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Projection Bias and Financial Risk Tolerance

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Behavioral finance theories explain "why" individuals exhibit behaviors that do not maximize expected utility. This study explores how projection bias, as explained by regret theory, may shape financial risk tolerance attitudes. The results suggest that gender, income, and stock market price changes, as measured by the NASDAQ, the Dow Jones Industrial Average, and the Standard & Poor's 500 indexes, help explain risk attitudes. Risk tolerance appears to be an elastic and changeable attitude. This research expands on the work of Shefrin [2000], who reported that recent stock market price changes exert a strong influence on risk tolerance attitudes and behaviors.

Are individuals purely rational when formulating risk-taking attitudes? Traditional economic and finance theory would argue that individuals use unemotional judgments to establish the attitudes that affect financial decisions and behaviors (Kahneman [2003]). This purely rational explanation for risk-taking attitudes assumes people develop preferences using logic and the laws of probability. But behavioral research suggests this view may not fully explain how individuals really develop these attitudes (Hirshleifer [2001]).

Psychologists have theorized that a person's attitudes and behaviors are not always consistent with efficient market theory or the maximization of expected utility (Warneryd [1999]). As an example, behavioral finance theorists point to herding behavior, the tendency of individuals to engage in momentum investing. Herding behavior occurs when more and more people join in the continuation of a price trend. Professionals and non-professionals alike appear to naively extrapolate current trends into the future (Plous [1993]).

Using data from the 1987 market collapse, Clarke and Statman [1998] report that stock market sentiment and risk tolerance attitudes dropped dramatically right after the market crash. This finding was counter to what would have been expected under a purely rational model of economics (Harlow and Brown [1990]). Given the probability of reversion to mean market pricing levels and other market data available at the time (monetary growth, GDP projections, etc.), the drop in stock prices should have resulted in stable or higher risk attitudes and market sentiment. Clarke and Statman [1998] found instead that changes in sentiment and risk tolerance fell and then quickly adjusted to the post-crash environment.

Anecdotal and empirical evidence suggests that certain financial decisions are affected by stock market sentiment and emotional disposition (Ackert, Church, and Deaves [2003]). But less well known is the role that stock market price changes play in determining an individual's financial risk tolerance attitude. Understanding the relationship, if any, between stock market returns and risk tolerance may help explain why investors exhibit herding behavior by purchasing risky investments during market up-trends, and selling securities during market downtrends.

On a more fundamental basis, the answer to this question may shed light on how investors make forecasts that affect their financial welfare (Clarke and Statman [1998]). We also hope to add to the growing body of knowledge about the role of investor psychology as a determinant of financial decisions.

Background Review

Financial risk tolerance is defined as the willingness to engage in "behaviors in which the outcomes remain uncertain with the possibility of an identifiable negative outcome" (Irwin [1993, p. 11]). Trone, Allbright, and Taylor [1996] have argued that predicting a person's financial risk tolerance is difficult because it is such an elusive and multidimensional concept. They concluded that risk tolerance, like other attitudes, is influenced by a number of predisposing factors. Thaler and Johnson [1990] concluded that "making generalizations about risk-taking preferences is difficult" (p. 660). They arrived at this conclusion after determining that a person's risk tolerance is elastic and somewhat easy to manipulate.

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One way to change a person's reported risk tolerance is to control the form in which a risky situation is presented. Although somewhat counterintuitive, framing a question so that it appears to offer a sure gain generally solicits a relative risk-averse response. Asking the same question with a sure loss outcome, on the other hand, produces a risk-taking response more often than would otherwise be expected (Thaler and Johnson [1990]).

Other research has also found risk attitudes to be changeable. For example, Ackert, Church, and Deaves [2003] determined that emotional disposition as well as economic factors could influence an individual's reported risk tolerance. They found that risk attitudes improved when respondents were in a better mood, and fell when respondents exhibited negative moods.

Regret theory helps explain the elasticity of financial risk tolerance. "Regret theory rests on two fundamental assumptions: first, that many people experience the sensations we call regret and rejoicing; and, second, that in making decisions under uncertainty, they try to anticipate and take account of those sensations" (Loomes and Sugden [1982, p. 820]).

Feelings of regret often outweigh feelings of joy, so in risky situations people tend to reduce regret. This may help explain why investors tend to exhibit herding behavior through momentum investing. When stock market prices are rising, momentum investors speculate that prices will continue to move higher. In effect, risk tolerance for momentum investors increases as prices move up, because the fear of missing out on continued gains (i.e., regret) outweighs the potential psychic and economic benefit of moving against the trend.

When prices move down, however, the herding instinct can cause investors to sell into the trend. This effectively shows that certain investors wish to minimize losses and avoid the regret associated with holding a security as it falls in value. This phenomenon also suggests that individual risk tolerance may decline in market reversals.

MacKillop's [2003] results confirm that a relationship may exist between market prices and risk tolerance. He reported that risk tolerance fluctuates with overall changes in the stock market. MacKillop concluded that individuals who invest tend to become more risk tolerant when the markets are rising and more risk averse when the markets are falling.

Shefrin [2000] described the risk-taking preference of institutional investors. He confirmed a widely assumed conjecture that professional advisors tend to be most risk tolerant during market highs and least risk tolerant during market bottoms. He also concluded that institutional investors are inclined to emphasize recent changes in market prices when adjusting portfolios. Shefrin [2000] noted that recent price changes seem to exert the strongest effect on whether a professional investor is more or less risk tolerant.

Projection Bias

Nearly all individual investors form expectations about future stock market prices by extrapolating recent trends into the future (Hirshleifer [2001]). Shefrin [2000] calls this phenomenon naïve extrapolation. Gruber [2001] calls it projection bias, the tendency of individuals to project current events into the future. It appears that random changes in events tend to change current tastes and preferences, which in turn affect long-term decisions and outcomes.

Much of the evidence surrounding projection bias has resulted from adolescent and youth risk-taking studies. These studies have generally found that the economic environment in which youths make risky decisions affects risk preferences. Risk tolerance attitudes and risky behaviors tend to increase during positive economic periods. For example, outcomes such as high school dropout rates increase when unemployment rates are low. It is possible that projection bias, or the tendency to project current events into the future, may also exist in relation to stock prices and financial risk tolerance attitudes.

Summary

Projection bias, when combined with regret theory, may help explain how investors form expectations by extrapolating trends (Hirshleifer [2001]). People generally seek to avoid losses. Theory suggests that when market prices trend downward, investors will sell into the trend. Although not necessarily rational, this may reduce any regret from not exiting the market sooner. As more investors sell, risk tolerance is likely to fall as well. So it appears that an individual's financial risk tolerance is elastic, and that economic events, as represented by stock market price data, may influence risk tolerance attitudes.

Methodology

This research was designed to determine whether stock market price changes, in conjunction with selected demographic factors, help explain financial risk tolerance attitudes. An Internet-based survey was used to collect data between September and December 2002. The self-administered survey was designed to solicit answers to a thirteen-item risk assessment questionnaire and a series of basic demographic and socioeconomic questions. The survey, hosted by a university-sponsored online survey system (www.rce.rutgers.edu/money/riskquiz/), was open to anyone with Internet access. However, use of the quiz was promoted by a non-profit national investment education program (see www.investing.rutgers.edu).

Respondents

Respondents ($N = 421$) were, on average, relatively young: The mean age was 32.03, with a standard deviation of 16.32 years. Approximately 48% of the respondents were female and 32% were married. 44% had a college degree or higher level of education. The majority of respondents reported household incomes of less than $49,999 yearly. Almost 60% indicated that they, or someone else in the household, were responsible for asset allocation decisions. The remaining 40% either used the services of a professional advisor or had no assets to invest at the time of the survey.

Dependent Variable

The dependent variable consisted of a summated score to a thirteen-item risk tolerance assessment instrument, similar to one originally published by Grable and Lytton [1999]. Grable and Lytton [1999, 2001] used a principal components factor analysis to test the validity of the risk tolerance assessment instrument. They were able to extract three subfactors represented by the instrument: 1) investment risk, 2) risk comfort and experience, and 3) speculative risk. The extraction of the three factors was interpreted to mean that the instrument measured more than one dimension of financial risk tolerance, an important consideration given the consistent observation that risk tolerance is a multidimensional construct (Callan and Johnson [2002]).

The average scale score was 27.03, on a scale of 13.00 to 47.00. The standard deviation of scores was 5.18, and the median score was 27.00. The reliability coefficient alpha was 0.72. The mean and reliability scores for the thirteen-item instrument were consistent with previous published results of studies using the same instrument.

Independent Variables

We used weekly closing prices for the NASDAQ Index, the Dow Jones Industrial Average (Dow), and the Standard & Poor's 500 Index (S&P 500) as independent variables in regression analysis models (Tables 1, 2, and 3, respectively). We collected data from September 2, 2002 through December 31, 2002. Table 1 shows the opening and closing prices for the NASDAQ, Dow, and S&P 500 over that period.

We included six additional independent variables, primarily as controlling factors: age, gender, marital status, attained educational level, household income, and age,[2] a polynomial variable to test for a possible curvilinear effect between age and risk tolerance. Age was measured continuously. Gender was dummy coded, with women coded as 1 and men coded as 0. Marital status and attained educational level were also dummy coded, with married respondents and those with a college degree or higher coded 1, and 0 otherwise. Income was originally measured categorically, with the measured income distance between each category being similar. For the purpose of this research, the household income was used as an interval variable.

Although a test of the relationships between risk tolerance and the six additional independent variables was not the primary focus of this research, we expected certain outcomes based on a review of the relevant literature. For example, we hypothesized that a convex-shaped ($\cap$) downward relationship between risk tolerance and age might be evident in the data, meaning that risk tolerance would increase linearly with age until the relationship would change and risk tolerance would decline at an increasing rate (Callan and Johnson [2002]). We also expected that risk tolerance would be positively associated with 1) being male (Sung and Hanna [1996]), 2) having higher household income (Cicchetti and Dubin [1994]; Powell and Ansic [1997]), 3) being married (Chang and DeVaney [2001]; Haliassos and Bertaut [1995]), and 4) having a higher level of attained education (Grable and Lytton [1998]).

Method of Analysis

We used three ordinary least squares regression analyses to test the relationship between stock market price changes and financial risk tolerance attitudes. We chose regression analyses, rather than another technique, because of the continuous nature of the risk tolerance dependent variable (Hair et al. [1995]). Each model included the six independent control variables, plus a variable measuring a stock market index price. The first model included NASDAQ data, the second model included Dow data, and the third model included S&P 500 data.

The data collection method made it possible to track survey completion dates, which ranged from Septem-

Table 1. *Historical Opening and Closing Index Prices*

Index	Opening Price at Inception of Research Project	Closing Price at Conclusion of Research Project
Nasdaq	1,302.67	1,335.51
Dow Jones Industrial Average	8,659.27	8,341.63
S&P 500	916.07	879.82

ber 2, 2002, to December 30, 2002. We grouped the respondents by week according to submission date. We then collected weekly opening and closing market price data to correspond to the weeks used in the study. The previous week's closing prices from the Nasdaq, Dow, and S&P were used to predict respondents' risk tolerance scores for the following week. In other words, we used closing market data from the last trading day of one week to predict risk tolerance scores for the following week.

Results

Table 2 shows the results from the regression analysis using NASDAQ data. Gender, household income, and the previous week's NASDAQ closing price were all significant predictors of financial risk tolerance. Specifically, men were more risk-tolerant than women, and those with higher household incomes were more risk-tolerant than others. We also determined that a positive relationship existed between NASDAQ closing prices and risk tolerance. As the previous week's closing price increased, risk tolerance scores also increased. Neither age nor the polynomial variable age^2 were found to be significantly related to risk tolerance scores. Educational level and marital status were also unrelated.

Table 3 shows the results using the Dow index data, which matched the results for the NASDAQ data. Women and those with lower household incomes were less risk-tolerant than others. The previous week's Dow closing value was positively related to risk tolerance scores. When the Dow moved ahead, risk scores moved up the following week. Conversely, when the Dow dropped, the following week's risk scores also declined. Age, age,^{2} educational level, and marital status were not related to risk tolerance scores.

Not surprisingly, the S&P 500 results were similar to those for the NASDAQ and the Dow (Table 4). A positive relationship between risk tolerance scores and the prior week's closing value was again observed. Men and those with higher household incomes exhibited higher risk tolerance scores. Age, age,^{2} educational level, and marital status were unrelated to the risk tolerance scores.

Summary

Our results from the three independent regression analyses support the idea that previous week closing prices affect risk tolerance attitudes the following week. This, in turn, suggests that individuals exhibit a form of projection bias by extrapolating recent trends into attitudes toward taking investment risks.

In addition to closing stock market prices, gender and income are also important factors in explaining respondents' reported risk tolerance attitudes. Is this simply an interesting anomaly supported by statistical significance? Our data suggest it is a better glimpse into the variety of factors that may impact financial decision making. Consistent with projection bias, respondents may have projected current events into the future in part by extrapolating closing stock market prices from the previous week into their reported risk tolerance attitudes. Our findings suggest that stock market price data does influence risk tolerance attitudes.

Table 2. *Predictors of Risk Tolerance Scores Using NASDAQ Data*

Variable	Coefficient	Beta	t
Age	0.0349	0.1099	0.5280
Age^2	-8.7090^{E-04}	–0.2355	–1.2200
Education[a]	0.2379	0.0228	0.4130
Gender[b]	–1.7782	–0.1716	–3.6230*
Income	0.8762	0.2447	4.6180*
Marital Status[c]	–0.5572	0.6349	–0.8780
NASDAQ Closing Price From Previous Week	0.0051	0.1119	2.3270**
Constant	18.9008		5.7020*

Note: *p < 0.01. **p < 0.05 and R^2 = 0.1170. F = 7.8139 (Sig. = 0.0001). [a]1 = College or higher; [b]1 = Female; [c]1 = Married.

Table 3. *Predictors of Risk Tolerance Scores Using Dow Jones Industrial Average Data*

Variable	Coefficient	Beta	t
Age	0.0269	0.0878	0.4090
Age^2	-8.0960^{E-04}	–0.2189	–1.1360
Education[a]	0.2593	0.0249	0.4500
Gender[b]	–1.7842	–0.1722	–3.6340*
Income	0.8741	0.2442	4.6050*
Marital Status[c]	–0.5872	–0.0530	–0.925
Dow Closing Price From Previous Week	0.0013	0.1046	2.2190**
Constant	14.5833		2.736*

Note: *p < 0.01. **p < 0.05 and R^2 = 0.1159. F = 7.7355 (Sig. = 0.0001). [a]1 = College or higher; [b]1 = Female; [c]1 = Married.

Table 4. *Predictors of Risk Tolerance Scores Using S&P 500 Data*

Variable	Coefficient	Beta	t
Age	0.0269	0.0846	0.4080
Age^2	-8.0871^{E-04}	0.2887	–1.1340
Education[a]	0.2682	0.0257	0.4660
Gender[b]	–1.7873	–0.1725	–3.6390*
Income	0.8730	0.2438	4.5970*
Marital Status[c]	–0.5998	–0.0542	–0.9440
S&P 500 Closing Price From Previous Week	0.0131	0.1004	2.1280**
Constant	14.2887		2.514**

Note: *p < 0.01. **p < 0.05 and R^2 = 0.1151. F = 7.6722 (Sig. = 0.0001). [a]1 = College or higher; [b]1 = Female; [c]1 = Married.

Discussion

We asked two questions at the beginning of this paper. Are individuals purely rational when formulating risk tolerance attitudes? And can stock market price changes, as measured by different market indexes, help explain financial risk tolerance attitudes? Our results suggest the answer to the first question is no, while the answer to the second question is yes.

Results from this study support and extend previous findings related to the elasticity of financial risk tolerance attitudes, such as Shefrin [2000], who originally studied the risk-taking preferences of institutional investors. We found that non-professional investors also exhibit the same pattern of risk tolerance adjustment based on stock market price changes. Just as important, we determined that short-term price changes have a significant impact on attitudes. Weekly closing market data appear to influence risk tolerance attitudes, holding all other factors constant.

Our findings also support the notion that individuals exhibit projection bias, as described by regret theory, in the way they develop financial risk tolerance attitudes and expectations. It appears that individuals form attitudes and expectations by extrapolating trends (Hirshleifer [2001]). When market prices go up or down, as represented by the previous week's closing prices of the NASDAQ, Dow, and S&P 500, respondents' risk tolerance the following week reflects the trend. This reaction to market changes is not rational in the sense of maximizing expected utility, but it is consistent with behavioral finance theories.

We believe our findings relating to demographic factors as predictors of financial risk tolerance attitudes are also noteworthy. As predicted, men and those with higher household incomes reported higher risk tolerance scores than others, holding other factors constant. We found no relationship between risk tolerance and age, age,^{2} marital status, or attained education level.

While these findings are somewhat unexpected, they are not inconsistent with recent research, such as Wang and Hanna [1997], who found that age is not a reliable predictor of risk tolerance. Previous research findings have not found consistent patterns related to marital status or education, so it is not surprising that these factors were insignificant here. Perhaps the inconsistencies have occurred because the determinants of risk tolerance are broader than simple demographic constants.

As indicated earlier, the relationship between stock market returns and risk tolerance may help explain why investors purchase risky investments during market up-trends and sell during market down-trends. Financial advisors, commentators, and others may be able to use this information as a background factor, or a "screen," when clients are asked to comment on their financial risk tolerance. For example, it might be reasonable to expect that during bull markets many clients will indicate a relatively higher level of financial risk tolerance. Alternatively, in a bear market, many clients may have a lower stated tolerance level.

Furthermore, financial services practitioners may wish to reconsider risk tolerance in light of changing market conditions. Results from this study indicate that clients' portfolios may need to be strategically reallocated periodically based on changes in their risk tolerance. Anticipating these elastic changes among clientele may facilitate better advisor/client discussions about the investment and financial planning process.

Finally, client education to increase understanding of the benefits of disciplined long-term investing may be an important deterrent to impulses arising from projection bias or a herd mentality.

Limitations and Recommendations

As in all research, the findings presented here are limited. First, the survey was not randomly distributed: The data represent a convenience sample of respondents who completed an Internet survey. This means that certain groups of individuals may have been excluded from the sample. As might be expected, the demographic profile of respondents tended to be younger and more technologically proficient than might be expected in the general population.

Second, the number of controlling factors used in the regression analyses was limited by the questions asked on the survey. It would be useful for future replications to include additional demographic and socioeconomic factors. Such additional data may better explain the role projection bias plays in establishing financial risk tolerance attitudes and expectations.

A review of the literature surrounding projection bias and regret theory suggests that other important factors may play a role in establishing a person's financial risk tolerance attitude. Some interesting research relates to emotion and choice decisions, and suggests that an individual's mood influences organizational and problem-solving skills (Ashby, Isen, and Turken [1999]). A person's mood and emotional state also seems to affect certain types of risk preferences and specific risk choices (Arkes, Herren, and Isen [1998]; Hirshleifer [2001]). For example, Hirshleifer reported that "people who are in good moods are more optimistic in their choices and judgments than those in bad moods" (p. 1551). Researchers interested specifically in risk tolerance studies are encouraged to explore this phenomenon in more detail. It is possible that a combination of projection bias and emotional disposition may play key roles in determining a person's initial and ongoing level of financial risk tolerance.

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