

QUANTITATIVE PORTFOLIO STRATEGIES

Alpha-Beta Recombination – Part 2

Managing Hedge Fund Selection Risk

Using Diversification or Replication

with RHFISSM Swaps

- Alpha-Beta Recombination is a synthetic investment strategy that adds an independent alpha return to a desired fixed income beta exposure. Given the potential for a greater alpha available outside traditional fixed income, plan sponsors are considering synthetic portfolios as a way to bolster performance of their increasing fixed income allocations.
- Part 1 of our two-part series revealed a great potential of synthetic fixed income to improve fixed income performance. However, these results relied on the uninvestable “average” fund as the alpha source in the alpha-beta recombination.
- Unlike traditional fixed-income managers, there is considerable performance variability across alpha sources used in synthetic fixed income. Using individual hedge fund returns, we show that the performance of the “average” alpha source significantly understates the risk of an actual synthetic fixed income strategy that must deal with manager selection risk.
- To a large degree, the success of a synthetic fixed income strategy depends on handling manager selection risk. We analyze two approaches to managing this risk: Diversification and Replication.
- Using the performance of the average synthetic fixed income portfolio as a benchmark, we analyze the performance of different synthetic portfolios with various degrees of naïve (i.e., random) diversification across funds and across styles. How quickly does diversification reduce manager selection risk? Is diversification across styles more valuable than diversification across funds?
- While a synthetic fixed income portfolio using two or three randomly selected funds (alpha sources) within the same style can meaningfully reduce the overall risk, it takes five or more funds of the same style, or more than two funds each from two different styles, to match the risk of using a single Fund of Funds. It takes even more funds of one style to approach the risk-adjusted performance of the “average” synthetic portfolio of that style.
- While using fund of funds can help control manager selection risk, more than five fund of funds is required to match the risk and IR of using the “average” manager of a single style fund. Bottom line: To reap the performance benefits of synthetic fixed income requires multiple alpha sources in the portfolio.

*This is a reprint of a paper that was originally published in 2008. Many thanks to Simon Polbennikov and Albert Desclée for their contributions to this paper.

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- Actively selecting alpha sources can appreciably improve the risk-adjusted performance of synthetic fixed income portfolios despite the presence of manager selection risk. In fact, a simple strategy of using past data to identify above-median hedge funds produced better performing synthetic portfolios. However, even with active selection, it still requires more than five funds of a given style to produce an information ratio comparable to that of the “average” portfolio.
- Another way to address manager selection risk is to use hedge fund replication to obtain an alpha source mimicking the “average” fund. Barclays Capital has developed techniques to track average hedge fund performance using Replicating Hedge Fund Indices (RHFISM) swaps using liquid derivatives. RHFI swaps offer other benefits as well: liquidity and transparency.
- We confirm our expectation that any increase in tracking error volatility (TEV) of a synthetic fixed income strategy introduced by adding RHFI tracking errors to the underlying alpha source is likely considerably less than the manager selection risk that is removed from the TEV by avoiding having to select individual managers.
- We show that a synthetic fixed income strategy using RHFI swaps is an effective and efficient way to manage the overall risk of synthetic fixed income strategies. In fact, synthetic fixed income using RHFI for a given style comes close to the synthetic performance using five funds of that style and outperforms traditional Core and Core+ managers. A synthetic fixed income portfolio using RHFI on the HFRI Composite Index also performs well relative to Core and Core+.

Contents

Introduction.....	3
Controlling Manager Selection Risk Via Diversification.....	5
Measuring Performance of a Synthetic FI Portfolio: Capturing Fund Diversification, Turnover, and Selection Risk	5
Diversification across Styles	14
Implications for Synthetic FI Portfolio Construction	17
Controlling Manager Selection Risk via Hedge Fund Replication (RHFI SM Swaps).....	19
Synthetic Hedge Fund Returns Using RHFI Swaps.....	20
Alpha-Beta Recombination using RHFI Swaps.....	23
Comparing Synthetic FI Returns Using RHFI with Diversified Hedge Fund Portfolios	28
Using RHFI to Achieve Style Diversification	30
Summing Up: Synthetic FI Portfolios	32

Introduction

In the first paper of the series, *Alpha-Beta Recombination – Part 1: Synthetic Fixed Income Portfolios using Hedge Funds and RBISM Swaps*, we show that synthetic fixed income (FI) has demonstrated a potential for higher active¹ returns (although with a possible increase in tail risk) compared with traditional FI portfolios.² However, we also show that another type of risk exists in synthetic FI, which is absent in traditional portfolios, namely the risk of picking a wrong hedge fund in the implementation of a synthetic strategy — manager selection risk. Incorporating this risk raises tracking error volatility (TEV) of synthetic FI strategies significantly above the TEV calculated assuming an investment in the hypothetical “average” hedge fund.

Figure 1, reproduced here from Part 1, shows that the TEV of a synthetic FI portfolio that uses the average MktNeut fund (i.e., the average of all MktNeut funds) and an RBI-2 beta portfolio is 49 bp/month.³ Its average active return over the U.S. Aggregate is 27 bp/month (compared with -1 bp/month for the average Core+ FI manager). However, the average TEV across MktNeut funds is considerably higher at 148 bp/month. If we incorporate the risk of selecting a single MktNeut fund for the synthetic FI strategy, the TEV, which we label TEV_{overall} , rises further to 163 bp/month.⁴ Figure 1 shows how, for each style, TEV_{overall} compares with the TEV of the “average” manager. Figure 2, illustrates difference in active returns and active risk from selecting a single synthetic manager versus the “average” manager (i.e., manager selection risk). Although the average monthly returns are little changed, the active risk of the synthetic FI strategies increases dramatically.

What can the investor do about manager selection risk? We consider three strategies: 1) Diversification with Naïve Manager Selection, 2) Diversification with Active Manager Selection, and 3) Replication using RHFISM Swaps.

First, the investor can diversify across several hedge funds, by adding either more funds of a given style, or funds with different styles. We call this “naïve diversification” because initial and replacement funds are selected at random. However, hedge fund diversification, even random, requires time, energy, and additional consultant expense.

Another way to approach manager selection risk is to try to increase performance by selecting hedge funds actively. Although manager selection risk remains, the potential increase in expected performance from active manager selection may more than compensate for that risk. How much better will a synthetic FI strategy perform if we assume that the investor actively selects managers according to some objective criteria? Does active manager selection boost the performance sufficiently for the information ratios (IR - annualized) to increase despite the presence of manager selection risk?

¹ Return in excess of the benchmark, in this case the U.S. Aggregate Index. Please see Part 1 for the definition of active return.

² We use five hedge fund styles from our Barclays Capital Global Hedge Fund Index and the Hedgefund.net (HFN) database (Macro, Market Neutral, Multi-Style, Broad Relative Value, and Fund of Funds) that are suitable alpha sources for synthetic FI because of their low correlation with the Aggregate Index, as well as with other systematic exposures that a sponsor would normally have in its portfolio as part of the asset allocation strategy.

³ RBISM Swaps offer a total return on a basket of liquid derivatives managed by Barclays Capital to replicate the U.S. Aggregate and other FI indices. RBI Series 2 (RBI-2) basket contains total return swaps (TRS) on the UST and MBS index components of the Aggregate and a blend of six funded Barclays Capital par swap indices for the other components (i.e., Agency, Credit, CMBS, and ABS). The swaps are weighted so as to match each sector's key-rate duration profile. See “Replicating Bond Index (RBISM) Baskets,” Lehman Brothers, August 2006 as well as Part 1 for a discussion of RBI performance and composition.

⁴ Please refer to Part 1 and its Appendix for a discussion of the TEV_{overall} formula.

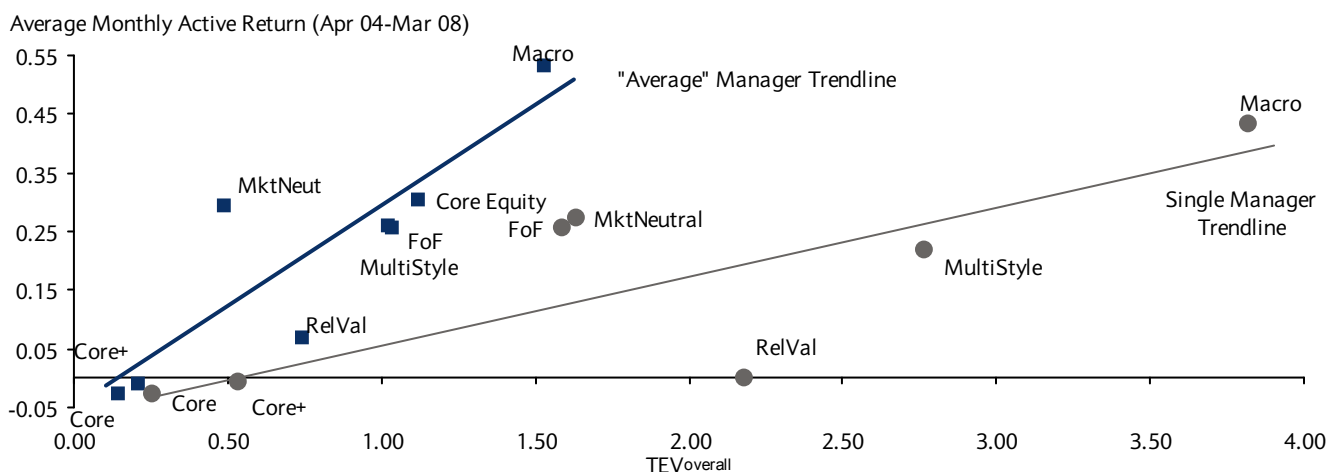
Finally, an innovative way to control manager selection risk is to use hedge fund replication.⁵ The goal of replication is to use baskets of liquid derivatives to mimic the average hedge fund. An investor obtains hedge fund exposure through a total return swap. For example, an investor could receive the total return on a replicating basket of derivatives designed to track the average Multi-Style hedge fund. The trade-off for the investor is whether the tracking error between the replicating portfolio and the average fund is less or greater than the risk owing to manager selection.

Figure 1. Synthetic FI Portfolio Performance using RBI-2: TE and TEV by Style, Incorporating Risk of Selecting a Single Hedge Fund. April 2004 – March 2008, % per month

Style	The "Average" Manager (i.e., a portfolio that invests equally in all funds)			Across All Managers		Selecting a Single Manager	
	Avg Monthly TE (Active Return)	TEV	IR (annual)	Avg Monthly TE _i (Active Return)	Avg TEV _i	TEV _{overall}	IR (annual)
Macro-2	0.53	1.53	1.21	0.43	3.36	3.82	0.39
MktNeut-2	0.30	0.49	2.11	0.27	1.48	1.63	0.58
MultiStyle-2	0.26	1.04	0.86	0.22	2.27	2.76	0.27
FoF-2	0.26	1.02	0.89	0.26	1.38	1.59	0.56
RelVal-2	0.07	0.74	0.32	0.00	1.77	2.18	0.00
Core	-0.03	0.14	-0.65	-0.03	0.25	0.26	-0.35
Core+	-0.01	0.21	-0.13	-0.01	0.39	0.54	-0.05

Source: Reprinted from Alpha-Beta Recombination – Part 1: Synthetic Fixed-Income Portfolios using Hedge Funds and RBISM Swaps, Barclays Capital
[Notation: The synthetic FI return for the Macro fund style with an RBI-2 synthetic beta is labeled Macro-2, and so forth.]

Figure 2. Synthetic FI Portfolio Performance: Active Returns from Selecting a Single Fund at Random versus the "Average" Fund. RBI-2, April 2004 – March 2008, % per month



Source: Reprinted from Alpha-Beta Recombination – Part 1: Synthetic Fixed-Income Portfolios using Hedge Funds and RBISM Swaps, Barclays Capital

⁵ Hedge fund replication offers other substantial benefits as well: no lock-up period, greater liquidity and transparency.

We now discuss each of the three approaches to manager selection risk in a synthetic FI portfolio strategy.

Controlling Manager Selection Risk Via Diversification

Measuring Performance of a Synthetic FI Portfolio: Capturing Fund Diversification, Turnover, and Selection Risk

For a synthetic FI strategy, what is the benefit of diversification across alpha sources (i.e., hedge funds)?

As discussed in Part 1, our earlier analysis of synthetic FI returns tracked hedge funds only for periods in which we were able to calculate adjusted fund returns. Once a fund stops reporting returns to the HFN database, its adjusted returns series also stops. Therefore, when calculating average TE_i , TEV_i , and $TEV_{overall}$ across funds, we used return windows of different length, start date, and end date. This made direct comparison in absolute terms difficult, particularly if a window excluded a period when the average fund (or beta source) strongly outperformed or underperformed. As a result, Figure 1 is not completely accurate because it includes funds that dropped in and out of the database over the April 2004 - March 2008 period.

To evaluate more realistically the potential risk and return of investing in hedge funds, we wish to incorporate an investor's selection, and possible occasional replacements, of hedge funds using actual return history. We then examine the relative performance of various multi-fund synthetic FI portfolio designs, i.e., portfolios of different style and portfolio size combinations. Because we substitute a new fund for a non-reporting fund, we can directly compare the TE and TEV over the same window (April 2004 - March 2008) for each synthetic FI portfolio. Using the full universe of funds that meet our selection criteria as the eligible set also helps us approximate the decision an investor would have had to have made if one of the funds in his portfolio became unavailable.

We generate a set of possible synthetic FI portfolios of a given design as follows. Each synthetic FI portfolio initially consists of one or more funds, chosen at random, that had adjusted returns in April 2004 (and, by definition, two years of history prior to that date).⁶ The number of funds in a portfolio design is referred to as the portfolio "size." If one of the funds in the synthetic FI portfolio ceases to report returns we assume the investor replaces that fund.⁷ The replacement fund is also chosen randomly from an eligible set of all other funds not currently in the portfolio (either within the same style or across styles, depending on the synthetic FI portfolio design) that have at least two years of returns history and a calculated adjusted return based on this history. This eligible set includes both funds that were available in April 2004 and continued to report returns and new funds that had developed a two-year track record by the time of their possible selection.

We then examine the performance of synthetic FI portfolios of different portfolio designs to answer such questions as: what is the return distribution of synthetic FI portfolios that contain several funds of a given style; how does this distribution change if several funds are selected from an assortment of styles; what if funds are not selected entirely randomly?

⁶ A group of funds in the portfolio usually contains a high percentage of funds chosen at the outset, because substitutions occur relatively infrequently. Consequently, the returns for the portfolios are heavily influenced by funds that were available at the start of the period.

⁷ Because funds participate in the HFN database voluntarily, they may cease reporting returns for a variety of reasons, but more often than not, funds cease reporting after sustained periods of poor performance or shortly before liquidation.

Specifically, we examine:

- How quickly naïve diversification reduces manager selection risk.
- The relative benefits of diversifying across fund styles compared with diversifying across funds within a particular style.
- How much diversification (across funds and/or styles) is needed to approach the lower $TEV_{overall}$ reported by fund of funds?

To measure the impact of manager selection risk for a specific synthetic FI portfolio design, we calculate the performance of a synthetic FI investor who allocates capital across a random group (of a fixed number) of hedge funds of a given style (or number of styles). Our methodology is as follows:

1. We select X number of hedge funds (e.g., three) at the beginning of our data period (April 2004). First, we select among hedge funds of the same self-reported style. Later, we repeat the portfolio construction selecting funds across styles. Each specific style and portfolio size combination represents a unique portfolio design. We then draw from actual hedge fund performance to generate a single return time series for this particular portfolio design. We then draw again to generate another single return time series for this design. We repeat this many, many times to produce a good representation of potential outcomes so we can measure the average return, and standard deviation, of that portfolio design.
2. For each draw from the historical hedge fund return database, we give \$1 to each of the X funds in the portfolio at the beginning of the period and calculate the value, and monthly returns, of the multi-fund portfolio over time.
3. If a fund in the portfolio subsequently becomes unavailable, we truncate the return series for that particular fund and select, also at random, a replacement from among the then current group of available funds of that style (later, across styles). The terminal value of the investment at the time the fund stopped reporting is reinvested in the substitute fund.
4. For each draw of a multi-fund portfolio's time series, we calculate its average (TE) and standard deviation (TEV) of monthly active returns.
5. We repeat steps a. through d. 10,000 times (to generate 10,000 portfolio time series) and calculate the $TEV_{overall}$ (i.e., risk of selecting a specific portfolio) using the formula below, where N is the number of possible portfolios.⁸ TE_i and TEV_i represent, respectively, the monthly tracking error (i.e., active return) and the tracking error volatility of the i^{th} random portfolio. The monthly active risk from randomly selecting a synthetic FI portfolio of a particular design (containing X funds) out of all possible synthetic FI portfolios of that design is:

$$TEV_{overall} = \sqrt{\frac{1}{N} \sum_{i=1}^N TEV_i^2 + \frac{1}{N} \sum_{i=1}^N TE_i^2 - \left(\frac{1}{N} \sum_{i=1}^N TE_i \right)^2} \quad (1)$$

⁸ We generate 10,000 portfolios so we are sure to include all possible combinations of available funds.

6. In a given month, we calculate the average monthly return across all 10,000 hedge fund portfolios. The resulting time series of these monthly returns belongs to the “average” hedge fund portfolio for that particular design. Although this “average” portfolio cannot be owned directly, we use it as a benchmark, to evaluate the performance of a particular portfolio design and to quantify fund selection risk. We calculate geometric mean and standard deviation of active returns of this “average” portfolio’s return series.
7. We then compare the TE and TEV of this “average” portfolio to the TE_i and $TEV_{overall}$ across portfolios to quantify the synthetic FI investor’s risk of having to select a specific portfolio and not being able to own the “average” portfolio.
8. As a separate exercise, we repeat all draws as outlined in steps a. through g., but narrow the universe of available funds (initial and replacements) to funds with above-median total return-based performance over the trailing two year period. This *active manager selection* process does not involve any “look-ahead” bias and is described in more detail below.

We now have the machinery to accurately measure the historical performance of synthetic FI portfolios of various designs.

The Notion of the “Average” Synthetic FI Portfolio

First, we will measure the performance of the “average” synthetic FI portfolio. This hypothetical single portfolio invests in the “average” hedge fund. In other words, it is assumed that the synthetic FI portfolio invests an equal dollar amount in each hedge fund in the portfolio. Each month, the return of the “average” synthetic FI portfolio is calculated as the average of that month’s returns of all portfolios of a particular strategy.

For example, suppose we wish to calculate the performance of a synthetic FI portfolio strategy that invests in a portfolio of three MktNeut hedge funds. As described above we form 10,000 portfolios using various combinations of three MktNeut hedge funds and calculate a time series of returns for each portfolio. This gives us a good idea of the distribution (*i.e.*, selection risk) of the performance of a synthetic FI portfolio strategy using three MktNeut funds. We also calculate the performance of the “average” synthetic FI portfolio strategy using three MktNeut funds. This “average” portfolio time series is generated by averaging the returns, for every month, across the 10,000 portfolios. This produces a single time series which we label the “average” synthetic FI portfolio.

An advantage of investing in the “average” fund is that the idiosyncratic risk of each fund is diversified away. As a result, the volatility of a synthetic FI portfolio using the “average” hedge fund is reduced. To avoid confusion, we will use the term “average” in quotes to refer to the “average” synthetic FI portfolio, *i.e.*, a single portfolio of a particular design, which invests in the “average” hedge fund.

The Distribution of Possible Synthetic FI Portfolio Outcomes, or the Risk of Not Being Able to Own the “Average” Synthetic FI Portfolio

As discussed, we generate the “average” synthetic FI portfolio to serve as a benchmark. It is unrealistic to expect an investor to be able to invest in the “average” hedge fund portfolio of a particular strategy. Instead, using the example above, the investor will have to select three particular MktNeut hedge funds. The distribution of the 10,000 synthetic FI portfolios using a strategy of investing in a portfolio of three MktNeut funds gives a representation of the investor’s range and likelihood of performance. In addition, we can measure the investor’s risk of having to select a particular three MktNeut fund combination.

To get a sense of the investor's selection risk we compare the tracking error volatility of the "average" synthetic FI portfolio with that of selecting a single synthetic FI portfolio.

Ultimately, of course, the investor is trying to outperform traditional FI portfolios (e.g., Core and Core+). Consequently, the true risk facing the investor is the risk that his particular synthetic FI portfolio underperforms his traditional alternatives, not the "average" synthetic FI portfolio. However, we wish to quantify manager selection risk to highlight a risk dimension prevalent in synthetic FI portfolio strategies and to suggest ways to manage this risk while still preserving the expected performance enhancement offered by synthetic FI.

Diversification within a Style

We first generate "average" synthetic FI portfolios to assess the diversification benefit from increasing portfolio size (i.e., the number of funds in the portfolio), but restricting funds to a particular style. Initially, funds are selected at random (naïve selection).

The "average" portfolio (of a given size) using naïve selection is our performance yardstick for diversified portfolios that invest across funds. We compare this portfolio to the returns averaged across all 10,000 synthetic FI portfolios of a given design. In doing this, we quantify the idiosyncratic manager selection risk of not owning the "average" portfolio. This is done for one-style portfolios as well as for portfolios that invest across styles, to assess the diversification benefits of investing across styles.

Then, as described above, we model investor's active selection of both initial and replacement funds. An investor may try to compensate for manager selection risk by choosing funds likely to outperform the average. The goal now is not to reduce $TEV_{overall}$ but to improve risk-adjusted performance (IR). To do that, we narrow the universe to the above-median funds. This has a positive effect on returns⁹ by skewing the diversified portfolio towards styles and funds that outperformed in the prior two-year period.

Impact of Fund Diversification on the "Average" Synthetic Portfolio Performance, with Naïve and Active Selection

Figure 3 shows the TE and TEV of the "average" synthetic portfolio (with RBI-2 as the beta replication strategy) as a function of the number of funds (X) for each hedge fund style, using both naïve and active manager selection. Here we are only examining the "average" portfolio's performance ignoring the cross-sectional variability across funds in a given month. Because we are calculating average returns each month, over many possible portfolios, we would normally expect little difference in TE and some decrease in TEV as the number of funds in the synthetic portfolio increases. However, as shown in Figure 3, there is some variation in TE and some increases in TEV. This is due to the fact that set of underlying funds is not constant over the data period: some funds stop reporting and have to be replaced. It is the large size portfolios that have a higher chance of having to make a fund substitution during its life.¹⁰

Figure 3 shows that while there are only small differences in the "average" portfolio's performance as its size increases from one to five funds, there generally is a significant improvement in risk-adjusted returns (average TE) when we switch to active manager

⁹ However, in practice, funds with a strong track record are less likely to be open to new investment.

¹⁰ Synthetic Macro portfolios show a larger increase in the average TE compared with other styles when more funds are added to the portfolio. This is largely due to the mechanics of generating portfolio returns and the relative performance of the initial universe of funds versus the universe of replacement funds. For most styles, the average returns of funds that subsequently become available within the replacement universe are similar to those of funds were available at the outset. However, for Macro, the newer funds had much higher average monthly TE and TEV relative to the initial investment universe.

selection. Active manager selection offers the highest increase in IR for RelVal style, with the average monthly TE (i.e., active return) more than doubling, while FoF and Macro information ratios drop with active manager selection due to the higher increase in TEV. It is quite remarkable that such a simple manager selection rule leads to such a large increase in the performance of the “average” synthetic FI portfolio. This suggests that active manager selection can be a key driver of synthetic FI portfolio performance

Figure 3. Performance of the “Average” Synthetic FI Portfolio using RBI-2: Naïve vs. Active Manager Selection. TE, TEV and IR as a Function of Number of Funds (X) within a Style. April 2004 – March 2008, % per month

Style	# Funds in Portfolio (X)	Naïve Selection			Active Selection			% Change in IR vs Naïve
		Avg TE (Active Return)	TEV	IR (annual)	Avg TE (Active Return)	TEV	IR (annual)	
Macro-2	1	0.56	1.61	1.20	0.89	2.58	1.11	-7.4
	3	0.59	1.66	1.24	0.96	2.73	1.21	-2.7
	5	0.61	1.68	1.25	0.97	2.77	1.22	-2.2
MktNeut-2	1	0.26	0.52	1.73	0.51	0.81	2.62	51.4
	3	0.28	0.54	1.77	0.52	0.83	2.63	48.5
	5	0.28	0.54	1.79	0.52	0.81	2.64	47.3
MultiStyle-2	1	0.19	0.98	0.69	0.53	1.59	1.12	63.1
	3	0.21	0.98	0.73	0.54	1.60	1.19	62.3
	5	0.21	0.98	0.75	0.54	1.59	1.21	61.6
RelVal-2	1	0.08	0.60	0.47	0.24	0.58	1.51	223.1
	3	0.11	0.59	0.62	0.25	0.59	1.59	155.3
	5	0.10	0.59	0.60	0.25	0.59	1.66	174.4
FoF-2	1	0.25	1.00	0.88	0.26	1.28	0.72	-17.3
	3	0.25	1.00	0.87	0.26	1.27	0.76	-12.4
	5	0.25	1.00	0.87	0.26	1.28	0.76	-12.9

Source: Barclays Capital

Incorporating Manager Selection Risk: Impact of Fund Diversification on Synthetic Portfolio Performance ($TEV_{overall}$ and IR), with Naïve and Active Selection

Having established “average” synthetic FI portfolio performance, we can now measure the magnitude of manager selection risk by examining the cross-sectional performance of synthetic FI portfolios of a given size. Figure 4 presents the $TEV_{overall}$ and IR likely to be faced by synthetic FI investors who use a given number of funds (X) in their synthetic FI portfolio. In other words, this figure quantifies both the manager selection risk of owning a specific portfolio of funds instead of owning the “average” manager and the incremental benefits of diversification, using both active and naïve manager selection.

If we define manager selection risk as the difference between $TEV_{overall}$ for a given portfolio size and the “average” portfolio TEV, a single-fund Macro or MultiStyle synthetic FI portfolio produces the highest manager selection risk ($TEV_{overall}$) in absolute terms ($TEV_{overall}$ of 4.04 and 2.71 respectively, using naïve manager selection) versus 161 bp and 98 bp for the “average” portfolio’s TEV. As a multiple of their corresponding “average” fund TEV, using

naïve selection RelVal and MktNeut produce the highest $TEV_{overall}$ (3.12x and 3.11x the average fund TEV, respectively).

Information ratios adjusted for manager selection risk (i.e., using $TEV_{overall}$ instead of the “average” portfolio TEV) experience the largest absolute drop relative to the “average” portfolio for MktNeut and Macro funds (from 1.73 to 0.53 for MktNeut, and from 1.20 to 0.42 for Macro), and the largest percentage drop - for RelVal funds (from 0.47 to 0.12). Incorporating active manager selection reverses some of the drop in risk-adjusted return seen with naïve selection, as the increase in average TE_i from active manager selection more than compensates for the increase in $TEV_{overall}$ for all five styles.

Figure 5 graphs the results from Figure 4. $TEV_{overall}$ across portfolios using active or random manager selection is similar for both RelVal and MktNeut funds, regardless of the portfolio size, though MktNeut funds have a higher average monthly return for the similar level of risk. As expected, going from a one-fund portfolio to a five-fund portfolio reduces $TEV_{overall}$ dramatically and brings IR closer to that of the “average” portfolio for all five styles using naïve manager selection (Figure 5b).

The incremental reduction in $TEV_{overall}$ relative to the “average” portfolio TEV starts slowing down at portfolio sizes of four and five funds for all styles except FoF, for which the slowdown begins at after two funds. Most of the incremental reduction in manager selection risk (i.e., lowering of $TEV_{overall}$) comes from simply adding a second fund to each style-specific portfolio (Figure 5a). A five-fund portfolio of RelVal funds ($TEV_{overall}$ of 0.94 versus the average fund TEV of 0.59) experiences the largest reduction in $TEV_{overall}$ as a multiple of the “average” fund TEV (from 3.12x the average fund $TEV_{overall}$ to 1.60x) while Macro funds experience the largest absolute drop in $TEV_{overall}$ when going from one fund to five funds (from 4.04 to 2.42).

Rather than simply adding more funds to the synthetic FI portfolio, an investor can also use active manager selection to boost risk-adjusted returns and compensate for the manager selection risk. In fact, combining active manager selection with an increase in portfolio size pushes the information ratios ahead of the “average” randomly selected fund for three of the five styles (MktNeut, MultiStyle, RelVal). On the other end of the spectrum, FoF experiences very little incremental gain in risk-adjusted returns using active manager selection, implying there is already a high degree of diversification in fund of funds.

Figure 4 also highlights how much diversification within a specific style is required to approach the level of diversification embedded in a single FoF as measured by $TEV_{overall}$. For example, the $TEV_{overall}$ of MultiStyle-2 using naïve selection approaches and drops below that of a single fund FoF-2 (156 bp $TEV_{overall}$) when it includes five or more funds (156 bp $TEV_{overall}$ for four funds, 145 bp for five funds), while MktNeut-2 and RelVal-2 can offer a lower $TEV_{overall}$ compared to a single FoF-2 by just adding a second fund to the synthetic FI portfolio.

Figure 4. Effect of Manager Selection Risk on Synthetic FI Portfolio Performance: $TEV_{overall}$ and IR
As a Function of Number of Funds (X) in Portfolio (using RBI-2). Active and Naïve Manager
Selection. April 2004 – March 2008, % per month

The “Average” Synthetic FI Portfolio- Naïve Selection (a) (from Figure 3)					Across All Synthetic Portfolios – Diversification with Naïve Selection (b)					Across All Synthetic Portfolios - Diversification with Active Selection (c)							
					Across All Portfolios			Selecting a Single Portfolio		Across All Portfolios			Selecting a Single Portfolio				
	# Funds in Port (X)	Avg TE	TEV	IR (annual)	Avg TE _i	Avg TEV _i	TEV _{ov- erall}	TEV _{overall} as Multiple of Avg Port TEV	IR (annual)	IR as % of the “Avg” Portfolio IR	Avg TE _i	Avg TEV _i	TEV _{overall}	Avg TE as Multiple of Naïve TE	TEV _{overall} as Multiple of naïve TEV	IR (annual)	IR as % of the “Avg” Portfolio IR
Macro-2	1	0.56	1.61	1.20	0.49	3.63	4.04	2.51x	0.42	35	0.82	4.31	4.73	1.65x	1.17x	0.60	50
	2	0.59	1.66	1.24	0.56	2.93	3.18	1.92x	0.61	49	0.91	3.67	3.93	1.63x	1.24x	0.80	65
	3	0.59	1.66	1.24	0.57	2.59	2.78	1.68x	0.71	57	0.94	3.41	3.59	1.64x	1.29x	0.90	73
	4	0.60	1.67	1.24	0.58	2.41	2.56	1.53x	0.79	64	0.96	3.26	3.39	1.65x	1.32x	0.98	79
	5	0.61	1.68	1.25	0.59	2.29	2.42	1.43x	0.85	68	0.96	3.15	3.24	1.62x	1.34x	1.03	82
MktNeut-2	1	0.26	0.52	1.73	0.25	1.44	1.61	3.11x	0.53	31	0.50	1.65	1.82	2.03x	1.13x	0.96	55
	2	0.27	0.53	1.75	0.26	1.11	1.19	2.24x	0.76	44	0.52	1.28	1.37	1.98x	1.15x	1.31	75
	3	0.28	0.54	1.77	0.27	0.95	1.02	1.88x	0.93	53	0.52	1.11	1.16	1.89x	1.15x	1.54	87
	4	0.28	0.53	1.80	0.27	0.85	0.90	1.68x	1.06	59	0.52	1.01	1.04	1.89x	1.16x	1.73	96
	5	0.28	0.54	1.79	0.28	0.79	0.83	1.54x	1.16	65	0.52	0.94	0.96	1.86x	1.16x	1.87	104
MultiStyle-2	1	0.19	0.98	0.69	0.16	2.30	2.71	2.79x	0.21	30	0.49	2.79	3.20	3.04x	1.18x	0.54	78
	2	0.20	0.98	0.72	0.19	1.84	2.03	2.07x	0.32	45	0.52	2.32	2.50	2.74x	1.23x	0.72	100
	3	0.21	0.98	0.73	0.20	1.61	1.73	1.76x	0.40	54	0.53	2.08	2.19	2.66x	1.26x	0.83	114
	4	0.22	0.98	0.76	0.21	1.48	1.56	1.59x	0.46	61	0.53	1.96	2.03	2.55x	1.30x	0.91	119
	5	0.21	0.98	0.75	0.21	1.38	1.45	1.48x	0.49	66	0.54	1.86	1.92	2.59x	1.32x	0.97	129
RelVal-2	1	0.08	0.60	0.47	0.07	1.58	1.86	3.12x	0.12	26	0.23	1.54	1.70	3.51x	0.91x	0.47	100
	2	0.10	0.58	0.58	0.09	1.21	1.34	2.28x	0.24	41	0.24	1.17	1.25	2.64x	0.94x	0.67	115
	3	0.11	0.59	0.62	0.10	1.04	1.13	1.92x	0.31	50	0.24	1.01	1.06	2.39x	0.94x	0.79	126
	4	0.10	0.59	0.61	0.10	0.95	1.02	1.73x	0.34	56	0.25	0.90	0.95	2.45x	0.93x	0.90	148
	5	0.10	0.59	0.60	0.10	0.89	0.94	1.60x	0.37	61	0.25	0.84	0.88	2.49x	0.93x	0.98	163
FoF-2	1	0.25	1.00	0.88	0.25	1.38	1.56	1.56x	0.55	62	0.25	1.71	1.88	1.00x	1.20x	0.45	52
	2	0.25	1.00	0.86	0.25	1.23	1.31	1.31x	0.65	75	0.25	1.52	1.60	1.03x	1.22x	0.55	64
	3	0.25	1.00	0.87	0.25	1.16	1.22	1.21x	0.71	82	0.26	1.44	1.49	1.03x	1.22x	0.60	69
	4	0.25	1.00	0.87	0.25	1.12	1.16	1.16x	0.74	85	0.26	1.40	1.44	1.02x	1.24x	0.61	70
	5	0.25	1.00	0.87	0.25	1.10	1.13	1.13x	0.77	88	0.26	1.38	1.41	1.03x	1.24x	0.63	72
Core	1	-0.02	0.15	-0.43	-0.02	0.23	0.27	1.85x	-0.23								
	2	-0.02	0.14	-0.42	-0.02	0.19	0.21	1.49x	-0.29								
	3	-0.02	0.14	-0.40	-0.02	0.17	0.19	1.34x	-0.30								
	4	-0.02	0.14	-0.41	-0.02	0.17	0.18	1.26x	-0.32								
	5	-0.02	0.14	-0.41	-0.02	0.16	0.17	1.21x	-0.34								
Core+	1	0.00	0.20	0.03	0.00	0.39	0.54	2.65x	0.00								
	2	0.00	0.20	0.06	0.00	0.34	0.41	2.07x	0.02								
	3	0.00	0.20	0.02	0.00	0.31	0.35	1.70x	0.01								
	4	0.00	0.20	0.03	0.00	0.29	0.31	1.55x	0.02								
	5	0.00	0.20	0.02	0.00	0.28	0.29	1.45x	0.01								

Source: Barclays Capital

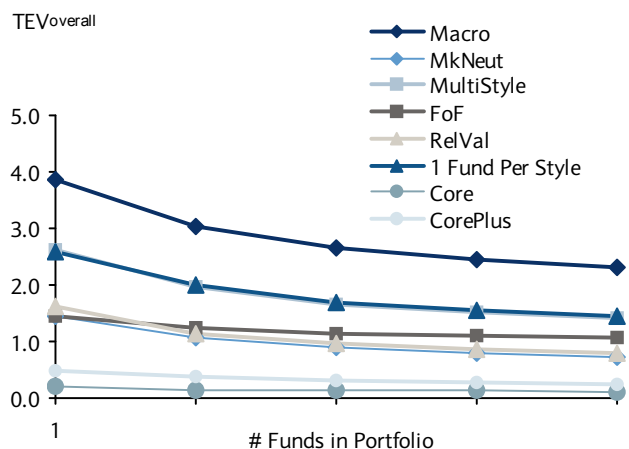
(a) “Average” Portfolio = A single hypothetical portfolio whose monthly return in a given month equals average return of all 10,000 synthetic FI portfolio returns for that month. Essentially, the “average” portfolio assumes the investor can invest an equal amount each month in all synthetic FI portfolios of a particular design. TE is the average active return of this “average” portfolio monthly time series, TEV is the standard deviation of its monthly time series.

(b) Average Across Portfolios = the average active return (TE_i) and standard deviation of active return (TEV_i) across the 10,000 synthetic FI portfolios over the April 2004-March 2008 period. TE_i and TEV_i are used to calculate $TEV_{overall}$ as a measure of cross sectional variability and the idiosyncratic manager selection risk from not owning the “average” portfolio. Naïve selection randomly selects the initial and replacement funds for each run,

(c) Active manager selection only uses funds with above median returns for the selection of the initial portfolio and replacements funds for each of the 10,000 portfolios.

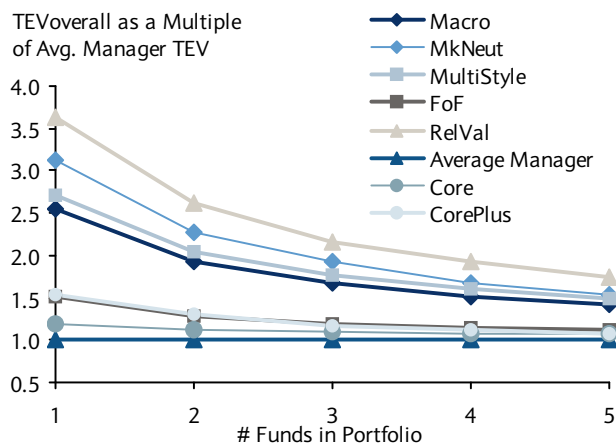
Figure 5: Effect of Manager Selection Risk on Synthetic FI Performance: Absolute $TEV_{overall}$ and $TEV_{overall}$ Relative to “Average” Portfolio, As a Function of Number of Funds (X) in Portfolio. Using Naïve Selection and RBI-2. April 2004 – March 2008

5a: Absolute $TEV_{overall}$ by Style



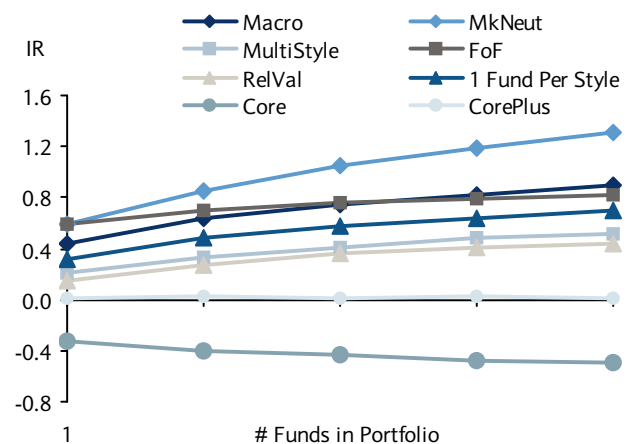
Source: Barclays Capital

5b: $TEV_{overall}$ Relative to Avg Portfolio of a Given Style



Source: Barclays Capital

5c: Information Ratio by Style



Source: Barclays Capital

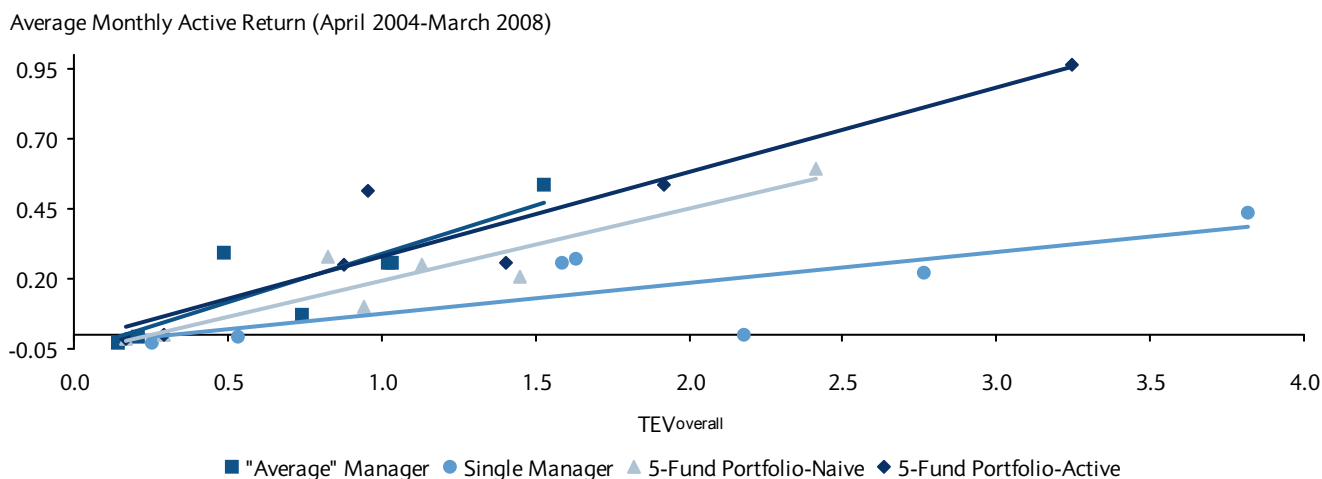
There is a clear diversification benefit with both naïve and active manager selection for funds, as the $TEV_{overall}$ converges towards the “average” portfolio with an increase in the number of funds in the portfolio. Figure 6 summarizes our findings. The figure plots each synthetic FI portfolio’s (by style) $TEV_{overall}$ against its active return depending on the underlying basket of funds in the portfolio. For example, Figure 6 plots synthetic FI results assuming the strategy can invest in the “average” portfolio (by style). As we discussed, this strategy, which is not implementable, shows the lowest $TEV_{overall}$ for a given level of active return. (Figure 6 provides a least squares line—a “performance line”—for the set of synthetic portfolios, and Core and Core+, of a particular fund strategy).

Figure 6 shows what happens to the performance line if the investor was required to select a single manager at random. While the expected active return is not much changed, the $TEV_{overall}$ is much higher, which reflects manager selection risk. As a result the performance line rotates downward.

The benefit of increasing the number of funds within the synthetic strategy is apparent. A five-fund synthetic portfolio strategy, using naïve selection, brings the performance line close to the performance line assuming the investor could invest in the “average” fund. Active selection improves performance further; in fact the increase in average monthly TE offered by active manager selection can even boost information ratios above that of the “average” selected manager.

However, even if synthetic FI investors owned all funds of a particular style and eliminated manager selection risk entirely, they may seek to increase their risk-adjusted returns by going across styles (to boost average returns and possibly lower return volatility). Given the low correlation of “Average” manager active returns of the five hedge fund styles (Figure 7), there is a potential for cross-style diversification in addition to manager selection diversification.

Figure 6: Synthetic FI Portfolio Performance: Comparing Active Returns from Selecting a One-fund Synthetic Portfolio, Five-fund Synthetic Portfolio (Naïve and Active Manager Selection), or the “Average” Manager.
April 2004 – March 2008, % per month



Source: Barclays Capital

Figure 7: Correlations of “Average” Manager Monthly Active Returns (Using RBI-2) by Style: April 2004 – March 2008

	Macro	MktNeut	MultiStyle	FoF	RelVal
Macro	1.00				
MktNeut	0.59	1.00			
MultiStyle	0.58	0.61	1.00		
FoF	0.78	0.63	0.86	1.00	
RelVal	0.40	0.24	0.51	0.49	1.00

Diversification across Styles

We now conduct the same experiment as before but remove the restriction of selecting the initial basket of funds and replacements from within the same hedge fund style. This multi-dimensional diversification—across style and funds—results in portfolios of hedge funds that may more closely represent the broader investment choices available to a synthetic FI investor and allows for more direct comparisons against FoF or broader hedge fund indices. By assuming the investor has identified a set of possible styles from which he will select and then a manager(s) from within the style, we incorporate manager selection risk as well as style selection risk, which is likely a more realistic framework.

We still limit the universe of funds to combinations of the four hedge fund styles we identified as being desirable for a synthetic FI strategy (we exclude FoF which is already somewhat diversified). Once any systematic exposures have been removed from funds within these styles, the synthetic FI investor may be somewhat indifferent as to which style to select for his synthetic FI strategy.

We specify in advance the synthetic FI portfolio design: Both the number of possible styles for the portfolio and the number of funds within each style (and so the size of the portfolio). No further restrictions are placed on the naïve selection of the actual styles used to generate each of the 10,000 portfolios. As before, naïve diversification uses the full available set of hedge funds within each style, while active manager selection is limited to above-median performers.

For example, a two-style, two funds per style synthetic FI portfolio design (i.e., each portfolio contains four funds) randomly selects one of the six two-style combinations available from the choice of four styles (Macro-MktNeut, Macro-MultiStyle, etc.). The initial portfolio for that two-style portfolio design then randomly includes two funds from each style at the start of the investment window. If a fund ceases reporting, the replacement fund can come from any of the available funds (or top half of funds if using active manager selection) within its own style. We generate a total of 10,000 separate portfolios each with this two-style two-fund design, with each portfolio randomly selecting the initial universe of styles and therefore different funds to choose from.

The results show that there are two types of diversification benefits from this synthetic FI portfolio design: systematic, from increasing the number of styles; and idiosyncratic, from adding more funds to each style component.

Effect of Manager and Style Diversification on the “Average” Synthetic Portfolio Performance

Figure 8 shows the effect on the “average” portfolio’s TE and TEV from increasing the number of styles available to the synthetic FI portfolio and/or number of funds within each

style, using both naïve and active manager selection. As before, our purpose in looking at “average” synthetic FI portfolios’ performance is to measure the effect of manager selection risk. Let us consider the results for “average” synthetic FI portfolios using naïve selection.

First, we set the number of styles to one and examine the effect of adding more funds within that style (from one to five). The increase in the average monthly TE is relatively modest, changing only from 27 bp to 31 bp as we move from one fund to five. The IR, on the other hand, increases (from 1.24 to 1.35), with the bulk of the increase happening from adding just a second fund.

Then, we alter the synthetic FI portfolio design by fixing the number of funds per style at one and experimenting with the addition of more styles (from one to four). The pattern does not change. With four funds overall (this time we don’t go to five), we end up with the TE of 31 bp and IR of 1.36, almost exactly the same numbers as before with a portfolio of more funds (5) across a single style. We then move along both dimensions, setting the number of funds per style to two and moving from one style to four (and so reaching the maximum of 8 funds in the portfolio). Again, the pattern is similar and close to our first one-style fund diversification case. For example, the “average” portfolio of four funds, two funds each per two styles, has virtually the same TE, TEV and IR as the one-style, four-fund synthetic FI portfolio and the four-style, one-fund portfolio.

**Figure 8: Performance of “Average” Synthetic FI Portfolios with Manager and Style Diversification:
TE, TEV and IR Using Naïve and Active Manager Selection. April 2004 – March 2008, % per month**

Synthetic FI Portfolio Design				The “Average” Portfolio - Across Styles Naïve Selection			The “Average” Portfolio - Across Styles Active Selection			
	# Funds per Style	# Styles	# Funds in Portfolio	Avg Monthly TE (Active Return)	TEV	IR (annual)	Avg Monthly TE (Active Return)	TEV	IR (annual)	% Change in IR
Manager Diversification Only	1		1	0.27	0.76	1.24	0.55	1.17	1.62	31.4
	2		2	0.30	0.78	1.31	0.57	1.18	1.67	27.6
	3	1	3	0.29	0.77	1.33	0.58	1.22	1.66	25.1
	4		4	0.30	0.78	1.33	0.58	1.18	1.69	26.7
	5		5	0.31	0.78	1.35	0.57	1.18	1.68	24.3
Style Diversification Only		1	1	0.27	0.76	1.24	0.55	1.17	1.62	31.4
	1	2	2	0.29	0.78	1.31	0.58	1.21	1.66	26.1
		3	3	0.30	0.78	1.35	0.59	1.23	1.65	22.3
		4	4	0.31	0.79	1.36	0.58	1.23	1.63	20.0
Manager & Style Diversification		1	2	0.30	0.78	1.31	0.57	1.18	1.67	27.6
	2	2	4	0.30	0.77	1.33	0.58	1.22	1.65	24.3
		3	6	0.31	0.79	1.34	0.58	1.23	1.64	22.2
		4	8	0.31	0.79	1.35	0.59	1.25	1.65	22.0
	1	FoF Only	1	0.25	1.00	0.88	0.26	1.28	0.72	-17.3
	2	FoF Only	2	0.25	1.00	0.86	0.26	1.28	0.75	-12.9
	3	FoF Only	3	0.25	1.00	0.87	0.26	1.27	0.76	-12.4
	4	FoF Only	4	0.25	1.00	0.87	0.26	1.28	0.75	-13.2
	5	FoF Only	5	0.25	1.00	0.87	0.26	1.28	0.76	-12.9

Source: Barclays Capital

Interestingly, however, synthetic FI portfolios containing four funds (irrespective of the fund-style combination) outperform the “average” synthetic FI portfolio containing four FoF. In fact, adding fund of funds to the synthetic FI portfolio produces negligible performance improvement, suggesting that additional FoF managers provide no diversification benefit as far as the “average” synthetic FI portfolio is concerned. These results are likely to change as we introduce the effect of manager selection risk, to which we now turn.

Incorporating Manager Selection Risk: Effect of Manager and Style Diversification on Synthetic Portfolio Performance

Figure 9 presents results of a similar two-dimensional experiment. But instead of looking at the “average” portfolio’s TE and TEV (across styles) we now look at the distributions of TE_i and TEV_i across all portfolios and calculate a single $TEV_{overall}$ for selecting a single synthetic FI portfolio of a specific design (# styles/# funds per style) to estimate manager selection risk. We examine the incremental reduction in $TEV_{overall}$ and changes in information ratio as we modify the portfolio design and add funds and increase the number of styles in the portfolio.

Again, defining manager selection risk as the difference between $TEV_{overall}$ across portfolios (Figure 9) and the TEV of the “average” portfolio (Figure 8), we find benefits from diversifying both across styles and across funds. The question is whether investors willing to invest in more than one fund to diversify the alpha source are better off adding funds within one style (which they may prefer) or adding funds from other styles. Diversification across funds within a single style reduces $TEV_{overall}$ from 274 bp for one fund to 155 bp for five. The information ratio more than doubles from 0.30 to 0.66. It should be noted that the starting-point $TEV_{overall}$ is already lower than that for some of one-fund “mono-style” portfolios discussed above, e.g., $TEV_{overall}$ of 404 bp for Macro or 271 bp for MultiStyle (Figure 4). The reason is that across the 10,000 possible portfolios the “one” style may be different every time as all four styles are available for selection.

Unlike the case for the hypothetical “average” portfolio of a specific style, diversification across styles now shows a clear edge. With one fund per style, $TEV_{overall}$ falls from 274 bp for one style to 156 bp for four styles. And the IR reaches 0.67. Comparing Figures 8 and 9 suggests that a key driver of improved performance by adding managers and styles in a synthetic FI portfolio is not diversification of returns, per se, but the reduction of manager selection risk.

When we move along both dimensions, setting the number of funds per style at two and ranging from one to four styles, the dynamics are similar for the 1–4 overall funds range. A two-fund, two-style combination (i.e., total number of funds in portfolio equals four) produces a result in between one style, four funds and four styles, one fund per style portfolios (both with four funds as well). Diversification benefits continue to accrue as we increase the portfolio size above four with $TEV_{overall}$ reaching as low as 125 bp and the IR as high as 0.85 for a synthetic FI portfolio containing eight funds (two funds, four styles). So it is clear that if the investor is willing to accept the overhead costs of having more funds in the portfolio, the benefits will increase (at least up to a point).

Adding active manager selection (i.e., simply selecting funds that have trailing total returns above the investment universe median return), also boosts risk-adjusted performance of synthetic FI portfolios. A one-style, five funds per style portfolio using active manager selection ($TEV_{overall}$ of 199 bp) is riskier than the same-size portfolio that uses naïve manager selection ($TEV_{overall}$ of 155 bp), but a higher return (average TE of 56 bp vs. 30 bp)

compensates for the additional risk increasing the IR to 0.98 compared with 0.66 for naïve selection.

Implications for Synthetic FI Portfolio Construction

The results in Figure 9 shed light on how an investor needs to design his synthetic FI portfolio to achieve a certain TEV or IR target. What are the trade-offs between investing in a single style versus across styles versus a fund-of-funds strategy?

Figure 9. Synthetic FI Portfolio Performance (Using RBI-2) with Manager and Style Diversification:
TEV_{overall} and IR (vs. the “Average” Portfolio) as a Function of Number of Funds (X) per Style and Number of Styles. Active and Naïve Manager Selection. April 2004 – March 2008, % per month

				The “Average” Portfolio - Across Styles				Across Portfolios - Naïve Selection						Across Portfolios - Active Selection							
Synthetic FI Portfolio Design				Naïve Selection (from Figure 8)				Across All Portfolios		Selecting a Single Portfolio				Across All Portfolios				Selecting a Single Portfolio			
	# Funds per style	# Styles	# Funds in Portfolio	Avg Monthly TE	IR TEV	IR (annual)	Avg TE _i	Avg TEV _i	TEV _{overall}	TEV _{overall} as Multiple of Avg Fund TEV		IR as % of Avg Fund IR	Avg TE _i	Avg TEV _i	TEV _{overall}	Avg TE _{Naïve}	TEV _{overall} as Multiple of Naïve TE	IR as % of “Avg” Mgr			
Manager Diversification Only	1		1	0.27	0.76	1.24	0.24	2.24	2.74	3.60x	0.30	24	0.51	2.60	3.15	2.14x	1.15x	0.56	45		
	2		2	0.30	0.78	1.31	0.28	1.78	2.12	2.71x	0.45	35	0.54	2.11	2.51	1.95x	1.18x	0.75	57		
	3	1	3	0.29	0.77	1.33	0.28	1.54	1.80	2.35x	0.54	41	0.56	1.94	2.30	2.00x	1.28x	0.85	64		
	4		4	0.30	0.78	1.33	0.29	1.42	1.65	2.13x	0.60	45	0.56	1.77	2.09	1.95x	1.27x	0.93	70		
	5		5	0.31	0.78	1.35	0.30	1.34	1.55	1.98x	0.66	49	0.56	1.68	1.99	1.89x	1.29x	0.98	72		
Style Diversification Only		1	1	0.27	0.76	1.24	0.24	2.24	2.74	3.60x	0.30	24	0.51	2.60	3.15	2.14x	1.15x	0.56	45		
		2	2	0.29	0.78	1.31	0.28	1.79	2.05	2.63x	0.47	36	0.56	2.13	2.43	2.00x	1.19x	0.79	60		
		3	3	0.30	0.78	1.35	0.29	1.57	1.74	2.22x	0.59	43	0.57	1.93	2.14	1.94x	1.23x	0.92	68		
		4	4	0.31	0.79	1.36	0.30	1.43	1.56	1.98x	0.67	49	0.57	1.80	1.95	1.90x	1.25x	1.02	75		
Manager & Style Diversification		1	2	0.30	0.78	1.31	0.28	1.78	2.12	2.71x	0.45	35	0.54	2.11	2.51	1.95x	1.18x	0.75	57		
		2	4	0.30	0.77	1.33	0.29	1.42	1.58	2.05x	0.63	47	0.57	1.79	2.00	1.97x	1.26x	0.99	74		
		3	6	0.31	0.79	1.34	0.30	1.27	1.38	1.74x	0.76	56	0.58	1.65	1.76	1.92x	1.28x	1.13	84		
		4	8	0.31	0.79	1.35	0.31	1.18	1.25	1.58x	0.85	63	0.59	1.56	1.63	1.93x	1.31x	1.25	92		
	1	FoF Only	1	0.25	1.00	0.85	0.25	1.38	1.56	1.56x	0.55	64	0.25	1.71	1.88	1.00x	1.20x	0.45	53		
	2	FoF Only	2	0.25	1.00	0.86	0.25	1.23	1.31	1.31x	0.65	75	0.25	1.52	1.60	1.03x	1.22x	0.55	64		
	3	FoF Only	3	0.25	1.00	0.86	0.25	1.16	1.22	1.21x	0.71	83	0.26	1.44	1.49	1.03x	1.22x	0.60	69		
	4	FoF Only	4	0.25	1.00	0.86	0.25	1.12	1.16	1.16x	0.74	86	0.26	1.40	1.44	1.02x	1.24x	0.61	71		
	5	FoF Only	5	0.25	1.00	0.87	0.25	1.10	1.13	1.13x	0.77	88	0.26	1.38	1.41	1.03x	1.24x	0.63	73		
HFRI Composite Index				0.21	1.02	0.72															

Source: Barclays Capital

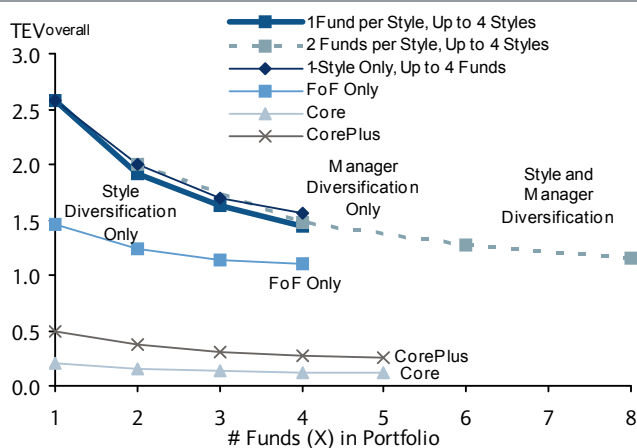
A synthetic FI portfolio that invests in a single fund of a single style using naïve selection (information ratio of 0.30) would need to expand to at least four funds per style (information ratio of 0.60) or have at least two funds per two styles (IR of 0.63) to reach or exceed the information ratio of a single FoF (IR of 0.55, $TEV_{overall}$ of 156 bp). To outperform a two-FoF synthetic FI portfolio on a risk-adjusted basis, a portfolio needs to diversify across three styles with two funds per style. To achieve a level of diversification and an information ratio comparable to a broad Hedge Fund Index such as the HFRI Composite (information ratio of 0.72, $TEV_{overall}$ of 102 bp)—to be discussed in more detail later—an investor would need a truly well-diversified portfolio holding maybe 5 or more funds, which may be well beyond what is reasonably manageable for most investors.

For investors who wish to limit their synthetic FI strategy to a single fund, then using a fund of funds seems the best way to produce higher active returns while controlling for manager selection risk. However, in the next section we provide the investor with another, arguably better, alternative.

Figures 10 and 11 express the same results in a visual form. Figure 10, for example, clearly shows the advantage of style diversification versus fund diversification. A synthetic FI portfolio containing one-fund, four-style combination outperforms a four-fund, one-style combination. It also demonstrates that increasing the portfolio size all the way to at least eight funds continues to both decrease $TEV_{overall}$ and increase the IR. Figure 11 highlights the comparisons between multi-fund portfolios diversified across funds, across styles, and across funds and style vs. “mono-style” portfolios and FoF.

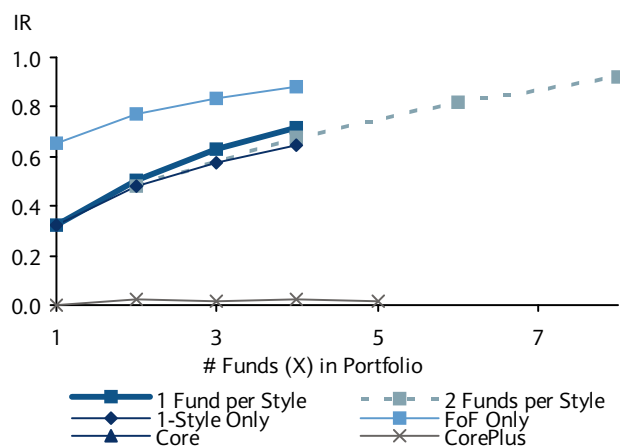
Figure 10: Is It More Efficient to Diversify within a Style or across Styles?
Synthetic FI Portfolio Performance with Manager and Style Diversification: $TEV_{overall}$ as a Function of Number of Funds (X) per Style and Style Diversification: Absolute $TEV_{overall}$ and IR. Naïve Manager Selection.
April 2004 – March 2008

10a. Absolute $TEV_{overall}$



Source: Barclays Capital

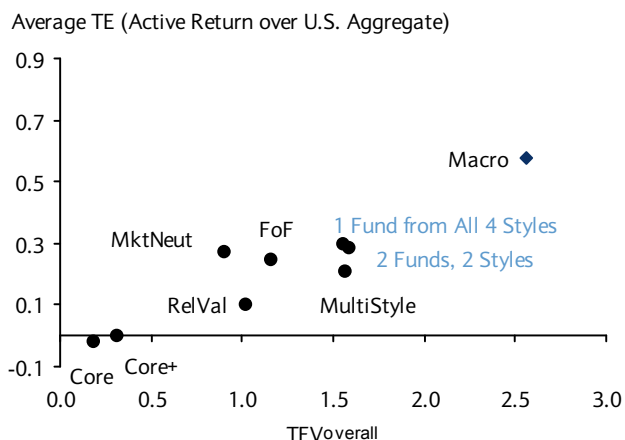
10b. Information Ratio



Source: Barclays Capital

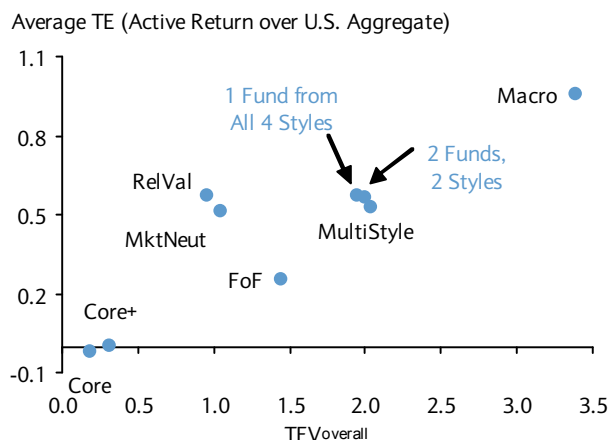
Figure 11: Comparing Portfolios Diversified Across Styles with Single-Style Portfolios and Fund-of-Funds
Manager Diversification Across Styles: Monthly TE and TEV_{overall} of Four-fund Portfolios within Specific Styles and Across Different Styles. April 2004 – March 2008, % per month

11a: Four-Fund Portfolios Using Naïve Manager Selection



Source: Barclays Capital

11b: Four-Fund Portfolios Using Active Manager Selection



Source: Barclays Capital

Another potential solution for reducing manager selection risk is to synthetically replicate hedge fund returns with liquid instruments to avoid manager selection risk altogether. As we will show, such a strategy replaces manager selection risk with another type of risk: replication risk. Synthetic replication can be done on individual hedge fund styles, on a series of FoF returns for additional style and manager diversification, or on a broad hedge fund index for even more style and manager diversification. This cashless replication strategy may allow the synthetic FI investor to attain alpha of a specific style with significantly lower manager selection risk while offering flexibility to choose a combination of styles or an even broader hedge fund index that cannot be “owned” to potentially lower the style selection risk.

Controlling Manager Selection Risk via Hedge Fund Replication (RHFSM Swaps)

We have highlighted manager selection risk present in a synthetic FI portfolio strategy. One approach to dealing with this risk is to diversify across a group of hedge funds. By diversification, the investor can hope to approach the performance of the “average” synthetic FI portfolio, earning the average hedge fund return each month, which we define as our benchmark. However, as we demonstrated, it takes more than five funds (excluding fund of funds) to approach the TEV of the “average” portfolio. We have shown that using fund of funds in a synthetic FI strategy is one way to improve performance while limiting the number of funds to less than five.

Alternatively, the investor can try to improve performance (IR) of synthetic FI strategies with less diversification by actively selecting a diversified group of funds according to some objective criteria. As we saw, active manager selection boosts synthetic FI performance with only a small increase in TEV and so significantly increases synthetic FI information ratios. In fact, the information ratio of a portfolio containing several funds diversified across styles

and constructed with active selection can exceed that of the “average” portfolio constructed with naïve selection.

Diversification, unfortunately, is often expensive and time consuming. In addition, many desirable funds may not be open to new investors. Another way to approach the “average” fund performance benchmark is to replicate it with a hedge fund replication technique that uses liquid derivatives. Instead of selecting a handful of funds, with the attendant selection risk, the investor can track the “average” fund directly. The trade-off for the investor is whether the cost and tracking error involved in replicating the “average” hedge fund of a given style or a hedge fund index more than offsets the cost (including monitoring and illiquidity costs) and tracking error volatility involved in selecting individual funds.

To investigate this alternative to synthetic FI diversification, we assume the investor uses replication to obtain direct exposure to the “average” hedge fund of a particular style or to broad hedge fund indices. Barclays Capital has developed a methodology to replicate hedge fund returns using baskets of liquid derivatives (e.g., swaps, futures, and options). As shown below, this basket of derivatives does a good job tracking hedge fund returns. In particular, Barclays Capital offer investors “Replicating Hedge Fund Index” (RHFISM) total return swaps that allow investors to obtain hedge fund exposure synthetically¹¹. An RHFI swap pays the total return on a basket of derivatives designed to track a portfolio of hedge funds (or a hedge fund index). In return, the investor pays 1-month LIBOR plus a spread. While the investor is exposed to tracking error between the RHFI and the corresponding average hedge fund bogey (in addition to counterparty risk from the swap), this tracking error risk may be smaller than the manager selection risk and costs involved in picking individual funds. Last, but not least, a RHFI swap is always an investable alternative.

Synthetic Hedge Fund Returns Using RHFI Swaps

For each of our five hedge fund styles we create an RHFI basket. Each basket is designed to track the “average” fund’s after-fee adjusted returns.¹² As shown in Figure 12, while each of the five RHFI generally tracked the performance of its corresponding “average” fund there was meaningful tracking error volatility. For example, for the period April 2004 – March 2008, the $MktNeut_{RHFI}$ had an average monthly total return of 47 bp/month and a standard deviation of 59 bp/month. This compares with 59 bp/month and 47 bp/month, respectively, for the “average” MktNeut fund.¹³ In addition, $MktNeut_{RHFI}$ had a monthly TEV against the “average” MktNeut fund’s 54 bp. In other words, the TEV of $MktNeut_{RHFI}$ was as large as the volatility of its own monthly return. The correlation of monthly returns between the RHFI and the average fund was 0.51 (Figure 12), and the monthly tracking error difference between the RHFI and the average MktNeut fund was -13 bp/month.

This pattern was similar for the other RHFI style funds as well. For the Macro style, the $Macro_{RHFI}$ had a monthly total return of 72 bp/month and standard deviation of 151 bp/month compared with 83 bp/month and 153 bp/month, respectively, for the “average” Macro fund. The correlation of monthly returns is 0.57. The monthly tracking error difference between the $Macro_{RHFI}$ and the average Macro fund is -11 bp/month with a tracking error volatility of 141 bp/month.

¹¹ See “Synthetic Replication of Hedge Fund Returns”, November 2007, Lehman Brothers, for a discussion of various hedge fund replication products.

¹² See Part 1 for details on the construction of adjusted hedge fund returns.

¹³ Returns for the “average” hedge fund manager are from Figure 2 of Part 1.

Although the various RHFIs reasonably tracked their respective “average” funds overall, there were months of large divergences, as the magnitude of both the minimum and maximum TE observed during the period show. For example, the minimum monthly tracking error for $\text{Macro}_{\text{RHF}}$ was -503 bp and for $\text{RelVal}_{\text{RHF}}$ it was -168 bp. The issues facing synthetic FI investors are whether the tracking error of the RHF versus the average fund exceeds the tracking error involved in selecting individual hedge funds, and whether any negative tail dependencies between the RHF and beta replication (i.e., RBI) are introduced.

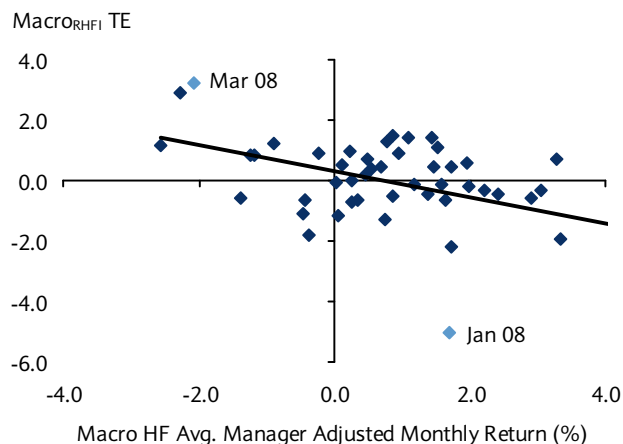
Figure 12: Monthly RHF Total Returns and Returns vs. “Average” Fund of Various Hedge Fund Styles and Indices. April 2004 – March 2008, % per month

Monthly RHF Total Returns								RHF Perf vs. The “Average” Hedge Fund/HFR Index						
Style	Avg	Stdev	Skew	Kurtosis	Min	Max	Correl w/ “Avg” HF	Auto Corr Lag1	Avg TE	TEV	Min TE	Max TE	Correl of TE w/ the “Avg” HF Return	Correl of TE w/ RBI-2 TE
Macro	0.72	1.51	-0.54	0.18	-3.34	4.00	0.57	-0.16	-0.11	1.41	-5.03	3.24	-0.47	-0.37
MktNeut	0.47	0.59	-1.00	0.70	-1.07	1.47	0.51	0.03	-0.13	0.54	-1.37	0.83	-0.32	-0.25
MultiStyle	0.48	1.15	-2.54	11.05	-5.03	2.46	0.49	-0.02	-0.07	1.14	-4.77	3.10	-0.47	-0.22
FoF	0.52	0.95	-0.95	1.88	-2.66	2.26	0.64	-0.02	-0.03	0.87	-1.78	2.08	-0.54	-0.08
RelVal	0.35	0.48	-0.47	-0.01	-0.69	1.34	0.19	0.07	-0.01	0.88	-1.68	4.10	-0.84	0.16
HFR Composite	0.59	1.17	-0.58	0.12	-2.35	3.22	0.80	0.01	0.04	0.73	-1.52	1.72	-0.24	-0.02
HFRX Investable-Global	0.25	0.79	-0.24	-0.55	-1.28	1.80	0.44	-0.01	0.04	1.03	-2.36	2.66	-0.72	-0.20

Source: Barclays Capital

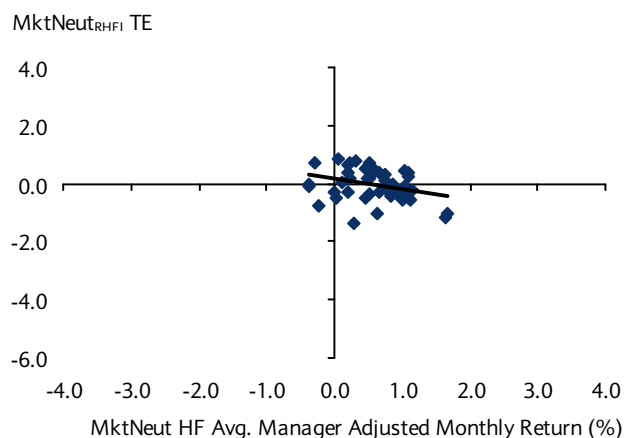
Figure 13. Monthly RHF_I Tracking Errors versus Monthly “Average” Fund Returns. Macro and MktNeut.
April 2004 – March 2008, % per month

13a: Macro_{RHF_I} TE vs. “Average” Fund’s Returns



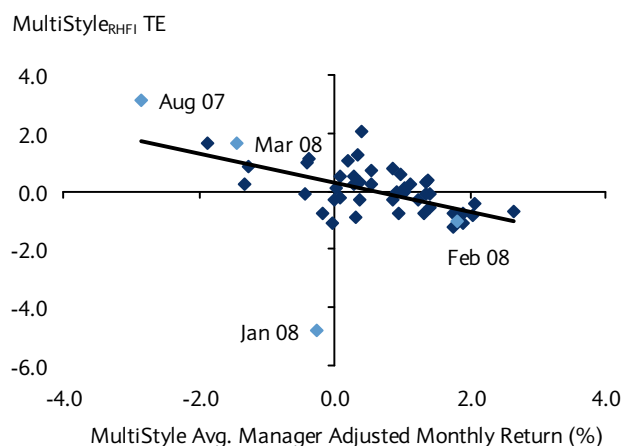
Source: Barclays Capital

13b: MktNeut_{RHF_I} TE vs. “Average” Fund’s Returns



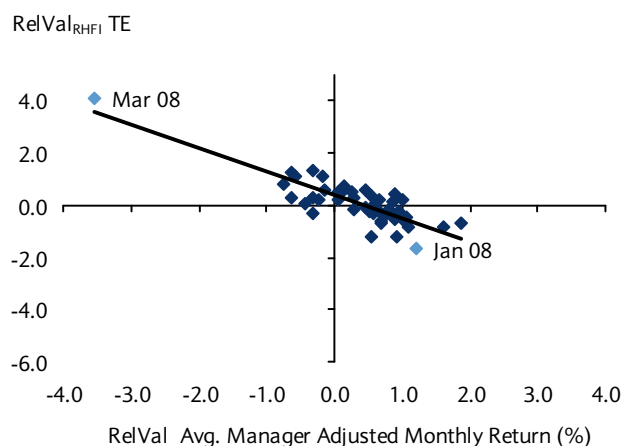
Source: Barclays Capital

13c: MultiStyle_{RHF_I} TE vs. “Average” Fund’s Returns



Source: Barclays Capital

13d: RelVal_{RHF_I} TE vs. “Average” Fund’s Returns



Source: Barclays Capital

We know from Part 1 that there is little tail dependency between hedge fund returns and Aggregate Index returns (Figure 5 in Part 1). However, negative tail dependencies could be introduced through the construction of the synthetic FI portfolio. The concern is that when hedge fund returns are negative is there a tendency for RHF_I and RBI tracking errors to be negative as well? If so, then the performance of the synthetic FI strategy may be exposed to more extreme tail behavior.

The good news is that the correlation of monthly RHF_I TE versus the average fund monthly return is negative for all five styles (Figure 12). In other words, below average RHF_I tracking errors have a tendency to occur when the average hedge fund returns are above average. To check for tail dependencies, Figure 13 plots monthly RHF_I TE versus the average monthly return for Macro_{RHF_I}, MktNeut_{RHF_I}, MultiStyle_{RHF_I}, and RelVal_{RHF_I} and shows little negative tail

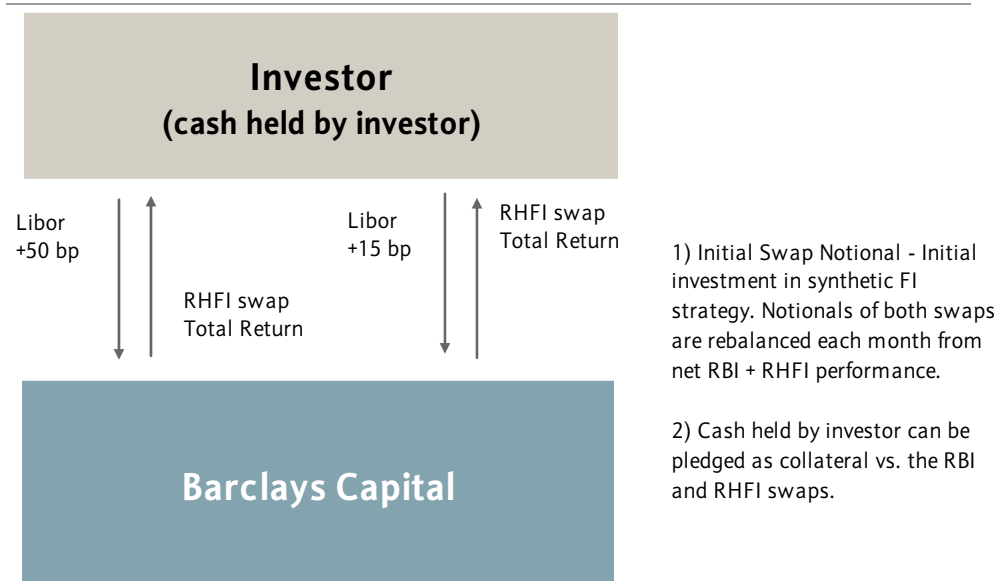
dependency between TE and average monthly return for these two styles. In other words, large negative RHFI tracking errors do not occur simultaneously with large hedge fund negative returns. If they did, then the synthetic FI portfolio returns might have a tendency to display more negative tail behavior. We now turn to the performance of synthetic FI portfolios using RHFI swaps as the alpha source.

Alpha-Beta Recombination using RHFI Swaps

In lieu of actual hedge funds, we use the RHFI as the alpha source in the synthetic FI strategy. Instead of investing in a specific hedge fund (and deal with search costs, manager selection risk, and lockup periods), investors enter into a RHFI total return swap whereby they receive the RHFI total return for a particular style and pay 1-month LIBOR plus a spread, which we assume to be 50 bp/year reflecting market levels.

Since investors are not using cash for either hedge fund exposure or beta exposure, we further assume that they invest cash at 1-month LIBOR. As before, to obtain the synthetic beta return, investors enter into an RBI swap and receive the total return on the RBI and pay 1-month LIBOR + 15 bp/year.

Figure 14. Alpha-Beta Recombination Structure Using RBI and RHFI Swaps



Source: Barclays Capital

As we did with actual hedge fund returns, we generate synthetic FI portfolio returns for various RHFI and RBI combinations. [Notation: Macro_{RHFI}-2 refers to the investor obtaining hedge fund exposure to the average Macro style fund using an RHFI swap, plus exposure to the Aggregate Index via a RBI-2 swap.] Investors are assumed to invest cash at 1-month Libor.

Figure 14 summarizes the structure of our alpha-beta recombination strategy using RBI and RHFI swaps. Unlike the synthetic FI strategy that made investments in particular hedge funds, synthetic FI using RHFI requires two total return swaps. The cash remains with the investor (perhaps held as collateral by the swap counterparty—the broker/dealer). The notionals for the two swaps are initially set at the amount that the investor would like to

allocate to the synthetic FI strategy. Each month thereafter, both notional amounts are adjusted to reflect the net total return performance of the two-swap combination.

We now calculate the returns for the synthetic FI strategy using both RHFI and RBI swaps. First, the monthly net RHFI swap return is given by:

$$\text{Monthly Net TR}_{\text{RHFI}} = \text{Monthly TR}_{\text{RHFI}} - (1 - \text{moL} + 50)/12$$

Adding the RHFI swap to the synthetic beta (i.e., the RBI swap), and assuming the investor earns 1-month LIBOR on un-invested cash, we have the synthetic FI portfolio total and active returns as follows:

$$\begin{aligned} \text{Syn FI Monthly TR}_{\text{RHFI}} &= \text{Monthly Net TR}_{\text{RHFI}} + \text{Monthly TR}_{\text{RBI}} - (1 - \text{moL} + 15)/12 + 1 - \text{moL}/12 \\ &= [\text{Monthly TR}_{\text{RHFI}} - (1 - \text{moL} + 65)/12] + \text{Monthly TR}_{\text{RBI}} \\ &= [\text{active return of RHFI}] + \text{RBI return} \end{aligned} \quad (2)$$

and

$$\begin{aligned} \text{Syn FI Active Monthly TR}_{\text{RHFI}} &= \text{Syn FI Monthly TR}_{\text{RHFI}} - \text{Agg Monthly TR} \\ &= \text{Monthly TR}_{\text{RHFI}} - (1 - \text{moL} + 50)/12 \\ &\quad + \text{Monthly TR}_{\text{RBI}} - (1 - \text{moL} + 15)/12 + 1 - \text{moL}/12 - \text{Agg Monthly TR} \\ &= \text{Monthly TR}_{\text{RHFI}} - (1 - \text{moL} + 65)/12 + \text{Monthly TR}_{\text{RBI}} - \text{Agg Monthly TR} \\ &= [\text{Monthly TR}_{\text{RHFI}} - \text{Monthly TR}_{\text{hedgefund style}}] \\ &\quad + [\text{Monthly TR}_{\text{hedge fund style}} - (1 - \text{moL} + 65)/12] \\ &\quad + [\text{Monthly TR}_{\text{RBI}} - \text{Agg Monthly TR}] \\ &= [\text{RHFI TE}] + [\text{active hedge fund style return}] + [\text{RBI TE}] \end{aligned} \quad (3)$$

As shown by equation (2), a synthetic FI portfolio's total return, and its volatility, is affected not only by the active RHFI return, but also by the magnitude of the RBI returns and the correlation of the RHFI returns with the RBI. Equation (3) shows that the active risk of the synthetic FI portfolio is determined by the risk of the underlying hedge fund style, the TEVs of the RHFI and RBI, and their interaction. Figure 13 already has shown that there is both negative correlation between RHFI TEs and the hedge fund returns and little evidence of negative tail dependencies.

What is the relationship between RBI tracking errors and RHFI tracking errors? Is there a tendency for below average RBI tracking errors to occur when RHFI tracking errors are also below average? If so, then this would exacerbate the negative tail behavior of synthetic FI portfolios.¹⁴ Figure 15 plots monthly RBI-2 TE versus the RHFI tracking errors for the "average" Macro and MktNeut funds and shows little negative tail dependency. In other words, relatively large negative RBI-2 tracking errors do not occur simultaneously with large

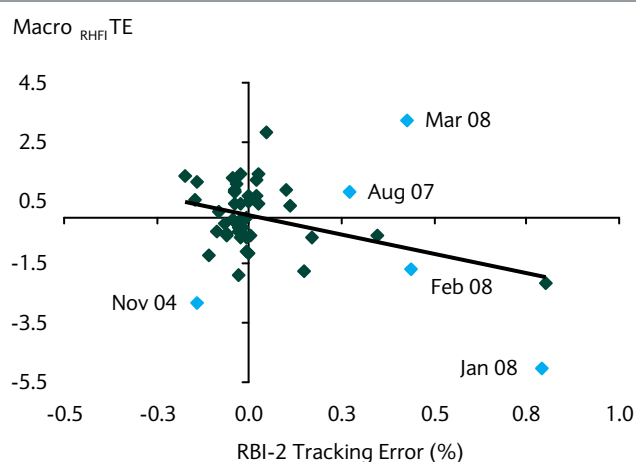
¹⁴ As discussed in Part 1 (Figure 7) there is some positive correlation between the RBI tracking errors and the Aggregate Index return.

negative RHF tracking errors suggesting that synthetic FI portfolio will not have any greater negative tail behavior than the underlying RHF returns themselves.

Figure 16 compares the relative performance of synthetic FI portfolios for each style as the alpha source, using either RHF or the “average” hedge fund that RHF attempts to replicate. Compared with the “average” fund, the RHF synthetic FI portfolio monthly active returns (TE relative to the Aggregate) are lower for all five fund styles with a comparable standard deviation (TEV). Consequently, information ratios for RHF synthetic FI are lower than those for synthetic FI using the “average” manager (e.g., 0.86 vs. 2.11 for MktNeut-2).

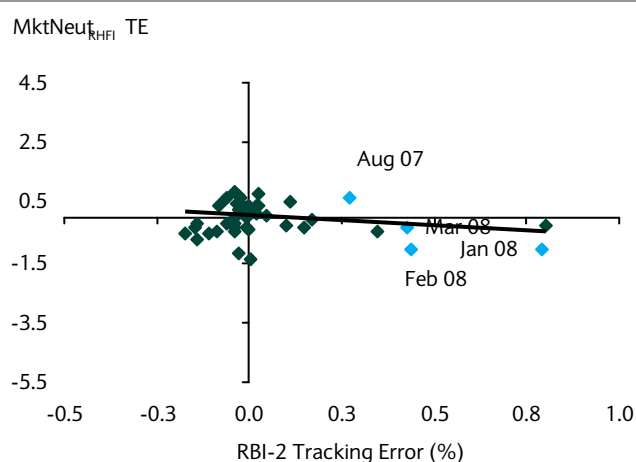
Figure 15.: Monthly RBI-2 Tracking Errors versus RHF Tracking Errors. Macro and MktNeut.
April 2004 – March 2008, % per month

15a: RBI-2 TE vs. Macro_{RHF} TE



Source: Barclays Capital

5b: RBI-2 TE vs. MktNeut_{RHF} TE



Source: Barclays Capital

In terms of tail behavior, the minimum total returns using RHF are larger in magnitude for four out of five styles (Macro is the exception) while the maximum total returns using RHF are smaller in magnitude for four out of five styles (MultiStyle is the exception here). However, in terms of extreme active returns, the picture is slightly different owing to the negative correlation between RHF TE and hedge fund returns. In general, however, RHF synthetic FI active return monthly minimums and maximums are both lower than those for synthetic FI using the “average” fund manager.

To summarize, hedge fund returns exhibit some negative tail behavior and the process of using RBI and RHF to construct synthetic FI portfolios moderately exacerbates this negative tail behavior.

Figure 16: Synthetic FI Portfolio Performance using RHF1 and Different RBI, April 2004 – March 2008, % per Month
Total Returns, Active Returns and IRs, by Style: Comparison with Synthetic FI Portfolio using the “Average” Fund.

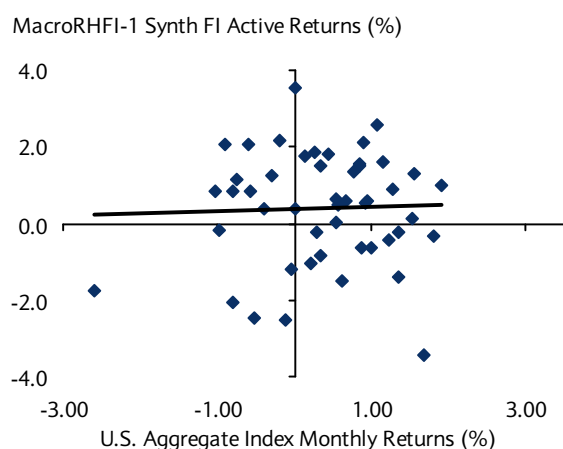
Synthetic FI Using RHF1										Synthetic FI using the “Average” Fund/Indices												
Total Returns										Active Returns												
Style	Avg	Stdev	Skew	Kurtosis	Min	Max	AutoCor		Avg (TE)	Stdev (TEV)	IR			Total Returns			Active Returns					
							Lag 1	Lag 2			Avg (annual)	Max	Min	Max	Avg (TE)	Stdev (TEV)	Min	Max				
Macro (Apr 04-Mar 08)																						
Macro _{RHF1} -1	0.73	1.75	-0.82	0.65	-4.36	3.64	0.01		0.37	1.47	-3.44	3.55	0.88	0.88	1.77	-5.41	3.76	0.52	1.46	-2.80	3.81	1.24
Macro _{RHF1} -2	0.74	1.75	-0.78	0.63	-4.34	3.60	-0.01		0.38	1.46	-3.07	3.52	0.91	0.89	1.84	-5.39	4.43	0.53	1.53	-2.79	4.29	1.21
Macro _{RHF1} -4	0.75	1.77	-0.67	0.39	-4.26	3.51	-0.04		0.39	1.49	-3.34	3.38	0.92	0.90	1.88	-5.31	5.38	0.54	1.59	-2.70	5.24	1.19
MktNeut (Apr 04-Mar 08)																						
MktNeut _{RHF1} -1	0.47	1.16	-1.40	3.33	-3.96	2.26	0.11		0.12	0.55	-1.64	1.01	0.74	0.64	0.99	-3.08	2.34	0.29	0.45	-0.74	1.27	2.19
MktNeut _{RHF1} -2	0.49	1.15	-1.45	3.47	-3.95	2.22	0.11		0.13	0.51	-1.62	0.99	0.86	0.65	1.01	-3.07	2.71	0.30	0.49	-0.72	1.83	2.11
MktNeut _{RHF1} -4	1.00	1.15	-1.32	3.14	-3.86	2.27	0.08		0.14	0.53	-1.56	1.61	0.91	0.67	1.04	-2.98	2.91	0.31	0.56	-0.60	2.77	1.92
MultiStyle (Apr 04-Mar 08)																						
MultiStyle _{RHF1} -1	0.49	1.37	-1.26	2.50	-3.93	2.92	0.11		0.14	1.10	-5.13	1.92	0.43	0.60	1.23	-3.03	2.36	0.25	1.03	-2.76	2.31	0.82
MultiStyle _{RHF1} -2	0.51	1.33	-1.26	2.49	-3.92	2.88	0.08		0.15	1.04	-4.76	1.82	0.49	0.61	1.24	-3.02	2.51	0.26	1.04	-3.03	2.29	0.86
MultiStyle _{RHF1} -4	0.52	1.34	-1.23	2.42	-3.83	2.92	-0.01		0.16	1.07	-5.02	1.78	0.52	0.63	1.24	-2.93	3.06	0.27	1.04	-2.81	2.92	0.89
FoF (Apr 04-Dec 2007)																						
FoF _{RHF1} -1	0.53	1.32	-0.98	1.65	-3.94	2.54	0.11		0.17	0.89	-2.76	1.73	0.68	0.62	1.28	-3.36	2.96	0.26	1.02	-1.91	2.26	0.89
FoF _{RHF1} -2	0.54	1.31	-1.01	1.75	-3.93	2.54	0.09		0.19	0.85	-2.39	1.71	0.75	0.62	1.28	-3.36	2.96	0.26	1.02	-2.18	2.17	0.89
FoF _{RHF1} -4	0.56	1.32	-0.88	1.32	-3.84	2.70	0.03		0.20	0.89	-2.65	2.36	0.77	0.63	1.30	-3.27	3.45	0.27	1.06	-1.99	2.82	0.89
RelVal (Apr 04-Mar 08)																						
RelVal _{RHF1} -1	0.36	1.11	-1.09	2.61	-3.67	2.44	0.08		0.00	0.47	-1.07	0.90	0.03	0.42	1.15	-2.74	2.92	0.06	0.72	-3.08	1.46	0.28
RelVal _{RHF1} -2	0.37	1.10	-1.15	2.69	-3.66	2.40	0.09		0.02	0.42	-1.06	0.77	0.13	0.43	1.18	-3.05	3.29	0.07	0.74	-3.39	1.61	0.32
RelVal _{RHF1} -4	0.39	1.12	-0.94	2.24	-3.57	2.44	0.07		0.03	0.49	-0.97	1.57	0.19	0.44	1.18	-3.47	3.02	0.08	0.76	-3.81	1.34	0.37
HFRI Composite (Apr 04-Mar 08)																						
HFRI Composite _{RHF1} -1	0.60	1.46	-0.94	1.79	-4.42	3.07	0.13		0.24	1.12	-2.45	2.76	0.75	0.56	1.27	-4.24	2.43	0.20	1.02	-1.64	2.43	0.68
HFRI Composite _{RHF1} -2	0.61	1.43	-1.01	2.07	-4.41	3.03	0.12		0.25	1.07	-2.10	2.74	0.82	0.57	1.27	-4.23	2.43	0.21	1.02	-1.63	2.41	0.72
HFRI Composite _{RHF1} -4	0.62	1.43	-1.03	1.76	-4.32	2.93	0.13		0.26	1.08	-2.34	2.47	0.85	0.58	1.28	-4.14	2.59	0.22	1.03	-1.84	2.34	0.75
HFRX Investable-Global (Apr 04-Mar 08)																						
HFRX Invest _{RHF1} -1	0.26	1.22	-1.07	1.76	-3.94	1.99	0.11		-0.10	0.76	-1.60	1.34	-0.44	0.22	1.33	-4.15	2.72	-0.14	1.02	-2.57	1.89	-0.47
HFRX Invest _{RHF1} -2	0.27	1.21	-1.14	1.91	-3.93	1.89	0.11		-0.09	0.72	-1.57	1.32	-0.42	0.23	1.38	-4.13	3.03	-0.13	1.07	-2.85	2.56	-0.41
HFRX Invest _{RHF1} -4	0.28	1.21	-1.03	1.59	-3.84	1.95	0.12		-0.07	0.74	-1.62	1.59	-0.35	0.24	1.42	-4.05	3.64	-0.12	1.13	-2.63	3.51	-0.35
Core														0.33	0.86	-2.44	1.86	-0.03	0.14	-0.73	0.17	-0.65
Core+														0.35	0.86	-2.41	1.90	-0.01	0.21	-0.81	0.33	-0.13
U.S. Aggregate														0.36	0.91	-2.60	1.91					

Synthetic FI Returns using the “average” hedge fund manager (the adjusted return series the RHF1 is attempting to replicate) are from Figure 11 in Part 1

As we did with “average” manager hedge fund returns in Part 1 (Figure 12), we look to see if there is any tail dependency between RHF synthetic FI portfolio active returns and Aggregate Index returns. In other words, when the Aggregate performs poorly, is there a tendency for the RHF synthetic FI portfolio to underperform. To identify tail dependency, Figure 17 plots the monthly Synthetic FI active returns for both $\text{Macro}_{\text{RHF}}$ and $\text{MktNeut}_{\text{RHF}}$ active returns against Aggregate returns.¹ The results show some tail dependency between adjusted active returns of all styles and Aggregate Index returns. In other words, large negative RHF synthetic FI portfolio active returns have not occurred reflecting the mostly small degree of tail dependency between hedge fund returns and the Aggregate Index. simultaneously with large negative Aggregate returns. If they did, then the synthetic FI portfolio returns would have a tendency to display more negative tail behavior.

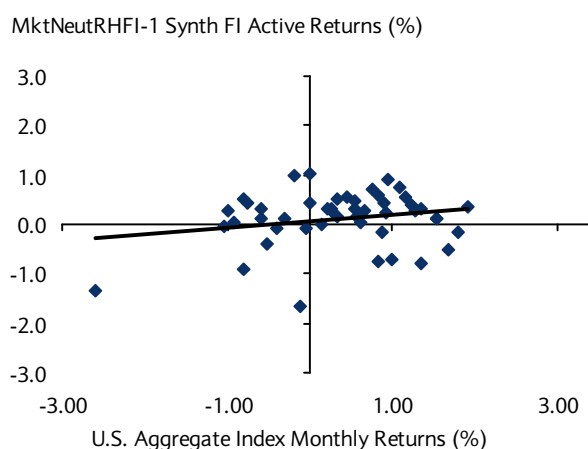
Figure 17: Signs of Tail Dependency? Monthly Synthetic FI Active Returns of $\text{Macro}_{\text{RHF}}$ and $\text{MktNeut}_{\text{RHF}}$ (using RBI-1 and RBI-2) versus Monthly Aggregate Index Returns, April 2004 – March 2008, % per month

17a: MacroRHF -1 vs. Aggregate Index



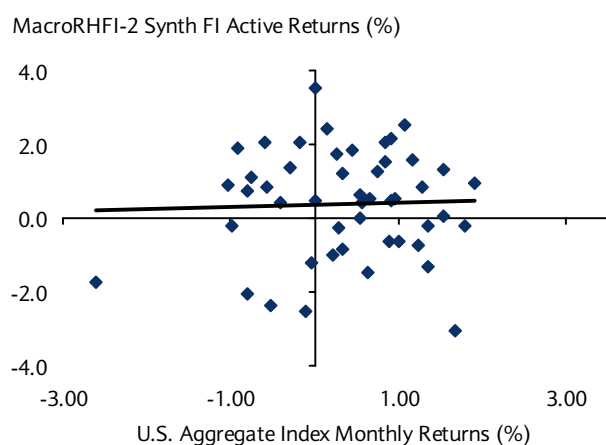
Source: Barclays Capital

17b: MktNeutRHF -1 vs. Aggregate Index



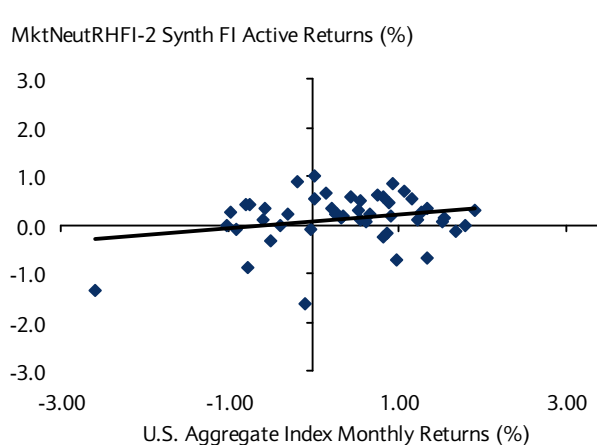
Source: Barclays Capital

17c: MacroRHF -2 vs. Aggregate Index



Source: Barclays Capital

17d: MktNeutRHF -2 vs. Aggregate Index



Source: Barclays Capital

¹ Other graphs are available from the authors.

Comparing Synthetic FI Returns Using RHFI with Diversified Hedge Fund Portfolios

Part 1 showed that synthetic FI using the “average” hedge fund offers better risk-adjusted returns than traditional Core and Core+ managers. Although we choose the “average” hedge fund as the benchmark we recognize that such a fund is not directly obtainable. Instead, synthetic FI managers must bear the manager selection risk of choosing a specific fund(s) for their synthetic FI strategy. As we demonstrated earlier in this paper, manager selection risk weakens the case for synthetic FI.

While diversification of managers reduces manager selection risk, it requires many managers. An alternative is to use hedge fund replication of the “average” manager. Does synthetic FI using RHFI offer a compelling option for synthetic FI? Moreover, how does synthetic FI using RHFI compare with diversified portfolios of funds that also seek to mitigate manager selection risk?

Figure 18 presents a comparison of the TE, TEV, and information ratio (IR) of synthetic FI (using RBI-2 as the beta source) for each style using a single hedge fund chosen at random (i.e., bearing full manager selection risk), single diversified five-fund portfolios using both naïve and active manager selection, synthetic HF replication using RHFI and the “average” hedge fund (our benchmark).

We think it is apparent that synthetic FI using RHFI is superior to using a single manager with its concomitant manager selection risk. While the TEs for synthetic RHFI are all lower than those for the single fund synthetic FI, the TEVs are much lower, producing superior IRs. In addition, we showed earlier that RHFI introduced little additional negative tail behavior into the synthetic FI strategy.

How did RHFI perform versus our (unobtainable) “average” synthetic FI portfolio? While TEV_{RHFI} is close (sometimes lower) to that of the “average” fund, the monthly TE is lower for each of the five styles. On a risk-adjusted basis, the information ratio of synthetic FI using RHFI is lower than the “average” fund IR for all styles. However, what is of practical importance is that while the TE_{RHFI} and IRs are lower than that of the “average” fund, they are still substantially greater than single manager Core and Core+ TEs and IRs, making a cashless RHFI (especially with their higher active returns) a viable FI portfolio solution.

But how does RHFI synthetic FI compare with synthetic FI using a diversified portfolio of funds? The results are mixed. RHFI synthetic FI portfolios all have lower returns than comparable five-fund portfolios of the same style (using naïve selection). However, since some RHFI portfolios also had somewhat lower TEV, some RHFI styles had similar IRs while others had lower IRs versus their comparable five-fund portfolios of the same style (using naïve selection). However, generally speaking, RHFI synthetic FI portfolios were in the performance vicinity of diversified five-fund portfolios which, given the expense and illiquidity of investing in several hedge funds, makes RHFI synthetic FI portfolios a compelling idea.

The synthetic investor can do better than RHFI if he has some fund manager selection skill as the TEs and $TEV_{overall}$ for all styles, except FoF, are superior to RHFI. Perhaps not surprisingly, having skill in FoF manager selection does not add much of a punch versus RHFI presumably because they are diversified portfolios of better than average funds.

Although the information ratios of RHFI-based synthetic FI portfolios are lower than the “average” fund, one thing that is clear is that the monthly TE and TEV track closely with the

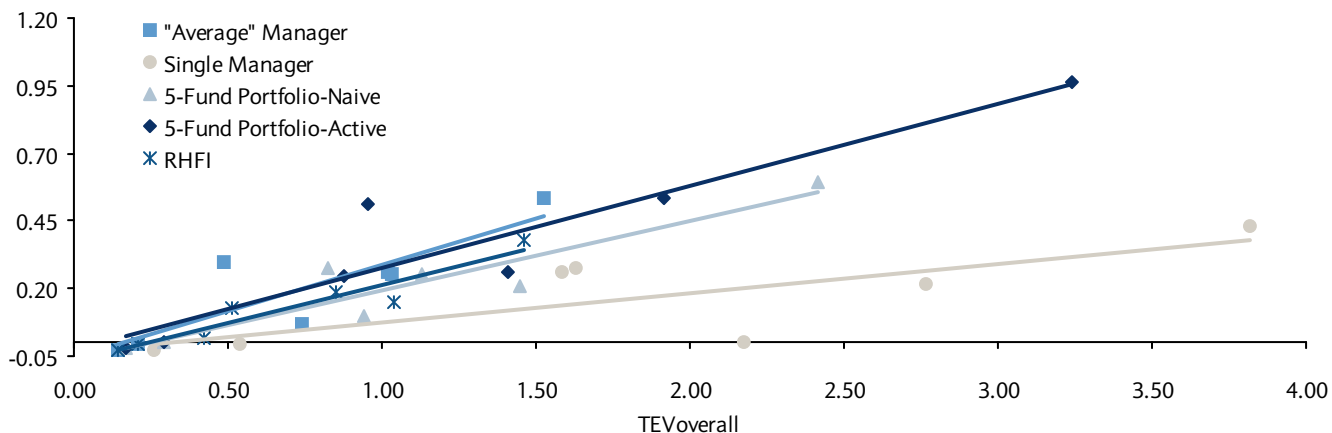
“average” fund. If used as a passive replication of a particular HF style in a synthetic FI portfolio, the active returns of an RHFI are an efficient way to achieve the desired level of return and risk of the “average” fund. These results are more easily interpreted in Figure 19 below. The fitted performance line for the RHFI synthetic FI styles lies close to the line for the “average” synthetic FI portfolio and just below the line for the 5-fund portfolio using naïve selection.

Figure 18. Synthetic FI Performance Using RBI-2: TE, TEV_{Overall} and IR: Single Fund, Five-fund Portfolio (Using Naïve and Random Manager Selection), RHFI, and Avg Fund. April 2004 – March 2008, % per month

Style	Across All Single Fund Synthetic FI Portfolios			Across All Synthetic FI Portfolios using Five-Funds and Naïve Manager Selection			Across All Synthetic FI Portfolios Using Five-Funds and Active Manager Selection			RHFI			The “Avg” Manager/Index		
	Avg TE _i	TEV _{Overall}	IR (annual)	Avg TE _i	TEV _{Overall} 5-Fund Port	IR (annual)	Avg TE _i	TEV _{Overall} 5-Fund Port	IR (annual)	Avg TE _{RHFI}	TEV _{RHFI}	IR (annual)	TE	TEV	IR (annual)
Macro-2	0.49	4.04	0.42	0.59	2.42	0.85	0.96	3.24	1.03	0.38	1.46	0.91	0.53	1.53	1.21
MktNeut-2	0.25	1.61	0.53	0.28	0.83	1.16	0.52	0.96	1.87	0.13	0.51	0.86	0.30	0.49	2.11
MultiStyle-2	0.16	2.71	0.21	0.21	1.45	0.49	0.54	1.92	0.97	0.15	1.04	0.49	0.26	1.04	0.86
FoF-2	0.25	1.56	0.55	0.25	1.13	0.77	0.26	1.41	0.63	0.19	0.85	0.75	0.26	1.02	0.89
RelVal-2	0.07	1.86	0.12	0.10	0.94	0.37	0.25	0.88	0.98	0.02	0.42	0.13	0.07	0.74	0.32
Core	-0.02	0.27	-0.23	-0.02	0.17	-0.34							-0.03	0.14	-0.64
Core+	0.00	0.54	0.00	0.00	0.29	0.01							-0.01	0.21	-0.12

Figure 19. Comparing Opportunities Offered by Various FI Strategies, April 2004 – March 2008, % per month

Average Monthly Active Return (April 2004-March 2008)



Source: Barclays Capital

Using RHFI to Achieve Style Diversification

Earlier we saw that there was a modest performance benefit to diversifying across fund styles beyond the benefit of simply adding more managers. However, to achieve the benefits of style diversification requires investing in a number of funds. How well might RHFI perform as a strategy to achieve style diversification by tracking the return of a broad diversified index or the “average” fund of funds that can’t be “owned” directly?

To investigate, we constructed RHFI synthetic FI portfolio where the alpha source was an RHFI swap on either adjusted returns of the “average” FoF or adjusted HFRI Composite Index returns.² Results are presented in Figure 20. We then compared these results with a strategy of investing in a large number of specific funds (across managers and styles) to reduce manager selection risk. Specifically, we compare the performance of RHFI synthetic FI versus the returns of multi-fund portfolios that can invest in at least three or four styles with two funds per style.

The monthly TE and TEV of the $FoF_{RHFI}-2$ and $HFRI_{RHFI}-2$ synthetic FI portfolios track their corresponding synthetic FI portfolios using the “average” fund/index. RHFI can be an effective way to receive exposure to a specific hedge fund style, as well as an efficient way to receive exposure to diversified HF Index and FoF returns without the manager selection risk or cost of selecting specific funds. Rather than randomly selecting funds across multiple styles (assuming they are investable), using an RHFI on the HFRI Composite Index for synthetic FI can produce comparable returns and return volatility. In addition, the $FoF_{RHFI}-2$ and $HFRI_{RHFI}-2$ synthetic FI portfolios performed well compared the naïve multi-fund portfolios that can invest across three or four styles with two funds per style.

The $FoF_{RHFI}-2$ and $HFRI_{RHFI}-2$ synthetic FI portfolios perform very close to their corresponding synthetic FI portfolios using their underlying “average” fund/index. However, how well do they compare with Core and Core+, and to the Aggregate especially with respect to their tail behavior? Both $FoF_{RHFI}-2$ and $HFRI_{RHFI}-2$ have greater total return volatility, active returns, TEVs and IRs than the average Core and Core+ manager. As expected, both $FoF_{RHFI}-2$ and $HFRI_{RHFI}-2$ have more negative skew and greater kurtosis than Core/Core+ and the Aggregate. The minimum and maximum monthly total and active returns are considerable, in absolute value, than for Core/Core+ indicating more tail risk for the synthetic FI strategies.

As shown in Figure 20, RHFI swaps are an effective way to reduce manager selection risk in synthetic FI portfolio strategies. RHFI synthetic FI portfolios perform closely to their corresponding synthetic FI portfolio using the “average” fund performance or index performance. In addition, RHFI synthetic FI portfolios do not introduce any meaningful tail dependencies beyond those contained in the synthetic “average” fund performance. Furthermore, RHFI synthetic FI portfolios perform less well versus synthetic FI portfolios containing a diversified set of hedge funds. However, for investors who do not have the time, energy, or money to select hedge funds, a RHFI synthetic FI portfolio is a viable competitor to Core and Core+

² We present results also for adjusted HFRX Investable-Global index returns. However, HFRX consistently underperforms HFRI so we assume it would not be a viable candidate for synthetic FI portfolios.

Figure 20. Summary of the Results: Comparing Various Synthetic FI Portfolios with Core/Core+ and the U.S. Aggregate Index, April 2004 – March 2008, % per month

Monthly Active Adj Fund Returns (a)					Monthly Synthetic/Traditional FI Total Returns					Monthly Synthetic/Traditional FI Active Returns						
	Avg	Stdev	Corr w/ RBI	Corr w/ RBI TE	Avg	Stdev	Skew	Kurt	Min	Max	Auto Corr Lag1	Avg TE	Stdev (TEV)	Min	Max	IR (annual)
Macro-2																
"Avg" Manager RHFI	0.49	1.38	0.03	0.04	0.89	1.84	-0.74	1.91	-5.39	4.43	0.23	0.53	1.53	-2.79	4.29	1.21
Single Manager (b)	0.34	1.51	-0.08	-0.30	0.74	1.75	-0.78	0.63	-4.34	3.60	-0.01	0.38	1.46	-3.07	3.52	0.91
5-Fund Port: Naïve (c)	0.51				0.92							0.49	4.04			0.42
5-Fund Port: Active (d)	0.56				0.96							0.59	2.42			0.85
5-Fund Port: Active (d)	0.93				1.33							0.96	3.24			1.03
MktNeut-2																
"Avg" Manager RHFI	0.25	0.46	-0.23	-0.19	0.65	1.01	-1.01	2.81	-3.07	2.71	0.13	0.30	0.49	-0.72	1.83	2.11
Single Manager	0.08	0.56	-0.01	-0.40	0.49	1.15	-1.45	3.47	-3.95	2.22	0.11	0.13	0.51	-1.62	0.99	0.86
5-Fund Port: Naïve	0.21				0.62							0.25	1.61			0.53
5-Fund Port: Active	0.23				0.64							0.28	0.83			1.16
5-Fund Port: Active	0.47				0.87							0.52	0.96			1.87
MultiStyle-2																
"Avg" Manager RHFI	0.21	1.08	-0.31	-0.40	0.61	1.24	-0.78	0.40	-3.02	2.51	0.23	0.26	1.04	-3.03	2.29	0.86
Single Manager	0.10	1.15	-0.25	-0.60	0.51	1.33	-1.26	2.49	-3.92	2.88	0.07	0.15	1.04	-4.76	1.82	0.49
5-Fund Port: Naïve	0.15				0.55							0.16	2.71			0.21
5-Fund Port: Naïve	0.17				0.57							0.21	1.45			0.49
5-Fund Port: Active	0.49				0.90							0.54	1.92			0.97
RelVal-2																
"Avg" Manager RHFI	0.02	0.57	-0.17	-0.40	0.43	1.18	-0.46	1.08	-3.05	3.29	0.15	0.07	0.74	-3.39	1.61	0.32
Single Manager	-0.03	0.46	-0.02	-0.39	0.37	1.10	-1.15	2.69	-3.66	2.40	0.08	0.02	0.42	-1.06	0.77	0.13
5-Fund Port: Naïve	0.04				0.44							0.07	1.86			0.12
5-Fund Port: Naïve	0.06				0.46							0.10	0.94			0.37
5-Fund Port: Active	0.21				0.61							0.25	0.88			0.98
FoF-2																
"Avg" Manager RHFI	0.21	1.00	-0.25	-0.34	0.62	1.28	-0.76	1.10	-3.36	2.96	0.15	0.26	1.02	-2.18	2.17	0.89
Single Manager	0.14	0.93	-0.09	-0.47	0.54	1.31	-1.01	1.75	-3.93	2.54	0.09	0.19	0.85	-2.39	1.71	0.75
5-Fund Port: Naïve	0.21				0.61							0.25	1.56			0.55
5-Fund Port: Naïve	0.21				0.61							0.25	1.13			0.77
5-Fund Port: Active	0.21				0.62							0.26	1.41			0.63
HFRI Composite-2																
Index	0.16	1.10	-0.27	-0.47	0.57	1.27	-1.34	3.27	-4.23	2.43	0.14	0.21	1.02	-1.63	2.41	0.72
RHFI	0.21	1.15	-0.13	-0.46	0.61	1.43	-1.01	2.07	-4.41	3.03	0.12	0.25	1.07	-2.10	2.74	0.82
Portfolio of Funds Across Style (Using RBI-2)																
3 Styles, 2 Funds per style: Naïve	0.26				0.66							0.30	1.38			0.76
4 Styles, 2 Funds per style: Naïve	0.26				0.67							0.31	1.25			0.85
3 Styles, 2 Funds per style: Active	0.54				0.94							0.58	1.76			1.13
4 Styles, 2 Funds per style: Active	0.55				0.95							0.59	1.63			1.26
Core																
"Avg" Manager Single Manager	0.33	0.86	-0.64	0.71	-2.44	1.86	0.10					-0.03	0.14	-0.73	0.17	-0.65
5-Fund Port	0.34				0.34							-0.02	0.15			-0.43
5-Fund Port	0.34				0.34							-0.02	0.14			-0.41
Core+																
"Avg" Manager Single Manager	0.35	0.86	-0.65	0.65	-2.41	1.90	0.13					-0.01	0.21	-0.81	0.33	-0.13
5-Fund Port	0.36				0.36							0.00	0.20			0.03
5-Fund Port	0.36				0.36							0.00	0.20			0.02
Barclays Capital U.S. Agg																
	0.33	0.92	-0.71	0.87	-2.60	1.91	0.11									

(a) Active Adjusted Return = Adjusted Monthly Return - (1-mo LIBOR + 15) / 12 = Active return of the alpha source

(b) Single manager average returns represent the average returns across all one fund portfolios (with substitution). TEV of active returns for the single manager portfolio measures TEVoverall and the idiosyncratic risk of selecting a single manager.

(c) 5-fund portfolio returns and risk are also presented as the average across all 5-fund portfolios of that particular style and portfolio size combination, thereby measuring the manager selection risk as well.

Source: Barclays Capital calculations, HedgeFund.net

Summing Up: Synthetic FI Portfolios

Using data from April 2004 to March 2008, a period that experienced a wide range of financial market conditions, we constructed realistic synthetic FI portfolios using alpha-beta recombination. We considered a variety of alpha sources: single style hedge funds, blended-style funds, hedge fund indices and replicating hedge fund returns using RHFSM swaps. We also considered a variety of beta alternatives using RBISM swaps. We then compared our results with traditional FI portfolios: Core and Core+.

We have found the following:

- RBI beta replication has worked reasonably well, despite the low and high market volatilities over the period. Although monthly tracking errors can be large, RBI total return and volatility closely match the Barclays Capital U.S. Aggregate Index.
- Over the period, we find that the particular RBI methodology has relatively little effect on the performance of synthetic FI portfolios. In relative terms, RBI tracking errors are small and contribute only modestly to the tail behavior of synthetic FI strategies.
- Using “average” hedge fund manager returns as the alpha source, we find that synthetic FI portfolios have produced higher total returns and either comparable or moderately higher standard deviations and extreme returns compared to the Aggregate Index. (Synthetic FI using Macro style hedge funds is an exception.) Synthetic FI behaves very much like fixed income.
- Synthetic FI portfolios have produced higher active returns, with the same or moderately more active risk, compared with traditional Core and Core+. For example, MktNeut-2 synthetic FI outperforms the “average” Core+ manager by 31 bp/month with a higher TEV of 49 bp/month vs. 21 bp/month for Core+.
- In the context of a plan sponsor’s overall portfolio, however, the additional risk of synthetic FI versus traditional FI appears to be negligible while the additional return will likely be meaningful over time.
- Synthetic FI portfolios do have more tail risk than traditional Core and Core+. The source of this tail risk is mainly in the nature of the hedge fund returns, and less due to the RBI beta or any severe interactions between the alpha and the RBI.
- The above results assume the investor can invest in the “average” alpha source. This is not realistic. The reality is that synthetic FI portfolio investors face significant alpha manager selection risk. We measure this risk and find that the case for synthetic FI is significantly weakened when manager selection risk is incorporated into the overall TEV for synthetic FI portfolios.
- We then consider various ways to manage this alpha selection risk via diversification with naïve manager selection, diversification with active manager selection and replication using RHFSM swaps.
- We find that with naïve diversification it takes more than eight funds of a given style (excluding FoF) to approach that style’s “average” fund performance. But even FoF, which already have some manager diversification, requires approximately five funds to approach the “average” FoF synthetic FI performance.

- Another way to deal with manager selection risk but with potentially fewer funds is to improve performance (IR) via diversification with active manager selection. Surprisingly, we found that a simple manager selection rule, with no look-back bias, can significantly improve synthetic FI performance—but it still requires approximately five funds of a given style to approach average performance. Although we do not necessarily recommend this selection rule, we find it suggestive that a skilful fund selector can add to synthetic FI performance. Certainly this is an area of future research.
- A synthetic FI investor may also choose to be style agnostic, especially if systematic risk exposures are hedged in the construction of synthetic FI portfolios. This opens the possibility of diversifying across styles in addition to diversifying across managers. We find that diversifying across style instead of within a style produces a slightly lower TEV and slightly higher IR for portfolios of the same size. This style diversification advantage is small when the styles are chosen at random. Moreover, investing across styles would require a portfolio of at least 4 funds to reach or exceed the information ratio of a single FoF. The case for style diversification becomes more compelling, however, when compared with specific “mono-style” portfolios.
- We then discuss a third way to handle manager selection risk: hedge fund replication using RHFI swaps. The idea is to replicate “average” hedge fund performance and skirt the problem of manager selection risk. The liquidity and transparency of RHFI vs. an actual hedge fund investment is a nice added bonus.
- However, the concern is that the alpha fund replication process adds more active risk volatility to the synthetic FI portfolio than it removes via elimination of manager selection risk. We find, however, that active risk from RHFI replication is considerably less than the manager selection risk that it replaces.
- RHFI synthetic FI portfolios (with an RHFI on a single fund style index or a broad hedge fund index) outperform Core and Core+ (between 3 bp/month to 39 bp/month versus Core+) depending on the underlying fund style. We see $MktNeut_{RHFI}-2$ (TE = 13 bp/month, TEV = 51 bp/month) as a compelling synthetic FI portfolio, as is $HFR1_{RHFI}-2$ (25 bp/month, 107 bp/month). They both outperform both the single Core+ manager (-1 bp/month, 54 bp/month) and the average Core+ manager (-1 bp/month, 21 bp/month).
- We also examine the tail behavior of RHFI synthetic FI portfolios and find little increase in tail risk beyond the tail risk inherent in the alpha source. The replication processes (for both the alpha and the beta) do not exacerbate tail behavior of the RHFI synthetic FI strategy.

Overall, synthetic FI portfolios have been a good strategy for investors trying to increase the performance of their fixed-income allocations, provided they pick an alpha source that outperforms or at least matches the “average” adjusted hedge fund returns. However, distribution of hedge fund returns within a given style exposes an investor to manager selection risk, which can be substantial if picking a single fund. An investor could pick multiple funds to lessen this risk, but successful implementation would require careful manager selection, due diligence, and monitoring of specific funds. We show that a viable alternative to synthetic FI with actual funds is a cashless strategy that uses RHFI swaps as the alpha source. RHFI swaps track closely with the “average” manager and offer superior risk adjusted returns to Core and Core+ managers.

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