Anticipating Changes in Client Risk Tolerance: A Financial Planning Perspective

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Financial planners and risk researchers often assume that a person's tolerance for financial risk remains stable over time. This is a key assumption underlying most financial planning investment strategies. This paper shows that while risk-tolerance, when measured at the aggregate level, appears to remain relatively stable, there is actually a great deal of inter-period shifting in risk-tolerance preferences among individuals. A regression and classification tree methodology was used with 2008 National Longitudinal Survey of Youth - 1979 cohort to provide a methodology that financial planners can use to anticipate and predict who is likely to either increase or decrease their tolerance for financial risk from one period to another. Results suggest that prior period risk tolerance is the best predictor of subsequent risk shift, with those exhibiting very low tolerance for risk shifting to a higher risk tolerance, and those with a high risk tolerance decreasing their tolerance for risk in later periods. Net household income and changes in income were also noted to be important predictors of shifting attitudes towards risk.

※ Key words: Financial Planning, Financial Risk Tolerance, NSLY Panel Data, Anticipating Changes in Risk Tolerance, Decision Tree

Ⅰ. Introduction

Financial risk tolerance — defined as a person's willingness to engage in a behavior that entails financial risk — has become, since the global economic crisis of 2008, an important

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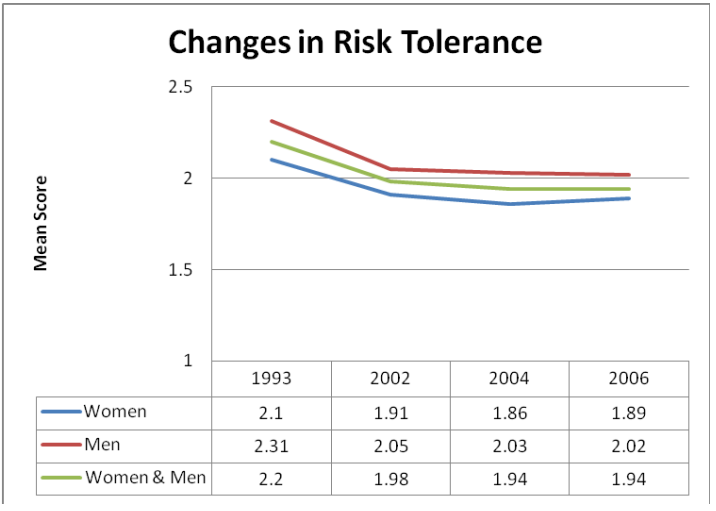
topic of discussion among financial planners. Roszkowski and Davey (2010) noted the following: "Assessment of risk tolerance is now generally recognized as a prerequisite to the development of a sound financial plan for the client" (p. 42). The measurement of a client's tolerance for risk has emerged from a recommended practice to a requirement for those who provide financial and investment advice in the United States, Europe, Australia, and Asia. The reason for this regulatory requirement is that the predominance of empirical data suggests that portfolios and asset allocation strategies that are designed without accounting for a client's tolerance for risk tend to either remain unimplemented, or when implemented, the level of systematic risk tends to be unsuitable for the client. Often, the risk of such portfolios exceeds the client's true level of risk aversion. The events that unfolded during the global market crash of 2008 are representative of financial strategies that were out-of-line with risk parameters for some clients. Roszkowski and Davey noted that the events of 2008 resulted in a shift in risk perceptions, with individuals perceiving the equity markets as being more risky. In retrospect, it is apparent that many investors were exposed to financial risks that far exceeded their willingness to engage in those financially risky behaviors.

Financial planners who were working with clients between 2008 and 2010 witnessed at least one of the following changes in their clients' attitudes: (a) tolerance for risk fell, (b) tolerance for risk increased, or (c) tolerance for risk remained unchanged. Because portfolios and asset allocation strategies are built in one period — and premised in part on the risk tolerance of clients in the period — for a holding period that can span multiple years, it is very important to know if changes in client risk tolerance are normal. Further, financial planners have a vested interest in anticipating and predicting who is likely to either increase or decrease their tolerance for financial risk from one period to another. The purpose of this paper is to address these two questions and to provide a method that can be used to estimate risk shift in later periods.

Ⅱ. Background Review

Although the 2008 economic collapse in the securities markets was devastating, the

event, while huge in magnitude, was not unprecedented in history. Similar shocks have occurred over time. A significant psychological and fiscal shock occurred during September 2001. On the 11th of September 2001 terrorists attacked the United States, destroying the World Trade Center in New York and severely damaging the Pentagon. The attack not only caused physical loss of life, the event stunned the world's financial systems. Data from the National Longitudinal Survey of Youth—1979 (NSLY) provides an insight into how this political and economic surprise impacted risk perceptions of individual investors. In 1993 a sample of Americans was administered a series of risk aversion assessments. The results from the assessment were used to estimate levels of risk aversion in 1993.[1] In 2002 the same individuals who answered the risk measures in 1993 responded to the same series of questions. As shown in Figure 1, risk tolerance decreased significantly from 1993 to 2002. The decrease in risk tolerance was exhibited by both men and women. What is interesting, however, is that from 2002 through 2006 risk tolerance remained relatively constant.[2]



	1993	2002	2004	2006
Women	2.1	1.91	1.86	1.89
Men	2.31	2.05	2.03	2.02
Women & Men	2.2	1.98	1.94	1.94

〈Figure 1〉 Changes in Risk Tolerance: 1993 to 2006

1) For the purposes of this paper, the inverse of risk aversion — risk tolerance — is used to describe these data.
2) Data for this example were obtained from the 2008 National Longitudinal Survey of Youth, 1979. A Friedman test was used to evaluate the change in risk scores. Using post-hoc tests, it was determined that risk tolerance dropped from 1993 (its highest point) to 2002. From 2002 through 2006 risk tolerance remained relatively stable.

The change in risk tolerance exhibited during the 1993-2002 period is somewhat perplexing. For decades, researchers have assumed that risk tolerance and its inverse — risk aversion — remain relatively constant. It has traditionally been thought that risk tolerance is a personality trait. Traits tend to be stable over periods of time, although personality traits do differ among individuals and groups. The decrease in risk tolerance between 1993 and 2002 presents two questions. The first is what might have caused the drop in tolerance for risk? The second is whether or not financial planners could have predicted the drop? One plausible explanation in response to the first question is that the events of September 2001 altered investors' perceptions of market risks. The answer to the second question is addressed in this paper.

Obtaining an answer to the later question is of importance in a financial planning context. For example, nearly all asset allocation decisions at the household level are made using a modern portfolio theory (MPT) framework, either implicitly or explicitly. MPT is premised on the assumption that investors (clients and their financial advisors) attempt to maximize returns while minimizing risks. A key assumption within the theory is that investors are risk averse and that risk preferences remain stable across time periods. Clients with a low risk aversion (high risk tolerance), holding other factors constant, should be able to tolerate greater asset volatility, and by doing so, increase their wealth over the life cycle. This last assumption is of critical importance. If an investor's risk tolerance shifts from one period to another — particularly from high to low — then the portfolio allocation designed in one period may be found to be inappropriate at a later date. This seems to be what happened to many investors during the 2008 market meltdown. It may also explain market losses that followed the 2001 terrorist's attacks in the United States and the decline in risk tolerance from 1993 to 2002.

Explanations for the 1993-2002 Risk-Tolerance Shift are alternate. Life cycle theory provides one possible alternative explanation for the decrease in financial risk tolerance from 1993 to 2002. Generally, youth and adolescents are thought to be more risk tolerant than others. A high tolerance for risk is a characteristic of those in young adulthood. Life cycle theory indicates, however, that a general level of conservatism begins to creep into the attitudes and behaviors of individuals as they transition from early- to middle-adulthood. Gardner (1993) noted that as income increases with age, a life-cycle pattern of youthful risk taking is rationally followed by adult prudence. Increases in risk aversion

can be attributed to increased experience, greater knowledge of outcomes associated with risk, and the realization that one's actions have relevant impacts on significant others. In some respects, the thought that there is more to lose through risky action may help to dampen risk attitudes, particularly for those with a family and increased financial capacity, as proxied by household income.

There is yet another possible explanation for the risk shift observed between 1993 and 2002: overconfidence. According to Griffin, Dunning, and Ross (1990), "Overconfident behavioral predictions and trait inferences may occur because people make inadequate allowance for the uncertainties of situational construal" (p. 1128). This happens because people do not always make allowances for uncertainties, even in situations when base rate probabilities are known (Griffin et al.; Nowell & Alston, 2007; Sitkin & Pablo, 1992). People tend to infer the meaning of a vague situation based on their available knowledge and experience. Plous (1993) noted that overconfidence is a common cognitive trap. As such, age or stage in the life cycle may help explain the relatively high risk tolerance exhibited in 1993 NSLY (Arkes, Christensen, Lai, & Blumer, 1987). Young adults may lack judgment-making skills necessary to assess probabilities with accuracy because they have had, by definition, less experience in identifying and estimating risky financial outcomes to develop specific risk-assessment knowledge. After aging and gaining experience in the financial markets and in the workplace people's appetite for risk may decline.

There is at least one other explanation for the risk-tolerance shift observed between 1993 and 2002. In 1979 Kahneman and Tversky proposed what they termed Prospect Theory as an alternative to expected utility theory (Plous, 1993). The numbers of studies that have tested one or more aspects of Prospect Theory between 1979 and 2010 have almost universally concluded that the way in which a risk choice is framed will influence the chosen preference. When outcomes are framed as a gain people tend to be risk averse, preferring to avoid a gamble; however, when outcomes are viewed as a loss people tend to be risk-seeking. What was once considered irrational behavior—i.e., taking risks in one situation and avoiding risks in another with the same numerical probability outcome—is now seen as behaviorally rational when coupled with the perception and intention reality of the decision maker (Neal, 2005). As will be shown later in this paper, the income level of respondents, at the mean level, was significantly lower in 1993 than it was in 2002. When faced with a risky choice in which a sure loss in income was

proposed (see the methods section for item wording) one would expect that those in young-adulthood would be more likely to take the risk. In effect, as a cohort, they had less to lose and more to gain by taking the risk. In 2002, however, the situation had changed for the majority of respondents. Incomes and educational levels were higher (see Table 3), more respondents were married, and households were larger, implying the presence of children. For respondents in 2002 the same question might have been framed not as a sure loss but as a framed gain. That is, it is possible that respondents perceived that they had much more to gain in 2002 than in 1993 by declining a risk choice.

1. Factors Associated with Risk Tolerance

As the preceding discussion suggests, there are multiple reasons why risk tolerance may have shifted downward between 1993 and 2002. In fact, it is likely that one or more of the reasons discussed above help explain the risk-tolerance shift. However, from a financial planning point of view these discussions can seem somewhat theoretical. The average practicing financial planner might argue that even if an external shock changes risk perceptions, unless he or she is able to predict the shock a description of the outcome is not very meaningful. This is the reason the vast amount of literature on risk assessment in the financial planning and counseling domain focuses on factors that a financial planner can assess in hopes of predicting or anticipating a client's current and future attitudes and behaviors.

Financial planners typically gather basic demographic and socioeconomic data about their clients. They do this in response to regulatory rules and as a possible mechanism to categorize clients into groups (e.g., high or low risk tolerance, fee structure platforms, etc.). Seven individual characteristics are commonly measured by both financial planners and researchers who are interested in understanding risk tolerance: sex, age, race, household size, household income, marital status, and educational level (See Grable [2008] for a review of these and other factors). The following brief discussion reviews each of these characteristics by summarizing the general consensus relationship between each variable and risk tolerance.

(1) Sex

Both in general and specifically within a financial planning framework, men tend to be more willing to take risks than women (Ardehali, Paradi, & Asmild, 2005; Bajtelsmit, Bernasek, & Jianakoplos, 1999; Grable & Roszkowski, 2007; Halek & Eisenhauer, 2001; Nairn, 2005; Yao & Hanna, 2005). Gilliam, Chatterjee, and Zhu (2010) found the sex bias towards risk tolerance to be consistent across generations and when controlling for other demographic and socioeconomic characteristics. This is illustrated in Figure 1. Women's tolerance for risk was consistently lower than that for men from 1993 to 2006.

(2) Age

The general consensus among financial planning practitioners and risk researchers is that a person's age is negatively associated with risk tolerance (Deaves, Veit, Bhandari, & Cheney, 2007; Gilliam et al., 2010; Nairn, 2005); although, others have noted that the age-risk tolerance relationship is somewhat weak and not meaningful (Ardehali et al., 2005). Ardehali et al.'s study was particularly relevant to the current research project because they suggested that risk tolerance may fluctuate across the life cycle.

(3) Race

The association between race and risk tolerance is often difficult to determine using survey methodologies. It is possible that racial background acts as a proxy for financial knowledge. Typically, Whites tend to be more knowledgeable about the outcomes associated with household financial risk taking, primarily because they have more experience taking financial risk. Evidence for this was reported by Xiao, Alhabeeb, Hong, and Haynes (2001). They noted that White business owners were more risk tolerant than other racial/ethnic groups. Wang and Hanna (2007) did not find such a consistent pattern. They "found that Whites were more likely than Blacks, Hispanics, and others to be willing to take some risk, no different for high risk, and less likely than Blacks and Hispanics to be willing to take substantial risk" (p. 15). On the other hand, Halek and Eisenhauer (2001) found that Blacks and Hispanics were significantly less risk averse that Whites.

(4) Household Size

Among risk researchers there is considerable debate regarding the relationship between household size and financial risk tolerance. Life cycle theory would suggest that as a person establishes other relationships through marriage and child birth tolerance for risk should decline. However, Halek and Eisenhauer (2001) found the opposite. Using Health and Retirement Survey data, they concluded that "those with children at home appear somewhat more inclined to accept the income gamble" (p. 20), although they did note that households with two members exhibited less risk tolerance than single person households. The more general consensus on the association between household size and risk tolerance was noted by Weagley and Gannon (1991) who argued that life-cycle factors, such as aging and having children, temper or reduce a household's tolerance for risk throughout the life cycle.

(5) Household Income

In general, the literature indicates that financial risk tolerance and household income are positively associated (e.g., Ardehali et al., 2005; Deaves et al., 2007; Nairn, 2005). Some have argued that income is predictive of risk tolerance, whereas others have theorized that risk tolerance leads to behavior that increases income over time. It is possible that income acts as buffer against the negative shocks associated with negative risk outcomes for some people (Slimak & Dietz, 2006). If true, this means that those with higher income should exhibit a higher tolerance for financial risk knowing that even if they encounter a loss they will have enough cash flow to soften the financial cost. On the other hand, lack of income or an income that is relatively low may prompt a gambling mentality where the person feels that they have nothing to lose by taking risk. This argument is an extension to Prospect Theory.

(6) Marital Status

A person's marital status in relation to financial risk tolerance has been explored in the literature; however, unlike other personal characteristics, the associations reported tend to be mixed. The general opinion of financial planners and researchers is that single individuals should be more risk tolerant than married persons (Yao & Hanna, 2005) because unlike singles, married people may perhaps feel that any financial loss could adversely impact

their family and relationships (Ardehali et al., 2005).

(7) Education

A person's education level is thought to be positively associated with financial risk tolerance (Gilliam et al., 2010; Grable, 2008; Halek & Eisenhauer, 2001; Riley & Chow, 1992). It is also possible that income and education are interrelated, with additional education leading to higher income (Ardehali et al., 2005).

The remainder of this paper addresses the following two questions: (a) is there a way to anticipate who is likely to either increase or decrease their tolerance for financial risk from one period to another, and if yes, (b) can that method be used to estimate risk shifts in later periods? Given that it is nearly impossible to predict social, political, military, and economic shocks that might be responsible, in part, in changing a person's risk tolerance and/or perception (see Roszkowski & Davey, 2010), the models that are tested here rely on client personal characteristics that can easily be assessed and evaluated, including sex, age, race, household size, household income, marital status, and education.

Ⅲ. Methods

1. Data Source and Sample

Data used to document changes in risk tolerance in this study come from the National Longitudinal Survey of Youth, 1979 cohort (NSLY). The dataset is unique because it is comprised of men and women who were born in the United States between January 1, 1957 and December 31, 1964. In 1979, respondents were between 14 and 22 years of age. By 1993 respondents were between 28 and 36 years of age. In 2006 these same respondents were aged 42 to 50. As a panel data project, respondents were initially interviewed annually from inception through 1994, and from 1995 onward biennially. One purpose of the initial panel study was to obtain longitudinal data from a wide cross-section of American culture. As such, the survey sample was designed to consist of three subsets: (a) a cross-section sample of non-institutionalized civilian youths (n = 6,111); (b) a supplemental

oversample of minority and economically disadvantaged non minority youths (n = 5,295); and (c) a military sample of enlistees in the Army, Air Force, Navy, and Marine Corps as of September 30, 1978 (n = 1,280), although in 1985 all but 201 randomly selected respondents in the military subsample were dropped from the survey. In 1991 the economically disadvantaged non-minority subsample was discontinued entirety. Due to missing values and sampling variations, the useable sample size for this study was N = 8,945 in 1993. The actual number of respondents used in the analyses varied from the 1993 figure to N = 7,292 in 2006.

2. Outcome Variables

Risk tolerance was measured using a risk aversion index that first appeared in the Health and Retirement Survey (HRS). The measure was initially validated by Barsky, Juster, Kimball, and Shapiro (1997). The measure was developed to estimate risk-preference parameters. The measure is based on economic utility theory, and as such, is related to MPT. For example, Barsky et al. noted a strong association between scores and wealth held in equities in the HRS. Since the 1990s, the questions comprising the index have been incorporated into the Health and Retirement Study as well as the NSLY. According to Barsky and his associates, "the principal requirement for the question aimed at measuring risk aversion is that it must involve gambles over lifetime income" (p. 539). The three questions are as follows:

A. 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?

If the respondent answered no, they were then asked

B. Suppose the chances were 50-50 that it would double your (family) income, and 50-50 that it would cut it in half. Would you still take the new job?

If the respondent answered no, they were then asked

C. Suppose the chances were 50-50 that it would double your (family) income and 50-50 that it would cut it by 20 percent. Would you then take the new job?

Based on responses, it is possible to separate respondents into one of four risk categories as follows:

1. If respondents indicated that they would not take the job in either situation (they answered no to A and C) they are considered to have very low risk tolerance (or high risk aversion) (coded 1).
2. If respondents indicated that they would not take the job if it cut their income by a third, but would take it if it only cut their income by one-fifth (they answered no to A and yes to C), they are considered to have low risk tolerance (coded 2).
3. If respondents indicated that they would take the job if it cut their income by a third, but would not take it if it cut their income by half (they answered yes to A and no to B), they are considered to have moderate risk tolerance (coded 3).
4. If respondents indicated that they would take the job regardless of the possible cut to their income (they answered yes to A and yes to B), they are considered to have high risk tolerance (coded 4).

Table 1shows the distribution characteristics of responses over four time periods: 1993, 2002, 2004, and 2006.[3] What is immediately apparent is the generally low level of risk tolerance across the four periods.

Three risk-tolerance change variables were created by subtracting previous period scores from current year scores. Specifically, 1993 scores were subtracted from 2002 scores; 2002 scores were subtracted from 2004 scores; and 2004 scores were subtracted from 2006 scores. In this way respondents were classified into one of three groups per year: (a) negative score change, (b) no score change, and (c) positive score change. Because the question of interest in this study was whether or not changes in risk aversion can be anticipated, a final recoding was administered. Respondents who showed a negative score change were coded -1, while those exhibiting a positive score change were coded 1. Those with no score change were eliminated from each analysis. Table 2 shows the frequency distributions for each period related to negative and positive score changes.

3) The risk questions have been asked four times beginning in 1993.

〈Table 1〉 Distribution Characteristics of Risk Aversion Responses

Year of Assessment	Percent of Respondents	Mean/SD
1993		2.21/1.26
High Risk Tolerance	25.2	
Moderate Risk Tolerance	16.8	
Low Risk Tolerance	11.5	
Very Low Risk Tolerance	46.5	
2002		1.98/1.21
High Risk Tolerance	18.9	
Moderate Risk Tolerance	15.7	
Low Risk Tolerance	10.2	
Very Low Risk Tolerance	55.2	
2004		1.95/1.16
High Risk Tolerance	17.0	
Moderate Risk Tolerance	13.8	
Low Risk Tolerance	15.8	
Very Low Risk Tolerance	53.4	
2006		1.96/1.20
High Risk Tolerance	18.5	
Moderate Risk Tolerance	14.9	
Low Risk Tolerance	10.7	
Very Low Risk Tolerance	55.9	

〈Table 2〉 Frequency of Risk-Tolerance Change Over the Three Periods

	1993 to 2002	2002 to 2004	2004 to 2006
Negative Change	2454	1712	1759
Positive Change	1691	1726	1644

The information presented in Table 2 illustrates an interesting phenomenon seldom seen in the risk-assessment literature. Figure 1 shows that mean risk-tolerance scores for respondents was 2.20, 1.98, 1.94, and 1.94 in 1993, 2002, 2004, and 2006, respectively. The only significant mean and median difference between periods was the 1993 to 2002 timeframe. Essentially, risk tolerance remained constant from 2002 through 2006. Data reported in Table 2 indicates that this global mean assessment may be masking real changes in risk tolerance. While it is true that the average risk-tolerance score for the sample remained relatively stable, the variability in risk-tolerance scores within each year was actually quite large. From 1993 to 2002 4,145 respondents exhibited a risk shift.

Between 2002 and 2004 3,438 respondents changed their risk tolerance, and in the period between 2004 and 2006 3,403 respondents shifted their tolerance for financial risk. This means that 57%, 47%, and 47% (using a sample size of N = 7,292) of respondents changed their risk tolerance from one period to the next in the three time frames examined. So, even though the mean level of risk tolerance remained stable from 2002 through 2006, the actual variability between periods was relatively large.

3. Predictor Variables

As will be discussed in more detail below, this study used a classification and regression tree methodology to identify variables that can be used to anticipate who may be prone to shifting their risk tolerance. Nine demographic and socioeconomic predictor variables were used in the initial model. Sex was coded 1 male, 2 female. Three racial variables were included: (a) Hispanic, (b) African-American, and (c) not Hispanic and no African-American. Household size, net household income, and education were measured as continuous variables. Marital status was coded dichotomously so that married respondents were coded 1, otherwise 0. In addition to these standard demographic and socioeconomic factors known to be associated with risk tolerance, three change variables were included in the initial model. A change in (a) household size, (b) household income, and (c) education were calculated and recorded as continuous variables. The inclusion of these change variables allowed changes in the life cycle to be controlled. Table 3 provides the frequency and mean and standard deviation descriptives for the sample based on the four periods of measurement.

4. Data Analysis Method

Recall from the initial discussion in this paper that risk tolerance in the U.S. between 1993 and 2002, among early- to middle-adult age Americans, fell significantly. There are multiple possible explanations as to why this change in risk tolerance might have occurred. Some have argued that the change was a natural result of the maturing process. Others have argued that an external shock, such as the 911 terrorist attacks in New York, might have played a significant role in causing the shift. While these insights may be useful

〈Table 3〉 Variable Descriptives (*N* = 7303)

Variable	Frequency	Mean/SD
Sex		
Male	50.5%	
Female	49.5%	
Race		
Hispanic	15.8%	
African-American	25.0%	
Not Hispanic, Not African-American	59.2%	
Household Size 1993		3.24/1.63
Household Size 2002		3.22/1.60
Household Size 2004		3.09/1.57
Household Size 2006		2.97/1.54
Household Income 1993		$38,192.34/$31,227.61
Household Income 2002		$61,354.54/$61,613.34
Household Income 2004		$64,697.43/$65,480.95
Household Income 2006		$69,372.05/$73,503.12
Marital Status 1993		
Single	45.5%	
Married	54.6%	
Marital Status 2002		
Single	41.4%	
Married	58.6%	
Marital Status 2004		
Single	41.8%	
Married	58.2%	
Marital Status 2006		
Single	42.8%	
Married	57.2%	
Education 1993		12.95/2.44
Education 2002		13.19/2.50
Education 2004		13.23/2.52
Education 2006		13.26/2.55
Household Size Change 1993 to 2002		-0.04/1.66
Household Size Change 2002 to 2004		-0.13/0.92
Household Size Change 2004 to 2006		-0.10/0.89
Income Change from 1993 to 2002		$25,818.81/$53,644.38
Income Change from 2002 to 2004		$4,530.83/$46,028.03
Income Change from 2004 to 2006		$5,773.72/$48,927.38
Education Change from 1993 to 2002		0.23/0.69
Education Change from 2002 to 2004		0.03/0.32
Education Change from 2004 to 2006		0.06/0.31

from a larger policy point of view, a more practical question faces financial planners as they work with clients; namely, was there a way to anticipate who was likely to either increase or decrease their tolerance for financial risk from one period to another, and if yes, can that method be used to estimate risk shift in later periods? A classification and regression tree methodology was used as a mechanism to answer these questions.

AnswerTree for PASW software was used for all analyses. AnswerTree is a non-parametric learning system that classifies cases into decision trees. Output from such trees can be used to develop decision rules. In effect, the software uses observations and variables that are theoretically associated with an outcome to predict (classify) future observations. A classification and regression tree approach was used to minimize what are known as impurity measures. If effect, the program searches for variables that provide the best prediction. The process is repeated until the maximum proportion of variance in the outcome variable can be explained by the predictors. At the top of each tree will be the best predictor. At the bottom of a tree will be effective but less important predictors. When combined, the variables shown in a decision tree can be used as a guide to future prediction.

Three decision tree models were tested. (Post-hoc tests are also reported.) The first test used the change in risk tolerance from 1993 to 2002 as the binary outcome. The following predictors were used: age, race, marital status in 1993 and 2002, household size in 1993 and 2002, household income in 1993 and 2002, education in 1993 and 2002, household size change, net household income change, education change, and 1993 risk tolerance. The same predictors were used with the change in risk tolerance variable from 2002 to 2004 and from 2004 to 2006. In all analyses the parent node was set at 100, whereas the child node as set at 50. A five level tree was specified with a minimum change in impurity of 0.0001.

Ⅳ. Results

1. Risk Shift: 1993-2002

Results from the first decision tree test are shown in Figure 2. The outcome variable

was change in risk tolerance from 1993 to 2002. Three variables were found to be the best portioning characteristics: (a) risk tolerance as measured in 1993, (b) net household income in 1993, and (c) income change from 1993 to 2002. Overall, the 71.44% of variance in risk shift was accounted for in the model.

Risk tolerance in 1993 was the best predictor of risk shift in 2002. Those who reported having very low risk tolerance in 1993 were predicted to have a positive risk change in 2002 (Node 1). The level of prediction was 100%. For those with risk tolerance greater than very low, the model predicted that 83% of these people would exhibit a negative risk shift. In other words, knowing nothing else about a client, other than their risk tolerance in 1993, a financial planner could predict with a high level of confidence that those with very low risk tolerance would show an increase in tolerance in 2002; alternatively, those with higher risk tolerance in 1993 would likely show a decline in risk tolerance. Node 4 confirms this observation. Of those who shifted their risk in 2002 to a lower level, all exhibited a high risk tolerance in 1993. For those with a moderate to low level of risk tolerance, household income in 1993 played an important role in predicting risk shift. At Node 7, for example, those with low risk tolerance (Node 5) and income less than or equal to $25,143 in 1993 were predicted to show an increase in risk tolerance, whereas those with income greater than $25,143 were predicted to report lower risk tolerance. Household income was also used to split the tree at Node 6. Here moderate risk tolerance was predictive of a negative risk-tolerance change. This effect was increased for those with income less than or equal to $14,461 (Node 9). For those with moderate risk tolerance income change greater than $14,461 was an important split factor in the tree (Node 10). Any change in income was predicted to bring about a negative risk shift, but the shift was more pronounced for higher income moderate risk tolerance individuals who experienced an income gain of $7,024 or more.

To summarize, a positive risk shift was most highly associated with low risk tolerance in 1993 and relatively low net income in 1993. A negative risk shift was associated with moderate to high risk tolerance in 1993 and relatively high (in comparison to the positive shift group) income in 1993 and a larger income gain between 1993 and 2002. In general, these results match both the life cycle theory of risk change and the risk preference prediction of Prospect Theory.

In Post-hoc Test of 1993-2002 data, a binary logistic regression procedure, using

change in risk tolerance from 1993 to 2002 as the dependent variable, was used to confirm the decision tree findings. The key variables indentified in the decision tree were used to predict risk-change scores. Risk tolerance in 1993, household income in 1993, and income change from 1993 to 2002 were included as covariates. As shown in Table 4, these three variables were found to be significantly associated with risk shift, as predicted in the decision tree. Of particular importance is the negative association between risk tolerance in 1993 and risk shift in 2002. Those with the highest risk tolerance in 1993 were found to be the most likely to exhibit a decrease in risk tolerance.

〈Table 4〉 Logistic Regression Post-Hoc Test of Decision Tree Results: 1993-2002

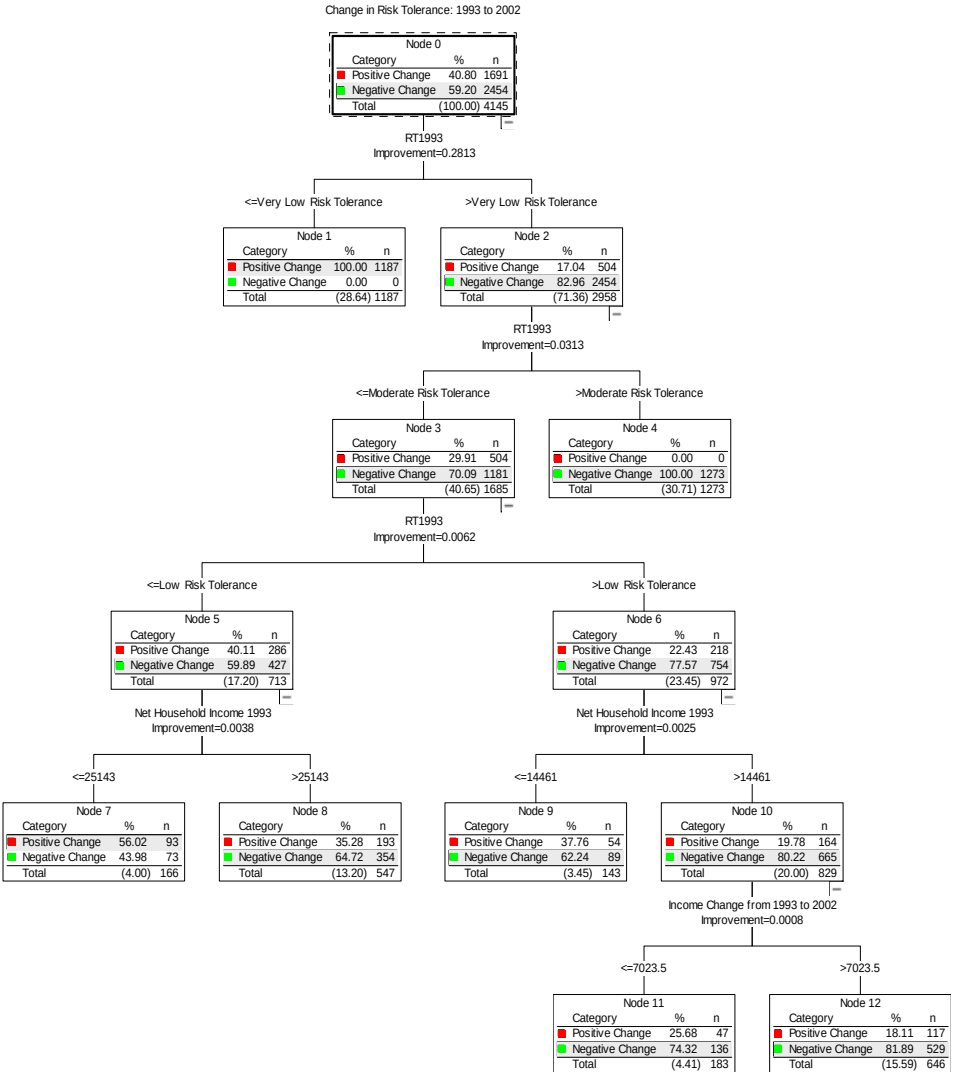
Variable	B	SE	Wald	Exp(B)
Risk Tolerance 1993	-2.41***	0.08	872.99	0.09
Household Income 1993	0.00**	0.00	7.45	1.00
Income Change from 1993 to 2002	0.00*	0.00	4.18	1.00
Constant	5.49***	0.22	636.02	242.11

Note: R^2 = 0.73 (Nagelkerke).
Model $\chi^2(3)$ = 2291.84, $p < .001$. *$p < .05$ **$p < .01$ ***$p < .001$

2. Risk Shift: 2002-2004

Given the results from the first classification tree, a second tree was created. In this model the same predictor variables were used but the outcome was altered to represent change in risk tolerance from 2002 to 2004. As suggested in the background review of this paper, the risk shift that was documented from 1993 to 2002 may have been caused by a number of factors, including the 2001 terrorists attack in the United States. There was the possibility that the variables selected for use in the tree were only randomly effective as decision tree factors. In order for financial planners to have confidence that previous period risk tolerance, in particular, and income more generally, can be used to anticipate risk shift in subsequent periods these variables should emerge through the variance proportion logarithms as important in trees that track change in later periods.

The second tree (Figure 3) shows that financial risk tolerance in 2002 was the best predictor of risk shift in 2004. Overall, the model explained 75.06% of the variance in risk-tolerance differences between 2002 and 2004. Just like the first model, those with a



〈Figure 2〉 Classification Tree Showing Predictors of Risk Shift: 1993-2002

very low risk tolerance in 2002 were predicted to have a positive risk shift in 2004 (Node 1). Those with a low, moderate, or high risk tolerance were significantly more likely to exhibit a negative change in 2004 (Node 2). Of these individuals, risk tolerance could be used for further differentiation. As was the case with the first model, those with high risk tolerance were predicted to exhibit a negative risk shift (Node 4). Those with a low

to moderate level of risk tolerance (Node 3) were further classified at Nodes 5 and 6. Moderate risk tolerance was associated with a negative change (Node 6), whereas a low risk tolerance was also related to negative change, but not to such a large extent (Node 5). As was the case with the first tree, a decision rule emerged: namely, among those who exhibit a risk shift, a positive shift will occur primarily among those with the very lowest risk tolerance in the original period.

In Post-hoc Test of 2002-2004 data, the second decision tree results were tested using a binary logistic regression. The dependent variable was change in risk tolerance from 2002 to 2004. In this post-hoc test only one independent variable was included as a covariate: risk tolerance 2002. Test results are reported in Table 5. As predicted in the decision tree, 2002 risk tolerance was negatively associated with risk shift from 2002 to 2004. Those with high risk tolerance in 2002 were more likely to indicate having a low level of risk tolerance in 2004.

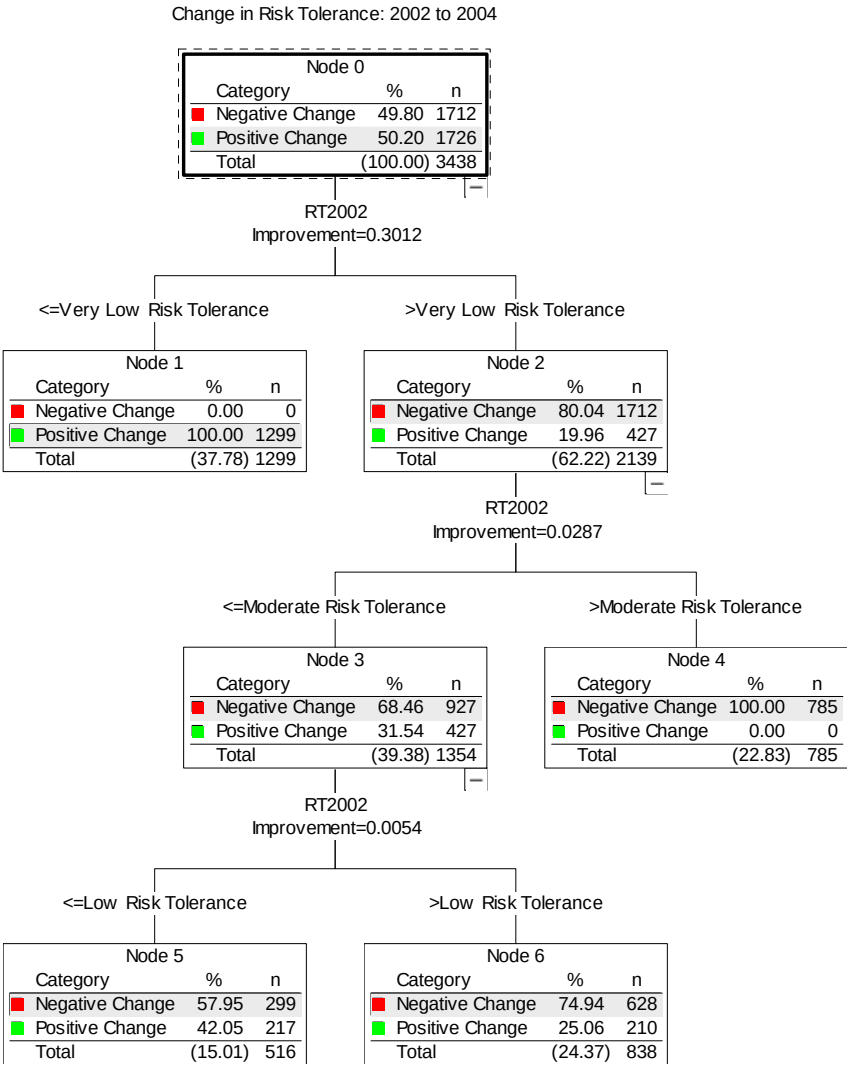
〈Table 5〉 Logistic Regression Post-Hoc Test of Decision Tree Results: 2002-2004

Variable	B	SE	Wald	Exp(B)
Risk Tolerance 2002	-2.40***	0.07	1099.34	0.09
Constant	5.49***	0.18	986.75	241.09

Note: R^2 = 0.74 (Nagelkerke).
Model $\chi^2(1)$ = 2795.90, $p < .001$. *$p < .05$ **$p < .01$ ***$p < .001$

3. Risk Shift: 2004-2006

Figure 4 represents that last classification tree created for this study. The outcome measure was change in risk tolerance from 2004 to 2006. As was the case with the first model, risk tolerance in the prior period was the most important factor explaining variance in the outcome. The model explained 69.59% of variance in risk shift. Net income in 2004 and income change from 2004 to 2006 were also important predictors. In general, the third decision tree mirrored that of the first tree, which suggest that among those who are likely to exhibit a risk-tolerance shift, prior risk tolerance, prior net household income, and income change can be used to anticipate who is probably going to change their risk tolerance, and in which direction that change may occur.



〈Figure 3〉 Classification Tree Showing Predictors of Risk Shift: 2002-2004

Specifically, as shown in Figure 4, those with the very lowest risk tolerance in 2004 were predicted to have a positive risk-tolerance shift in 2006 (Node 1). Node 2 shows that those with a low, moderate, or high risk tolerance were, overall, more likely to exhibit a negative risk-tolerance change. This was particularly true for those with high risk tolerance (Node 4). Net household income came into play at Nodes 5 and 6. For

those with a low or moderate level of risk tolerance and very low household income in 2004 (i.e., less than equal to $1,006), the model predicted a positive risk-tolerance change. Alternatively, those with low or moderate risk tolerance and higher income were predicted to have a negative risk-tolerance change. Income change from 2004 to 2006 was important at Nodes 7 and 8. A reduction in income was generally predictive of a negative risk shift.

In Post-hoc Test of 2004-2006 data, the last decision tree was evaluated using a binary logistic regression procedure, using change in risk tolerance from 2004 to 2006 as the dependent variable. As was the case with the first post-hoc test, risk tolerance, income, and income change were used as covariates in the model. Specifically, 2004 risk tolerance, 2004 income, and income change from 2004 to 2006 were used to predict risk shift. Results are reported in Table 6. Risk tolerance and income were found to be significantly associated with risk shift, but the income change variable was not significant. Overall, those with the high risk tolerance in 2004 were more likely to report a lower risk tolerance in 2006.

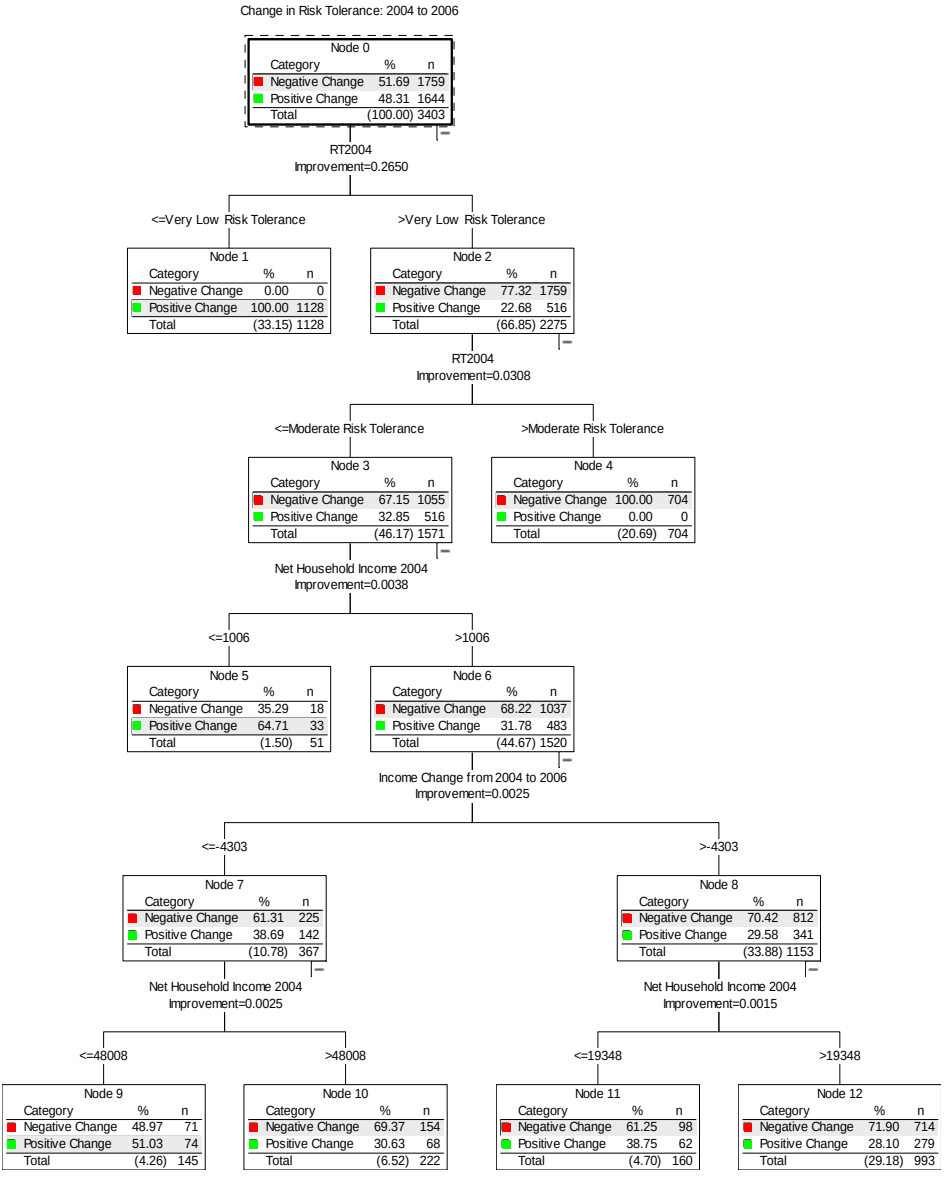
〈Table 6〉 Logistic Regression Post-Hoc Test of Decision Tree Results: 2004-2006

Variable	B	SE	Wald	Exp(B)
Risk Tolerance 2004	-2.19***	0.08	836.21	0.11
Household Income 2004	0.00*	0.00	4.36	1.00
Income Change from 2004 to 2006	0.00	0.00	0.43	1.00
Constant	4.77	0.18	712.55	118.42

Note: R^2 = 0.64 (Nagelkerke).
Model $\chi^2(3)$ = 1914.93, $p < .001$. *$p < .05$ **$p < .01$ ***$p < .001$

Ⅴ. Discussion

When evaluating the results from this study it is important to keep in mind two factors. First, the results represent classification trees that were specifically designed to differentiate between those who exhibited an actual risk shift from one period to another. These are the individuals of greatest interest to financial planners because it cannot be



〈Figure 4〉 Classification Tree Showing Predictors of Risk Shift: 2002-2004

assumed that a financial planning strategy based, in full or in part, on the client's risk tolerance, will remain viable from one period to another if the client exhibits a risk shift. Second, the risk-tolerance measure was based on income gambles. Even though Barsky

et al. (1997) found a significant correlation between the measure and equity ownership in households, there is still some debate among risk researchers as to whether the measure can or should be used as a general proxy for financial risk tolerance. Even so, the results from this study are noteworthy. To begin with, the results offer confirmation of the three alternate explanations of the 1993 to 2002 risk shift as discussed at the outset of this paper. Life cycle theory suggests that as people move from early- to middle-adulthood they tend to exhibit increasingly conservative tendencies. Gardner (1993) showed how this propensity is related to household income. In both the 1993 to 2002 and 2004 to 2006 decision trees there was a clear association between risk tolerance and income. Overconfidence was also seen, at least in the 1993 sampling frame. As predicted in the literature, this overconfidence decreased as panel respondents increased in age. It is likely that a combination of increased education, increased income, increased knowledge, increased experience, and family factors influenced this reassessment of risk tolerance in later periods. The tenets of Prospect Theory were also supported. Specifically, as income increased from the 1993 period to the 2006 period it is possible that panel respondents perceived that they had more to lose by taking income gambles, whereas in 1993, when income was relatively low, the act of engaging in an occupational income gamble had little perceived downside risk. While this is conjecture, the evidence does suggest that the way in which respondents framed their responses to the gamble questions changed from period to period.

Second, the importance of prior period risk tolerance, in particular, and prior period income and income change, in general, was documented. Financial planners have a valuable tool at hand that can be used to anticipate who among their clientele or prospects might exhibit a risk shift in the future. Of most importance, clients who, today, report having a very low risk tolerance are predicted to exhibit a positive risk shift in the future, if they change their risk tolerance. Alternatively, clients who report having a high risk tolerance today are nearly always the ones who will report a lower risk tolerance in the future, at least among those who are likely to change their tolerance for financial risk. For a purely practical point of view, financial planners ought to be cautious when working with clients who profess to have high risk tolerance, especially a tolerance to engage in risky income gambles. It is these individuals, particularly as their income increases, who are likely to reduce their risk tolerance in subsequent periods, especially when compared with clients who have a moderate or low level of risk tolerance.

Results from this study have potential policy implications as well. For example, in the United States, since 2008, the level of financial reform at the national level has been dramatic. Legislation was passed which focused on protecting households from credit and mortgage abuse. Prior to implementing new legislation or public policy designed to reduce market risks at the household level, policy makers should note that the individuals most likely to undergo a positive risk shift are those who, in some ways, can least afford to take increased financial risk; namely, lower income households. There seemed to be a prevailing attitude across the four periods among very low risk tolerant and low income individuals that they had nothing to lose by engaging in a risky behavior in a subsequent period. In other words, taking a gamble to increase income and wealth may have seemed like an appropriate course of action; however, in terms of risk capacity, these individuals might have later learned that implementing a high-risk strategy resulted in a monetary loss. In these situations, those with the least income to begin with may not be able to sustain such a loss. In other words, the people with the least risk capacity appear to be the ones who, from one period to another, are likely to shift their tolerance for risk higher. On the other hand, as income increased for other household respondents the risk shift was away from risk. Those with the greatest risk capacity began to shy away from risk.

In summary, financial planners should interpret the findings from this paper as an indication that they may already have the tools available to anticipate who, among their clientele, is likely to either increase or decrease their risk tolerance in the future. Of course, no one can reliably predict external market shocks that can alter client risk perceptions, but it may be possible to predict who is the most likely to exhibit a risk-tolerance shift in the future. The risk tolerance of clients, as measured today, can be an effective tool in predicting risk shift among those who are likely to change their risk tolerance in a subsequent period. While the longitudinal nature of this study makes the results unique, it is still important for future studies to replicate and extend the findings reported here. One potential avenue for further research involves comparing those who change their tolerance for financial risk from one period to the next against those who remain steadfast in the risk tolerance.[4] Additionally, as the results from this study intimate, the use of

4) A fourth decision tree was modeled to estimate positive and negative risk shift scores against those in the sample that had no change in risk tolerance during the 1993 to 2002 period. Results from the test were remarkably similar to those shown in the first decision tree (figure 2) that compared positive and negative risk-tolerance change. As shown below, Nodes 1, 3, and 4 indicate that those with a very low 1993 risk tolerance

panel data, rather than cross-sectional or longitudinal data, appears to offer insights into risk tolerance and risk aversion attitudes of individuals who are engaged in daily financial

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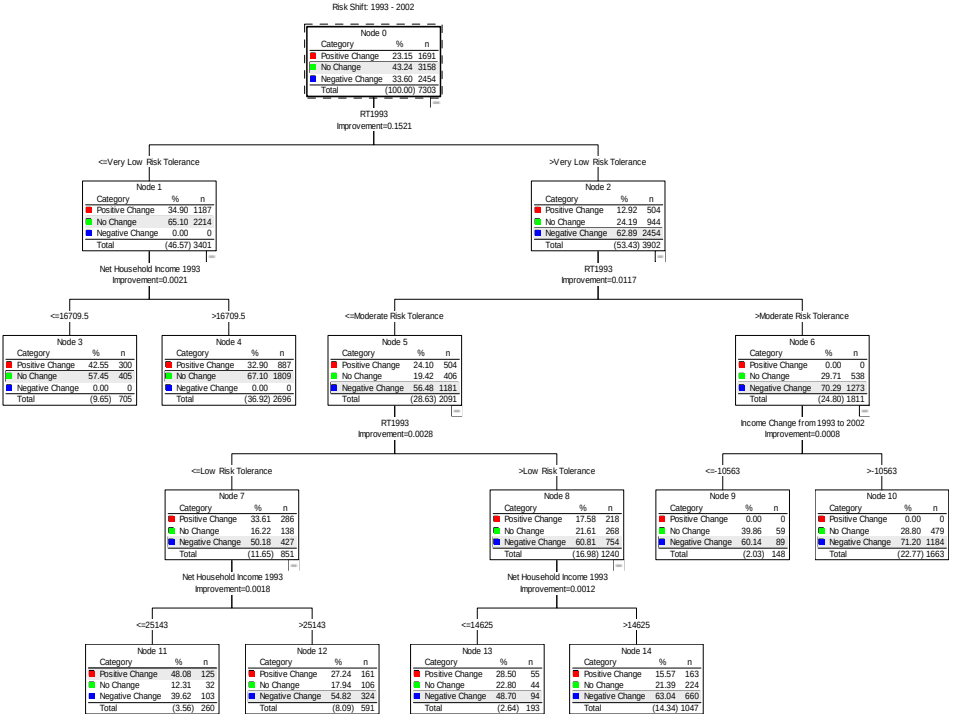
either made a positive change in risk tolerance or that they remained in the same level of risk tolerance. The percentages reported in the each node box have changed because the sample size, by including the no change category, is much larger. Following Node 2, which represents those with a low, moderate, or high risk tolerance, similar results to the first decision tree are evident. Nodes 6, 9, and 10 illustrate how having a high risk tolerance in 1993 is predictive of either staying the same in 2002 or exhibiting a decrease over the time period. For those with low and moderate risk tolerance (Node 5), the change prediction is a bit more complicated, but still in line with the decision tree outputs presented in this paper. In general, higher levels of risk tolerance in 1993 were predictive of negative risk-tolerance shifts over the period. However, as was the case with the decision tree frameworks presented earlier, income plays a role in shaping future risk tolerance. For those with a low risk tolerance in 1993 (Node 7) and net income less than or equal to $25,143 in 1993 (Node 11), the model predicts a small positive change in tolerance for risk. The opposite is true for those with income greater than $25,143 (Node 12). These individuals are predicted to exhibit a negative change. Finally, for those with a moderate level of risk tolerance (Node 8) the model predicts a negative risk-tolerance change. Further improvement in that prediction can be made by examining net income in 1993 (Nodes 13 and 14). Moderate risk tolerance combined with net income greater than $14,625 in 1993 is associated with a negative risk-tolerance change. Overall, the addition of the no change category in the decision tree did not significantly alter the findings from this study. It appears that individuals with low income and very low risk tolerance in one period will be more likely to either maintain their risk tolerance or increase their tolerance in a later period. For individuals with a high risk tolerance and relatively high income the opposite is true. Financial planners can anticipate that those fitting this profile will exhibit a negative risk-tolerance change in subsequent periods.



behavior. Future research that examines attitudinal and behavioral change over time, using panel data, may help the financial planning community gain a better understanding of the factors that influence their clients with faced with risky choices.

References

Ardehali, P. H., J. C. Paradi, and Mette Asmild, 2005, Assessing financial risk tolerance of portfolio investors using data envelopment analysis. *International Journal of Information Technology and Decision Making*, 4, pp. 491-519.

Arkes, H. R., Christensen C., Lai C., and Blumer C., 1987, Two methods of reducing overconfidence. *Organizational Behavior and Human Decision Processes*, 39, pp. 133-144.

Bajtelsmit, V. L., Alexandra Bernasek, and N. A. Jianakoplos, 1999, Gender differences in defined contribution pension decisions. *Financial Services Review*, 8, pp. 1-10.

Barsky, R. B., F. T. Juster, M. S. Kimball, and M. D. Shapiro, 1997, Preference parameters and behavioral heterogeneity: An experimental approach in the Health and Retirement Study. *The Quarterly Journal of Economics*, 112, pp. 537-579.

Deaves, R., E. T. Veit, G. Bhandari, and J. Cheney, 2007, The savings and investment decisions of planners: A cross sectional study of college employees. *Financial Services Review*, 16, pp. 117-133.

Gardner, W., 1993, A life-span rational-choice theory of risk taking. In N. J. Bell and R. W. Bell (eds.), *Adolescent Risk Taking*. Newbury Park, CA: Sage.

Gilliam, J. E., S. Chatterjee, and D. Zhu, 2010, Determinants of risk tolerance in the baby boomer cohort. *Journal of Business and Economics Research*, 8(5), pp. 79-87.

Grable, J. E., 2008, Risk Tolerance (pp. 1-20). In J. J. Xiao (Ed.), *Advances in Consumer Financial Behavior Research*, Springer, New York.

Grable, J. E., and M. J. Roszkowski, 2007, Self-assessments of risk tolerance by women and men. *Psychological Reports*, 100, pp. 795-802.

Griffin, D. W., D. Dunning, and L. Ross, 1990, The role of construal processes in overconfident predictions about the self and others. *Journal of Personality and Social Psychology*, 59, pp. 1128-1139.

Halek, M., and J. G. Eisenhauer, 2001, Demography of risk aversion. *The Journal of Risk and Insurance*, 68, pp. 1-24.

Kahneman, D., and A. Tversky, 1979, Prospect theory: An analysis of decision under risk. *Econometrica*, 47, pp. 263-291.

Nairn, A., 2005, Beyond Sandler: Risk tolerance and the UK investment deficit. Journal *of Financial Services Marketing*, 9, pp. 375-389.

Neal, M., 2005, 'I lose, but that's not the point': Situated economic and social rationalities in horserace gambling. *Leisure Studies*, 24, pp. 291-310.

Nowell, C., and R. M. Alston, 2007, I thought I got an A! Overconfidence across the economics curriculum. *Journal of Economic Education*, 38, pp. 131-142.

Plous, S., *The psychology of judgment and decision making*, McGraw-Hill, New York, 1993

Roszkowski, M. J., and G. Davey, 2010, Risk perception and risk-tolerance changes attributable to the 2008 economic crisis: A subtle but critical difference. *Journal of Financial Service Professionals*, 64(4), pp. 42-53.

Sitkin, S. B. and A. L. Pablo, 1992, Reconceptualizing the determinants of risk behavior. *The Academy of Management Review*, 17, pp. 9-38.

Slimak, M. W. and T. Dietz, Personal values, beliefs, and ecological risk perception. *Risk Analysis*, 26, pp. 1689-1705, 2006.

Wang, C. and S. D. Hanna, 2007, The risk tolerance and stock ownership of business owning households. *Journal of Financial Counseling and Planning*, 18(2), pp. 3-18.

Weagley, R. O. and C. F. Gannon, 1991, Investor portfolio allocation. *Journal of Financial Counseling and Planning*, 2(1), pp. 131-154.

Yao, R., and S. D. Hanna, 2005, The effect of gender and marital status on financial risk tolerance. *Journal of Personal Finance*, 4(1), pp. 66-85.

Xiao, J. J., M. J. Alhabeeb, G. S. Hong, and G. W. Haynes, 2001, Attitude toward risk and risk-taking behavior of business-owning families. *The Journal of Consumer Affairs*, 35, pp. 307-325.

패널자료를 이용한 고객의 위험성향 변화 예측에 관한 연구

John E. Grable.D.* · 박주영** · 최현자***

요 약

재무설계사들과 재무 분야의 연구자들은 한 개인의 재무위험 수용성향이 장기간에 걸쳐 변화하지 않는다는 가정 하에, 고객에게 서비스를 제공하거나 연구를 수행하는 경우가 많다. 이는 대부분의 재무설계 및 투자 전략에 있어서 강조되고 있는 주요 가설이기도 하다.

본 연구에서는 다기간에 걸친 소비자의 위험수용 성향을 분석함으로써 실제로는, 앞서 밝힌 기존의 가설과는 다르게, 개인의 위험수용 성향이 변화하였음을 밝혔다. 연구 수행을 위해 패널자료인 National Longitudinal Survey of Youth 자료를 사용하였으며, 회귀분석 및 Decision Tree를 사용하여 분석하였다.

결과에 따르면, t-1 시점의 위험 수용성향이 t 시점의 위험 수용성향 예측에 가장 중요한 요인인 것으로 나타났다. 즉, t-1 시점에서 매우 낮은 수준의 위험 수용성향을 보인 사람들이 t 시점에서는 위험수용 수준이 상승하는 양상을 보인 반면, t-1 시점에서 높은 수준의 위험 수용성향을 보인 사람들이 t 시점에서는 위험수용 수준이 하강하는 양상을 보였다. 또한, 가계소득과 소득의 변화 요인도 위험에 대한 태도 변화 예측에 중요한 요인인 것으로 나타났다. 본 연구의 결과는 재무설계사들이 고객의 기간간 위험수용성향 변화를 예측하는 데 유용하게 사용되어 질 것으로 기대된다.

핵심단어: 재무설계, 재무위험수용성향, 기간간 위험수용성향변화, 패널자료(NSLY), Decision Tree

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