ARE FEMALE MUTUAL FUND MANAGERS MORE SKILLED THAN MALE MANAGERS IN TERMS OF VALUE ADDED?

An empirical study in the European mutual fund industry between 12/2008 – 11/2018

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Abstract

This paper examines whether female and male portfolio managers investing in four geographically different categories of European actively managed mutual funds generate equivalent value-added estimates over the period of 2008 to 2018. The study focuses on the skill of a portfolio managers and employs a measure called value added, which is defined as gross alpha generated by a portfolio manager at a period of t multiplied by the fund size. Thus, as the product is expressed in monetary terms, the value-added estimate reveals insight into how much a portfolio manager is able to add value to their mandated funds in monetary terms. However, as indicated by the formula, some portfolio managers who manage large funds but generate low gross alphas might have a higher value added than other portfolio managers with small funds but high gross alphas. As indicated in many existing studies, female portfolio managers, for one reason or another, tend to be allocated less capital than their male counterparties. This potential discrimination aspect is also examined and discussed in the study.

The overall results suggest that there is a trend where female portfolio managers have higher gross alphas but smaller funds than their male counterparties, although there are differences between the sub-sample investment mandates. The findings of potential discrimination against female portfolio managers in capital allocation are discussed in great detail, although it is impossible to indicate the specific reasoning on why female managers might be allocated less capital than male managers. In addition, albeit none of the value-added estimates turned out significant in the present study, noticeable differences between the four geographical categories were discovered. Lastly, the performance persistence where the top outperforms the bottom consistently was documented when using the value-added estimates, indicating that past performers are able to extend their performance – no matter whether good or bad – to subsequent following periods.

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1   INTRODUCTION

The purpose of this section is to give an introduction to the topic of the present research; an alternative way of measuring mutual fund managers' performance. Further, the research questions will be presented together with the contribution of this paper to the previous literature and delimitations of the study.

1.1   Background of the topic of examination

Since the presentation of mutual funds to the broad audience towards the end of the 19th century, they have gained tremendous popularity within institutional as well as retail investors. In general, mutual funds act as financial intermediaries directing investors' savings and capital to the investment opportunities representing investors' preferences such as higher return or lower risk, thereby enhancing the stability of the financial markets and broader social welfare. Initially designed to ensure liquidity while protecting against inflation and generating return to the initial investment capital, they are by far the preferred investment vehicle. This is mainly because of the various benefits they provide such as risk diversification, enhanced return potential and professional management that are not otherwise easily achievable. Investors are willing to pay for fund managers' expertise, experience and their search for the most attractive investments as it should result in maximization of their expected return. Thus, the natural question arising is whether active portfolio managers are able to add value to their managed portfolios and ultimately to the end-investors' savings or if the passive portfolios are as good or even better investment alternative. The ability to generate abnormal portfolio returns has been examined to a large extent over the years and it is generally measured by using the fund's "alpha" (Jensen, 1967).

Evaluation and measurement of investment performance has been the centre of attention among academics as well as practitioners ever since the topic was introduced as a part of Modern Portfolio Theory (MPT). As suggested by Jensen (1967), the underlying concept of MPT has two dimensions; the ability to increase returns through successful prediction of future prices of the underlying securities and the ability to minimize the amount of "insurable risk". Although the existing literature dates back to as far as 1950's, more recent literature has researched the topic in several areas with the most popular studies being the tests on the market efficiency. Efficient Market Hypothesis (EMH) was introduced by Eugene Fama (1970) and it will be presented in a greater detail in the following sections. Some typical tests against the EMH consider the ability to generate abnormal returns by, for example, exploiting different investment strategies or by investing in dif-

ferent geographical areas. However, the question of finding the accurate measure of fund performance remains largely an unsolved question with various approaches suggested and examined, each of which provides clear benefits as well as disadvantages.

A natural step towards the fund performance measurement from the tests of EMH is to consider the traditional Capital Asset Pricing Model (CAPM) and its application to the study in order to evaluate investment performance. However, some academics have criticized the exploitation of CAPM in the performance measurement since such evaluations do not take the time-varying aspect of risk exposure of a fund into account, which leads to biased findings. As a response, Breen et al. (1989) suggested that such biases could be controlled by using public information. This was later supported by many academics, such as Ferson and Harvey (1991) as well as Fama and French (1992), who both concluded in their studies that by using public information variables such as dividend yields and interest rates, fund returns can be predicted and thus time variation in risk premiums can be modelled. As many different variables and models have been presented since, one of the latest studies by Berk and van Binsbergen (2012) suggested that any of the estimates of abnormal performance does not help to assess managerial skill, which should be measured by using the real monetary value added of the fund by the portfolio manager and their underlying investment strategy practiced.

Although there are various studies with rather contradicting results, it has been generally agreed in the existing literature that mutual funds that are actively managed, on average, fail to outperform the market, often demonstrated with a tradable benchmark, or a combination of passively managed portfolios. However, this is the case at least when measuring the return an investor receives to their underlying capital, net of fees. However, there is some evidence that certain factors such as past performance possesses predictive power for future performance. By looking at the existing studies of the topic, the investment performance measured either in absolute terms or on a risk-adjusted basis is commonly related to past performance, managerial characteristics such as manager's age, educational background, number of years of experience, etc. (Chevalier and Ellison, 1999) and fund characteristics related to expenses, turnover ratio and fund size (Prather et al., 2004). Although this is rather long list of variables, all academics as well as practitioners are thriving to find the one defining variable in order to access an untapped pool of abnormal returns. Thus, investors seem to recognize the studies suggesting that one can earn better returns if monitoring for the factors presented above to some extent and thus chase past winners as the performance tend to be persistent in many existing studies (Gruber, 1996). In a similar manner, funds that attract more money are suggested to subsequently generate higher returns than those that do not generate return or even lose the initial capital invested. However, this effect, generally referred to as smart money effect, is relatively short-lived and largely explained by a strategy employed by investors where they chase past winners (Gruber, 1996; Zheng, 1999).

A natural part of considering the factors that cause some funds' superior performance is gender of a portfolio manager. Female mutual fund managers' ability to generate higher returns than male portfolio managers is relatively new but broadly researched topic in the actively managed fund literature. When looking at the increasing amount of literature providing alternative and new aspects and methods to evaluate fund performance, one of the most argued reasoning against the ability to generate abnormal returns by female managers relates also back to the Efficient Market Hypothesis (EMH) and the underlying assumptions associated with the model. One of the most famous findings of the EMH is that no matter what is the level of market efficiency, it is a hard task to beat the market. Although there are some evidence supporting the over- and underperformance of a fund relative to their benchmark, the debate on the merits of female managers have not been properly researched as the existing literature has yet to reach consensus on whether gender of the portfolio manager can explain superior managerial skill – more specifically, whether female portfolio managers are more skilled than male portfolio managers in terms of ability to generate value added to their funds.

Further, when considering the EMH and gender of a portfolio managers, if male and female portfolio managers investing in the same market have, on average, the same level of skill, then both female and male portfolio managers should be allocated funds of equal size, on average (Pham, 2015). In theory, this would mean that both funds would generate equal value-added estimates, defined as gross alpha multiplied by fund size in the study conducted by Berk and van Binsbergen (2012). However, this is rarely the case as there is a deep imbalance in the gender split in the portfolio management industry – it is yet to be determined whether this is due to underlying factors that lead genders to be fundamentally differently skilled in portfolio management, or due to societal norms and pure investor preferences toward male portfolio managers.

In order to conduct a research studying whether the "gender phenomenon" does exist in the European actively managed mutual fund industry, the present study examines only Europe-based equity funds with investment exposure to either Europe, the U.S., Emerging Markets or Asia-Pacific, respectively. In addition to considering whether investors should invest with female managers over male portfolio managers, this study will also take a stand on the assumption that some geographically separated regions may be better investment alternatives than others and further, possibly better suited for female managers. In addition, this study aims to investigate whether the level of skill differ between the genders of the portfolio managers and whether investors are biased toward a particular gender as their preferred portfolio manager. Such information can shed light on the mutual fund industry's practices and can help investors make better decisions on what types of funds and what types of managers they should be investing with. On the other hand, it is vital also for the investment institutions to understand the popularity of their funds and the consequences of granting a specific mandate to a specific portfolio manager. Lastly, this study will examine whether such skill is persistent.

1.2 Topic of examination

As there is an ongoing debate on male and female mutual fund managers' skills and investment performance, the present study focuses on the question whether female portfolio managers are more skilled than their male counterparties in terms of value added – which, in turn, could lead to higher returns to investors and reveal of an untapped pool of skill:

To what extent does mutual fund manager gender impact on manager skill in terms of value added, defined as gross alpha multiplied by fund size (Berk & van Binsbergen, 2012) while controlling for the explanatory factors such as portfolio manager's educational level and years of work experience?

In order to investigate the research question of the present study, several sub-questions were introduced.

- *To what extent does mutual fund manager's gender impact on proper capital allocation to mutual fund managers?*
- *Are institutional investors better off by relying on past highly skilled portfolio managers as an indicator of future high skill performance in terms of value added defined above?*
- *As Emerging Markets and Asia-Pacific are often considered as less efficient in terms of information as well as being less analysed and exploited relative to the U.S. and European markets, should investors favour these fund categories over the others?*

The objective of this paper is to compare value-added estimates by female portfolio managers to value-added estimates of male managers. Further, the aim of the present study is to understand if female portfolio managers who are skilled are likely to have smaller funds in monetary terms than male managers who demonstrate the same level of skill. If this was proven to be statistically significant finding, it would imply that female managers are not allocated the same amount of capital from institutional investors although they have the merits to justify the same level of capital allocation. By limiting the study to professional mutual portfolio managers allows to control more adequately for wealth and investment knowledge differences among female and male portfolio manager groups. In addition, the present study aims to reveal whether the performance of a manager, either female or male manager, is consistent. Thus, the present study aims to discover whether there are any differences in mutual fund managers' skill levels between female and male portfolio managers, whether their performance is persistent, whether gender bias against females exists among institutional investors in the present mutual fund industry and whether there are differences in the value-added estimates between different investment mandates.

The perspective and model applied in the present study are different from many of the past research and methods applied in gender and mutual fund industry studies. The existing literature has been primarily measuring the net return an investor earns by investing in an average mutual fund. To widen the preponderance of research, the study by Rothstein Kass (2014) evaluated portfolio manager's skill by looking at fund returns without controlling the varying fund sizes, while Aggarwal and Boyson (2016) controlled for fund size and in addition, acknowledged some other factors but still solely assessed manager's performance as fund returns. In addition, the existing literature has focused on the U.S. market to a large extent, leaving the fast-expanding and developing European market to a less attention. Therefore, a research focusing on value-added estimates in the European fund industry seems to be missing from the economic research.

The present study assesses Europe-based mutual funds investing either in the Europe, the U.S., Emerging Markets or Asia-Pacific to see if there is evidence of skill differences related to gender, as suggested in the previous literature (see Berk and van Binsbergen, 2012). By applying the concept of measuring the value-added estimate, in addition to the gross alpha generated by the fund manager, fund size is acknowledged in the function of skill while ensuring that funds are sufficiently homogeneous as well as stationary and compared against a tradable benchmark. Additionally, this research aims to shed light on whether gender is related to the differing fund sizes between male and female-led funds (as opposed to the possess of skill) to further explore investor biases against female managers and potentially unearth an untapped talent pool of skilled managers. Lastly, the study will look at the persistence of any results deriving from the portfolio manager's skill measurement. As a result, the following main null hypotheses are put in place:

H_1= Female managers are equally skilled as male managers when it comes to fund management in
    terms of potential value added

H_2= When allocating investment capital, institutional investors do not have any biases between
    male and female mutual fund managers, implying that when allocating capital investors assign
    the same amount of capital to funds managed by male managers as to funds managed by
    female managers who have the same level of skill.

H_3= The performance of the portfolio managers in terms of value added is persistent.

H_4= The gross alpha of the funds investing in Emerging Markets and Asia-Pacific are higher than the gross
    alpha of the funds investing in Europe and the U.S. markets.

This research hypothesizes that mutual funds managed by female managers will show same level of returns than male managers when looking across all Europe-based funds investing either in Europe, the U.S.,

Emerging Markets or Asia-Pacific[1]. Nevertheless, as presented in existing literature, although female managers are assumed to be able to generate higher gross alphas, they will demonstrate lower value added. This is due to the finding of many existing studies and a general assumption that female-led funds are smaller in monetary terms than male funds (Pham, 2015). As a result, although female managers would demonstrate higher gross alphas as compared to male managers, since they are not given enough investment capital to drive down their alphas, female mutual fund managers might demonstrate lower value-added estimates. In other words, this is because they are not given enough investment capital to extract larger value-added estimates or reach their optimal point of value added. In this outcome, the skill difference between male and female managers may be inconclusive, but it would be likely that investor discrimination may be the cause of not receiving enough investment capital.

1.3   Contribution to the existing literature

The present paper contributes to the wide range of mutual fund performance literature and its assessment in several ways. First, this study compares the value-added measure of female and male portfolio managers by using a large sample of Europe-based mutual equity funds investing either in the Europe, the U.S., Emerging Markets or Asia-Pacific. This sample includes one of the largest proportion of female managed portfolios in the studies conducted on gender differences in the portfolio management.

Second, the mutual funds included in the present study are divided into four geographical categories covering most of the global investable area. The existing studies have focused almost exclusively on funds that consider only U.S. stocks and therefore funds investing in other regions such as Europe, Emerging Markets and Asia-Pacific have not been researched to the same extent. Third, the homogeneity if the sample is taken into account to ensure the mitigation of any biases related to the inappropriate benchmarking that have been thoroughly studied by for example Lehmann & Modest (1987), Elton et al. (1993), and Sensoy (2009) inter alia. In the present study, tradable benchmarks are used to assess the returns while prior research has generally used benchmarks that are not publicly traded, and as a result, ignores transactions costs, and are also not necessarily marketed to the broader public audience or even commonly known over the time of observation period. Fourth, most existing literature uses the net alpha an investor receives, i.e., the average abnormal return of a fund measured net of fees and expenses, as a measure of skill that a portfolio manager possesses. However, as argued by Berk and Green (2004) in their paper, if managerial skill is in short supply, the net returns are assigned in equilibrium by competition between the market participants, and not by the skill that managers possess. Thus, it was briefly hypothesized by some academics, based on this argument, that solely

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[1] Please see full selection criteria of the sample in Section 5.1.

the gross alpha would be the correct measure of managerial skill. However, this hypothesis is also flawed as the gross alpha is a measure of return, not a measure of value. Therefore, this study will look beyond these past, somewhat flawed hypotheses.

Thus, the most accurate measure of managerial skill is the expected value a manager is able to add to their fund, i.e., the product of the manager's abnormal return (his or her generated return before fees minus the benchmark return) and assets under management of their fund. This way of measurement covers the amount of money the managers take for themselves in shapes of incentive and base fee (portfolio manager's full fees multiplied by the assets under management) and the amount the portfolio manager gives to investors as return to their investment capital. Finally, in addition to comparing the value-added estimates generated by male and female portfolio managers, I will also take capital allocation, performance persistence and informational efficiency of the markets into account. Some of these aspects have been ignored in many existing studies.

1.4   Delimitations of the study

At the end of 2018, there are more than 58.000 mutual funds registered in Europe (ICI Global, 2019). This extensive number of investment vehicles consists of all sorts of mutual funds regardless of their investment strategy, geographical focus or asset class, even including funds of funds and index funds. In order to research the topic of this study in an orderly manner, a large set of selection criteria was introduced and thus, the final sample consists of 497 funds. As a consequence, the present study only studies the performance of a considerable subset of the overall European mutual fund market. Additionally, since the present study only covers a time period from December 2008 through November 2018, any inferences of the findings must be made with extreme applicable caution. The findings of the present study provide a rather static and potentially inflexible snapshot of the performance of the European mutual funds investing either in the Europe, the U.S., Emerging Markets or Asia-Pacific regions. However, as the employed observation period can be described as highly volatile in the European and also global market, i.e. the market experienced both upturns and downturns over the observation period, some cautious conclusions may be applied as long as the context is considered appropriately.

In order to examine the differences between female and male-led mutual funds, the sample had to be districted accordingly. One of the strictest selection criteria introduced in the study is that the fund must have only one fund manager reported in Morningstar database. Although team-lead funds could be labelled as headed by female or male portfolio managers, in order to avoid any misleading results, the present study only

includes funds that are run by one portfolio manager. Therefore, team or co-lead funds have been excluded from this study in order to focus only on gender differences in the mutual fund performance.

In terms of return and fund size data, the present study relies solely on Morningstar database and the data provided to them by the investing institutions, i.e., the fund organizations themselves. Since part of this study's objective is to investigate whether female or male managers can be labelled as skilled portfolio managers who are able to add value to their funds, misreported gross returns, fund sizes or other fund characteristics, even if random, are a concern. However, Morningstar sends a complete updated database to its clients each month in order to check that the data they provide is correct. In addition, Morningstar conducts random checks constantly in order to identify any outliers which data needs to be checked (Morningstar, 2018). Therefore, I am confident enough that the data is correct to use the data provided by Morningstar database in the study.

With regard to the models of choice in the present study, an underlying assumption has been that the generated return of a specific fund can be explained by a model which constitutes solely on the return of a market, although in various forms. Although some portfolio manager characteristics such as age, years of experience and educational background that were not controlled in other value-added studies are now controlled in the present study, the study ignores that some academics suggest that all traditional performance measurement models would improve by including additional explanatory factors such as factors suggested by Fama and French (1992) and Carhart (1997).

The potential drawback from not taking possible survivorship bias into account has been often debated in the past studies on fund performance. The present study was initially set to include non-surviving funds in the data screening from Morningstar Direct database. However, as a wide range of selection criteria was introduced, the final sample only included "surviving funds", i.e. all funds in the final sample were still marketed and distributed at the end of the observation period. I requested the monthly data from Morningstar in order to compare the monthly updates with the screening conducted in December 2018. Unfortunately, the data is only available for institutions buying their service and also providing the return and other data directly to Morningstar. As a result, it cannot be ruled out that some funds might have been functioning, i.e., active and subsequently terminated or merged within the observation period and thus not included in the final sample.

1.5   Structure of the paper

The structure of the paper is laid out as follows. Next, Section 2 presents briefly the European fund market and its regulation, followed by a review of existing literature on the gender differences and potential causes of different positions in the financial industry or broader economy in the Section 3. Section 4 gives an overview of the theoretical foundation for the most common performance measurement models together with the model applied explicitly in this study. The Section 5 describes the methodology and data applied in this study, with an especially high focus on the data collection and selection processes, survivorship bias, robustness checks, hypotheses testing and the result scenario analysis. Section 6 presents the empirical findings to support the research questions addressed earlier in the present study. Further building on the theoretical background and the empirical findings presented, Section 7 provides a detailed analysis of the results in the light of the theoretical framework presented in the study. Finally, in Section 8 a general discussion and conclusions of the study are provided.

2 THE EUROPEAN FUND MARKET

This section gives a brief introduction to the active asset management industry and to the present European fund market. Also, it includes some descriptive statistics to compose the global mutual fund market in terms of size, asset allocation across different asset classes and the regulation of the industry. Lastly, the section includes an explanation of the fund categories included in the sample of the present study.

2.1 An introduction to the European mutual fund market

Although the global mutual fund industry has been expanding rapidly over the last few decades, the research of portfolio performance and other characteristics have remained rather geographically narrow. As a largely dominating part of the existing literature is focusing solely on the U.S. market or to the funds that hold U.S. stocks, it is not until relatively recently, with the exception of a few very insightful studies of the underlying market, that the fund market in Europe has gained attention from the broader group of academics.

At the end of 2018, the U.S. mutual fund market was without any doubt the single largest market measured in total assets under management (AUM) of all asset classes – it constituted approximately 53 percent of the entire global market. The European market followed the U.S. market with approximately 35 percent market share, and the remaining 12 percent was managed in Africa and the broader Asia-Pacific regions (ICI Global, 2019). When dropping bond, money market and other funds and focusing on pure equity portfolios, the U.S. market constituted more than 60 percent, the European, Asia-Pacific and African market constituted approximately 23 percent, 13 percent on 0,2 percent of the world mutual equity fund AUM, respectively. Within the European market, Luxembourg, United Kingdom, Ireland, France and Germany represented more than 75 percent of all equities managed in the European market (See Table 1). Whereas the U.S. fund market is dominated by investments in equity funds covering approximately 50 percent of the AUM, the European market has a more even distribution of assets between asset classes; approximately 28 percent of the total AUM is invested in equity funds. In comparison, approximately 23 percent of the total European AUM is invested in the bond funds. As pointed in some studies, an average European investor has historically invested in bond funds rather than equity funds (Otten and Bams, 2002). This might have a role in explaining why European equity fund market has not gained attention from the academic industry.

When turning from AUM to other market characteristics, another interesting difference between the U.S. and the European fund markets is the number of funds available for investors. At the end of 2018, the U.S. market consisted of 37.551 funds with an average fund size of $714 million, while the European fund market

recorded 58.081 funds with an average size of $291 million, the Asia-Pacific market consisted of 34.342 funds with an average AUM of $188 million and African market recorded 2,010 funds with an average AUM of $91 million. To distinguish the role of equity strategies in different world regions further, the U.S. market consisted of 11.617 equity funds with an average size of $1.1 billion, the European market consists of 15.162 equity funds with an average size of $310 million, the Asia-Pacific market recorded 14.952 equity funds with the average AUM of $189 million and African region recorded 456 equity funds with an average size of $94 million. Table 1 below presents some characteristics of the overall global mutual fund industry.

Table 1 – Characteristics of the global mutual fund industry.

World Region / Market	Total Assets ($ MM)	No. of Funds	Avg. AUM ($ MM)	Asset Allocation ($ MM)				
				Equity	Bond	Money Market	Balanced/ Mixed	Others
World	*50 366 531*	*131 984*	*382*	*20 206 844*	*10 649 885*	*6 076 200*	*8 650 188*	*4 782 615*
Americas	**26 816 153**	**37 551**	**714**	**12 635 199**	**6 067 808**	**3 221 310**	**4 689 150**	**202 684**
Europe	**16 913 269**	**58 081**	**291**	**4 706 602**	**3 951 662**	**1 448 542**	**3 568 712**	**3 237 756**
Luxembourg	4 654 017	14 898	312	1 346 229	1 364 415	383 452	1 017 089	**542 832**
Ireland	2 772 568	7 285	381	730 187	602 879	558 719	131 093	**749 690**
Germany	2 323 408	6 468	359	317 123	521 111	8 928	1 062 737	**413 511**
France	2 074 766	10 804	192	333 502	308 934	373 736	362 498	**696 097**
United Kingdom	1 742 189	3 194	545	821 117	260 851	25 246	267 825	**367 147**
Netherlands	858 681	931	922	356 870	258 439	-	19 084	**224 289**
Switzerland	548 605	928	591	184 941	170 712	17 859	139 227	**35 866**
Sweden	383 496	631	608	229 300	37 478	23 390	87 455	**5 873**
Spain	324 856	2 584	126	91 942	82 319	7 786	104 496	**38 313**
Italy	274 375	1 122	245	22 378	52 955	3 651	115 366	**80 028**
Austria	197 965	2 019	98	29 634	74 910	37	76 957	**16 428**
Asia and Pacific	**6 455 093**	**34 342**	**188**	**2 822 377**	**625 151**	**1 383 546**	**297 938**	**1 325 280**
Africa	**182 016**	**2 010**	**91**	**42 666**	**5 264**	**22 802**	**94 388**	**16 895**

As of 31/12/2018. Source: ICI Global 2019.

Showing 10 largest European markets in terms of total assets.

As discussed above and visible in the Table 1, the European equity market is the largest in terms of number of funds but the average U.S. equity fund is more than twice larger than an average equity fund in Europe. All these differences in terms of number of funds and size per fund in the four geographically different regions is worth noticing and implies that if the market is more developed and started to develop earlier, the average fund size becomes larger and, with one exemption, the number of funds marketed increases. The exemption is Europe, which market can be described as fragmented and consisting of multiple small domestic markets and thus the large number of funds comes as no surprise. All these sub-markets have traditionally been subject to domestic legislations, entailing that the practical as well as theoretical dimensions of carrying out a cross-border evaluation of European portfolio management has been rather challenging. As a result,

this has reduced the amount of funds in the sample of present study as they are not comparable by their legislative characteristics. However, with the gradual and continuously increasing implementation of a harmonized legal framework regarding the sale of mutual funds across borders in Europe, it is puzzling how the European fund industry has still not received the same amount of attention as the U.S. markets. As the European fund market can be characterized as an exemption, it can be concluded that there seems to be a correlation between the development of a region and the number of funds available for sale as well as the average fund size.

Further, as one can see from the Table 1 above, there is a strong argument for why research has been focusing on the U.S. market, and only expanded to the European mutual fund market more recently. In addition, Asia-Pacific and especially African regions remain as very little examined. This gives an interesting basis for the present study as all categories of funds in terms of how analysed the market is in general are included.

2.2   Regulations of the European mutual fund market

As the popularity of mutual funds has been growing over the recent years, a more harmonised platform for cross-border sale of mutual funds has become required. As a result of many years of work, the first Undertakings for the Collective Investment in Transferable Securities Directives (UCITS) was introduced already in 1985 and have been expanding and developing since. The purpose of UCITS has been to create a barrier-free market for mutual funds across border and thus, some marketed investment funds are regulated by UCITS at the European Union level. Today, the investment funds following the UCITS directive accounts for approximately 75% of all collective investments in Europe. As one of the goals of introduction of UCITS is to improve the efficiency of the fund market in Europe as a whole, the most important points of the harmonized legislation are, among others, to assure a decent protection for consumers and to improve the supply of investment funds across borders of the member state (European Commission, 2019).

By focusing only on the points essential for the mutual fund industry, the UCITS-directives form a legal framework for the distribution of funds complying with UCITS directive in other member states of the European Union by using a so-called 'management company passport'. Each member state is responsible for monitoring and approving a fund based in the member state as a UCITS fund in case applied for an approval. After receiving such classification, the fund is legally allowed to pursue marketing and distribution across the borders but also continue to do so domestically. Although the local authorities of member states may implement the UCITS Directive with minor modifications, the most important rules necessary to obtain the

classification must be fulfilled in the time of application. Although a comprehensive presentation of the UCITS-directive and their requirements are beyond the scope of this paper, it is worthwhile to highlight a few key features as they are essential for the screening of the sample in the present study.

First, a fund following the UCITS directive cannot allocate more than 5 percent of the total fund value in a single security. However, there is an exception for this rule, as stipulated by Article 52 § 2, which states that the limit may be raised to a maximum of 10 percent by any member state. In addition, the securities and money market instruments held by a fund complying with UCITS directive that contribute more than 5 percent, but less than 10 percent of the total monetary value of the fund, is capped to an aggregate 40 percent of all assets managed by the fund. This restriction is often referred as the "5/10/40"-rule, implying that the minimum number of securities held by any fund complying with UCITS-directive is 16 securities (European Commission, 2019).

Secondly, according to the Article 52 § 5, the cumulative investment in transferable securities and additional money market instruments that have been issued by market participants originating from the same base sector may not be greater than 20 percent of the total fund value (European Commission, 2019). The purpose of this rule is to secure sufficient risk diversification in the funds complying with UCITS-directive (Official Journal of the European Union, 2009). Further, the importance of this rule became particularly clear in the most recent financial crisis as the financial sector crashed severely. The underlying rule is extremely important in protecting the investors' capital in relation to any sector-specific downturn.

Thirdly, a fund complying with UCITS directive can only hold securities that either are already, or will be within the following 12 months publicly listed on an exchange or on any other market venue that has been authorized. However, following the Article 52 § 1 and § 2, a maximum of 10 percent of the total fund value can consist of non-listed securities (European Commission, 2019), often referred as private equity investments.

To conclude, the three rules presented are put in place to ensure diversification of both, investment securities and risk. These three rules together with the cross-border permit of marketing and distributing serve the purpose of explaining why funds complying with UCITS-directive have been chosen as the broader sample group of the present study. By using the UCITS-certified investment funds, the homogeneity across any domestic borders is secured. The alternative research approach would have been to only focus on actively managed funds marketed on one of the European sub-markets and investing in the European, the U.S., Emerging or Asia-Pacific Markets. However, the final sample size would have been remarkably lower. Thus, it is an essential precondition to seize the importance of the group of European funds complying with UCITS cross-

border directive, which, by the end of 2018, accounted for approximately 55 percent of European assets un-der management, AUM. This number has more than doubled since 2010 to 45 percent in 2012 and is ex-pected to continue its growth as a vast majority of new funds are willing to comply with the UCITS-directive (European Fund and Asset Management Association, 2019 and Thomson Reuters, 2013). In addition, to state the obvious, the numbers presented above account for a remarkable part of the combined assets under man-agement figure of Europe (European Fund and Asset Management Association, 2019).

2.3   European fund categories examined

The present study examines the portfolio managers of funds registered in Europe investing either in European, the U.S., Emerging Markets or Asia-Pacific markets. This decision was made in order to capture the global market to as high extent as possible.

The present study takes on a different approach as opposed to existing literature and research, which have been focusing on the U.S. market or only nationally-restricted European countries and how their performance differs from each other. Since this study examines four geographically distinguish categories of funds, the present study is not only able to test whether female or male mutual fund managers are able to add higher value into their funds but also if the fund performance in terms of value added is better in one geographical invest-ment area than in the other. Lastly, this study sheds light also on the argument that the institutional investors favor male portfolio managers when it comes to capital allocation and whether their investment performance is actually persistent.

In addition to the Europe and the U.S. markets, by incorporating an evaluation of less examined Emerging Markets and Asia-Pacific market, the present study will shed light on whether there are any differences be-tween the ability of fund managers investing in highly informationally efficient and generally developed mar-kets to outperform the market index compared with the markets that are informationally less efficient and researched markets. Thus, this will provide clarification whether the institutional investors would be better of investing with actively managed fund managers focusing in markets that are less developed and possibly ex-ploited.

For institutional investors, all four funds categories studied in this paper are fairly common investments in a sophisticated and well-diversified portfolio. Although all the four categories of investment funds share a significant portion of indistinguishable investment characteristics, the most important difference between the

four types of investment categories stems from efficiency of a market since it can be characterized as decreasing between each category, the U.S. market being the most efficient. Therefore, in order to evaluate the active portfolio management capabilities of portfolio managers in terms of generating abnormal value-added estimates, these categories represent, at least theoretically, the full range of the efficiency scale of the markets.

3 LITERATURE REVIEW

The purpose of this section is to provide an overview of the existing literature on mutual fund performance evaluation and a brief introduction of the differences between male and female individuals that the hypothesis of the present research has been built on.

3.1 Previous studies on measurement of portfolio performance

Ever since the introduction of Capital Asset Pricing Model (CAPM) in the late 1960's, the studies regarding measurement of mutual fund performance started to flourish (Bodie et al., 2011). By applying the CAPM framework in his own study of mutual funds, Jensen (1967) became one of the first researchers to assess the performance of portfolio managers within the U.S. market. For the 115 funds that were surveyed in the study by Jensen through the period of 1945–1964, only one fund demonstrated a statistically significant positive alpha, irrespective if the fund returns were measured as gross or net of fund management fees. Although the studies have been focusing on the U.S. market, it has been generally agreed that actively managed funds on average do not beat the market, i.e., investing in an index, and these findings have been supported in many studies following the initial hypothesis. For example, Treynor and Mazuy (1966) identified only one out of 57 funds in the U.S. market to show statistically significant positive alpha and Henriksson (1984) found only three funds out of a sample of 116 U.S. funds to be statistically significantly superior in terms of market timing in his parametric test. Further, Bogle (2002) concluded that the measured Sharpe ratio of index funds exceeded the Sharpe ratio of the average actively managed fund and assuming that investing in index funds bears lower costs than investing in actively managed funds, he stated that index funds investing in the same space outperform active funds in both, net and gross terms.

As the topic has remained an unsolved debate with contradictory results, some researchers have been able to identify a larger number of funds in their samples that were able to beat the market. Stiglitz and Grossman (1980) suggested in their study that more informationally inefficient the markets are, the greater the difference in generated returns is between those managers who spend resources to obtain advantageous information and the ones who do not. Further, Minor (2001) challenged the findings of Bogle (2002) by changing the observation period from 1992–1996 to 1990–1994. By shifting the observation period by two years, Minor said he was able to demonstrate contradictory results and thus the outperformance is dependable on the observation period. Cremers and Petäjistö (2009) concluded that actively managed investment funds outperform their benchmark indices both before and after all expenses, i.e., in both gross and net

terms. Ippolito (1989) concluded that in his sample of 143 funds, 12 funds demonstrated significantly positive alphas in the U.S. during the observation period of 1965–1984. However, these results were challenged by Elton et al. (1993) in their study since the sample in Ippolito's research sample was claimed to include non-S&P 500 securities and Ippolito used the S&P 500 as a market index in his study in 1989. As a result of Elton et al. (1993) revised study, the results were found reverse when adding a non-S&P 500 index. In another study, Otten and Bams (2002) evaluated several European markets and detected a tendency for value-added performance with portfolio managers in the Netherlands, Italy, France and the United Kingdom being able to show abnormal stock picking ability. However, only the mutual fund managers in the United Kingdom demonstrated ability to generate significantly positive abnormal returns. Further, Grinblatt and Titman (1989) conducted a research of quarterly portfolio returns in the U.S. market in the 10-year period of 1975 through 1985. The authors found that prior the deduction of all trading expenses and management costs, a fraction of funds was able to generate significantly positive abnormal returns. However, as suggested in multiple studies, the top-performing funds were also characterized by charging high fees, with the end-result for an investor being that the actively managed fund underperformed the index fund in the net-of-fees basis.

Although the number of studies conducted in different regions vary largely, there are studies of almost every global sub-market performance. Huij and Post (2011) studied a sample of 137 U.S. listed funds investing in the Emerging Markets over the years of 1993–2006. They found some evidence for the statement that there might be a tendency for funds investing in the Emerging Markets to perform better than U.S. funds. This finding has been further supported by Kotkavuori-Örnberg et al. (2011) in their study where they found a corresponding tendency for a sample of 786 hedge funds investing in the Emerging Markets. However, the main finding of the study was that hedge funds investing in smaller, more geographically focused areas have a higher tendency to perform better than the hedge funds investing in the global market.

In general, the vast majority of the existing literature focuses on examining whether investors can earn better returns if investing with active portfolio management instead of passive portfolio management and whether some investment strategies or portfolio managers can earn statistically significant higher alphas than others. This topic of research has become popular especially due to the cost of investing in passive portfolio strategies is very minimal compared with investing in an actively managed fund. Further to the studies conducted, the discussion of portfolio manager's gender has been added to the research debate later and has not been studied to a thorough extent yet especially anywhere else than in the U.S. mutual fund market. One explanation for this is that female portfolio managers are not represented to the same extent as male portfolio managers and although it has been changing in the recent year and is expected to continue changing further. Prior to the discussion of previous research of portfolio manager gender impact on portfolio managers' value

added, I will introduce some background for gender differences and for the claim why female portfolio managers could in fact be able to generate higher value-added estimates than male portfolio managers and why this remains as a topic of controversial discussion because, for example, there is no consensus on how to test it in a reliable manner.

3.2 Gender differences on a psychological level

The differences between men and women has been a topic of research in multiple different areas of economy for some time. However, the differences in competencies between male and female mutual fund managers on portfolio management has not yet been studied to the same extent. The small number of female portfolio managers might explain the lack of research although the proportion of female managers have been increasing rapidly in the last few decades. However, female portfolio managers still remain as a minority in the mutual fund industry. The existing literature relating to gender differences in the active mutual fund industry has focused on the topics such as level of risk aversion, sensation seeking tendency, overconfidence and the level of competitiveness rather than female or male portfolio manager's better ability to add value to their mandated funds.

There is a general consensus in the existing literature that women tend to be generally more risk-averse than men. The meta-analysis of 150 studies conducted by Byrnes, Miller and Schafer (1999) concluded that men are more likely to tolerate and take on risk than women in variety of different situations, including making financial or investment decisions. Lighthall, Mather and Gorlick (2009) argued in their study that under acute stress, men tend to increase risk-taking while women tend to decrease any risk possible. This finding should be considered in a great detail in the present study as portfolio management can be described as a stressful environment. Jianakoplos and Bernasek (1998) found out in their study that on average, female portfolio manager holds less risky assets than an average male portfolio manager. Further, Powell and Ansic (1997) conducted a study to demonstrate that women are less likely to seek for a risk opportunities than men irrespective of familiarity and framing, costs or even ambiguity. On the other hand, Schubert, Brown, Gysler and Brachinger (2000) suggested in their study that context, framing and ambiguity matter when it comes to gender differences in risk attitudes but under controlled environment, gender-specific risk behaviours may not arise at all. On the same topic, a study by Meier-Pesti and Goetze in 2006 suggested that the characteristic of being a female affects financial risk-taking positively, while being a male lead to the opposite results. Nelson (2014) argued that the evidence for the claim "women are more risk averse than men" is much weaker than has been presented in the existing literature.

Nonetheless, the consensus seems to suggest that female individuals are more risk averse than their male counterparties. This has been researched in many different studies, contexts and environments – for example, in terms of allocating assets in accounts assigned for retirement savings, women were also found to exhibit a larger risk aversion (Bajtelsmit et al., 1999). Furthermore, when deciding to invest in an investment vehicle, women demonstrate less participation to risk-taking activities than men when looking at both groups' largest and riskiest mutual fund investment decisions as concluded in the study by Dwyer, Gilkeson and List in 2002.

Turning from risk-taking to another related topic, there is evidence that men tend to be more overconfident than women on average. Overconfidence is defined as "a cognitive bias in which a person's subjective confidence in his or her own judgment is reliably greater than the objective accuracy of those actual judgments" (Pallier et al., 2002). Overconfidence is a common trait and can occur for both men and women. Thus, it is an important factor to bear in mind in all research, as suggested by DeBondt and Thaler in their study in 1995: "Perhaps the most robust finding in the psychology of judgement is that people are overconfident".

Barber and Odean (2001) stated that in the industries such as finance and investing men tend to be more overconfident than women, which leads to two assumptions: men tend to trade more than women, and the performance of men will be hurt especially by risk-adjusted constant live trading. They showed that in the results of their study, these predictions were a matter of fact. Bengtsson, Persson and Willenhag (2005) used a substantial set of data of students at Stockholm University in order to conduct a study and came to the conclusion that male students have a higher tendency to aim for higher grades and predict themselves that they will be graded with a higher grade than female students. The overconfidence of male students can be the cause of the tendency to strive for higher grades, or potentially the more competitive nature of men. Also, Niederle and Vesterlund (2007) found comparable results as they demonstrated in their research that men in fact tend to be more overconfident than women. On the other hand, Johansson-Stenman and Bordblom (2010) did not find any evidence for the conclusion that men are perceived as more overconfident than women based on their field experiment.

Another topic worth consideration in the field of gender differences is a trait called "sensation seeking", which is closely related to the risk taking and overconfidence themes discussed above. Sensation seeking was first introduced and defined by Zuckerman in 1994 as "a trait defined by the seeking of varied, novel, complex, and intense sensations and experiences, and the willingness to take physical, social, legal and financial risks for the sake of such experience.". The meta-analysis by Cross, Cyrenne and Brown (2013) using Zuckerman's Sensation Seeking Scale supported the view that men and women differ in their likelihood

to show characteristics of sensation-seeking. Further, Grinblatt and Keloharju (2009) presented arguments supporting the hypothesis that men are more likely to demonstrate sensation seeking behaviour. According to their study, men are more attracted to alcohol and drug abuse, violence, high-risk sport activities and gambling and, maybe as a consequence, investors demonstrating sensation seeking characteristics tend to trade more frequently in the asset management industry.

To support the findings above further, some evidence has been presented to support the argument that men tend to be more competitive than women by the nature. Niederle and Vesterlund (2007) found men to have a preference for participating in a competition based on their observation that 73 percent of the men in their experiment chose to take part in a competitive tournament with an incentive scheme, while only 35 percent of the women did the same. In a different study, Gupta et al. (2005) showed similar result when men, given the choice between a tournament and a piece-rate pay scheme before performing a real task, chose the tournament option significantly more often than their women counterparties.

These traits have been studied further in the active mutual fund industry to some extent. One finding relating to the results showing men's lower risk aversion, overconfidence, sensation seeking tendency and competitiveness is that they are found to trade more than women when investing. Grinblatt and Keloharju (2009) supported the argument that men tend to trade more than women regardless of age, potentially linking the finding to an increased tendency of sensation seeking by men. Further, Barber and Odean (2001) documented a 45 percent increase in the trading frequency when male individuals were trading compared with women's trading, and as a result reduced male individuals' net return by approximately 2.7 percentage points a year compared with the average of 1.7 percentage points reduction of women.

3.3   Gender differences on an organizational level

Studies on gender differences on an organizational level has been largely focusing on leaders of different corporations, boards of directors and only more recently on mutual fund managers. The demonstrations of 'gender effect' or gender differences on organizations are not always necessarily in line with the cognitive traits of male and female individuals.

3.3.1 Economic gender inequality

Although the gender inequality in every part of the global economy and in a broader sense has been a subject of discussion for years, the equality has not been reached. The Gender Inequality Index (GII) measures gender inequalities in three important fields of human development; reproductive health, empowerment and economic status in 160 different countries globally (United Nations Development Programme, 2018). In 2017, the GII was 0.441 in the world – in countries were the human development was labelled as very high the index received a value of 0.170 whereas in the low human development countries the index was valued at 0.586 (United Nations, 2018). The values have been improving over the past years to some extent, but the progress is claimed to be too slow.

Gender inequality remains especially pervasive in the business world and female participation in the male-dominant industries – the World Economic Forum estimated that it would take approximately yet another 80 years for women to achieve economic parity with men (World Economic Forum, Global Gender Gap Report, 2018). The topic has been frequently and broadly discussed and examined as economic parity remains far away even though women have outpaced men in different parts of life, as for example in educational achievements (National Center for Education Statistics, 2017). Although men and women are often at or at least near to parity in education and health, the economic participation in the business world and the number of economic opportunities for women lag behind by approximately 20 percent, even in the most developed and gender-equal nations (Tyson, 2015).

For the reasons briefly discussed above, the gender inequality is an important matter to solve and obtain equality between genders. For example, the growth benefits of unlocking the female workforce would be very significant – multiple studies have suggested that achieving gender parity in workforce participation rates would increase gross domestic product (GDP) of developed nations by a significant 12 percent and by even larger percentage in the developing markets (Organization for Economic Co-operation and Development Report, 2017).

Especially in the recent years, the topic of gender equality and female participation in the activities that have historically been seen as male activities has been of great interest. One of the motivations for the present study is that the number of female portfolio managers have been significantly increasing especially in the recent years and is also expected to continue to grow for years to come. As female participation in the actively managed fund industry increases, the evaluation of performance between portfolio managers of different genders becomes more meaningful and likely to reveal significant results.

3.3.2   *Gender inequality in the financial sector*

While the gender equality is prevalent across most parts and industries of the international business world, women are especially and notoriously underrepresented in the financial sector. For example, fewer women participate in fund management than do in health care (37 percent of doctors are women), law (33 percent of lawyers are women), and accounting (63 percent of accountants are female) in the U.S., as suggested by Lutton and Davis in their study in 2015. According to Newlands and Marriage (2018), only one in 10 UK fund managers are female, while in the U.S. only 184 of 7,000 mutual funds are run by female portfolio managers. In general, financial sector seems to have a weaker professional pipeline for females, compared to other careers and industries that require similar education. One suggested reason for this is that it is actually rooted in systematic biases (i.e., discrimination) against females (Lutton & Davis, 2015).

According to Chadick and Ellig (2009), half of the investment capital in the United States comes from women, but very few women are actually involved in managing the capital invested. When looking at the financial industry, approximately 23 percent of investment bankers are female, which is a representation percentage that is among the highest in the industry (Alden, 2014). Investment banks are among the first financial institutions having started actively focusing on minorities and especially gender equality in the workplace and today, many international investment banks aim to having 50 percent of the analysts starting their career every year of being female. However, only about 12 percent of senior leaders at real estate firms and approximately 11 percent of senior leaders at venture capital firms are women (Beltran, 2016). These numbers decrease further in other career options of the financial sector, as only 10 percent of mutual fund managers are women, only 7 percent of buyout firm leaders are women, and only 3 percent of hedge fund managers are women in the United States (Beltran, 2016; Chadick & Ellig, 2009). As Lutton and Davis (2015) pointed out in their study, male portfolio managers exclusively managed 74 percent of the assets in the broader financial industry while females exclusively manage only 2 percent of the assets in the same industry, and mixed-gender management teams fill in the remaining portion (Lutton & Davis, 2015).

Ever since the latest global financial crisis in 2008–2009, financial institutions and capital management firms have come under severe public scrutiny among the broader audience. As Chadick and Ellig (2009) pointed out in their paper, gender diversity could be tapped into as an important and impactful factor in changing and rebuilding the global financial system and industry. In this scenario, women represent a significant component of necessary talent in order to construct an effective, stable, and growing economic model and to build a trustworthy and sustainable financial system and industry through new perspectives, diverse risk management styles, and high skill in asset management (Chadick & Ellig, 2009).

3.3.3 Glass ceiling against women

The term 'glass ceiling' was established to demonstrate organization's failure to promote female individuals, especially into the executive roles (Eagly & Carli, 2007). A broad range of evidence of such barrier especially in the business world and financial industry have been provided over the years. Although female individuals would be promoted to the top leadership roles, Lyness and Thompson (1997) argued that women in leadership positions have less authority within their organization, receive fewer stock options as a part of their compensation and have less international mobility than their male counterparties. Further, female individuals already in high positions were reported having more obstacles to be promoted in their careers than women on lower levels. Barreto et al. (2000) suggested that women are severely underrepresented in the higher levels of businesses and different organizations. However, the cause of this remains yet to be discovered. However, part of the problem still seems to arise from the perception of women as leaders – as an example, the stereotype regarding female managers is that they are often viewed as either competent or too warm and soft for the role – but not both.

With the large and still increasing number of women entering the higher positions in the business world over the last few decades, the glass ceiling against female professionals has potentially weakened or almost even disappeared, if it had even existed in the first instance. However, given that it is also been pointed out in the results of the present study, the active mutual fund industry is still dominated by male portfolio managers with the extremely high number of male managed funds in each study on the industry, I consider the glass ceiling as a potential problem for female mutual fund managers.

3.4   Previous studies on 'Gender Effect'

As pointed out above, it is still evident that female participation in the business world is limited and women continue to be broadly underrepresented in the financial sector and especially in active fund management. Such underrepresentation could potentially reveal an untapped pool of skilled fund portfolio managers. After all, much work has been done to show the benefits of gender diversity in other business industries (e.g., the benefits of female CEOs or of having female representation on corporate boards), and as a result, the idea of gender diversity benefits in fund management has become more popularized recently.

Some research has been conducted to study gender differences in the fund manager's 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 by a consulting firm Rothstein Kass in early 2014, hedge funds managed

by females outperformed hedge funds managed by male managers for two years in a row. From January 2013 through to the end of November 2013, the hedge funds led by women showed an average return of 9.8 percent compared to the 6.13 percent returns on the Global Hedge Fund index (HFRX). Similarly, between January 2007 and June 2013, hedge funds managed by females exhibited an average return of 6 percent while the HFRX Global Hedge Fund Index showed a loss of 1.1 percent and the Standard & Poor's 500 index returned 4.2 percent within the same timespan (Jones, 2014). The most common suggested reason for the suggested superior performance of hedge funds run by female managers is that women are more risk-averse than men on average, and such behaviour generate better return especially in the severely fluctuating market cycles (Byrnes, Miller & Schafer, 1999) that market experienced after the 2008 financial crisis. However, it is important to note that funds managed by females tend to be much smaller and focus on more niche investment strategies as compared to those managed by men (Pham, 2015), which might be the explanation to the outperformance rather than gender of the mutual fund manager. Additionally, it is important to remember that such studies focused solely on hedge funds, which only have 3 percent of female portfolio managers. Further, many of these studies focused only on return data in their models without controlling for proper and sufficient extraneous variables.

After the popular gender studies in 2013 and 2014, researchers began to look into the question of gender impact in fund management in more detail. Risk and performance metrics that cover one-year, three-year, and five-year horizons in the U.S. mutual funds and hedge funds showed that funds managed by women outperformed those managed by their male counterparties (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 favourable combination of risk tolerance preferences and investment strategies (Luongo, 2011). All in all, it is striking that females remain significantly underrepresented as mutual fund managers even though they show extremely high-quality performance.

However, the findings of better performance of female-led mutual funds are still questioned as other studies reveal that there is no such thing as 'gender impact' on financial investment industry or on the fund performance. Babalos, Caporale and Philippas decided to step beyond the market of United States and explore the performance of 358 European diversified equity mutual funds. According to their findigs, there were no statistically significant difference in performance as explained by gender when funds were evaluated against each funds' designated market indices (Babalos, Caporale & Philippas, 2015). However, male and female portfolio managers did exhibit different investment style consistency and risk factor responses (Babalos, Caporale & Philippas, 2015). To further support the claim, 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 & Boyson, 2016).

An interesting common trait about the studies conducted within company management and mutual fund industry is the perception of the broader market toward female portfolio managers or female leaders in general. Despite many studies find no difference female and male run funds in risk and performance measurements, Atkinson, Baird and Frye (2003) and Ruenzi (2005) among others found significantly lower flows of capital into female run funds – often approximately by one third lower than to male managed funds. Further, also Martin (2009) supported the concept in his study that the market identifies female CEOs to be more risk averse. Lee at al. (2007) reported that market reactions to the announcements of CEOs who are female are significantly more negative than to the announcements of male CEOs. While the market perception toward female CEOs could be reasonably argued in case a more risk averse CEO would be undesirable for shareholders, but this is very rarely the case. Further, the disparity between female and male run funds' characteristics and their capital flows could serve as a sign of discrimination.

Even though the results differ from the study conducted by Luongo (2011) in the United States, such findings could have significant implications for fund managers and investors when they set asset allocation strategies and pick management teams. However, all of these studies focused solely on pure returns as a measure of performance. Aggarwal and Boyson (2016) essentially replicated the Rostein Kass study conducted in 2014 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 institutional investors.

Much of the past research in this field has been challenged as notable studies present conflicting results for the initial findings, and as they ignore the question of manager skill or other important factors that should be controlled and do not address institutional investors' portfolio manager gender discrimination. Further, it is unclear if the phenomenon of female portfolio managers generating higher value added and returns is restricted to the United States only, if the findings are credible due to the limited number of funds headed by female portfolio managers, and if it is actually the gender that is the core driver of any differences in their ability to generate value added and returns to the institutional investors.

4 THEORETICAL FRAMEWORK

In this section, an overview of the main theoretical research and existing literature of mutual fund performance measurement are presented. Although the number of functions and models to evaluate mutual fund performance is very significant, only a small subset of the overall literature will be presented.

4.1 Performance assessment and evaluation

As there is a broad range of investment vehicles to select from, institutional investors are faced with a challenging task of choosing which portfolio manager, investment strategy and even investment institution to invest with among an almost endless number of providers, risk-return scales and portfolio managers of mutual fund vehicles. In order to help investors to identify their optimal investment vehicles, there are multiple indicators that aim to advise investors in this regard. The broad range of different characteristics such as strategy of a mandate and investment style are qualitative measures seeking to inform the end-investor on the basis of how each fund individually intends to beat the market or in general, generate returns. In addition, the fund's historical track record acts as a rough indicating estimate of how well the fund has been performing in the past, although the importance of this indicator has been challenged in the previous literature.

According to EMH and the concept of random walk presented briefly above and further below in more detail, past performance, investment strategy or any other fund characteristic alone is not adequate to provide an estimation of fund's performance in the future. Generally speaking, however, using the publicly known information has been and still is the only way for an average institutional investor to assess the potential return level of a fund at present and in the future. One of the simplest, yet somewhat misleading method for measuring and comparing performance of portfolios would be to compare the past, realized returns of funds within a group sharing roughly similar investment strategy, style and objectives. This, in turn, would enable the institutional investors to rank the portfolios and thus, choose intuitively the one with the highest realized return in the past. In addition to the violation of EMH and the concept of random walk, unless the method presented above is carried out within a truly homogeneous group of mutual funds with comparable benchmarks, risk profiles, other fund characteristics and fund strategies, the method of ranking funds based on their past performance may turn out to be extremely misleading.

Ever since the early 1960's, the academics and other participants in the economic industry have provided insights to the broad range of studies focusing on evaluating and measuring the performance of different investment vehicles. While the wide range of existing models and literature presented diverge in many aspects,

e.g. in terms of theoretical base and foundation, most of the models introduced are based on the famous paper by Harry Markowitz in the 1950's. He introduced the concept of portfolio diversification and illustrated in detail how any investor can reduce the volatility of their generated portfolio returns by constructing a portfolio of uncorrelated securities. By doing this, an investor would diversify their fund's risk without sacrificing the returns to a same extent. For a reason, Markowitz has often been ascribed as one of the important inventors of the relationship between the risk and return of a portfolio (Brealey et al., 2011).

4.2   Efficient Market Hypothesis

As briefly presented in the Section 1, the Efficient Market Hypothesis (EMH) is extremely central when considering the purpose and aim of present study. Essentially, almost all studies trying to shed light on abnormal fund performance are relying on the question of whether there are potential information asymmetries that may enable some investors to earn abnormal returns and that may exist among investors, as well as between geographically separated markets. Thus, one of the most debated and well-known themes in the academic financial world and almost all research remains to be about the EMH (Elton et al., 2011). After the publication of Fama's (1970) seminal paper, "Efficient Capital Markets", there was a general consensus that capital markets were extremely efficient when it came to reflecting and adjusting for the information provided on the common stock market (Malkiel, 2003). As a part of EMH also an idea of "random walk" was introduced in the literature by Graham (1965). The concept of random walk was presented to describe movements in price series; as a result, one cannot predict the movement of price based on its previous performance.

With regard to the gender of portfolio managers, supporters of the EMH argues that neither fundamental nor technical analysis should lead to superior returns of managers, female or male, and thus provide any help in identifying superior investment targets from the market. In the same vein, if the market would not adjust for new information promptly, managers could in theory be able to generate abnormal returns, and in this case, generate higher value added to the fund. However, this might be a short-term phenomenon – supporting the concept of a random walk, Graham (1965) suggested that while the stock market may act like a voting mechanism in the short run, it would approach a form of weighing mechanism in the long run, implicitly stating that true value will win in the end. (Malkiel, 2003).

There are three general forms of the level of EMH, with each relating to a certain magnitude of informational efficiency of the market (Bodie et al, 2011). First of the forms is known as a weak form of efficiency and claims that prices of traded assets already reflect all historical publicly available information of any given security at any point in time. Based on the assumption that historical track record does not provide any

guidance about the future performance, in other words random walk, aiming to detect potential price-patterns that would potentially lead to superior investments. The second form of efficiency is known as the semi-strong form of efficiency. This view of form claims both that prices reflect all publicly available information and that all prices will instantly change in order to reflect new public information made available at any given time. This suggests that neither fundamental nor technical analysis provides any guidance for an investor in order to make better advised investments. The third form is commonly known as strong-form of efficiency. Building on the assumptions of semi-strong form of efficiency, this form claims that also all non-disclosed, i.e., insider or hidden information has been incorporated in the market price of securities. Thus, irrespective of how much information an investor has, he or she will not be able to conduct better trades or other investment decisions than the market, since all information, public and non-public, is already reflected in current market prices (Bodie et al., 2011).

Although there is substantial amount of empirical studies supporting the EMH, some authors still question its validity in their papers. The Behavioural Finance School (BSF) is one such group. Without presenting the extensive range of their results, they suggest that in the market space there are a variety of anomalies that enables multiple arbitrage opportunities. These suggested anomalies are not compatible with the view of markets being informationally efficient (Bodie et al., 2011) as suggested above. The challengers of the EMH have criticized the underlying assumption of rational investors, suggesting that investors and other market participants are primarily driven by emotions and intuitions, which in turn leads to inconsistencies and inefficiencies. An example of such practice occurs when investors sell winning stocks based on the assumption that the price of the security will decrease in subsequent period. Further, another group has documented that price-to-earnings (P/E) ratios are indicators of the future performance of a security. In other words, this argument suggests that low P/E securities will tend to outperform stocks with high P/E ratio (Basu, 1977). The latest market event stirring critic against EMH is the most recent global financial crisis. In response to the critic, proponents of the EMH stated that market efficiency does not mean that there is no uncertainty about the future, as the market efficiency is solely a simplification. Although this simplification may not always hold true, the market is practically efficient for investment purposes.

In order to challenge the assumption of market efficiency in more practical terms, Grossman and Stiglitz (1980) questioned the assumption that the information, of any kind, is accessible to all investors and other market participants for free. However, collecting information requires a lot of resources, both in terms of capital and time invested. Thus, by assuming that the information for technical evaluation of market securities is not generally free of charge, the investors with great amount of information are still expected to generate a sufficient amount of capital to compensate for the costs occurred from the exercise. As presented above,

these findings contrast with the standard version of the EMH, where spending time and resources for additional information is useless. As a response to these findings and to the critics of the EMH, Fama (1991) proposed a modified version of EMH that would allow for temporary mispricing of securities. Even though active managers – both male and female – can benefit from their comparative advantages and profit from these inefficiencies occurring in the market in the short run, the view introduced by Graham (1965) and supported later by Fama (1991) suggests that these market inefficiencies occurred in the market will eventually be eliminated in the long run.

Since valuation methods are still far from an exact science and different models are introduced regularly without a definitive consensus, a satisfactory test of the EMH cannot be anticipated to be introduced in the near future. As EMH gained critic on the fact that tests on the market efficiency are conditional on a separate model with its own underlying assumptions, Fama (1991) introduced a concept called "joint hypothesis problem". In general, this means that it is not possible to confirm nor reject the level of market efficiency based on any empirical study, since the findings may be impacted by the testing model and its underlying assumptions. When applying this concept to the most papers measuring portfolio performance, the hypothesis means, in general terms, that the market efficiency becomes conditionally tested with the asset-pricing model or conversely, asset-pricing model becomes tested conditionally on informational market efficiency.

4.3 Value added – Managerial skill

Berk and van Binsbergen (2012) concluded in their paper that "an important principle of economics is that agents earn economic rents if and only if they have a skill in short supply". Contrasting a lot of previous studies in terms of approaches to measure mutual fund managers' performance, Berk and van Binsbergen (2012) presented a way of measuring portfolio manager skill which is to evaluate how much value, in monetary terms, a manager is able to add to their fund. By taking a step back and considering the definition of skilled fund managers, the concept of skill has been a widely challenged idea among researchers and practitioners and even the existence of a talent of stock picking and recognising optimal market timing has been questioned. In case there are no skill, this debate leads to the fundamental question of whether portfolio managers without talent can still earn economic rents, in this case revealing as returns to the funds and fees to the manager. However, given that fund managers are not only incentivised but also compensated with a generous base for their work and effort, the lack of consensus on the existence of skill is rather concerning. In theory, investors want to place their money with the most skilled managers in order to receive the highest possible return to their underlying investment (Berk & van Binsbergen, 2012).

The task of assessing skill or its existence is highly complex. Some existing studies used net alpha (i.e., the average abnormal return net of fees and expenses) to assess the skill of a portfolio manager (Carhart, 1997). However, Berk and Green (2004) challenged this approach arguing that if the supply of skill is limited, meaning that all portfolio managers are not equally skilled (or no one has skill), then in equilibrium, net alpha is not determined by manager skill and instead, it is determined by competition between managers. Thus, if some managers are more skilled than others, investing with the higher skilled managers should be in demand and they should demand and earn higher fees to compensate for their skill (Berk & Green, 2004). With that, gross alpha (i.e., the average abnormal return before any fees or expenses are subtracted) was suggested to be a closer measure of managerial skill.

However, Berk and van Binsbergen (2012) argued that the economic extent of managerial skill cannot be measured by the abnormal return generated by portfolio managers, no matter whether it is measured on the basis of net- or gross alpha, but rather by estimating the total value added to the fund in monetary terms. In other words, since net alpha estimates the abnormal return gained by end-investors and gross alpha estimates the return a portfolio manager is able to generate, neither one of them provide a reliable measure of the value-added estimate in monetary terms, as this measure would be dependent on the initial investment allocated by each investor. Therefore, Berk and van Binsbergen (2012) suggested that in addition to the gross alpha, the fund size needs to be included in the equation of measuring the value added. Berk and van Binsbergen (2012) were the first academics to introduce the idea of value added measure in monetary terms.

Thus, Berk and van Binsbergen (2012) suggested that value-added estimate is associated with the amount of money extracted from financial markets by each fund manager, meaning that the value generated must be a function of fund size. Therefore, in theory, holding fees constant, gross alpha can only differentiate managers if all funds are of the same size. Naturally, this is not the case, especially when comparing funds led by female and male portfolio managers as female managers tend to have smaller funds as suggested on the existing literature (Berk & van Binsbergen, 2012). In theory, a manager with a smaller alpha but larger fund might add more value than a manager with a large alpha but small fund (e.g., 1 percent return on a €10 billion fund is larger than 10 percent return on a €1 million fund) (Berk & van Binsbergen, 2012).

To conclude, Berk and van Binsbergen (2012) argued that "the skill of a mutual fund manager equals the value that the fund extracts from markets" (i.e., the value added to the fund in monetary terms), 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 taking a stand on how the fund decides to distribute the money between the compensation to the manager and return for the investors (Berk & van Binsbergen, 2012).

Although the model presented above measures the skill of a portfolio manager, it does not take a stand on whether the skilled portfolio managers are the ideal investors to invest with in terms of highest returns to the investors. Since fees between managers may vary, looking solely at fund size and gross alpha may not reveal everything on the best investment alternative for an investor. To analyse the theoretical framework of the topic, it is 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 & van Binsbergen, 2012).

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 and therefore it cannot be used as a measure of skill. Thus, gross alpha should be used instead and it is defined as

$$\alpha_{it} = R_{it}^{g} - R_{it}^{B}$$

where

α_{it} = the gross alpha, i.e., the benchmark adjusted realized gross return

R_{it}^{g} = the gross alpha of a manager i at a time t and

R_{it}^{B} = the benchmark return at a time t (Berk & van Binsbergen, 2012).

The equation above can also be presented in a different format that shows the decreasing returns to scale of a portfolio manager:

$$\alpha_i = a_i - b_i q$$

where

α_i = the gross alpha

a_i = the net alpha on the first cent that manager i actively invests,

b_i = the parameter that captures the decreasing returns to scale of manager i, and

$q = a_i/2b_i$ i.e., the optimal amount of money manager i has under active management (Berk & van Binsbergen, 2012).

Further, under the assumptions stated above, Berk and van Binsbergen (2012) introduced 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.

When combining the assumptions and the approach to obtain value-added estimates, the measure of the skill is calculated by multiplying the benchmark adjusted realized gross return of a fund by the real asset under management of the fund at the end of the previous period (Berk & van Binsbergen, 2012). Additionally, as the managers optimize, the equation looks as follows:

$$V_{it} = max[q_{i,t-1}(a_{it} - b_{it}q)]$$

Or, by showing the gross alpha calculation:

$$V_{it} = max[q_{i,t-1}(R_{it}^g - R_{it}^B)]$$

Thus, for a fund that exists for T_i periods this estimated value added, $\hat{S}_i$, is given by:

$$\hat{S}_i = \sum_{t=1}^{T_i} \frac{V_{it}}{T_i}$$

In general, this model accounts for two variables; first variable describes the fraction the portfolio manager deducts as compensation for their skill and effort provided, which is always positive as the managers always earn at least the base compensation. The second variable is the one the manager either provides or pulls from investors, which can, in turn, turn out either as positive or negative value for investors. When evaluating the value-added estimate, no matter if positive or negative, the essential questions is who benefits from the potential skill of a manager. Berk and van Binsbergen (2012) divided their sample of funds into 10 deciles in both sets, based on their net alphas and the value-added measures. They concluded that the sorting of funds based on net alpha suggested that only managers in the 10th decile demonstrated skill, and the sorting based on the value-added measure presented that 52 percent of actively managed assets were under management of skilled managers. Thus, the authors claimed that investors are able to identify managers who possess skill. This claim is further strengthened in the existing literature, where a pattern of inflows of capital into the highest performing portfolios were detected (e.g., Gruber, 1996; Sirri & Tufano, 1998).

The Figure 1 below demonstrates the equations presented above. It has the potential to show systematic discrimination; with the same gross alpha, two managers could have different value-added estimate showing that investors could be discriminating in terms of capital allocation to different, yet equally skilled, managers. Please see Figure 1 presenting value-added estimate and gross alpha in a gross alpha-fund size graph.
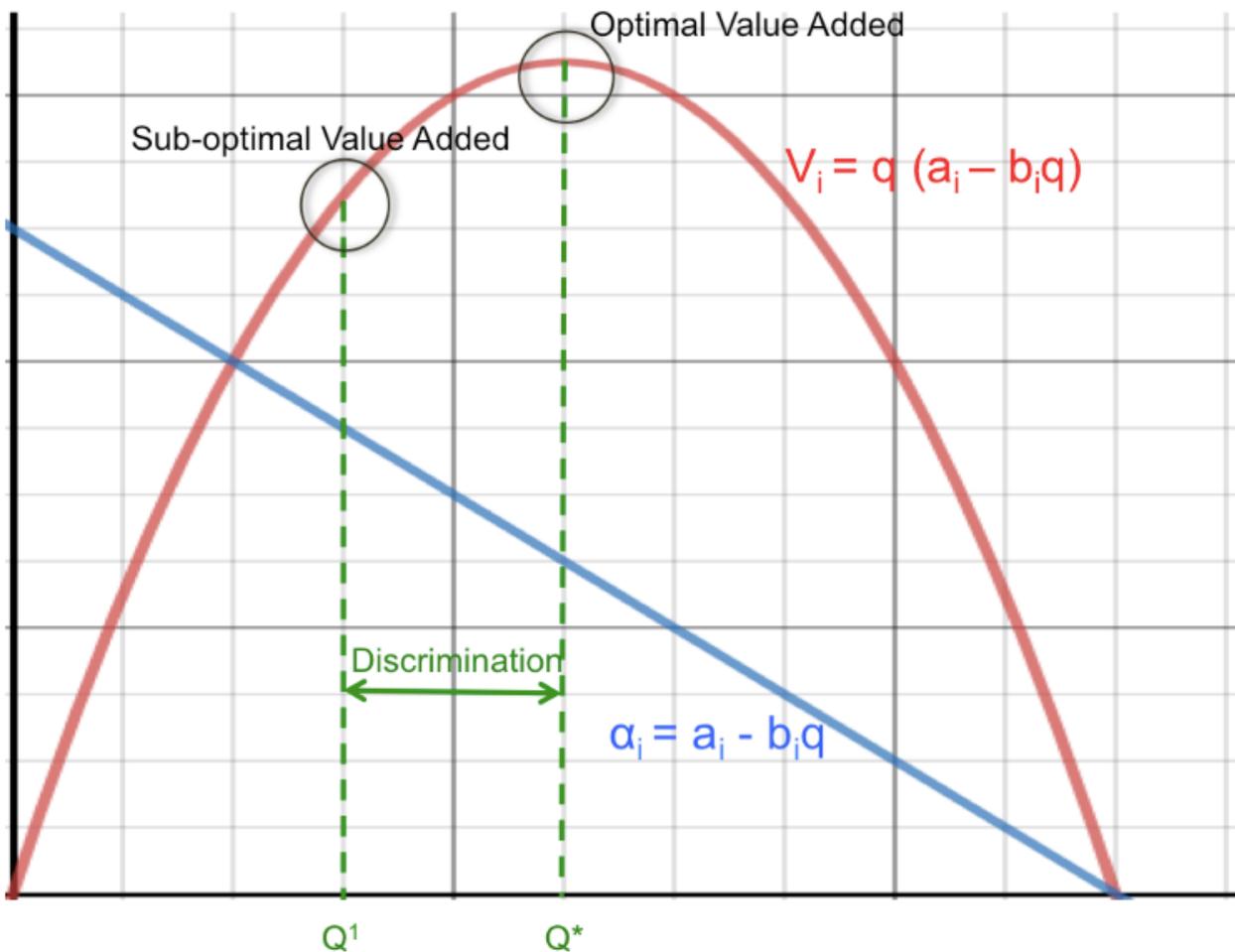
Figure 1 – Value-added estimate and gross alpha lines to demonstrate the potential discrimination against female portfolio managers.

Source: Borowski, 2017.

Thus, the optimal value added is the max of V_i indicated in Figure 1. The figure illustrates also how the value added is lower for funds which have high gross alpha but small fund size. According to the theoretical framework presented above, all managers that have their performance at the line $a_i - b_i q$ (blue line), should have the fund size Q^* in order to maximize their 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 the fund size Q^1 have higher current α but lower value added. On the other hand, the

manager that lie anywhere on the right side of the maximum point are allocated too much capital, i.e., they have too large funds to be explained by their ability to generate high gross alphas.

If females demonstrate significantly more often sub-optimal value-added estimates than their male counterparties, meaning that male managers exhibit optimal value added, there might be systematic discrimination in the market that does not allow female managers to receive the proper capital allocation from investors. As a result, the distance between average female fund size and average male fund sizes can reveal the potential discrimination in the market.

In order to illustrate these ideas further, a scenario of two managers is introduced. Manager A and Manager B are equally skilled, meaning that they both have equal gross alpha when given equal amounts of money to invest, leading to equal value-added estimates. If both of them are given more money to invest, gross alphas will decrease because investment opportunities are limited, implying that there are decreasing returns to scale. Thus, assuming the gross alpha is 1 percent for both managers when they have €100M assets under management each, it will decrease to 0 percent if an additional €100M is invested. If manager A charges a fee of 1 percent and has a fund with €100M AUM, the value added of Manager A 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 should not receive more money from investors as inflows under the assumptions stated above.

Meanwhile, if Manager B is as skilled as Manager A but charges a fee of 0,5 percent, Manager B will be given more money under the assumption that markets are competitive because Manager B's net alpha will not be zero when he or she manages a fund of €100M. With the first €100M invested with Manager B, he or she will generate a value added of €1M but will only receive €500K in fees – Manager B's net alpha is 0,5 percent. As a result, Manager B would receive additional funds from investors in a perfectly competitive market. If another €100M is invested, Manager B's overall gross alpha will become 0,5 percent because (1) gross alpha was 1 percent for the first €100M invested out of the €200M fund size and (2) gross alpha was 0 percent for the following €100M invested out of the €200M fund size. It is worth noticing that there is no value added on the funds that Manager B has invested at 0 percent gross alpha. Manager B's gross alpha becomes equal to the fees charged as fund size increases, but value added remains the same.

To conclude the example above, 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 are different from each other. However, all other factors aside, both investors generate equal value added, illustrating their equal skill.

In terms of value added, it is important to note that the fund size alone does not necessarily imply anything about the skill of a portfolio manager – having a large AUM does not inherently imply that the portfolio manager is particularly skilled. Instead, it is usually those managers with the highest skill that end up with the larger funds and also reap the higher rewards as fees (Lucas, 1978). Managers need to prove themselves with high alphas in order to attract investments, 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 high level of competition between highly skilled managers (Berk & van Binsbergen, 2015).

Overall, the concept of skill is considered as an important addition to the literature because investors appear to be able to identify manager skill and use the information when investing their capital. Managerial compensation is predominantly based on fund size, so investors effectively also determine managerial compensation as they allocate capital to funds (Berk & 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 arrive to a conclusion that particular managers possess managerial skill, "as current compensation better predicts future value added than past value added does" (Berk & van Binsbergen, 2015).

However, if external factors besides pure managerial skill influence whom investors allocate their investments to, then there is potential for the existence of an untapped pool of skilled managers. In the scenario of perfect markets, investors would give money to managers based on their skill – unfortunately, societal norms, industry pressures, and unconscious biases might sometimes keep people from acting perfectly rationally, thus keeping investors from investing with highly skilled managers based on factors that are not merit-based, such as gender (Dobbin, 2011).

4.4 Fund size (AUM) – Capital allocation

As fund size is one of the determinants of value-added estimate, it is important to understand the factor in great detail. Sirri and Tufano (1998) examined the determinants of the flows into and out of variety of different investment funds in their paper. Their study suggested that in general, in addition to the fund size, historical track record, marketing efforts and fees have an impact on the flows of funds. However, their study did not specify how much each of these determinants impact on the flows to and in to the fund. In addition, their study did not take a stand on the characteristics of mutual fund manager and thus, it is possible that end-investors are able to detect the differences between female and male managers and use portfolio manager gender as one piece of criterion when allocating capital to mutual funds.

Powell and Ansic (1997) showed that male and female investors demonstrate different strategies when making financial decisions of any kind. Although the authors did not find any significant evidence for the hypothesis that the ability to perform as a portfolio manager is affected by any way from these different characteristics, they argued that differences in the strategies employed may reinforce stereotypical assumptions that women are less capable of making successful financial decisions, because strategies tend to be easier to observe than preferences of risk levels or outcomes of either of these. Similarly, Heilman et al. (1989) found an interesting observation that managers consistently associate more desirable managerial traits with men and less desirable managerial traits with women. In order to explain the phenomenon, Oakley (2000) contended that gender stereotypes might be able to explain the lack of female CEOs in the business world because people, both females and males, tend to associate femininity with characteristics such as incompetence. Lastly, Lenton et al. (2001) argued that stereotypes can lead to false recognition of behaviour and traits that can be characterized as stereotypical, proposing that investors may incorrectly stereotype female individuals as being less capable financial managers or as being less financially intelligent.

As suggested by many existing studies, the funds run by women tend to be smaller than the funds run by their male counterparties. KPMG conducted a study at the end of last year and confirmed the same finding although they forecasted that the issue will change in the near-term at least to some extent. In 2013, they conducted the same study and concluded that only 2 percent of the institutional investors in the sample had women-owned or women-managed mandates in their portfolios. However, in 2018 the same number was 16 percent (KPMG, 2018). Although the number is still arguably low, direction of the development is correct. However, as in prior years, the majority of institutional investor who took part in the study said that the greatest barrier to invest in women-owned or women-managed funds is the lack of supply of such funds and not a discrimination towards female managers (KPMG, 2018).

4.5 Performance persistence

Although the topic of mutual fund performance measurement against other active managers, passive indices or investment strategies have been a central topic in the financial academic research, academics and practitioners have also presented several different methods for assessing persistence in the underlying performance of mutual fund managers. In simple terms, the tests described above are introduced in order to measure whether mutual fund managers who were able to outperform the benchmark index in one period are also able to maintain such performance in subsequent periods by the same intensity. On the other hand, the insight into

the potential phenomenon that funds that perform poorly in one period, will continue such performance in following periods is equally interesting.

By extending the discussion of performance persistence from the previous sections, the existing literature has described several approaches to measure whether the portfolio managers' performance is persistent. For example, Coetzmann and Ibbotson (1994) defined all funds included in their sample as either winners or losers in a sorting period depending on whether the fund's return over a calendar year exceeded, or was lower than the median return. The same approach was later adopted by many academics such as Malkiel (1995) in his study of performance persistence. By using the median return as a sorting value, he defined that the probability of a winner (or loser) to continue being a winner (loser) should equal 50 percent in case there is no persistence to be detected. Among many studies on the topic, Hendricks et al. (1993) found similar results when examining specifically autocorrelation in returns of mutual fund. In an occasion that significant auto-correlated coefficients did exist, the authors argued that it might imply that there is some degree of persistence of returns.

In addition to the above, an approach to evaluate the persistence in mutual fund performance is derived from research conducted in the European fund space. Out of these studies, especially two different approaches stand out from the existing literature. Blake and Timmermann (1998) conducted an insightful study where they constructed a time-series of returns based on abnormal returns of the sample funds over a 24-month period and subsequently sorted the funds into the groups of top and bottom quartile portfolios. As part of the time-series, the portfolios were held for one month and were rebalanced after. As many researchers and practitioners have followed a somewhat comparable approach, Otten and Bams (2002) constructed a similar time-series of returns in their study, but with a moderate justification of sorting funds based on their previous 12-month absolute returns and by extending the holding period in the model to 12 months.

As academics and practitioners have come to rather differing conclusions on the performance persistence in their research papers, all of the studies have brought some new and interesting views and challenged many existing studies in the economic literature. For example, to contrast with the studies discussed above, Carhart (1997) concluded that the persistence does not actually reflect superior stock-picking skills at all – the predictability of mutual fund returns can rather be explained by common factors in stock returns and by any persistent differences in the expenses, incentives and different transaction costs of mutual funds. According to his paper, it is only the strong, persistent underperformance by the worst-return mutual funds that remains anomalous.

5   METHODOLOGY AND DATA

The purpose of this sections is to describe the process of data screening and collection and an overall methodology employed in the present study. In addition, the section below presents the benchmark indices used in the study, survivorship bias and a brief discussion on regressions, hypothesis testing and scenario analysis.

5.1   Data selection

The core mutual fund performance and fund characteristics data used in this study was extracted from the Morningstar Direct database and the benchmark performance data from Datastream database. All sets of data were analysed by using Stata and Excel programmes.

The data extracted from Morningstar Direct database included monthly arithmetic gross return series and the monthly fund sizes reported in euros among other fund characteristics. The initial screening on Morningstar Direct database was set to include all European Open-end investment funds investing in equity and the screening resulted 52 592 funds. Since the data covers the period of 1st of December 2008 through 30th of November 2018, the maximum number of monthly observations of each variable for each fund is 120. The return data extracted for this analysis is measured gross of fees, i.e., before any buying or selling expenses and all annual management base and incentive fees. Although the screening was opted to include also all non-surviving funds, no terminated or merged funds were discovered at the time of screening. The topic will be discussed further later in the paper as the survivorship bias is an important topic for the study.

Cesari and Panetta (2002), among others, argued that in order to conduct a meaningful and reliable study in the mutual fund industry, funds have to be classified into homogeneous categories. Considering the large amount of resources and time invested to analyse the raw set of data composed of approximately 53 000 funds, a range of selection criteria was applied in order to secure homogeneity of the funds included in the sample. Following the obtained overall homogeneity of the sample, an intra-categorical homogeneity was also considered in order to compare the four geographical categories of funds. As all funds were required to pass the same range of criteria within each geographical focus, the intra-categorical homogeneity should also be obtained to a satisfactory extent. The full selection criteria of the present study are presented below together with the size of the final sample, as well as an overview of the number of funds succeeding to comply with each line of the criterion. After this, reasoning for employing these criteria in this study is provided.

Number of funds from the Morningstar Raw Dataset (Domicile: All Europe, investing in equity, including non-surviving funds): 85 748

1 *Inception date on or earlier than 01/12/2008*: 36 324

2 *Oldest share class:* 14 883

3 *Portfolio manager name disclosed:* 4 637

4 *Not an Index fund:* 4 405

5 *Not a Fund of fund:* 4 045

6 *UCITS-compliant:* 3 930

7 *Not a Small Cap fund:* 3 908

8 *Investing cross-border in Europe, the U.S., Emerging Market or Asia-Pacific:* 1 666

9 *Just one portfolio manager:* 827

10 *Same portfolio manager for at least seven out of ten years:* 503

11 *Sufficient Data:* 497

Final number of funds included: 497

First, all funds that are denoted as "second units" of an original fund were excluded from the sample as these investments are basically the same fund provided in a different form and typically targeted at somewhat different investors. Second, as the study covers a period of 12/2008 through 11/2018, all funds with inception date later than December 2008 were removed. Third, all index funds and money market funds were omitted from the sample as they are generally considered as passively managed investment vehicles and would not provide any insight into our study which is focusing solely on the actively managed funds' performance. Fourth, all funds of funds were omitted as they normally constitute of holdings in other mutual funds and therefore benefit other portfolio managers' good performance. Fifth, all non-UCITS compliant funds were excluded. Following Dahlquist et al. (2000) and their employed fund selection method, the present study includes only funds which are certified in accordance with the UCITS-directive. In general, this criterion assures that funds with less clear guideline in terms of investment mandates or requirements relating to diversification were excluded. On the other hand, all the funds included in the sample have option to market and distribute their funds across borders in the European Economic Area (EEA) and thus are more likely to have homogeneous investment mandates. However, although the funds following the UCITS directive have an option to market across the EEA, it does not necessarily mean that all managers choose to exercise the option. Thus, whereas the first line of reasoning focuses on securing the homogeneity in terms of strategic alignment and diversification of the funds included, the second consideration greatly enhances the level of homogeneity across the sample.

As one of the hypotheses of this study is to test whether there is a significant difference between the four geographically different sub-samples in terms of value-added estimates, the investment mandates in the sample had to be centred on investing in either a mix of large and mid-cap segments or them separately. This restriction is especially essential in consideration of constructing a homogeneous sample of funds to be evaluated. Otten and Bams (2002) conducted a study of five different sub-markets in Europe and concluded that funds that are either dominantly focused on, or have frequent exposure in the small cap segment were able to record abnormal performance, which was indicated by their positive net alphas. By excluding funds that predominantly invest in the small cap segment, the resulting sample of funds will consist of funds that have stated and documented investment strategy as targeting the large and/or mid-cap segment. Nevertheless, this does not restrict a single fund included in the sample from occasionally invest in small cap companies. In order to confirm whether such practices were conducted among the funds in the final sample, I randomly selected 15 funds within each of the four categories and based on quarterly data extracted from Morningstar database, screened the holdings of these funds. On average, the funds' exposure to the small cap segment was rather marginal and thus should not bias the end result. Therefore, no further action was needed on this topic.

After omitting all the funds described above, only the mutual funds managed by the same portfolio manager for at least seven years out of ten were included in the study. This criterion is added in order to distinguish the differences between male- and female-led portfolios in as accurate manner as possible. In addition to the portfolio manager's gender, characteristics such as age, years of experience and education level are included as explanatory variables in the regression in order to analyse the impact of gender on the value added generated.

Lastly, to ensure the homogeneity of the portfolios investing in different geographical areas, the benchmarks each portfolio is using as a description of the investment space were examined. Any outliers after excluding the Small Cap –funds were not found, meaning that all portfolios passing the criteria above were included in the study.

The selection criteria presented above can be characterized as being rather strict. The final sample is a highly uniform group of funds, which can only be considered as advantageous for the quality of the analysis. As a result, a consideration of the minimum initial investment required by investors does not have to be taken into account at this stage. If only funds with a high initial investment requirement were included in the sample, it would certainly change the target group of potential investors and probably the fee structure. However, the specific initial investment requirement has restricted, if any, impact on fund performance.

However, the data of portfolio manager characteristics, such as gender, age, educational level and years of experience are not available. Thus, I collected these pieces of information manually from sources such as Bloomberg, fund website or LinkedIn following the method implemented by Aggarwal (2016). Portfolio managers were identified as female if they were addressed as "Ms.", "Mrs." or "she" and naturally, male managers were identified if they were addresses as "Mr." or "he". Further, to divide these into the four categories discussed earlier and showing the split between female- and male-led portfolios, the data looks as follows:

Table 2 – The number of female and male portfolio managers per sub-sample.

	Europe	The US	Emerging Markets	Asia-Pacific	Total	Total (%)
Female	*54*	*15*	*6*	*16*	*91*	*18%*
Male	*242*	*59*	*60*	*45*	*406*	*82%*
Total	**296**	**74**	**66**	**61**	**497**	**100%**

Although the total number of funds is naturally lower than in previous studies researching all equity funds globally, the number of female-led portfolios is somewhat higher. In previous studies, the number of female-led mutual funds has usually been a one-digit percentage, in the present study I ended up with 18 percent of female-led funds. This makes the study more meaningful as a small number of funds in one category is not a limitation.

5.2   Benchmarks

A shared characteristic among a vast number of the models presented since the early 1960's is that, by assessing the relative returns of portfolios, investors gain a sense of whether the mutual fund manager gives or takes from investors by comparing their performance to the next best and somewhat comparable investment opportunity available to investors at the time. This passive investment opportunity is generally called benchmark. Thus, this leads to the question whether mutual fund managers should be evaluated against the benchmark reported in their prospectus, which might vary among a group of funds widely, or with respect to a broad market-based passive portfolio (see, inter alia, Sensoy (2009), Hsu et al., (2010), Angelidis et al. (2012)). When carrying out research studies at least remotely based on models such as CAPM-framework, the results may be extremely sensitive to the selection of a underlying benchmark which the returns are compared against, as concluded in the studies conducted by Elton et al. (1993) and Grinblatt and Titman (1994) inter alia. Elton et al. (1993) argued that a failure to include certain indices as a benchmark may present as a substantial over- or underperformance of fund, which, in turn, leads to findings and eventual conclusions be-

ing severely misleading. As suggested by Roll (1978), it is usually a difficult task to find the one "true" market portfolio that sufficiently accounts for all tradable securities in the respective space. Thus, no matter what is the choice of benchmark, it usually turns out to be difficult to distinguish portfolio performance from the inefficiency of the underlying benchmark (Roll, 1978).

The standard practice of measuring benchmark performance is to simply adjust for risk using a factor model. However, the extent to which factor models accurately account for risk and if they are actually even efficient to invest in have been subject to extensive debate in the industry. In response to the critique, the researchers have suggested a method where an alternative investment opportunity is constructed directly instead of using factor models to adjust for risk, meaning that they have valued the factors as investment opportunities available rather than risk factors. In the recent literature, this approach has been challenged as investors cannot really invest in the factor portfolios. As Breen and van Binsbergen (2012) pointed out in their study, these mutual funds do not take transaction costs into account and many of these factor portfolios were discovered substantially later than the starting date of mutual fund databases. Although I am solely looking at the gross alphas – meaning that the transaction costs would not, in theory, affect the results – the construction of factor model and invest in the portfolio would also require skill.

For the reasons stated above, I have decided to follow the existing literature by adopting a 'benchmark approach', meaning that the benchmarks used in the study need to be marketed and tradable during the entire observation period. By looking at the benchmarks stated in fund prospectuses, MSCI indices seem to be common. Therefore, I have decided to use Morgan Stanley Capital International (MSCI) indices as benchmarks to ensure homogeneity. MSCI indices were the first global market indices created in 1968. They are a great alternative for benchmarks as they must include enough stocks to represent the underlying equity market but at the same time, they cannot have so many stocks that exchange-traded funds (ETF) and mutual funds cannot mimic the underlying index (MSCI, 2019). With the four geographically separated categories of research, the benchmarks included in the study are:

- MSCI Europe NR EUR
- MSCI USA NR EUR
- MSCI EM NR EUR
- MSCI Asia Pacific NR EUR.

Prior to settling with the indices above, I had to take a few issues into account. As the purpose of this research is to assess the performance in terms of value-added estimates of four geographically separated categories of funds investing cross-border and predominantly comprising of large and mid-cap equity items, the

portfolio managers' mandated strategies and targeted investment opportunities do not naturally include the entire span of marketed securities in the underlying space. However, as a proportion of the holdings of the equity funds can include non-equity investments, e.g. money market instruments, bonds or equivalent, the mix of a portfolio products could complicate the choice of underlying market benchmark even further. In order to provide an example, Jensen (1967) confirmed the fact that mutual equity funds are seldom interily invested at any point in time and thus decided to include the product of the non-equity component with the annual average risk-free rate to the alpha estimate. Further, Cesari and Panetta (2002) found out in their study of Italian equity fund performance that the equity component in their sample was as low as 60 percent. Thus, the authors decided to include a second benchmark in the form of a value-weighted index of Italian government bonds in order to account for this finding in their research. Given that fund managers usually have a pre-defined benchmark in the form of a traded all-equity index, fund holdings tend to comprise a relatively low proportion of non-equity holdings. Moreover, non-equity holdings do not necessarily imply that these products present as a restriction on portfolio performance. As an example, cash holdings provide an opportunity to adjust the portfolio beta as a means of capitalising on the state of the economy and thus can be considered as rather a requirement to the fund. To conclude, the portfolio managers would benefit from having sufficient cash positions in bull markets and vice-versa in bear markets.

In order to alleviate this potential bias, I conducted a screening in the Morningstar Direct database to review the composition of each fund's holdings within the four categories (497 funds in total). With the use of quarterly data, measured at the 31st of March, 30th of June, 31st of September and 31st of December each year of the observation period, the holding information would indicate whether the amount of non-equity holdings was high and would require including another index benchmark. However, the amounts of non-equity holdings in the sample were over 90 percent on average for the whole observation period. The average equity component for the funds investing Europe, the U.S., Emerging Markets and Asia-Pacific were recorded on average at 93.9 percent, 90.6 percent, 93.9 percent and 92.9 percent[2], respectively. As the observation period can be characterised mainly as bull market after the financial crisis, the somewhat high equity-holding percentages are not a surprise. Thus, contrary to Jensen's conclusion in his paper in 1967, no additional cash benchmark was included because of market anticipation argument stated above.

5.3 Value added – managerial skill

As presented above in Section 4.3, the measurement of value added presented by Berk and van Binsbergen (2012) assesses the value of what a manager is able to add over the underlying benchmark index in monetary

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[2] All percentages calculated for monthly observation period – zero values have been omitted.

terms. In their research paper, the authors considered two hypotheses; "the strong form no-skill hypothesis" and "manager have skill that is in short supply". The former suggests that there are no managers that possess skill. This hypothesis was originally put forward by Fama in his papers regarding the EMH. Further, since all actively managed funds generally charge fees, these fees can only be accepted by investors who act irrationally. The managers who do not possess skill could either invest in the index, in which case they do not destroy nor create value, or worse, follow the classic example of "monkey investing". This term was presented by Berk and van Binsbergen (2012) and generally means that an investor "throws darts" and thus incurs unnecessary transaction costs.

However, it has been suggested that investors do not harvest the gains from the potentially existing under-lying skill because of the fact that the markets are competitive. Instead, managers aim to obtain the full benefit of the economic rents they generate from their underlying skill (Berk and van Binsbergen, 2012). The latter hypothesis was motivated by Berk and Green (2004) and suggests that managers have skill that is in short supply. It implies that if investors are fully rational, the return investors are expecting to receive is equal to the benchmark return, meaning that their investment alpha equals zero. As the fees charged by the portfolio manager cannot be negative, i.e., they are always positive, the expected value-added estimate will be positive for every single manager. Although the managerial skill is not perfectly observable and thus measurable, and since investors are rational, it is expected that each manager must still add some value to their funds (Berk and van Binsbergen, 2012).

In order to evaluate the value-added estimates while controlling for factors that might explain better (or worse) performance, such as portfolio manager's educational level and years of experience, the regression is defined as:

$$VA = b_0 + b_1 \times Gender + b_2 \times Educational\ level + b_3 \times Years\ of\ experience$$

where

VA = Value-added estimate, i.e., Gross alpha × ln(Fund Size)

b_0 = regression constant

b_1 = the impact if the portfolio manager is female

b_2 = the impact of educational level of a portfolio manager

b_3 = the impact of the portfolio manager's years of experience

Portfolio manager's age was not included as a controlling variable as it correlates strongly with portfolio manager's years of experience. Lastly, the outer 1 percent of both ends have been replaced with the sample

average in order to exclude the outlier portfolio managers. The results of the regression analysis are presented and analyzed in the following sections.

5.4   Fund size (AUM) – Capital allocation

As discussed in the Section 4.4, the differences in the size of the funds between female and male portfolio managers might reveal gender biases in capital allocation processes. To better understand the behaviour of institutional investors in the present study, the net asset flows into and out of the funds are examined using the same approach as Sirri and Tufano (1998) in their paper. To obtain a reliable measure of asset flows, the performance of the fund during the year must be adjusted because the size of the fund in monetary terms is affected both by the returns generated by a portfolio manager during the year and by the actual asset inflows and outflows, resulting in net flows. Hence, in order to compute asset flows as net of returns ($FLOW_{p,t}$), I will adjust the assets under management of the portfolio at the beginning of the month for the return earned by the portfolio during the month:

$$FLOW_{p,t} = \frac{ASSETS_{p,t} - ASSETS_{p,t-1} \times \left(1 + R_{p,t}\right)}{ASSETS_{p,t-1}}$$

where $ASSETS_{p,t}$ is the total assets in a portfolio p at the end of the month t and $R_{p,t}$ is the return of the portfolio p during the month t. Thus, the asset flow variable measures the growth in fund's assets in excess of the change in the value of the fund's assets due to performance. The exercise of normalizing the assets under management is conducted because the funds may differ in size. This approach is used in order to understand whether the fund inflows to the female-led funds are smaller than inflows to the funds run by male portfolio managers.

Since the study evaluates the value-added estimates which are the product of the gross return over benchmark and fund size, both components must be examined in great detail as they have vast impact on the outcome. Considering the fund size, one may be concerned about whether the component is stationary. Figure 2 below confirms that the concern seems to be valid – median fund size has been growing in each geographical category by approximately 100 percent over the observation period and as a result, seems like the fund size variable a non-stationary. When considering the reason for this growth of assets under management, it cannot be explained by an increased number of funds which was the case in the study by Berk and van Binsbergen (2012). Since only the funds with inception date no later than 01/12/2008 were included in the study, the number of funds cannot have grown during the observation period. On the contrary, the number of funds could have

decreased if some funds were decided to terminate during the observation period. This aspect has been further discussed together with survivorship bias.
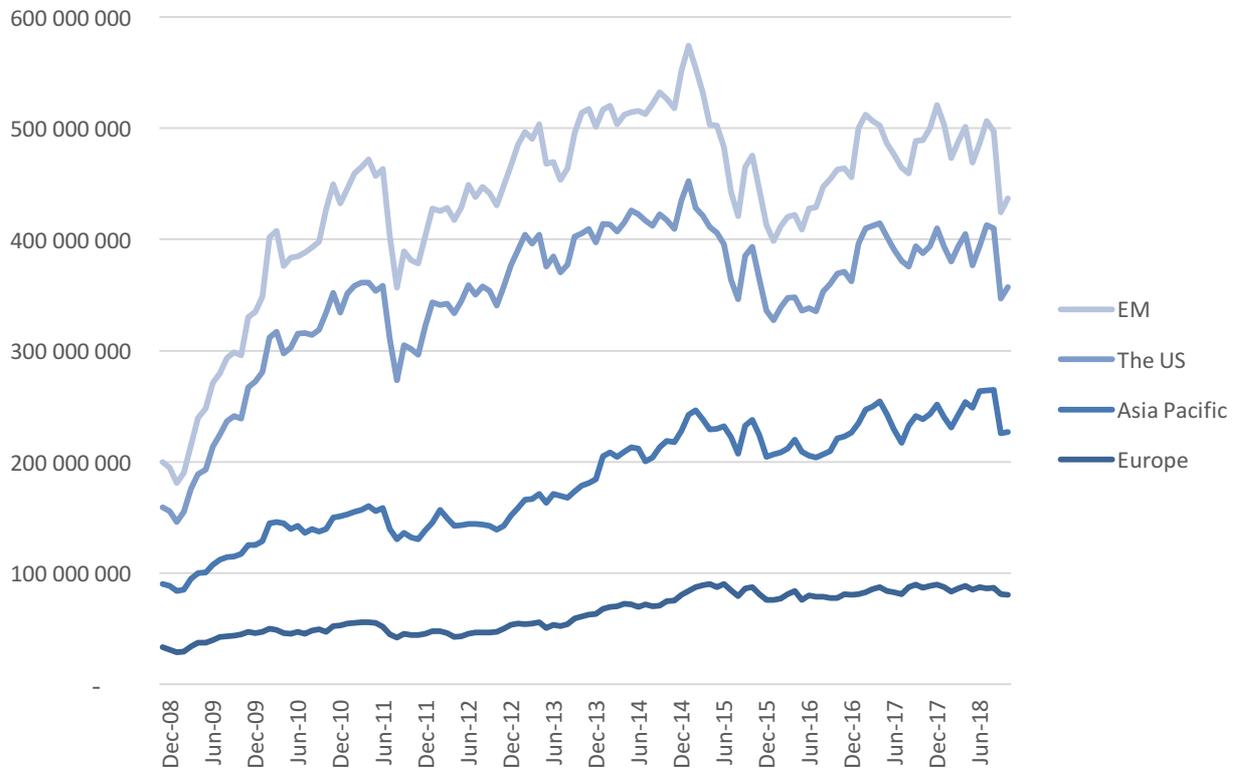
Figure 2 – Median fund sizes over the observation period in each of the four geographically distant categories.

Therefore, prior to starting to analyze the value-added regression estimates, the output of fund sizes need to be transformed to stationary values by taking a natural logarithm of all monthly assets under management values. As visible in the Figure 3 below, resulting from this the fund size variable is stationary as the values have remained roughly the same throughout the observation period and therefore I can proceed with the analysis.
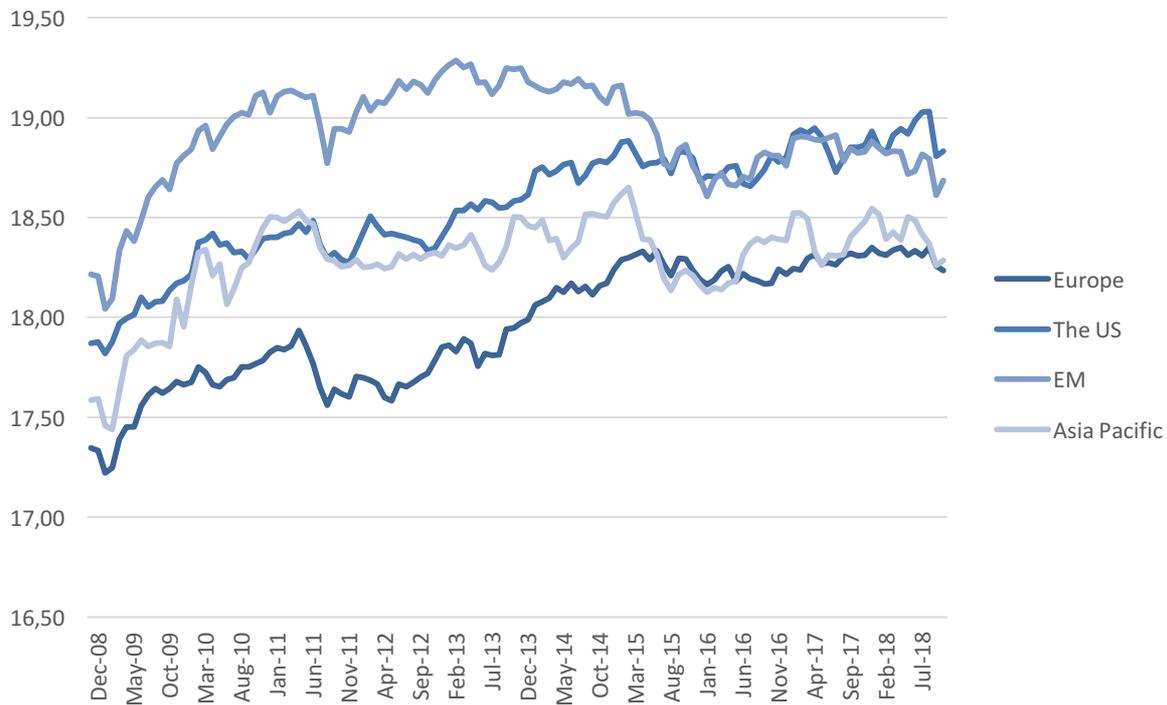
Figure 3 – Median values of natural logarithm fund sizes over the observation period in each of the four geo-graphically distant categories.

As visible in the Figure 3, although some growth is still detected in the fund size estimates, the fund size variable becomes stationary after the natural logarithm computation and thus can be used to calculate the regressions for the value-added estimates.

5.5   Performance persistence

As frequently examined in the existing literature, the performance persistence measures whether the portfolio managers are capable of replicating their performance consistently over subsequent periods of time. To be more specific, the interesting part for the broader audience is whether the well performing fund managers tend to present persistence in their performance, commonly referred to as a "hot hands" effect (Carhart, 1997). Although a number of studies suggest that the portfolio managers generate negative net alpha on average, the relative performance still persist (Bollen and Busse, 2004). The topic is extremely interesting as studies conducted by Gruber (1996) and later by Sirri and Tufano (1998) documented that investors tend to allocate their capital into previous year's top performers and withdraw their capital from previous year's poorly performing portfolio managers' funds.

Thus, in order to investigate the topic in the present study, a few hypotheses are put in place. In general terms, an indication of managerial skill persistence can be argued to be a fact if a portfolio with high return track record and a portfolio with low return track record demonstrate significantly corresponding performance in the following periods of time. However, in the event of non-significant results, any conclusions regarding the persistence of managerial skill cannot be made. Thus, the null-hypotheses are put in place:

$$H_0: VA_{good} = 0 \qquad H_1: VA_{good} \neq 0$$

$$H_0: VA_{poor} = 0 \qquad H_1: VA_{poor} \neq 0$$

Berk and van Binsbergen (2012) sorted funds into deciles based on their value-added estimates in order to assess the persistence in the managerial skill. In order to conduct such study, they defined a "Skill Ratio" measure, which is defined as:

$$Skill\ Ratio_i^T = \frac{\hat{S}_i^T}{\sigma(\widehat{S^T})}$$

where $\hat{S}_i^T = \sum_{t=1}^{T} \frac{V_{it}}{T}$ and $\sigma(\widehat{S_\iota}) = \frac{\sqrt{\sum_{t=1}^{T}(V_{it} - S_i)^2}}{T}$ (Berk and van Binsbergen, 2012).

In general terms, the skill ratio is the t-statistic of the populated value-added estimate measured over the entire track record of the fund all the way until the point of measurement (Berk and van Binsbergen, 2012). When completing the sorting methodology, the funds in the 10th decile can be considered as the funds where one has the highest confidence that estimated value-added over the part of the observation period is positive. Similarly, the funds sorted into the 1st decile can be considered as funds where the likelihood that the actual value-added estimate is negative is the highest, or at least considerably lower than the estimate of the 10th decile. Instead of employing the sorting methodology focusing always on the previous 12-month period, as suggested in the study by Otten and Bams (2002), the methodology employed to sort the sample suggested by Berk and van Binsbergen (2012) will increase as one is moving further in time.

5.6   Turnover ratio

Differences in portfolio managers' fund turnover ratios may capture different investment behaviour or strategies preferred by male and female managers. For example, the turnover ratio captures whether the portfolio managers prefer a buy-and-hold strategy or a strategy associated with considerable buying and selling activity, which may also describe the portfolio managers' perception of risk behaviour. As discussed in the Section 3,

Barber and Odean (2001) argue that men are more overconfident than women about their ability to make outperforming financial decisions which may, in turn, lead to a more frequent trading activity. By using brokerage account data, Barber and Odean (2001) found that men trade on average approximately 45 percent more than women. However, the authors had only a limited amount of self-reported data to the purposes of controlling for wealth effects and investment experience, which may explain differences in the underlying reported confidence. Therefore, turnover ratio is also an interesting and important factor to look at in the present study and the findings will be presented in the following sections.

5.7 Survivorship bias

Survivorship bias has gained a substantial amount of attention in the academic research and is a constant topic in the existing fund performance measurement literature (Brown et al., 1992). Looking at the existing literature, it is evident that there is no clear set of guidelines to instruct on how to approach and handle the possibly occurring survivorship bias in the research sample. Simply, the survivorship bias might occur if some funds that pass all selection criteria terminate their operations at any point during the observation period, which would naturally lead to exclusion of these funds from the final sample due to the omitted values in their track records. According to several academics and practitioners, the practice of excluding non-surviving funds from the sample may potentially lead to an upward bias of the overall estimate of funds' performance (e.g. Malkiel, 1995). This finding stems from the highly frequent tendency of non-surviving funds to underperform over several years prior to their final termination (Rohleder et al., 2010). However, some academics have demonstrated that the output effect of survivorship bias is actually relatively small and even negligible – for example, Grinblatt and Titman (1994) claimed that the estimated survivorship bias in their final sample was as low as 0.5 percent. However, the fact that some academics have found controversial findings aside, the more likely outcome remains that the findings about the overall performance will turn out biased as argued in a research paper by Malkiel (1995).

As indicated above, the screening of this study was initially set to include non-surviving funds. However, as the selection criteria introduced in order to end with a homogeneous final sample is rather strict, the final set of data did not record any funds that would have withdrawn from the market over the observation period. However, as the same topic and finding has occurred in existing studies, it seems that the sample generated from Morningstar Direct database did not exclude any non-surviving funds. Instead of ignoring the non-surviving funds, the fact that no such funds were found is due to the selection criteria introduced in the analysis and which can be characterized as rather strict. Thus, no adjustments were made prior to proceeding to the

analysis with the sample as a conclusion was made that no funds complying with the aforementioned selection criteria were terminated during the observation period.

5.8   Regression analyses and robustness

Following a study conducted by Jensen (1967), regression analyses computed in the present study have been conducted using Ordinary Least-Squares (OLS) method in order to estimate the different coefficients and their significances in the model. As OLS minimizes the sum of squared vertical distances between the actual recorded returns and the returns estimated by using the linear regression model, it is essential that the distribution of time series demonstrates characteristics such as non-existence of autocorrelation and high homoscedasticity (Gujarati, 2004). If heteroscedasticity or autocorrelation is detected in the sample, the consequences to the findings and results are fairly similar. While the coefficient estimates are not affected, the standard errors of the intercepts may be inaccurate and lead to false conclusions (Dahlquist et al., 2000). Further, this affect the t-statistic, which is used to assess the statistical significance of the results in the present study.

5.9   Hypothesis testing

The present study has four main hypotheses, as presented in the Section 1.2. Considering the first hypothesis regarding the value-added estimates, the two alternative outcomes to the hypothesis are that the estimate is higher or lower than zero. The negative value-added estimate is possible because the gross alpha (gross return less benchmark return) can be negative. In fact, there are also two potential outcomes for hypothesis 2 (female portfolio manager discrimination), hypothesis 3 (performance persistence) and hypothesis 4 (less efficient and exploited markets generate higher alphas). Thus, the tests throughout the paper are what is often called '2-sided tests'. This means that as the null-hypothesis for all main hypotheses will be that the test-coefficient is equal to zero, the alternative hypothesis is that the coefficient is significantly different from zero. In the event that the coefficient estimate is insignificantly different from zero, one will accept the null-hypothesis. Conversely, in the event that the coefficient estimate is significantly different from zero, the null-hypothesis will be rejected, implicitly claiming that the alternative hypothesis is valid.

Following the common practice, a conventional 5 percent significance level for all tests conducted in the present paper is applied. Thus, with the 2-sided test described above, the rejection region is the outer 2.5 percent in the distribution in both ends. The probability of committing a Type 1 error, i.e. the probability of failing

to accept the null-hypothesis which should have been accepted, is equal to the significance level chosen to follow in a study (in this case, 5 percent). Thus, in the combined sample of 497 funds it could be expected that approximately 25 funds appear outside the 95 percent acceptance region by chance. Although 5 percent significance level is broadly accepted and recommended as a significance level, I will also note any findings with 10 percent significance level, as these findings demonstrate weak significance.

5.10   Scenario analysis

In order to conclude and tight the hypotheses together, the following scenario analysis can be presented and evaluated. When considering the value-added estimates together with capital allocation between female and male portfolio managers, there are nine possible scenarios of results and what each outcome suggests in the light of the theory and previous studies discussed above. Please see Table 3 for the potential outcomes.

As suggested by Berk and van Binsbergen (2012), the alpha of a fund essentially illustrates the proper capital allocation to managers. If one of the examined groups has a higher alpha compared to another group of examination, it is a likely indication of minor capital allocation for the group which recorded higher alphas as they are not able to "drive down" their alphas. This essentially means that when a very skilled manager is allocated small amount of capital, he or she can record high alphas but if they are allocated more capital, the number of very profitable investment opportunities diminishes and thus their alphas become smaller. However, if these managers who consistently record high alphas are not allocated more capital, it is essentially an indication of possible discrimination against the group with higher alphas.

As presented in the Section 4, in general terms, value-added estimate demonstrates the skill of the portfolio manager. Theoretically, higher value-added estimate indicates higher skill of a portfolio manager, but given that discrimination in terms of capital allocation might play a role, a certain group of managers may be prevented from extracting their optimal value added since they are not allocated enough investment capital. If the capital is allocated rationally, higher value-added estimate should indicate higher skill of a portfolio manager.

Table 3 – Explanations of the nine potential scenarios.

	$Alpha_f > Alpha_m$	$Alpha_f = Alpha_m$	$Alpha_f < Alpha_m$
$VA_f > VA_m$	Female managers are able to generate higher gross alphas and thus their value-added estimate is higher; they should be granted even more capital in order to bring down the superior gross alphas.	Although female and male managers generate similar gross alphas, female managers have higher value-added estimates because they have larger funds. (Potential discrimination against male managers).	Female managers have larger funds than their male counterparties although their gross alphas would suggest that investors should invest with male managers as they have higher gross alphas. (Severe discrimination against male managers).
$VA_f = VA_m$	Female managers are able to generate higher gross returns but since they have smaller funds than their male counterparties, their value-added estimates are of same size. (Discrimination against female managers).	Both female and male managers demonstrate the same level of skill in terms of value added and are allocated capital in a fairly manner. (No discrimination).	Male managers are able to generate higher gross returns but since they have smaller funds than their female counterparties, their value-added estimates are of same size. (Discrimination against male managers).
$VA_f < VA_m$	Female managers are not given enough investment capital although they can generate higher gross alphas. (Severe discrimination against female managers).	Although female and male managers generate similar gross alphas, males have higher value-added estimates due to larger funds. (Potential discrimination against female managers).	Male managers are able to generate higher alphas and thus their value added is higher; they should be granted even more capital in order to bring down the superior gross alphas.

Please note: "Alpha" means gross alpha of a fund and "VA" means value-added estimate.

6 EMPIRICAL FINDINGS

The empirical findings of the paper are presented in the section below. The first part consists of an overview of general findings and descriptive statistics of the sample, while the second part will provide the results from the value-added regression analyses. In the third part I will present the findings relating to the fund sizes and capital allocation among the portfolio managers and finally the last two parts presents the results from the test on performance persistence of the mutual fund managers and turnover ratios.

6.1 General findings

In order to form an understanding of the findings of the present study, it is vital to understand the raw data and each of the components included in the regression analyses. As the fund size and stationary fund size components were presented already as a part of methodology, only the alphas should be presented.

Table 4 – Gross and Net Alphas of the sample.

	Europe		The U.S.		Emerging Markets		Asia-Pacific	
	Female	Male	Female	Male	Female	Male	Female	Male
Gross Alpha - Average	0,8 %	0,7 %	0,8 %	0,7 %	1,1 %	1,0 %	1,2 %	1,2 %
Gross Alpha - Median	1,0 %	0,9 %	0,6 %	0,8 %	0,9 %	0,9 %	1,2 %	1,1 %
Net Alpha - Average	0,1 %	0,1 %	-0,2 %	-0,1 %	0,3 %	0,1 %	0,4 %	0,3 %
Net Alpha - Median	0,1 %	0,0 %	-0,2 %	-0,2 %	0,2 %	0,1 %	0,4 %	0,2 %

As visible in the Table 4, the gross and net alphas both in average and median terms are higher in Asia-Pacific and Emerging Markets than within the funds investing in the Europe and the U.S. market. Although the gross alphas within the group of funds investing in the U.S. market are relatively high, interestingly all net average and median net alphas are negative. Within the group of managers investing in the European market both alphas tend to be a bit higher than in the U.S. market. Another interesting finding is that the female gross and net alphas tend to be higher than alphas from funds managed by their male counterparties.

In the regressions of the present study, I decided to control for factors such as portfolio manager's years of experience and educational level. Although the data regarding portfolio managers' ages was also collected, these data points cannot be included in the regression analysis as portfolio managers' years of experience correlate strongly with their ages. Over the observation period of 10 years, some general descriptive statistics for the sample of 497 funds investing in Europe, the U.S., Emerging Markets and Asia-Pacific markets are presented in the Table 5 below.

Table 5 – Summary statistics of the average characteristics of the portfolio managers.

		Average age	Average years of experience	Median education of PM	% of PMs having Master's Degree*
Europe	**Female**	41,5	18,3	Master's degree	44,2 %
	Male	43,6	18,6	Master's degree	48,4 %
	Total	43,2	18,5	Master's degree	48,0 %
The US	**Female**	41,1	15,9	Master's degree	60,0 %
	Male	45,2	19,9	Master's degree	47,5 %
	Total	44,4	19,1	Master's degree	50,0 %
Emerging Markets	**Female**	43,2	16,8	Master's degree + CFA	50,0 %
	Male	44,8	18,8	Master's degree	53,3 %
	Total	44,6	18,6	Master's degree	51,5 %
Asia Pacific	**Female**	44,6	18,6	Master's degree	43,8 %
	Male	46,1	20,6	Master's degree	40,0 %
	Total	45,7	20,1	Master's degree	41,0 %
Total	**Female**	42,1	16,8	Master's degree	45,2%
	Male	44,6	19,0	Master's degree	48,8%
	Total	43,9	18,8	Master's degree	48,2%

*Percentage of portfolio managers having only Master's degree – portfolio managers with additional certifications are not included in these counts.

Taking each of the four investment categories into account, an average fund manager has approximately 18,8 years of work experience and is 43,9 years old. Female mutual fund managers are two years younger and have approximately two years less of work experience on average than their male counterparties – in fact, in each of the categories examined in the present study, male mutual fund managers have more experience and are older than female managers. This finding is interesting bearing in mind the previous studies of how female mutual fund managers are argued being more capable to generate higher alphas and add value to their funds although, based on the present study, they have less experience on average.

The descriptive statistics above in the Table 5 suggest that the portfolio managers investing in Asia-Pacific markets have most experience and are also the oldest portfolio managers compared to other geographical regions on average. This might indicate that for portfolio managers based in Europe, Asia-Pacific market is the most challenging market and thus these mandates are only granted for portfolio managers with many years of experience. Managers who are early in their careers tend to start with portfolio mandates investing in Europe or the U.S., which are informationally more efficient and thus, in general terms, less risky than less efficient

markets. Further to the statistics above, below in the Table 6 some statistics regarding portfolio manager's characteristics are presented.

Table 6 – Descriptive statistics of the fund managers examined in the present study.

Gender	Count	Percent		Years of experience*	Count	Percent
Female	91	18,3		Less than 10 years	3	0,6
Male	406	81,7		11-20 years	190	38,2
Total	**497**	**100,0**		20-30 years	220	44,3
				30+ years	84	16,9
				Total	**497**	**100,0**

Age*	Count	Percent		Education	Count	Percent
Less than 30 years	2	0,4		High school/Upper secondary	8	1,6
31-40 years	53	10,7		Bachelor	161	32,4
41-50 years	239	48,1		Bachelor + CFA	17	3,4
51-60 years	169	34,0		Master	240	48,3
60+ years	34	6,8		Master + CFA	20	4,0
Total	**497**	**100,0**		Master, MBA	6	1,2
				MBA	21	4,2
				MBA, CFA	9	1,8
				PhD	13	2,6
				PhD, CFA	2	0,4
				Total	**497**	**100,0**

*At the end of November 2018.

As visible in the Table 6 above, the most common traits of a portfolio manager are female gender, 20-30 years of years of experience, age of 41-50 years and in possession of a master's degree.

6.2 Value added – managerial skill

As presented above in Section 4.4, the measurement of value added presented by Berk and van Binsbergen (2012) evaluates the monetary value of what the manager is able to add over the underlying benchmark index. In order to conduct the research, it is vital to understand the raw data prior to the analysis as it might need some light modifications.

During the observation period of December 2008 through November 2018, the broader global market experienced some severe fluctuations in terms of upturns and downturns, "bull" and "bear" markets. The financial crisis that started in late 2007 and continued all the way until 2009 and its sluggish recovery have been partially included in the observation period, which might cause problems to the present study. For example,

the problem of stationarity presented and solved above in the Section 5.4 can be related to this note. Over the full observation period of 10 years, the average and median value-added estimates for the 497 European, the U.S., Emerging Markets and Asia-Pacific funds are presented in the Table 7 below among some other descriptive statistics.

Table 7 – Summary statistics of the average and median value-added estimates during the observation period of 12/2008 – 11/2018.

		Average Value Added	Median Value Added	Lowest Value Added	Highest Value Added
Europe	**Female**	45 021	7 100	-74 886 623	87 946 775
	Male	165 876	10 721	-503 450 102	409 774 112
	Total	131 577	9 680	-503 450 102	409 774 112
The US	**Female**	-98 094	-4 484	-58 472 991	44 189 364
	Male	-74 404	-1 198	-526 115 176	293 081 578
	Total	-91 612	-1 656	-526 115 176	293 081 578
Emerging Markets	**Female**	57 635	11 243	-55 366 969	50 610 622
	Male	171 331	18 963	-206 658 696	184 070 874
	Total	145 062	16 670	-206 658 696	184 070 874
Asia-Pacific	**Female**	416 515	41 429	-119 742 466	145 848 293
	Male	463 496	46 941	-143 186 852	137 774 738
	Total	451 173	45 519	-143 186 852	145 848 293
Total		98 581	38 372		

All values are reported in Y2011 per month and presented in euros.

The value-added estimates above are calculated as gross alpha over underlying benchmark index, multiplied by the fund size which have been made stationary with natural logarithm. During the observation period, a median portfolio manager across all fund categories added an economically significant 38,372 euros (or 98,581 euros on average) over benchmark per month to his or her fund prior deducting any management fees or other costs. The standard error of the median fund size is approximately 8,634 euros, implying that the t-statistic is 4,44. Table 7 above suggests that in total terms, the portfolio managers investing in the Asia-Pacific have been able to generate highest value-added estimates both on average and on median terms and the portfolio managers investing in the U.S. have generated the lowest average and median value-added estimates. By relying solely on the table above, male portfolio managers investing in the Asia-Pacific have been the best performing class and male portfolio managers investing in the U.S. have been the worst performing group in terms of average and median value-added estimates.

Interestingly, female portfolio managers have generated higher median value-added estimates when investing in Europe or Asia-Pacific than male portfolio managers, although the average value-added estimate by females are lower than value-added estimate generated by male managers in each of the four categories. This suggest that the range between the highest and lowest value-added estimate is likely to be wider for male portfolio managers than for female portfolio managers, which is visible in the highest and lowest value-added estimate columns. However, although it is tempting to jump to the conclusion that female portfolio managers are able to generate more consistent returns, the finding may be explained by the low number of female portfolio managers in the sample. In each of the four categories, the highest and the lowest value-added estimates have been generated by male portfolio managers, suggesting that female portfolio managers' performance have been more consistent on average.

Table 8 – The results of regression researching fund managers investing in Europe.

Findings – **European portfolio managers investing in Europe**

Attributes	Coefficient	Robust Std. Err.	t	Significance level
Gender	0,12	0,09	1,03	0,22
Education	-0,04	0,03	-1,35	0,13
Years of experience	-0,02	0,01	-4,15	0,00
Number of obs.	35 520			

In the sample of funds investing in Europe, the coefficient of gender dummy variable suggests that if the portfolio manager is female, the value-added estimate is higher by 0,12 units ($0,12 \times gross\ alpha \times e^{\ln(fund\ size)}$ measured in absolute terms on a monthly basis) although the robust standard error is as high as 0,09, implying that the range of value-added estimates is relatively wide. In addition, this sub-sample suggests that the value-added estimates generated by female portfolio managers are higher than their male counterparties. However, when the standard error is close to the value-added estimate, it comes as no surprise that the average t-statistic is non-significant.

The variable of portfolio manager's educational level suggests that the higher educated the portfolio manager is, the lower is his or her value-added estimate. This is somewhat contradictory to the general expectation of the wider audience. However, the variable was not significant in this sub-sample. The variable describing portfolio manager's years of experience is statistically highly significant and suggesting that the correlation between the years of experience and the value-added estimate is positive, although the impact is more limited as compared to gender and education.

Table 9 – The results of regression researching fund managers investing in the U.S. market.

Findings – European portfolio managers investing in the U.S.

Attributes	Coefficient	Robust Std. Err.	t	Significance level
Gender	-0,29	0,34	-0,08	0,88
Education	0,14	0,08	1,72	0,07
Years of experience	0,02	0,02	1,40	0,16
Number of obs.	8 880			

In the sample of funds investing in the U.S., the coefficient of the gender dummy variable is negative at -0,29 and clearly insignificant. The negative coefficient could be explained by the average negative value add by managers investing in the U.S. in the sample. The negative coefficient would then imply that female managers outperform male managers in terms of smaller negative value add. However, given the insignificance of the results it is hard to argue for a correlation.

Interestingly, in the U.S. sub-sample, education seems to have a positive and significant correlation (at 10 percent significance level) with value added unlike in Europe, where the effect was slightly negative and insignificant. Moreover, the years of experience variable is slightly positive at 0,02 unlike in Europe. Although the findings lack significance.

Table 10 – The results of regression researching fund managers investing in Asia-Pacific.

Findings – European portfolio managers investing in Asia-Pacific

Attributes	Coefficient	Robust Std. Err.	t	Significance level
Gender	-0,17	0,26	-0,63	0,51
Education	-0,19	0,07	-2,67	0,01
Years of experience	-0,10	0,02	-5,31	0,00
Number of obs.	7 320			

In the sample of funds investing in Asia-Pacific, the coefficient of the gender dummy variable is also negative at -0,17 and insignificant. Education and years of experience, on the other hand, both indicate negative and highly significant correlations with the value-added estimate. Interestingly, these findings imply that the higher educational level or more years of experience a manager has, the lower their value-added estimate will be. Although these findings do not sound logical, these results are in line with what is observed for the funds investing in the European market sub-sample although with significantly larger average coefficients.

Table 11 – The results of regression researching fund managers investing in the Emerging Markets.

Findings – European portfolio managers investing in Emerging Markets

Attributes	Coefficient	Robust Std. Err.	t	Significance level
Gender	0,63	0,50	1,24	0,19
Education	0,09	0,09	1,00	0,29
Years of experience	-0,06	0,02	-2,86	0,01
Number of obs.	7 920			

In the sample of funds investing in Emerging Markets, the gender dummy variable shows the largest positive coefficient overall among the regions, albeit it is not significant. Intuitively, the finding could be explained by the fact that the investments into Emerging Markets are in general more illiquid and face higher transaction costs than in other markets. Excessive trading has been shown to be one of the factors causing women to outperform men in past research, which would therefore imply that female managers have a better chance to outperform and generate higher returns in Emerging Markets region.

Further, education also shows a positive coefficient with low significance, while years of experience is negatively correlated but highly significant. These findings differ from other regions, although the years of experience variable seems to be highly significant in each region except within the portfolio managers investing in the U.S. market.

Overall, the results are somewhat counterintuitive between the different sub-samples. Gender appears to have a positive correlation with manager value added overall, however I fail to find adequate significance for the result. Meanwhile, education level shows mixed results with positive correlation for the US and EM samples but negative for Europe and APAC. Years of experience is the most consistent of the three explanatory variables with highly significant negative correlations in Europe, APAC and EM.

As a conclusion, the scenario analysis presented in the Section 5.10 cannot be completed as conclusive as the findings of the present study were not statistically significant. Nevertheless, if the study would have presented significant results, the scenario would have been the one where value-added estimates for female and male managers are approximately equivalent but the alpha for female portfolio managers is higher, i.e., "Female managers are able to generate higher gross returns but since they have smaller funds than their male counterparties, their value-added estimates are of same size. (Discrimination against female managers)" based on the current insignificant findings.

Given the relatively small number of female managers investing in the US, APAC and EM markets as presented in Table 2, for the purposes of this paper it seems warranted to draw most inference from the sub-sample investing in Europe. There appears to be a correlation where female managers generate larger value add than their male counterparts. However, the finding is not significant at meaningful levels with a p-value of 0,22. Meanwhile, education is negatively correlated but insignificant and years of experience shows a significant negative correlation. Therefore, the natural conclusion to draw seems to be that female managers do appear to be outperform male managers although the results are not consistent across nor significant enough. Education-level in general seems to have very limited bearing on value added. Interestingly, years of experience is negatively correlated with value add and the most significant. The results are analyzed further in the following sections.

6.3   Fund size (AUM) – Capital allocation

Based on the present study, female portfolio managers have smaller funds than male portfolio managers on average and on median terms, implying that they are granted less capital to invest in all geographical regions except Asia-Pacific (please see Table 12).

Table 12 – Average and median AUM over the observation period.

		Average AUM (€MM)	Median AUM (€MM)
Europe	**Female**	240	59
	Male	255	61
	Total	252	60
The US	**Female**	307	113
	Male	317	113
	Total	317	113
Emerging Markets	**Female**	370	169
	Male	396	169
	Total	396	169
Asia-Pacific	**Female**	314	94
	Male	303	84
	Total	304	85

Interestingly, the female portfolio managers investing in the Asia-Pacific seem to have larger funds in terms of AUM on average and median terms than male portfolio managers investing in the same geographical area.

In all other geographical categories, female portfolio managers have smaller funds than male portfolio managers on average and on median terms. It is also worth noticing that across all funds included in the present study, the funds investing in the European market are the smallest in terms of AUM, on average.

As visible in the Figures 2 and 3 presented in the Section 5.4, the median fund sizes have been growing in each geographical fund category. However, the growth in fund sizes can be driven by either high returns, i.e., alphas of the funds or inflows to the fund. In case the growth is driven by inflows to the funds, it can be argued that the popularity of investing in the mutual funds has been growing over the observation period but it is hard to identify whether it is the only factor affecting the average and median fund size growth. On the other hand, if the growth is driven by high returns of the funds, it is important to note that the observation period starts from December 2008, which can be characterized as a severe downturn in the global economy. As the economy recovered, the period following the downturn can usually be characterized with growing and ultimately relatively high returns. In addition, it is logical that the values of the funds have been lower in the economic downturn and investors have not increased their investment capital at that point in time. However, as the economy recovers, investors tend to add their capital investments, leading to the average fund size growth. All in all, it is most likely that the average and median fund size growth has been driven by both, higher returns and increasing inflows to the funds.

Further, it is worth noticing that the Europe-based funds investing in the European market is the smallest fund category in terms of median fund size of the fund categories observed in the present research. The funds investing in the Emerging Markets has reported the largest fund sizes in terms of average and median AUM over the entire observation period. This is an interesting finding as funds investing in the Emerging Markets tend to be riskier than funds investing in the Europe or the U.S. markets. In addition, it is important to compare the table above to the bigger picture provided in the literature analysis – the fund sizes reported in this study are vastly smaller than the average U.S. mutual funds reported in the previous studies.

Lastly, when looking at the fund inflows as presented above in the Section 4.4, the average and median inflows for the full observation period are as follows:

Table 13 – Capital inflows over the observation period.

	Europe		The U.S.		Emerging Markets		Asia-Pacific	
	Female	Male	Female	Male	Female	Male	Female	Male
Average Inflow	0,34 %	40,66 %	0,83 %	1,07 %	0,67 %	58,03 %	5,73 %	61,68 %
Median Inflow	0,60 %	0,83 %	0,61 %	0,82 %	0,58 %	2,56 %	3,02 %	5,12 %

As expected, the average inflows are remarkably higher for male portfolio managers than for female portfolio managers and the inflows in general are higher for the funds investing in Asia-Pacific or Emerging Markets

than to funds investing in the U.S. or Europe. However, if the median inflows are detected, they are rather moderate. It needs to be borne in mind that the observation period consisted if both upturns and downturns, which can explain some of the inflows.

6.4 Performance persistence

In order to evaluate the performance persistence, the methodology presented in the 5.5 is followed. The results are presented below in the Table 13.

Table 14 – Performance persistence measure.

Category	Quintile	Value-added estimate	Std. Error	P-value
Europe	1st Quintile	-0,11	0,03	0,02
	2nd Quintile	-0,06	0,05	0,05
	3rd Quintile	0,13	0,06	0,13
	4th Quintile	0,17	0,06	0,41
	5th Quintile	0,22	0,03	0,19
Top outperforming Bottom		**Frequency** 51,2%	**P-value** 0,00	
The U.S.	1st Quintile	-0,33	0,05	0,12
	2nd Quintile	-0,29	0,09	0,44
	3rd Quintile	-0,26	0,07	0,81
	4th Quintile	0,07	0,11	0,09
	5th Quintile	0,11	0,04	0,11
Top outperforming Bottom		**Frequency** 54,1%	**P-value** 0,00	
Asia-Pacific	1st Quintile	-0,24	0,08	0,48
	2nd Quintile	-0,21	0,04	0,02
	3rd Quintile	-0,18	0,10	0,19
	4th Quintile	-0,06	0,09	0,13
	5th Quintile	0,07	0,11	0,26
Top outperforming Bottom		**Frequency** 50,5%	**P-value** 0,00	
Emerging Markets	1st Quintile	-0,11	0,07	0,06
	2nd Quintile	-0,07	0,06	0,12
	3rd Quintile	0,61	0,11	0,01
	4th Quintile	0,63	0,13	0,38
	5th Quintile	0,68	0,07	0,25
Top outperforming Bottom		**Frequency** 59,6%	**P-value** 0,00	

The Table 13 above provides the findings of the test on performance persistence measured within each quintile over the full observation period. If the comparison is restricted to only include the top and the bottom quintiles, the calculations reveal that managers in the top quintile outperformed the worst performing managers

by over 50 percent in every sub-sample over the observation period. In addition, these findings turned out as statistically significant in every sub-sample. Thus, the inference that the best performing managers in the past were also able to maintain good performance to subsequent periods can be drawn.

6.5   Turnover ratio

I have extracted the monthly turnover ratio data from Morningstar Direct database for each fund examined in this study. However, in case the yearly turnover estimate was missing for some or even all years of observation period, a fund was not omitted from this study solely because of these pieces of missing data points. Since turnover ratio is not mentioned in the hypotheses or research questions of the present study, the turnover ratio data is just seen as supporting information for the present study.

Table 15 – Average turnover ratios for female and male portfolio managers.

Average Turnover Ratio											
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Female managers	98,2	81,6	82,9	84,1	68,5	59,1	59,1	67,3	54,3	41,2	55,6
Male managers	117,9	108,6	91,6	104,9	77,6	66,2	59,7	67,5	62,1	47,0	51,2

Yearly average turnover ratios measured between 12/2008-11/2018.

As expected, based on Table 13, the average annual turnover ratio for all male-led funds with reported turnover estimates examined in the study is higher than the average turnover ratio of female-led funds for eight out of 11 years examined in the present study[3]. This comes as no surprise as in the study conducted by Atkinson, Baird and Frye (2003) the only fund characteristic that was marginally statistically significant between male and female-led funds was turnover ratio which was higher for male portfolio managers in their study.

Separately, an interesting observation from the Table 13 is that the average turnover ratio has been decreasing significantly over the observation period in both, female and male-led categories of portfolio managers. However, this is in line with the finding of significantly increasing fund sizes over the observation period. It was somewhat expected that the average turnover ratios in 2008 and 2009 were significantly higher than in the later years of the observation period as investors tend to withdraw their capital from the funds in an economic downturn.

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[3] The annual turnover ratio is calculated for each year between 12/2008–11/2018.

7 ANALYSIS

The section contains an analysis of the empirical findings presented in the preceding section. The analysis follows the same order as the empirical findings – an analysis of value-added estimates, fund size, performance persistence and turnover ratio are explained in a great detail below.

7.1 Value added – managerial skill

Based on the Table 7 in the Section 6.2, during the observation period, an average portfolio manager added approximately 38,372 euros over benchmark per month to their funds prior to deducting any management fees or other costs. By including all portfolio managers and each of the 120 months examined, approximately 51 percent of the value-added estimates were positive. This is somewhat higher than what has been presented in the previous literature (e.g., see Berk & van Binsbergen, 2012). However, it must be borne in mind that the research period runs from December 2008 to November 2018 and thus does not include many months that could be labelled as economic downturn (i.e., the most severe downturn months) – on the contrary, the economy has been expanding more months than shrinking during the observation period. Another difference that must be borne in mind is that it is the gross value-added estimate instead of net value-added estimates that are used in the study – thus, the estimate of net value added would be measured, meaning that the amounts that the portfolio manager takes with him or her and what the investors receive, the percentage of months with positive value-added estimates would most likely be lower.

The ability to which a portfolio manager can generate abnormal return is not only conditional on the fund manager's skill but also on multiple constraints faced by the portfolio manager. One such constraints widely debated in the existing literature (see, inter alia, Pastor et al., 2014) and also observed in the present study is the decreasing returns to scale. Thus, as suggested by Berk and Green (2004), the size of a fund managed by an active portfolio manager increases, the ability of the underlying fund to outperform the benchmark declines. This conclusion is in contrast with the findings by Berk and van Binsbergen (2012) who suggested that although an average manager would produce a negative estimate of value added, the final results would turn positive as most of the AUM is controlled by skilled managers. Although the present study follows the findings of Berk and Green (2004), one can question whether the sample size is large enough to draw any such conclusions. The findings can be result of pure luck or coincidence rather than a reliable measure of managerial skill.

As suggested by Graham (1965) and again later by Fama (1991), some active portfolio managers are able to use their comparative advantages and make profits in the short run rather in in the long run. When dividing

the observation period of the present study to shorter intervals, some further evidence of managerial skill was detected – even among otherwise less skilled portfolio managers. However, the results of Graham (1965), Fama (1991) and also the present study suggest that any short-term market inefficiencies for an average fund will be, as a rule, eliminated in the long run.

As hypothesized at the beginning of the paper, the highest median and average value-added estimates were generated by the group investing in the Asia-Pacific whereas the lowest median and average value-added estimates were reported by the group investing in the U.S. market. Although the group of funds investing in the Emerging Markets showed highest fund sizes, the impact of them was offset by the high gross alphas recorded by the funds investing in the Asia-Pacific market. On the other hand, although funds investing in Europe were smallest in terms of AUM, as the gross alphas for the funds investing in the U.S. were the lowest, they demonstrated the lowest value-added estimates. Thus, this implies that the informationally more efficient investment regions generate lower value-added than less exploited markets such as Asia-Pacific and Emerging Markets.

When looking at the controlling variables included in the value-added estimate regressions, some of the findings were rather puzzling. Although these characteristics are not inherent to the gender of a portfolio manager, they can influence the performance of their fund. First, the level of education did not seem to have a bearing on value-added in any other category than within the managers investing in the Asia-Pacific, which is surprising given the intuitive expectation that education is correlated with skill. One explanation could be that formal education, which is disclosed in the manager bibliography does not necessarily measure the time and effort spent developing him- or herself as an investor.

However, women in general have been suggested of having a higher educational level than men. As an example, Li et al. (2009) showed that mutual fund managers from undergraduate institutes with higher SAT scores tend to be able to generate higher risk-adjusted returns. On average, women fund managers graduated from institutes demonstrating higher SAT scores more often than their male counterparties. Although other variables need to be controlled in order to identify the underlying relationship between the mutual fund performance and the rank of undergraduate institute, the educational background might explain the superior investment performance rather than the gender of a portfolio manager. In that case, it would be a coincidence that women tend to have a what could be seen as better educational background. Surprisingly, in this study the level of education of managers' does not appear to have a consistent correlation with the value-added estimates.

Interestingly, the present study showed most evidence of correlation with the variable measuring portfolio managers' years of experience; however, when increasing the number of years of experience, the value-added

estimates decrease in every other sub-sample group except the managers investing in the U.S. market. Although this outcome seems highly illogical, Li et al. (2009) found comparable results in their study. According to them, managers with more years of working experience tend to generate lower returns than their counterparties with fewer years of working experience. Further, this finding was highly significant.

Nevertheless, when analyzing the Table 7, it must be borne in mind that the conclusions are only based on the data included in the present study. The number of funds led by female portfolio managers is significantly lower than the number of funds led by male portfolio managers and thus may lead to conclusions without strong evidence when considering the gender dummy and its effect on the value-added estimates. The low number of female managers in sub-samples investing in the regions outside Europe is indeed one of the limitations of this study.

7.2   Fund size (AUM) – Capital allocation

It has been often suggested as one difference between genders in the previous literature that female portfolio managers, on average, have smaller mutual funds than male portfolio managers in monetary terms. However, although the finding has been presented multiple times, the reason for this is yet to be agreed on. Based on the present study, the results imply equivalent conclusions – female portfolio managers manage smaller funds than male portfolio managers although the differences are not very material (please see Table 12). Thus, a very strong argument that female portfolio managers are allocated less capital than male portfolio managers purely because of the gender should not be made. The results comply with the previous studies but would require larger sample and more explanatory variables in order to present stronger arguments.

In addition to the differences on the fund sizes between female and male managers, it is worth noticing that across all funds included in the present study, the funds investing in the European market are the smallest in terms of AUM, on average. This is interesting because the sample consists only of the funds registered in Europe and one would assume that investing in European market would be popular among the managers based in Europe and this category would also be favored by European investors. However, when looking at the number of funds included in the study together with the average fund sizes, one can notice that the European fund market investing in Europe is quite fragmented with multiple smaller funds – the total AUM invested in the Europe is the highest of all the categories examined.

Another interesting finding is that the median fund size is larger for the group of funds investing in the Emerging Markets than in the U.S market. The U.S. has historically been the most popular continent in terms

of investment destination, but the data in the Figures 2 and 3 suggests that the popularity of investing in the Emerging Markets has been increasing especially over the observation period and even in the recent years. As a result, the group of funds investing in the Emerging Markets recorded the largest fund sizes on average and median terms.

7.3 Performance persistence

The question whether mutual fund portfolio managers are persistently able to generate value added to the investors is of great concern. However, in a way the tendency of performance to remain persistent signals whether managers are able to add value. Further, this information also provides institutional investors some evidence on whether past performance of a portfolio manager should be considered when making any investment decisions (Keswani and Stolin, 2004).

The present study documents findings that support the performance persistence in every sub-sample to some extent. Although every quintile in each sub-sample did not present as statistically significant, the overall "Top outperforming Bottom" frequency was highly statistically significant in each sub-sample. Generally speaking, this means that fund managers that have been performing well in the past keep beating the managers who performed poorly in subsequent periods. As suggested by Bauman and Miller (1994), contrary to the conclusions presented above, investors who choose to invest with a manager on the basis of a high current performance can be tricked into adverse timing. Also, by choosing only on the basis of past performance, one might ignore managers who are on track to recover from a decreasing ranking and thus able to generate high gains in the short-term. Another widely suggested explanation is called "hire high, fire low", which suggests that a mandate might be given to a manager whose ranking is extremely high but who is destined to fall in the near-term.

7.4 Informational Efficiency

As mentioned in the Section 6.2 and visible in the Table 7, the value-added estimates are both on average and median terms higher for all portfolio managers investing in the Emerging Markets or Asia-Pacific when comparing with managers investing in Europe or the U.S. market. Further, as shown in the Table 4, the gross and net alphas are higher in these regions versus in the informationally more efficient markets such as Europe and the U.S. markets. Thus, this implies that the null hypothesis 4 but in place in the Section 1.2 can be accepted and the investors should favor the Emerging Market and the Asia-Pacific fund categories over Europe and the

U.S. as according to one explanation provided, the formers are often considered as less efficient in terms of information as well as being less analyzed and exploited.

8   CONCLUSION

This section consists of limitations of the study and potential future research. In addition, concluding remarks are provided in order to combine the findings of the study.

8.1   Limitations of the study

As with any research, also the present study faces several limitations and it is vital to consider them when interpreting the findings of the study. Most importantly, although the present study found limited statistically significant results and it is therefore important not to generalize these results to the overarching concept of gender. These results should rather be interpreted as directional findings requiring further validation.

One of the limitations in the present study is omitted values and the lack of data. Some funds were excluded from the final sample although they passed all screening criteria solely because some of their return or AUM data points are missing. This is obviously a concern for the conclusions of the study – however, out of 497 funds that passed all of the screening criteria, only six funds were considered as having insufficient data.

As discussed, the percentage of female-led funds in the mutual fund industry has been increasing consistently. However, the number of female-led mutual funds remains still relatively low and therefore the findings of this study might lead to misleading results as the representation of male-led mutual funds is rather dominating. However, as the proportion of female mutual fund managers increase, the topic of the present paper will become more meaningful and might generate interesting conclusions.

Lastly, the self-selection bias might skew result to a large extent. As it is not mandatory for the fund organizations to report their data to Morningstar Database, the self-selection bias must be considered as a limitation for the present study. Further, if the hypothesis about female portfolio managers tending to have smaller funds than their male counterparties on average is proven to be correct, these smaller funds are more likely to be left out from the databases such as Morningstar. Thus, the sample of female portfolio managers would be decreased even further.

8.2   Future research

It can be argued that the rather strict selection criteria of the present study served the purpose of aligning investment strategies, increasing market exposure and guaranteeing sufficient return history, just to name a few. Thus, dropping some of the strict selection criteria by increasing the sample by increasing the observation period, accepting other fund originations or adding sub-samples the research could potentially have conveyed more insights into the value-added estimates, fund sizes, performance persistence and how the four geographically distant investment areas differ from each other.

Another interesting point of view I could have taken is to see if the portfolio managers with highest persistent value-added estimates are also rewarded for their proven skill. As Berk and van Binsbergen suggested in their study (2012), the outperforming portfolio managers were rewarded for their superior abnormal performance. This, in turn, would ultimately lead to smaller returns for the investors and therefore absorbing the advantage of investing with the best performing mutual fund managers. If this would be the case, it would ultimately mean that the portfolio managers with the highest persistent value-added estimates would earn the highest fees and thus investors would not benefit from the portfolio managers superior performance and skill.

Further, the evaluation of expense ratios of different funds may also provide additional perception into risk preferences. Lutton and Davis (2015) noted in their Morningstar report that funds that can be characterized carrying high costs tend to be riskier than funds that bear lower costs. Expenses of trading activity and other costs are deducted from a fund's income flows and generated returns. In order to keep yields of high-cost funds competitive, managers often follow riskier investment opportunities, such as buying lower quality equities. Thus, portfolio managers with lower expenses can offer the same returns without taking on the extra risk.

As discussed, Barber and Odean (2001) argued that female investors should outperform male investors on a risk-adjusted basis. Whereas rational investors should only participate in trading if the expected gains exceed the expected costs, overconfident investors tend to overestimate the significance of their information and further, their expected gains from these trades. The authors demonstrated that although both male and female managers reduce their net returns through trading, men do so by 0.94 percentage points more per year than women do. There are some evidence presented in the existing literature that may support the hypothesis that female fund managers outperform male fund managers. Thus, the investment style differences between female and male managers should be investigated further in connection to the value-added estimates.

Further, another aspect that could be included to extend the present study is fund expenses. In their study, Cesari and Panetta (2002) defined three principal categories of costs that have an effect on mutual funds. First,

some fees usually referred as 'bank fees' are paid to the associated custodian bank, which holds the fund's assets and run their day-to-day operations such as dividend and coupon payments, where applicable. Second group consists of the trading costs in the form of bid-ask spreads and brokerage fees, which are deducted from the returns of a fund. Third group of fees consists of management fees that are paid by the end-investor to the fund organization as a fixed annual percentage fee. As pointed in some existing studies, the management fee percentages of a fund are often highly correlated with the performance of a fund.

Although Berk and van Binsbergen (2012) had valid points on the argument why gross returns should be used instead of net returns when measuring value added, net returns should be used when considering the return from an investor's point of view. For example, Cesari and Panetta (2002) emphasized the significance of measuring relative returns as both net and gross of expenses when considering mutual fund performance. In simple terms, one measures whether the fund managers are capable of beating the market when measured in gross of fees basis. On the other hand, by using net returns, one measures whether the gross alpha generated is still more profitable for an investor than investing in the benchmark. However, in the event that the returns are measured as a net basis and Total Expense Ratio (TER) differs widely between the funds within the same sample, the abnormal return of the well (poorly) performing funds could simply be a consequence of low (high) TER. In the present study, only gross returns were employed as the aim of the study is to see whether female mutual fund managers are more skilled than their male counterparties – not whether the investors who invest with female managers receive more money in net terms.

8.3 Concluding remarks

Although the evidence for higher value-added estimates of female portfolio managers is weak for the whole observation period and all the sub-samples, some results are still close to statistically significant. Thus, this could change to a higher significance level in case the sample size would be larger and especially if the number of female managers would be larger. However, as the growth in number of female managers has been relatively fast recently, I am confident that the gap between female and male portfolio managers will shrink. Explanations for the potential difference in the value-added estimates have been provided throughout the paper. The key findings of the paper are described below.

As discussed in the following sections after the presentation of the hypotheses, it can be concluded that based on the present study, the null hypothesis 1 (Female managers are equally skilled as male managers when it comes to fund management in terms of potential value added) cannot be rejected nor accepted as the study did not reveal statistically significant results. However, the hypothesis 2 (When allocating investment

capital, institutional investors do not have any biases between male and female mutual fund managers, implying that when allocating capital investors assign the same amount of capital to funds managed by male managers as to funds managed by female managers who have the same level of skill.) can be rejected based on the findings of the present study – the female-led funds tend to be smaller than male-led funds in three out of four sub-samples[4] throughout the sample period. Only European-based funds investing in the Asia-Pacific showed higher fund sizes for female portfolio managers than to their male counterparties. However, it is essential to borne in mind that the sample of funds investing in the Asia-Pacific is relatively small and especially the female representation is limited. Thus, these factors might have an impact on the results of this study.

Hypothesis 3 (The performance of the portfolio managers in terms of value added is persistent.) can be accepted for each sub-sample in the sample's overall performance but not for each quintile separately. However, the "top outperforming the bottom" was highly significant in each geographical category examined in this study. Lastly, hypothesis 4 (The gross alpha of the funds investing in Emerging Markets and Asia-Pacific are higher than of the funds investing in Europe and the U.S. market.) can be accepted as the gross alphas and the value-added estimates are on average and median terms higher for the funds investing in the Emerging Markets and in the Asia-Pacific than for the funds investing in Europe or the U.S. regions for each year of the observation period.

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[4] The female-led portfolios were smaller than male-led portfolios in average and median terms in fund categories investing in Europe, the U.S. and the Emerging Markets. Female-led funds were larger than male-led funds in the fund group investing in the Asia-Pacific market.

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