Do Market Returns Influence Risk Tolerance? Evidence from Panel Data

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Abstract

This study used the 1992-2006 waves of the Health and Retirement Study to investigate changes in risk tolerance levels over time in response to stock market returns. Findings indicate that risk tolerance tends to increase when market returns increase and decrease when market returns decrease. Individuals who change their risk tolerance in this manner are likely to invest in stocks when prices are high and sell when prices are low. Researchers, employers, financial educators and practitioners should help investors overcome the bias of overweighting recent news of market performance.

Keywords

Cognitive bias, Health and Retirement Study, Longitudinal study, Multilevel analysis, Risk tolerance

Introduction

Investor reaction to recent stock market declines has heightened interest in the relationship between risk tolerance and wealth accumulation. Most importantly, it plays an essential role in determining household investment behavior (Yao et al. 2002), which, in turn, directly affects household saving behavior (Fisher and Montalto 2010) and growth of household wealth (Finke and Huston 2003; Keister 2000). Households with low risk tolerance are less likely to invest in stocks. This choice shields them from investment losses in down markets, but also prevents them from realizing gains in up markets. Households with excessively high risk tolerance, in contrast, are apt to lose a sizable portion of their wealth in down markets. Neither extreme position facilitates wealth accumulation. Having a sound understanding of risk tolerance is not only important for individual investors, but also for their financial advisors.

Asking clients about their level of risk tolerance is a standard practice in the financial industry. Many financial advisors treat risk tolerance as a stable trait that will not change over time. However, it is possible that risk tolerance changes in response to recent market news and events. Psychologists theorize that giving disproportionate salience to recent news and events contributes to cognitive bias (Tan and Ward 2000). It is possible that households that reallocate investments in response to market trends sell when security prices are low and/or buy when security prices are high (Grable et al. 2004; Yao et al. 2004). One indication of this possibility is that investors tend to switch to investment assets that have a significantly better recent trailing return history (Clark-Murphy et al. 2009). Investor confidence in their advisor's ability to manage their portfolio may decrease when market returns decline, resulting in the selling of securities. Such actions can be financially devastating in an era when the future of Social

Security is uncertain, and employers are replacing lifetime pensions with retirement plans that rely on contributions and market performance.

An analysis of changes in risk tolerance in response to market return fluctuations will increase understanding of the factors that may influence household propensity to participate in the stock market. Historically, over the long run, stocks tend to produce higher returns than other investments (Ibbotson Associates 2005). Thus, stock market participation will directly affect household wealth accumulation. Therefore, it is of great importance to investigate whether household risk tolerance is responsive to market trends. The research question of this study is: Does individual risk tolerance change in response to changes in market returns?

This study contributes to the literature of risk tolerance by supporting the recency effect, a type of projection bias, on risk tolerance. This study also contributes to the literature by disentangling the age effect and the aging effect by employing longitudinal data, a result which cannot be achieved by analyzing cross-sectional datasets.

Background and Literature Review

Measurement Issues

Consistent with previous research indicating that attitudes affect behavior (Ajzen 2005), researchers have established that attitudes toward risk affect investment behavior (e.g., Campbell 2006; Grable and Lytton 2003; Hallahan et al. 2004). Risk tolerance is a psychological characteristic that is not directly observable. As such, it is challenging to measure. Researchers have used various types of questions in survey research in an attempt to assess subjective risk tolerance. One type of question presents survey respondents with hypothetical scenarios and asks them to make a choice. For instance, Barsky et al. (1997) used hypothetical scenarios about income gambles in the Health and Retirement Study (HRS) to develop an index of relative risk

aversion. In a similar vein, Schubert et al. (1999) assessed subjective risk tolerance by framing questions as investment and insurance decisions and as abstract gambling decisions. Some surveys ask a combination of investment choices and subjective perceptions (e.g., Grable 2000; Halek and Eisenhauer 2001; Hartog et al. 2002). Other studies have used Survey of Consumer Finances (SCF) data, in which respondents are asked to report their willingness to take a certain amount of financial risks in expectation of a certain level of return (e.g., Yao et al. 2005).

Researchers like Barsky et al. (1997) have questioned whether respondents understand risk-tolerance questions and provide accurate answers when surveyed. However, they point out that the survey method does provide some important information about respondents' preferences. Such measures may, to some extent, reflect survey respondents' current attitude toward risk based on past experience with risky ventures. Among those studies that used the survey approach to measure risk tolerance, some employed national datasets such as SCF and HRS (e.g., Barsky et al. 1997; Chaulk et al. 2003; Yao et al. 2005); others collected data from small samples (e.g., Schubert et al. 1999). For example, Hanna and Lindamood (2004) developed a risk-tolerance measure by asking pension choice questions that included graphical illustrations to increase the chance that respondents understand each question. Caution should be used when generalizing results from small samples to the total population.

The SCF is a national survey and its question on risk tolerance is directly related to investment choices; however, it provides cross-sectional data and the risk-tolerance measure is simplistic in that it asks respondents to select one of four combinations of risk and return. The language used in these choices is very abstract (e.g., "take substantial financial risks expecting to earn substantial returns") and subjective, requiring individual interpretation that may cause "uninterpretable variation" (Kimball et al. 2008). Chaulk et al. (2003) argued that since context

is important to measures of risks, the SCF measure, which lacks an employment risk-tolerance measure to supplement the investment risk-tolerance measure, is not an ideal measure of risk tolerance.

The HRS is also a national survey and provides longitudinal data. Its risk-tolerance question describes a hypothetical situation and provides respondents with choices that are concrete (e.g., "a 50-50 chance the second job would double your total lifetime income"). This measure of risk tolerance (i.e., inverse of relative risk aversion) (see Barsky et al. 1997) is based on economic theory. It offers objective boundaries (Kimball et al. 2008) and provides another perspective on the measure of risk tolerance, although it only measures one aspect of risk tolerance that is not directly related to investing. Validity of the measure has been assessed. In 2002 and 2006, HRS also asked two more questions related to business investment and inheritance investment choices. However, the longitudinal nature of this study requires at least three waves to observe the change trajectory of risk tolerance. Hanna and Lindamood (2004) showed that the correlation between the HRS income gamble question and the SCF risk-tolerance question was significant and positive.

The HRS dataset, therefore, provides an excellent source of data for the purpose of this study. One drawback of the dataset is that it is focused on households that have at least one member who was between age 51 and 61 in 1992 and, therefore, is not representative of the total population in the United States. This limitation will be further discussed in the discussion and implications section.

Predictors of Risk Tolerance

Previous research has identified various predictors of individual risk tolerance. These predictors largely focus on demographic characteristics, economic characteristics, and

expectations/opinions. Horvath and Zuckerman (1993) found that one's psychological makeup and biological, demographic and socioeconomic characteristics affected risk tolerance. Malkiel (2007) suggested that risk tolerance was related to financial situation, lifecycle stage, and subjective factors such as whether an individual can sleep at night in observance of the volatility of portfolio returns. Mittra et al. (2007) stated that risk tolerance declines with years until retirement and increases with investment knowledge, sophistication, income, and net worth.

The preponderance of research on risk tolerance (e.g., Chaulk et al. 2003; Palsson 1996; Xiao et al. 2001) has concluded that risk tolerance decreases with age, implying a linear relationship exists between the two. In contrast, a study by Halek and Eisenhauer (2001) reported that risk tolerance increased with age before age 65 and then decreased. Recent research leans toward the interpretation that education has a positive effect on willingness to take risks (Gilliam et al. 2008; Grable and Joo 2004; Hartog et al. 2002; Xiao et al. 2001).

Results from nearly all previous studies indicate that males are more risk tolerant than females (e.g., Chaulk et al. 2003; Grable et al. 2004; Grable et al. 2006; Halek and Eisenhauer 2001; Hartog et al. 2002; Jianakoplos and Bernasek 2008). As an exception, Schubert et al. (1999) found that males and females did not differ in their risk propensities toward contextual decisions, but gender differences in risk propensity did exist in abstract gambling decisions.

The empirical evidence on marital status' effect on risk tolerance has been mixed. Sung and Hanna (1996) found that single males were more risk tolerant than married couples, and married couples were more risk tolerant than single females. Grable and Joo (2004), Halek and Eisenhauer (2001), and Hartog et al. (2002) found singles were more risk tolerant than married couples. However, Grable (2000) found the opposite. Gilliam et al. (2008) examined spousal differences in risk tolerance and found higher education of wives to be related to lower risk

tolerance among husbands. Individual risk tolerance also changes with family transitions, such as getting married or having children (Chaulk et al. 2003).

Race and household size are also associated with risk tolerance. In a study done by Coleman (2003), the SCF risk-tolerance measure was employed in the investigation of factors that influenced household willingness to take risks. Whites were found to be more risk tolerant than Blacks. Using the same measure of risk tolerance, Yao and her associates (2005) examined the relationship between race and risk tolerance in greater detail. The authors concluded that Blacks were less likely to be willing to take financial risks; however, those who do take some risks tend to be more willing to take substantial financial risks as compared with their White counterparts. When using a question in the HRS on purchasing term life insurance to assess risk tolerance, Halek and Eisenhauer (2001) found that Blacks and Hispanics were more risk tolerant than Whites. Research findings on the effect of household size showed that household size had a negative effect on risk tolerance (Coleman 2003) and is inversely related to risky asset ownership for Black households (Gutter et al. 1999).

Previous research has found that income is positively associated with willingness to take risks (Chaulk et al. 2003; Grable and Joo 2004; Hartog et al. 2002; Jianakoplos and Bernasek 2008). Results of recent research (e.g., Sung and Hanna 1996; Yao et al. 2005) found risk tolerance to be higher among individuals who had saved an adequate level of emergency fund (defined as liquid assets $\geq$ three months of income).

Researchers have not agreed on the influence of wealth on risk tolerance. Palsson (1996) found that wealth had a negative effect on risk tolerance. Halek and Eisenhauer (2001) concluded that risk tolerance first decreases with asset values and then increases after assets reach $4.4 million. However, Grable and Joo (2004), Hartog et al. (2002), Jianakoplos and

Bernasek (2008), Xiao et al. (2001), and Yao et al. (2005) noted a positive relationship between wealth and risk tolerance.

Hartog et al. (2002), Yao et al. (2004), and Yao et al. (2005) found self-employed people were more risk tolerant than otherwise similar people who work for others. In contrast, Halek and Eisenhauer (2001) concluded that self-employment decreased risk tolerance. Individuals who perceived themselves to be in good health were more likely to take some risks than those who were in fair or poor health (Yao et al. 2004; Yao et al. 2005).

Finally, rather than being a stable attitudinal construct, risk tolerance has been found to change over time (e.g., Kimball et al. 2008; Yao et al. 2004). Kimball et al. (2008) treated within-individual differences in risk-tolerance responses between 1992 and 1994 as measurement errors since the assumption of their study was that preferences do not change. However, Yao et al. (2004) related this change to patterns of stock market returns. Other studies have also found risk tolerance to be responsive to environmental factors such as market news and events. Clarke and Statman (1998) studied the effect of market return on newsletter writers' sentiment and found that after the stock market crash of 1987, individual risk tolerance fell dramatically. Shefrin (2000) explained individual risk-taking preference and reported that institutional investors' and financial advisors' risk-tolerance levels and market return changes were positively related. Grable et al. (2004) and Grable et al. (2006) reported that stock market price changes could explain changes in risk tolerance. Yao et al. (2004) examined risk tolerance using six cross-sectional SCF datasets. Results from this study indicated that the average level of risk tolerance as measured in this nationally representative data did change over time, but no significant changes in risk tolerance within and between groups were found. The cross-sectional nature of these data limits insight into change, however (Rogosa et al. 1982).

Limitations of Existing Studies

Existing studies of financial risk tolerance have three significant limitations. One, a simplistic measure of risk tolerance has generally been used (e.g., Coleman 2003; Xiao et al. 2001; Yao et al. 2005; Yao and Hanna 2005). Second, cross-sectional data have been employed (e.g., Yao et al. 2004) to study changes in national average risk-tolerance scores. Three, the effect of market returns on risk tolerance has often been entangled with other effects, such as aging and/or changes in human capital (e.g., Yao et al. 2004).

This study addresses these limitations. Using five waves of data from the Health and Retirement Study (HRS) allows study of the responsiveness of individual risk tolerance to market conditions over time. Including both the wave variable and the market return variable separates the impacts of aging and market returns on risk tolerance. Instead of asking one simple question, the HRS describes hypothetical scenarios and asks a series of questions with different combinations of risks and incomes. Respondent risk-tolerance level is then determined.

Conceptual Framework

Relative Risk Aversion

The Bernoulli Utility Function is often used to refer to a decision-maker's utility derived from wealth. When applied to households making investment decisions, the utility function can be expressed as the weighted sum obtained by adding the utility of accumulated wealth multiplied by their respective probabilities:

$$E(u \mid p, X) = \sum_{x \in X} p(x)u(x), \text{ where}$$

p = probability of accumulated wealth

u = utility

X = accumulated wealth

According to the Expected Utility Theory, if investors seek to maximize their utility and are risk neutral, they would own a portfolio that consists 100% of the asset that provides the highest expected return. But in reality, most individuals are risk-averse (Bailey et al. 1980), which implies that when facing choices with equal returns, people tend to choose the less-risky alternative; and some are willing to accept lower expected returns in exchange for lower risks. For risk-averse individuals, utility increases, but does so at a decreasing rate when wealth increases. Investment returns are uncertain and fluctuate around their average. Some assets demonstrate larger fluctuations than others and therefore are riskier. Some investors have lower levels of risk aversion and, consequently, can tolerate a higher level of such fluctuations than others. Investors with different risk aversion levels would receive different levels of utility from the same pattern of investment returns.

The most famous measures of risk aversion are absolute risk aversion introduced by Pratt (1964) and relative risk aversion established by Arrow (1965). Absolute risk aversion, expressed as $\frac{-u''(w)}{u'(w)}$, demonstrates that more risk-averse individuals would invest a smaller amount of wealth in risky assets, where $u'(w)$ represents marginal utility of wealth and $u''(w)$ represents the change of marginal utility. However, relative risk aversion, $\frac{-wu''(w)}{u'(w)}$ suggests that individuals with a lower level of risk aversion would invest a larger proportion of their wealth into risky assets. As shown in Arrow (1965), the relative risk aversion is the more useful of the two and is an increasing function of wealth. Risk tolerance is the inverse of risk aversion (Barsky et al. 1997; Brennan and Kraus 1976).

Recency Effect

The recency effect, a generally recognized cognitive bias, posits that the most recent observations have the largest impact on an individual's memory and, consequently, on perception (Miller and Campbell 1959). Therefore, given a history of stock market returns, people tend to focus on the most recent returns. Loewenstein et al. (2003) referred to this phenomenon as a projection bias. Miller and Campbell (1959) documented proceedings from a court trial that contained a combination of sequences of arguments for and against the plaintiff. When there was a postponement between the first and second message, but no break between the second message and the judgment, a recency effect occurred. This result suggested that people are more influenced by information just received if time has elapsed between information sets and the decision is made immediately after the most recent set of information is given. This effect has been found by many other researchers as well (e.g., Atkinson et al. 1965; Broadbent and Broadbent 1981; Brodie and Murdock 1977; Murdock 1962; Tan and Ward 2000).

The recency effect seems to contradict Arrow's notion that relative risk aversion is an increasing function of wealth (Arrow 1965). When market returns increase, the wealth of an individual is likely to increase. If relative risk aversion is positively related to wealth, the individual's risk aversion should increase (i.e., risk tolerance should decrease). However, if this individual is influenced by the recency effect, news of market trends would affect perception of future returns. Specifically, when asked a question regarding risk aversion during a period when market returns rise, this individual would focus more on recent news about the stock market up trend and perceive the probability of such high returns to be higher than compared with times when the market trend was down. Since his/her marginal utility diminishes at a lower rate when

wealth increases, the degree of curvature of his/her utility function should decrease, and, therefore, his/her relative risk aversion will decrease (i.e., risk tolerance would increase).

Hypothesis

If the recency effect has an impact on investors, it is hypothesized that risk aversion is negatively related to recent market returns (i.e., risk tolerance is positively related to recent market returns).

Methodology

Data

This study used data from 1992, 1998, 2000, 2002, and 2006 interview waves of the Health and Retirement Study (HRS), an on-going biannual study conducted by the University of Michigan and funded by the National Institute of Aging (grant number NIA U01AG009740). The purpose of HRS is to collect data about health, insurance, financial status, retirement planning, labor market participation, and family support systems of middle-aged and older adults (Juster and Suzman 1995). This study used Version H of the HRS data (Willis 2007) prepared by the RAND Corporation (St. Clair et al. 2008). The target population for HRS is non-institutionalized men and women born 1931 to 1941 living in the contiguous United States. If the selected respondent was married or partnered, his or her spouse/partner was automatically eligible to participate in the study, regardless of age. Blacks, Hispanics, and Florida residents were oversampled to increase precision of analyses by race and ethnicity and to allow state-level analysis of Florida data (Heeringa and Connor 1995). The initial 1992 HRS sample size was 12,654 respondents from 7,608 households.

Individuals were selected for this study if they reported being White or Black and had data for all study variables for at least two waves. For each wave, respondents were included *for*

that wave if they 1) provided answers to the risk-tolerance questions and other study variables, and 2) reported data on themselves rather than having a proxy respondent. The risk-tolerance questions were not included in core interviews for wave 2 (1994), wave 3 (1996), or wave 7 (2004). In the case of married/partnered respondents where both persons provided data, we selected the respondent who reported being most knowledgeable about the household's finances (which could vary by wave), under the assumption that this person was most likely to be the major financial decision maker for the household. The race question in HRS included three categories: White, Black, and other. Since "other" race includes small numbers of people from many difference races, including this group would not be statistically informative, so only Whites and Blacks were selected for this research. Those whose data were provided by a proxy respondent were excluded for that wave because proxies were not asked the risk-tolerance questions. After applying these sample selection criteria, the final sample size for this study was 2,465.

Measures

Risk Tolerance (Outcome Variable). In 1992, HRS respondents were asked an income gamble question:

> *"Suppose that you are the only income earner in the family, and you have a good job guaranteed to give you your current (family) income every year for life. You are given the opportunity to take a new and equally good job, with a 50-50 chance it will double your (family) income and a 50-50 chance that it will cut your (family) income by a third. Would you take the new job?"*

In the 1998 and later waves, this question was slightly modified as follows to eliminate the potential for status quo bias:

"Suppose that you are the only income earner in the family. Your doctor recommends that you move because of allergies, and you have to choose between two possible jobs. The first would guarantee your current total family income for life. The second is possibly better paying, but the income is also less certain. There is a 50-50 chance the second job would double your total lifetime income and a 50-50 chance that it would cut it by a third. Which job would you take -- the first job or the second job?"

If the respondent says he/she would take the risk, the same scenario but with riskier odds is presented. If the respondent then states he/she would not take the risk, the same scenario with less risky odds is asked. In Wave 1, the pair of jobs presented is a hypothetical current job and a new one. From Wave 4 forward, the pair of jobs presented is both new jobs, given that respondent will need to move and find a new job (St. Clair et al. 2008, p. 877).

[Insert Figure 1 about here]

Based on responses to the set of income gamble questions, respondents were assigned by the RAND researchers to a level of risk tolerance for each wave: most risk tolerant, 2nd most risk tolerant, 3rd most risk tolerant, and least risk tolerant (see Figure 1). For the present study, the four levels of risk tolerance were further categorized into substantial risk tolerance (most risk tolerant only), high risk tolerance (combination of most and 2nd most risk tolerant groups), and some risk tolerance (combination of most, 2nd most and 3rd most risk tolerant groups). Starting in Wave 4 (1998), the number of respondents asked these risk-tolerance questions varied from wave to wave based on cohort, age, and/or random selection.

Time-varying Independent Variables. Time was coded as the wave of data collection (e.g., 0, 1, 2). Stock market performance was measured as a continuous variable using Standard

and Poor's 500 index trailing 12-month returns (www.standardandpoors.com) prior to each interview. S&P 500 total return was computed by adding the price change from 12 months prior to the current interview plus the dividend distributions during this period, for each individual for each wave. For example, if a respondent was interviewed in October 1992, his/her S&P 500 score would be the total return of S&P 500 between October 1991 and September 1992. The 12-month trailing returns between 1992 and 2007 ranged from -26.6% to 52.1%, with an average of 12.3% and a standard deviation of 15.7%.

Financial status was measured using the following variables: household income (annual wage/salary income of individual/couple from all jobs during previous calendar year), net value of primary residence, financial assets (sum of dollar amounts in checking, savings, CDs, money market, bonds, stocks, and mutual funds), non-financial assets (net values of real estate excluding primary residence, vehicles, businesses, and all other things), emergency fund adequacy (sum of dollar amounts in checking, savings, and money market accounts divided by monthly income; 1=liquid assets greater than or equal to three months of income; 0=otherwise), and employment status (self-employed, not working, or working for someone else [reference]).

An amount equal to the lowest observed value plus $1 was added to the household's non-financial assets to eliminate negative and zero values prior to log transformation (due to the right skewness of the variable distribution). One dollar was also added to all values of household income and financial assets to eliminate zeros prior to log transformation (due to the right skewness of the variable distributions). Value of primary residence, household income, financial assets, and non-financial assets were then centered around sample mean at baseline. Other time-varying covariates included in the model were: marital status (1=married), household size (0=respondent only), and self-rated health (0=poor to 4=excellent).

Time Invariant Independent Variables. In the HRS, demographic information was collected only at the first interview of a respondent unless there were missing data, in which case respondents were asked the questions in subsequent waves to obtain a valid response. Demographic variables included gender (1=male), education completed by 1992 (less than high school, high school/GED, some college, or college [reference]), race (1=White/Caucasian, 0=Black/African American), and age at baseline.

Data Analysis

A cross-tabulation of risk tolerance and survey years was conducted to observe the percent distribution of risk tolerance over the years. The associations of time and other variables with the outcome of risk tolerance were analyzed using multilevel cumulative logistic regression analysis to examine whether market returns predicted a change in risk tolerance over time, controlling for the other factors in the model. The cumulative logistic regression approach was selected because the method relaxes the statistical assumptions of parallel regression lines of traditional ordinal regression, while taking into account the ordinal distribution of the dependent variable (Hedeker 2007). The cumulative logistic model examines the effect of the explanatory variables on the probability of being in the least risk tolerant group versus some risk group (categories 1 vs. 2-4), lower risk versus higher risk group (categories 1-2 vs. 3-4), and some risk versus the highest risk group (categories 1-3 vs. 4). Multilevel models were used for these analyses because they produce standard errors that are corrected for clustering at the individual level from repeated measures (Raudenbush and Bryk 2002). A *p*-value less than 0.05 was interpreted as statistically significant. Examples of the cumulative logistic regression method can be found in Leena et al. (2005), Seljamo et al. (2006), and Yao et al. (2005). Hierarchical

Generalized Linear Modeling 6.06 software (Raudenbush et al. 2006) was used for these statistical analyses.

Level of risk tolerance is estimated using the following specification, in reduced form:

$$\eta \text{ (risk tolerance)} = \beta_{00} + \beta_{01}(\text{Male}) + \beta_{02}(\text{White}) + \beta_{03}(\text{Age in 1992}) + \beta_{04}(\text{Less than high school}) + \beta_{05}(\text{High school/GED}) + \beta_{06}(\text{Some college}) + \beta_{10}(\text{Time}) + \beta_{20}(\text{S\&P 500}) + \beta_{30}(\text{Value of primary residence}) + \beta_{40}(\text{Household income}) + \beta_{50}(\text{Financial assets}) + \beta_{60}(\text{Non-financial assets}) + \beta_{70}(\text{Adequate liquid assets}) + \beta_{80}(\text{Self-employed dummy}) + \beta_{90}(\text{Not employed dummy}) + \beta_{100}(\text{Married}) + \beta_{110}(\text{Self-rated health}) + \beta_{120}(\text{Household size}) + r_0$$

Results

Sample Characteristics and Observed Risk Tolerance Changes over Time

Table 1 shows the descriptive statistics for study variables at baseline (year 1992), by level of risk tolerance. The majority of the sample was female (*n*=1,372; 55.7%), White (*n*=2,003; 81.3%), married (*n*=1,654; 67.1%), and working for others (*n*=1,638; 66.5%). Respondent's age ranged from 29 to 77 in 1992 with a mean of 52 (*SD* = 4.14). Mean household size (including respondent) was 3 (*SD* = 1.40). More than three-quarters of the total respondents (77.8%) did not have adequate emergency funds, and about half of the total respondents (*n*=1,274; 51.7%) had $5,000 or less worth of financial assets.

[Insert Table 1 and Figure 2 about here]

Mean levels of risk tolerance are illustrated in Figure 2. Although there was a general decrease in risk tolerance over time, the decrease was not linear. Risk tolerance increased between 1992 and 1998 and decreased between 1998 and 2000. From 2000 to 2002, the percentage willing to take substantial or high risk decreased, but the percentage willing to take

some risks increased. All levels of risk tolerance were higher in 2002 than in 2006. It is noteworthy that, across all years, the majority of respondents were in the group willing to take the least amount of risk.

Cumulative Logistic Results

Table 2 presents results of the multilevel cumulative logistic analysis. Consistent with the recency theory and the hypothesis, there was a significant positive linear relationship between S&P 500 returns and respondent risk tolerance. Controlling for time and other independent variables, a one percentage increase in market returns increased the probability of taking substantial or high risk by 1%. Therefore, one standard deviation increase in S&P 500 returns would increase the likelihood of taking substantial or high risk by 15.7%. In this analyses, the reference group for risk-tolerance trajectories consisted of females age 52 in 1992 who were working for someone else, had a college degree and average financial assets, and faced a 0% S&P 500 return. Figure 3 demonstrates the predicted trajectories of risk tolerance over time for this reference group.

[Insert Figure 3 and Table 2 about here]

Results of the logistic analyses (Table 2) indicated that significant relationships existed between risk tolerance and some independent variables. Each additional year of age above the sample mean decreased the likelihood of taking some risks by 2%. Likelihood of being in the high-risk or some-risk groups decreased as people aged. Males were more risk tolerant than females. Higher educational attainment was consistently predictive of higher levels of risk tolerance, as compared with not completing high school. Those who were self-employed or not working were more likely to report high risk tolerance than were wage earners. Those with greater financial assets reported lower levels of risk tolerance. Surprisingly, many of the

financial variables (net value of primary residence, household income, non-financial assets, and adequacy of emergency funds) were not statistically significant in any of the cumulative logistic models.

Discussion and Implications

The purpose of this study was to employ panel data to investigate changes in risk tolerance levels over time in response to stock market returns. Findings from a multilevel cumulative logistic regression analysis indicated a positive relationship between risk tolerance and market returns. Researchers, employers, financial educators and practitioners should help investors overcome the projection bias in order to reduce the likelihood of unnecessarily investment losses.

The Recency Effect

The 12-month trailing returns of the S&P 500 index had a significant positive effect on risk tolerance, which is consistent with the hypothesis but is contrary to what would have been expected under a purely rational economic model. Under such a model, a risk-averse investor's relative risk aversion, if not constant, should be an increasing function of wealth (i.e. risk tolerance is a decreasing function of wealth). When market return becomes negative, wealth decreases accordingly; therefore, risk aversion should decrease and risk tolerance should increase. In contrast, results from the multivariate analyses show that risk tolerance fluctuated positively with market returns. Such results suggest that investors are not behaving according to rational economic model assumptions. The fluctuation of risk tolerance in relation to market returns is not the result of time, since time is controlled for in the model. Such changes in risk tolerance in response to market returns may be an indication that investors, and possibly their financial advisors, overestimate their ability to understand risk and assess individual risk

tolerance. Giving a more positive response to financial risks when market returns are high may indicate an overestimation of one's true willingness to tolerate risk. Furthermore, this finding may reflect an underestimation of true risk-tolerance level when individuals become more reluctant to take risks when market returns are low. Future research should develop an instrument that can better facilitate investors' and financial advisors' ability to evaluate individual risk tolerance after taking the recency effect into consideration.

Since attitudes affect behavior, if individuals make portfolio reallocation decisions in the fashion demonstrated by this study, it is possible that they invest when market returns are high and withdraw partially or even completely from the market when returns are negative, which would lead to unnecessary financial losses. The pattern of risk-tolerance changes could be caused by lack of knowledge and experience and, therefore, financial education may be a necessary prescription for those who tend to focus on recent market returns, so that they can learn to recognize and overcome this bias that may sometimes turn out to be costly. Having the ability to understand risks and assess risk tolerance has a direct impact on individual well-being. The demand for financial education is on the rise. Employers could provide free or affordable financial education to employees. Many employers sponsor retirement plans, which provide money management education opportunities, specifically when employees sign up to participate in such plans. The government could provide economic incentives, such as tax benefits, to employers who provide financial education to their employees.

This study contributes to the literature by supporting the projection bias hypothesis and confirms the recency effect. It is important that financial practitioners recognize the tendency of their clients to be overly optimistic and perceive themselves to be more risk tolerant in years when market returns are high and become excessively pessimistic and less risk tolerant during

market down years. As fiduciaries of their clients, financial practitioners should thoroughly understand client risk tolerance and make portfolio recommendations that match the true risk-tolerance level of their clients, so that the buying high and selling low syndrome would not continue to occur and that the likelihood of unnecessarily losses would reduce.

The Age Effect and the Aging Effect

Consistent with previous research (e.g., Chaulk et al. 2003; Palsson 1996; Xiao et al. 2001), risk tolerance was found to decline with age. It is reasonable that younger individuals would be more risk tolerant than their older counterparts, since their investment horizons are longer. Therefore, younger people should view market declines as an opportunity to purchase shares "on sale." They have a longer time horizon to wait for these shares to appreciate in value. It is also possible that the age effect noted in this study captured a generation effect. People of different generations grew up in different socioeconomic environments, have different degrees of media exposure, and may have developed different perceptions toward risks. Future research should investigate the generation effect on risk tolerance to help financial planners better understand and serve the needs of clients from different generations.

Risk tolerance was also found to decline over time. This aging effect has implications for financial services professionals: advisors should periodically revisit their clients' risk tolerance. Young clients with little financial knowledge need to learn about risks and returns so they become more comfortable with investing. While investors tend to become more knowledgeable and gain more investment experience over time, they also face declining cognitive abilities (Fair 1994). As clients become older, they need to reevaluate their conditions and constraints when making portfolio allocation decisions. Understanding the trajectories of individual risk tolerance could help financial planners identify discrepancies between their clients' need to take financial

risks and their willingness to tolerate such risks, educate clients regarding investments and their associated risks, and make appropriate portfolio recommendations over their clients' life cycle.

Influence of Other Factors

Consistent with previous research findings (e.g., Chaulk et al. 2003; Halek and Eisenhauer 2001; Hartog et al. 2002), males were more risk tolerant than females. However, females need to be more risk tolerant when investing in order to obtain higher returns and accumulate more wealth because women generally have longer life expectancies than men. Education was found to have a positive effect on risk tolerance, which was consistent with previous research (e.g., Gilliam et al. 2008; Grable and Joo 2004; Hartog et al. 2002; Xiao et al. 2001). Education, to a certain degree, represents human capital. Individuals with higher human capital are more likely to have a greater financial cushion should losses occur, and thus it is reasonable for them to be more risk tolerant.

As compared with salary earners, individuals who were not working were more risk tolerant, which is opposite of what Hartog et al. (2002) found. Intuitively, this result may not seem reasonable. However, the risk-tolerance measure in this study is related to changing jobs. Employment-related risk-tolerance questions may be fundamentally different for those who were not working when interviewed. The 1992 questions start by assuming that the respondent had a good job with guaranteed income for life. The 1998 to 2006 questions assume the respondent had a job, needed to move for health reasons, and are given two job choices. People bring with them their own paradigm window to see the world through, and that does not necessarily change by participating in a hypothetical game. It is possible that when answering the risk-tolerance questions, those respondents were coming from the perspective that they were not working for pay at the present, even though they were given the hypothetical scenario where they were

assumed to have a job. They may have preferred to take risks since, in the absence of a current job, they had nothing to lose.

Inconsistent with what Sung and Hanna (1996) concluded, emergency fund adequacy was not found to have a significant effect on risk tolerance. Without a sufficient amount of funds saved in liquid forms, a person is more vulnerable to risks such as unexpected loss of employment. Individuals should be cautious in taking financial risks until they have accumulated a sufficient amount of emergency funds.

The amount of financial assets reported by a respondent was found to be negatively associated with risk tolerance, when controlling for home value and non-financial assets. It is plausible that those with more financial assets incur more sizable losses when returns decrease, making it more difficult for them to make up for such losses. It is also possible that individuals with different amounts of financial assets have different financial goals: those with a lower level of financial assets want to accumulate more by taking more risks, and those who have more would like to preserve it by taking reduced risks. Furthermore, our findings are generalizable to the middle-aged and older U.S. population, who may be in the dis-accumulation phase of their life cycle.

Wealth, as measured by net value of primary residence and other non-financial assets, did not significantly predict risk tolerance. Previous research regarding the relationship between wealth and risk tolerance have been inconclusive. Risk tolerance has been found to be positively related to wealth (e.g., Grable and Joo 2004), negatively related to wealth (e.g., Palsson 1996), or non-linearly related to wealth (e.g., Halek and Eisenhauer 2001). All else being equal, those with more wealth are better able to make up for financial losses and, therefore, should be able to take more risks.

Limitations

This study has several limitations. The risk-tolerance question asked in the 1992 HRS survey was related to risks associated in staying in one's current position or choosing a new job with different levels of income risk and reward. Such preferences may be related to factors other than its economic result, such as company loyalty and relationships with coworkers. Starting from 1998, respondents were asked to choose between two new jobs, both of which were located in a new city. This change reduced consistency of the measure over time; however, it also reduced the bias inherent in the original measure.

The measure of risk tolerance employed in this research was subjective response to a hypothetical scenario, which introduces problems such as how well the respondents understand the question, whether they provide an accurate answer to the question; and whether such responses reflect what they would do in reality. However, risk tolerance is subjective in nature and, as explained in the literature review, this measure of risk tolerance does provide valuable information about individual risk preferences.

Contributions of This Study

This study expands the literature by employing a national longitudinal dataset to investigate the changes of risk tolerance in response to market returns and confirmed the recency effect. The implications of the statistically significant positive relationship between risk tolerance and recent market returns are important to researchers, employers, financial educators and practitioners. This study also contributes to the literature by differentiating the age effect and the aging effect by employing longitudinal data, a result which cannot be achieved by analyzing cross-sectional datasets. A next step for future research would be to examine whether market returns influence objective risk tolerance as measured by investment behavior over time.

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Table 1

Risk Tolerance by Household Characteristics at Baseline

Household Characteristics	**Most Risk Tolerant**		**2nd Most Risk Tolerant**		**3rd Most Risk Tolerant**		**Least Risk Tolerant**	
	M or %	*SD*	*M* or %	*SD*	*M* or %	*SD*	*M* or %	*SD*
Primary Residence Equity	$48,273	$63,376	$53,344	$69,971	$57,248	$95,464	$57,011	$72,205
Annual Income	$49,172	$57,532	$43,429	$35,946	$50,806	$44,665	$46,413	$43,106
Financial Assets	$34,756	$120,547	$26,222	$79,199	$38,842	$167,005	$33,551	$108,445
Non-financial Assets	$65,271	$164,671	$47,910	$105,601	$82,053	$349,289	$70,990	$245,646
Adequate Liquid Assets	20%		21%		21%		23%	
Male	48%		43%		47%		43%	
White	80%		85%		85%		80%	
Married	65%		65%		70%		67%	
Self-rated Health (higher=better)	2.63	1.19	2.65	1.14	2.58	1.12	2.59	1.13
Household Size (0=respondent only)	1.81	1.48	1.72	1.41	1.78	1.33	1.79	1.39
Age	52.04	4.17	52.24	3.98	52.1	4.15	52.44	4.16
Employment Status								
Working for Others	60%		66%		74%		66%	
Self-employed	15%		13%		8%		12%	
Not Working	25%		21%		18%		22%	
Education								
< High School	22%		19%		17%		21%	
High School/GED	33%		36%		35%		40%	
Some College	23%		23%		22%		22%	
College Degree	22%		22%		26%		17%	

Table 2

Cumulative Logistic Analysis of Risk Tolerance

Parameter	Substantial Risk		High Risk		Some Risk	
	Coefficient	Odds Ratio	Coefficient	Odds Ratio	Coefficient	Odds Ratio
Level 1 (time-varying)						
Intercept	-2.32**	0.10	-1.31**	0.27	-0.36*	0.70
Wave	-0.01	0.99	-0.05**	0.95	-0.03*	0.97
S&P 500 Returns	0.01*	1.01	0.01*	1.01	0.00	1.00
Primary residence Equity (centered)	0.00	1.00	0.00	1.00	0.00	1.00
Annual Income (centered, log)	-0.03	0.97	-0.02	0.98	0.00	1.00
Financial Assets (centered, log)	-0.02	0.98	-0.04**	0.96	-0.03*	0.97
Non-financial Assets (centered, log)	0.00	1.00	0.01	1.01	0.01	1.01
Adequate Liquid Assets	-0.12	0.89	0.02	1.02	-0.05	0.95
Employment Status (Reference: Working for Someone Else)						
Self-employed	0.25	1.28	0.26*	1.29	-0.04	0.96
Not Working	0.17	1.19	0.20*	1.22	0.11	1.12
Married (Reference: Unmarried)	-0.15	0.86	-0.11	0.90	0.01	1.01
Self-rated Health	0.06	1.06	0.05	1.06	0.02	1.02
Household Size	0.02	1.02	0.00	1.00	-0.02	0.98
Level 2 (non-time varying)						
Male (Reference: Female)	0.46**	1.58	0.32**	1.37	0.27**	1.30
Education (Reference: College Degree)						
Less than High School	-0.44*	0.64	-0.43**	0.65	-0.47**	0.63
High School/GED	-0.52**	0.59	-0.50**	0.61	-0.53**	0.59
Some College	-0.16	0.86	-0.18	0.83	-0.27**	0.76
White (Reference: Black)	-0.06	0.94	0.03	1.03	0.04	1.04
Age in 1992 (centered)	-0.01	0.99	-0.01	0.99	-0.02*	0.98
Variance Component (df = 2,458)	0.45		0.47**		0.40**	
Model Fit: χ^2 (df = 20)	15,509		17,384		18,824	

Note. Reference categories for categorical and dichotomous variables are provided in parentheses.

*$p < .05$. **$p < .01$.

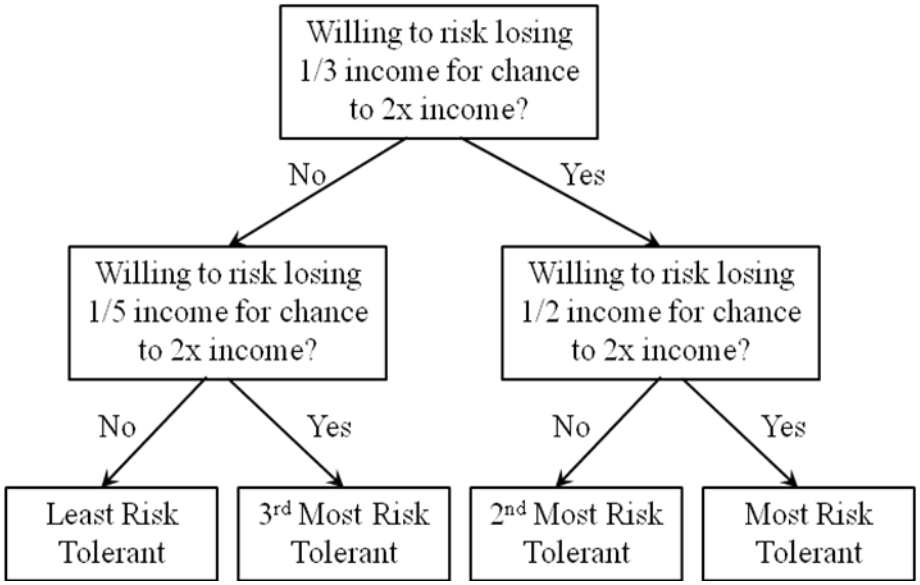

Figure 1. Risk Tolerance Categorization

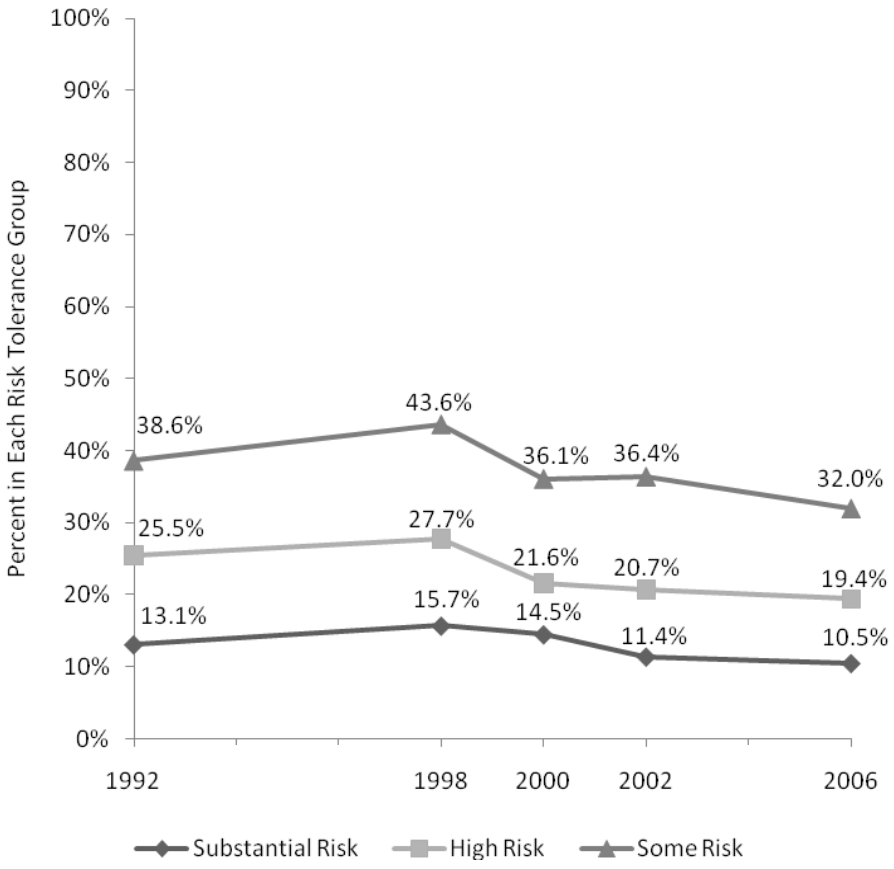

Figure 2. Observed Distribution of Risk Tolerance, By Wave

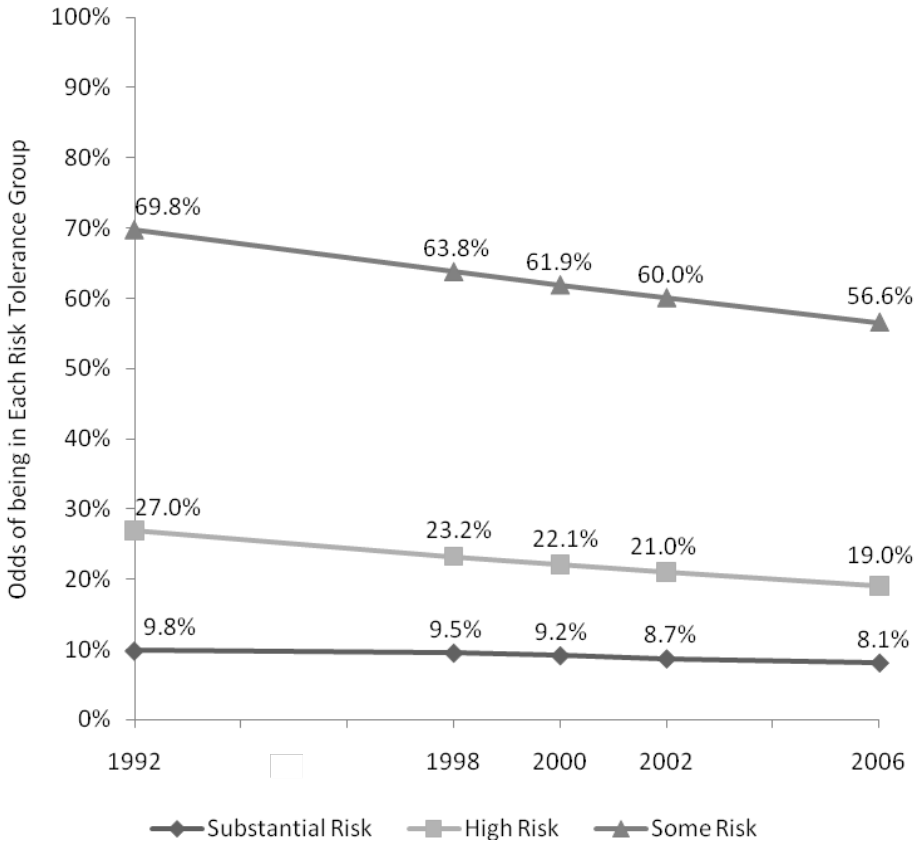

Figure 3. Predicted Trajectories of Risk Tolerance Levels, Controlling for Other Factors