PERSISTENCE IN HEDGE FUND PERFORMANCE IN BULL AND BEAR MARKETS: A MULTI PERIODS ANALYSIS

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By

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In line with the principles of the University of Johannesburg, I, Jean Luc Mubenga Tshitaka, declare that this dissertation in my own original work and has not been submitted at any other university or institution for degree purposes. I declare that I have written my own sentences and paragraphs throughout my dissertation and where material written by other people has been used; this has been carefully acknowledged and referenced. Every contribution to, and quotation from, the work of other people in this dissertation has been acknowledged through proper citation and reference.

Jean Luc Mubenga Tshitaka

November 2014

Dedications

Dedications

I dedicate this study to:

- To the almighty God, for being the best co-writer I could ever ask for.

- To my parents Mpoyi Kalala Tharciss and Mbiya Lukusa Marceline for their support since my childhood.

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Abstract

This dissertation investigates the persistence in the performance of hedge funds over the period of 19 years starting from January 1995 to March 2014. Aggregate monthly returns data of more than 6500 hedge funds from around the globe published by the Hedge Fund Research group are considered as a representative sample of hedge fund industry. The aim of the study is to investigate whether hedge fund managers have genuine skills to outperform the market during different economic cycles. For that purpose, we divide the sample period into 4 sub-samples that are characterised by different market trends. A skilled hedge fund manager is defined by his ability to outperform the market consistently during two consecutive sub-sample periods.

In order to identify managerial skills in hedge funds, we make use of both linear and quadratic capital asset pricing models (CAPM) and distinguish between outperformance, selectivity and timing skill. We define the outperformance skill as the ability of a fund manager to generally outperform the market. Selectivity skill is defined as the ability to select outperforming assets that will help the manager to outperform the market. In contrast, market timing skill is defined as the ability to get in and out of the market in time in order to either avoid more losses or make large profit. The multi-period framework is carried out using three different techniques: Contingence table, Chi-square statistic test and the Kolmogorov-Smirnov test. And we extend the analysis on whether the explanatories variables (factor loadings) can capture the variability of hedge fund excess return regardless the business cycle.

The results obtained from both methods of performance reveal that hedge fund managers have genuine skills to outperform the market return during good market conditions due to their selectivity skill. We find not statistically evidence of hedge funds market timing skill during the four sub-sample periods. The persistence analysis using the Cross-product ratio and Chi-square test reveals that in the long run hedge funds are not able to outperform the market consistently during all four sub-sample periods. We find evidence that the four-factor model produces robust results compared to the CAPM and the three-factor model, as represented by a higher R-square.

However, we find evidence of significant performance under the Kolmogorov-Smirnov test. The significant performance is due to Equity Hedge (EH), Even Driven (ED), Emerging Market (EM), Fund Weighted Composite (FWC) and Relative Value (RV) strategies during the

period 1 to 2 and 2 to 3. Our results suggest that the performance of hedge fund is persistent only at short term. These findings are in line with the existing literature. Based on the factor loading, we find no evidence of persistence in the role of factor loadings during the entire sample. The lack of persistence in the role of factor loading toward hedge fund strategies might be explained by the freedom enjoyed by fund managers. Therefore the same factor loadings are not always able to capture the variation of hedge funds excess returns in the long run.

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CHAPTER ONE

INTRODUCTION

1.1 Background

The aim of this minor dissertation is to assess the performance of hedge fund managers in different business cycles, especially in the bull and bear markets. Hedge funds are regarded as limited partnerships with fund managers who are the general partners and investors who are limited partners (Kidwell *et al*, 2003). Hedge funds are commonly defined by their freedom from the regulatory controls found in the Investment Company Act of 1940. Hedge funds are similar to mutual funds except that they have considerably fewer restrictions on their trading activities. A hedge fund can simultaneously take long and short positions in the market (Agarwal and Naik, 2004), make usage of leverage and derivatives products, invest in concentrated portfolios, and move quickly between different markets (Amin and Harry, 2003).

Unlike mutual funds, hedge funds do not tract a benchmark but instead seek to exploit mispricing securities and provide absolute returns (Brown *et al*, 1999). Hedge funds are more flexible in making investment decisions compared to mutual funds due to the lack of strong regulations in the hedge fund industry (Liang, 1999). The flexibility of hedge funds can make a portfolio's beta more stable than the beta of individual funds because time-varying betas can offset each other at the portfolio level (Manser and Schimid, 2009). This flexibility of the hedge fund industry pushes investors to consider investing and including hedge funds as an investment strategy to improve overall levels of return.

The presence of hedge funds in a portfolio can possibly result in an improvement of the risk-return trade-off due to a low correlation between hedge fund returns and returns of others assets classes (Fung and Hsieh, 1997). The low level of correlation of hedge funds with other assets classes presents a way to reduce risk through diversification despite the fact of a few notorious cases such as the failure of the Long-Term Capital Management (LTCM) that collapsed in the late 1990s. The growing hedge fund industry can permit diversification and also provide mechanisms for examining its own performance.

According to the Hedge fund research (HFR) group report released on April 2013, the total amount of capital invested in the global hedge fund industry increased during the first quarter of 2013 at the fastest rate since 2010 as most of the financial institutions were taking position for both growth and volatility across fixed incomes, equities, currencies and commodities. The same report shows that, assets under the management of hedge funds reached a record US2.375 trillion (HFR Report, April, 2013), and US2.630 trillion by the end of the last quarter of 2013 (HFR Report, April, 2014). Furthermore, the HFR reports that the hedge fund industry surged to another record level in the first quarter of the year 2014. Surprisingly, investors have allocated the amount of new capital to the industry since the second quarter of 2011 and global funds invested in the industry reached US2.70 trillion and US2.80 trillion by July 2014 surpassing previous records (HFR Report, July, 2014)

This positive attitude toward hedge funds is typically motived by the perception that they are largely a source of diversification, and that their managers enjoy more flexibility in allocating resources, a situation that enables them to achieve high returns (Fung and Hsieh, 1997). There is also the view that the hedge fund industry has low covariance with other financial assets and that it creates greater opportunities for diversification (Scheeweis and Spurgin, 1998). Hung-Gay *et al* (2002) suggest that besides this, there is a general belief that hedge funds are able to hedge while at the same time enhancing return performance. Dor *et al* (2006) add that hedge funds play a key role in institutions' portfolio as an alternative investment to other traditional assets.

The explosive growth of assets under hedge funds management gives rise to a number of studies on performance persistence analysis. The idea behind such studies is to check whether fund managers are capable of generating an abnormal rate of return compared to other assets classes regardless of market conditions. In addition, these studies attempt to find out whether hedge funds are able to exhibit persistence in their performance. For instance Edwards and Caglayan (2001) examined the monthly returns of hedge funds between January 1990 and August 1998 by estimating a six factor model for individual funds employing eight different strategies. They found that about 25% of these hedge funds are able to generate excess positive returns which differ markedly to the investment strategy employed. They also found evidence of performance persistence over 1 and 2 year horizons among both winners and losers. Furthermore, Patari and Tolvanen (2008) apply two complementary methodologies (stacked cross-sectional regression and

quartile portfolio approach) in their effort to detect persistence in performance of five different hedge strategies. They also compare the results obtained from both models to those obtained by using both standard multifactor models and their empirical Bayesian counterparts. They found evidence of both the degree and the existence of persistence in performance among hedge funds strategies.

These findings stand in contrast to those for mutual funds. For instance, Carhart (1997), Goetzmann and Ibbotson (1994) and Malkiel (1995) did not find evidence of performance persistence in the mutual fund industry. For hedge funds, Brown and Goetzman (2003), Capocci and Hubner (2004) and, Herzberg and Mozes (2003)

In this dissertation, we employ the extended CAPM previously used by Capocci *et al* (2005) and Carhart (1997). Furthermore, we also check if the outperformance enjoyed by fund managers is a result of selectivity or timing ability (Tihana, 2013 and Philippas, 2011). Finally, we check whether hedge fund managers are able to repeat the same level of performance in two or more consecutive periods by making use of the cross product ratio (CPR), the Chi-square and the Kolmogorov-Smirnov (K-S) test as employed by Agarwal and Naik (2000a) as well as the spearman rank correlation employed by Harri and Brorsen (2004).

Our results reveal that on average hedge funds outperform the market return, especially during the bull market periods, with some evidence of underperformance during the 2008-2009 sub-prime crisis. These findings are partly line with those of Capocci *et al* (2005) who suggest that most hedge funds significantly outperformed the market proxy during the whole test period, especially during a bullish period. Yet they did not find statistical evidence of underperformance during the bearish period. Our results also suggest that hedge fund managers outperform the market due to their selectivity skills which improve considerably over time, except during the period covering the financial crisis. However, no sign of market timing skills has been noticed during all four sub-sample periods under investigation, in line with the findings of (Philippas, 2011). In addition, Hung-Gay *et al* (2002) suggest that hedge fund managers do not show market timing abilities but do demonstrate superior security selection skills. Fama (1972), however, argues that that the performance of fund managers can be attributed to both selectivity and timing ability.

After using the extended CAPM, we find that the four-factor model is more robust to take into account the majority of the variations of hedge fund excess returns (Lam *et al* , 2010 and Carhart, 1997), but in some cases, during the second sub-sample period for instance, the three-factor mode was more appropriate (Bundoo, 2008). Furthermore, we investigate if there is possibility of persistence in the performance, both CPR and Chi-square methods of assessment lead to the same conclusions of lack of persistence in performance, which are in line with Malkiel and Saha (2005).

Carpenter and Lynch (1999) emphasis that the Chi-square test is well specified and more robust to detect persistence compared to the CPR test. We also use the Kolmogorov-Smirnov (K-S) test to check the persistence in performance in more than two periods as the likelihood of observing skills by chance is limited. The results reveal at same extend a level of persistence in performance of hedge funds managers in the sub-sample period 1 to 2 and 2 to 3, as the p-values are less than 0.05. Results that are in line with the finding of Agarwal and Naik (2000a) and Koh *et al* (2003). Agarwal and Naik (2000a) suggest that the K-S test, unlike the two period tests (CPR and Chi-square) involves tracking the history of series of successes and failures of individual hedge funds throughout the sample period under investigation and found persistence in performance at quarterly horizon. Gehin (2003) add also that one of the attractive features of the K-S test is that its distribution does not depend on the underlying cumulative distribution function being tested. Finally, we assess persistence in the role of factor loadings employed in this study. This is in order, to check whether factor loadings are able to explain the variation of hedge fund excess returns over time. The Spearman rank correlation coefficients show a general tendency of positive correlation but without statistically significant evidences, therefore indicating that there is no persistence. The results thus reveal that on average hedge funds are not exposed to the same levels of risk and/ or do not adopt the same strategies in their effort to generate abnormal returns due particularly to the lack of strong industry regulations. Also due to the fact that hedge fund managers always seek mispriced securities in order to generate positive returns, therefore they tend to combine simultaneously different strategies.

1.2 Research question

The research question in this dissertation is:" Do hedge funds outperform the market return persistently during different market cycles?"

1.3 Objective of the Study

A significant number of studies in the literature have studied the persistence of hedge funds' performance. Such studies include Eling (2009), Manser and Shimid (2008), Jordan and Simlai (2010) and Abdou and Nasereddin (2011). However, few have actually attempted to focus particularly on the impact of economic cycles on the persistence of hedge fund performance; such particular studies include among others Cappoci *et al* (2005) and Edwards and Caglayan (2011). For example Cappoci *et al* (2005) consider only two period framework and check whether different business cycles have an impact on hedge fund performance persistence. While Agarwal and Naik (2000a) use the multi-periods frame-work but did not focus on the impact of business trends in the performance. Their main intention was to check whether the different length of time have an impact on the performance persistence of hedge fund. The aim of this study is therefore to investigate whether economic business cycles such bear markets have negative impacts on hedge funds' performance with regard to their performance or whether hedge funds live up to the expectations to always deliver absolute returns regardless of these conditions in more than 2 periods.

1.4 Hedge funds

1.4.1 Background

While most people perceive hedge funds to be recent phenomenon, they have actually been around for more than 50 years. It is generally reported that Albert Wislow Jones set up the first hedge fund in 1949. Jones employed long-short strategies to hedge the market risk (taking a long position in the undervalued securities and short position in the overvalued securities). Hedge funds became popular after an article published in *Fortune* magazine in 1966 by Carol Loomis in which Loomis stated that Jones' fund significantly outperformed other mutual funds. Although, this article generated much interest in hedge funds, their popularity diminished as many suffered significant losses in the periods, 1969-1970 and 1973-1974. As result, hedge funds were out of fashion until

1986 (Agarwal and Naik, 2002), when an institutional investor reported the impressive performance of Julian Roberson's Tiger Fund. This particular fund reached an annual return of 43% after all expenses during its last six years. This produced a change in the general perception of the hedge fund industry ever since. Nowadays, hedge funds use more strategies beyond the simple "hedging" strategy employed by Jones in 1949.

1.4.2 What is a hedge fund

There is no common definition of what constitutes a hedge fund. Hedge funds were named after their investment strategy which intends to reduce risk regardless of the direction of the market by pooling investments in the mixture of long and short market positions (Lhabitant, 2004). Jones (2007) defines a hedge fund as a "fund that is incentivized and flexible enough to generate returns irrespective of the direction of core underlying markets". Brown et al (1999) defines hedge funds as limited partnerships or a limited liability companies established to invest in public securities and where the general partners make substantial personnel investment. The reason why it is difficult to define a hedge fund is because there is a lack of agreement on the term "hedge fund" and the diverse trading spectrum they should employ. Hedge funds are characterized by leveraging, derivatives and short selling strategies compared to others investment vehicles like mutual funds.

Another approach of defining hedge funds is to relate them to mutual funds. Hedge funds are similar to other asset managements, especially mutual funds in three ways:

- They are funded by capital from investors, rather than by bank loans or other sources of capital.
- They invest in publicly trades securities.
- The capital is managed and invested by expert fund managers.

The main dissimilarities between hedge funds and mutual funds are as fallow:

- Mutual funds are required to adhere to strict financial regulations, including the types and the level of risk that are exposed to, while hedge funds are free to pursue virtually any investment strategy associated with any level of risk.

- Investors in the mutual fund industry can withdraw funds daily while hedge funds have rules that restrict investors' ability to withdraw funds. The invested money is often locked into the fund for a period up to one year.
- Mutual funds are obliged to disclose a lot of information to investors. For example, they have to report their holding to the Security and Exchange Commission (SEC) and to have audited statements. By contrast, hedge funds may agree contractually to disclose some type of information and also to provide audited financial statements if it helps them to recruit new investors but they are not required doing so (Shin, *et al*, 1998).
- The incentive fees of hedge funds managers differ significantly from those of mutual funds managers. The compensation contract for mutual funds advisers is restricted by regulations such that the incentive compensation, if any, has to be symmetric. A dollar gain has to have the opposite impact on the compensation to the dollar loss. Consequently, relatively few mutual advisers have an incentive clause in their contracts and the compensation of mutual funds managers depends on the amount of assets being managed (Stulz, 1997), while hedge funds managers receive a substantial fraction of the profit they generate (Ackermann *et al*, 1999).
- Hedge funds are restricted to only accredited investors constituting a group of institutional investors (Eichengree *et al*, 1998).
- Mutual funds have goals that differ from those of hedge funds. For instance, mutual funds have a relative goal, which is to beat a benchmark index, while hedge funds have an absolute goal to achieve a positive rate of return at all the times; regardless of the market trends.

1.4.3 Hedge funds strategies

Originally, hedge funds intended to hedge the investor strategies, generate absolute returns and reduce the level of volatility in returns. Nowadays, hedge funds are heterogeneous in the way they behave in the market. Some strategies intend to reduce the risk faced by investors while others go for higher returns by using speculative strategies. In the following section, brief explanation of different investment strategies employed by fund managers are provided; interested readers are referred to the Hedge Fund Research (HFR) website for more details.

The HFR database has been used in hedge fund literature to assess persistence in performance by many studies like that of Agarwal and Naik (2000a). The HFR investment strategies are presented as monthly equally weighted performance indices and constructed as accurate, relevant, robust and contemporaneous strategy classification systems for all fund managers present in the database (*http*://hfr.com). The HFR investment strategies are classified into seven main strategies, each with a series of sub-strategies that contains equity hedge, event-driven, emerging markets, fund of funds, fund weighted composite, macro and relative investment strategies. The emerging market and fund weighted composite are generally combined with the other five strategies. The definitions of the seven main strategies and sub-strategies are those provided by the Hedge Fund research website (*http*://hfr.com)

1.4.3.1 Equity Hedge (EH)

Equity hedge strategies maintain simultaneously long and short positions primarily in equity and equity derivatives securities. A wide variety of investment processes can be employed to reach an investment decision, including both quantitative and fundamental techniques. Strategies can be broadly diversified or narrowly focused on specific sectors and can differ in terms of level of net exposure, level of leverage employed by fund managers, holding period, concentrations of market capitalizations and valuation range of typical portfolios. Equity hedge managers would typically maintain at least 50% exposure to, and may in some cases be entirely in, equities, both long and short. EH strategy is further split into 8 sub-strategies.

- Equity Market Neutral strategies
- Fundamental Growth strategies
- Fundamental Value
- Quantitative Directional Strategies
- Sector-Energy/Basic Materials Strategies
- Sector-Technology/Healthcare Strategies
- Short-Biased
- Multi-Strategy

1.4.3.2 Event Driven (ED)

Even Driven strategy is an investment strategy in which managers maintain positions in companies currently or prospectively involved in corporate transactions of a wide variety including but not limited to mergers, restructurings, financial distress, tender offers, shareholder buybacks, debt exchanges, security issuance or other capital structure adjustments. Security types can range from most senior in the capital structure to most junior or subordinated, and frequently involve additional derivatives securities. Event Driven exposure includes a combination of sensitivities to equity markets, credit markets and idiosyncratic, and company special development. Investment theses are predicted on fundamental characteristics (as opposed to quantitative), with the realization of the theses predicted on a specific development exogenous to the existing capital structure. This strategy is subdivided into seven sub-strategies.

- Activist Strategies
- Credit Arbitrage Strategies
- Distressed Restructuring Strategies
- Merger Arbitrage Strategies
- Private Issue/Regulation D Strategies
- Special Situations
- Multi-Strategies

1.4.3.3 Macro (M)

Macro is investment theses whereby managers trade a broad range of strategies in which the investment process is predicated on movement in underlying economic variables and the impact these have on equity, fixed income, currency and commodity markets. Managers employing this strategy use a variety of techniques, both discretionary and systematic analysis, combinations of top down and bottom-up theses, quantitative and fundamental approaches as well as long and short term holding periods. Although some strategies employ Relative Value techniques, Macro strategies are distinct from Relative Value strategies in that the primary investment theses is predicted on predicted or future movement in the underlying instrument, rather than realization of a valuation discrepancy between securities. In a similar way, while both Macro and equity hedge

managers may hold equity securities, the overriding investment thesis is predicted on the impact movements in underlying macroeconomic variables may have on security price, as opposed to Equity Hedge strategies, in which the fundamental characteristics of the company are the most significant and integral to investment theses.

- Active Trading Strategies
- Commodity-Agriculture Strategies
- Commodity-Energy Strategies
- Commodity-Metals Strategies
- Commodity-Multi
- Currency Discretionary
- Currency Systematic
- Discretionary Thematic
- Systematic Diversified
- Multi-Strategy

1.4.3.4 Relative Value (RV)

Relative Value strategy is a strategy in which the investment theses is predicated on the realization of a valuation discrepancy in the relationship between multiple securities. Managers employ a variety of fundamental and quantitative techniques to establish investment theses, and security types range broadly across equity. Fixed income strategies are typically quantitatively driven to measure the existing relationship between instruments and, in some cases, identify attractive positions in which the risk adjusted spread between these instruments represents an attractive opportunity for the investment manager. Relative Value positions may be involved in corporate transaction also, but as opposed to Even Driven exposures, the investment theses is predicted on realization of a pricing discrepancy between related securities, as opposed to the outcome of the corporate transaction. This strategy is divided into eight sub-strategies.

- Fixed Income-Asset Backed
- Fixed Income-Convertible Arbitrage
- Fixed Income-Corporate

- Fixed Income-Sovereign
- Volatility Strategies
- Yield Alternative-Energy Infrastructure
- Yield Alternative-Real Estate
- Value Multi-Strategies

1.4.3.5 Fund of Funds (FOFs)

Fund of funds invest with multiple managers through funds or managed accounts. The strategy designs a diversified portfolio of managers with the objective of significantly lowering the risk (volatility) of investment with an individual manager. The Fund of Funds manager has discretion in choosing which strategies to invest in for the portfolio. A manager may allocate funds to numerous managers within a single strategy. The minimum investment in a Fund of Funds may be lower than an investment in an individual hedge fund or managed account. The investor has the advantage of diversification among managers and styles with significantly less capital than investing with separate managers. The Fund of Funds strategy is divided into four sub-strategies.

- Fund of funds classified as “Conservative”
- Fund of funds classified as “Diversified”
- Fund of funds classified as “Market Defensive”
- Fund of funds classified as “Strategies”

1.5 Disadvantages of hedge funds

Hedge funds are generally regarded as a best alternative to many securities for investors who are attempting to reduce risk through diversification in order to achieve a better overall return on their portfolio. The dominant positive attitude toward hedge funds is justified by the fact that their presence in the portfolio improves the risk-return trade-off (Fung and Hsieh, 1997). Besides advantages presented by hedge funds, Gregarious (2003) highlights some disadvantages. The main disadvantages are as follow:

- There is lack of transparency in the industry due to the absence of absolute regulations.

- Hedge funds increasingly use leverage processes that expose the entire financial system to generate more returns.
- Hedge funds experience borrowing risk.
- Hedge funds offer poor liquidity to investors who invest in them as they prevent investors from withdrawing funds at any time.
- The combination of basic fees and performance-based fees leads to a situation where investors are paying more in total that might exceed any value created in the long term.
- The lack of explicit regulation leads to an absence in the protection of investors investing in the hedge fund industry.
- And finally, the measurement used to assess hedge fund performance is not transparent and is characterized by unrealistic assumptions.

1.6 Regulation of the hedge fund industry

Over recent years, the hedge fund industry has grown rapidly and as it operates on private basis, there is a possibility to experience deviations. Hence the regulation of the industry becomes a big concern, especially with the recent financial crisis. Joaquin and Moura (2011) report that the period 2008-2009 was marked by the world's worst financial crisis since the Great Depression of the 1930s.

The financial crisis has shaped a general perception that action must be taken to reduce the impact of groups of market players such as hedge funds. Hedge funds are a group of market players who enjoy a lot of freedom in the way they conduct their business. The freedom enjoyed by this industry presents an opportunity to avoid regulation. According to Fichtner (2013), US domestic hedge funds are structured in such way that they are able to avoid regulation by taking advantage of four different legislations. First, to be exempt from the Investment Company Act 1940 emphasizes the disclosure and registration and the use of certain investment techniques. This exemption is required in the hedge fund industry as it enables fund managers to leverage up by using all strategies at their disposal. Secondly, hedge funds try to exempt themselves from the Securities Act 1933 in order to prevent them from revealing trading strategies and other vital information about their operations. This Act requires that hedge funds restrict themselves to private placements. This means, for example, that they may not advertise and market their funds to the

general public and that they can only deal with accredited investors. Thirdly, to be exempted from the Investment Adviser Act of 1940, hedge fund managers are restricted to less than 15 clients per year and may not advertise publicly as investment advisers. The Investment Act of 1940 has changed to the Dodd-Frank Act 2011, and since March 2012, hedge fund managers are required to register with the Security Exchange Control (SEC). Finally, to avoid being affected by elements of the Security Exchange Act of 1934, which contains strict regulation and disclosure requirement; hedge funds must ensure that they have less than 500 investors.

These exemptions are crucial to the definition of hedge funds and their unique characteristics. Since they are not registered with the SEC, they are allowed to adopt a wider range of investment strategies that are not open to polled investment vehicles such as mutual funds. Hedge funds are therefore characterized by the freedom they enjoy in the pursuit of their goals. Edwards (2006) proposes a very comprehensive definition of hedge fund managers, stating that they are people who can

"*buy and sell whatever assets and financial instruments, trade any kind of derivatives instruments, engage in unrestricted short-selling, employ unlimited amount of leverage, hold concentrated positions in any securities without restriction, set redemption policies without restriction and can employ any fee and management compensation structure that is acceptable to their investors*"

The excessive risk taking behaviour of the hedge fund industry has caused major damages to the entire financial sector. For instance, Lubochinsky *et al* (2002) report that the risk faced by hedge funds managers resulted in significant losses suffered by the industry during the period August-October 1998. There is thus the consensus that hedge funds should be regulated in order to prevent more damages to the financial system and the global economy as whole. This view is expressed by Christopher Cox former chairman of the SEC before the senate banking committee "*Hedge funds are not, should not be, and will not be unregulated*". This idea has not gone unchallenged as some groups of market players believe that hedge funds are not the only threats to the financial system. Lutton (2008) argues that the relationship between hedge funds and the financial crisis is complex and less straightforward than it is often portrayed.

Despite these arguments, the regulation of hedge funds remains a crucial issue for policy makers who should seek a balance between decreased regulations to attract hedge funds and increased regulations to protect investors and the domestic market. Such a balance must push

regulators to learn from the United Kingdom and United States (which tend to regulate hedge funds loosely and attract huge funds) and Germany where there is an increased tendency towards regulation. Achieving balance between strong and less strong regulation must always take into account the characteristics of each domestic financial market and the global financial system as a whole. As Ladi (2008) suggests any regulation (current or future) must focus on two main areas: first, the protection of investors and second, the prevention of harm to the domestic and global financial systems.

CHAPTER TWO

LITERATURE REVIEW

The objective of this dissertation, as mentioned earlier, is to assess the persistence of performance in hedge funds during different market conditions. The performance measurement of fund managers is somehow a way of testing the validity of the efficient market hypothesis (EMH) in practice. The rationale behind the EMH is that prices in the market are fair at all times and investors have a homogeneous interpretation of information, hence hedge fund managers cannot take any advantage of the difference in prices by positioning themselves into different markets. Claims that the EMH does not seem to be convincing as many funds try to identify securities that are under-priced and whose values are expected to increase in the future particularly those that are expected to increase more significantly than others. These hedge fund managers believe that they can select securities capable of outperforming the market return. They thus perform a variety of valuation and forecasting techniques which help them in their investment decisions. By implication, the existence of one successful method of forecasting returns demonstrates the violation of the EMH framework.

To illustrate this, Capocci *et al* (2005) collect data of 2,894 hedge fund returns from MAR (Managed Account Report) during periods when market trends are both bullish and bearish. Making use of the capital asset pricing model as measure of performance, they find that two-thirds of individual funds strategies outperform market returns. Boyson and Cooper (2004) employ 1659 hedge funds selected from the TASS database from 1994-2000 and not only find evidence of outperformance but also of persistence at the quarterly horizon. By contrast, Jensen (1968) finds little evidence that any individual mutual fund is able to do better than the market. The existence of a hedge fund strategy creating a positive and statistically significant alpha; implies that the EMH does not hold in practice. Hence, hedge funds are able to generate an abnormal rate returns. They use different techniques at their disposal and produce a better rate of returns than what the "buy and hold" strategy can provide. The "buy and hold" strategy is influenced by the prevailing market trend. Researchers like Fama and MacBeth (1973) provide evidence that it takes more than just market returns to explain the entire change in the excess return of hedge funds. The same study adds that the beta of the portfolio is not a complete description of market risk. Therefore, hedge fund risk-returns will be explained by factors over and above the general state of the economy. Banz (1981) also discovers evidence of the size effect, when stocks are sorted on market capitalisation, the average return is much higher than that predicted by the CAPM. Rosenberg *et al* (1985) report that stocks with high boot-to-market equity ratios has higher average returns than

that captured by the beta market. At this point in the literature, many firm characteristics besides the market beta have been reported as having significant degrees of explanatory power for the average return. These include, for instance, the firm size (Herrera and Lockwood, 1994), the book-to-market (Chan *et al*, 1991) and earning-to-price (Jaffe *et al*, 1989). The CAPM is extended to more than just market factors. The combined or extended CAPM has been used intensively in the literature, for example Capocci (2009), Capocci *et al* (2005), Carhart (1997), Manser and Schmid (2008)

Cappoci *et al* (2005) have also demonstrate that the average R-square increases from 0.61 for the single factor model, to 0.80 for the four-factor model and to 0.84 for the combined model and all additional factors add explanatory power to the model. Carhart (1997) add that besides the improvement of the adjusted R-square, the four-factor model substantially improves on average the pricing errors of the CAPM and the three-factor model. These two type of models are generally used to assess performance of hedge funds. These are the capital asset pricing model (CAPM) proposed by Treynor, (1965); Treynor and Mazuy, (1966), and Jensen, (1968, 1969) and the asset pricing theory (APT) proposed by Connor and Korajczyk, (1986). These models assume that returns are normally distributed and are linearly related to other asset classes (Amin and Kat, 2003).

However, the normality assumption of hedge fund returns has been challenged by some studies such as Eling's and Faust's (2010), in which the hedge fund returns exhibit a higher degree of non-normality due to the specific nature of the strategies used and the degree of freedom they enjoy. Similarly, Dodson *et al* (2011) reject the possibility that hedge funds can outperform the market as their returns are not normally distributed. So also do, Ennis and Sebatian (2003) who indicate that on average, hedge fund did not provide investors with protection after the market has turned down.

Patari and Tolvanen (2008) On the other hand, suggest that the non-normality of hedge funds returns reality may be resolved by using several performance metrics that take into account the skewedness and kurtosis of funds distributions. They use the stacked cross-sectional regression, quartile portfolio approach, multifactor models and Bayesian counterparts. The overall results show that the Bayesian alphas are somewhat better predictors of performance than the other methods. For their part Abdou and Nasereddin (2011) used the support vector machines to test and predict the

performance of hedge fund strategies. They find evidence of performance and performance persistence only for funds focusing on emerging markets.

Despite criticism of the assumption of normality, the CAPM and different versions of APT models are intensively used in the literature due their simplicity in application. They have been used to assess hedge funds by the following- Capocci *et al* (2005), Capocci (2009), Brown and Goetzmann (2003), Chen and Liang (2007), Gregoriou and Pascalou (2010), Eling and Faust (2010). They have also been used to assess mutual funds by Otten and Bams (2002), Carhart (1997). In addition, Eling and Fraust (2010) use the augmented CAPM to find that hedge funds generate positive alphas that are significant whereas most mutual funds do not outperform traditional benchmarks in emerging markets. Joaquim and Moura (2011) have investigated the performance persistence of Brazilian hedge fund managers during the recent sub-prime financial crisis (2008-2009) and find evidence of performance persistence within the period of one to three months.

These widely divergent findings in the literature can be explained, possibly by the different databases consulted, periods under investigation, performance measures and statistical methods employed. For example, De Souza and Gokcan (2004) use the HFR database with the CPR method (Cross Product Ratio) as a persistence measure and find no persistence. By contrast, Edwards and Caglayan (2001) use the CPR method on data collected from MAR (Managed Account Report) and, find persistence in performance.

Furthermore, the period under investigation has a significant effect on the persistence in performance. The literature emphasizes that the period before 1994 was characterised by survival bias and backfilling in most hedge fund databases. For instance, even though pre-1994 data was considered in many of the studies such as Brown and Goetzman (2003), Brown *et al* (1999), Capocci and Hubner (2004), De Souza and Gokcan (2004) and Gregoriou and Rouah (2001), these studies did not find performance persistence in the industry. By contrast, Harri and Brorson (2004), Kosowiki *et al* (2007) and Park and Staum (1998) find persistence in performance even if data before 1994 are taken into account. Capocci *et al* (2005) have attempted to resolve the problem of survival bias by taking into account only data after 1994, yet they do not find persistence in performance.

Besides the time under investigation, differences in the particular measures employed to assess performance can also result in different conclusions. The most popular measure of performance encountered in the literature are Sharpe ratio, Jensen's alpha and appraisal ratio. Park and Staum (1998) use the appraisal ratio and suggest evidence of persistence in performance while Capocci *et al* (2005) did not find evidence of persistence in performance after employing the Jensen's alpha as measure of performance.

A further factor that produces different conclusions is the variety of methodologies employed to assess persistence. The most popular methods are cross-product ratio (CPR) test (Agarwal and Naik, 2000b, De Souza and Gokcan 2004; Kat, Menexe 2003), Chi-square test (Kouwenberg 2003; Malkiel and Saha 2005). Others are correlation based rank information coefficient test (Herzberg and Mozes 2003) and Spearman rank correlation (Agarwal and Naik 2000a; Harri and Brorsen 2004) for the two period frame work while the Kolmogorov-Smirnov test (Agarwal and Naik 2000a and Koh *et al* 2003) is used in the multi-period frame work.

De Souza and Gokcan (2004) use the CPR test, Herzberg and Mozes (2003) use the rank information coefficient and Malkiel and Saha (2005) use the Chi-square, all find no persistence in performance. By contrast, Henn and Meier (2004) use CPR, Kouwenberg (2003) uses the Chi-square and Park and Staum (1998) use both Chi-square and Spearman rank, and they all registered persistence in performance. In addition, Koh *et al* (2003) employ different measures of persistence (CPR, Chi-square and Kolmogorov-Smirnov tests) and reach a mixed conclusion, persistence at monthly and quarterly level not at yearly horizon. Agarwal and Naik (2000a) employ also a range of methods and suggest evidence of persistence performance of funds at quarterly and half-yearly horizon, but not at yearly level. Furthermore the evidence of persistence in performance using multi –period framework is much smaller than the two period frameworks.

CHAPTER THREE

METHODOLODIES

This chapter presents the methodologies used to assess the persistence in the performance of hedge funds during different economic cycles. Two econometric models are used namely the capital asset pricing model as in Capocci *et al,* (2005) and Brown *et al,* (1999); and a multi-factor model proposed by Carhart, (1997) and Capocci *et al,* (2005). We check also if factor loadings are able to explain the variations of excess returns generated by hedge funds over time. We make use of the Spearmen rank correlation (see Borsen and Harri, 2002 and Carhart, 1997). In addition, to assess performance persistence of fund managers, we use the Cross product ratio (see Agarwal and Naik 2000a, and Koh, Koh and Teo, 2003) and the Chi-square test (see Agarwal and Naik, 2000a, Koh, Koh and Teo, 2003) for the two period frameworks as well as the Kolmogorov-Smirnov test (see Agarwal and Naik, 2003a, and Koh, Koh and Teo, 2003)

3.1 Capital Asset Pricing Model (CAPM)

The first performance model used is the single index model based on the classical CAPM developed by Sharpe (1964), Lintner (1965) and Mossin (1966). The equation can be presented as follows:

$$E(r_{it}) - r_{ft} = \alpha_i + \beta_i [E(r_m) - r_{ft}] + \varepsilon_{it} \qquad t = 1,2,3.....T \qquad (1)$$

where $E(r_{it})$ is the expected return of hedge fund strategy, r_{ft} is the risk-free rate at time and $\boldsymbol{\varepsilon_{it}}$ the error term that should be serially independent $[E(\varepsilon_{it}) = 0]$, β_i is the sensitivity of the expected excess return of the hedge fund to the return of the market and $E(r_m)$ is the benchmark portfolio or market returns. The CAPM equation shows the relationship between the expected return and risk that is consistent with investors behaving according to the prescriptions of portfolio theory (Perold, 2004). This equation describes the deviation of the portfolio evaluated from the security market line and the intercept α_i of equation (1) commonly called Jensen's alpha is interpreted as a measure of out-and under-performance relative to the market proxy used (Jensen, 1968, 1969). This model relies on the assumption that markets are efficient in the sense described by Fama (1965) EMH. This is the case since all market participants have the same belief and implies that there is no possibility that an alpha statistically different from zero can be generated. Jensen's alpha can only measure the overall performance of a fund manager without specifically determining whether this performance is due to his/her market timing and selectivity skills. To

separate selectivity from market timing skill, we make use of the quadratic CAPM model proposed by Treynor and Mazuy (1966). They show that a fund manager with the ability to forecast the future returns of his portfolio precisely will lose less than what the market will lose if the market is forecast to go downwards, and will gain more positive returns than the market as a whole if the market is forecast to upward. Therefore, the hedge fund manager's portfolio returns is a concave function of the market returns. Mathematically this leads to the following quadratic CAPM:

$$r_{it} - r_{ft} = \alpha_i + \beta_{i1}[r_m - r_{ft}] + \beta_{i2}[r_m - r_{ft}]^2 + \varepsilon_{it} \quad (2)$$

Admati *et al* (1986), interpret α_i from equation (2) as a measure of the selectivity ability of outperforming investments strategies and the $\beta_{i2}[r_m - r_{ft}]^2$ as the component of forecasting ability. Therefore, the Treynor and Mazuy (1966) performance measure is expressed as follows

$$TM = \alpha_i + \beta_{i2}[r_m - r_{ft}]^2 \quad (3)$$

where α_i measures the selectivity ability of hedge fund managers while β_{i2} presents the estimated indicator of market-timing performance. Treynor and Mazuy (1966) argue that a positive value for α_i suggests selectivity skill and a positive β_{i2} is indicative of market-timing skill since it allows the characteristic line to become steeper as excess returns on the market portfolio get larger. A negative β_{i2} is interpreted as a lack of ability of fund managers to time the market. In addition, an insignificant value for β_{i2} is interpreted either as a lack of timing ability or as an indication that there is no attempt to time the market as in a case of buy and hold strategy.

3.2 The Asset Pricing Theory (APT) model

The arbitrage pricing theory formulated by Stephan Ross (1976) offers an alternative to the capital asset pricing model proposed by Sharpe (1963,1964), Lintner (1965) and Mossin (1966). The APT is based on the linear return generation process. It is not restricted to a single period but holds in both multi-period and single period cases. However, the theory begins with the traditional neoclassical assumptions of a perfectly competitive and frictionless market. Investors are assumed to believe (homogeneously) that the random returns of the asset are governed by k-factors in the generating process. The APT is based on intuition which can be translated into a factor model expressed as follows:

$$E(r_{it}) - r_{ft} = \alpha_i + \beta_{i1} f_{1t} + \beta_{i2} f_{2t} + \cdots + \beta_{it} f_{kt} + \varepsilon_{it} \quad (4)$$

Where α_i is the intercept of the regression, *fs* are standardized factors scores with zero mean and unit standard deviation, and β_{it} quantifying the sensitivity of each hedge fund return to the movements in the common factors. The common factors capture the systematic components of risk in the model. These factors are assumed to be pervasive meaning that they affect all securities (see Antoniou *et al*, 1998). The term ε_{it} is the noise term and is assumed to reflect the random influence of information that is not correlated to others assets.

$$E(\varepsilon_{it}/f_{it}) = 0 \quad (5)$$

where ε_{it} is the independent of f_{jt} for all i and j. In the next section, some of the most empirical extensions of APT are discussed.

Three-factors model of Fama and French (1993)

The single-factor model presumes that a single market index is enough to explain the fund's investment strategies. Since we can have a range of investment styles, the single-factor model can yield biased estimates of performance. Motivated by the growing empirical evidence of additional factors, Fama and French's (1993) research on the cross-sectional variation of return on stocks and bonds. The results show strong evidence of the relevance of two additional risk factors: namely size and book-to-market. The size factor is the return of the portfolio of small stocks minus the return on a portfolio of big stocks (small minus big in the size term) while the book-to-market factor is the return on a portfolio of value stocks minus the return on a portfolio of growth stocks (high minus low in terms of book-to-market). Fama and French's multi-factor model can be expressed as follows:

$$E(r_{it}) - r_{ft} = \alpha_i + \beta_{i1}[E(r_m) - r_{ft}] + \beta_{i2} SMB + \beta_{i3} HML + \varepsilon_{it} \qquad \text{For} \qquad t = 1,2,3.....T \quad (6)$$

where *SMB* is the factor mimicking portfolio for size (small minus big), *HML* the factor mimicking portfolio for book-to-market equity (high minus low). Furthermore, Fama and French (1993) show

that almost all known anomalies are effectively captured by the three-factor model[1], with only one exception. The short-term momentum strategy proposed by Jegadeesh and Titman (1993) remains the only anomaly that is not captured by the three-factor model.

Four-factor model of Carhart (1997)

The four-factor model of Carhart (1997) is an extension of the Fama and French (1993) three-factor model. The Carhart (1997) four-factor model attempts to capture the Jegadeesh and Titman (1993) one-year momentum anomaly left behind by Fama and French (1993) three-factor model. Grimblatt *et al* (1993) define the momentum factor as buying of stocks that were past winners and selling of past losers. The four-factor model can be expressed as follows:

$$E(r_{it}) - r_{ft} = \alpha_i + \beta_{i1}[E(r_m) - r_{ft}] + \beta_{i2} SMB + \beta_{i3} HML + \beta_{14} PY1YR + \varepsilon_{it} \quad \text{For} \quad t = 1,2,3.....T \qquad (7)$$

where *SMB* the factor mimicking portfolio for size (small minus big), *HML* the factor mimicking portfolio for book-to-market equity (high minus low), and *PY1YR*, the factor mimicking portfolio for momentum effect.

3.3 Performance Persistence measures

This section presents the non-parametric measures of performance persistence for two period frameworks and the Kolmogorov-Smirnov test for the multi-period framework. The underlying idea is to check if hedge funds managers are able to outperform the market in two or more consecutive periods. The fact that there is persistence in performance over two periods or more provides evidence that hedge funds managers have genuine skills to outperform the market. A manager is considered to be a winner if his/her Jensen's alpha is higher than the median of historical returns. If it otherwise, the manager is regarded as a loser.

3.3.1 Two-Period Tests of Performance Persistence

[1] How these factors are computed is not discussed in this study. Interested readers are referred to Fama and French (1993) original paper.

For two-period framework tests of persistence, we use the contingence table of winners and losers. Persistence in performance is defined as two consecutive wins (from sub-sample period one to sub-sample period two or from sub-sample period two to three or from sub-sample period three to four) expressed by WW or LL for losers. Similarly, winners in the first period and losers in the second period are denoted by WL and LW denotes the opposite. We employ alpha as a measure of performance from the equation (1) and, performance due to selectivity and timing skill from equation (3). We use both the cross-product ratio (CPR) proposed by Christensen (1990) and Chi-square statistic to detect whether hedge fund managers are able to achieve a level of persistence in their performance. The CPR is defined as:

$$\frac{WW * LL}{WL * LW} \tag{8}$$

This ratio captures the ratio of the funds which shows persistence in performance to the ones which do not. Under the null hypothesis of no persistence, the CPR coefficient equals one. This implies that each of the four categories denoted by WW, WL, LW and LL represent 25% of the total number of hedge funds. To determine the statistical significance of the CPR, we use the Z-statistic defined as:

$$Z - statistic = \frac{Ln(CPR)}{\sigma_{Ln(CPR)}} \tag{9}$$

Where

$$\sigma_{Ln(CPR)} = \sqrt{\frac{1}{WW} + \frac{1}{WL} + \frac{1}{LW} + \frac{1}{LL}} \tag{10}$$

A z-statistic greater than 1.96 indicates evidence of the presence of significant persistence in hedge funds' performance at 5% confidence level. We also conduct a Chi-square test comparing the distribution of observed frequencies for the four categories, WW, WL, LW and LL for each investment strategy of hedge funds with the expected frequency distribution. Carpenter and Lynch (1999) argued that the Chi-square test based on number of winners and losers is well specified, powerful and more robust to the presence of survivorship bias compared to other test methodologies. The Chi-square test statistic is given by this expression (see Agarwal and Naik, 2000a):

$$\chi^2_{Cal} = \frac{(WW - D_1)^2}{D_1} + \frac{(WL - D_2)^2}{D_2} + \frac{(LW - D_3)^2}{D_3} + \frac{(LL - D_4)^2}{D_4} \quad (11)$$

where

$$\begin{cases} D_1 = \dfrac{(WW + WL) * (WW + LW)}{N} \\ D_2 = \dfrac{(WW + WL) * (WL + LL)}{N} \\ D_3 = \dfrac{(LW + LL) * (WW + LW)}{N} \\ D_4 = \dfrac{(LW + LL) * (WL + LL)}{N} \end{cases} \quad (12)$$

We test this statistic against the critical value of the Chi-square at 1, 5, and 10% level of significance with the degree of freedom to one.

3.3.2 Multi-period persistence test: the Kolmogorov-Smirnov test

In this section, we investigate the persistence of hedge fund performance during multiple consecutive periods. A series of winners and losers for each hedge fund strategy is constructed and compared to the theoretical frequency distribution of two and more consecutive winners and losers. Under the null hypothesis of no persistence in hedge fund performance; the theoretical probability of strings of WWW and LLL equals to one-eighth while the strings of WWWW and LLLL equals one-sixteenth, and so on. The two-sample Kolmogorov-Smirnov (K-S) test based on the distribution of winners/losers is used to check if the observed distribution is statistically different from the theoretical distribution.

3.3.3 Spearman's Rank Correlation

The Spearman's rank correlation is used to identify and test the strength of relationship between two sets of data. It is often used as a statistical methodology to either prove or disprove a hypothesis. As we know, hedge fund are organised as limited partnership or limited liability companies (Brown *et al* , 1999) established with the intention to make important investment decisions in the public securities where the general partners make a substantial personal investment. This pushes them to use increasingly different strategies (short sale, leverage, etc.) which eventually increase levels of risk. We will thus use Spearman's rank correlation to check whether, fund managers bear the same level of risk regardless of market trends. Under the null

hypothesis, factors loadings performance are randomly ordered, we will thus first rank betas of the CAPM of the four different market trends. The highest value of beta will receive a value of one representing the first rank up to *n* rank. We will also rank size, book-to-market and momentum factors from equation (6) and (7).

Assume that there are two variables *X* and *Y*. The rank of each of the variables *X* and *Y* per case is determined by ordering the values from low to high, or from high to low. For each case, the difference in rank for variables *X* and *Y* is determined and given the symbol D_i. These differences are squared, and then summed up to produce $\sum D_i^2$. If there are n cases, the Spearman rank correlation between *X* and *Y* is defined as:

$$r = 1 - \frac{6\sum_{i=1}^{n} D_i^2}{n^3 - n} \quad (13)$$

This produces a correlation coefficient with a maximum value of 1, indicating a perfect positive persistence and with minimum value of -1, indicating a perfect negative persistence. A value of 0 indicates no sign of persistence for that particular strategy.

CHAPTER FOUR

EMPIRICAL RESULTS

4.1 Data and sub-samples

According to Cheng and Liang (2007) and Fung *et al* (2008), the major databases of hedge funds (with data on different funds including fund-of-funds) are the Centre of International Securities and Derivatives Markets (CISDM), Hedge Fund Research Inc. (HFRI), and Lipper TASS. Some researchers are of the opinion that combined these databases contain more information on the totality of hedge funds than any individual database (Fung et al, 2008; Patari, 2011; Titman and Tiu, 2011). However, The HFRI is considered to be one of the largest hedge fund databases available to researchers and practitioners and has been used intensively in the hedge fund literature to assess persistence in performance (Agarwal and Naik, 2000a, 2000b; De Souza and Jagonnathan *et al*, 2006).

The data collected from the HFRI are monthly data running from January 1995 up to March 2014.This period possesses two important features. First, the year 1995 was chosen to account for survivorship biases and backfilling encounter in most hedge funds research before 1994 (Capocci *et al*, 2005, Eling, 2009; and Chen and Liang, 2007). Manser and Schmid (2008) try to account for the survivorship bias issue by excluding data prior 1994 in their study on the persistence of raw and risk-adjusted returns for equity long/short hedge funds. In addition, Capocci and Hubner (2004) recognise the fact that hedge funds data after 1994 do not contain survivorship biases. Secondly, this time framework covers several market trends (bullish and bearish periods) that are an important feature in this study, as many studies were limited to the bullish period only (Koh *et al*, 2003).

The entire sample containing 232 monthly data points is divided into four sub-samples periods (see Muteba Mwamba, 2012). Kosowski *et al* (2007) suggest also that there is a breakpoint in the year 2000 for most hedge fund indices. The first sub-sample runs from January 1995 to December 2000; the second from January 2001 up to December 2006 to take into account the period before the sub-prime crises; the third from January 2007 to December 2010, and the final one from January 2011 to March 2014. This subdivision is an attempt to identify different market conditions, and in particular to include the Asian currency and financial crisis of 1997-1998 as well as 2008-2009 sub-prime crises. Furthermore, our intention is to capture the behaviour of funds managers during the Asian crisis (first sub-sample period) and the 2008-2009 sub-prime crisis (third sub-sample period) and also after both crises to determine if their performance remains

uniform. In addition, we wish to determine whether hedge funds are still able to outperform the market given that rating agencies failed to predict these crises (Ferri *et al*, 1999). The following table summarizes the description statistics of the seven main strategies for the all sample period, namely even driven (ED), equity hedge (EH), emerging market (EM), fund of funds (FOF), fund weighted composite (FWC), macro (MC) and relative value (RV).

Table 1: Description statistics for the entire sample period

	ED	EH	EM	FOF	FWC	MC	RV
Mean	0.626	0.651	0.547	0.257	0.515	0.451	0.470
Median	0.980	0.919	1.145	0.485	0.661	0.357	0.610
St. Dev.	1.957	2.691	4.018	1.699	2.042	1.810	1.232
Skew	-1.340	-0.292	-1.016	-0.831	-0.718	0.398	-2.874
Kurt	4.301	1.841	4.292	4.028	2.636	0.534	16.078
Max	4.760	10.440	14.360	6.410	7.210	6.380	3.933
Min	-9.330	-9.538	-21.450	-7.900	-9.130	-4.160	-8.111

Table 1 reports the descriptive statistics of the seven main strategies employed during the entire period under investigation. Emerging markets are the most affected (21.45%) by both crises compared to others strategies. The reason is that emerging markets are more fragile compared to developed economies due to their less competitive economic structures. Macro is the less affected strategy (4.16%) followed by the relative value strategy (8.11%). Still the highest rate of returns is achieved by strategies focusing in emerging markets, implying that additional risks must be taken to achieve higher expected rate of returns. Besides being the most affected strategy, emerging markets record the highest rate of returns (14.36%), but the equity hedge strategy presents a better risk-returns trade-off, and achieves up to 10.44% rate of returns for just 9.54% in the worst case of scenario.

Considering the measure of risk (in our case the standard deviation) emerging markets are more volatile (4.02%), indicating almost two times the level of volatility of the other strategies. By contrast, the relative value strategy shows a low level of volatility as, can be noticed on Figure 1 below. All investment strategies are negatively skewed indicating that the tail on the left side is longer or flatter than the right one. Except, macro investment strategy, which shows a positive skew; consequently the tail of the right side is longer or flatter than that of the left one. Macro

investment strategy indicates a greater chance to experience positive outcomes regardless the market conditions in which fund managers take positions.

Furthermore, all investment strategies exhibit excess Kurtosis, which measures the extent to which a distribution is more (or less) peaked than normal. All coefficients of the kurtosis are less than 3 implying that the distributions are plartykurtic. Eling and Faust (2010) explain that the negative skewed and excess kurtosis of hedge funds returns are attractive features for some investors because there is a possibility of extreme outcomes. In addition, the excess skewness and kurtosis encounter in most hedge funds returns distributions provide evidence of market inefficiency (German and Rokotamalala, 2011).

Tables 2, 3, 4 and 5 exhibit the descriptive statistics of the monthly returns of hedge funds for the four sub-samples. These tables show also the first four moments of return distribution. The EM strategy is still the most affected even at sub-sample level; the worst case scenario is observed during both financial crises. It is the most affected strategy in the first sub-sample (21.45%) and the third sub-sample (14.53%) while the MC strategy is the least affected strategy during both crises. The EH strategy provides a better rate of returns during the first sub-sample (1.41%) while the best rate of return is achieved by the MC strategy during the third sub-sample (0.45%). The RV strategy shows a low volatility value during almost in all sub-samples except during the sub-prime financial crises period during which the MC is the best alternative. All strategies are negatively skewed and have excess kurtosis as the results in table 1, implying that there is always the possibility of extreme outcomes. The presence of negative skewed and excess returns of hedge fund returns in different economic cycles show that hedge fund managers are persistent in the way the behave in the market. As the ultimate goal is to always generate a greater return that cause also a lot of volatility in the market.

The level of volatility reaches its maximum level during both crises, the EM strategy is more affected during the Asian crises than the 2008-2009 sub-prime crises, as these strategies focus mostly on emerging economics. The FOF, FWC and MC strategies seems to be more affected during the Asian crises than during the sub-prime crises. The expected rate of return is considerably much higher during the Asian crises than 2008-2009 crises, stating once again the severity of the later crises. The EH achieves 1.41% that is the highest rate of returns during the first crises while MC records 0.45% during the second period of crises. The FOF reports a loss of

0.068% during the second crises. Additionally, there is a general improvement in the level of expected return after both crises. The only exception is the MC strategy which records in the last sub-sample period a negative rate of return.

The freedom that hedge funds enjoy in their investment style might be one explanation of these extreme returns values as hedge funds are more active in shifting their asset allocation in different markets. The following tables (2, 3, 4 and 5) summarize the descriptive statistics for the seven main strategies of the four sub-samples periods.

Table 2: Description statistics for the sub-period 1

	ED	EH	EM	FOF	FWC	MC	RV
Mean	0.905	1.411	0.166	0.449	0.844	0.663	0.583
Median	1.265	1.395	0.780	0.585	0.990	0.400	0.835
St. Dev.	2.003	3.078	5.106	2.119	2.451	2.393	1.100
Skew	-1.747	-0.009	-0.800	-0.453	-0.747	0.195	-3.324
Kurt	7.502	1.063	3.352	2.551	2.603	-0.437	18.066
Max	4.760	10.440	14.360	6.410	7.210	6.380	2.430
Min	-9.330	-8.080	-21.450	-7.900	-9.130	-4.160	-6.230

Table 3: Description statistics for the sub-period 2

	ED	EH	EM	FOF	FWC	MC	RV
Mean	0.708	0.401	1.286	0.329	0.504	0.525	0.431
Median	0.970	0.595	1.725	0.425	0.702	0.468	0.470
St. Dev.	1.659	1.842	2.774	1.028	1.482	1.449	0.543
Skew	-0.697	-0.452	-0.698	-0.344	-0.479	0.383	-0.218
Kurt	1.095	-0.532	-0.186	-0.353	-0.375	0.918	0.040
Max	4.056	3.989	6.070	2.527	3.486	5.575	1.849
Min	-4.500	-4.080	-5.880	-2.337	-3.110	-2.920	-1.054

Table 4: Description statistics for the sub-period 3

	ED	EH	EM	FOF	FWC	MC	RV
Mean	0.216	0.143	0.384	-0.068	0.235	0.448	0.356
Median	0.749	0.603	1.214	0.403	0.428	0.379	0.868
St. Dev.	2.452	3.160	4.325	2.062	2.353	1.589	2.080
Skew	-1.099	-0.793	-0.973	-1.265	-0.827	0.218	-1.904
Kurt	1.789	0.935	1.864	1.735	1.043	-0.495	5.172
Max	4.743	6.374	9.618	3.324	5.147	4.089	3.933
Min	-8.271	-9.538	-14.526	-6.686	-6.922	-2.774	-8.111

Table 5: description statistics for the sub-period 4

	ED	EH	EM	FOF	FWC	MC	RV
Mean	0.443	0.292	0.021	0.157	0.236	-0.149	0.472
Median	0.729	0.426	0.242	0.387	0.396	-0.243	0.648
St. Dev.	1.589	2.357	2.988	1.202	1.571	1.191	0.948
Skew	-1.038	-0.723	-0.639	-0.708	-0.680	0.297	-0.989
Kurt	0.912	0.667	0.126	-0.176	0.164	-0.905	0.560
Max	3.026	4.908	4.845	2.128	2.779	2.371	1.974
Min	-3.942	-6.035	-7.898	-2.788	-3.890	-2.302	-2.180

For the regression inputs, we use the monthly Russell 3000 index as the market proxy obtained from yahoo finance (see Muteba Mwamba ,2012 and Cappoci *et al*, 2005), the 3 month US Treasury bill (obtained from INET Bridge) as the risk free rate of return (Muteba Mwamba, 2012) and the factor loading from the Kenneth. R. French Data Library (Eling, 2009).The size (SMB) in the Kenneth. R. French Data Library is computed for the period of June of each year, and all NYSE stocks on CRSP are ranked according to size which is the price multiplied by shares. Then the median NYSE size is used to split NYSE, AMEX, and NASDAQ stocks into two groups, small (S) and big (B).

The NYSE, AMEX, and NASDAQ stocks are also divided into three book-to-market equity groups based on the breakpoints for the bottom 30% (low), middle 40% (medium) and top30% (high) of the ranked values of the BE/ME (book-to-market equity) for the NYSE. Book-to-market equity is the book common equity for the fiscal year ending in calendar year *t*, divided by market equity at the end of December. The momentum factor is constructed from six value-weight portfolios formed using independent sorts on size and prior return of NYSE, AMEX, and NASDAQ stocks. The momentum factor is the average of the returns on two (big and small) high prior returns portfolios minus the average of the returns on two low prior returns portfolios. Big

means a firm is above the median market cap on the NYSE at the end of the previous month while the small firms are below the median NYSE market cap. Firms in the low prior return portfolio are below the 30th NYSE percentile and those in the high portfolio are above the 70th NYSE percentile (see http://mba.tuck.dartmouth.edu).

For their part, the HFRI indices are constructed using robust filtering, monitoring and quantitative selection processes by using the Hedge Fund Research (HFR) database and also the industry standard for hedge funds data. Hedge Fund research Inc. uses the UCITS (Undertaking for Collective Investment in Transferable Securities) techniques to construct the HFR Indices. This technique uses a defined and predetermined rules and objective criteria to select and rebalance components to optimize the representation of the Hedge Funds universe. The HFR indices utilize different methodologies such as quantitative techniques and analysis, multi-level screening, cluster analysis, Monte-Carlos simulation and optimization techniques to ensure that each index is a pure representation of its investment focus. The different components of all indices are eligible pools of more than 7500 funds that report to the HFR database which is screened for various reporting characteristics (see http://hfr.com).

Figure 1 plots the seven main investment strategies, Russell 3000 and the 3 months Treasury bill for the entire sample period. The seven main strategies include EH, ED, EM, FOF, FWC, MC and RV.

Figure 1: Hedge fund strategies, Russell 3000 and US 3 months Treasury bill

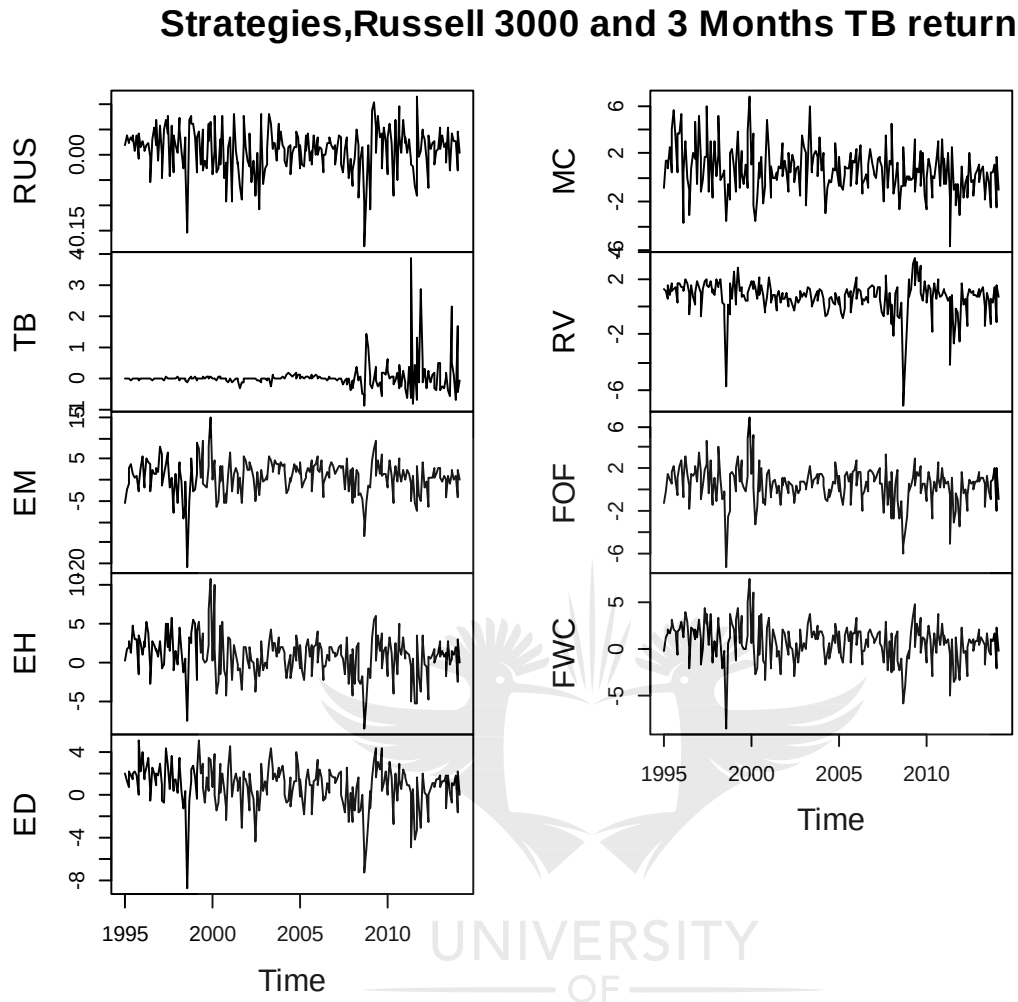

Figure 1 highlights the effect of financial crises, the 1998 Asian crises and the 2008-2009 sub-prime crises especially. All seven strategies and the return of Russell 3000 show greater noise during the periods, 1998 and 2008-2009 that can be seen on each graph in Figure 1, except the 3 months TB that is only volatile between 2008-2009 financial crises. One can state that despite it being volatile, it has been traditionally viewed as a safe investment, hence this explain why investors of any kind use the 3 months TB for investment and hedging purposes (Dupont and Sack, 1999). All strategies display a volatile pattern during the entire period under investigation, while the relative value strategy demonstrates a more stable pattern during all periods under investigation (except during both crises) compared to others strategies. One would expect a hedge funds manager who would like to reduce the risk of his portfolio, to include the relative value strategy (beside the US 3 months TB) when taking positions in his attempt to generate abnormal returns.

Comparing both crises periods (as reflected in the different graphs), the results show that all strategies experience greater volatility during the 2008-2009 crises than in 1998, confirming the view that the 2008-2009 sub-prime crises is the worst financial crises in the history of the financial market since the Great Depression. After both crises, the relative value strategy provides better opportunities for recovery than the other strategies. It is followed by the emerging market strategy which shows a less volatile trend than fund of funds, fund weighted composite and equity hedge strategies, all of which seem to follow a similar pattern.

4.2 Correlation

This subsection investigates a range of correlation coefficients between different strategies and their relation to factor loadings. The correlation coefficients have been computed for the entire sample period to assess the strength of the relationship between two parameters. Table 6 depicts the correlation between the seven main investment strategies employed by fund managers during the overall period under investigation. All coefficients of correlation shown in this table are positive, implying that each investment strategy moves in the same direction with the others. The strong positive correlation implies a high probability to experience extreme positive outcomes if both strategies are used simultaneously. The exception is when the macro strategy is combined with others strategies. The strength of the relationship tends to decrease particularly when macro is combined with the relative value strategy.

Table 6: Correlation of the overall sample period

	ED	EH	EM	FOF	FWC	MC	RV
ED	1						
EH	0.87342	1					
EM	0.79414	0.78651	1				
FOF	0.85229	0.87049	0.864268	1			
FWC	0.91418	0.96598	0.881719	0.928363	1		
MC	0.50249	0.55256	0.535822	0.696748	0.63279	1	
RV	0.81427	0.71949	0.679953	0.759554	0.75783	0.30889	1

Table 7 displays the correlation of seven main investment strategies with the factor loadings for the overall sample. The results show that there is a weak positive correlation between the market return and all seven investment strategies. The highest coefficient of correlation is achieved with

macro strategy, while the lowest with the equity hedge strategy. The absence of strong coefficient of correlations suggests that market returns do not count for most of the variations in the determination of hedge funds returns. This contradicts the CAPM. There is also a negative correlation between all seven main strategies with the book-to-market factor and the momentum factor, implying that hedge funds managers tend to consider growth past losing stocks with potential to growth in their investment processes. But the fund of fund and macro strategies are weakly positively correlated to the momentum factor. All strategies are positively correlated to the SMB factor, and the coefficients tend to be stronger compared to others factors.

Table 7: Correlation between strategies, market premium and factor loadings

	EH	ED	EM	FOF	FWC	MC	RV
Russell.3000.TB	0.0566	0.1046	0.0143	0.1435	0.1114	0.2548	0.1101
SMB	0.4821	0.4293	0.3279	0.3910	0.4623	0.2415	0.2296
HML	-0.3302	-0.1504	-0.2030	-0.2556	-0.3275	-0.1956	-0.0383
Mom	-0.0592	-0.1932	-0.1515	0.0623	-0.0904	0.1440	-0.1866

Table 8 shows the correlation coefficients within factor loadings and the market premium in order to check if there is a presence of multicollinearity condition. Multicollinearity is a condition in which two explanatories variables are exactly in linear relationship and when this situation occurs both variables are said to be linear dependent, and are therefore perfectly collinear (Asteriou and Hall, 2007)

Table 8: Correlation between factor loadings

	Rus. 3000-TB	SMB	HML	PR1YR
Rus.3000-TB	1			
SMB	-0.0198	1		
HML	-0.0101	-0.3575	1	
PR1YR	-0.0083	0.0791	-0.1504	1

The condition of multicollinearity distorts the standard error of estimates, leading to a problem when conducting the T-test for statistical significance of parameters (Defusso, Mcleavy, Pinto and Runkle, 2004). Table 8 shows the coefficient of correlation between explanatory variables. The low cross-correlation indicates that the multicollinearity condition does not affect all four monthly

explanatory variables; therefore the four factors are proxies for separate factors. The SMB and the HML factors exhibit a strong negative correlation (0.3575) while the lowest coefficient of correlation is achieved between HML and the market premium (0.0101).

4.3 SINGLE PERIOD PERFORMANCE ANALYSIS

4.3.1 Performance Analysis using Jensen's alpha.

This section aims to find out whether hedge funds have significantly outperformed the market over the four sub-sample periods under investigation. We examine the managerial skills of hedge funds managers based on their ability to beat the market. This is assessed using the alpha parameter in equation (1). The CAPM's alpha stands for Jensen' alpha and is reported in appendix 9 for the four different periods. The theoretical framework of the measurement of hedge funds' performance is underpinned by the famous efficient market hypothesis (EMH) proposed by Fama (1965). The EMH asserts that market participants are not capable of taking advantage of any market expectation regarding the securities' returns and risks to generate excess rate of returns from active trading activities (Blake, 1994). If the market is efficient in the sense of the EMH framework, hedge funds managers cannot take advantage of any difference in the securities market expectations regarding risks and returns and the price observed in the market is considered to be fair. With reference to equation (1), alpha must be zero for the EMH to hold in practice.

The literature suggests that on average hedge funds outperform the passive benchmark (Fung and Hsieh, 2004; Hasanhodizc and Lo, 2007 and Titman and Tiu, 2008). A close look at Table 9 shows that on average results are in line with the literature, hedge funds have outperformed market returns. The first sub-sample shows a general tendency of outperformance; most alphas are positive and significant regardless of the effect of the Asian crisis. The exception is emerging markets strategies which are negative and not significant. The second sub-period which covers the post-Asian crises demonstrates a general improvement as all strategies have a positive and statistical significant alpha at 0.1%, implying that on average, fund managers are more likely to outperform the market benchmark in the up-trend market. The third sub-sample period records a general tendency of underperformance; all alphas are negative and significant except equity hedge, emerging markets and fund of funds strategies are not significant but still negative.

Theodosios *et al* (2013) assert that hedge funds were able to generate higher returns compared to others assets during financial crises, except during the 2008-2009 sub-prime crises where almost hedge fund strategies suffered considerable losses. The last sub-sample period shows a slight improvement as the alphas of emerging market and relative value strategies are positive and significant at 5%. The R-square value ranks between (0.44 to 0.74), (0.12 to 0.84), (0.05 to 0.77) and (0.01 to 0.72) respectively for the four sub-sample periods, implying that an important fraction of the variation in the observed hedge funds excess returns are still unexplained Thus, a more robust model must be used to capture variations encountered in the hedge funds' excess returns. Fama and French (1993) argue that the expended model (three factor model) captures much of the cross section average returns amongst US stocks. For their part, Capocci *et al* (2005) suggest that the adjusted R-square improves significantly when the extended CAPM is employed.

4.3.2 Performance Analysis using alpha and beta 2 from Treynor and Mazuy (TM) model

Hedge funds managers can outperform the market by pure chance or by genius skill. We expect that performances due to pure chance will not persist while performances based on skills are likely to persist over time. Therefore, we define performance due to luck as the probability that the performance of funds managers is determined by factor luck, and skills-based performance as the probability that the hedge funds manager is able to outperform the market due to securities selection and market timing abilities (see Muteba Mwamba, 2012). A funds managers who has securities selection abilities will use information about the market to take advantage of any mispricing that he/she believes is taking place in the market, while managers with timing abilities will use the information derived from his/her own forecasts about the general behaviour of securities prices in the future and will adjust the weight of his/her portfolio over time.

After checking for outperformance of hedge funds managers during different market trends, we go one step further to determine whether selectivity and timing abilities can account for that outperformance. Table 10 shows the parameter alpha from the TM model represents the measure of selectivity. All strategies record positive and significant alphas during the first sub-sample period except relative value and emerging markets strategies. This implies that hedge funds managers were able to outperform the market due to selectivity abilities during the Asian crises. Selectivity ability improved considerably during the second sub-sample period. Only the relative value strategy shows evidence of a lack of selectivity skill with its alpha still positive but not significant. The level of

selectivity skill dropped significantly during the third sub-sample period covering the 2008-2009 financial crises, and only the equity hedge, fund weighted composite and relative value strategies are positive and significant at different levels of significance. Therefore, the underperformance of fund managers noticed in the third sub-sample period is justified not only by higher volatility but also by a lack of selectivity skill on the part of some fund managers. The last sub-sample period shows a slight improvement in selectivity skill with alphas of emerging markets and relative value strategies being positive and statistically significant.

Table 11 records beta 2 which measures the forecasting ability encountered in the hedge funds industry. The first sub-sample period is characterised by a lack of timing ability or no attempt to time the time. Even driven, emerging markets and fund of funds strategies display negative and statistically significant betas while the rest of strategies are not significant. The second sub-sample period shows also evidence of a lack of market timing or no attempt to forecast the direction of different assets related to all strategies. Furthermore, the third sub-sample period presents two betas that are negative and significant while the last sub-sample period shows five betas that are negative and significant. Hence, the outperformance and underperformance of fund managers encountered during these four sub-sample periods are associated with selectivity ability rather than hedge fund managers' ability to forecast the future. Jhanwar and Sehgal (2008) found evidence which contradict our results. They indicate that mutual funds managers have timing ability to forecast the direction of securities and to some extent even stock selectivity ability in India.

4.3.3 Hedge funds 'excess returns using the three and four-factor model

In this section, we interrogate the excess returns generated by hedge funds managers by making use of the Fama and French three-factor model and the Carhart four factor model. The adjusted R-square improved considerably for all four sub-sample periods, 0.01 to 0.92, -0.01 to 0.94, -0.01 to 0.92 and 0.02 to 0.78 using the Fama and French three-factor model and; 0.02 to 0.92, -0.02 to 0.94, 0.04 to 0.92 and 0.01 to 82 using Carhart's four factor model. The higher value of the adjusted R-square means that additional factors have increased the predictive power compared the results under CAPM. In addition, an insignificant intercept of both models also provides evidence of robustness of the two models. According to Merton (1973) a well-specified asset pricing model produces an intercept which is insignificantly different from zero. The insignificance of the intercept is explained

by the fact that all parameters captured all the relevant variation. The four-factor model shows mush more robust results compared to the three-factor model and results from the CAPM.

Table 12 shows the coefficients of the three and four factor models for the first sub-sample period. A close look at the results indicates that all strategies are positively related to the market premium and all coefficients are significant at 0.1%. This provides convincing evidence that the market premium plays an important role in explaining the excess returns variation observed during the Asian crisis. We observe also a size premium effect during this first sub-sample period. All coefficients of SMB are positive and statistically different from zero, implying that hedge funds investing in small cap stocks outperformed large cap stocks during this period. These findings are in line with Banz (1981) who suggests that stocks with small market capitalization (small cap) tend to have higher average returns than stocks with higher market capitalization. With reference to the HML factor, ED, FWC, MC and RV strategies are the only strategies that have coefficients that are statistically different from zero. The coefficients are positive and significant indicating that hedge funds consider value stocks as part of their strategies outperform those strategies that consider the growth stocks. The results above are valid for both models (three and four factor model) respectively. We also find evidence of the momentum effect using the four factor model. FOF and MC have coefficients which are positive and significantly different from zero.

Table 13 displays results of the three and four factor models during the post-Asian crisis. The market premium remains a significant factor that explains the variation of the hedge funds excess returns even after the crises, except for MC strategy. One explanation for this might be after suffering the effect of the Asian crises, hedge funds check closely to the market returns before taking any position. There is still evidence of size and book-to-market effects; as their coefficients are positive and significantly different from zero. The HML factor does not impact the FOF and MC strategies during this period, and their coefficients are not statistically different from zero. The second sub-sample period does not present enough evidence of the momentum effect, as almost all coefficient of the momentum factor are not significantly different from zero. The ED strategy is the exception to the rule as, it shows a negative coefficient and is statistically different from zero at 5%, implying that the excess returns observed during the period is justified by the fact that hedge funds employing this strategy tend to invest in past losing stocks. The absence of the momentum effect

implies that the three-factor model is more appropriate measure to capture most variations observed in hedge funds excess returns during this sub-period.

Table 14 shows the findings for both the three and four factor models during the period of 2008-2009 sub-prime crises. We still find evidence of the role of the market premium in determining the excess returns of hedge funds; all coefficients are positive and statistically different from zero at 0.1%, except the MC strategy. There is no sign of the size effect during this period. This can be explained by the fact that small companies are logically expected to be more sensitive to many risk factors as a consequence of their relatively undiversified nature and their reduced capability to absorb damaging financial events. The HML coefficients are negative and statistically different from zero at 5%, implying that the value premium provided to hedge funds managers was not sufficient to push hedge funds to invest in companies with high book-to-market values due to the uncertain financial environment. There is no evidence of the momentum effect during this sub-sample period.

Table 15 shows the results of the last sub-sample period. The findings reveal that the market premium is the main factor that explains the variation of excess returns of hedge funds. These findings are consistent with the principles of the CAPM. One of the reasons might be that, hedge funds tend to follow the market more closely than other factors possibly in response to the lesson learnt from the recent sub-prime crisis.

4.4 Performance persistence into two period's framework

In this section, we use two-period persistence in the performance of hedge funds to determine if managers are able to outperform the market in two consecutive periods. For two-period tests of performance persistence, we make use of the contingence table of winners and losers in two consecutive periods (from sub-sample 1 to sub-sample 2 etc.). A winner hedge funds manager is understood as one whose has the ability to generate an alpha greater that the median alpha of hedge funds using the same strategy.

Table 19 illustrates the results of both the CPR and Chi-square statistic to detect performance persistence. Under the null hypothesis of lack of persistence, the CPR must be equal to 1. The results show no evidence of persistence in performance among winners and losers hedge funds. All z-statistics values are less than the critical value at 1, 5 and 10% (2.58, 1.96 and 1.68) therefore no possibility that the null hypothesis can be rejected. We also find no evidence in

selectivity and timing skills performance persistence. We use also the Chi-square method to assess the persistence of fund managers' performance. Comparing Chi-square statistic at the same level of significance with degree of freedom equal to one, we do not find evidence of persistence in performance, selectivity and timing ability as the results reported by the CPR method.

4.5 Performance persistence in more than two periods

In this section, using the K-S test, we extend the persistence analysis from two periods to multi-period analyses, as the likelihood of detecting persistence by chance is lower in the latter case than in the former. Under the null hypothesis of no managerial skill (no persistence), the theoretical distribution of observing wins and losses follows a binomial distribution. As a large sample can be approximated by normal distribution, we perform the K-S test by comparing consecutive wins and losses of different hedge funds strategies to the normal distribution.

Table 20 displays the results of the K-S test by comparing the distribution of consecutive wins and losses of hedge funds with the normal distribution. The persistence observed in the hedge fund industry is captured by the distribution being statistically different from the normal distribution. We find statistical evidence of persistence in performance during the period 1 to 2 and 2 to 3. EH, ED, EM, FWC and RV have p-values that are less than 0.05. In contrast, FOF and MC investment strategies display evidence of lack of persistence in performance. It appears that as indicate by Carhart (1997), winners and losers are more likely to remain winners and losers. In addition, we find that all investments strategies fund managers are not able to beat the market persistently during the sub-sample period 3 to 4. This confirms once again that the 2008-2009 sub-prime crises is the worst financial crises since the Great Depression.

The results of Joaquim and Moura (2011)'s study are at variance with our findings. They argue that there is a fair number of hedge funds who exhibit performance persistence during the 2008-2009 sub-prime crises. Furthermore, the presence a group of fund managers capable to generate absolute return during this period of crises is justified by the fact this study included only hedge funds which possess *de facto* hedge funds characteristics from Anbima database.

4.6 Persistence analysis of different factors

In this section, we will find out whether different factor loadings used in this dissertation have been able to explain variations in the excess returns generated by hedge funds overtime. Under the null hypothesis, the performance of different factors loadings are randomly ordered. The coefficient is always expected to be between 1 (a perfect positive correlation meaning perfect positive persistence of the performance) and minus 1 (a perfect negative correlation meaning a perfect negative persistence of the performance). Ultimately, a coefficient close to 0 implies an absence of performance persistence during the two periods under investigation.

Table 21 illustrates the correlation coefficients of the beta parameter from the CAPM of the four sub-sample periods (period 1 and 2, 2 and 3 and finally 3 and 4) of the main strategies employed by hedge funds. The coefficient beta is understood as the sensitivity of the expected excess hedge fund return to the expected excess market return. The results reveal a strong a positive correlation tendency but no evidence of statistical significance for the first two sub-sample periods. The FWC, MC and RV present negative correlation coefficients but still not statistically significant for the second and third period. The FWC continues to be negative even if there is still not statistical evidence for the third and last periods. The EM strategy reveals a perfect positive correlation between sub-periods 2 and 3, implying perfect positive persistence of this strategy with regard to the market premium. In addition, the EH strategy also shows some evidence of performance persistence between period 3 and 4. Therefore, the correlation coefficients reveal that hedge funds managers using these strategies (EM and EH) might have taken the same level of risk in order to generate excess returns. As widely accepted, hedge fund enjoy so much freedom in their attempt to beat the market, they can leverage and take any position, or move in different markets in order to generate a positive alpha. Such flexibility allows them to bear the same level of risk during different market trends (between the 2 and 3 for EM; and 3 and 4 for EH).

We also go a step further to ascertain whether the excess returns generated in the hedge funds industry is persistently explained by other factor loadings. For example, a positive and significant coefficient of SMB implies that fund managers tend to invest heavily in small companies with future positive prospect than in big and well established companies during two market conditions. Table 22 and 23 show the correlation coefficients of the three and four factor models during the four sub-sample periods (from 1 to 2, 2 to 3 and 3 to 4). A close look at the last two tables, reveal that most correlation coefficients are positive but not statistically significant at

any level of significance. It is therefore, not statistically evident that hedge funds managers were investing heavily in small companies, or that the value premium provided to hedge funds for investing in high book-to-market or the momentum of winners (or losers) were the same during these four sub-sample periods which cover different market trends. The EH strategy is the only strategy that records the same level of persistence between sub-sample period 1 and 2 related to the HML factor while it is related to the market premium in period 3 and 4.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS

The aim of this dissertation is to investigate the persistence in performance of hedge fund managers during both bull and bear markets. The main objective of the study is to determine whether fund managers can exhibit persistence in performance during sample periods characterised by different bull and bear economic business cycles. To attain this objective, the monthly returns indices of hedge funds collected from Hedge Fund Research group are analysed

(taken into account) for the period between January1995 and March 2014. The data set is divided into four sub-sample periods in order to take into account different market trends. This is done in line with the practices revealed in the literature.

We use the Jensen alpha as the measure of outperformance. As Jensen alpha cannot specify whether the outperformance is due to market timing or selectivity skills. We use the quadratic CAPM (see Treynor and Mazuy, 1966) to determine whether outperformance is due to selectivity skills or timing ability. We also use the three and four factor models to assess hedge fund excess returns. As the literature confirms the role of additional factors explaining the excess return generating process. In addition, we use the Cross-product ratio and Chi-square statistic to assess persistence in two consecutive sub-sample periods and; include also the Kolmogorov-Smirnov test to determine if hedge funds present any level of persistence for more than two consecutive sub-sample periods. We attempt to understand whether factors that explain variations in fund excess returns also do so during different market conditions by making use of the Spearman rank correlation.

The main outcomes of our study are as follow:

Firstly, all investment strategies show noisy patterns during the period under investigation, implying that hedge funds managers engage in greater risks in their attempt to generate abnormal rate of returns during different market conditions. This behaviour is encouraged by a considerable degree of freedom enjoyed by the industry. Hedge fund managers focusing on emerging market strategies tend to bear more risk than those using the relative value strategies. The highest rate of expected returns is achieved still by the strategies focusing in emerging markets, and they are the most affected among all the strategies, implying that emerging economies are more fragile than developed ones. All strategies are negatively skewed and exhibit an excess kurtosis indicating that most hedge funds are more likely to experience negative outcomes, except the macro strategy which exhibits a positive coefficient of skewedness. The negative skewedness and excess kurtosis encountered in hedge fund returns provide evidence of market inefficiency. All strategies are strongly and positively correlated to each other, except macro strategy which emphasises a moderate positive coefficient with others strategies. We also find evidence of low correlation between market returns and all strategies, indicating that market returns do not account for the most variation observed in hedge fund returns.

Secondly, we find evidence of outperformance. Most hedge funds strategies are able to outperform the market returns, especially during bull market conditions, except during the 2008-2009 period where most hedge fund suffer big losses. We find also that the outperformance recorded by the industry is due to the selectivity skills than the timing skill. The R-square value ranks between 0.44 and 0.77, 0.12 and 0.84, 0.05 and 0.77 and, 0.01 and 0.72 for the four respective sub-sample periods when the CAPM model is used. This implies that an important portion of the variation in the observed hedge funds excess returns are still unexplained. Therefore a more robust model must be used in order to capture almost all variations. After using the three and four factor models, the adjusted R-square improves significantly 0.92, 0.94, 0.92 and 0.82 for the respective four-sub-sample periods. These adjusted R-square coefficients are in line with the best in the literature.

Thirdly, after taking into account the three and four factor models, the market return is still the main contributing factor, especially during both crises. There is also evidence of the size, book-to-market and momentum effects. The effect of these three last factor tends to change as we are moving from sub-sample one to sub-sample four. For instance, there is evidence of the size, book-to-market and momentum effect during the first two sub-samples but not sign of size effect during the 2008-2009 crises, even after this period. This can be explained by the fact that small companies are more sensitive to many risk factors as a result of their relatively undiversified and their reduced abilities to absorb damaging financial events.

Fourthly, we check whether hedge funds managers have genuine skills to outperform the market during consecutive periods of time, and we find no evidence of persistence in performance under both the Cross-product ratio and the Chi-square statistic. This therefore, reveals that in the long run, hedge funds are not able to outperform market returns consistently. However, for multi period framework, we use the Kolmogorov-Smirnov test; and we find some evidence of performance persistence, hence the persistence in performance is short term reality. The coefficients of EH, ED, EM, FWC and RV investment strategies are significant indicating persistence in performance in the sub-sample periods 1 to 2 and 2 to 3. The FOC and MC show lack of persistence in performance during sub-sample periods 2 to 3 and 3 to 4. Furthermore, we find no sign of persistence in performance from sub-sample period 3 and 4 for all investment strategies. One of the reasons for the robustness of this technique to detect persistence in

performance is that the Kolmogorov-Smirnov test statistic can be used for small sample size while, for example, the Chi-square test is more robust when the sample is moderately large enough to perform well. But also the uncertainty surrounding the 2008-2009 sub-prime crises has resulted in significant losses for most hedge funds that could not lead to a positive persistence in performance.

Finally, we find that the same factor loadings are not always able to capture the variations in the hedge fund excess returns during bull and bear economic cycles. As there is a strong positive correlation but no statistical evidence to confirm that persistence. The freedom enjoyed by hedge funds managers can considerably account for this lack of persistence in performance for different factor loadings. In this regard, the EM strategy is the only exception, and results reveal a perfect positive correlation between sub-sample period 3 and 4, implying that the market factor is able to explain the variation of EM excess returns for these two periods.

5.2 RECOMMENDATIONS

As most econometric models failed to predict exactly the 2008-2009 financial meltdown due to strong assumptions, such as the normality of hedge fund returns. A non-parametric model regression can be utilized to capture the relationship between the hedge fund returns and the global financial market as a whole. As the non-parametric techniques are able to capture the asymmetric behaviour of the hedge fund industry (Harris and Mazidas, 2013; Goodworth and Jones, 2007

References

Abdou, K. and Nasereddin, M. (2011) The Performance persistence of equity long/ short hedge funds. *Journal of Derivatives and Hedge Funds*, 15(1), 51-69.

Ackermann, C., McEmally, R. and Ravenscraft, D. (1999) The performance of hedge funds: risk, returns and incentives. *Journal of Finance*, 54(3), 833-874.

Adamti, A., Bhattacharya, S., Pfleiderer, P. and Ross, S. A. (1986) On timing and selectivity. *Journal of Finance*, 41(30), 715-730.

Agarwal, V. and Naik, N. Y. (2000a) Multi-period performance persistence Analysis of Hedge funds. *Journal of Financial and Quantitative Analysis*, 35, 327-342.

Agarwal V. and Naik, N. Y. (2000b) On taking the alternative route: risk, rewards and performance persistence of hedge funds. *Journal of Alternative Investment*, 2(4), 6-23.

Agarwal, V. and Naik, N. Y. (2002) *Introduction to hedge funds*. Gestion Alternative, AFG-ASFFI, France.

Agarwal, V. and Naik, N. Y. (2004) Risk and portfolio decision involving hedge funds. *Review of Financial Studies*, 17(1), 63-98.

Aman, M., Otto, H. and Markus, S. (2013) Hedge fund characteristics and performance persistence. *European Financial Management*, 19, 209-250.

Amin, S. G. and Kat, H. M. (2003) Hedge fund performance 1990-2000: Do the money machines really add value? *The Journal of Financial and Quantitative Analysis*, 38(2), 251-274.

Antoniou, A., Garett, I. and Priestley, R. (1998) Macroeconomic variables as common pervasive risk factors and empirical content of the arbitrage pricing theory. *Journal of Empirical Finance*, 5, 221-240.

Astereriou, D. and Hall, S. G (2007) *Applied econometrics*: *A Modern Approach*, New York: Palgrave Macmillan.

Banz, R. W. (1981) The relationship between return and market value of common stocks. *Journal of Financial Economics*, 9(1), 3-18.

Blake, D. (1994) *Pensions Schemes and Pensions Funds in United Kingdom*, Oxford: Oxford University press.

Bodson, L., Cavenaile, L. and Sougne, D. (2011) Does size effect mutual fund performance? General approach. *Journal of Asset Management*, 12, 163-171.

Boyson, N. M. and Cooper, M. J. (2004) *Do hedge funds exhibit performance persistence*? A

New approach, NBER Working Paper .Northeastern University and Purdue University.

Brown, S., Goetzman, W. N. and Ibbotson, R. G. (1999) Offshore hedge funds survival and performance. *Journal of Business*, 72(1), 91-117.

Brorsen, B. and Harri, A. (2002) *Performance persistence and the source of returns for hedge funds*, Working Paper, Oklahoma University.

Brown, S. and Goetzman, W. N. (2003) Hedge fund with style. *Journal of Portfolio Management*, 29(2), 101-112.

Bundoo, S. K. (2008) An augmented Fama and French three-factor model: New evidence form an emerging stock market. *Applied Economists Letters*, 15, 1213-1218.

Capocci, D. P. and Hubner, G. (2004) Analysis of hedge fund performance. *Journal of Empirical Finance*, 11(1), 55-89.

Capocci, D. and Hubner, G. (2005) Am analysis of hedge fund performance. *Journal of Empirical Finance*, 11 (1), 55-89.

Capocci, D. P. J., Corhay, A. and Hubner, G. (2005) Hedge fund performance persistence in bull and bear markets. *The European Journal of Finance*, 11 (5), 361-392.

Capocci, D. P. J. (2009) The persistence in hedge fund performance: extended analysis. *International Journal of Finance & Economic*, 14, 233-255.

Carhart, M. M. (1997) On persistence in mutual fund performance. *The Journal of Finance*, 52, 57-82.

Carpenter, J. N. and Lynch, W. A. (1999) Survivorship bias and attrition effects in measures of performance persistence. *Journal of Financial Economics*, 54, 337-374.

Chan, K. C.; Hamao, Y. and Lakonishok, J. (1991) Fundamentals and stock returns in Japan. *Journal of Finance*, 46 (5), 1739-1789.

Chen, Y. and Liang, B. (2007) Do market timing hedge funds time the market? *Journal of Financial and Quantitative Analysis*, 42(4), 827-856.

Christensen, R. (1990) *Log-linear models*, New York, Springer-Verlag.

Connor, G. and Korajczyk, R. (1986) Performance measurement with arbitrage pricing theory: A new framework for analysis. *Journal of Financial Economics*, 15, 374-394.

Costa, B. A. and Jakob, K. (2010) Enhanced Performance measurement of mutual funds: running the benchmark index through the hurdles. *Journal of Applied Finance*, 1, 95-102.

Defusso, R. A., McLeavy, D. W., Pinto, J. E. and Runkle, D. E. (2004) *Quantitative methods for investment analysis*, 2nd Edition, Charlottesville, CFA institute.

De Souza, C. and Gokcan, S. (2004) Hedge fund investing: a quantitative approach to hedge fund manager selection and de-selection. *Journal of Wealth Management*, 6 (4), 52-73.

Dor, A. B., Dynkin, L. and Gould, T. (2006) Style analysis and classification of hedge funds. *The Journal of Alternative Investment*, 9, 12-26.

Dupont, D. and Sack, B. (1999) The treasury securities market: overview and recent development. *Federal Reserve Bulletin*, 786-806.

Edwards, F. R and Caglayan, M. O. (2001) Hedge fund performance and manager skill. *The Journal of Futures Markets*, 21(11), 1003-1028.

Edwards, F. R. (2006) Hedge funds and investor protection regulation, Federal Reserve Bank of Atlanta. *Economic Review*, 4, 35-48.

Eichengreen, B., Mathieson, D., Chadha, B., Jensen, A., Kodras, L. and Sharna, S. (1998) *Hedge funds and financial market dynamics*. International Monetary Fund, Occasional Paper 166.

Eling, M. (2009) Does hedge fund performance persist? Overview and new empirical evidence. *European Financial Management*, 15(2), 362-401.

Eling, M. and Faust, R. (2010) The performance of hedge funds and mutual funds in emerging markets. *Journal of Banking and Finance*, 30, 1-17.

Ennis, R. M. and Sebastian, M. D. (2003) A critical look at the case for hedge funds. *Journal of Portfolio Management*, 29(4), 103-112.

Fama. E. F. (1965) Random walk in the stock market prices. *Financial Analyst Journal*, 21, 55-59.

Fama. E. F. (1972) Components of investment performance. *Journal of Finance*, 27(2), 551-567

Fama, E. F. and MacBeth, J. D. (1973) Risk, Return and Equilibrium: empirical test. *Journal of Political Economy*, 81 (3), 607-636.

Fama, E. F. and French, K. R. (1992) The cross-section of expected stock returns. *Journal of Finance*, 47 (2), 427-465.

Fama, E. F. and French, K.R. (1993) Common risk factors in the returns on the stocks and bonds. *Journal of Financial Economics*, 33, 3-56.

Fama, E.F. and French, K.R. (2004) The capital asset pricing model: theory and evidence. *Journal of Economic Perspectives*, 18 (3), 25-46.

Ferri, G., Liu, L. G. and Stiglitz, J. E. (1999) The procyclical role of rating agencies: evidence from the East Asian crisis. *Economic Notes by Banca Monte dei Paschi di Siena Spa*, 28(3), 335-355.

Fichtner, J. (2013) The rise of hedge funds: a story of inequality. *Journal for Societal Progress*, 2(1), 3-20.

Fung, W. and Hsieh, D. A. (1997) Empirical characteristics of dynamic trading strategies: The case of hedge fund. *Review of Financial Studies*, 10, 275-302.

Fung, W. and Hsieh, D. A. (1999) A primer of hedge funds. *Journal of Empirical Finance*, 6 (3), 309-331.

Fung, W. and Hsieh, D. A. (2004) Hedge fund benchmarks: a risk based approach. *Financial Analyst Journal*, 60 (5), 65-80.

Fung, W., Hsieh, D. A., Naik, N. and Ramadorai, T. (2008) Hedge funds: performance, risk and capital formation. *Journal of Finance*, 18(4), 1777-1802.

Gehin, W. (2003) Hedge fund performance, Risk and Asset Management Research Centre, Available from http://www.edhec-risk.com (Accessed 15 June 2014)

German, H. and Rokatamalala, C. K. (2011) Distortion risk measures for the hedge funds. *Journal of Risk Management in Financial Institutions*, 4 (3), 286-300.

Gregoriou, G. N. and Rouah, F. (2001) Last year's winning hedge fund as this year's selection; a simple trading strategy. *Derivatives Use, Trading and Regulation*, 7(3), 269-274.

Goetzmann, W. N. and Ibbotson, R. G. (1994) Do winners repeat? Patterns in mutual fund return behaviour. *Journal of Portfolio Management*, 20, 9-18.

Goodworth, T. R. J. and Jones, C. M. (2007) Factor-based, Non-parametric risk measurement framework for hedge funds and fund-of-funds, *The European Journal of Finance*, 13(7), 645-655.

Gregoriou G. N. and Pascalou, R. (2010) An empirical analysis of short-biased hedge funds' risk-adjusted performance: a panel approach. *Journal of Derivatives and Hedge Funds*, 16, 176-190.

Grinblatt, M. and Titman, S. (1993) Performance measurement without benchmarks: an examination of mutual fund returns. *Journal of Business*, 60, 97-112.

Harri, A. and Brorsen, B. W. (2004) Performance persistence and the source of returns for hedge funds. *Applied Financial Economics*, 14, 131-141.

Harris, R. D. F. and Mazidas, M. (2013) Dynamic hedge fund portfolio construction: A semi-parametric approach, *Journal of Banking and Finance*, 37, 139-149

Hasanhodizc, J. and Lo, A. W. (2007) Can hedge fund returns be replicated? The linear case. *Journal of Investment Management*, 5(2), 5-45.

Henn, J. and Meier, I. (2004) Performance analysis of hedge funds, in: Dichtl, H., Kleeberg, J. M. and Schlenger, C., eds, *Handbuch Hedge Funds*, 5, 435-466.

Herrera, A. and Lockwood, L. J. (1994) The size effect in the Mexican stock market. *Journal of Banking and Finance*, 18 (4), 621-632.

Herzberg, M. M. and Mozes, H. A. (2003) The persistence of hedge fund risk: evidence and implications for investors. *Journal of Alternative Investments*, 6(2), 22-42.

Hung-Gay, F, Xiaoqing, E. X. and Yau, J. (2002) Global hedge funds: Risk, return and market timing. *Financial Analysts Journal*, 58(6), 19-30.

Hedge fund research Indices April 2013, Available from http://www.hfr.com (Accessed 23 May 2013).

Hedge fund research reports, Available from http://www.hfr.com (Accessed 17 October 2013).

Hedge fund research reports, Available from http://www.hfr.com (Accessed 21 January 2014)

Hedge fund research reports, Available from http://www.hfr.com (Accessed 23 August 2014)

Jaffe, J., Keim, D. B. and Westerfied, R. (1989) Earning yields, market value, and stock returns. *Journal of Finance*, 44 (1), 135-148.

Jagonnathan, R., Malakhov, A. and Novikov, D. (2006) *Do hot hands persist among hedge fund managers? An American evaluation.* NBER-Working Paper, 12015.

Jegadeesh, N. and Titman, S. (1993) Returns to buying winners and selling losers: implications for stock market efficiency. *Journal of Finance*, 48 (1), 65-91.

Jensen, M. (1968) The performance of mutual fund in the period of 1945-1964. *Journal of Finance*, 23, 389-416.

Jensen, M. (1969) Risk, the pricing of capital assets and the evaluation of investment portfolios. *Journal of Business*, 42, 167-247.

Jhanwar, M. and Sehgal, S. (2008) On stock selection skill and market timing ability of mutual fund management in India. *International Research Journal of Finance and Economics*, Issue 15.

Joaquin, G. P. and Moura, M. L. (2011) Performance and persistence of Brazilian hedge funds in financial crisis. *Rev. Bras. Financas, Rio de Janeiro*, 9 (4). 465-488.

Jones. C. (2007*) Hedge funds of fund, a guide for investors*, John Wiley& Sons, Ltd.

Jordan, A. E. and Simlai, P. (2010) Risk characterization, stale pricing and the attributes of hedge funds 'performance. *Journal of Derivatives and Hedge Funds*, 17, 16-33.

Kat, H. M. and Menexe, F. (2003) Persistence hedge fund performance: the true value of a track record. *Journal of Alternative Investments*, 1 (4), 66-72.

Kenneth. R. French Data Library, Available from http://www.mba.tuck.dartmouth.edu (Accessed 24 August 2014)

Koh, F.; Koh, W. T. H. and Teo, M. (2003) *Asian hedge funds; returns persistence style, and fund characteristics*. Working Papers, Number 14.

Kosowski, R. Naik, N. Y. and Teo, M. (2007) Do hedge funds deliver alpha? A Beyasian and bootstrap analysis. *Journal of Financial Economics*, 3(4), 361-382.

Kouwenberg, R. (2003) Do hedge funds add value to a passive portfolio? *Journal of Asset Management*, 3(4), 361-382.

Ladi, L. (2008) Hedge funds: the case against increased global regulation in light of the subprime mortgage crisis. *International Law and Management Review*, 5, 99-139

Laffer, A. B. and Ranson, R. D. (1978) Some practical application of the efficient market concept. *Financial Management*, 7(2), 63-75.

Lam, K. S. K; Frank, L. K. and So, S. M. S. (2010) On the validity of the augmented Fama and French's (1993) model: evidence from the Hong Kong stock market. *Review of Quantitative Finance and Accounting*, 35, 89-111.

Liang, B. (1999) On the performance of hedge funds. *Financial Analysis Journal*, 55(4) 72-85.

Lintner, J. (1965) The valuation of risk assets and the selection of risk investments in stock portfolio and capital budget. *Review of Economics and Statistics*, 12, 13-37.

Lhabitant, F. (2004) *Hedge fund quantitative insights*, England, Wiley.

Lubochinsky, C., Fitzgerald, M. D. and McGinty, L. (2002) The role of hedge funds in international financial markets. *Economic Notes by Banc Monte dei Paschi di Spa*, Vol. 31, No 1, 33-57.

Lutton, D. (2008) The European Union, financial crisis and the regulation of hedge funds: a policy cul-de-sac or a policy window. *Journal of Contemporary European Research*, 4(3), 167-178.

Malkiel, B. G. (1995) Returns from investing en equity mutual funds 1971 to 1991. *Journal of Finance*, 50, 549-572.

Malkiel, B and Saha, A. (2005) Hedge Funds and Return. *Financial Analyst Journal*, 61 (6), 80-88.

Manser, S. and Schmid, M. M. (2008) The performance persistence of equity long/short hedge funds. *Journal of Derivatives and Hedge Funds*, 15 (1), 51-69.

Mayer-sommer, A. P. (1973) Understanding and acceptance of the efficient market hypothesis and its accounting implications. *American Accounting Association*, 45 (1), 88-106.

Merton, R. C. (1973) An intertemporal capital asset pricing model. *Econometrica*, 41(5), 887-887.

Mossin, J. (1966) The capital asset pricing market, *Econometrica*. 34 (34), 768-783.

Muteba-Mwanba, J. (2012) The effectiveness of hedge fund strategies and managers 'skill during market crisis: a Fuzzy, Non-parametric and Bayesian analysis, PHD (Economics), Retrieved from https://uj.digispace.uj.ac.za (Accessed 20 June2014).

Otten, R. and Bams, D. (2002) European mutual fund performance. *European Financial Management*, 8(1), 75-101.

Park, J. M. and Staum, J. C. (1998) *Performance persistence in the alternative investment industry*. Paradigm Capital Management, Inc. Unpublished manuscript.

Patari, E. J. and Talvanen, J. (2009) Chasing performance persistence of hedge funds: comparative analysis of evaluation techniques. *Journal of Derivatives and hedge funds*, 15 (3), 223-240.

Patari, E. J. (2011) Does the risk-adjustment method matter at all in hedge fund ranking. *International Research Journal of Finance and Economics Issues*, 75, 69-99.

Perold, A.F. (2004) The capital asset pricing model. *Journal of Economic Perspectives*, 18 (3), 3-24.

Philippas, N. (2011) Market timing and selectivity: empirical investigation into the features of Greek mutual fund managers. *The Journal of Applied Business Research*, 18, 97-108.

Rosenberg, B., Reid, K. and Lanstein, R. (1985) Persuasive evidence of market inefficiency, *Journal Portfolio Management*, 11, 9-17.

Scheeweis, T. and Spurgin, R. (1998) Multifactor analysis of the hedge funds, managed futures and mutual funds return and risk characteristic. *Journal of Alternative Investment*, 7(1), 1-24.

Sharpe, W. F. (1963) A simplified model for portfolio analysis. *Management Science*, 12, 277-293.

Sharpe, W. F. (1964) Capital asset prices: A theory of market equilibrium under conditional of risk. *The Journal of Finance*, 19(3), 425-442.

Shin, H. H. and Stulz, R. M. (1998) Are internal capital markets efficient? *Quarterly Journal of Economics*, 113(2), 531-552.

Stulz, R. M. (1997) Hedge funds: past, present, and future. *Journal of Economics Perspectives*, 21, 175-194.

Stult, R. M. (2007) The limits of financial globalization. *Journal of Finance*, 15, 1595-1638

Tavakoli, B. M. R. and Noor, H. A. (2014) Productivity and efficiency evaluation of US mutual funds. *Finance uver-Czech Journal of Economic and Finance*, 64(2), 120-143.

Theodosios, P.; Chrysostomos, S. and Costantinos, D. (2013) Hedge fund development and their role in economic crises. *Annals of the Alexandru Loan Cuza University*, 60(1), 168-181.

Tihana S. (2013) Market timing ability of mutual funds with tests applied on several Croatian funds, *Croatian Operational Research Review*, 4, 176-186.

Titman, S. and Tiu, C. (2011) Do the best hedge fund hedge? *The Review of Financial Studies*, 24 (1), 123-168.

Treynor, J. L. (1961) Toward a theory of the market value of risky asset. Unpublished Manuscript.

Treynor. J. L. (1965) How to rate management of investment funds. *Harvard Business Review*, 43, 63-75.

Treynor, J. L. and Mazuy, F. (1966) Can mutual funds outguess the market? *Harvard Business Review*, 44, 131-136.

Appendices

- **ED**: HFRI Event-Driven (Total) Index:
    - HFRI ED: Distressed/ Restructuring Index: **ED-DRES**
    - HFRI ED: Merger Arbitrage Index: **ED-MA**
- **EH**: HFRI Equity Hedge (Total) Index:
    - HFRI EH: Equity Market Neutral Index: **EH-EMN**
    - HFRI EH: Quantitative Directional Index: **EH-QUANT**
    - HFRI EH: Sector-Energy/Basic Materials Index: **EH-EBM**
    - HFRI EH: Sector-Technology/Healthcare Index: **EH-TH**
    - HFRI EH: Short Bias Index: **EH-SB**
- **EM**: HFRI Emerging Market (Total) Index:
    - HFRI Emerging Markets: Asia ex-Japan Index: **EM-ASIA-JP**
    - HFRI Emerging Markets: Global Index: **EM-GLOBAL**
    - HFRI Emerging Markets: Latin America Index: **EM-LAT-AM**

    - HFRI Emerging Markets: Russia/ Eastern Europe Index: **EM-REU**
- **FOF**: HFRI Fund of Funds Composite Index:
    - HFRI FOF: Conservative Index: **FOF-CONS**
    - HFRI FOF: Diversified Index: **FOF-DIV**
    - HFRI FOF: Market Defensive Index: **FOF-MKT-DEF**
    - HFRI FOF: Strategies Index**: FOF-STRAT**
- **FWC**: HFRI fund Weighted Composite Index:
    - HFRI Fund weighted Composite Index CHF**: FWC-CHF**
    - HFRI Fund Weighted Composite Index EUR: **FWC-EUR**
    - HFRI Fund Weighted Composite Index GBP: **FWC-GBP**
    - HFRI Fund Weighted Composite Index JPY: **FWC- JPY**
- **MC**: HFRI Macro (Total) Index:
    - HFRI Macro: Systematic Diversified Index: **MC-SYT-DIV**
- **RV:** HFRI Relative Value (Total) Index:
    - HFRI RV: Fixed Income-Asset Backed index: **RV-FIAB**
    - HFRI RV: Fixed Income-Convertible Arbitrage Index: **RV-FICA**
    - HFRI RV: Fixed Income- Corporate Index: **RV-FIC**
    - HFRI RV: Multi-Strategy Index: **RV-MS**
    - HFRI RV: Yield Alternatives Index: **RV-YA**

Table 9: Jensen's alpha in four sub-periods

	Period 1	Period 2	Period 3	Period 4
EH	1.194***	0.539***	-0.3250	-0.3240
ED	0.943***	0.861***	-0.404*	0.0910
EM	-0.30400	1.403***	-0.5600	0.736*
FOF	0.50600*	0.512***	-0.1260	0.0580
FWC	0.738***	0.657***	-0.424*	0.1200
MC	0.7350**	0.722***	-0.651**	-0.1500
RV	0.848***	0.633***	-0.550**	0.334*
ED-RES	0.644***	1.147***	-0.3420	0.2290
ED-MA	1.048***	0.430***	-0.42***	0.1870
EH-EMN	0.889***	0.385***	-0.1430	0.0250
EH-QUANT	0.51300	0.760***	-0.2490	-0.3360
EH-EBM	2.098**	1.242***	-0.5460	-1.378**
EH-TH	1.15100	0.11734	-0.660**	0.3830
EH-SB	1.588**	0.40188*	-0.1750	-0.0870
EM-ASIA-JP	-0.47500	1.171***	-0.7810	-0.7140
EM-GLOBAL	-0.27700	1.108***	-0.5870	-0.4540
EM-LAT-AM	0.08100	0.7093*	-0.7180	-1.036**

EM-REU	-0.00600	0.000145	-0.0730	-0.0930
FOF-CONS	0.68***	0.467***	-0.0660	0.0790
FOF-DIV	0.39900	0.514***	-0.1240	0.0020
FOF-MKT-DEF	0.71***	0.578***	-0.592*	-0.2340
FOF-STRAT	0.44700	0.523***	-0.1210	-0.1520
FWC-CHF	0.4400*	0.513***	-0.2900	-0.2070
FWC-EUR	0.5671**	0.657***	-0.374*	-0.1430
FWC-GBP	0.795***	0.789***	-0.434*	-0.1180
FWC-JPY	0.288000	0.413***	-0.2700	-0.1340
MC-SYT-DIV	0.942***	0.649***	-0.819*	-0.0560
RV-FIAB	0.670***	0.864***	-0.7280	0.893***
RV-FICA	0.986***	0.579***	-0.6240	0.0210
RV-FIC	0.35540*	0.757***	-0.2890	0.2590
RV-MS	0.554***	0.671***	-0.3650	0.2580
RV-YA	0.53986*	0.865***	-0.1850	0.3800

"*" 5%, "**" 1% and "***" 0.1% level of significance

Table 10: Treynor and Mazuy's selectivity skill

	Period 1	Period 2	Period 3	Period 4
Strategies	Alpha	Alpha	Alpha	Alpha
EH	1.226***	0.640***	0.407041	-0.25085
ED	1.413***	0.956***	0.6522**	0.17176
EM	0.40700	1.709***	0.929336	-0.46374
FOF	0.7920**	0.595***	0.348726	0.00572
FWC	0.959***	0.746***	0.50592*	-0.07706
MC	0.70800*	0.719***	0.372295	-0.17609
RV	1.26500	0.607	0.904***	0.3704**
ED-DRES	1.267***	1.216***	0.64172*	0.37787*
ED-MA	1.408***	0.541***	0.4458**	0.130147
EH-EMN	0.942***	0.358***	0.074802	0.043462
EH-QUANT	0.61300	0.830***	0.3889	-0.17241
EH-EBM	2.0550*	1.03200*	0.94348	-1.513**
EH-TH	1.07000	0.24200	0.64879*	0.27714
EH-SB	1.6020*	0.5680**	0.09242	-0.4826*
EM-ASIA-JP	-0.82600	1.515***	0.909917	-0.50245
EM-GLOBAL	1.00600	1.302***	0.88521*	-0.27497

EM-LAT-AM	0.52200	1.06900*	1.17626*	-0.76709
EM-REU	1.85800	3.122***	0.99404	-0.65906
FOF-CONS	0.931***	0.527***	0.34049	0.10264
FOF-DIV	0.66400*	0.598***	0.335119	0.04226
FOF-MKT-DEF	1.043***	0.5170**	0.334539	-0.18774
FOF-STRAT	0.906**	0.672***	0.378384	-0.05453
FWC-CHF	0.642**	0.585***	0.39516	-0.12182
FWC-EUR	1.430***	0.729***	0.52396*	-0.07816
FWC-GBP	0.991***	0.876***	0.59137*	-0.05737
FWC-JPY	0.49400*	0.503***	0.304321	-0.09719
MC-SYT-DIV	0.43900	0.56600	0.248501	-0.0698
RV-FIAB	0.95000	0.99200	0.726***	0.979***
RV-FICA	1.27100	0.39500	1.17957*	0.067277
RV-FIC	0.86900	0.84700	0.65646*	0.284258
RV-MS	0.78100	0.75600	0.64107*	0.30146*
RV-YA	0.89300	0.89600	0.243447	0.360766

"*" 5%, "**" 1% and "***" 0.1% level of significance

Table 11: Treynor and Mazuy's timing ability

	Period1	Period2	Period3	Period4
Strategies	Beta2	Beta2	Beta2	Beta2
EH	-0.0020	-0.006	-0.0047	-0.014*
ED	-0.1***	-0.006	-0.009*	-0.02**
EM	-0.029*	-0.018	-0.0134	-0.0236
FOF	-0.012*	-0.005	-0.0089	-0.01**
FWC	-0.0090	-0.005	-0.0046	-0.012*
MC	0.0010	0.001	0.00625	-0.0055
RV	-0.0170	0.002	-0.02**	-0.01**
ED-DRES	-0.3***	-0.004	-0.011*	-0.2***
ED-MA	-0.2***	-0.006	-0.0029	-0.0025
EH-EMN	-0.0020	0.002	-0.0001	-0.008*
EH-QUANT	-0.0040	-0.004	-0.0064	-0.02**
EH-EBM	0.0020	0.012	-0.0142	-0.0091
EH-TH	0.0030	-0.007	-0.0018	-0.0114
EH-SB	-0.0010	-0.010	-0.010*	0.0185*
EM-ASIA-JP	0.0140	-0.020	-0.0061	-0.0268
EM-GLOBAL	-0.1***	-0.011	-0.0112	-0.0178

EM-LAT-AM	-0.0180	-0.021	-0.0161	-0.0108
EM-REU	-0.071*	-0.021	-0.032*	-0.042*
FOF-CONS	-0.01**	-0.004	-0.010*	-0.1***
FOF-DIV	-0.0110	-0.005	-0.0086	-0.012*
FOF-MKT-DEF	-0.014*	0.004	0.00559	-0.0096
FOF-STRAT	-0.019*	-0.009	-0.0099	-0.02**
FWC-CHF	-0.0080	-0.004	-0.0054	-0.02**
FWC-EUR	0.0060	-0.004	-0.0067	-0.01**
FWC-GBP	-0.0080	-0.005	-0.0069	-0.013*
FWC-JPY	-0.0090	-0.005	-0.0032	-0.011*
MC-SYT-DIV	0.0210	0.005	0.01508	-0.0057
RV-FIAB	-0.0120	-0.007	-0.0021	-0.1***
RV-FICA	-0.0120	0.011*	-0.019*	-0.012*
RV-FIC	-0.0210	-0.005	-0.013*	-0.0098
RV-MS	-0.0090	-0.005	-0.011*	-0.01**
RV-YA	-0.0150	-0.002	-0.0039	-0.0092

"*" 5%, "**" 1% and "***" 0.1% level of significance

Table 12 Fama and French 3 factor model and Carhart 4 factor model for the sub-period 1

	alpha	Mtk	SMB	HML	R^2	alpha	Mtk	SMB	HML	PY1YR	R^2
EH	1.3***	0.4***	0.3***	0.0100	0.86	1.2***	0.5***	0.3***	0.030	0.030	0.86
ED	0.9***	0.4***	0.2***	0.2***	0.74	0.9***	0.3***	0.2***	0.2***	-0.050	0.75
EM	-0.3400	0.8***	0.3**	0.2500	0.47	-0.330	0.8***	0.34**	0.250	-0.010	0.46
FOF	0.531**	0.3***	0.2***	0.1100	0.60	0.381*	0.4***	0.2***	0.17*	0.09*	0.62
FWC	0.8***	0.4***	0.3***	0.093*	0.86	0.8***	0.4***	0.3***	0.090	0.005	0.86
MC	0.69**	0.4***	0.2***	0.188*	0.40	0.460	0.1***	0.19**	0.27**	0.14*	0.44
RV	0.7***	0.2***	0.1***	0.2***	0.47	0.8***	0.8***	0.1***	0.11**	-0.050	0.48
ED-DRES	0.6***	0.2***	0.2***	0.17**	0.54	0.7***	0.3***	0.2***	0.145*	-0.060	0.55
ED-MA	0.9***	0.3***	0.1***	0.2***	0.39	1.092	0.2***	0.1***	0.11**	-0.02*	0.43
EH-EMN	0.9***	0.1***	0.071*	0.070	0.14	0.67**	0.12**	0.0210	0.14**	0.12**	0.32
EH-QUANT	0.7***	0.8***	0.4***	0.020	0.92	0.8***	0.8***	0.4***	-0.040	-0.08*	0.92
EH-EBM	1.517*	0.9***	0.63**	1.1***	0.25	2.070	0.9***	0.7***	0.91**	-0.340	0.28
EH-TH	1.9***	0.7***	0.4***	-0.7***	0.86	1.7***	0.7***	0.4***	-0.7***	0.040	0.86
EH-SB	0.97**	-0.9***	-0.5***	0.4***	0.87	0.882*	-0.9***	-0.5**	0.5***	0.050	0.87
EM-ASIA-JP	-0.3620	0.5***	0.1700	-0.050	0.39	-0.1700	0.4***	0.2320	-0.120	-0.110	0.39
EM-GLOBAL	-0.3700	0.9***	0.4***	0.36*	0.52	-0.3800	0.8***	0.4***	0.37*	0.010	0.51
EM-LAT-AM	0.1328	0.7***	0.2400	0.090	0.32	-0.0500	0.7***	0.2640	0.150	0.110	0.31
EM-REU	0.0123	0.0100	0.0023	0.001*	0.14	0.0030	0.002	0.067	0.08**	0.02*	0.18

FOF-CONS	0.7***	0.2***	0.09**	0.060	0.38	0.6***	0.16***	0.14**	0.092*	0.051	0.40
FOF-DIV	0.4312*	0.33***	0.25***	0.110	0.56	0.2650	0.35***	0.2***	0.181*	0.10*	0.58
FOF-MKT-DEF	0.636**	0.24***	0.19***	0.22**	0.28	0.482*	0.25***	0.2***	0.28***	0.090	0.31
FOF-STRAT	0.5129*	0.52***	0.37***	0.140	0.71	0.3400	0.54***	0.3***	0.212*	0.127	0.72
FWC-CHF	0.49***	0.44***	0.25***	0.09*	0.86	0.49***	0.44***	0.3***	0.090	0.097	0.85
FWC-EUR	0.72***	0.08*	0.102*	-0.14*	0.49	0.58***	0.101*	0.154*	-0.080	0.09*	0.52
FWC-GBP	0.85***	0.44***	0.25***	0.080	0.87	0.85***	0.44***	0.2***	0.080	0.067	0.87
FWC-JPY	0.343**	0.44***	0.25***	0.080	0.86	0.351**	0.44***	0.3***	0.080	0.093	0.86
MC-SYT-DIV	1.05***	0.26***	0.0400	-0.110	0.50	1.04***	0.26***	0.0240	-0.110	0.010	0.50
RV-FIAB	0.662**	0.020	0.0900	0.070	0.01	0.5329*	0.030	0.1350	0.120	0.080	0.02
RV-FICA	0.97***	0.12***	0.07**	0.070	0.27	1.04***	0.11***	0.18**	0.040	-0.040	0.30
RV-FIC	0.30000	0.23***	0.12**	0.15*	0.35	0.3678*	0.23***	0.17**	0.129*	-0.030	0.34
RV-MS	0.53***	0.14***	0.11***	0.10*	0.34	0.46***	0.15***	0.1***	0.13**	0.040	0.35
RV-YA	0.29000	0.41***	0.25***	0.46***	0.43	0.1500	0.42***	0.2***	0.51***	0.090	0.45

"*" 5%, "**" 1% and "***" 0.1% level of significance

Table 13 Fama and French 3 factor model and Carhart 4 factor model for the sub-period 2

	alpha	Mtk	SMB	HML	R^2	alpha	Mtk	SMB	HML	PY1YR	R^2
EH	0.27**	0.4***	0.2***	0.1***	0.84	0.28*	0.4***	0.24***	0.11**	0.124	0.84
ED	0.6***	0.3***	0.3***	0.2***	0.74	0.5**	0.3***	0.3***	0.2***	-0.10*	0.75
EM	1.1***	0.5***	0.2***	0.21**	0.61	1.1*	0.5***	0.3***	0.24**	0.320	0.61
FOF	0.3***	0.1***	0.2***	0.09**	0.49	0.4**	0.2***	0.1***	0.07	0.423	0.49
FWC	0.5***	0.3***	0.2***	0.08**	0.81	0.52*	0.3***	0.2***	0.09**	0.187	0.81
MC	0.55**	0.0500	0.18**	0.0600	0.14	0.55*	0.0600	0.18**	0.0600	0.276	0.12
RV	0.5***	0.06**	0.05*	0.07**	0.21	0.50*	0.04*	0.05*	0.08**	0.956	0.22
ED-DRES	0.9***	0.2***	0.2***	0.3***	0.39	0.9**	0.12**	0.2***	0.2***	0.191	0.40
ED-MA	0.24**	0.2***	0.1***	0.1***	0.50	0.24*	0.2***	0.1***	0.1***	0.105	0.50
EH-EMN	0.23**	0.0945	0.04	0.1***	0.35	0.3**	0.05**	0.04*	0.1***	0.1***	0.54
EH-QUANT	0.4***	0.7***	0.4***	0.0600	0.94	0.4**	0.7***	0.4***	0.090	0.169	0.94
EH-EBM	0.6901	0.5***	0.13	0.5***	0.33	0.70	0.5***	0.1304	0.49**	0.240	0.32
EH-TH	0.2400	0.6***	0.3***	-0.3**	0.85	0.22	0.6***	0.3***	-0.3***	0.056	0.85
EH-SB	0.34*	-0.8***	-0.2**	0.19**	0.9	0.34	-0.8***	-0.18**	0.20**	0.389	0.90
EM-ASIA-JP	0.70**	0.5***	0.4***	0.25**	0.57	0.70	0.5***	0.4***	0.250	0.271	0.56
EM-GLOBAL	0.8***	0.4***	0.3***	0.160*	0.55	0.77	0.3***	0.3***	0.22**	-0.107	0.56
EM-LAT-AM	0.4103	0.8***	0.1005	0.260*	0.52	0.41	0.8***	0.1091	0.260	0.103	0.52
EM-REU	0.1031	0.1***	0.214	0.3070	-0.01	0.098	0.034	0.1098	0.251	0.197	-0.02

FOF-CONS	0.4***	0.1***	0.06**	0.040	0.35	0.39	0.1***	0.06**	0.040	0.098	0.34
FOF-DIV	0.32**	0.1***	0.2***	0.11**	0.50	0.33	0.2***	0.1***	0.09*	0.045	0.50
FOF-MKT-DEF	0.38*	-0.030	0.17**	0.102	0.11	0.40	0.0981	0.16**	0.060	0.177	0.12
FOF-STRAT	0.31**	0.3***	0.2***	0.10*	0.67	0.32	0.3***	0.2***	0.080	0.435	0.67
FWC-CHF	0.3***	0.3***	0.2***	0.08**	0.82	0.31	0.3***	0.2***	0.08*	0.078	0.82
FWC-EUR	0.5***	0.3***	0.2***	0.08**	0.82	0.46	0.3***	0.2***	0.08*	0.058	0.82
FWC-GBP	0.6***	0.3***	0.2***	0.070*	0.82	0.60	0.27***	0.19***	0.08*	0.154	0.82
FWC-JPY	0.22*	0.2***	0.2***	0.08**	0.82	0.22	0.2***	0.2***	0.08*	0.342	0.81
MC-SYT-DIV	0.52**	0.3***	0.16**	0.03	0.59	0.57	0.4***	0.15**	-0.07	0.1***	0.65
RV-FIAB	0.8***	0.06	-0.02	0.06	0.01	0.81	0.03	-0.02	0.09	0.096	0.02
RV-FICA	0.5***	0.01	0.09*	0.05	0.04	0.45	-0.03	0.09*	0.10*	-0.10*	0.09
RV-FIC	0.6***	0.1***	0.1***	0.1***	0.43	0.53	0.07**	0.14***	0.18***	-0.1***	0.52
RV-MS	0.60***	0.07***	0.07**	0.04	0.25	0.57	0.02	0.07**	0.09***	-0.1***	0.43
RV-YA	0.61***	0.20***	0.18**	0.16*	0.36	0.63	0.24***	0.18**	0.110	0.100	0.37

"*" 5%, "**" 1% and "***" 0.1% level of significance

Table 14 Fama and French 3 factor model and Carhart 4 factor model for the sub-period 3

	alpha	Mtk	SMB	HML	R^2	alpha	Mtk	SMB	HML	PY1YR	R^2
EH	0.270	0.5***	-0.02	-0.22**	0.78	0.270	0.5***	-0.020	-0.2*	-0.02	0.77
ED	0.370	0.4***	0.02	-0.110	0.67	0.370	0.4***	0.020	-0.11	0.01	0.66
EM	0.580	0.7***	-0.25	-0.31*	0.68	0.550	0.7***	-0.250	-0.4*	-0.06	0.68
FOF	0.100	0.3***	-0.07	-0.20*	0.51	0.120	0.3***	-0.070	-0.1*	0.03	0.51
FWC	0.400*	0.4***	-0.05	-0.16*	0.70	0.400*	0.4***	-0.050	-0.2*	-0.01	0.69
MC	0.73**	0.0812	-0.20	-0.020	0.03	0.76**	0.0900	-0.200	0.02	0.05	0.05
RV	0.490*	0.3***	0.04	-0.17*	0.55	0.46*	0.3***	0.040	-0.2*	-0.05	0.56
ED-DRES	0.330	0.3***	-0.01	-0.070	0.46	0.32	0.3***	-0.010	-0.08	-0.02	0.45
ED-MA	0.4**	0.2***	0.419	-0.09*	0.49	0.40**	0.2***	0.041	-0.1*	0.03	0.47
EH-EMN	0.150	0.0612	-0.04	-0.040	0.01	0.18	0.071*	-0.040	0.010	0.06*	0.12
EH-QUANT	0.200	0.5***	0.01	-0.19*	0.81	0.22	0.5***	0.010	-0.2*	0.03	0.81
EH-EBM	0.420	0.8***	-0.04	-0.5**	0.65	0.42	0.8***	-0.040	-0.5*	0.01	0.64
EH-TH	0.54*	0.4***	0.134	-0.1**	0.72	0.55*	0.4***	0.100	-0.3*	0.04	0.71
EH-SB	0.020	-0.6***	-0.4**	0.070	0.92	0.03	-0.6***	-0.4**	0.080	0.02	0.92
EM-ASIA-JP	0.76*	0.71***	-0.24	-0.5**	0.65	0.73	0.69***	-0.240	-0.5*	-0.06	0.65
EM-GLOBAL	0.590	0.55***	-0.15	-0.200	0.64	0.56	0.53***	-0.150	-0.3*	-0.06	0.64
EM-LAT-AM	0.720	0.62***	-0.22	-0.33*	0.60	0.67	0.60***	-0.220	-0.40	-0.09	0.61
EM-REU	-0.070	0.0312*	-0.02	-0.030	0.08	-0.07	0.0327*	-0.020	-0.03	0.08	0.06

FOF-CONS	0.040	0.21***	-0.04	-0.140	0.37	0.06	0.22***	-0.040	-0.12	0.02	0.36
FOF-DIV	0.090	0.27***	-0.05	-0.20*	0.47	0.11	0.28***	-0.050	-0.3*	0.03	0.47
FOF-MKT-DEF	0.68*	0.07120	-0.22	-0.020	0.03	0.71**	0.0900	-0.220	0.02	0.05	0.04
FOF-STRAT	0.090	0.38***	-0.08	-0.3**	0.60	0.1	0.39***	-0.080	-0.5*	0.03	0.60
FWC-CHF	0.260	0.37***	-0.03	-0.16*	0.71	0.26	0.37***	-0.030	-0.2*	0.02	0.70
FWC-EUR	0.340	0.37***	-0.03	-0.17*	0.71	0.34	0.37***	-0.030	-0.2*	0.06	0.71
FWC-GBP	0.41*	0.37***	-0.04	-0.16*	0.71	0.41*	0.37***	-0.040	-0.1*	0.01	0.70
FWC-JPY	0.240	0.36***	-0.03	-0.16*	0.70	0.24	0.3600	0.740	-0.2*	-0.01	0.70
MC-SYT-DIV	0.95*	0.03194	-0.34	0.030	-0.01	1.01*	0.0600	-0.300	0.120	0.12	0.04
RV-FIAB	0.70	0.07387	0.09	0.010	0.12	0.68***	0.0500	0.090	-0.02	-0.04	0.14
RV-FICA	0.52	0.54***	0.02	-0.35*	0.51	0.43	0.49***	0.020	-0.5*	-0.17**	0.58
RV-FIC	0.25	0.33***	0.04	-0.10	0.51	0.22	0.32***	0.040	-0.14	-0.05	0.51
RV-MS	0.29	0.28***	0.07	-0.18*	0.52	0.27	0.27***	0.070	-0.2*	-0.04	0.53
RV-YA	0.06	0.34***	0.13	-0.27*	0.44	0.03	0.32***	0.130	-0.3*	-0.05	0.44

"*" 5%, "**" 1% and "***" 0.1% level of significance

Table 15 Fama and French 3 factor model and Carhart 4 factor model for the sub-period 4

	alpha	Mtk	SMB	HML	R^2	alpha	Mtk	SMB	HML	PY1RY	R^2
EH	-0.31	0.51	0.05	-0.01	0.71	-0.21	0.48***	0.06	0.00	-0.13	0.72
ED	0.10	0.31	0.00	0.08	0.51	0.17	0.29***	0.01	0.09	-0.09	0.52
EM	-0.74	0.58	-0.02	0.02	0.53	-0.56	0.54***	0.00	0.03	-0.24	0.57
FOF	-0.09	0.24	-0.12	0.01	0.30	-0.05	0.23***	-0.11	0.02	-0.05	0.29
FWC	-0.14	0.34	-0.08	-0.02	0.53	-0.08	0.32***	-0.07	-0.01	-0.08	0.54
MC	-0.25	0.13	-0.31	-0.10	0.04	-0.25	0.13	-0.31	-0.10	0.00	0.01
RV	0.30	0.19	-0.15	0.02	0.27	0.33*	0.18**	-0.15	0.02	-0.05	0.26
ED-DRES	0.25	0.29	-0.03	0.16	0.48	0.28	0.29***	-0.03	0.16	-0.04	0.47
ED-MA	0.16	0.09	-0.06	-0.07	0.04	0.17	0.08	-0.06	-0.07	-0.01	0.01
EH-EMN	0.02	0.16***	-0.04	0.02	0.30	0.01	0.17***	-0.04	0.02	0.02	0.28
EH-QUANT	-0.37	0.50***	-0.08	-0.05	0.67	-0.35	0.50***	-0.08	-0.05	-0.01	0.66
EH-EBM	-1.38**	0.74***	0.15	-0.25	0.55	-1.27**	0.71***	0.16	-0.25	-0.14	0.55
EH-TH	0.37	0.35***	0.13	-0.31*	0.54	0.40	0.35***	0.14	-0.31*	-0.04	0.52
EH-SB	-0.21	-0.53***	-0.35*	-0.23	0.78	-0.37	-0.49***	-0.37**	-0.24	0.21*	0.82
EM-ASIA-JP	-0.69	0.62***	0.09	0.03	0.44	-0.50	0.57***	0.11	0.04	-0.24	0.45
EM-GLOBAL	-0.46	0.43***	-0.07	0.06	0.48	-0.31	0.39***	-0.05	0.07	-0.19	0.52
EM-LAT-AM	-1.06**	0.65***	-0.03	-0.10	0.52	-0.92*	0.62***	-0.01	-0.09	-0.18	0.52

EM-REU	-0.06	0.01	0.11	0.06	0.02	-0.06	0.01	0.11	0.06	0.01	0.01
FOF-CONS	0.06	0.16**	-0.11	0.03	0.18	0.09	0.15**	-0.11	0.03	0.54	0.16
FOF-DIV	-0.03	0.21**	-0.14	0.02	0.24	0.00	0.21	-0.13	0.02	-0.04	0.22
FOF-MKT-DEF	-0.33	0.11	-0.34	-0.06	0.03	0.11	0.11	-0.34	-0.07	0.02	0.01
FOF-STRAT	-0.17	0.32***	-0.07	0.00	0.44	-0.11	0.31***	-0.06	0.01	-0.08	0.44
FWC-CHF	-0.23	0.34	-0.07	-0.01	0.53	-0.17	0.33***	-0.06	-0.01	-0.07	0.53
FWC-EUR	-0.17	0.34***	-0.08	-0.02	0.53	-0.11	0.32	-0.07	-0.02	-0.08	0.53
FWC-GBP	-0.14	0.34***	-0.08	-0.01	0.53	-0.08	0.33***	-0.07	-0.01	-0.08	0.53
FWC-JPY	-0.16	0.34***	-0.08	-0.01	0.53	-0.09	0.32	-0.07	-0.01	-0.08	0.53
MC-SYT-DIV	-0.23	0.07	-0.57*	-0.16	0.08	-0.32	0.09	-0.58*	-0.16	0.12	0.07
RV-FIAB	0.84	0.08	-0.23	0.02	0.04	0.86	0.07	-0.22	0.02	-0.03	0.02
RV-FICA	0.01	0.27***	-0.07	0.02	0.41	0.08	0.25***	-0.06	0.03	-0.10	0.43
RV-FIC	0.24	0.22***	-0.12	0.05	0.32	0.27	0.21	-0.11	0.05	-0.04	0.31
RV-MS	0.22	0.16**	-0.18	0.05	0.18	0.27	0.15**	-0.17	0.05	-0.07	0.19
RV-YA	0.33	0.46***	-0.17	-0.07	0.62	0.39	0.44***	-0.16	-0.07	-0.09	0.62

"*" 5%, "**" 1% and "***" 0.1% level of significance

Table 16: Winners/losers in outperformance skill using Jensen's alpha

	PERIOD 1	PERIOD 2	PERIOD 3	PERIOD 4
EH	W	W	W	L
ED	L	L	L	L
EM	L	W	L	W
FOF	L	L	L	L
FWC	L	L	W	W
MC	L	W	L	L
RV	W	L	W	W
EH-EMN	L	L	L	W
EH-QUANT	L	W	L	L
EH-EBM	W	W	W	L
EH-TH	L	L	W	W
EH-SB	W	L	L	W
ED-RES	L	W	L	W
ED-MA	W	L	W	L
EM-ASIA-JP	L	L	W	L
EM-GLOBAL	L	L	L	W

EM-LAT-AM	W	L	W	L
EM-REU	W	W	L	L
FOF-CONS	W	L	L	W
FOF-DIV	L	L	L	W
FOF-MKT-DEF	W	W	W	L
FOF-STRAT	L	W	W	L
FWC-CHF	L	L	L	L
FWC-EUR	W	L	L	L
FWC-GBP	W	W	W	W
FWC-JPY	L	L	L	L
MC-SYT-DIV	W	L	W	W
RV-FIAB	W	W	W	W
RV-FICA	W	L	W	L
RV-FIC	L	W	L	L
RV-MS	L	L	L	L
RV-YA	L	W	L	W

Table 17: Winners/ Losers in selectivity skill

Strategies	Period 1	Period 2	Period 3	Period 4
EH	W	L	W	L
ED	W	W	W	L
EM	L	W	L	W
FOF	L	L	W	L
FWC	L	W	L	W
MC	W	W	W	L
RV	W	L	W	W

ED-DRES	L	W	L	W
ED-MA	L	L	L	L
EH-EMN	L	L	W	W
EH-QUANT	L	W	W	W
EH-EBM	W	W	W	L
EH-TH	L	L	L	W
EH-SB	W	L	L	L
EM-ASIA-JP	L	L	L	L

EM-GLOBAL	W	L	L	W
EM-LAT-AM	L	L	W	L
EM-REU	W	W	W	L
FOF-CONS	W	L	W	W
FOF-DIV	L	W	L	W
FOF-MKT-DEF	W	L	L	L
FOF-STRAT	L	W	L	L
FWC-CHF	L	L	L	L
FWC-EUR	W	L	W	L
FWC-GBP	W	W	W	W
FWC-JPY	L	L	L	L
MC-SYT-DIV	L	L	L	W
RV-FIAB	W	W	W	W
RV-FICA	L	L	W	L
RV-FIC	L	W	L	L
RV-MS	W	L	L	L
RV-YA	W	W	L	W

Table 18: Winners/Losers in market timing skill

Strategies	Period1	Period2	Period3	Period4
EH	L	L	L	L
ED	L	L	W	L
EM	L	W	L	L
FOF	L	L	L	L
FWC	L	L	W	W
MC	L	L	L	W
RV	L	W	L	W

ED-DRES	L	W	L	L
ED-MA	W	L	W	W
EH-EMN	L	W	W	L
EH-QUANT	L	W	L	W
EH-EBM	W	W	L	W
EH-TH	W	L	W	W
EH-SB	W	L	L	W
EM-ASIA-JP	W	L	W	L
EM-GLOBAL	L	W	W	W
EM-LAT-AM	W	L	L	W

EM-REU	L	L	L	L
FOF-CONS	W	W	L	L
FOF-DIV	W	L	W	W
FOF-MKT-DEF	L	W	W	W
FOF-STRAT	L	L	L	L
FWC-CHF	L	W	L	L
FWC-EUR	W	W	L	L
FWC-GBP	W	L	L	L
FWC-JPY	L	L	W	W
MC-SYT-DIV	W	W	W	L
RV-FIAB	W	L	W	L
RV-FICA	W	W	L	L
RV-FIC	L	L	L	W
RV-MS	W	L	W	L
RV-YA	L	W	W	W

Table 19: Two period's performance persistence

From period 1 to 2	Z-statistic	1%	5%	10%	Chi-square	1%	5%	10%
Jensen's alpha	0.2267	NO	NO	NO	0.0514	NO	NO	NO
Quadratic CAPM alpha	0.3122	NO	NO	NO	0.0976	NO	NO	NO
Quadratic CAPM beta 2	-0.8048	NO	NO	NO	0.6531	NO	NO	NO
From period 2 to 3								
Jensen's alpha	0.2267	NO	NO	NO	0.0514	NO	NO	NO
Quadratic CAPM alpha	0.3122	NO	NO	NO	0.0976	NO	NO	NO
Quadratic CAPM beta 2	-0.8048	NO	NO	NO	0.6531	NO	NO	NO
From period 3 to 4								
Jensen's alpha	-0.0897	NO	NO	NO	0.0081	NO	NO	NO
Quadratic CAPM alpha	-0.4013	NO	NO	NO	0.1613	NO	NO	NO
Quadratic CAPM beta 2	1.0204	NO	NO	NO	1.0537	NO	NO	NO

Table 20: Kolmogorov-Smirnov test for multi-period persistence in performance of hedge fund strategies

	Period 1	Period 2	Period 3	Period 4
	P-value	P-value	P-value	P-value
EH	0.000000	0.004375	0.009231	**0.18590**
ED	0.000001	0.02222	0.004545	**0.05637**
EM	0.000003	0.00000	0.000064	**0.30681**
FOF	0.007732	**0.96590**	**0.058760**	**0.30684**
FWC	0.000007	0.02222	0.009231	**0.47282**
MC	0.001289	**0.19180**	**0.058760**	**0.47280**
RV	0.001289	0.02222	0.002135	**0.10574**
ED-RES	0.001289	0.03613	0.004545	0.01319
ED-MA	0.000001	**0.37010**	0.03317	**0.4728**
EH-EMN	**0.057130**	**0.05713**	**0.25030**	**0.3068**
EH-QUANT	0000000	0.00003	0.004545	**0.3068**
EH-EBM	0000000	0.00003	0.000165	0.02819
EH-TH	0000000	0.007475	0.000956	**0.05637**
EH-SB	0.000037	0.001193	0.004545	0.000895

EM-ASIA-JP	0.000671	0.000006	0.000064	0.02819
EM-GLOBAL	0.000007	0.000301	0.000956	**0.3068**
EM-LAT-AM	0.000001	0.000145	0.000165	**0.1057**
EM-REU	0000000	000000	0.000956	0.02819
FOF-CONS	0.03613	**0.1911**	**0.09956**	**0.4728**
FOF-DIV	0.01329	**0.8888**	**0.05876**	**0.3068**
FOF-MKT-DEF	0.01298	**0.63070**	**0.05876**	**0.4728**
FOF-STRAT	0.000145	0.03578	0.0179	**0.3068**
FWC-CHF	0.000145	**0.27130**	0.0179	**0.4728**
FWC-EUR	0000000	**0.05686**	0.009231	**0.4728**
FWC-GBP	0.000006	0.007475	0.009231	**0.4728**
FWC-JPY	0.001193	**0.49100**	0.0179	**0.4728**
MC-SYT-DIV	0.000067	0.00418	0.009231	**0.05637**
RV-FIAB	0.01329	0.000145	0.004545	0.000316
RV-FICA	0.000167	**0.49100**	0.004545	**0.05637**
RV-FIC	**0.27000**	**0.13170**	0.0179	0.02819
RV-MS	**0.27000**	0.01329	**0.05876**	**0.3068**
RV-YA	0.002408	0.02222	**0.05876**	0.002356

Table 21: Spearman rank correlation using beta from the CAPM

	Period 1 to 2		Period 2 to3		Period 3 to 4	
	Correlation	P-value	Correlation	P-value	Correlation	P-value
ED	1.000	0.333	1.000	0.333	1.000	0.333
EH	0.900	0.083	0.700	0.233	1.000	**0.017**
EM	0.100	0.950	1.000	**0.017**	0.900	0.083
FOF	0.800	0.333	1.000	0.083	1.000	0.083
FWC	0.600	0.417	-0.800	0.333	-0.400	0.750
MC	1.000	1.000	-1.000	1.000	1.000	1.000
RV	0.900	0.083	-0.100	0.950	0.700	0.233

Table 22: Spearman rank correlation using the 3 factor model

		Period 1 to 2		Period 2 to3		Period 3 to 4	
		Correlation	P-value	Correlation	P-value	Correlation	P-value
ED	Mkt	0.866	0.333	0.866	0.333	1.000	0.333
	SMB	1.000	0.333	0.500	1.000	0.500	1.000

	HML	1.000	0.333	-0.500	1.000	1.000	0.500
EH	Mkt	0.700	0.233	0.700	0.233	1.000	**0.017**
	SMB	0.667	0.219	0.700	0.233	0.700	0.233
	HML	1.000	**0.017**	0.000	1.000	0.600	0.350
EM	Mkt	0.400	0.750	0.800	0.333	0.800	0.333
	SMB	0.400	0.750	-0.800	0.333	0.200	0.917
	HML	0.000	1.000	-0.800	0.333	0.600	0.417
FOF	Mkt	0.800	0.333	1.000	0.083	1.000	0.083
	SMB	0.800	0.333	0.800	0.333	0.200	0.917
	HML	-0.400	0.750	-0.600	0.417	-0.200	0.917
FWC	Mkt	0.333	0.667	-0.775	0.225	-0.632	0.368
	SMB	0.816	0.184	-0.258	0.742	0.400	0.750
	HML	0.316	0.684	0.400	0.750	0.400	0.750
RV	Mkt	0.900	0.083	0.000	1.000	0.900	0.083
	SMB	0.700	0.233	0.100	0.950	-0.700	0.233
	HML	0.667	0.219	0.100	0.950	0.200	0.783

Table 23: Spearman rank correlation using the 4 factor model

		Period 1 to 2		Period2 to3		Period 3 to 4	
		Correlation	P-value	Correlation	P-value	Correlation	P-value
ED	Mkt	0.500	1.000	0.500	1.000	1.000	0.333
	SMB	1.000	0.333	0.500	1.000	0.500	1.000
	HML	1.000	0.333	-0.500	1.000	0.500	1.000
	PY1RY	-0.866	0.333	-0.500	1.000	-0.500	1.000
EH	Mkt	0.700	0.233	1.000	0.017	0.700	0.233
	SMB	0.667	0.219	0.800	0.133	0.300	0.683
	HML	0.900	0.083	-0.100	0.950	0.600	0.350
	PY1RY	0.300	0.683	0.300	0.683	0.700	0.233
EM	Mkt	0.400	0.750	0.800	0.333	0.800	0.333
	SMB	0.632	0.368	-0.800	0.333	-0.400	0.750
	HML	0.000	1.000	-0.800	0.333	1.000	0.083
	PY1RY	0.000	1.000	0.200	0.917	0.400	0.750
FOF	Mkt	0.800	0.333	1.000	0.083	1.000	0.083
	SMB	0.949	0.051	-0.800	0.333	0.400	0.750

	HML	0.200	0.917	-0.600	0.417	-0.200	0.917
	PY1RY	0.316	0.684	1.000	0.083	-0.400	0.750
FWC	Mkt	0.258	0.742	-0.200	0.917	0.000	1.000
	SMB	-0.316	0.684	0.400	0.750	0.400	0.750
	HML	0.632	0.368	-0.400	0.750	0.200	0.917
	PY1RY	0.258	0.742	-0.400	0.750	0.200	0.917
RV	Mkt	0.000	1.000	0.400	0.517	0.900	0.083
	SMB	0.707	0.182	0.100	0.950	-0.700	0.233
	HML	0.103	0.870	-0.300	0.683	0.200	0.783
	PY1RY	0.600	0.350	0.100	0.950	0.700	0.233