12-2016

Gender effects in hedge funds performance

Karen Yoke Wah GAN
Singapore Management University, ywgan.2012@phdgm.smu.edu.sg

Gender Effects in Hedge Funds Performance

GAN YOKE WAH, KAREN

SINGAPORE MANAGEMENT UNIVERSITY
2016

Gender Effects in Hedge Funds Performance

by

Gan Yoke Wah, Karen

Submitted to Lee Kong Chian School of Business in partial fulfillment of the requirements for the Degree of Doctor of Philosophy in Business (General Management)

Dissertation Committee:

Philip Charles Zerrillo (Chair)
Professor of Marketing (Practice)
Singapore Management University

Lim Kian Guan
Professor of Finance
Singapore Management University

Lim Chu Yeong
Associate Professor
Singapore Institute of Technology

Singapore Management University
2016

Gender Effects in Hedge Funds Performance

GAN YOKE WAH, KAREN

Abstract

This paper shows that after controlling for total risks (as funds do not typically hold a completely large diversified portfolio) across different funds, female-managed funds appear to perform better in certain circumstances. For example, female-managed hedge funds perform better during post-crisis times, for investments using the Relative Value Style and also when investments are in the Asia excluding Japan region. However, there are still many conditions in which male-managed funds seem to perform better. Namely, male-managed funds performed significantly positive in the Relative Value, Security Selection, and Multiprocess Styles, notably during the pre-crisis period and also when investments are in the "America" and "Others" regions. The study also shows that females definitely do not like to take risks and female-managed funds have lesser inflows relative to male-managed funds, especially when the funds' returns are small. Moreover, fund flows into and out of female-managed funds are more sensitive to the return outcomes.

Table of Contents

Acknowledgements

I would like to express my sincere gratitude to my research supervisors Professor Philip Charles Zerrillo, Professor Lim Kian Guan and Associate Professor Lim Chu Yeong. They have been most supportive and encouraging throughout the project. Their guidance and support has been a significant factor in the completion of this project. Many thanks for their invaluable comments and advice in the process of preparing this dissertation.

1. Introduction

In today's world, top positions in politics, business and finance are occupied by women. Famous names such as Angela Merkel: Germany's Chancellor, Janet Yellen: Federal Reserve's Chairman and former US Secretary of State, Hillary Clinton, occupy top positions on Forbes' list of most powerful women year after year. Despite these apparent gains, inequality between men and women still exists today. Based on the World Economic Forum's 2015 Global Gender Gap Report, not a single country in the world has managed a perfect score of one which indicates perfect gender equality in terms of education and economic opportunities.

This disparity in opportunities is well-known in the financial world. This is an industry where men still occupy the majority of the most senior and powerful positions today. The Morningstar Report on Fund Managers by Gender in June 2015 showed that the incidence of female fund managers is rare. Women are so under-represented, that they constitute only 9.4% of all US mutual fund managers. As I show in this study, the scarcity of female managers can also be seen in the hedge fund industry, as participation is approximately 1%. So, where are the female fund managers? This question makes gender an interesting area of investigation for both practitioners and researchers.

This study investigates the effects of gender in the hedge fund industry and seeks to provide a better understanding and potential reasons for justifying the current shortage of female hedge fund managers. The hedge fund industry is an interesting arena to study gender effects, since it is similar to the mutual fund industry. There are several mutual funds studies on gender (eg. Bliss & Potter, 2002; Niessen-Ruenzi & Ruenzi, 2015).

Niessen-Ruenzi & Ruenzi (2015) report that investor bias towards the female gender is the reason for the lack of females. The study advances that the absence of female fund managers is due to their inability to attract inflows into the fund. Due to this inability to attract resources, females tend not to be as preferred by hiring companies as do their male counterparts.

Money flows into a fund are famously linked to its performance. This performance-flow relationship is well-known to be positive (eg. Sirri & Tufano, 1998; Chevalier & Ellison (1997). However, Niessen-Ruenzi & Ruenzi (2015) did not show that there is a difference in performance when female fund managers are compared to the males and continued to explain that the lower inflows into female-managed funds are simply due to gender biases.

Following from the above studies on mutual funds, I examined the gender-performance relationship as a starting point for hedge funds. Theoretically, performance has always been the main cause for why managers are chosen or not.

I tested the relationship between the presence of female managers in a fund and the fund performance. If good performance usually attracts money flows into a fund (eg. Sirri & Tufano, 1998), one reason for the dearth of female hedge fund managers may be due to their dull performance.

In line with the above, this study also looks at whether flows into a hedge fund are lower whenever it is managed by a woman. My results show that female-managed funds have lesser inflows relative to male-managed funds, especially when the funds' returns are small. Succinctly stated, fund flows into and out of female-managed funds are more sensitive to the return outcomes.

At the same time, I found that female-managed funds do not appear to underperform, after controlling for total risks of the funds, using both the Fama-MacBeth (1973) and time-series Portfolio Approaches. Total risk across funds is controlled because I recognise that funds do not typically hold a completely large diversified portfolio.

The recent 2008 global financial crisis sent financial markets into mayhem. In order to examine whether female managers' performance varies before and after this financial crisis, I tested the performance relationship for both periods. The results are fascinating, indicating that female-managed funds actually perform better on a risk-adjusted basis during the post-crisis times, suggestive of female hedge fund managers being more conservative and cautious after the global financial crisis.

I also introduced interaction variables into the performance relationship, exploring whether female-managed hedge funds perform differently for certain geographical mandates and investment styles. I found that there are some circumstances for which female-managed funds tend to perform well. Notwithstanding this, there are still a number of conditions whereby fund performance for male fund managers is better.

To probe deeper into the performance of female hedge fund managers, I investigated their risk-taking behaviour relative to the male managers. I found that females take on lower risks, which is in accordance with previous studies (eg. Byrnes et al., 1999). Moreover, I explored whether female hedge fund managers are more or less distinct in their strategies when managing their funds and found that they are less distinctive than their male peers.

To continue examining the performance of female-managed hedge funds, I found assorted results when fund characteristics are varied. This means that when we control for the level of certain fund characteristics, female-managed funds perform differently. I looked at three hedge fund characteristics to segment all of the funds into several classifications and performed a simple test of the difference in means for both before and post peak of the 2008 financial crisis to gauge female-managed hedge fund performance relative to male-managed funds. The results are notable. Female-managed hedge funds tended to perform better on a risk-adjusted basis during the post crisis time period. These results are consistent

with the earlier basic performance results. Again, I also recognise that male-managed hedge funds still perform better in many circumstances.

This study makes striking contributions to the literature on hedge funds as well as gender research in psychology. The existing hedge funds literature explored many fund characteristics and their effects on performance but there is a limited focus on gender. Hence, this study adds to the list of variables to better understand the determinants of hedge fund performance.

Moreover, this study contributes to the psychology literature on how the presence of different traits determines the way female fund managers and male fund managers behave, applied to a hedge fund setting. One such trait is explained by risk-taking papers such as Byrnes et al. (1999), which found females to be more risk-averse. In this study, I found evidence that female-managed hedge funds perform better than male-managed funds during times of uncertainty most notably during the post-global financial crisis. This may be because female fund managers are likely to be more cautious and conservative in their investment behaviour during these volatile times.

The remainder of this paper is organised as such: Section 2 reviews the current literature and structures the hypotheses. Section 3 describes the data, the variables used in this study and the methodology. Section 4 presents the results and finally Section 5 concludes with a discussion of the results.

2. Literature Review and Hypotheses

2.1 Determinants of Hedge Fund Performance

Hedge fund performance has been well studied. Studies have investigated various issues that may determine how a hedge fund performs. Some investigated biases and how they should be recognised while examining hedge fund performance (Fung & Hsieh, 2000). Several studies investigated performance benchmarks to better understand hedge fund returns (Fung & Hsieh, 2001; 2002a; 2002b; 2004). Agarwal et al (2009) analysed how the incentives provided to managers and other characteristics involving redemption terms affect hedge fund performance.

This study aims to contribute to this line of research on hedge fund performance by also looking at the gender of managers and their performance across a number of performance variables.

2.2 Gender

There are limited studies on the relationship between gender and hedge fund performance. A recent paper (Aggarwal & Boyson, 2015) studied this relationship and found that there is no difference in performance between females and males. The current study differs from the work of Aggarwal & Boyson, as different variables were used to investigate the gender effects on hedge fund performance. Firstly, my performance measure as the dependent variable is different as I apply

the Fung & Hsieh (2004) seven-factor model when estimating my Alpha measure. This method of estimating Alpha is used by many hedge fund studies (eg. Teo, 2011). I also control for riskiness of the funds when using the Alpha measure, so that the performance measure becomes risk-adjusted. Moreover, I segregated the total evaluation period into two subsamples: pre and post 2008 financial crisis periods. All of these measures and controls will be explained in greater details in the methodology section.

Another measure of performance also employed in this study is the Appraisal Ratio. This measure looks at the performance of the individual fund while taking into account the riskiness of all the funds in the portfolio. The Appraisal Ratio will be used for the Triple Sorts tests later in the paper. The Appraisal Ratio has previously been used in mutual fund studies (eg. Brown et al., 1992).

Further, I used various other dependent variables, such as (1) strategy distinctiveness, (2) risks and (3) flow, to examine the performance of female hedge fund managers. The database employed in this study is also different from that of Aggarwal & Boyson (2015). Additionally, and most importantly, the way I measure the Gender variable is also different. The operationalization of these characteristics will be explained in detail during later sections of this study.

In the Psychology literature, there is a stream of studies attempting to explain the difference in gender performance. For instance, it has been advanced that females

are brought up differently (eg. Hoffman, 1991) and assigned different roles as a child (Goodnow, 1988). These roots mould men and women differently influencing how they behave. One study documents that women are inflicted by the "Stereotype Threat" (Spencer et al., 1999), such that they think they are scrutinised in tasks that they generally do not excel. In that study, women unperformed in math tests when told they usually underperform. This study suggests that the possibility of being likened to the stereotype of losing builds an added pressure on women, such that their actual performance is affected. In lay terms, it is advanced that females choke under pressure when the stakes are higher.

Gneezy et al. (2003) further investigated this in competitive environments and found that women tend to underperform more than men when there is competition. Fryer et al. (2008) also added to the Stereotype Threat literature by looking at how the presence of financial rewards tend to further increase the stress levels of women during performance.

There are several studies on gender differences in the finance literature. Besides the recent work of Aggarwal & Boyson (2015) mentioned above, other studies include Atkinson et al. (2003), who found that investors put less money with mutual funds managed by females. Niessen-Ruenzi & Ruenzi (2015) explained that the lower inflows into female-managed funds is because investors may be subject to biases towards females. The finding of a bias is further supported when matched with the work of Kumar (2010) who found that female equity analysts

provided more accurate forecasts than their male counterparts. Additionally, Wolfers (2006) analysed performance of stocks of firms headed by females and males and found no significant differences.

2.3 Risks

It is well-documented in the literature, both finance and psychology, that women do not like risks. Barsky et al. (1997) examined risk preferences of their respondents with different habits and from different demographic groups. They found that males tolerate risks more than females. Byrnes et al. (1999) performed a meta-analysis of 150 similar studies and concluded that females are more risk-averse. Wilson & Daly (1985) explained that men tend to compete more and hence will take more risks while doing so.

Powell & Ansic (1997) found that females tend to take lower risks in making financial decisions, even in tasks they are familiar with. Linking to financial markets, Barber & Odean (2001) found that males trade more than females because males are overconfident, and not simply because they take more risks. Huang & Kisgen (2013) found the same story on overconfidence in the corporate finance world, showing that females actually make lesser acquisitions than men and also issue lesser debt.

The current literature supports the claim that females generally are less of a risk taker. Accordingly, Hypothesis 1 is as follows:

Hypothesis 1: Female hedge fund managers take lesser risks.

In this study, I control for risks and then test the performance of female-managed hedge funds. Hence, my Hypothesis 2 will be as follows:

Hypothesis 2: Female-managed hedge funds underperform on a risk-adjusted basis.

2.4 Strategy Distinctiveness

According to current social research, women tend to favour communal behaviour, whereas men are more individualistic and independent (eg. Josephs et al., 1992; Cross & Madson, 1997). Many studies summarise how women care more about the group relationships while men are tougher due in part to their family upbringing and environment (eg. Hoffman, 1991).

It follows that if women are less independent, they are more likely to adopt common strategies used by all their counterparts. On the other hand, since men are more independent in their thinking and at the same time, overconfident (Barber &

Odean, 2001), such that they believe in the accuracy of their undertakings, they are more likely to adopt more distinctive strategies when managing hedge funds.

Sun et al. (2012) explained in their study on hedge funds that when unique strategies that are distinct from others are adopted, the fund will enjoy greater performance. I propose that fund managers who are female tend to be less independent, more risk-averse and therefore are more likely to assume less distinct strategies. My Hypothesis 3 is as follows:

Hypothesis 3: Female hedge fund managers engage in less distinctive strategies.

2.5 Performance-Flow

Many studies examined money flows into a fund. Goetzmann et al. (2003) found that investors take money out of large hedge funds. Kumar et al. (2015) found that mutual funds with managers that have less familiar-sounding names attract lower money flows. Lan et al. (2013) looked at performance-induced flows as part of their model on hedge fund dynamics. Niessen-Ruenzi & Ruenzi (2015) found that investors put less money with mutual funds managed by women.

Following from these studies, I test whether the lesser flows apply to Female-managed hedge funds too. Hence, Hypothesis 4 is as follows:

Hypothesis 4: Female-managed hedge funds have lower money inflows.

3. Data and Methodology

3.1 Data

The data used to investigate these hypotheses comes from Eurekahedge database for the period January 1994 to October 2014. The data contains information on hedge fund characteristics, performance and assets under management for 16,606 hedge funds. This dataset includes both live and dead funds and hence survivorship bias is allayed. The reason why this database is selected is because it contains the hedge fund managers' biography which is important for my study. It is important to note, a recent paper, Aggarwal & Boyson (2015), which also focused on female hedge fund managers, used a different dataset from Thomson-Reuters.

There is a total of 16,606 funds in the database, however, only 13,909 funds has information on returns and assets under management. Out of this, 7,593 are live and 6,316 are dead. Other information used in my analysis include characteristics such as fees (both management and performance), size of the fund, notice period for redemption, style of investment, region where the fund invests, fund age since inception and minimum investment amount. For the minimum investment amount, in order to use US dollars as the base denomination, I use exchange rates as at end of October 2014 to convert those that are reported in the database as non-US dollars.

All funds in my dataset are classified into a total of five investment styles. The first four investment styles are consistent with those documented by Agarwal et al., (2009), namely Relative Value, Security Selection, Directional Traders and Multiprocess. I have also included an Others category to capture the funds that cannot easily be classified into the four Styles. The four styles are unique in their own ways. Those that adopt the Relative Value style, target lesser market exposure taking positions on relationships of the spread between financial assets' prices. Security Selection takes positions in undervalued and overvalued assets. The Directional Traders strategy speculates on the price trend of various securities. And finally the Multiprocess style adopts numerous strategies investing in significant events, for example, mergers and acquisitions. I also classify all funds in my dataset into five geographical investment regions. They are namely, America, Europe, Asia including Japan, Asia excluding Japan, and Others.

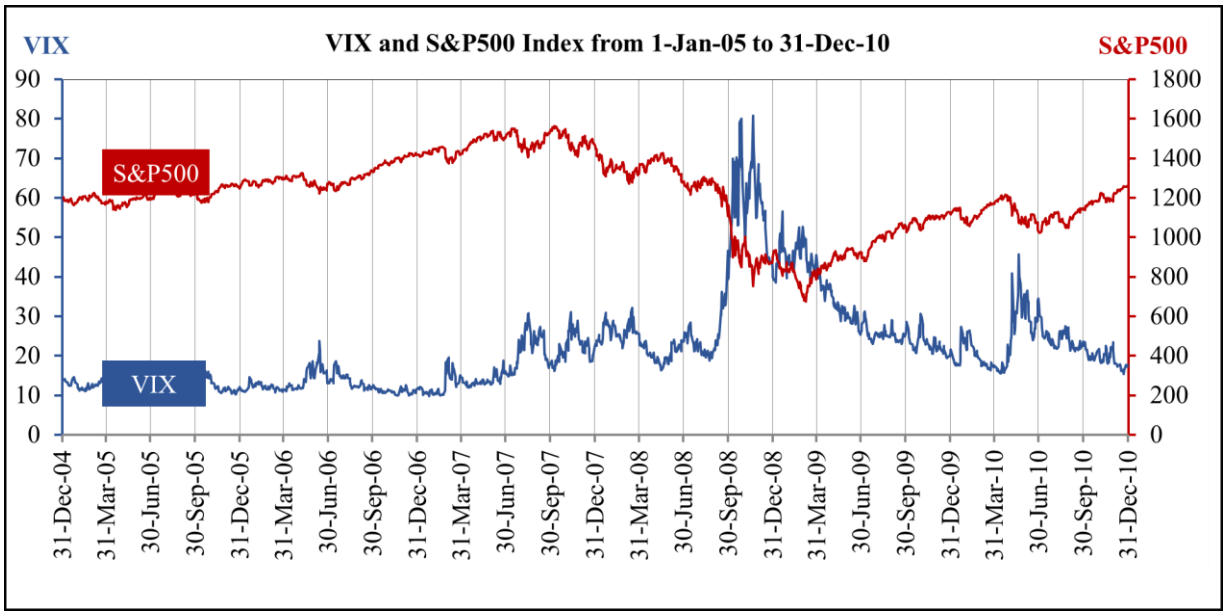
Further, to investigate whether there are differences in the performance of female-managed hedge funds during the pre and post 2008 financial crisis time periods, I segment the total evaluation period into two subsamples: pre-crisis period (January 1997 to August 2008) and post-crisis period (September 2008 to October 2014). The time surrounding September 2008 was recognised by many previous studies as the peak of the financial crisis (eg. Campello et al., 2010; Santos, 2011). In line with these previous studies, I use September 2008 to partition my total evaluation period, as there are heightened sensitivities to systemic risks after this date.

As shown by Figure 1 below, there is a significant fall in the S&P500 index and a spike in the VIX[1] index surrounding the month of September 2008, presenting evidence that this is the height of the financial crisis. Also, as shown in Figure 2, the volatility of the funds in my analysis (as represented by the average of the standard deviation of all the funds' excess returns for the past 12 months) escalated from September 2008. In combination these findings further justify the partitioning of the data.

[1] VIX represents the Chicago Board Options Exchange ("CBOE") Volatility Index for S&P500 index options

Figure 1: VIX and S&P 500 indices

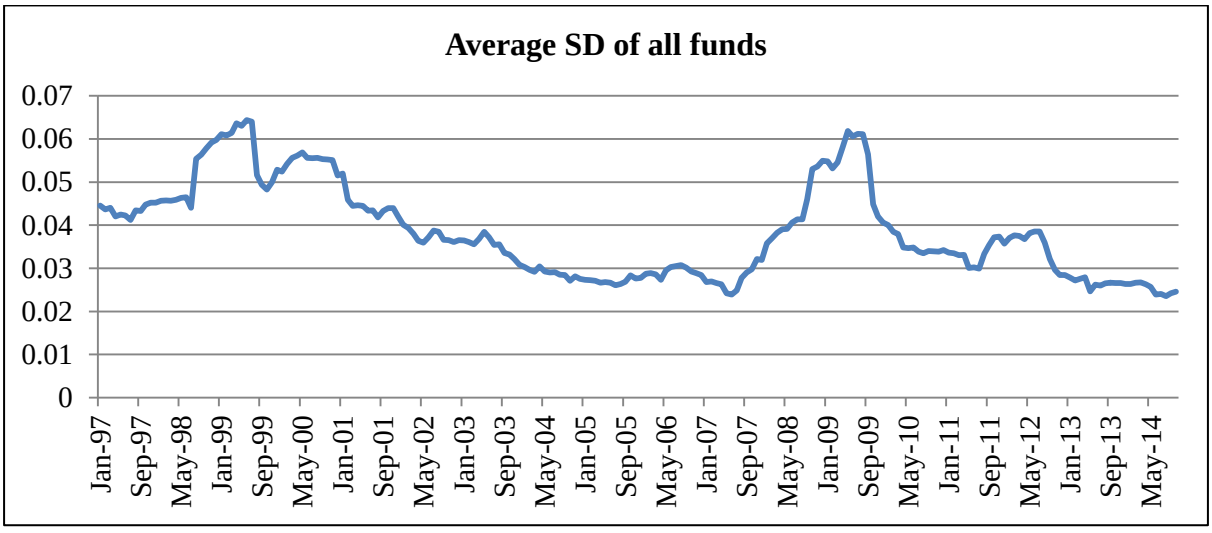
Figure 1 shows the VIX Index and the S&P500 index, highlighting the peak of the financial crisis during September 2008.



Source: Yahoo Finance

Figure 2: Average Standard Deviation of all funds

Figure 2 shows the average standard deviation of all the funds for my evaluation period.



Source: Eurekahedge database (www.eurekahedge.com)

3.2 Key variables

3.2.1 Gender Measure

The gender variable is obtained from analysing the biography of the managers provided in the database. I use the words ‘he’ or ‘she’ and ‘his’ or ‘hers’ to identify the gender of the managers. Those managers without clear indication of being a female are classified as males. Only the female managers who are either “Portfolio Managers” or “Chief Investment Officers” are included in my analysis. Other roles such as administration or marketing are dropped from the female variable. That is, they are not considered to be funds managed by a female. Such information is identified from a thorough analysis of the biography of the managers, either obtained from the database or from the web. Although another study on female managers uses the prefixes as gender identifiers (Aggarwal & Boyson, 2015), such a field is often not available in my database. Therefore, I use the above method instead.

In summary, I identified on average, across funds and over time, 129 female managers (see Table 1). However, it is worthwhile to note that at the beginning of our sample period, there were a small number of females. This number started to grow since the 2008 Global Financial Crisis (see Figure 3). Hence, I also report the maximum number of females and males otherwise the number of females will seem underestimated. The largest number of females was 146 recorded for May 2011.

In addition, as the female managers may not be managing the fund from the beginning of the fund's inception, I search the web for information as to whether the female managers started the fund or actually took over the fund. So, the Female dummy variable which spans both cross-sectional and over time, will only show a '1' for that month when the fund is actually managed by a female and '0' otherwise.

Table 1: Gender Statistics

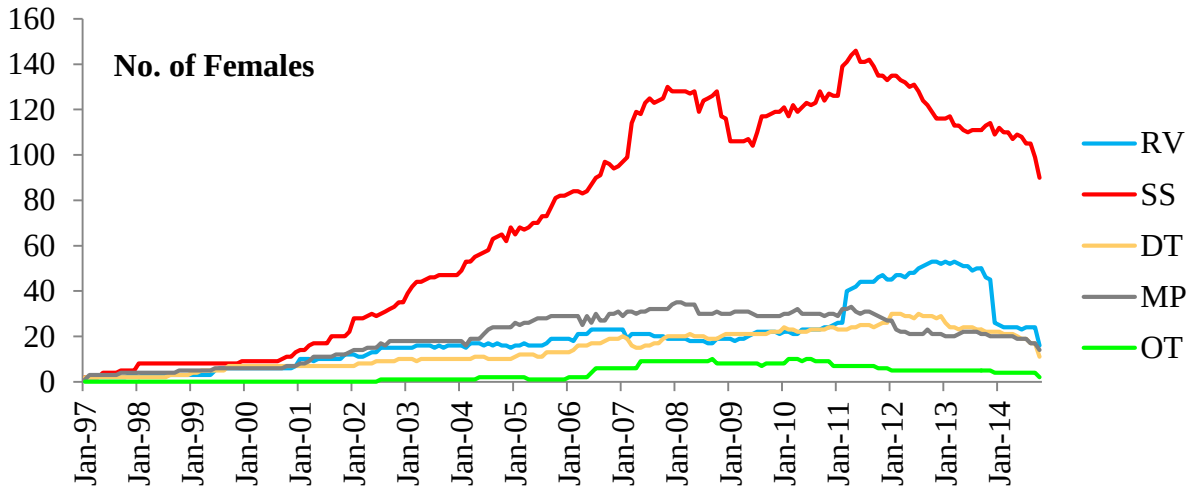
Table 1 shows the statistics of the Gender in our sample. In each of the style categories, I report the average number of Females and Males across funds and over time. I also report the maximum number of Females and Males.

Investment Strategy	Total Funds	Live Funds	Dead Funds	No. of Females (Ave/ month)	Max Females (per month)	No. of Males (Ave/ month)	Max Males (per month)
Relative Value	2,353	1,446	907	20	53	2,333	2,351
Security Selection	6,161	3,256	2,905	72	146	6,089	6,159
Directional Traders	3,030	1,594	1,436	14	30	3,016	3,028
Multi-process	1,964	1,101	863	20	35	1,944	1,963
Others	401	196	205	3	10	398	401
Total	13,909	7,593	6,316	129	-	13,780	-

Source: Eurekahedge database (www.eurekahedge.com)

Figure 3: Gender Statistics

Figure 3 shows the number of Females over time for each of the style categories in our sample. The style categories are Relative Value ("RV"), Security Selection ("SS"), Directional Traders ("DT"), Multiprocess ("MP") and Others ("OT").



Source: Eurekahedge database (www.eurekahedge.com)

3.2.2 Performance Measures

A. Alpha

This study uses Alpha as the main measure of performance. This is estimated using the Fung & Hsieh (2004) seven-factor model. I first estimate factor loadings using time-series regressions of returns against the seven factors (Fung & Hsieh, 2004) over a period of 36 months and multiplying that with the actual factors for the following month. This is done for the entire sample period of 250 months (January 1994 to October 2014), leaving me with a total of 214 months (January

1997 to October 2014) available for my analysis. Then, Alpha is calculated after subtracting the above factor times loadings from excess returns for each fund (as shown in the below equation). The Alpha measure is used as the dependent variable in the cross-sectional regressions for every month for the various multivariate analyses in this study.

$$Alpha_{i,m} = Excess\ Ret_{i,m} - (\beta_{1i,m}Equity_m + \beta_{2i,m}Size_m + \beta_{3i,m}BondMkt_m + \beta_{4i,m}CreditSprd_m + \beta_{5i,m}TFBond_m + \beta_{6i,m}TFCurr_m + \beta_{7i,m}TFComm_m)$$

where Equity is the excess of Standard and Poor's 500 returns over the risk-free return, Size is the Russell 2000 index monthly total return minus Standard & Poor's 500 monthly total return, BondMkt is the change per month in the 10-yr treasury constant maturity yield, CreditSprd is the change per month in Moody's Baa yield minus 10-yr treasury constant maturity yield, and the three Trend-following risk factors: TFBond, TFCurr and TFComm, representing Bond, Currency and Commodity respectively[2], i = fund i, m = month m, β = factor coefficient. These are consistent with the analysis of Fung & Hsieh (2004).

[2] The method for estimating each of the seven factors from Fung & Hsieh (2004) and data for the trend-following factors are obtained from David A. Hsieh's data library.

B. Appraisal Ratio

This study also employs another measure of performance - Appraisal Ratio. Appraisal Ratio is obtained from dividing Alpha for each fund with the total risks (as measured by Standard Deviation) of the excess returns of all the funds in the same portfolio. Standard Deviation in the equation below measures the deviation of the excess returns of all the funds in that particular portfolio 'j' that fund 'i' is in.

$$Appraisal\ Ratio_{i,m} = \frac{Alpha_{i,m}}{Standard\ Deviation_{j,m}}$$

where i = fund i, j = portfolio j, m = month m

This performance measure looks at performance of the individual fund while taking into account the riskiness of all the funds in the portfolio. The Appraisal Ratio will be used for the Triple Sorts tests later in the paper. The Appraisal Ratio is used in the mutual fund studies (eg. Brown et al., 1992).

3.2.3 Key Fund Characteristics

To control for the effects on performance from various characteristics that are common to a hedge fund, I include them in my multivariate analyses. First, the common type of hedge fund fees are included, both Management Fees and Performance Fees. Next, I control for the age of the fund since inception. Then, the size of the fund in terms of assets under management is controlled too. Both the fund age and size are lagged by 1 month. Moreover, since hedge funds have many restrictions on money withdrawals, I also control for the period of notice required to be provided before investors can take out money from the fund. Besides that, the minimum amount of investments in the fund is added as a control variable too. These are all shown in Table 2. In some of the multivariate tests later, I include Style and Region dummies too.

In Table 2 below, I also show the results from a test of difference in means between female-managed funds and male-managed funds for each of the fund characteristics, additionally, the t-statistics are also reported.

From this basic test of differences, it is worthwhile to note several interesting points. Firstly, female-managed funds charge higher fees, both management and performance. For management fees, female-managed funds charge 0.03% higher per month than males (t-statistic = 12.9) and for performance fees, female-managed funds charge 1.54% higher per month (t-statistic = 17.89).

Also, the funds that are managed by females are younger and smaller as shown by the results in fund age and size. For fund age, female-managed funds are about 8 months younger (t-statistic = -15.70). And for size, females manage funds that are smaller than males by about US$55 million (t-statistic = -23.41). Also, investors need to give longer notice for redemption of money for female-managed funds by about 5 days (t-statistic = 23.6).

Looking at Table 2, there is no evidence that female-managed funds underperform those managed by males across all funds in general. This assertion is supported by the findings that the coefficients for the performance measures, Excess Returns and Alpha, for "F-M" are both negative, but, not significant.

Also, as we delve into the individual styles, it indicates that only the Relative Value and Security Selection styles have significantly negative differences in mean excess returns between the female-managed funds and the male-managed funds. Although Directional Traders shows a negative difference, it is not significant. Multiprocess and Others both show positive signs. This seems to suggest that there is no clear evidence about the underperformance of female-managed funds.

Therefore, these initial analyses on the fund characteristics provide some evidence in contrast to our Hypothesis 2 that female-managed funds underperform male-managed funds.

The recent similar study by Aggarwal & Boyson (2015) focused on the Funds of Funds style in their study and found no significant performance differences between female-managed funds and male-managed funds in that style.

An interesting finding to note is, that the mean excess returns from the Security Selection style is not lower than the other styles even though there are more female managers in this style as shown by the gender statistics in Table 1.

Table 2: Key Fund Characteristics

This table reflects the fund characteristics, showing first the total mean for all the funds and then categorising into Females and Males. *Excess Returns* are the Returns of the fund in excess of the risk-free rate. *Alpha* is obtained from using time-series regressions of returns against the seven factors from Fung & Hsieh (2004) over a period of 36 months. *Management Fee* and *Performance Fee* are fees common to a hedge fund. *Age* is the fund's age from inception. *AUM* is assets under management. *Redemption Notice* is the period of notice required for redemption of money from the fund. Min Inv Amt is the minimum amount of investments in the fund. *Standard deviation* is the deviation of the fund's excess returns for the past 12 months. Also, the t-statistic is computed for the difference in means to show how the Females and Males compare in the various fund characteristics. (T-statistics are shown in the parentheses). The significance levels are denoted as ** and * for 1% and 5% respectively.

Fund Characteristics	**Mean**				**SD (monthly)**		
	All	Female	Male	F-M	All	Female	Male
Excess Returns (% annualised)	8.19	6.93	8.23	-1.30 *(-1.82)*	0.05	0.05	0.05
Alpha (% annualised)	7.95	7.35	7.97	-0.62 *(-0.84)*	0.05	0.05	0.05
Management Fee (% monthly)	1.52	1.55	1.52	0.03** *(12.90)*	0.01	0.004	0.01
Performance Fee (% monthly)	17.33	18.87	17.32	1.54** *(17.89)*	0.07	0.05	0.07
Age (in months)	57	49	57	-8.18** *(-15.70)*	62	57	62
AUM (US$mil, monthly)	164.81	111.37	166.44	-55.07** *(-23.41)*	732.70	618.96	735.98
Redemption Notice (days)	30	35	30	5.56** *(23.60)*	33	31	33
Min Inv Amt (US$mil, monthly)	149.44	245.36	147.76	97.60 *(1.67)*	5,197.91	11,865.84	5,096.61
Risk measure							
Standard deviation (annualised)	0.44	0.42	0.44	-0.02** *(-4.62)*	0.04	0.03	0.04

Styles Performance (Mean Excess Returns, % annual)	All	Female	Male	F-M	All	Female	Male
Relative Value	6.02	4.47	6.07	-1.59* *(-1.99)*	0.04	0.02	0.04
Security Selection	8.91	6.55	8.97	-2.42* *(-2.53)*	0.05	0.04	0.05

Directional Traders	8.03	5.16	8.07	-2.9 *(-1.42)*	0.06	0.05	0.05
Multiprocess	8.65	11.21	8.56	2.64 *(1.35)*	0.04	0.05	0.05
Others	10.84	10.53	10.8	2.39 *(0.72)*	0.06	0.05	0.05

3.2.4 Risk Measures

In order to test whether females actually take lower risks when managing hedge funds, I used the Standard Deviation as a measure of risks. The total risk is measured from calculating the standard deviation of the past 12 months' excess returns for each fund. The Standard Deviation measure used for risks is used in many finance papers (eg. Sharpe, 1964).

I removed data that are reflective of illiquid trading where the Standard Deviation of excess returns is less than 0.00001. There are only 31 such data points.

3.2.5 Strategy Distinctiveness

One of the many ways to determine the performance of hedge funds is whether the managers are skilled or not. If they are, they will tend to adopt unique strategies that differ from the rest of their peers (Sun et al., 2012). I test for this in

my study to explore the strategy distinctiveness of the female managers when compared to their male counterparts.

Following the definition of distinctiveness used in Sun et al. (2012), I calculate the "Strategy Distinctiveness Index" (SDI) by subtracting the correlation of the individual fund with all funds in the same style category for the past 24 months from 1 (see below equation). Therefore, if the SDI is higher, it would mean that the fund has adopted a strategy that is less similar with the other funds in the same style category.

$$SDI_{i,m} = 1 - correlation\ (Ret_{i,m},\ \mu_{a,m})$$

where $SDI_{i,m}$ is the Strategy Distinctiveness Index for fund i in month m, $Ret_{i,m}$ is the returns for fund i in month m and $\mu_{a,m}$ is the mean returns for all the funds in Style a that are in month m.

3.2.6 Flow

The Flow variable is calculated using the fund's assets under management and returns in the following equation:

$$\boldsymbol{FLOW_{i,m}} = \frac{AUM_{i,m} - AUM_{i,m-1} * \left(1 + Ret_{i,m}\right)}{AUM_{i,m-1}}$$

where $Flow_{i,m}$ is the flow of the fund i for month m, $AUM_{i,m}$ is fund i's total assets under management at time m, and $Ret_{i,m}$ is fund i's return over the previous month. I measure Flow at the end of the period. Similar to many existing studies (eg. Sirri & Tufano, 1998), Flow shows how much a fund grows on top of the growth that is derived from performance if there were no new inflows into the fund.

3.3 Methodology

The performance of female-managed hedge funds suggested by the summary statistics should be investigated further using several other approaches as explained in this section.

3.3.1 Fama-MacBeth (1973) Cross-sectional regressions

I analyse the performance of female-managed hedge funds using the multivariate analysis. The performance measure as described in the earlier section (Alpha) is used as the dependent variables for my analyses. To start, Fama-Macbeth (1973) cross-sectional regressions are run for every month of the sample period from January 1997 to October 2014, giving a total of 214 regressions. Thereafter I test whether the time-series average coefficient estimates are significantly different from zero by evaluating the t-statistics.

In the multivariate analyses, all of the fund characteristics described earlier are used as independent variables, including the Female dummy. Various dependent variables are used to test numerous hypotheses.

First, I test the performance relationship without including the region and style dummies (Equation 1). In this equation, I adjust for total risks of the funds using the variable Standard Deviation, which is the deviation of the fund's excess returns for the past 12 months. I control for total risks across different funds as funds do not typically hold a completely large diversified portfolio.

Equation 1 : Basic Alpha Regression

$$Alpha_{i,m} = \alpha + \beta_1 Female_{i,m} + \beta_2 MFee_i + \beta_3 PFee_i + \beta_4 LogAum_{i,m-1} + \beta_5 FundAge_{i,m-1} + \beta_6 MinInv_i + \beta_7 RedempNotice_i + \beta_8 SD_{i,m} + \epsilon_{i,m}$$

Next, I test for the interaction of the Female variable with the Region dummies and then the Style dummies in 2 separate tests (Equations 2 and 3 respectively). In the two equations, both Female and Male dummies are used. Also, similar to Equation 1, I adjust for risks of the funds using the variable Standard Deviation, which is the deviation of the fund's excess returns for the past 12 months.

Equation 2 : Region Interaction

$$Alpha_{i,m}$$

$$= \beta_1 MFee_i + \beta_2 PFee_i + \beta_3 LogAum_{i,m-1} + \beta_4 FundAge_{i,m-1} + \beta_5 MinInv_i + \beta_6 RedempNotice_i + \beta_7 SD_{i,m}$$

$$+\beta_8 Female_{i,m}\, G1_i + \beta_9 Female_{i,m}\, G2_i + \beta_{10} Female_{i,m}\, G3_i + \beta_{11} Female_{i,m}\, G4_i + \beta_{12} Female_{i,m}\, G5_i + \beta_{13} Male_{i,m}\, G1_i + \beta_{14} Male_{i,m}\, G2_i + \beta_{15} Male_{i,m}\, G3_i + \beta_{16} Male_{i,m}\, G4_i + \beta_{17} Male_{i,m}\, G5_i + \epsilon_{i,m}$$

Equation 3 : Style Interaction

$$Alpha_{i,m}$$

$$= \beta_1 MFee_i + \beta_2 PFee_i + \beta_3 LogAum_{i,m-1} + \beta_4 FundAge_{i,m-1} + \beta_5 MinInv_i + \beta_6 RedempNotice_i + \beta_7 SD_{i,m}$$

$$+\beta_8 Female_{i,m}\, S1_i + \beta_9 Female_{i,m}\, S2_i + \beta_{10} Female_{i,m}\, S3_i + \beta_{11} Female_{i,m}\, S4_i + \beta_{12} Female_{i,m}\, S5_i + \beta_{13} Male_{i,m}\, S1_i + \beta_{14} Male_{i,m}\, S2_i + \beta_{15} Male_{i,m}\, S3_i + \beta_{16} Male_{i,m}\, S4_i + \beta_{17} Male_{i,m}\, S5_i + \epsilon_{i,m}$$

After using Alpha as the dependent variable for the above Equations, I used other dependent variables (such as SDI, SD and Flow) to test for further relationships with the Female variable. These tests will be performed using Equation 4 below.

Equation 4 : All other dependent variables

$$DV_{i,m} = \alpha + \beta_1 Female_{i,m} + \beta_2 MFee_i + \beta_3 PFee_i + \beta_4 LogAum_{i,m-1} + \beta_5 FundAge_{i,m-1} + \beta_6 MinInv_i + \beta_7 RedempNotice_i + \sum_{S=1}^{S-1} \beta_8^S Style_i^S + \sum_{G=1}^{G-1} \beta_9^G Region_i^G + \epsilon_{i,m}$$

The above abbreviations represent the following: *Female* is the Dummy with '1' representing Female and '0' otherwise as Male. The symbol 'm' is month m. $MFee_i$ is the management fees for fund i. $PFee_i$ is the performance fees for fund i. $LogAUM_{i,m-1}$ is taking the logarithm of the assets under management for month m-1 for size of the fund i. $FundAge_{i,m-1}$ is the age of the fund i in previous month, $MinInv_i$ is the minimum amount of funds invested for fund i, $RedempNotice_i$ is the notice period given for redemption of money from the fund i, *Style* is the style dummy and *Region* is the dummy for the region of investment. $SD_{i,m}$ is the Standard Deviation of fund i, representing the deviation of the fund's excess returns for the past 12 months, to control for the total risks of funds. *S* represents the Styles and *G* represents the Regions. All β are the coefficient estimates. α represents the constant estimated from the regressions.

For the interaction terms in Equations 2 and 3, there are a total of 10 interaction variables in each of the two equations, 5 for Female and 5 for Male. For example, "Female G1" is the Dummy with '1' representing females managing the fund for Geographical Region 1 ("G1") and '0' otherwise. Similarly, "Male G1" is the Dummy with '1' representing males managing the fund for Geographical Region

1 (“G1”) and ‘0’ otherwise. The five regions, as explained earlier are namely, America (“G1”), Europe (“G2”), Asia including Japan (“G3”), Asia excluding Japan (“G4”) and Others (“G5”). The same applies for the five Styles, namely Relative Value (“S1”), Security Selection (“S2”), Directional Traders (“S3”), Multiprocess (“S4”) and Others (“S5”).

3.3.2 Triple Sorts Approach

To further investigate the performance of female-managed funds, I segregated all the hedge funds according to three important hedge fund characteristics. They are namely the size of the fund, performance fees and the redemption notice period. Existing researchers have discussed these fund characteristics in their relationship to performance (eg. Agarwal et al, 2009).

My first step was to divide all funds into two according to the size of their assets under management, categorising them into either “Small” or “Large” funds. Next, for each of the two size classes, I ranked them into three categories using the performance fees they charge - “Low” or “Medium” or “High” performance fees. This resulted in six buckets of classifications. Finally, in each of these six categories, I further sifted them into three categories each according to the length of the redemption notice period - “Short” or “Medium” or “Long”. Redemption notice period, as explained earlier in the report is the length of notice required for taking money out of the fund. In sum, there were eighteen classifications into which all funds were categorized (see Figure 4).

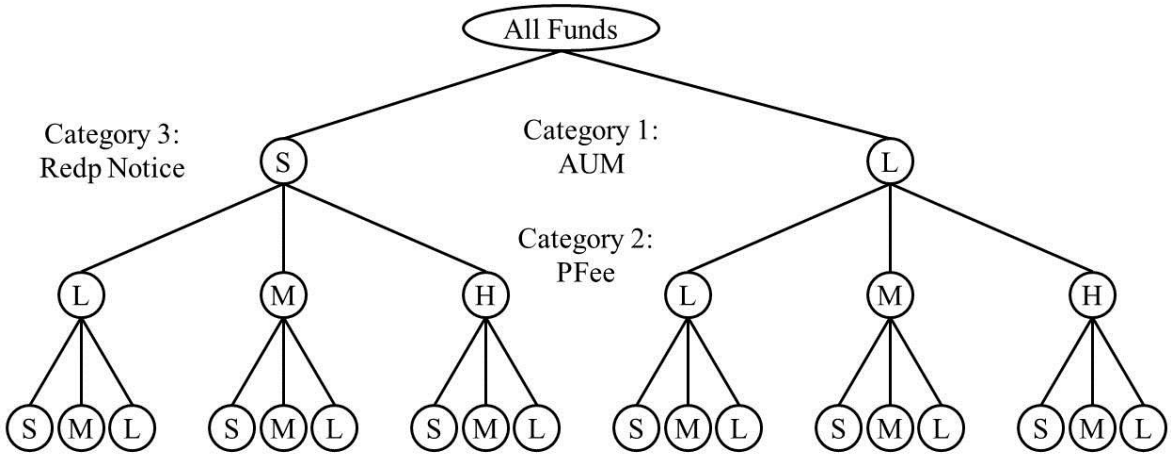
For assets under management, “S” and “L” denote Small and Large respectively. For performance fees, “L”, “M” and “H” represents Low, Medium and High respectively. For redemption notice period, “S”, “M” and “L” represents Short, Medium and Long respectively.

After classifying the funds into the eighteen buckets or segments, I identified the Appraisal Ratio for every female and male-managed fund. Appraisal Ratio, as explained earlier, is obtained from dividing Alpha with the total risks (measured by Standard Deviation) of the excess returns in each of the 18 segments, segregating into female and male-managed funds. Next, the spread of the mean Appraisal Ratio between the females and males (“F-M”) was computed to see whether female-managed funds perform significantly better or worse than male-managed funds on a risk-adjusted basis using the t-test.

To test for whether there is a performance difference between pre and post 2008 financial crisis periods, I performed the Triple Sorts tests three times: firstly for all periods (January 1997 to October 2014), secondly for the pre-crisis period (January 1997 to August 2008) and finally for the post-crisis period (September 2008 to October 2014).

Figure 4: Triple Sorts

Figure 4 shows how all funds are categorised according to 3 categories: 1. Assets under Management ("AUM"), 2. Performance fees ("PFee") and 3. Redemption Notice period ("Redp Notice").



S:Small, L:Large (for AUM); L:Low, M:Medium, H:High (for Pfees) ; S:Short, M:Medium, L:Long (for Notice period)

3.3.3 Portfolio Approach – Garch in mean

To analyse whether Females perform better than Males, I used the portfolio-based approach similarly employed by other researchers (eg. Teo, 2011). Firstly, I sort all the funds using Excess Returns by whether the fund is managed by a female or male in every month (that is, using the Female dummy variable) and then take the value-weighted average across all funds. This resulted in two time-series of average returns, one for females and one for males.

Next, I regressed each of these time-series against the seven factors from Fung & Hsieh (2004). The seven factors take care of the risks related to the nature of hedge funds. Namely they are the Equity factor which is the excess of Standard and Poor's 500 returns over the risk-free return; Size factor is the Russell 2000 index monthly total return minus Standard & Poor's 500 monthly total return; Bond market factor which is the change per month in the 10-year treasury constant maturity yield; Credit Spread factor which is the change per month in the Moody's Baa yield minus 10-year treasury constant maturity yield and three trend-following risk factors: Bond, Currency and Commodity[3].

There were two separate tests, one for Female and one for Male. The Garch-in-mean approach is used because it introduces another explanatory variable: contemporaneous return variance. This was estimated using the GARCH (1,1) model. This helps to avoid adhoc measures of historical variances that may correlate with the error in regression. The model contains variance as endogenous in the mean equation instead of standard deviation (Equation 5). This is because the use of standard deviation produces non-convergence due to a very flat maximum likelihood function.

I then report the constant from each of these regressions, which indicates the risk-adjusted excess returns.

[3] The method for estimating each of the seven factors from Fung & Hsieh (2004) and data for the trend-following factors are obtained from David A. Hsieh's data library.

Equation 5 : Garch-in-mean - Portfolio based approach

$$Excess\ Ret_m = c_0 + c_1 Equity_m + c_2 Size_m + c_3 BondMkt_m + c_4 CreditSprd_m + c_5 TFBond_m + c_6 TFCurr_m + c_7 TFComm_m + bVar(Ret_m) + \epsilon_m$$

$$Var\ (Ret_m) = d_0 + d_1 Var(Ret_{m-1}) + d_2 \epsilon_{m-1}^2$$

where Equity is the excess of Standard and Poor's 500 returns over the risk-free return, Size is the Russell 2000 index monthly total return minus Standard & Poor's 500 monthly total return, BondMkt is the change per month in the 10-yr treasury constant maturity yield, CreditSprd is the change per month in Moody's Baa yield minus 10-yr treasury constant maturity yield, and the three Trend-following risk factors: TFBond, TFCurr and TFComm, representing Bond, Currency and Commodity respectively[4], i = fund i, m = month m, c_1 to c_7 = factor coefficients, d = coefficients. c_0 is the risk-adjusted return. The Excess Returns ("Excess Ret_m") measure is the value-weighted average excess returns for all funds managed by either females or males in the two separate tests for month m. The Variance ("Var (Ret_m)") is the variation of all funds' value-weighted excess returns for month m, managed by either females or males in the two separate tests accordingly.

[4] The method for estimating each of the seven factors from Fung & Hsieh (2004) and data for the trend-following factors are obtained from David A. Hsieh's data library.

4. Results

4.1 Fama-MacBeth (1973) Cross-sectional regressions

4.1.1 Performance

The results reported in Table 3 are interesting. After controlling for the various fund characteristics, the coefficient estimate of the Female variable is negative but not significant. Therefore, this basic result using Fama-Macbeth (1973) regression with Alpha as the dependent variable indicate that there is no evidence that female-managed funds underperform male-managed funds on a risk-adjusted basis, providing no support for Hypothesis 2.

In the meantime, looking at the other control variables in Table 3, the coefficients are in line with existing studies. When a fund gets older, the performance tends to decline (Aggarwal & Jorion, 2010), as shown by the negative coefficient for the fund age variable in Table 3. When a fund charges higher performance fees, its performance is better than otherwise (Agarwal et al, 2009), as evidenced by the positive coefficient of the performance fee variable of my results below. Also, the significantly positive coefficient of the Standard Deviation variable is consistent with Capital Asset Pricing Model ("CAPM") studies that higher risks taken produce higher returns.

Table 3: Fama-Macbeth (1973) results with Performance as the dependent variable

Table 3 shows results from the Fama-Macbeth (1973) regressions with the performance measure as the dependent variable. ***Alpha*** is obtained from using time-series regressions of returns against the seven factors from Fung & Hsieh (2004) over a period of 36 months. In the multivariate analysis, the independent variables are the management fees, performance fee, fund age, the log of assets under management, minimum investment amount and the notice period for redemption. I also included the Standard Deviation to control for the total risks of funds. Period is from January 1997 to October 2014. (T-statistics are shown in the parentheses). The significance levels are denoted as ** and * for 1% and 5% respectively.

	Dependent variable
	Alpha (percent/year)
Independent variables	
Female	-0.51
	(-0.49)
Management fee	23.41
	(0.47)
Performance fee	3.64
	(0.68)
Fund age in months	-0.02
	(-1.93)
Log AUM (fund size)	-0.26
	(-1.09)
MinInv	-0.03
	(-1.12)
Redep Notice	0.02
	(1.61)
Stand Dev	126.97**
	(3.02)

Next, I continued to investigate whether there is difference in the performance of female-managed funds during the pre and post 2008 financial crisis time periods. To do this, I subdivided the total evaluation period into 2 subsamples: pre-crisis period (January 1997 to August 2008) and post-crisis period (September 2008 to October 2014). As explained earlier, September 2008 was recognised by many studies as the peak of the financial crisis, as this is the time when the financial markets saw clear signs of the financial turmoil.

Table 3.1: Fama-Macbeth (1973) results with Performance as the dependent variable (2 subsample periods - pre and post-crisis)

Table 3.1 shows results from the Fama-Macbeth (1973) regressions with the performance measure as the dependent variable. This is a continuation from Table 3 and shows results for the Female variable for 2 subsample periods. The 2 subsample periods are: (1) pre-crisis period: January 1997 to August 2008, (2) post-crisis period: September 2008 to October 2014. ***Alpha*** is obtained from using time-series regressions of returns against the seven factors from Fung & Hsieh (2004) over a period of 36 months. (T-statistics are shown in the parentheses). The significance levels are denoted as ** and * for 1% and 5% respectively.

	Dependent variable
	Alpha (percent/year)
Independent variable	
Female	
1. pre-crisis Period (Jan97-Aug08)	-1.59 (-1.06)
2. post-crisis Period (Sep08-Oct14)	1.32 (1.24)

As shown in Table 3.1, the coefficient of the Female variable is negative during the pre-crisis period and positive during the post-crisis period. Although the results are not significant, the signs seem to suggest that female-managed hedge funds actually perform better for the second period (post-crisis) because female fund managers are likely to be more cautious and careful when undertaking investment decisions amidst times of uncertainty and when there are heightened sensitivities to systemic risks.

Interaction variables

1. Geographical Investment Interaction

To explore further whether females perform better for investment mandates in certain geographical regions, I introduced the concept of interaction variables, whereby I multiplied the Female dummy variable with each of the five different region dummies. As explained in the Methodology section earlier, for example, if the "Female G1" dummy shows a "1", it represents a female handling an investment for the America region. The five regions, as explained earlier are namely, America, Europe, Asia including Japan, Asia excluding Japan and Others.

Table 3.2 shows very intriguing results. There is a significantly positive coefficient for the variable interacting female and Asia excluding Japan, reporting 7.49% annually with a t-statistic of 2.66. This means that there is evidence that female-managed funds actually perform better for investments in the Asia excluding Japan region. Although not significant, other regions such as America,

Europe and Others all have positive coefficients, suggesting that female-managed funds perform positively in these regions, except for Region 3 which is Asia including Japan, which shows a negative but not significant coefficient. On the other hand, it is interesting to note that male-managed funds perform significantly positive in the "America" and "Others" regions.

Again, similar to earlier analysis, the coefficients for the other explanatory variables are in consistent with existing studies. The coefficient for fund age variable is negative and significant. The coefficient of the performance fee variable is positive. Also, the coefficient of the Standard Deviation variable is significantly positive.

Table 3.2: Fama-Macbeth (1973) results with Performance as the dependent variable (Including Interaction with 5 investment Geographical regions)

Table 3.2 shows results from the Fama-Macbeth (1973) regressions with the performance measure as the dependent variable. The independent variables used are the same as Table 3 with additional interaction variables with **5 Geographical regions**. There are a total of 10 interaction variables: 5 for Females and 5 for Males. ***Alpha*** is obtained from using time-series regressions of returns against the seven factors from Fung & Hsieh (2004) over a period of 36 months. (T-statistics are shown in the parentheses). The significance levels are denoted as ** and * for 1% and 5% respectively.

Independent variables	Dependent variable = Alpha (percent/year)
Female G1	1.80
	(1.16)
Female G2	1.67
	(1.09)
Female G3	-0.97
	(-0.48)
Female G4	7.49**
	(2.66)
Female G5	1.84
	(1.09)
Male G1	3.03*
	(2.49)
Male G2	3.14
	(1.06)
Male G3	2.36
	(1.26)
Male G4	4.26
	(1.54)
Male G5	2.69*
	(2.01)
Management fee	22.96
	(0.47)
Performance fee	4.37
	(0.92)
Fund age in months	-0.02*
	(-2.27)
Log AUM (fund size)	-0.21
	(-0.97)
MinInv	-0.02
	(-0.90)
Redep Notice	0.02*
	(2.16)
Stand Dev	129.89**
	(3.28)

2. Investment Style Interaction

Similar to Table 3.2, the results in Table 3.3 presents very interesting results. The coefficients for the interactions with all the first four Styles are positive. Although not significant, there is an indication that female-managed funds perform

positively for these four Styles namely Relative Value, Security Selection, Directional Traders and Multiprocess. Although the "Others" Style shows a negative coefficient, it is not significant.

Male-managed funds, on the other hand, performed significantly positive in the Relative Value, Security Selection and Multiprocess Styles.

Yet again, similar to earlier on, the coefficients for the other independent variables are in consistent with existing studies. The coefficient for fund age variable is negative and significant. The coefficient of the performance fee variable is positive. Also, the coefficient of the Standard Deviation variable is significantly positive.

Table 3.3: Fama-Macbeth (1973) results with Performance as the dependent variable (Including Interaction with 5 Investment Styles)

Table 3.3 shows results from the Fama-Macbeth (1973) regressions with the performance measure as the dependent variable. The independent variables used are the same as Table 3 with additional interaction variables with **5 Investment Styles**. There are a total of 10 interaction variables: 5 for Females and 5 for Males. ***Alpha*** is obtained from using time-series regressions of returns against the seven factors from Fung & Hsieh (2004) over a period of 36 months. (T-statistics are shown in the parentheses). The significance levels are denoted as ** and * for 1% and 5% respectively.

Independent variables	Dependent variable = Alpha (percent/year)
Female S1	2.23
	(1.83)
Female S2	2.90
	(1.30)
Female S3	1.38
	(0.50)
Female S4	2.37
	(1.78)
Female S5	-5.55
	(-1.31)
Male S1	4.12**
	(3.41)
Male S2	4.31**
	(2.98)
Male S3	1.54
	(0.76)
Male S4	4.49**
	(3.63)
Male S5	-2.23
	(-0.70)
Management fee	46.95
	(1.02)
Performance fee	4.72
	(0.93)
Fund age in months	-0.02*
	(-2.12)
Log AUM (fund size)	-0.38
	(-1.86)
MinInv	0.00
	(-0.15)
Redep Notice	0.01
	(0.76)
Stand Dev	134.31**
	(3.18)

Next, similar to above Table 3.1 for the basic performance regression results, I continued to investigate whether there is a difference in female-managed hedge funds' performance during pre-crisis and post-crisis time periods. Again, I subdivided the total evaluation period into 2 subsamples: pre-crisis period

(January 1997 to August 2008) and post-crisis period (September 2008 to October 2014).

For the Geographical regions interactions results in Table 3.4, looking at the coefficients, although not significant, the signs seem to suggest that female-managed hedge funds actually perform better during post-crisis times relative to pre-crisis times in two regions: Europe, Asia including Japan. This further helps to explain that although in Table 3.2, Region 3 shows the only negative sign for the female interaction variable, this Table 3.4 helps to explain that it is only negative during the pre-crisis times. This suggests that females are more cautious when making investment decisions during times of uncertainty. Therefore, the message is clearer when we segregated the total evaluation period into pre and post-crisis periods.

For the Investment Style interactions, as shown in Table 3.5, there is a significantly positive coefficient of 5.32% annually for the variable interacting Female and Relative Value style for the post-crisis period. This means that there is clear evidence that female-managed hedge funds actually perform positively in the Relative Value style, during the post-crisis period. It is also worthwhile to note that for the same style, albeit not significant, the pre-crisis period coefficient is negative.

Nevertheless, as shown by the Interaction tests results, there are still many circumstances whereby male-managed funds appear to perform well. Namely, male-managed funds performed significantly positive in the Relative Value, Security Selection, and Multiprocess Styles, notably during the pre-crisis period.

Table 3.4: Fama-Macbeth (1973) results with Performance as the dependent variable (Including Interaction with 5 investment Geographical regions) (2 subsample periods - pre and post-crisis)

Table 3.4 is a continuation from Table 3.2 and shows results for the 10 **Geographical regions** interaction variables: 5 for Females and 5 for Males, for the 2 subsample periods. The 2 subsample periods are: (1) pre-crisis period: January 1997 to August 2008, (2) post-crisis period: September 2008 to October 2014. ***Alpha*** is obtained from using time-series regressions of returns against the seven factors from Fung & Hsieh (2004) over a period of 36 months. (T-statistics are shown in the parentheses). The significance levels are denoted as ** and * for 1% and 5% respectively.

	Dependent variable
Independent variable	**Alpha (percent/year)**
Female G1	
1. pre-crisis Period (Jan97-Aug08)	1.92 (0.94)
2. post-crisis Period (Sep08-Oct14)	1.71 (0.74)
Female G2	
1. pre-crisis Period (Jan97-Aug08)	-0.43 (-0.20)
2. post-crisis Period (Sep08-Oct14)	3.42 (1.58)

	Dependent variable
Independent variable	**Alpha (percent/year)**
Male G1	
1. pre-crisis Period (Jan97-Aug08)	2.96 (1.85)
2. post-crisis Period (Sep08-Oct14)	3.16 (1.76)
Male G2	
1. pre-crisis Period (Jan97-Aug08)	5.07 (1.15)
2. post-crisis Period (Sep08-Oct14)	-0.50 (-0.27)

Female G3		**Male G3**	
1. pre-crisis Period (Jan97-Aug08)	-2.57 (-1.04)	1. pre-crisis Period (Jan97-Aug08)	2.36 (0.94)
2. post-crisis Period (Sep08-Oct14)	1.07 (0.32)	2. post-crisis Period (Sep08-Oct14)	2.36 (0.89)
Female G4		**Male G4**	
1. pre-crisis Period (Jan97-Aug08)	5.85 (1.89)	1. pre-crisis Period (Jan97-Aug08)	2.84 (0.77)
2. post-crisis Period (Sep08-Oct14)	9.25 (1.92)	2. post-crisis Period (Sep08-Oct14)	6.94 (1.72)
Female G5		**Male G5**	
1. pre-crisis Period (Jan97-Aug08)	1.83 (0.74)	1. pre-crisis Period (Jan97-Aug08)	3.23 (1.73)
2. post-crisis Period (Sep08-Oct14)	1.84 (1.00)	2. post-crisis Period (Sep08-Oct14)	1.66 (1.04)

Table 3.5: Fama-Macbeth (1973) results with Performance as the dependent variable (Including Interaction with 5 Investment Styles) (2 subsample periods - pre and post-crisis)

Table 3.5 is a continuation from Table 3.3 and shows results for the 10 **Investment Styles** interaction variables: 5 for Females and 5 for Males, for the 2 subsample periods. The 2 subsample periods are: (1) pre-crisis period: January 1997 to August 2008, (2) post-crisis period: September 2008 to October 2014. ***Alpha*** is obtained from using time-series regressions of returns against the seven factors from Fung & Hsieh (2004) over a period of 36 months. (T-statistics are shown in the parentheses). The significance levels are denoted as ** and * for 1% and 5% respectively.

	Dependent variable
Independent variable	**Alpha (percent/year)**
Female S1	
1. pre-crisis Period (Jan97-Aug08)	-0.25 (-0.15)
2. post-crisis Period (Sep08-Oct14)	5.32** (3.11)
Female S2	
1. pre-crisis Period (Jan97-Aug08)	1.71 (0.55)
2. post-crisis Period (Sep08-Oct14)	4.92 (1.69)
Female S3	
1. pre-crisis Period (Jan97-Aug08)	2.59 (0.62)
2. post-crisis Period (Sep08-Oct14)	-0.19 (-0.06)
Female S4	
1. pre-crisis Period (Jan97-Aug08)	1.95 (1.17)
2. post-crisis Period (Sep08-Oct14)	2.83 (1.34)
Female S5	
1. pre-crisis Period (Jan97-Aug08)	NA NA
2. post-crisis Period (Sep08-Oct14)	-5.55 (-1.31)

	Dependent variable
Independent variable	**Alpha (percent/year)**
Male S1	
1. pre-crisis Period (Jan97-Aug08)	4.65** (2.85)
2. post-crisis Period (Sep08-Oct14)	3.11 (1.91)
Male S2	
1. pre-crisis Period (Jan97-Aug08)	5.40** (2.85)
2. post-crisis Period (Sep08-Oct14)	2.25 (1.05)
Male S3	
1. pre-crisis Period (Jan97-Aug08)	1.09 (0.37)
2. post-crisis Period (Sep08-Oct14)	2.39 (1.14)
Male S4	
1. pre-crisis Period (Jan97-Aug08)	5.79** (3.46)
2. post-crisis Period (Sep08-Oct14)	2.05 (1.24)
Male S5	
1. pre-crisis Period (Jan97-Aug08)	-2.54 (-0.50)
2. post-crisis Period (Sep08-Oct14)	-1.74 (-0.85)

In order to explore further, I also examined female managers' risk-taking behaviour and strategy distinctiveness in the following results sections.

4.1.2 Risks

Table 4: Fama-Macbeth (1973) results with Risk measure as the dependent variable

Table 4 shows results from the Fama-Macbeth (1973) regressions with the Risk measure as the dependent variable. ***SD*** represents the standard deviations of the past 12 months' excess returns. In the multivariate analysis, the independent variables are the management fees, performance fee, fund age, the log of assets under management, minimum investment amount, notice period for redemption and dummies for both regions and styles. Period is from January 1997 to October 2014. (T-statistics are shown in the parentheses). The significance levels are denoted as ** and * for 1% and 5% respectively.

Independent variables	**Dependent variable = SD (per month, no %)**
Female	-0.01**
	(-18.78)
Management fee	0.39**
	(25.07)
Performance fee	0.00
	(0.60)
Fund age in months	0.00**
	(26.80)
Log AUM (fund size)	0.00**
	(-30.11)
MinInv	0.00**
	(-3.53)
Redep Notice	0.00**
	(5.29)
Region 1	0.00**
	(-17.68)
Region 2	0.01**
	(7.25)
Region 3	0.00
	(-0.62)

Region 4	0.01**
	(19.51)
Style 1	-0.02**
	(-13.91)
Style 2	0.00
	(1.69)
Style 3	0.00**
	(3.55)
Style 4	-0.01**
	(-9.31)

As shown in the Table 4, females in this data set took lower risks as the coefficient of the Female variable is significantly negative at the 1% level. This is consistent with the literature which says that females take lesser risks (eg. Byrnes et al., 1999). Since the results show that females take lower risks, these results provide evidence in support of Hypothesis 1.

4.1.3 Strategy Distinctiveness

Table 5: Fama-Macbeth (1973) results with SDI as the dependent variable

Table 5 shows results from the Fama-Macbeth (1973) regressions with the ***"Strategy Distinctiveness Index" (SDI)*** as the dependent variable. SDI is calculated by subtracting from 1, the correlation of the individual fund with all funds in the same style category for the past 24 months. In the multivariate analysis, the independent variables are the management fees, performance fee, fund age, the log of assets under management, minimum investment amount, notice period for redemption and dummies for both regions and styles. Period is from January 1997 to October 2014. (T-statistics are shown in the parentheses). The significance levels are denoted as ** and * for 1% and 5% respectively.

Independent variables	**Dependent variable = Sdi (per month, no %)**
Female	-0.05**
	(-9.82)
Management fee	-0.33*
	(-2.08)
Performance fee	0.21**
	(7.66)
Fund age in months	0.00**
	(-4.58)
Log AUM (fund size)	0.00**
	(-5.90)

MinInv	0.00 (1.10)
Redep Notice	0.00** (-5.31)
Region 1	0.00 (-1.35)
Region 2	0.00 (0.47)
Region 3	0.04** (10.38)
Region 4	-0.04** (-6.48)
Style 1	-0.01 (-0.89)
Style 2	-0.07** (-6.87)
Style 3	-0.07** (-8.41)
Style 4	-0.05** (-4.88)

The results shown in Table 5 are consistent with our Hypothesis 3. Female managers are less distinctive in their strategies. The multivariate test above shows a significantly negative coefficient for the Female variable of 0.05 per month.

4.1.4 Flow

I tested the relationship between flow into the fund at end of month 'm' and whether there was a female manager in the prior month 'm-1'. At the same time, I added a variable to test for the interaction of the Female variable with the Returns variable, to examine the sensitivity of flows to female-managed funds, conditional on returns. I performed the tests separately for three levels of Returns – "Low", "Medium" and "High", for which results are shown in the following Tables 6.1, 6.2 and 6.3 respectively.

As shown in Table 6.1, the coefficient of the female variable is -0.03, with a t-statistic of 1.95, suggesting that female-managed funds over this period have lesser inflows relative to male-managed funds, especially when the funds' returns are small. Also, as shown in all 3 tables on Flows, most of the coefficients of the interaction of the Female variable with the Returns variable are positive across the three tables, indicating, though not significantly, that fund flows into and out of female-managed funds are more sensitive to the return outcomes. Notably, higher return tended to induce more inflows relative to male-managed funds, and lower returns induced more outflows relative to the male-managed funds.

Further, the coefficient estimates for the Returns variables are mostly positive across the categories of Returns, which is in consistent with existing studies. The performance of a fund as the core factor for choosing one has been well-documented. Money flows into a fund that reports good performance (eg. Sirri & Tufano, 1998; Chevalier & Ellison, 1997).

The coefficients on the other control variables are also consistent with existing research. As reflected by the significantly negative coefficients of the fund size variable, it shows that the money flows are attracted to smaller funds (Sirri & Tufano, 1998). Also, similar to flow studies incorporating the age of the funds, the results indicate a significantly negative coefficient on the fund age variable (Evans, 2010) for most of the categories of Returns.

Table 6.1: Fama-Macbeth (1973) results with Flow as the dependent variable (1 month lag) (Subsample 1 - Low Returns)

Table 6.1 shows results from the Fama-Macbeth (1973) regressions with the ***"Flow"*** at time m as the dependent variable, which is defined as $[AUM_{i,m} - (AUM_{i,m-1} * (1 + Ret_{i,m}))]/(AUM_{i,m-1})$, where $AUM_{i,m}$ is fund i's total assets under management at time m, and $Ret_{i,m}$ is fund i's return over the previous month. Flow is measured at the end of the period. In the multivariate analysis, the independent variables are the management fees, performance fee, fund age, the log of assets under management, minimum investment amount, notice period for redemption and dummies for both regions and styles. Period is from January 1997 to October 2014. I also control for prior period's returns. All control variables are at time m, except Female and Returns which are both at **1 month lag** (T-statistics are shown in the parentheses). The significance levels are denoted as ** and * for 1% and 5% respectively.

Independent variable	**Dependent variable = Flow at time m (per month, no %)**
Female (1 month lag or (m-1))	-0.03
	(-1.95)
Returns (1 month lag or (m-1))	0.16
	(1.10)
Female (m-1) * Returns (m-1)	2.02
	(0.95)
Management fee	-1.03
	(-0.96)
Performance fee	0.14
	(1.58)
Fund age in months	0.00
	(-0.80)
Log AUM (fund size)	-0.03**
	(-2.83)

MinInv	0.00
	(1.57)
Redep Notice	0.00
	(1.55)
Region 1	-0.04**
	(-2.62)
Region 2	-0.01
	(-1.51)
Region 3	0.07
	(0.92)
Region 4	-0.03*
	(-2.31)
Style 1	0.02
	(0.94)
Style 2	0.02
	(0.97)
Style 3	0.02
	(1.19)
Style 4	0.03
	(1.43)

Table 6.2: Fama-Macbeth (1973) results with Flow as the dependent variable (1 month lag) (Subsample 2 - Medium Returns)

Table 6.2 shows results from the Fama-Macbeth (1973) regressions with the ***"Flow"*** at time m as the dependent variable, which is defined as $[AUM_{i,m} - (AUM_{i,m-1} * (1 + Ret_{i,m}))]/(AUM_{i,m-1})$, where $AUM_{i,m}$ is fund i's total assets under management at time m, and $Ret_{i,m}$ is fund i's return over the previous month. Flow is measured at the end of the period. In the multivariate analysis, the independent variables are the management fees, performance fee, fund age, the log of assets under management, minimum investment amount, notice period for redemption and dummies for both regions and styles. Period is from January 1997 to October 2014. I also control for prior period's returns. All control variables are at time m, except Female and Returns which are both at **1 month lag** (T-statistics are shown in the parentheses). The significance levels are denoted as ** and * for 1% and 5% respectively.

Independent variable	**Dependent variable = Flow at time m (per month, no %)**
Female (1 month lag or (m-1))	0.01
	(0.21)
Returns (1 month lag or (m-1))	0.11
	(0.28)
Female (m-1) * Returns (m-1)	-2.09
	(-0.85)
Management fee	0.24
	(0.62)
Performance fee	-0.03
	(-1.13)
Fund age in months	0.00**
	(-11.66)
Log AUM (fund size)	-0.02**
	(-7.43)
MinInv	0.00
	(0.51)

Redep Notice	0.00
	(-0.77)
Region 1	0.00
	(-0.89)
Region 2	0.00
	(0.72)
Region 3	0.00
	(-0.69)
Region 4	-0.02**
	(-4.37)
Style 1	0.01
	(1.20)
Style 2	0.00
	(-0.79)
Style 3	0.00
	(0.13)
Style 4	0.01
	(0.81)

Table 6.3: Fama-Macbeth (1973) results with Flow as the dependent variable (1 month lag) (Subsample 3 - High Returns)

Table 6.3 shows results from the Fama-Macbeth (1973) regressions with the ***"Flow"*** at time m as the dependent variable, which is defined as $[AUM_{i,m} - (AUM_{i,m-1} * (1 + Ret_{i,m}))]/(AUM_{i,m-1})$, where $AUM_{i,m}$ is fund i's total assets under management at time m, and $Ret_{i,m}$ is fund i's return over the previous month. Flow is measured at the end of the period. In the multivariate analysis, the independent variables are the management fees, performance fee, fund age, the log of assets under management, minimum investment amount, notice period for redemption and dummies for both regions and styles. Period is from January 1997 to October 2014. I also control for prior period's returns. All control variables are at time m, except Female and Returns which are both at **1 month lag** (T-statistics are shown in the parentheses). The significance levels are denoted as ** and * for 1% and 5% respectively.

Independent variable	**Dependent variable = Flow at time m (per month, no %)**
Female (1 month lag or (m-1))	0.01
	(0.10)
Returns (1 month lag or (m-1))	-0.05
	(-1.10)
Female (m-1) * Returns (m-1)	0.06
	(0.05)
Management fee	0.01
	(0.02)
Performance fee	0.00
	(-0.09)
Fund age in months	0.00**
	(-9.54)
Log AUM (fund size)	-0.02**
	(-8.29)
MinInv	0.00
	(1.13)

Redep Notice	0.00
	(0.46)
Region 1	-0.01*
	(-2.15)
Region 2	0.00
	(-0.32)
Region 3	0.01
	(0.63)
Region 4	-0.02**
	(-2.69)
Style 1	0.00
	(0.09)
Style 2	-0.01
	(-0.53)
Style 3	0.00
	(-0.28)
Style 4	0.00
	(-0.01)

4.2 Triple Sorts Approach

Table 7: Triple Sorts – All Periods

Table 7 shows results of the test of the difference in mean Appraisal Ratio from Female and Male-managed funds in the 18 classifications, obtained using 3 hedge fund characteristics, namely Assets under Management ("AUM"), Performance fees and Redemption Notice period. For each classification, the coefficient of the difference in mean Appraisal Ratio and their t-statistics are reported. Period is from **January 1997 to October 2014**. The significance levels are denoted as ** and * for 1% and 5% respectively. In each classification, the average number of Females and Males over time is also reported.

Segments	F-M Appraisal ratio (monthly coeff, no%)	tstat of coeff	Average Females	Average Males
SLS	-1.00	-0.89	16.24	599.34
SLM	-0.93	-0.84	42.02	1345.10
SLL	-1.03	-0.82	16.56	347.12
SMS	-0.96	-0.86	15.45	575.05
SMM	-0.94	-0.84	43.29	1425.81
SML	-0.98	-0.81	16.85	359.77
SHS	-1.35	-0.89	0.75	29.34
SHM	-1.10	-0.83	1.28	80.71
SHL	-1.57	-0.85	0.52	24.54
LLS	0.10	1.30	17.22	593.73
LLM	0.07	1.20	40.36	1147.64
LLL	0.16	1.54	11.64	327.49
LMS	0.00	0.07	17.39	639.92
LMM	0.06	1.05	47.13	1403.63
LML	0.15	1.39	13.77	380.81
LHS	0.22	1.45	0.27	24.64
LHM	0.33	1.37	0.49	66.02
LHL	0.33	1.36	0.00	16.91

(For AUM):*S:Small, L:Large;* ***(For Pfees):*** *L:Low, M:Medium, H:High;* ***(For Notice period):*** *S:Short, M:Medium, L:Long*

Table 7.1: Triple Sorts – pre-crisis period:

This is a continuation from Table 7 and provides results for the first subsample period. The first subsample period is: **pre-crisis period: January 1997 to August 2008**. The significance levels are denoted as ** and * for 1% and 5% respectively.

Segments	F-M Appraisal ratio (monthly coeff, no%)	tstat of coeff	Average Females	Average Males
SLS	-1.52	-0.90	12.79	487.41
SLM	-1.47	-0.86	23.22	850.24
SLL	-1.76	-0.85	8.81	255.85
SMS	-1.50	-0.88	11.59	419.75
SMM	-1.47	-0.86	24.64	891.18
SML	-1.63	-0.84	9.26	267.19
SHS	-2.23	-0.91	1.04	15.14
SHM	-1.70	-0.86	1.41	40.94
SHL	-3.02	-0.87	0.36	10.80
LLS	0.10	0.87	17.57	502.30
LLM	0.08	0.84	31.34	825.96
LLL	0.24	1.36	6.71	231.18
LMS	-0.03	-0.32	17.10	505.16
LMM	0.08	0.85	31.74	869.34
LML	0.23	1.31	7.15	243.54
LHS	0.50	1.37	0.41	16.37
LHM	0.50	1.38	0.41	43.38
LHL	0.50	1.37	0.00	10.94

(For AUM):*S:Small, L:Large;* ***(For Pfees):*** *L:Low, M:Medium, H:High;* ***(For Notice period):*** *S:Short, M:Medium, L:Long*

Table 7.2: Triple Sorts – post-crisis period:

This is a continuation from Table 7 and provides results for the first subsample period. The first subsample period is: **post-crisis period: September 2008 to October 2014.** The significance levels are denoted as ** and * for 1% and 5% respectively.

Segments	F-M Appraisal ratio (monthly coeff, no%)	tstat of coeff	Average Females	Average Males
SLS	0.00	-0.09	7.88	280.47
SLM	0.03**	2.91	26.83	788.87
SLL	0.04**	3.12	10.79	179.74
SMS	0.02	1.57	7.87	300.44
SMM	0.02*	2.36	27.18	842.80
SML	0.03**	2.77	10.79	184.98
SHS	0.03*	2.33	0.07	19.43
SHM	0.03	0.99	0.35	53.93
SHL	0.03	1.00	0.28	17.47
LLS	0.03**	2.80	5.72	265.12
LLM	0.02*	2.43	19.86	607.29
LLL	0.02	1.86	7.26	176.25
LMS	0.02	1.90	6.21	309.44
LMM	0.01	1.33	26.36	834.90
LML	0.01	0.78	9.09	221.49
LHS	0.01	0.84	0.00	13.93
LHM	0.00	-0.23	0.22	37.64
LHL	0.00	-0.26	0.00	9.75

(For AUM):*S:Small, L:Large;* ***(For Pfees):*** *L:Low, M:Medium, H:High;* ***(For Notice period):*** *S:Short, M:Medium, L:Long*

Interestingly, Table 7, which shows triple sort results for all periods, contains negative coefficients for "F-M" for the small funds and positive coefficients for the large funds. However, none of these coefficients are significant. Moving on to the triple sorts for the pre-crisis period, January 1997 to August 2008, in Table

7.1, again we see the same phenomenon: negative coefficients for the small funds and mostly positive for the large funds, but all of these tests are not significant.

For the post-crisis period, September 2008 to October 2014, the results are outstanding. Table 7.2 shows that most of the coefficients are positive and many are significant. The significantly positive segments are “SLM’, “SLL”, “SMM”, “SML”, “SHS”, “LLS,” and “LLM”. These results portray a strong message about the performance of female-managed funds during periods of different risks. Consistent with Table 3.1, these triple sort results suggest that female-managed hedge funds actually perform better than male-managed ones during post-crisis times because they tend to be more conservative and cautious during the times when financial markets are bubbling in uncertainty and volatility.

Hence, our Hypothesis 2 on female-managed hedge funds underperform male-managed hedge funds does not hold on a risk-adjusted basis.

4.3 Portfolio Approach – Garch in mean

As explained earlier in the methodology section, the Garch-in-mean method is employed in using the portfolio or time series approach. This method introduces another explanatory variable: contemporaneous return variance. This was estimated using the GARCH (1,1) model. The model contains variance as

endogenous in the mean equation instead of standard deviation. This is because the use of standard deviation produces non-convergence due to a very flat maximum likelihood function.

There are two sets of results, one for Females and one for Males. The results in Table 8 provide more compelling evidence that female-managed hedge funds do not underperform Male-managed funds, lending no support to Hypothesis 2, which is consistent with the Fama-MacBeth (1973) results. In fact, this time-series results for the entire period (January 1997 to October 2014) shows a significant positive alpha for Females, with c0 of 0.3664. Although the c0 for Males shows a higher alpha of 1.41, it is not significant. Hence, it shows that female-managed hedge funds actually reported a significantly positive risk-adjusted alpha.

Next, a look at the variances for female-managed funds and male-managed funds tells an interesting story. The cost of variance in Risk premium is higher for females with a "b" coefficient estimate of 19.29 and is smaller for males at 15.96. These results indicate that female managers are more particular about taking on risk and likely to require a higher risk premium for compensation. This is consistent with the earlier Fama-Macbeth (1973) results with risks as the dependent variable, showing that females take on lower risks.

Table 8: Portfolio Approach – Garch in mean

Table 8 shows results from the portfolio sorting approach for each of the 2 categories: Females ('F"), Males ("M"). Dependent variables, "YF" and "YM", represent the value-weighted mean Excess Returns for Females and Males respectively. Excess Returns are the Returns of the fund in excess of the risk-free rate. Time-series regressions of mean excess returns are run against the seven factors from Fung & Hsieh (2004) over the period from January 1997 to October 2014. The seven factors are Equity (the excess of Standard and Poor's 500 returns over the risk-free return); Size (the Russell 2000 index monthly total return minus Standard & Poor's 500 monthly total return); BondMkt (the change per month in the 10-year treasury constant maturity yield); CreditSprd (the change per month in the Moody's Baa yield minus 10-year treasury constant maturity yield) and three trend-following risk factors: TF-Bond, TF-Currency and TF-Comm. Variance of Excess Returns at time m is also added as an independent variable, based on Garch-in-mean method. The coefficients of the independent variables and their significance levels are reported.

	Dep Var: YF			Dep Var: YM	
	coeff	stdr		coeff	stdr
c0	0.3664	0.0555	c0	1.4100	1.7109
c1	-0.0071	0.0565	c1	0.8735	1.2363
c2	-0.0090	0.0565	c2	0.8166	1.2341
c3	-0.0078	0.0565	c3	-1.3598	3.5776
c4	-0.4789	0.0399	c4	-3.5566	0.8715
c5	0.0702	0.0268	c5	0.7230	1.2320
c6	0.0330	0.0502	c6	0.7384	1.2308
c7	0.0342	0.0501	c7	0.7306	1.2311
b	19.286	0.4823	b	15.9617	0.0806
d0	0.0000	0.0000	d0	0.0003	0.0000
d1	0.8034	0.0093	d1	0.8064	0.0003
d2	0.0003	0.0001	d2	0.0008	0.0000

5. Conclusion and Limitations

The primary results from the Fama-Macbeth (1973) regressions portray a strong message. There is no evidence of underperformance of female-managed funds after controlling for total risks of the funds themselves. In fact, as shown later, when interaction variables are included in the analyses, a number of female-managed funds actually perform better than the male-managed funds. For example, there is evidence that female-managed funds performed significantly better in Asia (excluding Japan).

There is also evidence that female-managed hedge funds performance is significantly positive on a risk-adjusted basis, in the Relative Value style, during the post-crisis period (September 2008 to October 2014). To add a further boost to the message, as we segment all funds into three fund characteristics using the Triple Sorts approach, results are significantly positive for the "F-M" Appraisal Ratio for many of the eighteen segments, notably during the post-crisis period. Therefore, the Hypothesis 2 that female-managed hedge funds underperform is not supported.

Finally, as I test using the time-series Portfolio approach to further examine the performance of female-managed hedge funds, I show that there is a significant positive alpha for Females, with a constant estimate of 0.3664. Although the Males results show a higher alpha of 1.41, it is not significant. This was based on the Garch-in-mean method, introducing variance as endogenous into the analyses.

These time-series results are consistent with the earlier message that female-managed hedge funds do not underperform male-managed funds on a risk-adjusted basis.

The study also shows that females definitely do not like to take risks as shown by the negative coefficient on the Female variable when Risk measure was used as the dependent variable in the Fama-MacBeth (1973) analysis. There is also minor indication that female-managed funds have lesser inflows relative to male-managed funds, especially when the funds' returns are small. Moreover, fund flows into and out of female-managed funds are more sensitive to the return outcomes.

Overall, judging from the above results, after controlling for total risks (as funds do not typically hold a completely large diversified portfolio) across different funds, female-managed funds appear to perform better in numerous circumstances. For example, female-managed hedge funds perform better during post-crisis times, for investments using the Relative Value Style and also when investments are in Asia (excluding Japan). However, there are still many conditions in which male-managed funds seem to perform better. Namely, male-managed funds performance was significantly positive in the Relative Value, Security Selection, and Multiprocess Styles, notably during the pre-crisis period and also when investments are in the “America” and “Others” regions.

I recognise that my data is conditional on funds which have returns when alive and so it ignores the last month when they become dead. The assumed losses in the month when the fund becomes dead is not available. Going forward, I recommend for future studies to look into including the data when the fund becomes dead as it may further explain how female-managed hedge funds perform relative to male-managed funds.

In sum, this study makes contributions to current research in hedge funds and especially Gender research in the fields of finance or psychology. It shows that the reason for a relatively smaller number of females in the financial world may not necessarily be due to their performance. This is because this study found no evidence of the underperformance of female-managed hedge funds. Actually, as shown in Figure 3, even though there were fewer female managers at the beginning of our sample period, the number started to grow since the 2008 Global Financial Crisis. This is in line with our results that since female-managed hedge funds tend to perform better during post-crisis times, there is a rising number of them ever since the Global Financial Crisis.

References

Global Gender Gap Report. (2015). *World Economic Forum*.

Report on Fund Managers by Gender. (June 2015). *Morningstar*

Agarwal, V., Daniel, N. D., & Naik, N. Y. (2009). Role of Managerial Incentives and Discretion in Hedge Fund Performance. *The Journal of Finance, 64*(5).

Aggarwal, R., & Boyson, N. M. (2015). The Performance of Female Hedge Fund Managers. *Review of Financial Economics, Forthcoming*.

Aggarwal, R. K., & Jorion, P. (2010). The Performance of Emerging Hedge Funds and Managers. *Journal of Financial Economics, 96*, 238-256.

Atkinson, S. M., Baird, S. B., & Frye, M. B. (2003). Do Female Mutual Fund Managers Manage Differently? *The Journal of Financial Research, 26*(1), 1-18.

Barber, B. M., & Odean, T. (2001). Boys Will be Boys: Gender, Overconfidence, and Common Stock Investment. *The Quarterly Journal of Economics, 116*(1), 261-292.

Barsky, R. B., Juster, F. T., Kimball, M. S., & Shapiro, M. D. (1997). Preference Parameters and Behavioral Heterogeneity: An Experimental Approach in the Health and Retirement Study. *The Quarterly Journal of Economics, 112*(2), 537-579.

Bliss, R. T., & Potter, M. E. (2002). Mutual Fund Managers: Does Gender Matter? *The Journal of Business and Economic Studies, 8*(1), 1-91.

Brown, S. J., Goetzmann, W., Ibbotson, R. G., & Ross, S. A. (1992). Survivorship Bias in Performance Studies. . *The Review of Financial Studies, 5*(4), 553-580.

Byrnes, J. P., Miller, D. C., & Schafer, W. D. (1999). Gender Differences in Risk Taking: A Meta-Analysis. *Psychological Bulletin, 125*(3), 367-383.

Campello, M., Graham, J. R., & Harvey, C. R. (2010). The Real Effects of Financial Constraints: Evidence From a Financial Crisis. *Journal of Financial Economics, 97*, 470-487.

Chevalier, J., & Ellison, G. (1997). Risk Taking by Mutual Funds as a Response to Incentives. *Journal of Political Economy, 105*(6), 1167-1200.

Cross, S. E., & Madson, L. (1997). Models of the Self: Self-Construals and Gender. *Psychological Bulletin, 122*(1), 5-37.

Evans, R. B. (2010). Mutual Fund Incubation. *The Journal of Finance, 65*(4), 1581-1611.

Fama, E., & Macbeth, J. D. (1973). Risk, return, and equilibrium: Empirical tests. *Journal of Political Economy, 81*(3), 607-636.

Fryer, R. G., Levitt, S. D., & List, J. A. (2008). Exploring the Impact of Financial Incentives on Stereotype Threat: Evidence from a Pilot Study. *American Economic Review, 98*(2), 370-375.

Fung, W., & Hsieh, D. (2000). Performance Characteristics of Hedge Funds and Commodity Funds: Natural vs. Spurious Biases. *The Journal of Financial and Quantitative Analysis, 35*(3), 291-307.

Fung, W., & Hsieh, D. (2001). The Risk in Hedge Fund Strategies : Theory and Evidence from Trend Followers. *The Review of Financial Studies, 14*(2), 313-341.

Fung, W., & Hsieh, D. (2002a). Risk in Fixed-Income Hedge Fund Styles. *The Journal of Fixed Income, 12*(2), 6-27.

Fung, W., & Hsieh, D. (2002b). Asset-Based Style Factors for Hedge Funds. *Financial Analysts Journal, 58*(5), 16-27.

Fung, W., & Hsieh, D. (2004). Hedge Fund Benchmarks: A Risk Based Approach. *Financial Analysts Journal, 60*, 65-80.

Gneezy, U., Niederle, M., & Rustichini, A. (2003). Performance in Competitive Environments: Gender Differences. *The Quarterly Journal of Economics, 118*(3), 1049-1074.

Goetzmann, W. N., Ingersoll, J. E., & Ross, S. A. (2003). High-Water Marks and Hedge Fund Management Contracts. *The Journal of Finance, 58*(4), 1685-1717.

Goodnow, J. J. (1988). Children's Household Work: Its Nature and Functions. *Psychological Bulletin, 103*(1), 5-26.

Hoffman, L. W. (1991). The Influence of the Family Environment on Personality: Accounting for Sibling Differences. *Psychological Bulletin, 110*(2), 187-203.

Huang, J., & Kisgen, D. J. (2013). Gender and Corporate Finance: Are Male Executives Overconfident Relative to Female Executives? *Journal of Financial Economics, 108*, 822-839.

Josephs, R. A., Markus, H. R., & Tafarodi, R. W. (1992). Gender and Self-Esteem. *Journal of Personality and Social Psychology, 63*(3), 391-402.

Kumar, A. (2010). Self-Selection and The Forecasting Abilities of Female Equity Analysts. *Journal of Accounting Research, 48*(2), 393-435.

Kumar, A., Niessen-Ruenzi, A., & Spalt, O. G. (2015). What's in a Name? Mutual Fund Flows When Managers Have Foreign-Sounding Names. *The Review of Financial Studies, 28*(8), 2281-2321.

Lan, Y., Wang, N., & Yang, J. (2013). The Economics of Hedge Funds. *Journal of Financial Economics, 110*, 300-323.

Niessen-Ruenzi, A., & Ruenzi, S. (2015). Sex Matters: Gender Bias in the Mutual Fund Industry. *Working Paper, Available at SSRN: http://ssrn.com/abstract=1957317*.

Powell, M., & Ansic, D. (1997). Gender Differences in Risk Behaviour in Financial Decision-Making: An Experimental Analysis. *Journal of Economic Psychology, 18*, 605-628.

Santos, J. A. C. (2011). Bank Corporate Loan Pricing Following the Subprime Crisis. *The Review of Financial Studies, 24*(6), 1916-1943.

Sharpe, W. F. (1964). Capital Asset Prices: A Theory of Market Equilibrium Under Conditions of Risk. . *The Journal of Finance, 19*(3), 425-442.

Sirri, E. R., & Tufano, P. (1998). Costly Search and Mutual Fund Flows. *The Journal of Finance, 53*(5), 1589-1622.

Spencer, S., Steele, C., & Quinn, D. (1999). Stereotype Threat and Women's Math Performance. *Journal of Experimental Social Psychology, 35*(1), 4-28.

Sun, Z., Wang, A., & Zheng, L. (2012). The Road Less Traveled: Strategy Distinctiveness and Hedge Fund Performance. *The Review of Financial Studies, 25*(1), 96-143.

Teo, M. (2011). The Liquidity Risk of Liquid Hedge Funds. *Journal of Financial Economics, 100*, 24-44.

Wilson, M., & Daly, M. (1985). Competitiveness, risk taking, and violence: the young male syndrome. *Ethology and Sociobiology, 6*(1), 59-73.

Wolfers, J. (2006). Diagnosing Discrimination: Stock Returns and CEO Gender. *Journal of the European Economic Association, 4*(2-3), 531-541.