The Performance of Hedge Fund Performance Fees

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Abstract

We analyze the long-run outcomes associated with hedge funds' performance-based compensation. Over a 22-year period, the aggregate *effective* incentive fee rate in hedge funds is 2.5 times the average contractual rate (i.e., around 50% instead of 20%), and more than twice the effective incentive fee rate of private equity funds. In the cross-section of hedge funds, there is a substantial disconnect between lifetime performance and incentive fees earned. These outcomes stem from the asymmetry of the performance contract, investors' return-chasing behavior, and underwater fund closures. These outcomes do not appear to be fully anticipated by investors.

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1 Introduction

> *The real matters of contention are whether financial innovation over the last 40 years has been beneficial and whether the size of the U.S. financial system has outgrown its benefits. A common belief in our profession is that all that we observe is efficient. But do we have any theory or evidence to justify this conclusion?*
>
> —Luigi Zingales, Presidential Address,
> The American Finance Association, January 2015

The financial industry is often characterized by costly inefficiencies and dysfunction (Philippon, 2015; Zingales, 2015). Academics have documented cases of exploitation of unsophisticated clients; rent-seeking behavior; and many other manifestations of imperfect competition and agency conflicts.[1]

Unlike the general financial sector, the alternative asset management industry boasts more desirable features: thousands of funds compete for the capital of investors that, by definition, are deemed to be sophisticated; and the business model is typically built around performance-based contracts. Managers of hedge funds—the poster child of this industry—are compensated with arrangements that are known as incentive fees or performance fees. The implicit "promise" of the hedge fund compensation structure is that fund managers make money only if investors make money. "Pay for performance," the mantra goes.

In this paper, we present an array of findings that is difficult to reconcile with the enthusiastic promises of pay-for-performance in the hedge fund industry. The headline result is that the typical 20% profit-sharing agreement produces an *effective* incentive fee rate of about 50%, i.e., 2.5 times the corresponding nominal rate. By contrast, a similar 20% profit-sharing agreement in private equity investments produces an effective incentive fee rate that

[1] For instance, Ausubel (1991), Hortaçsu and Syverson (2004), French (2008), Greenwood and Scharfstein (2013), Gennaioli, Shleifer, and Vishny (2012), Célérier and Vallée (2017), Philippon (2019), Egan, Matvos, and Seru (2019), deHaan, Song, Xie, and Zhu (2021), and Vokata (2021). See Campbell, Jackson, Madrian, and Tufano (2011) for a discussion of consumer financial protection.

remains much closer to the nominal rate. We also document substantial distortions in the cross-sectional relationship between hedge fund performance and incentive fees. For instance, the subset of funds that produced strictly negative lifetime dollar returns earned on average incentive fees of about 0.8% of AUM per year, a paradoxical observation.

Given the evidence, and based on economic arguments we present below, it seems unlikely that hedge fund investors fully anticipated—or intended—these outcomes. The crucial implication is that investors may hold severely biased return expectations. To the extent that investors fail to anticipate that “20” becomes “50”, it must be the case that they underweight the probability of left-tail return realizations across funds and across time.

The possibility that hedge fund clients may hold overoptimistic expectations is especially meaningful given the the role played by alternative asset management fees in the increase of the cost of financial intermediation in recent decades (Greenwood and Scharfstein, 2013). In the spirit of Zingales (2015)’s presidential address cited in the beginning of this article, our study suggests that, at a minimum, economists should not automatically assume that the alternative asset management industry (and its ballooning revenue) is by definition consistent with an archetypal “perfect market”. In the particular example we study, despite the competitive environment and the presumed sophistication of investors, the long-run outcomes associated with hedge fund fees appear to be skewed in favor of the managers.

Our paper proceeds in three parts. In the first part, we calculate the returns and fees for a sample of about 6,000 hedge funds.[2] Over the 22-year period studied (1995–2016), investors paid about 50 cents in incentive fees for each dollar of gross profits earned. Thus, despite the widespread use of high-water mark provisions intended to prevent this outcome, the *effective* incentive fee rate was 49.6%, which is 2.62 times the asset-weighted average nominal rate of 19.0%.

We identify two main reasons why the effective level of incentive fees tends to exceed

[2] In a similar manner as in other studies, we infer gross returns and fees from reported net returns. Our results are therefore based on estimates. In Appendix A, we present extensive sensitivity analyses with respect to the assumptions used to obtain these estimates.

the nominal level. First, we show that the protection offered by high-water marks is greatly eroded by the behavior of managers and investors following poor performance. Most hedge funds offer a high-water mark provision.[3] In the case of losses, this provision implicitly compensates investors with "incentive fee credits," i.e., the right to recover prior losses without paying additional incentive fees. In principle, this should ensure that the long-run ratio of incentive fees to gross profits remains close to the nominal rate. We show that, in actuality, fee credits are often lost because investors tend to withdraw capital and managers tend to close their funds after poor performance.[4] Stated differently, capital tends to be disinvested precisely when the value of the high-water mark provision is highest.

Second, investors cannot offset gains and losses across funds. While aggregate profits from a hedge fund portfolio combine the results of winning and losing funds, the losses produced by losing funds cannot be used to diminish the incentive fees owed to winning funds. Hence, cross-sectional variation in fund performance causes the aggregate ratio of incentive fees to profits to be higher than the corresponding nominal rate. The lack of cross-fund performance netting also gives fund managers the incentive to offer multiple investment strategies using separate vehicles (i.e., become fund families).

The mechanisms described above are exacerbated by the strong return-chasing behavior of investors. Return chasing implies that funds experience larger outflows following losses. Therefore, outflows (and fund liquidations) tend to occur precisely when investors have accrued fee credits and cause the crystallization of losses in investors' portfolios, leading to the high observed effective incentive fee rate. One could hypothesize, however, that return chasing may lead to better returns and may therefore be justified regardless of its effect

[3]The high-water mark provision dictates that managers earn incentive fees only for new profits, i.e., above the previous high valuation of the portfolio. This provision is designed to ensure "that the manager is paid an incentive fee if and only if the manager has made money for the investor not only in the current year but since inception" (Getmansky, Lee, and Lo, 2015, p. 485). Some funds in our sample do not offer a high-water mark provision. This is not a first-order driver of our findings. As shown in the Appendix, our key results are virtually unchanged if funds without a high-water mark provision are excluded.

[4]The fact that both investors and fund managers tend to discontinue investments following poor performance is consistent with earlier studies such as Brown, Goetzmann, and Park (2001), Getmansky, Lo, and Mei (2004) and Liang and Park (2010).

on fees. This is not the case. We confirm that return chasing—as measured by net fund flows—does not seem to lead to superior performance. In fact, flow-adjusted fund returns are significantly lower than buy-and-hold returns, as previously found by Dichev and Yu (2011).

In the second part of the paper, we explore the relation between lifetime fund performance and incentive fees in the cross-section of funds. We study the allocation of fees across funds to determine whether, for instance, incentive fees in excess of the nominal rate accrue to right-tail performers. In that scenario, the fact that fees represent a high fraction of gross profits would not necessarily imply a surprising or unintended outcome.

We start the cross-sectional analysis by decomposing fund-level incentive fees into two parts: *i*) "lifetime-justified fees," and *ii*) "residual fees." Lifetime-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. We find that residual incentive fees average 0.77% of AUM 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.

The fact that a large fraction of incentive fees paid are unrelated to lifetime fund performance leads to a paradoxical observation in the cross-section of funds: Incentive fees as a share of gross profits are, on average, a *decreasing* function of funds' lifetime gross profits. For instance, funds with annualized profits of 4% on average earn an effective incentive fee rate of about 50%. By contrast, funds that deliver annualized profits above 8% earn on average an effective incentive fee rate of 25%.

In the last part of this study, we discuss our empirical results and propose an economic interpretation. Given the stark disconnect between the promises of pay-for-performance and the long-term outcomes we document, we conjecture that these outcomes were not anticipated nor intended by the investors who allocated capital to hedge funds during our sample period.[5] We refer to this conjecture as the unintended outcome hypothesis. An ideal test for this hypothesis would have been to survey investors about their fee expectations at the beginning of our sample (i.e., in the mid-1990s). Although such survey does not exist, we discuss several pieces of evidence that support the unintended outcome hypothesis.

First, we review industry sources and practitioner literature. Perhaps the most direct evidence comes from the way practitioners estimate the amount of incentive fees collected by the hedge fund industry as a whole. Practitioners use a net-of-fees aggregate return index that is considered representative of the broad hedge fund industry, calculate the average return over the period of interest, and infer the amount of incentive fees from that average net return using the nominal incentive fee rate.[6] As our results show, calculating incentive fees this way will underestimate the actual amount by two times or more (depending on the time period in question), because it ignores the existence of crystallized net losses and underwater incentive fees. We also review industry sources that discuss the impact of fees on the expected returns of hedge funds. Again, in those writings (including in those that directly criticize fees for other reasons), there is no evidence that practitioners expect the effective incentive fee rate to deviate substantially from the nominal rate. In sum, we conclude that most practitioners appear to overlook the long-term implications associated with asymmetric fees we document in this article.

A comparison of fee outcomes across hedge funds and private equity (PE) funds provides additional insights. For a representative sample of about 3,000 U.S. PE funds that operated during the same period as the hedge funds we study, we estimate that the effective incentive fee rate was approximately 22%, i.e., only about ten percent greater than the typical nominal rate of 20%. This is a far cry from what is observed in the hedge fund industry. Yet, the

[5]In fact, informal feedback from practitioners and financial press coverage of the first draft of this paper suggest that our results are perceived as highly surprising.

[6]See, for instance, the calculations presented in page 5 of "The value of the hedge fund industry to investors, markets, and the broader economy," June 19, 2012, a study commissioned by KPMG International and the Alternative Investment Management Association (AIMA).

practitioner literature and professional educational material seems to overlook the fact that the similar 20% profit-sharing agreement common in both industries leads to vastly different outcomes.[7]

Finally, the unintended outcome hypothesis is supported by a "reductio ad absurdum" argument. "20" becomes "50" because 60% of the gains on which incentive fees are paid are eventually offset by losses. Relatedly, a substantial fraction of funds have relatively short lives and tend to be liquidated due to lack of success or outright underperformance and failure. It is difficult to imagine that a CIO or advisor would present these odds when recommending a portfolio of hedge fund investments. Similarly, it seems unlikely that the board of a pension fund or other investors would approve such a portfolio. Extending this logic to fees, it seems very unlikely that investors would expect—let alone intend—to pay an effective incentive fee rate of more than twice the nominal rate.

In the conclusion of the article, we discuss potential mechanisms that could help explain why the expectations of investors may be biased. The mechanisms include overconfidence, selection neglect, tail risk neglect, and mental accounting. Although we do not know of any formal theory of inefficient or miscalibrated investment for the alternative asset management industry as a whole, we note that the hedge fund investing setting is similar to that described in models in which investment in innovative sectors may deviate from the fully-rational expectations paradigm, such as the economies described in Gennaioli, Shleifer, and Vishny (2012), Biais, Rochet, and Woolley (2015), and Hirshleifer and Plotkin (2020).

[7] To the contrary, hedge funds and PE funds are often discussed in parallel under the private alternative investments label, and the similarities between their performance-based fee structures tend to be highlighted. As discussed in the rest of the paper, we do not argue that hedge funds and private equity investments are directly comparable (e.g., their systematic risk exposures are certainly different), nor that one asset class is superior to the other. We simply point out that their profit-sharing agreements lead to very different outcomes.

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 universe of commercially-available hedge funds.[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 takes place at the end of each quarter. Because the objective of this study is to assess the outcomes of the typical compensation structure of hedge funds, 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 the $5m AUM threshold is minimal. Moreover, because we eliminate backfilled

[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.

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 Appendix A, 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% (Joenväärä et al., 2019). Finally, for each duplicate case, we keep the one with the longest series of valid returns and AUM data.

2.2 Primary Sample

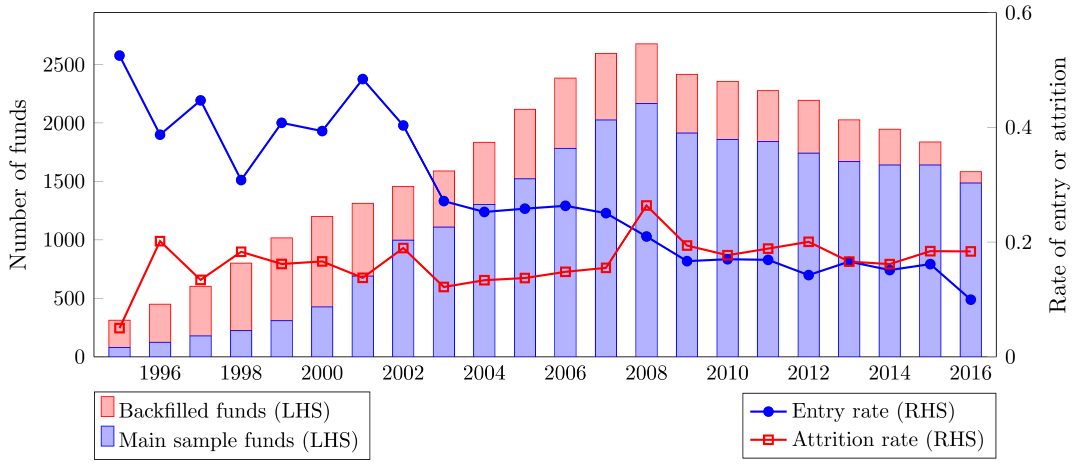
The final sample starts in the first quarter of 1995 and ends in the last quarter of 2016.In our main empirical analyses, we focus on "traditional" hedge funds,[9] i.e., we exclude commodity trading advisors (CTAs) and funds-of-hedge-funds (FoFs). Appendix A.5 presents results obtained when performing 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. As the right axis shows, fund entrance is larger than fund exit in every year until 2008. 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 performance to one of the data providers.

[9]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". Where relevant, we use these strategy definitions to cluster standard errors. 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.



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 (an early implementation was in Agarwal, Daniel, and Naik, 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.[10]

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.[11] 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 investment 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,

[10]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 Appendix A, we provide additional details and a sensitivity analysis for this choice.

[11]The FIFO rule was applied by Agarwal et al. (2009), Lim, Sensoy, and Weisbach (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 25^{th}	Percentiles 50^{th}	Percentiles 75^{th}	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%

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 Appendix A.4, we report results obtained when backfilled observations are not excluded.

2.4 Private Equity Fund Data

We also present estimates of the incentive fees for private equity (PE) funds. To do so, we use fund-level data obtained from Preqin in October 2017. Brown, Harris, Jenkinson, Kaplan, and Robinson (2015) analyze four PE datasets from major data providers (including Preqin) and conclude that fundamental empirical inference about fund-level performance is similar across the various sources.

The sample is constructed following literature standards and with the objective of ensuring that the PE fund operated in a similar time period and thus in similar market conditions as the hedge funds in our sample. We restrict the sample to funds whose status is listed as 'close' or 'liquidated', whose region of focus is the U.S., with fund size of at least 5 million dollars, and with vintage years from 1995 to 2011. We also require that funds have non-missing performance as measured by the Total Value to Paid-In capital multiple (TVPI). We then divide the sample into five categories: Buyout and Growth Equity, Venture Capital, Debt, Real Estate, and Other Private Capital.[12] Unlike hedge fund return data, the PE data we use is generally believed to be free of performance-related biases because it is primarily obtained via freedom of information act requests to clients (e.g., pension funds and endowments). Similar to hedge funds, private equity funds that use only insider capital are unlikely to be represented in these data. This is not a major concern for our purpose, because our aim is to study fee outcomes in the alternative asset management market, i.e., we are only interested in funds that utilize external capital.

3 Industry-Level Results

3.1 The Effective Incentive Fee Rate

One distinctive feature of hedge funds—if not the most distinctive—is their compensation structure (Loomis, 1970). Hedge funds charge performance-based fees that are asymmetric with respect to losses and gains. While a fund collects an incentive fee in periods with gross profits, it does not compensate its investors in periods with losses, nor does the fund pay back the incentive fees that have been previously collected. Moreover, investors cannot offset gains and losses across different funds. Because of this asymmetry, the portion of an investor's aggregate profits earned across a portfolio of hedge fund investments *may* exceed the average contractually stated incentive fee level. But just how large is this difference in reality?

To answer this question, we compute the industry-level effective incentive fee rate, defined

[12]The five categories are based on the following Preqin codes, respectively: 'Buyout' and 'Growth'; 'Venture (General)', 'Early Stage', 'Late Stage', 'Early Stage: Seed', 'Early Stage: Start-up' and 'Expansion / Late Stage'; 'Direct Lending', 'Mezzanine', 'Distressed Debt' and 'Venture Debt'; 'Real Estate'; 'Direct Secondaries', 'Infrastructure', 'Natural Resources', 'Secondaries', 'Special Situations', 'Timber' and 'Turnaround'. Funds with other investment codes or missing code are excluded.

as the ratio of aggregate incentive fees to aggregate gross profits:

$$\text{Effective Incentive Fee Rate} = \frac{\text{Aggregate Incentive Fees}}{\text{Aggregate Gross Profits}}. \tag{1}$$

We start by computing aggregate annual dollar returns and fees across all funds. The results are presented in Table 2. Following the academic literature, gross excess returns are defined as 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 annualized gross excess returns of 5.40% 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).

The penultimate row presents figures accumulated over the 22-year sample. During this period, aggregate gross profits and incentive fees amounted to \$228.2bn and \$113.3bn, respectively. Thus, the effective incentive fee rate was equal to 49.6% (\$113.3bn/\$228.2bn = 0.496), which is approximately 2.62 times the AUM-weighted nominal incentive fee rate of 19.0%.

The cumulative value of incentive fees paid amounts to 1.93% of AUM per annum. Including management fees, 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

[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, $\frac{\sum_{t\in T} G_t}{\sum_{t\in T} AUM_t}$:

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

Table 2. Hedge Fund Returns and 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%

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.

As explained in Section 2.3, these estimates rely on several assumptions regarding the fee calculation algorithm and sample selection choices. Although our assumptions are in line with literature standards, in Appendix A we present a battery of robustness tests. Those tests indicate that our headline results and inference are not particularly sensitive to reasonable variation in the assumptions.

Fees and the financial cycle 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.

To understand the economic impact of fees on investors' returns over the financial cycle, we graphically present how cumulative returns are divided between fund managers and investors over the sample period. In Figure 2, Panel A, we divide gross profits (gross excess returns minus management fees) into investors' share (i.e., net returns) 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 reaches 50% in 1998, 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.

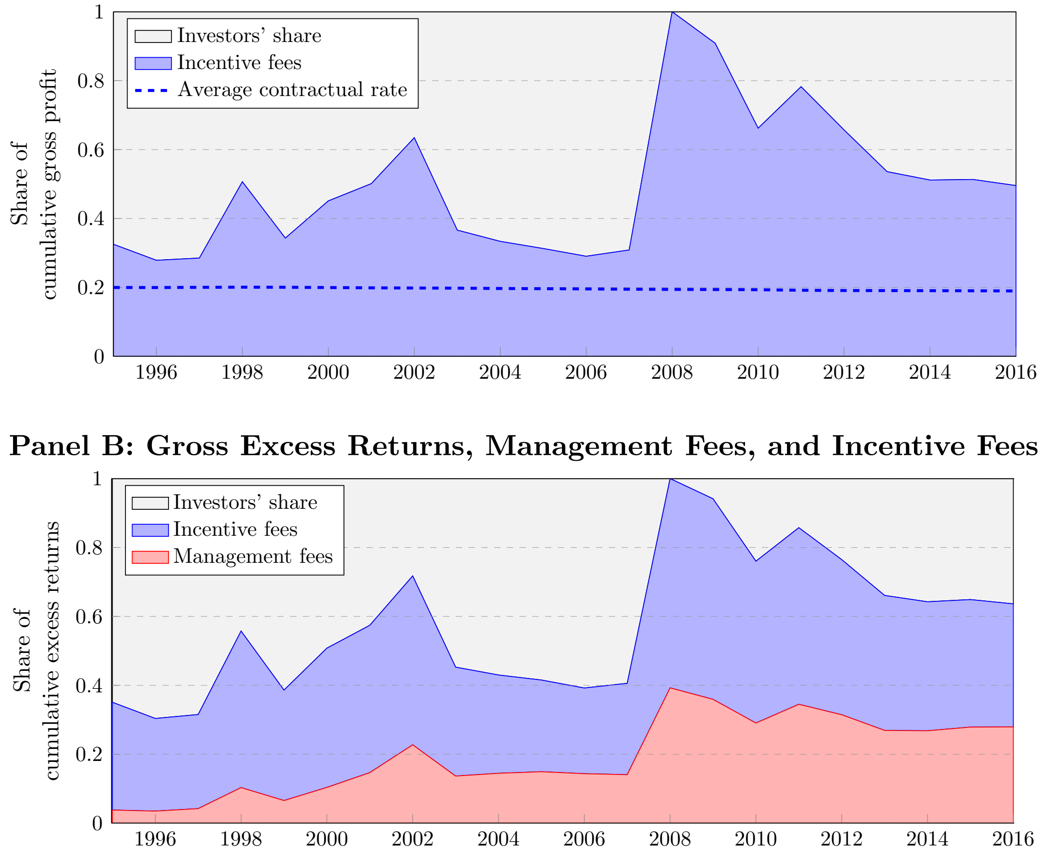
Incentive fees as a fraction of gross profits decrease after 2009, partially because fund returns tend to rebound after periods of crisis, while incentive fees grow significantly more slowly. This happens because right after a crisis many hedge funds find themselves below the high-water mark, and therefore they need to produce substantial returns 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.

In Figure 2, Panel B, we show how gross excess returns are divided between management fees, incentive fees, and investors' share (i.e., net returns over the risk-free rate). 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

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



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 amounted to more than 100% 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]

[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. By contrast, our results are based on detailed fund-level data.

Economic interpretation. The results presented above are attributable to the asymmetric nature of hedge funds' compensation contract and to the complex dynamics and path dependence of returns, fund flows, and fund closures. Yet, these findings have a simple economic interpretation. Close to 60% 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."

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 only the fees paid 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 larger sample of by Joenväärä et al. (2019).[15] In their study, the 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.

[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.

Thus, extrapolating to the larger sample of Joenväärä et al. (2019) 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, which is \$194bn more than if the profit-sharing agreement had been symmetric.[17]

3.1.1 Reconciling Actual and Nominal Incentive Fees

Next, we present a decomposition exercise designed to reconcile the effective incentive fee rate, i.e., 49.6%, with the average nominal incentive fee rate, i.e., 19.0%. From the point of view of 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 (i) fund-level profits that have not been offset by subsequent same-fund losses and (ii) net losses (defined as negative gross profits). Similarly, incentive fees can be classified into two categories based on whether the gross profits associated with the fees have subsequently been lost. We can formally express these concepts by further breaking down the ratio defined in Equation (1) as follows:

$$\begin{aligned}\text{Effective IF} &= \frac{\text{Aggregate IF}}{\text{Aggregate Gross Profits}} \\ &= \frac{\text{IF on Profits Not Lost} + \text{IF on Underwater Profits}}{\text{Gross Profits Not Lost} - \text{Net Losses}}. \end{aligned} \tag{2}$$

There are two principal reasons why the effective incentive fee rate is strikingly larger than the average nominal rate: losses incurred in the cross-section of funds, and losses incurred by funds that previously earned incentive fees. Both mechanisms influence the effective incentive fee rate because of the asymmetric nature of the compensation contract. The first mechanism, which can be thought of as a portfolio effect, increases the effective incentive fee rate by decreasing the denominator in Equation (2). The second mechanism can increase the

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

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

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."

Following the logic illustrated in Equation (2), Table 3 provides a decomposition of aggregate incentive fees and gross profits. 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%, as expected.[18]

We then account for 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 3, accounting for these losses takes the ratio of incentive fees to profits from 19.1% to 34.5%.

Next, we account for incentive fees paid for profits that have subsequently been lost due to same-fund losses. Using the terminology established in Equation (2), we call these fees "incentive fees on underwater profits." 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

[18] 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).

Table 3. 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%	

Table 3).

The amount of incentive fees on underwater profits is \$34.6bn (= \$113.2bn – \$78.6bn). We further categorize these fees across two 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 3, 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%.

The final subset of fees are live funds' underwater incentive fees. This component only captures underwater investors who were still invested in a live fund at the end of the sample period. This component is relatively small at $3.2bn (eighth row of the table). Adding this final component to the numerator brings the ratio of incentive fees to gross profits to 49.6%.

3.2 Why are Incentive Fees so High?

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, and only to the extent that those losses are crystallized by investors' outflows or fund closures.

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 A yet 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, this effect is large. This reflects the fact that the hedge fund industry is characterized by large cross-sectional and time-series variation in performance, and that the

Table 4. 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%

number of funds that are liquidated due to poor returns is substantial.

Table 4 helps illustrate the implications of the dispersion in cross-sectional performance on fees and profits. Each year, we separate fund-investor observations into those with gains in that year and those with losses in that 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 between 17.0% and 29.6% for funds with gains.[19] Gains accruing to investors who are below 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 (2).

The fact that gains and losses cannot be offset in the cross-section of funds provides

[19] 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 performance swings 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%.

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.

3.3 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 (2).

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.

3.3.1 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 liquidated (Grossman and Zhou, 1993; Lan, Wang, and Yang, 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 earlier 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.

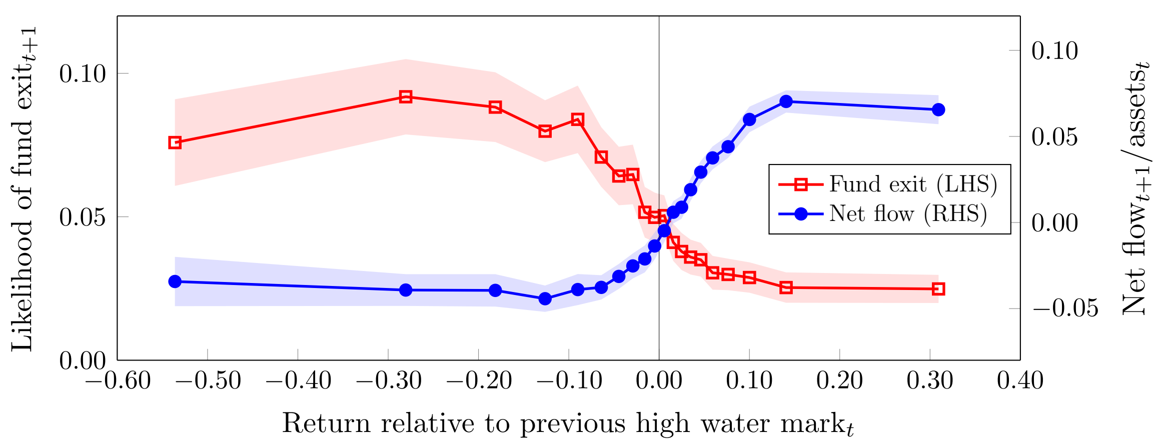
A number of factors can motivate funds to liquidate. First, it is possible that their investment strategies are no longer expected to be profitable. Second, as funds accumulate losses, it is hard to convince new investors to invest, since investors tend to chase returns on average. Third, the prospect 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. Thus, key personnel may strategically decide to leave.

Consistent with these arguments, funds in our data are three to four times more likely to

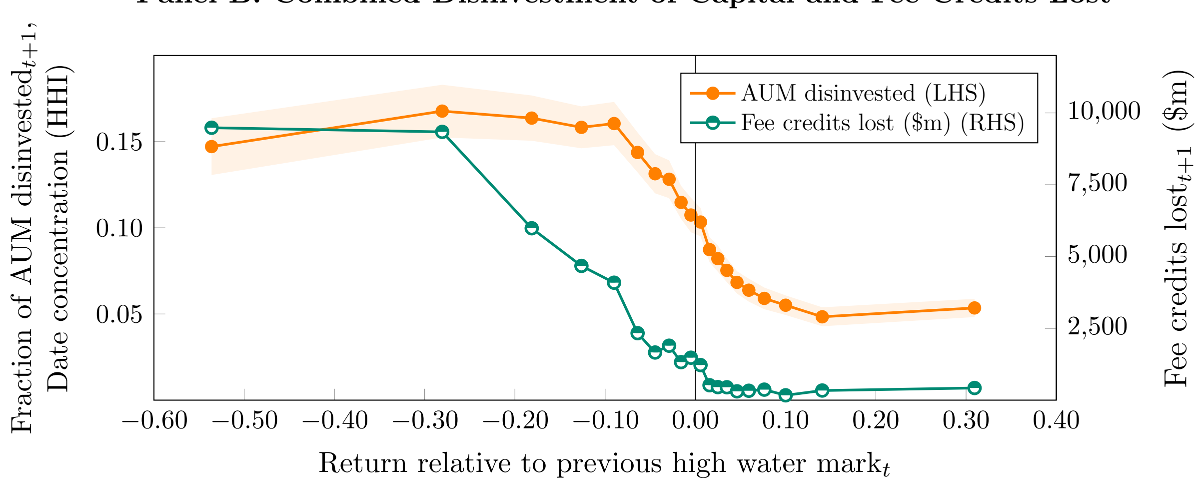
Figure 3. Fund Exit and Investor Flows Around the High-Water Mark

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



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-

Table 5. 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

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.[20] In Table 5, we

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

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 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.

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. In actuality, 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.

3.3.2 Investors' Return-Chasing Behavior

It has been widely documented that investors across many asset classes chase past returns (e.g., Chevalier and Ellison, 1997; Kaplan and Schoar, 2005; Ben-David, Li, Rossi, and Song, 2021). 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., Goetzmann, Ingersoll, and Ross, 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.

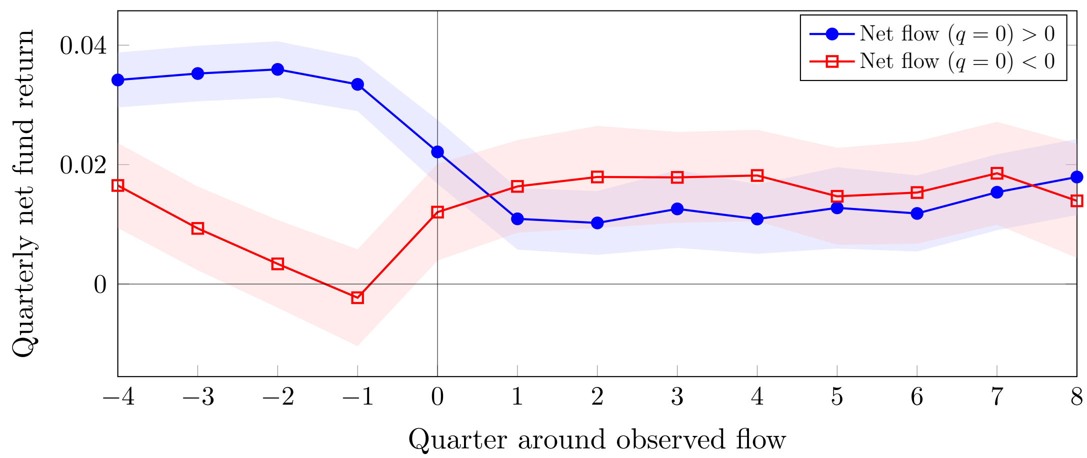
The estimates presented in Table 5 show that exit by investors is an important factor in destroying fee credits. Over the sample period, investors withdrawing money from underwater funds destroyed fee credits amounting to $25.6bn. Considering both fund exits and capital outflows, investors in our sample's 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 dollar value of fee credits destroyed due to capital disinvestment is about 44.0% of the value of incentive fees paid.

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, potentially making the impact on fees of second-order importance. 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 quarter $q = 0$: 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

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.



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.[21] 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 incentive fees.

[21] Given the speed with which the return differential between the two groups of funds disappears after conditioning on a single quarter of positive or negative flows, the effect is likely not only driven by decreasing returns, but also by statistical reversion to the mean (Rossi, 2019).

4 Profit Sharing in Other Alternative Investments

To gain additional perspective on whether the results we document should be considered surprising, we now compare profit-sharing outcomes across various types of private alternative investments, which are often collectively referred to as private equity (PE).

Interestingly, despite major difference in their investment strategies and fund structures, the major categories of private alternative capital funds share a common feature: they charge an asymmetric performance fee that is proportional to returns, and the modal contractual rate is 20%.[22] This is the case for open-ended funds such as traditional hedge funds and CTAs, as well as for closed-ended PE funds that engage in takeovers, finance private firms with equity and debt infusions, or invest in real estate. Considering how differently these funds operate, it seems remarkable that they share a common fee structure. Oddly enough, the ubiquitous 20% profit-sharing agreement does not seem to have been based on any sort of formal contracting, as theory would predict. Rather, the modern version of the incentive fee structure was originally proposed in the 1950s by the first hedge fund manager Alfred Winslow Jones, who was reportedly inspired by the ancient agreements between Phoenician merchants and their financiers.[23] In the subsequent decades, venture capital and buyout fund pioneers followed suit and adopted a similar 20% profit-sharing agreement. Although over time some funds introduced new contractual features (e.g., hurdle rates) and altered the fee levels, 70 years after it was first introduced, the 20% profit-sharing agreement is still the modal agreement used by hedge funds and by the major types of PE funds.

Our analysis shows that the stark disconnect between nominal and effective incentive fee rates seems to be specific to the hedge fund industry. Estimated effective incentive fee rates across the various types of private alternative capital funds are presented in Table 6. As discussed earlier, the effective-to-nominal incentive fee ratio is 2.62 for traditional hedge fund strategies. The figure is very similar, at 2.55, when CTAs are included (see Appendix A.5 for

[22]Funds of funds are the main exception.

[23]The Economist, February 8, 2014. Metrick and Yasuda (2010) (p. 2311) discuss further historical references on the origin on the 20% profit-sharing agreement in private investment.

Table 6. Effective Incentive Fees Across Private Alternative Capital Funds

Panel A shows aggregate summary statistics for the estimated incentive fees of the hedge fund and CTA fund population. Panel B shows statistics for the incentive fees of private equity funds. For each fund type, the table also reports the ratio of underwater incentive fees to total incentive fees and the ratio of net losses to gross profits that have not subsequently been lost. Both ratios are based on the decomposition of aggregate incentive fees and aggregates gross profits as defined in Equation (2). The figures presented are calculated using the returns of U.S.-focused funds from 1995 to 2016. See the data section for details.

Panel A: Hedge Funds

	N funds	Effective IF	Effective IF / Nominal IF	Underwater IF / Total IF	Net Losses / GP not Lost
Traditional Hedge Funds	5,917	49.6%	2.62	30.6%	44.5%
CTAs	1,600	41.9%	2.37	36.0%	31.8%
All Hedge Funds	7,517	47.6%	2.55	31.8%	41.6%

Panel B: Private Equity Funds

	N funds	Effective IF	Effective IF / Nominal IF	Underwater IF / Total IF	Net Losses / GP not Lost
Buyout & Growth Equity	811	20.8%	1.04	0%	3.8%
Venture Capital	785	24.4%	1.22	0%	18.0%
Debt	310	20.3%	1.02	0%	2.0%
Real Estate	702	26.0%	1.30	0%	23.1%
Other Private Capital	349	22.4%	1.12	0%	10.7%
All Private Equity	2,957	21.8%	1.09	0%	8.3%

a more detailed discussion of CTAs). In contrast, as shown in Panel B, PE effective incentive fee rates are much closer to the nominal rate, ranging from 20.3% to 26.0%. Aggregating across all PE funds, the effective-to-nominal incentive fee ratio is 1.09, which is reasonably close to 1.

5 Pay-for-Performance in the Cross-Section of Funds

The analysis carried out so far has focused on aggregate outcomes at the hedge fund industry level. In this section, we explore the relation between lifetime performance and fees in the cross-section of funds. Our results reveal a large disconnect between the promise of incentive-based compensation and actual long-term outcomes.

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

A significant driver of the empirical findings presented in the first part of the paper 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 more detail. For each fund i, we define the dollar value of lifetime-justified incentive fees and residual incentive fees as a function of the fund's lifetime gross dollar profits and its contractual incentive fee rate:

$$\text{Lifetime-Justified IF}_i = \text{Contractual IF Rate}_i \times \min\{0, \text{Lifetime Gross Profits}_i\}, \tag{3}$$

$$\text{Residual IF}_i = \text{Actual IF}_i - \text{Lifetime-Justified IF}_i. \tag{4}$$

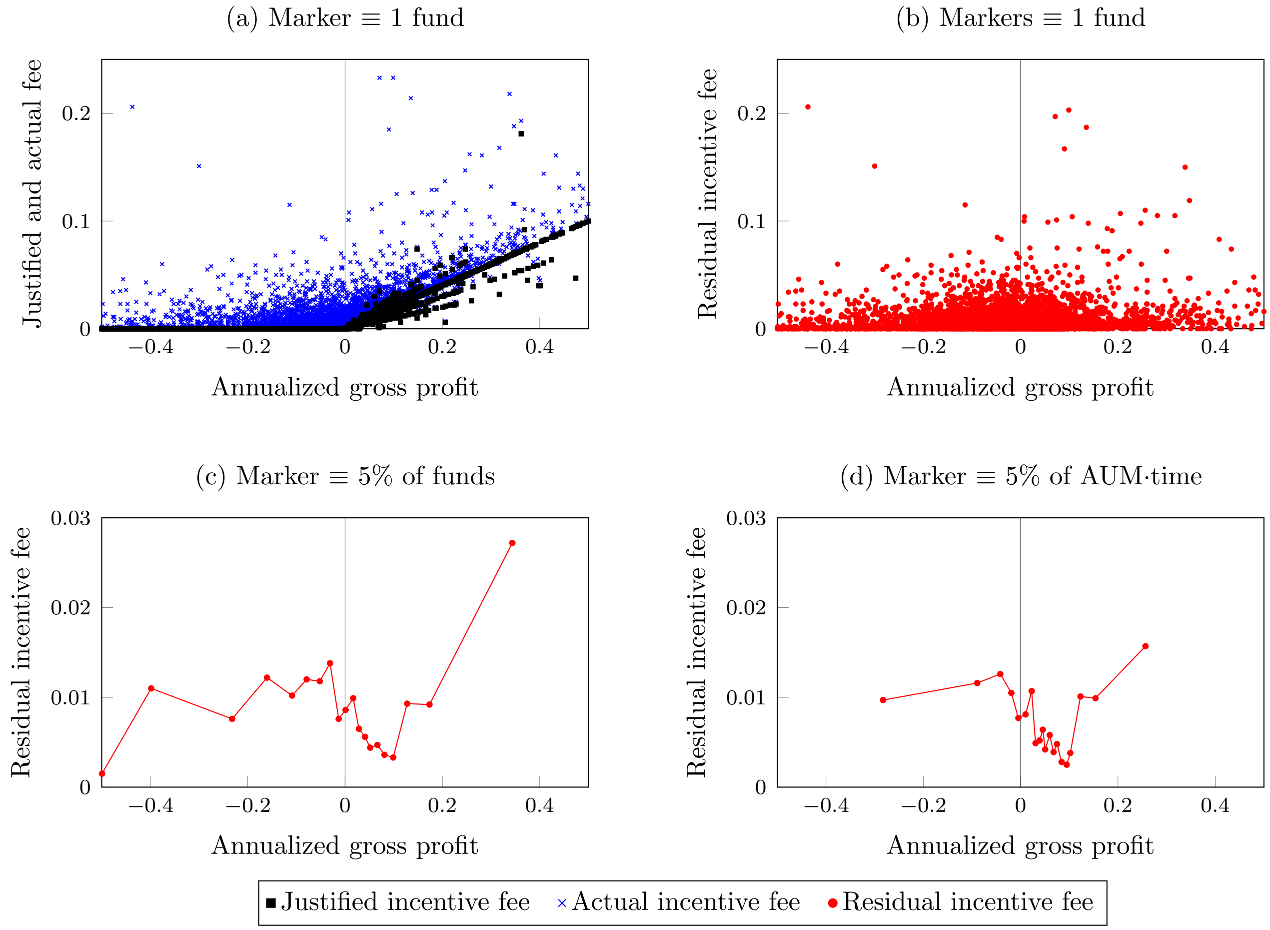
It is interesting to explore which funds collected the residual incentive fees. In particular, we examine whether the residual fees were paid to funds that generated high performance, or whether these fees were also paid to underperforming managers, effectively weakening the long-term relation between incentives and performance.

In order to compare justified and residual fees across funds, we annualize these variables and express them as a fraction of average beginning-of-quarter AUM. We then explore the relation between annualized incentive fees and annualized lifetime fund performance both graphically and analytically.

In Panel (a) of Figure 5, we present a scatter plot of actual incentive fees (square markers) and lifetime-justified incentive fees (x-shaped markers) with respect to lifetime fund performance measured as annualized gross profits. In the negative performance domain, lifetime-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

Figure 5. Justified and Residual Incentive Fee

The figure shows the relation between fund-level lifetime performance and incentive fees. Incentive fees are decomposed into lifetime-justified and residual fees using Equations (3) and (4), respectively. In all panels, the x-axis represents funds' lifetime annualized gross profits. Panel (a) shows a scatter plot of actual incentive fees (black squares) and justified fees (blue crosses). Panel (b) shows residual incentive fees (i.e., the difference between actual and lifetime-justified fees). Panels (c) and (d) summarize the distribution of residual incentive fee by grouping funds into 20 equal-sized bins and 20 bins representing the same amount of AUM·time invested, respectively.



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 domain of positive gains.

Panel (b) of the figure shows the residual incentive fees, i.e., the difference between actual incentive fees and lifetime-justified fees. 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. The "excess fees" do not tend to be earned by right-tail performance.

To facilitate the interpretation of the data, we group funds into 20 equal-sized bins. Panel (c) plots average residual incentive fees within each bin. By definition, justified fees are supposed to be zero in the domain of losses. However, the plot shows that funds with substantially negative lifetime performance have actually earned incentive fees. Moreover, there appears to be 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.

Panel (c) gives the same weight to each fund, regardless of size and length of return history. In Panel (d), funds are first sorted by annualized gross profits and then placed into 20 groups formed so that each group represents the same amount of AUM$\times$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 better-performing funds live longer and accumulate greater AUM. Nevertheless, the general picture remains the same.

In Table 7, we provide a formal analysis of the relationships presented in Figure 5. 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.[24]

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 residual incentive fee patterns visible in Figure 5, 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. A casual inspection of Figure 5 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 7 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

[24]Note that aggregate lifetime-justified incentive fees are lower than average lifetime-justified incentive fees across funds. The reason is that funds with negative lifetime gross profits have lifetime-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 7. Lifetime Fund Performance and Incentive Fees

Panel A shows aggregate and fund-level summary statistics for lifetime annualized incentive fees and management fees. Lifetime-justified and residual incentive fees are defined as in Equations (3) and (4), 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 $\cdot\, I_{\{\text{Gross profits}\leq 0\}}$				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 $\cdot\, I_{\{\text{Gross profits}>0\}}$				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

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. In other words, the slope for justified fees almost perfectly reflects the equal-weighted average contractual incentive fee rate of 19.36% as expected. The results presented in the fifth column 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% tails of performance 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 residual incentive fees are not proportional to performance and thus lead to a weakening of the sensitivity of incentive 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.

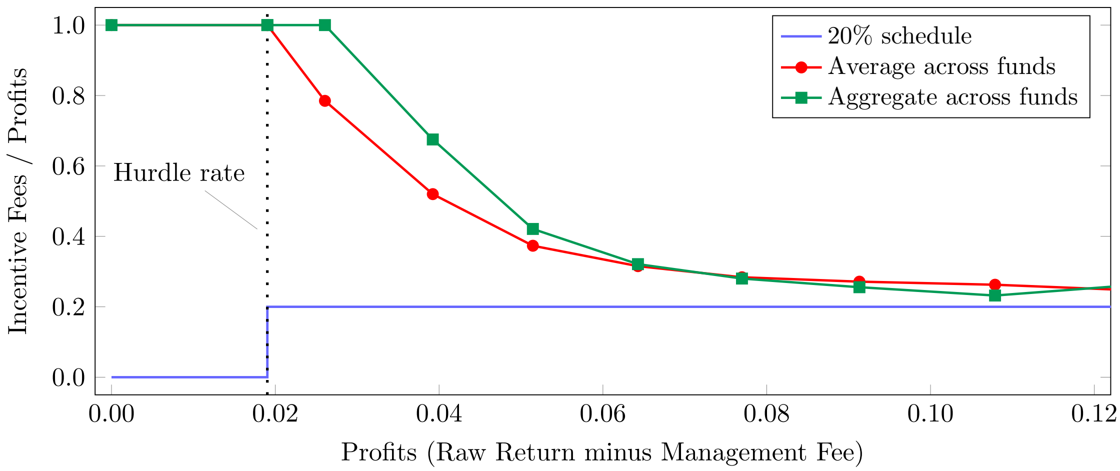
5.2 The 'Inverted' Incentive Fee Ratio

In many compensation contracts, the agent's share of profits increases with the magnitude of profits. For example, in a typical sales contracts, the more an agent sells, the higher the compensation *per unit sold* (e.g., Kuhn and Yu, 2021). The standard performance-based compensation contracts in alternative investments appear to follow the same principle. For example, in a typical contract, hedge fund managers receive no incentive fee if returns are below a certain high-water mark that often includes an hurdle rate, and receive 20% of the profits if the returns are above that hurdle, creating a step-wise function. In some type of real estate investments, there are often multiple hurdle rates, allowing managers to receive an increasing share of profits if they meet these rates.

In actuality, however, the cross-sectional relationship between effective incentive fee ratios

Figure 6. Nominal Incentive Fee Schedules and De Facto Incentive Fee Ratio

The figure presents an illustration of the ratio of incentive fees to profits (vertical axis) as a function of profits (horizontal axis). The blue line is a one-period-one-fund representation of the incentive fee schedule under the traditional 20% rate with a risk-free hurdle rate. The lines with red round markers and green square markers plot, respectively, the actual average and aggregate ratio of lifetime incentive fees to profits as observed in the data. The ratio is capped at 1 for illustration purposes. Only funds with a nominal incentive fee of 20% and an hurdle rate are included in the calculations. Each dot to the right of the hurdle rate represents approximately 10% of the funds. See the text for additional information.



and lifetime fund profits is inverted. This empirical fact is depicted in Figure 6. The blue line shows the intended outcomes of the typical 20% incentive fee contract. That is, incentive fees are zero below the risk-free hurdle rate (on average 1.9% p.a. in our sample), and increase to 20% of profits above the hurdle rate. This relationship holds by construction within any incentive fee crystallization period (usually a year).

The other two lines in Figure 6 show the annualized lifetime incentive fee ratios for funds with different levels of annualized profits (measured as the raw return minus the management fee). For this figure, we restrict the sample to funds with a nominal incentive fee rate of 20% and annualized raw returns above the management fee. We first identify funds whose annualized lifetime raw returns exceed their management fees but not the hurdle rate. Using the definitions established in the previous section, the justified lifetime incentive fee for these funds is zero. However, in reality, the average annualized incentive fee earned by these funds is approximately 1% per annum (as can be seen in Panel (c) and (d) of Figure 5). We then identify funds whose annualized lifetime profits are above the hurdle rate and group them into ten equally-sized groups. For each of these groups, we plot the average and the aggregate effective incentive fee ratios (line with red dot and line with green squares, respectively).

The de facto incentive fee ratio lines are a decreasing function of annualized profits. This empirical reality is a direct consequence of the residual incentive fee phenomenon discussed in the previous section. In sum, the ex-post profile of incentive fee ratios appears to be significantly different from how it is intended to be.

5.3 Adding Management Fees: 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.

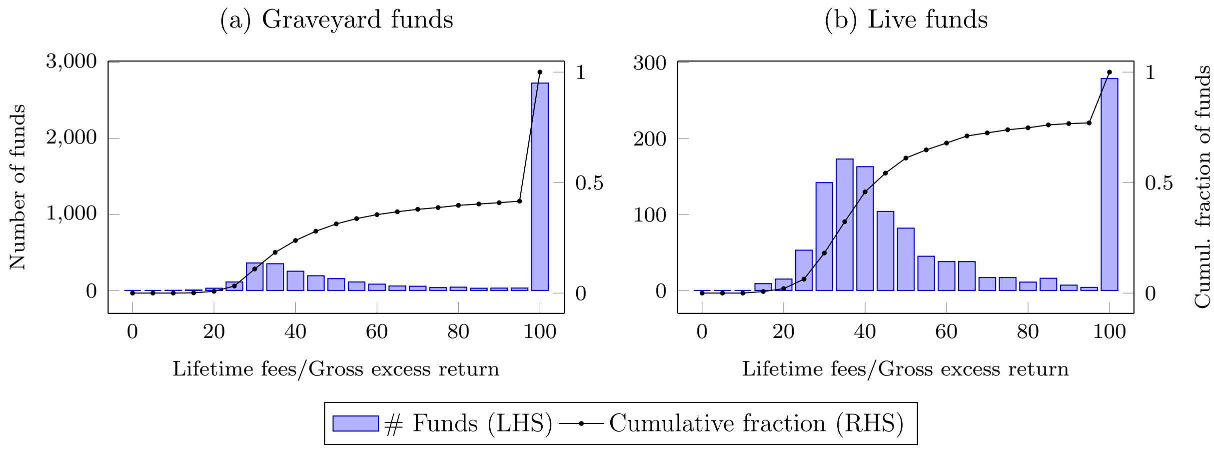
Here, we carry out a similar analysis at the fund level. For each fund, we calculate the dollar amount of gross excess returns generated and fees charged each year and sum these two figures over the fund's life. We then examine the distribution of the ratio of the latter to the former.

The distribution of lifetime fees to gross excess returns is presented in Figure 7. As discussed in Section 3.1.1, 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 narrative, 49.2% of graveyard funds generated negative gross excess returns over their life, as compared to only 13.9% of live funds.

Figure 7. 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 fraction of funds in each bin. Panels (a) and (b) present results for funds in the graveyard file and live file, respectively.



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 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 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 between 30% and 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.

Taken together, the evidence presented in Section 5 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.

6 Interpreting the Fee Outcomes

In the empirical analysis, we have documented several outcomes that appear to diverge from the implicit promise of the hedge fund fee structure. In a one-fund-one-period scenario, funds earn 20% of (positive) gross profits, by definition. However, in the long-run, the effective incentive fee rate on a portfolio of hedge fund investments exceeds the corresponding nominal rate by more than two times. Moreover, funds across the entire performance spectrum—including funds with lifetime net dollar losses—can earn substantial amounts of incentive fees.

As we have illustrated, our findings stem from the asymmetry of the incentive fee contract and are not driven by a single unexpected shock. Financial markets in general, and hedge fund strategies in particular, are known to experience periods of booms and busts. Similarly, it is common knowledge that hedge funds display significant cross-sectional return dispersion and that funds that go underwater are likely to experience large capital outflows, to be intentionally liquidated, or to fail. Therefore, it could be argued that a sophisticated investors could have anticipated the outcomes presented in this article.

6.1 The Unintended Outcome Hypothesis

A natural follow-up question is whether, during our sample period, clients of hedge funds internalized the long-run implications of asymmetric fees and thus anticipated the outcomes we document, e.g., that "20" effectively becomes "50". Obviously, this is a hard question to answer definitively. In what follows, we summarize the institutional setting and the evidence we currently have. In a nutshell, our interpretation of the evidence is that most buy-side investors tend to fail to anticipate the full implications of asymmetric fees.

Evidence from industry sources and practitioners literature. We start by noting that our study appears to be the first to formally define and study the concepts of aggregate effective incentive fee rate, lifetime-justified incentive fees, and residual incentive fees. Perhaps the most direct piece of evidence suggesting that practitioners ignore the implications associated with asymmetric fees comes from the methods they use to estimate the amount of incentive fees collected by the hedge fund industry. Practitioners will typically use a net-of-fees return index that is considered representative of the broad hedge fund industry, calculate the average return over the period of interest, and infer the amount of incentive fees from that average net return using the nominal incentive fee rate.[25] As our results show, calculating incentive fees this way will cause one to underestimate the actual amount by two or more times (depending on the time period in question).

More generally, industry writings tend to discuss incentive fees in simple and stylized settings, focusing on how gains are split between managers and investors, emphasizing the potential for alignment of interests, and ignoring the complex implications of asymmetric fees in a multi-period and multi-fund setting in which substantial losses can occur. For example, consider the report prepared in April 2008 for the President's Working Group on Financial Markets (a government-sponsored committee), titled "Principles and best practices for hedge fund investors."[26] The 60-page report was drafted by top buy-side investors (e.g., chief investment officers of large pension funds). The report discusses incentive fees: it emphasizes how fees are paid only when managers generate gains and describes how investors are protected by high-water mark provisions so that they pay incentive fees only on new gains. Another example is a trade article proposing to replace the traditional incentive fee with a tiered structure. Again, the article focuses only on the payoffs for a single fund over a single

[25] See, for instance, "The value of the hedge fund industry to investors, markets, and the broader economy," June 19, 2012, a study commissioned by KPMG International and AIMA.

[26] Available on `https://www.pionline.com/assets/docs/CO43600416.PDF`.

period in which the fund makes a gain.[27]

We further scan industry sources that analyze the impact of fees on returns. In a notable case, in his seminal investment book, the former Chief Investment Officer of the Yale University endowment David F. Swensen discusses how fees impact the expected returns investors can achieve by investing in hedge funds. Swensen argues that "fees create a substantial burden for hedge fund investors", and provides numerical examples meant to highlight how incentive fees can reduce clients' returns under different scenarios. Despite the sophistication of the arguments made, the examples do not hint at the fact that the *effective* weight of incentive fees could be substantially more than the nominal 20% rate.[28] In other examples, we find that even research articles that are explicitly meant to criticize certain features of incentive fees typically utilize stylized one-period examples where a fund delivers a positive return and do not address the issues we document here (e.g., Brown, 2012).

6.2 Why Would Investors Hold Biased Expectations?

Organizational and Behavioral Aspects Hedge fund clients are generally considered sophisticated. These are typically wealthy individuals, family officers, or professional managers acting on behalf of institutional investors. They usually invest in a small number of funds, since hedge funds require a minimum investment, as they are legally constrained by having fewer than 100 investors. Alternatively, investors rely on funds of hedge funds in order to achieve diversification and overcome the minimum investment constraint.

The selection process of hedge funds lends itself to partial information that could draw optimistic and overconfident investors. Typically, hedge fund managers pitch their strategy and past performance to potential investors. Since direct advertising is not lawful in the hedge fund space, personal connections are key for hedge fund managers to attract limited

[27]See Adil Abdulali, Jeffrey Tarrant, and Michael Oliver Weinberg, "Hedge fund fees – a perfect solution," *Pensions&Investments*, March 6, 2017. Available at `https://www.pionline.com/article/20170306/ONLINE/170309918/hedge-fund-fees-a-perfect-solution`.

[28]The examples are not one-period examples, yet incentive fees are always assumed to be 20% of gains. See "Return Expectations" in "Pioneering Portfolio Management: An Unconventional Approach to Institutional Investment", chapter 8, pages 190-192 (Swensen, 2009).

partners. But not all managers are able to attract capital: The pool of managers who can present their performance at any time is limited to those with recent success or favorable incubated/back-tested results. Hence, to begin with, investors observe a selected set of fund managers, all showcasing superb past performance. The presentation often involves secrecy and often requires a non-disclosure agreement. Since hedge funds invest in an array of assets, using derivatives and leverage and taking long or short positions, it is hard to choose the right benchmark. Finally, investors may be selective in the way that they discuss their own investment decisions, whereas they are more likely to share investment with peers only after successful performance (Han, Hirshleifer, and Walden, 2020; Hirshleifer, 2020). Overall, the matching process between investors and managers is likely to attract optimistic and overconfident investors who believe they can identify the best managers and avoid the bad ones, thus assigning low probability to left-tail outcomes (Gennaioli et al., 2012).

7 Concluding Remarks

The value and effect of performance-based compensation in alternative asset management has long been debated by academics and practitioners alike. For private equity, see Metrick and Yasuda (2010); Chung, Sensoy, Stern, and Weisbach (2012); Robinson and Sensoy (2013); Phalippou (2020). For hedge funds, see Goetzmann et al. (2003); Agarwal et al. (2009); Lim et al. (2016); Jorion and Schwarz (2019); Gupta and Sachdeva (2019).

In this article, we take a different and understudied angle: we focus on the ex-post, long-run outcomes associated with performance fees. Our analysis shows that, historically, the effective incentive fee rate at the hedge fund industry has been more than twice as high as the nominal rate, and that there is a strong disconnect between long-run performance and incentive fees in the cross-section of funds. One might be tempted to blame the global financial crisis of 2008 for these 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 periods of high volatility, 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 collapse 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.[29]

Given the magnitude of the distortions in the fee outcomes, we hypothesise that these outcomes were not intended nor fully anticipated by investors. Moreover, "20" becomes "50" for hedge funds, but not for private equity funds. We review several pieces of informal evidence suggesting that these outcomes are unlikely to have been intended by hedge fund clients. We conjecture that agency and behavioral factors may partially explain this puzzle.

Our results are surprising in light of the supposed sophistication of hedge fund clients. The results about the nature of incentive fees that we document are not driven by unexpected shocks, and could have largely been anticipated by investors with reasonable expectations about the distribution of fund return outcomes. Yet, investors appear to be slow in recognizing these facts. Early work, such as Getmansky et al. (2004) and Liang and Park (2010), demonstrate that many 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).

Despite the long history of questionable outcomes associated with the prevailing incentive fee contract, the hedge fund industry does not appear to be moving toward a more

[29]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.

symmetrical fee structure. On the contrary, the debate among fund managers and investors suggests that the industry is on a trajectory towards a fee structure that puts more weight on the variable component of fees (e.g., the newly-proposed "0-30" model). One implication of our study is that one way to tighten the link between long-term fund returns and incentive fees is to make the latter more symmetrical, not less. This means that funds should allow clawback of fees for periods much longer than currently considered—at least equal to the length of one financial market cycle or hedge fund strategy cycle (e.g., say, seven years). For instance, the traditional structure of PE funds implicitly or explicitly includes a long-term incentive fee clawback provision. Further, fund families could allow investors to offset gains and losses across funds, an agreement known as "performance netting" or "carry netting."

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Appendix A Sensitivity to Assumptions

A large number of studies document the presence of biases of various nature in hedge fund data.[30] 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.[31] 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 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).

A.1 Assumptions in the Baseline Analysis

A.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

[30] See Chapter 3 of Getmansky et al. (2015) and Chapter 6 of Agarwal, Mullally, and Naik (2015) for a review of the relevant literature.

[31] 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.

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, Gorton, and Rouwenhorst (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 A.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.[32] 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-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%.

[32]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.

In our baseline analysis, we take a relatively more conservative approach. First, 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. Our adjustment for delisting bias is identical to that of (Bollen, Joenväärä, and Kauppila, 2020). 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 A.3, we provide a sensitivity analysis with respect to the delisting bias adjustment.

A.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.[33] 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, 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.[34] To be conservative and for consistency with other studies, we nonetheless assume that all high-water-mark funds have a hurdle rate.

[33] 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 "bi-weekly/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.

[34] 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.

A.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.

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 26.4% 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 A.1, 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.

A.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 A.1. 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

Table A.1. 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

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 7), 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.

A.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 A.1, 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.

A.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 A.1.

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.