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Article

A Simplified Measure of Investor Risk Aversion

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Abstract

This article introduces a simplified measure of investor risk aversion. The single-item question combines elements from revealed preference and propensity measurement techniques in a way that matches traditional constant relative risk-aversion estimation procedures. Based on survey data from 500 investors living in the United States, scores from the proposed measure were found to correlate with other measures of risk aversion, as well as with indicators of risk-taking. A validity test showed that answers to the proposed measure were statistically associated with equity and cash ownership holdings in respondent portfolios. The simplicity and intuitive nature of the proposed measure and the alignment of question response categories to estimates of constant relative risk aversion make this a potentially valuable addition to the toolkit of researchers, financial educators, investors and those who provide advice to investors.

JEL: C83, D10, D11, D14, D19, D81

Keywords

Risk aversion, revealed preference, psychometrics, risk tolerance, financial planning

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A highly charged discussion within the financial services community involves the most appropriate way to measure an investor's risk aversion. Researchers and

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financial service professionals have historically been contentiously split in terms of opinion on the subject. Psychometric tests and scaling tools, which are sometimes referred to as a propensity measures or elicitation assessments (Cardak & Martin, 2019), are often used by investors and financial service professionals to evaluate risk aversion. An advantage associated with propensity measurement approaches is that a well-designed measure can account for an investor's deeply held feelings of fear, regret, anxiousness and greed. Propensity measures do a good job of uncovering an investor's subjective evaluation of investment outcomes. A disadvantage associated with propensity measures is that scores obtained from questionnaires are difficult to map to portfolio choices in a traditional mean-optimisation framework. This difficulty, coupled with the general lack of mathematical precision associated with the way propensity tests are developed and used, has led many researchers and those who provide advice to investors to opt for assessment tools designed around the concept of economic risk aversion.

Revealed preference methodologies are the primary way researchers evaluate an investor's risk aversion. Some have argued that revealed preference risk-aversion models provide the only rigorous theoretical way to link risk aversion to optimal portfolios (Hanna & Lindamood, 2004). Revealed preference measurement approaches assume investors are rational and that investors have the requisite cognitive skills needed to make risk and return (i.e., gain and loss) estimations (Grable & Chatterjee, 2016; Kahneman et al., 1991).

In the context of revealed preference measures, the most widely used modeling techniques employed by household finance researchers rely on the notion of constant relative risk aversion (CRRA). CRRA tests typically employ choice scenarios that require an investor to choose between two options, one with a certain outcome and the other with a chance of success or failure (Barsky et al., 1997). When CRRA measures are applied in a modern portfolio theory (MPT) framework, trade-offs can be estimated and mapped to an investor's utility function. This leads to a direct pathway to portfolio selection.

Classical economic theory (Von Neumann & Morgenstern, 1953) underlies the formulation of CRRA, as well as the use of revealed preference measures and techniques. This theory makes the assumption that a rational, utility-maximizing investor will base their portfolio choice on the utility function that maximizes the investor's level of welfare. This absolute level of investor utility reflects an investor's CRRA. CRRA can be defined as the rate at which an investor will give up a higher expected return in exchange for less volatility (Nguyen & Noussair, 2014). CRRA can be calculated using the following CRRA utility function:

$$U(W) = \begin{cases} \ln(W) & \text{if } \gamma = 1 \\ \dfrac{W^{1-\gamma}}{1-\gamma} & \text{if } \gamma > 0, \gamma \neq 1, \end{cases} \tag{1}$$

where utility received (U) is based on an individual's level of wealth (W) and risk aversion (γ).[1]

The following example, adapted from Hanna and Lindamood (2004), represents the type of question that is often used to derive estimates of CRRA:[2]

> Suppose that you are about to retire, and have two choices for a pension. Pension A gives you an income equal to your preretirement income. Pension B has a 50 per cent chance your income will be double your preretirement income, and a 50 per cent chance that your income will be 20 per cent less than your preretirement income. You will have no other source of income during retirement, no chance of employment, and no other family income ever in the future. All incomes are after-tax. Which pension would you choose?

At least three potential difficulties arise when CRRA choice-scenario questions are used in practice. First, test takers are asked to choose between two options in which the outcome probabilities are known prior to the decision. In reality, investors and those who provide advice to investors make decisions in environments where probabilities are generally never a priori known with certainty. Thus, the use of CRRA estimates assumes that risk and uncertainty are equivalent; or stated another way, it is necessary to assume that objective probability framing is similar to an investor's subjective probability estimation. Second, choice scenarios place a high cognitive load on the test taker. The types of questions asked to elicit estimates of risk aversion may simply be too complex for the average investor to answer with care and honesty (Guiso & Sodini, 2013). Third, very few investors or their advisors understand the connection between CRRA scores and anticipated behaviour. Consider the typical research project that incorporates CRRA estimates. Most studies apply an 'average' CRRA score as an input assumption into financial planning and investment models. Investors and those who provide guidance and advice to investors are then left to ponder what the score represents in a practical sense.[3]

A routine search of the internet produces thousands of links to papers, blogs and notes describing the calculation and application of CRRA coefficients. Nearly all such postings assume a reader has deep familiarity with the principles of economics. Some postings, on the other hand, over-simplify the concept of risk aversion and fail to provide any mathematical context. It is difficult to find information on the concept of CRRA that is accessible (both mathematically and practically) to those who most need to know how this economic tool can be used in practice, that is, investors and professionals who provide advice to investors. The purpose of this article is two-fold. The first purpose is to conceptualise the concept of CRRA in a way that makes sense to investors and those who provide advice to investors. This article's Appendix shows a methodology that can be used to derive estimates of CRRA. The second purpose is to introduce a simplified measure of investor risk aversion, which is based on the theoretical framework shown in the Appendix. As described in this study, this new measure can be used to validly evaluate an investor's (un)willingness to take financial risk. The measure presented in this article addresses the three significant concerns regarding the application of commonly used revealed preference assessment methods—unrealistic scenarios, high test taker cognitive load demand and applicability—while maintaining the aspects of questionnaire design that appeal to investors and those who advise investors.

Literature Review

According to Dickason and Ferreira (2018), investor risk aversion—or its inverse, financial risk tolerance—can be conceptualized as the amount of risk a person is unwilling to take when making a financial decision or investing money. Investor risk aversion is generally thought to be a relatively stable personality attribute (Gerrans et al., 2015) with investors exhibiting minimal variation in willingness to take risk across time except when an investor is subjected to extreme events (Cardak & Martin, 2019). Investor risk aversion is an important concept within the framework of investment and financial planning primarily because, historically, investor risk aversion has been found to be inversely associated with stock market participation (Mishra, 2018; Ruiz et al., 2018), with investor risk aversion describing risky asset allocation choices negatively and directly (Lei, 2018), as well as indirectly through perceptions of risk (Nguyen et al., 2019).

The manner in which investor risk aversion is measured in practice—both academically and by investors and those who provide advice to investors—tends to be quite diverse. As previously noted, measuring investor risk aversion using revealed preference items and tests is the primary way in which researchers link risk preferences to portfolio choices (Guiso & Sodini, 2013). Pratt (1964) and Arrow (1971) were among the first to introduce the concept of risk aversion as an aspect of financial and investment modeling. Arrow (1971) defined risk aversion, starting from a position of certainty, as an investor's *unwillingness* to take financial risk in a fair bet.[4] As noted by Hanna et al. (2001), there are several approaches that can be used to estimate investor risk aversion. Arrow and Pratt defined absolute risk aversion, as well as relative risk aversion (RRA), which has since been extended to the notion of CRRA. Absolute risk aversion measures the rate at which marginal utility decreases when wealth is increased by one unit, whereas RRA is the elasticity of marginal utility of wealth (Risk Aversion, n.d.). In practice, CRRA tends to be the most 'widely used parametric family for fitting utility functions to data' (Wakker, 2008, p. 1329).

Revealed Preference Tests

The most common revealed preference assessment approach involves asking a test taker numerous lottery or income/investment/asset choice-scenario questions. Then, based on the response pattern, estimating degrees of CRRA. CRRA scores are usually reported as whole numbers ranging for 1 to ∞. Although the range of potential CRRA scores can be quite large across a set of investors, for all practical purposes, risk-aversion scores based on revealed preference measures tend to be no greater than 10, which Mehra and Prescott (1985) argued is the maximum plausible level of investor risk aversion.

Propensity Measures

The primary alternative to revealed preference tests are propensity or elicitation measures. Nearly all propensity measures share a common psychometric basis. These assessment tools are sometimes single-item multiple choice questions (e.g., the risk-aversion question in the Survey of Consumer Finances [SCF]) or multi-item multiple-choice risk-aversion scales (e.g., Grable & Lytton, 1999). Other elicitation techniques include questionnaires that include several items that require test takers to respond using a Likert-type scale (e.g., the 11-item risk-aversion scale used in the German Socio-Economic Panel; Dohmen et al., 2011). Propensity and elicitation measurement techniques have an advantage over revealed preference tests in the way questions are asked. Question scenarios are designed to uncover an investor's subjective estimation of outcomes associated with one or more risky choices. In addition, propensity and elicitation measures tend to be presented in a less cognitively taxing format. A significant problem associated with these types of measures is the lack of a clear pathway from estimates of investor risk aversion to optimal portfolio choices (Guiso & Sodini, 2013). This is a key impediment for those wishing to incorporate risk-aversion scores into traditional portfolio developmental processes.

Revealed Preference and Propensity Measurement Compared

Three themes emerge from studies that describe methods commonly used to estimate investor risk aversion. First, as noted by Guiso and Sodini (2013), it turns out that revealed preference and propensity measurement scores tend to be positively correlated, although not perfectly. Second, risk-aversion measurement techniques suggest that investors tend to be risk averse and third, risk aversion varies across individuals based on personal and household characteristics. The inconsistent element in the way in which risk-aversion estimates are derived using the different methodologies relates to the choice scenarios presented in questions, tests and scales. While using objective probability estimates is a standard assumption within revealed preference measures, this is not a common element in propensity measures. On the other hand, the scaling technique is a common procedure imbedded in propensity measures but rarely something used in revealed preference tests. Rather than being forced to choose among evaluation methodologies that have distinct advantages and disadvantages, it would be ideal if researchers, investors and financial service professionals were able to use an assessment process that combines elements from different approaches (i.e., choice scenarios and scaled response choices) that leads to a valid measurement of CRRA while being easy to implement and interpret. Such a measure should also be associated with personal and household characteristics known to be related with investor risk aversion. The purpose of this study is to introduce a tool that meets these requirements.

Variables Associated with Investor Risk Aversion

Regardless of how investor risk aversion is assessed, recommendations from the literature are relatively unified in describing how certain investor characteristics ought to be associated with the degree to which someone is willing or unwilling to take financial risk. The literature also provides guidance on the way investor risk aversion should be related to actual risk-taking behaviour. Table 1 illustrates the type of findings commonly described in the risk-aversion assessment literature. Table 1 provides a sampling of papers that have examined CRRA and investor risk aversion in relation to investor characteristics, such as age, gender and income. The primary finding from each study is shown in the third column of the table.

The variables shown in Table 1 represent some of the most frequently assessed individual characteristics used either as descriptors of investor risk aversion, risk attitudes and risk-taking behaviour or as control variables in studies that consider CRRA and investor risk aversion. Given the purpose of the current study, the variables shown in Table 1 were used to validate the proposed measure of investor risk aversion.

Table 1. Summary Review of Associations between Investor Characteristics and Investor Risk Aversion

Variable & Author(s)	Year	Finding
Age		
Wang & Hanna	1998	Negative relationship between age and investor risk aversion
Grable	2000	Negative relationship between age and investor risk aversion
Hallahan et al.	2004	Positive relationship between age and investor risk aversion
Faff et al.	2009	A non-linear U-shaped relationship exists between age and investor risk aversion
Anbar & Eker	2010	No relationship between age and investor risk aversion
Yao et al.	2011	Investor risk aversion increases with age
Wong	2011	Investor risk aversion increases with age
Gibson et al.	2013	Younger investors exhibit lower investor risk aversion
Pinjisakikool	2017	Positive relationship between age and investor risk aversion
Brooks et al.	2018	Investor risk aversion increases with age at an increasing rate
Koekemoer	2018	Positive relationship between age and investor risk aversion
Cardak & Martin	2019	Willingness to take risk declines with age
Hartnett et al.	2019	Positive relationship between age and investor risk aversion

(Table 1 continued)

(Table 1 continued)

Variable & Author(s)	Year	Finding
Gender		
Grable	2000	Females exhibit higher investor risk aversion
Hallahan et al.	2004	Males exhibit lower investor risk aversion
Grable & Roszkowski	2007	Males are less risk tolerant; males overestimate their investor risk aversion
Anbar & Eker	2010	Males exhibit lower investor risk aversion
Larkin et al.	2013	Males exhibit lower investor risk aversion
Chavali & Mohanraj	2016	Females exhibit higher investor risk aversion
Fisher & Yao	2017	Gender differences are due to income uncertainty and net worth
Dickason & Ferreira	2018	Female investors exhibit higher investor risk aversion
Koekemoer	2018	Females exhibit higher investor risk aversion
Hartnett et al.	2019	Females exhibit higher investor risk aversion
Education		
Grable	2000	Education and investor risk aversion are negatively associated
Grable & Joo	2004	Education and investor risk aversion are negatively associated
Hallahan et al.	2004	Education and investor risk aversion are negatively associated
Wong	2011	Education and investor risk aversion are negatively associated
Larkin et al.	2013	Education and investor risk aversion are negatively associated
Pinjisakikool	2017	Education and investor risk aversion are negatively associated
Marital status		
Grable & Joo	2004	Those who are married exhibit more investor risk aversion
Hallahan et al.	2004	Singles exhibit lower investor risk aversion
Anbar & Eker	2010	No relationship between marital status and investor risk aversion
Wong	2011	Singles exhibit lower investor risk aversion
Koekemoer	2018	Marrieds exhibit more investor risk aversion
Household size		
Coleman	2003	Heads of larger households more likely to exhibit investor risk aversion
Eisenhauer & Ventura	2003	Larger households exhibit great investor risk aversion
Calvet et al.	2009	Financial sophistication increases with household size
Anbar & Eker	2010	No relationship between household size and investor risk aversion

(Table 1 continued)

(Table 1 continued)

Variable & Author(s)	Year	Finding
Income		
Grable	2000	Income and investor risk aversion are negatively associated
Grable & Joo	2004	Income and investor risk aversion are negatively associated
Faff et al.	2009	A non-linear relationship exists between income and investor risk aversion
Wong	2011	Income and investor risk aversion are negatively associated
Pinjisakikool	2017	Income and investor risk aversion are negatively associated
Fang et al.	2020	Investor risk aversion is lowest among those with the highest household incomes
Financial knowledge		
Grable	2000	Knowledge and investor risk aversion are negatively associated
Grable & Joo	2004	Knowledge and investor risk aversion are negatively associated
Wang	2009	Financial knowledge and investor risk aversion are negatively correlated
Gibson et al.	2013	Knowledge and investor risk aversion are negatively associated
Race/ethnicity		
Coleman	2003	Hispanic households exhibit high levels of investor risk aversion
Dickason et al.	2018	Whites and Asians exhibit more investor risk aversion than African Blacks
Hsiao et al.	2018	Minority women exhibit less risk aversion
Fisher	2019	Black households are more likely to exhibit high or some investor risk aversion
Employment status		
Schooley & Worden	1996	Non-employed individuals exhibit higher investor risk aversion
Halek & Eisenhauer	2001	Unemployed individuals exhibit lower investor risk aversion
Kannadhasan	2015	Self-employed individuals exhibit lower investor risk aversion
Shtudiner	2018	Self-employed individuals exhibit lower investor risk aversion
Personality		
Wong & Carducci	2013	Some aspects of personality are associated with investor risk aversion
Pinjisakikool	2017	Big five personality traits[5] predict investor risk aversion

(Table 1 continued)

(Table 1 continued)

Variable & Author(s)	Year	Finding
Dhiman & Raheja	2018	A negative association between investor risk aversion and personality traits exists
Rabbani et al.	2019	Investor risk aversion is negatively associated with extraversion, emotional stability and openness to new experiences
Home ownership		
Sung & Hanna	1996	No relationship between home ownership and investor risk aversion
Grable & Joo	2004	Home ownership and investor risk aversion are negatively associated
Yang	2004	Home ownership and investor risk aversion are negatively associated
Jianakoplos & Bernasek	2006	Home ownership and investor risk aversion are negatively associated
Larkin et al.	2013	No relationship between home ownership and investor risk aversion

Source: The authors.

Methods

Sample

Data for this study were obtained in late 2019 from a survey distributed to an online sample of 500 adults. The sample was chosen to be representative of individuals who were, at the time of the survey, likely to make an investment decision. The sample was not intended to be representative of the US population. The survey was developed using Qualtrics and distributed by Dynata. Respondents were paid $3 as an incentive for completing the survey, which took approximately 15 minutes to finish. The survey and procedure were first approved by the research team's university institutional review board prior to survey distribution. Respondent descriptive data are provided in Table 3.

The Proposed Measure

As noted in the review of literature, a common problem associated with measures of CRRA is that the choice scenarios presented to test takers tend to be abstract and cognitively challenging, making traditional questioning techniques less applicable to investors and the professionals who advise investors. The primary purpose of this article is to present the following simplified measure of investor risk aversion[6] that combines elements from CRRA measurement techniques with the attributes of a propensity measure and to provide evidence regarding this question's validity:

> Suppose you are considering making an investment. You have a chance to make an investment that will return either \$50,000 or \$100,000. Your financial advisor estimates that the probability of receiving \$50,000 is 50 per cent and the probability of receiving \$100,000 is also 50 per cent. You also learn from your financial advisor that shares in this investment are limited and difficult to obtain. Therefore, the less you are willing to invest, the lower the chance that you will be able to participate in the investment. Based on this information, what is the largest amount of money you would be willing to pay to participate in this investment, assuming you had the money?

This question differs from traditional CRRA assessment approaches. Typically, an investor would be asked a series of risk trade-off questions, each with a no risk option and an option in which success or failure is present, rather than one item. An estimate of CRRA would then be calculated based on an investor's sequence of choices. This results in estimates of the certainty equivalent wealth amounts associated with different values of CRRA (γ).

As an alternative, the proposed measure arrives at estimates of γ differently. Rather than requiring an investor to choose between two options, each offering a 50 per cent probability of success or failure and then using investor responses (to this and other questions) to arrive at an estimate of γ, the proposed measure of risk aversion asks an investor to choose from among the pre-determined certainty equivalent amounts associated with the trade-off. In other words, rather than estimating CRRA indirectly, investors are asked to directly choose from the certainty equivalent amounts associated with the choice scenario. Table 2 shows the choice options associated with the question.[7] The Appendix provides a detailed methodological discussion showing how the certainty equivalent amounts used in the proposed measure were estimated.

The third column in Table 2 shows the risk premiums associated with each level of γ.[8]

Validity Measures

Two types of validity tests were made in this study to determine whether the proposed measure offers investors, and those who provide advice to investors, a

Table 2. Question Response Options Based on γ Estimates

γ	Amount Willing to Invest (\$)	Risk Premium (\$)
1	70,711	4,289
2	66,667	8,333
3	63,246	11,754
4	60,571	14,429
5	58,566	16,434
6	57,083	17,917
7	55,978	19,022
8	55,143	19,857
9	54,499	20,501
10	53,991	21,009

Source: The authors.

reasonable insight into investing and financial preferences. First, convergent validity was tested to ensure that responses associated with the proposed measure were associated with other indicators of investor risk aversion and/or risk-taking behaviour. Second, concurrent validity was tested by estimating the significance of item scores in differentiating among varying levels of risky asset ownership. The following discussion describes the variables used for these tests.

In relation to the convergent validity tests, respondents were first asked the following general risk-aversion question, which was adopted from Blais and Weber (2006): 'How likely is it that you would bet a day's income at a casino?' Respondents were asked to choose an answer ranging from 1 = very unlikely to 10 = very likely. The modal response category was very unlikely (50.47%). Respondents were also asked to answer the ubiquitous SCF single-item risk-aversion question that asks: 'Which of the following statements comes closest to the amount of financial risk that you are willing to take when you save or make investments?' Four answer choices were provided: (a) take substantial financial risk expecting to earn substantial returns, (b) take above average risks expecting to earn above average returns, (c) take average financial risks expecting to earn average returns or (d) not willing to take any financial risk. The modal response category was 'take average financial risks expecting to earn average returns' (32.90%). It is worth noting that nearly 26 per cent of respondents indicated being not willing to take any financial risks.

Respondents also answered questions associated with one psychometric propensity scale and two traditional risk-aversion tests. The propensity scale was a psychometric questionnaire designed to assess an investor's willingness to take financial risk. Scale scores were estimated by summing answers to 13 items (Grable & Lytton, 1999). Higher scores were indicative of low (high) risk aversion (tolerance). In this study, scale scores ranged from 13 to 41, with a mean score of 24.85 (SD = 5.53).

Survey respondents were also asked to complete two revealed preference risk-aversion assessments. The first was the Barsky et al. (1997) income gamble test. Risk-aversion scores were based on summing responses to a series of skip-pattern questions that require a test taker to choose between two jobs where a 50/50 probability outcome exists that one job will either increase or decrease income with the other job offering income with certainty. This test has been widely used by researchers who are interested in matching risk-aversion scores to health and retirement outcomes at the household level. Test scores can range from 1 to 4. In this study, the modal response category was 1.00 (43.80%). The other revealed preference test used in this study was developed by Hanna and Lindamood (2004). The test was similar to the Barsky et al. test; however, the Hanna and Lindamood questioning process requires respondents to choose between pension choices where the reference point of success (50% probability) or failure (50% probability) is retirement income greater or less than pre-retirement income. It is important to note that for the purposes of this study, respondents were asked the test questions, whereas the original test also showed graphical representations of the test questions. Test scores can range from 1 to 7. The modal response categories in this study were 1.00 (25.50%) and 4.00 (25.50%).

Concurrent validity was assessed by testing the level of association between responses to the proposed measure and answers to the following question: 'Suppose that you were to take a snap-shot of your current financial position. Approximately what percent of your total savings and investments are invested in equities (e.g., stock mutual funds, stocks)?' Responses ranged from 0 to 100 per cent, with a mean of 16.99 per cent (SD = 25.44%). As a robustness check, respondents were also asked to indicate the percent of their portfolio held in cash. Similarly, answers ranged from 0 to 100 per cent, with a mean response of approximately 50.91 per cent (SD = 40.01%).

Control Variables

Several individual and household characteristics of survey respondents were assessed. These variables were used, as described in the review of literature, to confirm the validity of the proposed measure and as controls in a multivariate validity test.

Gender was coded 1 = male and 2 = female. Approximately 51 per cent of respondents were female. Age was measured in years. The mean age among respondents was 45.08 years (SD = 16.53). Marital status was assessed using four categories: (a) never married, (b) single but living with a significant other, (c) separated/divorced/widowed and (d) married. Approximately 49 per cent of respondents indicted being married at the time of the survey. Household size was measured by asking each respondent how many people lived in the respondent's household. The mean response was 2.57 (SD = 1.34). Employment status was coded as 1 = full time, 2 = part time or 3 = other. Nearly 42 per cent of respondents were employed on a full-time basis. Retirement status was coded 1 = retired, otherwise 0. Approximately 18 per cent of respondents indicted being currently retired. Racial/ethnic background was assessed using six categories: (a) Caucasian/White, (b) African-American/Black, (c) Hispanic/Latino/LatinX, (d) Native American, (e) Asian or Pacific Islander and (f) other. Because of data restrictions, this variable was recoded with native American and other being combined into one category. The modal category was Caucasian/White (62.03%).

Home ownership was coded dichotomously with those owning a home, with or without a mortgage, coded 1, otherwise 0. Approximately 60 per cent of respondents were homeowners. Household income was assessed using 11 categories ranging from 1 = none to 11 = above $100,000. Although each category of income was represented in the dataset, the modal category was $100,000 or above (23.50%). Formal attained education was measured using the following six categories: (a) some high school or less, (b) high school graduate, (c) some college/trade/vocational training, (d) Associate's degree, (e) Bachelor's degree and (f) graduate or professional degree. The 'some high school or less' and 'high school graduate' categories were combined in the final analysis. The modal education category was a Bachelor's degree (27.70%).

Respondent personality was measured using the 10-item personality measure (TIPI; Gosling et al., 2003). Given the predominance of literature linking certain personality traits and investor risk aversion, for the purposes of this study, the extraversion and agreeableness traits factors were specifically used in the validity tests. Extraversion was assessed by asking respondents to agree or disagree to the extent the following pair of traits applied to their situation: extraverted/enthusiastic. Scores could range from 2 to 14. The mean score was 7.75 (SD = 2.64). Openness was evaluated by having respondents state their level of agreement or disagreement to the extent the following trait pairs applied to their situation: open to new experiences/complex. The mean score was 9.02 (SD = 2.16). Finally, respondent financial knowledge was assessed by asking, 'How knowledgeable are you about personal finance topics?' The following five response categories were provided: (a) extremely knowledgeable, (b) very knowledgeable, (c) moderately knowledgeable, (d) slightly knowledgeable and (e) not knowledgeable at all. The modal response category was moderately knowledgeable (37.10%).

Statistical Tests

Estimates of the question's validity were conducted using correlational and Tobit regression tests. Scores obtained from answers to the proposed measure were correlated with scores on the other risk-aversion assessments. The concurrent validity of the proposed measure was then tested using a Tobit regression analysis with the percent of equity and cash holdings in a respondent's portfolio as the outcome measures. Individual and household characteristics, as described in the review of literature, were included as control variables in the Tobit model. The choice of the Tobit model was based the censored aspect of the outcome variable (i.e., equity holdings ranged from 0 to 100%; McDonald & Moffitt, 1980; Tobin, 1958). Validation confirmation was deemed to have occurred if risk-aversion scores on the proposed measure were negatively associated with equity holdings and positively related to cash holdings, controlling for the other variables in the model.

Results

Table 3 provides a descriptive overview of the sample. In general, respondents were representative of high-income US households with a middle-age head of household in 2019. The sample was not, however, intended to be representative of the US population but rather a cross-section of individuals who may be making investment and financial decisions that entail a degree of risk.

Table 4 shows the frequency distribution of scores for the proposed measure. Counter to what has been reported in the literature, rather than grouping around a γ of 3 to 4,[9] scores in this study varied across categories, with the modal response (i.e., 10) indicating a high degree of risk aversion. This degree of risk aversion is closer to scores exhibited by those who answer the single-item risk-tolerance item in the SCF (see Table 5).

Table 3. Sample Demographic Characteristics

Variable	Percentage	M (SD)
Gender		
Male (coded 1)	48.8	
Female (coded 2)	51.2	
Age (years)		45.08 (16.53)
Marital status		
Never married	27.3	
Not married/Living w/sig. other	10.7	
Married	49.3	
Separated	1.7	
Divorced	8.2	
Widowed	2.8	
Employment status		
Part time	17.7	
Full time	41.5	
Retired	18.2	
Not employed	17.1	
Other	5.5	
Racial/ethnic background		
Caucasian/White	62.0	
African-American/Black	13.5	
Hispanic/Latino/LatinX	10.7	
Native American	2.6	
Asian or Pacific Islander	6.2	
Other	4.9	
Housing ownership		
Own without a mortgage	29.5	
Own with a mortgage	31.0	
Rent	29.9	
Live with relative	9.0	
Other	0.6	
Household income		
$0	3.4	
Less than $20,001	11.7	
$20,001–$30,000	9.1	
$30,001–$40,000	7.6	
$40,001–$50,000	9.1	
$50,001–$60,000	8.3	
$60,001–$70,000	7.0	
$70,001–$80,000	6.1	
$80,001–$90,000	8.1	
$90,001–$100,000	6.1	
Above $100,000	23.5	

(Table 3 continued)

(Table 3 continued)

Variable	Percentage	M (SD)
Household size		2.57 (1.34)
Education		
Some high school or less	4.0	
High school graduate	18.6	
Some college/trade/vocation training	22.8	
Associate's degree	10.1	
Bachelor's degree	27.7	
Graduate or professional degree	16.9	
Extraversion		7.75 (2.64)
Openness to new experiences		9.02 (2.16)
Financial knowledge		3.24 (1.12)
% Portfolio equities		16.99 (25.45)
% Portfolio cash		50.91 (40.01)

Source: The authors.

Table 4. Frequency Distribution of Scores for the Proposed Measure

γ	Amount Willing to Invest ($)	Frequency	Percentage
1	70,711	66	12
2	66,667	24	5
3	63,246	29	6
4	60,571	61	11
5	58,566	52	10
6	57,083	21	4
7	55,978	38	7
8	55,143	29	5
9	54,499	16	3
10	53,991	197	37

Source: The authors.

Table 5 provides a summary of the descriptive statistics for the measures that were used in the convergent validity tests. As noted above, respondents exhibited high risk aversion as estimated with the proposed measure (i.e., 6.46 on a scale of 1 [low risk aversion] to 10 [high risk aversion]). This matched respondents' likelihood of betting a day's income at a casino (3.48 on a scale of 1 [very unlikely] to 10 [very likely]). Respondents fell in the average category in terms of the single-item SCF risk-aversion item, with a significant percentage of respondents indicating that they were not willing to take any financial risk. Scores on the propensity scale fell into the average range. Scores on the Barsky et al. (1997) test indicated that respondents were relatively risk averse (a score of 0 was indicative of high risk aversion). Similarly, scores on the Hanna and Lindamood (2004) test (H&L test) were skewed towards risk aversion (a score of 0 was indicative of high risk aversion).

Table 5. Risk-tolerance Measure Descriptives

Variable	Percentage	M (SD)
Proposed measure		6.46 (3.34)
Likelihood of casino betting		3.48 (3.14)
SCF Risk		2.31 (1.02)
Not willing	25.8	
Average	32.9	
Above average	26.0	
Substantial	15.3	
Propensity scale		24.85 (5.53)
Barsky et al. test		1.60 (1.05)
0.00	11.0	
1.00	43.8	
2.00	26.3	
3.00	12.2	
4.00	6.7	
H&L test		2.90 (1.96)
0.00	11.0	
1.00	25.5	
2.00	5.7	
3.00	11.2	
4.00	25.5	
5.00	13.3	
6.00	3.7	
7.00	4.2	

Source: The authors.

Convergent Validity Test Results

Table 6 shows the results from the test undertaken to determine the convergent validity of the proposed measure. Scores in the table represent correlation coefficients. The proposed measure was found to be statistically significantly associated with each of the other risk-aversion measures. When evaluating the coefficients, it is important to recall the way the other measures were coded. Specifically, the SCF item, the propensity scale, the Barsky et al. and H&L tests and the casino gambling item were coded so that higher scores indicated lower risk aversion. As such, it was expected that a high score on the proposed measure would be negatively associated with scores on these other measures. Likewise, a high score on the proposed measure was expected to be negatively related to equity ownership but positively associated with cash holdings. These relationships were confirmed, suggesting a consistent degree of convergent validity.

Table 6. Convergent Validity Correlation Coefficients

	CRRA Measure	SCF	Propensity Scale	Barsky et al. Scale	H&L Scale	Cash	Equities	Casino Gambling
CRRA measure	1.00							
SCF	–0.34**	1.00						
Propensity scale	–0.30**	0.52**	1.00					
Barsky et al. scale	–0.09*	0.04	0.21**	1.00				
H&L scale	–0.15**	0.08	0.21**	0.49**	1.00			
Cash	0.15**	–0.32**	–0.34**	–0.01	–0.02	1.00		
Equities	–0.09*	0.16**	0.24**	0.03	0.10*	–0.55**	1.00	
Casino gambling	–0.21**	0.53**	0.43**	–0.09*	–0.05	–0.17**	–0.00	1.00

Source: The authors.
Note: *$p < .01$, **$p < .001$.

Concurrent Validity Test Results

Table 7 shows the results from the multivariate Tobit regression that was designed to test the concurrent validity of the proposed measure. It was determined that holding the control variables constant—variables known to be associated with risk-taking attitudes and behaviours—scores from the proposed measure were able to distinguish among degrees of portfolio risk taken by respondents. Specifically, high scores on the measure (i.e., scores representing risk aversion) were negatively associated with equity ownership, yet positively associated with cash holdings. These relationships were statistically significant. The Tobit results provide support for the concurrent validity of the proposed measure.

Other variables were also found to be significantly associated with the portfolio composition of respondents. Compared to those who were married, respondents who were separated, divorced, or widowed were more likely to hold cash and less likely to invest in equities. In comparison to those employed on a full-time basis, retirees were found to hold more equities, whereas those with another employment status were found to hold fewer equities. Hispanic/Latino/LatinX respondents, compared to those who were White/Caucasian, were less likely to report holding equities, whereas those identifying as another racial/ethnic category were found to hold more cash. Cash ownership was lower among those holding a Bachelor's degree level of education, compared to those with a high school diploma or less, whereas those with a Bachelor's degree reported owning more

Table 7. Tobit Regression Results for Equity Holdings (Model 1) and Cash Holdings (Model 2)

	Coefficient		Standard Error		*P* Value	
Variable	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Marital status						
Never married	2.77	7.19	6.04	5.07	0.65	0.16
Live w/sig. other	1.53	–5.99	7.99	6.64	0.85	0.37
Sep/div/wid	–22.62	12.02	7.01	5.56	<.001**	0.03*
Employment status						
Part-time	–5.31	1.27	5.90	5.06	0.37	0.80
Retired	12.97	–10.74	6.58	5.90	0.05*	0.07
Others	–16.01	7.78	6.64	5.07	0.02*	0.12
Racial/ethnic						
Black/African	–4.50	–2.39	6.47	5.46	0.49	0.66
Hisp/Lat/LatinX	–18.88	–3.74	8.05	6.00	0.02*	0.53
Asian	–5.37	5.35	8.38	7.41	0.52	0.47
Other	–14.45	14.92	9.30	6.88	0.12	0.03*
Education						
Some college	16.78	–5.40	6.86	5.30	0.01*	0.31
Associate	5.55	–1.67	8.65	6.65	0.52	0.80
Bachelor	25.51	–12.39	6.78	5.46	<.001**	0.02*
Graduate degree	29.87	–11.01	7.62	6.32	<.001**	0.08
Gender	–13.90	7.02	4.45	3.82	<.001**	0.07
Age	0.06	0.09	0.17	0.15	0.73	0.55
Own home	–1.38	–9.46	5.09	4.21	0.79	0.02*
Financial knowledge	7.16	–5.59	2.01	1.67	<.001**	<.001**
Household income	1.96	–1.08	0.81	0.70	0.02*	0.12
Household size	–0.89	0.13	1.77	1.45	0.62	0.93
Extraversion	–1.41	0.06	0.81	0.69	0.08	0.93
Openness	0.92	0.12	0.99	0.83	0.35	0.89
New CRRA item	–1.29	1.22	0.63	0.54	0.04*	0.02*
Constant	–17.49	61.90	19.41	16.16	0.37	<.001**

Source: The authors.
Note: $^{*}p < .01$, $^{**}p < .001$.

equities. Equity ownership was also higher among those with some college education and those with a graduate degree. Women reported holding portfolios with less equity exposure, whereas homeowners were less likely to hold cash. Self-perceived financial knowledge was also related to the proportion of assets held in respondents' portfolios. As financial knowledge increased, cash holdings decreased while equity holdings increased. A positive association between household income and equity ownership was also noted.

Conclusion

While the discussion among researchers interested in the topic of financial risk-aversion assessment continues about the best way to assess an investor's willingness to take risk, this article offers an alternative approach to investor risk-aversion assessment by combing elements from traditional revealed preference estimation techniques and propensity measures. Based on data from a survey of 500 investors living in the United States, the test results suggest that the proposed measure was easy to understand, answer and interpret. Providing the certainty equivalent amounts, and linking these directly to a scale of γ, rather than asking multiple questions and then estimating γ appears to be conceptually easier for an investor or a person who provides advice to investors to quickly evaluate the degree of risk aversion exhibited by a score. Additionally, because each response option is measured as γ, it is still possible to use the estimate in a traditional mean-variance portfolio framework when selecting investments within a broadly diversified portfolio.

As with any study, the findings reported here should be evaluated in the context of certain limitations. For example, the sample used for the study was not representative of the larger US population. It is possible that a sample bias existed, which could have skewed CRRA scores away from historical norms. Additionally, given that the proposed measure tested in this study is new, follow up studies are needed to determine the reliability of question scores across time. Further tests will also be needed to validate the concept that a single item can be used in a valid manner to estimate CRRA with different samples and populations.

Even accounting for these research limitations, the findings from this study are noteworthy. The proposed measure allows investors or an investor's financial advisor to quantify their level of risk aversion in a precise manner. The certainty equivalent dollar amounts shown in Table 2 provide an intuitive insight into the level of risk aversion preferred by an investor. The way the question is asked—providing predefined advisor-derived probability estimates—combined with the certainty equivalent choice options—allows for a robust estimation of how closely an investor's objective and subjective evaluations align. Further, because the certainty equivalent amounts and risk premium amounts are scaled, it is relatively easy for an investor or the person who provides advice to the investor to estimate the degree to which the investor's risk aversion is higher or lower than another investor. The proposed measure also offers a unique benefit for researchers and those who advise investors. Specifically, the certainty equivalent amounts shown in Table 2 correspond directly to estimates of γ. This means that scores from the proposed measure can be directly applied to utility function models and ultimately to the selection of portfolios in a mean-variance portfolio framework. To this extent, the proposed measure overcomes the three most common problems associated with traditional revealed preference assessment techniques: unrealistic scenarios, high test taker cognitive load demand and applicability. While further research is needed to validate the question and to possibly expand the approach, results from this study do indicate that the proposed measure may be an appropriate tool for some researchers, investors and those who provide advice to investors when the goal is to obtain an estimate of CRRA in a simple, fast and valid manner.

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Appendix

The proposed measure asks investors to choose from certainty equivalent amounts as a direct way to measure CRRA. It is thus important to understand how the certainty equivalent amounts, and the resulting risk premiums, presented in this article were estimated. In order to estimate CRRA, it is useful to first conceptualise what is meant by RRA. In this regard, assume, for example, that an individual is faced with a one-time period decision in which the person will use all of their wealth to purchase or consume goods and services immediately. Also, assume that the utility of wealth is a twice differentiable function. Under these assumptions, RRA (Pratt, 1964) is estimated as follows:

$$\text{RRA} = -W\frac{U''(W)}{U'(W)}, \tag{A1}$$

where W is wealth, $U'(W)$ signifies marginal utility of wealth (the first derivative of total utility) and $U''(W)$ means the rate of change of marginal utility with respect to wealth (the second derivative of total utility).

Suppose further that this individual is risk averse and has the following power utility function, which exhibits a diminishing absolute risk aversion:

$$U(W) = \frac{W^{1-\gamma}}{1-\gamma}, \tag{A2}$$

with γ indicating the degree of relative risk aversion and W being equal to wealth, where $W > 0$, $\gamma > 0$, and $\gamma \neq 1$. This utility function cannot be applied for $\gamma = 1$ since the output will result in a division by 0, thus being undefined for that value. Instead, for $\gamma = 1$, a separate utility function can be used to indicate the same outcome as all other γ values to provide a complete proof. Thus, the CRRA utility function for any $\gamma > 0$ and $\gamma \neq 1$ is equivalent to Equation (A2). Taking the first derivative of Equation (A2) with respect to W, and using the power rule for differentiation (different from the power the utility function), results in the following:

$$U'(W) = \frac{(1-\gamma)W^{1-\gamma-1}}{1-\gamma} = W^{-\gamma}, \quad \text{(A3)}$$

The second derivative of this utility function is given by:

$$U''(W) = -\gamma W^{-\gamma-1}, \quad \text{(A4)}$$

Given the exponential nature of $U'(W)$, input values will always have a positive value whereas $U''(W)$ will always be negative because a risk-averse individual has a diminishing marginal utility of wealth. Therefore, one can conclude that the RRA function's output will always have a positive value despite the negative leading coefficient in the function.

Using the first and second derivatives in Equations (A3) and (A4) from above, the RRA function (A1) can be rewritten as follows:

$$\text{RRA} = -W\frac{-\gamma W^{-\gamma-1}}{W^{-\gamma}}, \quad \text{(A5)}$$

This can further be simplified as follows:

$$\text{RRA} = \gamma, \quad \text{(A6)}$$

This provides proof that RRA is, in fact, the constant value γ for all values when $\gamma > 0$, $\gamma \neq 1$. Hence, given conditions in Equations (A1) and (A2), for all values $\gamma > 0$ and $\gamma \neq 1$, one can then conclude that CRRA = γ.

In the case of $\gamma = 1$, the following logarithmic utility function can be used:

$$U(W) = \ln(W) \quad \text{(A7)}$$

Recall that $RA = -W\frac{U''(W)}{U'(W)}$ as such, the first and second derivatives of Equation (A7) with respect to W becomes:

$$U'(W) = \frac{1}{W}, \quad \text{(A8)}$$

and

$$U''(C) = -\frac{1}{W^2}, \quad \text{(A9)}$$

Converging these formulas results in the following:

$$\text{RRA} = -W\frac{-1/W^2}{1/W} = 1, \quad \text{(A10)}$$

This procedure illustrates how RRA is constant at $\gamma = 1$; it follows that RRA $= 1 = \gamma =$ CRRA. In the same manner, the earlier proof showed that RRA $= \gamma =$ CRRA. Therefore, given the utility functions shown in Equation (1) earlier in this paper, one can then conclude that RRA = CRRA = γ for all $\gamma > 0$.

Based on this methodology, it is possible to estimate certainty equivalent amounts associated with the proposed measure. The proposed measure presents an investor with two possible outcomes: receive \$50,000 or \$100,000, each with a probability of 50 per cent. The expected value of this investment, which represents the anticipated average value, is \$75,000, where expected value (EV) is calculated as follows:

$$EV = \sum_{i=1}^{n} W_i P_{Wi}, \tag{A11}$$

where W_i is a discrete random variable (with a possible outcome in a numerical form) with n outcomes, and P_{Wi} indicates a probability of W_i. In this example,

$$EV = (\$50{,}000 * 50\%) + (\$100{,}000 * 50\%), \tag{A12}$$

The certainty equivalent (CE) is the amount an investor with a relative risk aversion equal to γ would be willing to accept in lieu of taking a chance with an uncertain outcome. In other words, CE is the amount that an investor is indifferent to when making a decision between a choice scenario offering outcomes with probabilities and an immediate outcome with certainty. The CE can also be conceptualized as the lowest amount that an investor is willing to pay to avoid a gamble that has risky outcomes. An approximation of EV and CE allows the estimation of an investor's risk premium, which can be defined as follows:

$$\text{Risk Premium} = EV - CE, \tag{A13}$$

where EV denotes the expected value and CE is the certainty equivalent. Those with low risk aversion will have a lower risk premium compared to those with a higher aversion to risk.

To calculate CE, the following expected utility (EU) function can be applied. According to utility theory, an investor's possible level of wealth that maximizes the expected value of an investor's utility can be estimated by a utility value using the investor's utility function (Myerson & Zambrano, 2019). EU for wealth, assuming that wealth has a discrete distribution, thus, can be calculated as follows:

$$E(U(W)) = \sum_{i=1}^{n} U(W_i) P_{W_i}, \tag{A14}$$

where $U(W_i)$ means utility of W_i from the investment choice with n outcomes and P_{Wi} is a probability of W_i. Given two possible outcomes of wealth levels, this can be reduced to the following:

$$E(U(W)) = U(W_1) * P_{W_1} + U(W_2) * P_{W_2}, \tag{A15}$$

where $U(W_i)$ denotes utility of the first wealth outcome amount, $U(W_2)$ is utility of the second wealth outcome amount, P_{W_1} indicates a probability of of W_1, and P_{W_2} signifies a probability of W_2.

It follows that the utility obtained from a wealth outcome with certainty must at least equal the *EU* of a gamble as shown in Equation (A15). The expected utility of the risky choice associated with the investment must be less than or equal to that associated with avoiding the risky choice (or an amount offered with certainty). Stated another way, the *CE* amount will be greater than or equal to:

$$U(W_{CE}) \geq E(U(W)) \tag{A16}$$

Conceptually, this means that the utility from wealth by an investment offered with certainty must equal (or be greater than) to the expected utility obtained from making a choice between two possible investments containing two wealth outcomes with similar risk probabilities.

Continuing with the scenario using the logarithmic utility function shown in Equation (A7) when $\gamma = 1$, *EU* is defined by:

$$\begin{aligned} E(U(W)) &= \ln(\$50{,}000) * 50\% + \ln(\$100{,}000) * 50\% \\ &= 11.166, \end{aligned} \tag{A17}$$

Therefore,

$$\begin{aligned} U(W_{CE}) &\geq E(U(W)) \\ &\geq 11.166, \end{aligned} \tag{A18}$$

$$\ln(W_{CE}) \geq 11.166, \tag{A19}$$

Solving this for the expected wealth amount at *CE* is equivalent to: $W_{CE} \geq \$70,711$.

This suggests that for an investor with a relative risk aversion score of $\gamma = 1$, the *CE* amount the investor would be willing to invest is $70,711. This investor is willing to accept a risk premium of $4,289. In other words, an investor with a CRRA of $\gamma = 1$ will value the risky *EV* of $75,000 as equivalent to $70,711 with certainty and therefore be willing to accept a risk premium of $4,289. As the γ value increases, the risk premium also increases, thus lowering the *CE* amount.

Now consider cases were $\gamma > 1$. The following formula from Equation (A2) can be used to estimate the utility of a more risk averse investor, where $\gamma = 2$:

$$\begin{aligned} U(W) &= \frac{W^{1-2}}{1-2} \\ &= -\frac{1}{W}, \end{aligned} \tag{A20}$$

The *EU,* using Equation (A15), is given by:

$$\begin{aligned} E(U(W)) &= \left(-\frac{1}{\$50{,}000}\right) * 50\% + \left(-\frac{1}{\$100{,}000}\right) * 50\% \\ &= -0.000015, \end{aligned} \tag{A21}$$

Using the formula from Equation (A21), *CE* value can be estimated as follows:

$$\begin{aligned} U(W_{CE}) &\geq E(U(W)) \\ &\geq -0.000015 \end{aligned} \tag{A22}$$

$$-\left(\frac{1}{W_{CE}}\right) \geq -0.000015, \tag{A23}$$

As stated above, thus, at $\gamma = 2, W_{CE} \geq \$66,667$. Stated another way, the *CE* amount for an investor with a CRRA score of $\gamma = 2$ is \$66,667. This indicates an investor who has a risk premium of \$8,333.

Now consider a case where $\gamma = 5$. Using the formula shown in Equation (A2),

$$\begin{aligned} U(W) &= \frac{W^{1-5}}{1-5} \\ &= \frac{1}{-4W^4}, \end{aligned} \tag{A24}$$

Thus, *EU* can be calculated as follows:

$$\begin{aligned} E(U(W)) &= \left(-\frac{1}{4 * \$50{,}000^4}\right) * 50\% + \left(-\frac{1}{4 * \$100{,}000^4}\right) * 50\% \\ &= -2.13\text{E-}20 \end{aligned} \tag{A25}$$

Continuing with the estimate,

$$\begin{aligned} U(W_{CE}) &\geq E(U(W)) \\ &\geq -2.13\text{E-}20, \end{aligned} \tag{A26}$$

$$-\frac{1}{4W_{CE}^{4}} \geq -2.13\text{E-}20, \tag{A27}$$

Solving for W_{CE}, one can estimate W_{CE} as \$58, 566. The risk premium at this point is \$16,434.

Similarly, this estimation procedure can be replicated for other values of γ The actual values, based on the proposed measure, are shown in Table 2. Given this methodology, it is possible to link specific γ coefficients to certainty equivalent dollar and risk premium amounts. It is these dollar amounts that form the basis of the proposed measure.

Notes

1. It is common for consumption (*C*) and wealth (*W*) to be used interchangeably when discussing CRRA. Wealth (*W*) will be used in the formulas presented in this article.
2. CRRA assessment methodologies generally involve asking a series of similar questions, usually in a skip-pattern format. The common theme among CRRA tests is the use of 50/50 choice scenarios.
3. As noted in Risk Aversion (n.d., p. 21), 'Researchers in finance and in macroeconomics are so accustomed to [power utility functions] … that many of them do not even mention it anymore when they present their results.' Few researchers provide context

into what a particular CRRA scores mean in terms of financial and investment management practice.

4. For the purposes of this study, risk aversion is considered to be the inverse of risk tolerance.
5. The Big Five personality traits include openness to experience, conscientiousness, extraversion, agreeableness and neuroticism.
6. In this scenario, which is based on CRRA modelling examples commonly used in economics seminars, Shell (n.d.) showed that if an investor's wealth will equal either $50,000 or $100,000, each with an outcome probability equal to 50 per cent, the investor's expected wealth will be $75,000.
7. Only the certainty equivalent amount was shown to respondents.
8. Visualizing the scaling technique associated with the proposed measure is straightforward. An investor with a γ score of 1 is very much a risk taker. This investor is willing to potentially lose over $20,000 if the investment returns only $50,000 in pursuit of gaining $30,000. This investor's risk premium is very low. On the other end of the scale, an investor with a γ score of 10 is only willing to lose less than $4,000 in pursuit of gaining over $45,000. This investor's risk premium is very high. Scores between 1 and 10 help categorise other survey respondents along the risk-aversion scale.
9. As noted by Shell and others (e.g., Blanchett, 2017; Guiso & Sodini, 2013), the typical individual is thought to exhibit a relative risk aversion between 1 and 4, with a global mean of 3.5 (Guiso & Sodini, 2013), although it is important to note that there is a paucity of empirical evidence showing how these global estimates have been derived.

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