

The Impact of Mutual Fund Manager Gender on Investor Capital Allocations

By

Natalie Borowski

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JOSEPH WHARTON SCHOLARS

Faculty Advisor:

Professor Jules H. van Binsbergen

The Nippon Life Associate Professor of Finance, Finance Department

THE WHARTON SCHOOL, UNIVERSITY OF PENNSYLVANIA

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ABSTRACT

This study aims to understand whether the gender of mutual fund managers impacts investors' capital allocation decisions to US mutual funds. This study uses net alpha as an indication of proper capital allocation, as higher net alpha indicates not enough capital, and uses value added (gross alpha multiplied by fund size) as an indication of skill, as higher value added indicates higher skill given that capital is allocated properly (Berk and van Binsbergen 2015). This research utilized the Morningstar database to gather information on 5,000 US mutual funds to compare net alpha and value added between male funds and female funds. The present research found that female managers have statistically significantly higher net alpha and higher value added, compared to male managers, likely indicating that females are not allocated enough capital but have higher skill, as they are able to extract high value added even without proper capital allocation.

Keywords: Gender, Mutual Fund, Skill, Capital Allocation

INTRODUCTION

This study examines whether investors discriminate based on the gender of mutual fund managers when they allocate capital to mutual funds, by exploring differences in performance and skill among different groups of managers. The results of this study could help determine whether female-led mutual funds are an untapped opportunity for investors.

Women are notoriously underrepresented in the financial sector, especially within mutual funds, even though females have long ago reached educational parity with males (National Center for Education Statistics 2013). It is important to understand (1) whether skill levels and fund performances differ between the genders and (2) whether investors are biased toward a particular gender because such information can shed light on the mutual fund industry's practices and can help investors make better choices about what types of funds and what types of managers they should be investing with.

Under efficient markets, if males and females have, on average, the same skill levels (i.e., managerial skill levels do not differ on the basis of gender), then female-led funds and male-led funds should be of equal size, on average (Pham 2015). This would mean they would show equal value added (i.e., gross alpha multiplied by fund size). However, there is a deep imbalance between the genders in the world of mutual funds – is this due to underlying factors that lead the genders to be fundamentally differently skilled in mutual fund investing, or is this due to societal norms and investor preferences toward male managers?

This research utilized the Morningstar database to gather information on 5,000 US mutual funds, and R software was used to run statistical analysis in order to determine whether there were any statistically significant differences between male funds and female funds in terms of net alpha and value added. Through this methodology, this research hoped to understand the gender differences in fund management to give managers and investors the most accurate perspective within the current climate of the mutual fund industry.

The results of this study indicate the funds labeled as female had statistically significantly higher net alpha and statistically significantly higher value added when compared to funds labeled as male. Therefore, this study concluded that investors might hold institutional bias against females since females are not properly allocated capital, even though they show higher skill through higher value added.

BACKGROUND THROUGH LITERATURE REVIEW

Economic Gender Inequality

Gender inequality remains pervasive in the business world—the World Economic Forum estimates that it would take approximately another 80 years for women to achieve economic parity with men (World Economic Forum Global Gender Gap Report 2016). This figure comes as a shock to many, as economic parity remains far away even though women outpace men in educational achievements (National Center for Education Statistics 2013). In many parts of the world, men and women are at or near parity in health and education, but economic participation

and economic opportunities lag behind by about 20%, even in the most gender-equal nations (Tyson 2015).

Such gender inequality is an important issue to solve because the growth benefits of unlocking the female workforce are significant: achieving gender parity in workforce participation rates would increase the GDP of developed nations by 12% and by an even larger percentage in developing markets (Organization for Economic Co-operation and Development Report 2015).

Gender Inequality in the Financial Sector

While this issue is prevalent across most parts of the international business world, women are especially and notoriously underrepresented in the financial sector. Fewer women participate in US fund management than do in health care (37% of doctors are women), law (33% of lawyers are women), and accounting (63% of accountants are female) (Lutton 2015). In general, the financial sector seems to have a weaker professional pipeline for females, compared to other careers that require similar education, and this could be rooted in systematic biases (i.e., discrimination) against females (Lutton 2015).

Half of the investment capital in the United States comes from women, but very few women are involved in managing the invested capital (Chadick 2009). Looking at the finance industry, about 23% of investment bankers are female, which is a percentage that is among the highest in the industry (Alden 2014). Only about 12% of senior leaders at real estate firms and approximately 11% of senior leaders at venture capital firms are women (Beltran 2016). These numbers dwindle further in other parts of the financial sector, as only 10% of mutual fund managers are

women, only 7% of buyout firm leaders are women, and only 3% of hedge fund managers are women in the United States (Beltran 2016; Chadick 2009). Males *exclusively* managed 74% of the finance industry's assets, females *exclusively* manage 2% of the industry's assets, and mixed-gender management teams fill in the remaining portion (Lutton 2015).

Financial institutions and funds have come under much public scrutiny in recent years due to the global economic crisis, and gender diversity could be tapped into as an important and impactful factor in changing and rebuilding the financial system. With this, this research posits that women represent a significant component of necessary talent to construct an effective, stable, and growing economic model and to build a trustworthy and sustainable financial system through new perspectives, diverse risk management styles, and high skill in asset management (Chadick 2009). As result, if systematic discrimination is present, it is important to consider and resolve.

Gender and Fund Manager Performance

Much research has been done to study gender differences in fund managers' risk tolerance and performance, due to the recently popularized idea that funds run by women tend to outperform funds that are run by men. According to a report put out by Rothstein Kass (now KPMG) in 2013, funds managed by females showed an average return of 9.8%, while funds managed by men showed a 6.13% return on the HFRX Global Hedge Fund index (Jones 2014). Similarly, between January 2007 and June 2013, hedge funds managed by females exhibited an average return of 6%, while the HFRX Global Hedge Fund Index showed a loss of 1.1% and the Standard & Poor's 500 index returned 4.2% within that timespan (Jones 2014)

However, such popular reports may not always be the most reliable in their research methods and in considering key factors. It is important to note that funds managed by females tend to be much smaller and more niche as compared to those run by men (Pham, 2015). Additionally, such studies focused solely on hedge funds, which have only 3% women, and looked only at returns without controlling for proper extraneous variables.

Gender and Financial Investment

After the popular studies of 2013 and 2014, researchers began to look into the question of gender in fund management further. Risk and performance metrics that cover one-year, three-year, and five-year horizons in U.S. mutual funds and hedge funds find that funds managed by women outperform those managed by men (Luongo 2011). Such findings also indicate that funds composed of an equal number of female and male managers are likely to lead to greater financial market stability, as a result of a favorable combination of risk tolerance preferences and investment strategies (Luongo 2011). Overall, it is striking that females remain significantly underrepresented as fund managers, even though they show quality performance.

Unfortunately, such results are still questioned as other studies reveal that there is no gender impact on financial investment performance. Stepping beyond the United States and exploring the performance of 358 European diversified equity mutual funds, there were no statistically significant difference in performance as explained by gender when funds were evaluated against each funds' designated market indices (Babalos 2015). However, males and females did exhibit different investment style consistency and risk factor responses (Babalos 2015). Further, a study of worldwide funds between 1994 and 2013 showed no difference in performance or risk

between all-female and all-male funds when matched by fund size, fund category, and year of observation (Aggarwal 2016)

Even though these results differ from the Luongo (2011) study in the United States, such findings could have significant implications for fund managers and investors, as they set asset allocation strategies and pick management teams. However, all of these studies focused on returns as a measure of performance—Aggarwal (2016) essentially replicated the Rostein Kass (2013) study but controlled for proper variables to isolate impact on returns. Unfortunately, the aforementioned studies ignored the concept of fund manager skill due to their intense focus on fund returns and did not go further to test whether there has been discrimination against female fund managers by investors.

Theoretical Framework: Manager Skill Level vs. Manager Returns

The consideration of manager skill level is critical to evaluating mutual funds. The concept of skilled fund managers has been a contested idea among researchers—there is much debate about whether stock picking or market timing talent exists (Berk and van Binsbergen 2015). However, given that fund managers are compensated generously for their work, the lack of consensus on the existence of skill is concerning (Berk and van Binsbergen 2015). In theory, investors want to place money with the most skilled managers (Berk and van Binsbergen 2015).

The question of assessing skill is complex. Some studies use net alpha (i.e., the average abnormal return net of fees and expenses) to assess manager skill (Carhart 1997). However, if the supply of skill is limited, then in equilibrium, net alpha is not determined by manager skill

and is instead determined by competition between investors, as higher skilled managers should demand higher fees (Berk and Green 2004). With that, gross alpha (the average abnormal return before fees are subtracted) may be a closer measure of managerial skill. However, gross alpha is still just a measure of returns as opposed to directly being a measure of value (Berk and van Binsbergen 2015).

Value is associated with the amount of money extracted from financial markets by each manager, meaning that it must be a function of fund size. Therefore, in theory, holding fees constant, gross alpha can only differentiate managers if all funds are the same size, which is not the case, especially when comparing female funds and male funds (Berk and van Binsbergen 2015). After all, a manager with a smaller alpha but large fund might add more value than a manager with a large alpha but small fund (e.g., 1% returns on \$10 billion is large than 10% returns on \$1 million) (Berk and van Binsbergen 2015).

In a 2004 study, Berk and Green determined that there was no theoretical reason for gross alpha to be related to manager skill, and in 2015, Berk and van Binsbergen argued that “the skill of a mutual fund manager equals the value the fund extracts from markets” (i.e., the value added of the fund), which is the fund's gross return over its benchmark multiplied by assets under management. This measure of “value added” calculates the amount of money the fund obtains from financial markets without evaluating how the fund decides to distribute the money (Berk and van Binsbergen 2015). Thus, the measure is an indication of “the resulting product of all the skills used to extract money from financial markets” (Berk and van Binsbergen 2015).

However, fees between managers may vary, so looking at fund size may not tell the whole story. To analyze the theoretical framework to approach this problem, it's important to hold certain assumptions constant: (1) investors are rational, (2) financial markets are competitive, (3) managers optimize, and (4) managers face decreasing returns to scale (Berk and van Binsbergen 2014). Thus, gross alpha generated by an active manager is $\alpha_i = a_i - b_i q$ with a_i as the alpha on the first cent that manager i actively invests, b_i as a parameter that captures the decreasing returns to scale of manager i , and q as the amount of money manager i has under active management (Berk and van Binsbergen 2014).

Under these assumptions, Berk and van Binsbergen (2014) introduce the following propositions: (1) net alpha does not measure managerial skill, (2) gross alpha only measures managerial skill if all managers set their fees to ensure that all funds have the same AUM, and (3) value added (the product of AUM and gross alpha) always measures skill.

Net alpha is not a measure of skill because under the assumption that investors are rational and financial markets competitive, all managers would have zero net alpha because non-zero net alpha investment opportunities would be competed away. Additionally, since managers optimize, managerial skill follows the equation $V_i = \max [q(a_i - b_i q)]$ with V_i as managerial skill, and the optimal amount the manager decides to actively manage is $q = a_i / 2b_i$.

To illustrate these ideas, let's assume that Manager A and Manager B are equally skilled, in that they both have equal gross alpha when given equal amounts of money to invest. As each is given more money to invest, gross alpha will decrease because investment ideas are limited so there are

decreasing returns to scale. Let's assume that gross alpha is 1% for both managers with \$100M assets under management (AUM), but gross alpha will decrease to 0% if an additional \$100M is invested. If Manager A charges a fee of 1% and has a fund with \$100M AUM, Manager A's value added is \$1M, and the total monetary fee collected by Manager A is \$1M. As a result, Manager A's net alpha is zero—Manager A is in equilibrium and will not receive more money from investors. Meanwhile, if Manager B charges a fee of .5% with the same skill as Manager A, Manager B will be given more money under perfect competition because Manager B's net alpha will not be zero at \$100M AUM. With the first \$100M invested in Manager B, Manager B will generate a value added of \$1M but will only receive \$500K in fees—Manager B's net alpha is .5%. As a result, Manager B may receive additional funds from investors in a perfectly competitive market. With another \$100M, Manager B's overall gross alpha will become .5% because (1) gross alpha was 1% for \$100M out of the \$200M AUM and (2) gross alpha was 0% for the other \$100M out of the \$200M AUM. Note that there is no value added on the funds that Manager B's invested at 0% gross alpha. Manager B's gross alpha becomes equal to the fees charged as fund size increases, but value added stays the same.

Manager A and Manager B are equally skilled. In equilibrium, Manager A and Manager B have different gross alphas and different fund sizes because their fee structures differ. However, both investors have equal value added, illustrating their equal skill.

In terms of value added, it is important to note that skill cannot be defined exactly by fund size—having a large fund does not inherently imply skill. Instead, it is those managers with the highest skill that end up with the larger funds and reap the higher rewards (Lucas 1978). Managers need

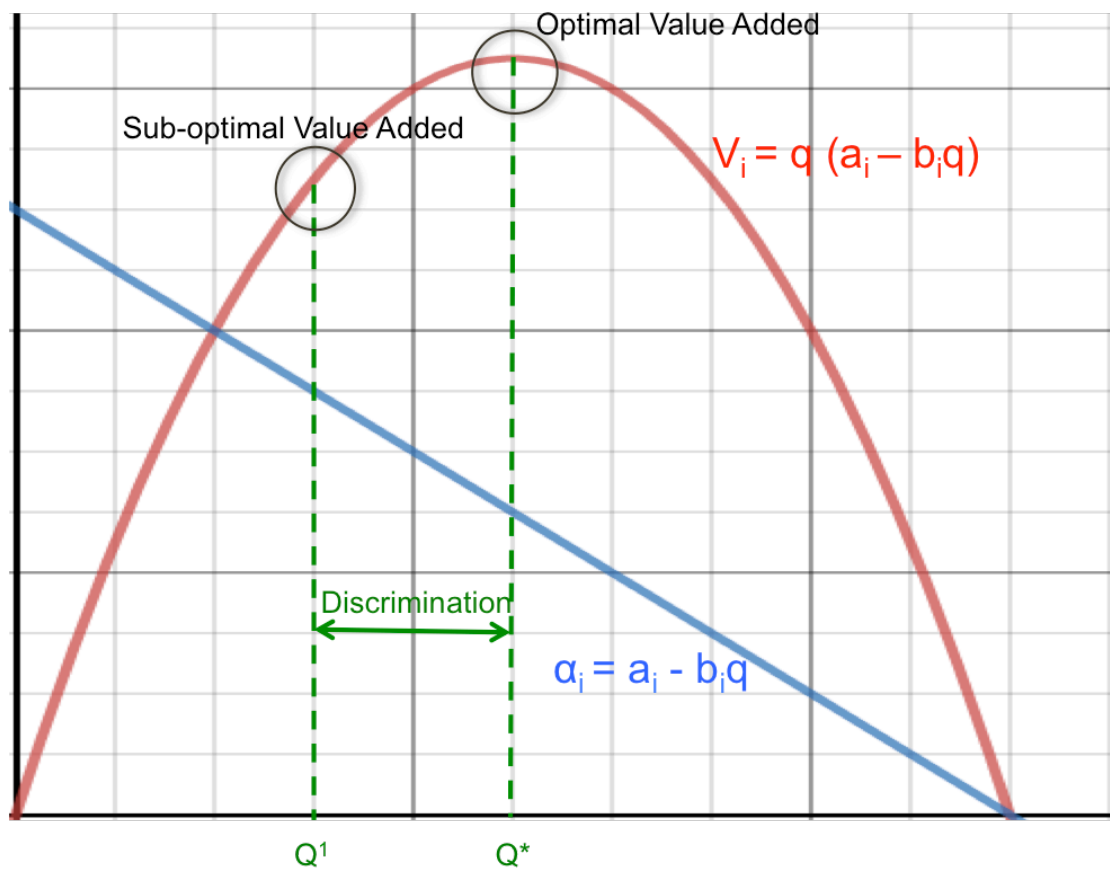
to prove themselves with high alpha to attract investors, and those managers with the highest alphas should continue to receive more investments until the most skilled managers have large funds in a space with much competition between highly skilled managers (Berk and van Binsbergen 2015).

Overall, the concept of skill is important because investors appear to be able to detect manager skill and use the information to invest their capital (Berk and van Binsbergen 2015). Managerial compensation is predominantly based on fund size, so investors effectively determine managerial compensation as they allocate capital to funds (Berk and van Binsbergen 2015). Thus, there is a “very strong positive cross-sectional correlation between managerial skill and managerial compensation,” suggesting that investors are able to deduce managerial skill, “as current compensation better predicts future value added than past value added does” (Berk and van Binsbergen 2015). However, if external factors besides pure managerial skill influence whom investors give money to, then there is potential for the existence of an untapped pool of skilled managers. In a perfect world, investors would give money to managers based on skill—unfortunately, societal norms, industry pressures, and unconscious biases might sometimes keep people from acting perfectly rationally, thus keeping investors from funding highly skilled managers based on factors, such as gender, that are not merit-based (Dobbin 2011).

The graph of $V_i = q(a_i - b_i q)$ and $\alpha_i = a_i - b_i q$ has the potential to show systematic discrimination – with the same α_i line, two managers could have different V_i , showing that investors could be discriminating in terms of capital allocation to different, yet equally skilled, managers. Please see Figure 1.

The optimal value added is the max of V_i indicated in Figure 1. According to the theoretical framework laid out above, all managers that have their performance at $\alpha_i = a_i - b_i q$ (the blue line), should have fund size Q^* with maximum value added. However, if there are managers that lie anywhere on the left side of the maximum point (e.g., one such point is indicated as sub-optimal value added in Figure 1), those managers are not getting the optimal capital allocation for their performance under efficient markets. Managers with fund size Q^1 have higher current α but lower value added.

Figure 1: Graph of Value Added and Alpha to Show Possible Discrimination



If females are significantly exhibiting sub-optimal value added while males are exhibiting optimal value added, there might be systematic discrimination in the market that impedes females from receiving the proper capital allocation from investors. As a result, the distance between average female fund size and average fund sizes can quantify the amount of discrimination in the market, as shown in Figure 1.

RESEARCH QUESTION

The Present Study

All in all, it is clear that female participation in the business world is still limited, and women continue to be largely underrepresented in the financial sector (especially in fund management). Such underrepresentation could potentially lead to an untapped pool of skilled fund management talent. After all, much work has been done to show the benefits of gender diversity in other business areas (e.g., the benefits of female CEOs or of having female representation on corporate boards), and recently, the idea of gender diversity benefits in fund management has become popularized.

Unfortunately, much of the past research in this field has been questioned, as notable studies show conflicting results, ignore the question of manager skill, and do not address investor discrimination. It is further unclear if the phenomenon of higher female returns is restricted to the United States, if findings are credible due to the limited number of female-run funds, and if gender is the core driver of differences.

This research aims to determine whether mutual fund manager gender impacts (1) proper capital allocation to mutual fund managers and (2) manager skill in terms value added, as defined as gross alpha multiplied by fund size (Berk and van Binsbergen 2015). The objective of this paper is to compare female value added to male value added and understand if women who are skilled are likely to have smaller funds than men who are skilled because they are not afforded the same amount of capital from institutional investors. Therefore, the present research hopes to discover whether or not mutual fund manager skill level differs between the genders and whether or not investor bias against females exists in the mutual fund industry.

This perspective is different from much of the past research in gender and mutual funds because much of the literature is primarily concerned only with the return an investor can earn by investing in a mutual fund. The Rothstein Kass (2013) study assessed skill by looking at fund returns without controlling for or acknowledging fund size, while Aggarwal (2016) controlled for fund size and acknowledged further extraneous factors but still solely assessed performance as fund returns.

This research studies US-based mutual funds to see if there is evidence of skill differences related to gender (as shown in previous literature) using the concept of value added, ensuring that funds are assessed against a tradable benchmark and fund size is acknowledged as a function of skill. Additionally, this research would like to understand whether gender is related to the differing fund sizes between men and women (as opposed to the reason of skill) to further explore investor biases against female managers and potentially unearth an untapped talent pool of skilled managers.

Target Audiences

The target audiences of this research are (1) investors (high net worth individuals, institutional investors, etc.) who are looking to invest in mutual funds, (2) mutual fund managers who are looking to expand their teams, and (3) college women considering post-graduation careers.

Investors want the highest returns possible from the best, most highly skilled managers. Investors pick skilled managers and give them large sums of money to get large value added. However, if investors have just been giving money to highly skilled men, then there might be a pool of highly skilled female managers who are managing small funds and receiving returns that show high skill. Such research could be a call to action for investors to place their money with female fund managers, as these fund managers have the same skill as their male counterparts but have not been given the proper amount of invested capital and compensation.

Additionally, given that females may be highly skilled at fund management, mutual fund managers who are incentivized to have the highest performing funds or funds with the highest value added would likely expand their talent search more deliberately.

Finally, women are a critical audience because women are extremely under-represented in mutual funds. Very few women are involved in managing invested capital in the United States, and the financial sector seems to have a weaker professional path for females, compared to other careers that require similar education (Lutton 2015). As a result, understanding that women may be vital assets to fund performance may lead to improvements in the professional pipeline and give college women the confidence to pursue a career in fund management post-graduation.

HYPOTHESES

The goal of this research is two-fold: (1) measure managerial skill level between genders in terms of value added and (2) measure institutional differences between female funds and male funds to understand investor decisions. As a result, the following null hypotheses are put into place.

H_{01} = Females are equally as skilled as males when it comes to fund management in terms of potential value added

H_{02} = Investors do not have any institutional biases between males and females, implying that when allocating capital investors assign the same amount of capital to male candidates and female candidates who have the same skill and charge the same fees

This research hypothesizes that mutual funds managed by females will show higher returns than men when looking across all US-based funds (Rothstein Kass 2013; Jones 2014; Luongo 2011). However, with higher returns, this research hypothesizes that female funds will show lower value added because female funds are smaller than male fund (Pham, 2015). As a result, females might have higher net alphas as compared to men because they are not given enough investment capital to drive down their net alpha, and females might have lower value added because they are not given enough investment capital to extract larger value added or reach their optimal point of value added. In this outcome, the skill difference between males and females may be inconclusive, but it would be likely that investor discrimination may be the cause of not receiving enough investment capital.

METHODOLOGY

The present research aims to determine whether mutual fund manager gender impacts mutual fund manager value added (skill) and understand investor decisions in terms of capital allocation. In order to determine if there is a relationship between gender and manager skill, as well as if there are fundamental differences between female and male funds determined by investor capital allocation, this research employed statistical methodology on available mutual fund data across time to compare (1) the net alpha and (2) the value added between female mutual funds and male mutual funds.

Data was collected about (1) mutual fund manager gender from a variety of funds as well as about (2) fund annual returns, (3) fund management fees, and (4) fund size (AUM). Data from live, US-based mutual funds was acquired from the Morningstar database. The data covered a span of time between 2006 and 2016. Morningstar also provided information on the 1 year, 3 year, 5 year, 10 year, and 15 year gross alphas that were pre-calculated, as well as fund management fees, fund manager names, fund size, and fund annual returns for 5,000 mutual sub-funds. The entire database contains over 20,000 mutual sub-funds, but only the first 5,000 funds could be exported for analysis.

Data regarding mutual fund managers' gender was derived from searching each fund manager's name (the names were given by Morningstar CISDM) on the fund website, Bloomberg, and/or LinkedIn (Aggarwal 2016). Managers were determined as female if they were addressed as "Ms.," "Mrs.," or "she." Managers were determined as male if they were addressed as "Mr.," or

“he.” The fluidity of gender was not addressed in this study, as prior research has kept gender as a binary variable and the data given did not require gender to be treated as non-binary.

The gross alpha used in this study was calculated based on the funds’ annual returns. While Morningstar did give data regarding gross alphas for 1 year, 3 years, 5 years, 10 years, and 15 years timeframes, Morningstar’s method of calculation is unclear so the pre-calculated alphas were viewed as unreliable. As a result, for this study, a separate gross alpha was calculated based on the annual return data Morningstar provided. In order to calculate gross alpha, returns from 2006 to 2016 for each sub-fund were used. Plotting a regression of fund return minus the risk free rate for each corresponding year as the y-axis and market return minus the risk free rate for each corresponding year as the x-axis, gross alpha could be derived as the intercept of the equation. With this method, a gross alpha for each fund was generated, across the time period of 2006 to 2016. However, some fund only included data for one or two years. In order to make sure all data was fairly comparable, only funds with all years of returns between 2006 and 2016 were included in the statistical analysis, with all other funds excluded.

It is important to note that funds managed by females are often much smaller and more niche as compared to those run by men (Pham, 2015). This research hopes to understand whether there is a persistent differences in (1) net alpha (i.e., gross alpha minus management fee) between male funds and female funds and (2) value added (i.e., gross alpha multiplied by fund size) between male funds and female funds.

Analysis Explanation

This research considers US-only funds. Within the data from Morningstar, many of the separated funds were actually sub-funds of a larger firm. There were two possible routes for analysis: (1) treat each sub-fund as its own fund and (2) completely collapse sub-funds that were under the same firm name into one fund. In order to collapse sub-funds together, the weighted average, weighted by fund size, was calculated of the management fees and the funds' gross alphas. The weighted average gross alpha was considered the new, larger fund's gross alpha, and the weighted average management fee was considered the new management fee. The new fund size was the sum of the sub-funds' fund sizes.

It is important to note that not all funds had information on the returns between 2006 and 2016, so those funds were excluded from analysis. As a result, option 1 (using 5,000 sub-funds separately) only yielded 780 usable data points due to a significant amount of excluded funds. Option 2, unfortunately, did not yield enough data points for analysis.

It was critical to determine which funds would be considered female fund and which would be considered male funds. Most funds in the dataset had multiple managers, and an insignificant number included all or a majority of female managers. Therefore, funds were labeled as female funds if 10% of their fund managers were females—the statistical software only found a fair balance of female funds and male funds when 10% female was considered female. Funds with exclusively male managers were labeled as male.

Once funds were classified as either a female fund and a male fund, two t-test were run using R software: (1) average net alpha was compared between the male funds group and the female funds group to determine whether capital was allocated fairly and (2) average value added (gross alpha multiplied by fund size) was compared between the male fund group and the female fund group to show whether possible skill differences exist or if investor discrimination based on gender may be playing a role in sub-optimal value-added. Results were considered significant if the p-value derived from the t-test was less than .05 (i.e., $p < .05$ means statistical significance).

If investors are allocating capital to the best investors, those investors should have net alphas that are near zero and should have very high value added. However, if a specific group of managers has a higher average net alpha, those managers are likely not receiving the proper funds they deserve—one possible explanation for this would be discrimination. Thus, those managers who are not receiving the proper funds might have lower value added due to their smaller fund size, not due to real lower skill, because their value added is sub-optimal as they are prevented from having larger funds—their value added might be higher (and could reach an optimal level) if they were allocated more money by investors.

Scenario Analysis of Possible Results

There are nine possible scenarios of results. Please see Figure 2.

Net alpha illustrates if capital is being properly allocated to managers. If a group has a higher net alpha compared to another group, that is a likely indication that investors are not allocating

enough capital to the group with the higher net alpha—this indicates possible discrimination against the group with higher net alpha.

Value added demonstrates skill. Higher value added often indicates higher skill, but given that discrimination in terms of capital allocation might be at play, a certain group of managers may be prevented from extracting their optimal value added since they are not given enough funds. If capital is allocated properly, higher value added should indicate higher skill.

Figure 2: Explanation of the Nine Possible Result Scenarios

Note: “alpha” means net alpha. “VA” means value added.

	$\alpha_{\text{Female}} > \alpha_{\text{Male}}$	$\alpha_{\text{Female}} = \alpha_{\text{Male}}$	$\alpha_{\text{Female}} < \alpha_{\text{Male}}$
$VA_{\text{Female}} > VA_{\text{Male}}$	Females are not given enough capital but can still extract high value added, showing high skill (Discrimination against females)	Females and males are both allocated capital fairly, and females show higher skill by extracting higher value added	Females are likely allocated capital fairly, but skill is inconclusive (Possible reverse discrimination, as males might be prevented from extracting high value added)
$VA_{\text{Female}} = VA_{\text{Male}}$	Females are not given enough capital, but males and females show the same skill (Possible discrimination, as females might be prevented from extracting optimal value added)	Females and males are both allocated capital fairly and show the same skill level	Females are likely allocated capital fairly, and males and females show the same skill (Possible reverse discrimination, as males might be prevented from extracting optimal value added)
$VA_{\text{Female}} < VA_{\text{Male}}$	Females are not given enough capital, but skill is inconclusive (Possible discrimination, as females might be prevented from extracting high value added)	Females and males are both allocated capital fairly, and females show lower skill by extracting lower value added	Females are likely allocated capital fairly but do not extract higher value added, showing lower skill (Reverse Discrimination, as male are likely more skilled but not given capital)

RESULTS

Looking at all 5,000 sub-funds separately, without grouping under the firm level, net alpha was statistically significantly larger for female funds than for male funds ($n = 780$, female mean = 7.07, male mean = 5.27, $p = 2.28e-06$). This potentially indicates that females are not given enough capital because their net alphas are so high. Additionally, female funds showed statistically significantly higher value added as compared to male funds ($n = 780$, female mean = 209,697,048,979, male mean = 44,004,869,481, $p = 2.2e-16$). This higher value added shows that females are likely more skilled than males since they are able to extract higher value added even while not receiving enough investment capital.

Together, these two statistically significant results indicate that females are not given enough capital but can still extract higher value added, showing higher skill. Thus, it is possible that the reason that females are not receiving enough investment capital from investors is that investors might be discriminating against females based on gender, even when these female fund managers might be more skilled and extracting more value added than male fund managers. It is likely that gender is impacting investors' capital allocation decisions.

CHALLENGES AND COVEATS

While this study found statistically significant results, it is vital to wary of these conclusions and to not generalize these results fully to the overarching concept of gender.

Small Percentage of Females

First, only 10% of mutual fund managers are women in the United States (Chadick 2009). As a result, finding a sufficient sample that included a sufficient number of female funds within the proper timeframe proved challenging, especially since many of these women manage funds with a team of men. It is unclear if females are extracting higher value added or if it is the combination of males and females. This study did not include any female-only funds, and the only parameter to labeling a fund as female was that the fund's management team was composed of at least 10% females. Perhaps when men and women manage a fund together, those funds should not be labeled as female since discrimination might not be as much of a factor when men are also present as the face of the fund. Additionally, perhaps it is diversity, not strictly gender, that leads to high value added and thus high skill.

Self-Selection Bias in the Females who Manage Funds

The results of this study show that females have higher skill than males, but this should not be generalized as a gender outcome—the takeaway might be that the women in the sample happen to be more skilled than the men in the sample. The takeaway cannot be that females, as a gender, are better at investing. There is a huge selection bias in the females that manage mutual funds—very few females choose to work in finance and very few choose to stay within finance and make

it to high management levels. Given the industry, females are much more filtered than males, as it is likely that only the highest skilled of all females are mutual fund managers because there are so few of them.

Small Sample Size Compared to the Universe of US Mutual Funds

This research focused on past mutual fund data and employed statistical methods, so sampling was done by choosing data from databases. Various databases could have been chosen, but given the resources available, Morningstar was viewed as the best option. Unfortunately, Morningstar only allowed for 5,000 funds to be downloaded and analyzed, even though the actual universe of US mutual funds is at least five times larger. Perhaps if data could have been obtained for all US mutual funds, the results would have been more comprehensive.

With that small number, the data was further narrowed because not all 5,000 funds could be used—4,220 funds were excluded because Morningstar did not include all the return between 2006 and 2016 for those funds. After excluding so many funds from the sample, there were less data points (only 780). Results were significant with 780 data points, but the results cannot be fully compelling because they do not fairly represent the true, large number of US mutual funds.

SIGNIFICANCE

Understanding these effects could have significant implications for mutual funds, as investors decide which managers to invest with and as management teams for funds are created. If such research increases investment into female funds along with increasing gender diversity in funds,

it is possible that certain funds will be able to start extracting more value added with more capital, which could have positive effects on the global economy and financial system.

From a more macro-lens, a significant increase in investment dollars given to female managers and an uptick in gender diversity among mutual fund management teams in the United States could be a crucial step in moving toward gender parity in the finance industry. While the world is still approximately another 80 years away from women achieving economic parity with men, such an increase in parity within a specific industry would bring us one step closer (World Economic Forum Global Gender Gap Report 2014).

FUTURE RESEARCH

Future research could be done to more comprehensively and reliably find the answer to whether gender is related to investors' capital allocation decisions. First, in the future, more mutual funds could be analyzed. A sample size of closer to 20,000 funds would be more accurate. Such a larger sample size could (1) allow for the collapsing of sub-funds under the firm level, to better reflect the structure of mutual funds and (2) include more females so that the definition of a female fund and a male fund could be clearer (and perhaps even a mix-gender fund category could be added). Additionally, in the future, interviews could prove interesting to provide a more holistic perspective on this research question. Interviews could be conducted, employing a semi-structured method of interviewing, to question how industry professionals view and experience gender differences when managing mutual funds.

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