# The Effect of Hedge Fund Managers' Facial Characteristics on Investment Behavior and Performance

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## Abstract

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Mingyue Zhang

This paper investigates what affects hedge fund performance and risk-taking in a behavioral finance context. Links between physical characteristics and behavioral traits have been well established. However previous studies have relied on small size samples in controlled conditions. In this paper, we explore the relationship between facial width-to-height ratio (fWHR), a face structure metric identified by previous research to be associated with a cluster of behavioral traits in men, and investment behaviors in real financial markets using a sample of 178 hedge funds from 1994 to 2016. We find that risk-taking of hedge funds correlates positively with fWHR of their managers, while there is no significant evidence proving the association between fWHR and hedge fund performance. Although this is a study of association, the results may shed light on biological determinants of hedge fund investment behaviors.

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## 1. Introduction

Hedge funds are high-risk investment partnerships, seeking to realize large capital gains by taking both long and short positions. They display several features that make hedge funds different from individual or other institutional investments such as mutual funds and pension funds. For example, hedge funds have less regulatory constraints, more concentrated portfolios, more flexible investment opportunities, fewer conflicts of interest and also the ability to impose restrictions on investor redemptions (Li, Zhang and Zhao, 2011). Hedge funds have flourished since the 1990s and have become an increasingly popular investment vehicle, leading to a number of studies regarding hedge fund performance (Ackermann McEnally, and Ravenscraft, 1999; Brown, Goetzmann, and Ibbotson, 1999; Edwards and Caglayan, 2001; Edwards and Liew, 1999; Liang, 2000; Fung & Hsieh, 2001). Although great process has been made in analyzing how contractual arrangements (such as incentive fees) affect hedge fund performance, there is limited research on the impact of hedge fund managers. Li et al., (2011) provide one of the first studies on the impact of hedge fund manager characteristics on hedge fund performance. However, their study focuses on characteristics such as educational background, age, and work experience. Given that personal traits and preferences of top executives may impact firm-level decisions and outcomes (Cronqvist, Makhija, and Yonker, 2012; Graham, Harvey, and Puri, 2013), we will look into managers' personal characteristics, more specifically biological characteristics, to answer the question --- what affects hedge fund performance. Recent biological and psychological studies indicate that facial Width-to-Height Ratio (fWHR) of males is related to some social behaviors such as sensation-seeking (Campbell et al, 2010), aggression (Carré and McCormick, 2008), being less

trustworthy (Stirrat and Perrett, 2010) and better financial achievement (Wong et al., 2011). It has been documented that the underlying biological link between fWHR and behavioral traits is testosterone (Carré and McCormick, 2008; Gurven and Gaulin, 2016; Lefevre et al., 2013), a steroid hormone that is believed to affect human behaviors through neutral mechanisms (Dabbs and Mallinger, 1999; Mehta and Beer, 2010). Consistent with the suggestion that testosterone is the underlying factor between fWHR and behaviors, a number of those behaviors associated with fWHR are also proved to be related to testosterone levels (Archer, 2006; Roberti, 2004, Hartgens and Kuipers, 2004, Mazur and Booth, 1998; Sherman, Lerner, Josephs, Renshon, and Gross, 2016; Eisenegger, Naef, Snozzi, Heinrichs, and Fehr, 2010; Apicella et al., 2008). Considering the link between fWHR and behavioral traits that reflect individual risk preference, we conjecture a positive relationship between hedge fund managers' facial features and fund risk-taking.

In this study, we examine the association between fWHR of hedge fund managers, their risk-taking behavior and their performance using a sample of 178 hedge funds. Firstly, we investigate whether fWHR affects hedge fund performance, measured by monthly return using cross-sectional data. Then, we take into account standard deviation and skewness of return to investigate the effect of fWHR on hedge fund risk-taking behaviors based on panel data ranging from 1994 to 2016. In general, we do not find evidence showing hedge fund performance is related to its manager's fWHR. However, we find a positive association between hedge fund managers' fWHR and their risk-taking behaviors, showing that hedge funds whose managers have wider faces (relative to height) tend to experience higher risks in terms of return. This is consistent with the previous study by Apicella et al.

(2011) and Wong et al. (2011), suggesting that fWHR predicts competition driven behavior and higher risk taking of the person.

This study contributes to the existing literature on hedge fund performance in a behavioral finance context. While recent research has expanded our knowledge concerning biological influences on numerous personality traits, the identification of specific biological markers is still in its infancy. We look from the angle of hormone level, using fWHR to proxy for the testosterone level of hedge fund managers, and find positive association between fWHR and risk. Unlike most previous research, this study examines the relationship between facial metrics and behavior traits in a much larger sample of highly skilled investors over a long period. The conclusion is meaningful to investors as they can make preliminary speculation on hedge fund performance by identifying fund managers' facial characteristics before their investment. Given that hedge funds have attracted a wide range of market participants to invest in, identifying managers' facial features and the relationship to risk-taking behaviors could be helpful to potential investors in selecting hedge funds and also helpful to hedge fund boards in finding the managers whose risk-taking behaviors are compatible with the risk appetite of the fund. Policy makers could apply fWHR to surveil risk-taking levels of the whole industry and implement stringent regulations when they notice the average fWHR of hedge fund managers on the market is increasing, as this shows a tendency towards more aggressive investment behaviors.

The remainder of the paper is organized as follows. Section 2 reviews previous literature and develops our main hypotheses. Section 3 describes data and methodology used in the paper. Section 4 presents empirical results. Section 5 states conclusions, implications, and limitation of this study.

## 2. Literature Review and Hypothesis Development

This study builds upon the following four subtopics discussed first in the literature review: (i) Hedge fund performance and risk, (ii) Facial characteristics and testosterone, (iii) fWHR and testosterone, and (iv) fWHR and performance.

### *2.1. Hedge Fund Performance and Risk-taking*

Although the explosive development of hedge funds, both in numbers and assets under management (Citibank, 2018), has attracted the attention of the financial press and academics, research on what affects hedge fund performance is rather limited compared to other investment tools such as mutual funds. This is mainly due to hedge funds' private characteristics and data availability constraints. The data limitation has been addressed by Morningstar CISDM Database, the oldest database tracking hedge fund qualitative and quantitative information in the market. In general, existing studies on hedge fund performance can be categorized in two streams depending on the perspective of study. Some studies explain hedge fund performance by analyzing contractual agreements or organizational features of hedge funds, such as incentive fee, management fee and fund size. Comparatively, the other category investigates this question by looking into evidence associated with hedge fund managers.

The agency problem usually arises when cooperating parties have different goals and there is a division of labor (Jensen and Meckling, 1976; Ross, 1973), as the fundamental theory applied to explain hedge fund performance. Hedge fund managers' compensation is structured into two parts: a management fee which is normally a fixed proportion of assets under management and an incentive fee which is a proportion of annual profits. Considering this two-part compensation structure, hedge fund managers have stronger financial motivation to perform better in order to receive a higher reward (Mietzner et al.

2011, Mietzner and Schweizer 2014, and Cumming et al. 2014). Therefore, arrangements which could align the interest of hedge fund managers and investors are believed to be the essential determinants when discussing hedge fund performance. Ackermann et al. (1999) explore the determinants of hedge fund return and volatility, finding that the superior performance of hedge funds is related to incentive fee whereas management fee is positively related to the volatility of hedge funds which has the potential to result in agency problems. A similar result has been found by Franklin et al. (2001) in which hedge funds that pay higher incentive fees are associated with higher excess returns. Moreover, Agarwal et al. (2009) conclude that managerial incentives such as incentive fee, high-water marks provisions, and managerial discretion, such as lockup period and redemption requirement, are positively related to hedge fund performance. The impact of incentive arrangements on performance is especially obvious in emerging hedge funds who are more likely to be open to new investors than established hedge funds. One possible reason is that managers of emerging hedge funds are on average younger than those from hedge funds with a long history. Therefore, these younger managers have stronger incentive to outperform their peers during initial periods for reputation reasons (Aggarwal and Jorion, 2009). Overall, these contractual arrangements of hedge funds affect hedge fund performance by reducing the agency problems between hedge fund managers and investors.

Similarly, these managerial incentive arrangements also affect hedge fund managers' investment strategies and risk-taking behaviors. Carpenter et al. (2000) report that incentive fee increases hedge fund risks when a fund's return is below the benchmark. They also prove that the optimal reaction of a risk averse hedge fund manager when facing an increased incentive fee is to reduce a fund's risk. In contrast, Kouwenberg and Ziemba

(2007) report that higher incentive fees lead to increased risk-taking, but that risks are reduced considerably when managers invest their own money in the fund.

The second stream of literature seeks to investigate hedge fund performance by examining factors related to hedge fund managers. For example, Edwards (2001) proves that some hedge funds earn excess return and the persistence of good performance is due to management skill rather than chance. Li et al. (2011) find that managers with better educational backgrounds and work experience are more likely to achieve higher returns and subsequently take fewer risks. Sun and Wang (2011) report similar results holding that skilled hedge fund managers are more likely to generate and pursue unique investment strategies that will lead to superior performance.

In sum, while previous literature examines factors affecting hedge fund performance by looking into contractual arrangements such as incentive fees and lock-up period provision, this study will examine the question by analyzing physical characteristics of hedge fund managers, specifically facial structure measured by facial Width-to-Height ratio.

### *2.2. Facial characteristics convey certain information and the underlying factor is testosterone*

Facial characteristics are believed to serve as a reliable clue to people's attractiveness, emotion, personality traits as well as behavioral tendencies. There is literature indicating that naive judgments based on facial appearance may provide more accurate assessments of individuals than well-informed judgments can. For example, Roney, Hanson, Durante and Maestripieri (2006) conducted a research study and found that women can detect men's hormone concentrations and interest in infants by tracking cues in men's faces, and that women use this information to make mate attractiveness judgments. Also, it has been found people can make accurate estimation on the physical strength and fighting ability of others

based on facial information (Sell et al, 2009) and could identify the picture of non-cooperative participants in a Prisoner's Dilemma game based on facial photographs (Verplaetse, Vanneste and Braeckman, 2007). Moreover, Rule & Ambady (2008) conducted a study asking participants to make naive personality judgments from the photographs of CROs of Fortune 500 companies and they found that these judgments correctly predicted the financial success of these companies. Together, these findings suggest that people can make inferences about others' personality traits as well as behavioral traits based on certain signals conveyed by the face. The mechanism behind the judgments based on face and the underlying factor linking facial characteristics to human behaviors is found to be testosterone level (Carre and McCormick, 2008), a steroid hormone that is mainly produced by the testes and stimulates the growth of the jaw, cheekbones and brow ridges in males (Özener B, 2012).

The emerging study on the interaction between hormones and human behaviors has also aroused the interest of economists, as one attempts to explain economic behaviors of humans from the perspective of hormones. Chen. & Ozdenoren (2005) investigate the gender difference in decision-making by setting up an auction game. The results imply that biological state plays an important role in influencing individuals to make economic decisions. Coates and Herbert (2008) study the relationship between testosterone and financial return by analyzing the behaviors of 17 male traders in London for 8 consecutive business days. The result shows that these traders made higher profits (above daily average) on days when their testosterone levels were above their median level. Furthermore, Apicella et al (2008), who combine fWHR together with other 3 sexual dimorphism measurements to create a score indicating the degree of facial masculinity and find that

men with higher testosterone levels are more risk-taking in an investment game with real monetary payoffs. This is the very first study to explore the relationship between testosterone and financial risk preferences in men.

### *2.3. fWHR can be used as the proxy for testosterone levels in men*

The most precise measurement of testosterone levels could be done by collecting saliva samples (Lefevre et al, 2013), which is nearly impossible to carry out for a large sample of hedge fund managers. An alternative measurement of testosterone level is fWHR which has been identified as a possible proxy measure of testosterone exposure.

Weston, Friday and Lio (2007) were the first to highlight the concept of fWHR. By analyzing an ontogenetic series of human skulls, they identify fWHR as a sexual dimorphism facial structure (men's fWHRs are larger than women's) for humans independent of body size and age. According to their study, the sex difference of fWHR in males and females emerged from puberty, during which the growth trajectories of males and females diverged for bizygomatic width and not for upper facial height. Puberty is also the time when testosterone concentrations increase in boys (Verdonck et al, 1999). The study is consistent with Vanderschueren and Bouillon's (1995) report stating testosterone facilitates the growth of bone by increasing outside bone diameter and bone mass during male development.

Moreover, fWHR does not change significantly over time (Jia, van Lent, and Zeng, 2014) and has been empirically proven to be positively related to baseline testosterone levels as well as reactive testosterone by Lefevre et al. (2013). With regards to Lefevre et. al. (2013), the authors investigated the link between testosterone and fHWR, and other 2 well-characterized sexually dimorphic facial metrics (lower-face to whole-face-height and cheekbone prominence) by collecting saliva samples from 188 Caucasian men before and

after a speed-dating session. The collected samples were used to assess salivary testosterone level of male participants. Altogether, these findings show that fWHR is a better proxy measure of testosterone levels compared with other facial metrics and validate hedge fund managers' facial characteristics as a measure of their testosterone level.

### *2.4. fWHR and performance, risk-taking, other behaviors*

Existing research has shown that fWHR, which is positively associated with testosterone, is associated with aggression and unethical behaviors, attractiveness to women, leadership influence as well as financial performance. For example, Carré and McCormick (2008) claim that men do have higher fWHR than women and that this ratio predicts reactive aggressive behaviors in a laboratory setting. In the same study, researchers also obtained a similar finding in professional hockey players when aggression is defined as the number of penalty minutes per game. Stirrat and Perrett (2010) report broadly the same finding that men with higher fWHR are more likely to exploit the trust of others and are less trusted than males with lower fWHR. Moreover, Haselhuhn and Wong (2012) demonstrate that fWHR predicts self-perceived power, and men with higher fWHR are more likely to cheat and deceive when it comes to financial gain.

Although men with higher fWHR may be untrustworthy and aggressive on an interpersonal level, many researchers have proved that these people are quite popular at a societal level, and are more likely to achieve higher social status and better financial performance. Specifically, Katherine et al (2014) examine the role of fWHR in speed-dating events where single women were asked to rate their interest in a man for a short-term and long-term relationship. The result shows that fWHR is positively associated with men's attractiveness to women in short-term, though not in a long-term relationship. In terms of leadership, Lewis, Lefevre, and Bates (2012) studied the association between fWHR and

politically relevant personality traits, finding that fWHR is positively related to achievement drive in an elite sample of 29 former US presidents.

A series of recent literature has also attempted to establish the relationship between fWHR and financial decision-making and economic behaviors. Wong, Ormiston & Haselhuhn (2011) are the first to identify a positive relationship between CEOs' fWHRs and their firm's financial performance, indicating that firms whose male CEOs have wider faces (higher fWHR) will achieve superior financial performance. Following their study, Kim and Kamiya (2015) demonstrate that CEOs with higher fWHR are more acquisitive in terms of merger frequency as well as the amount of money spent on mergers, and subsequently more likely to make a firm riskier. Jia et al. (2014) found that CEOs with higher fWHR are more likely to misreport financial statement. While some studies examine the effect of fWHR of CEOs on firm performance, little is known about the effect of fWHR on investment decisions of hedge fund managers.

Therefore, we formulate our hypothesis as follows:

*H1: Hedge fund managers with higher fWHR will improve hedge fund performance in terms of return.*

*H2: Hedge fund managers with higher fWHR will increase hedge fund risk.*

## 3. Data and Methodology

### *3.1 Data*

Data on hedge funds is mainly obtained from the Morningstar CISDM Database (formerly the MAR Database), which is one of the oldest and largest database of hedge fund in the market. Morningstar has been offering qualitative and quantitative information for hedge funds since 1994. Our database contains 4,941 active funds as well as 15,514 defunct funds

as of June, 2016. A total number of 4,132 funds were dropped due to the missing information on investment strategy. We exclude funds of funds in our sample since they invest in hedge funds with share restrictions and funds of funds themselves impose share restrictions. We also exclude funds with no data on monthly returns in our sample, leading to a sample size of 9,924.

The sample period in this study starts from 1994, before which CISDM only kept track of active funds, leading to survivorship bias in the database since non-surviving funds normally have poorer performance (Edwards and Caglayan, 2001). The database reports both active and non-surviving funds after 1994. Thereby, we could eliminate survivorship bias by including data after 1994. Since hedge fund managers are allowed to backfill returns when they enter the database, we follow common practice and delete the first 12 observations, and also drop samples with less than 12 observations (Edwards and Caglayan, 2001; Schaub and Schmid, 2013). For the remaining funds in our sample, only 2,404 funds have name information on their managers, which is important for us to search for their photographs online.

We then collected facial pictures of hedge fund managers by searching in Google Image, LinkedIn, hedge funds' official websites and also various financial medias. Afterwards, all these pictures with a tilt of the head were horizontally aligned using Adobe Photoshop and we followed Kamiya, Kim, and Park's (2015) guidelines for selecting photos by scoring each picture from 1 to 5 based on its quality. For example, pictures with higher pixels received a higher score. Pictures in which the managers are of fairly neutral facial expression and are facing front will also get a higher score. Then, we narrowed down to the pictures which received at least 3 scores, finally giving us 178 management teams that

have at least one manager photograph of neutral face left in our sample. These management teams manage 351 funds, however, we dropped duplicate observations and only kept one of their funds under management based on a random sorting.

### *3.2 Independent Variable*

The independent variable is fWHR, which was calculated as bizygomatic width (maximum horizontal distance from the left facial boundary to the right facial boundary) divided by upper-face height (vertical distance from the mid-point of the upper-lip to the highest point of the eyelids). (See Figure 1 and Stirrat and Perrett,2010; Lefevre et al, 2013).

### *3.3 Dependent Variable*

Since our primary research question is fWHR of managers affecting hedge fund performance and risk-taking, our dependent variables are return and volatility of hedge fund investment. Average monthly return, which is defined as the change in net asset value during the month divided by the net asset value at the beginning of the month, is used to measure hedge fund performance. Due to the dynamic investment strategies, hedge fund returns are known to be non-normal. Therefore, we used not only the standard deviation but also the skewness of hedge fund returns as the measure of risks.

### *3.4 Control Variables*

Following previous research on hedge fund performance, we control for the possibility that hedge fund performance and risk taking behaviors of managers are related to several fund characteristics such as fund size, management fee, performance fee, whether or not the manger holds investment in the fund, lockup period, hedge fund groups, high water mark, whether or not the fund is closed to investment, and also whether or not there are more than one managers in the management team. These factors are either proved related to hedge fund performance by previous study or regarded related theoretically.

Fund size is the total asset of the hedge fund and large funds normally perform better than small funds because of economies of scale. Management fee is the percentage of the fund's net assets that is paid to fund management for their management and administrative service. Outside the fixed management fee, hedge fund managers also receive an incentive payment in excess of a given benchmark. Their performance fee, also called "incentive fee", is the percentage of a fund's profits paid to hedge fund managers. Funds with higher return will pay a higher performance fee, which is more likely to attract skilled managers and to align the interests of managers with investors. Lockup period is the time period during which investors cannot withdraw the money after their investment and it can be regarded as a measure of fund liquidity. High-water mark is the highest peak value that a fund has reached. It ensures hedge fund managers will not get incentive payment for poor performance and may lead to excess risk under some conditions. Personal Capital is a dummy variable indicating whether the manager holds investment in the fund they manage. We also include three dummy variables indicating whether a fund is closed to new investors, whether a fund is offshore, and whether a fund has more than one manager in the sample. Hedge funds in the sample are categorized into 6 groups based on different types of investment strategies according to The Morningstar CategoryClassifications (see Table 2) for Hedge Fund: Directional Equity, Directional Debt, Event, Global Derivatives, Multistrategy and Relative Value. We generate a group of dummy variables, which have a value of 1 if a fund is in the specified category and 0 otherwise to control the different investment strategies. We also include year dummy variables in all of the regressions to avoid time-specific shocks that may affect the results.

Table 3 presents the summary statistics of all the variables used in regression. The average monthly return, standard deviation and skewness are 0.85%, 4.71% and 0.03 respectively, with a dispersion of 0.57%, 2.69% and 1.65. The skewness is of wide dispersion with the lowest value of -11.53 and the highest of 5.41. The average fWHR of hedge fund managers in our sample is 1.87 with a standard deviation of 0.14. In terms of control variables, we find that most funds charge a 20% performance fee and a 1%-2% management fee. About 40% of the hedge fund managers invest their own capital in the fund they manage and 40% of the funds are offshore. Most of hedge funds in the sample have only 1 manager and only 7% of the funds are closed to new investment.

***3.5 Regression model***

The regression model set up to examine the relationship between fWHR and the performance of hedge fund managers is:

$$\alpha_{i,j} = \beta_{0j} + \beta_{1j} fWHR_i + \beta_{2j} ManagementFee_i + \beta_{3j} PerformanceFee_i + \beta_{4j} PersonalCapital_i + \beta_{5j} ClosedtoInvestment_i + \beta_{6j} ManagementTeam_i + \beta_{2j} Offshore_i + \varepsilon_i \quad (1)$$

where $\alpha_{i,j}$ denotes hedge fund return (the geometric mean of monthly return over the entire lifetime) and risk measures (standard deviation, skewness of monthly return over the entire lifetime) $j = 1,2,3$ for funds i=1,…, I. The independent variable $fWHR_i$is the average value of the calculated facial width-to-height ratio for all the managers of fund i., *ManagementFee, PerformcanceFee*, *PersonalCapital, ClosedtoInvestment, ManagementTeam and offshore* are controlled variables that are listed in the previous section.

To explore the relation between hedge fund performance and fWHR, we first estimate the regression model (1) with ordinary least squares using cross-sectional data. We also conduct an estimation based on panel data.

The empirical regression model for panel data is:

$$y_{i,t} = \alpha_0 + \beta \ \ X'_{it} + f'_i\gamma + u_i + e_{it} \qquad (2)$$

$y_{it}$ is hedge fund performance measurement at time *t*, $X'_{it}$ is our time-varying regressor fWHR for fund *j* at time *t*, and $f'_i$ is a vector of time-invariant variables, including fund size, performance fee, management fee, lockup period, and whether the hedge fund is offshore and is closed to investment. $u_i$ is unobserved heterogeneity, representing the all the unobserved factors that will affect $y_{it}$but is not correlated with time while $e_{it}$ is idiosyncratic error, representing all the factors that will affect $y_{it}$ and varies across time.

In the panel data regression, we apply sequential estimation which is a two-stage estimation procedure firstly introduced by Kripfganz (2015) aiming at explaining the effect of time-variant variables in a model with many time-invariant variables. We didn't apply fixed-effects regression because most variables in our regression model are time-invariant, such as Management Fee, Performance Fee, Personal Capital, Closed to Investment, High Watermark, meaning that they remain unchanged during the whole sample period. In the model, we regard fWHR as a time-variant variable since it is calculated as the average fWHRs of all the managers of a certain fund, so the value will change over time if a fund experiences a change in managers. Moreover, traditional "fixed effects" estimation excludes all time-invariant variables from the model, resulting in incorrect coefficients on the remaining variables. Besides, "random effects" estimation

is also not appropriate for our model because it relies on exogeneity assumptions that are too strict to be acceptable. Since incorrect assumptions about the exogeneity of some variables may cause inconsistency of all coefficient estimation, we apply sequential estimation for panel data estimation, which can provide partial robustness to such misspecification. The first stage of sequential estimation regress dependent variable on time-varying independent variables only and subsequently regress residuals from the first stage on time-invariant variables in the second stage. The estimation procedure is:

Step 1: Estimation of the coefficients of time-varying regressor

$$y_{it} = X'_{it}\hat{\beta} + \tilde{u}_i + e_{it}, \qquad \tilde{u}_i = f'_i\gamma + u_i \qquad (3)$$

$y_{it}$ is hedge fund performance measurement at time *t*, $X'_{it}$ is our time-varying regressor fWHR for fund *j* at time *t*.

Step 2: Estimation of the coefficients of time-invariant regressors. In this step, we will estimate the residuals from step 1 on time-invariant regressors.

$$y_{it} - X'_{it}\hat{\beta} = f'_i\gamma + u_i + \tilde{e}_{it} \qquad (4)$$

## 4. Empirical results and discussion

As mentioned in the previous section, this paper will investigate the association between fWHR of hedge fund managers and their performance, indicated by hedge fund monthly return, in addition to risk-taking behaviors, indicated by two volatility metrics. Table 4 and Table 5 present the results of empirical regression of cross-sectional data and panel data respectively.

As in the cross-sectional regression model, the coefficient of fWHR on hedge fund performance, measured by Monthly Return, is not significant. Actually, except the coefficient of Management Team, all the other variables have insignificant coefficients. Although we find a positive relationship between fWHR and risk in panel data, the effect of fWHR on hedge fund risks may not have been detected in cross-sectional data due to the small sample and possible measurement error associated with calculating fWHR.

Table 5 reports the panel data regression results. There are 18726 observations in panel data sample. The dependent variables in columns 1-3 are hedge funds' return, standard deviation of return, and skewness of return. In column (1), the coefficient of average fWHR on hedge fund monthly return equals 0.277 but the relationship is not significant. The results from column (2) and (3) reveal a strong positive relation between fWHR and hedge fund risks. The coefficient of average fWHR in column (2) is 0.931 and is positively significant, indicating that hedge funds whose managers have higher fWHR tend to take more risks. This is consistent with results in column (3), where the coefficient is -0.097 and significant at 5% level. The parameter estimates suggest that all else being equal, a hedge fund whose managers with higher average fWHR will experience a higher standard deviation of return as well as a lower skewness of return, which is associated with higher total risk and higher downside risk. As mentioned in Section 2, fWHR is directly associated with the testosterone level of body. Meanwhile, the testosterone level of body will influence human's daily behavior, including daily trading and investment decisions. People with high level of testosterone tend to be more aggressive and confident. Therefore, hedge fund managers who have relatively higher level of fWHR represents to have higher level of testosterone, which, as a result, directly influence affects their hedge fund managerial

behaviors. As illustrated by the result of the regression, the risks of these fund are significantly associated with fWHR ratio.

For the control variables in the regression, we find that hedge fund size is negatively related to standard deviation since larger funds are more established and thus are less willing to take excessive risks. Meanwhile, large sized hedge funds usually have more investment options so they could reduce the total risk by investing in a diversified portfolio. The coefficient of management fee keeps positive for all the three dependent variables but is only significant for measurement of risk. This result is consistent with previous study finding that management fee creates an agency problem. Previous studies have mixed results on the relationship between hedge fund performance and performance fee (incentive fee): some of them state higher incentive fees lead to better performance while others find funds with higher performance fees do not perform better than those with lower fees. The reason for this mixed result could be that managers' monetary payoffs depends not only the percentage of the performance fee but also on other fund characteristics (Agarwal, 2009). The empirical result of this study shows that performance fees are not significantly related to hedge fund monthly return nor standard deviation of return but it does encourage managers to take more risks to achieve when measuring risks with skewness of return. When hedge fund managers have their own money invested in the fund, this is negatively related to monthly return and positively related to standard deviations. It can be observed that hedge funds whose managers invest their personal capital in the fund have a lower monthly return (-0.32%). One possible reason is that managers are not willing to bear more risk when they use their personal capital as the investment fund base, since they should absorb investment loss like other limited partners.

## 5. Conclusion

In this paper, we examine the association between fWHR of hedge fund managers, their performance and risk-taking behaviors. Although the question of what drives the performance and investment behavior of hedge funds has been largely studied by previous literature, this paper contributes to this stream of literature from the perspective of behavioral finance. Moreover, this is the first study linking facial metrics to behavioral traits, specifically risk-taking behaviors, based on a large sample of highly skilled investors in real financial markets over a long period.

The primary findings of this study are that fWHR of hedge fund managers has no significant effect on their performance measured by monthly return. The result remains the same with both cross-sectional data and panel data. However, fWHR is positively related to risk-taking behaviors of hedge fund managers, suggesting that managers with higher fWHR are more likely to make risky investments. The positive association between fWHR and risk-taking levels is consistent with Coren & Anna (2008) and Carre & McCormick (2008) who demonstrate that men with higher level of testosterone and proxy by fWHR are more likely to engage in riskier behaviors. The coefficient of average fWHR on monthly return is not significant, indicating that overall return rates of these hedge funds are not directly associated with fWHR and the risk-taking behaviors of the managers who have higher fWHR do not enhance the performance of their funds. One potential reason could be that as most hedge funds are well-diversified, risk-taking investments may not improve the monthly return rate.

The results of this research provide valuable implications for several groups of organizational stakeholders. For hedge fund investors, the results suggest that funds whose

managers have higher fWHR are associated with higher volatility in return, therefore investors can assess and make inference on their investment risk level by evaluating the fWHR of hedge fund managers. The finding is also relevant for any hedge fund personnel who make hiring and staffing decisions, and investment fiduciaries who allocate capital to hedge funds, as it relates to hiring managers or financial analysts for their team. By applying facial recognition to analyze the fWHR of candidates in the recruitment process, the recruiters can quickly assess the candidate's possible risk preference and filter the applications, and select the candidate who shares the similar risk appetite with the fund. For regulators, market supervision, and policy makers, the results are meaningful to them for evaluating hedge fund risk and potential consequences for capital market given that hedge funds are not required to provide the same level of disclosure as mutual funds. Hedge fund managers themselves also may be attract by the results because of personal curiosity. This study could enhance their insights into their own investment behaviors.

The results and implications of this study should be considered in light of its limitations. For example, measurements of hedge fund performance in addition to monthly return can be added in further research. Since human face is of 3 dimension and our calculation of fWHR is based on 2-dimensional photos, the measurement might be affected by the head posture of hedge fund managers. Some pictures were taken from downside or upside angle, and in some pictures hedge fund managers are facing sideways or slightly rotating their head. Although we could rotate the pictures before grading them, the measurement of fWHR could be problematic. It is documented that managers from higher-SAT undergraduate institutions are more likely to achieve better performance (Li et al, 2011). However, there is no educational information on hedge fund managers in the Morningstar

database nor on hedge fund official website, so we could not control the effect of hedge fund managers' educational background in this study. Another limitation is that the sample might subject to possible selection bias since we exclude all the funds whose mangers' facial photographs are unavailable. This unavailability might be associated with hedge fund performance. Hedge funds with poorer performance could have an incentive to advertise for themselves, e.g. by given public presentation, to acquire new investors for their hedge fund. Therefore, it would be more likely to picture of underperformaing hedge fund managers on websites or media. Meanwhile, funds with better performance usually do not have the inventive to do so. For example, four of the six largest hedge-fund portfolios are closed to new investors (Shapiro, 2013), so they have no reason to advertise. This could result in a selection bias. Another interesting question for further research to examine is the potential ethnical effects. Majority of hedge fund managers in our sample are from North America or Europe, thus the extent to which my findings of fWHR extend to other ethnic groups remains unknown. People from different ethnic groups might experience different facial bone structures, further researches could investigate the effect of fWHR across different ethnic groups.

## References:


Ackermann, C., McEnally, R., & Ravenscraft, D. (1999). The performance of hedge funds: Risk, return, and incentives. *The Journal of Finance*, *54*(3), 833-874.

Agarwal, V., Daniel, N. D., & Naik, N. Y. (2009). Role of managerial incentives and discretion in hedge fund performance. *The Journal of Finance*, *64*(5), 2221-2256.

Aggarwal, R. K., & Jorion, P. (2010). The performance of emerging hedge funds and managers. *Journal of Financial Economics*, *96*(2), 238-256.

Apicella, C. L., Dreber, A., Campbell, B., Gray, P. B., Hoffman, M., & Little, A. C. (2008). Testosterone and financial risk preferences. *Evolution and human behavior*, *29*(6), 384-390.

Apicella, C. L., Dreber, A., Gray, P. B., Hoffman, M., Little, A. C., & Campbell, B. C. (2011). Androgens and competitiveness in men. *Journal of Neuroscience, Psychology, and Economics*, *4*(1), 54-62.

Brown, S. J., & Goetzmann, W. N. (2001). *Hedge funds with style* (No. w8173). *National Bureau of Economic Research.*
(http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.202.7058&rep=rep1&type=pdf)

Carpenter, J. N. (2000). Does option compensation increase managerial risk appetite. *The Journal of Finance*, *55*(5), 2311-2331.

Carré, J. M., & McCormick, C. M. (2008). In your face: facial metrics predict aggressive behaviour in the laboratory and in varsity and professional hockey players. *Proceedings of the Royal Society of London B: Biological Sciences*, *275*(1651), 2651-2656.

Carré, J. M., McCormick, C. M., & Mondloch, C. J. (2009). Facial structure is a reliable cue of aggressive behavior. *Psychological Science*, *20*(10), 1194-1198.

Chen, Y., Katuščák, P., & Ozdenoren, E. (2013). Why can't a woman bid more like a man. *Games and Economic Behavior*, *77*(1), 181-213.

Coates, J. M., & Herbert, J. (2008). Endogenous steroids and financial risk taking on a London trading floor. *Proceedings of the national academy of sciences*, *105*(16), 6167-6172.

Cumming, D., Dai, N., Haß, L. H., & Schweizer, D. (2012). Regulatory induced performance persistence: Evidence from hedge funds. *Journal of Corporate Finance*, *18*(5), 1005-1022.

Edwards, F. R., & Caglayan, M. O. (2001). Hedge fund performance and manager skill. *Journal of Futures Markets: Futures, Options, and Other Derivative Products*, *21*(11), 1003-1028.

Edwards, F. R., & Liew, J. (1999). Hedge funds versus managed futures as asset classes. *Journal of Derivatives*, *6(4)*, 45-64.

CitiBank (2018).Opportunities and Challenges for Hedge Funds in the Coming Era of Optimization
(http://www.citibank.com/icg/global_markets/prime_finance/docs/Opportunities_and_Challenges_for_Hedge_Funds_in_the_Coming_Era_of_Optimization.pdf)

Fung, W., & Hsieh, D. A. (2001). The risk in hedge fund strategies: Theory and evidence from trend followers. *The Review of Financial Studies*, *14*(2), 313-341.

Haselhuhn, M. P., & Wong, E. M. (2011). Bad to the bone: facial structure predicts unethical behaviour. *Proceedings of the Royal Society of London B: Biological Sciences*, rspb2011.1193.
Jia, Y., Lent, L. V., & Zeng, Y. (2014). Masculinity, testosterone, and financial misreporting. *Journal of Accounting Research*, *52*(5), 1195-1246.
Kantrowitz, B., & Kalb, C. (1998). Boys will be boys. *Newsweek*, *11*, 55-60.
Kim, Y. H., & Kamiya, S. (2015). The Testosterone of the CEO and the risk of the firm. *Shinichi, The Testosterone of the CEO and the Risk of the Firm (January 29, 2015)*.
Kim, Y. H., Kamiya, S., & Park, S. (2018). The Face of Risk: CEO Facial Masculinity and Firm Risk. *European Financial Management*, forthcoming.
Kouwenberg, R., & Ziemba, W. T. (2007). Incentives and risk taking in hedge funds. *Journal of Banking & Finance*, *31*(11), 3291-3310.
Kripfganz, S., & Schwarz, C. (2013). Estimation of linear dynamic panel data models with time-invariant regressors.
(https://www.ecb.europa.eu/pub/pdf/scpwps/ecbwp1838.en.pdf?80cfd12fbb83c262ab6ff954b3108c21)
Lewis, G. J., Lefevre, C. E., & Bates, T. C. (2012). Facial width-to-height ratio predicts achievement drive in US presidents. *Personality and Individual Differences*, *52*(7), 855-857.
Lefevre, C. E., Lewis, G. J., Perrett, D. I., & Penke, L. (2013). Telling facial metrics: facial width is associated with testosterone levels in men. *Evolution and Human Behavior*, *34*(4), 273-279.
Li, H., Zhang, X., & Zhao, R. (2011). Investing in talents: Manager characteristics and hedge fund performances. *Journal of Financial and Quantitative Analysis*, *46*(1), 59-82.
Malkiel, B. G., & Saha, A. (2005). Hedge funds: Risk and return. *Financial analysts journal*, *61*(6), 80-88.
Mietzner, M., Schweizer, D., & Tyrell, M. (2011). Intra-Industry Effects of Shareholder Activism in Germany – Is There a Difference between Hedge Fund and Private Equity Investments? *Schmalenbach Business Review*, *63(2)*, 151-185.
Mietzner, M., & Schweizer, D. (2014). Hedge funds versus private equity funds as shareholder activists in Germany—differences in value creation. *Journal of Economics and Finance*, *38*(2), 181-208.
Mehta, P. H., & Beer, J. (2010). Neural mechanisms of the testosterone–aggression relation: the role of orbitofrontal cortex. *Journal of cognitive neuroscience*, *22*(10), 2357-2368.
Özener, B. (2012). Facial width-to-height ratio in a Turkish population is not sexually dimorphic and is unrelated to aggressive behavior. *Evolution and Human Behavior*, *33*(3), 169-173.
Rule, N. O., & Ambady, N. (2008). The face of success: Inferences from chief executive officers' appearance predict company profits. *Psychological science*, *19*(2), 109-111.
Sell, A., Cosmides, L., Tooby, J., Sznycer, D., Von Rueden, C., & Gurven, M. (2009). Human adaptations for the visual assessment of strength and fighting ability from the body and face. *Proceedings of the Royal Society of London B: Biological Sciences*, *276*(1656), 575-584.
Sherman, G. D., Lerner, J. S., Josephs, R. A., Renshon, J., & Gross, J. J. (2016). The interaction of testosterone and cortisol is associated with attained status in male executives. *Journal of personality and social psychology*, *110*(6), 921.

Shapiro, H., Why Aren't Hedge Funds Advertising? *The New Yorker*
Retrieved October 31, 2013, from
(https://www.newyorker.com/business/currency/why-arent-hedge-funds-advertising)
Stirrat, M., & Perrett, D. I. (2010). Valid facial cues to cooperation and trust: Male facial width and trustworthiness. *Psychological science*, *21*(3), 349-354.
Sun, Z., Wang, A., & Zheng, L. (2011). The road less traveled: Strategy distinctiveness and hedge fund performance. *The Review of Financial Studies*, *25*(1), 96-143.
Ahmed, S., Sihvonen, J., & Vähämaa, S. (2019). CEO facial masculinity and bank risk-taking. *Personality and Individual Differences*, *138*, 133-139.
Tim Adams, (2014). Joa hunting is a matter of big data, not how you perform at an interview.
(https://www.theguardian.com/technology/2014/may/10/job-hunting-big-data-interview-algorithms-employees)
Tsujimura, H., & Banissy, M. J. (2013). Human face structure correlates with professional baseball performance: insights from professional Japanese baseball players. *Biology letters*, *9*(3), 20130140.
Vanderschueren, D., & Bouillon, R. (1995). Androgens and bone. *Calcified tissue international*, *56*(5), 341-346.
Valentine, K. A., Li, N. P., Penke, L., & Perrett, D. I. (2014). Judging a man by the width of his face: The role of facial ratios and dominance in mate choice at speed-dating events. *Psychological science*, *25*(3), 806-811.
Verdonck, A., Gaethofs, M., Carels, C., & de Zegher, F. (1999). Effect of low-dose testosterone treatment on craniofacial growth in boys with delayed puberty. *The European Journal of Orthodontics*, *21*(2), 137-143.
Weston, E. M., Friday, A. E., & Liò, P. (2007). Biometric evidence that sexual selection has shaped the hominin face. *PLoS One*, *2*(8), e710.
Wong, E. M., Ormiston, M. E., & Haselhuhn, M. P. (2011). A face only an investor could love: CEOs' facial structure predicts their firms' financial performance. *Psychological Science*, *22*(12), 1478-1483.
Yamagishi, T., Tanida, S., Mashima, R., Shimoma, E., & Kanazawa, S. (2003). You can judge a book by its cover: Evidence that cheaters may look different from cooperators. *Evolution and Human Behavior*, *24*(4), 290-301.

# Appendix

## Table 1: Variable Definitions

This table gives a detailed description of the data-gathering process and calculation methods for all variables. Management fee is the percentage of the fund's net assets under management that is paid annually to fund management for administering the fund. Performance fee (incentive fee) is the percentage of profits (over high-water mark) that is given to fund management in reward for positive performance.

| Variable Name | Description and Calculation |
|---|---|
| | ***Dependent Variables*** |
| Avg Monthly Returns | Geometric average of monthly returns of each year (dependent variable used in cross-sectional data) |
| Monthly Return | Return of each month (dependent variable used in panel data) |
| Standard Deviation | Standard deviation of monthly returns |
| Skewness | Skewness of monthly returns |
| | ***Independent Variable*** |
| AvgfWHR | Average of fWHR of the hedge fund managers |
| | ***Control Variables*** |
| Fund Size | Logarithm of the amount of fund asset under management |
| Management Fee | The fund's management fee in percent |
| Performance Fee | The fund's incentive fee in percent |
| Personal Capital | Dummy variable which equals 1 if the manager holds investment in the fund |
| LockUp | Dummy variable which equals 1 if there is a lockup period in the fund |
| Groups | Six different hedge fund investment style groups |
| High Watermark | Dummy variable which equals 1 if the hedge fund has high watermark provision |
| Closed to Investment | Dummy variable which equals 1 if the fund is closed to new investments |
| Off Shore | |

| | |
|---|---|
| | Dummy variable which equals 1 if the fund structured under foreign law, or located outside the U.S |
| Management Team | Dummy variable which equals 1 if the fund has more than 1 manager |

**Table 2. Morningstar Hedge Fund Categories**

According to different types of investment strategies, the Morningstar classifies hedge funds into 31 categories, which map into six broad category groupings (directional equity, relative value, directional debt, global/derivatives, event, and multistrategy).

| **Broad Category Groupings** | **Categories** |
|---|---|
| Directional Equity | Asia/Pacific |
| | Bear-Market |
| | China |
| | Emerging-Markets |
| | Europe |
| | Global |
| | U.S. Long/Short Equity |
| | U.S. Long/Short Small |
| | Emerging Markets Long |
| | Long |
| Directional Debt | Long/Short |
| | Long-only |
| Event | Distressed Securities |
| | Event-Driven |
| | Merger Arbitrage |
| Global Derivatives | Currency |
| | Global Macro |
| | Systematic Futures |
| Multistrategy | Multistrategy |
| | Long-Only Other |
| | Fund of Funds - Debt |
| | Fund of Funds - Equity |
| | Fund of Funds - Event |
| | Fund of Funds - Macro/Systematic |
| | Fund of Funds - Multi Strategy |
| | Fund of Funds - Relative Value |
| Relative Value | Convertible |
| | Debt |
| | Diversified |
| | Equity |

**Table 3: Summary Statistics**

This table presents descriptive statistics (mean, median, standard deviation, min, and max) for all the variables.

| Variable | #Obs. | Mean | Std. Dev | Min | Q1 | Median | Q3 | Max |
|---|---|---|---|---|---|---|---|---|
| Avg Monthly Returns | 178 | .85 | .57 | -1.78 | .56 | .83 | 1.14 | 3.21 |
| Standard Deviation | 178 | 4.71 | 2.69 | .64 | 2.69 | 4.35 | 5.90 | 16.91 |
| Skewness | 178 | .03 | 1.65 | -11.53 | -.48 | .038 | .61 | 5.41 |
| AvgfWHR | 173 | 1.87 | .142 | 1.60 | 1.78 | 1.87 | 1.95 | 2.34 |
| Management Fee | 174 | 1.53 | .53 | 0 | 1 | 1.5 | 2 | 4.5 |
| Performance Fee | 174 | 19.36 | 3.14 | 0 | 20 | 20 | 20 | 25 |
| Personal Capital | 178 | .39 | .49 | 0 | 0 | 0 | 1 | 1 |
| Closed to Investment | 178 | .07 | .25 | 0 | 0 | 0 | 0 | 1 |
| Off Shore | 178 | .39 | .49 | 0 | 0 | 0 | 1 | 1 |
| Management Team | 178 | .24 | .43 | 0 | 0 | 0 | 0 | 1 |

**Table 4: Cross-sectional regressions of hedge funds returns and risk**

This table presents the result from cross-sectional regressions, where the dependent variables are average monthly returns, standard deviation and skewness of returns.

| | Avg Monthly Return | Standard Deviation | Skewness |
|---|---|---|---|
| | (1) | (2) | (3) |
| AvgfWHR | -0.138 | 0.192 | -1.247 |
| | (-0.38) | (0.12) | (-1.28) |
| Management Fee | 0.014 | 0.930** | 0.360 |
| | (0.14) | (2.14) | (1.39) |
| Performance Fee | -0.019 | -0.003 | 0.046 |
| | (-1.05) | (-0.04) | (0.93) |
| Personal Capital | -0.072 | -0.677 | -0.119 |
| | (-0.65) | (-1.35) | (-0.40) |
| Closed to Investment | 0.292 | 0.527 | -0.017 |
| | (1.44) | (0.58) | (-0.03) |
| Management Team | -0.151 | -0.271 | -0.821*** |
| | (-1.30) | (-0.52) | (-2.62) |
| Offshore | -0.140 | -0.833* | -0.588** |
| | (-1.27) | (-1.68) | (-1.99) |
| Group Controls | Yes | Yes | Yes |
| Year Controls | Yes | Yes | Yes |
| Constant | 0.605 | -1.094 | -2.686 |
| | (0.67) | (-0.27) | (-1.10) |
| Observations | 160 | 160 | 160 |
| Adjusted $R^2$ | 0.030 | 0.122 | 0.186 |

*t* statistics in parentheses

$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

**Table 5: Panel regressions of hedge funds returns and risk**

This table presents the result from panel data regressions, where the dependent variables are monthly returns and standard deviation.

| | Monthly Return | Standard Deviation | Skewness |
|---|---|---|---|
| | (1) | (2) | (3) |
| AvgfWHR | 0.277 | 0.931*** | -0.097** |
| | (1.03) | (5.97) | (-2.55) |
| lgFundSize | 0.021 | -0.105*** | -0.007*** |
| | (1.17) | (-10.13) | (-2.76) |
| Management Fee | 0.078 | 0.782*** | 0.022* |
| | (0.96) | (16.66) | (1.93) |
| Performance Fee | 0.011 | 0.011 | 0.012*** |
| | (0.79) | (1.37) | (6.61) |
| PersonalCapital | -0.321*** | -0.288*** | 0.024** |
| | (-3.71) | (-5.74) | (1.98) |
| HighwaterMark | 0.204 | 0.000 | 0.000 |
| | (1.09) | (.) | (.) |
| LockUp | 0.122 | 1.080*** | 0.015 |
| | (1.41) | (21.55) | (1.23) |
| Closed to investment | 0.011 | 0.359*** | 0.030 |
| | (0.09) | (4.75) | (1.61) |
| Offshore | 0.117 | -0.193*** | -0.008 |
| | (1.31) | (-3.75) | (-0.67) |
| Management Team | -0.079 | -0.067 | -0.089*** |
| | (-0.88) | (-1.28) | (-7.04) |
| Constant | 0.000 | 0.877 | 0.219 |
| | (.) | (0.64) | (0.66) |
| Group Controls | Yes | Yes | Yes |
| Observations | 18726 | 18720 | 18720 |
| Adjusted $R^2$ | | | |

*t* statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

**Figure 1. Illustration of measurement**

We follow Carre and McCormick (2008) and Lewis, Lefevre (2012) in measuring the facial width-to-height ratio. Specifically, fWHR is calculated as bizygomatic width, the maximum horizontal distance between the left and the right zygion, divided by upper facial height, the vertical distance between the highest point of the upper-lip and the highest point of the eyelids.