive fees ($m)	Fees/Profits	Marginal effect
Investor-fund profits not lost	410,938	78,640	19.1%	
Net losses	−182,771			+15.3%
Subtotal	228,167	78,640	34.5%	
Underwater investor exits		19,228		+8.4%
Subtotal	228,167	97,868	42.9%	
Underwater fund exits		12,254		+5.4%
Subtotal	228,167	110,122	48.3%	
Live underwater funds		3,157		+1.4%
Total	228,167	113,278	49.6%	

as expected.[20]

The first effect we examine is the contribution of net losses experienced by hedge fund investors in aggregate. In this context, net losses are equal to the sum of negative gross profits generated across all funds that had not been recovered as of the end of the sample. This figure is $182.8bn. Subtracting this from the amount of profits reported in the first row of the table results in the overall amount of gross profits of $228.2bn. (This is the same amount of cumulative gross profits shown in Column (7) of Table 2.) As shown in the third row of Table 5, accounting for these losses takes the ratio of incentive fees to profits from 19.1% to 34.5%.

Next, we focus on the effect of incentive fees paid for profits that have subsequently been

[20]The former figure, i.e., 19.1%, reflects a profit-weighted average of nominal fees for hedge fund investors earning profits. This is expected to be very close to the AUM-weighted average nominal fee rate of 19.0% because there is no strong cross-sectional correlation between incentive fee levels and fund returns once backfilled returns are excluded (Jorion and Schwarz, 2019).

lost due to same-fund losses. This will tend to increase the effective incentive fee ratio via a "denominator effect." These fees account for the difference between the overall cumulative amount of fees, i.e., \$113.2bn, (Column (8) of Table 2), and the fees paid exclusively for profits that have not been subsequently lost, i.e., \$78.6bn (first row of Table 5). Using the terminology established in Equation (1), we call these fees "incentive fees on underwater profits."

The amount of incentive fees on underwater profits is \$34.6bn (= \$113.2bn − \$78.6bn). We further categorize these fees across two important dimensions. First, we identify whether investors' capital with which the fees are associated was still invested in the same fund as of the end of the sample. If this is the case, then it is possible for investors to "earn back" those losses without paying additional fees. On the contrary, if the capital has been disinvested, then investors can no longer earn their losses back with future profits at the same funds, and therefore the fee credits generated by their losses are permanently destroyed. Second, in the latter scenario, we identify whether the capital has been disinvested due to investors' withdrawals or fund exits.

In the fourth row of Table 5, we report the amount of incentive fees on underwater profits at the time of investors' capital withdrawals. The figure is \$19.2bn and brings the ratio of incentive fees to profits to 42.9%.

We then calculate the amount of fees that were underwater at the time of fund exit. This figure is \$12.3bn over the sample period (sixth row of the table). This reflects 5.4% of accumulated investor profits in our sample. Adding this to the numerator brings the fraction of incentive fees to profits to 48.3%.

Note that the concepts of "fee credits lost" and "incentive fees on underwater profits" are related but not identical. At the moment of an underwater fund exit or investor exit, fee credits lost partially or fully translate into incentive fees on underwater profits only if during the life of the fund a positive amount of incentive fees was paid for profits earned on the capital being disinvested. For this reason, the incentive fees associated with underwater investor exits and with underwater fund exits in Table 5 ($19.2bn and $12.3bn, respectively) are lower than the fee credits lost due to investor outflows and fund liquidations presented in Table 4 ($25.6bn and $24.2bn, respectively). The difference is notably larger for fund exits. This finding is explained by the fact that a nontrivial number of poor-performing funds that were liquidated during our sample period earned little to no incentive fees and delivered large losses to their investors before liquidating. Thus, this subsample of funds is associated with a large amount of fee credits lost but a low amount of incentive fees on underwater profits.

The final component of incentive fees on underwater profits is incentive fees paid by investors who were still invested in the fund at the end of the sample. This component only captures underwater investors who were still invested in a live fund at the end of the sample period. Unsurprisingly, this component is relatively small at $3.2bn (eighth row of the table). Adding this final component to the numerator arrives at the overall fraction of incentive fees to net profits of 49.6%, as reported in Table 2 and shown in Figure 2.

5 How Are Fees Distributed Across Funds?

The analysis carried out so far has focused on aggregate outcomes and has shown that investors pay an effective incentive fee rate that is more than twice the corresponding nominal rate. Next, we turn to the relation between fees and fund performance in the cross-section of funds.

Hedge funds are considered to be one of the most costly forms of active asset management (French, 2008). One of key the reasons why investors are willing to pay high fees to hedge funds is that incentive fees are designed to be paid only in the case of high returns. However, as previously discussed, the asymmetry of the compensation structure and the volatility of fund returns may create a disconnect between multiperiod performance and incentive fees.[21] In this section, we explore the relation between lifetime performance and fees earned in the

[21] For instance, see the example of the two funds with the same two-year return but different incentive fees in Section 4.2.

cross-section of funds. Our results indicate that a significant portion of incentive fees that funds earn is unrelated to their long-run performance, thus weakening the long-term link between returns and incentive fees.

5.1 What Fraction of Returns Do Funds Keep?

A key result of the first part of our analysis is that, over the entire sample period, hedge funds have retained approximately 64% of aggregate gross excess returns in the form of management and incentive fees.

Here, we carry out a similar analysis at the fund level. For each fund, we calculate the dollar amount of gross excess returns generated and fees charged each year and sum these two figures over the fund's life. We then examine the distribution of the ratio of the latter to the former.

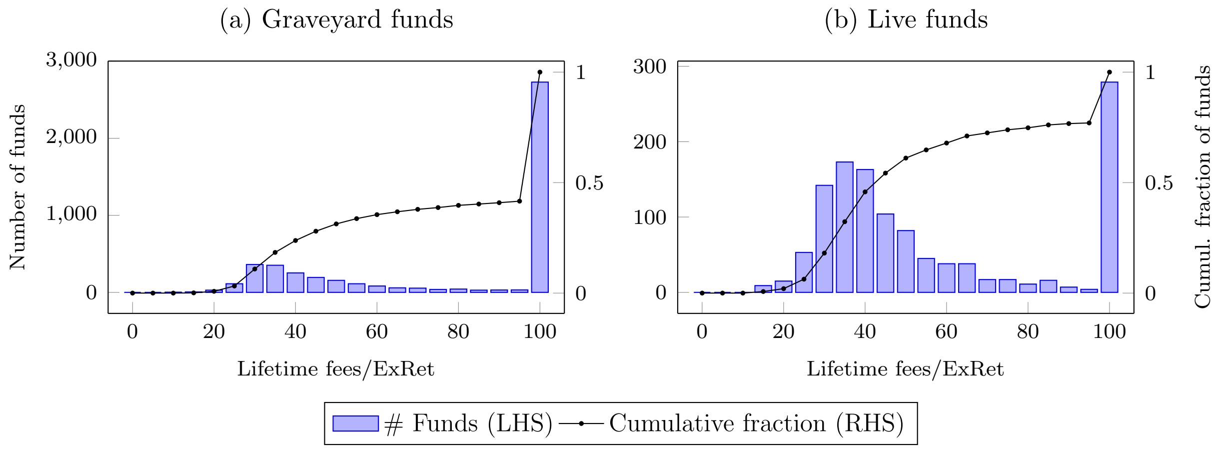
The distribution of lifetime fees to gross excess returns is presented in Figure 5. As discussed in Section 4, a factor that contributes to the high observed ratio of fees to performance at the aggregate level is the closure of poor-performing funds. Thus, to provide additional insight, in the figure we sort funds into two groups based on whether the funds were in the live file or in the graveyard file as of the end of our sample period.

Of the 5,917 funds in existence during the sample period, only 1,217 were still "live" at the end of the sample. As pointed out in various prior studies, the relatively high attrition rate largely reflects the substantial number of funds exhibiting poor performance, especially immediately before delisting. Consistent with this interpretation, 49.2% of graveyard funds generated negative gross excess returns over their life, as compared to only 13.9% of live funds.

With respect to fees, 57.7% of graveyard funds earned cumulative fees that were in excess of 100% of gross excess returns, and 68.9% earned cumulative fees in excess of 50% of gross excess fund returns. Overall, investors in graveyard funds paid a ratio of fees to gross excess returns of 118%, indicating that graveyard funds in aggregate earned cumulative fees

Figure 5. Histogram of Lifetime Fees to Gross Excess Returns

The figure presents histograms (bars) of total fees (management and incentive fees) collected by funds divided by their lifetime gross excess return. Funds are grouped into bins based on this ratio, which is capped at 100% for presentation purposes. When a fund's lifetime gross excess return is negative, the ratio is set at 100% in this chart. The line with markers (plotted on the right axis) shows the cumulative number of funds in each bin. Panels (a) and (b) present results for funds in the graveyard file and live file, respectively.



exceeding their cumulative gross returns (i.e., they generated slightly negative excess dollar returns after fees).

The picture looks somewhat rosier for live funds. Yet, despite the substantial survivorship bias in this subsample, the ratio of fees to excess returns is high for a large fraction of these funds. For instance, 49.9% of live funds have collected 30% to 60% of gross excess returns in fees. Moreover, fees represent more than the entire gross excess return for 21.9% of live funds. In aggregate, fees represent 39% of gross excess returns for live funds.

Across all funds, fees represent over half of gross excess returns generated for 62.7% of funds and over 100% of gross excess returns for 50.3% of funds.

5.2 Are Incentive Fees "Justified" by Lifetime Fund Performance?

The evidence presented in the first part of this paper indicates that the effective incentive fee rate paid in aggregate by hedge fund investors is significantly higher than the nominal fee rate. A significant driver of this empirical finding is the fact that some funds that initially perform well and collect incentive fees eventually experience poor returns and face outflows or cease to operate. This suggests that some funds earned incentive fees that, ex-post, are not "justified" by their long-term performance.

Here, we explore this concept in greater detail. For each fund i, we define the dollar value of justified incentive fees and residual incentive fees as a function of the fund's lifetime gross dollar profits and its contractual incentive fee rate:

$$\text{Justified IF}_i = \text{Contractual IF Rate}_i \times \min\{0, \text{Lifetime Gross Profits}_i\}, \tag{2}$$

$$\text{Residual IF}_i = \text{Actual IF}_i - \text{Justified IF}_i. \tag{3}$$

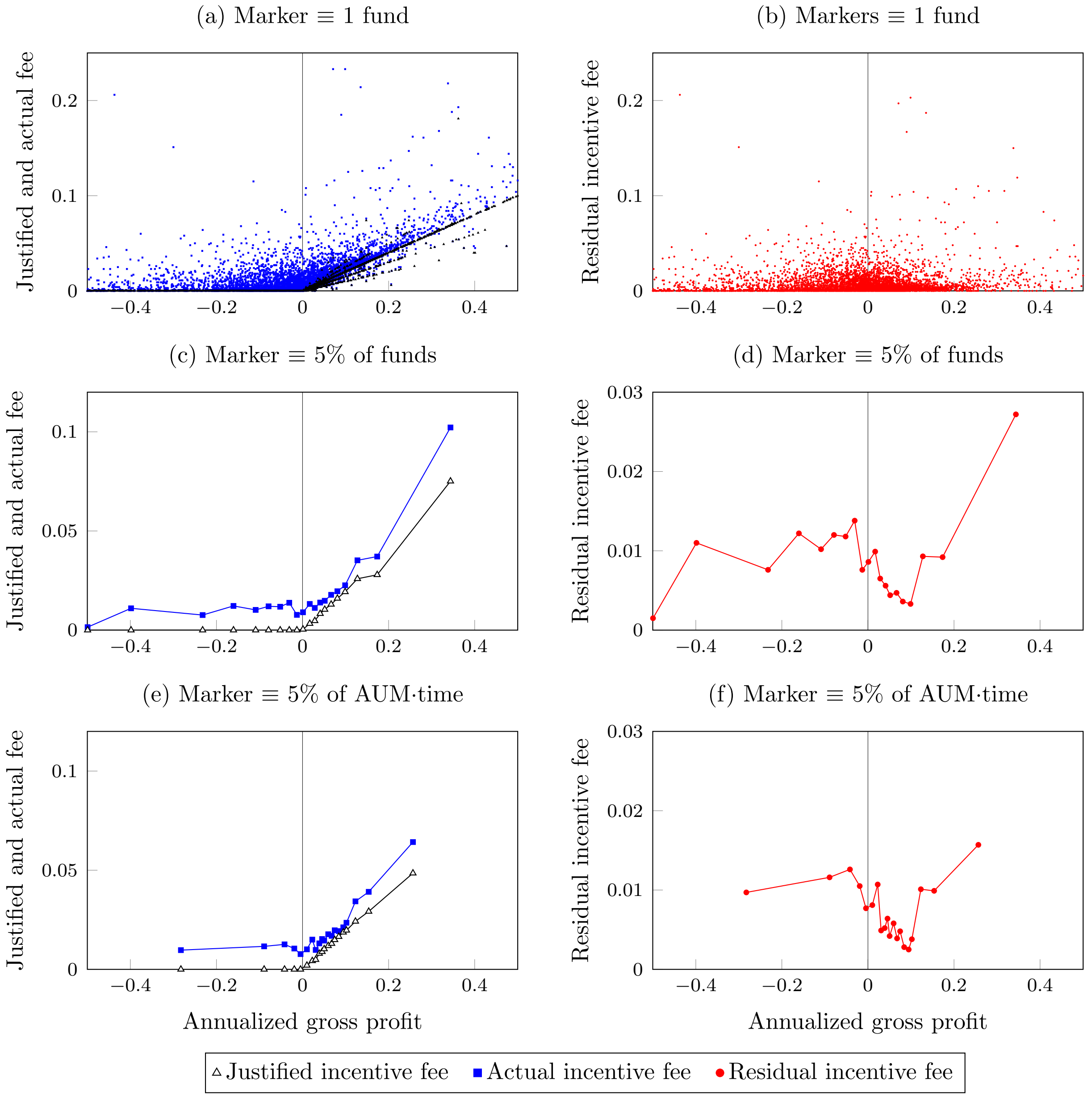
It is interesting to explore which funds collected the residual incentive fees, i.e., the incentive fees paid beyond the contractual rate. In other words, we examine whether the residual fees were paid to funds that generated high performance (and therefore may be incentive compatible), or whether these fees were also paid to underperforming managers, effectively weakening the long-term relation between incentives and performance.

To make the analysis of justified and residual fees comparable across funds, we annualize these variables and express them as a fraction of AUM. We then explore the relation between annualized incentive fees and annualized lifetime fund performance both graphically and analytically.

In Panel (a) of Figure 6, we present a scatter plot of actual incentive fees (square markers) and justified incentive fees (triangle markers) with respect to lifetime fund performance measured as annualized gross profits. In the negative performance domain, justified incentive fees are zero by construction; however, actual fees paid are positive in many cases. In the domain of positive lifetime performance, the justified fee markers compose multiple lines with different slopes, with the slopes reflecting different levels of incentive fee rates for different funds. The most visible line corresponds to a slope of 0.2, reflecting the fact that the majority of funds have a 20% contractual incentive fee rate. Just as in the domain of negative performance, actual incentive fees tend to be greater than justified fees in the

Figure 6. Justified and Residual Incentive Fee

The figure shows the relation between fund-level lifetime performance and incentive fees. Incentive fees are decomposed into justified and residual fees using Equations (2) and (3), respectively. In all panels, the x-axis represents funds' lifetime annualized gross profits. Panel (a) shows a scatter plot of actual incentive fees (blue squares) and justified fees (black triangles). Panel (b) shows residual incentive fees (i.e., the difference between actual and justified fees). Panels (c) and (d) summarize the same data by grouping funds into 20 equal-sized bins. Panels (e) and (f) summarize the data by grouping funds into 20 bins representing the same amount of AUM·time invested.



domain of positive gains.

Panel (b) of the figure shows the residual incentive fees, i.e., the difference between the actual incentive fees and the justified fees. The panel shows that the dot cloud is distributed almost uniformly across the entire spectrum of lifetime performance, suggesting the lack of a clear relation between residual incentive fees and performance.

To facilitate the interpretation of the scatter plot, we sort funds into 20 equal-sized bins. The average annualized incentive fee within each bin is plotted in the middle section of Figure 6. Panel (c) plots the actual and justified incentive fees, and Panel (d) plots residual incentive fees. By definition, justified fees are supposed to be zero in the domain of losses and are a monotonically increasing function of performance in the domain of gains. However, the line reflecting actual incentive fees shows that the nonlinear behavior of residual fees adds substantial noise to the relation between incentive fees and gross profits, leading to the observation that even funds with substantially negative lifetime performance have actually earned incentive fees. Panel (d) confirms that there is no clear positive relation between residual incentive fees and actual performance for most funds. In fact, for the 90% funds with the least extreme absolute performance, residual incentive fees appear to be, on average, higher for funds with negative performance than for funds with positive performance. The relation between residual incentive fees and performance has a negative slope for most values in the positive domain. The relation becomes positive only when considering the 10% of funds that have extreme performance, either positive or negative. It should be noted that extreme annualized performance tends to be mechanically associated with shorter return histories; thus, the two extreme bins should be interpreted with caution.

The middle panels of the figure (i.e., Panels (c) and (d)) weight each fund equally, regardless of size and length of return history. In Panels (e) and (f) of Figure 6, funds are first sorted by performance and then placed into 20 groups formed so that each group represents the same amount of AUM×time invested. This grouping allows us to better account for differences in size and time in existence across funds. Naturally, the spectrum of returns shrinks as small funds and short-lived funds tend to produce extreme annualized returns. Also, the distribution mechanically shifts to the right, since profitable funds live longer and accumulate greater AUM. Nevertheless, the general picture remains the same: There is no clear monotonic relation between performance and incentive fees paid in excess of justified incentive fees, and the relation between total incentive fees and performance appears to be relatively weak outside of the best-performing groups of funds.

In Table 6, we provide a formal analysis of the relationships presented in Figure 6. Panel A presents summary statistics for the annualized incentive fee and its two components, as well as management fees. The statistics for the cross-section of funds are calculated first at the fund level and then across funds. For comparison, in the second column of Panel A we also report the corresponding fee rates calculated using aggregate fees, returns, and AUM figures, i.e., as in Table 2.[22]

Over their life, hedge funds in our sample collected on average 1.80% of AUM per year as incentive fees and 1.49% of AUM per year as management fees. By construction, only funds with positive gross profitability earned fees that are classified as justified (1.94% p.a.). On the other hand, both profitable and unprofitable funds earned around 0.77% p.a. in residual incentive fees. In fact, the amount of residual fees is actually 0.05% larger in the domain of losses. Consistent with the patterns visible in the right panels of Figure 6, the difference becomes larger (0.16% p.a.) and statistically significant if we trim the observations in the 2.5% extreme tails of performance (untabulated t-stat $= -3.75$).

Thus, not only are residual fees unjustified by lifetime fund performance, but profitable funds and unprofitable funds seem to earn a similar amount of residual fees. Considering that incentive fees are supposed to reward hedge funds for outperformance only, this finding has paradoxical implications. For instance, Panel (d) of Figure 6 shows that there is a group of funds whose annualized gross dollar profit is in the range of -20%, and yet those funds have, on average, earned incentive fees of about 0.7% per year. This fee level would be justified if those funds had delivered positive gross profits of about 3.7% p.a. ($= 0.7\%/19\%$),

[22] Note that aggregate justified incentive fees are lower than average justified incentive fees across funds. The reason is that funds with negative lifetime gross profits have justified incentive fees equal to zero when considered individually; however, in aggregate, these funds lead to a decrease in cumulative gross profits and thus to a decrease in aggregate justified incentive fees.

Table 6. Lifetime Fund Performance and Incentive Fees

Panel A shows aggregate and fund-level summary statistics for lifetime annualized incentive fees and management fees. Justified and residual incentive fees are defined as in Equations (2) and (3), respectively, and annualized. IF refers to funds' lifetime incentive fees. *Gross Profits* refers to funds' annualized gross profits. Panel B presents regressions exploring the relation between the two components of incentive fees and gross profits. In the regression, fund-level fee and return variables are winsorized at the 1% and 99% levels to mitigate the impact of outliers. All coefficients in Panel B are multiplied by 100 for presentation purposes. The differences presented in the last column of Panel A and the third and sixth regression specifications in Panel B exclude funds in the 2.5% tails of the distribution of gross profits. t-statistics are presented in parentheses. Standard errors are clustered by fund strategy. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively. The coefficients marked with ‡ are omitted in the regression output due to lack of variation in the dependent variable.

Panel A: Annualized Fees (% of AUM)

		Cross-section of funds					
	Aggregate	Average	Std. Dev.	$I_{\{GP>0\}}$	$I_{\{GP\leq 0\}}$	Difference	Difference
Incentive fee (%)	1.93	1.80	2.67	2.69	0.79	1.89***	1.39***
Justified IF (%)	0.74	1.03	2.08	1.94	0.00	1.94***	1.56***
Residual IF (%)	1.19	0.77	1.37	0.74	0.79	−0.05	−0.16***
Management fee (%)	1.51	1.49	0.48	1.47	1.50	−0.04**	−0.04**
Tails trimmed	No	No	No	No	No	No	2.5%
Observations	5,917	5,917	5,917	3,150	2,767	5,917	5,623

Panel B: Relation Between Incentive Fee Components and Gross Profits

Dependent variable:	Justified IF	Residual IF		Justified IF	Residual IF	
Intercept	1.15***	0.75***	0.71***			
	(27.16)	(13.03)	(13.28)			
Gross profits	4.39***	0.56***	0.02			
	(11.09)	(5.32)	(0.15)			
$I_{\{\text{Gross profits}\leq 0\}}$				0‡	0.95***	0.95***
					(11.75)	(12.23)
Gross Profits · $I_{\{\text{Gross profits}\leq 0\}}$				0‡	0.90***	0.87***
					(13.76)	(7.35)
$I_{\{\text{Gross profits}>0\}}$				0.00	0.43***	0.55***
				(0.76)	(5.32)	(8.61)
Gross profits · $I_{\{\text{Gross profits}>0\}}$				19.42***	2.74***	0.94
				(151.43)	(5.11)	(1.52)
Tails trimmed	No	No	2.5%	No	No	2.5%
Observations	5,917	5,917	5,623	5,917	5,917	5,623
R^2	0.54	0.33	0.33	0.98	0.36	0.34

suggesting that for those funds there exists a gap of around 24% p.a. between the annualized gross profits that would justify the incentive fees earned and the actual lifetime gross profits delivered.

A casual inspection of the right panels of Figure 6 suggests that the relation between residual fees and gross profits is relatively weak, especially outside of the extreme quantiles of performance. Panel B of Table 6 provides a formal examination of this relation. To provide a benchmark for how the relation between incentive fees and gross profits ideally *ought to be*, we start by regressing justified incentive fees onto gross profits. We then regress residual incentive fees onto gross profits. Consistent with the examination of the data plotted in the figure, the relation is much weaker for residual fees than for justified fees. Specifically, the slope for the former component of fees is only 12.7% of the slope of the latter (= 0.56/4.39). Moreover, when funds in the 2.5% tails of performance are trimmed, the slope for residual fees becomes economically zero and statistically insignificant.

We next examine these relations in the domain of gains and losses separately. The results are presented in the last three specifications of Panel B. To provide a benchmark, we again begin by showing results for justified incentive fees. For this component of fees, the intercept and slope in the domain of losses are equal to 0 by construction and are omitted in the regression output due to lack of variation in the dependent variable. In the domain of gains, a 1% increase in annualized gross profits is associated with a 0.194% increase in justified incentive fees. Thus, the slope for justified fees almost perfectly reflects the equal-weighted average contractual incentive fee rate of 19.36%. The results presented in Column (5) show that the relation between fees and gross profits is significantly weaker for the residual component. Both intercepts are positive and statistically significant, which is in net contrast to the results obtained for the justified portion of fees. The slope is only 0.90 in the domain of losses and 2.74 in the domain of gains. Moreover, in the sixth column we find that the latter slope becomes economically and statistically indistinguishable from zero once the 2.5% of best-performing funds are excluded.

These results indicate that, in practice, the majority of funds receive residual incentive fees that are relatively insensitive to lifetime fund performance. The analysis suggests that fees that funds earn in excess of the contractual rate are not proportional to performance and thus lead to a weakening of the sensitivity of fees to performance. In fact, the residual component of incentive fees resembles what one might expect from a fixed management fee rather than an incentive-compatible performance fee.

5.3 Adding Management Fees

We conclude this section by considering the distribution of both management fees and incentive fees with respect to fund performance measured as gross excess returns, i.e., returns before fees. We conduct this analysis in Figure 7.

In Panel A, annual fees are presented as a fraction of AUM. The chart is generated by means of a local polynomial regression of fees onto gross excess returns. Each fund is a unit of observations. The x-axis is restricted to returns between -22.5% and 22.5% because observations outside this range become sparse and reflect short-lived funds and small funds with highly unusual returns (i.e., outliers). In Panel B, we split funds into 20 equal-sized groups sorted on their gross excess return and plot average dollar annual fees.

By construction, funds on the extreme right of the performance distribution have earned the majority of the incentive fees that are justified by lifetime performance. In contrast, management fees and the residual portion of incentive fees appear to be almost unrelated to lifetime performance.

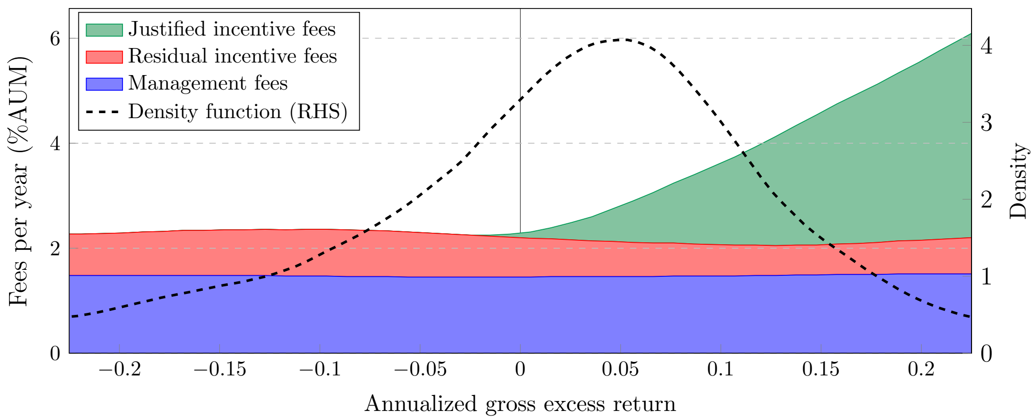
The figure also demonstrates the importance of our findings. The dashed line shows the density of funds along the performance spectrum. The left portion of Panels A and B show that a large number of poor-performing funds have collected a considerable amount of management fees and even incentive fees. For instance, the bottom 45% of funds have failed to deliver net lifetime returns higher than the risk-free rate and often produced substantial losses, and yet they have earned an average of \$1.8m in management fees and \$1.1m in incentive fees per year.

Panel C provides additional analysis that demonstrates the extent to which residual incentive fees are distributed in a way that resembles management fees. The plot shows

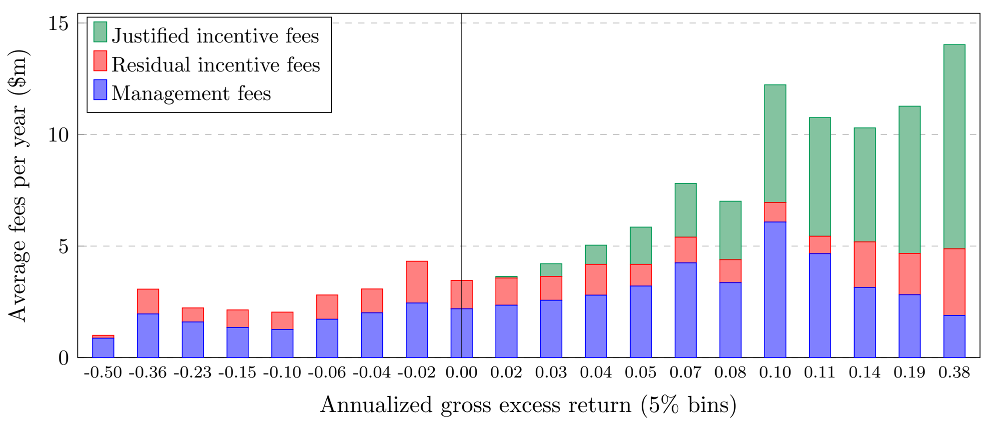
Figure 7. Fees Paid Across the Performance Spectrum

The figure shows the distribution of fees across the performance spectrum. Justified incentive fees and residual incentive fees are defined in Equations (2) and (3), respectively. See the text for details.

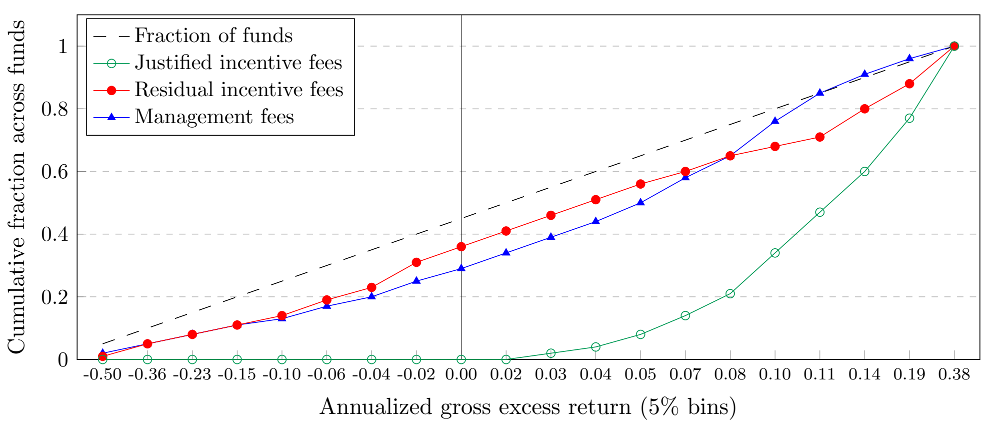
Panel A: Annual Fees Across the Performance Spectrum



Panel B: Dollar Fees Across the Performance Spectrum



Panel C: Cumulative Dollar Fees Across the Performance Spectrum



the dollar value of fees across the equal-sized groups (formed as in Panel B), accumulated across the performance spectrum. As expected, justified incentive fees are flat at zero for the losing region and monotonically increasing in the positive performance region. Management fees and residual incentive fees are distributed almost uniformly across performance groups. This finding suggests, again, that residual incentive fees are mostly independent of lifetime performance.

Taken together, the evidence presented in this section suggests that the prevailing hedge fund compensation structure fails to protect investors from paying fees to fund managers that perform poorly in the long run. In fact, there exists a sizeable disconnect between long-term fund performance and lifetime fees earned. This disconnect is in stark contrast with the "promise" of the prevalent hedge fund compensation contract that only outperforming managers will be rewarded with substantial fees.

5.4 Assessing the "1-and-30" Fee Structure

The analysis described in the previous section can provide insights to evaluate the anticipated effects of different compensation structures. Specifically, in recent years, investors and managers have considered transitioning from the traditional "2-and-20" fee structure to "1-and-30", i.e., decreasing the fixed rate of management fees and increasing the rate of performance fees.

Based on Panel A of Figure 7, we can speculate about the anticipated results of such a reform. Reducing management fees to 1% will shrink management fees (the purple region). However, the 30% performance fee will translate to larger red and green regions with a steeper curve. Hence, the decrease in management fees is likely to be offset by an increase in the residual incentive fees. These fees are likely to be paid regardless of the funds' performance, as Panel A shows. Hence, it is plausible that for many funds the reform will not alter the overall fees by a material amount.

Moreover, changing the fee structure can alter both the behaviors of managers and investors along several dimensions. For example, managers might take greater risks or decide to liquidate their funds after smaller losses than before (and hence potentially destroy investors' fee credits). If steeper incentives induce fund managers to take greater risks, the distribution of lifetime fund performance will display fatter tails. If fund return dispersion increases, is it likely that the mechanisms that make the effective incentive fee rate depart from the corresponding nominal rate will be exacerbated.

In sum, accelerating the performance component in hedge funds' fee structure may not necessarily lead to the desired results. As we show, in the long run, a significant part of incentive fees paid are unrelated to funds' performance and are distributed across funds in a way that resembles management fees. A caveat to this conclusion is that the nature of the discussion in this section is speculative and is based on observations made in the current equilibrium.

6 Discussion of Assumptions and Robustness

A large number of studies document the presence of biases of various nature in hedge fund data.[23] To carry out the tests described throughout this paper, we have combined data from two of the best available commercial data sets and we have applied best practices in the literature to correct the reported returns for known biases. Specifically, we have taken steps to mitigate survivorship bias, backfill bias, and delisting bias.

Moreover, funds usually report net-of-fee returns and do not disclose the amount of fees charged.[24] Thus, we have estimated quarterly gross returns and incentive fees by means of an algorithm that uses information about quarterly net returns, high-water-mark provisions, nominal fee rates, and a set of assumptions. In this section, we detail the steps taken to correct for known biases, and we discuss the assumptions used in our analysis and potential

[23]See Chapter 3 of Getmansky, Lee, and Lo (2015) and Chapter 6 of Agarwal et al. (2015) for a review of the relevant literature.

[24]In fact, anecdotal evidence suggests that even some large institutional investors are not fully aware of the exact amount of performance fees they pay to external managers. See, for example, CalPERS tries to get handle on management fees, *The Sacramento Bee*, July 2, 2015.

caveats. Then, we present a battery of sensitivity tests with respect to key assumptions. Finally, we report results obtained using other types of funds whose performance is also reported in hedge fund databases, i.e., commodity trading advisors (CTAs) and funds of hedge funds (FoFs).

6.1 Assumptions in the Baseline Analysis

6.1.1 Baseline Analysis: Correction of Performance Biases

For the purpose of our study, three types of return biases are of particular concern: survivorship bias, backfill bias, and delisting bias.

Survivorship bias exists when a database tracks only the performance of the funds that are still reporting as of the moment the data are obtained by the researcher. Because the probability of survival is positively related to past performance, this is known to create a upward bias in observed fund returns. Since 1994, both BarclayHedge and TASS keep two separate files tracking the performance of funds that are currently reporting and of those that have delisted. Using the data providers' jargon, these files are called "live" and "graveyard," respectively. Following the standard approach in the literature, we obtain and merge the live files and the graveyard files and analyze the combined data starting in 1995. However, Bhardwaj et al. (2014) demonstrate that in some instances the entire track record of a fund is removed from both the live file and the graveyard file, usually at the request of underperforming managers. This leads to an additional upward bias in average fund returns, which is referred to as "graveyard bias." We are not able to recover the returns of funds that have been permanently removed from the track records kept by the data vendors between 1994 and 2018. Therefore, although we follow the literature's best practice of including graveyard funds in our analysis, the performance of the funds we study is likely still upward biased due to the remaining graveyard bias identified by Bhardwaj et al. (2014).

The other two biases that we consider, backfill bias and delisting bias, originate from the fact that hedge funds report performance on a voluntary basis. Specifically, funds can strategically choose when to start and when to stop reporting, leading to an upward bias in reported performance, on average.

Backfill bias (also known as instant history bias) refers to the fact that when a fund starts reporting to a database, it is allowed to backfill part or all of its historical returns. After their inception, many hedge funds go through an incubation period in order to generate a track record that they can then advertise via data vendors such as BarclayHedge and TASS to attract additional outside investors. Thus, unsurprisingly, funds tend to start reporting to databases after experiencing abnormally high performance. This bias can effectively be eliminated by removing the backfilled returns from the main dataset. In order to do so, we use the procedure developed by Jorion and Schwarz (2019) to identify backfilled returns and exclude these observations from the sample. Consistent with known results, the average backfilled return in our data (2.47% per quarter) is significantly higher than the average return after listing (0.97% per quarter). In Section 6.4, we present results obtained when backfilled observations are not excluded.

Lastly, hedge fund returns are subject to delisting bias. This bias exists because returns are voluntarily reported to the data vendors weeks and sometimes months after the returns have occurred. Moreover, funds tend to strategically delay reporting when experiencing negative returns (Aragon and Nanda, 2017) and can decide to completely delist at any time, without first backfilling the most recent returns earned.[25] Although funds can delist for reasons other than failure (Liang and Park, 2010), researchers agree that the unreported returns tend to be poor (Getmansky et al., 2015). Among the major hedge fund performance biases, delisting bias is believed to be the most difficult to estimate and control for (Jorion and Schwarz, 2013). The crux of the problem is that it is difficult and sometimes impossible for researchers to observe or infer the unreported returns. A handful of papers have undertaken this difficult task. Using 13-F equity holdings (Agarwal, Fos, and Jiang, 2013), fund-of-hedge-

[25] Thus, delisting bias also reflects a look-back bias (also referred to as hindsight bias). For this reason, we cannot simply assume that investors could have disinvested from delisted funds before the poor unreported returns occurred.

funds holdings (Aiken, Clifford, and Ellis, 2013), and cross-listings in multiple databases (Jorion and Schwarz, 2013; Joenväärä et al., 2019), prior studies have found that fund performance after delisting is on average poor. Given the uncertainty regarding how to control for delisting bias, we follow prior literature and adjust the last reported return by cumulatively adding a terminal return. Aiken et al. (2013) recommend that researchers perform robustness tests by attributing delisting returns ranging from −25% to −100% (e.g., Titman and Tiu, 2010). Ang and Bollen (2010) report that fund-of-hedge-fund managers estimate liquidation losses relative to NAV of around 50%, and cite anecdotal evidence that losses close to 100% are not uncommon in the case of fund failure; however, they recognize that funds often delist from commercial databases for reasons other than failure and thus adjust their terminal return assumption to −25%.

In our baseline analysis, we take a relatively more conservative approach. We distinguish between fund delistings that likely reflect performance-driven liquidations and failures from delistings that are likely due to other reasons, and we assume a negative terminal return only for the former group. Liang and Park (2010) carefully study fund attrition in 1995–2004 TASS data and estimate that only about 35% of delistings in that period reflect "real failure." They then propose an algorithm to impute fund failure. We adopt their criteria and assume that a delisted fund has failed if the fund had strictly negative average returns in the last six months and strictly negative net flows in the last 12 months. Using these criteria in our sample, only 34.8% of delistings are considered to be fund failures, which is nearly identical to the real failure rate estimated by Liang and Park (2010). In our baseline analysis, we assume a terminal return of −50% in the case of imputed fund failure and do not adjust the return of other delisted funds. This adjustment leads to a decrease in the aggregate quarterly index return of the hedge funds in our sample of −0.28%. Comparing across biases, adjusting for survivorship bias (i.e., by including graveyard funds) has the largest effect on average fund performance, followed by the backfill bias adjustment (see Table 1) and by the delisting bias adjustment. In Section 6.3, we provide a sensitivity analysis with respect to the delisting bias adjustment.

6.1.2 Baseline Analysis: Estimation of Fees

As discussed, hedge funds report returns net of fees, and the actual amount of fees charged is not known. Management fees are calculated as a fraction of AUM and are therefore relatively easy to estimate. Incentive fees are calculated as a fraction of gross profits and then collected by the fund manager at prespecified intervals. Thus, in order to estimate the amount of fees charged, researchers have to use an algorithm that exploits the available information and knowledge about the working of funds' compensation structure. Our algorithm closely follows Agarwal et al. (2009), which appears to be the standard in the literature. Whereas Agarwal et al. (2009)'s algorithm is estimated at an annual frequency, other studies have applied the same methodology in order to infer gross returns and fees at the quarterly frequency (e.g., Lim et al., 2016) and monthly frequency (e.g., Cao and Velthuis, 2017).

In our combined data set, some of the funds that meet all other data requirements report AUM information that appears to be updated only once per quarter.[26] To avoid dropping these observations, we estimate gross returns and accrued incentive fees at the quarterly frequency. However, we assume that quarterly-accrued incentive fees are netted at the investor-fund level each calendar year and actually collected by the manager only if the net annual amount is positive. Note that this is equivalent to assuming that funds offer their investors a full calendar-year clawback provision. Based on anecdotal evidence, not all funds offered this provision, especially in the early part of the sample. Thus, our assumption is conservative, as we likely underestimate the true amount of incentive fees collected by funds,

[26]The "admin" files in both BarclayHedge and TASS contain a variable entry that refers to a fund's "subscription frequency." By far, the most frequent entry for this variable is "monthly," followed by "biweekly/semimonthly" and "quarterly." In some cases, the entry is missing. At any rate, it appears that funds that report to databases less frequently than every month nonetheless report month-by-month returns (e.g., at the beginning of April, a fund that reports quarterly will report the returns for January, February, and March). However, in some cases, the funds do not report month-by-month AUM values; this explains why some funds appear to have stale AUM within a quarter.

especially in periods with large within-year return volatility.

Following Lim et al. (2016), we also assume that all funds that have a high-water-mark provision also have hurdle rate provisions. Consistent with Lim et al. (2016), we assume that the the hurdle rate is equal to the three-month LIBOR and that it is cumulative over time. Similarly to other assumptions, we believe that our hurdle rate assumptions lead to an underestimation of the actual amount of incentive fees collected by managers because in reality not all funds have a hurdle rate provision. In fact, in the BarclayHedge database we observe that over 70% of funds have no hurdle rate.[27] To be conservative and for consistency with other studies, we nonetheless assume that all high-water-mark funds have a hurdle rate.

6.2 Sensitivity Analysis: Unobserved Flows

We use the algorithm first proposed by Agarwal et al. (2009) to infer gross returns and fees from net returns. Because the analysis is carried out at the quarterly frequency and thus we use quarterly net fund flows, our analysis ignores fund flows that take place within a given quarter. To account for the resulting loss of information, in our baseline analysis we assume that funds experience a quarterly inflow and outflow of 2.5% of AUM in addition to the observed net flow. Specifically, when implementing the algorithm, we assume that at the end of each fund-quarter observation, preexisting investors experience outflows of 2.5% of AUM and that an equivalent inflow of capital takes place for the new fund-quarter investor. This unobserved flow rate adjustment is motivated by the following calculation. For each fund-quarter observation in our sample, we determine the sign of the net quarterly fund flow. Then, we identify whether each quarter contains monthly net flows with the opposite sign of the net quarterly flow and average the absolute value of these flows (as a fraction of lagged AUM) across quarters. The resulting figure is 2.67%, which we round to 2.5% for our baseline analysis.

[27]Our TASS data do not contain information about hurdle rate provisions. Using different data sources that include TASS and pre-date our data by about a decade, Agarwal et al. (2009) find that only 61% of funds in their sample have a hurdle rate, confirming the idea that not all funds offer a hurdle rate provision.

It is likely, however, that this adjustment is insufficient to capture the full extent of capital turnover. Because return and AUM data are reported at A monthly frequency, heterogeneity in within-month flows is netted out and remains unobserved. This is not a trivial issue because hedge fund investors tend to be institutions that rebalance their portfolios periodically (e.g., quarterly or annually) and because hedge funds typically impose share restrictions (e.g., redemption notice periods and temporary restrictions on withdrawals). For both of these reasons, fund flows tend to cluster within certain months, and thus net monthly flows likely hide the true amount of capital turnover. Consistent with these arguments, Jorion and Schwarz (2015) examine SEC Form D filings and find that "only examining net flows masks high turnover and convex responses of inflows and outflows to performance." Specifically, they estimate that funds experience average yearly outflows of 26.35% of previous AUM and investor turnover of 38.49%. Because Form D is usually filed every 12 months, it is not possible to directly incorporate the estimates of Jorion and Schwarz (2015) into flow adjustments for the Agarwal et al. (2009) algorithm.

Given the uncertainty about the exact rate of unobserved inflows and outflows to be used, we check the sensitivity of our results with respect to this parameter. In Panel A of Table 7, we present key results obtained when the unobserved quarterly flow rate is set to 0%, 1.25%, 2.5%, 3.75%, and 5%. The results based on the baseline assumption (i.e., 2.5%) are presented in bold. As expected, the various cross-sectional and aggregate ratios of fees to returns increase with the unobserved flow rate. However, the sensitivity of the results to the unobserved flow parameter is arguably limited. For instance, when the parameter is set to 0%, we estimate that 62.3% of funds have collected fees that amount to more than 50% of the dollar gross excess returns generated over their lifetimes and that the aggregate effective incentive fee rate is 48.9%. When the parameter is set to 5%, these figures increase only to 63.0% and 50.3%, respectively.

Table 7. Sensitivity Analysis

The table presents sensitivity analysis for the main results presented in the paper. Panel A presents the sensitivity of the results to various rates of unobserved quarterly flows. Panel B shows the sensitivity of the results to the adjustment for delisting bias. Panel C shows the results for several sample definitions: *i*) the main sample including backfilled observations; *ii*) a sample restricted to only hedge funds having high-water mark provisions; *iii*) a sample that contains only commodity trading advisors (CTAs); *iv*) a sample that contains both hedge funds and CTAs; and *v*) a sample that contains only fund-of-hedge-funds (FoFs). Figures in boldface reflect the results obtained using the sample and assumptions of the baseline analysis reported throughout the paper.

Panel A: Sensitivity of Results to Unobserved Flow Rates

Unobserved flow rate	0.00%	1.25%	**2.50%**	3.75%	5.0%
Cross-section of funds					
Tot Fees/GrossExRet > 50%	62.3%	62.5%	**62.7%**	62.8%	63.0%
Tot Fees/GrossExRet > 100%	50.3%	50.3%	**50.3%**	50.3%	50.3%
Aggregate results					
Effective IF/Gross profits	48.9%	49.3%	**49.6%**	50.0%	50.3%
Effective IF/Nominal IF	2.58	2.60	**2.62**	2.63	2.65
TotFees/GrossExRet	63.4%	63.6%	**63.7%**	63.9%	64.1%
TotFees/NetRet	1.73	1.74	**1.76**	1.77	1.78

Panel B: Sensitivity of Results to Delisting Bias

Adjust for:	Never	Imputed failure only				Any delisting
Terminal return	n.a.	−25%	**−50%**	−75%	−100%	−10%
Implied index return adjustment	0.00%	−0.14%	**−0.28%**	−0.42%	−0.54%	−0.28%
Cross-section of funds						
Tot Fees/GrossExRet > 50%	58.8%	62.1%	**62.7%**	63.0%	63.1%	73.0%
Tot Fees/GrossExRet > 100%	43.9%	49.0%	**50.3%**	51.2%	51.5%	58.4%
Aggregate results						
Effective IF/Gross profits	37.0%	42.4%	**49.6%**	59.8%	72.8%	47.9%
Effective IF/Nominal IF	1.95	2.24	**2.62**	3.15	3.84	2.53
Tot Fees/GrossExRet	51.2%	56.8%	**63.7%**	72.6%	82.7%	62.6%
Tot Fees/NetRet	1.05	1.31	**1.76**	2.65	4.78	1.67

Panel C: Sensitivity of Results to Backfill Bias and Type of Funds

Sample	**Main sample**	Main + backfilled	HWM funds	CTAs	HFs + CTAs	Fund of funds
N funds	**5,917**	6,386	5,067	1,600	7,517	1,677
Nominal incentive fee rate	**19.0%**	18.9%	19.4%	17.7%	18.6%	9.9%
Cross-section of funds						
Tot Fees/GrossExRet > 50%	**62.7%**	58.2%	63.6%	73.1%	64.9%	64.0%
Tot Fees/GrossExRet > 100%	**50.3%**	44.0%	50.9%	55.0%	51.3%	51.2%
Aggregate results						
Effective IF/Gross profits	**49.6%**	44.0%	49.7%	41.9%	47.6%	74.1%
Effective IF/Nominal IF	**2.62**	2.34	2.56	2.37	2.55	7.49
Tot Fees/GrossExRet	**63.7%**	57.8%	64.2%	57.4%	62.1%	91.4%
Tot Fees/NetRet	**1.76**	1.37	1.79	1.35	1.64	10.61

6.3 Sensitivity Analysis: Delisting Bias

As discussed above, in our baseline analysis we control for delisting bias by appending a terminal return of −50% to fund delistings that are identified as being driven by failure using the criteria recommended by Liang and Park (2010). Here, we discuss the sensitivity of our results with respect to the delisting bias adjustment.

The robustness tests are presented in Panel B of Table 7. We carry out three types of sensitivity tests. First, we show results obtained without adjusting for delisting bias. Second, we vary the terminal return for imputed fund failures around the return used in the baseline analysis. We consider alternative terminal returns of −25%, −75%, and −100%. Third, we consider a terminal return of −10% applied to all delistings. The latter adjustment is motivated by the recent findings of Joenväärä et al. (2019), who use funds cross-listed on multiple data vendor platforms to augment delisting returns (see Panel C of Table 3 of that paper). In short, they find that some of the funds that delist from BarclayHedge and TASS keep reporting to other data vendors for a few additional quarters. Consistent with prior literature suggesting that delistings are followed by poor performance, they find that the average annual augmentable fund abnormal return (relative to non-delisted funds) is −12.35% for TASS and −9.76% for BarclayHedge. A simple back-of-the-envelope calculation (based on the length of the delisting return period and on the average return of non-delisted funds) suggests that these delisting returns can be summarized into a terminal return of approximately −10%. Note that this adjustment is probably still conservative because returns following delistings driven by the most catastrophic failures and liquidations likely remain unreported to any data vendor. Coincidentally, both the baseline adjustment (i.e., terminal return of −50% for failed funds) and the last version of the adjustment (i.e., terminal returns of −10% for all delisted funds) lead to an implied adjustment to the aggregate hedge fund index return of about −0.28% per quarter. However, as we discuss below, the two methods to adjust for delisting bias yield slightly different results when it comes to the relation between fees and returns, especially for cross-sectional results.

The robustness tests suggest that the cross-sectional results are not very sensitive to the terminal return assumed in the case of imputed fund failure. For instance, the fraction of funds for which lifetime fees amount to more than the entire amount of gross excess returns generated is 43.9% with no adjustment and grows to 50.3% and 51.5% when the terminal return is assumed to be −50% and −100%, respectively. As discussed in Section 5 (e.g., see Figure 5), our cross-sectional results are mainly driven by the stylized fact that many graveyard funds produced mediocre or even negative returns over their lifetime (before any adjustment for delisting). Thus, adjusting for imputed fund failure has little effect on the ratio of fees to returns for the bulk of the funds. On the contrary, intuitively, the cross-sectional results are more sensitive to the version of the adjustment where we assume that the terminal return is −10% for all delisted funds (right-most column of Panel B). For instance, under the latter assumption, the fraction of funds with fees greater than gross excess returns increases to 58.4%.

Moving to the aggregate results, the effective incentive fee rate is 37.0% when we do not adjust for delisting bias. That is, the effective incentive fee rate is nearly twice as high (1.95 times) as the nominal fee rates even under this overly optimistic assumption. When adjusting for imputed fund failure, the ratio of incentive fees to gross profits and the ratio of total fees to gross excess returns grow monotonically with the magnitude of the assumed terminal return. Adjusting the final return of all delisted funds (right-most column) leads to aggregate results that are very close to the baseline results, e.g., the effective incentive fee rate estimate is 47.9% and 49.6%, respectively.

6.4 Sensitivity Analysis: Backfill Bias

We also check the sensitivity of our results to the backfill bias adjustment. It is commonly accepted that researchers should exclude backfilled returns because they suffer from a severe selection bias. It is nonetheless interesting to explore how the results change when backfilled observations are not removed. In Panel C of Table 7, we compare the key results of our analysis in the baseline case (Column 1) and when backfilled returns are not excluded (Column 2). First, note that the number of funds increases from 5,917 to 6,386. Our analysis ends in 2016; however, we obtained the data in 2018. There are over 400 funds that started reporting between 2016 and 2018 and that are excluded from our main analysis because they do not have valid non-backfilled returns during the main sample period (1995–2016). However, if we do not exclude backfilled observations, the pre-2017 returns of these funds can enter the sample. Consistent with the observation that contractual incentive fee rates have slightly decreased in recent years, the AUM-weighted nominal incentive fee rate declines slightly from 19.0% to 18.9% when backfilled observations are not removed. As expected, the inclusion of backfilled returns leads to ratios of fees to returns that are slightly lower than yet not meaningfully different from those obtained in the baseline analysis. The reason why the inclusion of backfilled returns does not have a large effect on the results is that by construction the backfilled returns happen in the early part of a fund's life. When a fund starts reporting to a data vendor, the fund's AUM tends to increase and its performance tends to deteriorate relative to the backfilled performance, thus leading in many cases to losses that partially offset the profits generated during the incubation period.

6.5 Additional Results: CTAs and Fund-of-Funds

The analysis carried out throughout this paper focuses on the sample of hedge funds described in Section 2. Here, we report results for other types of funds. The results are presented in the last four columns of Panel C of Table 7.

First, we present results when excluding funds with no high-water-mark provision. There are 850 such funds in our sample and, as previously mentioned, they are more prevalent in the early part of the sample. In theory, the lack of a high-water-mark provision could lead us to observe a higher effective incentive fee ratio, thus exacerbating our results. However, this does not seem to be the case. When all funds are included, the aggregate effective incentive fee rate is 2.62 times higher than the corresponding nominal rate. When funds with no high-water-mark provisions are excluded, this figure becomes 2.56, i.e., it barely changes. Similarly, the cross-sectional results remain qualitatively and quantitatively unchanged.

We next present results for CTAs and FoFs. The results obtained for CTAs are qualitatively similar and quantitatively close to the results obtained using the main sample of hedge funds. In the cross-section, a large fraction of funds have collected fees that are greater than half the gross excess returns generated (73.1% of CTAs) and greater than the entire amount of gross excess returns generated (55.0% of CTAs). In aggregate, the effective incentive fee rate is 2.37 times the AUM-weighted contractual rate (i.e., 41.9% instead of 17.7%). In some cases, academic papers analyze samples that combine hedge funds and CTAs. In the fifth column of Panel C, we present results for a sample that includes hedge funds and CTAs. Given that the results for the two types of funds are qualitatively similar and that hedge funds are larger and more numerous than CTAs, the results for the combined sample are similar to those obtained when only hedge funds are included.

Finally, we report results for the sample of funds-of-hedge-funds. Before discussing the results, a few clarifications are in order. First, investors who invest in hedge funds via FoFs pay an additional layer of fees to the FoFs. Here, we consider only this second layer of fees. FoF fee rates are normally only about half as large as hedge funds' fee rates. In fact, the AUM-weighted nominal incentive fee rate for FoFs in our sample is 9.9%, and more than half of these funds charge a round 10% incentive fee. Second, because FoFs are diversified portfolios of hedge funds, the likelihood of extremely poor performance and failure is lower for the former type of funds than for the latter. For this reason, we do not adjust the returns of FoFs for delisting bias. Third, the net returns of FoFs are know to be low, e.g., in our sample, the AUM-weighted net returns of FoFs are less than half the AUM-weighted net returns of hedge funds.

The ratios of aggregate fees to returns for FoFs are even higher than they are for hedge funds. The effective incentive fee rate is 74.1%, which is 7.49 times the nominal incentive fee rate. Moreover, the ratio of management fees plus incentive fees to gross excess returns is equal to 91.4%, i.e., almost the entire amount of returns earned on the underlying portfolio of hedge funds is retained by managers as fees.

7 Conclusion

The effect of hedge funds' performance-based compensation on managerial behavior has long been debated by academics and practitioners alike. In this article, we focus on a different and little-understood implication of the asymmetric nature of incentive fees. We argue that the fraction of incentive fees paid relative to gross profits can exceed the nominal incentive fee rate by a significant margin, both at the fund level and in aggregate across a portfolio of hedge fund investments. Intuitively, this can happen because investors have to pay incentive fees when the performance of a given fund is good, but they are not equally compensated when that fund or another fund loses money.

The historical analysis of a large sample of hedge funds reveals that the impact of the asymmetry is significant. The estimates show that investors have paid 49.6% of aggregate gross profits as incentive fees, that is, the effective incentive fee rate has been more than twice as large as the average nominal incentive fee rate of 19.0%. We show that the difference in fees, the "residual incentive fees," were paid to managers irrespective of their lifetime performance. These higher ex-post incentive fees decrease investors' net aggregate returns by 1.19% per year.

The economic magnitude of the results is large. Over the sample period studied (1995–2016), the investors in the sample's hedge funds paid $133bn in incentive fees and earned $228bn in aggregate gross profits. This means that investors paid $70bn more than they would have paid if incentive fees had been completely symmetric. Extrapolating these results to hedge funds not included in the sample studied here suggests that the latter figure is likely around $194bn over the last two decades.

It is important to note that our results are not driven by an unusual period. The mechanisms that erode investors' share of profits are at play in both good or bad periods: *i*) investors are unable to offset losses against profits across funds, and *ii*) exit by investors and managers can crystallize underwater incentive fees and destroy outstanding fee credits.

Our results are surprising in light of the sophistication of hedge fund investors. In the U.S., only institutional investors and accredited investors can allocate capital to hedge funds. The results about the nature of incentive fees that we document are not entirely driven by a single unexpected shock. Yet, investors are slow to recognize these facts. Early work, such as Getmansky et al. (2004) and Liang and Park (2010), demonstrate that hedge funds tend to have short lives and that a significant portion of them end up with losses. Further, legal scholars advised instituting clawback provisions for fees given cases of tremendous losses and frauds (Cherry and Wong, 2009). According to the survey of the largest hedge fund managers (Waterman and Kehoe, 2019), as of 2019, only 16% of funds offer clawback of *some* past fees.

Despite the long history of poor outcomes associated with the prevailing compensation contract, the hedge fund industry does *not* appear to be moving toward a more symmetrical incentive structure. On the contrary, the debate among fund managers and investors suggests that the current consensus is to replace the traditional 2-and-20 fee scheme for one with a lower management fee and higher incentive fee, for example, 1-and-30. Our findings suggest that loading up the incentive fees may not lower the amount of fees that investors pay in aggregate over a full market cycle. Our findings also suggest that increasing the incentive fee rate is unlikely to protect investors from paying fees to fund managers that perform poorly in the long run and that for many funds a higher incentive fee may not substantially tighten the link between lifetime performance and fees.

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