Funds of Hedge Funds Performance Persistence under Difference Market States

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First draft: August 2013

This draft: August 2013

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Abstract

We examine the performance persistence of funds of hedge funds (FOHFs) under different market states. We show that FOHFs deliver persistent performance on a semi-annual and quarterly rebalancing frequency but we can hardly find evidence of performance persistence in annually rebalanced FOHF portfolios. It is found that market states do not significantly influence on the performance persistence of FOHFs. This finding is distinct to a previous research (Capocci, et al. 2005) where hedge funds were found to deliver persistent performance only in good market state. We also document evidence on the existence of superior FOHF managers who consistently generate positive risk-adjusted return under different market states.

JEL Classification: G2; G11; G15

Key words: Fund of hedge funds, hedge funds, return, performance persistence, alpha

1 Introduction

A Fund of Hedge Fund (FOHF) is a fund that holds a diversified portfolio of hedge funds. FOHFs provide opportunities for investors to get desired exposure to the hedge fund industry and, at the same time, reduce the risk associated with individual hedge fund investment through diversification. In the last decades, FOHFs have received more and more popularity in financial markets with total value of Asset under Management (AUM) reaching $533 billion by the first quarter of 2012. This accounted for about 25% of the total investment received by the hedge fund industry (Schizas, 2012).

FOHF managers are expected to deliver returns through their expertise in fund selection and this partly explains the second layer fees charged by FOHF managers (Ang et al., 2008). However, many studies have found that FOHFs on average generate unsatisfactory returns. A FOHF manager may face the following challenges in selecting suitable hedge funds and maintaining the performance of his/her hedge fund portfolio. Firstly, hedge funds usually adopt dynamic trading strategies which results in time-varying risk exposures. It then requires a FOHF manager to often rebalance his/her hedge fund portfolio. Secondly, the successful hedge fund managers may leave their positions to establish their own funds. The performance of a previous successful fund may not be maintained at the same level of performance due to staff attrition. Lastly, hedge funds usually impose lock-up periods on their products, which may substantially reduce the liquidity of a FOHF's portfolio. Therefore, it becomes difficult for FOHF managers to time the market. Consequently, it is interesting to know whether FOHFs can deliver a persistent performance over time.

Moreover, the performance persistence of FOHFs many vary under different market states. It was found that ordinary hedge fund returns tend to “co-move” under negative market shocks and significant contagions among hedge fund returns were observed under bear market conditions (Agarwal and Naik 2000a, Boyson et al. 2008).Thus it is reasonable to question whether FOHF managers are able to maintain their performance when market declines.

This paper is motivated to provide a performance persistence analysis with special focus on FOHFs. In particular, this research investigates the performance of FOHFs in different market states. To our knowledge, this is the first study on the performance persistence of FOHFs under different market states. We examine the performance persistence during the period from January 1997 to March 2009, which includes two good market states and two bad market states. In addition, this paper contributes to the existing literature with after-GFC evidence. We find that FOHFs deliver strong persistent performance during a holding period of a half-year or a quarter whereas there is no evidence of performance persistence over yearly holding period. We also have documented performance persistence of FOHFs under different market states. We find, during a half-yearly or quarterly holding period, best performing FOHFs continue to deliver higher mean returns than the worst performing FOHFs under both good and bad market states. This finding is different to the results of Capocci et al. (2005), where ordinary hedge funds were found to deliver persistent performance only in the good market state.

This paper is organised as follows. The related literature is reviewed in Section 2. Section 3 provides description of data and data processing procedures. Section 5 sets out the research methods and models employed in the research. Section 5 presents results and conclusions are drawn in Section 6.

2 Literature Review

The performance persistence has been studied at individual hedge fund level but the evidence is mixed. Agarwal et al. (2000) tested the performance persistence in different hedge fund styles over different time horizons. They found significant performance persistence across hedge fund styles at quarterly horizon. However, they documented weak evidence of performance persistence at longer (yearly) time horizon. Many other research have also documented strong performance persistence over short periods (quarterly or semi-annual). Bares et al. (2003) examined the performance persistence of hedge funds over different holding periods ranging from one month to three years. They found evidence of strong performance persistence over one to three months but the persistence reduces rapidly if the holding period is lengthened to longer than one year. In a more recent research of Harri and Brorsen (2004), almost all hedge fund styles under research were found to exhibit short-term performance persistence for up to three or four months. Although short-term performance persistence has strong relation with superior manager skills, Eling (2009) argued that it could also be caused by survivorship bias, back filling bias and return smoothing.

There are evidence on long term performance persistence. Edwards and Caglayan (2001) and Jagannathan et al. (2010) documented performance persistence at one year or even three-year time horizon. In the most recent research of Ammann, et al. (2013), hedge funds were found to perform persistently[1] at three-year time horizon. The researchers tried to relate fund specific characteristics to performance persistence. They found the “Strategy Distinctiveness Index” (SDI) developed by

[1] The performance of the hedge funds in Ammann et al. (2013) is measured by alpha.

Wang and Zheng (2012) can effectively identify the funds with persistent performance.

Capocci, et al. (2005) examined the performance of hedge funds in the time period from January 1994 to December 2002 and investigate the performance persistence respectively in the bull market from January 1994 to March 2000 and in the bear market from April 2000 to December 2002. They claimed that the most predicable superior performance is found in the bullish market only.

Previous studies have established several benefits of investing in FOFHs. For example, Ang et al. (2008) proposed that the exposure to different investment styles through investing in FOHF comes with due diligence in fund selection and oversights in portfolio management, which helps to reduce the cost for unskilled investors. Brands and Gallagher (2005) found that in a mean-variance structure, FOHFs provide enhanced performance as the number of funds in the portfolio increases. Such diversification benefit has also been documented in Amo, et al. (2007).

Moreover, many studies have found that FOHFs deliver unsatisfactory returns. Brown et al. (2003) found, comparing with average hedge funds, FOHFs generated lower risk adjusted returns during the time period of 1994 to 1999. Beckers et al. (2007) found, on average, that FOHFs underperformed fund-weighted composite by more than 5% per year during 1991 to 2005. Some more recent evidence suggests that the 2008 global financial crisis (GFC) has detrimental impacts on global FOHFs. Schizas (2012) pointed out that the monthly return of global FOHFs has decreased sharply after GFC from 0.66% to 0.27%, without any recovery in the post-crisis period. Brown et al. (2011) raised a diversification puzzle in FOHFs returns. They documented a decreasing trend in FOHF returns with the rise in the number of

underlying hedge funds in the portfolio. They suggested that FOHFs tend to over diversify their portfolio and be more exposed to left-tail risk. The argument was supported by their finding that the magnitude of FOHFs' negative skewness is an increasing function of the number of funds in FOHFs portfolios.

Only few studies have shed light on the performance persistence of FOHFs. FOHFs are usually included as a subset hedge fund style in the previous performance persistence research. Harri and Brorsen (2004) employed three different procedures to decide the existence of performance persistence across different hedge fund styles. Their results suggested that FOHFs deliver strong performance persistence in all the three procedures. Similar results are obtained in Edwards and Caglayan (2001). Under a two consecutive period framework, they found previous better/worse performing funds in the previous period continue to deliver above/below average performance in the subsequent period.

In addition, another group of studies on the impact of 2008 Global Financial Crisis provide relevant information on the performance persistence of FOHFs. Schizas (2012) compared the performance of FOHFs before, during and after the crisis (from 1999 to 2011) and found substantial deterioration in the performance of FOHFs. The correlation between FOHFs returns and stock markets has increased after the crisis. In another comparative study, Edelman et al. (2012) documented a decline in the ability of FOHF managers to gain excess return. The average alpha (5.28% annually) generated before the crisis (2005–2007) has diminished in the subsequent period (2008–2011).

FOHFs are included in the research of Capocci et al. (2005) but they are mixed with other hedge fund strategies in the performance persistence test. They found FOHFs,

as a subset of hedge fund strategies, behaved differently to other hedge funds during the bearish period. There is no significant evidence of underperformance of FOHFs when market falls. As a diversified portfolio of hedge funds, the risk-return characteristics of FOHFs are expected to be different from individual hedge funds. Thus, it is worthwhile to concentrate on FOHFs as a particular interest group.

3 Data

3.1 Data

The data is provided by Hedge Fund Research Inc. (HFR). The reporting period starts from January 1991 and ends on 31 January 2010. The period covers the major market shocks to the hedge fund industry including the collapse of Long Term Capital Management in 1998, the burst of the high-tech bubble in the early 2000s and the 2008 GFC. There are 14,968 hedge funds included in the data pool and 4,055 of them are classified as FOHFs. The whole sample includes both living funds and defunct funds. HFR further classify the FOHFs into four subcategories according to their investment strategies: Conservative, Diversified, Market Defensive and Strategic.

Data quality has been a concern for hedge fund research as all information available is voluntarily disclosed by hedge funds. Hedge fund data is conjectured to be subject to survivorship bias and back-fill bias. Survivorship bias occurs because data vendors only receive return information from surviving funds so that the performance reported by data vendors normally overstate the true industry performance. Fung and Hsieh (1997) suggested including dead funds in the research sample to reduce survivorship bias. To account for survivorship bias, we combined the data of living hedge funds with the data of the hedge funds in the graveyard so that the sample covers both living and dead funds[2].

Back-fill bias is caused by the reporting behaviour of hedge funds. It is generally agreed that a hedge fund is most likely to disclose its information to data vendor when it is satisfied with its past performance. Thus, when a hedge fund starts to

[2] HFR data pool does have a separate collection of dead funds which is made up of funds liquidated after they began reporting to the data vendor or ceased to report but are still in operation.

report, it usually back-fills its performance prior to the reporting date so that its average performance can be polished due to the existence of a period of superior performance.

To alleviate back-fill bias, the returns of a hedge fund before the initial reporting date are deleted. The practice is commonly adopted in hedge fund studies, such as Fung and Hsieh (1997 and 2001) and Fung, et al (2008).

Although many studies questioned the quality of the hedge fund data provided by commercial data vendors, the recent study of Edelman et al. (2013) provided evidence on the reliability of such data. They proved that the reporting mega funds have many similarities with those non-reporting mega funds. They compared the performance of mega funds that chose not to report to commercial databases with the performance of reporting mega funds. They presented evidence that there is no significant difference between the average return and volatility of the two groups. Thus, they claim that the performance of non-reporting funds can be inferred using the available performance reporting funds. The findings of this study add some credit to the reliability of the data provided from commercial data vendors.

To further enhance the quality of the data, we filtered out the funds reporting in currencies other than the US dollar and deleted funds reporting less than 24 months return as well as the funds not reporting on a monthly basis. We selected the funds which reported their returns on a net-of-all-fees basis and we excluded the funds without reported net assets, usage of leverage, management fees, incentive fees, redemption frequency and a lockup period. There are 5,501 hedge funds that passed all the filters and 1,380 of them are FOHFs. The quality of the data is reported in the following table.

3.2 Identify different market states

There are a few studies on identifying different market states using econometrics techniques, see, for example, Gonzalez, et al. (2005) and Pagan and Sossounov (2003). It would be ideal to employ one of the methods to identify different market states during the sample period of this paper. However, identifying market states using complex technique is beyond the scope of this paper. We follow the practice of Capocci, et al. (2005) to divide the market into different market states at the observable turning points. The equity market trend is used to break the market condition into good and bad states. Figure 1 plots the time series of MSCI world index from January 1997 to December 2009. Four turning points are identified as the cut off points of the whole period. The market is in good state from January 1997 to March 2001 and from April 2003 to October 2007. The market is in bad state from April 2001 to March 2003 and from November 2007 to March 2009. During the good state periods, the monthly index return was positive in 67% of the months and the average monthly return was 1.13%. In the contrast, during the bad market state period, the monthly index return was 44% positive and the average monthly return was -1.26%. Even though the identification of different market states here is rather simplistic, the identified turning points allow sufficient observations to be included in each sub-period.

4. Description of research procedures and models

4.1 Performance persistence test

We will follow the methodology of Carhart (1997) to construct decile portfolios and investigate whether there are significant differences in the performance of different decile portfolios. In every January, all FOHFs are sorted based on their previous year's performance at a descending order and be put into 10 equally weighted portfolios. Thus, portfolio 1 includes the best performing funds in the previous year and Portfolio 10 is made up of the worst performing funds in the previous year. The portfolios are held till the end of the year and will be reformed again. Fund ceased to report during a year will be included in the equally weighted portfolio till the month they disappeared and the portfolio will be rebalanced to calculate the average return in the following months. Eventually, we obtain a time series of monthly returns of each decile portfolio from January 1997 to March 2009.

To test the existence of performance persistence through the sample period, we will calculate the spread between the mean return of each decile portfolio (P1) and the worst performing decile portfolio (P10) and test the significance of the spreads using t-test. Statistically significant spreads indicates performance persistence (Carhart 1997 and Capocci et al. 2005).

To test the existence of performance persistence in the good market, we reform the time series by excluding the returns in the bearish periods (April 2001 to March 2003 and from November 2007 to March 2009) from the whole sample period. We exclude the returns in the bullish periods (January 1997 to March 2001 and April 2004 to October 2007) to form the time series of the bear market. We repeat the t-test for

each group of time series to examine whether the spreads between each decile portfolio mean returns and the mean return of P10 is significant greater than zero.

4.2 Excess return

In order to understand the causes of the difference in decile portfolio performance and to analyse the risk-adjusted return, I employ Edelman et al. (2012) eight-factor model to decompose the portfolio return into alpha return and risk factor exposure returns. This model is a recent expansion of the seven-factor model of Fung and Hsieh (2004). The seven-factor model has been popular in hedge fund research literature (Jagannathan, et al. 2010 and Fung et al. 2008). Ammann et al. (2011) compared the two models and found the eight-factor model can be easier implemented and they suggest it to be a better alternative to the seven-factor model. The eight-factor model is given by:

$$R_t^k = \alpha_t^k + \sum_{i=1}^{8} \beta_i^k F_{i,t} + e_t^k$$

Where R_t^k is the excess return of the decile portfolio k at time t, α_t^k represents the excess return of the portfolio over the risk premium. β_i^k is the portfolio's risk exposure to the ith factor and e_t is the residual. The list below introduces the eight factors in the regression model.

$F_1 = excess\ return\ on\ S\&P\ 500\ index$;

$F_2 = small\ minus\ big\ factor, calculated\ using\ Russell\ 2000\ index\ monthly\ return - S\&P\ 500\ monthly\ return$;

$F_3 = bond\ market\ factor, monthly\ change\ in\ the\ 10 - year\ treasury\ bond\ yield$;

$F_4 = credit\ spread\ factor, the\ monthly\ change\ in\ the\ Moody's\ Baa\ yield\ minus$

$10\ year\ treasury\ bond\ yield$;

$F_5 = emerging\ market\ risk\ factor, MSCI\ Emerging\ Market\ Index$;

$F_6, F_7, F_8 = trend\ following\ risk\ factors\ measured\ by\ the\ monthly\ returns\ of$

$portfolios\ of\ look-back\ straddle\ on\ bond, currency\ and\ commodity\ respectively.$

To examine whether market states have an influence on the alpha generating ability of FOHF managers, we introduce a dummy variable to the eight-factor model. The dummy variable takes value of one if a return is generated in the bull markets (January 1997 to March 2001 and April 2004 to October 2007) and zero elsewhere. The regression model thus takes the form of:

$$R_t^k = \alpha_t^k + \sum_{i=1}^{8} \beta_i^k F_{i,t} + Dummy_t^k + e_t^k$$

Where $Dummy_t^k$ equals one when R_t^k falls in the period between January 1997 and March 2001 and between April 2004 and October 2007. $Dummy_t^k$ equals zero elsewhere.

5 Results

5.1 The performance of FOHFs over the sample period

Table 2 shows the summary statistics of the performance of the average FOHFs and ten decile FOHF portfolios in the sample period and in the different market states respectively.

According to the summary statistics, FOHFs on average generate positive monthly return of 0.46% over the whole sample period. In addition, all decile portfolios have generated positive returns from January 1997 to March 2009 except P10, which represents the combination of the previous worst performers. The return distribution of average FOHFs is close to normal distribution with minor negative skewness and moderate kurtosis. However, seven out ten decile portfolios exhibit negative skewness and all the portfolios exhibit high level kurtosis. The return of average FOHFs in good market state is much higher than its return in the bad market state whereas the return volatility of average FOHFs is similar in the different market states. The returns of average FOHFs under bad market state is non-normally distributed with skewness equal to -2.2 and a kurtosis of 5.64. This is in contrast to the close to normally distributed returns of the average FOHFs in the good market state. Comparing the performance of different decile portfolios in different market states, we find P1, P2 and P3 consistently generate higher returns than P9 and P10 under both market states. However, the distributions of the decile portfolio returns vary across market states. Four out of ten decile portfolios (P2, P3, P4 and P8) have positive skewness in the good market state, whereas the skewness of all the decile

portfolios drop to lower than -1 in the bad market state. High level of negative skewness indicates higher probability of extreme losses. The changes in the level of skewness indicate that both previous winners (top decile portfolios) and previous losers (bottom decile portfolios) are likely to suffer similar exposures to extreme negative market shocks in the bad market states. In addition, we find the middle portfolios tend to have higher negative skewness in bad market states than the top and the bottom portfolios.

5.2 The performance persistence of FOHFs over the whole period

To test whether the performance of FOHFs persist from January 1997 to March 2009, we calculate the average returns of the decile portfolios and apply t-test to the means of each individual decile portfolios against the mean of the bottom portfolio P10. Significant t-test results indicate the existence of performance persistence. In order to examine the existence of performance persistence over different time horizon, we also rebalance the portfolio on both annual and semi-annual basis.

The t-test result indicates whether the mean return of an individual decile portfolio is significantly greater than the mean return of P10. Apparently, there is no evidence of FOHFs performance persistence over the sample period if the decile portfolios are rebalanced annually. The range of the average monthly return of the ten portfolios is between 0.34% and 0.57%. However, we can observe significant performance persistence if the portfolios are rebalanced on the semi-annual or quarterly basis. This finding coincides with the finding of Eling (2009), where hedge fund performance is found to persist over short time horizons up to six months. In addition, Eling (2009) found no evidence of long-term persistence in hedge fund

performance. It looks the performance persistence of FOHFs is similar to hedge funds

FOHFs are expected to concentrate investments on the hedge funds with superior performance, which is usually measured by the value of excess return, alpha. If the expectation is realistic, successful FOHFs may generate significant positive alpha. To test this question, we apply eight-factor model to decompose the decile portfolio return into alpha return and beta return. The correlation coefficients of the eight factors are summarised in Table 4. The regression results are reported in Table 5, Table 6 and Table 7.

In table 4, SP500RF is the spread between S&P's 500 and risk free interest rate; SMB is the difference between Russell2000 and S&P500 monthly return; TYB is the monthly change in the return of 10-year treasury bond yield; CSPRD is the credit spread as the monthly change in Moody's Baa yield and 10-year treasury bond yield; EMRF is the risk premium of MSCI Emerging Market Index; PTFSBD, PTFSFX and PTFSCOM are the monthly returns of portfolios of look-back straddles on treasury bonds, foreign exchange and commodity. The risky factors are loosely correlated except SP550RF and EMRF. The two factors measure the excess return from US equity market and global emerging equity markets. Therefore, it is not surprising to see a strong correlation between the two factors.

According to the information in Table 5, FOHFs on average deliver significant alpha during the sample period. Particularly, portfolio 2, 3, 5, 7 and 8 have significant positive alpha. Average FOHFs has significant risk exposure to equity market factors, credit spread factor and emerging market factor. Option factors play insignificant roles in explaining the return of FOHFs. Most medium- and underperforming decile portfolios (P5, P7, P8, P9 and P10) have great exposure to traditional equity market (S&P 500) whereas all outperforming portfolios take risk exposure to Small minus Big (SMB) factor.

In Table 6, when changing rebalance frequency, the previous worst performing portfolio (P10) produces significantly negative alpha whereas the outperforming portfolios still have positive alphas. In particular, P1 and P2, which are made up of the previous best performing funds, generate the highest alpha returns when the decile portfolios are rebalanced every half year. Most outperforming FOHFs have significant exposure to small-cap assets (SMB factor) whereas most previous underperforming FOHFs have significant exposure to large-cap assets (S&P 500). The regression result indicates that FOHFs mainly gain their returns through the exposures to equity markets. The explanatory power of U.S government bond factor is very weak. The returns of decile FOHF portfolios are negatively related to the changes in credit spread. Moreover, the previous worst performing portfolio (P10) exhibits significant exposure to the trend following factor PTFSBD, which represented by the excess return of look-back straddle on U.S. government bonds.

The results in Table 7 mirror the results in Table 6 except that P10 is the only decile portfolio generating negative excess return.

5.3 The performance persistence in different market states

The following results, reported in Table 8, 9 and 10 are obtained by comparing the mean returns of the decile portfolio 1 to 9 against the mean return of P10 in good and bad market states respectively.

In general, there is no significant evidence that FOHF performance persists in either good or bad market states when the decile portfolios are rebalanced annually. However, when shortening the rebalancing frequency, we tend to get significant evidence on the performance persistence. Market states appear to have weak impact on the performance persistence. For example, using semi-annually rebalanced portfolios, we find P10 always generates the lowest returns in both market states and the mean returns of the outperforming fund portfolios are significantly different from the mean return of P10 in both market states. Similar results can be obtained using quarterly rebalanced portfolios. However, it is noticed that the significance of the mean difference is less outstanding under bad state.

To examine whether different market states influence the alpha generating ability of FOHFs, we introduce a dummy variable to the eight-factor model. The variable takes value of one if the market is in good state or zero if the market is in bad state. The significance of the coefficient of the dummy variable indicates whether the decile portfolio perform significantly differently under different market states. The regressions are run for annually, semi-annually and quarterly rebalanced portfolios respectively. The results are reported in Table 11, 12 and 13.

According to the information disclosed in the last row of Table 11, FOHFs on average are sensitive to the changes of market states. The coefficient of the dummy variable for FOHFs overall is 0.518, which suggests that FOHFs receive 0.518% higher monthly excess return under good market state. The coefficient is significant at 10% confidence level. All underperforming funds (P5, P6, P7, P8, P9 and P10) show significant sensitivity to the changes of the market states. In the contrast, the coefficients of the dummy variables for all the previous outperforming funds (P1, P2, P3 and P4) are insignificant. It may indicate that the managers of the outperforming funds have better market timing skill so that their risk-adjusted return is not subject to the changes in the market states. Controlling for the impact of market states, SMB, credit spread and emerging market are the factors that have significant impact on the return of FOHFs. This observation is consistent with the results obtained in the ordinary eight-factor model (Table 5) where the return of FOHFs are found to be significantly explained by its exposure to SMB, credit spread and emerging market factor.

Table 12 reports the regression results of the semi-annually rebalanced portfolios. Noticeably, the worst performing funds (P9 and P10) have generated significant negative alphas after controlling for the impact of market states. In addition, almost all FOHF portfolios are sensitive to the changes in market states. The coefficient of the market state dummy variable is found to be significant in eight out ten regression models. The results don’t change a lot if the portfolios are rebalanced quarterly, as reflected in Table 13.

6 Conclusions

This research aims to clarify the performance persistence of FOHFs over different time horizons and under different market states. Using decile portfolio approach and eight-factor model, the research presents some important evidence to the FOHFs performance. The major findings are summarised below.

Firstly, on an annual basis, we can hardly find any evidence of performance persistence based on mean returns. However, if the portfolios are rebalanced semi-annually or quarterly, we find significant evidence of performance persistence. This observation is consistent with the findings of performance persistence research literature using hedge fund samples.

Secondly, at a semi-annual or quarterly rebalancing frequency, we find strong evidence of performance persistence with respect to excess return. The outperforming funds (mean return) deliver significant positive alphas whereas the worst performing funds (P10) generate significant negative alpha. With regard to risk exposures, outperforming funds are more exposed to size factor (SMB) whereas underperforming funds are more exposed to equity factor (S&P 500). Especially, it is found the return of the worst performing funds has significant risk exposure to trending following factors.

Thirdly, the evidence on the relation between market states and performance persistence is mixed. When we measure performance using mean return, we find no evidence on the impact of market states on the performance persistence. This is distinct to the finding of Capocci et al. (2005) that hedge funds exhibit no persistent performance under bad market states.

Lastly, The alpha generating ability of FOHFs is significantly impacted by market states. On average, FOHFs generate 0.518% higher return in good market states. Based on annually rebalanced portfolio, market states are found to be significant to explain the variation in the returns of the underperforming funds. We find some evidence on the existence of FOHF managers who consistently generate positive excess return under different market states. Moreover, when the portfolios are relanced on a quarterly basis, markets states are found to significantly explain the variation of the returns of the outperforming funds.

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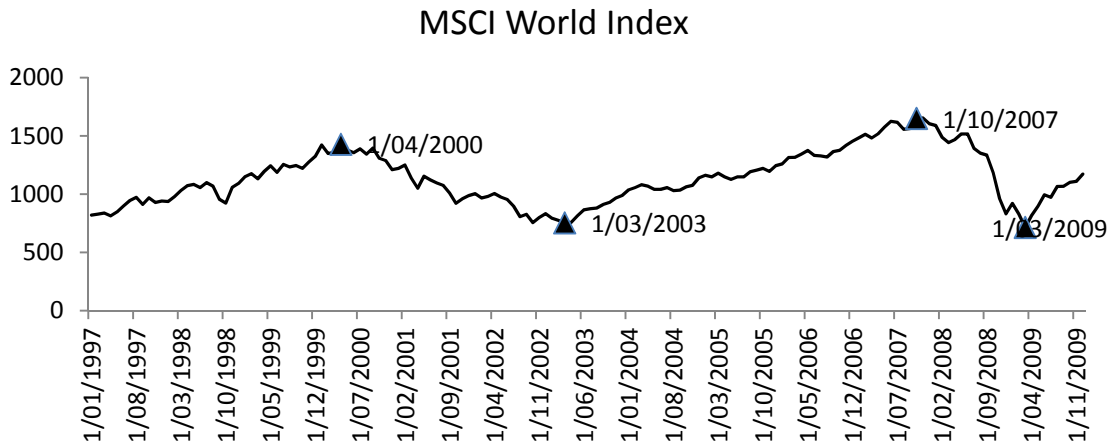
Figure 1, MSCI World Index from January 1997 to December 2009



The diagram shows the MSCI World Index changes during 1997 to 2009.

Table 1: HFR FOHFs data description

	FOHF strategies	Number of funds	Weight in the total FOHFs sample
FOHF categories	Conservative	318	23.04%
	Diversified	565	40.94%
	Strategic	437	31.67%
	Market Defensive	60	4.35%
	Total	1380	100%

Number of reporting months	FOHFs (weight in the total)
Less than 37 months	357 (25.87%)
37 – 60 months	497 (36.01%)
61 – 96 months	394 (28.55%)
97 – 120 months	44 (3.19%)
Above 120 months	88 (6.38%)

Table 2, the summary statistics of FOHF semi-annually rebalanced portfolios over multiple periods

	Whole Period 1-1997 to 3-2009				good states 1-1997 to 3-2001 & 4-2003 to 10-2007				bad states 4-2001 to 3-2003 & 11-2007 to 3-2009			
	Mean	SD	Skew	Kurt	Mean	SD	Skew	Kurt	Mean	SD	Skew	Kurt
P1	0.68	3.08	0.11	4.79	0.99	3.47	-0.09	3.69	-0.13	1.44	-1.00	0.93
P2	0.66	2.14	1.13	7.45	1.01	2.27	1.25	6.95	-0.26	1.45	-1.83	4.11
P3	0.59	1.73	0.22	4.19	0.96	1.69	0.66	4.55	-0.35	1.49	-1.67	2.76
P4	0.54	1.51	-0.97	4.73	0.90	1.31	0.06	2.01	-0.40	1.61	-2.30	5.74
P5	0.51	1.54	-0.96	4.32	0.83	1.40	-0.34	2.90	-0.33	1.57	-2.32	5.89
P6	0.50	1.59	-1.21	5.21	0.85	1.40	-0.46	3.63	-0.40	1.71	-2.30	5.82
P7	0.35	1.47	-1.54	6.41	0.69	1.19	-0.20	1.25	-0.51	1.78	-2.20	5.83
P8	0.52	1.63	-0.62	4.13	0.92	1.41	0.49	1.75	-0.51	1.72	-1.87	4.88
P9	0.23	1.74	-1.29	4.42	0.62	1.50	-0.90	3.68	-0.77	1.92	-1.73	4.59
P10	-0.15	2.68	-2.21	9.55	0.25	2.61	-2.54	12.88	-1.19	2.60	-2.16	7.10
Average FOHF	**0.46**	**1.69**	**-0.69**	**3.59**	**0.82**	**1.58**	**-0.22**	**2.63**	**-0.46**	**1.61**	**-2.20**	**5.64**

In table 2, P1 to P10 represent the 10 decile portfolios. Every year, the FOHFs are ranked in the descending order of their previous year's average returns and are grouped into 10 equally weighted portfolios. P1 represents the FOHFs generating the highest returns in the previous years while P10 contains the FOHFs with the lowest returns in the previous years. Another two groups of time series are calculated by rebalancing the portfolios on semi-annually and quarterly basis. The statistics reported in table 1 are calculated using the return time series of the semi-annually rebalanced portfolios. The reported statistics include the average monthly return (Mean), the standard deviation of the monthly return (SD), the skewness (Skew) and Kurtosis (Kurt) of the monthly return time series. The statistics during the good market state periods (January 1997 to March 2001 and April 2003 to October 2007) and the bad market state periods (April 2001 to March 2003 and November 2007 to March 2009) are reported separately.

Table 3 FOHFs performance persistence (1-1997 to 3-2009)

	Annually rebalanced		Semi-annually rebalanced		Quarterly rebalanced	
	mean	p value	mean	p value	mean	p value
P1	0.466	0.338	0.680***	0.007	0.731***	0.004
P2	0.573	0.160	0.660***	0.002	0.528***	0.007
P3	0.485	0.252	0.590***	0.002	0.552***	0.005
P4	0.465	0.286	0.540***	0.004	0.448**	0.012
P5	0.542	0.172	0.510***	0.005	0.549***	0.004
P6	0.402	0.380	0.500***	0.006	0.497***	0.008
P7	0.450	0.298	0.350**	0.023	0.531***	0.007
P8	0.407	0.369	0.520***	0.005	0.449**	0.018
P9	0.337	0.498	0.230*	0.073	0.439**	0.020

1. P1 to P10 represent the 10 decile portfolios. Every year, the FOHFs are ranked in the descending order of their previous year's average returns and are grouped into 10 equally weighted portfolios. P1 represents the FOHFs generating the highest returns in the previous years while P10 contains the FOHFs with the lowest returns in the previous years. Another two groups of time series are calculated by rebalancing the portfolios on semi-annually and quarterly basis.
2. *** significant at 99% level, ** significant at 95% level, * significant at 90% level, the significant level is obtained from t-test on whether the mean of the monthly returns of one decile portfolio is different to the mean monthly return of P10.

Table 4, Correlation coefficient matrix of the eight factors

	SP500RF	SMB	TBY	CSPRD	EMRF	PTFSBD	PTFSFX	PTFSCOM
SP500RF	1.000	0.011	-0.159	-0.250	0.746	-0.158	-0.198	-0.176
SMB	0.011	1.000	-0.217	-0.199	0.245	-0.060	0.047	0.005
TBY	-0.159	-0.217	1.000	0.392	-0.198	0.005	0.096	0.095
CSPRD	-0.250	-0.199	0.392	1.000	-0.357	0.192	0.322	0.183
EMRF	0.746	0.245	-0.198	-0.357	1.000	-0.204	-0.199	-0.157
PTFSBD	-0.158	-0.060	0.005	0.192	-0.204	1.000	0.229	0.186
PTFSFX	-0.198	0.047	0.096	0.322	-0.199	0.229	1.000	0.359
PTFSCOM	-0.176	0.005	0.095	0.183	-0.157	0.186	0.359	1.000

Table 4 reports the correlation coefficient matrix of Fung, et al (2008) eight factor model. SP500RF is the spread between S&P's 500 and risk free interest rate; SMB is the difference between Russell2000 and S&P500 monthly return; TYB is the monthly change in the return of 10-year treasury bond yield; CSPRD is the credit spread as the monthly change in Moody's Baa yield and 10-year treasury bond yield; EMRF is the risk premium of MSCI Emerging Market Index; PTFSBD, PTFSFX and PTFSCOM are the monthly returns of portfolios of look-back straddles on treasury bonds, foreign exchange and commodity.

Table 5, the risk exposures of decile FOHF portfolios (eight-factor model, 1-1997 to 3-2009, annually rebalanced portfolios)

	alpha	SP500RF	SMB	TBY	CSPRD	EMRF	PTFSBD	PTFSFX	PTFSCOM	Adj. R^2
P1	0.231	0.029	0.172 ***	-0.901	-3.132 **	0.146 ***	-0.008	0.004	0.023	0.324
P2	0.307 **	0.062	0.124 ***	0.429	-2.293 ***	0.088 ***	-0.017 *	0.002	-0.003	0.445
P3	0.226 **	0.033	0.057 *	-0.015	-2.010 ***	0.097 ***	-0.008	0.001	0.004	0.428
P4	0.199 *	0.037	0.100 ***	0.209	-1.960 ***	0.093 ***	-0.015 *	0.000	-0.009	0.465
P5	0.297 ***	0.118 ***	0.076 ***	-0.395	-1.875 ***	0.052 **	-0.002	0.001	0.004	0.515
P6	0.150	0.031	0.064 **	-0.230	-1.772 ***	0.087 ***	-0.004	0.001	-0.009	0.479
P7	0.208 **	0.071 **	0.058 **	0.077	-1.754 ***	0.077 ***	0.000	-0.003	-0.011	0.521
P8	0.183 **	0.073 **	0.044 *	0.091	-2.182 ***	0.066 ***	0.007	0.000	0.000	0.488
P9	0.072	0.075 **	0.047	0.110	-1.275 **	0.108 ***	-0.001	0.000	-0.005	0.496
P10	0.114	0.092 **	0.048	0.749	-2.220 ***	0.121 ***	0.015 *	0.005	-0.012	0.484
FOHFs	0.207 **	0.060 *	0.079 ***	-0.068	-1.942 ***	0.093 ***	-0.005	0.001	-0.001	0.534

1. SP500RF is the spread between S&P's 500 and risk free interest rate; SMB is the difference between Russell2000 and S&P500 monthly return; TYB is the monthly change in the return of 10-year treasury bond yield; CSPRD is the credit spread as the monthly change in Moody's Baa yield and 10-year treasury bond yield; EMRF is the risk premium of MSCI Emerging Market Index; PTFSBD, PTFSFX and PTFSCOM are the monthly returns of portfolios of look-back straddles on treasury bonds, foreign exchange and commodity.
2. *** significant at 99% level, ** significant at 95% level, * significant at 90% level
3. P1 to P10 represent the 10 decile portfolios.

Table 6, the risk exposures of decile FOHF portfolios (eight-factor model, 1-1997 to 3-2009, semi-annually rebalanced portfolios)

	alpha	SP500RF	SMB	TBY	CSPRD	EMRF	PTFSBD	PTFSFX	PTFSCOM	Adj. R^2
P1	0.432 **	-0.023	0.226 ***	-0.160	-2.379 *	0.166 ***	-0.003	0.003	0.016	0.318
P2	0.438 ***	0.033	0.106 **	0.513	-2.461 ***	0.110 ***	0.009	0.003	-0.005	0.341
P3	0.363 ***	0.071 **	0.102 ***	0.142	-2.569 ***	0.059 **	-0.002	0.004	-0.008	0.437
P4	0.288 ***	0.047	0.063 **	-0.243	-1.973 ***	0.072 ***	-0.005	0.000	0.001	0.476
P5	0.243 **	0.046	0.054 **	-0.271	-1.600 ***	0.083 ***	-0.007	0.002	-0.001	0.465
P6	0.243 **	0.090 ***	0.081 ***	-0.343	-1.388 **	0.060 ***	-0.007	-0.003	-0.003	0.491
P7	0.108	0.089 ***	0.053 **	-0.313	-1.648 ***	0.052 ***	-0.001	-0.001	0.000	0.451
P8	0.285 ***	0.113 ***	0.032	-0.192	-1.782 ***	0.069 ***	0.004	0.000	0.000	0.525
P9	-0.024	0.106 ***	0.034	-0.004	-1.635 ***	0.083 ***	-0.004	-0.002	-0.007	0.532
P10	-0.456 ***	0.033	0.025	0.508	-2.458 ***	0.192 ***	-0.031 ***	0.007	-0.012	0.503

4. SP500RF is the spread between S&P's 500 and risk free interest rate; SMB is the difference between Russell2000 and S&P500 monthly return; TYB is the monthly change in the return of 10-year treasury bond yield; CSPRD is the credit spread as the monthly change in Moody's Baa yield and 10-year treasury bond yield; EMRF is the risk premium of MSCI Emerging Market Index; PTFSBD, PTFSFX and PTFSCOM are the monthly returns of portfolios of look-back straddles on treasury bonds, foreign exchange and commodity.
5. *** significant at 99% level, ** significant at 95% level, * significant at 90% level
6. P1 to P10 represent the 10 decile portfolios.

Table 7, the risk exposures of decile FOHF portfolios (eight-factor model, 1-1997 to 3-2009, quarterly rebalanced portfolios)

	alpha	SP500RF	SMB	TBY	CSPRD	EMRF	PTFSBD	PTFSFX	PTFSCOM	Adj. R^2
P1	0.482 **	-0.025	0.163 ***	-0.630	-2.222 *	0.134 ***	-0.003	0.005	0.013	0.318
P2	0.290 **	-0.007	0.096 ***	0.236	-2.212 ***	0.099 ***	0.000	0.001	0.003	0.341
P3	0.305 ***	0.057 *	0.068 **	-0.092	-2.083 ***	0.072 ***	-0.004	0.003	0.002	0.437
P4	0.198 **	0.048	0.056 **	0.049	-1.997 ***	0.063 ***	-0.005	0.003	0.000	0.476
P5	0.294 ***	0.064 **	0.052 **	-0.333	-1.561 ***	0.066 ***	-0.002	0.001	-0.001	0.465
P6	0.252 ***	0.072 **	0.075 ***	-0.343	-1.507 ***	0.069 ***	0.002	-0.002	-0.007	0.491
P7	0.271 **	0.091 ***	0.083 ***	-0.282	-1.447 **	0.070 ***	-0.004	0.001	-0.006	0.451
P8	0.163	0.101 **	0.079 **	0.052	-1.222 *	0.096 ***	-0.012	0.001	-0.007	0.525
P9	0.210	0.099 **	0.055	0.155	-1.994 **	0.100 ***	0.009	0.000	-0.004	0.532
P10	-0.462 **	0.089	0.063	0.859	-3.100 ***	0.181 ***	-0.026 *	0.003	-0.009	0.503

7. SP500RF is the spread between S&P's 500 and risk free interest rate; SMB is the difference between Russell2000 and S&P500 monthly return; TYB is the monthly change in the return of 10-year treasury bond yield; CSPRD is the credit spread as the monthly change in Moody's Baa yield and 10-year treasury bond yield; EMRF is the risk premium of MSCI Emerging Market Index; PTFSBD, PTFSFX and PTFSCOM are the monthly returns of portfolios of look-back straddles on treasury bonds, foreign exchange and commodity.
8. *** significant at 99% level, ** significant at 95% level, * significant at 90% level
9. P1 to P10 represent the 10 decile portfolios.

Table 8, performance persistence in good and bad market states (annually rebalanced portfolios)

	Good state		Bad state	
	mean	p value	mean	p value
P1	0.851	0.423	-0.529	0.267
P2	0.913	0.312	-0.305	0.104
P3	0.802	0.461	-0.335	0.121
P4	0.786	0.486	-0.365	0.141
P5	0.896	0.308	-0.375	0.143
P6	0.743	0.559	-0.481	0.219
P7	0.789	0.480	-0.425	0.181
P8	0.776	0.502	-0.549	0.263
P9	0.718	0.596	-0.647	0.357
P10	0.777	N/A	-0.804	N/A

1. P1 to P10 represent the 10 decile portfolios.
2. *** significant at 99% level, ** significant at 95% level, * significant at 90% level, the significant level is obtained from t-test on whether the mean of the monthly returns of one decile portfolio is different to the mean monthly return of P10.
3. The good market state periods include January 1997 to March 2001 and April 2003 to October 2007. The bad market state periods include April 2001 to March 2003 and November 2007 to March 2009.

Table 9, performance persistence in good and bad market states (semi-annually rebalanced portfolios)

	Good state		Bad state	
	mean	p value	mean	p value
P1	0.992**	0.039	-0.126**	0.013
P2	1.014**	0.012	-0.264**	0.026
P3	0.959***	0.010	-0.352**	0.039
P4	0.898**	0.012	-0.402*	0.053
P5	0.830**	0.022	-0.326**	0.037
P6	0.853**	0.019	-0.396*	0.054
P7	0.689*	0.058	-0.511*	0.087
P8	0.924**	0.010	-0.511*	0.085
P9	0.620	0.102	-0.772	0.207
P10	0.247	N/A	-1.187	N/A

1. P1 to P10 represent the 10 decile portfolios.
2. *** significant at 99% level, ** significant at 95% level, * significant at 90% level, the significant level is obtained from t-test on whether the mean of the monthly returns of one decile portfolio is different to the mean monthly return of P10.
3. The good market state periods include January 1997 to March 2001 and April 2003 to October 2007. The bad market state periods include April 2001 to March 2003 and November 2007 to March 2009.

Table 10, performance persistence in good and bad market states (quarterly rebalanced portfolios)

	Good state		Bad state	
	mean	p value	mean	p value
P1	1.149***	0.009	-0.350*	0.094
P2	0.849**	0.022	-0.302*	0.065
P3	0.918**	0.012	-0.393*	0.089
P4	0.792**	0.026	-0.444	0.107
P5	0.917***	0.010	-0.405*	0.095
P6	0.842**	0.019	-0.395*	0.096
P7	0.887**	0.016	-0.388*	0.093
P8	0.777**	0.043	-0.399*	0.096
P9	0.772**	0.043	-0.423	0.113
P10	0.158	N/A	-1.082	N/A

1. P1 to P10 represent the 10 decile portfolios.
2. *** significant at 99% level, ** significant at 95% level, * significant at 90% level, the significant level is obtained from t-test on whether the mean of the monthly returns of one decile portfolio is different to the mean monthly return of P10.
3. The good market state periods include January 1997 to March 2001 and April 2003 to October 2007. The bad market state periods include April 2001 to March 2003 and November 2007 to March 2009.

Table 11, the risk exposures of decile FOHF portfolios (with dummy variable, 1-1997 to 3-2009, annually rebalanced portfolios)

	alpha	SP500RF	SMB	TBY	CSPRD	EMRF	PTFSBD	PTFSFX	PTFSCOM	Dummy
P1	-0.032	0.017	0.174 ***	-0.913	-2.986 **	0.149 ***	-0.006	0.004	0.021	0.363
P2	0.036	0.050	0.126 ***	0.416	-2.142 ***	0.091 ***	-0.015 *	0.002	-0.004	0.374
P3	-0.058	0.021	0.059 *	-0.028	-1.852 ***	0.099 ***	-0.006	0.001	0.002	0.393
P4	-0.095	0.024	0.102 ***	0.196	-1.796 ***	0.096 ***	-0.013	0.000	-0.011	0.406
P5	-0.040	0.103 ***	0.079 ***	-0.411	-1.688 ***	0.055 ***	0.000	0.001	0.002	0.465 **
P6	-0.293	0.011	0.068 *	-0.250	-1.526 ***	0.092 ***	-0.001	0.001	-0.012 *	0.612 ***
P7	-0.167	0.054 *	0.061 **	0.060	-1.545 ***	0.080 ***	0.002	-0.003	-0.013 *	0.519 **
P8	-0.302 *	0.052 *	0.048 **	0.068	-1.913 ***	0.070 ***	0.009	0.000	-0.003	0.669 ***
P9	-0.367 *	0.055	0.050 *	0.090	-1.031 *	0.112 ***	0.002	0.000	-0.008	0.606 **
P10	-0.473 *	0.065	0.053	0.722	-1.894 ***	0.127 ***	0.019 **	0.005	-0.016 *	0.812 ***
FOFHs	-0.168	0.043	0.082 **	-0.085	-1.734 **	0.097 ***	-0.002	0.001	-0.004	0.518 *

1. SP500RF is the spread between S&P's 500 and risk free interest rate; SMB is the difference between Russell2000 and S&P500 monthly return; TYB is the monthly change in the return of 10-year treasury bond yield; CSPRD is the credit spread as the monthly change in Moody's Baa yield and 10-year treasury bond yield; EMRF is the risk premium of MSCI Emerging Market Index; PTFSBD, PTFSFX and PTFSCOM are the monthly returns of portfolios of look-back straddles on treasury bonds, foreign exchange and commodity. The dummy variable is given value of 1 if the return falls in the good market state periods and 0 if the return falls in the bad market state periods.
2. *** significant at 99% level, ** significant at 95% level, * significant at 90% level
3. P1 to P10 represent the 10 decile portfolios.

Table 12, the risk exposures of decile FOHF portfolios (with dummy variable, 1-1997 to 3-2009, semi-annually rebalanced portfolios)

	alpha	SP500RF	SMB	TBY	CSPRD	EMRF	PTFSBD	PTFSFX	PTFSCOM	Dummy
P1	0.189	-0.034	0.228 ***	-0.171	-2.244 *	0.168 ***	-0.001	0.003	0.014	0.337
P2	-0.019	0.013	0.110 ***	0.492	-2.207 **	0.114 ***	0.012	0.003	-0.008	0.631 *
P3	-0.094	0.050	0.106 ***	0.121	-2.315 ***	0.063 ***	0.000	0.004	-0.011	0.632 **
P4	-0.178	0.027	0.066 ***	-0.264	-1.714 ***	0.077 ***	-0.002	0.000	-0.002	0.644 ***
P5	-0.101	0.031	0.057 **	-0.287	-1.409 **	0.086 ***	-0.005	0.002	-0.003	0.475 **
P6	-0.136	0.073 **	0.083 ***	-0.360	-1.177 **	0.064 ***	-0.004	-0.003	-0.005	0.524 **
P7	-0.261	0.072 **	0.056 **	-0.330	-1.443 ***	0.055 ***	0.002	-0.001	-0.003	0.511 **
P8	-0.185	0.092 ***	0.035	-0.214	-1.521 ***	0.074 ***	0.007	0.000	-0.003	0.649 ***
P9	-0.422 **	0.088 ***	0.037	-0.023	-1.414 **	0.087 ***	-0.002	-0.002	-0.010	0.550 **
P10	-0.635 **	0.025	0.027	0.500	-2.358 **	0.193 ***	-0.030 **	0.007	-0.013	0.247

4. SP500RF is the spread between S&P's 500 and risk free interest rate; SMB is the difference between Russell2000 and S&P500 monthly return; TYB is the monthly change in the return of 10-year treasury bond yield; CSPRD is the credit spread as the monthly change in Moody's Baa yield and 10-year treasury bond yield; EMRF is the risk premium of MSCI Emerging Market Index; PTFSBD, PTFSFX and PTFSCOM are the monthly returns of portfolios of look-back straddles on treasury bonds, foreign exchange and commodity. The dummy variable is given value of 1 if the return falls in the good market state periods and 0 if the return falls in the bad market state periods.

1. *** significant at 99% level, ** significant at 95% level, * significant at 90% level
2. P1 to P10 represent the 10 decile portfolios.

Table 13, the risk exposures of decile FOHF portfolios (with dummy variable, 1-1997 to 3-2009, quarterly rebalanced portfolios)

	alpha	SP500RF	SMB	TBY	CSPRD	EMRF	PTFSBD	PTFSFX	PTFSCOM	Dummy
P1	-0.172	-0.054	0.168 ***	-0.660	-1.858	0.140 ***	0.001	0.005	0.009	0.904 *
P2	-0.143	-0.026	0.100 ***	0.216	-1.971 ***	0.103 ***	0.003	0.001	0.000	0.598 **
P3	-0.151	0.037	0.071 **	-0.113	-1.830 ***	0.077 ***	-0.001	0.003	-0.001	0.630 ***
P4	-0.251	0.028	0.059 **	0.028	-1.748 ***	0.067 ***	-0.002	0.003	-0.003	0.621 ***
P5	-0.208	0.042	0.056 **	-0.356	-1.282 **	0.070 ***	0.001	0.001	-0.004	0.694 ***
P6	-0.177	0.053 *	0.078 ***	-0.363	-1.269 **	0.073 ***	0.004	-0.002	-0.009	0.592 ***
P7	-0.125	0.074 **	0.086 ***	-0.300	-1.227 *	0.074 ***	-0.001	0.001	-0.009	0.548 **
P8	-0.039	0.092 **	0.081 **	0.043	-1.110	0.098 ***	-0.011	0.001	-0.008	0.280
P9	-0.038	0.088 **	0.057	0.143	-1.857 **	0.102 ***	0.011	0.000	-0.006	0.342
P10	-0.329	0.095	0.062	0.865	-3.175 ***	0.180 ***	-0.027 **	0.003	-0.008	-0.185

1. SP500RF is the spread between S&P's 500 and risk free interest rate; SMB is the difference between Russell2000 and S&P500 monthly return; TYB is the monthly change in the return of 10-year treasury bond yield; CSPRD is the credit spread as the monthly change in Moody's Baa yield and 10-year treasury bond yield; EMRF is the risk premium of MSCI Emerging Market Index; PTFSBD, PTFSFX and PTFSCOM are the monthly returns of portfolios of look-back straddles on treasury bonds, foreign exchange and commodity. The dummy variable is given value of 1 if the return falls in the good market state periods and 0 if the return falls in the bad market state periods.
2. *** significant at 99% level, ** significant at 95% level, * significant at 90% level.
3. P1 to P10 represent the 10 decile portfolios.