Performance persistence of hedge fund: A result of different systematic risk exposure

Miss Prapakan Pimpasan

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

บทคัดย่อและแฟ้มข้อมูลฉบับเต็มของวิทยานิพนธ์ตั้งแต่ปีการศึกษา 2554 ที่ให้บริการในคลังปัญญาจุฬาฯ (CUIR)
เป็นแฟ้มข้อมูลของนิสิตเจ้าของวิทยานิพนธ์ ที่ส่งผ่านทางบัณฑิตวิทยาลัย

The abstract and full text of theses from the academic year 2011 in Chulalongkorn University Intellectual Repository (CUIR)
are the thesis authors' files submitted through the University Graduate School.

A Thesis Submitted in Partial Fulfillment of the Requirements
for the Degree of Master of Science Program in Finance
Department of Banking and Finance
Faculty of Commerce and Accountancy
Chulalongkorn University
Academic Year 2017
Copyright of Chulalongkorn University

ความสม่ำเสมอของผลการดำเนินงานของเฮดจ์ฟัน ผลลัพธ์ที่เกิดจากการเปิดรับความเสี่ยงเชิงระบบที่แตกต่างกัน

นางสาวประภาคาร พิมพาสาร

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิทยาศาสตรมหาบัณฑิต
สาขาวิชาการเงิน ภาควิชาการธนาคารและการเงิน
คณะพาณิชยศาสตร์และการบัญชี จุฬาลงกรณ์มหาวิทยาลัย
ปีการศึกษา 2560
ลิขสิทธิ์ของจุฬาลงกรณ์มหาวิทยาลัย

Thesis Title	Performance persistence of hedge fund: A result of different systematic risk exposure
By	Miss Prapakan Pimpasan
Field of Study	Finance
Thesis Advisor	Roongkiat Ratanabanchuen, Ph.D.

Accepted by the Faculty of Commerce and Accountancy, Chulalongkorn University in Partial Fulfillment of the Requirements for the Master's Degree

.....Dean of the Faculty of Commerce and Accountancy
(Associate Professor Pasu Decharin, Ph.D.)

THESIS COMMITTEE

.....Chairman
(Assistant Professor Anirut Pisedtasalasai, Ph.D.)

.....Thesis Advisor
(Roongkiat Ratanabanchuen, Ph.D.)

.....Examiner
(Assistant Professor Kanis Saengchote, Ph.D.)

.....External Examiner
(Kridsda Nimmanunta, Ph.D.)

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

ประภาคาร พิมพาสาร : ความสม่ำเสมอของผลการดำเนินงานของเฮดจ์ฟัน ผลลัพธ์ที่เกิดจากการเปิดรับความเสี่ยงเชิงระบบที่แตกต่างกัน (Performance persistence of hedge fund: A result of different systematic risk exposure) อ.ที่ปรึกษาวิทยานิพนธ์หลัก: ดร. รุ่งเกียรติ รัตนบานชื่น, 60 หน้า.

ความแตกต่างของการเปิดรับความเสี่ยงเชิงระบบส่งผลต่อผลการดำเนินงานและความสม่ำเสมอของผลการดำเนินงานของเฮดจ์ฟัน โดยเฮดจ์ฟันที่มีการเปิดรับความเสี่ยงเชิงระบบต่ำอย่างสม่ำเสมอมีผลการดำเนินที่ดีกว่าเฮดจ์ฟันที่มีการเปิดรับความเสี่ยงเชิงระบบรูปแบบอื่น ผลการศึกษานี้ขัดแย้งกับ Capital Asset Pricing Model (CAPM) อันเกิดจากความผิดปกติของสินทรัพย์ที่มีความเสี่ยงต่ำ (Low-volatility anomaly) อย่างไรก็ตามเฮดจ์ฟันที่มีการปรับการเปิดรับความเสี่ยงเชิงระบบที่เป็นไปตามสภาวะตลาด (market timing) โดยอาศัยความสามารถในการพยากรณ์ภาวะตลาดของผู้บริหาร ยังคงเป็นรูปแบบการบริหารความเสี่ยงเชิงระบบที่สำคัญโดยเฉพาะอย่างยิ่งในช่วงเวลาที่เกิดวิกฤตการณ์ทางการเงิน เมื่อพิจารณาความสม่ำเสมอของผลการดำเนินงานของเฮดจ์ฟันพบว่า รูปแบบของการเปิดรับความเสี่ยงเชิงระบบไม่มีผลต่อความสม่ำเสมอของผลการดำเนินงาน แต่เฮดจ์ฟันที่มีรูปแบบของการเปิดรับความเสี่ยงเชิงระบบต่ำและขณะเดียวกันมีการปรับการเปิดรับความเสี่ยงเชิงระบบที่เป็นไปตามสภาวะตลาดจะส่งผลให้เฮดจ์ฟันดังกล่าวมีความน่าจะเป็นสูงสุดในการชนะเฮดจ์ฟันอื่นๆที่มีแผนการลงทุนรูปแบบเดียวกันอย่างสม่ำเสมอ

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

ภาควิชา การธนาคารและการเงิน ลายมือชื่อนิสิต .....

สาขาวิชา การเงิน ลายมือชื่อ อ.ที่ปรึกษาหลัก .....

ปีการศึกษา 2560

5982991626 : MAJOR FINANCE
KEYWORDS: HEDGE FUND / PERFORMANCE / PERFORMANCE PERSISTENCE / MARKET TIMING / LOW-VOLATILITY ANOMALY

PRAPAKAN PIMPASAN: Performance persistence of hedge fund: A result of different systematic risk exposure. ADVISOR: ROONGKIAT RATANABANCHUEN, Ph.D., 60 pp.

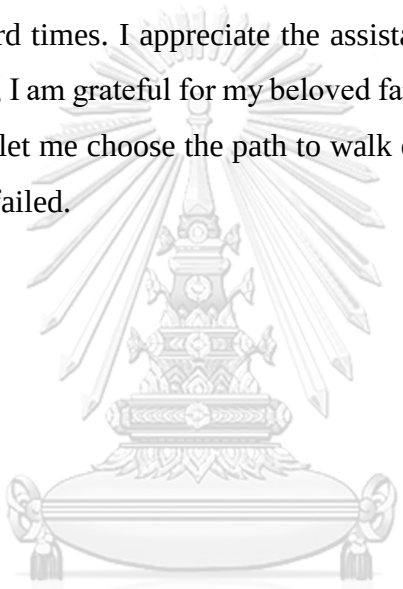
This paper has made the statement that the different systematic risk exposure style affects hedge fund performance and performance persistence. Employing maintain low systematic risk exposure (LSR) style leads superior performance for hedge fund during the full-time period. The outperformance of LSR style in this finding challenges the principle of standard Capital Asset Pricing Model (CAPM) and being supported by the “Low-volatility anomaly” in the equity market. However, the market timing, one of systematic risk exposure style, is still crucial and should be taken into consideration when managing portfolios systematic risk exposure, especially during the crisis period. Moreover, there is the evidence in support of performance persistence for all systematic risk exposure style. However, in the crisis period, the ability to time the market along with the ability to maintain low systematic risk exposure are proved to be necessary skills of fund managers to have the highest probability of repeating winner performance.

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

Department: Banking and Finance Student's Signature .....
Field of Study: Finance Advisor's Signature .....
Academic Year: 2017

ACKNOWLEDGEMENTS

This thesis would not have been possible without the guidance from Roongkiat Ratanabanchuen, Ph.D., my advisor, and all members of the committee who have spared their valuable time to help me improve my work. I wish to also express my deepest thanks to Mr.Thanat Chongcharoensiri, Ms.Siriporn Rangsisophin, Mr.Passakorn Triwatcharikorn, and Katenipa Darongsuwan, all of whom have provided me with guidance, advance, and the most important of all - support during my hard times. I appreciate the assistance I have received from all faculty's staffs. Lastly, I am grateful for my beloved family who has always believed in me and has always let me choose the path to walk on, and for always being here even along the path I failed.



จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

CONTENTS

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Page

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Chapter 1
Introduction

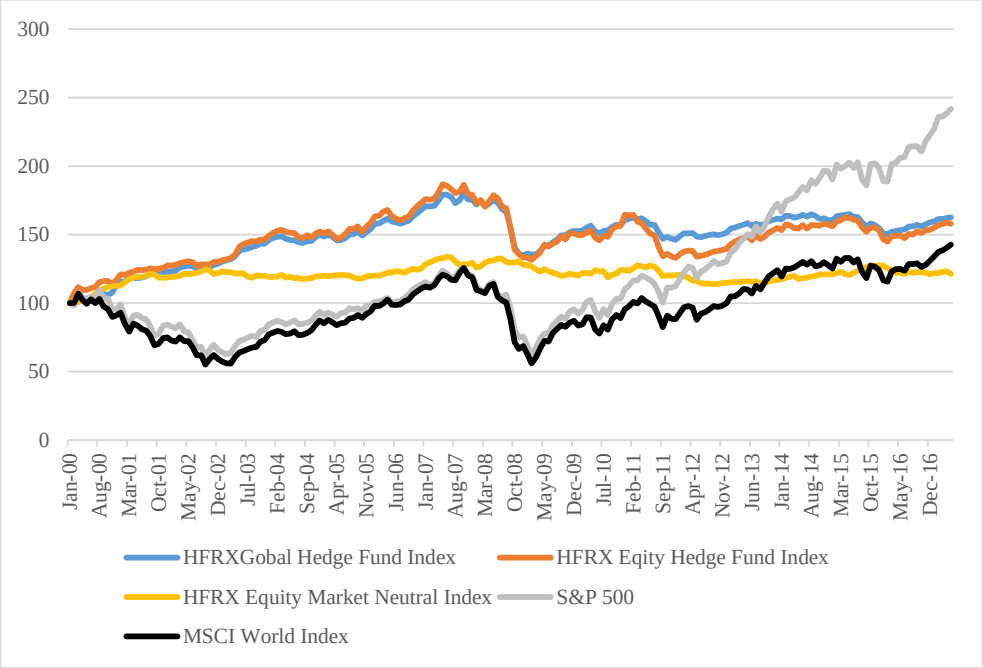
1.1 Introduction

A common understanding about hedge fund is that they are market-neutral. This belief, however, may have been an overstatement after all. Studies have shown, if not proven, that hedge funds are in fact exposed to market with the level of exposure depending on strategies employed. Hedge funds studied in these literatures can be grouped based on their systematic risk exposure into 2 basic categories - Directional and Non-directional hedge funds. Directional hedge funds are those which managers maintain exposure to the market without placing much emphasis on hedging risk. As a result, the performance of these funds may fluctuate year by year. Hedge fund strategies which belong in the Directional group include Emerging Markets, Global Macro, Managed Futures, Event Driven, and Long/Short Equity. Non-directional hedge funds, on the other hand, are those which managers employ strategies which are less-sensitive to market movement. In other words, these strategies are designed with the purpose of delivering positive returns in any market conditions. A technique mainly used for managing Non-directional hedge funds is hedging strategy that provides low volatile performance. Hedge fund strategies in this group include Equity Market Neutral, Fixed Income Arbitrage, and Convertible Arbitrage.

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Supporting evidence for the argument that hedge funds are not absolutely market-neutral can be seen from figure 1.1 which shows the cumulative returns from 5 major indices: Global hedge fund, Equity hedge fund, Equity Market Neutral Hedge funds, Standard & Poor's (S&P) 500, and MSCI World, compounded monthly from 2000 to 2017. During the sub-prime crisis in 2008, it was clear that performance of all hedge funds was affected by the negative market forces at the time, resulting in a sharp decline of the cumulative return for all indices, except for the Equity Market Neutral Hedge funds Index, which seemed to have less negative relative to other indices.

Figure 1.1: shows the cumulative monthly return over time from January 2000 to December 2016 from 5 major indices including Global Hedge Fund, Equity Market Neutral, Equity Hedge Fund, Standard & Poor's (S&P) 500, and MSCI World Index.



Source: Bloomberg.

This phenomena is confirmed by a mutual claim of previous studies positing that hedge funds may, in fact, be exposed to systematic risk from various market factors. Patton (2009) developed several different concepts regarding market neutrality. Using statistical tests, he found that approximately one-quarter of Market-Neutral hedge funds were shown to be exposed to market risk at statistical significance level. Bali, Brown, & Caglayan (2014) also argued that the cross-sectional differences in hedge fund returns were determined by economic uncertainty from macroeconomic risks.

With evidence provided, to reject the statement that systematic risk is one important factor determining hedge fund performance would be a mistake. However, the term "systematic risk" is not only limited to macro risks affecting the entire market such as interest rate risk, inflation risk, unemployment, economic growth rate. The other common hedge fund risk factors, which are also treated as systematic risks and have been intensively studied in many past research papers (and will therefore employed in this research) have been proven significant to overall hedge fund performance even for

Non-directional hedge fund. According to Bali, Brown, and Caglayan (2012) who conducted the test on well-known common factors including market returns, size, growth, momentum, bond market, credit spread and trend-following factors, all of which are systematic risk factors in the common factor model. They found that systematic risk extracted from the factor model was proven to be a highly significant factor explaining the dispersion of cross-sectional returns. The finding is also consistent with Non-directional hedge fund samples. However, residual risks and tail risks measured seemingly had little explanatory power. This finding was later confirmed by the study of Hwang et al. (2017).

Given the importance of systematic risk in determining hedge fund performance, this means that hedge fund manager should take the management of systematic risk exposure more seriously. Nonetheless, since there are various styles of systematic risk exposure, defined here as "the pattern of portfolio's systematic risk exposure over different market conditions", for example, maintaining level of systematic risk exposure or considering the market timing. Given the fact that each systematic risk exposure style can differ greatly from one to another, one cannot conclude that one style outperforms others unless proved.

One of the famous systematic risk management styles is Market Timing concept, which was first introduced by Treynor and Mazuy in 1966 and re-confirmed by Henriksson and Merton in 1981. Market Timing is an act of adjusting the level of portfolio's systematic risk exposure or beta based on economic trend, corporate information, and market factors in the way that are beneficial to investors. Despite the small difference between models, both studies argued that managers of funds with superior market timing skill - the market timers - will utilize information in hand and to predict the future more accurately than non-market timers. Market timers will increase the portfolio's beta when good market performance can be expected, and vice versa. However, several studies on market timing skill of managers of mutual funds and pension funds found little empirical for this argument.

Yet, the validity of the above marketing timing concept has never been conclusive in the view of hedge fund performance. In a study of Bali, Brown, and Caglayan (2012), they considered only the level of systematic risk at a time while totally disregarded the market timing concept. For hedge funds which employ Directional and

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Semi-Directional strategies, the highest systematic risk quintile hedge funds outperformed the lowest quintile when using raw return and alpha as performance measurements. This findings remained robust when considering the two crises period between 1997-1998 (Dot-com crisis) and 2007-2010 (Sub-prime crisis). It can therefore be concluded that systematic risk could be a powerful determinant of the cross-sectional differences in hedge fund returns. Importantly, it can also be implied from the finding that that the market timing may not be a necessary condition for better performance because maintaining high systematic risk exposure had proved to be outperformed for all market conditions. If this is truly the case, investors who want to maximize returns should invest in high systematic risk hedge funds for higher returns.

However, maintaining high systematic risk may not always be an appropriate strategy because high systematic risk exposure in a strong market condition may lead to higher return. In a weak market condition, however, it is likely to lead to worse performance as a result of increased exposure of portfolio to negative effects from market. This argument is confirmed by the study of Namvar et al. (2016). Using hedge fund data from January 1996 to December 2010, they found that skilled maanger had shifted their effort across business cycle. In weak market conditions, skilled manager focused on minimizing systemtic risk exposure via the reallocation across asset class. In strong market condition, however, skilled manager shifted their attention to asset selection. Hedge funds with maintaining low systematic risk exposure could outperform other hedge funds if they had superior asset selection ability.

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Both studies beg into question for the validity of the findings, also, whether their findings would have turned out differently if they had not disregarded market timing concept.

As systematic risk exposure level affects hedge fund performance, it means that skilled managers should take into account market timing when managing systematic risk of a portfolio. Yet, market timing is not the strategy employed by every hedge fund manager, and some do show superior performance, as mentioned earlier. Hence, the first objective of this research is to explore the extent to which the systematic risk exposure style - referred to as the pattern of portfolio's systematic risk exposure over different market conditions - promotes superior performance. Tests are to be conducted

on the basis of the same sample and time period in order to show the explicit evidence of the comparison among different systematic exposure style.

Study of superior performance of different systematic risk exposure would not give any benefit to investors if they fail to know which fund to invest in advance before making an investment decision. An important piece of information in investor's hand is historical information of hedge fund performance. Hence, it is important to know whether past performance of a fund gives any clues about its future performance. In other words, does the fund performance persist over time?

"Performance persistence" refers to the ability of fund managers to continue to generate returns above the average market returns provided that the same hedge fund strategy is employed, thus being able to outperform other hedge funds consistently overtime. Consistent outperformance or performance persistence of hedge funds does not happen by luck, instead, but by skills of fund managers. Therefore, it can be said that performance persistence is one of the criteria that should be used when judging if a hedge fund manager is a skilled one.

Performance persistence is important for hedge fund investors when making investment decision. Investing in hedge funds is normally restricted to lock up period in which investors cannot withdraw their investment from the fund for a period of time. Investors have to spend a lot of time and energy going through a fund's investment policies and bet against risks hoping that the funds they choose to invest would perform well. In many cases, however, they turned out unexpectedly. However, if there is any correlation between past performance (either good or bad) and future performance, in other words, if the performance persistence exists, investors can have some useful information in hand just by looking at past performance of the hedge funds they are interested in, instead of spending such long hours seeking appropriate funds to invest.

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Early studies focused on investigating whether hedge funds showed any performance persistence. Most found some evidence indicating performance persistence, but only in short-term (i.e. monthly and quarterly)(Agarwal, Naik, Agarwal, & Naik, 2000). When they looked at performance of the samples on a yearly basis, the funds' performance persistence disappeared. Later studies tried to gain insight into specific factors affecting performance persistence. In other words, they aimed at answering the question "why persistence occurs?" From these studies, persistence in

performance could result from a number of sources. Major areas of focus were hedge fund strategies, economic cycle and fund characteristics. Abdou & Nasereddin (2011) studied performance persistence according to hedge fund strategies in different economic periods. After employing several methodologies, they found that none of the samples showed long-term performance persistence. Tudor and Cao (2012) examined the ability of hedge funds and funds of hedge fund to generate consistent absolute return over time. They found that hedge funds with Options Arbitrage, Fixed Income, Global Macro, Emerging Markets strategies, and Event Driven, had significantly better chance of producing absolute returns. However, although many papers direct their attention on this issues, results have not been conclusive.

Despite the fact that rich academic literatures have looked into factors affecting hedge fund performance persistence, hardly any has addressed the effect of "systematic risk exposure". It has been overlooked possibly because flexibility of hedge fund investment - the characteristic which makes it possible for hedge fund to time the market. Theoretically, timing the market provides a significant risk reduction when the market is in its downward state, and leads to higher returns in relation to market return when the market is in its upward state. This argument is supported by the study of Fung & Hsieh (1997) and others. They noted that hedge funds differ from traditional mutual funds because they are loosely regulated by the SEC. This allows for extensive use dynamic trading strategies and flexible investment tools; for example, short selling, leverage and various types of arbitrage activities. Thus, performance of hedge funds will be option-liked, suggesting the possible existence of timing ability.

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

However, if it is the case, we would see hedge fund returns not being affected by market downward trend, or returns which are relatively higher than the market return when the market is going upward. However, as mentioned earlier, not every hedge funds use market timing strategy, but those funds turn out to have superior performance. Hence, this research objective is not only conduct the test to show the explicit evidence of which the systematic risk exposure style promotes superior performance, but also conduct the test to show whether systematic risk exposure style is one of significant factor determine hedge fund performance persistence. The second objective of this research, therefore, is to answer whether different systematic risk exposure affects the performance persistence.

1.2 Objectives

According several studies, it has been confirmed that a large majority of hedge funds carry a significant amount of systematic risk. Therefore, the risk exposures of hedge funds is an important area of research that requires attention and much more to be done. However, given different management styles, each of which expose funds to systematic risk at different degree thus resulting in different performance, one needs a better understanding of this issue while making investment and management decision involving hedge funds.

The main objective of this paper is to explore the extent which systematic risk exposure style can lead to the superior performance and whether such performance persist. This research compares performance and performance persistence of different systematic risk exposure styles based on its exposure characteristics.

Systematic risk exposure styles are classified on 3 bases, named in this paper as Market-timing base, Maintaining Systematic Risk Exposure-based, and Combined-based, and divided into 8 sub-groups. Styles which belong to the Market Timing – based category include those Market Timing strategy (MT) and Opposite to Market Timing strategy (OMT). Styles which belong to the Maintaining Systematic Risk Exposure – based include Maintain High Systematic Risk (HSR) and Maintain Low Systematic Risk (LSR). However, there are some funds that fall into both, these funds are grouped into one of the following styles under Combined-based: Market timing and High systematic risk (MTHSR), Market timing and Low systematic risk (MTLSR), and Opposite to Market timing and High systematic risk (OMTHSR), and Opposite to Market timing and Low systematic risk (OMTLSR). Funds that cannot be classified under this paper's criteria have been excluded. The style descriptive and classification method will be explained in more detail in the methodology part.

The objective of this paper are as follows;

1. Examine whether systematic risk is an important factor explaining hedge fund performance. The aim of setting this objective is to reconfirm the importance of studying of systematic risk exposure onward.
2. Examine which systematic risk exposure style(s) among the 8 styles show(s) superior performance.

3. Examine which systematic risk exposure style(s) among the 8 styles promote(s) performance persistence.

1.3 Hypothesis

In order to examine which the systematic risk exposure style shows superior performance and performance persistence, the importance of systematic risk to hedge fund performance should be confirmed first. Therefore, the first hypothesis in this paper is as follows;

Hypothesis I: *Systematic risk has positive significant effect in explaining hedge fund return.*

The first hypothesis is re-confirmed by previous studies on the explanatory power of systematic risk to hedge fund returns, and the fact that hedge fund performance is affected by the common market factors. Thus, different systematic risk exposure level overtime should be taken into consideration when making an investment or management decision.

Hypothesis II: *Market timing style (MT) - a group of hedge funds, managers of which employ a market timing strategy shows superior performance to the other 7 styles when measured by risk-adjusted return.*

Behind this hypothesis is the rationale that managers managing funds using MT style have superior skills of forward looking to future market movement and manage portfolio's systematic risk exposure level efficiently to their predication. If the systematic risk is indeed an important factor for hedge fund performance as stated in hypothesis I, funds with market timing skill will outperform other funds of which managers do not employ or inefficiently employ market timing strategy.

Hypothesis III: *Market timing style (MT) promotes superior performance persistence to the other systematic risk management styles.*

The rationale behind this hypothesis is that, with the ability of forward looking and predicting the market movement, managers employing MT style should manage their portfolio's systematic risk exposure more efficiently than managers employing the other styles which are directly affected by market movement due to their un-adjusted portfolios' systematic risk exposure. Fund managers who can predict and adjust their

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

portfoli's beta efficiently and consistently over time should, therefore, show the evidence of superior performance persistence to the others.

1.4 Contribution

This paper contributes to the performance persistence literature in several respects. First, to the best of my knowledge, there have been few research papers that have looked into relationship between systematic risk exposure styles and hedge fund's performance and performance persistence. By taking into account of different systematic risk exposure styles when considering performance persistence, it is hoped that this research gap has been filled to some extent. Since systematic risk is an important factor determining hedge fund performance, the management of systematic risk exposure will therefore important to the consistency of the performance persistence of hedge fund.

Second, the mentioned few studies that looked into systematic risk exposure styles totally disregarded the concept of market timing ability. Most, if not all, considered only hedge funds with maintained high or low systematic risk exposure. This paper fills this gap by that take into account market timing ability of hedge funds as one of the systematic risk exposure style, and compare every style on the same bases of sample and time period.

The systematic risk management styles focused in this paper are classified based on 3 categories into 8 groups;

1. **Market timing-based,** including funds that show evidence of employing 1) Market Timing strategy (MT) and 2) Opposite to Market Timing strategy (OMT)
2. **Maintaining Systematic risk exposure-based,** including funds that employ 3) High Systematic Risk Exposure strategy (HSR) and 4) Low Systematic Exposure Risk (LSR).
3. **Combined-based**, includes funds that fall into both basis, as mention earlier. Funds in this category are further divided into 5) Market Timing with Maintaining High Systematic Risk Exposure strategy (MTHSR), or 6) Maintaining Low Systematic Risk Exposure strategy (MTLSR). On the other hand, some hedge funds employ 7) Opposite to Market Timing with

Maintaining High Systematic Risk Exposure strategy (OMTHSR), or 8) Maintaining Low Systematic Risk Exposure strategy (OMTLSR).

This research contributes the explicit empirical evidence of the comparison among different portfolio's systematic risk exposure on hedge fund performance and performance persistence through the classification of systematic risk management into 8 styles. It provides the benefit for both hedge fund managers and investors. This is because if MT style can be proven to outperform the other styles as hypothesized, managers should employ market timing as their strategy when managing their portfolio's systematic risk exposure. For investors, on the other hand, this study will show empirical evidence whether past performance is a useful tool on which to base their investment decision. If the answer is yes, this paper then takes them further to answering the question "which style of systematic risk management provide persistence of outperforming performance?"

The rest of this paper will be structured as follows: chapter 2 literature review, chapter 3 methodology, and chapter 4 empirical result, and chapter 5 conclusion.

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Chapter 2
Literature review

2.1 Performance persistence

The study of performance persistence was first introduced by Agarwal, Naik, Agarwal, & Naik (2000), they introduced a common method of traditional two-period performance persistence using contingency table-based method which is non parametric-based method. They found the evidence of short term persistence. When considering longer timeframe, the persistence disappeared.

Later studies moved further to investigate what factors affect the persistence in performance by using more complicated mythology. Abdou & Nasereddin, (2011) examined the performance persistence of some strategies for different economic periods using several methodologies. They find hedge fund returns performance related to different strategies was not persistent over the long-term. Indeed, only the returns of emerging market strategy were persistent during the recession.

Tudor & Cao (2012) examined the ability of hedge funds and funds of hedge funds to generate a consistent absolute return over time, using Bayesian multinomial probit and regular multinomial logit regressions. They found that hedge funds which use Options Arbitrage, Fixed Income, Global Macro, Emerging Markets strategies, or are Event Driven, have a significantly better chance of producing absolute returns, but there was no evidence of performance persistence in absolute return when the hedge funds strategies and characteristics are taken into account.

Sun, Wang, & Zheng (2014) proposed conditional performance measures using downside returns and upside return by comparing the overall hedge fund market return with its historical median to determine the market state whether it is in up or down state. They findings suggested that the downside return measure is useful indicator of managerial talents for investors to select the funds but upside return is not.

2.2 Hedge fund and systematic risk

The most commonly used for neutrality is based on the correlation of portfolio's return and the market return, or beta. A fund may be said to be market neutral if it

generates return that are uncorrelated with the return on some market index, or a collection of market risk factors. Many hedge fund literatures showed the evidence contradict with the common understanding of hedge fund- market neutral investment that able to generate all the time positive return in any market conditions, according to advantage of flexibility in investment by using long and short position in related securities, so it can be hedge against the market exposure. However, due to dynamic nature of hedge fund's trading strategies and investment flexibility, cause hedge fund returns to have nonlinear relation with market returns. Thus, the simple linear correlation and betas cannot give the appropriate information about the neutrality or diversification benefit offered by hedge funds.

Supporting the in-market neutral of hedge funds, work by Asness, Krail, & Liew (2001), argued that at the individual level, more than a quarter of long-short hedge funds exhibit statistically significant and economically large exposure to the market. Also, Patton (2009) developed a number of different concepts of market neutrality. Using statistical tests, he found that approximately one-quarter of market-neutral hedge funds exhibit statistical significant exposure to market risk. Confirmed by the study of Bali, Brown, & Caglayan (2011) that hedge fund returns are exposed to market factors.

Bali et al. (2012) examined the predictive power of systematic risk to hedge fund performance by decomposing total risk to systematic risk and unsystematic risk. They found that systematic risk has significant predictive power to hedge fund performance compared with unsystematic risk. Also, funds with high systematic risk exposure generated 6% higher annual raw return on average than that of funds in that low systematic risk exposure. The outperformance of the highest systematic risk quintile over the lowest systematic risk quintile was still robust when using alpha as a performance measurement.

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

2.3 Hedge fund timing ability

Market timing can be view as a kind of tactical asset allocation strategy- increasing (decreasing) market exposure prior to a market rise (fall), which result in a convex relation between funds returns and market returns. Decomposing market timing skill from selectivity skill, it is empirically implemented by adding proxies for market timing strategy. This concept was first introduced by Treynor and Mazuy (1966)

(hereafter TM), they proposed the use the square of the market excess return as a proxy for market timing ability. Supporting TM model (hereafter HM), proposed an alternative method by using an option payout on the market return to capture market timing ability. Several of literature discussing these concept in mutual fund sample. Most of the empirical studies documented little evidence of market timing ability in mutual funds and some even find negative timing ability (concavity) that is writing option contract for free or systematically adjusting market exposure in a perverse way.

Market timing in the view of hedge fund samples were yet conclusive. Several studies found no evidence of market timing ability of hedge funds. H. G. Fung, Xu, & Yau (2002) examined the performance of global equity hedge fund with reference to their target geographic markets in the year period 1994-2000. They found that global hedge funds manager do not show the positive market timing ability. French and Ko (2007) investigated hedge fund portfolio performance whether it exhibited security selection and market timing skill. After adjusting their betas for liquidity, and accounting for nonlinearity, they found no statistically significant evidence of market timing ability on the sample of 157 long-short equity hedge funds in the year period 1996-2005. Supported by Lo (2008) they found that most of the excess return generated by hedge funds during 1994-2008 was attributable to security selection and hedge funds on average could not time the market during this period.

In contrast, however, there were some studies found the timing ability of hedge funds. W. Fung & Hsieh (1997) showed that dynamic strategies employed by hedge funds can result in option-like returns, suggesting the possible existence of timing ability. Considered of complicated investment style of hedge funds, W. Fung & Hsieh (2002) also constructed a look-back straddle factor to model nonlinear returns of trend-following hedge funds. They proposed 3-trend following factors including bond, currency and commodity. Chen (2007) examined the ability of hedge funds in various investment categories to time their focus markets. He found that only a few fund categories (i.e. Global macro and Managed futures) can time the bond and currency markets, but timing ability is sparse in the equity market. Chen & Liang (2007) examined whether self-described market timing hedge funds have ability to time the U.S. equity market. Proposed new measure for timing and volatility jointly that related to fund returns to the squared Sharpe Ratio of the market portfolio, they found the

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

evidence of timing ability for both aggregate and fund levels. In addition, timing ability appears relatively strong in bear and volatile market conditions. Kacperczyk, Nieuwerburgh, & Veldkamp (2014) proposed a new definition of skill as general cognitive ability to pick stocks or time the market. They found the evidence for stock picking in boom and market timing in recession. Moreover, the same fund managers that picks well in expansion also time the market well in recession.

The conclusion of hedge fund timing ability, several paper found timing ability of hedge fund which is opposed to the finding of mutual fund sample that mostly found the negative timing ability. The reason behind this, Ferson & Schadt (1996) found that a mutual fund typically experience money inflows during a period of high expected market return based on public information. Such fund inflows reduce the market fund's market exposure because fund has to hold more cash before eventually allocating the new money to the market. Consequently, there arises negative relation between the expected market return and the fund's market exposure. Hedge funds, however, may have different money flow patterns from mutual funds, because they can effectively manage money flow with greater discretion. For example, hedge funds may be closed to new capital in order to discourage undesired fund inflows, and imposed redemption restriction (lock-up provision) to restrict money outflow. Therefore, these features of hedge fund flow could possibly account for the low explanatory power of public information.

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Chapter 3
Methodology

3.1 Sample

This research focuses on monthly return of Global Hedge Funds based on MorningStar database. Monthly returns from January 2000 to May 2017 were selected given the fact that, during the period, both bull and bear markets existed. The separation of market states, according to Chen & Liang (2007), the crisis period was from July 2007 to December 2009.

Hedge fund databases are normally subject to potential biases which need to be minimized in order to improve accuracy of the findings. This study focuses on elimination of two major biases, namely survivorship bias and back-filled bias.

Survivorship bias; prevalence of survivorship bias usually leads to inaccurate and over-optimistic findings due to the fact that "failed" samples are overlooked and excluded from the sample, while "successful" samples receive excessive attention. To eliminate this type of bias, this paper has therefore included both live and dead funds in the sample. Back-filled bias, on the other hand, can be defined as an attempt to distort indices of hedge funds by retroactively reporting specific relatively well-performed hedge funds to be included in the database. To minimize the effect of this bias, different authors have chosen to remove various period of fund's observations ranging from 12 months to as many as 36 months depending on the nature and size of data in hand. In this paper, however, a 12-month removal has been chosen because of two major reasons, the first being that 12 and 24 are the two most adopted number of dropped observations according to W. Fung & Hsieh (2001), 12-months drop-off, however, was reported the frequently backfill period. The number of 12 was, however, chosen over 24 due to limited observations available in this study. To remove more than 12 months of observations, the researcher will require more samples which spanned over a longer period of time.

Adjusting the two biases above, the total number of funds left are 3,055 which can be sub-grouped into various strategies.

However, according to the study of Brown et al. (1998) different style factor among hedge funds can lead the reversal in the persistence phenomenon because of the differences in the level of systematic risk across managers. This is especially relevant in the case of hedge funds, which are exposed to significantly different levels of risk depending on whether they follow directional or non-directional strategies. Therefore, only hedge funds using the Directional Equity strategy, according to categorization by MorningStar are used as a sample in this paper.

Funds in Directional Equity are primary invest in stocks and usually have either net long or net short market exposure to equities.[1] This category has been chosen because the focus of this study is on systematic risk management of hedge funds which seek to invest in equity market rather than other alternative investments such as bonds and currency. Funds that follow these strategies are more likely to engage in managing portfolio's risk exposure along with the volatility of equity market.

The Sub-strategies of Directional Equity Hedge Fund include Asia/Pacific Long/Short Equity, Bear-Market Equities, China Long/Short Equity, Emerging-Markets Long/Short Equity, Europe Long/Short Equity, Global Long/Short Equity, U.S. Long/Short Equity, U.S. Long/Short Small-Cap Equity, Emerging Markets Long-Only Equity, and Long-Only Equity, all of which will be used to determine independent variables, that is, returns from different equity markets, and explore the extent to which fund can efficiently manage their portfolio's risk exposure.

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

After scoping down the sample, number of funds by year which belong to Directional Equity Hedge Fund category are as shown in Table 3.1. The descriptive statistics of directional equity hedge fund monthly return are shown in Table 3.2.

[1] Directional Equity Hedge Fund is unlike the arbitrage and equity market-neutral hedge funds which tend to balance out long and short equity-market exposure, according to the categorization by Morningstar.

Table 3.1: Number of funds by year after categorization into Directional Equity Hedge Fund and adjustment for data biases

Year	Total obs.	Directional Equity Hedge fund
2000	423	195
2001	491	232
2002	586	279
2003	709	331
2004	845	394
2005	998	472
2006	1136	539
2007	1317	641
2008	1499	721
2009	1712	840
2010	1978	1,036
2011	2248	1,232
2012	2449	1,337
2013	2751	1,380
2014	3020	1,396
2015	3054	1,402
2016	3054	1,435
2017	3054	1,441

Source: MorningStar, 2017

Table 3.2: Descriptive statistics of Directional Equity Hedge fund monthly return

	No. of monthly return data	Mean	S.D.	Min	Max
Overall	205,134	0.57%	4.44%	-56.89%	70.61%
Directional equity	102,155	0.68%	5.16%	-56.89%	70.32%

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

3.2 Factors and market returns

There were several factors and market return used in this paper. Table 3.3 summarizes the factors and market returns employed for the Nine - factor model and Market timing model, which will be explained in methodology part.

Factors are including; Worldindex_rf is the excess market return of the market portfolio on month t which use MSCI World Index[2] as a proxy of market portfolio.

[2] MSCI world index (MXWO): provided by Bloomberg is a free float weighted equity index. It was developed with a base value of 100 as of December 31, 1969. MXWO includes developed world markets, and does not include emerging markets.

Global_SMB is the factor-mimicking portfolio for size. $\text{Global}_{\text{HML}}$ is the factor-mimicking portfolio for book-to-market equity. Global_MOM_t is the factor-mimicking portfolio for momentum effect. The 3-Global factors are provided by Kenneth R. French Data Library[3]. Treasury_t is The bond market factor which is the monthly change in the 10-year treasury constant maturity yield. CreditSpread_t is the credit spread factor which is the monthly change in the Moody's Baa yield less 10-year constant maturity treasury yield. $\text{PTFSBD}_t, \text{PTFSFX}_t, \text{PTFSCOM}_t$ are bond, currency, and commodity trend-following factor which is the return of lookback straddle factor capturing the non-linear returns of trend-following hedge funds. These 3 trends-following factors were introduced and provided by Fung and Hsieh (2001). The global index used as a proxy of world equity market returns is MSCI (All)[4] World Index.

Table 3.3 Descriptive statistics of the factors and market returns

Variable	Mean	S.D.	Min	Max
WorldIndexrf	0.004688	0.043144	-0.21068	0.107038
Global_SMB	0.000609	0.016113	-0.0981	0.1037
Global_HML	0.001875	0.019139	-0.0954	0.1164
Global_MOM	0.003825	0.035702	-0.2426	0.1781
Treasury	-0.00013	0.002474	-0.0108	0.0095
CreditSpread	-0.0292	0.010797	-0.065	-0.015
PTFSBD	-0.02303	0.150415	-0.2663	0.505
PTFSFX	-0.01381	0.192621	-0.3	0.6922
PTFSCOM	-0.00133	0.153094	-0.2465	0.4287

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

3.3 Methodolody

This study took deductive approach to the question "Is performance persistence of hedge fund a result of different systematic risk exposure? The processes were divided

[3] Kenneth R. French Data Library: http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

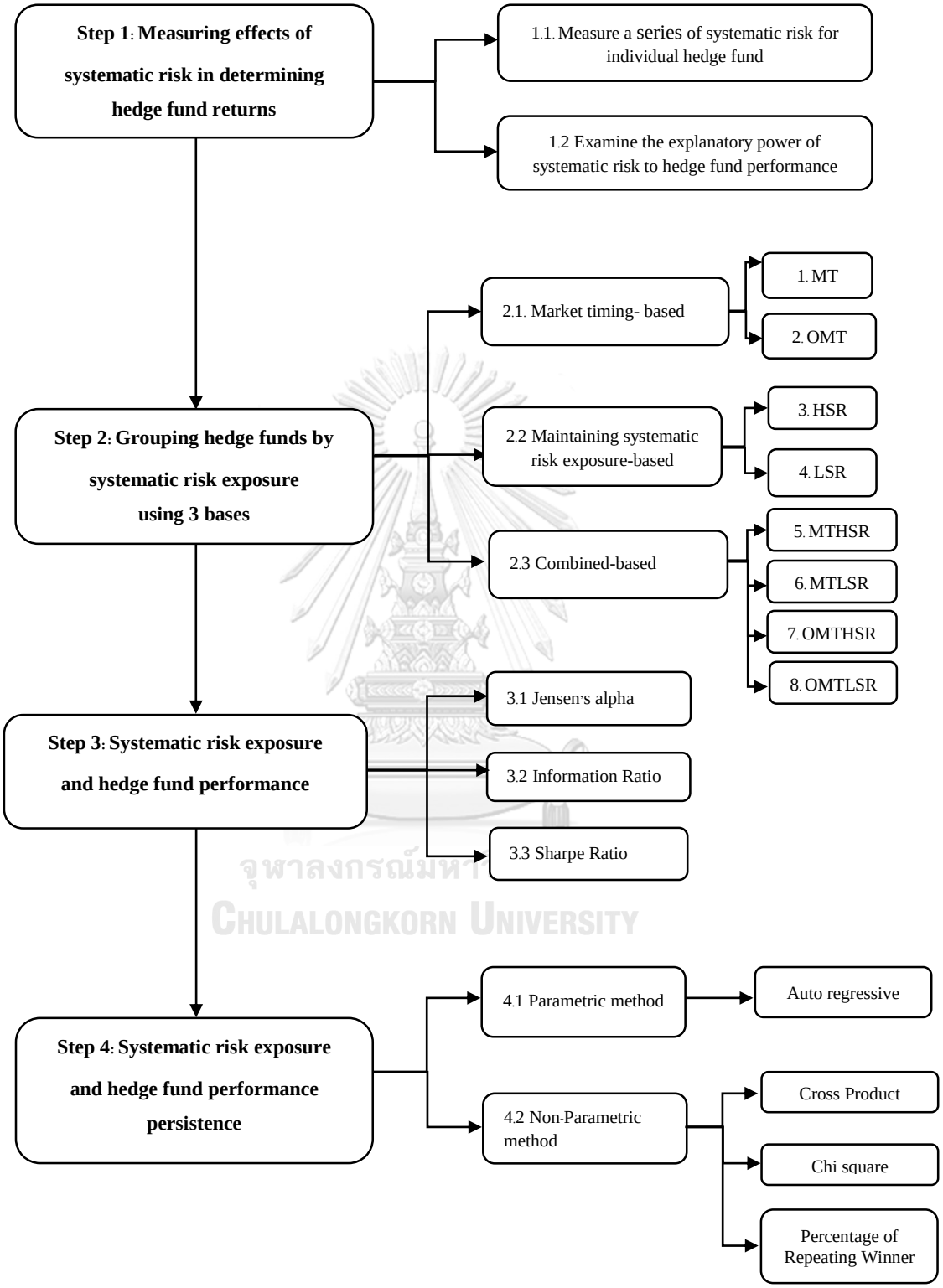
[4] MXWD: MSCI world index: is a free float weighted equity index. It was developed with a base value of 100 as of December 31, 1969. MXWO includes both developed world markets and emerging markets.

into 4 steps, each of which had to be conducted to obtain results which were then used as variable in the next equation.

As it was hypothesized in this paper that systematic risk was a determining factor for explaining hedge fund performance, it is first necessary to prove if this statement is valid. The researcher, therefore, began with measuring the extent to which systematic risk affects hedge fund returns. Having justified the hypothesis, the second step would then be taken by grouping hedge funds based on systematic risk exposure styles according to the author's own classification which shall be outlined later in this section. Each exposure style was then used for hedge fund performance and performance persistence testing in step 3 and 4, respectively. The methodology diagram is shown in Figure 4.1. The aim, in short, was to see the extent to which each exposure style improves or undermines hedge fund performance, and which style would lead to the best performance persistence.

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Figure 3.1: The methodology diagram



จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

1) Measuring effects of systematic risk in determining hedge fund returns

According to Modern Portfolio theory introduced by Markowitz (1952), assuming the excess return of each fund i is driven by the set of common factors and fund specific factor, the total risk of the fund could be classified into systematic and unsystematic risk. While systematic risk represents a part of variance of fund's return that is attributable to overall volatility of the common factor, unsystematic risk, which is related to fund's specific volatility, represents the other part of variance in fund's return that is *not* attributable to overall volatility of the common factor. Both types of risks will be tested whether they are significant in determining hedge fund return.

1.1) Measuring the individual fund's systematic risk

This paper implements the factor model adapted from that of Fama and French (1993), Cahart (1997) and Fung and Hsieh (2001, 2004). One major benefit of this model is that it takes into consideration complexity of hedge fund investment which causes non-linear relationship with market returns that needed to be captured by using more complex variable.

However, in the original Fama and French (1993) paper, the model was including equity market factor (the S&P500 total return), size spread factor (the return of the Wilshire Small Cap 1750-the return of the Wilshire Large Cap 750). Nonetheless, the sample in the paper was from the US markets. This means that when it comes to understanding global hedge funds in other investment arenas other than the US, findings of these studies had limitations in terms of generalizability. To fill this research gap, this paper will substitute S&P500, which is a US stock market, with MSCI World Index[5] to improve the model fit for explaining global hedge fund returns. Size factor (Small Minus Big-SMB), Value-growth factor (High Minus Low-HML), and momentum factor (Winners minus Losers-MOM) factors were also substituted with Global SMB, Global HML, and Global MOM provided by Kenneth R. French Data Library[6]. Any study on global hedge fund which fails to include global equity and global value factors

[5] MSCI world index (MXWO): provided by Bloomberg is a free float weighted equity index. It was developed with a base value of 100 as of December 31, 1969. MXWO includes developed world markets, and does not include emerging markets.

[6] Kenneth R. French Data Library: http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

would certainly fail to produce accurate findings, not to mention their representativeness.

Other factors used in this model, following David A. Hsieh[7], include bond market factor (the quarterly change in the 10-year constant maturity treasury yield), credit spread factor (the credit spread factor which is the monthly change in the Moody's Baa yield less 10-year constant maturity treasury yield), and 3 trend-following factors for bond, currency, and commodities markets. The Nine-factor model is as following (Eq.1):

$$r_{i,t} - r_{f,t} = \alpha_i + \sum_{k=1}^{9} \beta_k \cdot f_{k,t} + \varepsilon_{i,t} \quad \text{(Eq.1)}$$

Where $r_{I,t} - r_{f,t}$is the excess return of fund i in month t. $f_{k,t}$ is the common risk factor in month t. the set of common risk factors $f_{k,t}$ in this paper are including $f_{k,t} = \{ \text{WorldIndex} - rf_t, \text{Global}_{SMB_t}, \text{Global}_{HML_t}, \text{Global}_{MOM_t}, \text{Treasury}_t, \text{CreditSpread}_t, \text{PTFSBD}_t, \text{PTFSFX}_t, \text{PTFSCOM}_t \}$, where $\text{WorldIndex} - rf_t$ is the excess market return of the market portfolio on month t which use MSCI World Index as a proxy of market portfolio. Global_SMB is the factor-mimicking portfolio for size. Global_{HML} is the factor-mimicking portfolio for book-to-market equity. Global_MOM_t is the factor-mimicking portfolio for momentum effect. Treasury_t is The bond market factor which is the monthly change in the 10-year treasury constant maturity yield. CreditSpread_t is the credit spread factor which is the monthly change in the Moody's Baa yield less 10-year constant maturity treasury yield. $\text{PTFSBD}_t, \text{PTFSFX}_t, \text{PTFSCOM}_t$ are bond, currency, and commodity trend-following factor which is the return of lookback straddle factor capturing the non-linear returns of trend-following hedge funds. These 3 trends-following factors were introduced by Fung and Hsieh (2001).

Note that the reason behind using the 9-factor model, instead of the 4- and 6-factor is that, from Table 4.1, the 9-factor model gives the highest adjusted R-square for the sample used in this paper which implies the best fitted to the sample.

[7] David A. Hsieh Data Library: https://faculty.fuqua.duke.edu/~dah7/HFData.htm

Table 4.1: The results from Pooled OLS regression of fund's excess return on several independent variables including; Excess return on World Index, Global SMB, Global HML, Global MOM, (4-Factor), treasury, credit spread (6-Factor), and the 3 trend-following factors of bond, currency, and commodity (9-Factor).

	(1)	(2)	(3)
Model	4-Factors	6-Factor	9-Factor
VARIABLES	ExcessReturn	ExcessReturn	ExcessReturn
WorldIndex_rf	0.461***	0.447***	0.457***
	(114.9)	(103.9)	(104.0)
Global_SMB	0.490***	0.470***	0.469***
	(50.48)	(48.21)	(48.54)
Global_HML	-0.0227***	-0.0506***	-0.0508***
	(-2.993)	(-6.391)	(-6.364)
Global_MOM	0.0277***	0.0338***	0.0339***
	(5.370)	(6.556)	(6.572)
Treasury		0.958***	0.986***
		(15.37)	(15.74)
CreditSpread		-0.0943***	-0.0707***
		(-7.850)	(-5.831)
PTFSBD			-0.00690***
			(-6.022)
PTFSFX			0.0253***
			(29.85)
PTFSCOM			-0.0183***
			(-20.37)
Constant	0.00434***	0.00182***	0.00263***
	(31.29)	(4.579)	(6.611)
Observations	154,033	154,033	154,033
Adj.R-squared	0.149	0.151	0.157

Robust t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

In order to decomposition the component of total risk, taking the variance to Eq.1, will get Eq.2 which states that total variance of hedge fund return can be broken down into two terms; systematic risk and unsystematic (idiosyncratic) risk:

$$\sigma_i^2 = \beta_i{}^2\sigma_f{}^2 + \sigma_{\varepsilon,i}^2 \qquad \text{(Eq.2)}$$

Where σ_i^2 represents the total risk of fund i. $\beta_i{}^2\sigma_f{}^2$ denotes fund's systematic risk component. $\sigma_{\varepsilon,i}{}^2$ represents the fund's unsystematic risk component,

The systematic risk, therefore, can be measured as the difference between total risk and unsystematic risk. However, the purpose of this research is to answer the question of how fund-level systematic risk exposure changes over time in different

market environments. To observe changes over time, a series, rather than a single variable (systematic risk of each fund), was required. The window of 36-month period was used in rolling regression. The obtained series of systematic risk variable will be grouped into different styles in the next step.

Series of systematic risk is obtained from the following equation:

$$SR_{i,t} = \beta_{i,t}{}^2 \sigma_{f,t}{}^2 = \sigma_{i,t}^2 - \sigma_{\varepsilon,i,t}^2 \quad \text{(Eq.3)}$$

1.2) The extent to which systematic risk explains hedge fund returns

In order to test *hypothesis 1 - whether systematic risk is a significant factor explaining hedge fund return* - this paper conducted a pooled OLS regression of one-month ahead individual fund excess returns on systematic risk (Eq.4), with unsystematic risk as controlled variable in Eq.5. This research also further investigates whether the explanatory power still exist during the crisis period by adding crisis dummy variable for crisis period (July 2006 to December 2009) as shown in following equation;

$$r_{i,t} - r_{f,t} = \omega_t + \beta_1 \cdot SR_{i,t-1} + \varepsilon_{i,t} \quad \text{(Eq.4)}$$

$$r_{i,t} - r_{f,t} = \omega_t + \beta_1 \cdot SR_{i,t-1} + \beta_2 \cdot USR_{i,t-1} + \varepsilon_{i,t} \quad \text{(Eq.5)}$$

$$r_{i,t} - r_{f,t} = \omega_t + \beta_1 \cdot SR_{i,t-1} + \beta_2 D_{Crisis} * SR_{i,t-1} + \varepsilon_{i,t} \quad \text{(Eq.6)}$$

Where $SR_{i,t}$ and $USR_{i,t}$is the systematic and unsystematic risk of fund i in month t, respectively. D_{Crisis} is a dummy variable which takes the value of 1, indicating that the return is from crisis period. $\varepsilon_{i,t}$ is the error term. β_1 is the correlation coefficient showing the relationship between systematic risk and hedge fund excess return. If systematic risk is a significant factor explaining hedge fund return, β_1 must show the statistically significantly different from 0.

2) Grouping hedge funds into 8 systematic risk exposure styles

This section presents categorization of systematic risk management into 8 styles based on 3 major categories; the first being based on the concept of market timing (MT and OMT), the second based on the level of maintaining systematic risk exposure (HSR and LSR). Funds which can be put under both of these two categories will be put in the third category, which will be called Combined-based. Styles in the third category is

sub-divided into 4 groups (MTHSR, MTLSR, OMTHSR, and OMTLSR), thus when added up to the groups under the first two category gives the total groups of 8.

2.1) Market Timing - Based

The concept of market timing introduced by Treynor and Mazuy (1966) (hereafter referred to as TM) plays a critical role in categorization of systematic risk exposure styles in this paper.

They argued that returns from market timing ability funds should be non-linear but convexity with the market return. This is because these funds consistently outwit the market by utilizing their market information, technical, and fundamental analysis to predict future market movement and manage their portfolio's systematic risk exposure efficiently. When the market is in its upward state, managers increase portfolio's exposure, as a result, fund returns will increase relatively greater than the market return. Conversely, when the market is in its downward state, structure of fund's equity is exposed to market movements in a way that lead to losses of fund returns will be relatively smaller than that of the market. The TM model used to capture market timing ability is as following equation;

$$r_{i,t} - r_{f,t} = \alpha_i + \sum_{k=1}^{9} \beta_k \cdot f_{k,t} + \gamma_m \left(r_{m,t} - r_{f,t}\right)^2 + \varepsilon_{i,t} \qquad \text{(Eq.7)}$$

Where $r_{m,t} - r_{f,t}$ is the excess equity market return. The MSCI World index as is used as a proxy of market return in this paper. γ_i represents the market timing skill of hedge fund manager, when this value is positive and significant, the manager has market timing ability.

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Supporting TM model, Henriksson and Merton (1981) (hereafter referred to as HM), proposed an alternative method by using an option payout on the market return to capture market timing ability.

$$r_{i,t} - r_{f,t} = \alpha_i + \sum_{k=1}^{9} \beta_k \cdot f_{k,t} + \gamma_m D_t \left(r_{m,t} - r_{f,t}\right) + \varepsilon_{i,t} \qquad \text{(Eq.8)}$$

Where D_t is the dummy variable, which is equal to 1 when the market excess return is positive, and equal to 0 for vice versa. Also, γ_i measures the market timing ability, when this value is positive and significant, the manager has market timing ability.

Funds in the Market Timing –based Style includes those with both positive and negative statistical significant $\gamma_{m,i}$ from the time series regression by fund of TM and HM Market timing models. It can sub-divide the exposure into 2 styles as follows:

Style 1: Market Timing Style (MT)

Funds which are managed by managers who are 'market timers', those funds with positive statistical significance of γ_i (for at least 1 model), have been categorized into the first systematic risk exposure style called Market timing style (MT).

However, it is possible for fund to show market timing ability for one model and oppose to another (negative statistical significance of γ_i). To avoid the spurious results, these funds are excluded.

This paper has hypothesized that MTS outperform other styles and lead to better performance persistence because systematic risk of hedge fund's portfolio is managed in the manner that promote efficient adjustment of market movement which is one of the skill needed from fund managers.

Style 2: Opposite to Market Timing Style (OMT)

However, there are managers who are not market timers. A group of managers who manage their portfolio in the opposite rather than the same direction of market movements. When the market is in bull state, systematic risk exposure of hedge funds in this group are decreased, and vice versa. The researcher has hypothesized portfolio systematic risk exposure by this style to be inefficient. This style will be referred to as the Opposite to Market Timing (OMT). Funds which are categorized into OMT style are those funds with negative statistical significance of γ_i (for at least 1 model). Also, same as MT style, it is possible for fund to show timing ability in one model but oppose to another. To avoid the spurious results, these funds are excluded.

2.2) Maintaining Systematic Risk Exposure -Based

On the other hand, other managers choose to maintain systematic risk exposure at a specific level regardless of which state the market is in. This exposure style receives the researcher's attention because it challenges the market timing theory. Findings from the study of Bali, Brown, and Caglayan (2012) show statistically significant effect of maintaining high systematic risk on market return. By maintaining SR in the 5th

(highest) quintile, the sample (of funds) generated 6% higher annual raw return on average than that of funds in the lowest systematic risk quintile. The outperformance of the highest systematic risk quintile over the lowest systematic risk quintile was still robust when using alpha as a performance measurement.

Yet, findings of studies on systematic risk exposure have never been conclusive given different sample groups and study period. Namvar et al (2016), for example, they found that hedge funds with low systematic risk exposure potentially perform better if they are superior in generating alpha. If this statement is valid, it implies that the managers with superior timing and selectivity skill could be outperformed by those who do not even consider portfolio's systematic risk. Importantly, it will pose a great challenge to the belief that systematic risk management of hedge fund is a determining factor of performance.

Provided such inconclusive findings about which factor truly explains hedge fund performance, it is worth considering both systematic risk management styles which, in this paper, will be categorized as Maintain High Systematic Risk (HSR) and Maintain Low Systematic Risk (LSR) under which the two identical groups of samples were tested, other things being equal. Such controlled environment allows us to clearly see where the effect on hedge fund performance is coming from. Funds categorized under the Maintaining Systematic Risk Exposure-Based group, therefore, will be distinguished into 2 different management styles as explained below. They are distinguished based on systematic risk exposure which is ranked into a monthly quintile portfolio obtained from Eq.1. The 1st quintile is the lowest rank of systematic risk exposure in a given month and the 5th quintile is the highest rank.

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Style 3: Maintain High Systematic Risk (HSR)

For funds which belong to this group, systematic risk exposure is always maintained at relatively higher level than others regardless of market state. In other words, they always stay in the 5th quintile of the monthly systematic risk quintile portfolio.

Style 4: Maintain Low Systematic Risk (LSR)

In contrast, systematic risk exposure of funds in this group is always maintained at the level relatively lower than others regardless of market state. In other words, always stay in the 1st quintile of the monthly systematic risk quintile portfolio.

2.3) Combined - based

The Combined – based funds are those funds which can be put under both of Market Timing and Maintaining Systematic Risk Exposure based criteria. It can sub-divide into 4 styles as follows

Style 5: Market Timing and Maintain High Systematic Risk (MTHSR)

For funds which belong to this group, their systematic risk exposure is always stayed in the 5th quintile of the monthly systematic risk quintile portfolio. At the same time, these funds show the positive statistical significance of γ_i from regression Eq.7 or Eq.8.

Style 6: Market Timing and Maintain Low Systematic Risk (MTLSR)

For funds which belong to this group, their systematic risk exposure is always stayed in the 1st quintile of the monthly systematic risk quintile portfolio. At the same time, these funds show the positive statistical significance of γ_i from regression Eq.7 or Eq.8.

Style 7: Opposite to Market Timing and Maintain High Systematic Risk (OMTHSR)

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

For funds which belong to this group, their systematic risk exposure are always stayed in the 5th quintile of the monthly systematic risk quintile portfolio. At the same time, these funds show the negative statistical significance of γ_i from regression Eq.7 or Eq.8.

Style 8: Opposite to Market Timing and Maintain Low Systematic Risk (OMTLSR)

For funds which belong to this group, their systematic risk exposure is always stayed in the 1st quintile of the monthly systematic risk quintile portfolio. At the same time, these funds show the negative statistical significance of γ_i from regression Eq.7 or Eq.8.

Table 4.2: Summary of the grouping criteria for 8-systematic risk exposure styles

No.	**Systematic risk exposure style**	**Criteria**
1.	Market Timing (MT)	γ_i shows the *positive* statistically significance for at least 1 model from TM- and HM- Market timing model
2.	Opposite to Market Timing (OMT)	γ_i shows the *negative* statistically significance for at least 1 model from TM- and HM- Market timing model
3.	Maintain High Systematic Risk (HSR)	Fund which is always stay in the *5^{th} quintile* (the highest systematic risk rank) of the monthly systematic risk quintile portfolio.
4.	Maintain Low systematic Risk (LSR)	Fund which is always stay in the *1^{st} quintile* (the lowest systematic risk rank) of the monthly systematic risk quintile portfolio.
5.	Market Timing and Maintain High Systematic Risk (MTHSR)	γ_i shows the *positive* statistically significance for at least 1 model from TM- and HM- Market timing model. At the same time, its SR always stays in the *5^{th} quintile* of the monthly systematic risk quintile portfolio.
6.	Market Timing and Maintain Low Systematic Risk (MTLSR)	γ_i shows the *positive* statistically significance for at least 1 model from TM- and HM- Market timing model. At the same time, its SR always stays in the *1^{st} quintile* of the monthly systematic risk quintile portfolio.
7.	Opposite to Market Timing and Maintain High Systematic Risk (OMTHSR)	γ_i shows the *negative* statistically significance for at least 1 model from TM- and HM- Market timing model. At the same time, its SR always stays in the *5^{th} quintile* of the monthly systematic risk quintile portfolio.

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

8.	Opposite to Market Timing and Maintain Low Systematic Risk (OMTLSR)	γ_i shows the negative statistically significance for at least 1 model from TM- and HM- Market timing model. At the same time, its SR always stays in the 1st quintile of the monthly systematic risk quintile portfolio.

3) Systematic risk management style and performance

After classifying each fund into 8 systematic risk exposure styles, this paper was then examined the performance of each style using 3 performance measurements; Jensen's alpha, Sharpe Ratio and Information Ratio. Kernel Density Estimation and hypothesis test were used in order to compare performance among different systematic risk exposure style.

3.1) Performance measurement

- **Jensen's Alpha**

Jensen's alpha ($\propto$) is referred to risk adjusted excess return or abnormal return which is the measurement of manager skills. This measurement is based on the Efficient Market Hypothesis that the markets are efficient, and all market participants have the same beliefs about the asset prices, which presumably suggest no mispricing in the market. As a result, the alpha should be statistically significance equal to zero. However, skilled manager attempts to exploit the mispricing that occurs in the market, thereby generating a certain value of alpha statistically different from zero. The Jensen's alpha obtains from the following equation;

$$\alpha_i = (r_{i,t} - r_{f,t}) + \sum_{k=1}^{9} \beta_k \cdot f_{k,t} + \varepsilon_{i,t} \qquad \text{(Eq.8)}$$

- **Sharpe Ratio**

Sharpe Ratio measures the risk-adjusted return of the portfolio. It is calculated by the portfolio's excess return over the risk free rate of return divided by the standard deviation representing the excess return per unit of total risk. Sharpe Ratio is measured by the following equation;

$$\text{Sharpe Ratio}_i = \frac{(R_{i,t} - R_{f,t})}{\text{S.D.}_i} \qquad \text{(Eq.9)}$$

Where Sharpe Ratio_i is the Sharpe Ratio of fund i and $S.D._i$ is the standard deviation of fund return.

- **Information Ratio**

Information Ratio (IR) measures the risk-adjusted return of the portfolio. It is measured by the active return of the portfolio divided by the amount of risk in portfolio relative to the benchmark, on the other words, its represents the benefit to cost ration.

The different between Sharpe Ratio and IR is that, normally the IR aims to measure risk-adjusted return of the portfolio in relation to the benchmark, not a risk free-rate of return as in Sharpe Ratio. Moreover, IR also measures the consistency of investment performance though the tracking error, or the active risk of the portfolio. Information Ration is measured by the following equation;

$$\text{Information Ratio}_i = \frac{AR_i}{TE_i} \qquad \text{(Eq.10)}$$

Where $AR_{i,t}$ is the Active Return which represented by fund's alpha, and $TE_{i,t}$ is the Tracking Error measured by the standard deviation of the active return.

3.2) Style performance

After measuring the performance of individual fund, this paper employs Kernel Density Estimation, which is one of the non-parametric way to estimate the probability density function of a random variable, to compare the performance among systematic risk exposure style.

Kernel Density Estimation;

$$f(x) = \frac{1}{nb}\sum_{i=1}^{n} K\left(\frac{x_i - X}{b}\right) \qquad \text{(Eq.11)}$$

Where f(x) is the Kernel density estimate, n is the sample size or the number of funds in particular SRM style, b is the bandwidth, K is the chosen Kernel (weight function)

4) Systematic risk management style and performance persistence

In order to investigate performance persistence for each systematic risk management style, this paper uses parametric (regression-based) and non-parametric (Contingency table, Chi-square, and Percentage of Repeating Winners) method. The tests were conducted on monthly, quarterly, half-yearly and yearly basis using

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

performance measures in step 3 including: fund's excess return, alpha, information ratio, and Sharpe Ratio.

4.1) Parametric method

The parametric method employed the cross-sectional technique which is an Autoregressive model by regressing previous performance on the current performance. A positive significant of correlation coefficient of the lag performance suggests that a hedge finds that did well in the given period did well on the consequence period and vice versa. In other words, hedge fund has performance persistence. The autoregressive equation using excess return as a performance measure is as follow;

$$\text{Performance}_{i,t} = \beta_0 + \beta_1 \text{Performance}_{i,t-1} + \varepsilon_{i,t} \quad \text{(Eq.12)}$$

Where the performance measure tested are including: fund's excess return, alpha, information ratio, and Sharpe Ratio. The test was conducted on monthly, quarterly, half-yearly, and yearly basis.

4.2) Non-Parametric method

The non-parametric method, this paper employs the concept of Contingency Table-based method, which was first introduced by Agarwal, Naik, Agarwal, & Naik (2000).

Construction of Contingency Table

Contingency table is the table reports the performance of individual hedge fund by classifying hedge fund into the winner and the loser. At time t, the winner funds are those funds with performance higher than the median performance of all fund following the Directional Equity strategy, the otherwise are the loser. Persistence in this context relates to the funds that are winner (loser) in two consecutive periods, denoted by WW (LL), showing the repeated performance over time. As opposed to the repeated performer, the non-repeated performer are those funds which are classified as the winner in the first period, and the loser in the consecutive period WL, and vice versa (LW).

The performance measures employed in this research are including fund's excess return, Jensen's alpha, Sharp Ratio, and Information Ratio. The tests were conducted on monthly, quarterly, half-yearly, and yearly basis separately. The average

performance of individual hedge fund was used instead of monthly performance when considered a longer than 1-month period performance.

After constructing contingency table, the performance persistence was tested by using 3 methods including; Cross Product Ratio, Chi-square, and Percentage of Repeating Winner.

- **Cross Product Ratio (CPR)**

The Cross Product Ratio is calculated by the sum of hedge fund performance from the Contingency table following the same systematic risk exposure style as following equation;

$$\mathrm{CPR_s} = \frac{\mathrm{WW_s} \times \mathrm{LL_s}}{\mathrm{WL_s} \times \mathrm{LW_s}} \qquad \text{(Eq.13)}$$

Where $\mathrm{CPR_s}$ is the Cross Product Ratio of funds following style s. $\mathrm{WW_s}$ ($\mathrm{LL_s}$) is the number of times that fund i following style s performs as the winner (loser) for 2 consequence timeframe, $\mathrm{WL_s}$ ($\mathrm{LW_s}$) is the number of times that fund i following style s performs as a winner (loser) at the first period and loser (winner) at the consequence period.

The null hypothesis in this setting represents that lack of persistence ($\mathrm{CPR_s} = 1$), in other words, when there is no persistence, the four categories denoted by $\mathrm{WW_s}$, $\mathrm{LL_s}$, $\mathrm{WL_s}$ and $\mathrm{LW_s}$ would equal to one fourth of the total number of funds. The alternative hypothesis represents the evidence of performance persistence.

Ho: $\mathrm{CPR_s} = 1$; lack of persistence Ha: $\mathrm{CPR_s} \neq 1$; Persistence in performance

The determination of statistical significance of $\mathrm{CPR_s}$ is using Z-statistic which assumes the sample has normal distribution in the first place. The calculation of Z-statistic is as following (Eq.13).

$$Z - statistic = \frac{\ln(\mathrm{CPR_s})}{\alpha_{\ln(\mathrm{CPR_s})}} = \frac{\ln(\mathrm{CPR_s})}{\sqrt{\frac{1}{\mathrm{WW_s}} + \frac{1}{\mathrm{WL_s}} + \frac{1}{\mathrm{LW_s}} + \frac{1}{\mathrm{LL_s}}}} \qquad \text{(Eq.14)}$$

- **Chi-square**

Chi-square is one of the common performance persistence measurement. It is calculated as following equation;

$$\mathrm{Chi-square} = \frac{(\mathrm{WW} - \mathrm{D1})^2}{\mathrm{D1}} + \frac{(\mathrm{WL} - \mathrm{D2})^2}{\mathrm{D2}} + \frac{(\mathrm{LW} - \mathrm{D3})^2}{\mathrm{D3}} + \frac{(\mathrm{LL} - \mathrm{D4})^2}{\mathrm{D4}} \qquad \text{(Eq.15)}$$

Where

$$D1 = \frac{(WW + WL)(WW + LW)}{N} \quad D2 = \frac{(WW + WL)(WL + LL)}{N}$$

$$D3 = \frac{(LW + LL)(WW + LW)}{N} \quad D4 = \frac{(LW + LL)(WL + LL)}{N}$$

The null hypothesis is that the funds in a given systematic risk exposure style does not show the evidence of performance persistence. The determination of statistical significance by using the critical value of Chi-square at 5%, corresponding to the critical value of a Chi-square statistic of 3.84, and the degree of freedom is equal to 1.

- **Percentage of Repeating Winner (PRW)**

The Percentage of Repeating Winner is the proportion of winner persistence over the first period winner performance, which is calculated by following equation;

$$PRW_s = \frac{WW_s}{WW_s \times WL_s} \quad \text{(Eq.16)}$$

Given the probability of winner and loser is equally at 50%, the threshold for PRW is 50%, also, the higher of PRW is the better it is.

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Chapter 4
Empirical Result

Results will be explained in 4 sections following the methodology

4.1 The effects of systematic risk in determining hedge fund returns

As it was hypothesized in this paper that systematic risk management was a determining factor explaining hedge fund performance, in order to prove the validity of this statement, the researcher conducted a cross sectional regression, the sample of which consists of one-month ahead individual fund excess returns on fund systematic risk, with and without controlled variables that might affect the relationship between systematic risk and excess return. The controlled variables added are 1) unsystematic risk and 2) crisis dummy variable, which indicates the returns in the month during crisis period (July 2006 to December 2009).

Table 5.1 shows results from the cross sectional regression of one-month ahead individual fund excess returns on fund systematic risk (1). The controlled variables added include unsystematic risk (Model 2) and crisis dummy variable (Model 3). The results show that systematic risk extracted from the 9-factor model is positively correlated to hedge fund return (0.890) at 99% confidence level. Even after controlling for unsystematic risk factor, the finding remains robust with the correlation coefficient 0.839 at 99% confidence level. The unsystematic risk component has been observed to be positively correlated with hedge fund returns with correlation coefficient 0.214 at 95% confidence level, contrary to the study of Bali et al. (2014) which found no statistical evidence supporting the explanatory power of unsystematic risk factor on hedge fund return. However, the systematic risk component still has relatively more explanative power in comparison to the unsystematic risk component. After adding crisis dummy variable, the positive correlation of systematic risk factor remains intact and systematic risk factor tends to be more significant during the period of crisis. Hence, the hypothesis 1 stating that *systematic risk has positive significant effect in explaining hedge fund return* cannot be rejected.

Table 5.1: The results from cross sectional regression of one-month ahead individual fund excess returns on systematic risk (1), with unsystematic risk as controlled variable (2), and crisis dummy variable for crisis period (July 2006 to December 2009) (3).

	(1) Excess return	(2) Excess return	(3) Excess return
lag_SR	0.890***	0.839***	0.513***
	(5.126)	(4.792)	(2.939)
lag_USR		0.214**	
		(1.970)	
D_crisis*lag_SR			2.084***
			(4.307)
Constant	0.00603***	0.00571***	0.00607***
	(29.52)	(25.48)	(29.84)
Observations	100,716	100,716	100,716
Adj. R-squared	0.00103	0.00129	0.00206

Robust t-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

4.2 Systematic risk exposure styles

This section presents categorization of systematic risk management into 8 groups based on 3 major categories; the first being based on the concept of market timing (MT and OMT), the second based on the level of maintaining systematic risk exposure (HSR and LSR). Funds which can be put under both of these two categories will be put in the third category, which will be called Combined-based. Styles in the third category is sub-divided into 4 groups (MTHSR, MTLSR, OMTHSR, and OMTLSR), thus when added up to the groups under the first two category gives the total groups of 8. The criteria for categorization has been explained in the methodology part.

From the total sample of 1,441 funds, 423 funds fall into one of the 3 categories. Market Timing-based category, 148 can be classified as MT style and 75 funds as OMT style. In the Maintaining Systematic Risk Exposure-based category, 117 can be classified as HSR style and 40 funds as LSR style, respectively. In the Combined-based category, 43 funds can be classified as one of the styles under the Combined-based category. The remaining funds (1,018) of the total sample cannot be classified under the criteria implemented in this paper. Figure 5.2 shows the number of funds being

classified into the 8 styles. Table 5.2 shows the descriptive statistic of funds sorted by systematic risk exposure styles.

Figure 5.2: Diagram shows the number of fund classified into different systematic risk exposure style

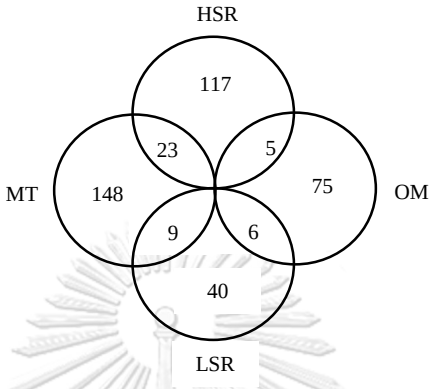


Table 5.2: The descriptive statistics of funds sorted by systematic risk exposure style.

Style	No. of funds	Percentage to total of funds	No. of monthly return data	mean	sd	max	min
MT	148	35%	22,557	0.612%	4.092%	62.290%	-51.986%
OMT	75	18%	7,810	0.603%	5.088%	67.660%	-74.420%
HSR	117	28%	9,819	0.743%	7.504%	109.100%	-67.125%
LSR	40	9%	3,674	0.614%	4.855%	116.164%	-53.187%
MTHSR	23	5%	6,672	0.666%	6.259%	36.590%	-41.680%
MTLSR	9	2%	3,056	0.414%	1.763%	14.110%	-8.870%
OMTHSR	5	1%	528	-0.185%	7.499%	18.190%	-24.752%
OMTLSR	6	1%	788	0.566%	7.026%	39.451%	-28.127%
Total	423	100%	54,904	0.621%	5.329%	116.164%	-74.420%

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

4.3 The performance of each systematic risk exposure style

Having classified hedge funds into 8 systematic risk management styles, tests were conducted in order to find which systematic risk management style performs best. Figure 5.3 graphically shows the Kernel Density Estimation of each of the 3 performance measurements, namely, Jensen's alpha (5.3A), Sharpe Ratio (5.3B) and Information Ratio (5.3C). The performance measured was both that of full period and of crisis period. The x-axis shows performance of each style and the y-axis shows the density of each. Since there is not a single fund among the samples that managers employed OMTLSR management style during crisis period, this means that during the crisis period only 7 styles are considered.

From figure 5.3, funds managed by OMTLSR style turn out to produce both the best and worst performance when measured by alpha (figure 5.3A). It also shows the best performance when measured by Information ratio (figure 5.3C). MTLSR style shows the best performance when measured by Sharpe ratio (figure 5.3B). OMTHSR style shows the worst performance when measured by all 3 measurement tools. No funds managed by MT style shows superior performance, while the LSR style, whether with and without market timing ability, turned out to outperform other styles in full period.

This finding contains an important implication - that market timing ability, represented by MT style, might not be the ability of fund managers that necessarily lead to superior performance. This statement, however, can be rejected when it comes to the crisis period. The results show that funds managed by combined MT styles (MTLSR, MTLSR) show superior performance during crisis period while funds managed by OMT style perform worst during crisis period. It can be concluded, therefore, that during the crisis period, market timing ability is a significant skill that help achieve superior performance.

The argument for importance of market timing skill is then further reinforced by the findings that no funds managed by MT style show superior performance compared to other styles during full period sample, even when measured using all of the 3 measurement tools. However, in crisis period, combined MT style outperform those managed by other styles.

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Figure 5.3: The graph shows Kernel Density Estimation comparing the performance of each systematic risk exposure styles including MT, OMT, HSR, LSR, MTHSR, MTLSR, OMTHSR, and OMTLSR. The criteria for performance measurements include Jensen's alpha (5.3 A), Sharpe Ratio (5.3 B) and Information Ratio (5.3 C). The performance measured is that of the funds during both full and crisis periods. The x-axis represents the performance measurement and the y-axis represents the density.

Figure 5.3A: Jensen's alpha

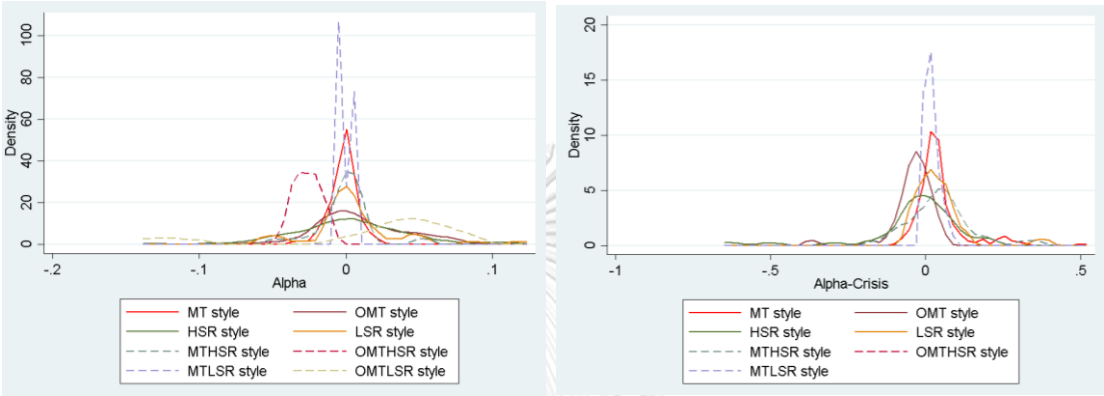


Figure 5.3B: Sharpe Ratio

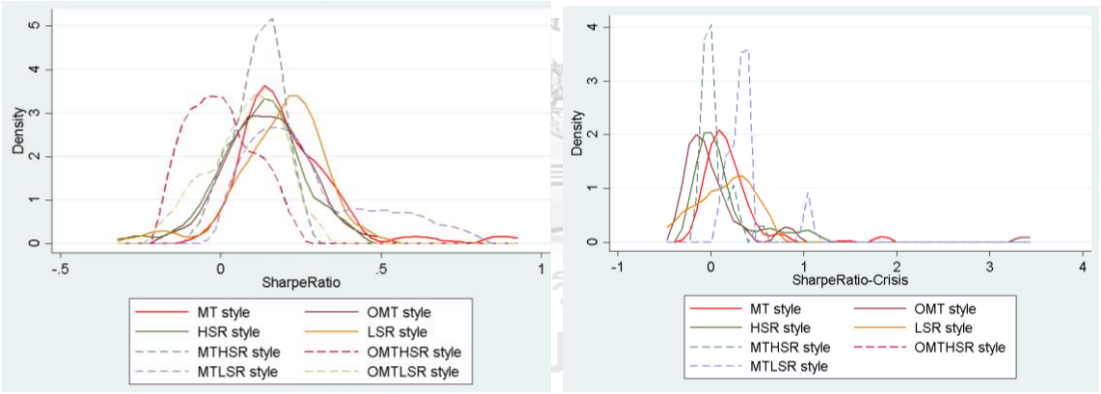
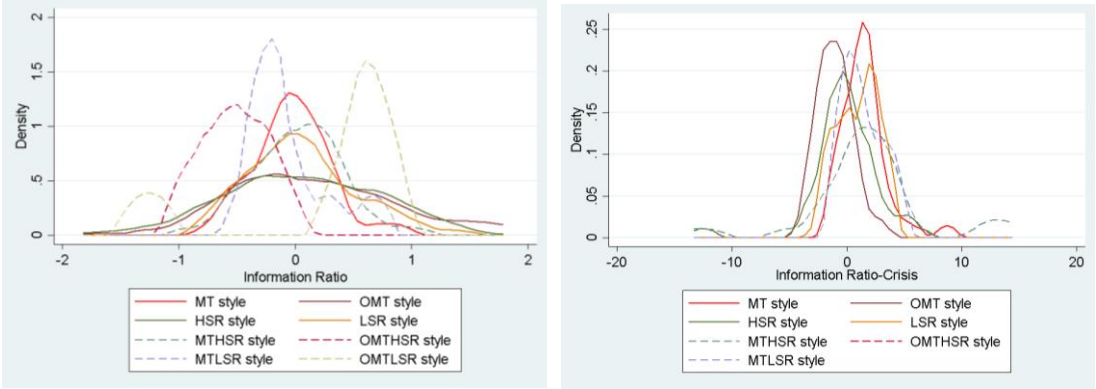


Figure 5.3C: information Ratio



To see whether the results obtained are consistent with non-parametric method, statistical test for the hypothesis has been conducted. Table 5.3 shows the statistical test for the performance of the 8 styles using 3 measurements including Jensen's alpha, Sharpe Ratio and Information Ratio. The tests are conducted in 2 periods, namely, Panel A: full period (January 2000 to December 2017) and Panel B: crisis period (July 2006 to December 2009).

Considering Panel A: Full time period, LSR and OMTLSR styles are the only two that generate positive alpha which is significantly different from zero at 99% confident level. On the other hand, HSR and OMTHSR styles are the only two that generate negative alpha which is significantly different from zero at 99% and 90% confidence level respectively. This finding contradicts to the findings of the study of Bali Brown, and Caglayan (2001a). They found that funds in the highest systematic risk quintile rank outperformed the lowest quintile rank when measured by alpha. Moreover, the LSR and OMTLSR styles also outperform other styles when measured by Information ratio. These are the only two styles that show positive Information ratio. MT style does not show any superior performance. However, when employing MT with LSR (MTLSR), funds show superior performance measured by Sharpe ratio. HSR and OMTHSR styles show the worst performance, with OMTHSR style showing the worst performance when measured by all 3 measurements.

From the findings obtained above, it can be concluded that, during full period, funds managed by LSR style have superior performance to those managed by others. More importantly, the MT style does not show superior performance as hypothesized. These findings are consistent with the Kernel Density Eastiomation presented in figure 5.3.

The conclusion made from the results in Panel A, however, does not apply when it comes to the case for crisis market environment. When considering Panel B which represents crisis time, the results show that employing only LSR style does not lead to outperformance, unless market timing strategy is also employed. The statement is supported by the findings that in crisis period, MT, MTHSR and MTLSR provide superior performance when measured by alpha, with positive value which is

significantly different from zero. When measured by Sharp ratio and Information ratio, the MTLSR always shows the superior performance. OMT is the only style that shows the worst performance for all 3 measurements.

In conclusion, during full period, LSR style - a systematic risk exposure style which disregards market timing - leads superior performance. MT style, on the other hand, does not show superior performance as hypothesized. However, during the crisis period, Market Timing strategy turns out to be a necessary factor leading to outperformance of the funds. This statement is supported by the outperformance of MT style regardless of maintained level of systematic risk exposure of the funds.

From the findings, hypothesis II, stating that - *Market timing style (MT) - a group of hedge funds, managers of which employ a market timing strategy shows superior performance to the other 7 styles when measured by risk-adjusted return* - cannot be strongly rejected.

Discussion

The outperformance of LSR style in this finding challenges the principle of standard Capital Asset Pricing Model (CAPM) which states that the expected excess return on a security is equal to its level of systematic risk, beta, times the expected excess return on the market portfolio. Hence, the funds with high beta securities (consistent with HSR style in this research) should produce higher expected return.

However, many empirical studies found that may not always be the case. High beta securities might not always produce higher return as expected but rather low beta securities. This phenomena is called “Low - volatile anomaly”. According to Black, Jensen, & Scholes (1972), conducting the test on the sample of securities listed on the New York Stock Exchange between January 1926 and March 1966, they found that the securities’ expected excess returns were not strictly proportional to its beta. After forming portfolio by beta and performing time series regression of the portfolio excess returns on the market portfolio excess returns, they found that high beta securities had significant negative intercepts. Low beta securities, on the other hand, had significant positive intercepts. This finding is in contradiction to the predictions of the traditional CAPM.

The reasons behind this anomaly is possibly the unrealistic assumptions of CAPM that there are always riskless borrowing and lending opportunities available to all investors. The weakness of this CAPM assumption is also supported by the study of Frazzini & Pedersen (2011), in which they found that the leverage constrained was one of the important factor that invalidated the CAPM assumption. Conducting a test on samples from U.S. equities, 20 international equity markets, Treasury bonds, corporate bonds, and futures, from the year 1926 to 2012, the study reconfirmed that securities with high beta delivered low risk adjusted returns.

In CAPM, the investors invest in the portfolio with the highest expected excess return per unit of risk, and leverage or de-leverage this portfolio to suit their risk preferences. In practice, however, not all investor has access to leverage. The leverage-constrained investors, for example, mutual funds and individual investors, overweight risky securities or the assets, the beta of which is above 1 on average, instead of leveraging. On the other hand, leverage-unconstrained investors such leveraged buyout funds and Berkshire Hathaway do have access to leverage. Since portfolios of low-beta securities have higher alphas and Sharpe ratio than portfolios of high-beta securities, this group of investors can take advantage of this effect by applying leverage to low beta securities and buying securities with beta below 1 on average. This group of investors is being compensated by investors facing borrowing constraints who take the other side.

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

The Scholes's findings and others supports the finding of this research. Since the sample of this research is Directional Equity Hedge Funds, which is normally exposed to the market given the fact that most of the fund managers use leverage technique to amplify the return instead of hedging against market risk. These funds may take advantage of being able to leverage and exploit this anomaly. As a result, funds with low systematic risk exposure, or funds with a portfolio of low beta security, promote superior performance to other style.

The findings contribute to the study of systematic risk management in 2 aspects. First, from the viewpoint of hedge fund managers, systematic risk is a significant factor affecting fund performance especially during crisis period. However, MT styles with market timing strategy is unlikely to produce the level of alpha as high as that of LRS style. Managers should focus on selecting the right stocks to invest in rather than

focusing on market states. From the viewpoint of investors, on the other hand, the findings imply that one should pay attention to different managerial ability of managers depending on different market states. Put simply, in bull market state, investors should focus more on stock selection ability measurement, while in bear market state, investors should focus more on market timing ability measurement.

Table 5.3: The results from statistical test of 8 style performance separately measured by 3-performance measurement tools including Jensen's alpha, Sharpe Ratio and Information Ratio. The tests were conducted in 2 period including Panel A: full period (January 2000 to December 2017) and Panel B: crisis period (July 2006 to December 2009)

Panel A: Full period

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	MT	OMT	HSR	LSR	MTHSR	MTLSR	OMTHSR	OMTLSR
Alpha	-0.000800	-0.00210	-0.00441**	0.00823***	-0.00237	-0.000607	-0.0280*	0.0283***
	(-1.011)	(-1.134)	(-2.458)	(3.589)	(-1.615)	(-0.535)	(-1.700)	(3.632)
Sharpe Ratio	14.95%	11.85%	9.90%	12.65%	10.63%	23.50%	-2.47%	8.05%
Information Ratio	-2.19%	-4.60%	-7.17%	17.07%	-6.34%	-3.57%	-38.25%	41.56%
Observations	22,557	7,810	9,819	3,674	6,672	3,056	528	788
Adj.R-squared	0.199	0.193	0.328	0.0151	0.643	0.0674	0.0472	0.0606

Robust t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Panel B: Crisis Period

	(9)	(10)	(11)	(12)	(13)	(14)	(15)
VARIABLES	MT	OMT	HSR	LSR	MTHSR	MTLSR	OMTLSR
Alpha	0.0427***	-0.0401***	-0.0251	0.0393	0.0398***	0.0178***	0.0282
	(6.321)	(-2.901)	(-1.448)	(1.592)	(3.759)	(2.712)	(0.897)
Sharpe Ratio	11.97%	-4.10%	2.41%	8.73%	2.08%	34.77%	-22.38%
Information Ratio	84.55%	-76.24%	-32.90%	69.56%	82.92%	95.19%	74.80%
Observations	4,063	1,131	1,059	632	1,176	538	58
Adj.R-squared	0.151	0.410	0.518	0.0192	0.710	0.0163	0.267

Robust t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

4.4 Systematic risk exposure style and performance persistence

This section examines whether systematic risk exposure style is a source of performance persistence. The test is conducted using parametric and non-parametric methods.

1) Parametric Method

Using parametric-based method, table 5.4.1 shows the results from autoregressive model, regressing the previous performance on the current performance. The tests were conducted for both full period (Panel A) and crisis period (Panel B), on monthly, quarterly, half – yearly and yearly bases. The performance measurements employed include excess return (Panel 1A, 1B), alpha (Panel 2A, 2B), Information ratio (Panel 3A, 3B), and Sharpe ratio (Panel 4A, 4B).

From the findings of Panel A: full period, almost every systematic risk management styles show positive and statistical significant correlation coefficient of the previous and current period performance for all time intervals. This suggests that the measured hedge funds that perform well in one period also perform well in the next period and vice versa.

However, the exceptions are the LSR, MTLSR, OMTHSR and OMTLSR styles, which did not show evidence of performance persistence for some time intervals when measured by excess return and Sharpe ratio.

An interesting point is that, OMTHSR style is one of styles that produce the worst performance when measured by Sharpe ratio shown in table 5.3. At the same time, this style shows evidence of performance persistence when measured on a quarterly and a half - yearly basis. It could be implied that this style continues to underperform other management styles during some time intervals.

Considering Panel B: crisis period, LSR style in the only one showing insignificant correlation coefficient of excess return for almost every time interval. When measured by excess return, the result obtained show the weakest relationship between past performance and current performance on yearly basis, with no statistical significance. This applies to almost every style except the OMT.

The magnitude of correlation coefficients from the regression for both full and crisis periods are spurious and conclusion cannot be made therefrom. However, this research also conducted the non-parametric methods to see if there is any possibility that other evidence of persistence may occur.

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Table 5.4.1 shows the results from autoregressive model, regressing the previous performance on the current performance. The tests were conducted for both full period (Panel A) and crisis period (Panel B), on monthly, quarterly, half – yearly and yearly bases. The performance measurements used were excess return (Panel 1A, 1B), alpha (Panel 2A, 2B), information ratio (Panel 3A, 3B), and Sharpe ratio (Panel 4A, 4B).

Panel A: Full period	All data	MT	OMT	HSR	LSR	MTHSR	MTLSR	OMTHSR	OMTLSR
Panel 1A: Excess Return									
Monthly	0.106***	0.0735***	0.139***	0.140***	-0.0845	0.137***	-0.00762	0.073	0.0646
Quarterly	0.894***	0.834***	0.849***	1.020***	0.823***	0.842***	0.965***	0.544**	0.254
Half-yearly	0.853***	0.815***	0.620***	1.049***	0.523	0.786***	0.971***	1.056	-0.56
Yearly	0.954***	0.690***	1.545***	1.001***	0.942***	0.759***	0.422	-0.0604	1.826
Panel 2A: Alpha									
Monthly	0.931***	0.922***	0.941***	0.936***	0.936***	0.934***	0.882***	0.913***	0.894***
Quarterly	0.996***	0.994***	0.995***	1.003***	1.001***	0.989***	0.979***	0.978***	1.084***
Half-yearly	0.958***	0.928***	1.003***	0.961***	0.996***	0.985***	0.923***	0.860***	1.139***
Yearly	0.949***	0.901***	1.068***	0.971***	0.796***	0.950***	0.893***	1.244***	1.275***
Panel 3A: Information ratio									
Monthly	0.933***	0.927***	0.939***	0.936***	0.943***	0.944***	0.901***	0.920***	0.914***
Quarterly	0.994***	0.996***	1.004***	0.998***	0.998***	0.979***	0.972***	0.984***	0.983***
Half-yearly	0.948***	0.940***	1.004***	0.956***	0.880***	0.963***	0.958***	0.941***	0.950***
Yearly	0.942***	0.935***	1.059***	0.974***	0.843***	0.900***	0.935***	1.152**	0.833**
Panel 4A: Sharpe ratio									
Monthly	0.122***	0.102***	0.169***	0.144***	0.0881***	0.111***	0.118***	0.0479	0.128*
Quarterly	0.921***	0.916***	0.925***	0.921***	1.081***	0.819***	0.905***	0.623**	0.520**
Half-yearly	0.899***	0.919***	0.743***	0.938***	1.230***	0.793***	0.963***	1.044*	-0.358
Yearly	0.958***	0.856***	1.185***	1.031***	1.190***	0.717***	0.826***	0.813	1.359

Panel B: Crisis period	All data	MT	OMT	HSR	LSR	MTHSR	MTLSR
Panel 1B: Excess Return							
Monthly	0.237***	0.171***	0.327***	0.386***	-0.346	0.386***	0.105*
Quarterly	0.629***	0.676***	0.703***	0.635***	0.312	0.488***	0.862***
Half-yearly	0.468***	0.544***	0.937***	0.333**	0.367*	0.317**	0.675**
Yearly	0.313***	0.181	1.017***	0.287	0.402	0.13	0.319
Panel 2B: Alpha							
Monthly	0.914***	0.912***	0.924***	0.925***	0.853***	0.902***	0.840***
Quarterly	0.991***	0.982***	1.011***	0.988***	1.110***	0.984***	0.921***
Half-yearly	0.944***	0.905***	1.039***	0.957***	1.052***	0.946***	0.829***
Yearly	0.972***	0.882***	1.188***	1.001***	0.867***	1.032***	0.602***
Panel 3B: Information ratio							
Monthly	0.908***	0.900***	0.891***	0.914***	0.935***	0.903***	0.823***
Quarterly	0.986***	0.976***	1.028***	0.989***	1.007***	0.963***	0.958***
Half-yearly	0.894***	0.881***	1.029***	0.929***	0.771***	0.877***	0.844***
Yearly	0.930***	0.906***	1.148***	0.957***	0.818***	0.899***	0.707***

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

Panel 4B: Sharpe ratio							
Monthly	0.236***	0.185***	0.305***	0.295***	0.00516	0.330***	0.156***
Quarterly	0.806***	0.855***	0.758***	0.671***	1.123***	0.554***	0.885***
Half-yearly	0.636***	0.639***	0.757***	0.459***	0.929***	0.372*	0.885***
Yearly	0.380***	0.358***	0.779***	0.167	0.612***	0.0596	0.678**

*** p<0.01, ** p<0.05, * p<0.1

2) Non-Parametric-based Method

Using non-parametric-based method, table 5.4.2 shows the results of performance persistence measured by Cross Product Ratio (CPR), and Chi-Square. Moreover, Percentage of Repeating winner (PRW) is used to identify which style produces repetitive "winner" performance. The tests were conducted for both full period (Panel A) and crisis period (Panel B), on monthly, quarterly, half – yearly and yearly bases. The performance measurements used were excess return (Panel 1A, 1B), alpha (Panel 2A, 2B), information ratio (Panel 3A, 3B), and Sharpe ratio (Panel 4A, 4B).

From table 5.4.2, the results obtained from the CPR method are consistent with those obtained from Chi-square method. However, these results are only consistent with the parametric method shown in table 5.4.1 to a certain extent. For example, LSR style does not show any evidence of performance persistence on a monthly basis when measured by the excess return using the parametric method (table 5.4.1, the correlation coefficient of -0.0845), but it does show performance persistence when measured by the non-parametric method (table 5.4.2, CPR and Chi-square of 1.4 and 14.26, respectively).

When employing the non-parametric method, evidence of performance persistence is weaker over time, as presented in a decrease of the number which represents the level of performance persistence shown in table 5.4.2. Almost every style shows evidence of performance persistence for all time intervals when measured by alpha and Information ratio. However, the findings vary when measured by excess return and Sharpe ratio for both full time and crisis period.

However, the CPR and Chi-square methods along with the parametric method presented in table 5.4.2 did not produce explicit evidence in support of different degree

of performance persistence between systematic risk exposure styles. It could be implied that different systematic risk management styles may not explain differences in terms of performance persistence

While the CPR and Chi-square methods are to an extent beneficial for investors and fund managers because they help give some clue about future performance based on past performance of a fund, these two methods cannot answer the question whether a fund, if it is now the winner, will continue to win. These are what investors and fund managers pay their attention to. In other words, they care about whether funds with good performance which has persisted over time will remain the winner. The PRW method has therefore been employed for this purpose – to tell the probability that a fund will continue to be the winner over time, and the results show that funds which perform well repeatedly are those with PRW greater than 50%. The higher PRW, the better it is.

In terms of excess return, OMTLSR shows the highest PRW for every time interval except when measured on a half – yearly basis. On the other hand, LSR, MTLSR, and OMTHSR show the level of PRW lower than 50%. Turning to consider the risk – adjusted return performance measurements, the results show that when measured by alpha, OMTLSR style gives superior performance as well as the highest PRW. The OMTHSR style, on the other hand, shows the worst performance as well as the lowest PRW. Both findings are true for all time intervals. The only exception is when the measurement was done on a yearly basis, due to the fact that there was insufficient information for both styles, making the comparison on a yearly basis impossible. These findings of PRW measured by alpha is consistent with those obtained when measured by Information ratio. When measured by Sharpe ratio, MTLSR style produces superior performance to others, and OMTLSR style provides highest PRW. MTHSR provides PRW lower than 50% for all time intervals.

PRW does not tell much when measured in full period since the results are spurious depening on time interval insidered and measurement used, but says more when measured in crisis period. Considering risk-adjusted return performance measurement, MTLSR style produces superior performance and higher PRW. The

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

OMT style, which produces the worst performance, on the other hand, provides the lowest PRW in comparison to other style.

In conclusion, there is evidence in support of performance persistence of hedge fund performance. However, the strength of evidence varies depending on the 8 systematic risk management styles, the performance measurements used, and the time intervals considered. For full period, it is true to an extent that the combined LSR styles (both MTLST and OMTLSR) produces repeated winner's performance due to the higher PRW for all risk adjusted return measurements. However, the pure LSR style does show the highest PRW in comparison to other styles, but its PRW is still greater than 50%. During crisis period, the ability to time the market along with the ability to maintain low systematic risk exposure, represented by the MTLSR style, are necessary skills of fund managers. In contrast, the lack of market timing skills, represented by the OMT is likely to lead to the worst performance and lower probability of repeating winner's performance in comparison to other styles.

Hence, ***Hypothesis III,*** stating that - *Market timing style (MT) promotes superior performance persistence in comparison to the other systematic risk management styles,* - cannot be rejected. In addition, MT style shows superior performance persistence when measured by risk-adjusted return performance measurement in crisis period.

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Table 5.4.2 shows the results of performance persistence measured by Cross Product Ratio (CPR), and Chi-Square. Moreover, Percentage of Repeating winner (PRW) is used to identify which style more frequently repeat the winner's performance. The tests were conducted for both full period (Panel A) and crisis period (Panel B), on monthly, quarterly, half – yearly and yearly bases. The performance measurements used included excess return (Panel 1A, 1B), alpha (Panel 2A, 2B), information ratio (Panel 3A, 3B), and Sharpe ratio (Panel 4A, 4B).

Panel 1A: Excess Return measure

Persistence Measurement	Time interval	MT	OMT	HSR	LSR	MTHSR	MTLSR	OMTHSR	OMTLSR
CPR	Monthly	**1.23**	**1.3**	**1.26**	**1.4**	1.04	**1.34**	1.71	1.46
	Quarterly	**1.31**	**1.41**	**1.64**	1.13	1.21	1.21	1.38	2.59
	Half-yearly	**1.41**	**1.74**	1.25	1.31	**1.62**	0.86		1.2
	Yearly	0.84	**1.65**	1.27	1.86	0.87	0.67		12
Chi-Square	Monthly	**44.28**	**21.21**	**17.25**	**14.26**	0.22	**6.01**	1.18	1.49
	Quarterly	**25.12**	**11.63**	**25.79**	0.59	1.7	0.79	0.09	2.81
	Half-yearly	**19.3**	**13.97**	2.45	1.15	**5.28**	0.23	0.38	0.05
	Yearly	2.22	**4.84**	1.17	2.37	0.21	0.7		2.72
PRW	Monthly	**51.70%**	**54.00%**	**55.60%**	47.10%	**55.20%**	45.00%	46.20%	**57.00%**
	Quarterly	**51.60%**	**55.00%**	**60.00%**	39.20%	**59.70%**	42.80%	33.30%	**64.00%**
	Half-yearly	**51.80%**	**58.10%**	**58.90%**	37.80%	**64.20%**	33.80%	0.00%	**54.50%**
	Yearly	44.30%	**52.20%**	**56.10%**	41.00%	**55.60%**	30.00%		**80.00%**

Panel 2A: Alpha measure

CPR	Monthly	**84.57**	**147.36**	**86.01**	**119.47**	**95.14**	**106.72**	**43.56**	**34.25**
	Quarterly	**31.23**	**49.43**	**37.78**	**41.63**	**26.84**	**32.28**	**20**	**90**
	Half-yearly	**13.62**	**20.58**	**16.35**	**16.88**	**15.79**	**26.12**		9.5
	Yearly	**5.81**	**9.71**	**6.5**	**5.99**	**5.5**	**8.24**		
Chi-Square	Monthly	**10,881.69**	**3,523.07**	**3,455.62**	**1,474.71**	**1,622.24**	**801.46**	**36.32**	**59.66**
	Quarterly	**2,678.17**	**884.52**	**889.97**	**364.68**	**366.1**	**190.44**	**7.29**	**25.4**
	Half-yearly	**871.45**	**291.9**	**286.35**	**111.78**	**135.1**	**85.21**	2.88	2.64
	Yearly	**206.65**	**76.15**	**64.96**	**21.82**	**27.69**	**20.77**		
PRW	Monthly	**90.80%**	**90.70%**	**91.00%**	**90.00%**	**91.90%**	**92.10%**	**72.70%**	**95.10%**
	Quarterly	**85.80%**	**85.20%**	**87.00%**	**84.60%**	**85.60%**	**86.70%**	**62.50%**	**95.70%**
	Half-yearly	**79.60%**	**79.10%**	**82.20%**	**76.20%**	**82.40%**	**85.70%**	**60.00%**	**90.50%**
	Yearly	**71.50%**	**70.70%**	**73.80%**	**63.30%**	**72.90%**	**75.60%**		

Panel 3A: Information ratio measure

CPR	Monthly	**93.72**	**121.58**	**73.79**	**109.44**	**92.9**	**101.72**	**13.75**	**90**
	Quarterly	**34.02**	**42.87**	**40.23**	**35.77**	**39.44**	**39.24**	4.67	**63**
	Half-yearly	**15.36**	**19.1**	**16.48**	**16.44**	**18.36**	**23.55**	3	**54**
	Yearly	**6.84**	**7.05**	**6.96**	**4.35**	**8.11**	**7.88**		
Chi-Square	Monthly	**11,116.07**	**3,401.89**	**3,339.99**	**1,452.39**	**1,615.65**	**793.04**	**19.85**	**92.23**
	Quarterly	**2,760.62**	**845.86**	**909.47**	**346.4**	**422.39**	**203.09**	1.87	**25.81**
	Half-yearly	**930.97**	**281.06**	**288.29**	**110.64**	**146.85**	**81.22**	0.53	**11.19**
	Yearly	**240.84**	**59.67**	**69.31**	**15.43**	**39.83**	**19.68**		
PRW	Monthly	**91.40%**	**89.80%**	**89.90%**	**89.90%**	**91.70%**	**92.10%**	**57.90%**	**96.40%**
	Quarterly	**86.50%**	**84.20%**	**86.70%**	**83.40%**	**87.50%**	**87.80%**	40.00%	**95.50%**
	Half-yearly	**81.20%**	**78.50%**	**81.30%**	**76.30%**	**82.90%**	**85.80%**	**50.00%**	**94.70%**
	Yearly	**73.70%**	**67.60%**	**73.40%**	**61.00%**	**74.00%**	**78.40%**		

Panel 4A: Sharpe ratio measure

CPR	Monthly	**1.3**	**1.24**	**1.21**	**1.27**	1.01	**1.4**	**3**	1
	Quarterly	**1.36**	**1.31**	**1.73**	0.98	1.19	**1.86**		2.58
	Half-yearly	**1.19**	**1.47**	**1.5**	0.79	1.27	1.3		1.2
	Yearly	1.09	1.37	1.47	1.18	0.92	0.96		12
Chi-Square	Monthly	**71.12**	**13.88**	**11.98**	**7.69**	0.02	**8.44**	**4.41**	0
	Quarterly	**32.77**	**7.09**	**31.11**	0.01	1.53	**9.18**	2.63	2.79
	Half-yearly	**5.02**	**6.79**	**7.73**	1.08	1.31	0.79	0.38	0.05
	Yearly	0.58	1.92	2.8	0.22	0.07	0.01		2.72
PRW	Monthly	**53.80%**	**52.50%**	49.40%	**51.50%**	47.40%	**53.90%**	**50.00%**	**51.80%**
	Quarterly	**54.60%**	**52.20%**	**52.00%**	44.20%	47.90%	**59.50%**		**62.50%**
	Half-yearly	**52.90%**	**54.80%**	48.20%	42.90%	46.20%	**55.30%**		**54.50%**
	Yearly	49.70%	**50.40%**	46.60%	46.40%	40.60%	**55.80%**		**80.00%**

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Crisis period

Panel 1B: Excess Return measure

Measurement	Time interval	MT	OMT	HSR	LSR	MTHSR	MTLSR
CPR	Monthly	**1.66**	**1.97**	**1.67**	**1.75**	**1.51**	1.45
	Quarterly	**1.64**	1.22	**3.57**	**2.6**	**2.63**	2.1
	Half-yearly	**1.49**	1.36	**3.38**	1.38	1.57	1.81
	Yearly	1.03	0.94	0.47	1	0.31	0.47
Chi-Square	Monthly	**55.66**	**18.46**	**10.99**	**6.95**	**5.04**	2.61
	Quarterly	**14.03**	0.45	**17.45**	**5.25**	**7.34**	2.48
	Half-yearly	**4.4**	0.44	**7.76**	0.28	0.85	0.85
	Yearly	0.01	0.01	1.78	-	2.89	0.64
PRW	Monthly	**58.00%**	**56.90%**	**63.00%**	**50.60%**	**60.50%**	**54.90%**
	Quarterly	**60.70%**	**52.30%**	**68.40%**	**55.80%**	**65.20%**	**61.10%**
	Half-yearly	**61.00%**	48.40%	**72.50%**	42.10%	**61.10%**	**52.60%**
	Yearly	**59.20%**	33.30%	43.50%	45.50%	40.00%	27.30%

Panel 2B: Alpha measure

CPR	Monthly	**103.7**	**131.62**	**64.55**	**184.62**	**125.4**	**155.21**
	Quarterly	**33.5**	**38.63**	**39.38**	**29.14**	**30.45**	**78.67**
	Half-yearly	**19.78**	**61.11**	**10.8**	**48.56**	**10.5**	**36**
	Yearly	**4.97**	**6.43**	**8.1**	**19.25**	**5.6**	**8.33**
Chi-Square	Monthly	**2,361.82**	**457.03**	**416.31**	**273.75**	**333.24**	**204.2**
	Quarterly	**457.07**	**87.7**	**96.29**	**45.6**	**58.27**	**47.99**
	Half-yearly	**180.61**	**41.85**	**25.6**	**26.87**	**16.37**	**18.43**
	Yearly	**35.64**	**6.91**	**11.01**	**8.56**	**5.44**	**4.43**
PRW	Monthly	**92.10%**	**88.80%**	**90.80%**	**91.70%**	**95.00%**	**96.80%**
	Quarterly	**89.20%**	**75.00%**	**88.10%**	**80.00%**	**91.30%**	**95.20%**
	Half-yearly	**87.00%**	**73.50%**	**80.00%**	**86.40%**	**87.50%**	**93.10%**
	Yearly	**73.30%**	**63.20%**	**77.10%**	**77.80%**	**80.00%**	**83.30%**

Panel 3B: Information ratio measure

CPR	Monthly	**116.02**	**81.27**	**72.89**	**134.64**	**133.64**	**155.21**
	Quarterly	**40.12**	**60.63**	**33.36**	**29.14**	**18.36**	**125.38**
	Half-yearly	**27.35**	**34.4**	**11.18**	**75**	**11.84**	**36**
	Yearly	**5.2**	**5.25**	**7.19**	**11**	**8.55**	**30**
Chi-Square	Monthly	**2,413.75**	**413.47**	**431.38**	**260.3**	**340.69**	**204.2**
	Quarterly	**484.64**	**99.42**	**91.24**	**45.6**	**47.24**	**52.94**
	Half-yearly	**205.05**	**35.89**	**26.53**	**29.8**	**17.78**	**18.43**
	Yearly	**36.31**	**5.55**	**10.56**	**6.04**	**8.4**	**8.8**
PRW	Monthly	**92.40%**	**86.00%**	**90.60%**	**90.60%**	**94.80%**	**96.80%**
	Quarterly	**90.20%**	**77.30%**	**86.80%**	**80.00%**	**88.50%**	**96.70%**
	Half-yearly	**89.20%**	**70.60%**	**80.40%**	**85.70%**	**89.10%**	**93.10%**
	Yearly	**73.80%**	**63.60%**	**74.20%**	**66.70%**	**82.60%**	**85.70%**

Panel 4B: Sharpe ratio measure

CPR	Monthly	**1.5**	**1.59**	1.34	1.31	**1.48**	**1.83**
	Quarterly	**1.43**	1.23	**1.98**	1.18	1.38	**2.99**
	Half-yearly	0.94	1.33	2.33	1	1.01	0.44
	Yearly	1.6	1.36	2.36	0.31	0.29	0.5
Chi-Square	Monthly	**35.38**	**8.61**	3.65	1.69	**4.64**	**6.67**
	Quarterly	**7.05**	0.44	**5.21**	0.16	0.82	**5.06**
	Half-yearly	0.11	0.35	3.83	-	0	1.2
	Yearly	3.3	0.16	1.87	1.69	3.28	0.47
PRW	Monthly	**57.90%**	**51.40%**	**55.80%**	**53.40%**	**54.20%**	**62.70%**
	Quarterly	**60.80%**	45.60%	**54.30%**	**51.90%**	49.10%	**70.20%**
	Half-yearly	**57.70%**	39.30%	**58.30%**	**50.00%**	**51.60%**	**59.30%**
	Yearly	**65.00%**	33.30%	46.70%	38.50%	33.30%	**50.00%**

Remarks:

The **bold numbers** in CPR and Chi-square are those that show statistical significance level at 95% confident level.

The **bold numbers** in PRW are those which are greater than the threshold of 50%.

The blue highlight are those which show the superior performance persistence relative to other styles.

The yellow highlight are those which show the worst performance persistence relative to other styles.

The blue fonts are highlighted for those styles which have superior performance for given a performance measurement in section 5.3.

The red fonts are highlighted for those styles which have the worst performance for given a performance measurement in section 5.3.

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

Chapter 5
Conclusion

A common understanding about hedge fund is that market neutral investment can generate all the time positive return in any market conditions. In fact, there are a significant number of hedge fund literatures which show evidence against this statement. In these literatures, hedge fund returns are exposed to the market risk, the level of which depends largely on the strategy employed and market conditions.

The market risk or the systematic risk is one important factor determining hedge fund performance, this statement has been proved to valid in many of empirical studies. However, there are various styles of systematic risk exposure, defined as "the pattern of portfolio's systematic risk exposure over different market conditions", for example, maintaining level of systematic risk exposure or considering the market timing. Given the fact that each systematic risk exposure style can differ greatly from one to another, one cannot conclude that one style outperforms others unless proved.

In response to this research gap, this study aims to explore the extent to which different of systematic risk exposure style affect performance and performance persistence of hedge fund. As levels of systematic risk exposure differ according to different management styles among hedge fund managers, the author therefore categorized levels of systematic risk exposure based on management styles and conducted the test under different market environment (full period and crisis period). The final question to ask, therefore, is "which systematic risk exposure style promotes superior performance and performance persistence of hedge funds?"

The samples studied are Global Hedge Funds from the period of January 2000 to December 2017. After scoping down to Directional Equity hedge funds and adjusting for potential data biases, samples of 1,441 hedge funds were classified into 8 styles based on 3 major categories; the first being based on the concept of market timing (MT and OMT), the second based on the level of maintaining systematic risk exposure (HSR and LSR). Funds which could be put under both of these two criterias, were put in the third category, which is called Combined-based. Styles in the third category is sub-divided into 4 groups (MTHSR, MTLSR, OMTHSR, and OMTLSR). Other funds that

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

cannot be classified based on the mentioned criteria were excluded from this study. As a result, the criterion excluded 1,018 samples irrelevant to the research question. Therefore, remaining 423 samples were considered.

The findings show that systematic risk is an important factor explaining hedge fund returns, especially during crisis period. During full period, LSR style - a systematic risk exposure style which disregards market timing - leads superior performance. MT style, on the other hand, does not show superior performance as hypothesized. However, during the crisis period, Market Timing strategy turns out to be a necessary factor leading to outperformance of the funds. This finding is supported by the outperformance of MT style regardless of maintained level of systematic risk exposure of the funds.

The outperformance of LSR style (in full period sample) in this finding challenges the principle of standard Capital Asset Pricing Model (CAPM) which states that the expected excess return on a security is equal to its level of systematic risk, beta, times the expected excess return on the market portfolio. However, empirical evidence in this research found that it may not always be the case. High beta securities might not always produce higher return as expected but rather low beta securities. This phenomena is called “Low - volatile anomaly”, which has been proved by many of empirical studies.

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Conducting the test to answer does the fund performance persist over time? Using both parametric and non-parametric method, there is evidence in support of performance persistence of hedge fund. However, the strength of evidence varies depending on the 8 systematic risk management styles, the performance measurements used, and the time intervals considered. For full period, it is true to an extent that the combined LSR styles (both MTLST and OMTLSR) produces the higher of probability in repeating winner’s performance. Considering the LSR style alone, it does not show the highest PRW in comparison to other styles, however, its PRW is still greater than 50%. During crisis period, the ability to time the market along with the ability to maintain low systematic risk exposure, represented by the MTLSR style, are necessary

skills of fund managers. In contrast, the lack of market timing skills, represented by the OMT is likely to lead to the worst performance and lower probability of repeating winner's performance in comparison to other styles.

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

REFERENCES

Abdou, Khaled, and Mahdi Nasereddin. "The Persistence of Hedge Fund Strategies in Different Economic Periods: A Support Vector Machine Approach." *Journal of Derivatives and Hedge Funds* 17 (2011): 2-15.

Agarwal, Vikas, and Narayan Y Naik. "Multi-Period Performance Persistence Analysis of Hedge Funds." *Journal of Financial and Quantitative Analysis* 35 (2000): 327-42.

Asness, Clifford, Robert Krail, and John Liew. "Do Hedge Funds Hedge?". *The Journal of Portfolio Management* 28 (2001): 6-19.

Bali, Turan G., Stephen J. Brown, and Mustafa O. Caglayan. "Macroeconomic Risk and Hedge Fund Returns." *Journal of Financial Economics* 114 (2014): 1-19.

Bali, Turan G., Stephen J. Brown, and Mustafa Onur Caglayan. "Do Hedge Funds' Exposures to Risk Factors Predict Their Future Returns?". *Journal of Financial Economics* 101 (2011): 36-68.

Bali, Turan G., Stephen J. Brown, and Mustafa Onur Caglayan. "Systematic Risk and the Cross Section of Hedge Fund Returns." *Journal of Financial Economics* 106 (2012): 114-31.

Black, Fischer, Michael C. Jensen, and Myron Scholes. "The Capital Asset Pricing Model: Some Empirical Tests." (1972): 1-52.

Brown Stephen J, William N Goetzmann, Roger G Ibbotson. "Offshore Hedge Funds: Survival & Performance 1989 - 1995." *Survival* (1998).

Chen, Yong. "Timing Ability in the Focus Market of Hedge Funds." *Journal of Investment Management* 5 (2007): 66-98.

Chen, Yong, and Bing Liang. "Do Market Timing Hedge Funds Time the Market?". *Journal of Financial and Quantitative Analysis* 42 (2007): 827.

Ferson, Wayne E., and Rudi W. Schadt. "Measuring Fund Strategy and Performance in Changing Economic Conditions." *The Journal of Finance* 51 (1996): 425.

Frazzini, Andrea, and Lasse H Pedersen. "Betting against Beta." 111 (2011): 1-25.

Fung, Hung Gay, Xiaoqing Eleanor Xu, and Jot Yau. "Global Hedge Funds: Risk, Return, and Market Timing." *Financial Analysts Journal* 58 (2002): 19-30.

Fung, William, and David A. Hsieh. "Empirical Characteristics of Dynamic Trading Strategies: The Case of Hedge Funds." *Review of Financial Studies* 10 (1997): 275-302.

Fung, William, and David A. Hsieh. "Hedge-Fund Benchmarks: Information Content and Biases." *Financial Analysts Journal* 58 (2002): 22-34.

Fung, William, and David A. Hsieh. "The Risk in Hedge Fund Strategies: Theory and Evidence from Rrend Followers." *The Review of Financial Studies* 18 (2001): 313-41.

Huang, Ying Sophie, Carl R. Chen, and Isamu Kato. "Different Strokes by Different Folks: The Dynamics of Hedge Fund Systematic Risk Exposure and Performance." *International Review of Economics and Finance* 48 (2017): 367-88.

Kacperczyk, Marcin, Stijn Van Nieuwerburgh, and Laura Veldkamp. "Time-Varying Fund Manager Skill." *Journal of Finance* 69 (2014): 1455-84.

Lo, A. "Hedge Funds, Systemic Risk, and the Financial Crisis of 2007–2008." (2008).

Namvar, Ethan, Blake Phillips, Kuntara Pukthuanthong, and P. Raghavendra Rau. "Do Hedge Funds Dynamically Manage Systematic Risk?". *Journal of Banking and Finance* 64 (2016): 1-15.

Patton, Andrew J. "Are "Market Neutral" Hedge Funds Really Market Neutral?". *Review of Financial Studies* 22 (2009): 2495-530.

Sun, Z, Aw Wang, and Lu Zheng. "Hedge Fund Performance Persistence over Different Market Conditions." *Ckgsb.Edu.Cn* (2014).

Tudor, Deniz, and Bolong Cao. "The Absolute Returns of Hedge Funds." *Managerial Finance* 38 (2012): 280-302.

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

APPENDIX

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Appendix 1: the Contingency table reports the performance of individual hedge fund by style for full time (Panel 1) and crisis period (Panel 2). Individual fund performance is classifed into the winner and the loser. At time t, the winner funds are those funds with performance higher than the median performance of all fund following the Directional Equity strategy, the otherwise are the loser. Funds that are winner (loser) in two consecutive periods, denoted by WW (LL). As opposed to the repeated performer, the non-repeated performer are those funds which are classified as the winner in the first period, and the loser in the consecutive period WL, and vice versa (LW). The performance measurements employed include excess return (Panel 1A, 1B), alpha (Panel 2A, 2B), Sharpe ratio (Panel 3A, 3B), and Information ratio (Panel 4A, 4B). The time intervals include monthly, quarterly, half-yearly, and yearly.

Panel 1: Full period

Panel 1A: Excess return

Time interval		MT	OMT	HSR	LSR	MTHSR	MTLSR	OMTHSR	OMTLSR
Monthly	WW	4,256	1,340	1,562	427	736	217	12	49
	WL	3,983	1,143	1,246	479	598	265	14	37
	LW	4,011	1,164	1,261	480	610	266	16	38
	LL	4,609	1,291	1,264	752	515	436	32	42
Quarterly	WW	1,369	437	553	103	275	68	2	16
	WL	1,285	358	369	160	186	91	4	9
	LW	1,292	370	380	153	190	88	4	11
	LL	1,589	427	416	269	155	142	11	16
Half-yearly	WW	659	209	259	42	145	24	-	6
	WL	612	151	181	69	81	47	1	5
	LW	601	166	186	62	84	44	2	6
	LL	786	209	163	133	76	74	5	6
Yearly	WW	254	82	96	16	55	9	-	4
	WL	320	75	75	23	44	21	-	1
	LW	312	63	86	24	46	23	-	1
	LL	331	95	85	64	32	36	1	3

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

Panel 1B: Alpha

Time interval	Style	MT	OMT	HSR	LSR	MTHSR	MTLSR	OMTHSR	OMTLSR
Monthly	WW	8,200	1,773	2,576	818	1,295	596	16	137
	WL	835	181	254	91	114	51	6	7
	LW	814	186	264	86	112	53	3	8
	LL	7,010	2,798	2,239	1,143	938	484	49	14
Quarterly	WW	2,572	525	787	252	393	182	5	45
	WL	427	91	118	46	66	28	3	2
	LW	410	102	122	45	63	30	1	1
	LL	2,126	874	691	342	284	149	12	4
Half-yearly	WW	1,146	219	346	99	192	84	3	19
	WL	294	58	75	31	41	14	2	2
	LW	271	71	81	28	35	17	-	1
	LL	947	387	287	148	118	74	3	1
Yearly	WW	477	70	135	38	78	34	-	8
	WL	190	29	48	22	29	11	1	-
	LW	166	43	48	15	23	12	-	1
	LL	384	173	111	52	47	32	-	-

Panel 1C: Sharpe ratio

Time interval	Style	MT	OMT	HSR	LSR	MTHSR	MTLSR	OMTHSR	OMTLSR
Monthly	WW	4,584	1,284	1,225	535	545	317	11	44
	WL	3,934	1,162	1,253	504	604	271	11	41
	LW	3,947	1,176	1,276	500	618	271	13	42
	LL	4,394	1,316	1,579	599	692	325	39	39
Quarterly	WW	1,532	396	386	136	174	125	-	15
	WL	1,272	362	356	172	189	85	6	9
	LW	1,282	380	376	168	193	79	5	11
	LL	1,449	454	600	209	250	100	10	17
Half-yearly	WW	711	184	157	60	73	57	-	6
	WL	633	152	169	80	85	46	1	5
	LW	638	180	177	81	92	42	2	6
	LL	676	219	286	85	136	44	5	6
Yearly	WW	299	71	54	26	28	29	-	4
	WL	303	70	62	30	41	23	-	1
	LW	292	74	84	30	46	21	-	1
	LL	323	100	142	41	62	16	1	3

Panel 1D: Information ratio

Time interval	Style	MT	OMT	HSR	LSR	MTHSR	MTLSR	OMTHSR	OMTLSR
Monthly	WW	8,428	1,734	2,449	843	1,274	609	11	135
	WL	795	197	274	95	115	52	8	5
	LW	776	203	282	90	114	54	5	6
	LL	6,860	2,804	2,328	1,110	956	469	50	20
Quarterly	WW	2,622	515	749	246	391	194	2	42
	WL	409	97	115	49	56	27	3	2
	LW	397	108	119	48	54	26	2	2
	LL	2,107	872	735	342	305	142	14	6
Half-yearly	WW	1,195	216	325	103	189	91	2	18
	WL	277	59	75	32	39	15	2	1
	LW	260	74	81	28	33	17	1	1
	LL	926	386	308	143	125	66	3	3
Yearly	WW	499	71	127	36	77	40	-	8
	WL	178	34	46	23	27	11	1	-
	LW	157	48	48	18	19	12	-	1
	LL	383	162	121	50	54	26	-	-

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Panel 2: Crisis period

Panel 2A: Excess return

Time interval	Style	MT	OMT	HSR	LSR	MTHSR	MTLSR	OMTHSR	OMTLSR
Monthly	WW	1,053	177	238	84	161	84	-	-
	WL	763	134	140	82	105	69	-	-
	LW	768	138	160	75	114	67	-	-
	LL	924	206	157	128	112	80	-	-
Quarterly	WW	318	45	65	24	43	33	-	-
	WL	206	41	30	19	23	21	-	-
	LW	199	44	34	18	27	12	-	-
	LL	212	49	56	37	38	16	-	-
Half-yearly	WW	164	15	37	8	22	10	-	-
	WL	105	16	14	11	14	9	-	-
	LW	102	20	18	10	16	8	-	-
	LL	97	29	23	19	16	13	-	-
Yearly	WW	93	5	10	5	6	3	-	-
	WL	64	10	13	6	9	8	-	-
	LW	55	8	18	5	15	4	-	-
	LL	39	15	11	6	7	5	-	-

Panel 2B: Alpha

Time interval	Style	MT	OMT	HSR	LSR	MTHSR	MTLSR	OMTHSR	OMTLSR
Monthly	WW	1,693	238	384	144	323	214	-	-
	WL	145	30	39	13	17	7	-	-
	LW	169	22	36	12	20	13	-	-
	LL	1,501	365	236	200	132	66	-	-
Quarterly	WW	447	51	96	32	84	59	-	-
	WL	54	17	13	8	8	3	-	-
	LW	86	8	12	7	10	4	-	-
	LL	348	103	64	51	29	16	-	-
Half-yearly	WW	200	25	44	19	42	27	-	-
	WL	30	9	11	3	6	2	-	-
	LW	60	2	10	3	8	3	-	-
	LL	178	44	27	23	12	8	-	-
Yearly	WW	85	12	27	7	20	10	-	-
	WL	31	7	8	2	5	2	-	-
	LW	48	4	5	2	5	3	-	-
	LL	87	15	12	11	7	5	-	-

Panel 2C: Sharpe ratio

Time interval	Style	MT	OMT	HSR	LSR	MTHSR	MTLSR	OMTHSR	OMTLSR
Monthly	WW	1,084	151	198	101	129	104	-	-
	WL	787	143	157	88	109	62	-	-
	LW	784	144	165	84	113	64	-	-
	LL	853	217	175	96	141	70	-	-
Quarterly	WW	326	31	44	27	26	40	-	-
	WL	210	37	37	25	27	17	-	-
	LW	208	45	39	22	32	11	-	-
	LL	191	66	65	24	46	14	-	-
Half-yearly	WW	154	11	21	14	16	16	-	-
	WL	113	17	15	14	15	11	-	-
	LW	119	17	21	10	19	10	-	-
	LL	82	35	35	10	18	3	-	-
Yearly	WW	93	4	7	5	5	7	-	-
	WL	50	8	8	8	10	7	-	-
	LW	58	7	10	6	14	4	-	-
	LL	50	19	27	3	8	2	-	-

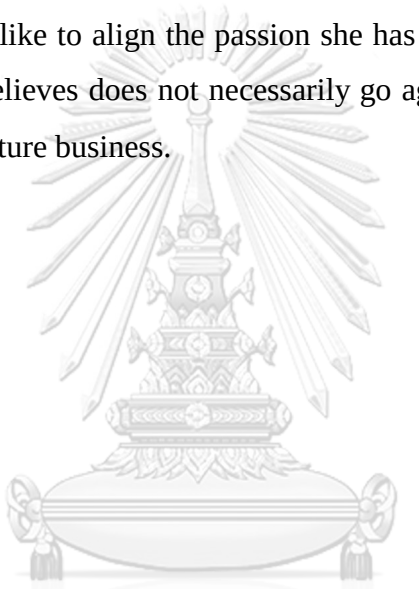
Panel 2D: Information ratio

Time interval	Style	MT	OMT	HSR	LSR	MTHSR	MTLSR	OMTHSR	OMTLSR
Monthly	WW	1,655	222	365	145	307	214	-	-
	WL	136	36	38	15	17	7	-	-
	LW	163	28	34	14	20	13	-	-
	LL	1,554	369	258	195	148	66	-	-
Quarterly	WW	444	51	92	32	77	59	-	-
	WL	48	15	14	8	10	2	-	-
	LW	83	6	13	7	13	4	-	-
	LL	360	107	66	51	31	17	-	-
Half-yearly	WW	199	24	41	18	41	27	-	-
	WL	24	10	10	3	5	2	-	-
	LW	57	3	11	2	9	3	-	-
	LL	188	43	30	25	13	8	-	-
Yearly	WW	76	14	23	6	19	12	-	-
	WL	27	8	8	3	4	2	-	-
	LW	52	4	6	2	5	1	-	-
	LL	96	12	15	11	9	5	-	-

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

VITA

Prapakan Pimpasan was graduated from Thammasat University in Economics. By the time she finished the bachelor degree, she had realized the problem underlying Thai education and realized that someone had to take an action. Despite the fact that her attempt may have been just a drop in the ocean, she decided to join the fellowship of Teach for Thailand. Afterwards, she worked as a researcher at Thailand Development Research Institute in the field of educational research. In the future, she would like to align the passion she has towards finance with social benefits, which she believes does not necessarily go against each other, and is the sustainable way for future business.



จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY