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Andrew Conlin

ESSAYS ON PERSONALITY TRAITS AND INVESTOR BEHAVIOR

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ANDREW CONLIN

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AND INVESTOR BEHAVIOR**

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Abstract

This dissertation contributes to the understanding of investor behavior by using personality traits to help explain investor decision-making. The work is novel, as personality traits have not been used much in finance research. The data used in this dissertation is also new to the field, consisting of observations on personality traits and socioeconomic variables combined with official records of investors' stockholdings.

The first essay provides evidence that personality traits significantly affect the stock market participation decision. The essay shows that subscales of traits (i.e., lower-level traits or facets) can provide a better model of behavior, with some subscales of a single higher-level trait having opposite effects on behavior. The novelty seeking subscales *exploratory excitability* and *extravagance* have positive and negative effects, respectively, and the reward dependence subscales *dependence* and *sentimentality* have positive and negative effects, respectively. The magnitudes of the effects are large, with marginal effects on the probability of being a stock market participant of up to four percentage points.

The second essay explores the relationship between personality traits and risk aversion. We estimate risk aversion from equity holdings and from survey measures. The traits display a distinctive *pattern* of correlations with the estimates of risk aversion. Some traits are significantly related to observed portfolio characteristics such as portfolio volatility, number of stocks held, and trading frequency. The pattern of the traits' relationships with the various measures of risk aversion indicates that personality traits should not be considered as merely drivers of risk aversion but as preference parameters distinct from risk aversion.

The third essay shows that personality traits are related to an investor's preferences for value versus growth stocks and for small capitalization stocks versus large capitalization stocks. We find more extravagant individuals favor large capitalization growth stocks; more impulsive people favor small capitalization growth stocks; more sentimental investors prefer small capitalization value stocks; and more social investors prefer small capitalization stocks with a tilt towards value.

Keywords: investor behavior, personality traits, risk aversion, size premium, stock market participation, temperament, value premium

Conlin, Andrew, Kolme esseetä luonteenpiirteistä ja sijoituskäyttäytymisestä.

Oulun yliopiston tutkijakoulu; Oulun yliopisto, Oulun yliopiston kaupakorkeakoulu, Rahoituksen yksikkö

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Tiivistelmä

Tämä tutkimus auttaa ymmärtämään sijoituskäyttäytymistä selittämällä sijoittajien päätöksentekoa heidän luonteenpiirteillään. Tutkimustuloksilla on uutuusarvoa, sillä luonteenpiirteiden merkitystä ei ole juurikaan tutkittu rahoitustutkimuksessa. Tutkimusaineisto on sekin luonteeltaan tavanomaisesta poikkeava, koostuen yksityishenkilöiden luonteenpiirteitä ja sosioekonomista asemaa kuvaavista muuttujista sekä heidän osakeomistustaan koskevista virallisista rekisteritiedoista.

Tutkimuksen ensimmäinen essee osoittaa, että luonteenpiirteillä on merkittävä vaikutus yksityishenkilön päätökseen toimia osakemarkkinoilla. Tutkimustulosten mukaan osallistumispäättöstä kyetään ennustamaan paremmin käyttämällä luonteenpiirteiden pääluokkia mittaavien muuttujien sijasta luonteenpiirteiden alaluokkia mittaavia muuttujia. Tämä selittyy sillä, että alaluokkia mittaavilla muuttujilla on eräissä tapauksissa vastakkaismerkkisiä, pääluokkaa mittaavassa muuttujassa toisensa peittäviä, yhteyksiä osallistumispäätökseen. Tämä voidaan havaita muun muassa pääluokkaan ”elämystahokkuus” kuuluvien ”kokeilunhalun” (+) ja ”tuhlaavaisuuden” (-) kohdalla, samoin kuin pääluokkaan ”palkkiorippuvuus” kuuvilla ”riippuvuudella” (+) ja ”sentimentalisuudella” (-). Kaiken kaikkiaan luonteenpiirteitä mittaavien muuttujien vaikutuksen suurusluokka on korkea, vastaten yksittäisen muuttujan kohdalla jopa neljän prosentin marginaalivaikutusta osakemarkkinoille osallistumisen todennäköisyyteen.

Toinen essee tarkastelee luonteenpiirteiden ja riskinkarttamisen asteen välistä yhteyttä. Tutkimuksessa mitataan yksityishenkilön riskinkarttamisen astetta toisaalta hänen osakeomistuksensa rakenteen perusteella ja toisaalta kyselytutkimuksen avulla. Sijoittajien luonteenpiirteiden ja muodostettujen riskinkarttamisen astetta mittaavien muuttujien väliset korrelaatiot muodostavat selkeän rakenteen. Eräät luonteenpiirteet ovat merkitsevässä riippuvuussuhteessa muun muassa sijoittajan osakesalkun volatiliiteettiin, salkkuun sisällytettyjen osakesarjojen määrään ja sijoittajan kaupankäyntiaktiivisuuteen. Luonteenpiirteitä kuvaavien muuttujien ja riskinkarttamisastetta kuvaavien muuttujien välisen yhteyden perusteella luonteenpiirteitä tulisi tarkastella ennemmin erillisinä sijoittajien preferenssejä kuvaavina muuttujina kuin riskinkarttamisasteen taustalla olevina perustekijöinä.

Kolmas essee osoittaa, että luonteenpiirteet ovat yhteydessä siihen, suosiiko sijoittaja arvo- vs. kasvuosakkeita ja/tai alhaisen markkina-arvon vs. korkean markkina-arvon yhtiöiden osakkeita. Tutkimustulokset osoittavat, että ”tuhlaavammat” sijoittajat suosivat korkean markkina-arvon omaavia kasvuosakkeita, kun taas ”impulsiivisemmat” sijoittajat suosivat alhaisen markkina-arvon omaavia kasvuosakkeita. Vastaavasti ”sentimentalisemmat” sijoittajat suosivat ylipäättään alhaisen markkina-arvon omaavia arvo-osakkeita, ”sosiaalisten” sijoittajien suosiessa heidänkin alhaista markkina-arvoa, suunnaten kiinnostustaan samalla arvo-osakkeisiin.

Asiasanat: arvopremio, kokopremio, luonteenpiirteet, rahoitusmarkkinoihin osallistuminen, riskiversio, sijoituskäyttäytyminen, temperamentti

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Oulu, June 2017

Andrew Conlin

Original essays

This thesis is based on the introductory chapter and the following essays, which are referred throughout the text by their Roman numerals:

- I Conlin, A., Kyröläinen, P., Kaakinen, M., Järvelin, M.R., Perttunen, J. and Svento, R. (2015). Personality traits and stock market participation. *Journal of Empirical Finance*, 33, 34–50.
- II Conlin, A., Miettunen, J., Perttunen, J., Puhakka, M., and Svento, R. (2017). Personality Traits and Risk Aversion. Manuscript.
- III Conlin, A., and Miettunen, J. (2017). Personality Traits and Portfolio Tilts towards Value and Size. Manuscript.

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Original publications are not included in the electronic version of the dissertation

Contents

Abstract	
Tiivistelmä	
Acknowledgements	7
Original essays	9
Contents	11
1 Introduction	13
1.1 Background.....	13
1.2 Aims and Contribution.....	14
1.3 Data.....	14
2 Theory	17
2.1 Classical Finance.....	19
2.1.1 Investor Preferences	19
2.1.2 The Fama-French Three Factor Model.....	21
2.2 Personality Trait Theory.....	21
2.2.1 The Temperament and Character Inventory	22
2.2.2 The Temperament and Character Inventory and the Five Factor Model	22
2.3 Behavioral Finance	25
3 Summary of Original Essays	25
3.1 Essay I: Personality Traits and Stock Market Participation	29
3.2 Essay II: Personality Traits and Risk Aversion	29
3.3 Essay III: Personality Traits and Portfolio Tilts towards Value and Size.....	30
List of references	31
Original essays	41

1 Introduction

1.1 Background

Is my portfolio optimal? This is probably one of the most important questions an investor faces, yet it is also a question that most investors are not likely to ask themselves. Individuals hold their wealth in two main forms, housing and financial assets. The financial assets individual investors have easiest access to, and that they usually hold, can be grouped into the broad classes of cash, bonds, and stocks. The investor must choose how much of the portfolio is to be invested in each class.

This portfolio choice problem should be easy to solve, at least according to classical finance. Assuming the risky assets (stocks and bonds) offer a higher expected return than the risk-free rate (cash), individuals should invest some of the portfolio in risky assets (Arrow, 1965). The share of wealth the investor should put into the risky assets depends on the investor's level of risk aversion (Arrow, 1965; Pratt, 1964). The choice of how much to invest in each individual stock or bond is a simple function of the securities' expected returns, variances, and covariances (Markowitz, 1952). Classical finance also has an easy solution for this potentially daunting last choice – invest in a mutual fund that mimics the overall market (Tobin, 1958; Sharpe, 1964).

Individual investors do not follow these simple rules, however. A large fraction of individuals do not own stocks (e.g., Haliassos & Bertaut, 1995; Vissing-Jørgensen, 2003). Individual investors often invest only a small portion of their net wealth in stocks (e.g., Friend & Blume, 1975; Vissing-Jørgensen, 2003). Individual investors' stock portfolios are commonly far from the market portfolio, with individuals tending to own only a few stocks (e.g., Calvet et al., 2007; Goetzmann & Kumar, 2008).

Finance researchers have proposed many possible explanations for individual investors' deviation from optimal behavior. The lack of stock market participation may be due to things as simple as being aware of the stock market as an investment vehicle (Guiso & Jappelli, 2005) or fixed costs of participation (Vissing-Jørgensen, 2003). An individual's level of financial knowledge has also been shown to affect the participation decision (Van Rooij et al., 2011). To the extent that talking with others may lower the cost of acquiring information, more social individuals are more likely to invest in the stock market (Hong et al., 2004); and individuals are more likely to participate if their neighbors' portfolios have performed well

(Kaustia & Knüpfer, 2012). Cognitive ability (Christelis et al., 2010; Grinblatt et al., 2011) and personal beliefs such as trust (Guiso et al., 2008) and political party affiliation (Kaustia & Torstila, 2011) affect stock market participation.

Variation in risk aversion is not the only reason for variation in the share of wealth invested in risky assets. Investments in private businesses and housing can affect the share of wealth invested in stocks (Chiappori & Paiella, 2011; Moskowitz & Vissing-Jørgensen, 2002; Flavin & Yamashita, 2002; Heaton & Lucas, 2000). Common financial advice is to invest aggressively when young, and shift from stocks into less-risky fixed income securities as retirement approaches; age also seems to affect the share of wealth invested (Ameriks & Zeldes, 2004). Some of the same factors that affect the participation decision are also likely to affect the decision of how much to invest, such as trust (Guiso et al., 2008) and social interaction (Hong et al., 2004).

Most individual investors also hold portfolios that are not well-diversified (Keloharju & Lehtinen, 2015; Goetzmann & Kumar, 2008). Investors may hold only a few stocks because they do not understand the benefits of diversification (Van Rooij et al., 2011). Others may be overconfident in their ability to identify good investment opportunities (Barber & Odean, 2001; Barber et al., 2009). Individual investors also have a tendency to avoid foreign stocks (French & Poterba, 1991) and often exhibit a preference for shares of local companies (Coval & Moskowitz, 1999; Grinblatt & Keloharju, 2000; Huberman, 2001; Seasholes & Zhu, 2010).

Personality traits offer a promising line of research in the ongoing search for the reasons underlying individual investor heterogeneity. As the literature cited above indicates, risk aversion and initial wealth are not the only sources of variation across investors. This dissertation uses personality traits to explain decisions made by individual investors for each of the situations above: the stock market participation decision; the level of investment relative to total wealth and risky behavior in the portfolio; and the securities held in the portfolio.

1.2 Aims and Contribution

The aim of this dissertation is to provide empirical evidence of the connection between personality traits and individual investor behavior. This aim is pursued through three separate but interrelated essays.

Each essay shows that personality traits are related to a particular part of the basic decisions an investor must make. The first essay shows that personality traits

are related to the stock market participation decision. The second essay shows that personality traits help explain the choice of the amount to invest in the stock market. The third essay shows that personality traits are related to an investor's choice for holding value stocks over growth stocks and small capitalization stocks over large capitalization stocks.

The overall contribution of this dissertation is the evidence it provides on the relationship between personality traits and individual investor behavior. Personality traits are shown to be significantly related to investor behavior, with effects robust to the inclusion of standard controls like gender, education, income, wealth, and risk aversion. This dissertation employs a data set uniquely suited to the task; the data set is the combination of official records of stockholdings with detailed personality trait data and socioeconomic data for a large sample of individuals. The stockholdings data come from the Finnish Central Securities Depository (Euroclear Finland), and the personality traits and socioeconomic data come from the Northern Finland Birth Cohort 1966. This population-based cohort consists of almost all babies born in Oulu and Lapland Provinces in 1966, providing for a sample nearly free of selection bias.¹ Having official records of stockholdings avoids any misstatement of holdings by investors, be it intentional or inadvertent. The sample used in this dissertation has distinct advantages over samples of college students which are often used in personality trait studies. The detail of the data and the scope of the sample allow for confident interpretation of the results.

The main contribution of Essay I is that it shows personality traits are related to the stock market participation decision. One issue the literature on stock market participation has had trouble explaining is the non-participation of wealthy individuals (Campbell, 2006). A wealthy individual should hold a diversified portfolio, and broad ownership of equities would be part of an efficient portfolio. Wealthy households often invest in private businesses, and these investments may substitute for investments in the stock market (Heaton and Lucas, 2000; Campbell, 2006). However, unless the private business holdings are perfectly correlated with the stock market, private business owners should invest some of their wealth in stocks for diversification purposes. Essay I also contributes to the stock market participation puzzle for wealthy individuals by showing that personality traits affect the participation decision even for individuals of high socioeconomic status. (We use socioeconomic status as our proxy for wealth in this essay.)

¹ Section 1.3 contains more information on the Northern Finland Birth Cohort 1966 data.

Essay II contributes by showing the relationship between personality traits and risk aversion and how personality traits help explain risky behavior above and beyond that of risk aversion. The study combines four different survey questions measuring risk aversion into a composite risk aversion measure. This composite measure is shown to be significantly correlated with the level of stock market investment and the share of wealth invested in stocks. The personality traits *exploratory excitability*, *extravagance*, *sentimentality*, and *dependence* are also significantly related to the level of investment and share of wealth invested; the traits' effects are robust to the inclusion of the composite risk aversion measure. Essay II also contributes by showing how personality traits offer a detailed understanding of risky behavior. For example, exploratory excitability (willingness to try new things) and impulsiveness (acting without full information) are both negatively correlated with survey measures of risk aversion, but the two traits show distinct effects on the number of stocks held in the portfolio and the number of trades executed.

Essay III contributes by showing that personality traits help to explain the choice between value stocks and growth stocks and between small capitalization stocks and large capitalization stocks. The value premium (Fama & French, 1992) and size premium (Banz, 1981; Fama & French, 1992) have been known for a long time. Even Graham & Dodd (1934) advocated buying stocks with low price-to-value measures. While Fama & French (1992) stress that the value premium is due to value stocks being riskier than growth stocks, Graham & Dodd (1934) interpreted the lower relative price of value stocks as a sign that the stocks were less risky than relatively higher priced stocks. This essay shows that individual investors with higher scores on personality traits associated with risk aversion tend to own value stocks and large capitalization stocks; these individuals seem to see value stocks as less risky, in contrast to the Fama & French (1992) interpretation. The evidence that personality traits indicate a preference for certain types of stocks is a significant contribution to the literature on the value and size premiums.

This dissertation adds to our understanding of individual investors by showing how personality traits help to explain individual investor behavior. As pensions shift from defined benefit to defined contribution, individual investors will be more responsible for their quality of life during retirement. If individuals do not invest in the stock market, it will likely be difficult for them to build enough wealth to maintain a lifestyle in retirement similar to that of their working years. Individual investors as a group affect stock prices over the short and medium term (Barber et al., 2009). Understanding why investors behave as they do will help determine the

best market and policy responses to improve individual investors' financial well-being. If investor decision-making is affected more by things like awareness and lack of knowledge, financial intermediaries may have the clearest incentives and means to reach out to individual investors. If investor decision-making is affected by inherent characteristics such as personality, it may be more difficult for the market or policy makers to influence individual investors' decisions.

1.3 Data

The Northern Finland Birth Cohort 1966 (NFBC 1966) is part of a longitudinal research program.² All babies with an expected due date in the year 1966 in the provinces of Oulu and Lapland (approximately the northern half of Finland) were invited to participate in the study. The study enrolled over 95% of the births recorded in the provinces: there were 6265 male, 5964 female, and 2 undetermined, for a total of 12,231 enrollees. The total population of Oulu and Lapland provinces was approximately 600,000 in 1966 (approximately 14% of the population of Finland). The cohort researchers gathered data through clinical examinations and questionnaires over the years. Essay I in this dissertation uses data from the 31-year-old follow-up study conducted in 1997. Essays II and III use data from the 46-year-old follow-up study conducted in 2012. The observations on the personality traits and socioeconomic variables come from these surveys.

With all of the cohort members being born in northern Finland and with the majority of the members still residing in northern Finland at the time of the follow-up surveys, one may question the representativeness of the sample. I cannot claim that the sample is truly representative of the overall population of Finland (in Essay I) or of the overall population of investors in Finland (in essays II and III). In the essays, I point out differences in educational attainment, income, and wealth between the sample and the overall population of Finland. These differences, though, are not of such magnitude that would lead one to doubt the veracity of the essays' conclusions. The response rates to the follow-up studies were above 60%. (Our usable sample size was lower than this due to missing responses.) It is possible that personality traits have an effect on the likelihood of response; unfortunately, I cannot rule this out nor can I test it in any way. However, the data set is unique in

² The cohort's webpage details the NFBC 1966 history, data collections, and publications: <http://www.oulu.fi/nfbc/node/44315>

that there are few large population-based samples with personality trait and socioeconomic observations which can be combined with the national register of stock ownership.

The NFBC 1966 is focused on Oulu and Lapland, and one may wonder if the cohort members' stockholdings exhibit any regional bias. Individuals may have a preference for local companies over more distant companies (Coval & Moskowitz, 1999); Nokia may have influenced investor decisions, as it has had a large economic impact on the Oulu region. I show in the essays that these issues are unlikely to have influenced the results. Controlling for investors who purchased Nokia shares first does not alter the results in Essay I. In Essay III, we show that of the 10 most popular stocks of the cohort investors in 2010, only one of the stocks could be considered a local stock. The other 9 stocks have headquarters elsewhere in Finland and are among the 10 most widely held stocks nationally.

2 Theory

There are two main schools of thought regarding investor behavior: (1) classical finance, which assumes investors are fully rational and expected utility maximizing; and (2) behavioral finance, which allows persistent and systematic mistakes by investors. In classical finance, the behavior of investors leads to efficient markets (Malkiel & Fama, 1970; Fama, 1991), while in behavioral finance the actions of investors may lead to inefficient markets.

2.1 Classical Finance

2.1.1 Investor Preferences

The classical finance models assume utility functions with forms that allow for variation in risk aversion and wealth, but not in other characteristics. An often-used functional form is power utility, with utility U measured over final wealth W :

$$U(W) = \frac{W^{1-\gamma}}{1-\gamma} \quad (1)$$

where γ is the individual's level of risk aversion. For an individual to be risk-averse (as opposed to risk-neutral or risk-loving), we must use the constraint of $\gamma > 0$.³ This functional form embodies two key assumptions of microeconomics – nonsatiation and decreasing marginal utility. It is easy enough to add uncertainty to this model by simply assuming that the individual has only two choices for investing. The two choices are a risk-free asset and a risky asset. The risky asset may provide a positive or negative return; the only restriction is that the expected return on the risky asset is positive. With these two choices, final uncertain wealth is written as:

$$\widetilde{W} = (1 + r_f)W_0 + (\tilde{r} - r_f)\alpha W_0 \quad (2)$$

³ If $\gamma = 1$, the utility function becomes $U = \ln(W)$.

where W_0 is the investor's initial level of wealth, α is the percentage of wealth invested in the risky asset, \tilde{r} is the uncertain return of the risky asset, and r_f is the return on the risk-free asset. The individual chooses the level of α in order to maximize the level of utility. In order to solve this problem, we insert Equation (2) into Equation (1), and maximize $U(\widetilde{W})$ by choosing α . The first order condition is

$$E \left[U' \left((1 + r_f)W_0 + (\tilde{r} - r_f)\alpha W_0 \right) (\tilde{r} - r_f) \right] = 0. \quad (3)$$

To solve Equation (3) for α , we take a first-order Taylor expansion of U' around $(1 + r_f)W_0$. We then insert the resulting expression back into Equation (3). Using the constant relative risk aversion property of the power utility function⁴, we end up with the following equation:

$$\alpha = \frac{(1 + r_f)E(\tilde{r} - r_f)}{\sigma_{\tilde{r}}^2} \frac{1}{\gamma} \quad (4)$$

where $\sigma_{\tilde{r}}^2$ is the variance of the excess return.

The optimal share of wealth to invest in the risky asset increases with the expected return on the risky asset and decreases with the variance of the risky asset. The optimal share of wealth is also inversely related to the level of risk aversion; *ceteris paribus*, investors with higher levels of risk aversion should invest a lower percentage of their wealth in the risky asset. With the assumptions of $\gamma > 0$ (risk aversion) and a positive expected excess return on the risky asset, the model implies that all investors should invest some amount of their wealth into the risky asset, no matter how risk-averse they may be. Even extremely risk-averse investors will be better off investing some wealth in the risky asset because it offers a higher expected return than the risk-free asset.

Equation (4) can be greatly simplified, if we assume homogenous expectations. If all investors have the same expectations regarding the expected excess return and variance of the risky asset, then there is a direct relationship between the share of wealth invested in the risky asset and the individual's level of risk aversion. We can

⁴ A complete derivation of the expression for the optimal share of wealth invested is in Appendix A of Essay II in this dissertation.

simplify further, by assuming a risk-free rate of zero and that the expected excess return on the risky asset is equal to its variance. One could choose historical levels of approximately 6% for the risk premium and 20% (0.04) for the standard deviation (variance). However, the actual levels chosen for the risk free rate, the expected return, and variance of the market make no difference in the analysis; homogenous expectations turn this ratio into a scalar multiplier in the equation. A ratio of one is not unreasonable, though. A risk-free rate of 0, a risk premium of 6%, and a standard deviation of 24.5% produce a ratio of 1:

$$\alpha = \frac{(1+0.00)E(0.06-0.00)}{0.245^2} \frac{1}{\gamma} = 1 \left(\frac{1}{\gamma} \right). \quad (5)$$

The inverse of Equation (5) is used in Essay II to estimate an individual's level of risk aversion from known levels of stockholdings and self-reported values for wealth.

2.1.2 Fama-French Three-Factor Model

The theory underlying Essay III is based on the work of Fama & French (1992, 1993). Fama & French (1992) show how the variation in returns across portfolios of firms sorted by size or book-to-market ratio is almost monotonic, while there is no pattern in the variation of returns on portfolios of stocks sorted by market beta. Using this information, Fama & French (1993) propose a three-factor model to explain stock returns:

$$r_{i,t} = \beta_{i,MKT}MKT_t + \beta_{i,HML}HML_t + \beta_{i,SMB}SMB_t \quad (6)$$

where $r_{i,t}$ is the excess return on stock i in period t , MKT_t is the excess return on the market portfolio, HML_t is the return on a portfolio that is long stocks with high book-to-market ratios and short stocks with low book-to-market ratios, SMB_t is the return on a portfolio that is long small capitalization stocks and short large capitalization stocks, and the β_i 's represent stock i 's loading on the respective factor.

The outperformance of small stocks over large stocks and value stocks over growth stocks should not exist in an efficient market if the risks inherent in value stocks and small stocks are no greater than those of growth stocks or large stocks.

Both firm size and book-to-market are easily available to investors, so earning an excess return from such common knowledge should not be possible. Fama & French (1993) argue that the value premium and size premium are indicative of underlying systematic risk factors; investors are only getting an excess return because they are taking on excess risk. If this is true, we should find that individuals more willing to take risk have tilts towards value and small stocks in their portfolios.

2.2 Personality Trait Theory

Personality psychology is the study of differences in individuals, such as traits, intelligence, attitudes and motivation. Following the focus of this dissertation, the discussion here will be only about traits. Roberts (2009) defines personality traits as “the relatively enduring patterns of thoughts, feelings, and behaviors that reflect the tendency to respond in certain ways under certain circumstances” (p. 140). Personality researchers have developed numerous trait models, with varying traits and varying numbers of traits. This dissertation uses the four temperament traits of the Temperament and Character Inventory (TCI) of Cloninger et al. (1993). After thorough discussion of the TCI, I will briefly discuss how it relates to the Five-Factor Model of personality (see McCrae & Costa, 1997).

2.2.1 *The Temperament and Character Inventory*

The TCI is a revised version of the Tridimensional Personality Questionnaire (TPQ) of Cloninger (1987). Cloninger (1987) lays out a model of personality with traits that have physiological roots in neurotransmitter pathways in the brain, with the level of neurotransmitter activity influencing the expression of the trait. The theoretical basis of the model helps to explain the hereditary nature of personality traits and allows for testable hypotheses regarding pharmaceutical treatment of personality disorders. The three traits in the model are: (1) novelty seeking (reflecting our willingness to actively engage with and seek out sources of reward and stimulus) is based on the dopamine pathway; (2) harm avoidance (which measures our behavioral inhibition in response to punishment or lack of rewarding stimulus) is based on the serotonin pathway; and (3) reward dependence (the degree to which behavior is maintained, especially in response to social feedback) is based on the norepinephrine pathway (Cloninger, 1987). A true-false questionnaire asking about the respondents’ typical reaction or behavior in various situations related to novelty, punishment, and social reinforcement was developed to measure the traits.

The higher-level traits are each composed of lower-level subscales (sometimes called facets), allowing for more detailed specification of different aspects of the traits. In the TPQ, each trait has four subscales. Subsequent to testing and refinement of the TPQ, persistence was determined to be independent of the other reward dependence subscales and was designated as a higher-level trait in the Temperament and Character Inventory (TCI) of Cloninger et al. (1993). The four temperament traits of the TCI reflect our consistent behavioral responses to stimuli, while the three character traits reflect the dynamic process of how we see ourselves in relation to the world around us.⁵ The temperament traits of the TCI are novelty seeking, harm avoidance, reward dependence, and persistence. Persistence has no subscales, while novelty seeking and harm avoidance have four subscales and reward dependence has three subscales. I now briefly describe the traits and subscales. Cloninger et al. (1994) provides detailed descriptions of the traits and subscales.

Individuals high in novelty seeking have a tendency to be active, outgoing, impulsive, and willing to explore new things (Cloninger et al., 1987; Cloninger et al., 1994). The four subscales of novelty seeking are exploratory excitability, impulsiveness, extravagance, and disorderliness. Higher scores on exploratory excitability are associated with the willingness to try new things and behavioral activation to seek relief of boredom. More impulsive individuals are willing to make rash decisions and are comfortable making decisions when complete information is unavailable. High scores on extravagance reflect a general preference for spending money over saving money. Individuals with high scores on disorderliness dislike rules and regulations, displaying a willingness to break rules or lie when possible.

The trait harm avoidance measures the level of worry, fear, and trepidation one feels when facing new or unknown situations (Cloninger et al., 1987, 1994). The four subscales of harm avoidance are worry/pessimism, fear of uncertainty, shyness, and fatigability. Higher scores on worry/pessimism reflect greater levels of worry, anxiety, and pessimism when facing potentially dangerous situations, but also in situations in which most people feel comfortable. Higher scores on fear of uncertainty reflect the inability to stay calm and confident when facing uncertainty

⁵ The character traits are self-directedness, cooperativeness, and self-transcendence. Observations on the character traits are not available for the NFBC 1966 cohort; only the temperament portion of the TCI has been administered to the cohort members. Therefore, I refrain from further discussion of the three character traits.

in risky situations. Shyness measures how comfortable one feels when meeting or talking with strangers. Fatigability measures both emotional and physical feelings of fatigue, both in general and in response to stressful situations.

The trait reward dependence reflects our responses to emotional stimuli and our relationships with others (Cloninger et al., 1987, 1994). The three subscales of reward dependence are sentimentality, attachment, and dependence. Sentimentality measures our emotional response to the appeals of others and emotional stimuli such as poetry and movies. Higher scores on attachment reflect having warm and open relationships with others. Individuals with higher scores on dependence prefer to do things their own way instead of conforming to the group. The trait persistence reflects the ability to maintain focus and effort, even when facing failure and frustration along the way (Cloninger et al., 1993).

The TCI has a long history of use in the fields of psychiatry and medicine. Temperament traits of the TCI have been related to various medical conditions such as schizophrenia (Hori et al., 2008), eating disorders (Gruca et al., 2007), and even atherosclerosis (Hintsanen et al., 2009). Even within the NFBC 1966, the TCI has been shown to be related to depression and anxiety (e.g., Nyman et al., 2011; Kampman et al., 2012), personality disorders (Kantjärvi et al., 2009), and physiological indicators of metabolic syndrome (Sovio et al., 2007). Economists may be more interested in works that show the relationship between the TCI and behaviors such as gambling (Martinotti et al., 2006), drug addiction (Milivojevic et al., 2012), and smoking and drinking (Wills et al., 1994; Cloninger et al., 1988).

Despite the widespread use of the TCI in psychiatric and health research, there is inconclusive evidence regarding the hypothesized connections between the traits and the underlying neurotransmitter pathways. Ebstein et al. (1996) find evidence for a link between dopamine and novelty seeking, as do Suhara et al. (2001). Peirson et al. (1999) find a relationship between harm avoidance and serotonin. Garvey et al. (1996) find a relationship between reward dependence and norepinephrine. Gerra et al. (2000) show evidence for relationships between dopamine and novelty seeking, harm avoidance and serotonin, and reward dependence and noradrenaline. Hansenne et al. (2002) find a connection between novelty seeking and dopamine, but they do not find a connection between harm avoidance or reward dependence with their respective neurotransmitters. While Ebstein et al. (1996), Melke et al. (2003), and Kuhn et al. (1999) find some evidence for appropriate genetic links to the traits, Verweij et al. (2010) and Service et al. (2012) do not find supporting evidence for such genetic links.

2.2.2 *The Temperament and Character Inventory and the Five Factor Model*

The Five-Factor Model (FFM) is an atheoretical model that developed over time, starting with scouring the dictionary for words describing individuals (Allport & Odbert, 1936) and ending with factor-analyzed questionnaires (see McCrae & John, 1992). The five traits are openness to experience, conscientiousness, extroversion, agreeableness, and neuroticism. There is an extensive literature using the FFM, both in psychology, psychiatry, and the social sciences. In finance and economics, the FFM has been used to look at factors underlying economic preferences (Becker et al., 2012; Dohmen et al., 2012; Dohmen et al., 2010), household financial decisions (Brown & Taylor, 2014; Ameriks et al., 2009), and economic outcomes across various domains (Borghans et al., 2008; Almlund et al., 2011).

As explained in Section 2.2.1, the psychobiological model of Cloninger (1987) and Cloninger et al. (1993) is based on testable relationships between temperament traits and neurotransmitter pathways in the brain. Despite the stark contrast in the theoretical bases between the two models of personality, the traits show significant correlations across the models (De Fruyt et al., 2000), and the models show a similar ability to predict clinical personality disorders (De Fruyt et al., 2006).

I do not argue that the TCI is a better model of personality traits than the FFM; I leave such work for researchers in psychiatry and psychology. The NFBC 1966 follow-up study conducted in 1997 used the temperament portion of the TCI (see Miettunen et al., 2004), and the 2012 follow-up study used the same questionnaire. Personality trait assessments for a large sample of adults are not readily available. The opportunity to combine such personality trait data with official register data on stockholdings is even rarer. The TCI is without doubt a functional model of personality, with clearly defined traits and subscales. The traits and subscales also allow the formation of intuitive and testable hypotheses for their relationships with investor behavior.

2.3 Behavioral Finance

The behavioral finance approach, in contrast to classical finance, allows investors to make mistakes in their expectations about the future and in the way they make decisions (see Hirshleifer, 2001; Barberis & Thaler, 2003). These errors in judgement and decision-making, generally referred to as investor psychology, are only half of the story in behavioral finance. If investors make poor decisions, their

actions are unlikely to have any lasting effect on market prices. If prices move away from fundamental value, arbitrageurs (colloquially referred to as “smart money”) will take the opposite side of the trade and push prices back to fundamental value. For pricing errors to be more than transient, there must be some limits to arbitrage (Shleifer & Vishny, 1997; Barberis & Thaler, 2003) that limit the willingness or ability of arbitrageurs to correct pricing errors. The main argument of behavioral finance – that investors may make persistent and systematic errors which cause prices to move away from fundamental value – rests on these two ideas: (1) investor psychology, the impetus for prices moving away from fundamental value; and (2) limits to arbitrage, the constraints that keep prices from returning to fundamental value.

The use of personality traits to explain investor behavior is clearly in line with the behavioral finance approach. Personality traits should have no effect on investor behavior in the standard CRRA expected utility function. Evidence that personality traits affect investment behavior indicates that the standard CRRA expected utility function is not complete. Obviously, no model of human behavior will ever be complete, at least if it is to be parsimonious. Adding a few more parameters that reflect personality traits to the standard models, though, would improve the models yet keep them parsimonious. The evidence shows that personality traits affect investor behavior. The next step in this line of research is to develop formal models which allow personality traits to affect investor psychology.

The literature on investor psychology can be divided into two areas, beliefs and preferences (e.g., Barberis & Thaler, 2003). The term *beliefs* refers to how an investor forms expectations for the future, and the term *preferences* refers to how an investor makes a choice over an uncertain outcome. Some of the common errors made in the formation of expectations are overconfidence, conservatism, and representativeness. Overconfident investors believe the distribution of outcomes is much narrower than it is in reality – they think they know more than they actually do. This can lead to poor investment decisions, such as trading too frequently (Barber & Odean, 2001). Conservatism means investors do not update their beliefs enough when given new information. Representativeness means that investors extrapolate too far into the future from a small sample of observations. Barberis et al. (1998) show how a model that incorporates conservatism and representativeness can explain the momentum effect (Jegadeesh & Titmann, 1993) and overreaction (DeBondt & Thaler, 1985). Daniel et al. (1998) use overconfidence along with self-attribution bias in a model to explain momentum and overreaction.

The most commonly used model of preferences used in behavioral finance is prospect theory (Kahneman & Tversky, 1979). Prospect theory differs from expected utility theory in the following ways: an investor makes a choice by comparing outcomes to a reference point instead of evaluating the expected utility of the outcomes; the value function has a kink at the reference point, leading to an investor being risk-averse over gains and risk-loving over losses; and the value function exhibits loss aversion – it is steeper for losses than for gains – implying that a loss of 100 dollars is more “painful” than a gain of 100 dollars is “pleasurable” (Kahneman & Tversky, 1979). Benartzi & Thaler (1995) show how prospect theory preferences and a tendency to think in the short term (i.e., to be myopic) can lead to non-participation in the stock market.⁶

Where will personality fit into behavioral finance? Personality traits may affect an investor’s beliefs. A more impulsive investor may assume a very narrow distribution of outcomes and thus act similarly to an overconfident investor. A more sentimental investor may be more prone to conservatism and representativeness, being slow to change expectations at first but then extrapolating too far from a small sample. Personality traits may fit better as preference parameters in a utility function, influencing how an investor makes choices over uncertain outcomes. Distinguishing between the two will be difficult, requiring new data and creative work with multi-parameter utility functions. The rewards may be great, though, and researchers should take up the challenge.

⁶ I acknowledge that the papers cited here covering beliefs and preferences are not recent. The papers cited are among the core papers in behavioral finance, receiving thousands of citations over the years. The beliefs and preferences mentioned here, along with others not discussed, are still widely used in research today (e.g., Malmendier & Tate, 2015; Daniel & Hirshleifer, 2015; Ahmed & Safdar, 2016; Chang & Cheng, 2015; Frydman & Camerer, 2016).

3 Summary of Original Essays

3.1 Essay I: Personality Traits and Stock Market Participation

Essay I provides evidence that personality traits affect stock market participation. Stock market participation rates are far from 100% in Finland (Grinblatt & Keloharju, 2000; Keloharju & Lehtinen, 2015); Europe (e.g., Guiso et al., 2003; Guiso & Jappelli, 2005), and the USA (e.g., Campbell, 2006; Haliassos & Bertaut, 1995). In classical finance, all individuals should invest some of their wealth in stocks, as long as the risk premium on stocks is positive. Even very risk-averse individuals should own stocks because the positive risk premium leads to higher expected utility for some non-zero percentage of wealth invested in stocks, as compared to not investing in stocks. The literature has many explanations for the low levels of stock market participation, including fixed costs of investment (Vissing-Jørgensen, 2003); individuals not being aware of the stock market as an investment choice (Guiso & Jappelli, 2005), lack of trust in the fiduciary (Guiso et al., 2008), and intelligence (Grinblatt et al., 2011). Personality traits represent new, previously unexplored factors that affect the stock market participation decision.

The data set used in the study is the combination of observations on personality traits and socioeconomic variables from the Northern Finland Birth Cohort 1966 with official register stockholdings data from the Finnish Central Securities Depository (Euroclear Finland). The observations on personality traits and socioeconomic variables are from 1997, and the stockholdings data cover the period 1995–2010. The main analysis uses the time window 2003–2010, which is after the dramatic rise and fall of the stock market around the turn of the millennium. Using a long window to determine stock market participation allows more individuals to be identified as participants than using a single observation date. Investors may sell all holdings and reenter the market later, for tax or liquidity reasons, and a single date may not count such investors as participants.

The results show that personality traits have a consistent and sizeable effect on stock market participation. Of the higher level traits, harm avoidance and reward dependence are negatively related to participation, while persistence is positively related to participation. Using the subscales, the strongest effects are from extravagance and sentimentality, which are both negatively related to stock market participation. The effects are consistent in regressions using all the traits and controls, when running regressions using only a single trait and when using a

subsample of high socioeconomic status individuals (those with a university education and a managerial occupation). For extravagance and sentimentality, a change of standard deviation is associated with an approximate 0.04 change in the probability of being a participant. The economic significance of the trait effects is large when one considers the unconditional probability of participation is only 0.17.

3.2 Essay II: Personality Traits and Risk Aversion

Essay II shows how personality traits are related to risk aversion. Risk aversion is a key parameter in economics and finance; it determines an individual's willingness to pay for uncertain outcomes. Understanding what factors influence the level of risk aversion, the way it is expressed in different domains, and its possible changes over time would greatly help in modeling economic behavior. Weber et al. (2002) propose that an individual's level of risk aversion can vary across risk domains such as financial, health, and recreational. This approach is also used by Dohmen et al. (2011) and Halko et al. (2012). Prospect theory allows risk aversion to vary according to the frame of the situation, with people being risk-averse over gains but risk-loving over losses (Kahneman & Tversky, 1979). Zuckerman & Kuhlman (2000) explain risk-taking behavior with personality traits.

This study follows the general approach of Becker et al. (2012) and Zuckerman & Kuhlman (2000) by using measures of risk aversion as dependent variables and personality traits as the independent variables in the analysis. The difference lies in the set of risk-aversion measures that we use, which lead to the conclusion that personality traits should be considered as preference parameters separate from risk aversion.

The paper uses measures of risk aversion from both a survey and from real-world behavior. The survey questions are of two general formats, with three questions asking for the respondent's willingness to pay for an uncertain outcome and one question simply asking respondents to state their general willingness to take risks. The real-world measures of risk aversion are an estimate of the investor's level of absolute risk aversion and the level of relative risk aversion. Absolute risk aversion is estimated from the amount of wealth invested in stocks, while relative risk aversion is estimated from the share of wealth invested in stocks. We also use three characteristics of the investor's portfolio (volatility, number of stocks in the portfolio, and number of trades) as indications of risk-taking behavior.

We find the traits extravagance and sentimentality to have a strong positive relationship with real-world risk aversion, while exploratory excitability is

negatively related to only relative risk aversion, and dependence is negatively related to only absolute risk aversion. When using the survey measures of risk aversion as the dependent variables, some of the more striking results are: extravagance has a very weak correlation with the risk aversion in the monetary gambles but not with general risk aversion; sentimentality is negatively related to risk aversion, except it shows no relationship with the question asking about a risky investment; and dependence shows essentially no correlation with any of the survey measures of risk aversion. When looking at the portfolio characteristics, among other results we find: exploratory excitability is positively related to the number of stocks held in the portfolio, but it shows no relationship with portfolio volatility or trading activity; impulsiveness is positively related to trading activity but not to volatility or the number of stocks in the portfolio; and extravagance and sentimentality are negatively related to the number of stocks held and trading activity, but not to portfolio volatility. The results, taken as a whole across the three areas (revealed preference, survey measures, and portfolio characteristics), lead to the conclusion that personality traits are capturing preference parameters separate from that of risk aversion.

3.3 Essay III: Personality Traits and Portfolio Tilts towards Value and Size

In Essay III, we take an even closer look at how personality traits are related to investor behavior. The paper analyzes the relationship between personality traits and investors' preferences for value stocks over growth stocks and preferences for small capitalization stocks over large capitalization stocks. We use the market-to-book ratio as the measure of value, and the market capitalization in euros as the measure of size. For most individual investors, these measures are easily observable and more intuitive than the stock's loadings on the value and size factors of Fama & French (1993).

The data set comes from combining observations on personality traits, risk aversion, and socioeconomic variables from the Northern Finland Birth Cohort 1966 follow-up survey conducted in 2012. The investor portfolio holdings come from the Finnish Central Securities Depository (Euroclear Finland) and the stock characteristic data are taken from Thompson-Reuters Datastream. The stockholding observations are taken at month-end from January 2009 to December 2010. The time discrepancy between the end of the stockholdings data, and the NFBC 1966 survey in 2012 should not drastically affect the results. Personality

traits are fairly stable in adulthood (see Almlund et al., 2011), and gender and educational attainment are unlikely to have changed between 2010 and 2012. The survey responses to risk aversion questions may have been different in 2010 from what they actually are in 2012, but we have no way of testing this.

In this paper, we deviate from Essay I and Essay II by combining the personality traits to make the analysis clearer and to avoid any potential multicollinearity problems. Based on the trait descriptions and factor loadings of the subscales (see Miettunen et al., 2004), we combine the subscales as follows: exploratory excitability with extravagance; impulsiveness with disorderliness; and attachment with dependence. Sentimentality is not combined with any other subscale.

The data set presents an econometric issue, in that we have a time series of observations for the stockholdings, but we have only one observation for personality traits and the other independent variables. There are two ways to approach this: (1) we can take a time-series average of the dependent variable for each person so that we can run OLS regressions, or (2) we can take cross-sectional averages of the dependent variables for groups of individuals sorted into a high or low group for each trait, and plot these averages over time. The cross-sectional averages can be equally weighted or value-weighted. We do both in order to provide the most complete analysis.

The results indicate that individuals with higher scores on extravagance and exploratory excitability tend to hold larger capitalization stocks and growth stocks. Individuals with higher scores on impulsiveness and disorderliness tend to hold small capitalization growth stocks. Sentimentality is related to holding small capitalization value stocks. Higher scores on attachment and dependence are associated with smaller capitalization stocks, with weak evidence for a preference for value stocks over growth stocks. We perform similar analyses using the HML and SMB factor loadings (Fama & French, 1993) in place of the market-to-book ratio and market capitalization of the stocks, and we find consistent results. The Finnish stock market is dominated by a few large firms, so we also do separate analyses for widely-held stocks and “unpopular” stocks. We find consistent results in this analysis, too. The overall evidence is generally consistent across the various analyses, with some results not being statistically significant in all analyses. However, we do not find any conflicting results across the analyses.

The aim of this paper is to show that personality traits are related to portfolio preferences for value and size, and we are confident that we succeed. A secondary yet still important finding is that an individual’s level of general risk aversion is not

consistently related to the preference for growth or value stocks. The classical argument is that value stocks *must be* riskier because they have traditionally provided higher returns than growth stocks. If value stocks are riskier, then we would expect individuals with higher levels of risk aversion to have a portfolio tilt towards growth stocks. In most of our analysis, however, we find no significant relationship between risk aversion and the portfolio tilt towards growth or value.

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- I Conlin, A., Kyröläinen, P., Kaakinen, M., Järvelin, M.R., Perttunen, J. and Svento, R. (2015). Personality traits and stock market participation. *Journal of Empirical Finance*, 33, 34–50.
- II Conlin, A., Miettunen, J., Perttunen, J., Puhakka, M., and Svento, R. (2017). Personality Traits and Risk Aversion. Manuscript.
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