Risky Business

A Look at Individual Decision Making Under Conditions of Risk and Uncertainty

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Individuals make decisions everyday that that affect their lives in the spheres of finances, safety and health. These decisions are filled with varying levels of risk and uncertainty. How individuals choose their risk tolerance can affect how much safety they purchases on automobiles, how much insurance to purchase and even how the government values a statistical life.

These are important issues to individual risk assessment. This paper looks at possible answers to understanding individual risk analysis better by exploring previous literature in the area and by investigating possible links between demographic analysis and risk aversion.

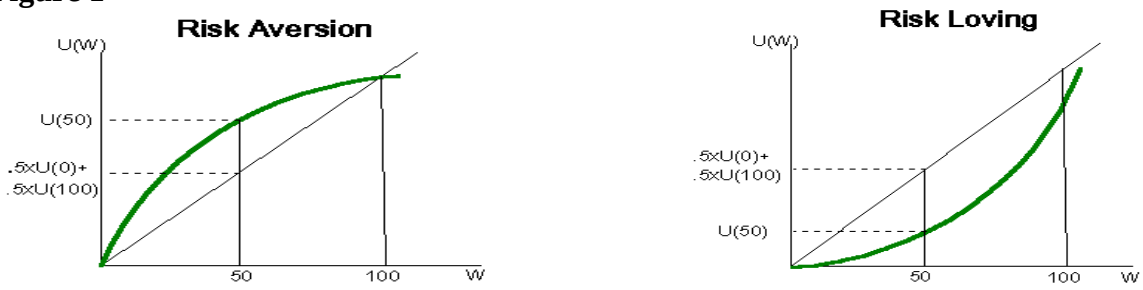
A lot of research has been devoted to try and explain the phenomenon of risk aversion and its consequences. The contention of this paper is that demographic influence/background of an individual can help drive their risk decisions in a meaningful way, not only directly but also through indirect channels such as media outlets and socio-economic pressures.

Most of the research in economic risk analysis starts from the concept of Expected Utility Theory (EUT). EUT hypothesizes that economic agents, i.e. individuals, will make their decisions about risk and uncertainty by constructing weighted averages and expected values of the possible future outcomes.[1] For example, suppose someone had a 50% chance of winning $50 and a 50% chance of winning $0. This person, if risk neutral, would be willing to pay up to $25 to play this gamble ((.5*50)+(.5*0)=25). The risk averse person, preferring to avoid

[1] Kahneman, Daniel and Tversky, Amos. Prospect Theory: An analysis of Decision Under Risk. Econometrica Journal. March 1979. 47:2

risk, will be willing to pay some amount of money greater than or equal to 0, but less than or equal to 25. These preferences form a utility function that is shaped concave down and forms the basis for the concept of diminishing marginal utility.

Figure 1



Although EUT has been instrumental in understanding risk behavior, a particular deviation from EUT has been Prospect Theory. This theory was introduced by Daniel Kahneman and Amos Tversky in 1979. The authors noticed certain invalidations of the basic EUT assumptions and sought to explain them using a more advanced analysis. Prospect Theory's main contribution was its introduction of two distinct phases of individual level analysis: an *editing* phase and an *evaluation* phase. The editing phase is where information is compartmentalized, broken down into more easily understandable forms and where certain individual characteristics can play a role in risk decision preference (i.e. demographic influences). The evaluation phase is a similar component to the basic weighted average approach found in EUT.[2]

[2] *Ibid*.

Extensions of prospect theory have been looked at in studies like the one by Hans Binswanger, where he used empirical evidence from rural India to find parallel conclusions that expand upon prospect theory.

His conclusions follow the prospect theory framework, noting that individual evaluations differ based on differing reference points, which leads to certain situational decisions-making that is inconsistent with some of the normal behavior predicted by expected utility models of statistics and economics.[3]

There is other literature that seeks to explain the concavity of the diminishing utility function, especially where the size of the risk and time span matters. In a paper by Matthew Rabin he finds that expected utility theory does not provide a plausible explanatory account of attitudes towards small and modest risks. The author concludes that expected utility theory provides a useful model for understanding large-scale risk decisions and insurance. But the author also points out the limitations expected utility theory is as a predictive theory for any behavioral risk decisions below these very large levels, such as low and modest risk decisions.[4]

Some research in this area has been devoted to looking at possibilities that individual background characteristics play a role in risk preferences and decisions. In a paper by John E. Grable and Ruth H. Lytton, empirical analysis indicated that the demographic background of respondents mattered a great deal in risk tolerance. Specifically they determined that educational level of

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[3] Binswanger, Hans P. Attitudes toward Risk: Theoretical Implications of an Experiment in Rural India. The Economic Journal. December 1981. 91:364

[4] Rabin, Matthew. Risk Aversion and Expected-Utility Theory: A Calibration Theorem Econometrica, September 2000, 68:5

respondents was the most significant differentiating and classifying factor, also gender, self-employment status, and income also were found to be effective in discriminating among levels of risk tolerance. Their findings indicate that demographic characteristics provide a solid starting point in risk assessment of individuals.[5]

This paper seeks to establish the idea that background characteristics of individuals play a significant role in establishing and influencing a person's risk preferences.

One aspect of demographic analysis that hasn't been specifically studied from the angle of explaining risk tolerance is religiosity. Religiosity has been looked at from the causal standpoint of how risk aversion affects the religiosity of a person, but there is no current literature trying to link the religiosity of a person as a cause in their risk tolerance in other areas besides the spiritual.

Alan S. Miller and John P. Hoffmann indicate in a recent paper that religious behavior can be seen as risk averse preferences and nonreligious behavior as risk taking preferences. They also determined that risk preference is not only a predictor of risk tolerance between gender groups, but also within each gender.[6]

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[5] Grable, John E. and Lytton, Ruth H. Investor Risk Tolerance: Testing The Efficacy Of Demographics As Differentiating And Classifying Factors. *Financial Counseling and Planning*. Volume 9(1), 1998.

[6] Miller, Alan S. and Hoffmann John P. Risk and Religion: An Explanation of Gender Differences in Religiosity. *Journal for the Scientific Study of Religion*. March 1995. Vol. 34. Number 1. pp. 63-75.

Another study, by Andrew M. Greeley, also indicates that religious behavior is the result of a general risk averse tolerance position.[7] Finally, in a paper by Joan Abbott-Chapman, and Carey Denholm, connections between youth risk patterns and youth religious tendencies were connected to conclude that high levels of religiosity were positively correlated with high levels of risk aversion, particularly in areas such as risks to health and safety.[8] But the causal direction suggested in the study was that the risk aversion was causing the high level of religiosity.

These findings will be expanded on in this paper, particularly where causal patterns are concerned. Using a signaling variable, this study seeks understand whether risk aversion, already present in an individual's decision patterns, is causing high levels of religiosity, or vice versa.

The methodology used in this study was a survey methodology. The survey instrument was a combination of pair-wise comparison questions and direct contingent valuation questions. These questions were used as measures of risk preference. The methods were borrowed from the basic tenets of an article by Kip Viscusi, where he rated the different risk preference data gathering methods, particularly with regard to survey methodologies.[9]

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[7] Greeley, Andrew M. and Durkin, John T. A Model of Religious Choice Under Uncertainty On Responding Rationally to the Nonrational. *Rationality and Society.* 1991. Vol. 3. Number 2. pp. 178-196.

[8] Abbott-Chapman, Joan and Denholm, Carey. Adolescents' Risk Activities, Risk Hierarchies and the Influence of Religiosity. *Journal of Youth Studies.* September 1, 2001. Vol. 3. Number 3. pp. 279-297.

[9] Viscusi, Kip W. The Value of Risks to Life and Health. Journal of Economic Literature. December 1993. 31:4

The pair-wise risk comparison questions were designed to put respondents in a given situation of risk and uncertainty and to provide them two choices, one choice being more risk seeking, the other choice being more risk averse. Several of these questions were asked in succession and from them some level of risk tolerance could be inferred. The direct-contingency questions offered respondents a change in some risk level, usually dealing with risk to safety and health, and asked the respondents what they would be willing to pay for such a decrease in risk. These "willingness-to-pay" questions were very useful in evaluating different levels of risk tolerance between demographic groups.

Demographic information was gathered from respondents using primarily categorical variables. Gender, Income level, Age, Religiosity and other demographic characteristics were all considered and broken down into different categories, wherein analysis of variance could be done by these different groupings.

One variable distinction that is especially unique to this study is what is called a signaling variable. This variable measured the point at which the demographic information was collected from the respondent. It measured this through use of two separate, yet equal survey types. One type, version A, asked all of the demographic information in the beginning of the survey, while a second, version B, asked all of the demographic information at the end of the survey. The difference between the two surveys was only found in this arrangement of questions; all of the questions asked and possible answers were exactly the same otherwise. This signaling variable provided some useful insights

into the impact of demographic signaling into the risk analysis thought process of an individual.

The data collected was gathered entirely from a student population at a regional university in Kentucky (Murray State University). Potential respondents were sought in four separate principles of microeconomics classes. All four classes were considered to be adequate representations of the student body at large being that principles of microeconomics is a university course elective and a university course requirement for a wide cross-section of major disciplines. This cross-section was confirmed when 48% of respondents were non-business majors.

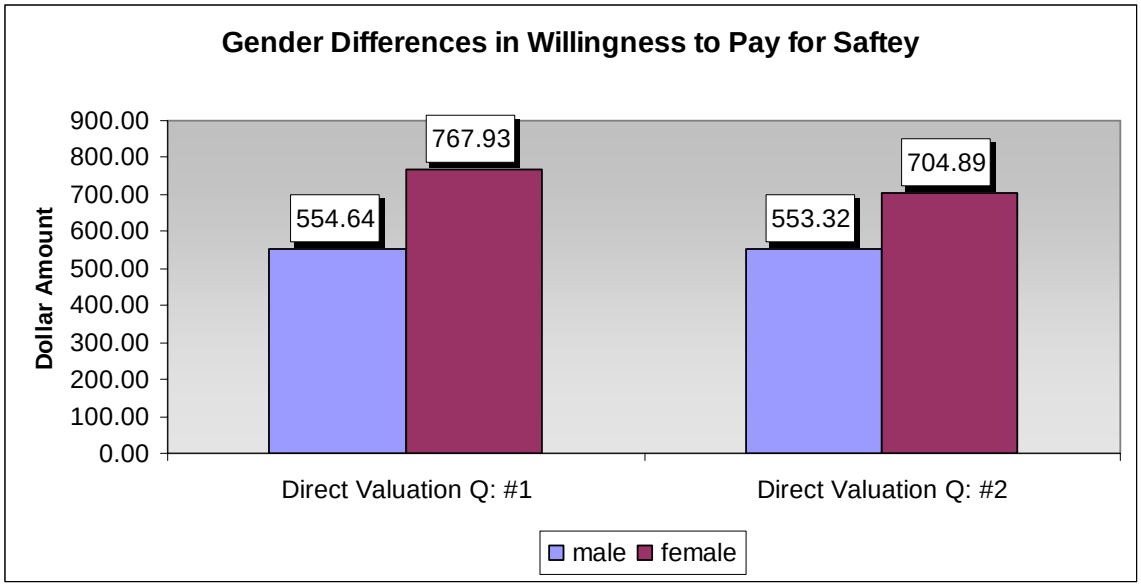
The data collection process gathered 190 survey respondents, 51% of which were male and 49% were female. These percentages, along with the business percentage indicators gave strong evidence of the potential usefulness and lack of bias of the data collected.

The results of this research showed statistically significant differences in risk tolerance between and within varying demographic groups. The main tool for assessing differences in risk tolerance was the direct contingent valuation method, used mainly for ease of estimation. Respondents were grouped into categories by how they answered the demographic section of the survey and group averages were taken of their willingness-to-pay for varying safety levels. These averages were statistically tested for differences using a two-tailed T-Test.

Significant differences were found among three main groups of interest; gender, income and religiosity. Females were hypothesized to be more risk

averse than men based on previous literature. Risk aversion was measured by how much a group was willing to pay for safety on average. High dollar amounts indicate that a particular group values safety highly and thus is more risk averse. The opposite is true for low levels of willingness-to-pay. In Figure 2 we see the different levels at which males and females were willing to pay for safety for two separate valuation questions. The female willingness-to-pay averages were statistically higher than the male averages at a 95% Confidence Interval using a two-tailed T-Test.

Figure 2

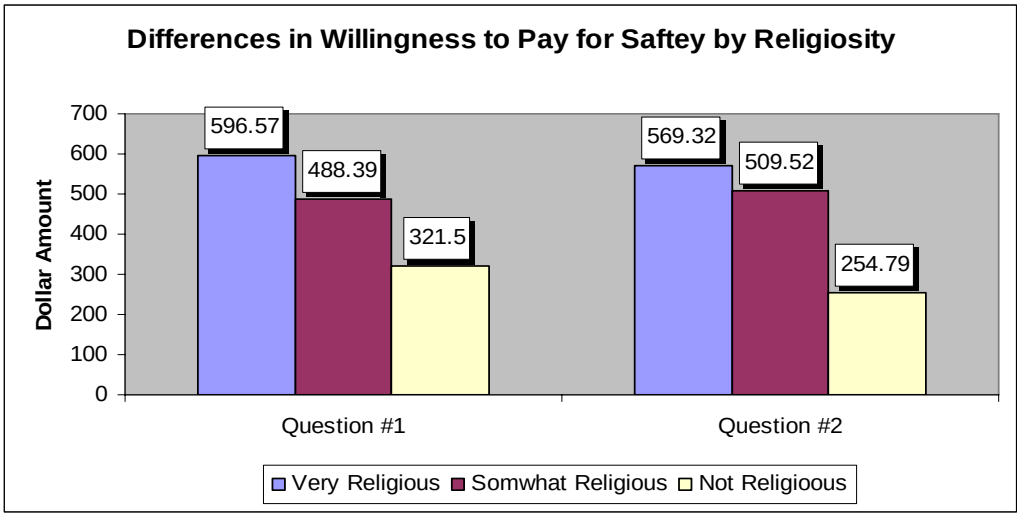


Significant differences were also found between different levels of income groups. The general hypothesis regarding these groups would be that the higher the income level of an individual, the higher the value that individual would place on safety. The logic is that safety is seen as a normal good, and therefore is

consumed more at higher income levels. Respondents indicating that they viewed themselves as middle-class were on average willing to pay for safety at levels over $310 while respondents viewing themselves as lower-class valued the same safety at less $280. Although these differences are smaller than the ones present between gender, the differences still follow the same pattern that one would expect between demographic groups.

Finally, respondents' religiosity showed statistically significant differences between each of three groups, labeled within the survey as *Very Religious*, *Somewhat Religious* and *Not Religious at All*. The results are shown in Figure 3. It is obvious that there is a distinctive pattern between risk attitudes and religious groups. The highest level of religiosity seems to be positively correlated with higher levels of risk aversion. This fits fairly adequately with previous literature suggesting that more risk averse people will be more religious. Interesting however is the seemingly symmetrical pattern with which willingness-to-pay for safety seems to decrease as levels of religiosity drop. This pattern is intuitively not complicated seeing that it is just a continuation of the previous hypothesis.

Figure 3



These differences in risk preference between demographic groups are clear indications that demographic influences impact individual decision making in situations of risk and uncertainty. But besides differences *between* groups, differences were also found *within* groups through use of the signaling variable.

Within the gender demographic group there was clear evidence that two separate groups of females responded completely differently to risk. One group had been randomly given Survey A, where the demographic information was asked in the beginning of the survey (thus forcing them to think about their demographic influences) while the other half were randomly given Survey B, which had the demographic questions at the end of the survey. Intuitively, one would think that these two groups would respond the same regarding risk preference, with maybe some sampling variability. However, the female group that took Survey A turned out to be more risk averse than those females that took Survey B, at a statistically significant level, using the same two-tailed T-Test. This indicates that there is more than sampling variability going on, and some demographic thought process is dominating the risk preference mechanism. This same phenomenon occurred within the income groups as well, with middle-class respondents who took Survey A being more risk averse than middle-class respondents who took Survey B.

Religiosity was also interesting in that the Very Religious respondents who took Survey A were more risk averse to a statistically significant point than other Very Religious respondents who took Survey B. This can be seen in

Figures 4 & 5. Figure 4 shows the distribution of the willingness-to-pay by survey. Survey A follows the distribution we would expect, with Very Religious respondents desiring more safety and with less religious groups desiring less safety. Survey B's distribution of willingness-to-pay is almost uniform, i.e. all three groups were willing to pay roughly the same amount for safety when they weren't forced to think about their religiosity before they made their decisions about risk preferences. This is significant evidence to support the fact that demographic signaling plays role in risk preference decisions on the individual level. Figure 5 shows the statistical differences present between the different Very Religious groups as well as the varying levels of willingness-to-pay from the other religious groups as well.

Figure 4

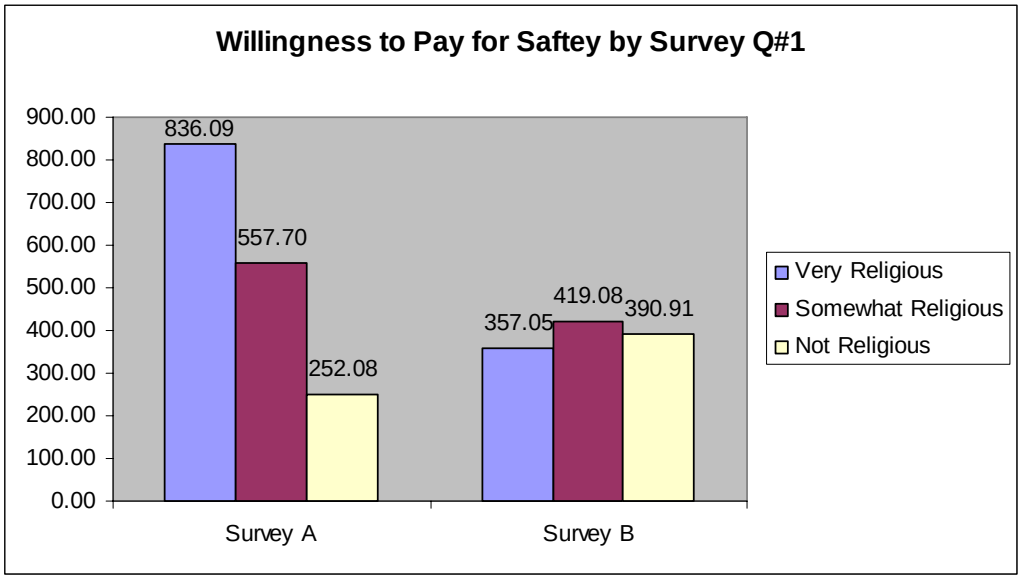
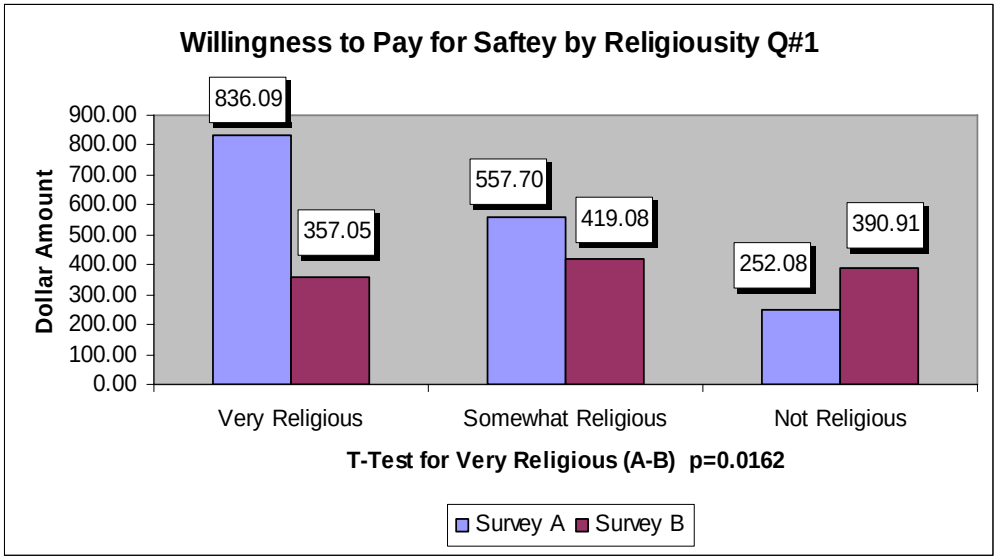


Figure 5



These results show that different demographic groups can easily be classified into varying levels of risk preference simply based on categorical information. Females were more risk averse than males, middle-class respondents were more risk averse than lower-class and high levels of religiosity were correlated with higher levels of risk aversion. These facts would be useful, not as a final analysis tool in examining individual risk preference, but clearly as a starting point in understanding how different groups of people behave under conditions of risk and uncertainty. Also, these facts lend credence to the idea that when considering the editing phase of individual risk analysis as discussed in Prospect

Theory, demographic influences can be reliable tools in breaking down individual risk choices.

Besides the blanket evaluation between demographic groups, it is also obvious that signaling plays a role. Signaling in a market generally offers one party some subtle information that helps them make a more informed strategic decision. The results of demographic signaling can be seen in this study, but the causes are not as clear. Respondents who were forced to think about their demographic background were much more prone to act in the "socially acceptable" way, or in other words were more likely to do what was expected (i.e. females are expected to be more risk averse, higher income individuals are suppose to buy more safety, ect.). Society, through media outlets and socio-economic circumstance, place various values on groups of people that can affect how people act. This could potentially be what is affecting individual risk preferences when individuals are cued into a certain demographic thought process.

This signaling evidence also suggests certain implications about causal direction of risk aversion and demographic choices, such as religiosity. It has generally been thought that risk aversion, already present in a person's thought process, is what forces many to choose higher levels of religiosity. However, evidence in this study suggests that there might not be such a clear distinction. If risk aversion was causing higher religiosity, then the risk aversion should have stayed the same within the Very Religious Group, despite what survey they took. This of course is not what we saw, indicating that some influence from the

demographic (in this case religiosity) was at least partially influencing the risk preference (in this case aversion) of an individual.

Further analysis of these findings should be done from a more mathematical approach, using value functions and model building that include both demographic and signaling variables. Areas of possible extensions are insurance markets and portfolio management assessment.

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