Personality Differences and Investment Decision-Making

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Abstract

We survey thousands of affluent American investors to examine the relationship between personalities and investment decisions. The Big Five personality traits explain investors' beliefs about the stock market and economy, risk preferences, and social interaction tendencies. Two personality traits, Neuroticism and Openness, stand out in their explanatory power for equity investments. Investors with high Neuroticism and those with low Openness tend to allocate less investment to equities. We examine the underlying mechanisms and find evidence for both standard channels of preferences and beliefs and other nonstandard channels. We show consistent out-of-sample evidence in representative panels of Australian and German households.

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1. Introduction

The recent household finance literature shows large and persistent heterogeneity in people's portfolio composition and returns (e.g., Fagereng, Guiso, Malacrino, and Pistaferri, 2020). While investment differences have been related to individual characteristics such as age, wealth, intelligence and financial literacy, these individual characteristics do not fully account for the observed heterogeneity (e.g., Gomes, Haliassos, and Ramadorai, 2021). A similar challenge arises when using demographic variables to explain investor beliefs—a key ingredient of portfolio decisions. For example, Giglio, Maggiori, Stroebel, and Utkus (2021) show that there is persistent heterogeneity in investor expectations and an exhaustive list of demographic variables can only explain a small fraction of this variation. Overall, the empirical evidence suggests a need to expand the set of characteristics to explain the process through which people make investment decisions.

In this paper, we bring in a new set of individual attributes to shed light on the process of financial decision-making. Our overarching hypothesis is that persistent differences in personality traits can explain persistent differences in both beliefs and investment decisions. This, we argue, is plausible ex-ante for two reasons. First, extensive research has shown that personality traits matter for a variety of life outcomes, including health and aging, marital and career success, and economic decisions such as spending behaviors (Becker, Deckers, Dohmen, Falk, and Kosse, 2011). As investment decisions just represent another form of life decisions, it is reasonable to expect personality traits to also play a role. Second, many concepts coined by personality psychologists, such as Neuroticism and Conscientiousness, are related and potentially complementary to concepts developed by economists, such as risk aversion and time preference. These psychology-based concepts can potentially provide new ways to measure and demonstrate the forces behind investment decisions above and beyond the traditional measures.

To organize our empirical analysis, we first develop a stylized portfolio-choice model to illustrate the potential connections between personality traits and portfolio decisions.

In this model, an investor weighs between optimizing a standard mean-variance utility and maintaining a "target portfolio." The former captures the pecuniary effect of standard mean variance preferences while the latter, in a reduced form, reflects non-pecuniary effects. For example, some individuals may enjoy investing in the stock market as a social activity and therefore derive utility from a source independent of investment returns. Such a tendency, in our model, would be reflected by a target portfolio with a high equity share. Hence, portfolio choice is determined through two channels: the standard mean-variance optimization and the target portfolio.

We hypothesize that personality traits can affect portfolios through both channels. Motivated by the growing literature that uses surveys to study people's investment decision process (Choi and Robertson, 2020; Chinco, Hartzmark, and Sussman, 2021; Giglio et al., 2021; Liu, Peng, Xiong, and Xiong, 2021), we design and administer a nationwide survey to collect information on personality traits and investment decisions. This approach is particularly well-suited for the study of personality traits, because psychologists have spent decades refining the measurement of personality traits and have come up with well-established questionnaires ready for use. In addition to having a module on personality traits, the survey also asks about expectations of key economic indicators, risk preferences, social interaction tendencies, and asset allocation decisions. The American Association of Individual Investors (AAII) distributes our survey to its members, whose median reported wealth is 3.5 million U.S. dollars. The survey yields 3,325 completed voluntary responses.

We document four main findings about the relationship between personality traits and investment decisions. First, the Big Five personality traits have significant power for explaining belief heterogeneity. Neuroticism stands out: investors high in Neuroticism are more pessimistic about average future stock returns and assign a greater probability to a crash. They are also more pessimistic about future economic growth and expect higher inflation. When explaining expectations about stock market returns, the explanatory power of the five personality traits, measured by the adjusted R-squared, is comparable to that of

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all demographic variables combined.

Second, personality traits are also related to risk preferences. In particular, investors high in Openness are more willing to take risks. Moreover, an investor's elicited expected stock return and risk aversion are uncorrelated, suggesting that these two measures reflect different aspects of individual characteristics.

Third, we connect personality traits to portfolio holdings and examine the underlying mechanisms. Investors who score high on Neuroticism or low on Openness tend to invest less in equities. However, these two traits appear to affect investment decision-making through different channels: high Neuroticism is associated with pessimistic beliefs about future stock returns and tail risks, whereas low Openness is associated with high risk aversion. Moreover, the two traits remain significant in explaining asset allocations even after controlling for risk aversion and return expectations. This suggests that personality traits carry additional explanatory power for investment decisions beyond the traditional framework of beliefs and preferences.

Fourth, we find that investors' personality traits also affect other aspects of belief formation and portfolio decisions. For example, investors react differently to the behavior of the people in their social circles: those who score high on Neuroticism and Extraversion are more likely to adopt a certain investment when it becomes popular among people around them. We also find that personality traits are correlated with extrapolative and contrarian tendencies. Consistent with before, Neuroticism and Openness stand out: higher Neuroticism is associated with more contrarian beliefs while higher Openness with more extrapolative beliefs.

The above results are based on correlations between personality traits and asset allocations. A natural concern is omitted variables, the variation of which affects both personalities and investment decisions. We address this concern in two ways. First, in investor-level regressions, we include a large set of demographic variables, such as income and wealth, as well as preference and belief characteristics as controls. The explanatory power of personality

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traits is robust to the inclusion of these controls. Second, we note that personality traits display remarkable stability within individuals over time (Cobb-Clark and Schurer, 2012; Flinn, Todd, and Zhang, 2018; Parise and Peijnenburg, 2019).[1] The high persistence in personality traits mitigates the concern that the correlation between personality traits and equity allocations is due to concurrent omitted variables, since personality traits have been mostly determined before the realizations of concurrent variables. Instead, personality traits capture persistent differences across individuals that also manifest themselves in financial decisions.

We also note that, interestingly, personality traits important for financial decisions are different from those that covary with other economic outcomes. For example, one key personality trait in the labor economics literature is Agreeableness.[2] However, we find no evidence that Agreeableness plays a direct role in financial decisions.[3] Therefore, the importance of each personality trait may vary from one economic domain to another, and our exercise shows that Neuroticism and Openness are the most relevant traits in the domain of financial decisions.

Our analysis has important implications on how economists could bring personality traits into a financial-decision framework. First, personality traits are not equally important, and their relative importance may be domain-specific. Second, personality traits may operate through different channels. Therefore, even though multiple traits may affect asset allocation simultaneously, the underlying mechanisms could be completely different, as in the case of Neuroticism and Openness in our analysis. Third, to fully connect personality traits to

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[1]For example, Costa and McCrae (1994) and Roberts and DelVecchio (2000) find that personality traits measured 6 to 30 years later display correlations between 60% and 80% with the original measures. More recently, Parise and Peijnenburg (2019) confirm, using a representative sample of households in the Netherlands, that personality traits are highly persistent over time, with a correlation coefficient of 0.66 to 0.88 across waves.

[2]An important factor in negotiation, Agreeableness has shown to be a valid predictor for wages in workplace (Heineck, 2011; Nyhus and Pons, 2005), bargaining power in real estate markets (Goldsmith-Pinkham and Shue, 2021) and in intra-household decisions (Flinn et al., 2018; Flinn, Todd, and Zhang, 2021; Gu, Peng, and Zhang, 2021).

[3]We speculate that the relevance of Agreeableness hinges on direct human interactions, which are absent in many settings of financial decision-making.

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investment decisions, we may need to go beyond the traditional framework by considering the social aspect of investment decision-making, a topic that has recently received growing attention (Han, Hirshleifer, and Walden, 2018; Hirshleifer, 2020). Finally, the measure system of personality traits and that of preferences (e.g., risk, time, and social) complement each other in explaining individuals' economic behavior (Becker et al., 2011). In light of this complementarity, personality traits can provide a useful set of noncognitive attributes. Indeed, many household panels begin to include a module of personalty traits, and it would be useful for researchers to begin including these additional variables either as explanatory variables or as controls in household-level analysis. [4]

To examine the robustness of our results, we conduct similar analysis using two additional datasets: the "Household, Income and Labour Dynamics in Australia" (HILDA) Survey and the "German Socio-Economic Panel (GSOEP)" Survey. The two datasets cover representative panels of the Australian and German population, respectively. Again, traits Neuroticism and Openness stand out and their associations with investors' equity shares are qualitatively the same as those in our U.S. survey. These results not only offer an important out-of-sample test, but also demonstrate the robustness of our findings in different populations across business cycles.

A vast literature documents persistent heterogeneity in investment decision-making and outcomes across households (Benhabib and Bisin, 2018; Bach, Calvet, and Sodini, 2018; Campbell, Ramadorai, and Ranish, 2019; An, Bian, Lou, and Shi, 2021; Fagereng et al., 2020). The heterogeneity in portfolio decisions can be attributed to demographic variables, such as age, gender, wealth, IQ, and geographic location (Barber and Odean, 2001; D'Acunto, Hoang, Paloviita, and Weber, 2019a,b), and to other characteristics, such as own or friends' past experience and political orientation (Malmendier and Nagel, 2011, 2016; Bailey, Cao, Kuchler, and Stroebel, 2018; Meeuwis, Parker, Schoar, and Simester, 2018; Nagel and Xu,

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[4]The following household panels include, or have included before, a personality module: the Household, Income and Labour Dynamics in Australia (HILDA) Survey, the German Socio-Economic Panel (SOEP) Survey, the British Household Panel Survey (BHPS), the Health and Retirement Study (HRS), and the Wisconsin Longitudinal Study (WLS).

2021). Giglio et al. (2021) recently show that beliefs are mostly characterized by large and persistent individual differences unexplained by demographic variables. Our paper contributes to this literature by showing that personality traits can explain the cross-sectional difference in beliefs after controlling for demographic variables. This result puts forward personality traits as promising variables for understanding why some people are persistently optimistic while others are persistently pessimistic. In a similar spirit, we also show that personality traits can explain cross-sectional differences in risk aversion and social interaction. The latter result adds to the recent literature on the social aspects of investment decisions (Hirshleifer, 2020).

Our paper is also related to the growing literature on the implications of personality for economic outcomes, including income, wealth, educational attainment and achievement (Almlund, Duckworth, Heckman, and Kautz, 2011). In the domain of financial decisions, Grinblatt and Keloharju (2009) studies how sensation seeking—one particular personality trait—affects excessive trading, Conlin, Kyröläinen, Kaakinen, Järvelin, Perttunen, and Svento (2015) examine the correlation between an alternative set of personality traits and stock market participation, and Parise and Peijnenburg (2019) show that low noncognitive abilities contribute to a greater probability of financial distress. Our paper adds to this nascent literature along two dimensions. First, our survey covers the respondents' personality traits and financial investments, as well as beliefs, risk preferences, and social interaction. In doing so, we are able to examine the channels through which personality traits affect investment decisions. Second, by surveying thousands of Americans who have invested substantial amounts in financial markets, we focus on a more sophisticated spectrum of market participants and show personality traits matter among these people.

Our paper complements the literature that attempts to link financial decision-making to genetics. For example, Kuhnen, Samanez-Larkin, and Knutson (2013) study how a particular genetic variation explains financial decisions through its effects on Neuroticism. There is further evidence that both financial decisions and personality traits are persistent and appear

correlated with genetics.[5] In a recent study, Sias, Starks, and Turtle (2020) study how genetic traits predict an individual's Neuroticism and therefore equity market participation. It has been shown that personality traits are shaped by both genetics and environment (Bouchard et al., 1994). Hence, genetics provide an a priori source of variation with clean measurement. In comparison, while survey-based measurements of personality traits may be noisy, they summarize information from both genes and experiences.

Finally, our paper contributes to a growing literature that uses a survey-based approach to study how people make financial decisions. Previous literature has shown how survey expectations explain equity holdings (Giglio et al., 2021), how surveys can differentiate various finance theories (Choi and Robertson, 2020; Liu et al., 2021), and how surveys can shed light on the subjective perception of risks (Chinco et al., 2021). We highlight the value of survey-based personality traits by demonstrating how they enrich our understanding of investment decisions.

2. Big Five Personality Traits and Investment Decisions

2.1. Definitions and Measurements

The Big Five model of personality traits arises from the factor analysis of statements people use to describe themselves.[6] Across numerous studies that vary in survey questions, languages, and cultures, a stable structure of five traits emerges as a parsimonious way to organize individual differences that can be articulated in natural languages. This finding is

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[5]For instance, Lesch, Bengel, Heils, Sabol, Greenberg, Petri, Benjamin, Müller, Hamer, and Murphy (1996), Sen, Burmeister, and Ghosh (2004), and Kuhnen and Chiao (2009) find an association between a serotonin transporter promoter polymorphism, anxiety-related personality traits (such as Neuroticism), and financial risk-taking in experimental setups, and Cesarini, Dawes, Johannesson, Lichtenstein, and Wallace (2009) and Barnea, Cronqvist, and Siegel (2010) suggest that genetic factors likely account for a significant portion of variation in real-life portfolio allocations across individuals.

[6]Parallel to this survey-based approach, lexical analysis of the trait terms in natural languages has also identified five similar dimensions (e.g., Goldberg, 1981; John, Angleitner, and Ostendorf, 1988).

surprising, since the theories of personality have been remarkably diverse and the questionnaires designed to operationalize them show little resemblance to each other (McCrae and John, 1992). Below, we explain these five traits and the standard measurement methodology adopted in this paper.

Openness. Openness (to experience) refers to the tendency to be open to new aesthetic, cultural, or intellectual experiences. People who are open to experience are intellectually curious, open to emotion, sensitive to beauty, and willing to try new things. They tend to be more creative and more aware of their feelings. They are also more likely to entertain unconventional ideas[7].

We use the 20-item form from the SAPA Personality Inventory (Condon and Revelle, 2015), which measures each personality trait by four questions. To measure Openness, we ask respondents self-evaluate, on a scale of 1 to 6, whether they are "full of ideas," are "able to come up with new and different ideas," are "original thinkers," and "love to think up new ways of doing things."

Conscientiousness. Conscientiousness refers to the tendency to be organized, responsible, and hardworking. Conscientious people display self-discipline, have a strong sense of duty and responsibility, and strive for achievement against outside expectations. Accordingly, the psychology literature has found that Conscientiousness is a strong predictor for job performance and is half as important as IQ (Almlund et al., 2011). To measure Conscientiousness, our survey asks the respondents to self-evaluate whether they "like order," "start tasks right away," "work hard," and "neglect duties."

Extraversion. Extraversion refers to an orientation of one's interests and energies toward the outer world of people and things rather than the inner world of subjective experiences; it is often characterized by positive affect and sociability. Extraverts are enthusiastic, action-

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[7]The definitions of personality traits are taken from the *American Psychological Association Dictionary (2007)*.

oriented people who enjoy interacting with people, possess high group visibility, and tend to assert themselves. To measure Extraversion, our survey asks whether the respondents "usually like to spend free time with people," "like going out a lot," "avoid company," and "dislike being the center of attention."

Agreeableness. Agreeableness refers to the tendency to act in a cooperative unselfish manner. Agreeable individuals are more considerate, kind, generous, helpful, trustworthy, and altruistic. For Agreeableness, we ask respondents to self-evaluate whether they are "concerned about others," "sympathize with others' feelings," are "sensitive to the needs of others," and "use others for own ends."

Neuroticism. Neuroticism refers to a chronic level of emotional instability and proneness to psychological distress. More neurotic people are less predictable and less consistent in their emotional reactions. They tend to be flippant in the way they express emotion and are more likely to interpret ordinary situations as threatening and minor frustrations as difficult. To measure Neuroticism, our survey asks respondents to self-evaluate whether they "get overwhelmed by emotions," are "worriers," "worry about things," and "panic easily."

Research in neuroscience shows that personality traits have a biological basis (McAdams, 2015). In particular, they are related to different brain systems, which are brain areas and neural circuitries that generate given behavioral functions. For example, Extraversion is related to brain systems governing *positive emotionality*, while Neuroticism is related to brain systems governing *negative emotionality*. Conscientiousness and Agreeableness are related to neurocognitive systems governing *effort control*. These brain systems co-evolve with personality dispositions from early stages of development.

Caveats. While the five-factor model has become an important tool for understanding personalities, several limitations should be noted. First, while the five-factor model repre-

sents the highest hierarchical level of dispositional traits, it omits more granular variations across individuals.[8] Second, personality surveys ask respondents to rate themselves on a 5- or 6-point continuum with respect to certain statements, such as "I am a cheerful optimist." Responses are meaningful only if people mean the same thing when they refer to a cheerful optimist. Third, measures of personality traits are context-free, which should be interpreted as "psychology of the stranger" that provides information about persons that one would need to know when one knows nothing else about them (McAdams, 1992). Despite these limitations, the Big Five model provides an efficient and high-level summary of individual differences from a psychological perspective, and can potentially shed new light on investors' heterogeneity.

2.2. Conceptual Framework

The Big Five model has strong predictive power for life outcomes, including divergent thinking abilities (McCrae, 1987), marital adjustment and divorce (Kelly and Conley, 1987), health outcomes such as coronary disease (Dembroski, MacDougall, Costa, and Grandits, 1989), spending behavior (Weston, Gladstone, Graham, Mroczek, and Condon, 2019), job performance (Barrick and Mount, 1991), and corporate decisions (Gow, Kaplan, Larcker, and Zakolyukina, 2019). Given that many of these life outcomes concern economic decisions, it is natural to expect personality traits to also affect financial decisions. However, the exact nature of these effects is unclear as the literature offers limited guidance. In this section, we use a simple framework of investment decisions to provide some guidance on subsequent analysis.

In a standard framework, financial decisions are determined by an investor's preferences and beliefs over asset returns. Many existing studies, however, show that financial decisions are also driven by other, non-pecuniary factors. For example, Gao and Lin (2015) show that retail investors trade, not just because they derive utility from asset returns, but also because

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[8]For example, personality traits can be further broken down to 10 or 27 dimensions (Ashton, Lee, Goldberg, and de Vries, 2009; Condon, 2018; Revelle, Dworak, and Condon, 2020).

they enjoy the social aspect of discussing stocks with their trader friends. More recently, the rise of ESG investment suggests that people invest in ESG-related stocks not just because they believe these stocks will outperform, but also because of ethical and environmental concerns (Pástor, Stambaugh, and Taylor, 2021). In order to fully understand the implications of personality traits for investment decisions, we need to also consider non-pecuniary factors. For instance, Extraverts may enjoy the interactions with people more and have a stronger tendency to follow their friends.

To incorporate both pecuniary and non-pecuniary factors, we consider the following simple framework. The market has two assets: a risk-free asset with an interest rate of zero and a stock with a stochastic return r. w_i denotes the portfolio share allocated to the stock by investor i, who makes her decision based on two considerations. The first is the standard mean-variance utility maximization. Under this consideration, personality traits can affect investment decisions through standard channels of beliefs and risk preferences. The second consideration is meant to capture the non-pecuniary factors, such as the above-mentioned social and ethical concerns. To this end, we use w_i^* to denote the investor i's allocation to the risky asset if her decision is entirely determined by the second consideration. We refer to this portfolio as the "target portfolio." For instance, w_i^* is higher for investors who derive more utility from the social aspect of stock trading. Under this second consideration, personality traits can affect portfolio choice through the target portfolio.

Investor i's decision is determined by the following objective function

$$\max_{w_i} \quad (1-\alpha)\left(w_i E_i[r] - \frac{1}{2}\gamma_i w_i^2 Var_i[r]\right) - \alpha\frac{1}{2}(w_i - w_i^*)^2, \tag{1}$$

where the first term captures standard mean-variance maximization: γ_i is the coefficient of risk aversion, and $E_i[r]$ and $Var_i[r]$ are the subjective mean and variance of stock returns. The second term, with a quadratic formulation, is a simple parameterization that penalizes deviation from the target portfolio. Finally, parameter α, with $\alpha \in [0, 1]$, represents the

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weight that the investor allocate to the non-pecuniary factors.

Objective function (1) implies that the optimal portfolio is given by:

$$w_i = \frac{(1-\alpha)E_i[r] + \alpha w_i^*}{(1-\alpha)\gamma_i Var_i(r) + \alpha}. \tag{2}$$

The above equation illustrates that an investor's decision is determined by not only her belief (i.e., $E_i[r]$ and $Var_i(r)$) and preference (i.e., γ_i) but also other factors that are summarized by w_i^*. In one extreme case of $\alpha = 0$, the decision is determined by the traditional mean variance optimization $w_i = \frac{E_i[r]}{\gamma_i Var_i(r)}$. In the other extreme case of $\alpha = 1$, the investor's decision is w_i^* and hence is completely guided by factors other than the traditional utility maximization.

According to this simple framework, personality traits can affect investment decisions through two separate channels. First, they affect asset allocations through their effects on the expected return $E_i[r]$, the perceived risk $Var_i(r)$, or the risk aversion γ_i. For instance, if investors high in Neuroticism are likely to be pessimistic (i.e., have lower expected return $E_i[r]$), they would hold less risky assets. Second, personality traits may carry additional explanatory power for investment decisions beyond their correlation with beliefs and preferences, through their effects on the target portfolio share w_i^*. In the aforementioned example, social traders will have higher target shares w_i^* and hence higher allocations to the risky asset. Our goal is to examine empirically the relevance of both channels for investors' financial decisions.

It is worth noting that the framework also offers a natural explanation of the "low sensitivity" phenomenon documented in Giglio et al. (2021) and Liu et al. (2021). These studies find that although investors' portfolios respond to their reported expectation of future returns, the sensitivity appears to be excessively low relative to the implication from a standard utility maximization framework. While this phenomenon can be driven by transaction costs or investor inertia, our framework offers an additional simple interpretation. An investor's

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financial decisions are partly driven non-utility maximization factors, as summarized by the target portfolio share w_i^*. In fact, the sensitivity of the stock allocation to the expected stock return decreases in α and approaches zero when α approaches one.

3. Survey Description

We design and administer a nationwide survey through the American Association of Individual Investors (AAII), a nonprofit organization of about 150,000 members. The main purpose of AAII is to assist "individuals in becoming effective managers of their own assets through programs of education, information and research." Previously, survey expectations from AAII members have been used to study the formation of investor expectations over time. For example, Greenwood and Shleifer (2014) show that the expectations based on the AAII surveys are highly correlated with those based on other surveys such as the Gallup investor survey and Graham-Harvey CFO survey.

AAII distributed the survey on our behalf via an email to its members on November 22, 2019. Members were given two weeks to complete the survey, and a reminder was sent out on November 29. We obtain 3,325 valid responses after filtering, yielding a 2% response rate out of roughly 150,000 AAII members.[9]

3.1. Survey Design

The survey, attached in the Appendix, has four sections. When administering the survey, we randomize the order of the first three sections, which represent the core of the survey and aim to collect three distinct sets of information.

Personality. The first section draws upon the well-established questionnaire approach to measure the Big Five personality traits. In particular, we use the 20-item form from the

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[9]We exclude 4 respondents who took over 10,000 seconds to complete the survey and 56 respondents whose answers to risk aversion questions are not self-consistent (more details in Section 4.2). The small number of inconsistent responses also demonstrates the high quality of our survey respondents.

SAPA Personality Inventory (Condon and Revelle, 2015) and randomize the order of these items.[10] Each item is a brief and concise description of a person, such as "I usually like to spend my free time with people." The respondent is asked to evaluate if the item is an accurate description of himself or herself by choosing a score from 1 to 6, where 1 represents "Very Inaccurate" and 6 represents "Very Accurate." Each big-five personality trait is then derived from the equal-weighted average of the respondents' scores for the four questions corresponding to this trait. For example, "I usually like to spend my free time with people" is one of the four questions corresponding to Extraversion. A respondent's score for this trait will be the average of of his or her responses (1–6) for this question and three other questions.

Belief and preference parameters. The second section elicits a set of parameters that are central ingredients in standard models of portfolio decision-making. First, we ask respondents to report their expectations about the stock market return, GDP growth, and inflation rate in the following year. To capture beliefs about tail events, we ask them to assign probabilities to the tail events that the stock return will be above 20% or below −20% in the following year. To capture extrapolative and contrarian beliefs, we ask them if they believe stock price trends will continue or reverse in the future, conditional on a past gain or loss. Second, we follow Van Rooij, Lusardi, and Alessie (2011) and elicit investors' risk attitude by asking them to choose between a job with a stable income and a job with a risky but higher expected income. Third, to capture the "social interaction" dimension of investment decisions, we ask how the respondents typically react when a new financial product becomes popular among people around them.

Equity allocation. The third section asks about the allocation of financial assets, our key outcome variables of portfolio choice. Specifically, we ask the correspondents to evaluate,

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[10]Condon and Revelle (2015) show that the personality scales derived from these 20 items correlate well with the IPIP Big-Five Factor Markers, a mainstream personality questionnaire that uses 50 or 100 items.

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in their retirement and non-retirement accounts, how much money they have invested and what fraction of the investment is in equities. Combining these questions gives the fraction of investment in risky shares.

Demographics. The last section includes standard questions on demographics, including age, gender, race, income, wealth, location, education.

3.2. *Summary Statistics of Personality Traits and Demographics*

Table 1(a) reports summary statistics. Our respondents are predominantly white males older than 60 and around 80% fall into this category. Relative to the general population, they are more educated and wealthier: 90% of them have a college degree, more than 80% have wealth over 1 million dollars, and about one third of them have an annual income greater than $200,000. Figure 1 reports the histograms of selected demographic variables, which confirm these patterns. Although the AAII sample is skewed in demographics by over-representing white males older in age, these individuals are also the ones more actively invested in the stock market, making it rather relevant for the study of retail behavior.

The five personality traits have different means but similar standard deviations, suggesting that variations in their magnitudes are comparable. While Openness and Extraversion exhibit little skewness, the other three have skewed distributions: Agreeableness and Conscientiousness are negatively skewed, whereas Neuroticism is positively skewed. These distributions are visualized in Figure 2, which reports the histograms of personality traits.

Table 1(b) reports the pairwise correlation between personality traits. While the Big-Five traits are designed to capture different sources of variation across people, their empirical measures appear to be mildly correlated. For example, people who are more agreeable tend to be more open and conscientious, whereas people who are more neurotic tend to be less conscientious. We therefore, in the following analysis, include all five personality traits as regressors to examine the effect of independent variation in a given trait. As a cross-

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validation check, our correlation coefficients in Table 1(b) are similar to those reported in Almlund et al. (2011).

Personality traits are also correlated with some demographic characteristics. In early and middle adulthood, it is well documented that as people get older, they tend to become agreeable and conscientious (e.g., Srivastava, John, Gosling, and Potter, 2003). In comparison, people in our sample are significantly older. Table 2 reports the results when we regress personality traits on demographic variables. We find that female respondents tend to have higher Agreeableness and higher Neuroticism, while older respondents tend to have higher Agreeableness, lower Conscientiousness, lower Neuroticism, higher Extraversion and lower Openness. Overall, the explanatory power of the demographic variables is small: the R-squared is 3% to 5%. We include these demographic variables as controls in subsequent regressions.

3.3. Summary Statistics of Beliefs and Preferences

Table 1(c) reports the summary statistics of belief and preferences. The average expected one-year stock market return is 5.57%. There is substantial heterogeneity across respondents in the expected return. Respondents at the 10th percentile of the distribution report a one-year expected stock return of -10%, while respondents at the 90th percentile expect a one-year return of 14%. The cross-respondents standard deviation of the one-year expected return is 9.51%. Similarly, the average probabilities of the extreme events that the stock market rises or falls by more than 20% are 18.49% and 25.09%, respectively, with large heterogeneity across respondents. The average expected one-year GDP growth and the average expected inflation rate are both about 2%, with the 10th-90th percentile bounds around 1% to 3%.

Following Van Rooij et al. (2011), we ask respondents three questions to elicit their risk aversion. Each question asks the respondents to decide between a safe job and a risky job. In the first question, the risky job has a 50% chance to double the income and a 50% chance

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to cut the income by 20%. In the second question, the risky job has a 50% chance to double the income and a 50% chance to cut the income by 33%. In the third question, the risky job has a 50% chance to double the income and a 50% chance to cut the income by 50%.

The risky jobs in these three questions are increasingly riskier and require higher levels of risk appetite. Consistent with this property, we find that 60% of the respondents pick the risky job in the first question, 27% pick the risky job in the second question, and 6% pick it in the third question. If the respondent prefers more to less and answers these questions in a self-consistent way, picking the risky job in the second question should imply picking the risky job in the first question, and picking the risky job in the third question should imply picking the risky job in the second question. Out of the 3,385 respondents who completed the survey, only 56 are not self-consistent and are excluded from subsequent analysis.

We conclude this section by discussing two more appeals of our AAII survey. First, our survey was distributed by AAII to its members, many of whom had been AAII members for years and had a strong sense of affiliation. Indeed, AAII provides a variety of services to its members, including sending out regular newsletters and organizing annual conferences on investing. Therefore, compared to respondents from other survey platforms such as MTurk or Prolific, our respondents were able to complete the survey with more patience and care, ensuring the high data quality in our survey. Second, we are interested in not only examining the link between personality traits and investment choices, but also shedding light on the underlying mechanism. Compared to other surveys with a personality module, the self-designed nature of the AAII survey allows us to collect responses on beliefs, risk preference, and social interactions and examine the mechanism more directly.

4. Linking Personality Traits with Beliefs, Preferences, and Social Tendencies

4.1. Expectation

In this section, we link personality traits with investor beliefs and preferences. We start with the questions about return expectations. Although our survey only captures one cross-section of return expectations, previous research has documented that belief variation is mostly summarized by individual fixed effects (Giglio et al., 2021). In other words, investors tend to have very large and persistent differences in their views. Therefore, this first exercise aims to attribute investor-level expectations about future stock market performance and economic outcomes to personality traits.

In Table 3, Column (1) reports the results of regressing expected market returns on the five personality traits while controlling for demographic variables. Investors with high Neuroticism are more pessimistic in their expectations: a one-point increase in Neuroticism is associated with a 79-basis-point drop in the forecast of future one-year market return. In contrast, investors high in Conscientiousness and Extraversion are more optimistic in their forecasts: a one-point increase in Conscientiousness (Extraversion) is associated with a 66-basis-point (82-basis-point) increase in the forecast of future one-year market return.

Columns (2) and (3) are concerned with the tails in the distribution of beliefs about stock market returns. While investors high in Neuroticism do not exhibit any difference in their assessed probability of an extreme upside, they are much more concerned with the downside risk: a one-point increase in Neuroticism is associated with a 102-basis-point increase in the predicted probability of a 20% market crash within the next year. In comparison, investors with high Extraversion and Conscientiousness expect a lower probability of a market crash.

A distinct pattern for Openness is worth noting. While Openness is uncorrelated with average beliefs, higher Openness leads to a higher estimated probability for both the *upside* and the *downside.* Intuitively, people with higher Openness are more willing to entertain

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the possibility of extreme events, which may explain why they assign greater probabilities to both tails at the same time.

How much explanatory power do personality traits have? Table 3(b) runs the regression separately for personality traits and other demographic variables. The five personality traits turn out to have explanatory power similar to that of all the demographic variables combined, including gender, age, income, wealth, education and location. The adjusted R-squared is comparable across the two specifications. These results suggest that personality traits may help explain why some people are persistently optimistic while others are persistently pessimistic.

We also find that personality traits shape how investors forecast other macroeconomic variables. Columns (4) and (5) report regression results using expected GDP growth and expected inflation as dependent variables. Higher Neuroticism is associated with a more pessimistic forecast while higher Extraversion with a more optimistic forecast. Moreover, higher Neuroticism is associated with a *higher* inflation forecast. Panel (b) shows that the explanatory power of personality traits for GDP growth and inflation expectations is also similar to that of all demographic variables combined.

Overall, the results so far consistently highlight Neuroticism as a key determinant in cross-sectional variation in beliefs: neurotic investors are more pessimistic about market returns and economic growth, assign a greater probability to a market crash, and expect future inflation to be higher. While Conscientiousness and Extraversion also matter for investors' beliefs, Neuroticism is the only trait that explains beliefs about stock returns, GDP growth, and inflation.

One concern about these results is that an investor's expected stock return and her personality traits are both affected by her recent experiences. We believe this is unlikely to fully explain our results because the five personality traits are context-free constructs. In fact, the psychology literature notes that the five-factor model is designed to capture unconditional differences in personality traits, which abstract away from the contextual and

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conditional nature of human experiences (McAdams, 1992). Moreover, the five personality traits are stable for an individual, and intra-individual changes are found to be generally unrelated to adverse life events (Cobb-Clark and Schurer, 2012; Anusic and Schimmack, 2016).

We also probe how personality traits affect an investor's belief-formation process. Two of the simplest, most explored belief-formation processes in the literature are extrapolative beliefs and contrarian beliefs. In the survey, we ask respondents if they believe a stock will rise, fall, remain the same over the next year if it has risen (fallen) a lot over the last year. Based on their answers, we assign each respondent an extrapolation score ranging from −100 to 100, where a higher score indicates a more extrapolative (and less contrarian) tendency. Table 4 reports the results when regressing the extrapolation score on personality traits. Neuroticism and Openness again stand out: higher Neuroticism is associated with less extrapolative (more contrarian) beliefs while higher Openness is associated with more extrapolative (less contrarian) beliefs. Therefore, personality traits not only affect the level of beliefs, but also the perception of trends and streaks.

4.2. Risk Aversion

In Table 5, Columns (1) to (3) report the results from Logit regressions, in which the dependent variables are the dummy variables indicating whether the respondent is willing to take a particular bet. Column (4) reports the result from an OLS regression, in which the dependent variable is the implied risk aversion parameter.[11] This risk aversion parameter is uncorrelated with the respondent's expected stock return, which suggests that it captures a different aspect of the investment decision-making process.

These regression results suggest that Openness, Agreeableness, and Extraversion are

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[11]The implied risk aversion parameter equals 1 if the respondent picks the risky job in all three questions, 2 if the respondent picks the risky job in the first two questions and rejects it in the third question, 3 if the respondent picks the risky job in the first question and rejects it in the second and third questions, and 4 if the respondent rejects the risky job in all three questions; that is, a higher parameter value implies a higher risk aversion.

strongly correlated with risk aversion. An investor is more risk-averse if she is low in Openness, high in Agreeableness, or low in Extraversion. The connection between Openness and risk aversion is quite intuitive: an investor with higher Openness tends to be more open to taking risks, whereas an investor with lower Openness tends to be more conservative. Similarly, an investor with higher Extraversion enjoys social interaction and tends to be more excitement-seeking (McCrae and Costa Jr, 1997). However, the association between Agreeableness and risk aversion seems less obvious. In contrast to Kuhnen et al. (2013), we do not find a significant relationship between risk aversion and Neuroticism.

Conceptually, the results in Sections 4.1 and 4.2 suggest that personality traits can provide deeper psychological foundations for the origins of individual differences in beliefs and preferences (see McAdams, 2015, for a review). A related literature specifically examines how a particular genetic variation explains financial decisions through its effects on Neuroticism (Kuhnen et al., 2013, among others).

4.3. Social Interaction Tendencies

A recent literature begins to investigate how social interactions contribute to financial decision-making (e.g., Bailey et al., 2018; Han et al., 2018; Hirshleifer, 2020). To capture this social aspect, we include the following question: "upon seeing a new type of investment becoming popular among people around you, would you consider investing in it as well?" This captures a scenario that many investors face regularly—e.g., how to respond when Bitcoin became a popular investment amongst the general public—and the resulting measure can interpreted as a measure of social "herding". The options range from "Definitely No" to "Definitely Yes," coded as scores from 1 to 5.

Table 6 reports results when regressing measures of social interactions on personality traits. The dependent variable in Column (1) is the score from 1 to 5 and, in Column (2), is a dummy variable that equals one for "Yes" or "Definitely Yes." In both specifications, Neuroticism and Extraversion are associated with a higher degree of social "herding." It

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is intuitive why Extraversion matters here: an extravert derives utility (and pleasure) from interacting with others and tends to copy their investment decisions after such social interactions. The positive coefficient on Neuroticism is also worth noting. One possible explanation is that more neurotic investors have more fear of missing out (FOMO), and therefore tend to follow the crowd.

The results above suggest that, to fully incorporate personality traits into a financial-decision framework, we need to go beyond the standard framework of beliefs and preferences by accommodating social interaction tendencies. In particular, personality traits may affect how investment strategies (Han et al., 2018; Hirshleifer, 2020) and expectations (Bailey et al., 2018) transmit in the population, an aspect that has been often ignored in traditional finance models but has recently received growing attention.

5.   Personality Traits and Asset Allocation

In this section, we examine the relationship between personality traits and asset allocation decisions. We start with our main data set, the AAII survey, which covers a cross-section of American investors. To further establish robustness in panel data and in an international setting, we conduct similar analysis using two household panels for the Australian and German populations.

5.1.   AAII Survey

We obtain in our AAII survey each respondent's overall equity share as a fraction of financial wealth, and regress it on the five personality traits, controlling for gender, age, state, and education fixed effects. Table 7 reports the results. As shown in Column (1), both high Neuroticism and low Openness are associated with low equity shares. However, these two effects appear to operate through difference channels. Specifically, as shown in Tables 3 and 5, high Neuroticism is associated with low expected returns and high crash

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risks, but has no meaningful correlation with risk aversion. Hence, the effect of Neuroticism on equity allocation is likely through the belief channel. In contrast, high Openness is associated with low risk aversion, and high perceived risks, but has no significant correlation with expected returns. That is, this effect is dominated by the preference channel: investors with high Openness have low risk aversion and hence high equity allocation, despite their high perceived risks.

We then separately analyze the equity shares in retirement and non-retirement savings. In our sample, retirement savings and non-retirement savings are of similar magnitude. In Column (2) of Table 7, we repeat the regression but use the equity share of the retirement saving as the dependent variable. Results are consistent with the evidence in Column (1): high Openness and low Neuroticism are associated with higher equity shares.

In Column (3), we repeat the regression but use the equity share of the assets outside of retirement saving as the dependent variable. The coefficient associated with Openness is consistent with that in Columns (1) and (2), but the coefficient associated with Neuroticism is no longer significant. We suspect that the data in non-retirement savings are more noisy, because they may include alternative investments such as private equity and hedge funds that are risky but not counted in the equity share.[12]

In Columns (4) to (6), we additionally control for the respondents' belief and risk preferences from the survey. While the respondents' expected equity return, belief about tail risks in the stock market, and risk aversion can explain their equity shares, the explanatory power of Openness and Neuroticism remains robust. This suggests that personality traits carry additional explanatory power for investment decisions beyond the traditional framework of beliefs and preferences, likely through non-stantard forces modelled by the "target portfolio." Therefore, there is a need to extend standard models of portfolio choice by considering alternative forces, such as social interactions and non-pecuniary preferences.

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[12]We inform the respondents that equities include not only individual stocks, but also mutual funds and exchange-traded funds (ETFs) that mainly hold equities. Equities do not include ordinary bonds, preferred stocks, convertible bonds, and various money market funds.

One concern about the above specification is omitted variables affecting both sides of the equation. This concern, however, is largely mitigated by the fact that measures of personality traits are highly persistent in time-series (Costa and McCrae, 1994; Parise and Peijnenburg, 2019). It is also important to note that personality traits are increasingly stable with age (Roberts and DelVecchio, 2000). This feature, combined with the AAII sample's overrepresentation of older individuals, suggests that the measured personality traits in our sample are likely to represent persistent—not transitory—individual characteristics.[13] Therefore, it is unlikely that the correlation between personality traits and equity allocations is due to *concurrent* omitted variables, since personality traits have been mostly determined before the realizations of concurrent variables.

5.2. The HILDA Survey

One concern, inherent in our cross-sectional setting, is that the effects of personality traits on investment decisions are time-varying and our results only capture one snapshot at a time. For instance, perhaps Neuroticism leads to more pessimistic investment only after a long bull market, if Neurotic investors worry more about a reversion after a long boom. Since the AAII survey data do not allow us to directly address this issue, we resort to a different dataset to examine the robustness of our results in a panel setting.

We bring additional data from the Household, Income and Labour Dynamics in Australia (HILDA) Survey. The HILDA Survey is a household-based panel study that collects information about economic and personal well-being, labour market dynamics, and family life. It covers the period from 2001 to 2017. The personality data were collected in 2005, 2009, 2013, and 2017. The investment data were collected in 2002, 2006, 2010, and 2014. We merged these data in adjacent years (for example, the 2005 personality data are merged with the 2006 investment data), obtaining three measurements (2005–2006, 2009–2010, and

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[13]The persistence in personality traits holds true also in the HILDA survey that we used: Cobb-Clark and Schurer (2012) and Flinn et al. (2018) show that all big-five personality traits are stable over time and across age cohorts. This claim is also consistent with the evidence that personality traits have genetic and biological roots (Kuhnen et al., 2013; McAdams, 2015; Sias et al., 2020).

2013–2014).[14]

We choose this dataset for complementary analysis for the following reasons. First, with a panel structure, the HILDA Survey allows us to track a given household's portfolio decisions and personality traits over time. Second, the HILDA sample has much more balanced demographics. For example, the numbers of female and male respondents are close and the distribution across age brackets is smooth. Third, the HILDA Survey concerns a sample from the population of a different country, Australia, with comparable institutional features. Therefore, it provides an "out-of-sample" test of the results of the AAII survey.

We perform similar analysis using the data from the HILDA Survey. Specifically, we regress the equity share as a fraction of the financial assets on the five personality traits, controlling for the demographic variables including gender, age, income, wealth, and income. To avoid potential data errors, we drop observations where the equity wealth is above financial wealth. Since this data cover multiple years, we also control for year fixed effects.

Because the HILDA data contain household investments and individual personality traits, we consider two specifications. In Column (1) of Table 8, we restrict the HILDA data to the subsample of one-person households, allowing us to perfectly match a person's personality traits with her portfolio holdings. In Column (2), we use the subsample of respondents who claim to be "always" or "usually" the one who makes the households' savings, investment, and borrowing decisions. It is reassuring that these results further validate our previous analysis: both Neuroticism and Openness are significantly correlated with the equity shares in household portfolios.

5.3. The GSOEP Survey

We further test our main result using the German Socio-Economic Panel (GSOEP) Survey. This survey is also a household-based panel study. The personality and investment data were collected in 2005, 2009, 2012, 2013, and 2017. This survey allows us to test our

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[14]For details, see https://melbourneinstitute.unimelb.edu.au/hilda.

main result in a different language and cultural setting. However, the survey only provides a dummy variable for stock market participation. Hence, the analysis is restricted to the extensive margin. With this limitation in mind, we run the regression in Table 8, using this dummy variable (multiplied by 100) as the dependent variable.

Table 9 reports the results. In order to relate the person-level personality data to the household-level financial data, we restrict the data to the subsample of one-person households, or the subsample of respondents who claim to be the "head" of the household. Similar to the results on the intensive margin in the U.S. and Australian samples, Neuroticism and Openness are significantly negative while Agreeableness is insignificant for the analysis on the extensive margin. Moreover, Conscientiousness and Extraversion are correlated with stock market participation in the German data.

6. Conclusion

We conduct a nationwide survey among affluent American individual investors to study the implications of personality traits for investment decisions. Our evidence suggests that personality traits affect investment decisions via three distinct channels: beliefs, preferences, and social interaction tendencies. Two traits, Neuroticism and Openness, are particularly important for explaining equity investment, through two different channels: Neuroticism through beliefs while Openness through preferences. We discuss how to incorporate personality traits into future frameworks of financial decision-making and advocate the need to consider social interactions in such frameworks.

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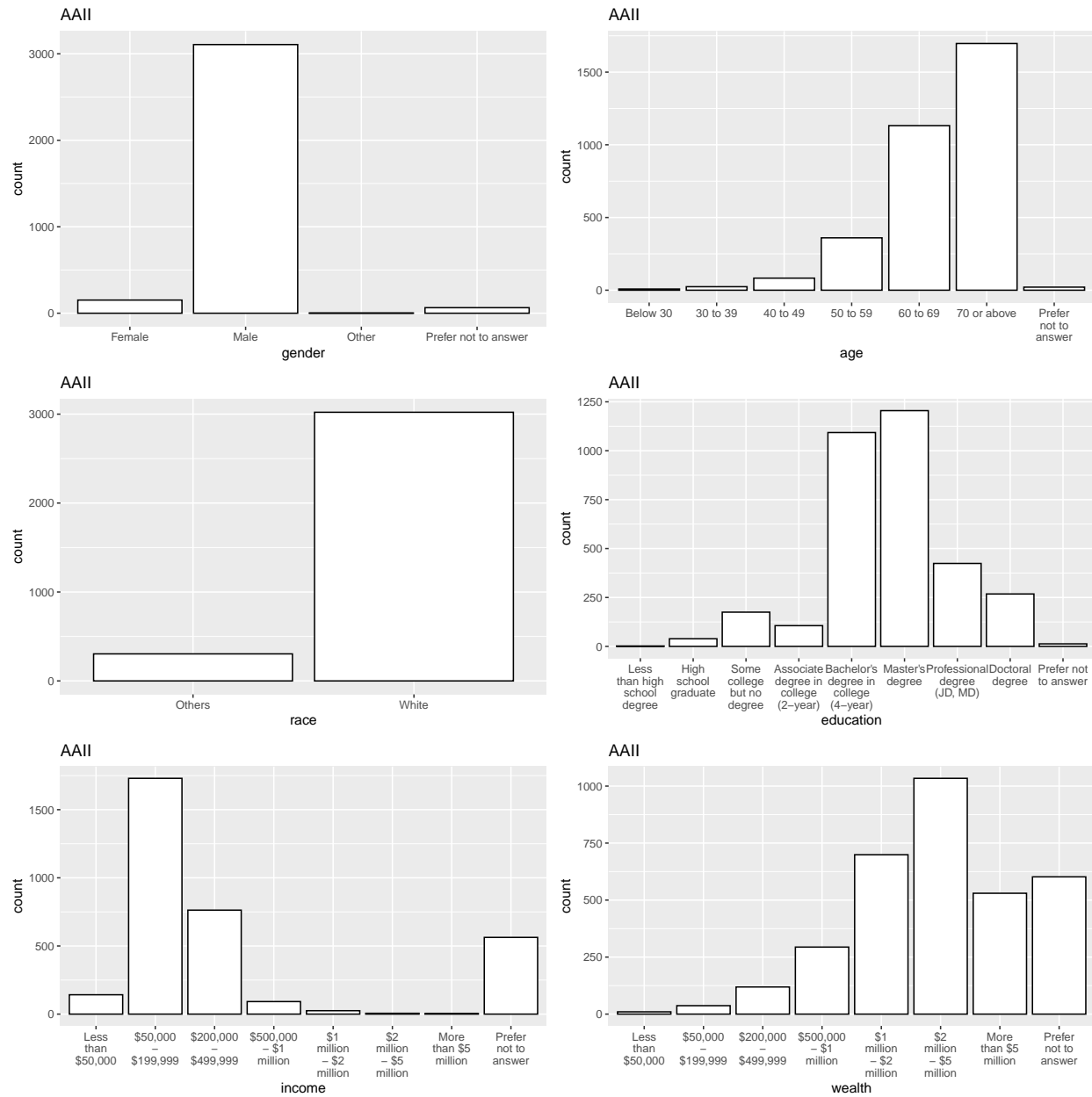
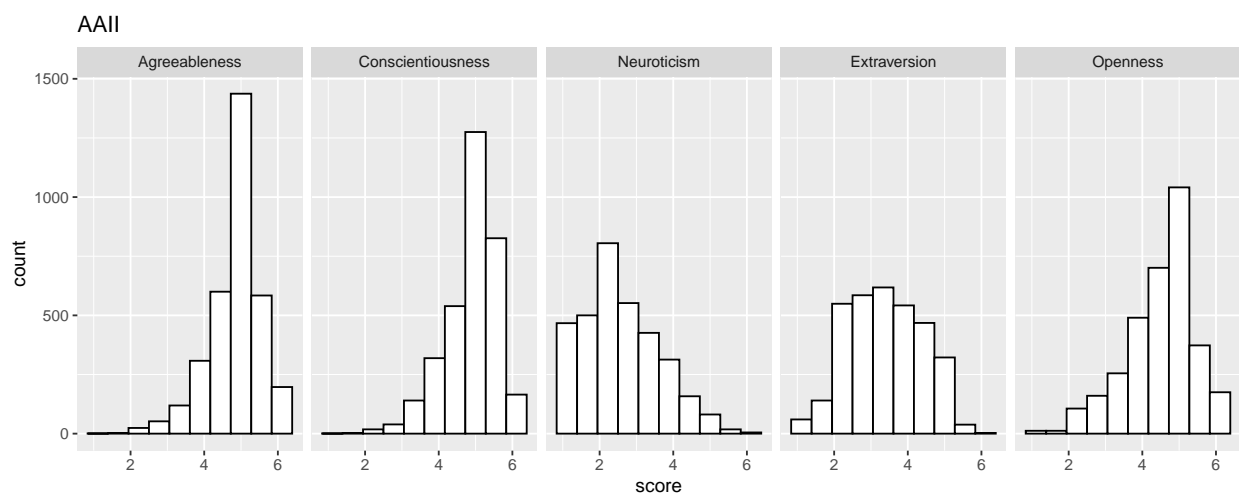Fig. 1.   Distribution of Demographic Variables in the AAII survey

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Fig. 2.   Distribution of Personality Traits in the AAII Survey

Panel (a) reports the summary statistics of personality traits and demographic variables. "Male" is the dummy variable which is 1 if the respondent is a male. "White" is the dummy variable which is 1 if the respondent's self-identified race is white. "College" is the dummy variable which is 1 if the respondent has a bachelor's degree or above. There are 3,325 respondents in total.

Panel (a) Demographics and Personality Traits						
	Mean	Std Dev	10 Pct	50 Pct	90 Pct	Skewness
Male	0.93	0.25	1.00	1.00	1.00	−3.51
White	0.91	0.29	1.00	1.00	1.00	−2.83
Age	68.23	8.50	55.00	75.00	75.00	−1.43
Income (in $1000)	233.29	369.41	125.00	125.00	350.00	12.97
Wealth (in $1000)	3271.95	2353.79	750.00	3500.00	7500.00	0.76
College	0.90	0.30	0.00	1.00	1.00	−2.65
Agreeableness	4.86	0.73	3.75	5.00	5.75	−0.84
Conscientiousness	4.89	0.74	3.75	5.00	5.75	−0.80
Neuroticism	3.39	0.97	2.00	3.50	4.75	−0.06
Extraversion	2.59	1.04	1.25	2.50	4.00	0.39
Openness	4.48	0.92	3.25	4.50	5.65	−0.63

Panel (b) Correlation Matrix					
	Agreeableness	Conscientiousness	Neuroticism	Extraversion	Openness
Agreeableness	1.00	0.21	0.01	0.14	0.18
Conscientiousness	0.21	1.00	−0.07	0.12	0.24
Neuroticism	0.01	−0.07	1.00	−0.14	−0.11
Extraversion	0.14	0.12	−0.14	1.00	0.16
Openness	0.18	0.24	−0.11	0.16	1.00

Panel (c) Belief and Preferences						
	Mean	Std Dev	10 Pct	50 Pct	90 Pct	Skewness
Expected Stock Return	5.57	9.51	−10.00	7.00	14.00	−1.23
Stock Rise by >20%	18.49	16.25	1.00	15.00	40.00	1.54
Stock Fall by >20%	25.09	18.41	5.00	24.00	50.00	1.02
GDP Growth	1.97	1.31	1.00	2.00	3.00	−0.88
Inflation	2.05	1.03	1.00	2.00	3.00	0.30
Pick Risky Job 1	0.60	0.49	0.00	1.00	1.00	−0.42
Pick Risky Job 2	0.27	0.44	0.00	0.00	1.00	1.03
Pick Risky Job 3	0.06	0.23	0.00	0.00	0.00	3.77

Table 2: Personality Traits and Investor Characteristics

We regress each personality trait on demographic variables. In these regressions, we use the sub-sample of the AAII respondents who indicate they are either male or female, and provide their income and wealth information. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

| | (1) | (2) | (3) | (4) | (5) |
	Agreeableness	Conscientiousness	Neuroticism	Extraversion	Openness
Female	0.29***	−0.02	0.25**	0.06	−0.04
	(0.07)	(0.07)	(0.11)	(0.10)	(0.09)
Age	0.01***	−0.01***	−0.01**	0.01***	−0.01**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Log Income	0.03	0.09***	−0.08**	0.09***	0.05
	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)
Log Wealth	−0.04*	0.04**	−0.03	0.02	0.01
	(0.02)	(0.02)	(0.03)	(0.03)	(0.02)
College	0.05	−0.03	0.03	−0.08	0.07
	(0.05)	(0.05)	(0.07)	(0.07)	(0.06)
Race F.E.	Y	Y	Y	Y	Y
State F.E.	Y	Y	Y	Y	Y
Observations	2,607	2,607	2,607	2,607	2,607
R^2	0.04	0.05	0.04	0.05	0.03
Adjusted R^2	0.01	0.02	0.01	0.02	0.002

Table 3: Personality Traits and Investor Belief

Panel (a) reports the regressions of investor beliefs on personality traits. Each cell in Panel (b) reports the adjusted R-squared of a regression, with personality traits only or with demographics fixed effects only. Dependent variables are (1) the expected stock return, (2) the probability that the stock market rises by more than 20%, (3) the probability that the stock market falls by more than 20%, (4) the expected GDP growth rate, and (5) the expected inflation. Demographics fixed effects include gender, age, income, wealth, education and location. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)
		Stock Return		GDP Growth	Inflation
	Mean	Prob(>20%)	Prob($< -20\%$)	Mean	Mean
Agreeableness	−0.10	−0.34	−0.09	−0.01	0.002
	(0.24)	(0.40)	(0.46)	(0.03)	(0.03)
Conscientiousness	0.66***	−0.07	−0.99**	0.04	−0.07***
	(0.24)	(0.40)	(0.46)	(0.03)	(0.03)
Neuroticism	−0.79***	−0.21	1.02***	−0.07***	0.05***
	(0.16)	(0.28)	(0.32)	(0.02)	(0.02)
Extraversion	0.82***	1.27***	−1.07***	0.09***	−0.02
	(0.18)	(0.30)	(0.34)	(0.02)	(0.02)
Openness	0.04	1.49***	0.92**	−0.003	0.01
	(0.19)	(0.32)	(0.37)	(0.03)	(0.02)
Demographics F.E.	Y	Y	Y	Y	Y
Observations	3,325	3,325	3,325	3,325	3,325
R^2	0.06	0.06	0.04	0.04	0.04
Adjusted R^2	0.03	0.04	0.01	0.02	0.01

Panel (a) Benchmark Results

Panel (b) Adjusted R^2 under Alternative Specifications of Explanatory Variables

Personality Traits Only	0.02	0.01	0.01	0.01	0.005
Demographics F.E. Only	0.01	0.02	0.01	0.01	0.01

Table 4: Personality Traits and Belief Formation

This table reports results from an OLS regression, in which the dependent variable is a respondent's "extrapolation score" that is constructed based on her responses to the following two questions. 1) "If a stock's price has risen a lot over the last year, its price over the next year will..." 2) "If a stock's price has fallen a lot over the last year, its price over the next year will..." For the first question, a respondent receives a score of 100 if her answer is "Continue to rise;" a score of −100 if her answer is "Start to fall;" or a score of 0 if her answer is "Remain the same" or "Cannot say." Similarly, for the second question, a respondent receives a score of 100 if her answer is "Continue to fall;" a score of −100 if her answer is "Start to rise;" or a score of 0 if her answer is "Remain the same" or "Cannot say." A respondent's extrapolation score is the average of her scores for these two questions. Demographics fixed effects include gender, age, income, wealth, education and location. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1) Extrapolation Score
Agreeableness	0.89
	(0.86)
Conscientiousness	−0.38
	(0.87)
Neuroticism	−1.30**
	(0.59)
Extraversion	−0.10
	(0.64)
Openness	1.55**
	(0.69)
Demographics F.E.	Y
Observations	3,325
R^2	0.03
Adjusted R^2	0.01

Table 5: Personality Traits and Risk Aversion

Columns (1)–(3) report results from Logit regressions, in which the dependent variables are the dummy variables indicating whether the respondent is willing to take each bet. Column (4) reports the result from the OLS regression, in which the dependent variable is the implied risk aversion parameter from the survey responses. Demographics fixed effects include gender, age, income, wealth, education, and location. We also report McFadden's pseudo R-squared for Logit regressions (McFadden (1974)). *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)
	Bet 1	Bet 2	Bet 3	Risk Aversion
Agreeableness	-0.15***	-0.22***	-0.25**	0.09***
	(0.05)	(0.06)	(0.10)	(0.02)
Conscientiousness	-0.06	-0.03	0.05	0.02
	(0.05)	(0.06)	(0.11)	(0.02)
Neuroticism	-0.04	-0.08**	-0.04	0.03*
	(0.04)	(0.04)	(0.08)	(0.02)
Extraversion	0.13***	0.14***	0.10	-0.06***
	(0.04)	(0.04)	(0.08)	(0.02)
Openness	0.15***	0.15***	0.40***	-0.08***
	(0.04)	(0.05)	(0.10)	(0.02)
Demographics F.E.	Y	Y	Y	Y
Observations	3,325	3,325	3,325	3,325
R^2				0.06
Pseudo-R squared	0.05	0.04	0.08	

Table 6: Personality Traits and Social Influence

Column (1) reports the result from an OLS regression, in which the dependent variable is the score from 1 (Definitely No) to 5 (Definitely Yes) assigned by respondents to the question, "upon seeing a new type of investment becoming popular among people around you, would you consider investing in it as well?" Column (2) reports the result from a Logit regression, in which the dependent variable is the dummy variable indicating if the score is 4 (Yes) or 5 (Definitely Yes). Demographics fixed effects include gender, age, income, wealth, education and location. We also report McFadden's pseudo R-squared for Logit regressions (McFadden (1974)). *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)
	Score	Yes or Definitely Yes
Agreeableness	0.01	0.01
	(0.02)	(0.13)
Conscientiousness	0.01	−0.07
	(0.02)	(0.12)
Neuroticism	0.04***	0.19**
	(0.01)	(0.09)
Extraversion	0.04***	0.33***
	(0.01)	(0.09)
Openness	0.02*	−0.06
	(0.01)	(0.10)
Demographic F.E.	Y	Y
Observations	3,325	3,325
R^2	0.03	
Adjusted R^2	0.005	
Pseudo-R squared		0.10

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Table 7: Personality Traits and Equity Allocation: AAII Data

Regression results based on our AAII survey. We regress each investor's equity-to-wealth ratio on personality traits and controls. Demographics fixed effects include gender, age, income, wealth, education, and location. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	Total	Retirement	Non-Retirement	Total	Retirement	Non-Retirement
Agreeableness	−0.46	−0.02	−0.70	−0.39	0.12	−0.61
	(0.57)	(0.57)	(0.72)	(0.56)	(0.56)	(0.72)
Conscientiousness	−1.32**	−0.66	−1.00	−1.51***	−0.84	−1.17
	(0.58)	(0.58)	(0.72)	(0.58)	(0.57)	(0.72)
Neuroticism	−1.74***	−2.55***	−0.80	−1.44***	−2.23***	−0.55
	(0.40)	(0.39)	(0.49)	(0.39)	(0.39)	(0.49)
Extraversion	−0.33	0.14	−0.05	−0.65	−0.30	−0.31
	(0.43)	(0.43)	(0.53)	(0.43)	(0.42)	(0.54)
Openness	0.94**	1.50***	1.15**	0.95**	1.40***	1.14**
	(0.46)	(0.46)	(0.57)	(0.46)	(0.45)	(0.58)
Expected Return				0.23***	0.24***	0.22***
				(0.05)	(0.05)	(0.06)
Up Tail				−0.01	0.04	−0.02
				(0.03)	(0.03)	(0.04)
Down Tail				−0.08***	−0.09***	−0.05
				(0.02)	(0.02)	(0.03)
Risk Aversion				−1.17***	−1.44***	−0.90
				(0.44)	(0.44)	(0.56)
Demographic F.E.	Y	Y	Y	Y	Y	Y
Observations	2,807	3,285	3,281	2,807	3,285	3,281
R^2	0.08	0.07	0.09	0.10	0.10	0.10
Adjusted R^2	0.05	0.05	0.07	0.07	0.07	0.08

Table 8: Personality Traits and Equity Allocation: Australian HILDA Data

Regression results based on the HILDA survey, which has a panel structure. The dependent variable is the share of stock assets in households' total financial wealth, which is between 0 and 100. In Column (1), we use the subsample of one-person households. In Column (2), we use the subsample of respondents who claim to "always" or "usually" be the one who makes the household's savings, investment and borrowing decisions. Demographics fixed effects include gender, age, income, wealth, and location. We also control for year fixed effects. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	One-Person Household	Decision Maker in the Household
	(1)	(2)
Agreeableness	0.04	−0.17
	(0.30)	(0.23)
Conscientiousness	−0.39	−0.35*
	(0.27)	(0.20)
Neuroticism	−0.56**	−0.46**
	(0.27)	(0.20)
Extraversion	0.13	−0.26
	(0.24)	(0.18)
Openness	0.81***	0.63***
	(0.25)	(0.20)
Demographic F.E.	Y	Y
Year F.E.	Y	Y
Observations	5,542	8,924
R^2	0.17	0.16
Adjusted R^2	0.17	0.16

Table 9: Personality Traits and Equity Allocation: German GSOEP Data

Regression results based on the GSOEP survey, which has a panel structure. The dependent variable is stock market participation, which is 0 if the person holds no stock assets and 100 if the person holds any stock assets. In Column (1), we use the subsample of one-person households. In Column (2), we use the subsample of respondents who claim to be the head of household. Demographics fixed effects include gender, age, income, wealth, and location. We also control for year fixed effects. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	One-Person Household	Decision Maker in the Household
	(1)	(2)
Agreeableness	0.30	−0.73
	(0.40)	(0.45)
Conscientiousness	−2.06***	−1.97***
	(0.61)	(0.56)
Neuroticism	−1.07**	−0.94***
	(0.38)	(0.28)
Extraversion	−1.16**	−1.11*
	(0.41)	(0.54)
Openness	1.11***	1.27***
	(0.25)	(0.35)
Demographic F.E.	Y	Y
Year F.E.	Y	Y
Observations	10,250	10,781
R^2	0.15	0.16
Adjusted R^2	0.15	0.15

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Appendix A.   Appendix A: Survey Questions

Our survey has 4 sections.

A.1.   Section I

In this section, you will see a number of different phrases and sentences. Please use the response options to indicate how accurately each phrase or sentence describes you.

1. Usually like to spend my free time with people.
2. Get overwhelmed by emotions.
3. Like order.
4. Am concerned about others.
5. Am full of ideas.
6. Like going out a lot.
7. Am a worrier.
8. Start tasks right away.
9. Sympathize with others' feelings.
10. Am able to come up with new and different ideas.
11. Avoid company.
12. Worry about things.
13. Work hard.
14. Am sensitive to the needs of others.
15. Am an original thinker.
16. Dislike being the center of attention.
17. Panic easily.
18. Neglect my duties.
19. Use others for my own ends.
20. Love to think up new ways of doing things.

Answer options for each question above are the same:

- Very Inaccurate

- Moderately Inaccurate

- Slightly Inaccurate

- Slightly Accurate

- Moderately Accurate

- Very Accurate

A.2. Section II

This section asks your opinion about financial markets and the economy in general.

We start with three questions that ask how you make financial decisions under various hypothetical financial situations.

1. First, in your opinion, if a stock's price has risen a lot over the last year, its price over the next year will

    - Continue to rise

    - Start to fall

    - Remain the same

    - Cannot say

2. Second, in your opinion, if a stock's price has fallen a lot over the last year, its price over the next year will

    - Continue to fall

    - Start to rise

    - Remain the same

    - Cannot say

3. Third, upon seeing a new type of investment becoming popular among people around you, would you consider investing in it as well?

- Definitely yes

- Yes

- Maybe

- No

- Definitely no

4. We next ask you to make various predictions about the U.S. economy in 2020. First, what do you think the return would be for the S&P 500 Index in 2020? (Note: the S&P 500 Index is one of the best representations of the U.S. stock market.)

    - A slide bar between -50 and 50 for S&P 500 Index Return (%).

5. Second, in your opinion, what is the probability that the S&P 500 Index will rise by more than 20% in 2020? (An answer of 0% means that it cannot happen, an answer of 100% means it is sure to happen.)

    - A slide bar between 0 and 100 for Probability (%).

6. Third, in your opinion, what is the probability that the S&P 500 Index will fall by more than 20% in 2020? (An answer of 0% means that it cannot happen, an answer of 100% means it is sure to happen.)

    - A slide bar between 0 and 100 for Probability (%).

7. We move on to other economic indicators. What do you think the GDP growth rate would be for the U.S. in 2020?

    - A slide bar between -10 and 10 for US GDP Growth (%).

8. How much inflation do you expect for the U.S. in 2020? (Note: inflation rate is the rate at which prices for goods and services increase.)

    - A slide bar between -10 and 10 for Inflation Rate (%).

9. Finally, we ask about how you perceive risks. Suppose you are the only income earner in the family, and you already have a good job guaranteed to give you your current

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income every year for life. You are given the opportunity to take a new, equally good job. With a 50% chance it will double your income, and with a 50% chance, it will cut your income by 20%. Would you take the new job?

- Yes.
- No.

10. Suppose the chances were 50% that it would double your income and 50% that it would cut your income by 33%. Would you take the new job?

- Yes.
- No.

11. Suppose the chances were 50% that it would double your income and 50% that it would cut your income by 50%. Would you take the new job?

- Yes.
- No.

A.3.   Section III

This section asks about your financial decisions.

1. How many years have you been investing in the stock market (including stocks, mutual funds, ETF, etc.)?

- Less than 5 years
- 5 to 10 years
- 11 to 20 years
- 21 to 30 years
- More than 30 years

In the next four questions, we will ask about your asset allocation within and outside of your retirement plan.

2. First, how much money have you saved in your retirement accounts (such as 401(K)s, IRAs, and Keogh accounts)?

- Less than $50,000
- $50,000 - $199,999
- $200,000 - $499,999
- $500,000 - $1 million
- $1 million - $2 million
- $2 million - $5 million
- More than $5 million
- Prefer not to answer

3. Second, within your retirement accounts, what percentage is currently invested in equities? Equities include not only individual stocks, but also mutual funds and exchange-traded funds (ETFs) that mainly hold equities. Equities do not include ordinary bonds, preferred stocks, convertible bonds, and various money market funds.

- Less than 10%
- 10% - 20%
- 20% - 30%
- 30% - 40%
- 40% - 50%
- 50% - 60%
- 60% - 70%
- 70% - 80%
- 80% - 90%
- More than 90%
- Prefer not to answer

4. Third, outside of your retirement accounts, what is your total financial wealth? Your

financial wealth typically includes: cash, stocks, mutual funds, ETFs, bank deposits, etc.

- Less than $50,000
- $50,000 - $199,999
- $200,000 - $499,999
- $500,000 - $1 million
- $1 million - $2 million
- $2 million - $5 million
- More than $5 million
- Prefer not to answer

5. Finally, outside of your retirement accounts, what percentage of your financial wealth is invested in equities? Equities include not only individual stocks, but also mutual funds and exchange-traded funds (ETFs) that mainly hold equities. Equities do not include ordinary bonds, preferred stocks, convertible bonds, and various money market funds.

- Less than 10%
- 10% - 20%
- 20% - 30%
- 30% - 40%
- 40% - 50%
- 50% - 60%
- 60% - 70%
- 70% - 80%
- 80% - 90%
- More than 90%
- Prefer not to answer

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A.4. Section IV

Lastly, we have some questions about your demographic information. (Answer options omitted.)

1. What is your gender?

2. What is your age?

3. In which state do you currently reside?

4. What is the highest level of school you have completed or the highest degree you have received?

5. Choose one or more races that you consider yourself to be.

6. What was your total household income before taxes during the past 12 months?

7. What is your total household wealth (including real estate, financial assets, pension plans, etc.)?