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What determines risk tolerance?

Michael Guillemette, Ph.D., CFP®[a,*], David Nanigian, Ph.D.[b]

[a]Department of Personal Financial Planning, College of Human Environmental Sciences, University of Missouri, 239B Stanley Hall, Columbia, MO 65211, USA

[b]The Richard D. Irwin Graduate School, The American College, 270 South Bryn Mawr Avenue, Bryn Mawr, PA 19010, USA

Abstract

It is important for financial planners to understand what drives risk tolerance as it directly influences the portfolio allocation preference of clients. We hypothesize that habit formation, loss aversion and investor sentiment account for significant variation in risk tolerance. We analyze average monthly scores from a widely used risk tolerance questionnaire. We find that the habit formation, loss aversion, and sentiment proxies account for −1.06%, 38.51%, and 13.21% of the variation in average monthly risk tolerance, respectively. Habit formation did not account for additional variation in average monthly risk tolerance when controlling for loss aversion and sentiment.

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1. Introduction

It is important for financial planners to understand what factors account for variation in risk tolerance. Knowledge of these factors will help planners identify what types of economic situations might affect clients' preferences for risky assets. According to Modern Portfolio Theory assets with a higher variance should have a higher expected return (Markowitz, 1952). This corresponds to the concave form of a typical investor's utility function. The greater the concavity of someone's utility function, the less willing they are to accept

* Corresponding author. Tel.: +1-573-884-9188; fax: +1-573-884-8389.
E-mail address: guillemettem@missouri.edu (M. Guillemette)

variation in consumption over time. More risk averse individuals must be compensated with a higher expected return, compared with those who are less risk averse, to accept greater consumption variation. The degree of risk aversion determines the optimal mix of risky and risk-free assets within an investor's portfolio.

The three primary theories that help explain willingness to take investment risk include habit formation (Abel, 1990), loss aversion (Kahneman and Tversky, 1979), and investor sentiment (Baker and Wurgler, 2007). Habit formation might explain why client risk tolerance shifts when a job loss or a sudden windfall is experienced. Many financial planners are aware that clients become more willing to take investment risk after experiencing prior investment gains and less willing to take risk after successive market declines. Loss aversion and the house money effect have been used to explain this behavior, but to what extent does it drive client risk tolerance? Many financial planners recall the euphoria clients experienced in the late 1990s when technology stocks were climbing to record highs. Retail investors piled into tech stocks during this period of extraordinarily high sentiment, but many who did lost significant wealth when the bubble popped. The extent to which sentiment drives risk tolerance will help financial planners understand how client preferences for risky assets might change in relation to the economic outlook.

The next section of this article provides an overview of the literature on factors that have been used to explain variation in risk tolerance. The literature review also helps to explain why different proxies were selected for habit formation, loss aversion, and investor sentiment. Section 3 outlines the conceptual framework and hypothesis. Section 4 describes the methodologies used to construct measures for habit formation, loss aversion, and investor sentiment. The article concludes with the results and practical implications for financial planners.

2. Literature review

Consumption-based asset pricing models are based on the covariance between asset returns and consumption growth. Individuals prefer a smooth consumption path over their lifecycle to maximize expected lifetime utility, which results in a low covariance between asset returns and consumption growth (Campbell, 2003). In this case it is difficult to explain the equity premium without an unrealistically high coefficient of relative risk aversion (RRA) (Campbell, 2003). Variation in risk tolerance has been attempted to be explained in the literature through models that incorporate habit formation.

Models that incorporate habit formation have been introduced to provide a possible explanation for one of the factors that drives risk tolerance. The relative income hypothesis states that individuals evaluate their consumption levels in relation to those of other people, rather than on an absolute basis (Duesenberry, 1949). Individuals assess their current consumption levels based on a weighted average of their relative recent past consumption under a theory known as habit formation. Habit preferences can be either internal or external. Abel (1990) proposes an external habit formation model, which is similar to Duesenberry's (1949) "Catching up with Joneses" hypothesis. Habit formation helps explain why the disutility experienced during recessions is so severe, even though the consumption shock is relatively small given the time horizon of the lifecycle (Campbell and Cochrane, 1999). Habit formation implies that risk aversion is time-varying, which means that the optimal allocation of a household's portfolio to risky assets also varies over time (Heaton and Lucas, 2000). Models of habit formation imply that risk aversion varies with short-term changes in consumption (Campbell and Cochrane, 1999).

Constantinides (1990) claims that the equity premium can be explained in a rational expectations model using habit preferences. Mehra and Prescott (2003) state that habit preferences cannot resolve the equity premium because it results in extreme aversion to consumption risk. They also question whether individuals actually have significant time-varying countercyclical changes in relative risk aversion (RRA) that is implied by habit formation models, such as the one developed by Campbell and Cochrane (1999). Habit preferences can explain the difference between the historically low real returns of treasury securities compared with stocks because increased risk aversion increases the quantity demanded for treasury securities, which drives down the risk free rate (Weil, 1989).

Studies in behavioral finance attempt to explain variation in risk tolerance using prospect theory. Prospect theory states that individuals evaluate gains and losses from a reference point and describes the utility function as being steeper in the loss domain compared with the gain domain (Kahneman and Tversky, 1979). Benartzi and Thaler (1995) find that the historical equity premium can be explained if investors are loss averse and myopic. Thaler and Johnson (1990) find that individuals experience less disutility from losses after a prior gain and greater disutility after a prior loss. Therefore, models that incorporate loss aversion should decrease an individual's coefficient of loss aversion, λ, after prior losses and increase it after prior gains. It is important to note that the more negative λ is, the more someone overweighs losses compared with equivalent gains.

The empirical finding of Thaler and Johnson (1990) implies that risk aversion is time-varying. After experiencing prior financial gains, individuals should become less risk averse because prior gains will protect them from subsequent losses. After experiencing prior losses, current losses should make individuals more risk averse. Barberis, Huang, and Santos (2001) study asset prices by incorporating the findings of Kahneman and Tversky (1979) and Thaler and Johnson (1990). They find that individuals are loss averse from fluctuations in consumption and that λ is dependent on previous investment returns. Their framework helps explain the high historical equity premium, the low correlation between stock returns and consumption growth and the excess volatility and predictability of equity returns.

Investor sentiment is another factor that may help explain variation in risk tolerance. The closed-end fund discount is one proxy for investor sentiment (Lee, Shleifer, and Thaler, 1991; Baker and Wurgler, 2006; Baker and Wurgler, 2007). When closed-end funds are less discounted or are priced above net asset value (NAV) investors may be optimistic about future returns (Lee, Shleifer, and Thaler, 1991). During periods of high sentiment equity prices mean revert, resulting in lower future returns. Poterba and Summers (1988) find evidence of mean reversion in stock returns and state that one of the possible explanations is "price fads" that cause equity prices to deviate from fundamental values. The findings of Thaler and Johnson (1990) imply that when closed-end funds trade at a significant premium to NAV investors have become less risk averse. Investor sentiment helps explain why risk aversion decreases during high sentiment periods.

Fig. 1. Conceptual framework.

Other proxies for investor sentiment include average stock turnover, trading volume, number of IPOs, first-day IPO closing prices, the demand for dividend paying stocks, and the equity-to-debt-issue ratio. When noise traders are optimistic, there is greater stock turnover, which increases liquidity. Trading volume is a signal that investors have heterogeneous beliefs and differ in their evaluations of equity prices (Hong, Scheinkman, and Xiong, 2006).[1] Lowry and Schwert (2002) state that IPOs tend to be held when investors are optimistic and are, therefore, willing to pay an inflated price. Cornelli, Goldreich, and Ljungqvist (2006) find that high gray market prices (a signal that investors are optimistic) are a good predictor of first-day IPO closing prices. The demand for dividend-paying stocks should rise when investors' marginal propensity to consume is high and they are pessimistic about future returns. Baker and Wurgler (2002) find that companies issue more equity relative to debt before periods of low stock market returns.

3. Conceptual framework and hypothesis

The conceptual framework is displayed in Fig. 1. Habit formation, loss aversion and sentiment should account for significant variation in risk tolerance. Risk tolerance directly influences portfolio allocation preference. Habit formation assumes the curvature and slope of the utility function are the same in the gain and loss domains. Rational agents should derive the same utility and disutility from equivalent gains and losses. However, observed levels of habit formation over small stakes have translated into unrealistically high levels of risk tolerance over larger stakes (Rabin, 2000; Rabin and Thaler, 2001). Prospect theory modified consumption models by changing the slope of the utility function in the loss domain (Kahneman and Tversky, 1979). Given the empirical evidence that people are loss averse (Tversky and Kahneman, 1992; Schmidt and Traub, 2002; Pennings and Smidts, 2003; Booij and Van De Kuilen, 2009) we hypothesis that the loss aversion model will account for greater variation in risk tolerance than the habit formation model.

4. Methods

Risk tolerance is measured using a questionnaire that has been developed by FinaMetrica, a leading provider of risk profiling tools. The questionnaire has been psychometrically tested for validity and reliability (Moreschi, 2011; Van de Venter, Michayluk, and Davey, 2012) and used to profile more than 500,000 people worldwide. The questionnaire includes 25 risk

Table 1 Distribution of sample

Descriptive	N
Mean	3,726
σ	1,356
75th percentile	4,476
Median	3,683
25th percentile	2,683
Minimum	1,640
Maximum	8,047

tolerance questions that can be found at http://goo.gl/18dkl5. Scores range from 0 to 100 with zero being most risk averse and 100 being most risk tolerant. The monthly mean risk tolerance scores (MRTS) of individuals surveyed in the United States and Canada was provided to us by FinaMetrica. The repeated cross sectional data were collected between January 2003 and December 2010. In total, 357,677 different individuals were surveyed. Table 1 provides descriptive statistics on the number of people surveyed per month. The minimum number of people surveyed in any given month was 1,640 so we believe that the sample is representative of the broader population of investors. No demographic or socio-economic data were provided.

We use a model developed by Illmanen (1995) in this analysis as a proxy for external habit-based preferences. A proxy for external habit formation is derived by taking the exponentially weighted ratio of past real consumption to current real consumption, λ. The Ilmanen (1995) model is similar to the habit formation model developed by Constantinides (1990), as the subsistence level of consumption is the exponentially weighted mean of past consumption. As the gap between the exponentially weighted ratio of past real consumption to current real consumption rises, RRA increases.

Indexed and seasonally adjusted real monthly personal consumption expenditures are obtained from the Federal Reserve Bank of Saint Louis.[2] Ilmanen (1995) assigns smaller weights to consumption levels that are further out in time. A smoothing coefficient of 0.90 is used to capture business cycle effects and the weights for the cumulative last 12 months and cumulative last 36 months are 70% and 95%, respectively (Illmanen, 1995). Eq. (1) displays the derivation of the habit formation proxy.

$$INVC_t = \frac{(((C_{t-1}) + (0.9 * C_{t-2}) + (0.9^2 * C_{t-3}) + \ldots) * 0.1)}{Ct} \tag{1}$$

The proxy for loss averse preferences is developed by Kahneman and Tversky (1992) and Barberis, Huang, and Santos (2001). Kahneman and Tversky (1992) find that individuals weigh losses 2.25 times more than equivalent gains when they are offered isolated gambles. They estimate that the marginally decreasing aspect of the value function, α, is 0.88. In the Barberis et al. (2001) model losses are not evenly weighted as there is evidence that sensitivity differs depending on whether a prior gain or loss preceded the current loss. λ increases after a prior gain and decreases after a prior loss because of the house money effect (Thaler and Johnson, 1990). Barberis, Huang, and Santos (2001) create a parameter, k, to

Table 2 Descriptive statistics

	MRTS	Loss aversion	Habit formation	Sentiment
Mean	53.2520	−2.3652	0.7016	−0.1124
Σ	0.9274	4.6431	0.0275	0.3324
75th percentile	53.9462	0.3154	0.7186	0.1200
Median	53.2681	−0.7262	0.7069	−0.0530
25th percentile	52.5293	−4.511	0.6945	−0.4070
Minimum	51.1398	−15.0205	0.6055	−0.8070
Maximum	55.2460	4.3936	0.7360	0.5380

determine how much more painful losses are after a prior loss and how much less painful they are after a prior gain. They find that $k = 3$ results in a mean λ that is approximately -2.25. For example, if the stock market falls 10% in a given month k is multiplied by -0.10 and then added to -2.25, which results in a loss aversion weight, w, of -2.55. If the stock market rises five percentage in a given month k is multiplied by 0.05 and then added to -2.25 which results in $w = -2.10$. The return on Fama and French's value-weighted portfolio of U.S. stocks[3] is used to proxy for the market return, *Mkt*. The one-month Treasury bill rate, *Rf*, is subtracted from *Mkt* to account for the opportunity cost of investing in the equity market. The derivation of the loss aversion proxy is displayed in Eq. (2).

$$(Mkt - Rf)^{0.88} \text{ if } (Mkt - Rf) \geq 0, \text{ else } w((-1)(Mkt - Rf))^{0.88} \tag{2}$$

Shumway (1997) develops an asset pricing model based on loss averse investors. The model explains annual returns better than competing models, but it does not explain monthly, quarterly, or half-year returns. This is consistent with the finding that a one-year evaluation period is utility maximizing assuming that investors are myopic and loss averse (Benartzi and Thaler, 1995). A one-year moving average is used for the loss aversion proxy.

Baker and Wurgler (2007) develop an index to measure investor sentiment that includes the monthly change in the closed-end fund discount, *CEFD*, detrended log turnover, *TURN*, the number of IPOs, *NIPO*, the first day return on IPOs, *RIPO*, the dividend premium, *PDND*, and the equity share in new issues, *S*, as factors. The index is standardized to have a mean of zero and a variance of one (Baker and Wurgler, 2007). Eq. (3) displays the Baker and Wurgler (2007) sentiment index formula.[4]

$$\begin{aligned}\Delta Sentiment = {} & -0.17\Delta CEFD + 0.32\Delta TURN + 0.17\Delta NIPO + 0.41\Delta RIPO \\ & - 0.49PDND - 0.28\Delta S\end{aligned} \tag{3}$$

5. Results

Descriptive statistics on all of the regression variables are reported in Table 2. The average coefficient of loss aversion was -2.37, which is consistent with the prior literature (Tversky and Kahneman, 1992; Schmidt and Traub, 2002; Pennings and Smidts, 2003; Booij and Van De Kuilen, 2009). A correlation matrix is displayed in Table 3. The highest correlation in the

Table 3 Correlation matrix

	INVC	Sentiment	Loss aversion	*MRTS*
INVC	1.0000	0.3396**	−0.1607	0.0014
Sentiment	0.3396**	1.0000	0.3332**	0.3758**
Loss aversion	−0.1607	0.3332**	1.0000	0.6258**
MRTS	0.0014	0.3758**	0.6258**	1.0000

*$p < 0.05$. **$p < 0.01$.

matrix is between the loss aversion proxy and MRTS. However, this correlation is only 0.63, assuaging concerns of collinearity problems. A Shapiro-Wilk normality test was run on *MRTS*. The null hypothesis of a normal distribution was not rejected at conventional confidence levels. MRTS for 2,327 individuals were analyzed immediately following the recent global financial crisis (GFC) and lower MRTS was found among respondents who perceived the stock market to be riskier than it was two years ago (Gibson, Michayluk, and Van de Venter, 2013). A positive relation between MRTS and positive stock market expectations were also reported during the GFC (Gibson, Michayluk, and Van de Venter, 2013). MRTS was found to be highly correlated (0.90) with the S&P 500 during the stock market crash of 2008–2009 (Guillemette and Finke, 2014). However, although risk tolerance was highly correlated with equity market returns it only declined 5% during the global financial crisis, compared with a much greater decline in Dutch stock market returns (Hoffmann, Post, and Pennings, 2013). If the FinaMetrica score is used in a linear manner to determine an equity allocation for a client, the average equity shift during the GFC would have been ~4%. Such a large shift in one's asset allocation will have a meaningful impact on wealth outcomes, especially over longer time horizons. Table 4 displays the results from ordinary least squares (OLS) regressions of *MRTS* on the hypothesized factors that account for variation in risk tolerance. The signs of the parameter estimates are consistent with theory for loss aversion and sentiment. The habit formation proxy was not statistically significant in any model. For a prospect theory utility function that incorporates the house money effect, as λ increases, *MRTS* increases. The sentiment index is positively associated with *MRTS*.

When each of the three hypothesized determinants of *MRTS* are examined in separate univariate regressions (Columns 1–3), the loss aversion proxy explains the greatest amount of the variation in *MRTS*. This is evidenced by the largest adjusted R^2 value (0.3851) among the three univariate regressions. Overall, loss aversion and sentiment contribute meaningfully to explaining variation in *MRTS*. This is evidenced by the adjusted R^2 value of our regression model improving from 0.3851 (Column 2) to 0.4107 (Column 7) when the loss aversion and sentiment variables are added to the plain vanilla model with only the loss aversion proxy.

The values of our dependent variable fall within a finite range. Therefore, we also examine the results from a β regression model with a logit link specification. A β regression model is a generalized linear model for dependent variables that are marginally distributed following a β distribution. The model was originally designed for percentage data that range from 0 to 100%. The MRTS variable is scaled by a factor of 1/100 to conform to the parameters of a β distribution. The β regression model results, which are displayed in Table 5, are consistent with the OLS results.

Table 4 Variation in MRTS–OLS model

Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$INVC_t$	0.0472 (3.48)			3.5291 (2.74)	−4.8095 (3.41)	1.1790 (2.98)	
Loss aversion		0.1250** (0.02)		0.1284** (0.02)		0.1146** (0.02)	0.1125** (0.02)
Sentiment			1.0483** (0.27)		1.1834** (0.28)	0.4819 (0.26)	0.5250* (0.23)
Constant	53.2189** (2.44)	53.5476** (0.08)	53.3698** (0.09)	51.0797** (1.92)	56.7592** (2.40)	52.7501** (2.09)	53.5770** (0.08)
Adjusted R^2	−0.0106	0.3851	0.1321	0.3894	0.1411	0.4053	0.4107
Observations	96	96	96	96	96	96	96

*$p < 0.05$. **$p < 0.01$.

Table 5 Variation in MRTS-β regression model

Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$INVC_t$	0.0019 (0.01)			0.1418 (1.31)	−0.1933 (−1.43)	0.0475 (0.41)	
Loss aversion		0.5018** (7.86)		0.5153** (8.04)		0.4601** (6.64)	0.4514** (6.85)
Sentiment			0.0421** (3.97)		0.0475** (4.26)	0.0193 (1.90)	0.0211* (2.29)
Constant	0.1290 (1.33)	0.1422** (42.89)	0.1350** (36.47)	0.0430 (0.57)	0.2712** (2.85)	0.1100 (1.34)	0.1433** (43.85)
ln *L*	314	337	321	338	322	340	340
AIC	−621	−669	−636	−669	−636	−670	−672
Observations	96	96	96	96	96	96	96

*$p < 0.05$. **$p < 0.01$.

6. Conclusions

Loss aversion and sentiment accounted for significant variation in *MRTS* from 2003 to 2010. Loss aversion and sentiment accounted for 41.07% of the variation in *MRTS*. When the habit formation proxy was added to the model with loss aversion and sentiment it did not account for additional variation in *MRTS*. This time period, while relatively short, is important because it encompassed the greatest financial panic since the Great Depression. Analysis over a longer time period, if and when a longer time-series of data becomes available, would be an interesting extension for future research.

It is in time periods such as these where the assessment of how a client will react to a severe market downturn will be critical in determining whether they continue to follow their financial planner's investment recommendations. This article provides evidence that more of the variation in *MRTS* is explained by loss aversion than by sentiment. It is essential for risk tolerance surveys to include questions that measure a client's level of loss aversion. The marginal effect of the sentiment proxy observed in the OLS models also supports the inclusion of questions that measure investor sentiment. We find no evidence that measuring the weighted ratio between current and past consumption improves risk tolerance assessment when loss aversion and sentiment are already being measured.

7. Practical implications

It is imperative that a financial planner assess risk tolerance correctly; otherwise the client may be in a portfolio that is excessively risky. If a client is in a portfolio that is too risky, it may increase the likelihood that he or she will sell out of stocks after a sharp decline in equity prices. This would result in lower future returns, which could possibly preclude or delay a client's attainment of his or her goals. This is because periods of low equity valuations are usually followed by higher than average stock returns (Basu, 1977; Campbell and Shiller, 1988; Fama and French, 1988). Helping clients understand their willingness to take risk before a portfolio allocation is constructed will reduce the likelihood that they will sell stocks during a severe market downturn. From 1991 to 2004 investors lost 1.56% annually in dollar-weighted returns because of market timing (Friesen and Sapp, 2007).

There is evidence that myopic behavior may play a role in the reluctance to invest in stocks. Thaler, Tversky, Kahneman, and Schwartz (1997) provide experimental evidence that the frequency at which investment performance is presented can affect a client's propensity to invest in stocks. In the experiment, different groups of investors were compared. One group was shown return data and participants were asked to allocate their portfolios between stock and bond funds on a monthly basis. Another group was shown the same data as the first group but allocated their portfolios between stock and bond funds on an annual basis. Participants in the first group allocated 59.1% of their portfolios to bond funds, yet participants in the second group allocated only 30.4% to bond funds.

Helping clients identify myopic behavior is important because evidence has indicated the risk of equities is decreasing in the length of one's holding period (Blanchett, Finke and Pfau, 2013). Myopic behavior could include checking stock prices or viewing investment statements on a daily, monthly or even quarterly basis. Since stocks should only be used to meet long-term goals, short-term fluctuations are irrelevant. Oftentimes the financial media sells the misperception that short-term fluctuations matter, but evidence suggests that even professional fund managers cannot successfully time the market (Carhart, 1997; Detzel and Weigland, 1998; Cremers and Petajisto, 2009).

Behavioral strategies that help clients take a long-term view and stay invested in stocks will help increase the likelihood that they will accomplish their goals. A Certified Financial Planner designation increased investor certainty during periods of underperformance, improving a client's ability to maintain a consistent investment approach during market downturns (James, 2013). Winchester, Huston, and Finke (2011) found that those who had a financial planner, and particularly those who had a written plan (that included an investment policy statement), were far less likely to shift their wealth into cash during the 2008 recession. Simple techniques such as waiting until the end of client meetings to discuss returns, and emphasizing longer run performance when they are discussed, are other ways that may help keep clients in portfolios that are aligned with their preferences.

Notes

1 It should also be noted that when an index changes its constituents; then index funds need to conduct trades simply to continue to replicate their index.
2 Real personal consumption expenditure data can be found at https://research.stlouisfed.org/fred2/series/PCEC96/.
3 The return data can be found on Kenneth French's Web site at http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html#Research. We are grateful to Kenneth French for providing this data.
4 The sentiment data can be found on Jeffrey Wurgler's Web site at http://people.stern.nyu.edu/jwurgler/. We are grateful to Jeffrey Wurgler for providing this data.

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