The Effects of Varying Degrees of Risk Aversion on Long-Term Aggregate Wealth

I. Introduction

Psychologists and sociologists have long studied the formation of preferences and beliefs, developing an abundance of evidence illustrating risk preferences of individuals differ significantly. Under expected utility theory, the idea that subjective values associated with an individual’s gamble is the statistical expectation of the individual’s valuations of the outcomes of that gamble, risk preferences can be modeled (using utility functions), specifically risk-aversion. Risk preferences can be evaluated in three buckets: risk-averse, risk neutral, and risk loving.

An individual is risk-averse if they prefer a certain payoff to any risky prospect that is lower than the expected value of the risky prospect; the difference between the certainty equivalent and the expected value of the risky prospect is called the risk premium. In contrast, risk-loving individuals require a certainty equivalent valued higher than the expected value of the risky prospect. Risk-neutral individuals seek to maximize the expected value of the risky prospect. Often risk aversion preferences change within the wealth-domain. Changes in one’s risk-aversion preferences can be measured by absolute or proportional (relative) changes in wealth.

This paper will seek to examine the impact of risk preferences on the long-term accumulation of wealth. Wealthier investors are found to be more risk-averse (Paravisni, Rappoport, Ravina). This paper will aim to add to the existing literature in three ways: (1) determine if varying degrees of risk-averse preferences impact the building long-term wealth (i.e. is there a point where risk aversion hinders wealth accumulation), (2) develop theories on optimal portfolio choices based on risk preferences and holdings, and (3) determine the differences risk aversion preferences cause on accumulating wealth for different initial wealth brackets. Past literature indicates there is correlation between risk-aversion and wealth (Iglesias, Goncalves).

It is hypothesized that those who are risk-averse when young will accumulate more wealth over time than there less risk-averse counterparts; although a caveat exists: there will be an inflection point where individuals who are too risk averse will generate less long term wealth than their counterparts. It is anticipated that individuals who show high degrees of risk aversion will be too concerned with the risk of their choices, missing out on opportunities to grow their wealth, while those who are risk-averse enough will make prudent, cautious decisions in their route to wealth accumulation.

This paper may impact both financial advice and economic policy: (1) the portfolios of investors who are risk averse can be studied and utilized to offer guidance towards the creation of indices and portfolios, and (2) during times of financial crisis, governments may lean on more strict monetary policy. Utilizing the VIX index, a stock market option-based implied volatility, which strongly co-moves with measures of monetary policy stance, lax monetary policy has been shown to decrease risk aversion (Bekaert, Hoerova). If risk aversion appears to be a driver of long-term wealth accumulation, the tightening of monetary policy may be implemented to increase long-term wealth.
II. Literature Review

An important piece of literature demonstrating the feasibility of calculating risk-aversion coefficients through panel data is Young-II Kim and Jungmin Lee’s work, *The long-run impact of a traumatic experience of risk aversion*. Their addition to the risk aversion literature finds that traumatic experiences (the Korean War) have a long lasting impact (an increase) on risk preferences for those aged four-eight during the Korean War. The two author’s utilize five hypothetical lottery questions from the Korean Labor and Income Panel Study (KLIPS) to approximate changes in risk aversion coefficients from 1950 to 2004. The duo of economists use both structural and reduced form estimates to value risk aversion parameters. These estimates, combined with a log-likelihood model are used to calculate the probability of choosing the lottery choice with the higher expected value, enabling one approximate risk aversion coefficients. A difference in difference analysis allowed Kim and Lee to avoid cohort effects based on the intensity of the war; the two found those who resided to more severely damaged provinces during the Korean War were more risk averse in the long-term.

Another piece of literature that examines calculating risk-aversion coefficients through the use of panel data is Matthew Shapiro’s *Risk Preferences In the PSID: Individual Imputations and Family Covariation*. The literature examines relative risk tolerance based on survey questions about hypothetical gambles over lifetime income. The paper examines the use of preference parameters in regression models to control for differences in preferences across individuals; by studying the covariation of risk preferences amongst household members, strong covariation in attitude about risk is found. Strong covariation exists between parents and children, siblings, and spouses. Shapiro’s paper used a noisy log risk tolerance model where the log of the risk parameter is assumed to be normally distributed. To account for variance, Shapiro estimate the variance for the PSID data by using samples from Health and Retirement Study (HRS). Both pieces of literature utilizes a utility function that demonstrates constant relative risk aversion. Similarly, Shapiro used a probability model to determine the chance of selecting the lottery option with the higher expected payoff.

III. Data & Empirical Strategy

The following paper will examine Michigan University’s Panel of Income Dynamics (PSID). Panel data will be utilized from the years 1996 and 2017. In 1996, individuals were asked 5 hypothetical lottery questions to determine risk aversion preferences:

<table>
<thead>
<tr>
<th>Question Number</th>
<th>Option A (safe choice)</th>
<th>Option B (risky choice)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Keep Current Income</td>
<td>½ Keep Current Income, ½ Lose 1/3 Current Income</td>
</tr>
<tr>
<td>2</td>
<td>Keep Current Income</td>
<td>½ Double Current Income, ½ Lose ½ Current Income</td>
</tr>
<tr>
<td>3</td>
<td>Keep Current Income</td>
<td>½ Double Current Income, ½ Lose 20 % Current Income</td>
</tr>
<tr>
<td>4</td>
<td>Keep Current Income</td>
<td>½ Double Current Income, ½ Lose 10 % Current Income</td>
</tr>
<tr>
<td>5</td>
<td>Keep Current Income</td>
<td>½ Double Current Income, ½ Lose 75 % Current Income</td>
</tr>
</tbody>
</table>

Risk aversion coefficients will be calculated, and the accumulated of wealth will be tracked based on varying degrees of risk-aversion. Long-term will be considered the twenty year time horizon in-between 1996 and 2017.

To examine the impact of risk-aversion on long-term wealth accumulation, structural estimation will be used to approximate the risk aversion parameter for our main analysis. The structural analysis will assume a constant relative risk aversion (CRRA) utility function.
The risk aversion parameter $\gamma$ and the structural noise parameter $\mu$ will be estimated. The heterogeneity of parameters will be accounted for by controlling for individual characteristics such as age, gender, education, marital status, and household income. White’s standard errors will be used as well. Using the structural estimates, a log-likelihood model will be constructed to predict the probability of one choosing the lottery choice with a higher expected payoff. As one’s risk aversion parameter $\gamma$ approaches one, this will signal a less risk averse individual. The indexes in the model below, i and j, represent individuals and lottery questions respectively. $y_i^j$ represents the choice of Option A or Option B from the hypothetical lottery. $X$ represents the vector of control variables.

$$
\ln L(y, \mu; y, X) = N_i \sum_j [\ln (\text{VEU}|y_i^j = 1) + \ln(1 - \text{VEU})|y_i^j = -1)]
$$

The equation below represents the standard OLS and White’s corrected multivariate regression model that will be utilized to predict risk aversion parameter’s impact on wealth accumulation. A difference in difference method will be utilized to compare if age plays any role as well. $T_i^{a,b}$ will represent if there is any age impact between the different risk aversion cohorts on wealth accumulation. $W_i$ represents aggregate wealth.

$$
W_i = X_i \beta + \alpha_i T_i^{a,b} + \alpha_2 \text{Age}_i + \alpha_3 T_i^{a,b} \times \text{Age}_i + \epsilon_{ij}
$$

A key underlying assumption in the methodology is that the risk aversion coefficients of the individuals will stay relatively constant over time (CRRA).

IV. Limitations

The following literature may encounter some limitations given the nature of the panel data. Since only one year of panel data exists, where risk aversion is calculable, constant relative risk aversion will be assumed over time. Findings are conditional on risk aversion coefficients remaining relatively stable since 1996. Moreover, the variance in one’s risk-preferences cannot be accounted for due to one year of sample sizes. The final limitation involves removing the bias of control factors of individuals. Past literature indicates, background traits such as education can heavily influence risk preference; it is important to distinguish if other background factors are drivers of wealth accumulation. (Eckel and Grossman)

V. Extensions

This paper could be extended by evaluating risk neutral and risk-loving domains on long term wealth accumulation. Additionally, risk-aversion can be examined in different domains such as hypothetical lotteries involving services. Risk preferences are often domain specific; for example, most individuals are risk-averse in the domain of gains and risk-loving in the domain of losses. Individuals will wager more to avoid losing what they already have. Another interesting extension would involving examining if an individual can actively train their risk preferences to achieve better outcomes.
VI. References


