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Gender differences in revealed risk taking: evidence from mutual fund investors

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Abstract

Using data from a national survey of nearly 2000 mutual fund investors, we investigate whether investor gender is related to risk taking as revealed in mutual fund investment decisions. Consonant with the received literature, we find that women exhibit less risk-taking than men in their most recent, largest, and riskiest mutual fund investment decisions. More importantly, we find that the impact of gender on risk taking is significantly weakened when investor knowledge of financial markets and investments is controlled in the regression equation. This result suggests that the greater level of risk aversion among women that is frequently documented in the literature can be substantially, but not completely, explained by knowledge disparities.

Keywords: Risk taking; Gender differences

JEL classification: D81; G11; J16

1. Introduction

In recent years, the financial press has issued frequent warnings that women are ill-prepared for retirement years due in part to their selected investment programs. Academic literature has largely confirmed this anecdotal evidence by suggesting that women are less likely than men to invest in riskier, but higher returning, assets (see, e.g., McDonald, 1997; Kahn, 1996; Richardson, 1996). One particularly interesting line of inquiry addresses the relationship between gender and revealed

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financial risk preferences using large-scale survey data. For example, Jianakoplos and Bernasek (1998) examine total holdings of risky assets, and find that single white women generally hold lower proportions of risky assets than other groups.

Although these sorts of studies provide significant insights into the investment decision across gender types, one critical shortcoming in the literature is that large-scale survey studies offer poor control over potential gender differences in knowledge sets—in fact, we are aware of no previous large-scale study of actual investment practices that has measured and analyzed the effects of context-specific knowledge on the investment decision. In this paper, we have a unique opportunity to advance the literature by empirically examining risk-taking in mutual fund investments across gender types, while controlling for investor-specific financial investment knowledge. Using mutual fund investment data is a natural extension of the extant literature given that mutual fund investment is at record levels, continues to grow, and is widely discussed in the popular press, making it a relatively unambiguous decision context for both men and women. In addition, our data provide a natural test of the Hudgens and Fatkin (1985) conjecture that gender differences occur only in situations where the probability of success is low.

2. Data

In 1995 the Office of the Comptroller of the Currency and the Securities Exchange Commission jointly conducted a survey of 2000 randomly selected mutual fund investors. In addition to basic demographic information, the survey asked respondents about the types of mutual funds they owned and the channels through which these funds were purchased. Respondents were also asked a series of questions in order to determine their understanding of basic financial concepts.

Because one purpose of this study is to examine whether the risk-taking behavior of mutual fund investors is correlated with gender, we focused on three pieces of information pertaining to the type of fund owned. Specifically, we examined the types of mutual funds that respondents had purchased for their LARGEST single investment, their most recent (LAST) investment, and their RISKIEST investment. The RISKIEST measure is a composite variable created by selecting the riskiest mutual fund type reported across all investment channels. In order to examine the level of risk within mutual fund selections, the riskiness of the fund type was coded using an ordinal ranking system. Money market and municipal money market funds were coded 0, municipal bond funds were coded 1, bond funds were coded 2, mixed/balanced funds were coded 3, and stock funds were coded 4. The 0–4 rankings correspond to the risk level (typically measured as the variance of returns) associated with each category, where 4 is considered the riskiest option.

The upper panel of Table 1 contains means and standard deviations for each mutual fund type, as well as the proportion of respondents that invested in each fund type. The right-most column of Table 1 contains large sample *t*-statistics testing the null hypothesis of homogenous investment decisions across men and women. For the LARGEST investment category, the bond fund response was not well-represented for men or women, leading us to omit this response from our analysis and truncate the remaining responses, resulting in a 0–3 risk scale (i.e. money market, municipal bond, mixed, and stock) for this investment category. A striking finding is that across the three investment categories women appear to take less risk than men. This general observation is supported via *t*-tests, which in each case reject the null at the $P < 0.01$ level. We should note that nonparametric sign tests support all of the results of the parametric *t*-tests.

Table 1
Descriptive statistics

Gender	Mean (S.D.)	Probabilities of each risk category					*t*-test of means
		Money market $P(0)$	Municipal $P(1)$	Bond $P(2)$	Mixed $P(3)$	Stock $P(4)$	
LARGEST							
Female	2.09 (1.21)	0.19	0.11	–	0.11	0.59	−3.56
Male	2.33 (1.13)	0.15	0.07	–	0.08	0.70	
LAST							
Female	2.55 (1.63)	0.22	0.07	0.09	0.16	0.45	−4.05
Male	2.85 (1.56)	0.18	0.05	0.06	0.16	0.55	
RISKIEST							
Female	3.19 (1.35)	0.11	0.04	0.08	0.11	0.67	−4.86
Male	3.47 (1.14)	0.06	0.03	0.05	0.08	0.78	
Age							
Female	2.49 (1.26)						0.18
Male	2.48 (1.21)						
Education							
Female	4.30 (1.38)						−3.66
Male	4.53 (1.39)						
Income							
Female	3.23 (1.16)						−2.98
Male	3.38 (1.05)						
Investment knowledge							
Female	6.20 (2.22)						−14.30
Male	7.67 (2.35)						

Means are for the individuals that invested nonzero amounts in that category. Large sample *t*-statistics presented in right-most column. LARGEST, type of fund in which respondents had the largest investment; LAST, type of fund in which respondents made the most recent investment; RISKIEST, riskiest type of fund in which respondents held an investment. Investment knowledge, summed response to a 12-item scale.

Even though the descriptive statistics in the upper panel of Table 1 suggest that women take less risk than men, it is inappropriate to draw such a conclusion from unconditional differences. Theory and previous empirical findings suggest that other factors including age, education, and income influence risk taking. We also gather data on these attributes, and present descriptive statistics in the lower panel of Table 1.[1] Large sample *t*-tests of means indicate that populations of men and women in

[1]Age was coded 1 for 18–34 years, 2 for 35–44 years, 3 for 45–54 years, 4 for 55–64, and 5 for 65 and older. Education was coded 1 for some high school or less, 2 for completed high school, 3 for trade school past high school, 4 for some college, 5 for completed college, and 6 for attended graduate school. Income was coded 1 for less than $15,000 per year, 2 for $15,000–$35,000, 3 for $35,000–$75,000, 4 for $75,000–$150,000 and 5 for $150,000 and over. Gender is measured as a dichotomous variable, coded 1 for males and 0 for females. Of our subjects, 41.6% are female and 54.6% are college graduates (26.5% had some graduate school). Almost two-thirds (66.3%) had purchased their first mutual fund prior to 1993. The average respondent owned slightly more than three different funds, and 39.6% owned four or more funds while only 23.3% owned a single fund.

the sample did not differ in age. However, men reported income and education levels that exceeded levels reported by women ($P < 0.01$).

While we have a rough measure of general education via the Education variable, intuition suggests that specific knowledge of investment practice is related to investment risk preferences. We measure investment knowledge by using the summed responses to a 12-item scale that had potential scores ranging from 0 to 12. Six of the scale items required responses that could be compared to a known answer. An example of this type of item is: 'Can a stock mutual fund lose money?' Correct answers to these six items were coded 1; incorrect answers were coded 0. The remaining six items in the scale measured self-reported understanding of the meaning of selected financial and investment terms.[2] An example of this type of item is: 'Do you know what a redemption is?' Yes answers to these items were coded as 1; no answers were coded as 0. The lower panel of Table 1 indicates that the average investment knowledge score is 6.20 and 7.67 for women and men. A *t*-test strongly suggests that this difference is significant ($t = -14.30$), implying that men and women have different knowledge sets concerning investment decisions. This finding suggests that the unconditional findings must be viewed with caution, since subjects may be revealing differences in their specific investment knowledge rather than displaying any underlying differences in risk preferences.

3. The empirical model

To supplement our unconditional findings in Table 1, we use a simple empirical model that controls for other important factors that may affect investment choice.[3] Given that the survey responses are coded 0, 1, 2, 3, and 4 for those that invested, a linear regression model is inappropriate. Estimation of the model via ordinary least squares would treat the difference between 0 and 1 identical as that between 3 and 4. In fact, the responses represent a ranking and therefore one-unit changes are not directly comparable in this manner. To amend this shortcoming, we build a model around a latent regression of the form:

$$Y_i^* = X_i' \beta + \varepsilon_i, \tag{1}$$

where Y_i^* is unobserved, X_i is a vector of person-specific exogenous variables, β is the estimated response coefficient vector, and ε_i is the well-behaved random error component. Although we do not directly observe Y_i^*, we do observe an approximation of Y_i^*:

$$\begin{aligned} Y_i = 0 \text{ if } Y_i^* \le 0; \quad = 1 \text{ if } 0 < Y_i^* \le \phi_1; \quad = 2 \text{ if } \phi_1 < Y_i^* \le \phi_2; \quad = 3 \text{ if } \phi_2 < Y_i^* \le \phi_3; \\ = 4 \text{ if } \phi_3 < Y_i^* \le \phi_4. \end{aligned} \tag{2}$$

The ϕ_i are unknown parameters that are estimated jointly with β; Y_i^* is unknown since the questionnaire requests the survey respondents to select the answer that most closely represents their

[2] In some cases, the psychology literature has shown that there are gender differences in self-reports of knowledge and ability, such that men tend to overestimate relative to women. For this reason, we performed a sensitivity analysis using an investment knowledge measure that contained only the six items for which there is a known answer. The results of these alternative analyses were not qualitatively different than those presented in Tables 2 and 3.

[3] Sample sizes are generally less than 2000 due to incomplete observations.

true random variable value. As such, we obtain threshold levels of risk taking by measuring how exogenous variable vector X_i, which includes gender, age, income, education, and investment knowledge, affects ranked responses, Y_i^*.[4]

4. Empirical results

Table 2 contains ordered probit estimates for each of the three dependent variables (LARGEST, LAST, and RISKIEST investment), calculated with and without a control for investor knowledge. An important first finding is that each of our models performs reasonably well: examination of the χ^2 statistics suggests that the models explain a significant amount of the variation in the dependent variable. Parameter estimates in Table 2 provide evidence of the control factors that affect risk taking. Estimated coefficients of income are positive and significantly different from zero in four of the models, and the coefficients of education are positive and significant in every model. This result

Table 2
Ordered probit estimation results

Variable	Model					
	LARGEST	LARGEST	LAST	LAST	RISKIEST	RISKIEST
Constant	0.20	−0.03	−0.09	−0.37	0.31	−0.03
	(1.24)	(−0.20)	(−0.75)	(−2.96)	(2.40)	(−0.20)
Gender	0.23	0.14	0.18	0.07	0.27	0.14
	(3.21)	(1.93)	(3.41)	(1.34)	(4.66)	(2.33)
Age	−0.03	−0.04	−0.01	−0.02	−0.02	−0.03
	(−1.17)	(−1.54)	(−0.50)	(−1.02)	(−0.89)	(−1.51)
Education	0.14	0.11	0.09	0.04	0.14	0.07
	(5.48)	(3.82)	(4.64)	(2.02)	(6.50)	(3.50)
Income	0.02	0.01	0.14	0.13	0.13	0.12
	(0.54)	(0.20)	(5.76)	(5.18)	(4.79)	(4.06)
Investment knowledge	–	0.07	–	0.09	–	0.12
		(4.32)		(7.32)		(8.13)
χ^2 (d.f.)	49.3 (4)	67.8 (5)	88.5 (4)	142.3 (5)	111.2 (4)	180.3 (5)
n	1316	1316	1927	1927	1996	1996

Gender is a dichotomous variable that equals 1 for males, 0 for females. t-ratios are reported in parentheses beneath coefficient estimates. Estimates of ϕ_i are available upon request. LARGEST, type of mutual fund in which respondents had the largest investment; LAST, type of mutual fund in which respondents made the most recent investment; RISKIEST, riskiest type of fund in which respondents held an investment. Investment knowledge, summed responses to a 12-item scale.

[4]A few aspects of our estimation procedure merit further consideration. Firstly, since the ϕ_is are free parameters, there is no significance to the unit distance between the set of observed values of Y, thus avoiding symmetric treatment of one-unit changes in the dependent variable. Secondly, estimates of the marginal effects in the ordered probability model are quite involved because there is no meaningful conditional mean function. We therefore compute the effects of changes in the covariates on the j probabilities: $\partial\text{Prob}[\text{cell } j]/\partial X_i = [f(\phi_{j-1} - X_i'\beta) - f(\phi_j - X_i'\beta)]^*\beta$; where $f(\cdot)$ is the standard normal density, and other variables are defined above. By definition, these effects must sum to zero since the probabilities sum to one. Thirdly, our choice of regressors follows theory and previous empirical findings, which suggest that age, education, investment knowledge, and income are associated with risk taking.

implies that wealthier, more educated investors tend to take on more risk than their less educated, less wealthy counterparts. When investor knowledge is included, its effect is positive and highly significant for all three measures, indicating that it contributes to risk taking above and beyond the contribution made by general education.

Estimated coefficients of the gender variable in Table 2 provide interesting information. We should first note that, in the models that *exclude* the measure of investor knowledge, the coefficient of the gender variable is positive and significantly different from zero ($P<0.05$) in all cases. This suggests that men take on more risk than women when selecting mutual funds. However, when investor knowledge is included, gender is significant at $P<0.05$ for only the RISKIEST investment. In contrast, its significance drops to $P<0.054$ in the LARGEST investment model and is below conventional levels for the LAST investment model ($P=0.18$). Interestingly, this change in the level of significance is driven by the reduction of the coefficient estimate rather than imprecision. Comparison of the gender coefficients reveals that for each model type the estimate decreases by nearly 50% when investor knowledge is included.

Although these coefficient estimates provide insights into how the gender effect changes when an individual-specific knowledge regressor is included, not much information beyond their statistical significance can be used since they are not marginal effects. To amend this situation, we present marginal effects from the models that include the investment knowledge regressor. The estimates in Table 3, panel A, corresponding to respondents' LARGEST mutual fund investments, can be read as follows: men are ~5% more likely than women to be in cell 4 (stock fund). Alternatively, men are 3.4% less likely to be in cell 0 (money market fund). This finding is consistent across each of the investment categories and serves to enhance the results discussed above.

Given that these effects are robust across investment category, it is interesting to understand how they change when the investment knowledge regressor is *excluded* from the specification. Marginal effects estimates from these models are directly beneath the marginal effects estimates from the models that include the investment knowledge variable and support the general observations of the coefficient estimates in Table 2. For example, in the LARGEST investment category, men are ~8.3% more likely than women to be in cell 4 (stock fund)—an increase of nearly 60% compared to the marginal effect estimates when investor knowledge is included. Likewise, the marginal effects increase by 140% and 95% when the investor knowledge variable is excluded from the other models. These results confirm our findings in Table 2 and suggest that the gender effect is greatly attenuated when one properly controls for investor knowledge.

5. Concluding remarks

Using data from nearly 2000 mutual fund investors, we find evidence that suggests women take less risk than men in their mutual fund investments. We find, however, that the observed difference in risk taking is significantly attenuated when we include a financial investment knowledge control variable in the regression model, suggesting that the gender effect found in previous studies that employ less specific knowledge controls may be biased upward. Our findings have several practical implications. Firstly, our results are contrary to Hudgens and Fatkin (1985), who conjecture that gender differences occur only in situations where the probability of success is low. Accordingly, the prevalence of educational investment marketing efforts that target women is understandable. Secondly, our findings

Table 3
Marginal effects estimates

Variable	Money market $P(0)$	Municipal $P(1)$	Bond $P(2)$	Mixed $P(3)$	Stock $P(4)$
LARGEST					
Gender	−0.034	−0.010	–	−0.007	0.052
w/o knowledge	−0.055	−0.016		−0.012	0.083
Age	0.011	0.003	–	0.023	−0.016
Education	−0.026	−0.007	–	−0.005	0.039
Income	−0.002	−0.005	–	−0.001	0.003
Investment knowledge	−0.017	−0.005	–	−0.004	0.026
LAST					
Gender	−0.020	−0.003	−0.003	−0.003	0.030
w/o knowledge	−0.050	−0.008	−0.007	−0.007	0.072
Age	0.006	0.001	0.001	0.001	−0.009
Education	−0.011	−0.002	−0.002	−0.002	0.017
Income	−0.035	−0.006	−0.005	−0.005	0.052
Investment knowledge	−0.025	−0.004	−0.004	−0.004	0.037
RISKIEST					
Gender	−0.020	−0.006	−0.010	−0.011	0.045
w/o knowledge	−0.037	−0.012	−0.019	−0.020	0.088
Age	0.005	0.002	0.003	0.003	−0.012
Education	−0.010	−0.003	−0.006	−0.006	0.024
Income	−0.015	−0.005	−0.008	−0.009	0.037
Investment knowledge	−0.015	−0.005	−0.008	−0.009	0.037

Gender is a dichotomous variable that equals 1 for males, 0 for females. Marginal effects are calculated as changes in the covariates on the j probabilities: $\partial \text{Prob}[\text{cell } j]/\partial X_i = [f(\phi_{j-1} - X_i'\beta) - f(\phi_j - X_i'\beta)]^*\beta$. LARGEST, type of mutual fund in which respondents had the largest investment; LAST, type of mutual fund in which respondents made the most recent investment; RISKIEST, riskiest type of fund in which respondents held an investment. Investment knowledge, summed responses to a 12-item scale.

may be relevant to the current discussion regarding the privatization of the US social security system. Proponents of privatization have suggested that women would benefit from the right to manage their own retirement investments (Anonymous, 1999). However, our findings raise the concern that privatization could further magnify existing gaps between men's and women's retirement savings. Finally, our findings may help to explain the paucity of women in professions that require a penchant for risk-taking behavior (Chevalier and Ellison, 1999).

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