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Performance Characteristics of Hedge Funds and Commodity Funds: Natural vs. Spurious Biases

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Abstract

It is well known that the pro forma performance of a sample of investment funds contains biases. These biases are documented in Brown, Goetzmann, Ibbotson, and Ross (1992) using mutual funds as subjects. The organization structure of hedge funds, as private and often offshore vehicles, makes data collection a much more onerous task, amplifying the impact of performance measurement biases. This paper reviews these biases in hedge funds. We also propose using funds-of-hedge funds to measure aggregate hedge fund performance, based on the idea that the investment experience of hedge fund investors can be used to estimate the performance of hedge funds.

I. Introduction

Hedge funds and commodity funds are of interest to investors and academics because they present return profiles that are very different from mutual funds. In this emerging research effort, much attention has focused on documenting the general characteristics of fund performance. Fung and Hsieh (1997a) first reported that the returns of hedge funds typically have low correlation to standard asset indices. Documented more extensively in Schneeweis and Spurgin (1998), these results have been confirmed in all subsequent studies. A second set of results, reported in Fung and Hsieh (1997a) and verified in Brown, Goetzmann, and Ibbotson (hereafter, BGI (1999)) and Brown, Goetzmann, and Park (hereafter, BGP (1997)), quantitatively showed that there are many hedge fund styles, each exhibiting different return characteristics. In addition, Fung and Hsieh (1997a), (1997b) found evidence that some of these styles can generate option-like returns. These are the types of interesting return characteristics that make hedge funds and commodity funds valuable as "alternative investments" to the standard asset classes.

The two sets of results have important implications for the construction and risk management of portfolios of hedge funds. On the whole, hedge funds are

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"zero-beta like" investments.[1] While zero-beta securities have no systematic risk, it is well known that they have absolute risk. Hedge fund failures have occurred in companies with event risk in their trading styles. A case in point is Long-Term Capital Management (LTCM) in Greenwich, CT. Until mid-1998, LTCM's returns had low correlation with any of the major asset markets and a standard deviation comparable to that of the S&P 500 index. While LTCM had low systematic and absolute risk as measured by conventional methods, it, nonetheless, had evident significant risk by mid-1998.

Zero-beta and event risk performance characteristics mean that simple linear statistical measures such as standard deviations, Sharpe ratios, and correlations with standard asset indices can be misleading measures of hedge fund risk (Fung and Hsieh (1997a)). Therefore, to understand risk and return of hedge funds, one must model their dynamic trading strategies. For example, Fung and Hsieh (2000) applied option strategies to model trend-following strategies.

Two approaches further our understanding of hedge fund investing.[2] The first asks: As an investment category, what kind of risk return characteristics does the hedge fund industry offer as a whole? The second approach asks a more detailed question: How does one go about constructing hedge fund portfolios and manage the ongoing risk?

The answer to the first, the performance measurement, question should communicate to investors whether the general performance profile of the hedge fund industry is attractive. When convinced that the general performance characteristics of the industry add value, investors can directly access these returns by employing funds-of-hedge funds managers. The due diligence, portfolio construction, and risk management processes associated with the investment are entrusted to outside agents, and the investors need not be directly concerned with the second, the portfolio management, question.

If an investor wishes to directly manage an investment in hedge funds, answers to the portfolio management question are essential and, of course, entail the development of an analytical framework to assess the many trading styles offered by hedge fund managers, extensive due diligence efforts, and tools to assist in the construction and ongoing management of the portfolio. These two approaches are not mutually exclusive; indeed, institutional investors have pursued them in parallel as part of an overall management strategy.

There are basic impediments to providing succinct answers to these two questions. Information on hedge funds is not easily available. In the U.S., hedge funds are generally offered by private placements, which are exempt from the registration and disclosure requirements that govern the issuance and trading of public securities. Hedge funds domiciled in offshore financial centers generally operate with fewer restrictions, disclosure requirements, and regulatory supervision. The lack of disclosure requirement makes it difficult to obtain information on hedge funds, particularly in the U.S. because the Securities and Exchange Commission explicitly limits the ability of offshore hedge funds to disseminate in-

[1]There are some exceptions. Fung and Hsieh (1997a) found that the "value" style had strong positive exposure to equities, while BGI showed that "short sellers" had strong negative exposure to equities.

[2]The term "hedge fund," when used collectively, includes commodity funds.

formation about their activities. Unlike the Investment Company Institute, which provides general information with attested accuracy for mutual funds, there is no industry association for hedge funds. Well-known database suppliers of mutual fund data such as Morningstar do not offer a comparable service for hedge funds. Investors and academics rely on information collected by database vendors from cooperative hedge fund managers. Recent published works[3] used data supplied by TASS Investment Research, MAR/Hedge, and Hedge Fund Research (HFR).

This paper focuses on the performance measurement question. We use the concept of the "market portfolio" of hedge funds to denote the value-weighted portfolio of all hedge funds. The return to the market portfolio of hedge funds provides the aggregate investment experience in hedge funds, analogous to the concept of market portfolio in the Capital Asset Pricing Model, such as the CRSP (Center for Research in Security Prices) value-weighted portfolio in all stocks.

The return of the market portfolio of hedge funds could be easily calculated if one has access to the complete record of performance data and assets under management of all hedge funds, including those that have ceased operation. Unfortunately, no such record exists. Thus, the market portfolio of hedge funds is not observable.

Typically, the market portfolio is proxied by an equally-weighted portfolio of the hedge funds in a database collected by database vendors. We call this the "observable portfolio." Schneeweis and Spurgin (1998) report a comprehensive tabulation of the basic performance statistics using this approach. More recently, similar results are reported in BGI, and Ackerman, McNally, and Ravenscraft (hereafter, AMR (1999)).

Two potential biases can arise when using the portfolio of hedge funds in a database to proxy the market portfolio. A "selection" bias occurs if the hedge funds in the observable portfolio are not representative of the universe of hedge funds. An "instant history" bias occurs if database vendors backfill a hedge fund's performance when they add a new fund into their database. We can use the returns of the observable portfolio to proxy those of the market portfolio if we can adjust for selection bias and instant history bias. Leaving aside issues on data collection methods, selection bias is a natural consequence of the way the hedge fund industry is organized, whereas the instant history bias is synthetically generated by database collection methods.

The calculation of the return of the observable portfolio of a given database requires an accurate record of funds entering and leaving that database. A crude and biased method is to use the performance of the "surviving" funds, i.e., those hedge funds in a database that are still in operation. We call this the return of the "surviving portfolio." This procedure can lead to "survivorship bias," if funds drop out of a database for reasons of poor performance.[4] The returns of the surviving portfolio can be used to proxy that of the market portfolio if we can first adjust for survivorship bias, and then selection as well as instant history biases. Like selection bias, survivorship bias is also a natural bias that arises from the birth, growth, and death process of hedge funds.

[3]See Fung and Hsieh (1997a), Eichengreen et al. (1998), Schneeweis and Spurgin (1998), BGI, and AMR.

[4]We can also apply these three concepts of performance to a subset of hedge funds.

These biases are recognized by most database vendors and academics (see, for example, BGI, BGP, Fung and Hsieh (1997b), and AMR). Once the biases have been identified and estimated, researchers can obtain a more accurate estimate of the return of the market portfolio of hedge funds.

Our purpose is to provide an overview of these data issues and new results using the TASS database as of September 1999. We also propose a simple alternative, which is founded on practicality and not on statistical techniques, for measuring the returns of the market portfolio.

II. Survivorship Bias

Typically, hedge fund data sold by database vendors only contain information for funds that are still operating. The same is true of Morningstar's mutual fund database. The rationale appears to be based on the assumption that subscribers to these data services are only interested in funds that accept new capital.

Databases containing information only on existing funds are known to contain potential biases. To explain these biases, it is common practice to distinguish between "surviving" funds and "defunct" funds. Surviving funds are still operating and reporting information to the database vendor at the end of the data sample. Defunct funds have left the database for any number of reasons, including bankruptcies, liquidations, mergers, name changes, and voluntary stoppage of information reporting. If funds become defunct primarily because of poor performance, then the historical performance of surviving funds is an upward-biased measure of the experience of a typical hedge fund investor, who would have invested in both surviving and defunct funds. This survivorship bias has been well documented in the mutual fund literature (see, for example, Grinblatt and Titman (1989), Brown, Goetzmann, Ibbotson, and Ross (1992), and Malkiel (1995)).

A. The Difference in Performance between Observable and Surviving Portfolios

Following Malkiel (1995), we measure survivorship bias as the difference in the performance of two portfolios. The observable portfolio invests equal amounts in each fund in the database each month starting from the beginning of the data sample. When new funds are added to the database, the portfolio is rebalanced to maintain equal investment in each fund. Similarly, returned capital from defunct funds is reinvested in the remaining funds. This portfolio represents a simple strategy of investing in all funds in a database each month. If there is no selection bias (i.e., if the database contains a representative sample of the universe of hedge funds), the return of this portfolio measures the performance of the entire industry, progressing naturally through the birth, growth, and death process of individual funds.

The surviving portfolio invests equal amounts in all funds that are still in the database at the end of the sample. The treatment of new funds is as in the observable portfolio but, by construction, there are no defunct funds in the surviving portfolio. The return of the surviving portfolio is often referred to as the

"pro forma" returns of a given set (or portfolio) of funds. Specifically, the surviving portfolio represents an investor who avoids all defunct funds. Although this investor escapes from poor performance of funds that go out of business, he will not benefit from having good performing funds that no longer accept capital and stop reporting to database vendors.[5]

Calculating the performance of the observable portfolio of hedge funds is quite a challenge. In the absence of a central repository for hedge fund information, it is nearly impossible to find complete and accurate information on funds after they have ceased operation or have limited the release of performance information. Database vendors can only offer information on funds that have dropped out of their databases. Since many vendors started collecting hedge fund data in the early 1990s, at best they only have incomplete records of defunct funds in the 1980s.

Before proceeding, the equally-weighted portfolios are not meant to represent actual investment experience, since it is not possible to reallocate across hedge funds on a monthly basis. A value-weighted construct is a more natural gauge of investment experience. However, assets under management are frequently incomplete or simply not available in hedge fund databases, so the equally-weighted construct is the only proxy that can be calculated from individual hedge funds.

B. Survivorship Bias in Commodity Funds

Commodity funds are funds managed by commodity trading advisors (CTAs), who trade primarily futures contracts. For individual commodity funds,[6] estimates of survivorship bias can be found in Schneeweis, Spurgin, and McCarthy (1996), Fung and Hsieh (1997b), and Diz (1999). Using data provided by TASS, Fung and Hsieh (1997b) examined surviving and defunct funds operated by CTAs from 1989 to 1995. They found that a commodity fund drops out of the database with a probability of 19% per year, which is high compared to the 5% drop out rate in mutual funds.[7] The survivorship bias, i.e., the performance difference between the surviving portfolio and the observable portfolio, averaged 3.4% per year. In

[5]The problems from using only surviving funds are well known in the hedge fund industry. The surviving portfolio is widely recognized to have an upward bias in performance because "bad funds" (i.e., poorly performing funds that have ceased operation) are excluded. What is less well known is the existence of an offsetting bias from the exclusion of "good funds" that ceased reporting their returns. Note that the standard conception of survivorship bias, as applied to mutual funds, refers only to the bias caused by deleting bad funds that have ceased operating due to poor performance. The issue of deleting good funds that have ceased voluntary reporting never arises, because all mutual funds are required to publicly disclose their returns. For our purpose, we choose to include the deletion of good funds as a survivorship bias, because this is a natural consequence of the way the hedge fund industry is organized. Some authors, such as Ackerman, McNally, and Ravenscraft (1999), refer to the deletion of good funds as selection bias. We reserve selection bias for a different phenomenon, namely, that funds may choose not to be included in a vendor's database at all.

[6]We distinguish between individual commodity funds and commodity pools. See Irwin, et al. (1993) for a detailed description.

[7]A fund drops out of the database for many reasons. The manager may have stopped reporting performance information to the database vendor. The fund may have merged with another fund. The database vendor may have removed the fund from the database if the manager provided return information deemed unreliable. Last, the fund may have gone bankrupt.

contrast, the survivorship bias in mutual funds was estimated to be in the range of 0.5% to 1.5% per year.

This paper updates the results of Fung and Hsieh (1997b) by adding two more years of data. Between 1989 and 1997, the observable portfolio returned, on average, 15.5% per year, while the surviving portfolio returned 19.1%. The survivorship bias in commodity funds is, therefore, 3.6% per year. Although higher than the 1.4% estimate implied by the information in Schneeweis, Spurgin, and McCarthy (1996), the conclusions are similar.

C. Survivorship Bias in Hedge Funds

Estimates of survivorship bias in hedge funds can be found in BGI, and BGP. BGI studied annual returns of offshore hedge funds listed in the 1989 through 1995 issues of the *U.S. Offshore Funds Directory*. Offshore hedge funds differ from onshore hedge funds as follows. An onshore hedge fund accepts U.S. domiciled investors and operates under the regulatory environment described previously. In particular, an onshore hedge fund cannot have more than 100 investors.[8] An offshore hedge fund operates outside the U.S., accepting primarily non-U.S. investors. Typically, many hedge fund managers operate simultaneously onshore and offshore vehicles employing almost identical strategies.[9] Thus, BGI argued that their offshore hedge fund sample is reasonably representative of hedge funds.

BGI's sample was largely free of survivorship bias, with one exception. The *U.S. Offshore Funds Directory* contained funds that were in operation at the end of each year. Missing were funds that were operating at the end of the previous year but dropped out of the sample in the subsequent year. While this might introduce a small bias in the returns of hedge funds, the magnitude of this bias should be a fraction of the normal survivorship bias.

BGI found that offshore funds have a 20% drop out rate, and their returns averaged 13.3% per year. They estimated the survivorship bias at 3% per year. In other words, the surviving portfolio of offshore funds operating at the end of 1995 had an average historical return of 16.3% per year.

BGP used the TASS hedge fund and commodity fund database. Table 1 in BGP indicated that TASS began keeping track of defunct funds in 1994. There were 244 defunct funds from 1994 to 1996. BGP found that, during the period 1993–1996, hedge funds had a drop out rate of 15%, and the observable portfolio returned, on average, 12.2% per year with a standard deviation of 4.8%. These results are similar to those for offshore funds in BGI.

While BGP did not provide a direct estimate of the survivorship bias, we analyzed the TASS hedge fund database as of September 1999. This database contained 1,120 surviving and 602 defunct hedge funds. The estimates of survivorship bias are summarized in Table 1. The surviving portfolio had an average return of 13.2% from 1994 to 1998, while the observable portfolio had an average

[8]This restriction increased to 500 investors recently, but it does not apply to the sample studied in this paper.

[9]Note that Fung and Hsieh (1997a) did not distinguish between onshore vs. offshore hedge funds. Both are included. If a manager operated identical onshore and offshore funds, we used only the one with the longer history in our sample.

TABLE 1

Summary of Estimates of Hedge Fund Performance

Article (Data Source)	Period	Portfolio	Average Annual Return	Survivorship Bias	Instant History Bias
Panel A. Individual Hedge Funds					
BGI (Offshore Hedge Fund)	1989–1995	Surviving	16.3%	Yes	No
		Observed	13.3%	No	No
BGP (TASS)	1993–1996	Adj. Observed	12.2%	No	No
Latest (TASS)	1994–1998	Surviving	13.2%	Yes	Yes
		Observed	10.2%	No	Yes
		Adj. Observed	8.9%	No	No
		Liquidated	−0.4%	- - -	Yes
		Merged	7.2%	- - -	Yes
		Return Stoppage	8.0%	- - -	Yes
Panel B. Funds-of-Hedge Funds					
Latest (TASS)	1994–1998	Surviving	7.6%	Yes	Yes
		Observed	6.3%	No	Yes
		Adj. Observed	5.6%	No	No

return of 10.2% during this time, thus we infer that the survivorship bias is 3.0% per year for hedge funds.

D. Performance of Defunct Funds

The TASS hedge fund database provides some explanations for why 602 funds became defunct: 60% were liquidated; 4% were merged into another fund; and 28% were removed because the manager stopped reporting return information. No explanations were available on the remaining 8%. Table 1 provides the average returns for three types of defunct funds, showing that defunct funds (regardless of their reason for becoming defunct) typically have lower returns than surviving funds. Funds that liquidated, however, performed substantially worse than funds that became defunct for other reasons. During 1994–1998, the portfolio of liquidated funds averaged −0.4% per annum, while the portfolio of merged funds and the portfolio of funds that stopped reporting returns averaged 7–8% per annum.

These results, along with those of BGI and BGP, differ from a recent study by AMR, who find that the average returns of defunct funds are not lower than the returns of surviving funds. It is possible, as AMR suggests, that differences in the data account for the divergent findings. AMR merged the HFR and MAR databases, while BGI, BGP, and the Fung and Hsieh papers used the TASS data set. In addition, AMR included funds-of-hedge funds in their analysis, while the other papers did not.[10]

[10]Up to the time of the writing of this paper, correspondence with the authors of the AMR study did not completely resolve some of these issues. Although the precise details are not directly relevant to this paper, the AMR study noted differences in the performance characteristics of offshore vs. onshore hedge funds. There is a tax bias in favor of hedge fund managers using offshore vehicles to attract investors. Until the U.S. tax code changes, this trend in the hedge fund industry is likely to persist. It is unclear whether the conclusions reached in AMR sufficiently heeded this difference. Note that,

III. Instant History Bias

We now discuss how to adjust the returns of the observable portfolio to obtain a proxy of the returns of the market portfolio without instant history bias.

When a vendor adds a new fund into a database, historical returns are often back filled. In the words of Park (1995), funds come into a database with instant histories. This happens because it is much easier for fund managers to market themselves if they have good track records. New hedge funds typically undergo an incubation period, trading on money from the managers' friends and relatives. After compiling good performance, these funds then market themselves to database vendors and hedge fund consultants. When vendors put these funds into their databases, they back fill the earlier returns during the incubation period.

Park (1995) estimated the incubation period 27 months in the MAR CTA database. BGP also found a 27-month incubation period in the TASS CTA database, but 15 months in the TASS hedge fund database.

We update the BGP results for commodity funds by using the observable portfolio, which naively invests in all of the existing funds each month, and the adjusted observable portfolio, which invests in all of the existing commodity funds each month after deleting the first 27 months of returns. For the period 1989–1997, the adjusted observable portfolio's return averaged 11.9% per year, while the observable portfolio was 15.5%. This gives an estimate of 3.6% per year for the instant history bias.

For hedge funds, TASS actually provides direct information on the incubation period, i.e., the lag between the inception date of a fund and the date it enters the TASS database. Table 2 provides the distribution of the incubation period for the hedge funds in the TASS database. The median was 343 days, which is very close to the estimate of 15 months in BGP. We, therefore, calculated the adjusted observable portfolio by dropping the first 12 monthly returns from each hedge fund. This portfolio returned an average of 8.9% during 1994–1998. Previously, we found that the observable portfolio's return averaged 10.3%. Thus, the instant history bias for hedge funds is 1.4% per year.

BGI's data did not have any instant history bias. They found that, when a fund was first listed in the *U.S. Offshore Funds Directory*, it typically had more than a one-year return history. BGI found the average return of offshore hedge funds at 13.3% per year, very similar to the 12.7% estimated from the TASS hedge funds.

Once again, AMR reached a contrary conclusion and found no instant history bias in their data. This result might be because of the difference in datasets. In addition, AMR measured instant history bias differently than Park (1995), BGP, and the present study.

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in line with the industry trend, the earlier studies by BGI, BGP, and, to an extent, Fung and Hsieh (1997a) are predominantly based on offshore hedge funds. The results in Liang (2000) confirm that there is a difference in the attrition rates and survivorship biases between the HFR database (which has more onshore funds) and the TASS database (which has more offshore funds).

TABLE 2

Distribution of Hedge Fund Incubation Period
(Number of Days from Inception to Entry into TASS Database)

%	Individual Hedge Fund	Funds-of-Hedge Funds
Min	0	0
1%	0	28
5%	40	51
10%	61	71
25%	128	178
50%	343	484
75%	829	1,111
90%	1,913	2,018
95%	2,660	2,418
99%	4,734	4,944
Max	9,983	9,693

IV. Selection Bias

A hedge fund consultant needs the consent of a hedge fund manager before information can be released to a third party, creating the possibility of selection bias. Presumably, only funds with good performance want to be included in a database, which means that the returns of funds in the database are higher than the returns of all existing funds.[11] Thus a vendor's database may not provide a true picture of the achievable performance of all funds available for investment.[12]

While there are no estimates of the size of the selection bias in hedge funds, Fung and Hsieh (1997a) found anecdotal evidence suggesting that the selection bias could be limited. Managers with superior performance did not necessarily participate in vendors' databases, particularly when the managers were not interested in attracting more capital. For example, George Soros's Quantum Fund has been closed to new investments since 1992 even though Quantum has a legendary performance record. In fact, Quantum has regularly returned capital to investors to keep the fund's assets under management at around $5 billion. However, database vendors have been able to obtain Quantum's returns through other public sources. In contrast, Long-Term Capital Management has successfully kept its performance from database vendors and the general public since its inception.[13] This anecdotal evidence indicates that offsetting factors are at work. While some hedge fund managers are eager to include their good performance in vendors' databases, other managers deliberately keep their good performance away from them. This limits the magnitude of the selection bias.

It would certainly be interesting to study the selection bias in hedge fund and commodity fund databases. However, to do this accurately, we need input from the investors of funds that do not generally disclose their performance data

[11]By selection bias, we mean that hedge funds refuse to participate in a vendor's database. AMR used the term to mean funds that dropped out of a database when the manager stopped reporting information to a vendor.

[12]Note that selection bias does not exist in mutual fund databases, because mutual funds must publicly disclose their performance.

[13]Note that LTCM was one of the 940 funds in the Fung and Hsieh (1997a) universe, but it did not have the requisite 36 months of returns at the end of 1995 to be included in the final sample of 409 funds used in the study.

to database vendors. In the next section, we propose a less onerous alternative that could provide empirical clues to measuring the selection bias.

V. Funds-of-Hedge Funds as a Proxy of the Market Portfolio of Hedge Funds

We now introduce a third proxy for the market portfolio of hedge funds using an equally-weighted portfolio of funds-of-hedge funds. The idea is quite simple. If we want to estimate the investment experience of hedge funds, it is natural to look at the experience of the hedge fund investors. In this context, funds-of-hedge funds represent typical investors in portfolios of hedge funds with generally available performance history.

Unlike mutual funds, where the concept of funds-of-mutual funds has not gained popularity, the structure of the hedge funds market has led to the demand for funds-of-hedge funds. A market portfolio of hedge funds is not a practical investment proposition. The minimum investment in a single hedge fund runs from U.S.$100,000 to well over U.S.$1 million. With more than 1,000 hedge funds on offer, it would take a very substantial investment to create a portfolio that proxies the market in the literal sense,[14] not to mention the daunting task of administering such a large portfolio of essentially private investment vehicles. Therefore, in contrast to mutual funds where passive diversification leads investors to low cost indexed funds, the reverse is true of hedge fund investing. For these reasons, investors use funds-of-hedge funds as a way to access a diversified portfolio of hedge funds.

A. Track Records of Funds-of-Hedge Funds Avoid Many Biases

The investment experience of funds-of-hedge funds avoids many of the inherent biases that are idiosyncratic to using individual hedge fund returns from databases to measure industry performance. As portfolio managers generally do not directly engage in trading, an important element of the services a fund-of-hedge funds manager offers is to provide investors with accurate performance information on a timely basis. The majority of the funds-of-hedge funds track records can be reconciled and audited to match the underlying funds' performance records. These track records retain the investment experience of hedge funds that have gone out of business due to poor performance, as well as hedge funds that have stopped reporting to database vendors because of good performance. Thus, individual track records of funds-of-hedge funds do not contain the survivorship bias that the pro forma returns of the underlying portfolio of hedge funds do. Similarly, the question of selection bias does not arise. In addition, when a fund-of-hedge funds adds a hedge fund to its portfolio, the portfolio's past investment records are unaffected, so there is no instant history bias.

As the track records of funds-of-hedge funds contain an accurate picture of the experience of a group of hedge fund investors, the aggregate experience

[14]One of the values of a fund-of-hedge funds is to overcome the investment size constraint that limits individual investors' ability to diversify.

of all funds-of-hedge funds, weighted by their assets under management, should provide a good approximation of the aggregate investment experience. Since no one has a complete record of the universe of funds-of-hedge funds, we use the equally-weighted average of the returns of funds-of-hedge funds in a database.

B. Funds-of-Hedge Funds Contain Less Return Measurement Biases than Individual Hedge Funds

In using a sample of funds-of-hedge funds to estimate the experience of the universe of funds-of-hedge funds, we need to consider potential biases. We base our results on the TASS hedge fund database of September 1999, where there were 262 surviving and 60 defunct funds-of-hedge funds. Of the 60 defunct funds, 42 were liquidated, two were merged, and 15 were removed due to the lack of return information.

Table 1 shows that the surviving portfolio of funds-of-hedge funds averaged 7.7% per year during 1994–1998. The observed portfolio averaged 6.3%. Thus, the survivorship bias for funds-of-hedge funds is only 1.4% per year, less than half that of individual hedge funds. Note that the 1994–1998 period included two years (1994 and 1998) with poor hedge fund performance, and three years (1995–1997) with good hedge fund performance.

There is an argument that could justify using surviving funds-of-hedge funds to measure the aggregate investment experience in hedge funds. As the hedge fund industry in aggregate did not go out of business, funds-of-hedge funds that did are poor proxies for the universe of hedge funds.[15] Similarly, the returns of surviving funds-of-hedge funds are good proxies for the performance of the universe of hedge funds because they reflect the same set of investor demands that shapes the hedge fund industry. In addition, their track records are more continuous than individual hedge funds.

We now turn to the issue of instant history bias in two steps. First, we estimate the incubation period in funds-of-hedge funds. Table 2 shows that the median incubation period for funds-of-hedge funds is 484 days or roughly 16 months. In the second step, we measure the instant history bias in funds-of-hedge funds, by comparing the average return of the equally-weighted portfolio with and without the first 16 monthly returns of each fund-of-hedge funds. This yields an estimate of the instant history bias of 0.7%, half that of individual hedge funds.

Last, we deal with the issue of selection bias. Funds-of-hedge funds typically invest in a diversified portfolio of hedge fund styles and are less prone to capacity constraints. Consequently they are more amenable to disclosing their track records to attract more capital, so there is little selection bias in large samples of funds-of-hedge funds.

[15]Perhaps an analogy is useful. If we are unable to observe the returns of the S&P 500 index, we can use the aggregate return of all domestic U.S. mutual funds as a proxy. We can justify excluding mutual funds that went out of business because, presumably, they had disappointing performance: Either they underperformed the market or barely matched the index while promising above index returns to their investors. Either way, their exclusion has no material impact on that approximation.

C. Funds-of-Hedge Funds as a Proxy for the Market Portfolio of Hedge Funds

In this subsection, we discuss how to use the performance of funds-of-hedge funds to estimate the performance of the market portfolio of hedge funds.

While a single fund-of-hedge funds may represent a non-random sample of individual hedge funds available for investments, the aggregate experience of all funds-of-hedge funds should be a fairly representative sample of hedge funds that are open for investments. It is closer to a bias-free proxy of the market portfolio of hedge funds than are averages derived from databases of individual hedge funds.

Over the sample period 1994–1998, the equally-weighted portfolio of funds-of-hedge funds in the TASS database returned 6.3% per annum. This is similar to the HFR fund-of-hedge fund index which returned 6.4%. If we adjust for instant history bias, the return would be 5.6%.

To relate the returns of funds-of-hedge funds to the returns of individual hedge funds, it is helpful to discuss two factors that cause these two returns to diverge. The first factor is the operating expenses and management fees charged by a fund-of-hedge funds.[16] Typically, database vendors report the returns of funds-of-hedge funds net of all fees and expenses to reflect the investment experience of investors in funds-of-hedge funds. Here, we must distinguish between fees and expenses charged by the underlying hedge funds that funds-of-hedge funds invest in, and the fees and expenses charged by the funds-of-hedge funds. We refer to the former as hedge fund fees and expenses and the latter as portfolio fees and expenses.

The average portfolio fees and expenses provide an indirect answer to the portfolio management question we posed at the beginning of the paper. Although these fees and expenses do not directly tell how to manage a hedge fund portfolio, they do tell how much it costs, on average, to manage a portfolio that performs in line with the hedge fund market. These portfolio fees and expenses should be added back into the net returns of funds-of-hedge funds to provide an estimate of the performance of the market portfolio of hedge funds in the conventional way where the portfolio management costs are excluded. Before doing so, we need to consider the second factor that can cause the net return of funds-of-hedge funds to systematically diverge from the market portfolio of hedge funds.

This second factor concerns the cash held by funds-of-hedge funds. As a rule, funds-of-hedge funds regularly hold cash to deal with potential redemptions, but report returns on total assets managed inclusive of cash. Therefore, the reported funds-of-hedge funds returns are downward biased estimates of the investment experience of the underlying hedge fund portfolios. The question arises as to whether any cash balance is needed for individual investors holding a portfolio of hedge funds where outside investor withdrawals are not relevant. We contend that most hedge fund portfolios carry an unavoidable cash balance, and are a consequence of the cumbersome contribution and withdrawal process of in-

[16]We are indebted to Howard Wohl and an anonymous referee for these points.

dividual hedge funds.[17] The performance drag of cash balances in funds-of-hedge funds is not likely to be different from that in hedge fund portfolios of individual investors. Nonetheless, to arrive at a more accurate proxy of the market portfolio of hedge funds, the performance drag of cash balances should be removed from the net return of funds-of-hedge funds.

Unfortunately, funds-of-hedge funds data collected by consultants do not contain sufficient information to facilitate direct estimates of the portfolio management costs. Operating expenses must be extracted from the annual reports of funds-of-hedge funds, and their intertemporal cash positions are almost impossible to ascertain with any degree of accuracy. Fortunately, the more significant parts of the portfolio management cost, namely the fixed fees and incentive fees of funds-of-hedge funds, are obtainable from their offering documents. The distribution of the fixed fees and incentive fees for the funds-of-hedge funds in the TASS database are in Table 3. For fixed fees, the mode is 1–2%, and the median is 1.5%. For incentive fees, the mode is 0%, and the median is 10%.

TABLE 3

Distribution of Fixed Fees and Incentive Fees in Funds-of-Hedge Funds

	Number of Funds-of-Hedge Funds		
Fixed Fee	Total	Live	Defunct
Panel A. Distribution of Fixed Fees			
Nil	7	4	3
0–1%	77	69	8
1–2	186	154	32
2–3	37	23	14
3–4	12	10	2
4–5	0	0	0
5–6	3	2	1
Panel B. Distribution of Incentive Fees			
Nil	111	99	12
0– 5%	19	17	2
5–10	72	62	10
10–15	24	19	5
15–20	72	51	21
20–25	24	14	10

Accounting for the effect of fixed fees is fairly straightforward: we need only to add them back into the returns of the funds-of-hedge funds. Accounting for the effect of incentive fees is more problematic. It is customary to pay incentive fees on performance in excess of a hurdle rate, but the TASS database did not have complete information on hurdle rates. Out of the 322 funds-of-hedge funds, only 67 had information. Seven had no hurdle rates; 33 had an absolute hurdle rate ranging from 5% to 20%; and 27 used a benchmark interest rate for hurdle rates. So it is not clear exactly how much of the incentive fees should be added back

[17]Most hedge funds require a notification period from investors to add and redeem capital. Redemption dates and frequency also vary from fund to fund. This makes it almost impossible to operate a hedge fund portfolio without any cash balance.

in.[18] In addition, there is quite a variety of incentive fee arrangements among funds-of-hedge funds. A proper analysis should also include the different hedge fund styles that funds-of-hedge funds adopt as their portfolio emphasis. The lack of information on the cash balances of funds-of-hedge funds in the TASS database is also problematic.

To estimate the performance of the hedge funds in the funds-of-hedge funds, we consider two extreme cases. At one extreme, we add back only fixed fees and ignore incentive fees and cash balances. This implies that, during 1994–1998, funds-of-hedge funds earned 7.8% per year from their hedge funds investment. At the other extreme, we assume a 5% cash balance and a Treasury bill rate of 5%, a fixed fee of 1.5%, and an incentive fee of 10% on performance in excess of the Treasury bill rate. Using these parameters, the underlying hedge fund investments of funds-of-hedge funds had to return 8.1% to result in a net return of 6.3%. This is consistent with our earlier estimate for the market portfolio for the same period of 8.9% based on the individual hedge funds in the TASS database.

Table 4 contains year-by-year estimates of hedge funds with the returns of the adjusted observable portfolio of individual hedge funds in column 2, and the returns of the observable portfolio of funds-of-hedge funds (net of fees and expenses) in column 3. The implied returns of the hedge fund portfolios in funds-of-hedge funds are in column 4, and column 5 is an estimate of the portfolio management cost with a range of 1.3–2.9% per year.

TABLE 4

Annual Returns of Hedge Funds

Year	Individual Hedge Funds[a]	Funds-of-Hedge Funds[b]	Implied Hedge Fund Returns[c]	Implied Portfolio Cost[d]
1994	0.5%	−2.7%	−1.5%	1.3%
1995	15.4%	10.6%	12.8%	2.2%
1996	15.8%	12.9%	15.8%	2.9%
1997	15.1%	10.3%	12.7%	2.4%
1998	4.4%	0.0%	1.3%	1.3%

[a] The adjusted observable portfolio return of the individual hedge funds in the TASS hedge fund database.
[b] The observable portfolio return of the funds-of-hedge funds in the TASS hedge fund database.
[c] Estimated using the following assumptions: 5% cash balance, 1.5% fixed fee, 10% incentive fee, hurdle rate set to be the one-year Treasury bill rate.
[d] The difference between the implied hedge fund returns in column 4 and the funds-of-hedge funds returns in column 3.

What we achieve here is to establish a readily observable, almost bias-free measure of the after-costs returns of the hedge fund market's performance—the funds-of-hedge funds index performance provided by database vendors. In terms of the portfolio management costs of a typical hedge fund portfolio, our data suggest a figure of approximately 1.3–2.9% per annum. Undoubtedly, further research will yield more accurate estimates of the portfolio management costs. Working from the demand side of hedge funds narrows the problem down to well-

[18] Often the Treasury bill rate is used as a proxy for the risk-free return to capital.

defined, readily observable parameters and avoids spurious biases that arise from database collection procedures.

D. Exclusion of Public Commodity Pools

Now we turn to the issue of funds-of-funds that invest in commodity funds known as "commodity pools" in the CTA industry. Elton, Gruber, and Rentzler (1990) found publicly offered commodity pools returned an average of only 4.4% per year during 1980–1988. Irwin, Krukemyer, and Zulauf (1993) found an average return of 9.4% per year during 1986–1990, and they attributed the large discrepancy between the returns of publicly offered commodity pools and individual commodity funds to the high cost and fees of commodity pools. For publicly offered commodity pools, Table VI in Irwin, Krukemyer, and Zulauf (1993) showed that commissions were 9.3% of equity, fixed fees 5.0% of equity, and incentive fees were 20.0% of gross trading profits. These fees are consistent with the findings in Edwards and Ma (1988), and are substantially higher than those charged by funds-of-hedge funds. Gross of all costs, Table VII in Irwin, Krukemyer, and Zulauf (1993) found the returns to commodity pools to be 21.2%.[19] With these high costs, it is not surprising that commodity pools have not gained in popularity over the years.

VI. Multi-Period Sampling Bias

The last bias we consider does not deal with how hedge fund and commodity fund data are collected by database vendors. Instead, it deals with the research requirement that a fund must have sufficient history before it is included as a sample in a study. The bias from this procedure is called "multi-period sampling bias."[20] For example, Fung and Hsieh (1997a) required 36 months of return history before a fund was included in their study, to ensure sufficient degrees of freedom in their regressions. AMR required funds to have 24 months of return history for inclusion in their study.

The requirement of sufficient history may or may not be problematic, depending on the context in which the information is used. For example, if an investor would not invest in funds with less than 36 months of return history, then a study imposing those restrictions would not create an incorrect inference (assuming no other biases were present).

Nonetheless, it is of interest to know if requiring funds to have a minimum return history makes a difference in average returns. To answer this, we create a fifth portfolio, the same as the adjusted observable portfolio, with one additional restriction; each fund in the portfolio must have at least 36 months of return history.

For the period 1989–1997, the fifth portfolio's average return for commodity funds was 12.0% per year, 0.1% higher than that for the adjusted observable portfolio. For the period 1994–1998, the fifth portfolio's return for hedge funds

[19] Private communication with the authors, Edwards and Liew (1999), also shows that public commodity pools continue to charge high fees in the 1990s.

[20] Our use of the term "multi-period bias" is different from that of AMR.

was 9.5% per year, 0.6% higher than that for the adjusted portfolio. Thus, the multi-period sampling bias, if it existed, was very small.

VII. Conclusion

Hedge funds and commodity funds are interesting investment vehicles for investors and academics. Their return profiles are quite different from those of mutual funds and standard asset indices, thus representing diversification opportunities for investors. They also provide a new data source for testing asset pricing theories and the efficiency of markets.

The structure of the hedge fund and commodity fund industry is such that complete and accurate information on the universe of funds and their histories is almost unobtainable. Understandably, database vendors have their own idiosyncratic ways of coping with incomplete information. Consequently, attempts to estimate industry-wide performance statistics have to deal with a litany of biases. Some biases are natural to the birth, growth, and death process of hedge funds while others are spuriously generated through the application of statistical techniques to circumvent data deficiencies.

We propose the simple alternative of using funds-of-hedge funds to estimate the performance of the hedge fund market. To measure the performance experience of a set of assets, the natural starting point is to observe the experience of investors in those assets. Funds-of-hedge funds invest in hedge funds. Their track records are almost free of the many biases contained in databases of individual funds. A sufficiently broad array of funds-of-hedge funds in aggregate should be a good proxy for the market's demand for hedge fund strategies. The average return of funds-of-hedge funds can, therefore, serve as a good proxy of the market portfolio of all hedge funds. Fortuitously, several database vendors report indices of funds-of-hedge funds.

Although the funds-of-hedge funds alterative is simple and readily available, there remain two caveats. The return of funds-of-hedge funds is a measure of the return on hedge funds net of all costs, including those incurred in managing a portfolio of hedge funds. Alternatively, we can remove the effects of the cash holdings in funds-of-hedge funds as well as the fees and expenses charged by funds-of-hedge funds to obtain the net return on hedge funds, before incurring the portfolio management cost. By making reasonable assumptions, we find that estimates of the industry's performance statistics, after adjusting for various measurement biases, are consistent with the performance statistics of funds-of-hedge funds. The convergence of performance estimates based on data from the supply side of hedge funds (using the individual funds performance records) and the demand side of hedge funds (using the funds-of-hedge funds performance records) adds credence to existing empirical conclusions on the aggregate performance of the hedge fund industry. Further research and careful documentation of the structural parameters of funds-of-hedge funds such as fees, expenses, and cash balances are likely to provide more accurate estimates of the hedge fund industry's performance characteristics.

Beyond measuring the performance of the entire hedge fund industry, our method can be adapted to individual hedge fund styles to help refine answers to

performance measurement and portfolio management questions, and to adjust to the many, and varied, individual trading styles of hedge funds.

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