AN ANALYSIS ON THE SIGNIFICANCE OF PERSONAL CHARACTERISTICS AND MARKET EXPECTATIONS ON DETERMINING RISK TOLERANCE

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Abstract

To understand the significance of specific personal characteristics and market outlook expectations on risk tolerance, data from the 2019 Survey of Consumer Finances was evaluated. A multiple linear regression was run using risk tolerance as the dependent variable and the following independent variables: age, age2, dependents, gender, financial knowledge, education level, income, job status, marital status, expenses, expectations on market performance over the next five years, and expectations on market performance over the next year. The results of the regression showed that being male results in a significantly higher risk tolerance than being female. It also showed that risk tolerance decreases with age and increases with education level and financial knowledge. Being fully employed also resulted in a much higher risk tolerance score than those who are not fully employed. Risk tolerance also showed to increase with income and be higher for those who are married. The number of dependents was not shown to be significant in affecting risk tolerance. In regards to the effects of changes in market expectations, risk tolerance increased with those individuals who believed the market would perform better over the next five years relative to the past five. Risk tolerance also increased for those who believed the market would perform worse over the next year relative to the past year. Risk tolerance was not significantly affected by those who believed the market would perform worse over the next five years as well as better over the next year. This study indicated the importance of an individual's personal characteristics on determining their risk tolerance and provides clarity into why risk differs among investors.

KEYWORDS: (Risk Tolerance, Characteristics, Expectations)

JEL CODES: D81, D84

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Signature

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Part I: Introduction

Operating under uncertainty creates an element of risk for which an individual must evaluate. This situation causes unique decision-making to occur across individuals as each person perceives and responds to risk differently. Identifying the objective differences in choices and outcomes that occur across individual decision-making is an easy task, but identifying the causes of these differences is less simple. Why different people make the unique choices they do when operating under risk has been a widely discussed and debated topic that has left conflicting opinions on the root of this problem. These differences in decision-making have formed the discussion for the determinants of an individual's risk tolerance. Personal factors have been at the forefront of this conversation and have been used to differentiate risk tolerance across people. Another important and overlooked factor in this discussion is the importance of market behavior on an individual's decision-making and risk perception. The significance of specific personal characteristics on an individual's risk tolerance will be analyzed in this paper in addition to the impact that expectations on market outlooks have.

Prior research has shown that personal characteristics like gender, age, income, education, and others are significant factors in determining risk tolerance. Investment decisions are influenced by many different factors that lead investors to their choices. The personal characteristics of an investor are very closely tied to determining their decision-making because these characteristics often form the foundation on which investment choices are made. Risk tolerance is an extremely important factor that influences the decisions of investments and both the successes and failures that result from that. Classifications have been made to identify different types of investors and their

risk tolerances. They are known as risk-averse, risk-neutral, and risk-preferring. Each of these classifications is associated with a different risk preference and investment tendencies. Prior research has shown the importance of investigating personal characteristics like age, gender, employment, marital status, education level, income, and others in determining the risk preference and classification of that investor. This is extremely important to better understand why different investors make the decisions they do.

Financial risk tolerance refers to the amount of uncertainty or volatility an investor is willing to accept in their financial decision (Faff et al., 2008). It has been shown that risk tolerance is a variable that changes over time due to personal circumstances. Risk tolerance begins to shift for investors when their age increases. This is also true for younger investors being much more risk-tolerant. When looking at these changes it is very important to look at the future market expectations of the investor. Financial decisions are very closely tied to future market expectations. Investors will dictate their decisions based on how they expect the market to behave in the future. Changes in the economic climate will affect the outcome of investment choices. This is why forecasting future market behavior is crucial to financial planning and investment success. Understanding market expectations are extremely important in navigating the uncertainty of investment choices. Continuous changes in economic behavior has a strong impact on an investor's future expectations (Mahdzan et al., 2017). Changes in interest rates, inflation rates, and returns on assets are among the concerns of investors that influence their decision-making and risk tolerance (Ibid). Positive economic expectations will increase the likelihood of holding risky assets while negative economic expectations

will likely cause investors to save more and hold less risky assets (Ibid). This behavior is very connected with retirement planning which is heavily influenced by risk tolerance and future market expectations.

The factors that decide an investor's risk tolerance are extremely important to examine to identify reasoning for the differences among investor choices. This has begun to become an increasingly more interesting topic to investigate as investors today have more freedom to orchestrate their portfolio and retirement planning. This makes understanding the root of investment decisions much more critical as these decisions hold significant implications for the investor's future. Retirement planning is very closely tied to the individual's expectations of market behavior. This makes risk tolerance extremely important in the discussion of retirement planning. Many investors' risk tolerance shifts as they get older and approach their retirement. This causes them to adjust their investment strategies as they begin to reach a point where they can not afford to hold significant risk. The factors that influence an investor's risk tolerance also affect retirement planning causing this to be an extremely relevant piece of this discussion. Additionally, the changes in decision-making due to economic circumstances indicate an adjustment occurring in the individual's time horizon. The time horizon of each investor is important to recognize as it guides the investment strategies for their goals. This goes to show that the occurrence of either positive or negative market perceptions holds significant implications for the investment planning and long-term success of that individual.

When looking at the importance of understanding the determinants of risk tolerance and investment choices, retirement planning is crucial to the conversation

because the level of an investor's risk tolerance has critical implications for that individual's future. The growth in the number of retirement choices investors can choose from has come from many countries shifting away from defined benefit plans to defined contribution plans (Ibid). A defined benefits plan is a retirement plan where an employee receives a specific payment amount once they retire whereas a defined contribution plan is when an employee contributes money and their employer matches some of their contribution towards their chosen investment (Team, T. I. 2022). Defined contribution plans are becoming much more common and favorable among employees as it allows them the freedom to make their own investment choices. This makes the factors of education and financial literacy extremely important as individuals now have an increased responsibility to understand their financial options to make the best choices. Low financial literacy can cause individuals to plan poorly for their retirement. This causes individuals to be unable to maintain their pre-retirement standard of living because they lack the necessary income to sustain their lifestyle, sometimes forcing people to rely on welfare benefits (Mahdzan et al., 2017). This presents a very dangerous economic situation for countries with aging populations. That is why understanding the significance of factors like education level and others that contribute to risk tolerance are extremely important.

Investigating the significance of an investor's personal characteristics on their investment choices is necessary to understand the differences among investment choices. This is important because it can give insight into why some people have more financial success than others. This also can explain how some investors are more successful in

reaching their retirement goals than others. This is because it has been said among investment managers and financial professionals that demographic characteristics can be used to differentiate among investor risk tolerance and identify them into risk level categories (Anbar et al., 2010). The significance of these demographic characteristics on determining financial risk tolerance will be measured in this study. In addition, how financial risk tolerance is influenced by changes in market expectations over time will be examined.

Part II: Economic Theory

II.a: Expected Utility Theory

Investors make choices that they believe most maximize their utility. A balance between risk and the expected value of an investment is weighed by an investor in making their decision. Expected value is extremely important to this discussion and for understanding decision-making under uncertainty. The expected value of an investment is how much is expected to be earned. More specifically, the expected value is defined as the sum of the product of the probabilities and the value of each outcome (Perloff, 2013, p. 566). Looking at the expected value of an investment is crucial to decision-making as it provides insight into the future returns of that investment. However, investment decision-making is not solely driven by expected value and is largely influenced by the risk associated with the given investment. This is because most people are risk-averse, meaning they are less willing to engage with risk and will only choose a riskier investment choice if the expected value is significantly higher than the less risky option (Perloff, 2013, p. 569).

According to John von Neumann and Oskar Morgenstern, a rational person maximizes expected utility (Perloff, 2013, p. 569). This means that every person's maximum utility comes from a bundle between expected value and risk that is determined by their individual preferences.

$$EU = \sum_{i=1}^{n} \theta_i U(V_i)$$

This function demonstrates the expected utility from the probability-weighted average of the utility from the monetary value (Ibid). In this function, θ_i is the probability of the outcome, with V_i representing the value of outcome i, and U is the utility from V_i. Based on this equation, U increases with an increase in V_i, meaning that utility increases when the value of outcome i increases. In this equation, V_i is reflecting the earnings from the given decision which has a positive relationship with utility, indicating that as wealth increases (because earnings increase wealth) so does utility.

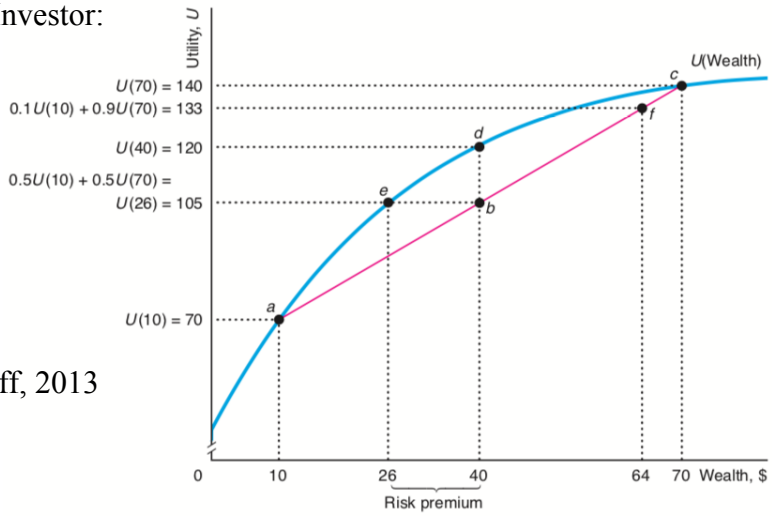
II.b: Risk Preference

Risk preference differs among investors based on their willingness to make a fair bet. A fair bet is classified as a bet in which you have a 50/50 chance of winning and losing and you will receive the same amount if you win that you would pay if you lose. (Perloff, 2013, p. 570). A common example of this is a coin flip, where there is an equal chance of it being heads and tails on each toss. The expected value of a fair bet is 0 because there is an equal chance of winning and losing the same wager. There are three classifications of investor risk preferences that can be identified through the fair bet

framework. The risk-averse investor is unwilling to make a fair bet because the expected value is 0 (Perloff, 2013, p. 570). The risk-neutral investor is indifferent about making a fair bet (Ibid). The risk-preferring investor is likely to make a fair bet (Ibid).

A risk-averse individual will have a diminishing marginal utility of wealth. This means that the individual's utility increases with wealth but at a diminishing rate. The amount of utility this investor receives from each dollar is less than the previous dollar. The utility function of the risk-averse investor has a concave relationship with wealth (Perloff, 2013, p. 570). The risk-averse investor will engage in the investment if their expected utility increases from the investment decision. The risk premium is important to look at when examining the risk-averse investor because it indicates the amount of excess return the investment would need to yield on top of the risk-free return for an investor to tolerate the risk (Perloff, 2013, p. 572). The risk premium reflects the difference between the expected wealth from the risky investment and the amount of certain wealth (Ibid). The risk premium is shown by the dotted line between 'e' and 'b' in the graph below. The risk premium is crucial in understanding the decision-making of risk-averse investors as it explains when these investors engage in more risky choices.

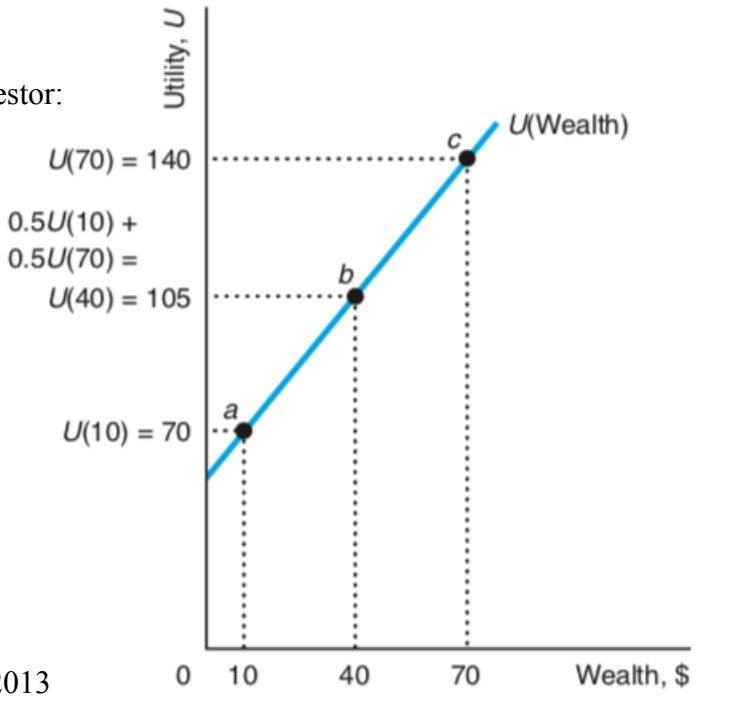
Risk-Averse Investor:



Source: Perloff, 2013

A risk-neutral investor is indifferent about engaging in a fair bet. This results in the risk-neutral investor having a constant marginal utility of wealth (Perloff, 2013, p. 573). The utility function of this investor reflects a straight diagonal line. This means that the risk-neutral investor receives the same amount of utility from each additional dollar they receive (Ibid). This constant relationship means that the utility function of the risk-neutral investor is entirely dependent on wealth and not influenced by risk (Ibid). This causes the risk premium for risk-neutral investors to be zero because they are willing to engage in a riskier decision if the outcome produces a higher expected value (Ibid). The expected value of the outcome is very important to the decision-making of the risk-neutral investor as they are primarily motivated by changes in wealth. This results in risk-neutral investors choosing the investment with the highest expected value as their maximum expected utility is driven by maximizing expected value (Perloff, 2013, p. 573).

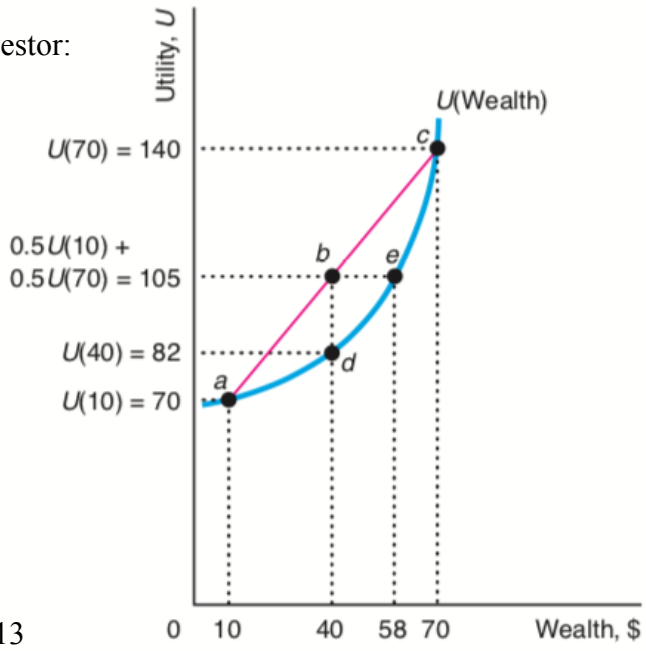
Risk-Neutral Investor:



Source: Perloff, 2013

An investor that is risk-preferring will have an increasing marginal utility of wealth (Ibid). This means that this person gains more utility for each additional dollar they receive. A risk preferring investor is willing to engage in a risky decision because the expected utility they gain from engaging in the decision is higher than the expected utility they receive from their certain amount of wealth. This results in the utility function for the risk preferring investor to be convex to the horizontal axis which in this context is wealth. A risk-preferring investor can have a negative risk premium because they are willing to pay a certain price to make a fair bet (Ibid). This negative risk premium reflects the price an investor is willing to pay to engage in a risky decision. The line between 'e' and 'b' in the graph below reflects the risk premium. The decrease in wealth from points 'e' to 'b' shows the negative risk premium. This aspect is extremely important in understanding the decision-making of investors and how they differ across risk preferences.

Risk-Preferring Investor:

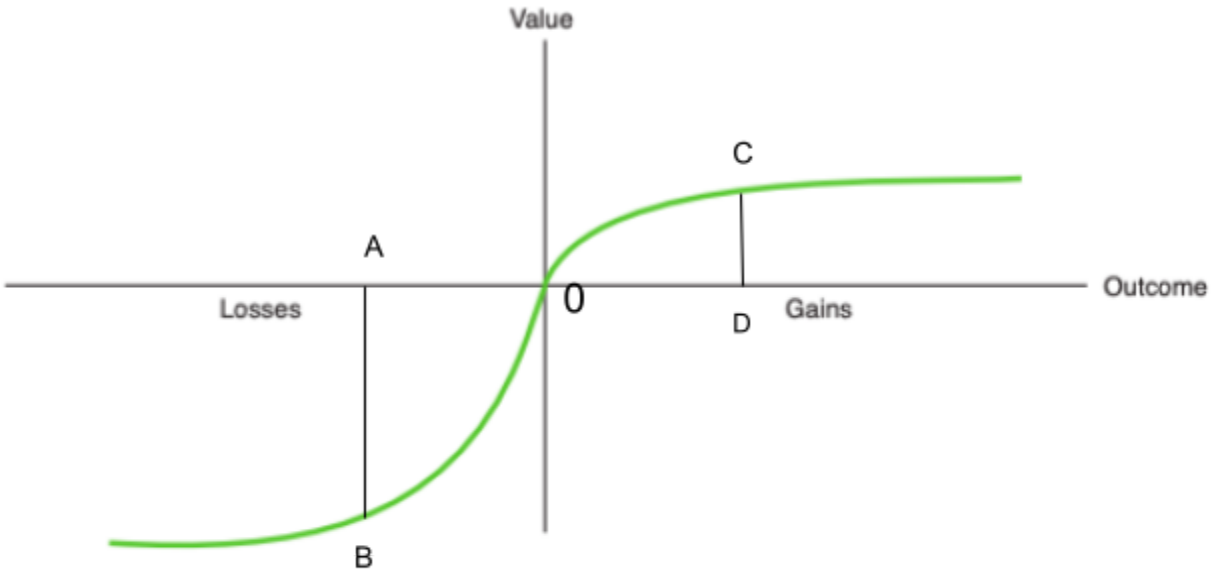


Source: Perloff, 2013

II.c: Prospect Theory

An additional theory that explains decision-making under uncertainty is prospect theory. This theory differs from expected utility theory and provides explanations for the situations where the framework of expected utility theory is violated. This is possible because prospect theory explains that people are concerned about the gains and losses from an investment, and the changes in their wealth that occur from that outcome (Perloff, 2013, p. 590). This is different from the expected utility theory where people's primary concern is the level of their wealth. The idea behind prospect theory is that people treat gains and losses differently (Perloff, 2013, p. 591). In making a decision using prospect theory, individuals place subjective weights on the likelihoods of the outcomes rather than using calculated probabilities (Ibid). This can be visualized through the shape of the prospect theory value function. As seen below, the curve follows an 'S' shape, passing through the origin which is referred to as the reference point. The reference point is extremely important to the construct of prospect theory and one of the main ways it differs from expected utility theory. The gains and losses are treated relative to the reference point rather than a certain level of wealth as used in expected value theory.

Prospect Theory Value Function: $A0 = 0D \;\&\; AB > CD$



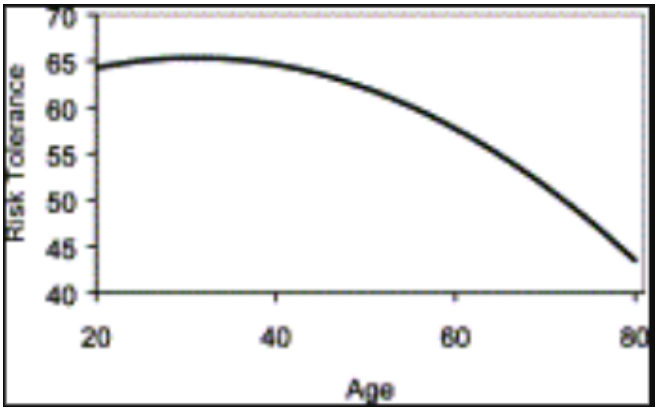
Source: Perloff, 2013

The significance in understanding prospect theory is that people react differently to losses than gains. The prospect theory value function curve shows that there is a greater value on losses than there is on gains. This indicates a loss aversion tendency by investors which means that they dislike losses more than they like gains (Perloff, 2013, p. 591). The differences in how individuals approach decisions that concern losses and gains are extremely important in understanding an individual's risk perception. It has been shown that investors are often more risk-averse in decision making that involves gains and more risk-preferring in decisions concerning losses (Perloff, 2013, p. 581). This is known as the "reflection effect", where risk tolerances are reversed for gains and losses (Ibid). This is extremely important to further understanding an individual's decision-making involving risk and the factors that influence those choices.

Part III: Literature Review

III.a: Age

One of the primary personal characteristics that determine an investor's risk tolerance is age. Risk tolerance is higher for younger investors because they have more time to recover from potential losses of high risk. Older investors are less willing to take on financial risk as they age because they have less time to recover from losses associated with risky investments (Anbar et al., 2010). As investors approach closer to their retirement age, their investments shift to less risky assets to ensure they can maintain their desired wealth into retirement. The relationship between age and risk tolerance is non-linear (Ibid). This means that risk tolerance increases with age and eventually decreases. Age and risk tolerance have been shown to have a concave relationship as seen below (Hallahan et al., 2003). A quadratic relationship has been found between age and risk which can be seen in the chart below. This shows risk tolerance increasing with age to a point, and then decreasing continually.



Source: Hallahan et al., 2003

This chart shows that risk tolerance is high during the earlier years between 20 and 40 and begins to decrease as age increases (Hallahan et al., 2003).

III.b: Gender

Gender is another personal characteristic that has been heavily discussed in the conversation of risk tolerance determinants. It has been found that women are more risk-averse than men and that gender is a significant predictor of financial risk tolerance (Anbar et al., 2010). Gender has been shown to have a strong relationship with risk tolerance as studies have shown men and women to weigh risk differently. Women have been shown to weigh the probability of loss and ambiguity heavier than their male counterparts (Olsen et al., 2001) Women have also been shown to emphasize risk reduction in their portfolios more so than men (Ibid).

Additional literature has shown that the differences seen in the financial risk tolerances between genders are due to the individual circumstances of that person. Individual variables such as income uncertainty and wealth have been shown to impact risk tolerance differently for men and women (Fisher et al., 2017). This study is meaningful because it shows that the differences between risk tolerance of men and women are not due to gender in itself, but rather because of how men and women respond to economic and demographic characteristics differently. Income uncertainty is shown to have a negative effect on risk tolerance for women and a positive effect on the likelihood of men having some risk tolerance (Fisher et al., 2017). It has also been found that women are less willing than men to engage in risky tournament-style compensation

schemes (Niederle et al., 2007). These differences are very important to the discussion of risk tolerance as they provide insight into the financial decision-making tendencies between genders. Additionally, this holds impacts on the retirement security between genders.

III.c: Education

Education level has been a widely discussed factor that has been argued to be a significant determinant in an individual's risk tolerance. Increased levels of education are associated with higher levels of risk tolerance (Larkin et al., 2013). Financial education is very important for forming investment strategies and attaining financial goals. Successful investment strategies are dependent on proper financial education. Less educated investors are less risk-tolerant than higher educated investors and base their investment choices on personal circumstances rather than financial reasoning (Cavazzelli et al., 2015). Higher levels of education have been shown to produce higher levels of financial literacy which translates to more advanced risk management strategies such as portfolio diversification (Ibid). Diversification of investments is extremely important for managing risk and optimizing investment goals. Past research has largely agreed and shown a consensus that education is significant in determining an individual's risk tolerance and holds a positive relationship. More educated investment managers have also shown to be more willing to engage in riskier investment strategies than less educated investment managers (Andreu et al., 2019). Additionally, the funds of the more risk-tolerant investment managers have been shown to perform higher than the funds of less risky managers (Ibid).

On the other hand, there have been conflicting opinions in past research on the significance of financial literacy in affecting an individual's risk tolerance. Financial literacy has been shown to not hold a significant effect on risk tolerance unlike education (Cavezzali et al., 2015). Part of the difficulty in comparing the significance of financial literacy and education on risk tolerance is that financial literacy is a more or less subjective assessment of yourself, whereas education level is completely objective. The objective characteristics and factors allow for more straightforward analysis and eliminate issues of bias. There have been studies that have provided other opinions on the effect of education on risk tolerance. Higher educated individuals tend to avoid more risk according to a study by Harrison et al. In addition to this, education did not show to have a significant effect on risk tolerance during a study by Hallahan (2003).

III.d: Income

Income is an extremely important factor in the discussion of personal finance. This is because disposable income is necessary to be able to invest and save your money. An individual who does not have high enough income will be forced to consume their earnings on daily consumption and be unable to invest any savings in profitable opportunities in the market (Kumar et al., 2015). Adequate savings are essential to be able to engage in investment opportunities and to obtain necessary saving amounts, income will need to be high. This reflects a positive relationship between wealth and risk tolerance (Ibid). Wealthier individuals have a higher capacity for risk tolerance because they have more savings to compensate for potential losses (Ibid). More specifically, it has been found that total family income and net assets in addition to personal income are

significant predictors of risk tolerance and hold a positive relationship (Anbar et al., 2010).

However, Faff et al. found that income can have a negative relationship with risk tolerance. Their study showed that individuals with lower income can be more willing to take higher risks to achieve greater wealth (Faff et al., 2008).

III.e: Marital Status

Marital status is an important factor when looking at financial risk tolerance as marriage creates joint incomes that can alter the budget constraints of households. Despite marriage often allowing for higher household income, literature has predominantly found marital status to be insignificant in affecting the risk tolerance of an individual (Anbar 2010, Hallahan 2003, Gumus 2015). On the other hand, it has been said that the risk tolerance of married investors is dependent on their age group (Chaulk et al., 2013). Younger married couples have shown to be less risk-tolerant than unmarried individuals in their same age group (Ibid). Additionally, older married couples were found to be more risk-tolerant than unmarried individuals in their same age group (Ibid).

III.f: Dependents

The existence of dependents in a household is associated with a lower risk tolerance compared to individuals with no dependents (Chaulk et al., 2013). This can be explained by individuals with dependents requiring a more guaranteed return on their investments as they have more financial responsibilities because of their dependents

(Ibid). This relationship was reversed in the high-income group, where investors with dependents were more willing to engage in risk (Ibid). Additionally, the existence of dependents showed no effect on risk tolerance for older households compared to their counterparts with no dependents (Ibid). A non-linear relationship between risk tolerance and dependents has shown to exist with risk tolerance decreasing at a decreasing rate as dependents increase and decreasing at an increasing rate as age increases (Faff et al., 2009). This causes dependents to show a quadratic association with risk tolerance over time (Ibid).

III.g: Employment

An individual's employment is another important characteristic to examine when discussing personal risk tolerance. It has been found that individuals who are employed are more risk-tolerant than those who are not (Anbar et al., 2010). Employment is extremely important to an individual's investment decision-making because it establishes a given level of financial security allowing individuals to engage in risk. Additionally, the level of an individual's employment has also been found to be foundational in an investor's risk tolerance. Investors who are employed in a profession that requires a higher level of financial expertise have been shown to exhibit a higher level of risk tolerance than those who are not employed in a field with high expertise (Gumus et al., 2015). These investors use their expertise from their employment field to conduct financial decisions and often lead to them engaging in riskier investments (Ibid).

III.h: Market Expectations

Changes in market expectations are extremely important to look at as they impact the outcome of investment decisions. Changes in the market like interest rates, inflation, and asset returns affect the risk associated with each investment (Mahdzan et al., 2017). High inflation can result in investors experiencing negative real returns on their savings (Ibid). This then can negatively impact the incomes of investors, leading them to be less willing to engage in risky investment choices (Ibid). On the other hand, positive market expectations will increase an investor's willingness to hold risky assets that can bring a greater return, therefore positively affecting the investor's risk tolerance (Ibid). It has been found that positive return expectations cause equity purchases from investors to increase (Merkle et al., 2014). Following market volatility, investors adjust their portfolio allocation to counteract the market changes (Ibid). This behavior alters the risk tolerance of the portfolio and therefore the investor. It has also been found that risk tolerance is positively related to previous investment performance as well as market expectations (Gibson et al. 2013). This is because positive market conditions and investment success predominantly go hand in hand with each other, as investment success is based on the market's performance. Additionally, positive investment performance will increase the confidence level of that investor, inclining them to engage in similar decisions in the future. This will therefore increase the risk tolerance of that investor as they now have a higher level of confidence in their investment decisions from their previous success.

Part IV: Model

IV.a: Overview

To discover the significance of specific personal characteristics and changes in market outlook on an individual's risk tolerance, a study was conducted to evaluate the chosen variables. The data used in this study was compiled from the 2019 Survey of Consumer Finances. This survey contains data from families in the United States regarding demographic characteristics, income, and balance sheet questions (Survey of Consumer Finances). Select portions of this dataset were used in the execution of the following model and analysis.

The goal of this model was to evaluate the significance of specific factors on an individual's risk tolerance. To accomplish this, a multiple linear regression was used to examine the relationship between risk tolerance and the chosen variables from the dataset. A breakdown of the dependent and independent variables can be seen below in addition to the model shown in the form of a function.

Dependent Variable: Riskscore

Independent variables: male, age, age2, married, dependents, knowledge, expenses, income, education, employed, better5, better1, worse5, worse1

$$Riskscore = f(male, age, age^2, married, dependents, knowledge, expenses, income, education, employed, better5, better1, worse5, worse1)$$

IV.b: Description of Variables

The dependent variable *riskscore* is the label used for the measure of risk tolerance in this study. The dataset produces values between '-1' and '10', with '-1' meaning the respondent is not at all willing to take on financial risk and '10' meaning the respondent is very willing to take on financial risk. The value of the dependent variable is dependent on the measures of the independent variable. That is why *riskscore* is the dependent variable in this study to achieve the goal of evaluating its most significant predictors.

Fourteen independent variables were used in this study. Of those variables, several are personal characteristics, personal finance measurements, and economic indicators. The first independent variable, *male,* was a dummy variable produced from the preexisting *sex* variable in the original dataset. Only *male* was used in this study to avoid a collinearity issue resulting from the inclusion of both *male* and *female* in the regression. Both of these terms showed to be perfectly collinear because they were both dummy variables produced from the same original *sex* variable.

The next two variables used, *age* and *age2*, showed the age of each respondent in the dataset. The variable *age2* is the squared value of *age.* This variable *age2* was used in addition to *age* to correct for the quadratic relationship that has been found between age and risk in previous studies in order to produce accurate results in the linear regression. In addition to these variables, marital status was included in the study with the label *married.* The variable *dependents* was used to show the number of financially dependent people in a household. The data from this variable was pulled from the *PEU* variable in the dataset. This stands for "primary economic unit" and reflects the total number of

people in a household that are not financially independent with the inclusion of the primary financial supporter of the household. This causes the values for *dependents* to range from '1' to '12' because at the minimum there will always be at least one person in the primary economic unit which is the respondent.

The variable *employed* was included to differ between risk tolerances amongst individuals who are employed and unemployed. *Employed* was a dummy variable that was created from the pre-existing *jobstatus* variable in the original dataset. A dummy variable was used for this instance to simplify the data associated with the original job status variable to now only reflect either "employed" or "unemployed". It is important to note that the data for the unemployed term includes everyone who is not fully employed. This includes respondents who are retired or unable to work.

The variable *knowledge* refers to the respondent's level of knowledge about personal finances. This variable ranges from the values '-1' to '10' with '-1' reflecting that the respondent is not at all knowledgeable about personal finances and '10' reflecting that they are very knowledgeable about personal finances. In addition to this variable, *education* was included in the model to represent the respondent's level of education.

The variable *income* was included in the model. This variable reflects each respondent's total household level of income (for the 2018 year) before taxes and deductions. In addition to *income,* the level of the respondent's expenses was included in the model. *Expenses* reflect respondents whose spending exceeded their total income for that year. It is important to note that the spending that is recognized in this variable does not include any spending on purchases of a new home, automobile, or investments.

The last four independent variables concern future market outlooks. The variables *better5* and *worse5* reflect how the respondent expects the economy to perform over the next five years relative to the past five years. Both of these are dummy variables. The variable *better5* reflects that the respondent expects the economy to perform better over the next five years than it has over the last five. *Worse5* reflects that the respondent believes the economy will perform worse over the next five years. The other two variables, *better1* and *worse1,* follow the same structure as the previous two variables except they are regarding the market outlook over the next year relative to the past year. The term *better1* means that the respondent believes the economy will perform better next year than it did the past year. The term *worse1* means that the respondent believes the economy will perform worse over the next year than it did the past year.

IV.c: Summary Statistics

The following page contains data on the summary statistics of the variables used in the model. The left column of the chart contains the names of all of the variables. The chart includes the total number of observations in the dataset for each variable which reflects the total number of respondents involved in the study. In addition to these, key summary statistics are included to provide insight into the responses of the study and a general overview of the respondents' characteristics and answers. The table below contains each variable's mean, standard deviation, and the minimum and maximum values of the recorded responses.

Variable	Obs	Mean	Std. dev.	Min	Max
riskscore	28,885	4.726294	2.936137	-1	10
male	28,885	.7761814	.4168091	0	1
dependents	28,885	2.372685	1.360881	1	12
age	28,885	53.21984	16.24365	18	95
age2	28,885	3096.198	1747.677	324	9025
married	28,885	.5379955	.4985629	0	1
better5	28,885	.3344296	.4717989	0	1
worse5	28,885	.2709711	.4444689	0	1
worse1	28,885	.2053661	.4039759	0	1
better1	28,885	.2369742	.4252337	0	1
knowledge	28,885	7.388991	2.177354	-1	10
education	28,885	10.24739	2.700152	-1	14
employed	28,885	.6472217	.4778427	0	1
income	28,885	137972.6	803983.6	0	4.50e+07
expenses	28,885	.0167215	.1282281	0	1

The summary statistics chart shown above reflects that there are 28,885 observations for each variable. This means that 28,885 respondents were questioned in the study. Looking at *riskscore*, the mean value of 4.726 reflects the average value of all of the responses in the survey. Keeping in mind that the values for *riskscore* range from -1 to 10 which is seen through the min and max values in the chart, a mean of 4.726 indicates that on average all of the respondents are slightly more risk-averse than not. The standard deviation tells us how dispersed the data is from the mean. The value 2.936 is the measure of one standard deviation for *riskscore.* One standard deviation from the mean will contain 68% of all the values for that given variable. This means that 68% of all the values for *riskscore* will be between 1.79 and 7.65.

The mean value for *male* is equal to 0.776. This means that 77.6% of the respondents in the survey were male and 22.4% were female. This indicates that of the 28,885 participants in the survey, 22,414 were male and 6,471 were female.

The variable *dependents* showed a mean value of 2.373. The min and max values for *dependents* range from 1 to 12. This indicates that the base value for all responses is 1 which tells us that any value greater than 1 will show the number of dependents in that household. The mean value of 2.373 reflects that on average there were 1.373 dependents in a household. Additionally, the chart shows that one standard deviation for *dependents* is equal to 1.36. Since 68% of all the values in the dataset will lie within one standard deviation from the mean, it is evident that 68% of all the values for *dependents* will be between 1.013 and 3.733. This reflects that 68% of the respondents had between 0.013 and 2.733 dependents in their household.

The mean value for *age* is equal to 53.219. This reflects the average age of all the respondents in the study. The min and max is especially important to look at for *age* as it indicates the range of people that were involved in the study. The min for *age* is equal to 18 and the max is 95. The standard deviation for *age* is equal to 16.243. Based on the mean of 53.219, the one standard deviation indicates that 68% of all respondents in the survey are between 37 and 69 years old. Additionally, two standard deviations away from the mean contain 95% of the data in the study. This reflects that 95% of the respondents in the study are between the ages of 21 and 85 years old. The variable *age2* reflects the squared value of the original *age* variable.

The variable *married* contains a mean value of 0.538. Since *married* is a dummy variable, the values only range from 0 to 1 which can be seen on the chart's min and max

values. A value of 1 for this variable reflects the respondent is married and 0 reflects that they are not married. A mean of 0.538 indicates that 53.8% of the respondents in the survey are married.

The variables *better5, worse5, worse1,* and *better1* are all dummy variables that produce values of either 0 or 1. This results in the min and max for all four of these variables to be 0 and 1. A value of 1 reflects a 'yes' answer to a question surrounding that specific variable. For instance, a value of 1 associated with the *better5* variable reflects that the respondent believes the market will perform better over the next five years than it has over the past five years. The mean value for the *better5* variable is 0.344. This means that only 34.4% of the respondents answered that they believed the market will perform better over the next five years relative to the past five. The mean value for *worse5* is equal to 0.2709. This indicates that 27.09% of respondents believed that the market will perform worse over the next five years relative to the past five. It is also important to note that the remaining respondents who did not respond saying whether they believed the market will perform better or worse over the next five years believed it will perform the same. The mean for the variable *better1* equaled 0.2369. This value reflects that 23.69% of respondents believed the market will perform better over the next year than it has over the last year. The mean for *worse1* resulted in 0.2054. This value indicates that 20.54% of the respondents believed the market will perform worse over the next year than it has over the last year. Additionally, it is important to recognize the circumstances of the present economy when discussing these four variables. This survey took place during the 2019 year when the United States was experiencing tremendous economic growth and stock market performance. This is important to recognize as these four variables concern

individual perceptions on market outlook during a time when the US economy was experiencing unprecedented growth.

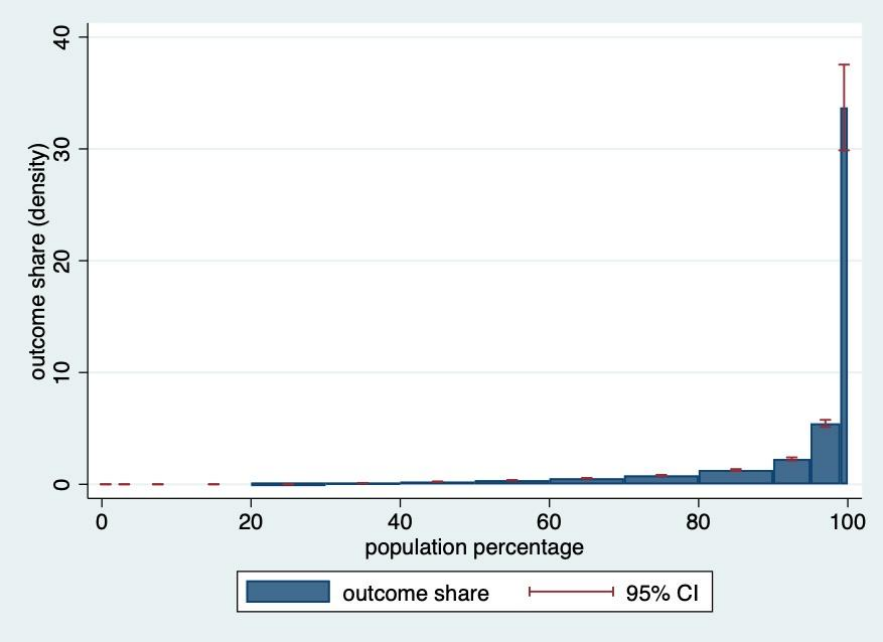
The variable *knowledge* produced a mean value of 7.388. With the values for *knowledge* ranging from -1 to 10 and '10' reflecting that the respondent believes they have a high level of knowledge of personal finances, on average the respondents in this survey believe they have a somewhat high level of knowledge of personal finances. The standard deviation for *knowledge* equals 2.177. One standard deviation away from the mean encompasses 68% of all the values in the survey for this data. This means that 68% of respondents fall between the personal finance knowledge level of 5.211 and 9.565. Additionally, two standard deviations away from the mean indicate that 95% of the respondents have a knowledge level between 3.034 and 10.

The *education* variable produced values between -1 and 14 based on the min and max terms in the chart. The value '14' reflects a professional degree and higher. The value '-1' reflects a less than 1st grade level of education. The mean for *education* produced a value of 10.247. A value of 10 is associated with an associate's degree in an occupation or vocational program.

The variable *employed* is a dummy variable resulting in it producing only values of 0 or 1. A value of '1' for a response indicates the respondent is fully employed and '0' means they are not fully employed. The mean value produced for *employed* is equal to 0.6472. This shows that 64.72% of the respondents in the study are fully employed.

The variable *income* produced a mean value of 137,972.6. This represents the average total household income before taxes and deductions of the respondents in the survey for the 2018 year. The standard deviation is important to look at for this variable

as it provides insight into the range of incomes in the survey. The standard deviation for *income* equals 803,983.6. This large standard deviation reflects that the data is very spread out away from the mean. This is a result of large data points skewing the data to the right. Based on the min and max values, the maximum observed data point for *income* is 45,000,000. This data point as well as other large values for *income* in this survey result in the data being skewed to the right. The graph below shows a histogram representing the percentile shares of the total data for *income.*



The variable *expenses* produces values of either 0 or 1. A value of 1 for *expenses* indicates that the respondent's spending exceeded their income for that year. A value of 0 for *expenses* means their spending did not exceed their income. The mean for *expenses* produced a value of 0.167. This means that 16.7% of respondents in the survey had spending that exceeded their income for that year.

IV.d: Regression Results

Linear regression

Number of obs	= 28,885
F(14, 28870)	= 390.83
Prob > F	= 0.0000
R-squared	= 0.1765
Root MSE	= 2.665

riskscore	Coefficient	Robust std. err.	t	P>|t|
age	.0092915	.0062478	1.49	0.137
age2	-.0001823	.00006	-3.04	0.002
knowledge	.2449691	.0090308	27.13	0.000
income	1.46e-07	2.49e-08	5.87	0.000
education	.2102538	.0068404	30.74	0.000
male	1.097287	.0492946	22.26	0.000
employed	.7174325	.040832	17.57	0.000
married	.1886702	.04657	4.05	0.000
expenses	.3123433	.1260782	2.48	0.013
better5	.2667219	.0404702	6.59	0.000
worse5	.033063	.0385502	0.86	0.391
better1	.048093	.0434797	1.11	0.269
worse1	.1335221	.0395873	3.37	0.001
dependents	-.0100813	.0156703	-0.64	0.520
_cons	-.7243714	.1727595	-4.19	0.000

The results of the multiple linear regression are shown in the chart above. The results reflect the significance of each of the independent variables on the dependent variable *riskscore*. The coefficient terms tell us how significant each independent is on the dependent variable. The value for each coefficient term represents the effect on the dependent variable for one increase in the unit of the independent variable. The p-value column reflects the statistical significance of the independent variables in the model. A p-value of less than or equal to 0.05 means the result is statistically significant. A p-value of 0.05 reflects that there is a 5% chance that the null hypothesis is true and the results from the data are due to random chance. Additionally, a statistically significant result

leads to a rejection of the null hypothesis. The null hypothesis for any of the independent variables in the model would be that it does not impact *riskscore*. The alternative hypothesis would be that the independent variable does impact *riskscore*. The t-value in the chart represents the differences in the coefficients relative to the variances in the sample. The greater the t-value, the greater the confidence in the significance of the value of the coefficient. The robust standard errors column represents the unbiased variances of the coefficients across the model.

The model was corrected for heteroskedasticity after running White's test which proved that the existence of heteroskedasticity in the model was significant. The results of White's test can be seen below.

```
White's test
H0: Homoskedasticity
Ha: Unrestricted heteroskedasticity

  chi2(108) = 2888.07
Prob > chi2 =  0.0000

Cameron & Trivedi's decomposition of IM-test
```

Source	chi2	df	p
Heteroskedasticity	**2888.07**	**108**	**0.0000**
Skewness	**1648.21**	**14**	**0.0000**
Kurtosis	**3.13**	**1**	**0.0767**
Total	**4539.42**	**123**	**0.0000**

White's test tests for heteroskedasticity in the original OLS model that was run before correcting for heteroskedasticity. The results chart above shows that the null hypothesis that is being tested is for the existence of homoscedasticity. The alternative hypothesis in this test is for the existence of heteroskedasticity in the model. Homoscedasticity is the opposite of heteroskedasticity which means that the variances are

even among the samples in the model. The p-value for this test is shown next to the Prob > chi2 result which produces a p-value of 0.000. This result is extremely statistically significant which leads us to reject the null hypothesis.

Looking at the results of the regression analysis, eleven of the observed independent variables produced statistically significant results. *Age2* produced a p-value of 0.02 which indicates that there is roughly a 2% chance that the null hypothesis for this term is true. The rejection of the null hypothesis means that the value of the coefficient term is significant. The coefficient for *age2* resulted in the value of -0.0001823. This coefficient term indicates that for every one-unit increase in *age2,* an individual's *riskscore* changes by -.0001823. These results reflect a negative relationship between *age2* and *riskscore*. Since *age2* and *age* both measure the same information, a joint significance test was run on *age* and *age2* following the regression. This is important because the p-value that *age* produced was equal to 0.137 which reflects statistically insignificant results despite *age2* showing significant results. The joint significance test indicates if *age* and *age2* are both statistically insignificant. The results of the joint significance test are shown below.

```
. test age age2

 ( 1)  age = 0
 ( 2)  age2 = 0

       F(  2, 28870) =   38.58
            Prob > F =    0.0000
```

The p-value of 0.000 reflects that the chances of the null hypothesis being true are 0%. This means that the results of the information from *age2* and *age* are jointly statistically significant. These results confirm previous research claiming risk tolerance decreases with age.

Additionally, *knowledge* produced statistically significant results with a p-value of 0.000. This p-value leads us to reject the null hypothesis and look to the coefficient term to gauge the significance of *knowledge* on *riskscore*. The coefficient for *knowledge* is 0.24497. This means that for every one-unit increase in *knowledge*, *riskscore* increases by 0.24497. These results reflect that risk tolerance increases with financial literacy.

Income also produced statistically significant results with a p-value of 0.000. The coefficient that was produced for *income* equaled 0.000000146. This means that every one-unit increase in *income* results in a .000000146 increase in *riskscore*. These results reflect a positive relationship between *income* and *riskscore* but the extremely small coefficient term indicates a minimal effect on an individual's risk tolerance from an increase in income. Based on this coefficient term, a $1 million increase in *income* results in *riskscore* increasing by 0.146.

The variable *education was* also shown to be statistically significant with a p-value of 0.000. The coefficient for *education* showed be 0.21025. This reflects that every unit increase in *education* results in a 0.21025 increase in *riskscore*. This shows that education level and risk tolerance have a positive relationship with each other and proves that individuals with higher levels of education have a higher level of risk tolerance. Additionally, the high t-value for *education* provides greater confidence in the accuracy and significance of the results.

The variable *male* also showed to be statistically significant from producing a p-value of 0.000. The coefficient for *male* equaled 1.097. Since *male* is a dummy variable, the possible values for this term are only 0 and 1. This causes the coefficient term to show the effect being male has on *riskscore* relative to not being a male. The coefficient shows that being male causes an individual's *riskscore* to be 1.097 more than being female.

The variable *employed* also showed to be statistically significant with a p-value of 0.000. *Employed* is also a dummy variable which means the coefficient reflects the direct effect being employed has on *riskscore* relative to being not fully employed. The coefficient for *employed* equaled 0.7174. This means that an individual's *riskscore* increases by 0.7174 if they are fully employed compared to not fully employed.

The variable *married* also showed to be statistically significant with a p-value of 0.000. This term was also a dummy variable which means that the coefficient for *married* reflects the change in an individual's *riskscore* if they are married compared to unmarried. The coefficient for *married* showed to be 0.18867. This means that an individual's *riskscore* increases by 0.18867 if they are married relative to being unmarried.

The variable *expenses* also produced statistically significant results with a p-value of 0.013. *Expenses* is also a dummy variable which means that the coefficient reflects the change in an individual's *riskscore* for those whose spending exceeded their income for that year. The coefficient for *expenses* is equal to 0.3123. This means that an individual whose spending exceeded their income for the year has a *riskscore* that is 0.3123 higher than someone who did not.

Of the variables concerning changes in market perception, *better5* and *worse1* were the only two that showed to be statistically significant. The variable *better5* produced a p-value of 0.000 and *worse1* produced a value of 0.01. The coefficient for *better5* showed to be equal to 0.2667. This reflects that when an individual expects the market to perform better over the next five years than it has over the last five years, their *riskscore* will increase by 0.2667. The coefficient for *worse1* showed to be equal to 0.1335. This indicates that when an individual expects the market to perform worse over the next year than it has over the last year, their *riskscore* will increase by 0.1335.

Three of the independent variables included in the model showed to be statistically insignificant. The variable *dependents* showed to be very statistically insignificant with a p-value of 0.520. This means that there is a 52% chance that the null hypothesis is true and the results of this data were random. This reflects that the variable *dependents* has no significant effect on an individual's *riskscore.* The variables *worse5* and *better1* also showed to be statistically insignificant. The variable *better1* produced a p-value equal to 0.269 and *worse5* produced a p-value equal to 0.391. This means that there is a 26.9% chance the results from the data of *better1* were random and a 39.1% chance the results from the data of *worse5* were random. This indicates that an individual's *riskscore* is not meaningfully impacted by a positive market outlook over the next year as well as a negative market outlook over the next five years.

Part V: Conclusion

The results from the regression analysis provide an indication into the personal characteristics and factors that influence risk tolerance the most. The independent variable with the largest statistically significant coefficient term from the regression analysis was *male*. This leads to the conclusion that gender is the strongest determinant of risk tolerance. The variable *employed* had the second-largest statistically significant coefficient reflecting that employment status is another strong determinant of an individual's risk tolerance. The terms *knowledge* and *education* both showed to be significant in affecting *riskscore.* The variables *income* and *expenses* also showed to be significant in affecting risk tolerance. Additionally, the personal characteristics of marital status and age showed to be significant in affecting risk tolerance. The results of the regression also showed that the only changes in market perceptions that affect a person's risk tolerance are when the market is expected to perform worse over the next year and better over the next five years.

Based on the results from the model, it can be concluded that men are more risk-tolerant than women. Also, individuals who are fully employed are much more risk-tolerant than individuals who are not. Higher educated individuals are also shown to be more risk-tolerant than less educated individuals. Additionally, the term *knowledge* showed that personal financial literacy is key to an individual's risk tolerance, showing that those with a higher level of personal financial literacy are more risk tolerant. People with a higher level of income were also shown to be more risk-tolerant based on the positive coefficient of *income.* The term *expenses* indicated that people with worse savings habits are more risk-tolerant than those who do not. This reflects that individuals

who do not save as much compared to others have a higher propensity for risk causing them to be more risk-tolerant. Married individuals were also shown to be more risk-tolerant than unmarried individuals. This can support the notion that people become more risk-tolerant after they become married because they have a higher level of financial security from the shared finances of a couple. Age was the only variable that showed a negative relationship with risk tolerance based on the negative coefficient of *age2*. This means that older people are more risk-averse than younger people and an individual's level of risk tolerance continues to decrease as they age. Additionally, based on the results from the changes in market perceptions it can be concluded that individuals are more risk-tolerant when they expect the market to perform better over the next five years. Also, it was shown that an individual's risk tolerance increases when they expect the market to perform worse over the year reflecting that people become more risk-tolerant over short negative economic periods.

Much of the results of this study align with the conclusions of previous research. In addition to this, marital status and financial literacy were both shown to be significant determinants of risk tolerance as these are two terms that have had conflicting opinions on their significance in previous research. The results of this study confirm the significance of several personal characteristics affecting risk tolerance as well as two types of changes in market expectations. This is extremely beneficial to understanding the investment strategies as well as the successes and failures of investors across demographics. Understanding the formation of an investor's risk tolerance is critical to identifying the reasoning behind why some individuals are more financially prepared and secure for their future.

Appendix

Risk Tolerance Score Chart:

X7557 (SHOW CARD 2)
Some people are fully prepared to take financial risks when they save or make investments, while others try to avoid taking financial risks.

On a scale from zero to ten, where zero is not at all willing to take risks and ten is very willing to take risks, what number would you (and your {husband/wife/partner}) be on the scale?

-1. *NOT AT ALL WILLING TO TAKE FINANCIAL RISKS
1.
2.
3.
4.
5.
6.
7.
8.
9.
10. *VERY WILLING TO TAKE RISKS

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