

Eurex Derivative Products in Alternative Investments: The Case for Hedge Funds

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Abstract

Within the past decade, the growth in global investment markets has spurred the creation of a variety of derivative instruments traded on a number of non-U.S. futures and options exchanges. The development of these exchanges has provided impetus for the development of new financial products such as European based hedge funds. Even in those cases where derivatives may not necessarily be used directly to implement hedge fund strategies, academic research has shown that derivatives can be used in representing fundamental hedge fund return patterns. Most research on the use of derivative instruments to represent hedge fund product returns has focused on U.S. derivative markets. This paper examines the use of various futures and option contracts traded on Eurex and several other European futures and options exchanges in representing the performance of various European based hedge fund strategies. Results show that European futures and option contracts can be used 1) as part of a multi-factor hedge fund replication model to describe the return process of many European based hedge fund strategies and 2) as part of a set of passive systematic “strategy based” trading programs that reflect the return processes of many European based hedge fund strategies.

This research was supported in part by a grant from Eurex, however, the results and the commentary are those of the authors and do not necessarily reflect those of Eurex. The presentation is based on information obtained from sources that (CISDM) considers to be reliable; however, makes no representation as to, and accepts no responsibility for, the accuracy or completeness of the information. Past performance is not an indication of future results.

1. Introduction

Within the past decade, the growth in global investment markets has spurred the creation of a variety of derivative instruments traded on a number of non-U.S. futures and options exchanges. The development of derivative markets in the U.S. has been one of the major driving forces behind the growth in hedge funds and various trading strategies employed by them. The increase in the variety and liquidity of the exchange traded derivatives in Europe has had a similar consequence leading to the development of various investment products such as European based hedge funds. These funds often use European based derivative products to implement their trading strategies. Even when derivatives may not be used directly to implement various hedge fund strategies, academic research has shown that derivatives can be used to represent fundamental hedge fund return patterns.

Most research on the representation of hedge returns using derivative instruments has focused on U.S. derivative markets (Schneeweis and Kazemi, 2003). This paper examines the use of various futures and option contracts traded on Eurex and several other European futures and options exchanges in representing the performance of various European based hedge fund strategies. Results show that European futures and option contracts can be used

- 1) as part of a multi-factor hedge fund replication model to describe the return process of many European based hedge fund strategies and
- 2) as part of a set of passive systematic “strategy/security based” trading programs which reflect the return processes of many European based hedge fund strategies.

2. Hedge Funds: Factor and Security Based Replication

Hedge funds have been described as skill-based investment strategies obtaining returns from the unique skill or strategy of the trader. Many hedge fund strategies are managed to obtain positive returns regardless of market conditions rather than to track traditional stock or bond indexes. As a result, hedge funds have been described as absolute return strategies, as these returns do not depend solely on the long-term return on underlying traditional stock and bond markets. However, academic research has shown that various hedge fund strategy returns are driven largely by market factors such as equity index returns, bond market returns, credit risk and market volatility, which are consistent with the underlying strategy, and that various hedge fund strategy returns can be represented by systematic trading systems.¹

For instance, the convertible arbitrage strategy may be designed to do one or several of the following

- buy convertible bonds,
- short the underlying equity,
- short the underlying interest rate risk, and
- hedge the credit risk.

These transactions are supposed to isolate the return provided by the options embedded in the convertible bonds, which are often sold by corporations at below equilibrium price. To the degree that these simple passive trading strategies are highly correlated with underlying strategies of a particular set of hedge funds, one can consider hedge fund returns as a combination of managers' skills and an underlying return to the strategy itself.

¹ See Fung and Hsieh (1997), Schneeweis, Kazemi and Martin (2003) and Schneeweis and Kazemi (2003). For application of these techniques to traditional asset classes see Fama et al. (1993,1996).

3. Data and Methodology

In this paper we analyze the benefits of traditional stock and bond markets as well as futures and option contracts as investment tools within the hedge fund strategy complex. Futures and option data (e.g., Dow Jones EURO STOXX 50, FTSE 100) as well as traditional stock (e.g., Dow Jones EURO STOXX 50, FTSE 100) and bond (e.g. Merrill Lynch European Government (10+) and Corporate (BBB)) indexes are obtained from Bloomberg. European hedge fund strategy portfolios were obtained from a database developed by Schneeweis Partners, LLC, which is based on a number of hedge fund databases (e.g., CISDM, Tass, and Altvest), and reflect the performance of an equally weighted portfolio of European based hedge fund managers for a variety of hedge fund strategies (e.g., convertible arbitrage, fixed income arbitrage, event driven, and long/short equity (equity hedge)). The analysis is conducted for the period January 1998 through March 2003.²

We use a series of rolling regressions to estimate the parameters of certain trading strategies (i.e., the weights of the portfolios that are expected to track the performance of various hedge fund strategies). These estimates are then used to form a portfolio. We examine the performance of this over the twenty-four month estimation period (in-sample period) as well one month following the estimation period (out-of-sample period). The process is repeated by moving the estimation window one month forward (the length remains twenty-four months) and obtaining estimates of the resulting portfolio's performance for the in-sample and out-of-sample periods.

The in-sample performance of the portfolio tells us whether the portfolio can track the historical performance of certain hedge fund strategies. More importantly, the out-of-sample performance of the portfolio represents the potential return from a trading strategy where the parameters of the strategy are estimated and updated on a monthly basis using data from the most recent twenty-four month period. Thus, the trading strategies discussed here represent systematic dynamic strategies involving futures and options contracts with the goal of replicating return processes of various hedge fund strategies.

Two approaches (multi-factor and security (style) based) are used to test the potential use of futures and options contracts in hedge fund strategy applications. It is important to note that many hedge fund managers currently use these contracts in specific cases to manage their portfolios. It is not the purpose of this study to provide a case by case analysis of particular strategies and how they use these contracts. Instead, this paper provides a more general approach to illustrating the potential use of these contracts in hedge fund strategy management by replicating the underlying returns of various strategies using a combination of traditional equity and bond indexes as well as equity and fixed income derivatives.

² In some instances the starting date is different because data were not available. See Exhibit 1.

Our results show that dynamic trading strategies involving futures and options can capture the fundamental aspects of return patterns of various hedge fund strategies. Though in most instances the replicating portfolios do not perform as well as the hedge fund portfolios they are supposed to track, the replicating portfolios consisting of futures and options contracts offer several advantages not provided by the hedge fund portfolios:

1. Futures and option contracts require small investments and thus can be used as overlay strategies.
2. Due diligence costs associated with investments in hedge funds could be significant and a replicating portfolio approach based on exchange traded futures and options does not involve such manager search and selection costs.
3. Investments in hedge funds could entail a long delay because of the due diligence process, while a replicating portfolio can be created very quickly with minimum transaction costs.
4. Hedge fund investments are not transparent and for this reason they are avoided by some institutional investors who are accustomed to the transparency offered by traditional asset classes. Replicating portfolios based on exchange traded futures and options are completely transparent.
5. Investments in hedge funds may involve certain risks that are not captured by raw data on their historical performance (e.g., fraud risk). Replicating portfolios based on exchange traded futures and options have no exposure to such risks.
6. Investments in hedge funds are not liquid since most funds have lock-up and lengthy notification periods. Replicating portfolios based on exchange traded futures and options are highly liquid.

3.1 Multi-Factor Hedge Fund Return Replication

Previous studies (Schneeweis, Martin, and Kazemi, 2003) have shown that hedge fund exposures to various market factors can explain close to 60% of cross-sectional differences in average rates of return on several hedge fund strategies. This is expected, as many hedge fund strategies hold similar securities as traditional equity or fixed income mutual funds and thus factors that can explain returns on equity and fixed income funds should have some explanatory powers when applied to hedge funds. In this study the following market factors for European markets are used to describe the return processes of various European based hedge fund strategies:³

³ More complex multi-factor models exist which can be used to replicate the return process (e.g., swaps, etc.) more accurately. The model used in this analysis is simplified for presentation purposes.

- **Equity Market Risk:** This is represented by the monthly rate of return on Dow Jones EURO STOXX 50 and/or FTSE 100.
- **Interest Rate Risk:** This is measured by the return on Merrill Lynch EMU (European) Direct Governments (10+ years).
- **Credit Risk:** This is measured by the return on Merrill Lynch EMU (European) Corporates, BBB Rated.
- **Volatility Return:** This is represented by the return on a straddle position determined from options prices based on the implied volatility for options on Dow Jones EURO STOXX 50 or FTSE 100.

The purpose of this line of research is exploratory for it provides us with a better understanding of the factors driving the return processes of various hedge fund strategies.

3.2 Hedge Fund Strategy Return Replication

This part uses derivatives instruments to implement “simplified” versions of various hedge fund trading strategies. It is shown how UK and European futures and option contracts and underlying cash positions can be used to implement various replicating strategies. The following is a list of strategies examined in this area:

- **Convertible Arbitrage Strategy Replication:** Cash, futures, and option positions are used to capture potential equity, bond and volatility exposures of this strategy. For example, being long convertible bonds and short equity and government bonds may represent a convertible arbitrage trade. The same return pattern may be obtained using positions in equity options and fixed income and equity index futures.
- **Fixed Income Arbitrage Strategy Replication:** Fixed income futures are used to capture potential return to a fixed income strategy that is based on changes in term and/or credit spreads. For example, being long/short the long-term fixed income futures and short/long the short-term fixed income futures provide one means of capturing return to changes in the yield spread.
- **Event Driven Strategy Replication:** Event driven returns are often based on changes in interest rates and equity markets, which affect underlying returns to distressed debt and merger arbitrage. As a result, fixed income and equity index futures and options may be used as a basis for creating representative portfolios.
- **Long/Short Equity (Hedge Equity) Strategy Replication:** Equity based investments are used to capture differential performance of various sectors of equity markets such as small cap versus large cap stocks, or value versus growth stocks. For example, being long/short the Dow Jones EURO STOXX 50 and FTSE 100 may be viewed as a geographical equity market trade. In this example, the actual positions are not weighted to minimize market exposure.

In this analysis only futures and option contracts are employed to capture the returns to the various hedge fund strategies. The reason for this approach is to create positions that require little if any direct investment. In certain cases the inclusion of additional investments may result in improved tracking (e.g., high yield debt in event driven, or convertible bonds in convertible hedging). The examples used in this paper are for illustrative purposes only.

The actual instruments used to capture the return in each strategy are as follows:

- **European Convertible Arbitrage:** Dow Jones EURO STOXX 50, Euro Bund, FTSE 100, UK Gilt, and implied volatility based straddles
- **European Fixed Income Arbitrage:** Euro Schatz and Euro Bund
- **European Event Driven:** Dow Jones EURO STOXX 50, Euro Bund, FTSE 100, UK Gilt
- **European Long/Short:** Dow Jones EURO STOXX 50 and FTSE 100

4. Research Results: Multi-Factor Analysis and Style Based Analysis – European Markets

4.1 Multi-Factor Hedge Fund Return Replication

Results in Exhibit 1, which cover the period January 1998-March 2003, show the correlation relationships between various European hedge fund strategy portfolio returns and market factors discussed in the previous section. Results are as expected. For instance, those strategies (long/short equity and event driven) that have equity exposures have generally a high correlation with the Dow Jones EURO STOXX 50. The long/short equity portfolio has a correlation of 0.67 with the Dow Jones EURO STOXX 50, while the event driven hedge fund strategy portfolio has a correlation of 0.78 with the same index. In contrast, the two fixed income strategies, fixed income arbitrage and convertible arbitrage, have correlations of -0.18 and 0.16 with the Dow Jones EURO STOXX 50, respectively. Lastly, the European Hedge Fund portfolio, which is an equally weighted portfolio of the four hedge fund strategy portfolios used in this analysis, and the Hennessee Europe Hedge Fund Index, which is composed of a larger set of European hedge fund strategies (market neutral, event driven, distressed securities, and equity hedge), show similar sensitivity to the Dow Jones EURO STOXX 50 (0.74 and 0.61, respectively). An interesting feature of Exhibit 1 is that all European strategies have insignificant exposure to credit risk as measured by their correlations with Merrill Lynch EMU (European) Corporates, BBB Rated Index.

Exhibit 1. Factor Based Determinants of Hedge Fund Returns

Factor Correlations (January 1998 - March 2003)

	Dow Jones EURO STOXX 50	Merrill Lynch Euro Gov 10+ years	Merrill Lynch Euro Corp BBB Index	Straddle Return Dow Jones EURO STOXX 50**
Fund of Fund Portfolio (Euro)	0.42	0.01	0.11	0.09
Hedge Fund Portfolio (Euro)	0.74	-0.04	0.06	-0.09
Hennessee Europe Index	0.61	-0.06	0.06	0.19
Fixed Income Arbitrage (Euro)*	-0.18	0.31	0.01	0.18
Long/Short Portfolio (Euro)	0.67	-0.04	0.06	0.20
Event Driven Portfolio (Euro)***	0.78	-0.11	0.06	-0.26
Convertible Arbitrage Portfolio (Euro)	0.16	-0.07	0.02	-0.17

* Data covers April 1999-March 2003

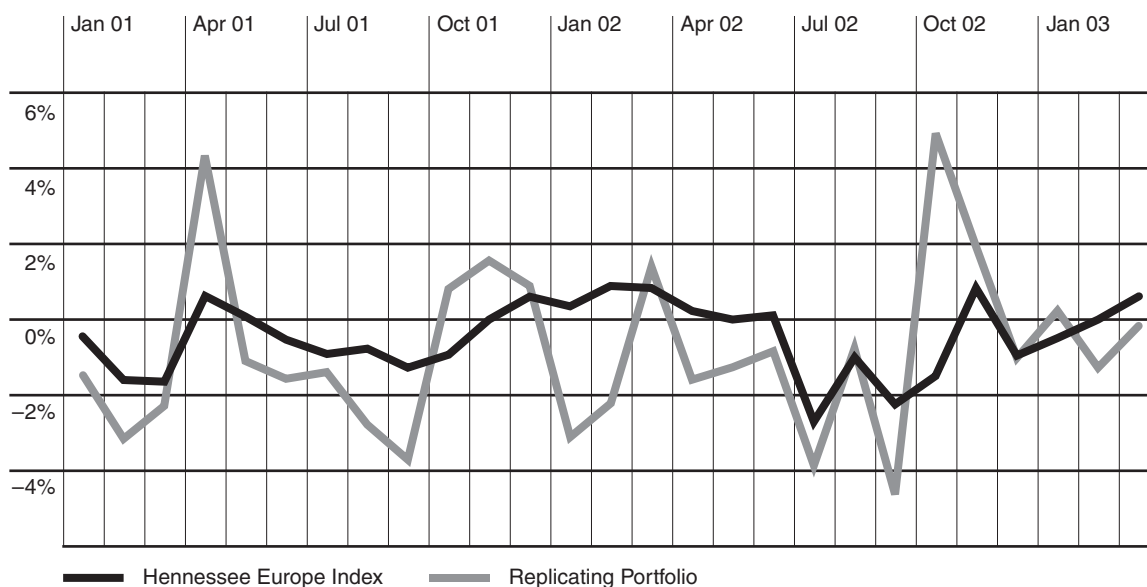
** Data covers June 1998-March 2003

*** Data covers November 1998-March 2003

Exhibits 2a-2f present the results of our rolling regression procedure that was discussed earlier. For instance, the graph displayed in Exhibit 2a presents the performance of Hennessee Europe Hedge Fund Index and out-of-sample performance of the replicating portfolio. It can be seen that while the replicating portfolio is more volatile than the hedge fund index, it tends to provide the same directional return patterns when there are large movements in the hedge fund index. The first table of Exhibit 2a presents the summary of the estimates obtained from a series of rolling regressions. For instance, the in-sample explanatory power of the replicating portfolio is rather high (represented by an R-squared of 0.606). Also it can be seen that on average the replicating portfolio required a long position of 46% in Dow Jones EURO STOXX 50, a short position of 19.1% in FTSE 100, a long position of 60.6% in Merrill Lynch EMU (European) Corporates, BBB Rated Index, and a short position of 25.3% in Merrill Lynch EMU (European) Direct Governments (10+ years) Index. To the degree that these weights do not add up to one, it indicates that leverage (positive or negative) must be used to implement the strategy. The second table in Exhibit 2a demonstrates the out-of-sample results of the replicating strategy. It can be seen that out-of-sample (January 2001-March 2003), the replicating portfolio lost 7.06% while the hedge fund index lost 2.96%. The difference (4.10%) may be attributed to the skill of hedge fund managers who are in the Hennessee Europe Hedge Fund Index. Finally, we can see in this table that the out-of-sample correlation between the replicating portfolio and the hedge fund index is 43%.

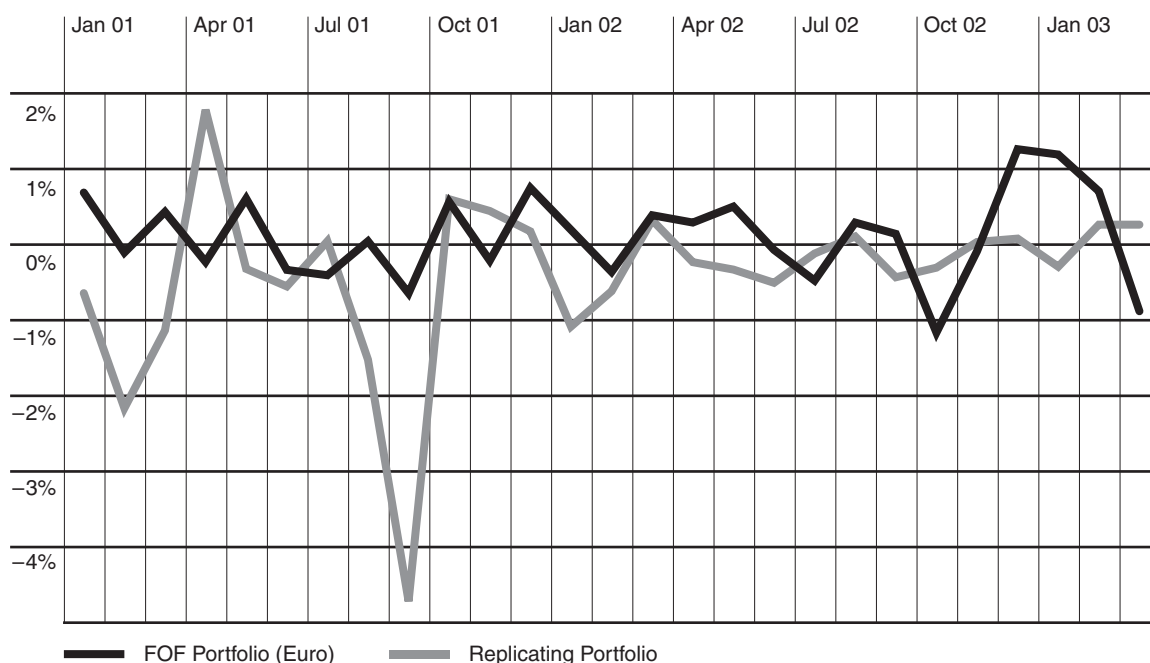
Exhibits 2a-2f show that each hedge fund strategy, on average, has exposures to market factors represented by returns to equity index and fixed income instruments. As important, as illustrated in Exhibits 2a through 2c, the average R-squared in the multi-factor model (in-sample) is well above 50% for the equity related and diversified hedge fund strategies (e.g., long/short equity, event driven, fund of funds, and European hedge fund index). For those hedge fund strategies that attempt to minimize market exposure (convertible arbitrage and fixed income arbitrage) the average R-squared (in-sample) is between 0.25 and 0.32.

Exhibit 2a. European Hedge Fund: Factor Analysis – Tracking



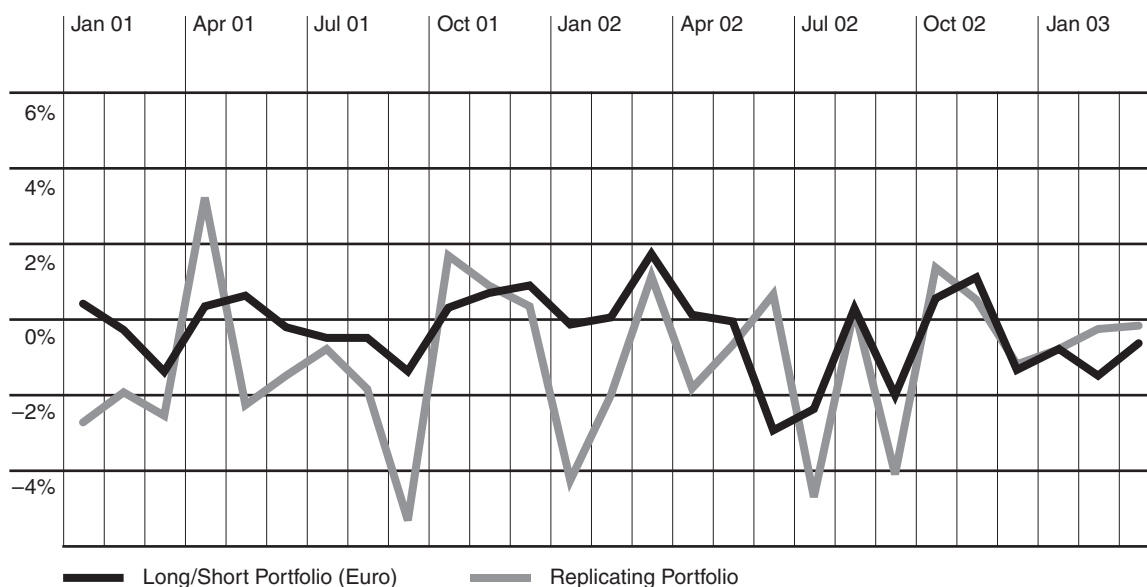
In-Sample Regression Results		Average Value of Estimated Coefficient	
RSQ		0.606	
Intercept		0.009	
Dow Jones EURO STOXX 50 Total Return		0.460	
FTSE 100		-0.191	
Merrill Lynch EMU Corporates, BBB Rated		0.606	
Merrill Lynch EMU Direct Governments, 10+ years		-0.253	
Straddle Return FTSE 100 (UKX)		0.003	
Straddle Return Dow Jones EURO STOXX 50 (SX5E)		0.018	
Out-of-Sample Statistics		Mean	Standard Deviation
Hennessee Europe Index		-2.97%	3.35%
Replicating Portfolio		-7.06%	7.92%
Error Term		4.10%	7.14%
Correlation		43%	

Exhibit 2b. Fund of Funds: Factor Analysis – Tracking



In-Sample Regression Results		Average Value of Estimated Coefficient	
RSQ		0.543	
Intercept		0.005	
Dow Jones EURO STOXX 50 Total Return		0.080	
FTSE 100		0.018	
Merrill Lynch EMU Corporates, BBB Rated		0.474	
Merrill Lynch EMU Direct Governments, 10+ years		-0.119	
Straddle Return FTSE 100 (UKX)		0.006	
Straddle Return Dow Jones EURO STOXX 50 (SX5E)		-0.002	
Out-of-Sample Statistics		Mean	Standard Deviation
Fund of Funds Portfolio (Euro)		4.19%	2.01%
Replicating Portfolio		-2.05%	3.90%
Error Term		6.23%	4.01%
Correlation		20%	

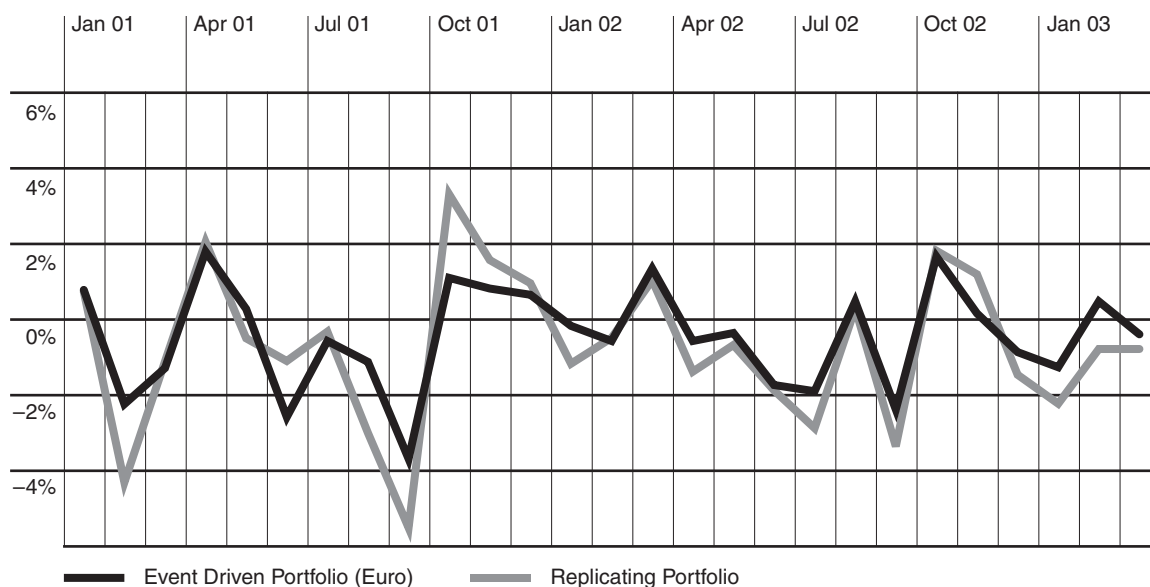
Exhibit 2c. Long/Short: Factor Analysis – Tracking



In-Sample Regression Results		Average Value of Estimated Coefficient	
RSQ		0.677	
Intercept		0.011	
Dow Jones EURO STOXX 50 Total Return		0.410	
FTSE 100		-0.196	
Merrill Lynch EMU Corporates, BBB Rated		0.396	
Merrill Lynch EMU Direct Governments, 10+ years		-0.160	
Straddle Return FTSE 100 (UKX)		0.011	
Straddle Return Dow Jones EURO STOXX 50 (SX5E)		0.009	
Out-of-Sample Statistics		Mean	Standard Deviation
Long/Short Portfolio (Euro)		-0.98%	3.83%
Replicating Portfolio		-9.99%	7.13%
Error Term		9.01%	6.34%
Correlation		46%	

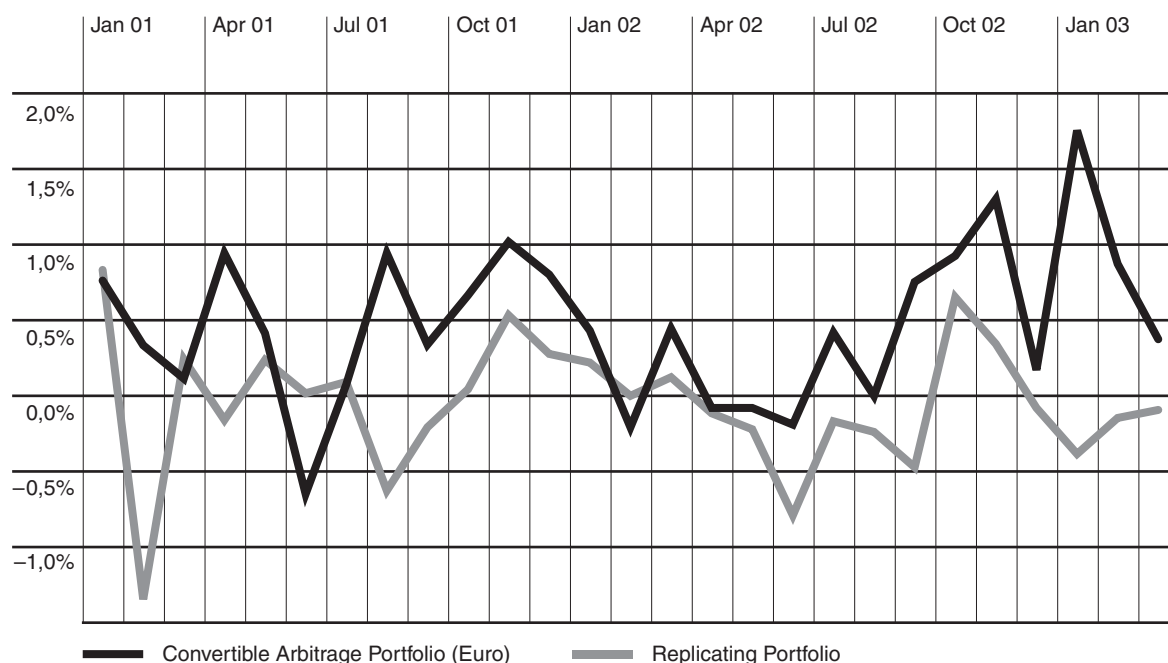
As expected, on average, out-of-sample correlations between the factor-based tracking portfolio and the active hedge fund manager index are lower than the in-sample estimated correlations. Also, as expected, active hedge fund-based manager portfolios have a positive excess return relative to the passive yet investable factor-based replicating portfolios. Finally, while Exhibits 2a-2f display the average position in each of the fixed income and equity instruments, each position displays some variation from month to month. This is to be expected since hedge fund managers follow dynamic trading strategies with their investment positions changing to reflect new market conditions.

Exhibit 2d. Event Driven: Factor Analysis – Tracking



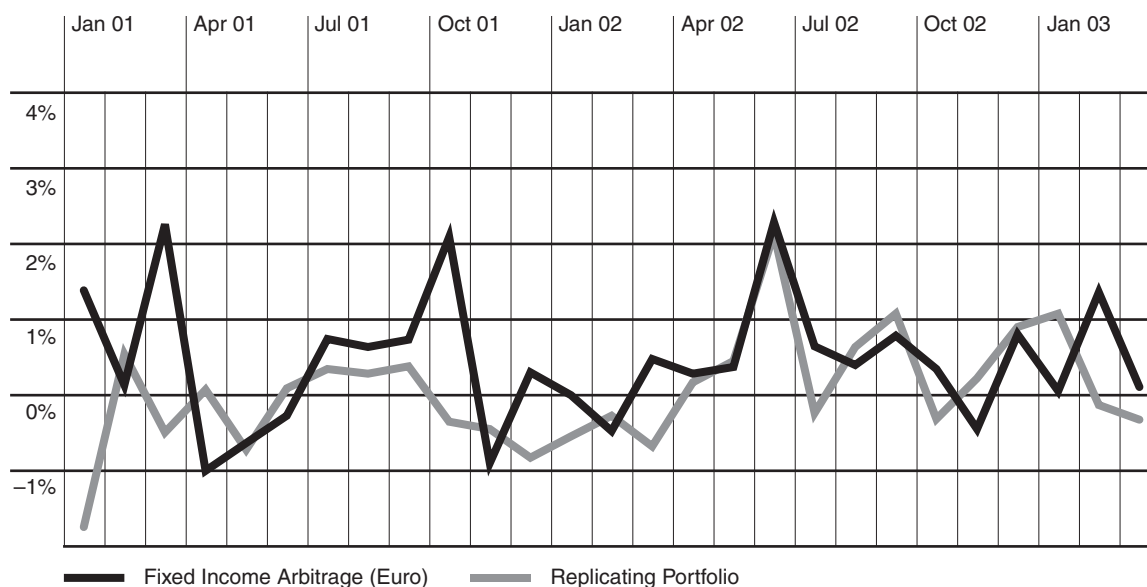
In-Sample Regression Results	Average Value of Estimated Coefficient	
RSQ	0.858	
Intercept	0.003	
Dow Jones EURO STOXX 50 Total Return	0.220	
FTSE 100	0.073	
Merrill Lynch EMU Corporates, BBB Rated	0.415	
Merrill Lynch EMU Direct Governments, 10+ years	0.023	
Straddle Return FTSE 100 (UKX)	0.004	
Straddle Return Dow Jones EURO STOXX 50 (SX5E)	-0.003	
Out-of-Sample Statistics	Mean	Standard Deviation
Event Driven Portfolio (Euro)	-2.67%	4.79%
Replicating Portfolio	-6.34%	6.97%
Error Term	3.67%	3.38%
Correlation	90%	

Exhibit 2e. Convertible Arbitrage: Factor Analysis – Tracking



In-Sample Regression Results		Average Value of Estimated Coefficient	
RSQ		0.319	
Intercept		0.004	
Dow Jones EURO STOXX 50 Total Return		0.060	
FTSE 100		-0.043	
Merrill Lynch EMU Corporates, BBB Rated		0.018	
Merrill Lynch EMU Direct Governments, 10+ years		-0.019	
Straddle Return FTSE 100 (UKX)		-0.004	
Straddle Return Dow Jones EURO STOXX 50 (SX5E)		0.002	
Out-of-Sample Statistics		Mean	Standard Deviation
Convertible Arbitrage Portfolio (Euro)		8.28%	1.82%
Replicating Portfolio		1.88%	1.54%
Error Term		6.40%	2.17%
Correlation		17%	

Exhibit 2f. Fixed Income Arbitrage: Factor Analysis – Tracking



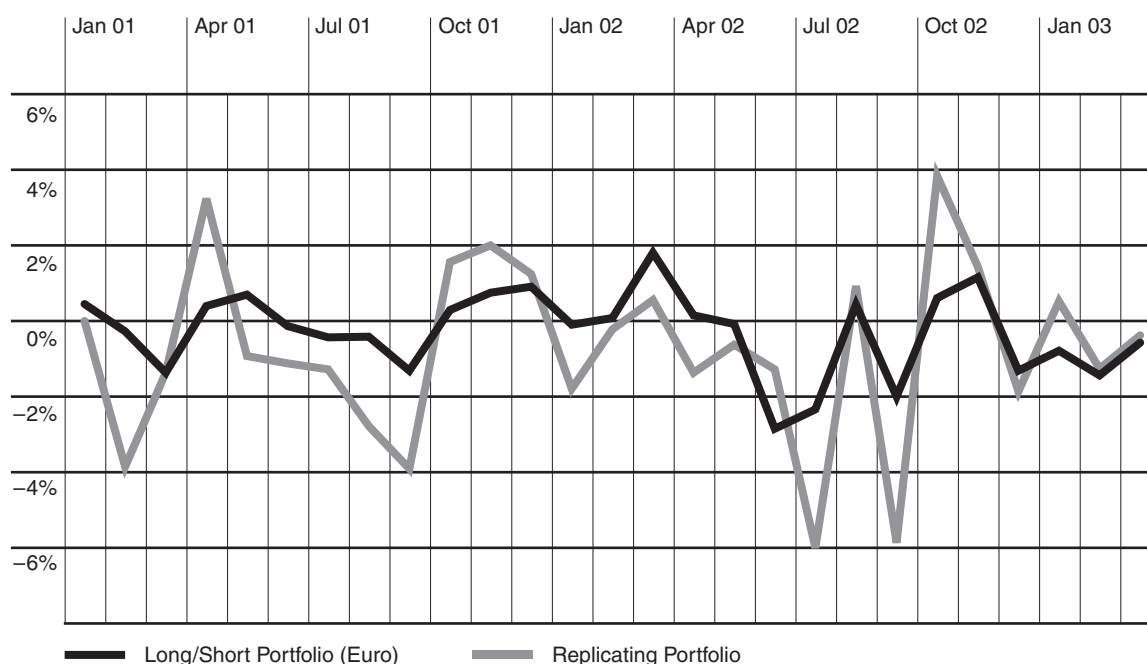
In-Sample Regression Results	Average Value of Estimated Coefficient	
RSQ	0.292	
Intercept	0.002	
Dow Jones EURO STOXX 50 Total Return	0.060	
FTSE 100	-0.119	
Merrill Lynch EMU Corporates, BBB Rated	-0.062	
Merrill Lynch EMU Direct Governments, 10+ years	0.119	
Straddle Return FTSE 100 (UKX)	0.007	
Straddle Return Dow Jones EURO STOXX 50 (SX5E)	-0.001	
Out-of-Sample Statistics	Mean	Standard Deviation
Fixed Income Arbitrage (Euro)	7.87%	2.96%
Replicating Portfolio	2.89%	2.58%
Error Term	4.97%	3.59%
Correlation	16%	

However, as mentioned earlier, using these replicating portfolios to access hedge fund returns would provide a number of advantages that are not captured by historical data (e.g., higher degree of liquidity and transparency as well as no due diligence cost or lengthy manager search and selection process).

4.2 Hedge Fund Strategy/Security Based Return Replication

Results in Exhibits 3a-3d show the potential use of futures/option contracts to track the performance of various hedge fund strategies. In Exhibits 3a-3d, futures contracts such as the Dow Jones EURO STOXX 50 and Euro Bund, both traded on Eurex, and FTSE 100 are used to create replicating portfolios for various European hedge fund strategies. Results from the multi-factor model indicate that various futures contracts can be used to capture the generic trading strategy over the time period in question.

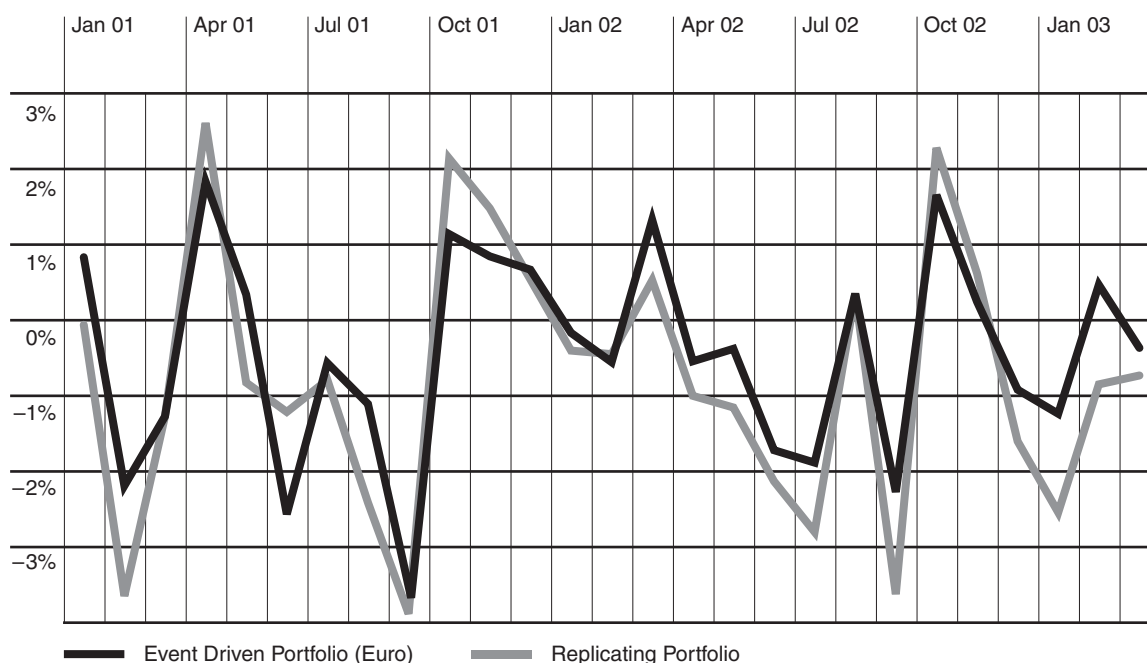
Exhibit 3a. Hedge Funds: Style Based Long Short Equity Tracking



In-Sample Regression Results		Average Value of Estimated Coefficient	
RSQ		0.467	
Intercept		0.008	
Dow Jones EURO STOXX 50 Future		0.420	
FTSE 100 Future		-0.188	
Out-of-Sample Statistics		Mean	Standard Deviation
Long/Short Portfolio (Euro)		-0.98%	3.83%
Replicating Portfolio		-6.82%	8.26%
Error Term		5.83%	6.28%
Correlation		69%	

For instance, as indicated in Exhibit 3a, on average over the period January 2001-March 2003, European long/short equity is replicated by long positions in the Dow Jones EURO STOXX 50 Futures and short positions in FTSE 100 Futures. Again, we see that the replicating strategy is more volatile than the hedge fund portfolio and it underperforms the portfolio as well. These differences may reflect the skills of the managers that are in the long/short hedge fund portfolio.

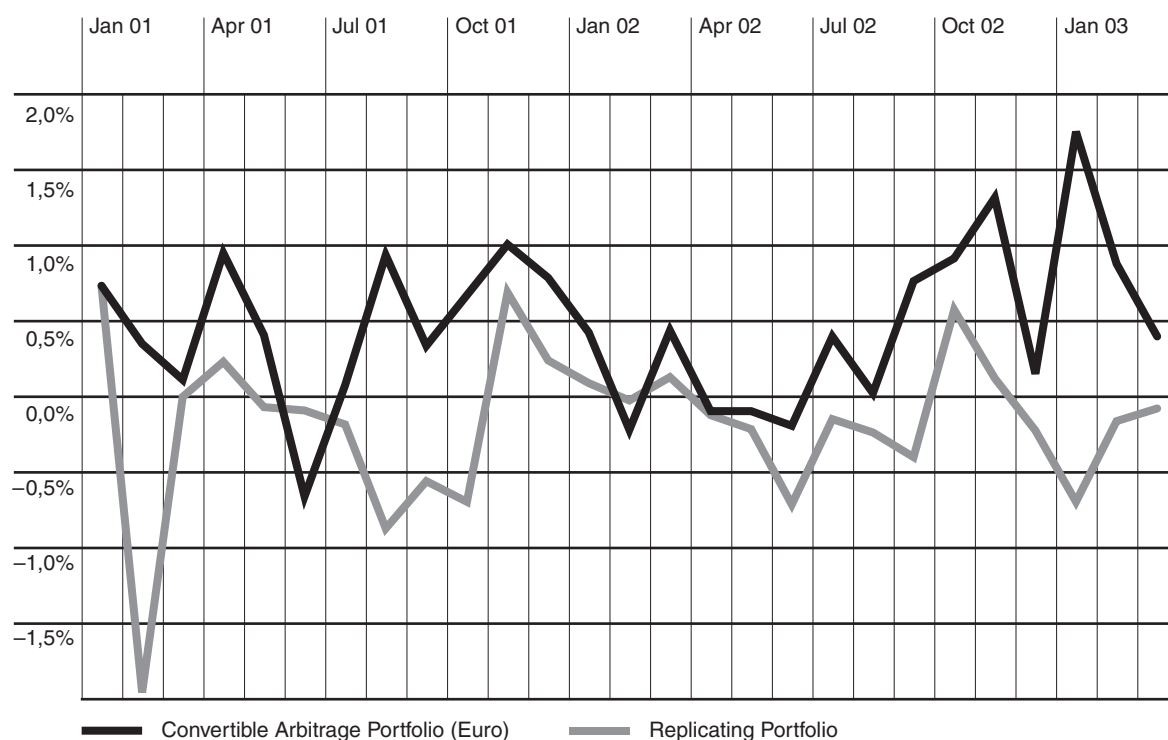
Exhibit 3b. Hedge Funds: Style Based Event Driven Tracking



In-Sample Regression Results		Average Value of Estimated Coefficient	
RSQ		0.818	
Intercept		0.003	
Dow Jones EURO STOXX 50 Future		0.220	
FTSE 100 Future		0.073	
Euro Bund Future		-0.049	
Gilt Future		0.226	
Out-of-Sample Statistics		Mean	Standard Deviation
Event Driven Portfolio (Euro)		-2.67%	4.79%
Replicating Portfolio		-6.83%	6.10%
Error Term		4.16%	2.66%
Correlation		91%	

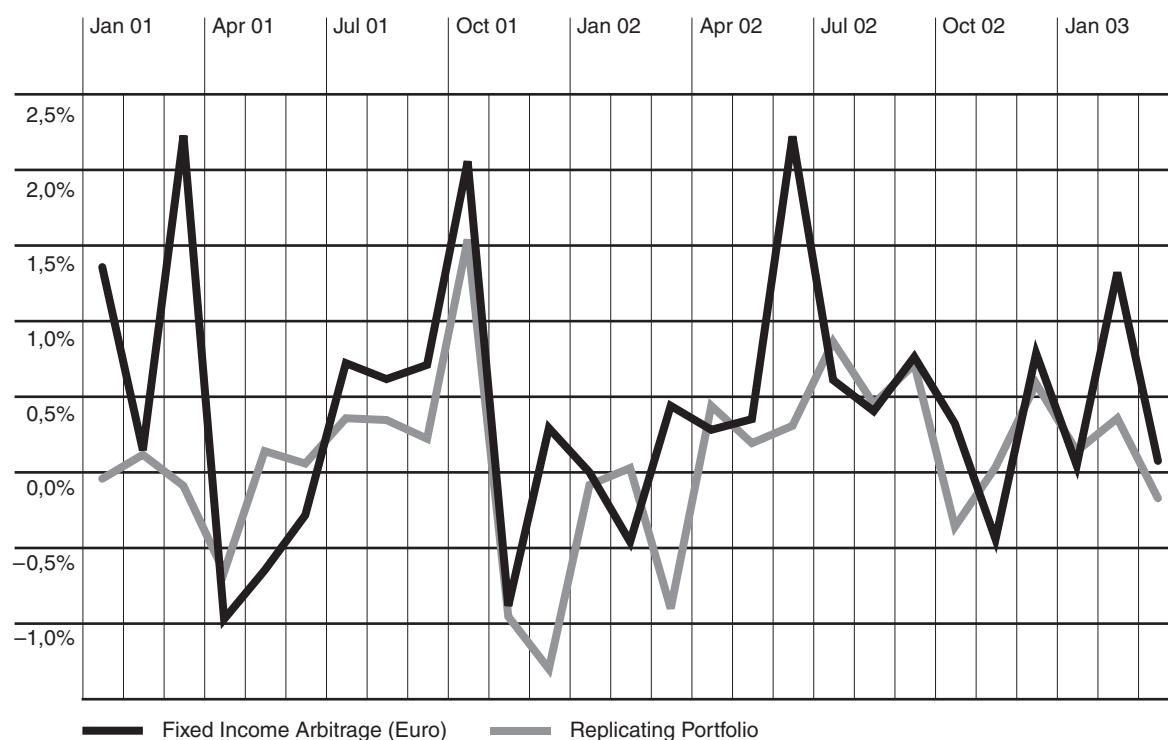
As shown in Exhibit 3b, a European event driven portfolio is replicated with long positions in Dow Jones EURO STOXX 50 and Gilt Futures as well as a short position in Euro Bund Futures. This is consistent with event driven hedge fund strategies often being a combination of equity sensitive corporate action based strategies (e.g., merger arbitrage) and interest sensitive distressed security positions as well as various long and short positions. The average R-squared for the in-sample security based replication for long/short equity is over 0.45 while the out-of-sample correlation is approximately 0.70 (Exhibit 3a). Further, the average R-squared for the in-sample security based replication for event driven is over 0.80 while the out-of-sample correlation is approximately 0.91 (Exhibit 3b). However, as shown in Exhibits 3c and 3d, the R-squared for the other European hedge fund strategies (convertible arbitrage and fixed income arbitrage) for the in-sample periods are below 0.35 while the out-of-sample correlations range between 0.12 and 0.47. In short, the ability of security based replication to replicate European hedge fund returns is strategy dependent.

Exhibit 3c. Hedge Funds: Style Based Convertible Arbitrage Tracking



In-Sample Regression Results	Average Value of Estimated Coefficient	
RSQ	0.334	
Intercept	0.004	
Dow Jones EURO STOXX 50 Future	0.050	
FTSE 100 Future	-0.034	
Euro Bund Future	-0.120	
Gilt Future	0.041	
Straddle Return FTSE 100 (UKX)	-0.002	
Straddle Return Dow Jones EURO STOXX 50 (SX5E)	0.001	
Out-of-Sample Statistics	Mean	Standard Deviation
Convertible Arbitrage Portfolio (Euro)	8.28%	1.82%
Replicating Portfolio	0.61%	1.86%
Error Term	7.66%	2.43%
Correlation	12%	

Exhibit 3d. Hedge Funds: Style Based Fixed Income Arbitrage Tracking



In-Sample Regression Results		Average Value of Estimated Coefficient	
RSQ		0.302	
Intercept		0.002	
Euro Bund Future		0.190	
Euro Schatz Future		0.394	
Out-of-Sample Statistics		Mean	Standard Deviation
Fixed Income Arbitrage (Euro)		7.87%	2.96%
Replicating Portfolio		3.53%	2.00%
Error Term		4.33%	2.68%
Correlation		47%	

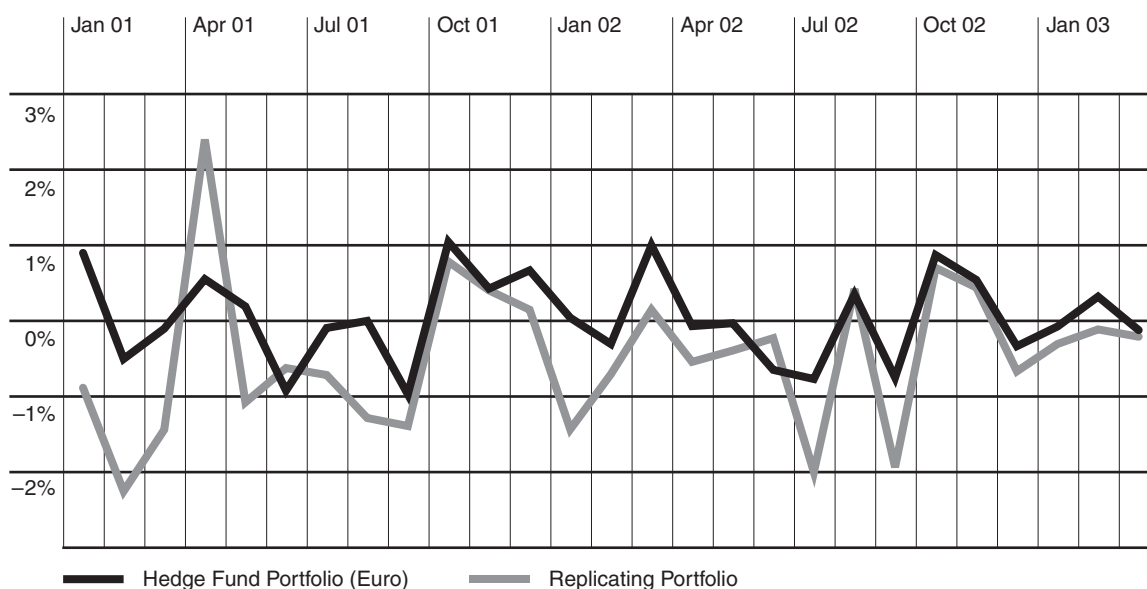
In addition, the out-of-sample returns (annual return⁴) for the active manager based hedge fund portfolios are all above that of the security based replicating portfolios: long/short equity (-0.98% vs -6.82%); event (-2.67% vs -6.83%); convertible arbitrage (8.28% vs 0.62%); and fixed income arbitrage (7.87% vs 3.53%). Active hedge fund based manager portfolios should have positive excess returns relative to passive yet investable factor based replicating portfolios. The reason is that hedge fund portfolios impose additional direct or indirect costs as well as risks on investors (e.g. lack of liquidity and transparency, due diligence cost, fraud and manager risk, etc.)

⁴ Annual returns were derived by multiplying the monthly average by twelve.

4.3 Portfolio Analysis

Results in Exhibits 4 and 5 show the relative performance of traditional assets and hedge funds over the period January 2001-March 2003. These assets include the Dow Jones EURO STOXX 50 and the Merrill Lynch EMU (European) Direct Governments Index (10+ years) as well as various hedge fund benchmarks and the corresponding futures/options contract replicating portfolios. In Exhibit 4, results show a very high correlation (64.5%) between the equally weighted hedge fund portfolio (long/short equity, event driven, convertible arbitrage, and fixed income arbitrage) and a portfolio (equally weighted) of the replicating strategies discussed in the previous section. However, results in Exhibit 4 also show that the portfolio of the actual hedge fund investment outperformed the portfolio of the replicating strategies. Again, this is expected; active investment should outperform a simple passive security based replicating portfolio.

Exhibit 4. Hedge Fund Strategies: Performance



	Descriptive Statistics					
	Monthly Mean			Monthly Standard Deviation		
	2001	2002	2001/2003	2001	2002	2001/2003
Hedge Fund Portfolio	0.10%	0.00%	0.05%	0.66%	0.59%	0.58%
Replicating Portfolio	-0.50%	-0.52%	-0.47%	1.24%	0.90%	1.00%
	Information Ratio			Correlations		
				Hedge Fund Portfolio	Replicating Portfolio	
	Hedge Fund Portfolio	15.50%	0.20%	8.60%	100.00%	64.50%
Replicating Portfolio	-40.20%	-57.40%	-47.30%	64.50%	100.00%	

The replicating portfolios do have the advantage of full transparency and liquidity. In addition, to the degree that an overlay investment is desired, futures and option based portfolios may provide a reasonable addition without requiring additional capital investment. Furthermore, for foreign investors only a small portion of the actual investments would be exposed to currency risk. In short, the relative return tradeoff between active and passive management must be compared with the relative risks and investment constraints of the investor. In addition, the relative underperformance of the replicating portfolios are often due to relative poor performance in a few out-of-sample months (e.g., for long/short equity and convertible arbitrage – February 2001 and September 2001). Future research entails the use of additional derivative based strategies (e.g., collar strategies) to manage the risk of extreme return movements on non-manager based replication portfolios.

Exhibit 5. Hedge Fund and Traditional Asset Portfolios Performance

	Descriptive Statistics					
	Monthly Mean			Monthly Standard Deviation		
	2001	2002	2001/2003	2001	2002	2001/2003
Hedge Fund Portfolio	0.10%	0.00%	0.05%	0.66%	0.59%	0.58%
Replicating Portfolio	-0.50%	-0.52%	-0.47%	1.24%	0.90%	1.00%
	Information Ratio			Correlations		
	2001	2002	2001/2003	Hedge Fund Portfolio	Replicating Portfolio	
	Hedge Fund Portfolio	15.50%	0.20%	8.60%	100.00%	
Replicating Portfolio	-40.20%	-57.40%	-47.30%	64.50%	100.00%	
	Monthly Mean			Monthly Standard Deviation		
	2001	2002	2001/2003	2001	2002	2001/2003
	Hedge Fund Portfolio	0.10%	0.00%	0.05%	0.66%	0.59%
Replicating Portfolio	-0.50%	-0.52%	-0.47%	1.24%	0.90%	1.00%
Merrill Lynch	0.54%	1.10%	0.80%	2.35%	1.84%	2.00%
Dow Jones STOXX 50	-1.56%	-3.28%	-2.71%	6.46%	9.05%	7.33%
Traditional Portfolio	-0.51%	-1.09%	-0.95%	3.34%	3.91%	3.39%
Traditional Portfolio + Hedge Fund	-0.39%	-0.87%	-0.75%	2.78%	3.23%	2.81%
Traditional Portfolio + Replicating Hedge Fund Portfolio	-0.51%	-0.98%	-0.86%	2.88%	3.29%	2.87%
	Information Ratio			Correlations		
	2001	2002	2001/2003	Hedge Fund Portfolio	Replicating Portfolio	
	Hedge Fund Portfolio	15.46%	0.17%	8.63%	100.00%	
Replicating Portfolio	-40.16%	-57.38%	-47.27%	64.55%	100.00%	
Merrill Lynch	22.99%	59.56%	40.14%	-21.77%	-23.21%	
Dow Jones STOXX 50	-24.13%	-36.21%	-36.99%	83.31%	79.37%	
Traditional Portfolio	-15.26%	-27.87%	-28.15%	83.64%	78.96%	
Traditional Portfolio + Hedge Fund	-13.94%	-26.96%	-26.81%	84.86%	78.88%	
Traditional Portfolio + Replicating Hedge Fund Portfolio	-17.65%	-29.66%	-29.88%	83.46%	81.52%	

Traditional Portfolio = Equal Weighted

Traditional Portfolio + Hedge Fund (Rep Port) = 80% Traditional + 20% Hedge Fund

Hedge Fund Portfolio (HF)

Replicating Portfolio (RP-HF)

Traditional Portfolio (TP)

Merrill Lynch EMU Government Bond (Merrill Lynch)

In Exhibit 5, the equally weighted portfolio of the hedge fund indexes (HF) and the equally weighted portfolio of the replicating strategies (RP-HF) are combined with an equally weighted European traditional stock and bond portfolio. In each case, the standard deviation of the combined portfolio (traditional stock/bond and active manager hedge fund indexes (portfolio TP and HF) or traditional stock/bond and replicating security based hedge fund investments (portfolio TP and RP-HF)) on average decreased by approximately 0.55% (1.9% annually), while the return increased by approximately 0.15% (1.8% annually) in comparison to the traditional only portfolio. The basis for the risk reduction is the low correlation between either the active hedge fund portfolio or the replicating portfolio and the traditional assets portfolio.

The results of this section demonstrate that exchange traded futures and options can be used to capture many of the benefits provided by European based hedge funds to investors who already have positions in traditional asset classes. In particular, dynamic trading strategies involving futures and options traded on Eurex and other European exchanges could provide the same diversification benefits that a portfolio of European based hedge funds would provide without exposing investors to the additional costs and risks of hedge fund investing.

5. Summary

Hedge funds often use derivative products to implement their trading strategies. However, derivatives may also be used to replicate returns to hedge fund strategies that involved long/short positions in traditional asset classes. This study has illustrated the potential use of the European futures and options contracts as an investment vehicle. Results presented in this article indicate that investments in the Eurex futures and options contracts provide access to the return opportunities offered by several hedge fund strategies. Further, this access is accompanied by the high degree of liquidity and transparency offered by exchange traded futures and option contracts.

Results in this analysis indicate that existing futures and options markets may be used to hedge or transform the risk exposure of financial institutions with large investments in hedge funds.

Our results show that dynamic trading strategies involving futures and options can capture the fundamental aspects of return patterns of various hedge fund strategies. Though in most instances the replicating portfolios do not perform as well as the hedge fund portfolios they are supposed to track, the replicating portfolios consisting of futures and options contracts offer several advantages not provided by the hedge fund portfolios.

1. Futures and option contracts require small investments and thus can be used as overlay strategies.
2. Due diligence costs associated with investments in hedge funds could be significant and a replicating portfolio approach based on exchange traded futures and options does not involve such manager search and selection costs.
3. Investments in hedge funds could entail a long delay because of the due diligence process, while a replicating portfolio can be created very quickly with minimum transaction cost.
4. Hedge fund investments are not transparent and for this reason they are avoided by some institutional investors who are accustomed to the transparency offered by traditional asset classes. Replicating portfolios based on exchange traded futures and options are completely transparent.
5. Investments in hedge funds may involve certain risks that are not captured by raw data on their historical performance (e.g., fraud risk). Replicating portfolios based on exchange traded futures and options have no exposure to such risks.
6. Investments in hedge funds are not liquid since most funds have lock-up and lengthy notification periods. Replicating portfolios based on exchange traded futures and options are highly liquid.

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Appendix I: Construction of Benchmark Indexes for Option-Based Strategies

This section describes a number of option based passive benchmarks incorporating the Dow Jones EURO STOXX 50 and FTSE 100 Indexes. The benchmarks are not meant to mimic the performance of active managers. As is true for passive indexes such as the Dow Jones EURO STOXX 50 Index, these indexes follow a mechanical trading strategy and assume no transactions costs such as commissions or bid/ask spread or management fees. Furthermore, these indexes are not based on observed option prices, but on implied volatility quotes. As such, these indexes are not directly investible. They are useful for exploring the source of historical returns to option strategies and the use of such contracts in the creation of such strategies.

The indexes are constructed assuming a portfolio consisting of a one-month at-the-money equity index call option and a one-month at-the-money put option. The portfolio is bought at the beginning of each month and then sold at the end of the same month. Call and put prices are calculated using the reported implied volatilities of at-the-money calls and puts. The payoff to this strategy will depend on the difference between implied volatility and realized volatility of the underlying index. Option premiums are much less than an investment in the underlying index. As such, the monthly percentage change in an option premium is much larger than the percentage change in the underlying security.

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