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The effect of sentiment on institutional investors: A gender analysis

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A Gender Analysis

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Abstract. In this paper, we explore whether male and female fund managers react differently to sentiment. Our main idea is that sentiment indicates mispricings of stocks relative to their fundamental values, and that rational fund managers should profit from these mispricings. As trading against the mispricing is risky, we hypothesize that female fund managers take on less aggressive positions. Indeed, our empirical results show that male fund managers hold portfolios with significantly higher total fund risk and unsystematic risk when sentiment is bad. For female fund managers, we find significantly lower levels in unsystematic risk when sentiment is bad. This difference in risk-taking behavior does not affect fund returns or risk-adjusted performance.

JEL-Classification Codes: *G11, G23, G40*

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1. Introduction

Are women "temperamentally" better suited as investors given the level of market sentiment? In this paper, we examine whether gender affects how *institutional investors* react to sentiment. Institutional investors play a pivotal role for the global financial system, and it is of major interest for their clients whether they can exploit irrationalities in financial markets, how they react to extreme levels of sentiment, and whether this eventually influences performance.

A large body of empirical research focuses on retail investors and sentiment (e.g., Brown and Cliff, 2004; Kumar and Lee, 2006; Schmeling, 2009), whereas the impact of sentiment on the decisions of institutional investors received less attention (e.g., Schmeling, 2007). Studies on institutional investors mostly analyze their aggregate behavior: Institutional investors exhibit herding behavior (e.g., Sias, 2004), home bias (e.g., Strong and Xu, 2003), and loss aversion (e.g., Coval and Shumway, 2005), and this has an impact on economic volatility (e.g., World Bank, 2015).

In contrast, we focus on the impact of sentiment at the individual institutional investor level by considering gender as a mediator for sentiment. To the best of our knowledge, this area of research is rather untouched and offers new insights especially for delegated portfolio management. How does sentiment-driven behavior of fund managers depend on gender? By answering this question, our research also generates actionable insights for fund families and fund investors.

Anecdotal evidence suggests that female fund managers may be "temperamentally" better investors. One example is Baillie Gifford's Sarah Whitley who retired in 2018. In an interview,

she posited that female fund managers are better at avoiding noise, acting against the "herd", and focusing on their own view (e.g., Jefferies, 2015). If this is indeed the case, male and female fund managers' reactions to sentiment can plausibly differ.

Research over the last decades has established deviations from the classical investment decision process that only considers the expected return and risk of an investment opportunity. The weather has an influence on trading activity (e.g., Goetzmann *et al.*, 2015) and risk-taking (e.g., Bassi *et al.*, 2013), as do social factors such as neighborhood (e.g., Pool *et al.*, 2015) or demographic similarity (e.g., Jaspersen and Limbach, 2018). A large body of literature finds that demographic characteristics matter as well: Age (e.g., Chevalier and Ellison, 1999a, 1999b), education (e.g., Chevalier and Ellison, 1999b), and, related to the topic of this paper, gender (e.g., Jianakoplos and Bernasek, 1998; Barber and Odean, 2001; Dorn and Huberman, 2005; Beckmann and Menkhoff, 2008; Niessen-Ruenzi and Ruenzi, 2018) affect investment decisions.

Focusing on gender differences, the literature finds similar behavior but different outcomes for retail investors and institutional investors. In general, women are more risk averse and invest more conservatively than men (e.g., Jianakoplos and Bernasek, 1998), and this also holds for female fund managers as compared to their male counterparts (e.g., Beckmann and Menkhoff, 2008). These differences in risk aversion, however, have no impact on performance (e.g., Atkinson *et al.*, 2003; Niessen-Ruenzi and Ruenzi, 2018). Male retail investors also trade more than female ones, which harms performance (e.g., Barber and Odean, 2001). Again, the higher trading propensity of male fund managers (e.g., Atkinson *et al.*, 2003) and their more variable investment styles (e.g., Niessen-Ruenzi and Ruenzi, 2018) do not affect performance.

Whether the observed differences in behavior between male and female mutual fund managers are due to innate characteristics or the institutional framework is up for discussion. Indeed, the institutional framework differs for male and female fund managers. Fund flows into female-managed funds are significantly lower than into male-managed funds (e.g., Atkinson *et al.*, 2003; Niessen-Ruenzi and Ruenzi, 2018) due to a gender bias by fund investors (e.g., Niessen-Ruenzi and Ruenzi, 2018). Hibbert *et al.* (2013) posit different levels of financial knowledge (e.g., Dwyer *et al.*, 2002) as a potential explanation for differences in risk aversion. They find that among finance professors, where the financial knowledge is comparable, there are no significant differences in risk aversion.

Overall, the literature on institutional investors gives mixed evidence on the differences between male and female fund managers. We therefore focus on a specific channel which may be affected by gender: Sentiment which describes the irrational component in the market or in investors' expectations about future cash flows and risks (e.g., Baker and Wurgler, 2007). Sentiment can lead to inefficient market outcomes as it affects stock prices, especially of stocks that are difficult to assess and hard to arbitrage (e.g., Baker and Wurgler, 2006). Good retail investor sentiment drives prices away from their fundamental values due to overoptimistic investors, and subsequent price corrections in the long term lead to lower stock returns (e.g., Brown and Cliff, 2005; Schmeling, 2007).

In contrast, institutional investors who build their expectations based on fundamental information have a stabilizing effect on markets and lead to correction of stock price movements (e.g., Lakonishok *et al.*, 1992; Bohl and Brzeszczyński, 2006; Schmeling, 2007). Periods of high sentiment are followed by lower returns, and periods of fear in the market

indicate good buying opportunities (e.g., Simon and Wiggins, 2001). Fund managers can profit from such irrationalities: They analyze surveys, indices, and other measures which allows them to infer market-wide sentiment (e.g., Bank and Brustbauer, 2014; Wang *et al.*, 2020), adjust their expectations upwards when they expect retail sentiment to be low (e.g., Schmeling, 2007), consider market sentiment when investing (e.g., Wang *et al.*, 2020), and adjust their market exposure when aggregate sentiment levels change (e.g., Zheng *et al.*, 2020). Hence, the first hypothesis we explore in this paper is that (rational) fund managers recognize (irrational) sentiment as a trading opportunity: Good sentiment indicates overvaluation, bad sentiment indicates undervaluation of securities. Hence, fund managers should trade as a reaction to sentiment changes, and take on more aggressive long positions, use more active investment styles, and take on more risky bets when sentiment is bad. In line with this, Dong and Doukas (2018) show that fund manager skill matters most in extreme sentiment periods.

Is this effect the same for male and female fund managers? The literature on the connection between sentiment and gender is scarce. De Amicis *et al.* (2020) show that stock markets do not react differently to the earning conference call tones of male and female senior managers, even though female managers have a more positive and less vague tone. Relatedly, Mather *et al.* (2021) show that diverse boards express more cautious and less positive sentiment in their earnings press releases. Using the well-known consumer sentiment index of the University of Michigan, Jacobsen *et al.* (2014) find that women are on average less optimistic than men and that asset allocations become comparable when controlling for this gender-specific sentiment. All of these studies, however, consider differences in sentiment between male and female investors. In contrast, we explore differential *reactions* between male and female investors to

the *same* market-wide sentiment. Olsen and Cox (2010) find that female professional investors are more sensitive to uncertainty or ambiguity when investing. Additionally, they put more weight on security compared to gains in their investment task. In line with this, our second hypothesis is that female fund managers react less strongly to sentiment: Compared to their male counterparts, they trade less when sentiment changes, and take on less aggressive long positions, use less active investment styles, and take on less risky bets when sentiment is bad.

We test our hypotheses by analyzing a sample consisting of single managers who run a diversified domestic U.S. equity fund between 1992 and 2015. Our analysis consists of two stages. In the first stage, we analyze how trading activity and risk-taking of male-managed and female-managed funds relates to sentiment by running a regression of these dependent variables on the interaction of sentiment and a female fund manager dummy. As our sentiment measure, we use the Chicago Board Options Exchange (CBOE) volatility index (VIX) adjusted for macroeconomic conditions. We proxy trading activity by the turnover ratio and consider total fund risk, systematic risk, and unsystematic risk. The main coefficients of interest are the ones for sentiment (for hypothesis 1) and the interaction term (for hypothesis 2). Our results show that male fund managers, on the one hand, hold significantly riskier portfolios (measured by total fund risk and unsystematic risk) when sentiment is bad. Female fund managers, on the other hand, have significantly less risky portfolios (measured by unsystematic risk) than their male counterparts when sentiment is bad. The effects themselves and the differences are also economically significant.

In the second stage, we explore the performance consequences of the differences in risk-taking. Using the results from the first stage, we explore whether the higher risk-taking of male fund

managers pays off through a higher performance (measured as the Carhart (1997) four-factor alpha and as the gross return). Our results indicate that this is not the case: We find no significant relation between the higher risk due to bad sentiment and performance. Hence, fund investors do not receive a compensation for the higher risk that (male) managers take on.

Our paper contributes to three main strands of the finance literature. First, we contribute to the extensive research on investment behavior of mutual fund managers. Parts of this literature focus on demographics, such as age (e.g., Chevalier and Ellison, 1999a, 1999b), gender (e.g., Atkinson *et al.*, 2003; Kempf *et al.*, 2013; Babalos *et al.*, 2015; Niessen-Ruenzi and Ruenzi, 2018), and education (e.g., Chevalier and Ellison, 1999b; Andreu and Puetz, 2017). We look at the investment behavior as a response to irrationalities in the market. We contribute to this by showing that managers react differently to sentiment, depending on their gender.

Second, we contribute to the body of literature regarding the determinants of fund performance. One strand of this literature focuses on fund characteristics such as fund size or fund family size (e.g., Chen *et al.*, 2004; Yan, 2008), others focus on manager characteristics such as education (e.g., Chevalier and Ellison, 1999b; Gottesman and Morey, 2006), tenure (e.g., Golec, 1996), gender (e.g., Babalos *et al.*, 2015), or outside industry experience (e.g., Cici *et al.*, 2018). Dong and Doukas (2018) find that high investor sentiment harms fund performance. We show that male fund managers take on more excess risk (measured by unsystematic risk) than female fund managers, but that there is no performance consequence of doing so.

Third, we contribute to the research on the impact of sentiment on investor behavior, especially risk-taking and trading activity. One part of the literature focuses on sentiment as a trading strategy. Managers take retail investor sentiment into account and trade on it (e.g., Schmeling,

2007; Liao *et al.*, 2011; Massa and Yadav, 2015). Liao *et al.* (2011) find that sentiment affects the herding behavior of managers away from high prior sentiment stocks. Fu (2014) investigates individual fund manager sentiment and shows that high manager sentiment leads to a better performance. We contribute to this literature by investigating the link between gender and sentiment. We find a significant and positive impact of sentiment on risk-taking, which differs between male and female fund managers.

2. Data and Methodology

2.1 DATA

The main data for our study is from the Center for Research in Security Prices (CRSP) Survivor-Bias-Free Mutual Fund Database and MFLinks. CRSP contains, among others, information on fund characteristics, such as fund returns, assets under management, management structure, and investment objective, for all public traded open-end mutual funds since 1962. Our sample covers the time period from January 1992 to December 2015. We measure the fund objective from the CRSP objective code, and retain only diversified domestic U.S. equity funds. To aggregate share class level variables to the fund level, we use the MFLinks Wharton Financial Institution Center Number (WFICN), and manually verify the link by checking fund names, fund family names, and manager names.

Since we classify our funds as male- or female-managed by manager first names, we exclude all funds where the manager name is not provided, is given as the management company name, or where multiple names are given. We exclude all team-managed funds even if all names are given and all managers are of the same gender, as Baer *et al.* (2011) show that single-managed

and team-managed funds behave differently. Based on this we obtain a clean set of comparable funds. Additionally, we exclude all fund-year combinations where the manager changes during the calendar year, as we cannot attribute the behavior to one unique manager. We only consider fund-year combinations where a fund reports more than six months. We assume that a year with less than two quarters of fund data reported cannot be representative for a fund. Additionally, all funds need a history of at least 36 months in total to be considered.

We compute a fund's gross return, turnover ratio, and expense ratio as the value-weighted average of all its share classes, using total net assets (TNA) at the beginning of the month as the weight for the month. Fund age is the age of the oldest share class in years. Fund-specific manager tenure is also measured in years and computed as the current date minus the date the current manager took control. For missing or negative values (which we attribute to reporting mistakes), we calculate $imputedTenure$. We manually check our dataset for the first date at which the manager is reported as current manager and use this as the date the current manager took control.[1]

To identify a manager's gender, we combine different approaches. First, we follow a similar strategy as Niessen-Ruenzi and Ruenzi (2018) and match all first names in our manager sample with a list of popular names from the U.S. Social Security Administration (SSA).[2] Since our focus is on U.S. mutual funds and the list provides information on U.S. American citizens, this

[1] ImputedTenure is therefore a downward-biased estimate of the actual manager tenure.

[2] The SSA publishes this list via https://catalog.data.gov/dataset/baby-names-from-social-security-card-applications-national-data. The list gives the name, the corresponding gender, and how often a name was used in a given year going back to 1880.

provides a reasonable match between first name and gender for a large part of our sample. When the SSA information is ambiguous, we follow Sargis and Lutton (2016) to compute the probability that this name is either male or female. We use a cutoff probability of 95% for gender attribution. For the remaining names we run a web search using manager name, fund name, and fund family name in a similar way as Aggarwal and Boyson (2016). We manually check for different spellings and obvious reporting mistakes.

We hand-collect data on managerial characteristics from different sources including morningstar.com, bloomberg.com, fund family websites, newspapers, or websites such as Linkedin.com, zoominfo.com, or relationshipscience.com. We collect information on birth and graduation year of a manager as well as academic and professional degrees. To calculate manager age, we use the birth year of a manager. If this information is not available, we follow Chevalier and Ellison (1999a) and assume that a manager was 21 years old when obtaining the first degree.

2.2 METHODOLOGY

To analyze the reaction of male and female fund managers towards sentiment, we run a panel regression with fund fixed effects and standard errors double clustered at manager and year level. The dependent variables are the manager reaction (trading activity and risk-taking) and the fund performance. The main independent variable is the interaction term of the female dummy (with a value of one if a manager is female, and zero otherwise) and the sentiment measure. Control variables include manager characteristics (e.g., age, education, and tenure) and fund characteristics (e.g., fund age, fund size, and fund flow).

2.2.a Manager Reaction and Performance

We use different measures of manager reaction: First, we focus on trading activity measured as the fund turnover ratio. Trading activity is an established proxy for investor overconfidence, with high activity associated with poor performance of retail investors (e.g., Barber and Odean, 2000). Fund turnover may also be due to fund flows and thus reflect involuntary rather than voluntary trading. We therefore use the CRSP turnover ratio to focus on the latter (in line with, e.g., Puetz and Ruenzi, 2011) which adjusts aggregate sales and purchases of securities for flow-induced trading.

Second, we analyze the risk taken by the managers and consider total fund risk, systematic risk, and unsystematic risk separately. Total fund risk is the annualized standard deviation of monthly fund returns in year t. Systematic risk is the factor loading on the market factor in the Carhart (1997) four-factor model in year t. Finally, unsystematic risk is the annualized standard deviation of the residual monthly returns from the Carhart (1997) four-factor model in year t.

We also explore whether (potentially) different reactions of female fund managers affect fund performance. We use both annual gross returns and risk-adjusted Carhart (1997) four-factor alphas.

2.2.b Sentiment

As our main measure of sentiment, we use the CBOE volatility index VIX. VIX measures implied volatility, based on options of the S&P 500 (e.g., Whaley, 2008) and reflects investors' expectations about future market volatility. Since sentiment proxies tend to be serially correlated (e.g., Schmeling, 2009), we apply an Augmented Dickey Fuller test which allows us

to reject the null hypothesis of a unit root at the 95% confidence level. We also follow Baker and Wurgler (2006) to adjust the VIX level for the state of the economy and run a multivariate linear regression of the VIX level on macroeconomic indicators[3]. We use the resulting regression residuals as a cleaner measure of irrational sentiment in our analyses. Note that VIX measures "fear" in the market (e.g., Baker and Wurgler, 2007): A high level indicates bad sentiment, a low level indicates good sentiment. Figure 1 shows our final sentiment measure between 1992 and 2015.

Insert Figure 1 about here.

2.2.c Control Variables

Fund age and fund size affect fund risk (e.g., Chevalier and Ellison, 1997) and turnover (e.g., Kogan and Jin, 2008; Puetz and Ruenzi, 2011). Therefore, we include lagged fund age and fund size as controls in all regressions. Additionally, we add manager age and dummies for manager education, as they may have an impact on investment behavior (e.g., Golec, 1996; Chevalier and Ellison, 1999b; Menkhoff *et al.*, 2013). We also control for performance, manager tenure, and expense ratio (all controls with a lag of one year): Prior performance affects trading activity (e.g., Puetz and Ruenzi, 2011); manager tenure and costs influence fund risk (e.g., Golec, 1996; Menkhoff *et al.*, 2006; Andreu and Puetz, 2017) and turnover (e.g., Christoffersen and Sarkissian, 2011; Niessen-Ruenzi and Ruenzi, 2018). For the turnover

[3] Growth in the industrial production index (Federal Reserve Statistical Release G.17), growth in consumer nondurables, durables, and services (BEA National Income Accounts Table 2.3.5), and a dummy variable for NBER recessions.

regression, we include fund flows in year *t* as a control following Puetz and Ruenzi (2011). For all other regressions, we lag fund flows by one year.

2.3 SUMMARY STATISTICS

Our final data sample contains 8,720 fund-year observations, where 7,999 observations have a male fund manager and 721 a female fund manager. There are 1,045 unique funds that are managed by 1,094 unique fund managers, of which 995 (90.95%) are male and 99 (9.05%) are female. The percentage of female fund managers in our data sample is comparable to the percentages of other studies in the finance literature: E.g., 5.6% in Atkinson *et al.* (2003), 7% in Chevalier and Ellison (1999b), 10.94% in Niessen-Ruenzi and Ruenzi (2018), 16.5% in Babalos *et al.* (2015), and 19% in Beckmann and Menkhoff (2008). Table I provides the summary statistics of our data sample at the fund level, based on manager gender as well as the difference between the means, respectively.

Insert Table I about here.

The univariate comparison in Table I offers some preliminary insights. Panel A shows that, on average, male fund managers have significantly higher fund tenure, are more likely to have a secondary academic degree but less likely to have a professional qualification, and are slightly older than female fund managers. With respect to the funds managed, Panel B indicates that female fund managers, on average, are responsible for significantly smaller and older funds and experience significantly lower (net) inflows than male fund managers. Differences with respect to turnover ratio and expense ratio are insignificant. Overall, our data sample is comparable to that of other studies (e.g., Atkinson *et al.*, 2003; Baer *et al.*, 2011; Jaspersen and

Limbach, 2018; Niessen-Ruenzi and Ruenzi, 2018) and indicates that the institutional framework differs between male and female fund managers.

Last, Panel C shows differences in risk-taking between male and female fund managers: Unsystematic risk is significantly lower for female-managed funds on the 1% level for all three factor models. The picture for systematic risk and investment style is not fully conclusive: Differences in systematic risk are mostly insignificant, the book-to-market (HML) beta is lower and the momentum beta is higher for female-managed funds. Overall risk and performance are similarly, which is in line with Niessen-Ruenzi and Ruenzi (2018).

3. Main Results

3.1 REACTION TO MARKET SENTIMENT

We first explore whether sentiment affects male and female fund managers differently. To do so, we run multivariate linear panel regressions of turnover and risk (as the dependent variables) on sentiment (shocks, in the case of turnover) interacted with the female dummy. We control for manager and fund characteristics that may be related to sentiment and affect investment behavior. The main equation is as follows:

$$Reaction_{i,t} = \alpha + \beta * Sent_t + \gamma * Female_{i,t} + \delta * Sent_t * Female_{i,t} + CV + \varepsilon_{i,t}. \quad (1)$$

$Reaction_{i,t}$ is the reaction of fund i in year t, measured by either the turnover ratio, total fund risk, systematic risk, or unsystematic risk. $Sent_t$ is the sentiment measure (shock) in year t. $Female_{i,t}$ is a dummy variable that takes on the value one if the manager of fund i in year t is

female, and zero otherwise. CV are manager and fund characteristics and include fund return, manager tenure, fund flow, size, age, expense ratio (costs), manager education, and manager age. All regressions include fund fixed effects. As our dependent variables systematic risk and unsystematic risk are estimates, we must account for heteroscedasticity (e.g., Saxonhouse, 1976; Hornstein and Greene, 2012). Therefore, we use weighted least squares and weight these variables by the inverse of their standard errors. Regression standard errors are double clustered on fund manager and year level. We cluster on the year level instead of using year fixed effects due to the sentiment measure, which is the same for all funds in a year. We cluster on the fund manager level as some fund manager run more than one fund.

Table II displays the estimation results.

Insert Table II about here.

3.1.a Trading Activity

We first discuss the results for trading activity. As outlined above, we hypothesize that changes in sentiment, irrespective of the direction, should increase trading activity. If sentiment declines, stocks become more undervalued (or less overvalued) relative to their fundamental value. This constitutes an investment opportunity, and rational fund managers will adjust their portfolios. Similarly, if sentiment improves, stocks become more overvalued (or less undervalued), which also constitutes an investment opportunity and increases trading activity. In summary, both negative and positive changes in sentiment should increase trading activity. However, due to their higher risk-aversion, the effect should be less pronounced for female

fund managers. We therefore explore the relation between turnover and *the absolute value* of the change in the VIX.

Column (1) of Table II shows the results for the regression with turnover ratio as dependent variable. In contrast to our hypothesis, we find a positive but statistically insignificant impact of absolute VIX changes on the turnover ratio in the baseline regression. The interaction term with the female dummy is also not statistically significant at any conventional significance level. Similarly, we find little impact of the control variables with the exception of education (measured by PhD) and manager age. Overall, we can reject the hypothesis that male and female fund managers differ in their sentiment-induced trading activity.

3.1.b Fund Risk

In this section, we analyze the differences with respect to total fund risk, systematic risk, and unsystematic risk. Above, we argued that it is rational for fund managers to select a high (low) exposure to systematic risk if sentiment is bad (good), as stocks are likely to be undervalued (overvalued) in aggregate. The effect should be less pronounced for female fund managers due to their higher risk-aversion. Similarly, fund managers should take on more unsystematic risk when sentiment is bad: Undervaluation makes more active investment styles and more active bets potentially more profitable. Female fund managers should also exhibit this behavior, but less aggressively than their male counterparts.

We focus on systematic risk and unsystematic risk based on the Carhart (1997) four-factor model. In column (4) of Table II, where the dependent variable is unsystematic risk, we exclude PhD as explanatory variable, as there is not enough variation in the sample.

Consistent with our conjecture, column (2) and (4) of Table II show that male managers take on significantly more total fund risk (11.4 percentage points) and unsystematic risk (1.8 percentage points) when sentiment is bad. The effect is economically significant as well: A one-standard deviation increase in the VIX leads to an absolute increase in total fund risk of 11.27 percentage points (=0.114∗0.989). Compared to the total fund risk of the average fund, this implies a relative increase of 19.62% (=0.1127/0.5743). For unsystematic risk, a one-standard deviation increase in the VIX leads to an absolute increase of 1.78 percentage points and a relative increase of 12.49%. The coefficient for systematic risk in column (3) of Table II is also positive but statistically insignificant.

The interaction term between VIX and the female dummy is negative and significant in column (4) of Table II, indicating that female fund managers take on unsystematic risk less aggressively due to sentiment as compared to their male counterparts. Given the unsystematic risk of the average fund, a one-standard deviation increase in the VIX leads to an economically significant relative difference in the reaction of -5.55%.[4]

As a high amount of unsystematic risk should (on average) not be rewarded with higher expected returns, the increase in unsystematic risk indicates a higher propensity of male fund managers to gamble at the expense of the fund investors. However, it is possible that the more active bets of male fund managers actually pay off and generate a higher performance. We

[4] We repeat the analysis with total fund risk winsorized at the 99% quantile and trimmed at 1.6. Our main findings do not change.

therefore analyze the performance consequences of the manager's risk-taking in the next section.

3.2 PERFORMANCE CONSEQUENCES

In line with the previous section, we measure fund performance by yearly Carhart (1997) four-factor alphas. The main equation is as follows:

$$Perf_{i,t} = \alpha + \gamma * Female_{i,t-1} * \widehat{UnsysRisk}_{i,t-1} + \delta * Male_{i,t-1} * \widehat{UnsysRisk}_{i,t-1} + \theta * Female_{i,t-1} + CV + \varepsilon_{i,t}. \quad (2)$$

$Perf_{i,t}$ is the performance of fund i in year t, measured as the gross return and the four-factor alpha. $\widehat{UnsysRisk}_{i,t-1}$ is the unsystematic risk reaction of fund i in year t-1 to sentiment, defined as the fitted values from the initial regression using Equation (1). We use fitted values instead of realized unsystematic risk to explore the impact of the different reactions of male and female fund managers to sentiment.

We interact the (gender-specific) fitted values with the female dummy and with a male dummy that takes on the value one for male-managed funds, and zero otherwise. Our regression remains well-defined as we interact the two (perfectly negatively correlated) dummy variables with the fitted values and include the female dummy, but neither the fitted value itself nor the male dummy. As controls, we use lagged fund size, fund age, fund flow, expense ratio (costs), and manager tenure. Again, we apply fund fixed effects and double cluster at the fund manager and year level. Table III shows the results.

Insert Table III about here.

Table III shows that the (excess) level of unsystematic risk that fund managers take on due to bad sentiment has no performance consequences. Both for gross return and the four-factor alpha, the estimates for the interaction effects are statistically insignificant. Specifically, the more active bets male fund managers take on to leverage sentiment do not result in significantly higher performance. Therefore, fund investors do not receive a compensation for the higher risk male fund managers take on.

4. Robustness Tests

4.1 IMPACT OF PAST VALUES OF RISK

As a first robustness check, we add the past values of our dependent variables as explanatory variables in Equation (1) as an additional control for serial dependence. We only display results for the dependent variables total fund risk and unsystematic risk, since these were the only specifications in which we found a significant impact of sentiment. Table IV gives the results.

Insert Table IV about here.

Table IV shows that our main results still hold when we include lagged risk as a control variable. Again, male fund managers have higher total fund risk and unsystematic risk when sentiment is low, and the unsystematic risk effect is smaller for female fund managers. The economic magnitude of the effect, however, is somewhat smaller: A one-standard deviation increase in the VIX leads to an absolute increase of 9.2 percentage points (relative increase of 16.02%) for total fund risk for male fund managers. For unsystematic risk, the absolute increase amounts to 1.88 percentage points (the relative increase of 13.19%). The relative difference in unsystematic risk equals -4.86%.

4.2 SENTIMENT MEASURE

In our main analysis, we measure irrational sentiment via the VIX adjusted for the state of the economy. We now explore in how far our results depend on this sentiment measure. Our alternative sentiment measure is the CBOE Put-Call-Ratio (PCR). This indicator is available starting at September 1995, which reduces our sample size compared to the other analyses. We again construct the orthogonalized version of the sentiment measure, as for the VIX. Table V shows the results for trading activity and risk-taking with PCR as the sentiment measure.

Insert Table V about here.

As for the VIX, a high (low) value corresponds to bad (good) sentiment. In contrast to the analysis in Table II, we now find that a) female managers trade significantly more when sentiment changes and b) managers significantly take on more systematic risk when sentiment is low. However, we find no significant results for total fund risk and unsystematic risk, and no significant sentiment-induced risk differences between male and female fund managers.

Insert Table VI about here.

In Table VI, we display the results for Equation (2), but now using the fitted value of the turnover change since absolute changes in PCR only cause a difference in trading activity between male and female fund managers. The results are in line with our main findings: Even though male and female fund managers react differently to sentiment (shocks, in this case), this differential behavior does not affect performance.

4.3 IMPACT OF INVESTMENT OBJECTIVES AND COMPANY FIXED EFFECTS

In untabulated results, we repeat our main analyses using different combinations of fixed effects. First, we apply fund-objective fixed effects. In this way, we consider that female fund managers may self-select into certain types of funds. If these funds have lower risk, our results may suffer from a bias (e.g., Niessen-Ruenzi and Ruenzi, 2018). However, our results remain unaffected by including fund-objective fixed effects.

Additionally, we conduct the analysis with fund-objective and management company fixed effects. Similar to the possible self-selection into certain fund objectives, female managers may also self-select into certain fund management companies (e.g., Niessen-Ruenzi and Ruenzi, 2018). The results are comparable to the analysis with only fund and segment (objective) fixed effects, except that the reaction of male fund managers (but not of female fund managers) is now significant at the 10% level for systematic risk. Our main results do not change compared to the initial analysis.

In a last step, we only control for fund-objective and management company fixed effects. In this constellation, all risk reactions for male fund managers are statistically significant, but the interaction term for sentiment and the female dummy is again only statistically different from zero for unsystematic risk. Overall, the results concerning the interaction terms are robust for different combinations of fixed effects.

5. Conclusion

In this paper, we explore whether male and female fund managers react differently to market sentiment. Our first hypothesis is that rational managers should interpret irrationally good (bad)

sentiment as a sign of overvaluation (undervaluation) in stock markets, and adjust their investment portfolios accordingly. Our second hypothesis is that female fund managers should react less aggressively due to higher risk-aversion. Our empirical results show that male fund managers hold portfolios with higher total fund risk and unsystematic risk when sentiment is bad. For female fund managers, we find significantly lower levels in unsystematic risk (by about 50%) than for their male counterparts when sentiment is bad. As suggested by standard asset pricing models, the higher level of unsystematic risk is not associated with higher fund performance (nor are there any performance differences between male- and female-managed funds). Therefore, we conclude that fund investors bear unrewarded risks in the portfolios managed by male fund managers due to the latter's more active bets.

Appendix: Definitions and data sources of main variables

This table defines the main variables and data sources we use in the empirical analysis (OC: Own calculation).

Variable name	Description	Source
$Female_{i,t}$	Dummy variable that takes on a value equal of 1 if a fund i is managed by a female manager in year t, and 0 otherwise.	Free sources (LinkedIn.com etc.)
$Fund\ flow_{i,t}$	Computed as $\frac{TNA_{i,t} - TNA_{i,t-1} * (1 + fund\ return_{i,t})}{TNA_{i,t-1}}$. $TNA_{i,t}$ denotes fund i's total net assets in year t and $fund\ return_{i,t}$ denotes fund i's return in year t. Flows are winsorized at the top 99% and bottom 1%.	CRSP, OC
$FundSize_{i,t}$	Logarithm of a fund's total net assets (TNA) plus one, $\ln(TNA_{i,t} + 1)$.	CRSP, OC
$ExpenseRatio_{i,t}$	Annual expense ratio of fund i.	CRSP
$FundAge_{i,t}$	Logarithm of fund i's age plus one (in years), computed based on the date the oldest share class was first offered.	CRSP, OC
$MangerTenure_{i,t}$	Tenure of fund i's manager (in years), difference between a date t and the date when the manager started managing fund i.	CRSP, OC
$ImputedTenure_{i,t}$	Tenure of fund i's manager (in years) if $ManagerTenure_{i,t}$ is negative. Based on the date the manager can be first associated with the respective fund in the dataset.	CRSP, OC
$TurnoverRatio_{i,t}$	Annual turnover ratio of fund i.	CRSP
$Age\_manager_{i,t}$	Logarithm of manager age in years plus 1, whereas manager age is	Free sources

	calculated using the birth year or the graduation year of a manager.	
MBA_i	Dummy variable that takes on a value equal to 1 if the manager received an MBA, and 0 otherwise.	Free sources
PQ_i	Dummy variable that takes on a value equal to 1 if the manager received a professional qualification (CFA, CFP or CPA), and 0 otherwise.	Free sources
PhD_i	Dummy variable that takes on a value equal to 1 if the manager received a PhD, and 0 otherwise.	Free sources
$R_{i,t}$	Annual gross return of fund i in year t.	CRSP
$Systematic\ Risk_{i,t}$	Fund i's factor loading on the market factor from the four-factor model of Carhart (1997) in year t.	CRSP, OC
$Unsystematic\ Risk_{i,t}$	Annual standard deviation of fund i's residual returns from the four-factor model of Carhart (1997) in year t.	CRSP, OC
$Fund\ Risk_{i,t}$	Fund i 's annual monthly return standard deviation in year t.	CRSP, OC
$Fund\ Risk\ Win_{i,t}$	Fund i 's annual monthly return standard deviation in year t winsorized at the 99% quantile.	CRSP, OC
$Fund\ Risk\ Trim_{i,t}$	Fund i 's annual monthly return standard deviation in year t trimmed at 1.6.	CRSP, OC
$CAPM\ alpha_{i,t}$	Jensen (1968) one-factor alpha in year t.	CRSP, OC
$Three\ factor\ alpha_{i,t}$	Fama and French (1993) three-factor alpha in year t.	CRSP, OC
$Four\ factor\ alpha_{i,t}$	Carhart (1997) four-factor alpha in year t.	CRSP, OC

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Table I. Summary statistics

This table reports fund and manager characteristics by gender for all observations in our sample. Panel A reports manager characteristics for all (column 1), male (column 2), and female (column 3) fund managers who solely managed diversified domestic U.S. equity funds during our sample period from 1992 until 2015. Panel B reports characteristics for funds run by all (column 1), male (column 2), and female (column 3) fund managers. Panel C reports return and risk measures for funds run by all (column 1), male (column 2), and female (column 3) fund managers. Column 4 reports differences between characteristics. Significance of the differences is calculated using a two-sided t-test. *** indicates 1% significance, ** 5% significance, * 10% significance. Variable definitions are provided in the appendix.

A. Manager characteristics				
Manager characteristic	All managers	Male managers	Female managers	Difference (female-male)
Tenure (years)	6.8	6.9	5.3	**-1.6*****
MA (%)	13.04	13.74	5.27	**-8.47*****
PhD (%)	3.07	3.35	0.00	**-3.35*****
MBA (%)	57.21	57.39	55.20	**-2.19**
PQ (%)	51.79	50.67	64.22	**13.55*****
Manager age (years)	47.9	48.0	46.2	**-1.8*****
B. Fund characteristics				
Fund characteristic	All funds	Male managers	Female managers	Difference (female-male)
Fund age (years)	14.2	14.1	15.5	**1.4*****
Fund size (Mio. $)	1,543.12	1,599.02	922.87	**-676.15*****
Size start (Mio. $)	371.65	377.79	294.41	**-83.38**
Turnover ratio (%)	96.31	96.45	94.75	**-1.7**
Expense ratio (%)	1.33	1.33	1.34	**0.01**
Fund flow (%)	19.92	20.43	14.14	**-6.29****
C. Return and risk				
Fund return (%)	11.67	11.75	10.79	**-0.96**
Sharpe ratio	0.2362	0.2378	0.2187	**-0.0191**
CAPM alpha (%)	1.28	1.33	0.75	**-0.58**
3-factor alpha (%)	0.65	0.69	0.22	**-0.47**
4-factor alpha (%)	0.72	0.76	0.21	**-0.55***
Unsys. risk	0.2389	0.2417	0.2072	**-0.0345*****
Unsys. risk (3F)	0.1611	0.1633	0.1378	**-0.0255*****
Unsys. risk (4F)	0.1425	0.1444	0.1215	**-0.0229*****

Syst. risk	1.0377	1.0363	1.0541	**0.0178**
Syst. risk (3F)	0.9910	0.9902	1.0004	**0.0102**
Syst. risk (4F)	0.9792	0.9776	0.9968	**0.0192***
Total fund risk	0.5743	0.5752	0.5637	**-0.0115**
SMB_beta	0.2389	0.2399	0.2278	**-0.0121**
HML_beta	0.0009	0.0042	-0.0355	**-0.0397****
MOM_beta	0.0113	0.0088	0.0384	**0.0296*****

Table II. Impact of sentiment on male- and female-managed funds

This table reports regression results, where the dependent variable is the turnover ratio (column 1), total fund risk (column 2), systematic risk (column 3), and unsystematic risk (column 4). DeltaVIX is *the absolute value* of the change in the VIX. All variables are as defined in the appendix. All controls are lagged by one year except the education dummies, and fund flow in column (1). All observations are on a yearly frequency. All regressions include fund fixed effects. We display robust standard errors clustered at manager and year level in parentheses, and calculate significance based on a two-sided t-test. *** indicates 1% significance, ** 5% significance, * 10% significance.

	Turnover ratio	Total fund risk	Syst. risk	Unsys. risk
	(1)	(2)	(3)	(4)
Female	0.004	-0.044**	-0.034	-0.011**
	(0.068)	(0.019)	(0.021)	(0.004)
deltaVIX	0.025			
	(0.018)			
Female∗deltaVIX	0.028			
	(0.048)			
VIX		0.114***	0.015	0.018***
		(0.030)	(0.010)	(0.006)
Female∗VIX		0.006	0.002	-0.008**
		(0.014)	(0.013)	(0.004)
Fund return	-0.112	-0.033	0.116***	-0.013
	(0.089)	(0.203)	(0.034)	(0.018)
Tenure	0.002	-0.001	0.001	-0.0004
	(0.004)	(0.002)	(0.001)	(0.0005)
Fund flow	-0.019			
	(0.022)			
Lagged fund flow		0.012	0.025**	0.0001
		(0.012)	(0.010)	(0.003)
Fund size	-0.011	0.030	0.020**	0.005
	(0.021)	(0.022)	(0.009)	(0.003)
Fund age	-0.006	-0.078*	-0.001	-0.011
	(0.038)	(0.041)	(0.020)	(0.010)
Costs	-9.494	-6.437*	-2.713	-0.854
	(21.736)	(3.528)	(2.175)	(1.643)
MA	0.011	-0.034	-0.021	0.008
	(0.022)	(0.031)	(0.026)	(0.009)
MBA	-0.001	0.010	-0.007	-0.002

	(0.025)	(0.015)	(0.021)	(0.007)
PhD	-0.152***	0.023	0.042	
	(0.053)	(0.034)	(0.063)	
PQ	0.004	-0.001	-0.006	0.006
	(0.016)	(0.021)	(0.018)	(0.006)
Manager age	0.137*	0.025	-0.036	-0.028
	(0.077)	(0.071)	(0.051)	(0.021)
Fund FE?	Yes	Yes	Yes	Yes
Adjusted R^2	0.171	0.470	0.913	0.890

Table III. Performance consequence of sentiment-induced unsystematic risk levels
This table reports regression results, where the dependent variable is fund i's performance in year t. In column (1), performance is computed as the gross return. In column (2), performance is computed as the Carhart (1997) four-factor alpha. UnsysRisk is the fitted value from the regression using Equation (1). Female (Male) is a dummy variable that takes on the value one, if fund i is managed by a female (male) fund manager in year t, and zero otherwise. The remaining control variables are as defined in the appendix. All controls are lagged by one year. All observations are on a yearly frequency. All regressions include fund fixed effects. We display robust standard errors clustered at manager and year level in parentheses, and calculate significance based on a two-sided t-test. *** indicates 1% significance, ** 5% significance, * 10% significance.

	Gross return	Four-factor alpha
	(1)	(2)
Female∗UnsysRisk	2.195	0.031
	(5.450)	(0.716)
Male∗UnsysRisk	2.060	0.308
	(3.635)	(0.272)
Female	0.007	0.002
	(0.372)	(0.076)
Fund flow	-0.008	-0.001
	(0.065)	(0.006)
Tenure	0.008***	0.001
	(0.002)	(0.001)
Costs	-7.563	0.240
	(19.724)	(1.765)
Fund age	0.030	0.007
	(0.079)	(0.011)
Fund size	-0.112***	-0.016***
	(0.021)	(0.003)
Fund FE?	Yes	Yes
N	4,186	4,186
Adjusted R^2	-0.008	0.089

Table IV. Impact of past values of risk

This table reports regression results, where the dependent variable is either fund *i*'s total fund risk or unsystematic risk. All variables are as defined in the appendix. These regressions include past values of the dependent variables as controls. All controls are lagged by one year except the education dummies and manager age. All observations are on a yearly frequency. All regressions include fund fixed effects. We display robust standard errors clustered at manager and year level in parentheses, and calculate significance based on a two-sided t-test. *** indicates 1% significance, ** 5% significance, * 10% significance.

	Total fund risk	Unsystematic risk
	(1)	(2)
Female	-0.036**	-0.011***
	(0.016)	(0.004)
VIX	0.093**	0.019***
	(0.038)	(0.006)
Female∗VIX	0.006	-0.007**
	(0.018)	(0.003)
Lagged risk	0.389***	0.087
	(0.123)	(0.056)
Fund return	0.101	-0.011
	(0.153)	(0.019)
Tenure	-0.001	-0.0003
	(0.002)	(0.0004)
Fund flow	0.007	0.0001
	(0.009)	(0.003)
Fund size	0.026*	0.004
	(0.015)	(0.003)
Fund age	-0.057	-0.007
	(0.036)	(0.008)
Costs	-3.713*	-0.801
	(1.980)	(1.630)
MA	-0.030	0.008
	(0.026)	(0.009)
MBA	0.012	-0.001
	(0.011)	(0.007)
PhD	0.017	
	(0.040)	
PQ	-0.005	0.005

	(0.011)	(0.005)
Manager age	-0.009	-0.028
	(0.056)	(0.020)
Fund FE?	Yes	Yes
Adjusted R^2	0.560	0.891

Table V. Impact of sentiment measured as put-call ratio

This table reports regression results, where the dependent variable is the turnover ratio (column 1), total fund risk (column 2), systematic risk (column 3), and unsystematic risk (column 4). DeltaPCR is *the absolute value* of the change in the PCR. All variables are as defined in the appendix. In contrast to Table II, we measure sentiment via the put-call ratio. All controls are lagged by one year except the education dummies, and fund flow in column (1). All observations are on a yearly frequency. All regressions include fund fixed effects. We display robust standard errors clustered at manager and year level in parentheses, and calculate significance based on a two-sided t-test. *** indicates 1% significance, ** 5% significance, * 10% significance.

	Turnover ratio	Total fund risk	Syst. risk	Unsys. risk
	(1)	(2)	(3)	(4)
Female	-0.035	-0.084***	-0.051***	-0.012**
	(0.052)	(0.026)	(0.019)	(0.006)
deltaPCR	-0.260			
	(1.438)			
Female∗deltaPCR	4.163**			
	(1.875)			
PCR		1.127	1.041**	-0.104
		(1.609)	(0.494)	(0.182)
Female∗PCR		0.220	0.155	-0.176
		(0.395)	(0.426)	(0.149)
Fund return	-0.138	0.052	0.125***	0.007
	(0.102)	(0.241)	(0.037)	(0.017)
Tenure	0.001	-0.006	0.001	-0.001*
	(0.006)	(0.004)	(0.002)	(0.001)
Fund flow	-0.030			
	(0.024)			
Lagged fund flow		0.009	0.023**	-0.0002
		(0.017)	(0.011)	(0.003)
Fund size	-0.017	0.024	0.020**	0.010*
	(0.024)	(0.036)	(0.010)	(0.005)
Fund age	-0.028	-0.178***	-0.034*	-0.026***
	(0.037)	(0.058)	(0.018)	(0.009)
Costs	-20.728	-14.471***	-2.591	-0.340
	(21.122)	(3.563)	(2.494)	(1.780)
MA	0.007	-0.017	-0.020	0.015
	(0.023)	(0.074)	(0.026)	(0.012)

MBA	-0.053*	0.016	0.001	0.003
	(0.030)	(0.020)	(0.021)	(0.007)
PhD	-0.095***	0.062	0.044	
	(0.037)	(0.081)	(0.075)	
PQ	-0.014	-0.023	-0.008	0.006
	(0.018)	(0.030)	(0.019)	(0.008)
Manager age	0.098*	0.003	-0.042	-0.060*
	(0.050)	(0.103)	(0.051)	(0.034)
Fund FE?	Yes	Yes	Yes	Yes
Adjusted R^2	0.178	0.375	0.917	0.873

Table VI. Performance consequence of PCR-induced turnover changes
This table reports regression results, where the dependent variable is fund i's performance in year t. In contrast to Table III, we use the fitted value for the turnover change as a function of the PCR change from the regression using Equation (1). Female (Male) is a dummy variable that takes on the value one, if fund i is managed by a female (male) manager in year t, and zero otherwise. The remaining control variables are as defined in the appendix. All controls are lagged by one year. All observations are on a yearly frequency. All regressions include fund fixed effects. We display robust standard errors clustered at manager and year level in parentheses, and calculate significance based on a two-sided t-test. *** indicates 1% significance, ** 5% significance, * 10% significance.

	Gross return	Four-factor alpha
	(1)	(2)
Female∗deltaTurnover	0.762	-0.174
	(1.497)	(0.152)
Male∗deltaTurnover	0.951	-0.086
	(1.077)	(0.119)
Female	-0.068	-0.026*
	(0.055)	(0.015)
Fund flow	0.039	-0.006
	(0.059)	(0.008)
Tenure	0.001	-0.0001
	(0.005)	(0.001)
Costs	9.957**	-1.516
	(4.696)	(1.532)
Fund age	0.064	-0.009
	(0.102)	(0.012)
Fund size	-0.077***	-0.016***
	(0.027)	(0.004)
Fund FE?	Yes	Yes
N	3,596	3,596
Adjusted R^2	0.007	0.094

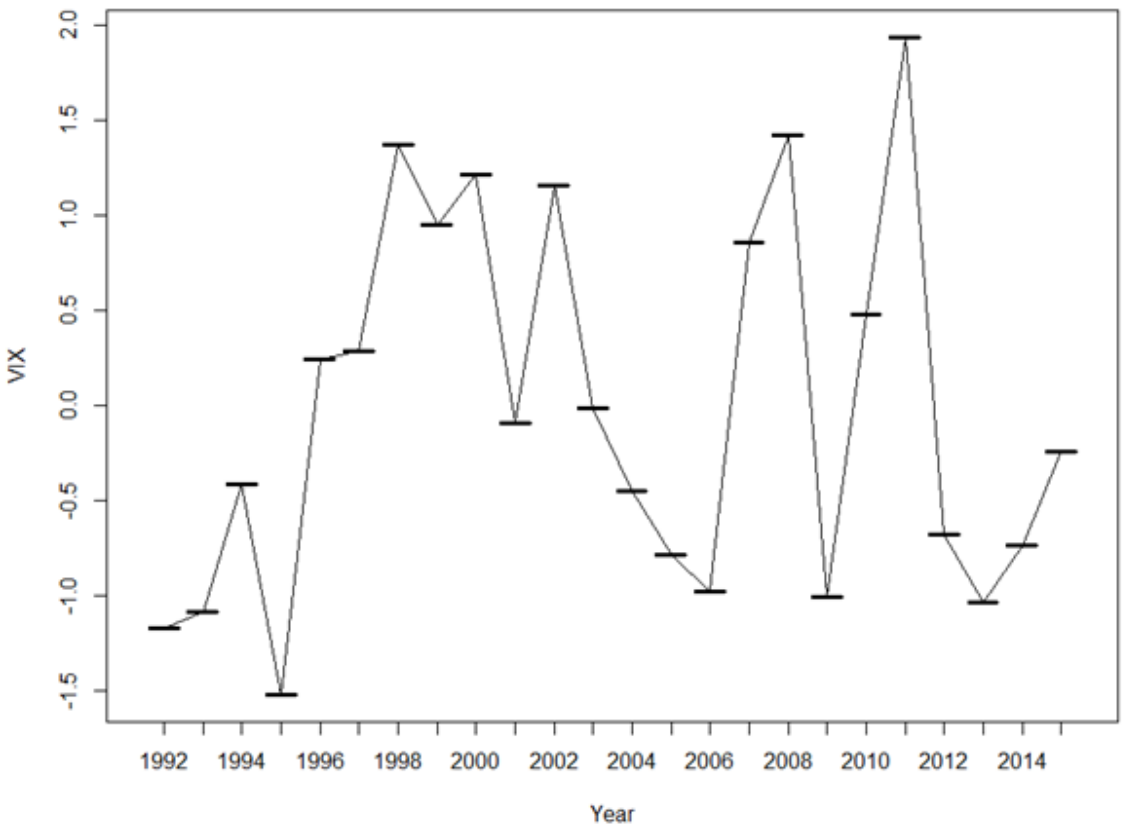

Figure 1. Sentiment measure

The figure shows our sentiment time series from 1992 until 2015. We run a regression of CBOE VIX level on macroeconomic indicators as in Baker and Wurgler (2006). The figure displays the regression residuals which we use throughout the paper. High values indicate bad sentiment, low values indicate good sentiment.

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