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Risk aversion for decisions under uncertainty: Are there gender differences?

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ABSTRACT

It has become well accepted that women are more risk averse than men. For objective probability gambles, typically used in eliciting risk aversion, we find women generally have a lower valuation than men, thus exhibiting greater risk aversion. This paper investigates whether this finding extends to decisions under uncertainty – where probabilities are not given and individuals may assign different probabilities to the same event (e.g. outcomes of award shows or sporting events).We find that for decisions under uncertainty, men and women value the bets similarly, both before and after controlling for participants' subjective probabilities.

There has been an abundance of research conducted during the last two decades related to gender differences in risk aversion, mostly finding women to be more risk averse than men (Byrnes, Miller, & Schafer, 1999; Croson & Gneezy, 2009; Eckel & Grossman, 2002, 2008). So prevalent is the finding of women's greater risk aversion that further research has proposed mechanisms by which it operates: from avoidance of negative social consequences for non-conformance to stereotypes (Larkin & Pines, 2003), to "feeling more" (Croson & Gneezy, 2009), e.g. having stronger emotional reactions to losing (Eriksson & Simpson, 2010), to higher perceptions of negative outcomes and lower expectations of enjoyment for risk-taking (Harris, Jenkins, & Glaser, 2006). Some researchers have found that factors such as stereotype threat, personality traits, women's greater gambling aversion and domain of the decision predict differences in risky decision making between the genders (Carr & Steele, 2010; Demaree et al. 2009; Fehr-Duda, De Gennaro, & Schubert, 2006; Schubert et al. 1999; Vlaev et al. 2010; Wieland et al. 2014). Additionally, other research finds that gender differences in entering risky competitions is moderated by the domain of the competition, with both men and women taking more risk in domains that are stereotyped as consistent with their gender (e.g. men and math; women and fashion)(Wieland & Sarin, 2012).

This is an important topic because the results of research on gender differences in risk aversion become a central part of discussions on competitiveness, management style, labor markets and investment success (Booth & Nolen, 2012; Eckel & Grossman, 2008; Kahan et al., 2007; Kristof, 2009; Wieland & Sarin, 2012).

In decisions under risk, where probabilities are known, it is common to find that men are less risk averse than women. Since probabilities are given, a comparison of risk aversion can be made by simply comparing valuations of the bet. In decisions under uncertainty, where individuals must rely on their own subjective probabilities of outcomes – the kind of decisions that dominate our day-to-day decision making – we *must* control for subjective probabilities.

Suppose you are asked to value a bet that pays $100 if a movie wins the best picture award in the upcoming Oscars; otherwise nothing. Clearly, your valuation of such a bet depends on your subjective probability that the movie will actually win. Hypothetically, if John and Jane have identical subjective probabilities of the movie winning the best picture award and John assigns a higher valuation to the bet than Jane, then, John is less risk averse or more risk tolerant than Jane (Yaari, 1969). In general, individuals are likely to have different subjective probabilities and therefore a higher valuation may not imply lower risk aversion.

In this paper, we describe a simple method that controls for subjective probability in the comparison of gender differences in risk aversion. The method can be easily applied to compare valuations or risk aversion between any two groups. We then apply the method to empirically examine the gender difference in risk aversion for decisions under uncertainty. We state our findings succinctly:

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For bets on real events, where valuations depend on subjective probabilities, women are not more risk averse than men in our samples.

1. A simple method to control for subjective probabilities

Subjective probabilities are an integral part of the valuation of bets on real events. Savage (1954, 1978) formalized the theory for accounting for subjective probabilities and forcefully argued that these probabilities influence real economic choices. Our choice of a career, an investment or an entrepreneurial project depends on our subjective probability of success or failure.

A typical method to establish if a gender difference in risk aversion exists is to ask participants their valuation of a bet. In the subjective expected utility model, the valuation of a bet is influenced both by risk aversion (curvature of utility) and by subjective probability. Therefore, we need to account for subjective probabilities of success and failure along with other control variables (age, education) to examine gender differences in risk aversion.

We note that in recent years, alternative models of decisions under uncertainty have been proposed (Sarin & Wakker, 1992; Schmeidler, 1989; Tversky & Kahneman, 1992). In these models, risk aversion is influenced by both the weighting of probability and the curvature of utility. Researchers have found that women are more loss averse and there is a gender difference in probability weighting (Charupat et al. 2013; Fehr-Duda et al. 2006; Hogarth, Portell, & Cuxart, 2007). Here we assume the subjective expected utility model; though, it will be fruitful to extend our approach to alternative models in future research.

Consider a bet on an event E, in which an individual receives $X if the event occurs; otherwise nothing ($0). Under the subjective expected utility model, valuation of the bet depends on the individual's beliefs (subjective probability, P) and tastes (utility, U). The individual provides the subjective probability, P(E), and the valuation of the bet (certainty equivalent, CE). Rationally, P(E) lies between 0 and 1 and CE should lie between $0 and $X. In the subjective expected utility model:

$$\mathbf{U(CE) = P(E)U(X) + (1 - P(E))U(0)}$$

A widely accepted functional form of the utility function is the following power form (Keeney & Raiffa, 1976; Tversky & Kahneman, 1992):

$\mathbf{U(X) = (X)^{\alpha}}$, where $\alpha > 0$ determines the curvature of the utility function.

We can set U(0) = 0. Thus,

$\mathbf{(CE)^{\alpha} = P(E)\,X^{\alpha}}$.

Taking the natural logarithm of both sides,

$$\alpha LN\ (CE) = \alpha LN(X) + LN\ (P(E)),\ \text{or}$$

$$LN\ (CE) = b_0 + b_1\ LN\ (P(E)).$$

Note that the above equation also applies if we use selling price rather than certainty equivalent to determine the valuation of the bet.

We can write:

$$LN\ (Valuation) = b_0 + b_1\ LN\ (Probability).$$

The multiple regression model that we use to control for subjective probability to establish whether women are more risk averse than men is:

$$LN\ (Valuation) = b_0 + b_1\ LN\ (Probability) + b_2\ Gender. \quad (1)$$

In (1), gender is a dummy variable with Male = 1, and Female = 0. Therefore, if the coefficient b_2 is positive and statistically significant, one can assert that on average men have a higher valuation of the bet than women (after controlling for subjective probabilities), and are less risk averse.Our participants differ in age and education, both of which may influence their valuations. For all the studies included in this manuscript, the education variable is dummy coded as either less than a four year college degree (0), or a four year college degree or higher (1). We control for age and education:

$$LN\ (Valuation) = b_0 + b_1\ LN\ (Probability) + b_2\ Gender + b_3\ Age + b_4\ Education. \quad (2)$$

Our focus is on the sign and statistical significance of b_2. If b_2 is statistically significant, then we can establish that on average:

$$\frac{Valuation\ of\ Men}{Valuation\ of\ Women} = Exp\ (b_2). \quad (3)$$

Even though the underlying relationship between probability and valuation is non-linear, we also explore whether the linear model provides a better fit for the data. In the linear model:

$$Valuation = b_0 + b_1\ (Probability) + b_2\ Gender + b_3\ Age + b_4\ Education.$$

The linear relationship was used by Slovic and Lichtenstein (1968), and was also advocated by Savage (1971) provided stakes are low. In the linear model,

$$Valuation\ (Men) - Valuation\ (Women) = b_2.$$

It has been observed in decision making (Dawes & Corrigan, 1974; Stock & Watson, 1998) that linear methods produce better results than theoretically more general nonlinear models. Therefore we will report results for both linear and nonlinear models. Valuation and probability are scaled between 0 and 1 for all regressions herein. The regression results are therefore comparable across studies.

We note that the multiple regression method that we use will not provide the best fit for extreme risk aversion ($\alpha \le 0$). We do not observe such extreme risk aversion in any of our studies. Abdellaoui, Bleichrodt, and Paraschiv (2007), Eliashberg and Hauser (1985) and Wakker (2008) provide methods that are flexible with respect to wider shapes of utility functions.

2. Study 1: games of chance

In the first study we sought to replicate prior research to ensure that the gender differences in risk aversion replicated with an Amazon Mechanical Turk (MTurk) sample using the traditional economic method of measuring risk aversion: valuation of gambles in which the probability of the outcome is provided. Again, recent research is robust with findings in economics of gender differences in risk aversion: see Croson and Gneezy (2009) for an overview. For this experiment, we adapted a methodology employed in prior research (Chow & Sarin, 2001), and examined various levels of outcome probability.

2.1. Method

2.1.1. Design and procedure

One hundred and six participants were recruited and paid through MTurk and the study was run online. Five participants were excluded from the analysis because their responses came from IP addresses that had already responded to the survey, and there was no way to ensure that these participants did not take the survey twice. In these cases, and in all studies included in this manuscript, the second response, (indicated by the time the respondent took the survey), from the repeated IP address was excluded from the analysis. The final sample includes 101 participants: 57 women and 44 men. Several recent studies have verified the advantages and appropriateness of the MTurk subject population for conducting experimental research related to judgment and decision making (Eriksson & Simpson, 2010; Paolacci, Chandler, & Ipeirotis, 2010).

Participants first completed a consent form and then were given brief instructions that stated, "*We are interested in your judgments.*