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## Article

# Are funds of hedge funds efficient? : an empirical analysis for North American, Asia Pacific, and European long/short funds of hedge funds

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# Are Funds of Hedge Funds Efficient? An Empirical Analysis for North American, Asia Pacific, and European Long/Short Funds of Hedge Funds

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This study aims to examine whether long/short funds of hedge funds truly provide better diversification benefits to hedge fund investors as compared to efficient portfolios of long/short hedge funds in North America, Europe, and Asia Pacific. Data of long/short hedge funds and long/short FOHFs are obtained from Eurekahedge databases from 1st January 2008 to 31st December 2016. Mean-variance optimization method is employed to construct efficient portfolios of 100 long/short hedge funds with highest Sharpe ratios for each of the selected regions. To ensure the robustness of our findings, two rolling windows of observation are set up for a comparative analysis. This study concludes that most of the single-region focused long/short FOHFs in the sample, did not outperform the constructed efficient portfolios of long/short hedge funds investing in the same region. In fact, many long/short FOHFs did not survive more than a period of six years as observed in this study. (JEL: G11)

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## I. Introduction

According to Eurekahedge Inc., the global hedge fund industry has been experiencing a bumpy ride since 2016. There was a huge redemption of US\$8.7 billion in September 2016, the highest amount since 2009. Events such as the war in the Middle East, the conflict in Ukraine, the election in the United States, the Syrian refugee crisis in Europe, and the Brexit, have led to many uncertainties in many investments around the world, including hedge fund investments. Thus, it is indeed a challenging period for hedge fund managers to show-off their self-claimed superior managerial skills.

In terms of investment strategies, some strategies benefited from these changes while others did not. According to Eurekahedge Inc., Event Driven strategy appeared to be the worst performing strategy in 9 out of 12 months in 2016, while CTA/managed futures and multi-strategy hedge funds appeared to do well with US\$17.1 billion growth of funds during the first 9 months of the year and the highest inflow of US\$11 billion fund amount in its history. In terms of geographical regions, hedge fund investors have also shifted their investments to adjust for changes. As a result, the North American hedge fund industry experienced a total net inflow of US\$13.1 billion in 2016, while a heavy investor redemption with an amount of US\$17.1 billion was experienced by the European hedge fund industry within the same year. In Asia, Asia-Pacific-including-Japan strategy had a decrease in its net asset value (NAV) by 3%, while Asia-excluding-Japan strategy performed better and grew up to 2.39% of its NAV. North American hedge funds achieved an average return of 18% and many of them had a double-digit return by August 2016, while European and Asian hedge funds only achieved an average return of 8%.

As defined by BarclayHedge Ltd., funds of hedge funds (FOHF) is a portfolio of hedge funds, pursuing similar or different investment strategies. FOHFs are classified exclusively by the fundamental

objective, which is to offer better diversification benefits across investment styles, sectors and/or regions, while charging investors with much lower management fees. Thus, FOHFs attract great attention from institutional investors (Amenc et al., 2004). With the present uncertainty in the global economic and political landscape around the world, it may seem harder for investors to navigate the situation and manage their portfolios profitably. Being self-claimed as a well-diversified and professionally managed portfolio of hedge funds, a FOHF should be able to offer hedge fund investors better diversification benefits as compared to individual hedge funds and/or portfolios of hedge funds out there. This study aims to examine the merit of this claim.

Based on the statistics provided by Eurekahedge Inc., 90% of the hedge fund industry is in three regions: Asia-Pacific, North America, and Europe, and the most popular strategy adopted by hedge funds in these three regions is long/short. Therefore, this study will mainly focus on only long/short hedge funds and long/short FOHFs that are investing fully in each of the above-mentioned regions. The main objective of this study is to examine whether the performance of long/short FOHFs are truly superior than any efficient portfolios of long/short hedge funds, investing in each of the three regions: Asia Pacific, North America, and Europe.

The remainder of this paper is organized as follows: Section II reviews relevant studies on performances of hedge funds and FOHFs. Section III presents the data and the methodology used in this study. Section IV discusses the empirical findings of this study. Section V concludes.

## **II. Review of past studies**

Hedge funds compared to traditional investments perform better (Ding and Shawky, 2007). The performance achieved by this industry is undoubtedly associated with the diversification benefits offered to investors. Evidence of the benefits of diversification offered by hedge funds is available in many studies. Fung and Hsieh (2001) find that when the underlying market experiences losses, adding trend-following hedge funds to a portfolio of stocks and bonds can reduce the volatility of that portfolio if it previously consisted of only stocks and bonds. Using monthly returns of hedge funds from January 1994 to December 2000 from CSFB/Tremont database, Asness et al. (2001) find a

significant evidence of excess returns offered by hedge funds in their sample. Empirical findings provided in Darius et al. (2002) also suggest that diversification benefits can be achieved in a portfolio of hedge funds. Lubochinsky et al. (2002) find evidences that when the allocation to hedge funds in one's portfolio is increased, returns of that portfolio improve consistently from 0.7% to 1.6%. Favre et al. (2000) discover that when 10% of hedge funds is invested in the Swiss pension fund, the modified Sharpe ratios improve significantly from 0.22 to 0.30 under the mean-variance (MV) framework and from 0.21 to 0.28 under the modified value-at-risk (VaR) framework. Lewis (2009) also shows that the inclusion of hedge funds in a life cycle investment product enhances its overall returns.

The low or negative correlation with underlying markets (Lubochinsky et al., 2002) is a great source for diversifying risks in hedge funds. As a result, hedge funds are expected to contribute to a greater diversification effect on a portfolio of securities (Cvitanić et al., 2003). Bacmann and Gawron (2004) find that the degree of risk is reduced greatly for a portfolio consisting of both hedge funds and traditional securities. This happens when the percentage of the portfolio allocation for managed futures and - especially - FOFs is above 80%. Furthermore, the authors also find that when hedge funds are added in a portfolio containing a large amount of bonds, the risk of a portfolio can be reduced by 50%. Using hedge fund data collected from CSFB/Tremont hedge fund indexes, Amenc and Martellini (2002) find that including an optimal number of hedge funds in a portfolio of securities can reduce the portfolio volatility without reducing its returns. Using data obtained from TASS for hedge funds and MSCI for Swiss as well as international equities and bonds between January 1994 and December 2000, Signer and Favre (2002) also find that a portfolio that includes hedge funds performs better than a portfolio without hedge funds. In another study by Hagelin and Pramborg (2003) where the HFR fund weighted composite index and the HFR fund of funds index are used, significant increases in geometric returns are found for a portfolio with hedge funds while its standard deviations remain constant. French (2005) finds that that even if hedge funds do not offer any diversification benefits, an efficient frontier constructed for portfolios that include hedge funds outperforms portfolios that include only traditional securities such as bonds and equities. This suggests that adding hedge funds in a portfolio can enhance returns while maintaining risk levels.

If individual hedge funds offer diversification benefits to investors (Edwards and Caglayan, 2001), it would make more sense for a portfolio of hedge funds to offer a greater diversification effect. Furthermore, in terms of a managerial perspective, managing a single fund manager is easier than managing many individual funds' managers. Kat and Palaro (2007) find that a fund of funds provides a low correlation between individual hedge funds through diversification, which suggests that a fund of funds should have less risk than that of individual hedge funds present in that fund of funds. According to Amenc et al. (2004), FOFs are reported as the most preferred investment vehicle by institutional investors. By December 2002, FOFs represented around 20% to 25% of the assets of the entire hedge fund industry and had up to US\$1 million by the end of 2004. Amin and Kat (2003) also confirm that a portfolio of hedge funds, i.e. a hedge fund index, performs better than individual hedge funds. In Gueyié and Amvella (2006), when adding FOFs into a portfolio of stocks and bonds, the authors find that the risk-adjusted performance of the portfolio is improved, especially when the portfolio allocation for FOFs increases. Hutson (2006) reports that the number of FOHFs was so significant in 2004, as it reached to around two third of the total hedge funds in Australia. The relaxation in regulation imposed on FOHFs has allowed more investors with lesser wealth to invest in FOHFs. Closer monitoring process, flexibility in redemption, and lower minimum investment requirement may contribute to the rapid growth of FOHFs in recent years. Hutson (2006) argues that FOHFs often reflect the actual performance better in terms of their reported returns and proves that FOHFs offer better diversification benefits to a portfolio as they have a lower correlation with the underlying market (S&P 500) as compared to that of hedge fund index. Kooli (2007) also examines the benefit of adding FOHFs to a benchmark portfolio by applying mean-variance spanning tests over the period of 1994-2004. The author finds that including FOHFs to a set of benchmark portfolios of U.S. stocks improve its risk-return trade-off. However, the author realizes that the finding will be less evident when an internationally diversified portfolio is considered as a benchmark. The use of financial derivatives may be the reason why FOHFs can manage their risks better as compared to individual hedge funds (Peltomäki, 2013).

However, several studies find that inefficiency is achieved by a fund of hedge funds (FOF). Adding a fund of hedge funds in a portfolio consisting of other traditional securities (stocks and bonds) may not

necessarily enhance returns for that portfolio (Ennis and Sebastian, 2003). Using the MV framework, Ennis and Sebastian (2003) construct four different portfolios with different allocations among a fund of hedge fund index, an equity index, and a bond index, using data collected for the period of 1994-2002, to see if a fund of hedge funds can enhance a portfolio's returns. Results obtained from these portfolios show that a portfolio with a higher allocation for the fund of hedge fund index has a lower return and a lower Sharpe ratio, while a portfolio that excludes the fund of hedge fund index has the highest return. Standard deviations are all the same in these portfolios.

As evidenced by the above-mentioned studies, one may say that although hedge funds appear to play a vital role in risk reduction in a portfolio of investment, FOHFs simply known as a portfolio of hedge funds, may or may not necessarily offer a good risk reduction to a portfolio of investment. This raises a question of "Why so?". However, it seems unclear on the exact types of FOHFs were selected for each of the above-mentioned studies, since FOHFs possess many different characteristics, i.e. investment strategies, geographical mandates, etc. Therefore, drawing a definite conclusion from the above-reviewed studies may not be possible. Moreover, FOHFs that are diversified across asset classes and geographies, do not have positive performances according to Shawky et al. (2012). Thus, this study is limited to only long/short strategy, the most commonly adopted strategy by hedge fund investors in three regional markets: Asia Pacific, North America, and Europe. This study is, therefore, expected to make a meaningful contribution to the knowledge of how long/short FOHFs and portfolios of long/short hedge funds perform.

### **III. Research methodology**

#### *A. Data and Sample Selection*

According to Eurekahedge Inc., more than 90% of the global hedge fund industry is in three main regions: North America, Asia Pacific, and Europe. Thus, data used in this study, i.e. monthly returns and fund characteristics, are mainly extracted from North American, Asia Pacific, European hedge fund databases, and fund of hedge funds (FOHFs) database. The four databases are all provided by Eurekahedge Inc., one of largest world hedge fund data providers. Monthly returns of all funds

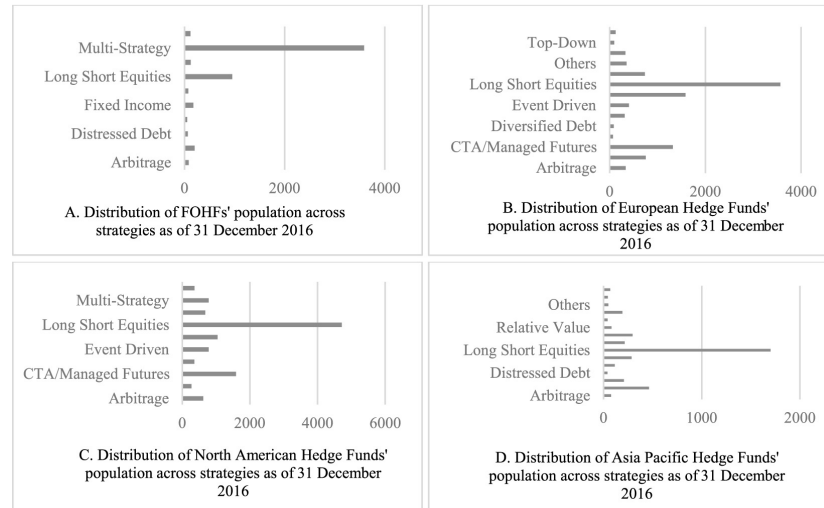


FIGURE 1.

reported to Eurekahedge Inc., are net of operating fees, i.e. management fees and performance fees.

As shown in figure 1, long/short strategy appears to be the second most popularly adopted strategy among FOHFs and the most popularly adopted strategy among North American, Asia Pacific and European hedge funds. Therefore, all long/short hedge funds that are present in the three Eurekahedge databases of North American, Asia Pacific, and European hedge funds, are selected for this study. For FOHF database, only long/short FOHFs with 100% investment made in each of the three selected regions are chosen for this study.

The study period is from 1<sup>st</sup> January 2008 to 31<sup>st</sup> December 2016, which is then divided into three sub-sample periods: (1) 1<sup>st</sup> January 2008 - 31<sup>st</sup> December 2010, (2) 1<sup>st</sup> January 2011 - 31<sup>st</sup> December 2013, and (3) 1<sup>st</sup> January 2014 - 31<sup>st</sup> December 2016. To ensure the robustness of all findings, two rolling windows of observation are set up for a comparative analysis: in-sample and out-of-sample periods. The first and the second above-mentioned sub-sample periods are the two in-sample periods, and the second and the third above-mentioned sub-sample periods are the two corresponding out-of-sample periods, respectively.

All Asia Pacific, North American, and European long/short hedge funds, and long/short FOHFs investing fully in each of the three



selected regions, with full monthly-return data during both in-sample period and its respective out-of-sample period, are included in the analysis. The full monthly-return data requirement for these funds over a period of 6 years, certifies their long-term performance during the study period, which ensures that comparative analyses made for this study will be accurate and sound. The study sample consists of 1,433 long/short North American hedge funds, 1,078 Asia Pacific long/short hedge funds, 1,194 European long/short hedge funds, 7 long/short FOHFs investing fully in North America, 54 long/short FOHFs investing fully in Asia Pacific, and 2 long/short FOHFs investing fully in Europe (see table 1). Descriptive statistics and the number of hedge funds and FOHFs that are included in all sub-samples of this study are also shown in table 2.

As details of hedge funds included in a FOHF are often unknown to hedge fund investors, except its investment strategy and geographical mandate. Moreover, as a FOHF is often claimed to be a well-diversified portfolio of hedge funds, it is expected to be an efficient portfolio of hedge funds, having similar strategy and geographical mandate with the FOHF. Therefore, in this study, comparative analyses made for long/short FOHFs and constructed efficient portfolios of long/short hedge funds investing in each of the three selected regions, will provide an insight on whether those long/short FOHFs provide better diversification benefits to hedge fund investors. The comparative analyses will be done for both in-sample and out-of-sample periods, to ensure the robustness of all findings.

#### *B. Portfolio construction methods*

Mean-Variance (MV) optimization method is adopted. Efficient portfolios of Asia Pacific, European, and North American long/short hedge funds are constructed for 100 hedge funds with highest Sharpe ratios in each of the in-sample periods. The selection of 100 funds with highest Sharpe ratios is based on the rationality that investors want to select best performing funds among the top 100 for their investment. The performance of these portfolios will be then compared to those of long/short FOHFs, investing fully in Asia Pacific, North America, and Europe, respectively.

The MV approach was first developed by Markowitz (1952) to evaluate portfolio investments. Under this framework, it is assumed that

**TABLE 1. Selected Samples of Long/Short Hedge Funds and Long/Short FOHFs Investing Fully in the Asia Pacific, North American, and European Regions during the Study Period of 1<sup>st</sup> January 2008 - 31<sup>st</sup> December 2016**

Samples of	the Entire Sample Period (1 January 2008 - 31 December 2016)	Period consisting of the In-Sample Period (1 January 2008 - 31 December 2010) & the Out-of-Sample Period (1 January 2011 - 31 December 2013)	Period consisting of the In-Sample Period (1 January 2011 - 31 December 2013) & the Out-of-Sample Period (1 January 2014 - 31 December 2016)
Asia Pacific Long/Short Hedge Funds	1078	165	167
North American Long/Short Hedge Funds	1433	251	232
European Long/Short Hedge Funds	1194	199	233
Long/Short funds of Hedge Funds investing fully in Europe	2	1	0
Long/Short funds of Hedge Funds investing fully in North America	7	2	2
Long/Short funds of Hedge Funds investing fully in Asia Pacific	54	16	14

**Note:** This table reports the number of selected long/short hedge funds and long/short FOHFs, whose monthly return data are fully present during the following periods: (1) the entire sample period, (2) period consisting of the in-sample period (1<sup>st</sup> January 2008 – 31<sup>st</sup> December 2010) and the out-of-sample period (1<sup>st</sup> January 2011 - 31<sup>st</sup> December 2013), and (3) period consisting of the in-sample period (1<sup>st</sup> January 2011 - 31<sup>st</sup> December 2013) and the out-of-sample period (1<sup>st</sup> January 2014 - 31<sup>st</sup> December 2016). Source: Eurekahedge Inc.

**TABLE 2. Descriptive Statistics for Samples of Asia Pacific, North American, and European Long/Short Hedge Funds, whose month returns are available fully during Both In-sample and Out-of-Sample Periods**

Samples of	Average Monthly Return (%)	Monthly Standard Deviation (%)	Sharpe Ratio
165 Asia Pacific Long/Short Hedge Funds Present in both			
In-sample Period: (1 <sup>st</sup> January 2008 - 31 <sup>st</sup> December 2010) and	Maximum	25.1476	0.6828
Out-of-Sample Period: (1 <sup>st</sup> January 2011 - 31 <sup>st</sup> December 2013)	Minimum	0.9822	-0.2248
167 Asia Pacific Long/Short Hedge Funds Present in both			
In-sample Period: (1 <sup>st</sup> January 2011 - 31 <sup>st</sup> December 2013) and	Maximum	15.5905	0.7366
Out-of-Sample Period: (1 <sup>st</sup> January 2014 - 31 <sup>st</sup> December 2016)	Minimum	0.6915	-0.2268
199 European Long/Short Hedge Funds Present in both			
In-sample Period: (1 <sup>st</sup> January 2008 - 31 <sup>st</sup> December 2010) and	Maximum	18.2268	0.8964
Out-of-Sample Period: (1 <sup>st</sup> January 2011 - 31 <sup>st</sup> December 2013)	Minimum	0.7182	-0.1715

( Continued )

TABLE 2. (Continued)

Samples of	Average Monthly Return (%)	Monthly Standard Deviation (%)	Sharpe Ratio
233 European Long/Short Hedge Funds Present in both			
In-sample Period: (1 <sup>st</sup> January 2011 - 31 <sup>st</sup> December 2013) and	Maximum	7.2706	1.1066
Out-of-Sample Period: (1 <sup>st</sup> January 2014 - 31 <sup>st</sup> December 2016)	Minimum	0.3733	-0.2547
251 North American Long/Short Hedge Funds Present in both			
In-sample Period: (1 <sup>st</sup> January 2008 - 31 <sup>st</sup> December 2010) and	Maximum	23.0130	11.8811
Out-of-Sample Period: (1 <sup>st</sup> January 2011 - 31 <sup>st</sup> December 2013)	Minimum	0.0626	-0.2276
232 North American Long/Short Hedge Funds Present in both			
In-sample Period: (1 <sup>st</sup> January 2011 - 31 <sup>st</sup> December 2013) and	Maximum	20.9047	1.2415
Out-of-Sample Period: (1 <sup>st</sup> January 2014 - 31 <sup>st</sup> December 2016)	Minimum	0.3354	-0.4510

**Note:** This table reports the average monthly return, monthly standard deviation, and Sharpe ratio for each of the 6 sub-samples of Asia Pacific, North American, and European long/short hedge funds. For each of the three regional markets, long/short hedge funds with full monthly return data for each of the following two sets of sub-sample periods are chosen to be in the two sub-samples, respectively: (1) the in-sample period of 1<sup>st</sup> January 2008 - 31<sup>st</sup> December 2010 and the out-of-sample period of 1<sup>st</sup> January 2011 - 31<sup>st</sup> December 2013, and (2) the in-sample period of 1<sup>st</sup> January 2011 - 31<sup>st</sup> December 2013 and the out-of-sample period of 1<sup>st</sup> January 2014 - 31<sup>st</sup> December 2016.

risk-adverse investors need to make a trade-off between risks known as standard deviations, and rewards known as returns on their investment decision problems. Therefore, the utility function for investors is constrained as only a function of mean and variance of the return distribution. The allocation of funds for each asset in an optimal portfolio is done via solving a linear programming problem, either maximising return or minimising variance. There are two assumptions under this framework: (1) the investors' utility function is quadratic and/or (2) the returns of assets are normally distributed.

The objective function of the quadratic programming (Elton, Gruber, Brown, and Goetzmann, 2003) is stated as follows:

Minimise:

$$\sigma_p^2 = \sum_{i=1}^N X_i^2 \sigma_i^2 + \sum_{i=1}^N \sum_{\substack{j=1 \\ j \neq i}}^N X_i X_j \sigma_i \sigma_j \rho_{ij} \quad (1)$$

Subject to:

$$\bar{R}_p = \sum_{i=1}^n X_i \times \bar{R}_i \quad (2)$$

$$\sum_{i=1}^N X_i = 1 \quad (3)$$

Where  $X_i$  is the weight for hedge fund  $i$ , where  $i$  is ranging from 1 to 100;  $\bar{R}_i$  is the average return for hedge fund  $i$ ;  $\sigma_i^2$  is the variance for hedge fund  $i$ ;  $\rho_{ij}$  is the correlation coefficient between hedge fund  $i$  and hedge fund  $j$ ;  $\sigma_p^2$  is variance of a portfolio of hedge funds;  $\bar{R}_p$  is the average return for a portfolio of hedge funds;  $N$  is the number of hedge funds in a portfolio, i.e.  $N = 100$  in this study. All unconstrained variables are not imposed to be non-negative, implying short selling is allowed for funds in each portfolio. GRG nonlinear engine is selected to run the linear programming to smooth the nonlinear.

For each of the in-sample periods, from each regional hedge fund database, 100 long/short hedge funds with highest Sharpe ratios will be selected to construct 20 efficient portfolios of long/short hedge funds. Among these 20 portfolios, the first portfolio is the minimum-variance portfolio, the twentieth portfolio is the maximum-return portfolio, and the rest are constructed with different combinations between these two efficient portfolios. The performance of all constructed efficient portfolios of long/short hedge funds in that region will be compared

with the performance of long/short FOHFs investing fully in the same region and during the same in-sample period. The performance of 20 efficient portfolios constructed for an in-sample period will be then observed during the following out-of-sample period, which are then compared with the performance of the same long/short FOHFs during that out-of-sample period. This process will help to confirm the results obtained earlier for the in-sample period. To understand further how external factors such as economic and/or political conditions might affect the performance of the hedge fund industry in each of the three selected regions, in-sample and out-of-sample performances of the constructed efficient portfolios of long/short hedge funds for that region, will also be compared.

#### **IV. Empirical findings**

##### *A. Performance of Efficient Portfolios of Asia Pacific Long/Short Hedge Funds and FOHFs Investing fully in the Asia Pacific Region*

*Findings Obtained for the In-Sample Period of 1st January 2008 – 31st December 2010 and the Out-of-Sample Period of 1st January 2011 – 31st December 2013*

As shown in table 2, there are 165 Asia Pacific long/short hedge funds, having full monthly return data for both the above-mentioned in-sample and out-of-sample periods. These funds have average monthly returns ranging from (–1.64%) to 2.54%, while their standard deviations range largely from 0.98% to 25.15%. The high standard deviations for some Asia Pacific long/short hedge funds in the sample may somewhat explain the low range, i.e. from (–0.22) to 0.68, of Sharpe ratios obtained for this sample of funds. Out of the 165 funds, 100 funds with highest Sharpe ratios are selected to construct 20 efficient portfolios as described in the previous section. Results obtained for these 20 efficient portfolios for the in-sample period of 1<sup>st</sup> January 2008 - 31<sup>st</sup> December 2010, are shown in figure 2, part A.

In the sample of Asia Pacific long/short FOHFs, only 17 FOHFs have full monthly returns during both above-mentioned in-sample and out-of-sample periods (see figure 2, part C and E). As shown in figure 2, part C, these Asia Pacific long/short FOHFs have less favourable risk and return trade-offs as compared to those obtained for portfolios of

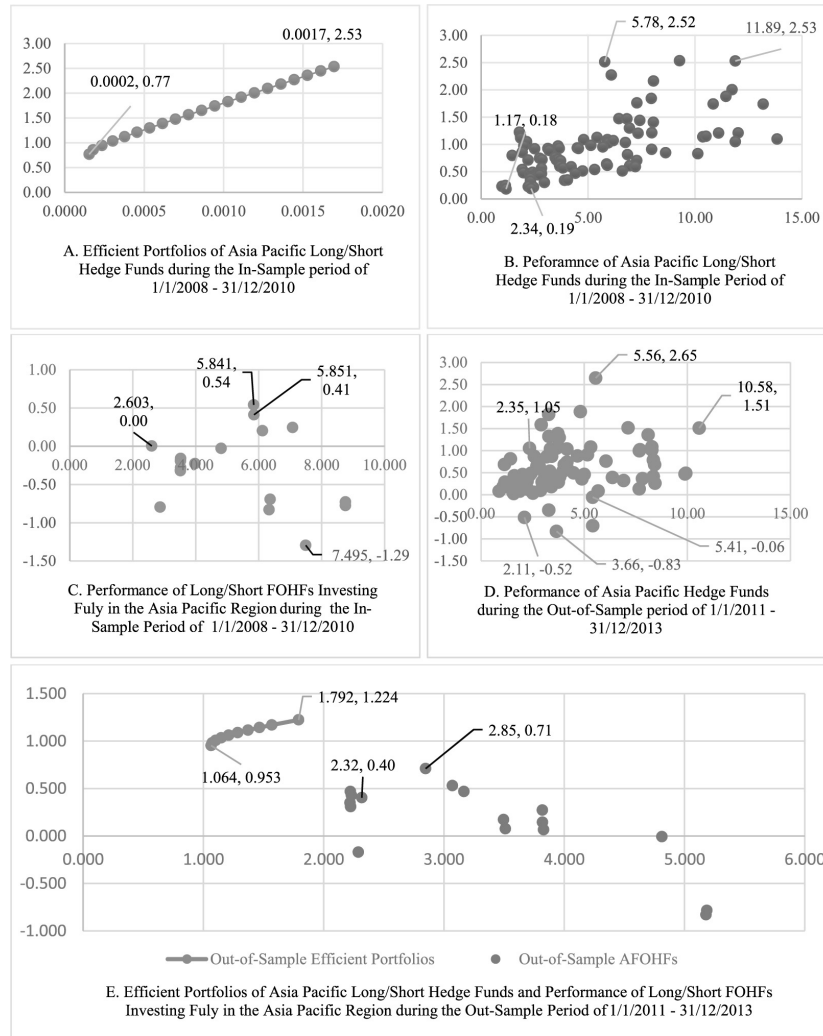


FIGURE 2.

**Note:** Values on X-axis and Y-axis are referred to standard deviations and returns, respectively. All numbers are per 100.

Asia Pacific long/short hedge funds lying on the efficient frontier, constructed for the above-mentioned in-sample period (see figure 2, part A). In terms of the individual performance, most of the 100 Asia Pacific long/short hedge funds, selected to construct the efficient portfolios,

have higher risk and return trade-offs than those of the 17 Asia Pacific long/short FOHFs, as shown in figure 2, part B.

As compared with the risk and return trade-offs obtained during the above-mentioned in-sample period for the efficient portfolios of Asia Pacific long/short hedge funds (see figure 2, part A), their risk and return trade-offs obtained during the out-of-sample period (see figure 2, part E) appear to be less favourable. This could be because more Asia Pacific long/short hedge funds suffered from negative returns during the out-of-sample period (see figure 2, part D), while none did so during the in-sample period (see figure 2, part B). This finding may imply a likely higher economic uncertainty present in the Asia Pacific region during the out-of-sample period, as compared to that during the in-sample period.

As observed for the out-of-sample period (see figure 2, part E), the 17 Asia Pacific long/short FOHFs are all below the efficient frontier obtained for the efficient portfolios of Asia Pacific long/short hedge funds, that are constructed earlier during the in-sample period. In short, this finding confirms that the constructed portfolios of Asia Pacific long/short hedge funds have superior risk and return trade-offs than those of the 17 Asia Pacific long/short FOHFs during both the above-mentioned in-sample and out-of-sample periods.

*Finding Obtained for the In-Sample Period of 1<sup>st</sup> January 2011 - 31<sup>st</sup> December 2013 and the Out-of-Sample Period of 1<sup>st</sup> January 2014 - 31<sup>st</sup> December 2016*

There are 167 Asia Pacific long/short hedge funds with full monthly return data during both the above-mentioned in-sample and out-of-sample periods as shown in table 2. The average monthly returns of these funds range from (−1.35%) to 2.89%, while their standard deviations and sharp ratios range from 0.69% to 15.59%, and from (−0.23) to 0.74, respectively. Similar to the previous in-sample and out-of-sample periods, the first 100 Asia Pacific long/short hedge funds with highest Sharpe ratios are selected to construct the 20 efficient portfolios as explained in the portfolio construction method section. Results obtained for these 20 efficient portfolios for the in-sample period of 1<sup>st</sup> January 2011 - 31<sup>st</sup> December 2013, are shown in figure 3, part A.

Among many Asia Pacific long/short FOHFs present in the FOHF database, only 15 have full monthly returns during both the above-mentioned in-sample and out-of-sample periods (see figure 3,



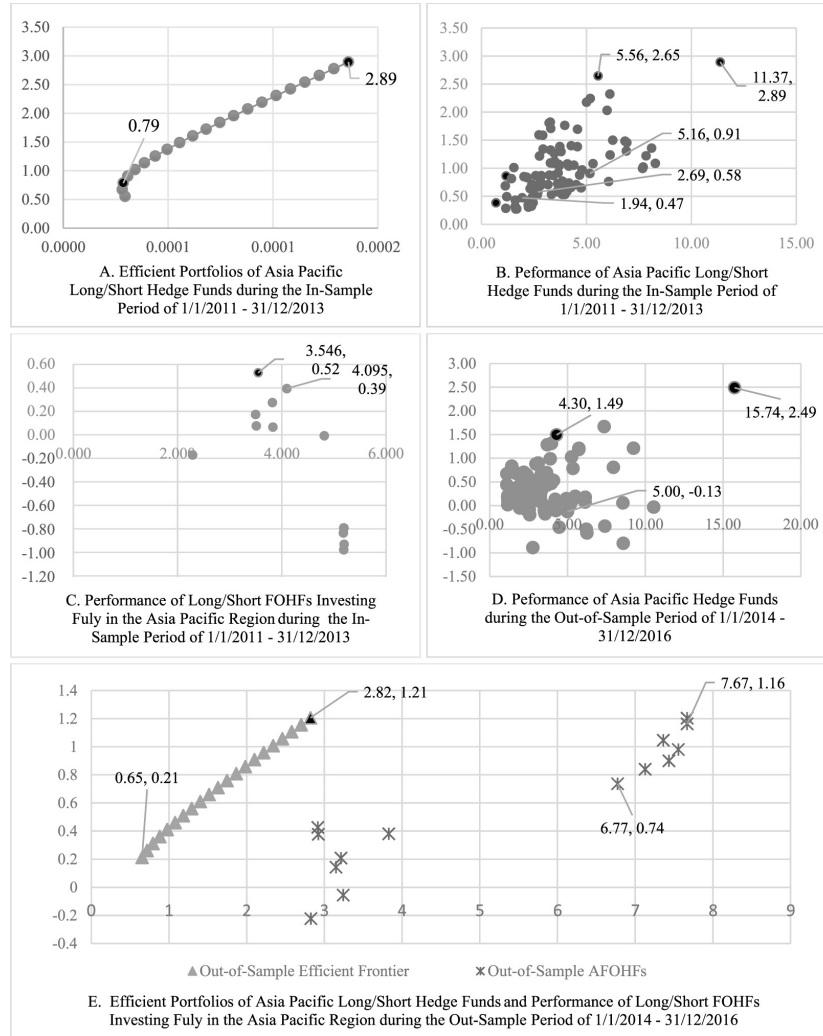


FIGURE 3.

**Note:** Values on X-axis and Y-axis are referred to standard deviations and returns, respectively. All numbers are per 100.

part C and part E). These Asia Pacific long/short FOHFs have much lower average returns and higher standard deviations (see figure 3, part C) as compared to those obtained for portfolios of Asia Pacific long/short hedge funds lying on the efficient frontier, constructed for the

above-mentioned in-sample period (see figure 3, part A). In terms of the individual performance, most of the 100 Asia Pacific long/short hedge funds, selected to construct the efficient portfolios, have higher returns at a given risk, or lower risks at a given return, as compared to those of the 15 Asia Pacific long/short FOHFs (see figure 3, part B).

As compared with the risk and return trade-offs obtained during the above-mentioned in-sample period for the efficient portfolios of Asia Pacific long/short hedge funds (see figure 3, part A), their risk and return trade-offs obtained during the out-of-sample period (see figure 3, part E) appear to be less favourable. Again, this could be because quite a several number of Asia Pacific long/short hedge funds suffered from negative returns during the out-of-sample period (see figure 3, part D), while none did so during the in-sample period (see figure 3, part B). This may suggest that the Asia Pacific economic landscape became likely more uncertain during the out-of-sample period, as compared to that during the in-sample period.

As observed for the out-of-sample period (see figure 3, part E), the 15 Asia Pacific long/short FOHFs are all below the efficient frontier obtained for the efficient portfolios of Asia Pacific long/short hedge funds, that are constructed earlier during the in-sample period. This finding confirms that the constructed portfolios of Asia Pacific long/short hedge funds have superior risk and return trade-offs than those of the 15 Asia Pacific long/short FOHFs during both the above-mentioned in-sample and out-of-sample periods.

#### *B. Performance of Efficient Portfolios of European Long/Short Hedge Funds and FOHFs Investing Fully in the European Region*

*Findings Obtained for the In-Sample Period of 1<sup>st</sup> January 2008 - 31<sup>st</sup> December 2010 and the Out-of-Sample Period of 1<sup>st</sup> January 2011 - 31<sup>st</sup> December 2013*

As shown in table 2, there are 199 European long/short hedge funds, having full monthly return data for both the above-mentioned in-sample and out-of-sample periods. These funds have average monthly returns ranging from (−1.14%) to 2.79%, while their standard deviations range largely from 0.72% to 18.23%. The low range of Sharpe ratios, i.e. from (−0.17) to 0.90, obtained for the 199 European long/short hedge funds, may be due to the high standard deviations of many funds. Out of the 199 funds, 100 funds with highest Sharpe ratios are selected to construct

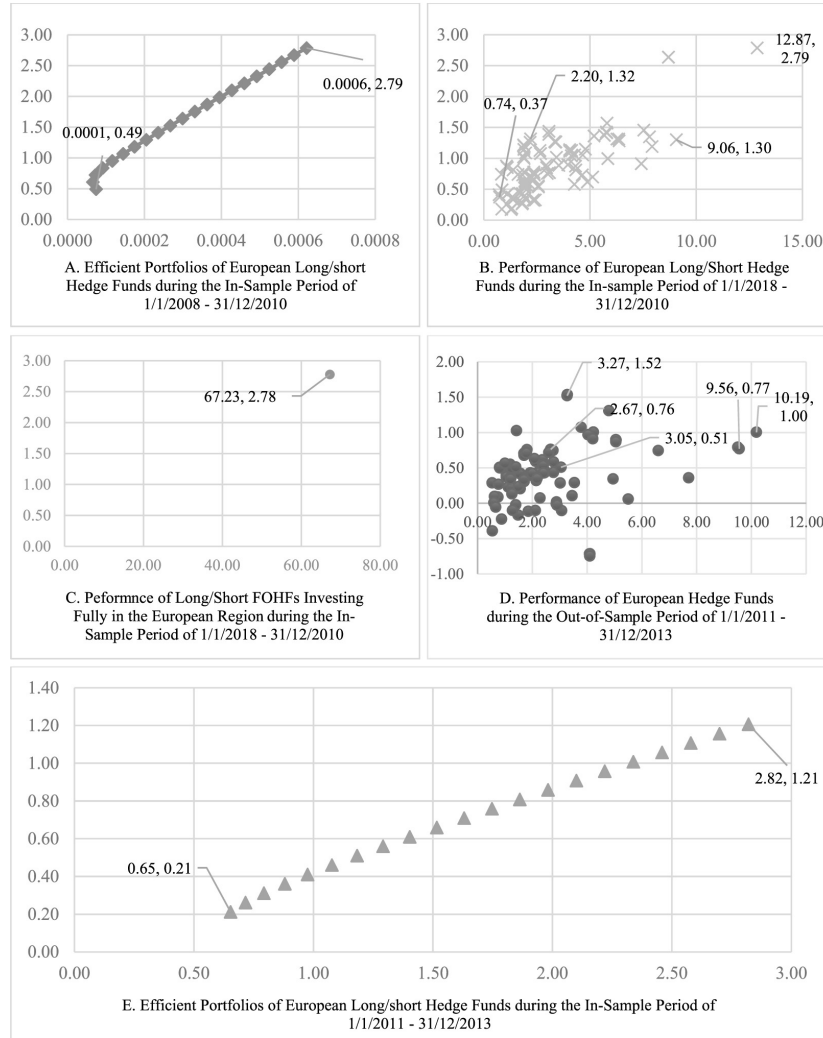


FIGURE 4.

**Note:** Values on X-axis and Y-axis are referred to standard deviations and returns, respectively. All numbers are per 100.

20 efficient portfolios as described in the portfolio construction method section. Results obtained for these 20 efficient portfolios for the in-sample period of 1<sup>st</sup> January 2008 - 31<sup>st</sup> December 2010, are shown in figure 4, part A.

In the sample of European long/short FOHFs, only 1 FOHF has full monthly returns during the above-mentioned in-sample period (see figure 4, part C). This fund stopped reporting to the European hedge fund database during the out-of-sample period. As shown in figure 4, part C, this European long/short FOHF has less favourable risk and return trade-off as compared to those obtained for portfolios of European long/short hedge funds lying on the efficient frontier, constructed for the above-mentioned in-sample period (see figure 4, part A). In terms of the individual performance, most of the 100 European long/short hedge funds, selected to construct the efficient portfolios, have lower returns and much lower standard deviation, resulting in higher Sharpe ratios as compared to the European long/short FOHF (see figure 4, part C).

As compared with the risk and return trade-offs obtained during the above-mentioned in-sample period for the efficient portfolios of European long/short hedge funds (see figure 4, part A), their risk and return trade-offs obtained during the out-of-sample period (see figure 4, part E) appear to be less favourable. As shown in figure 4, part D, many European long/short hedge funds have lower returns at a given standard deviation, as compared to theirs during the in-sample period (see figure 4, part B). This may suggest that the European region likely experienced a rising uncertainty in its economy during the out-of-sample period, and thus, affecting the performance of most European long/short hedge funds.

Since none of European long/short FOHFs survived during the out-of-sample period, investing in efficient portfolios of European long/short hedge funds seemed to be the only option for long/short hedge fund investors who wish to diversify risk from the hedge fund investment.

*Finding Obtained for the In-Sample Period of 1<sup>st</sup> January 2011 - 31<sup>st</sup> December 2013 and the Out-of-Sample Period of 1<sup>st</sup> January 2014 - 31<sup>st</sup> December 2016*

There are 233 European long/short hedge funds with full monthly return data during both the above-mentioned in-sample and out-of-sample periods as shown in table 2. The average monthly returns of these funds range from (−0.33%) to 2.10%, while their standard deviations and sharp ratios range from 0.37% to 7.27% and from (−0.25) to 1.1, respectively. Like the previous in-sample and out-of-sample periods,

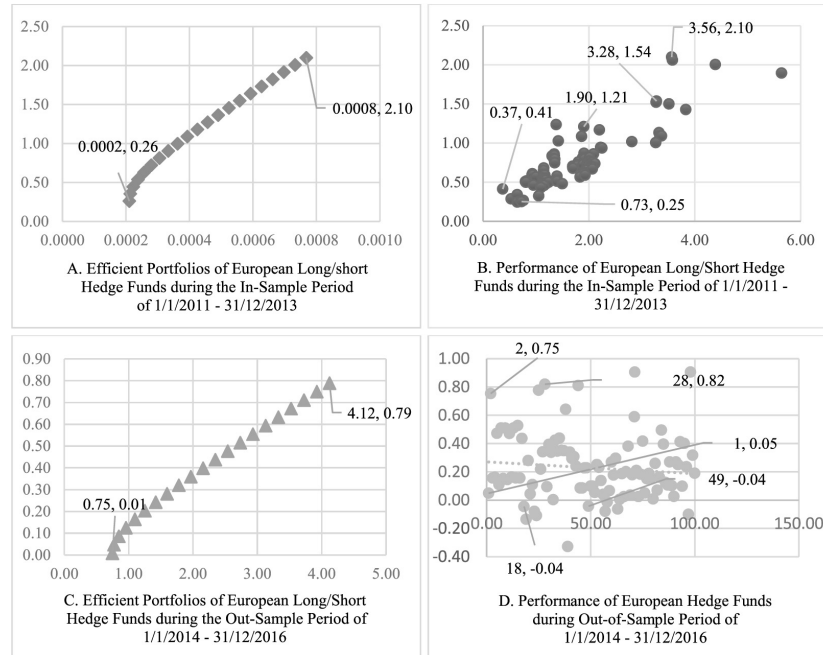


FIGURE 5.

**Note:** Values on X-axis and Y-axis are referred to standard deviations and returns, respectively. All numbers are per 100.

the first 100 European long/short hedge funds with highest Sharpe ratios are selected to construct the 20 efficient portfolios as explained in the research methodology section. Results obtained for these 20 efficient portfolios for the in-sample period of 1<sup>st</sup> January 2011 - 31<sup>st</sup> December 2013, are shown in figure 5, part A.

As compared with the risk and return trade-offs obtained during the above-mentioned in-sample period for the efficient portfolios of European long/short hedge funds (see figure 5, part A), their risk and return trade-offs obtained during the out-of-sample period (see figure 5, part C) appear to be less favourable. Again, this could be because that many European long/short hedge funds have negative returns during the out-of-sample period as shown in figure 5, part D, while all the funds have positive returns during the in-sample period (see figure 5, part B). This may suggest that the European economic condition continuously became likely uncertain during the out-of-sample period of 1<sup>st</sup> January

2014 - 31<sup>st</sup> December 2016, as compared to that during the in-sample period of 1<sup>st</sup> January 2011 - 31<sup>st</sup> December 2013. Unfortunately, none of the European long/short FOHFs in the sample, survived during both the above-mentioned in-sample and out-of-sample periods. Thus, comparison between the performance of European long/short FOHFs with the constructed efficient portfolios of European long/short hedge funds cannot be made for the two said periods. For long/short hedge fund investors investing in Europe, selecting an efficient portfolio of European long/short hedge funds would be the best option to diversify their investment risk during the above-mentioned periods.

*C. Performance of Efficient Portfolios of North American Long/Short Hedge Funds and FOHFs Investing Fully in the North American Region*

*Finding Obtained for the In-Sample Period of 1<sup>st</sup> January 2008 - 31<sup>st</sup> December 2010 and the Out-of-Sample Period of 1<sup>st</sup> January 2011 - 31<sup>st</sup> December 2013*

As shown in table 2, there are 251 North American long/short hedge funds, having full monthly return data for both the above-mentioned in-sample and out-of-sample periods. These funds have average monthly returns ranging from (–2%) to 4.55%, while their standard deviations range largely from 0.06% to 23.01%. Sharpe ratios of these funds are largely ranging from (–0.23) to 11.88, reflecting the exceptionally good performances of some North American long/short hedge funds during the in-sample and out-of-sample periods. Out of the 251 funds, 100 funds with highest Sharpe ratios are selected to construct 20 efficient portfolios as described in the portfolio construction method section. Results obtained for these 20 efficient portfolios for the in-sample period of 1<sup>st</sup> January 2008 - 31<sup>st</sup> December 2010, are shown in figure 6, part A.

Among North American long/short FOHFs present in the FOHF database, only 2 have full monthly returns during both the above-mentioned in-sample and out-of-sample periods (see figure 6, part C and part E). These 2 American long/short FOHFs have much lower average returns, i.e. 0.03% and 0.16%, and higher standard deviations, i.e. 3.4 and 2.36, respectively (see figure 6, part C) as compared to those obtained for portfolios of North American long/short hedge funds lying on the efficient frontier, constructed for the above-mentioned in-sample period (see figure 6, part A). In terms of the

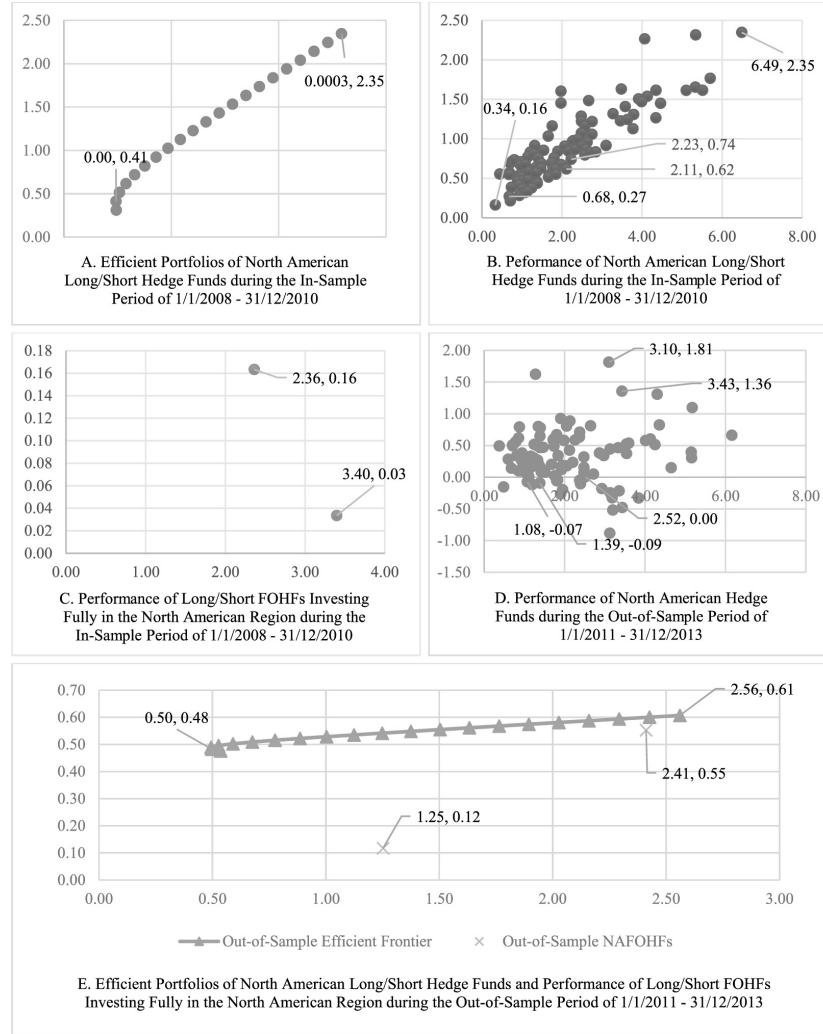


FIGURE 6.

**Note:** Values on X-axis and Y-axis are referred to standard deviations and returns, respectively. All numbers are per 100.

individual performance, most of the 100 North American long/short hedge funds, selected to construct the efficient portfolios, have higher returns at a given risk, or lower risks at a given return, as compared to those of the 2 North American long/short FOHFs (see figure 6, part B).

During the out-of-sample period of 1<sup>st</sup> January 2011 - 31<sup>st</sup> December 2013, risk and return trade-offs obtained for the efficient portfolios of North American long/short hedge funds (see figure 6, part E) appear to be less favourable than theirs during the above-mentioned in-sample period (see figure 6, part A). This could be because that more North American long/short hedge funds suffered from negative returns during the out-of-sample period (see figure 6, part D), while none did so during the in-sample period (see figure 6, part B). This may suggest a likely higher economic uncertainty present in the North American region during the out-of-sample period, as compared to that during the in-sample period.

As shown in figure 6, part E for the out-of-sample period, the 2 North American long/short FOHFs are all below the efficient frontier obtained for the efficient portfolios of North American long/short hedge funds, that are constructed earlier during the in-sample period. This finding suggests that the constructed portfolios of North American long/short hedge funds have superior risk and return trade-offs than those of the 2 North American long/short FOHFs during both the above-mentioned in-sample and out-of-sample periods.

*Findings Obtained for the In-Sample Period of 1<sup>st</sup> January 2011 - 31<sup>st</sup> December 2013 and the Out-of-Sample Period of 1<sup>st</sup> January 2014 - 31<sup>st</sup> December 2016*

There are 232 North American long/short hedge funds (see table 2) having full data for both the above-mentioned in-sample and out-of-sample periods. As compared to long/short hedge funds from other two regions, North American long/short hedge funds have a wider range of the average monthly returns and standard deviations, i.e. from (−3.71%) to 4.34% and from 0.34% to 20.90%, respectively. As compared to the sample of North American long/short hedge funds present during the previous two sub-sample periods, these 232 funds have lower Sharpe ratios, ranging from (−0.45) to 1.24, during the above-mentioned in-sample and out-of-sample periods. To construct 20 efficient portfolios, 100 funds with highest Sharpe ratios from the above-mentioned sample of 232 funds are selected. Results obtained for these 20 efficient portfolios for the in-sample period of 1<sup>st</sup> January 2011 - 31<sup>st</sup> December 2013, are shown in figure 7, part A.

Among North American long/short FOHFs, only 2 FOHFs have full monthly returns during both the above-mentioned in-sample and



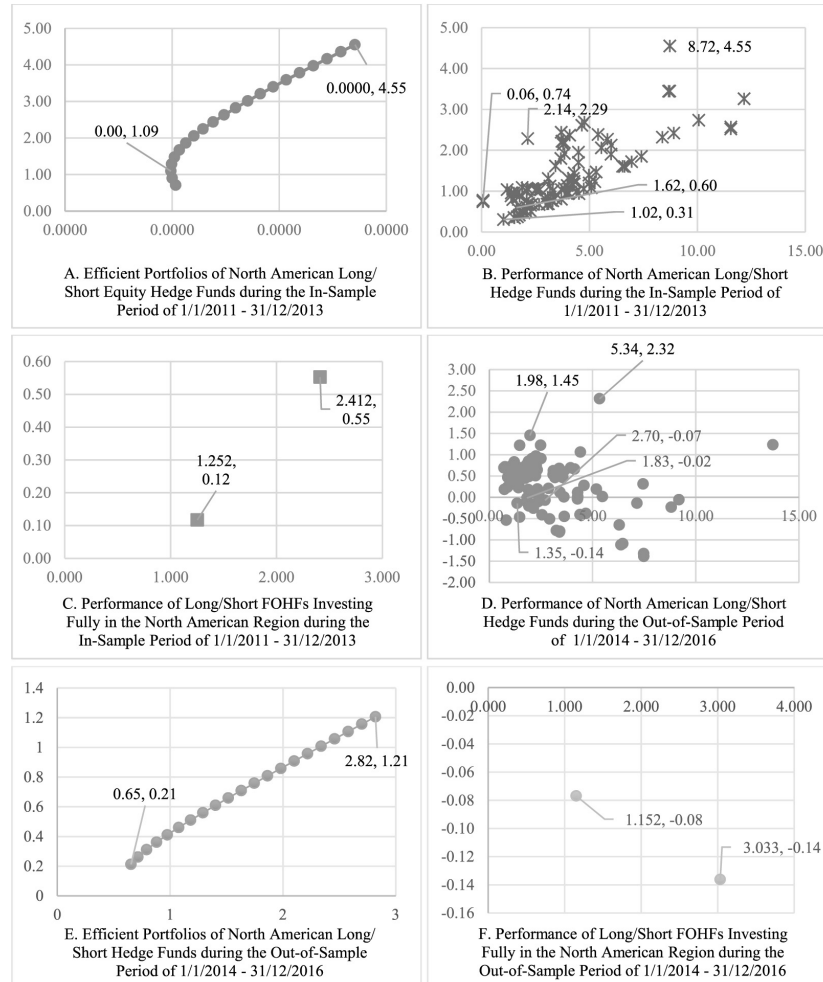


FIGURE 7.

**Note:** Values on X-axis and Y-axis are referred to standard deviations and returns, respectively. All numbers are per 100.

out-of-sample periods (see figure 7, part C and part F). As shown in figure 7, part C, these 2 North American long/short FOHFs have less favourable risk and return trade-offs as compared to those obtained for portfolios of North American long/short hedge funds lying on the efficient frontier, constructed for the above-mentioned in-sample period

(see figure 7, part A). In terms of the individual performance, most of the 100 North American long/short hedge funds, selected to construct the efficient portfolios, have higher risk and return trade-offs than those of the 2 North American long/short FOHFs, as shown in figure 7, part B.

As compared with the risk and return trade-offs obtained for the efficient portfolios of North American long/short hedge funds during the in-sample period of 1<sup>st</sup> January 2011 - 31<sup>st</sup> December 2013 (see figure 7, part A), their risk and return trade-offs obtained during the out-of-sample period (see figure 7, part E) appear to be less favourable. This could be because more North American long/short hedge funds suffered from negative returns during the out-of-sample period (see figure 7, part D), while none did so during the in-sample period (see figure 7, part B). This suggests that the North American economy was highly uncertain during the out-of-sample period, as compared to that during the in-sample period.

As observed for the out-of-sample period (see figure 7, part F), the 2 North American long/short FOHFs have negative returns, and thus clearly less efficient as compared to all efficient portfolios of North American long/short hedge funds (see figure 7, part E) during this period. For long/short hedge fund investors investing in North America, selecting an efficient portfolio of North American long/short hedge funds would be highly suggested to diversify their investment risk.

## **V. Conclusions**

This study examined whether long/short FOHFs truly provide better diversification benefits to hedge fund investors as compared to efficient portfolios of long/short hedge funds in each of the three regions: North America, Europe, and Asia Pacific, where more than 90% of the hedge fund industry is located. Data of the sample of long/short FOHFs and long/short hedge funds are obtained from the FOHF, Asia Pacific, European, and North American hedge fund databases provided by EurekaHedge Inc. over a period of 1<sup>st</sup> January 2008 and 31<sup>st</sup> December 2016. Employing the mean-variance framework proposed by Markowitz (1952), efficient portfolios of 100 long/short hedge funds with highest Sharpe ratios were constructed for each of the three regions: North America, Asia Pacific and Europe, over the study period. Three sub-sample periods with three years each were set up to confirm if

similar results obtained in the in-sample period will also be achieved during the out-of-sample period. Only long/short hedge funds and long/short FOHFs with full monthly return data for both in-sample and out-of-sample periods were included in the analysis. Performances of the constructed efficient portfolios were observed and compared with those of the selected long/short FOHFs, investing fully in the same region during the same period.

The findings of this study showed that performances of the constructed efficient portfolios of long/short hedge funds were better than those of the selected long/short FOHFs, investing fully in the same regions (Asia Pacific, Europe and North America), during the study period. Although long/short FOHFs appeared to be the second most popular strategy for FOHFs, they did not have a long-lasting performance over a six-year period, as observed in this study. As a result, despite many long/short FOHFs present in each of the three selected regions, only a very small number of them fulfil the requirement of having full monthly return data for both in-sample and out-of-sample periods. In addition, the constructed efficient portfolios of long/short hedge funds, investing in Asia Pacific, Europe, and North America, had poorer performances during the out-of-sample periods, suggesting that there has been a growing economic uncertainty in the Asia Pacific, European and North American regions since the year 2008. Therefore, during similar volatile market conditions, long/short hedge fund investors, who wish to invest in a single region such as Asia Pacific, Europe, and North America, are highly advised to invest in an efficient portfolio of long/short hedge funds, rather than in a long/short FOHF investing fully in that region. In addition, taking a proactive step of monitoring a portfolio of your own, investors can also avoid possible frauds that often occur during a financial crisis (Majed, 2018).

The under-performances of many long/short FOHFs investing in a single regional market as found in this study, could be due to the unexpected volatility that had been present concurrently in Asia Pacific, Europe, and North America, during the study period. Moreover, the study focuses mainly on long/short FOHFs, that were largely invested by hedge fund investors. For future research, similar studies may be also conducted for the rest of other investment strategies of FOHFs, investing in Asia Pacific, Europe and North America, to see if similar results can be found. Finally, this study raises two further research questions for future research: (1) “why do single-region focused long/short FOHFs do not perform well over a long period of time as

evidenced in this study?”, and if so, (2) “Will multi-region focused long/short FOHFs offer better diversification benefits to hedge fund investors?”.

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