Risk-Tolerance Estimation Bias: Do Married Women And Men Differ?

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A person's estimation of their risk tolerance, defined as the willingness to engage in financial activity whose outcome is uncertain, plays an important role in nearly all household financial decisions (Duda, Bruhin, Epper, & Schubert, 2010). Fewer errors would be observed in financial decisions if consumers were accurate in the evaluation of their risk tolerance. However, this is not the case (Shefrin, 2000). The economics and household finance literature is replete with tests of consumer biases. Three generalizations emerge from the literature. First, when people are overconfident they establish guesses about an outcome that are too high. Conversely, consumers who exhibit underconfidence tend to guess too low. Second, consumers often estimate with overconfidence when faced with general knowledge assessments (Lichtenstein, Fischhoff, & Phillips, 1999). Third, men tend to exhibit overconfidence in most household consumer decisions that involve risk.

While a great deal has been written about consumer confidence biases, very little is known about a related cognitive predisposition known as *estimation bias*. Grable and Roszkowski (2007) defined risk tolerance estimation bias as the systematic over- or underestimation of a person's financial risk tolerance compared to an independent criterion. The purpose of this paper is to report on a test that measured how well married men and women were able to estimate their financial risk tolerance. This paper adds to the body of literature on sex-based estimation bias as it relates to household decisions that involve financial risk.

Review of Literature

The general consensus among consumer educators and researchers is that women perceive risks differently than men (Jianakoplos & Bernasek, 1998; Schubert, Brown, Gysler, & Brachinger, 1999). Furthermore, several studies suggest that women are less willing to engage in risky behaviors than men (Arano, Parker, & Terry, 2010; Grable, 2008; Jianakoplos & Bernasek; Kohler, 1996; Neelakantan, 2010; West, Moskal, Dziuban, & Rumbough, 1996). This sex-risk relationship has been documented in a wide variety of situations.

Differences in risk tolerance between women and men may help account for "women's lower levels of wealth compared to men's" (Jianakoplos & Bernasek, p. 620). In other words, wealth dispersions between women and men may be attributable, in part, to the choices women make, vis-à-vis men, when faced with a risky financial decision. If women, on average, choose less risky alternatives (Hersch, 1996), then it is possible that this behavior will result in asset growth that lags that of men. Further, if it is found that married women systematically underestimate their risk tolerance in a biased fashion, this may explain wealth discrepancies observed at both the national and household levels.

Although not widely studied, an essential element in the examination of sex differences in financial risk tolerance is an individual's risk tolerance estimation bias. Much of the literature suggests that individuals tend to be overconfident when making household financial predictions (e.g., the future of stock prices or the stability of employment) (Shefrin, 2000). Overconfidence appears to be a constant even when outcome probabilities are known beforehand (Griffin, Dunning, & Ross, 1990; Nowell & Alston, 2007; Sitkin & Pablo, 1992). What is less well known is whether estimation bias resembles overconfidence bias. It is known that men tend to be overconfident when making predictions. Camerer and Lovallo (1999) attributed men's overconfidence to their tendency to be overly optimistic when making a prediction. One of the first tests of estimation bias

extended the work published on overconfidence bias to the study of risk-tolerance estimation. Grable and Roszkowski (2007) showed that women were more likely to underestimate their risk tolerance, while men were significantly more likely to overestimate their willingness to engage in a risky financial behavior.

In an earlier study, Moreschi (2005) calculated risk-tolerance estimation bias by evaluating self-assessed risk tolerance scores compared to objectively measured risk-tolerance. He concluded that the majority of individuals inaccurately gauge their financial risk tolerance. Only 4% of those in his study were able to accurately evaluate their own tolerance for risk. Seventy-three percent underestimated their risk tolerance, while 23% overestimated it. After controlling for age, education, and income, Moreschi determined that men were more likely to overestimate their risk tolerance.

Estimation bias studies are important because research results help to answer a question originally posed by Bajtelsmit and Bernasek (1996): why is the willingness of women and men to engage in financial behaviors significantly different? While many studies demonstrate that men tend to be more risk tolerant than women, both generally and in the context of financial decisions, the more substantive answer to the question might reside in the understanding of women's tendency to underestimate their risk tolerance. Underestimation may lead to behaviors that exaggerate the risk-return tradeoff. That is, women's tendencies when making decisions that involve financial risk may be to choose alternatives that provide low risk and return outcomes.

The inclusion of marital status in studies of risk-tolerance estimation bias is an important extension of traditional estimation bias research. The literature indicates that single individuals tend to be more risk tolerant than those who are married (Grable, 2008; Yao & Hanna, 2005). Ardehali, Paradi, and Asmild (2005) theorized that marital differences in risk tolerance may be related to the perception among married individuals that if they incur a financial loss, the outcome could hurt their spouse and family. The purpose of the present study is to expand upon previous

work (e.g., Gilliam, Goetz, & Hampton, 2008; Grable & Roszkowski, 2007; Moreschi, 2005; Yilmazer & Lyons, 2010) by studying marital status, in addition to sex, as a factor associated with risk-tolerance estimation bias.

Method

Sample

The data for this study were collected in 2006 using a web-based survey tool. The respondents were chosen from a convenience sample of faculty and staff primarily from a large southwestern public university. A total of 430 individuals responded to the survey; however, 48 surveys were discarded because of missing data. After data cleaning and matching data for married couples, the final sample consisted of 191 married couples. The average respondent was 44.17 (*SD* = 11.59) years of age, although the age distribution was wide (i.e., 23 to 75 years). On average, respondents had been married for 14 years in 2006. The educational level of respondents was relatively high. Slightly more than 40% of those responding held a post-graduate degree. Thirty-four percent were university graduates. Fifteen percent indicated completing an associate's degree, while 11% had a high school diploma or lower level of education.

Outcome Measures

Respondents were asked to respond to two subjective risk-tolerance assessment measures and to provide descriptive data regarding their portfolio asset allocation. These three items were used to measure the respondent's subjective and objective tolerance for financial risk. The first subjective risk-tolerance measure was a single-item question that is widely used in the personal and household finance literature—the Survey of Consumer Finances (SCF) risk question. The question reads as follows: "Which of the following statements on this page comes closest to the amount of financial risk that you are willing to take when you save or make investments?

1. Take substantial financial risk expecting to earn substantial returns (Coded 4)
2. Take above average financial risk expecting to earn above average returns (Coded 3)
3. Take average financial risk expecting to earn average returns (Coded 2)
4. Not willing to take any financial risk (Coded 1)."

The SCF is sponsored by the Federal Reserve Board and administered by the National Opinion Research Center at the University of Chicago. While there have been a few critiques of the item (e.g., Finke & Huston, 2003; Hanna, Gutter, & Fan, 2001), baseline measures of validity and reliability have been reported (e.g., Grable & Lytton, 2001; Grable & Schumm, 2007), which have suggested that the question offers reasonable levels of validity and reliability, particularly when the research outcome is associated with the measurement of a person's tolerance for investment risk. In this study, 6% of respondents indicated a willingness to take substantial risk. Approximately 33% indicated an above-average risk tolerance. Fifty-three percent were willing to take average risk, while 8% were not willing to take any risk. A *chi-square* test was utilized to determine if women and men responded differently to the question. The association between sex and SCF risk question responses was significant ($\chi^2(3) = 24.98$, $p < 0.001$). In general, men were more likely to exhibit above-average to substantial risk tolerance compared to women.

Respondents were also asked to respond to a 13-item risk-tolerance scale that required respondents to answer a series of multiple-choice questions that assess a person's willingness to take personal finance risks (Grable & Lytton, 1999) (see http://njaes.rutgers.edu/money/riskquiz/). Scores ranged from 14 to 39. Respondents scored 26.58 ($SD = 4.95$) on average, with higher scores representing an elevated tolerance for financial risk. A significant mean difference in scores for women (M = 25.85) and men (M = 27.96) was noted ($t_{380} = 3.78$, $p < 0.001$, two-tailed).

Cronbach's alpha for the scale was $\alpha = 0.75$. Scores on the 13-item scale were highly correlated with responses to the SCF risk question ($r = 0.60$).

An objective measure of risk tolerance was also assessed in the survey. Respondents were asked what percent of their total investment portfolio was invested in each of five categories: (a) stock or equity funds; (b) bonds or bond funds; (c) investment property and/or real estate investment trust; (d) cash; and (e) "other" investments, defined as collectibles, commodities, and business ownership interests. A panel of experts was used to categorize respondents into one of the following three risk levels based on each respondent's description of their current asset allocation strategy: (a) conservative (coded 1), (b) moderate (coded 2), and (c) aggressive (coded 3). The panel, a Delphi panel, consisted of experienced financial planners and personal financial planning faculty members from a nationally recognized university specializing in financial planning education. The inter-rater reliability of the process was $\alpha = 0.89$. An average objective risk score was calculated by averaging the Delphi scores, with mean intervals of 0.20 between scores (e.g., 1.20, 1.40, etc.). The mean score was 1.96 ($SD = 0.69$). Delphi risk scores were found to be correlated with scores on the SCF risk question ($r = 0.18$) and the 13-item risk measure ($r = 0.15$).

Procedure

Differential prediction modeling techniques were utilized to test for risk-tolerance estimation bias among married women ($N = 191$) and married men ($N = 191$). First, subjective estimation bias scores were calculated. To test for subjective bias, scores on the 13-item scale were used to predict self-assessed risk tolerance on the SCF item. This test was based on psychometric assumptions. The 13-item scale was considered to be more psychometrically robust, and as such, a more accurate measure of financial risk tolerance, whereas the SCF risk question was assumed to provide a simple estimate of each respondent's own assessment of their risk tolerance. Using the more reliable instrument to predict scores on

the single-item self-evaluation was one way to measure estimation bias within the sample. Because of the ordinal coding of the SCF risk question, an ordered logit regression model was used to predict categories of risk tolerance. The predicted category (i.e., none, average, above average, and substantial) from the regression was saved for all respondents. Category predictions were as follows: 26 respondents had no risk tolerance, 187 had average risk tolerance, 112 had above-average risk tolerance, and 23 had substantial risk tolerance. Estimation bias was calculated by subtracting the predicted category from actual SCF categories to obtain residual risk scores. That is, if someone reported an above-average risk tolerance on the SCF question they would have been coded 3; however, if the prediction indicated that their score was 2 the difference would be a score of 1. A positive score indicates an overestimation bias, whereas a negative number suggests underestimation. Respondents' residual risk scores were either -1, 0, 1, or 2. These scores were used as the outcome variable in a *chi-square* test and an ordered logit regression model. The regression was used to determine if estimation bias existed after controlling for a respondent's sex, age, the number of years married, and educational level. Age (M = 44.18; SD = 11.59) and years married (M = 14.04; SD = 11.51) were coded in years. Sex was coded women = 1, otherwise 0. Because of the homogenous nature of the sample, educational status (M = .74; SD = .44) was coded dichotomously, where some college = 1, otherwise 0.

One criticism of the subjective test of estimation bias is that both the SCF risk question and the 13-item risk measure were based on respondents' self-assessments. In order to deal with the possibility that the first test might provide a non-generalizable outcome, a second objective test was performed. In this case, scores from the Delphi panel of portfolio risk categorizations were used to predict SCF risk scores using an ordered logit regression model. Predicted scores were saved and subtracted from reported SCF risk question scores using the same procedure as described above. As with the first test, the scores were used as the outcome variable in a *chi-square* test and an ordered logit regression model,

with sex, age, years married, and educational status as independent variables.

Results

The methodological approach began by applying an ordered logit regression model procedure to predict SCF risk categories using scores from the 13-item risk-tolerance scale. Overall, this "subjective" risk-tolerance model was statistically significant ($\chi^2(1) = 160.29$, $p < 0.001$) with approximately 42% of variance explained by the model (Nagelkerke Pseudo R-square). Residual risk-tolerance scores were calculated by subtracting the predicted risk category from actual SCF responses. A *chi-square* test was utilized to determine if a significant difference in residual risk-tolerance scores was evident. The association between sex and residual risk scores was not significant at the $p = 0.05$ level ($\chi^2(3) = 7.10$, $p = 0.07$), although it should be noted that more women (n=39) than men (n=28) exhibited a negative residual score, which suggests underestimation of risk tolerance by some women and men. More men (n=33) than women (n=24) had a positive residual score, where positive scores were indicative of an overestimation of risk tolerance. In other words, while the majority of respondents did a reasonably good job of estimating their risk tolerance, potential estimation bias was noted at the extremes.

A follow-up ordered logit regression model procedure was used to test whether, when controlling for respondents' sex, age, years married, and educational level, estimation bias would be observed. In the analysis, women and those with some college education were the omitted categories for the categorical predictors. Table 1 shows the results from the regression. Overall, the model was statistically significant ($\chi^2(4) = 14.45$, $p < 0.01$) with approximately 5% of variance explained by the model (Nagelkerke Pseudo R-square). Compared to women, men were predicted to overestimate their financial risk tolerance. Alternatively, those with less than a college degree, when compared to those with

some college education, were predicted to underestimate their risk tolerance, whereas younger respondents were found to be more likely to overestimate their risk tolerance. The relationship between risk estimation and years married was not significant. Although the level of explained variance was modest, the direction of the associations confirmed the possibility of a sex-based risk-tolerance estimation bias.

Table 1

Summary of Regression Analyses for Variables Predicting Residual Value Risk Tolerance for Married Respondents

	Subjective Test Ordered Logit Regression Model			Objective Test Ordered Logit Regression Model		
Variable	Parameter Estimate	SE	Wald	Parameter Estimate	SE	Wald
Sex (Women Omitted Category)	0.48	0.22	4.62 *	1.13	0.22	25.73 ***
Age	-0.03	0.01	5.24 *	-0.04	0.01	9.52 **
Years Married	0.03	0.01	3.68	0.02	0.01	2.19
Education (College Omitted Category)	-0.60	0.26	5.54 *	-1.00	0.26	15.28 ***

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

A second test was used to incorporate an objective evaluation of potential estimation bias. An ordered logit regression was used to predict SCF risk scores using portfolio risk estimates from the Delphi panel. The model was statistically significant ($\chi^2(1) = 11.20$, $p < 0.01$) with approximately 4% of variance explained by the model (Nagelkerke Pseudo R-square). As was the case with the subjective model, residual risk-tolerance scores were calculated by subtracting the predicted risk category from actual SCF responses. A *chi-square* test was utilized to examine differences between married women and married men. The association was statistically significant ($\chi^2(3) = 24.60$, $p = 0.001$). More women (n=15) than men (n=11) exhibited a negative residual score, whereas more men (n=89) than women (n=46) were categorized with a positive residual score. These positive scores were representative of an overestimation of risk tolerance.

An ordered logit regression model procedure was utilized to evaluate the objective test *chi-square* result. Using sex, age, years married, and educational level as independent factors, with women and those with some college education as the omitted variable categories, it was determined that this "objective" model was statistically significant ($\chi^2(4) = 48.73$, $p < 0.001$), with approximately 15% of variance explained by the model (Nagelkerke Pseudo R-square). Table 1 shows the results from the regression. The results mirrored that of the subjective test. It was determined that men, those with some college education, and younger respondents were more likely to overestimate their financial risk tolerance. The relationship between risk tolerance estimation and years married was not significant.

Discussion

The results from this study expand upon previous literature by reporting a sex-based risk-tolerance estimation bias, accounting for marital status. Based on ordered logit regression model results, women were predicted to underestimate their risk tolerance and men were predicted to overestimate their tolerance for financial risk.

Two other variables were also found to be associated with risk-tolerance estimation bias. It was determined that older respondents were more likely to underestimate their financial risk tolerance. This might be indicative of an experience factor associated with age, where older individuals may, in fact, be more willing to take risks, but they use past experience to dampen their self-assessment. Educational status was found to be positively associated with an overestimation of risk tolerance. Those respondents who reported having at least some college education were more likely to overestimate their tolerance for taking financial risks. Because education and experience are not necessarily related, it is possible that those with some post-secondary education equated general academic wisdom with specific financial decision-making expertise. If true, this suggests

that better educated consumers may be engaging in a bias that could result in excess risk being taken when making financial decisions. Of course, the opposite may be true among those with a lower level of education. These individuals may systematically underestimate their tolerance for risk and engage in behaviors that limit their ability to accumulate wealth or receive benefits from consumer decisions that others obtain in the marketplace.

The results from this study have non-trivial implications for consumer educators, financial advisors, and policy makers. The key point to note is that over- or underestimation of risk tolerance may be leading consumers to choose different portfolios from those that would be optimal for themselves given their true preferences. This may help explain why women accumulate less wealth over their lifetime than men (Jianakoplos & Bernasek, 1998). Risk and return, over the long-term, tend to be positively associated (Finke & Huston, 2003). Further, a consumer's assessment of their own risk tolerance, as a guide for matching assets to comfort level, is generally thought to be highly positively correlated (Roszkowski & Davey, 2010). As such, consumers who systematically underestimate their risk tolerance may not only choose low risk/return assets, their selection of such assets may be skewed even lower than one would expect, in terms of return outcomes, because of estimation bias. Results from this study suggest that this scenario is much more likely for married women than it is for married men. Married men were shown to be more prone to overestimate their risk tolerance.

Estimation bias appears to be a factor associated with risky consumer choice. This insight can be used by consumer educators to better understand why women sometimes select investment assets with low risk and return tradeoffs. Future studies are needed to learn more about such choices. Additional research ought to include explanatory personality factors, such as Type A/B personality, locus of control, and self-esteem. Household variables, including wealth and income, family size, and general socio-economic status should also be included in analyses. Only by continuing and expanding tests of estimation bias will the

household consumer education and finance fields gain a better understanding of risk-tolerance differences between women and men.

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