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ALTERNATIVE ROUTES TO HEDGE FUND RETURN REPLICATION: A NOTE

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1. Introduction

Although hedge funds still attract a lot of money, hedge fund performance is clearly deteriorating, with every next year looking worse than the year before. In part, this reflects lower interest rates and a global decline in risk premiums. Part of hedge funds' disappointing performance, however, is also due to the huge flows of money into the sector. Although some strategies are more sensitive to over-investment than others, the commoditization and institutionalisation of hedge funds is not doing investors any good. Of course, things would be different if hedge fund and fund of funds managers didn't take the kind of excessive fees that they do. With interest rates and risk premiums at historically low levels, taking '2 plus 20' amounts to splitting the pre-fee fund return 30/70 between manager and investor. When a fund of funds introduces a second layer of fees, this deteriorates to 40/60.

Driven by a desire to reduce costs and improve investor returns, as well as to avoid the many other drawbacks of hedge fund investing, several attempts to replicate hedge fund returns have been undertaken recently. The latter have received substantial media attention, but without highlighting the differences and similarities between the different approaches. This short note aims to correct this.

2. The Factor Model Approach

One way to replicate hedge fund returns is by the use of so-called factor models. The goal of the factor model approach is to generate the same returns as a given fund on a month-to-month basis. One might refer to this as 'strict replication'. With this approach the return on a particular fund is attributed to a number of risk factors, such as the return on some large cap or small cap stock index, the return on some government bond index, the return on some commodity index, changes in credit spreads, changes in market volatility, etc. Once the relevant risk factors have been identified and the fund's sensitivity to these factors has been estimated, we can construct a portfolio of stocks, bonds, and other securities, with the same set of factor sensitivities as the fund. Since it has the same factor sensitivities, the resulting portfolio will generate returns that are similar to those of the fund.

Although this all sounds straightforward enough, which explains part of its popularity, in practice the factor model approach encounters a number of problems, the most essential being the fact that in practice we often have little or no idea how a hedge fund's returns are actually generated. As a result, it is not at all clear which risk factors to use.

One risk factor that is often left out is liquidity. However, many hedge funds essentially act as market makers, buying illiquid assets while hedging the resulting position with more liquid assets. Equity market neutral funds for example tend to go long small cap stocks, while shorting large caps. Likewise, fixed income arbitrage funds purchase old T-bonds, while shorting the on-the-run T-bond (historically, the liquidity premium on the on-the-run bond has been around 3bps). Leaving liquidity out as a risk factor, which is well compensated, means the replicating portfolio will be short on expected return as well as downside risk.

Another problem concerns the fact that stripped down to the basics the typical factor model is nothing more than a linear multiple regression. The implicit assumption therefore is that the relationship between the fund return and the risk factors is linear (and normal), which of course need not be true. Highly dynamic trading strategies and the use of derivatives are likely to introduce all sorts of non-linear, non-normal behaviour.

A third problem with factor models is that the effort and costs associated with putting the factor replicating portfolio together and maintain its sensitivities over time can be quite high. Volatility, for example, can be a difficult factor to capture. Liquidity in volatility futures and swaps is low and these instruments are priced off implied volatility, which is typically a few percentage points higher than spot volatility. Likewise, some authors have attempted to incorporate some form of non-linearity by introducing options in the replicating portfolio. Although intuitively plausible, in practice this also makes the execution of these strategies more difficult and more expensive.

Factor model-based replication of hedge fund returns has been discussed at several places in the literature.[1] Most studies, however, are limited to the replication of hedge fund indices, are largely in-sample and don't take real-life hurdles like transaction costs into account. This makes it difficult to say in how far the above problems will prevent the proper replication of individual hedge fund returns. We can, however, look at how much of the variability in hedge fund returns is explained by these models. Hasanhodzic and Lo (2006) construct a six-factor model[2] and use it to replicate the returns on 1,610 individual hedge funds, covering all major strategy classes. They find that the factor model used is unable to explain the bulk of the variation in individual hedge funds' returns. Table 1 summarizes their results. It shows that on average their six-factor model only explains 15-20% of the variation in individual hedge fund returns. Obviously, a model that leaves 80-85% of a fund's return variability unexplained is unlikely to provide a very fruitful starting point when looking to replicate hedge fund returns accurately.

Strategy Group	Average Variation Explained
Convertible Arbitrage	17.3%
Emerging Markets	19.4%
Equity Market Neutral	10.4%
Event Driven	19.5%
Fixed Income Arbitrage	14.9%
Global Macro	14.8%
Long/Short Equity	21.6%

Table 1: Average percentage of individual hedge fund return variation explained. Source: Hasanhodzic and Lo (2006, Table 5).

[1] See for example Agarwal and Naik (2004), Hasanhodzic and Lo (2006), Jaeger and Wagner (2005), and Schneeweis et al. (2003).

[2] The risk factors used in this study are S&P 500, GSCI, VIX, USD, AA-rated corporate bonds, and the spread between BAA-rated corporate and T-bonds.

How about the replication of portfolios of hedge funds, funds of funds and hedge fund indices? In these cases most of the idiosyncratic risk is diversified away, which should result in a much more accurate replication. Indications that this is not really the case can be found in Schneeweis et al. (2003), Agarwal and Naik (2004), as well as Jaeger and Wagner (2006). Table 2 summarizes the out-of-sample replication results of Schneeweis et al. (2003) for five equally-weighted portfolios of European hedge funds over the period Jan 2001 – March 2003.[3]

	Index		**Replica**		
Strategy	**Mean**	**StDev**	**Mean**	**StDev**	**Corr. index and replica**
Composite	-2.97%	3.35%	-7.07%	7.92%	43%
Fixed Income	7.87%	2.96%	2.89%	2.58%	16%
Long/Short	-0.98%	3.83%	-9.99%	7.13%	46%
Event Driven	-2.67%	4.79%	-6.34%	6.97%	90%
Convertible Arb	8.28%	1.82%	1.88%	1.54%	17%

Table 2: European hedge fund index return replication. Source: Schneeweis et al. (2003, Exhibit 2a-2f).

From table 2 it is clear that, despite the much higher systematic component in the index returns, the factor model used is unable to accurately replicate the returns on the above indices. As to judge from the correlation between the index return and the replicating return, the best results are obtained for long/short equity and event driven. Given the straightforward nature of these strategies, this is not really surprising. More complex strategies, like fixed income and convertible arbitrage, do a lot worse. Looking at the standard deviations we see that a relatively high correlation between index return and replicating return still does not guarantee that the replicating and index returns exhibit similar statistical properties. For event driven the standard deviation of the replicating returns is 46% higher than that of the index return. Obviously, errors like this will cause major problems in portfolio risk management.

[3] The risk factors used in this study are Eurostoxx 50, FTSE 100, European BBB-rated bonds, Euro government bonds, and FTSE 100 and Eurostoxx 50 straddle returns.

HFRI Index	Variation Explained
Managed Futures	34.3%
Equity Market Neutral	35.3%
Fixed Income Arbitrage	40.5%
Global Macro	49.7%
Merger Arbitrage	52.9%
Convertible Arbitrage	54.0%
Distressed	68.4%
Long/Short Equity	88.5%

Table 3: Percentage of HFRI return variation explained. Source: Jaeger and Wagner (2005, Exhibit 4).

The Schneeweis et al. (2003) results are by no means unique. Table 3 shows to what extent the factor model used in Jaeger and Wagner (2005) was able to explain the variation in the well-known HFRI indices over the period Jan 1994 – Dec 2004. In addition, figure 1 and 2 show the match of the replica return (RFS) and the HFRI (non-investable) and HFRX (investable) equity market neutral (fig. 1) and merger arbitrage (fig. 2) index returns over time. The picture we get from table 3 and figure 1 and 2 is not very different from what we saw before in table 2. Relatively straightforward strategies, like long/short equity, score quite well, but more complex strategies, like managed futures and equity market neutral, come out a lot worse. Overall, this confirms that *the factor model approach has serious difficulty producing acceptable replicas, even for some of the most diversified hedge fund indices around.*

Figure 1 and 2 also clearly show that investable and non-investable indices, even from the same index provider (!), can produce completely different returns at times. We discuss this in more detail in Kat and Palaro (2006b).

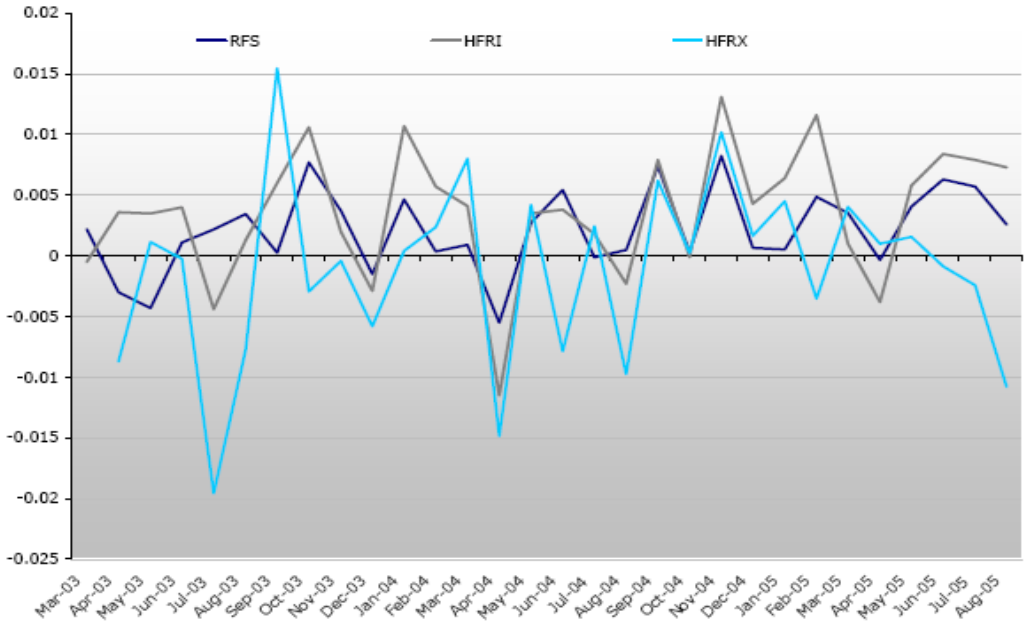

Figure 1: Monthly returns HFRI (non-investable) and HFRX (investable) Equity Market Neutral indices versus replica return (RFS). Source: Jaeger and Wagner (2005, Fig. 8).

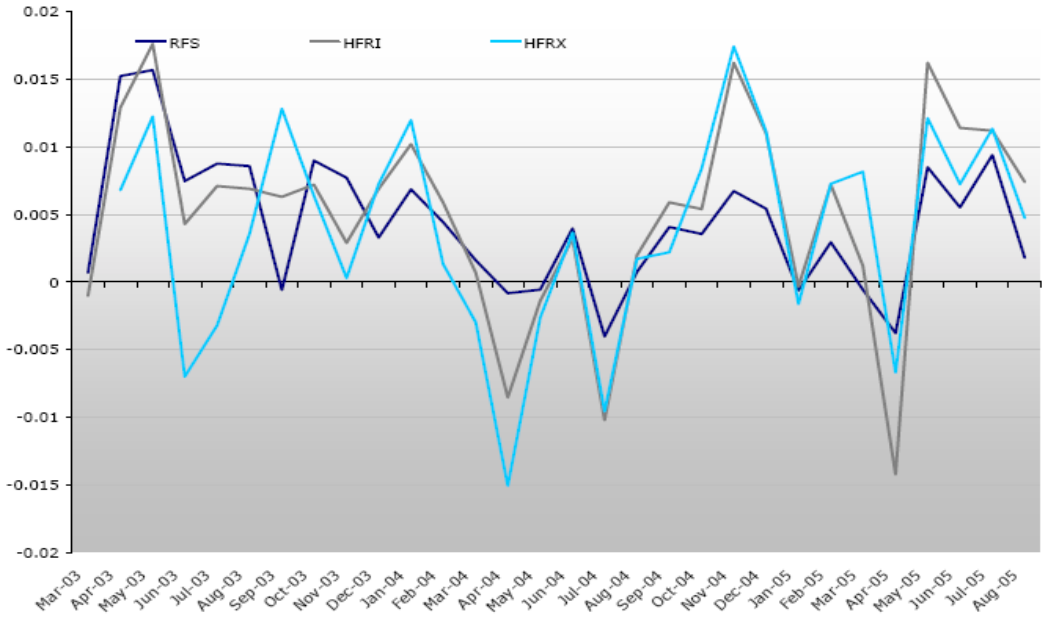

Figure 2: Monthly returns HFRI (non-investable) and HFRX (investable) Merger Arbitrage indices versus replica return (RFS). Source: Jaeger and Wagner (2005, Fig. 12).

3. The FundCreator Approach

Partly in reaction to the various shortcomings of factor models, Kat and Palaro (2005) developed an alternative approach to hedge fund return replication (which, after the website www.FundCreator.com where this approach is advertised, we will refer to as 'the FundCreator approach'). Their aim is not to generate the same month-to-month returns, but only to produce returns with the same statistical properties as found in a particular hedge fund's actual returns. In contrast with the factor model approach, one might refer to this as 'loose replication'.

The basic observation underlying the FundCreator approach is that in most applications, strict replication is not really required. Investors invest in hedge funds for their return properties, i.e. their low volatility, low correlation with stocks and bonds, etc. It is therefore sufficient to produce returns with these particular properties. As long as the returns generated exhibit the desired characteristics, the sequence in which they arrive is of no real importance.

Although the econometrics are seriously complicated, the basic idea underlying the FundCreator approach is straightforward. The first step is to decide on the return characteristics of the fund to be created, including its relationship with the so-called 'reference portfolio', which will typically be (a good proxy for) a traditional investment portfolio. The next step is the selection of the 'reserve asset'. The latter is the main source of uncertainty in the replication strategy. Although allocations to the reserve asset will change over time, the strategy will never sell the reserve asset short. As such, it can be interpreted as the core portfolio of the strategy. Next step is the design of an exotic option, which, given the joint probability distribution of the return on the reference portfolio and the reserve asset, has the exact same return characteristics as the fund we want to replicate. The last step is the derivation of a hedging strategy for the above option. Mechanical execution of this strategy will produce returns with the desired characteristics.

Especially in light of the shortcomings of the factor model approach, a number of points about the FundCreator approach are worth nothing:

1. The FundCreator approach is much more than a hedge fund replication technique. Since it allows investors to freely specify what return properties they want to see generated, it is first and foremost a fund creation technique, with replication only being one of many possible applications.

2. FundCreator does not require the determination of relevant risk factors and subsequent estimation of factor sensitivities. Instead, it requires the estimation of the joint return distributions of (1) the fund to be replicated and the reference portfolio and (2) the reference portfolio and the reserve asset. Although complications in doing so are unavoidable, this concentration on the bottom line makes the approach significantly more robust than the factor model approach, which not only needs the fund returns but also needs to know where they are coming from.

3. The FundCreator approach does not impose a particular structural form on the fund returns or the returns on the reference portfolio or the reserve asset. Again, this makes the approach more flexible and robust than the factor model approach, which explicitly assumes a linear relationship between the risk factors and the fund return.

4. Unlike the factor model approach, the FundCreator approach does not prescribe the user what assets to trade. In fact, the choice of assets to trade precedes the construction of the replication strategy. This means investors can easily avoid illiquid and costly securities, such as corporate bonds, options, and volatility swaps. In most cases it will be sufficient to trade liquid futures markets only.

5. The FundCreator approach, as a hedge fund replication technique as well as a synthetic fund creation technique, has been extensively tested out-of-sample, under realistic conditions in Kat and Palaro (2005) and Kat and Palaro (2006a). Both studies strongly confirm the practical viability of the approach.

6. Although Kat and Palaro (2005) use copulas, a non-parametric implementation of the FundCreator approach is also possible. Instead of copulas, the two joint distributions could be estimated using a kernel approach for example, subsequently deriving the exotic option's payoff function using a numerical procedure instead of the parametric distributions.

Note that one consequence of the first point mentioned is that the FundCreator approach allows investors to adapt a hedge fund's return characteristics to their own taste. Instead of taking a fund's return characteristics as firmly given, it allows them to replace everything they don't like by something they like better. Doing so, investors create their own ideal diversifier, not available anywhere else in the market.

4. Conclusion

With average hedge fund performance steadily deteriorating, interest in hedge fund return replication is growing. Currently, there are two competing approaches on offer. Although theoretically straightforward, factor model based replication suffers from a number of serious problems, including a lack of realistic out-of-sample testing so far. The approach may have some merit for funds following straightforward strategies like basic long/short equity for example. In general, however, it fails to convince. Partly thanks to its less ambitious goal and its concentration on the bottom line, the FundCreator approach is substantially more flexible and robust. In out-of-sample tests carried out so far, it performs remarkably well. Until the proponents of the factor model approach manage to successfully overcome their practical challenges, there is no doubt that the FundCreator approach is the preferred way forward. The same conclusion is also reached by Hasanhodzic and Lo (2006, p. 44), who state that "….more sophisticated nonlinear models, including …. Kat and Palaro's (2005) copula-based algorithm, may yield significant benefits in terms of performance and goodness-of-fit."

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