

HEDGE FUND PERFORMANCE: THE CANADIAN MARKET CASE

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Abstract

With the growth of hedge fund industry, investors are interested in the possibility of replicating hedge funds returns by using market indexes. Most papers on the hedge fund performance are based on data prior the 2007-2008 financial crisis. This study uses monthly returns data for 59 Canadian hedge funds in Bloomberg database from January 2009 to September 2016 to investigate the hedge funds performance and possibility of replication in the post-crisis period. We follow Hzsanhodzic's (2006) linear factor model to determine the significance of expected returns can be explained by six common risk exposures. We find that "clone" hedge funds returns would be hard to realize under Canadian market conditions by using current post-crisis data.

Keywords: Hedge Funds; Replication; Canadian Market; Post-Crisis Period

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1: Introduction

Since Alfred Winslow Jones launched the first hedge fund in 1949, this investing innovation model has developed and expanded significantly over last decades. Hedge fund became popular with institutional and individual investors since 1990. With the number of hedge funds growing, the managed assets increased dramatically over the same period as well, there is sufficient data became available towards hedge funds research. Both hedge fund managers and general investors are concerning these academic research papers about hedge fund industry and its risk-return performance in the market. Especially, Kat and Amin (2001) claim that hedge fund returns are only different with returns of other traditional asset classes, not offer a superior risk-return profile.

Hedge funds performance getting worse every year, especially in 1998 Long-term Capital Management (LTCM) almost went bankruptcy, which reminded investors that hedge funds also comes with high risk. Before that time, hedge funds primarily been invested as private investment vehicles by individual or institutional investors. And there is little public information available about risks of hedge fund strategies. Although in recent years Securities and Exchange Commission (SEC) has realized this shadow district and increased the disclosure requirements because of Dodd-Frank Act, investors' interest in the performance of hedge funds is continuing growing.

On the other hand, hedge fund managers are struggling to advertise hedge funds although they make a lot of effort into generating returns. With more and more studies on hedge funds, investors have a better understanding of the industry. Hedge fund managers cannot advertise on the superior risk-return performance anymore, but rather selling hedge funds as a diversified investment vehicle. That refers to the reduced risk of other investment portfolios, like stocks and bonds, without losing expected returns. In addition, conflicts arise between institutional investors and hedge fund managers. On the culture side, pension plan sponsors always require information and procedure transparency from managers, while managers hardly provide that. From the regulatory perspective, plan sponsors expect to impose more restrictions on the investment procedures. Hedge fund managers, however, are not willing to restricted by strict rules, which may hurt performance. They also have divergence in assets liquidity and capacity. Usually, most hedge funds impose lock-up structures of 6 months to 5 years, while institutional investors require

a higher degree of liquidity in their assets to meet asset obligations. Besides, a successful manager offers the least capacity since they may close hedge funds for investors altogether. However, investors desire more capacity for managing their assets and capturing investment opportunities.

Thus, when investors understand the basic nature of hedge funds, which cannot offer superior performance. And they do have different goals with hedge fund managers. Then questions are coming, can investors not hire managers by paying such expensive fees? Is it possible to replicate hedge fund returns without investing in hedge funds?

Most studies on the hedge fund returns or replication area are conducted prior the 2007-2008 financial crisis. They analyzed the performance of hedge funds based on risk-factor models and concluded on the possibility of hedge funds replication. As we all known, the 2007-2008 financial crisis changed the whole world investment market structure. With the crisis period past, we are curious that if hedge funds returns can still be replicated based on current performance? What is the hedge fund performance in Canada after the global financial crisis?

To investigate answers of these questions, we are going to proceed our paper by focusing on Canadian hedge funds market from January 2009 to September 2016. We use linear regression to measure six risk factors' impact on hedge funds performance by collecting data from the Bloomberg database. We follow Ennis and Sebastian (2003) who apply Shape's (1992) asset-class factor model on mutual funds to develop linear clones of hedge funds use six factors to estimate the main risk exposure that hedge fund face: interest rate, the stock market, bond market, currency, commodity, and volatility. All these factors are tradable and available on the public securities market. Then we decompose the expected returns into each risk factor for evaluating the performance of hedge funds. To make it clear, we do not include data during financial crisis period 2007 to 2008, and we do not include year dummies in the regression either. Since adding a dummy variable would separate our total sample into two phases, one phase sample size with only two years' data is too small. And we could not decompose returns if adding a dummy variable.

From our conclusion, we show that six risk factors are insignificant toward hedge funds performance on an average basis. Fund specific alpha, refers to manager-selection skills, places an important role in the hedge funds performance determination. Different with Hzsanhodzic's (2006) suggestion on hedge funds prior the financial crisis period, we find it would be hard to replicate hedge fund returns in the Canadian market after the financial crisis. Our findings could help investors in the Canadian market to make a more rational and reasonable decision on if hire hedge funds managers to manage their assets. Since hedge funds replication by using market

indexes is hard to realize, hiring hedge funds managers via paying certain performance fees would be a more efficient way. Besides, our findings could help scholars investigate effects of the 2007-2008 financial crisis on hedge funds market, and compare the difference between Canadian market and the US market.

This paper organizes as follows. In Section 2, we briefly discuss the theoretical and empirical literature about hedge fund returns and replication. In section 3, we collect monthly returns data for Canadian hedge funds in the Bloomberg database from January 2009 to September 2016. After cleaned and processed the sample, we summarized statistics for each factor exposure related to 59 Canadian hedge funds. In Section 4, we carry out a linear regression analysis of hedge fund returns to determine funds performance sensitivity to each factor. Then we decompose the fund's monthly returns into risk factors. We conclude in Section 5.

2: Literature Review

This paper relates to the literature about hedge fund returns and hedge fund replication.

2.1 Hedge Fund Return

The first part is how to measure hedge fund returns. Compared to other investment tools like mutual funds, there are few studies conducted on the hedge funds area. Since most hedge funds operated in the private area, which is difficult to access the data. There are two major traditional performance measures for hedge funds, the Sharpe ratio and Jensen's alpha. Sharpe (1966) introduced the Sharpe ratio as a measure for calculating risk-adjusted return, which became the industry standard since then. Sharpe ratio calculated as the average return earned in excess of the risk-free rate per unit of deviation.

$$\text{Sharpe ratio} = \frac{R_a - R_f}{\sigma_p} = \frac{\text{Mean Portfolio Return} - \text{Risk free rate}}{\text{Standard Deviation of Portfolio Return}}$$

In general, Sharpe ratio used to evaluate a portfolio's overall risk-return profile when a new asset class introduced in it. Hedge funds as diversified investment vehicles, Sharpe ratio is useful to justify the diversification benefit for a portfolio.

Another measurement is Jensen's alpha, which introduced by Michael Jensen (1968) to evaluate the performance of mutual funds. Jensen's alpha measures the risk-adjusted return of a portfolio or investment based on the predicted capital asset pricing model (CAPM).

$$\text{Jensen's Alpha} = R_i - (R_f + \text{Beta} * (R_m - R_f)) = \text{Portfolio Return} - [\text{Risk Free Rate} + \text{Portfolio Beta} * (\text{Market Return} - \text{Risk Free Rate})]$$

Investors prefer to invest assets with positive Jensen's Alpha, which means the asset's expected return is higher than current portfolio's risk-adjusted return.

However, some studies are questioning the above two traditional measures of hedge funds performance, since these methods assume hedge funds returns are normally distributed. For example, Amin and Kat (2002) use a dynamic trading based performance measure, which does not require assumptions about fund returns distribution. However, this study investigates hedge

fund performance on a stand-alone basis that may differ from hedge fund managers' expert skills in the real world. Thus, the studies on hedge fund returns still have a lot of problems need to be explained.

There are several empirical studies on hedge funds performance as well. Ackermann, McEnally and Ravenscraft (1999) using a large sample of hedge fund data from 1988 to 1995 conclude that hedge funds consistently outperform mutual funds, but not standard market indexes. Agarwal and Naik (2000) find that hedge fund investment outperforms the benchmark by a range of 6% to 15% per year. Thus, some studies based on the early 1990s data are believed hedge funds can beat the benchmark. Then with the growth of hedge funds investigation, Fund and Hsieh in 1998 pointed that "performance of a sample of investment funds contains biases." Therefore, some studies show the different conclusions. Brown and Goetzmann (1999) find that after taking bias and other components into consideration, hedge fund return from 1989 through 1995 lower than S&P 500 return over the same period. Ibbotson and Chen (2006) claim the similar conclusions as above. They find that alpha statistically significant toward hedge fund returns. That means managers may have some skill in beating the market. With the fees included, however, hedge funds underperformed the benchmark from 1995 to 2006. In a summary, most studies conducted in recent years conclude that hedge funds do not generate a superior return and cannot beat the benchmark.

2.2 Hedge Fund Replication

Another part of literature is about hedge funds replication. Following Sharpe's (1992) work on mutual fund returns, there are several studies developed factor models to replicate hedge funds month-to-month returns. Sharpe in 1992 illustrates an application of asset class factor model to analyze the performance of mutual funds. He develops a method for explaining mutual funds returns by decomposing returns into two parts: one is the asset class factors "style", and the remainder classified as "selection".

From Sharpe's (1992) asset-class factor model on mutual funds, Fung and Hsieh (1997) developed the empirical model to hedge funds. The paper focuses on hedge fund managers and commodity trading advisors (CTAs) and extends Sharpe's (1992) model by involving more strategy component factors related to hedge fund returns. Several authors contributed to the asset-class factor model as well. Ennis and Sebastian (2003) found that diversified hedge fund portfolios are not market-neutral. The performance of hedge funds was not good enough and the high cost of investing in funds cannot warrant hedge funds inclusion in balanced portfolios. In

addition, Schneeweis and Spurgin (1998) explained the model factors as “factors that incorporate the possibility of returns to trending prices, short sales, and volatility may better capture relative return movement.” Then based on all these factors explanation, we investigate Canadian hedge fund performance as the following paper.

3: Data and Research Methodology

We used linear regression to time series data of hedge fund performance to explore the determinate of Canadian hedge fund performance and tried to decomposition the hedge fund return using some fundamental factors.

3.1 Sample Specification and summary statistics

We used Bloomberg hedge screen tool to get hedge fund performance data. We had two screening criteria; the country is Canada and fund type is “hedge fund”. There is 94 hedge fund in screening result. We used the monthly return of hedge fund, and we concentrated on the after-crisis period, so our sample period started from January 2009 to September 2016. To make sure we had sufficient sample size for each hedge fund, we excluded those hedge funds which had less than two-year performance data. We had 59 hedge fund in our sample which had more than two-year data after 2009. We also divided these 59 hedge funds into 8 categories based on their strategy which are Equity Hedge (36), Event Driven (4), Fixed Income Relative Value (2), Fixed Income Directional (1), Marco (4), Multi-Strategy (10), CTA/Managed Futures (1) and Restricted (1). We can see that most of the Canadian hedge funds follow the Equity Hedge strategy and Multi-Strategy. The hedge fund strategy came from Bloomberg Hedge Fund profile of each fund. All hedge funds in our sample are live, and we didn’t include those funds in the graveyard.

Table 1: Summary statistic for multivariate linear regression

| Category | Sample Size | Statistic | SPX Index | | | | VIX Index | | | | GCANM Index | | | | DXY Currency | | | | | | | |
|-----------------------------|-------------|-----------|-----------|-------|-------|------|-----------|-------|-------|-------|-------------|-------|-------|-------|--------------|------|-------|-------|-------|-------|-------|------|
| | | | Min | Med | Mean | Max | SD | Min | Med | Mean | Max | SD | Min | Med | Mean | Max | SD | Min | Med | Mean | Max | SD |
| Equity Hedge | 36 | beta | -0.02 | 0.00 | 0.00 | 0.02 | 0.01 | -0.55 | 0.08 | 0.08 | 0.89 | 0.25 | -2.56 | 0.01 | -0.02 | 1.84 | 1.02 | -2.75 | 0.11 | 0.24 | 2.80 | 1.06 |
| | | t-Stat | -1.67 | 0.17 | 0.19 | 2.83 | 1.11 | -2.49 | 0.50 | 0.37 | 2.32 | 1.14 | -2.56 | 0.01 | 0.00 | 2.58 | 1.07 | -4.41 | 0.10 | 0.14 | 2.38 | 1.07 |
| Event Driven | 4 | beta | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | -0.18 | 0.30 | 0.22 | 0.45 | 0.30 | -0.10 | 0.04 | 0.10 | 0.43 | 0.23 | -2.77 | 0.27 | -0.28 | 1.12 | 1.74 |
| | | t-Stat | 0.26 | 0.72 | 0.74 | 1.26 | 0.42 | -0.88 | 1.07 | 0.78 | 1.85 | 1.18 | -0.07 | 0.05 | 0.10 | 0.39 | 0.20 | -1.98 | 0.16 | -0.28 | 0.53 | 1.16 |
| Fixed Income Relative Value | 2 | beta | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | -0.12 | -0.04 | -0.04 | 0.05 | 0.12 | 0.34 | 0.51 | 0.51 | 0.67 | 0.23 | -1.22 | -0.68 | -0.68 | -0.14 | 0.77 |
| | | t-Stat | 0.88 | 1.19 | 1.19 | 1.50 | 0.44 | -1.18 | -0.42 | -0.42 | 0.34 | 1.07 | 0.59 | 1.02 | 1.02 | 1.46 | 0.61 | -1.87 | -1.02 | -1.02 | -0.16 | 1.21 |
| Fixed Income Directional | 1 | beta | -0.01 | -0.01 | -0.01 | 0.00 | 0.00 | 0.18 | 0.18 | 0.18 | 0.18 | 0.00 | 0.42 | 0.42 | 0.42 | 0.42 | 0.00 | 0.56 | 0.56 | 0.56 | 0.56 | 0.00 |
| | | t-Stat | -1.58 | -1.58 | -1.58 | 0.01 | 0.01 | 1.15 | 1.15 | 1.15 | 1.15 | 0.00 | 0.42 | 0.42 | 0.42 | 0.42 | 0.00 | 0.49 | 0.49 | 0.49 | 0.49 | 0.00 |
| Macro | 4 | beta | -0.01 | 0.00 | 0.00 | 0.00 | 0.01 | -0.18 | -0.05 | -0.05 | 0.06 | 0.11 | 0.14 | 0.49 | 0.56 | 1.11 | 0.44 | -1.01 | -0.20 | -0.24 | 0.45 | 0.64 |
| | | t-Stat | -1.51 | 0.45 | 0.15 | 1.19 | 1.17 | -0.65 | -0.28 | -0.22 | 0.33 | 0.49 | 0.28 | 0.47 | 0.71 | 1.62 | 0.62 | -1.00 | -0.10 | -0.14 | 0.65 | 0.68 |
| Multi-Strategy | 10 | beta | -0.01 | 0.00 | 0.00 | 0.01 | 0.01 | -0.45 | -0.08 | -0.05 | 0.45 | 0.25 | -2.47 | -0.09 | 0.03 | 1.33 | 1.08 | -2.04 | -0.05 | -0.12 | 1.94 | 1.28 |
| | | t-Stat | -0.82 | 0.17 | 0.56 | 2.32 | 1.24 | -2.20 | -0.54 | -0.28 | 1.94 | 1.14 | -2.04 | -0.08 | 0.15 | 2.01 | 1.12 | -1.65 | -0.04 | -0.23 | 1.37 | 1.06 |
| CTA/Managed Futures | 1 | beta | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -0.07 | -0.07 | -0.07 | 0.00 | -0.31 | -0.31 | -0.31 | -0.31 | 0.00 | 0.48 | 0.48 | 0.48 | 0.48 | 0.00 | |
| | | t-Stat | 1.08 | 1.08 | 1.08 | 1.08 | 0.00 | -0.51 | -0.51 | -0.51 | -0.51 | 0.00 | -0.56 | -0.56 | -0.56 | 0.00 | 0.58 | 0.58 | 0.58 | 0.58 | 0.00 | |
| N/A | 1 | beta | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 | 0.55 | 0.55 | 0.55 | 0.00 | -0.32 | -0.32 | -0.32 | -0.32 | 0.00 | |
| | | t-Stat | 0.21 | 0.21 | 0.21 | 0.21 | 0.00 | 1.02 | 1.02 | 1.02 | 1.02 | 0.00 | 0.42 | 0.42 | 0.42 | 0.42 | 0.00 | -0.20 | -0.20 | -0.20 | -0.20 | 0.00 |

| Category | Sample Size | Statistic | SPX Index | | | | SP500 Index | | | | IBUSURU Index | | | | Statistic | Significance (%) | | | | | | | |
|-----------------------------|-------------|-----------|-----------|-------|-------|-------|-------------|-------|-------|-------|---------------|-------|-------|-------|-----------|------------------|------|---------|------|------|------|-------|------|
| | | | Min | Med | Mean | Max | SD | Min | Med | Mean | Max | SD | Min | Med | | Mean | Max | SD | | | | | |
| Equity Hedge | 36 | beta | -2.16 | -0.23 | -0.29 | 1.55 | 0.61 | -0.15 | -0.01 | 0.01 | 0.25 | 0.09 | -0.09 | 0.05 | 0.10 | 0.55 | 0.15 | Adj. R2 | 0.01 | 0.05 | 0.10 | 0.51 | 0.11 |
| | | t-Stat | -1.93 | -0.37 | -0.24 | 3.58 | 0.87 | -1.47 | -0.09 | 0.07 | 1.50 | 0.77 | -1.90 | 0.65 | 0.75 | 3.47 | 1.18 | p(F) | 0.02 | 0.72 | 1.43 | 14.75 | 2.41 |
| Event Driven | 4 | beta | -1.15 | -0.40 | 0.12 | 2.40 | 1.59 | -0.10 | -0.05 | -0.05 | 0.00 | 0.04 | -0.09 | 0.15 | 0.13 | 0.32 | 0.17 | Adj. R2 | 0.04 | 0.13 | 0.15 | 0.30 | 0.11 |
| | | t-Stat | -0.78 | -0.38 | 0.30 | 2.73 | 1.65 | -0.74 | -0.47 | -0.42 | 0.01 | 0.31 | -0.77 | 1.16 | 0.80 | 1.65 | 1.07 | p(F) | 0.60 | 1.68 | 1.63 | 2.53 | 0.80 |
| Fixed Income Relative Value | 2 | beta | -0.27 | 0.11 | 0.11 | 0.49 | 0.54 | -0.03 | -0.02 | -0.01 | 0.02 | 0.16 | 0.16 | 0.16 | 0.16 | 0.17 | 0.00 | Adj. R2 | 0.09 | 0.13 | 0.13 | 0.17 | 0.05 |
| | | t-Stat | -0.46 | 0.34 | 0.34 | 1.14 | 1.13 | -0.47 | -0.27 | -0.27 | 0.07 | 0.28 | 2.15 | 2.26 | 2.26 | 2.38 | 0.16 | p(F) | 1.47 | 1.85 | 1.85 | 2.22 | 0.53 |
| Fixed Income Directional | 1 | beta | -0.94 | -0.94 | -0.94 | 0.00 | 0.00 | -0.02 | -0.02 | -0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | Adj. R2 | 0.09 | 0.09 | 0.09 | 0.00 | 0.00 |
| | | t-Stat | -1.47 | -1.47 | -1.47 | 0.00 | 0.00 | -0.25 | -0.25 | -0.25 | 0.00 | -0.03 | -0.03 | -0.03 | -0.03 | 0.00 | 0.00 | p(F) | 0.80 | 0.80 | 0.80 | 0.80 | 0.00 |
| Macro | 4 | beta | -0.52 | -0.25 | -0.30 | 0.16 | 0.17 | -0.08 | 0.00 | 0.01 | 0.13 | 0.11 | -0.15 | 0.09 | 0.08 | 0.30 | 0.19 | Adj. R2 | 0.04 | 0.07 | 0.08 | 0.13 | 0.04 |
| | | t-Stat | -1.13 | -0.33 | -0.48 | -0.13 | 0.45 | -1.32 | -0.15 | -0.08 | 1.30 | 1.20 | -1.47 | 0.77 | 0.84 | 3.28 | 1.94 | p(F) | 0.56 | 0.86 | 1.11 | 2.19 | 0.74 |
| Multi-Strategy | 10 | beta | -2.03 | 0.26 | 0.05 | 0.73 | 0.80 | -0.12 | 0.00 | 0.01 | 0.16 | 0.09 | -0.17 | 0.07 | 0.05 | 0.28 | 0.12 | Adj. R2 | 0.01 | 0.10 | 0.13 | 0.37 | 0.11 |
| | | t-Stat | -2.03 | 0.28 | 0.17 | 1.07 | 0.92 | -1.38 | 0.01 | 0.06 | 1.61 | 0.89 | -1.31 | 0.69 | 0.45 | 2.03 | 1.03 | p(F) | 0.13 | 1.05 | 1.05 | 1.77 | 0.55 |
| CTA/Managed Futures | 1 | beta | -0.14 | -0.14 | -0.14 | 0.00 | 0.03 | 0.03 | 0.03 | 0.03 | 0.00 | -0.09 | -0.09 | -0.09 | -0.09 | 0.00 | 0.00 | Adj. R2 | 0.57 | 0.04 | 0.04 | 0.04 | 0.00 |
| | | t-Stat | -0.25 | -0.25 | -0.25 | 0.00 | 0.39 | 0.39 | 0.39 | 0.39 | 0.00 | -1.20 | -1.20 | -1.20 | -1.20 | -1.20 | 0.00 | p(F) | 0.57 | 0.57 | 0.57 | 0.57 | 0.00 |
| N/A | 1 | beta | -0.42 | -0.42 | -0.42 | 0.00 | 0.02 | 0.02 | 0.02 | 0.02 | 0.00 | -0.13 | -0.13 | -0.13 | -0.13 | -0.13 | 0.00 | Adj. R2 | 0.15 | 0.15 | 0.15 | 0.15 | 0.00 |
| | | t-Stat | -0.41 | -0.41 | -0.41 | 0.00 | 0.17 | 0.17 | 0.17 | 0.17 | 0.00 | -0.98 | -0.98 | -0.98 | -0.98 | -0.98 | 0.00 | p(F) | 0.68 | 0.68 | 0.68 | 0.68 | 0.00 |

Table 1 presents the summary statistic for the beta coefficient and t-statistic for each category. We also reported the minimum, maximum and standard deviation of each parameter. From Table 1, we can see that for those categories that we have a larger sample, parameters of risk factors tend to vary within the category. For equity hedge category, we can see that the highest t-statistic was 3.58 for S&P TSX index which is positive significance, the lowest t-statistic was -1.93 which is negative significance. We can also see that most of our parameters are consistent with their category definition. For example, fixed income relative value category tends to be significant with Barclays US Aggregate Bond Index (LBUSTRUU index). In contrast, equity hedge category is not significant with the bond market. However, because of the direction of risk factors' impact tend to vary within many categories, the mean parameters tend to be insignificant for most risk factors. That would make us unable to replicate hedge fund performance using different market indexes.

From the summary statistic, we find that the maximum value of adjusted R-square in Equity Hedge Category is 0.51. So, we run another regression on the average return of Equity Hedge Category to our six risk factors in order to explore the possibility of replicate performance of Equity Hedge Category. Table 2 shows the summary statistic of this regression. From Table 2, we find that the adjusted R-square was only 0.1. So, the explanatory power of this regression is relative low. For the six risk factors, only volatility was statistically significant, other five risk factors are not significant. So, we can't replicate the whole category or we need more detailed strategy category. For other categories, even the maximum value of adjusted R-square was lower than 0.33 so that we can't replicate other categories.

Table 2: Regression Result of Average Return in Equity Hedge

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|----------------|-------------|------------|-------------|--------|
| C | -0.004713 | 0.003457 | -1.363067 | 0.1764 |
| VIX_INDEX | 0.061869 | 0.029240 | 2.115910 | 0.0372 |
| GCAN3M_INDEX | 0.013037 | 0.056548 | 0.230542 | 0.8182 |
| DXY_CURRENCY | -0.284601 | 0.470406 | -0.605011 | 0.5468 |
| SPX_INDEX | 0.213364 | 0.687333 | 0.310424 | 0.7570 |
| SPGSCI_INDEX | 0.002160 | 0.461059 | 0.004685 | 0.9963 |
| LBUSTRUU_INDEX | 0.158742 | 0.108944 | 1.457099 | 0.1487 |

| | | | |
|--------------------|----------|-----------------------|-----------|
| R-squared | 0.159357 | Mean dependent var | -0.002461 |
| Adjusted R-squared | 0.100707 | S.D. dependent var | 0.033655 |
| S.E. of regression | 0.031915 | Akaike info criterion | -3.979176 |
| Sum squared resid | 0.087598 | Schwarz criterion | -3.788551 |
| Log likelihood | 192.0317 | Hannan-Quinn criter. | -3.902207 |
| F-statistic | 2.717098 | Durbin-Watson stat | 1.883000 |
| Prob(F-statistic) | 0.018271 | | |

According to Hzsanhodzic (2006), the impact of most risk factors tends to have a clear direction. For example, S&P 500 index has a very negative influence to Dedicated Short Bias category. Even the maximum value of a parameter is negative and the mean parameter is negative significant. The different between the result of US market and Canadian market may come from the category definition. Hzsanhodzic (2006) used the category definition from TASS database and we used Bloomberg. In TASS database, there are Dedicated Short Bias, Equity Market Neutral whereas there's only Equity Hedge in Bloomberg. Another reason is that we still used US indexes for volatility and commodity. The country difference may contribute to the unclear pattern in our model.

3.2 Methodology

We used OLS method to run a linear regression for each of 59 hedge funds in our sample. Hedge fund return was the dependent variable; independent variables were the following six factors; 1. The first difference of COBE volatility index (VIX); 2. The total return of Canadian 3-month government bond index (GCAN3M); 3. The total return of US dollar index (DXY); 4. The total return of S&P TSX index (SPX); 5. The total return of S&P GSCI commodity index; 6. Barclays US Aggregate Bond Index (LBSTRUU index). These six factors included hedge funds' risk exposure toward interest rate, the stock market, bond market, currency, commodity, and volatility. We used the linear regression to measure the significance of these six factors' impact on hedge fund performance. Then, we decomposed the hedge fund return into these six risk factors so that hedge fund performance can be cloned by a portfolio of these six indexes. The following is our regression model;

$$R_{it} = \alpha_i + \beta_{i1} * RiskFactor1_t + \dots + \beta_{iK} * RiskFactorK_t + \epsilon_{it}$$

For the return decomposition, we used the following model;

$$E[R_{it}] = \alpha_i + \beta_{i1} * E[RiskFactor1_t] + \dots + \beta_{iK} * E[RiskFactorK_t]$$

In our model, hedge fund return was determined by six risk factors and a fund specific factor. The impact of each single risk factor was determined by risk factor exposure (β) and multiplied by expected return of this risk factor. For the fund specific factor, it does not a measure of fund manager's skill to earn an fund specific return. It is a measure of the impact of all other risk factors other than these six risk factors in our model. This decomposition showed investors that the risk sources and risk premium of each hedge fund strategy. So, investors can have a better understanding of risk nature of different hedge fund strategy and make the investment decision based on their ability and willingness to specific risk exposure.

4: Regression Result and Performance Decomposition

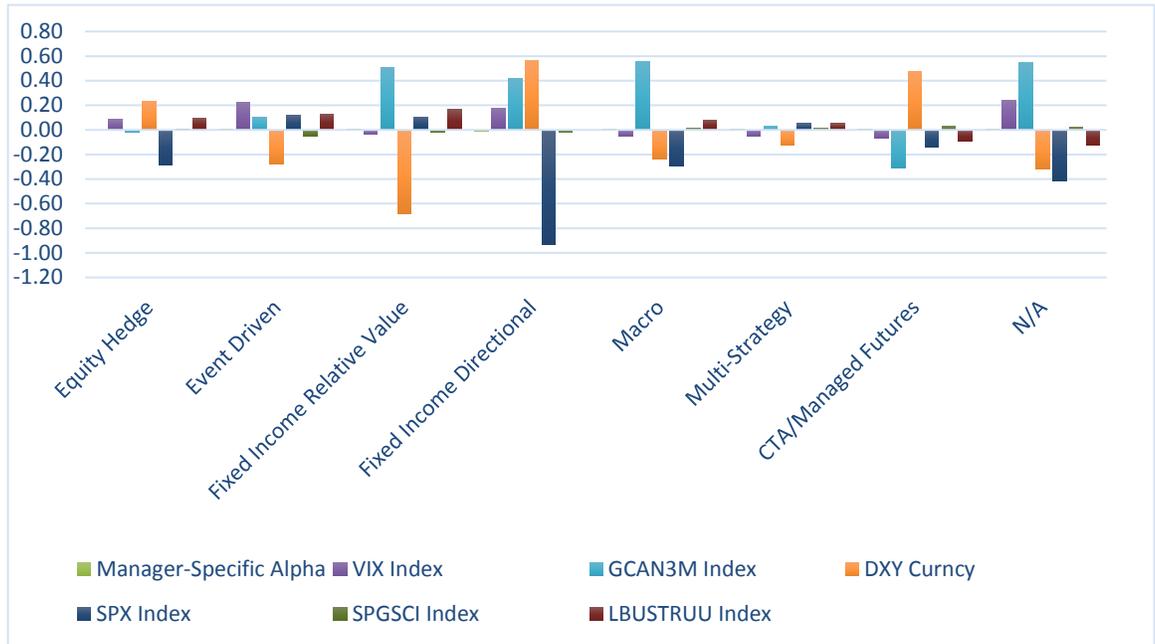
4.1 Regression Results

In this section, we estimated regression models using the OLS method and got the coefficient estimate of different categories.

Figure 1 showed the average regression coefficient of each category. From Figure 1, we can see that currency (DXY index), interest rate (GCAN3M) and stock market (S&P TSX index) have a greater impact on hedge fund performance than other risk factors. However, the direction tends to vary among different categories. For example, US dollar index has a positive impact on equity hedge, fixed income directional and managed futures categories and has a negative impact on event-driven, fixed income relative value and macro categories.

From the regression result, we can see that risk factors have a stronger influence on Fixed Income relative value, Fixed Income Directional, and Macro categories. Government bond has strong a positive influence on both Fixed Income Directional and Fixed Income relative value. This result is consistent with their strategy. The stock market tends to have a great negative influence to Fixed Income Directional and Equity Hedge. Compared with other risk factors, US dollar index has an influence on almost all categories.

Figure 1: Average Regression Coefficient



4.2 Decomposition

After determined the hedge performance sensitivity toward each risk factor. We can decompose hedge fund return into each risk factor to determine the contribution of each factor to the overall performance. We used the following method to decompose the hedge fund return:

$$\text{Contribution of risk factor } i = \text{Average} \left[\frac{\text{Factor beta } i * \text{Average return of factor } i}{\text{Average return of hedge fund } j} \right]$$

Table 3 presents the decomposition result below:

Table 3: Decomposition of total mean return of hedge funds

| Average Percentage Contribution of Factors | | | | | | | | |
|--|-----------|--------------|--------------|-----------|--------------|----------------|-------|-------|
| | VIX Index | GCAN3M Index | DXY Currency | SPX Index | SPGSCI Index | LBUSTRUU Index | Alpha | Total |
| Equity Hedge | 1% | 66% | -64% | -10% | 16% | -11% | 102% | 100% |
| Event Driven | 42% | 2% | -46% | 54% | -5% | 21% | 33% | 100% |
| Fixed Income Relative Value | -10% | -146% | 264% | -97% | -3% | 17% | 76% | 100% |
| Fixed Income Directional | -14% | 71% | 99% | 164% | 3% | 0% | 105% | 100% |
| Macro | -12% | -44% | 22% | 23% | 17% | 0% | 94% | 100% |
| Multi-Strategy | 5% | -199% | 183% | 14% | 7% | -6% | 96% | 100% |
| CTA/Managed Futures | -23% | 57% | -96% | 31% | 10% | -30% | 151% | 100% |
| N.A. | 260% | 249% | -135% | 177% | 43% | -221% | 80% | 100% |

From Table 3, we can see that volatility, interest rate, the stock market and currency have greater contribution toward hedge fund performance. However, the direction tends to vary among different category. For example, the fixed income relative value category has a great negative contribution from government bond index which indicates the risk-free rate. In contrast, the equity hedge category has a great positive contribution from government bond index. For the event-driven category, other than other categories, none of these six risk factors has the dominate effect. This result is consistent with the fact that hedge funds in the event-driven category usually does not expose to a specific risk factor. Using our return decomposition, investors can replicate the hedge fund performance using a linear portfolio of these six indexes. However, we still need to consider the contribution of fund specific alpha when replicating the hedge fund performance. The fund specific alpha consists of fund manager's ability and risk exposure of other risks other than those six factors we included in our model.

5: Conclusion and Limitation

5.1 Conclusion

Before the 2008 financial crisis, most studies concluded that hedge funds returns can be replicated. For example, Kat and Palaro (2005) by applying dynamic trading strategy found that hedge funds returns are not unique and can be replicated. Hzsanhodzic (2006) demonstrated that the possibility of replicating hedge fund is real. Although all these studies conducted under several strict constraints, conclusions are similar that replication hedge funds returns are possible and could benefit investors.

However, from our study on hedge funds returns based on Canadian market post-crisis period, the “un-replicated component” alpha places a heavy weight in the hedge funds returns. The alpha factor includes manager-selection skills and other factors that not involved in the six major risk factors listed, and the alpha quite significant in most of our strategies. Thus, the alpha factor is non-replication nature and cannot be used to replace our six index risk factors.

In addition, the impact of each risk factor on hedge fund performance tend to vary within each hedge fund category. The maximum value of coefficients tends to be positive and the minimum value of coefficients tend to be very negative. On average, many of our risk factors are insignificant toward hedge funds performance. In this case, we cannot determine the direction of risk factors’ influence and that make us unable to replicate hedge fund performance using market indexes.

In a summary, the possibility of hedge funds returns replication in the Canadian market in the post-crisis period is relative low, especially compared to previous studies on hedge funds performance and replication.

5.2 Limitation

There are still many limitations in our study. First, we only have a small group of Canadian hedge funds in our sample. In some strategy categories, we only have one sample in that category. Our estimation of average parameters may not be very accurate. Our sample time

period is also relatively small, we only have 7 years' data since we only focus on the post-crisis period. We used monthly return so we have 93 sample for each hedge fund. Another point is that the true model may not be linear. We may have the problem of model misspecification. Most of the studies of research used linear regression models so we just followed other researches. If we have enough time, we could do some research on other models such as log-linear model. We do not have accesses to hedge fund grave yard so we can only research on active hedge funds. So, we may have survivorship bias in our research. Those hedge funds in our sample may already be successful so we were not looking into the whole picture of the hedge fund industry.

Appendix: List of Hedge Funds

Below is the whole list of all selected hedge funds data.

| Equity Hedge (36) | Event Driven (4) |
|--------------------------|--|
| FSCENRE CN Equity | ROSSEAU1 CN Equity |
| SPRBUBEA CN Equity | ASLSPSIT CN Equity |
| HEDGEDLT CN Equity | RSOPPORT CN Equity |
| HEDGEDLP CN Equity | VERTXLP CN Equity |
| CRSTEHLN CN Equity | |
| ROSCPLP CN Equity | Fixed Income Relative Value (2) |
| HILSCPEQ CN Equity | AMETHARB CN Equity |
| GOODCAPT CN Equity | RSCAPINV CN Equity |
| GOODWOOD CN Equity | |
| PALINTR CN Equity | Fixed Income Directional (1) |
| HILCMNEA CN Equity | PICMIOA CN Equity |
| JMKLSFDL CN Equity | |
| WARAINC CN Equity | Macro (4) |
| FIEMKNA CN Equity | VERTXBAL CN Equity |
| WARAPER CN Equity | TERHIIN CN Equity |
| PMLSEQA CN Equity | NIAGLEGB CN Equity |
| LIGHTWA CN Equity | BPIGLOP CN Equity |
| NRCNSGLP CN Equity | |
| HIRSHCPE CN Equity | Multi-Strategy (10) |
| WARAONE CN Equity | FRIFANO CN Equity |
| HILLCAG CN Equity | TIPOPPRA CN Equity |
| FFLSLPF CN Equity | JMKTOTRE CN Equity |
| KINGVICT CN Equity | GWQNTMS CN Equity |
| DYNALPHA CN Equity | JMCTLST CN Equity |
| LMLSMOME CN Equity | FSHEDGE CN Equity |
| DYNIOPA CN Equity | FFMSLPF CN Equity |
| PMMNCLA CN Equity | GBMGLOBA CN Equity |
| CCLMKNA CN Equity | INDIABA CN Equity |
| NORMNIA CN Equity | NEXNEAF CN Equity |
| SPROHEDL CN Equity | |
| PMGLMKNE CN Equity | CTA/Managed Futures (1) |
| PMGLLSHO CN Equity | NIAGDIS CN Equity |
| TRITGBA CN Equity | |
| TERCGTEU CN Equity | Restricted (1) |
| LAKERDI CN Equity | SPRSPAN CN Equity |
| HILUSAGH CN Equity | |

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