Ca' Foscari
University
of Venice

Master's Degree Programme

in Economics and Finance
Curriculum Finance

Final Thesis

An Empirical Study on Objective and Subjective Financial Risk Tolerance: Moderated Mediation of Financial Literacy and Personality Types

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Academic Year
2020 / 2021

Mi è doveroso dedicare questo spazio alle persone che hanno contribuito, con il loro instancabile supporto, alla realizzazione di questo elaborato.

Un ringraziamento particolare va alla mia relatrice, professoressa Cruciani, per avermi guidato fin dalla scelta dell'argomento e per avermi trasmesso le sue conoscenze durante tutto il percorso di stesura della tesi.

Ringrazio infinitamente la mia famiglia: mamma, papà, Luca e Lucia. Renderli orgogliosi è stata la mia fonte di motivazione più grande e dedico a loro questo traguardo in modo che sia, per quanto possibile, una vittoria anche per tutti i sacrifici che hanno affrontato in mia assenza.

Grazie a mio marito, Joe, che mi ha sempre sostenuto. Con il suo appoggio posso sorridere dei dispiaceri passati ed insieme a lui guardare con fiducia alle sfide del futuro.

Gloria

Introduction

Nowadays, investors are increasingly responsible of their own financial future. They are expected to make decisions regarding portfolio allocation, wealth accumulation, and retirement preparedness. Dealing with financial risk is unavoidable and failing to do so effectively has negative economic repercussions which bear the potential to expose the individual investor to financial distress.

The single most important factor on which every aspect of the asset allocation process is based on is the investor's *financial risk tolerance*. This information is fundamental, and each institution or advisory service provider measure the investor's risk tolerance with instruments that frequently differ across industries. Investors are often unsure of their own level of risk tolerance; the concept of financial risk is complex, and the *perception* of it is ultimately what drives decision making and behavior, even more so than the actual level of risk tolerance.

This dissonance between the investor's perception and her own actual level of risk tolerance is more easily understandable in the presence of an investor-advisor relationship. The financial advisor has access to an objectively measured level of financial risk tolerance obtained through an assessment tool, while the investor bases her decision making on a subjectively perceived level of investment risk tolerance. Without awareness and self-efficacy, the individual does not have the confidence to behave genuinely in accordance with her risk tolerance levels. Several questions may arise. Is it possible to align an investor's perception of her own investment risk tolerance with her real tolerance? What is at the cause of this divergence is assessment? Are all investors equally misinformed of their own investment risk tolerance? The present study aims to answer the following research question:

Which are the factors and in what way do they affect the level of subjectively perceived investment risk tolerance of the investor?

The present study is based on an original 40-item testing instrument which is used to collect data on two populations of investors. The questionnaire is based on previous literature, by combining instruments from several published studies and existing surveys. Data is collected through an online questionnaire; a total of 245 respondents represent the American sample and the Italian one consists of 102.

In Chapter I, the present study provides the definition of risk tolerance and reviews the most important models of risky choices. Then, the topics of objective and subjective risk tolerance are explored by providing three research examples with the articles of Chang et al. (2004), Asaad (2015), and Lind et al. (2020). The chapter ends with a review on the methodologies available in literature to measure risk tolerance.

In Chapter II, a review on the existing literature contributions on the factors affecting financial risk tolerance is provided and validated scales to measure financial literacy and personality types are presented and discussed. Existing research has shown that several demographics, socioeconomic, and attitudinal factors affect risk tolerance, and that it is necessary to examine these relationships in more detail. This study contributes to existing ones by focusing on demographics, financial literacy, and personality types as factors affecting risk tolerance.

In Chapter III, the data collection procedure, and the data collection instrument are explained thoroughly. The 40-item questionnaire specifically designed for this study is composed of five blocks: *objective risk tolerance* measured with the Grable and Lytton 13-item scale, *subjective risk tolerance* measured with the one-item self-assessment question from the American Survey of Consumer Finances (SCF) and the DNB 6-item questionnaire, *financial literacy* measured with the 5-item questionnaire proposed by Lusardi, *personality types* assessed with the TIPI 10-item validated scale, and lastly there are 17 items collecting *demographics*. In this chapter, descriptive statistics of the American and Italian samples are discussed with great emphasis both on differences and similarities.

In Chapter IV, four types of analysis are applied to the American and Italian samples separately: a *four-quadrant analysis*, a *multi linear regression analysis*, a *simple mediation analysis*, and a *moderated mediation analysis*. Data analysis is run with STATA using bootstrapping techniques and hypothesis testing procedures which are based on the paper by Preacher, Rucker, and Hayes (2007). The four-quadrant analysis is useful to highlight the differences among four types of investors which are hesitant, overconfident, realistic low-risk, and realistic-high risk investors. The multi linear regression analysis is instrumental in the identification of the main independent variables which describe subjectively measured investment risk tolerance. Moreover, simple mediation analysis and moderated mediation analysis are important to understand the

causality of the relationships among the variables and the extent to which the mediator and moderator variables affect those interactions.

The conclusions of the present study focus on the importance of this research and to the contributions it provides to existing literature. Moreover, useful policy implications are provided to practically implement the findings of this study.

Chapter I Risk tolerance

A thorough discussion on risk tolerance must begin with a clear definition of the concept of "risk". As it turns out, risk is not an unambiguous notion; multiple sources of risk are part of any individual's life and there are several meanings of risk, justified by the fact that hazards, the sources of risks, are quite heterogenous.

This chapter begins with the definition of risk and financial risk and continues by providing additional explanations on risk tolerance, risk attitude, and risk perception. Subsequently, a brief summary of frameworks for dealing with risky choices is presented. The non-comprehensive overview begins with Expected Utility Theory, Modern Portfolio Theory, and CAPM. Next, Behavioral Finance, Prospect Theory and Cumulative Prospect Theory are examined.

The following sections of this chapter illustrate the difference between objective and subjective risk tolerance by providing definitions and examples found in literature. Lastly, the chapter ends with a review of the financial risk tolerance assessment tools utilized in research.

1.1 Risk and Financial Risk

The goal of this section is to provide a general definition for risk as well as a definition of financial risk.

In most contexts, the notion "risk" stands for a danger of unwanted and unfortunate events, not just uncertainty about the potential outcomes of an incident. Accordingly, "risk" can be defined as the possibility of physical and/or social and/or financial harm/detriment/loss due to a hazard within a particular time frame (Rohrmann, 2008).

"Hazard" refers to something physical such as a substance, event or situation that can become harmful for people, nature, or human-made facilities. A hazard is a physical entity while risk is not.

From a different perspective, within natural sciences, "risk" is usually defined as the realization of a set of possible outcomes and their probabilities. From a mathematical point of view, Olivieri and Pitacco (2015) state that "risk can be defined as a random number, X, whose actual outcome (or realization) is unknown. Yet, a set of possible outcomes has to be specified, and probabilities over this set have to be assigned" (p. 1).

When considering "financial risk", the only focus are the financial consequences of events; hence financial risk is usually expressed in terms of its monetary impact. Financial risk can be defined as the possibility of a financial loss. Following from the mathematical definition of risk, it is important to notice that financial risk is a random number as well. When discussing financial risk, randomness is always involved. The approach is no longer deterministic but statistical.

Financial risks are everywhere, and they affect anyone: from individuals to firms, from financial markets to governments. Because of their different nature, financial risks are often categorized under different labels: liquidity risk, currency risk, credit risk, operational risk, default risk and so forth.

The focus of this project is on financial risk and, apart from this section in which the distinction is made clear, whenever "risk" is mentioned, it is intended as financial risk. Moreover, this project analyzes financial risk which affects the individual.

1.2 Risk Tolerance

1.2.1 Defining Risk Tolerance, Risk Attitude, and Risk Perception

Financial risk tolerance is extremely relevant in relation to the individual's financial behavior. In the effort to define risk tolerance it is useful to review some of the definitions proposed in literature. In his work, Grable (2018) provides a definition of risk tolerance which was formerly introduced in 1964 by Kogan and Wallach. He reports that "risk tolerance is the willingness of an individual to engage in a behavior where there is a desirable goal, but attainment of the goal is uncertain and accompanied by the possibility of loss" (p. 3). Many researchers theorize risk tolerance as the highest amount of uncertainty someone is willing to accept when making a financial decision or "the willingness to engage in behaviors in which the outcomes remain uncertain with the possibility of an identifiable negative outcome" (Irwin, 1993, p.9).

Moreover, sometimes in literature the term "risk preference" is used to describe risk tolerance. Therefore, it is relevant to report Weber & Milliman (1997) definition of risk preference as a person's "tendency to be attracted or repelled by alternatives that he or she perceives as more risky over alternatives perceived as less risky"(p.128). This definition decomposes risk tolerance into two parts: risk attitude and risk perception. These two components of risk tolerance are analyzed below.

Risk attitude is widely believed to be a singular trait of an individual. Risk attitude can be described as the "chosen state of mind with regard to those uncertainties that could have a positive or negative effect on objectives" (Hillson & Murray-Webster, 2006). Risk attitude is highly impacted by context; examples of different contexts in which risk attitude is expressed are traffic offenses, portfolio choice, smoking, occupational choice, participation in sports, and migration. Dohomen et al. (2005) find that "risk attitudes are strongly but imperfectly correlated across different life contexts. This provides some support for the standard assumption of a single underlying trait, but also points to a value-added from asking context-specific questions, in order to capture variation in risk perceptions" (p.34).

Risk attitude is influenced by risk perception. As Hillson & Murray-Webster (2006) analyze, perception comprises several factors. They call "rational situational factors" those characteristics such as familiarity and proximity; "subconscious heuristics" are those factors functioning at both individual and group level, and lastly emotions. As the authors state, "the influence of perception on risk affects the answers to such questions as "How uncertain is it? And how much does it matter?" (p. 3).

It is rather not surprising that "people misstate their risk tolerance" (Grable & Lytton, 1999). Risk tolerance is a complex concept based both on the individual's attitude towards risk and the perception of it. Moreover, financial risk tolerance plays a crucial role in shaping the individual's financial behaviors. Interestingly, despite the difficulty to define someone's risk tolerance, this individual's trait is an important factor that influences a wide range of personal financial decisions stretching from financial planning to investment suitability.

Over decades of research, the effort to explain risk tolerance and the outcomes from risky actions has led to both normative and descriptive models. Normative models describe how people *should* make decisions; the primary normative model is the Expected Utility Theory. Descriptive models explain how people *do* make decisions, they tend to be based on varied behavioral and or psychological perspectives; these models allow for decisions toward less optimal and less rational outcomes. Behavioral finance is a descriptive model, as explained below.

1.2.2 From the Expected Utility Theory to Modern Portfolio Theory and CAPM

The Expected Utility Theory (EU) is a framework for dealing with risky choices that was formally defined by Von Neumann and Morgenstern (1947). They argued that consumers should select choices with the highest expected utility. In its most basic form, EU assumes that consumers are rational and that risk preferences remain constant. As such, a consumer should make the same choice (tradeoff) in terms of riskiness regardless of the situation or event.

When outcomes are not certain, the rational agent is faced with dealing with uncertainty. Uncertainty implies working with probabilities, in this specific framework focusing on financial decisions the agents are comparing different prospects. A prospect is a series of wealth outcomes, each of which is associated with a probability. Prospects are also called lotteries. As explained by Johnstone and Lindley (2013) "each such uncertain prospect reduces to a probability distribution over a domain of possible payoffs. Decision-making therefore boils down to a choice between different possible probability distributions of returns."

In this normative framework, if decision-making is rational, the decision-maker must act as if his main objective is to maximize expected utility *E[u(x)]*. The expected utility of an act is a weighted average of the utilities of each of its possible outcomes, where the utility of an outcome measures the extent to which that outcome is preferred, or preferable, to the alternatives. The utility of each outcome is weighted according to the probability that the act will lead to that outcome (Briggs). Expected utility, is defined as $E[u(x)] = \int_x f(x)u(x)$, where expected utility is the weighted sum of the probability of the outcomes; *u(x)* is a real-valued function representing the utility obtained from certain wealth or payoff *x*, and *f(x)* is the probability density function of *x*.

It is important to notice that in EU there are essential axiomatic properties: completeness, transitivity, continuity, independence, and dominance.

EU implies that individuals faced with uncertainty maximize the utility expected across possible states of the world. In this framework the rational individual is viewed as an "homo economicus", meaning that he is well-behaved, and his preferences are time-invariant; he has access to perfect information and foresight as well as unlimited computational abilities.

As Johnstone and Lindley (2013) summarize, in economics, decision-makers are assumed to be *risk averse*. When looking at the utility curve, they have a "positive but diminishing marginal utility for money, and hence *u(x)* is increasing and concave" (p.225). When faced with a lottery, a risk averse decision-maker will not engage in it if the expected monetary value is zero, or less, therefore meaning that there is nothing to gain.

The assumption that in economics decision-makers are risk adverse is based on Bernoulli's seminal works from 1713. With the famous St. Petersburg paradox, Bernoulli provides a puzzle that ultimately challenges the notion of maximizing expected utility. This theoretical casino game works as follows. A fair coin is tossed, and the initial stake begins at two dollars. If heads appear, the coin is tossed again, and the stake is doubled every time heads appears. The first time tails appears, the game ends and the player wins whatever is in the pot. In the St. Petersburg coin game, the expected gain is infinite, therefore, this leads to determine as rational to pay *any* finite fee for a single opportunity to play the game. Bernoulli "solves" the paradox by suggesting that utility *u(x)= ln(x)*, this formulation implies that marginal utility is decreasing, meaning that the value of an addition dollar gets lower the more money has been accumulated. Moreover, the work of Arrow (1970) suggests that the utility function of a rational agent should be "taken to be a bounded function.… since such an assumption is needed to avoid [the St. Petersburg] paradox". Subsequently, the axiomatization proposed by von Neumann and Morgenstern (1947) entail that the decision maker's utility function is bounded, and marginal utility is decreasing, all thanks to the five axioms previously mentioned.

For detailed discussion of the axioms refer to von Neumann and Morgenstern (1947) and Johnstone and Lindley (2013).

In summary, according to the Expected Utility Theory a rational decision-maker can have a concave utility function which represents risk aversion, a linear function which represents risk neutrality, or a convex function which represents risk loving. A risk-averse person will always reject a lottery in favor of receiving its expected value for sure, also called the certainty equivalent. Simply put, risk-averse people need an additional incentive to make them want to take on the risk of the gamble, referred to as the risk premium. A risk-neutral consumer will have a zero-risk premium, and a certainty equivalent equal to the expected value of the gamble. Similarly, a risk-loving consumer

will have a negative risk-premium, since she would need an extra incentive to accept the expected value, not the risky gamble, and her certainty equivalent would be greater than the expected value of the gamble.

After reviewing the important implications that the Expected Utility Theory has on the creation of a model to describe risk attitudes, it is necessary to briefly review Markowitz's Modern Portfolio Theory and to analyze in detail the assumptions this theory is based on.

Markowitz's Modern Portfolio Theory (MPT) was first published in 1952 and was later awarded a Nobel Prize in 1990. Modern portfolio theory is a theory on how risk-averse investors can construct portfolios to maximize expected return based on a given level of market risk. In Markowitz's framework, each financial asset is characterized as a random variable with a probability distribution over its possible returns. Then, two moments – mean and variance – are used to rank the distributions (Liu, 2004). The mean-variance selection criterion is simple: it is desirable that one selects a portfolio that maximizes mean but minimizes variance.

Markowitz's original contribution regards the creation of portfolios. A portfolio is a linear combination of asset variables; the portfolio, just like the individual assets, is characterized by its mean and variance. MPT argues that an investment's mean and variance should not be viewed alone but should be evaluated by how the investment affects the overall portfolio's risk and return. The statistical measure of correlation becomes essential to evaluate how investments interact within the portfolio.

The portfolio mean is calculated as follows: $E[R] = \sum_{i=1}^{n} w_i E[R_i] = \sum_{i=1}^{n} w_i \mu_i$, where the portfolio has n assets. Each ith asset has a mean of returns μ_i and a variance σ_i^2. The proportion of the value of the portfolio that asset i makes up is w_i, the sum of all $w_i = 1$. In the simplest representation of the model, $w_i \geq 0$, thus short selling is not allowed.

In summary, the expected return of the portfolio is the weighted sum of the individual assets' returns.

The portfolio variance is calculated as follows: $\sigma^2(R) = \sum_{i=1}^{n} \sum_{j=1}^{n} w_i w_j \sigma_{i,j}$, where $\sigma_{i,j}$ is the covariance between the return on asset i and the return on asset j, and where the same term represents the variance of the asset when $i=j$. To calculate the variance of the

portfolio it is necessary to compute the variance-covariance matrix of the individual assets.

The revolutionary contribution by Markowitz consists of the ability to obtain a portfolio with lower variance than the weighted sum of the individual assets' variances. This is attainable by selecting non-correlated assets, assets that have lower or negative correlations. The MPT graphical representation utilizes standard deviation on the horizontal axis and expected return on the vertical axis to create the risk/return space. The set of attainable points in the risk/return space is a cloud of points, it is important to recall that short selling and borrowing are not allowed in this initial description of the model. Given any two points in the set, a convex path within the set connects them. In this risk-return space is possible to identify the minimum risk portfolio, which is the leftmost point on this set. Similarly, the maximum return portfolio exists, being the portfolio which consists only of the assets with the highest expected return.

Since in the model the investor is assumed to be rational and risk adverse, she will: a) prefer a greater expected return to a smaller, risk being fixed; b) prefer a smaller risk to a greater, expected return being fixed. The set of points identifiable by following these rules, and the corresponding portfolios, forms the so-called efficient frontier.

To choose between all efficient portfolios that lay on the efficient frontier, the investor forms a family of MV indifference curves.

As Johnstone and Lindley (2013) clearly explain:

> These indifference curves are understood as equivalue curves defined by some indifference function $V(\sigma,\mu)$. Each such curve shows the locus of (σ,μ) points for which $V(\sigma,\mu)$ is held constant. These curves are drawn convex downwards on the basis that, for assets known only by their MV parameters (σ,μ), the risk averse investor requires marginally greater compensation in μ for each further increment in risk σ (see Meyer, 1987, for related proofs). Since risk averse investors prefer lower σ for fixed μ, higher (more northwesterly) indifference curves represent greater expected utility to the investor. (p. 225)

Once the efficient frontier has been identified, and once the indifference curves have been represented, "selecting an optimal portfolio is equivalent to locating the tangent point between an indifference curve and the frontier of an opportunity set" (Liu, 2004).
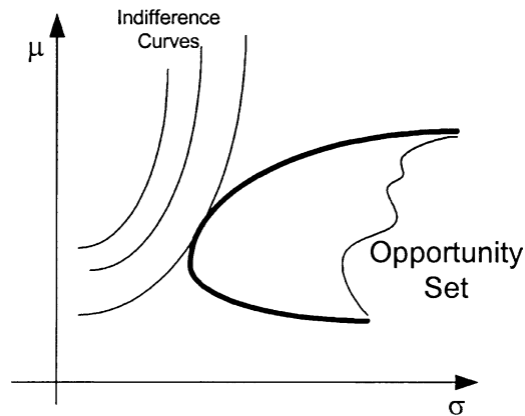
Figure 1 - Efficient Frontier and Indifference curves (Liu, 2004)

The purpose of this section is not to exhaustively cover Markowitz groundbreaking work, rather this quick overview is meant to highlight the importance of the assumption the model is based on.

As Hawley & Beyhaghi (2012) analyze, the assumptions can be summarized as follows: a) the investors are rational; b) the investors are risk averse and make decisions based on the axioms of expected utility theorem; c) risk aversion (the risk-return trade-off) is linear or constant; d) a monotonic investor always prefer a portfolio with a higher expected return over another portfolio with a lower expected return; e) the investor knows the expected return of each asset in her portfolio; therefore, to calculate the expected return of an asset one needs to know the distribution of the return of that asset.

After reviewing the Expected Utility Theory and the Modern Portfolio Theory, the obvious next step is to describe the Capital Asset Pricing Model (CAPM), the third and last normative model analyzed in this chapter.

The Capital Asset Pricing Model is based on the work of William Sharpe (1964), as well as other independent contributors such as Lintner (1965), and Mossin (1966). With this important economic model, Sharpe introduces the concepts of systematic and idiosyncratic risks, portfolio beta, diversification, and the linear relationship between beta as a measure of portfolio/asset risk and the expected return of portfolio/asset (Hawley & Beyhaghi, 2012). As seen previously, an investor can reduce the total risk of her portfolio by adding assets that are not completely correlated, this process is called diversification. Through diversification, the investor can reduce idiosyncratic risk which

is a portion of total risk that is asset specific. The other component of total risk is systemic risk, this risk is common to all assets, and it cannot be diversified away.

Sharpe (1964) argues that since idiosyncratic risk can be diversified away, for the correlation of each asset to be meaningful, such measure should not describe the relationship with all other assets in the portfolio, but the correlation of each single asset with a common underlying factor that matters. Moreover, Sharpe shows that the highest benefit of diversification is represented by the market portfolio; this portfolio has the best return versus risk ratio because it is the best diversified of all possible portfolios. If investors select their portfolios rationally, meaning by following the risk/return tradeoff as discussed in Markowitz's model, and if they all share the same opinion about each asset, meaning they all use the same values of expected returns, variances, and correlations, then Sharpe shows that in equilibrium "there is a linear relationship between the expected return of an asset and its sensitivity to the return on the market portfolio, or beta" (Hawley & Beyhaghi, p. 11).

The CAPM has become one of the most widely accepted models. The derivation of the model is beyond the scope of this brief overview; however, the discussion would be incomplete without looking at the CAPM equation:

$$E(R_i) = R_f + \frac{COV(R_i, R_M)}{VAR(R_M)} \left[E(R_M) - R_f \right]$$

$$E(R_i) = R_f + \beta_i \left[E(R_M) - R_f \right]$$

Where $E(R_i)$ is the expected return on asset i, $E(R_M)$ is the expected return on the market portfolio of risky assets, and R_f is the return on the risk-free bonds. β_i represents the sensitivity of the expected excess asset returns to the expected excess market returns. $E(R_M) - R_f$ is known as the market premium, while $E(R_i) - R_f$ is known as the risk premium. The appeal of the CAPM equation is that computations are greatly reduced, instead of finding all the pair-wise correlations between the assets in the portfolio, it is sufficient to compute the correlation between each asset to the market.

Early on, scholars realized the explanatory limits of the CAPM, and other alternative models came into existence. For instance, Fama and French (1992) proposed a three-factor model, Black (1972) proposed a version of CAPM in which is not assumed that investors can lend and borrow at a common risk-free rate, and Ross (1976) proposed the

Arbitrage Pricing Theory (APT) in which assets are sensitive to different economic factors and hence "factor loadings" come to replace the beta of CAPM.

As for the other normative models, the primary focus of this analysis is to identify the assumptions behind the CAPM model. As an extension to the Modern Portfolio Theory, the CAPM maintains the same assumptions about investors: rationality, risk aversion, and monotonic preferences. Moreover, as Arnold (2005) summarizes: investors are able to broadly diversify across a range of investments; they are price takers and cannot influence the price of single assets; they can lend and borrow unlimited amounts under the risk free rate of interest and trade without transaction fees or taxation costs; investors deal with securities that are all highly divisible into small parcels; lastly, investors have homogeneous market expectations, because all information is available at the same time to all investors.

This brief exploration, from Bernoulli to Sharpe, provided some cornerstone models that have been studied and discussed for decades by scholars. Even though the creation of these models provided groundbreaking results, the low explanatory power of these models when working with real data (Fama & French, 1992), motivated financial economists to propose new models to relate the variations in expected returns with common risk factors. The need to model reality led to the creation of many subsequent normative models, as well as sparking the interest of several scholars who took a completely different approach to the task, a *descriptive approach*.

1.2.3 From Behavioral Finance to Prospect Theory and Cumulative Prospect Theory
The traditional, normative, financial theories that are reviewed in the previous section were well constructed to make financial decisions; however, they were unable to explain disruptions in stock markets. Often, peculiar phenomenon such as stock market bubbles, market overreaction or under reaction, and momentum and reversals materialized in stock markets, defying all theories, and arising questions. This need for answers led to a new descriptive approach: Behavioral finance. In the words of Ricciardi and Simon (2000), "behavioral finance attempts to explain and increase understanding of the reasoning patterns of investors, including the emotional processes involved and the degree to which they influence the decision-making process" (p.2). This approach is multidisciplinary, and it involves psychology, sociology, and finance. "The proponents

of behavioral finance continuously challenge [normative models' assumptions] and believe that numerous factors, including both rational and irrational thinking, drive investor behavior" (Mishra & Metilda, 2015).

Many researchers have questioned the accuracy of EUT, the record of Friedman and Savage is to be the first ones that in 1948 challenged the standard utility function assumption by showing that few people have a constant risk aversion throughout the entire domain of wealth. Their famous paradox was the example of consumers who purchase insurance but also gamble. In 1979, Kahneman and Tversky, two Israeli psychologists and economists, empirically prove that expected utility theory makes faulty predictions about people's decisions in many real-life choice situations. The deviations from EUT are systematic and these violations show patterns that may be explained by an alternative model. They first propose an alternative model that challenges the Expected Utility Theory as a descriptive model of decision making under risk. Until Kahneman and Tversky's Prospect Theory, the favorite method for describing risk tolerance had been Expected Utility Theory.

Prospect Theory is the most important theoretical contribution to the understanding of how individuals respond to investment risk. Prospect Theory is the described and empirically founded alternative to EUT.

> "The key elements of the theory are: 1) a value function that is concave for gains, convex for losses, and steeper for losses than for gains, and 2) a nonlinear transformation of the probability scale, which overweights small probabilities and underweights moderate and high probabilities" (Kahneman & Tversky, p. 297).

By using several hypothetical choice problems, the authors assess and describe a numerous list of ideas that are relevant in prospect theory. Beside the two key concepts listed above, the first relevant feature of prospect theory is the so-called *reference point*. When assessing the riskiness of a lottery, the investor tends to focus on gains and losses from an arbitrary starting point. Moreover, investors display a *break-even* effect and a *house-money* effect. The break-even effect refers to those situations in which a prospect becomes more attractive because it offers a chance to recover prior losses. The house-money effect, on the other end, describes those prospects in which the investor increases risk-seeking behavior because of a prior gain, in a way, the investor interprets the previous gain as a cushion for subsequent losses. The second feature of PT is *loss*

aversion. Loss aversion is a cornerstone in PT, it describes "one of the basic phenomena of choice under both risk and uncertainty which is that losses loom larger than gains. the observed asymmetry between gain and losses is far too extreme to be explained by income effects or by decreasing risk aversion" (Kahneman & Tversky, 1992). Moreover, investors are *myopic*. Myopic loss aversion predicts that "an investor's bond allocation should fall as their evaluation period lengthens and rise when negative investment returns occur" (Finke & Guillemette, 2016). In similar studies, researchers found an increase in equity allocation as a result of limiting the ability to the investors to view short-run returns. The third feature is *risk seeking*. As seen in previous sections, investors are generally assumed to be risk averse. Prospect theory reconciles the multitude of observations in which investors portrait risk-seeking decision making. In more detail, people often prefer the small probability of winning a large prize over the expected value of that prospect. Moreover, risk-seeking is prevalent in the domain of losses, meaning when the investor is faced with the decision between a sure loss and a substantial probability of a larger loss. The fourth feature is *framing effects*. Framing refers to the way a prospect is formulated. Normative theories assume that, no matter the way a prospect is formulated, equivalent prospects should yield the same order. Prospect theory reconciles the abundant evidence that describes the difference in preference order of equivalent prospects, based on the sole framing of the prospect, whether it is a gains or losses formulation. The fifth feature is *source dependence*. This specific feature holds that people assess outcomes and express preferences relative to an existing reference point, or status quo. Reference points that appear to be random in nature can also influence the decision of the individual choice. A kind of experiment that has been repeated multiple instances involves that a random variable is assigned to an individual, then the individual is asked to price an object. Results show that they will use that random number as reference point for the pricing of items. Lastly, *nonlinear preferences*. Prospect theory allows for the utility of a risky prospect to be nonlinear, meaning that the difference between probabilities of 0.99 and 1.00 has more impact on preferences than the difference between probabilities of 0.10 and 0.11.

In the initial formulation of Prospect Theory, Kahneman and Tversky do not expand the theory to prospects with more than two outcomes. With the 1992 formulation, Kahneman and Tversky introduce the Cumulative Prospect Theory. This framework is able to accommodate for framing effects, nonlinear preferences, source dependence, risk-

seeking and loss aversion. In the Cumulative Prospect Theory, the authors abandon the assumption that the weighting function is a monotone transformation of the outcome probabilities, instead, they explicitly formulate a weighting function. The new weighting function is concave near 0 and convex near 1, in this way, as CPT assumes that people overweight small probabilities and underweight large probabilities. For the complete formulation of the weighting function and its coefficients please refer to Kahneman and Tversky (1992).

See the following *Figure 2* and *Figure 3* from Kahneman and Tversky that describe the utility function and weighting function.

Figure 3. Weighting functions for gains (w^+) and for losses (w^-) based on median estimates of γ and δ in equation (12).
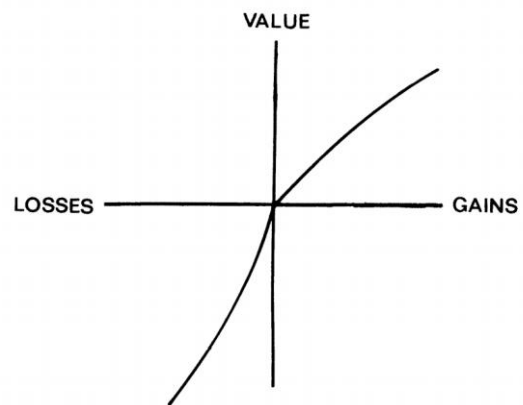
FIGURE 3.—A hypothetical value function.

Figure 2 - Weighting functions for gains and losses (*Kahneman and Tversky, 1992)*

Figure 3- *A hypothetical value function (Kahneman and Tversky, 1992)*

This brief discussion of behavioral finance, prospect theory, and cumulative prospect theory helps understanding the focus of the research. Comprehending investor's decision-making process requires moving away from the rigid and axiomatic assumptions of Expected Utility and immersing in a much more challenging, and exciting, world in which investors are not only utility oriented, but also affected by emotions and interactions with others. This wider breadth approach is integral part of this investigation.

1.3 Risk Tolerance: Objective risk tolerance VS Subjective risk tolerance

As much as normative models describe how investors should behave, the evidence collected on the field depicts numerous systematic deviations from the behavior of the "homo economicus". Behavioral researchers analyzed such deviations and investigated even further in order to provide models which better describe how individuals actually behave. One additional level of complexity needs to be taken into consideration: self-perception. The definition provided in the dictionary of psychology created by the American Psychological Association defines self-perception as: "a person's view of his or her self or any of the mental and physical attributes that constitute the self. Such a view may involve genuine self-knowledge or varying degrees of distortion."

Thanks to the recent works of behavioral finance scholars, it is possible to identify and define the distortions, also called biases, that affect investors. Shefrin (2007) defines bias as a predisposition towards error. In other words, a bias is a prejudice or propensity to make decisions while already being influenced by an underlying belief. In this section the biases of *overconfidence*, *illusion of control*, *self-attribution, confirmation,* and *excessive optimism* are defined in order to introduce the ideas of *objective* risk-tolerance and *subjective* risk tolerance.

Overconfidence is a bias that affects decision making. According to Shefrin, overconfidence "pertains to how well people understand their own abilities and the limits of their knowledge" (Shefrin, 2007). This bias is discussed in detail in the following sections, at this point it is important to understand that, in general, people tend to overestimate their ability to perform well. This, in turn, leads to impulsive decisions and to less search for help and direction in making major decisions (Chira, 2008). In itself, overconfidence is not to be viewed as an intrinsically positive or negative trait. There are both pros and cons that are discussed in later sections. Overall, overconfidence is generally believed to increase risk tolerance (Mishra & Metilda, 2015).

Illusion of control is defined as the "tendency of people to believe they can control and/or influence outcomes that in reality they have not influence over" (Shefrin, 2007). Consequently, investors "expect a greater return about an event which follows their preferences" (Ullah, 2015). Moreover, the individual while making investment decisions underestimates the risk which opposes his preference and overestimates the result which is in line with his preference.

Self-attribution bias is a cognitive phenomenon by which people tend to attribute success to innate aspects such as talent and foresight, and attribute failures to situational factors (Mishra & Metilda, 2015). According to Heider's (1958) definition, self-attribution bias represents people's propensity to claim an irrational degree of credit for their success and the irrational denial of responsibility for their failure. These traits have been observed in numerous studies on managers, however, investors are not immune to this bias. It has been observed that an investor who is prone to the self-attribution bias would assign the increase in the value of an investment that she has bought to her being savvy and to bad luck or some external factor if it decreases in value (Mishra & Metilda, 2015).

Confirmation bias is a cognitive bias, or tendency to interpret information in such a way that it confirms preconceptions, while avoiding interpretations which contradict previously held beliefs (Shefrin, 2007). It is possible to observe this trait with consumers; if a consumer has a strong feeling towards a particular brand, he will be inclined to pick the information that is in agreement with the opinion held. Consequently, no matter if considering confirmation bias in context of individual or corporate decision-making, it manifests in the form of emphasizing what people want to believe while ignoring anything that transcends preconceived notions (Chira, 2008).

Excessive optimism is related to the overestimation of the number of favorable outcomes in comparison to unfavorable ones (Shefrin, 2007). As for previous biases, several studies have been conducted on managers and how they operate their business. Just as managers are influenced by excessive optimism, so are individuals; individuals exhibit excessive optimism when they decide on their investments and in the way they live their daily lives. Brown and Cliff (2005) have studied the influence of sentiment on the value of stock prices and have concluded that "sentiment does affect asset valuation".

Although this is not a comprehensive description of all the investors' biases, the traits so far defined are useful to understand the difference between *objective* risk-tolerance and *subjective* risk tolerance. Recalling the definition, risk tolerance is "the willingness to engage in behaviors in which the outcomes remain uncertain with the possibility of an identifiable negative outcome" (Irwin, 1993). As Yao and Curl (2011) asserted, "risk tolerance is a psychological characteristic that is not directly observable. As such, it is challenging to measure". Researchers have used various types of questions in surveys to assess subjective risk tolerance. The methods developed and used to measure risk

tolerance are discussed in detail in the following chapters. At this point it is important to highlight that numerous biases affect the decision-making process as well as the individual's self-perception.

Colleen Asaad (2015) conducted an interesting research on assessing knowledge and confidence. In the paper she investigates financial knowledge and financial confidence, also called perceived or subjective knowledge. According the Asaad's findings, to make sound financial decisions "individuals must not only possess the necessary knowledge but must also have the ability and confidence to apply their knowledge." The study highlights that both knowledge and confidence influence financial behaviors, and "surprisingly, the effect of financial confidence on behaviors is just as important as the effect of financial knowledge". Moreover, Asaad investigates the interaction of financial knowledge (objective knowledge) and confidence (subjective knowledge). In instance, when confidence exceeds actual knowledge, an individual is displaying the overconfidence bias.

In a more recent study Lind et al. (2020) investigate "how individual differences in objective financial knowledge (competence) and subjective financial knowledge (confidence), numeracy, and cognitive refection were associated with sound financial behavior and subjective financial wellbeing." The research is based on two levels of assessments: an objective assessment, by using knowledge-based questions, and a subjective assessment, by asking people to rate their level of financial knowledge.

While the previous two studies focus on financial knowledge, Chang, DeVaney, and Chiremba in 2004 conducted a study on the determinants of subjective and objective risk tolerance. The authors used the database from the 2001 Survey of Consumer Finances (SCF). To measure subjective risk tolerance they use the responses to the SCF question that asks about the amount of risk that people are willing to take when making savings or investing decisions. To measure objective risk tolerance they calculate a ratio of risky assets to net worth. One of the findings of their research indicates that "subjective risk tolerance was positively related to objective risk tolerance" (p.65).

To the extent of this research, this investigation does not aim at financial knowledge rather at a more specific financial trait: risk tolerance. Objectively measured and subjectively perceived risk tolerance are relevant because on one hand:

Risk tolerance is an important factor that influences a wide range of personal financial decisions. Risk tolerance is an underlying factor within financial planning models, investment suitability analyses, and consumer decision frameworks. The debt versus savings decision individuals regularly make, the type of mortgage selected, and the use and management of credit cards are examples of situations where a person's financial risk tolerance can influence behavior. Financial risk tolerance also affects the way people invest their resources for short- and long-term goals such as saving for a significant purchase and retirement. It is reasonable to expect that people with varying levels of risk tolerance should act differently when making investment decisions, with those having a high-risk tolerance investing more aggressively. (Grable, p.4)

On the other hand:

Anderson et al. (2017) showed that people's subjective financial knowledge (i.e., confidence) was a better predictor of savings behavior than their objective financial knowledge (i.e., competence). Similarly, Allgood and Walstad (2013) found that subjective financial knowledge was a stronger predictor of less costly practices in credit card use than objective financial knowledge. Beliefs about the extent of one's own knowledge might thus be as important (or more) as actual knowledge when it comes to sound financial behavior. (Lind et al., p.627)

Rather than focusing on financial knowledge/literacy, this research focuses on risk tolerance. Without knowledge, the individual is oblivious of her risk tolerance level. Without perception, the individual does not have the confidence to behave genuinely in accordance with her risk tolerance levels. This research investigates: a) the relationship between objective risk tolerance and subjective risk tolerance, and b) the moderating and mediating role of financial literacy and personalities on such relationship.

1.4 Measuring Risk Tolerance

The need to provide a tool to assess risk tolerance has been a focus of study for over 75 years in the United States. In practice, several methods are used to measure and assess risk tolerance: a) personal or professional judgment, b) heuristics, c) objectivity, d) single item questions, e) choice dilemmas, f) risk scales, or g) mixed measures. (Grable, 2008. Grable & Lytton, 1999).

Personal or professional judgment refers to a not particularly accurate way to assess risk tolerance. The judge assessing the risk tolerance of the investor formulates a judgment on the assumption that others have the same risk tolerance as the judge. Others can be more or less risk tolerant compared to the judge.

The use of heuristics refers to the application of simplified rules that result in a mental shortcut to solve a problem. The heuristics method assumes the presence of strong correlations between demographic and socioeconomic characteristics and financial tolerance. Commonly used heuristics assume that males, self-employed, young are more risk tolerant than females and older investors. "The preponderance of research on the topic of heuristic validity suggests that very few heuristic rules can be used reliably. The majority of risk-tolerance heuristics can lead to potentially serious miscalculations and incorrect categorizations of individuals into risk-tolerance groups" (Grable, 2000; Grable & Lytton, 1999).

Risk tolerance measured with objective measures is based on the assessment of an individual's current investment approach and the risk tolerance is inferred from the observation. Factors to keep in consideration are the proportion of assets invested in equities, which are considered risky assets, as well as the ration of risky assets to wealth. This type of risk tolerance measure assumes that investors act in a rational way and that asset allocation is a result of the personal choice rather than the advice of a third party. As a result, objective measures "tend to be descriptive rather than predictive, do not account for the multidimensional nature of risk, and often fail to explain actual investor behavior" (Grable & Lytton, 1999).

Single item questions are useful in those instances in which it is not possible, because of time constrains or unavailability of scales, to administer several questions on risk tolerance. The popularity of single item questions as a method to measure risk tolerance has gained ground because it is often the only available data on risk tolerance in national surveys of consumers. One risk-assessment item was developed by the National Opinion Research Center at the University of Chicago under the sponsor of the Federal Research Board as originally asked in the Survey of Consumer Finances (SCF). The SCF question asks:

Which of the following statements on this page comes closest to the amount of financial risk that you are willing to take when you save or make investments?

1. Take substantial financial risk expecting to earn substantial returns.

2. Take above-average financial risks expecting to earn above-average returns.

3. Take average financial risks expecting to earn average returns.

4. Not willing to take any financial risks. (Grable & Lytton, 1999).

Another single item risk-assessment measure is included in the German Socio-Economic Panel Study (SOEP), a large and representative study of the German population with more than 20,000 respondents per annual wave. The SOEP question asks:

How do you see yourself: are you generally a person who is fully prepared to take risks or do you try to avoid takin risks? Please tick a box on the scale, where the value 0 means: ' not at all willing to take risks' and the value 10 means: 'very willing to take risks'. (Dohmen et al., 2005).

Until the mid-1970s, choice dilemmas were a popular method of risk assessment. Choice dilemmas refer to hypothetical scenarios where respondents are asked to make a risk choice. The most widely used questionnaire was developed by Wallach and Kogan (1959, 1961) and is referred to as the Choice Dilemmas Questionnaire. The questionnaire required subjects to advise other individuals regarding 12 choices with two outcomes: a sure gain or a sure loss. Choice dilemmas were commonly used to assess risk-taking propensities for three decades. Starting in the 1980s, the choice dilemma method began to lose credibility because of lack of validity and reliability. Ultimately, the major problem consisted in a lack of consistency between the choice dilemmas questionnaires used by different researchers. Moreover, the lack of predictive power of these questionnaires was partially attributable to the one-dimensional type questions used in the instruments. (Grable, 2008).

In the 1980s and 1990s the development of risk scales took a leap forward. Researchers agree on the following three core risk-tolerance dimensions for a scale: a) investment risk, b) comfort and experience, c) speculation. This type of scales is commonly referred to as multidimensional risk measure because it investigates several aspects of the individual's risk-taking profile.

The four most popular multidimensional risk measure used in research were proposed by: Barsky, Juster, Kimball, & Shapiro in 1997; Roszkowski in 1999; Hanna &

Lindamood in 2004; Grable & Lytton in 1999. Barsky et al. (1997) used hypothetical scenarios about income gambles in the Health and Retirement Study (HRS) to develop an index of relative risk aversion. The questionnaire is administered by an interviewer, and it is based on a total of two questions; the first question is the same of everyone, then, according to the answer to the first question (whether it is 'yes' or 'no') the interviewer is instructed to continue with one of two available scenarios as the second question. "The questions separate the respondents into four distinct risk preference categories, depending on the answers to two questions. The categories can be ranked by risk aversion without having to assume a particular functional form for the utility function" (Barsky et al.,1997) . This scale is most often used to derive a person's relative risk aversion within EUT frameworks (Yao & Curl, 2011; Grable, 2008). The second scale worth of mention, and one of the most reliable ones, is the Survey of Financial Risk Tolerance that was originally created by Roszkowski for The American College. The survey tries to asses risk tolerance directly through a combination of closed-and open-ended questions. Even though the reliability of the scale is exceptionally high, there is little evidence on the survey's validity (Grable, 2008). The survey proposed by Hanna and Lindamood in 2004 is a "risk-tolerance measure [with] pension choice questions that include graphical illustrations to increase the chance that respondents understand each question" (Yao & Curl, 2011). An example of a question which is part of their questionnaire is:

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

Using this approach, several other questions ask respondents to choose among various percentage changes in income. The result allows for the calculation of a person's relative risk aversion withing EUT framework (Grable, 2008).

Lastly, A publicly available alternative is a 13-item risk scale developed by Grable and Lytton (1999). This multiple-choice question scale has been tested and shown to offer acceptable levels of validity and reliability. The authors started from an instrument with

over 100 assessment items which were selected from a review of academic and trade publications. Subsequently, through pilot studies and tests, questions were eliminated in order to reduce redundancy and to remove items that were empirically related to each other. The result was a 13-item risk scale with high reliability and validity.

Since so many constituencies have expressed the importance of assessing financial risk tolerance, "one might assume that there is an unanimously accepted scale for determining an individual's tolerance for investment risk. However, this has been, and continues to be, a subject of debate among financial counselors, financial planners, and academicians" (Gillian et al., 2010). Multidimensional risk-assessment scales have been used for decades, and as it turns out, only one has gained popularity as a measure of risk tolerance: the Grable and Lytton 13-item scale. It must be addressed that one other measure continues to survive: the single-item assessment found in the Survey of Consumer Finances. "These measures are widely used because they are (a) available in the public domain, (b) easy to administer, and (c) relatively easy for respondents to answer" (Gillian et al., 2010).

In this research study both the SCF question and the Grable and Lytton questionnaire are administered to the participants in the study. The complete discussion of the items of the Grable and Lytton survey is covered in detail in Chapter Three.

1.5 Remarks

Chapter I begins with a literature review on the theories of risky choices, this step is necessary to introduce and understand the focus of the present study. Relevant normative and descriptive theories are briefly reviewed, and several definitions are provided. The concept of financial risk tolerance is defined and explained; more importantly, the pivotal distinction between objectively measured financial risk tolerance and subjectively perceived financial risk tolerance is made clear and examples of existing studies are provided. Lastly, several methods utilized in research to measure risk tolerance are introduced, the most important ones for the present study are the SCF question and the Grable and Lytton questionnaire. The next chapter provides a literature review on the factors associated with risk tolerance. Demographics, Financial Literacy, and Personality types are explained, then for each factor, measuring instruments from existing studies are described in detail.

Chapter II Factors associated with risk tolerance: A review

In chapter one, after providing the definition of risk tolerance and subsequently reviewing the models which describe it, the topic of objective and subjective risk tolerance was explored by providing three research examples with the articles of Chang et al. (2004), Asaad (2015), and Lind et al. (2020). The chapter ended with a review on the available methodologies to measure risk tolerance. The significance of risk tolerance for the investor is reflected in the effort placed by investment advisers, researchers, and policy makers into understanding the factors associated with financial risk tolerance. In this chapter, the factors will be discussed with more emphasis on three characteristics which are essential to the scope of this research: Demographics, Financial Literacy, and Personality Types.

In 2008, Grable compiled a review of 125 studies on risk tolerance which were published between 1960 and 2006. The author summarized the findings by identifying: the characteristics associated with financial risk tolerance; the traits of each individual characteristics associated with an individual who is more risk tolerant; and the level of support in the literature. High level of literature review means that 80-100% of reviewed papers support the assumed relationship, while moderate support refers to 50-79%, and low support refers to 0-49%. There are a number of demographics, socioeconomic, psychosocial, and other factors generally thought to be associated with financial risk tolerance. The table compiled by Grable is reported in the Appendix and it summarizes consensus findings from the literature regarding the influence of certain individual characteristics on risk tolerance. Noticeably, the factors with the highest consensus are: Gender, marital status, net worth, financial satisfaction, financial knowledge, income source, income variability, self-esteem, sensation seeking, and mood.

The detailed discussion on the factors that affect risk tolerance begins with a wide variety of characteristics which all fall under the umbrella called demographics.

2.1 Demographics

The term demographics refers to particular characteristics of a population. Examples of demographic characteristics include age, race, gender, ethnicity, religion, income, education, home ownership, sexual orientation, marital status, family size, health and disability status. Only some of these demographics are collected in this research - the detailed list is reported in Chapter Three – to keep the focus on the features relevant to the investigation on risk tolerance.

Age, despite being such a simple information to collect, arises multiple hypothesis on the association with levels of risk tolerance. The generally supported theory is that younger investors can assume more risk than older ones, however, from Grable's table, it is possible to note that there is only moderate consensus among researchers on the topic. There are several studies on the effect of age on risk tolerance, both utilizing cross-sectional data and panel data. As Wang and Hanna (1998) summarize, for "the results based on cross-sectional data, […] there may be generational effects" (p.30). On the other hand, research which uses panel data is capable of controlling for the generational effects. A massive panel data study was conducted by Dohmen et al. (2017), the authors utilized two datasets: the DNB Household Survey and the German Socio-Economic Panel Study (SOEP). The DNB survey is a representative survey regarding Dutch households, the data had been collected on a yearly basis and available data ranged from 1993 to 2011 with an average of 5,000 respondents per year. In the DNB there are six questions which relate to risk tolerance. The SOEP collects information yearly from an average of 20,000 respondents per year. For six years the survey included a single-item measure of risk attitude. The available data referred to the 2004, 2006, 2008, 2009, 2010, and 2011 surveys. Despite the abundance of panel data, "age profiles are typically difficult to identify because they may also reveal changes across cohorts or periods of observation". (p. 95). With a sophisticated model specification which utilizes GDP growth rates as a proxy for period effects, and by controlling for education and income, the research reaches the conclusion that "risk attitudes decline with age when taking calendar time and cohort effects into consideration" (p.114). Yao, Sharpe, and Wang (2011) provide another example of a study conducted with panel data. For their research they utilize SCF data from seven survey years. Interestingly, their conceptual framework is based on the idea that three independent factors affect risk tolerance: aging effect, generation effect, period effect. The goal of the authors is to disentangle their effect on risk tolerance.

Without discussing the hypothesis on generation and period effect, it is meaningful to notice that also this research concludes that "risk tolerance generally decreases as people age" (p.883).

When considering **race**, or ethnic category, as a factor affecting risk tolerance, there is a moderate consensus in literature that non-Hispanic white are assumed to be more risk tolerant. Several studies have been analyzing specific groups or ethnic minorities financial behavior, especially in the United States. For instance, Yao (2008) investigated financial behaviors of Asian Americans, Bowen (2008) researched money matters of African American, and Watchravesringkan (2008) analyzed financial behavior of Hispanic Americans. Yao, Gutter, and Hanna (2005) use the Survey of Consumer Finances (SCF) datasets from six different years for a total of 23,243 observations to investigate the effect of race and ethnicity on financial risk tolerance. In agreement with previous statements, the authors find that white respondents are significantly more likely to be willing to take *some* risk than are blacks. In turn, blacks are significantly more likely to be willing to take some risk than Hispanics. The interesting finding of their research is that the pattern is reversed for willingness to take *substantial* amount of risk. Hispanics are more likely to take substantial amount of risk, followed by blacks and whites. As the authors explain, this risk attitude may be motivated by the desire to close the gap in terms of standard of living. "However, this pattern poses dangers, as investment scams always work by persuading unsophisticated people of the possibility of substantial gains. However, an additional consideration is that many will find themselves with little to lose. Therefore, conceptually the willingness to take risk to get ahead may seem palatable to one who realistically has little at stake" (p.58). As always, several factors interact with each other and their relationship needs further research. The authors find that other factors such as the participation in financial market and income instability may partially explain the racial inequality. In fact, most of unbanked households are non-White or Hispanics, and these household are exposed to labor force instability.

When considering **gender** as a factor affecting risk tolerance, there is high consensus in literature that males are more risk tolerant than women. Hira and Loibl (2008) highlight in their research the gender differences in investment behavior. They conclude that within a household, women are more involved in day-to-day money tasks, while men are more involved with investing. Moreover, they find that women are more likely to have

visited a financial planner than men and that women display less financial confidence than their male partner. Also, Fisher and Yao (2017) analyze and summarize previous research's finding on gender and risk tolerance. Because of their longer life expectancy, women should hold riskier portfolios. Despite this, women "invest financial resources more conservatively than do men" (p.192). Additionally, women are better investors. Because of higher level of overconfidence, men trade more frequently than women. This behavior ultimately reduces men's returns. Despite this, women engage less than men in the stock market. Fisher and Yao's research, rather than simply accepting gender as a variable affecting risk tolerance, try to identify factors that contribute to gender differences in risk tolerance. Their findings, while supporting the statement that women are less risk tolerant than men, expand the knowledge on this topic by indicating that "the economic characteristics, demographic characteristics, and expectations serve as moderating variables in the relationship between gender and risk tolerance" (p.200). Interestingly, two variables had significantly different relationship with financial risk tolerance among men and women: income uncertainty and net worth. According to their findings, women have, on average, lower income, and higher uncertainty in their income from year to year than men. For women, this resulted in more conservative investments, motivated by the need to hold money in low return accounts to buffer the risk of negative income shocks. On the other hand, men invest aggressively despite their level of income uncertainty arising the legitimate question that such portfolio allocations may not be appropriate given the fluctuations in income. Moreover, women also have a lower net income than men, on average. However, "while net worth increased risk tolerance for both men and women, it did not affect women as much as it did men" (p.200). As seen with age as a factor affecting risk tolerance, and now with gender, relationships among factors are often difficult to disentangle.

There is moderate consensus in literature regarding **marital status**; the prevailing hypothesis is that singles are more risk tolerant. However, the consensus is high that single males are more risk tolerant. As Hira and Loibl (2008) note, when considering the risk tolerance of a married couple, "the risk level of the combined husband-wife portfolio is between the risk levels of the two individual portfolios" (p.254). The research on marital status and risk tolerance is not consistent, for instance Yao et al. (2004) conclude that respondents who are married are more likely to take some risk than otherwise similar single females but less willing to take some risk than single males. Moreover, other

research conducted by Hallahan et al. (2004) find that married respondents have lower scores on a risk tolerance measure than unmarried respondents, controlling for other factors, including gender. It is relevant to address that the research on same sex marriages is limited because the scarcity of data. Hanna and Lindamood (2004) specifically investigate risk tolerance of same-sex couples and find that "marriage is somewhat related to greater risk tolerance for males and lower risk tolerance for females" (p.12). Moreover, "married males have higher stock ownership than their unmarried counterparts. Married females have higher stock ownership rates than their unmarried counterpart" (p.13).

There is high consensus in literature that stable and predictable **income** is a factor for higher risk tolerance. Also, consensus is high in literature when considering income source, for instance, business owners have higher risk tolerance. Grable (2000) finds that "respondents with higher incomes were more risk tolerant than those with lower incomes" (p.628). Finke and Huston (2003) conclude that in their research " the mean income for those willing to accept financial risk are substantially higher than those in the risk adverse category" (p.242). Moreover, Fisher and Yao (2017) assert that existing research shows that "an increase in income is associated with higher levels of risk tolerance, while income uncertainty appears to be associated with lower risk tolerance" (p.193).

Another factor that affects risk tolerance is **net worth**. There is high consensus in literature that higher net worth allows investors to be more risk tolerant. Sages and Grable (2010) investigate the effect of net worth, among other factors, on financial risk tolerance. Their findings, in agreement with the previously stated hypothesis, report that after controlling for age, "non-risk takers displayed the lowest levels of self-assessed net worth" (p.63). Additionally, Finke and Huston (2003) investigate financial risk tolerance and wealth. In the study, they find that those willing to accept financial risk have higher net worth levels compared to the risk adverse group. Moreover, the authors analyze behavioral variables such as: saver, retirement motive, and credit card debt. Not surprisingly, higher net worth was associated with households in which: income is greater than spending, saving for retirement is a top two priority and outstanding credit card balance is low.

On the topic of **education**, there is moderate consensus in literature that a bachelor's degree or even higher education have the effect to increase financial risk tolerance. As seen in multiple examples so far, demographic features interact with each other. For instance, income and education may be connected because as Finke and Huston (2017) recall, "more educated individuals may expect greater increases in future earnings, or a higher lifetime income" (p.236). The authors find that in their sample, the percentage of people willing to take financial risk was much higher among the people with a college degree than among those with less than high school education. Finke and Huston explain such difference because of coursework exposure to financial topics and instruments, as well as a result of future expected high levels of income. Moreover, Mishra and Metilda (2015) find in their research that " overconfidence increases with the level of education" (p.233) and that also the self-attribution bias increases with education, and as seen in previous chapters, overconfidence in turn has the effect to increase risk tolerance. Education levels seem to be an incorrect measure, new articles on the topic are not crystal clear and additional research not always agrees with previous findings. A more precise measure of financial knowledge is called financial literacy. The next section describes it in detail.

2.2 Financial Literacy

The previous section ended with a discussion on the effect of education on risk tolerance. As seen before, the relationships among several factors and the effect they have on risk tolerance, and financial behavior more generally, are often difficult to disentangle. Behrman et al. (2010) investigate the impact of financial literacy and schooling on wealth accumulation by conducting a very rigorous analysis of the Chilean Social Protection Survey with a total of 13,054 respondents. The authors build their research on previous studies that linked financial literacy and schooling with positive financial outcomes, however, they "isolate the causal effects of financial literacy and schooling on wealth outcomes" (p.25). The study contributes to previous research by supporting financial literacy and schooling as positive factors to the creation of wealth, but more interestingly, it uncovers an even stronger positive impact of financial literacy. Behrman et al. conclude that "financial literacy is at least as important, if not more so, than schooling" (p.25). Also, Van Rooij, Lusardi, and Alessie (2007) come to a similar conclusion in their research by stating that "education is only an imperfect proxy for financial literacy and

empirical studies that account for education may not fully account for the effect of financial literacy" (p.13).

Is it possible then to completely disregard education levels as a factor, and solely focus on financial literacy? Lusardi (2012) provides useful insights on this matter. In her research she finds that "There are large differences in financial knowledge across educational attainment: numeracy, in particular, is especially lacking among those with low educational attainment" (p.8). Moreover, she concludes that there is a very strong correlation between financial literacy and numeracy. In summary, education levels affect numeracy, which in turn affects financial literacy. However, numeracy alone is not sufficient to explain different levels of financial literacy. Studies found that variables describing the family background, such as the parents' education, influence the individual's level of financial literacy. As always, multiple factors are involved and the way they interact with each other still needs further research.

As people in developed countries are increasingly called to make financial decisions on their own, the importance of financial literacy has been widely recognized as an important factor determining the financial decision-making competencies for individual investors. The analysis continues with providing a definition of financial literacy.

Financial literacy encompasses a wide range of meanings all related to financial knowledge. Over time, several definitions of financial literacy have been provided. One of the first definitions comes from Noctor, Stoney and Straddling's work in 1992. They define financial literacy as "the ability to make informed judgement and to make effective decisions regarding the use and management of money". Financial literacy investigates basic financial concepts as well as more advanced ones. Van Rooij, Lusardi, and Alessie (2007) include in their research on financial literacy concepts such as interest compounding, inflation, and time value of money. They also investigate rather sophisticated financial knowledge topics with questions regarding the difference between bonds and stocks, the relationship between bond prices and interest rates, and the basics of risk diversification.

Numerous studies have provided essential findings on the importance of financial literacy. In their papers, Van Rooij, Lusardi, and Alessie (2007) as well as Aren and Aydemir (2015) review previous studies' findings in their respective literature reviews. In summary, financial illiteracy has consequences for household behavior on several

aspects. Studies find that individuals struggle with simple calculations which leads to poor savings behavior and unpreparedness for post-retirement times. Other studies also prove the contrary, by showing that individuals who were exposed to financial education in high school or in the workplace save more and are better equipped to accumulate wealth. Additionally, lack of financial literacy leads to no intention to control personal budget and financial dissatisfaction.

Moreover, Van Rooij, Lusardi, and Alessie (2007) conclude that lack of literacy prevents households from participating in the stock market. Guiso and Jappelli (2008) show that among those who invest in stock, financial illiteracy has been considered as the reason for portfolio under-diversification. Allgood and Walstad (2013) analyze credit card practices by asking specific questions on full credit card repayment, carried over balance, minimum payments, and late fees. They conclude that financial literacy has a significant effect on credit card behavior. Moreover, Aren and Aydemir (2015) investigate the moderating effect of financial literacy on risk awareness in general and investment intention. The authors conclude that individuals "when equipped with higher financial literacy, their attitudes to financial risk taking […] would differ" (p.24). They conclude that financial literacy acts as a moderator on risky investment intention.

This is a non-exhaustive review on some important findings and studies on financial literacy. This brief summary aims to justify the importance of financial literacy as a major explanatory factor in this present study which seeks to analyze objective and subjective financial risk tolerance.

2.2.1 Measuring Financial Literacy

As financial literacy gained importance as an essential ingredient in effective financial decision making, the effort to develop an assessment instrument increased. Starting in the early 1990s questions about credit cards, bank accounts, and insurance were added to American national surveys. More recently, starting from 2004, the work of Lusardi and Mitchell begin to gain ground as the financial literacy instrument of choice. A brief overview on other surveys is provided.

Lusardi and Mitchell (2013) utilize their standardized set of three questions. These questions were first introduced in the 2004 US Health and Retirement Study, and they are often referred to as **The Big Three**. The authors' approach is focused on the analysis of general financial principles. The three questions investigate respectively numeracy

and capacity to do calculations related to interest rates, inflation, and the risk of diversification. The characteristics of this financial literacy instrument are its simplicity, brevity, relevance, and capacity to differentiate knowledge levels such as basic and advanced financial literacy. The questions are in a multiple-choice format in which one of the options is "do not know". The number of correct answers is computed.

Another approach to measure financial literacy is based on topic-specific questions in an effort to understand financial knowledge that is necessary to deal with specific financial needs. Bowen (2002) in her study on financial knowledge of teens and their parents uses a 19-item financial literacy instrument. Questions cover topics such as, tax returns, loans and borrowing, knowledge on checks and debit cards, insurance, and fees. The author is interested in investigating the financial terms and concepts needed to function in day-to-day financial activities. The questions are multiple-choice format, and the number of correct answers is recorded.

Van Rooij, Lusardi, and Alessie (2007) in their study on the Dutch **DNB** Household Survey (DHS) utilize two modules designed to evaluate basic and advanced financial literacy for a total of 16 questions. The first module is composed of five questions covering numeracy, interest compounding, inflation, time value of money and money illusion. The households are instructed to answer the questions without additional data and without the use of a calculator. The second module is composed of 11 questions which cover much more advanced financial topics. These questions are related to investment and portfolio choice. Specifically, they investigate the knowledge of financial assets, the returns and riskiness of different assets, the understanding of the concept of risk diversification, the working of mutual funds, and the relationship between bond prices and interest rates. The questions are multiple-choice format and include a "do not know" answer. The answers are interpreted by the number of correct answers in each module. Also, the percentages of "do not know" are relevant. Interestingly, the authors include an additional question on self-assessed financial literacy by asking the respondent to grade their own understanding of economics on a scale from one to seven where one is very low and seven is very high.

The **OECD** (2017) survey measures financial literacy with an aggregate score which is the sum of three modules: financial knowledge, financial behavior, and financial attitudes. Financial knowledge is assessed with seven questions covering the time value

of money, interest paid on loans, interest plus principal, compound interest, risk and return, inflation, and diversification. The financial behavior score is calculated using seven questions that investigate household budgeting, active saving, considered purchases, timely bill payments, keeping watch of financial affairs, and long-term goal setting. Financial attitudes are measured with three questions. This 17-item method was introduced in 2009 as a common method to measure baseline financial literacy, with some minor changes between 2009 and 2017, and has been tested in 14 countries.

The last financial literacy instrument to be covered is the **Big Five**. These five questions have been used widely in the literature to provide a general understanding of a person's financial literacy in a multitude of studies as well as in national surveys like the National Financial Capability Study (NFCS) which was first administered in the US in 2009. The Big Five consists of the Big Three by Lusardi and Mitchell with the addition of two questions. These two additional questions test knowledge about mortgage interest and bond prices. As always, the format is multiple-choice with a "do not know" option.

As Hastings et al. (2013) summarize, other than objective financial literacy assessment instruments, it is important to acknowledge a different measure of financial literacy that has been used in the literature. Individuals can also self-assess their financial knowledge or, alternatively, the level of confidence in their financial abilities. Two main problems arise and are worth mentioning. First, there is not always a strong correlation between individual self-reports and the actual financial decisions they take. Second, respondents are often overly optimistic about their actual level of knowledge. Nonetheless, studies find that self-assessed financial capabilities and more objective measurements of financial literacy are generally positively correlated, and self-reported financial literacy or confidence often has independent predictive power for financial outcomes relative to more objective test-based measures of financial literacy. For example, Allgood & Walstad (2012) find that in the 2009 NFCS survey, both self-assessed financial literacy and the fraction of correct answers on the Big Five financial literacy questions are predictive of financial behaviors in a variety of domains.

In this study, financial literacy is assessed using the Big Five instrument. It is the method of choice because of its brevity, completeness, and wide use in other research studies. The wording of the five questions is illustrated in Chapter Three.

2.3 Investor's Personality Types

As investigated so far, several factors affect financial risk tolerance. Demographic features have been the focus of researchers for many decades, but ultimately their explanatory power was not exhaustive. The importance of financial literacy has been illustrated in the previous section. Also in this instance, financial literacy is a major factor in understanding risk tolerance, but alone it is not sufficient to explain the differences in people's ability to accept uncertainty when making financial decisions. This raises the question of whether there are omitted variables that further explain financial risk tolerance.

Personality theories were first discussed in psychology and afterwards the power of personality traits has been used in behavioral predictions across several areas. As Pinjisakikool (2017) explains, "personality traits have facets that could cover a wide range of behavior across domains, including risk preferences and risk taking " (p.33). For this reason, growing interest in recent financial research has led to include personality traits as psychological factors affecting behavior. This section begins wish an overview on four major personality theories. Then, some examples of existing research on the relationship between personality and financial behavior are presented. Lastly, a brief overview on assessment tools is provided.

Personality theories were proposed centuries ago by Ancient Greek and Roman physicians and philosophers. Interestingly, they had an impact even on modern works, but to the extent of this analysis the focus is on the following four theories which are the most widely known and accepted personality theories in modern psychology: Temperament theory by Keiser and Bates (1984), The Big-Five theory by McCrae and Costa (1992), the Meyers-Briggs Type Indicator (Meyers, 1980), and Behavioral Investor Types (BIT) by Pompian (2012).

As Cervellati (2017) summarizes in his work for CONSOB, the **temperament theory** proposed by Keiser and Bates (1984) argues that temperament determines behavior according to four main categories, which are: Artisan, Guardian, Idealist, and Rational. Artisans tend to be fun-loving, optimistic, realistic, and focused. They are the "doing" temperament because they need action, and they pride themselves on being unconventional, bold, and spontaneous. Artisans are the temperament with the natural ability to excel in any of the arts as well as in the athletic and military field. Guardians

tend to be dutiful, cautious, humble, and focused on credentials and traditions. Moreover, they pride themselves on being dependent helpful and hardworking. They represent the cornerstone of society. Idealists, as a temperament, are passionately concerned with personal growth and development. They tend to be giving, trusting, spiritual, and they are focused on personal journeys and human potentials. They usually work with people, in education or counselling, in social services or personnel work. Lastly, rationals tend to be pragmatic, skeptical, and focused on problem solving and systems analysis. Rationals are the problem-solving temperament, and they love to analyze and understand how thing work. An individual's personality is assessed and then categorized under one of these temperaments.

The **Big-Five theory** (McCrae and Costa, 1992) is one of the most commonly used taxonomies in the management and psychology literature. The Big-Five theory states that there are five main personality traits, namely Openness to new experiences (O), Conscientiousness (C), Extraversion (E), Agreeableness (A), and Neuroticism (N). According to this model, human personality is measured along these five major dimensions, each of which is distinct and independent from the others. When the score is high, the trait is applicable to the personality; when the score its low, the opposite trait is present. People are assumed to have different levels of key personality factors which drive thoughts and behavior, the result of the combination of these traits describes the individual's personality.

The **Openness** trait refers to openness to new experiences and ideas. Individuals with high score on this trait tend to be creative, adventurous, and intellectual. Openness describes a person's tendency to think abstractly and to enjoy playing with ideas. On the other end of the spectrum, individuals with low score on Openness tend to be practical, traditional, and focused on the concrete. They prefer to avoid the unknown and stick to traditional ways. The **Conscientiousness** trait refers to an individual's level of goal orientation and persistence. Those with a high score on conscientiousness are organized and determined, they are able to focus on long-term goals and give up on immediate gratification. On the other end, a low score on this trait depicts impulsiveness. The trait of **Extraversion** refers to people's inclination to seek attention from others. Individuals with high score enjoy building friendships, like the feeling of admiration and power, and actively pursue excitement and romance. Introverts, on the other hand, prefer to conserve their energy and they are not as interested in earning these social rewards. People with

high score on the **Agreeableness** trait are often altruistic, emphatic, and trustworthy. They tend to enjoy serving and taking care of others and are friendly and generous. On the other hand, individual with low scores on this trait tend to show less empathy and are more likely to put their own concerns ahead of others. Lastly, the **Neuroticism** trait describes the tendency to act with negative feelings in response to stressors. Individuals with high score tend to be anxious, moody, and nervous. On the other hand, low scorers on this trait tend to be more likely to brush off their misfortune and move on (Owens, 2021).

The **Meyers-Briggs Type Indicator**, or MBTI, (Meyers, 1980) is based on the basic preferences of each of the four dichotomies specified or implicit in the theory of psychological type which was introduced in the 1920s by Carl G. Jung. MBTI identifies four pairs of preference alternatives: extraversion/introversion, sensing/intuitive, thinking/feeling, judging/perceiving. According to this theory, each individual is predisposed to use prevalently one out of the two preferences of each pair. All the possible combinations of the four pairs of traits depict a total of 16 different personalities. The **extraversion/introversion** pair describes in which way individuals interact with each other. While extraverts may prefer to build relationships with others and learn by talking and asking questions, introverts prefer to do research on their own, they rarely like to share personal information and are reflective before voicing their opinions. The **sensing/intuitive** pair describes the way people gather information. While some people trust their senses, what they can touch, hear, and see by focusing on the present, others prefer to pay attention to impressions or the meanings of patterns therefore privileging thinking, often about the future, over hands on experience. The **thinking/feeling** pair describes how people make decisions. A thinking preference highlights a tendency to relay on logic and numbers to infer the correct impersonal and objective decision. On the other hand, a feeling preference describes a different approach in which other people's points-of-view are involved in the decision making. Values are highly regarded and each decision's effect on others is considered in an attempt to maintain harmony. Lastly, the **judging/perceiving** pair describes lifestyle orientations. This pair strictly focuses on the outside world, not on the inner world of an individual. A judging preference may better describe an individual who enjoys a planned and organized way of living and who feels more comfortable when decisions are made, and life feels under control as much as possible. On the contrary, a perceiving preference may better describe an individual who

has a flexible and spontaneous way of life, capable to adapt to the world rather than organize it. As all types are equal, there is no best type. Beside the pair preferences briefly discussed, an exhaustive description of all 16 types can be found in the Meyers & Briggs Foundation's official website.

Interestingly, the three theories of personality presented so far are linked to each other. For instance, Keirsey's temperament theory contains four of the Big Five factors and is also related to the MBTI. Moreover, also the Myers-Briggs model and Big Five have linking points. For example, a high score on agreeableness corresponds to the feeling preference, and low agreeableness corresponds to thinking. Curiously, the Myers-Briggs model does not include Neuroticism.

The last model presented in this section is the **Behavioral Investor Types** (BITs) proposed by Pompian (2012). With this work, the author merged Keiser's personality theory with behavioral finance studies. Pompian believes it is extremely important to exploit the psychological typing of personalities in finance to categorize investors. Understanding investor types is helpful in the investor-advisor relationship as well as for the investor herself, who gains better awareness of hidden biases. In fact, Pompian links temperaments to the most common cognitive biases they frequently exhibit; by doing so he identifies four types of investors: Preserver, Follower, Independent, and Accumulator. The Keiser's and Pompian's personalities do not exactly overlap, because financial personalities and general personality may differ in some respects. It is important to notice that Pompian's assessment process is more complex than Keiser's evaluation questionnaire. Nevertheless, Guardians are often Preservers, Idealists tend to be Followers, Rationals are generally Independent, and Artisans are typically Accumulators.

Those investors who are identified as **Preservers** are cautious and tend to place great importance on financial security and wealth preservation. Losses have a severe effect on them to the point that they often struggle to make any financial decision, fearing they may be taking the wrong decision or holding on too much risk. Preservers are often dominated by emotions, they exhibit strong loss aversion, as well as status quo, endowment, anchoring, and mental accounting biases. Those investors who are identified as **Follower** tend to be passive investors who are not interested in managing their own money. Often, they do not have their own investment ideas and prefer to follow friends, colleagues, or other popular trends. They are exposed to regret and fear of missing out

on the latest investment fad as well as lacking long-term planning. Interestingly, they tend to overestimate their risk tolerance and jump into seemingly lucrative investments. The cognitive biases which relate more strongly to this investors type are recency, hindsight, regret aversion, framing, and cognitive dissonance. Those investors who are identified as **Independent** tend to enjoy being involved with the investment process by contributing with their own ideas and having an active role. Often, they display unconventional or "contrarian" ideas which jeopardize their ability to plan long-term goals, however many independents are capable to commit to their financial plan and successfully accomplish it with strong determination. They understand the risks involved with investing, but still struggle to admit their own mistakes. The behavioral biases Independents tend to be exposed to are cognitive conservatism, availability, confirmation, representativeness, and self-attribution. Lastly, those investors who are identified as **Accumulators** tend to be very confident in themselves, they enjoy having an active role in the decision-making process and are interested in accumulating large amounts of wealth. They are often risk takers who are willing to adapt and change their plans often according to market conditions. Accumulators often display an entrepreneurial attitude which may create conflict in the client-advisor relationship. The behavioral biases accumulators are more prone to are overconfidence, self-control, affinity, outcome, and illusion of control. (Pompian, 2018).

This review on personality theories is relevant because, although personality traits cannot specifically predict behavior, differences in personalities have been used in research to better understand financial behavior and decision making. In the next section, the findings of a few examples of personality theories applied to financial research are illustrated.

Bucciol and Zarri (2017) use more than 10,000 observations from the US Health and Retirement Study (HRS) to investigate the influence of personality traits on investors' portfolios. In their study they use the Big Five personality traits to which they add several unrelated personality characteristics like Cynical Hostility, Anxiety, and Anger. The authors felt the need to include these additional traits because they had received far less attention in research on economic outcomes. The personality scores are constructed on 47 raw variables on personality which are collected in the "participant lifestyle" section of the HRS survey. The authors conclude that "three personal traits, namely,

Agreeableness, Cynical Hostility and Anxiety, significantly shape portfolio choices" (p.8).

Brown and Taylor (2014) investigate the relationship between personality traits and financial decision-making on household finances. Their analysis utilizes data from the British Household Panel Survey (BHPS) which comprises approximately 10,000 annual individual interviews. They are able to exploit the Big Five personality traits because the survey includes an assessment tool of 15 questions. Brown and Taylor focus on specific aspects of household finances, such as unsecured debt and different types of financial assets. The authors conclude that "some personality traits are statistically significantly associated with the amount of unsecured debt and financial assets held by households" for instance "[…] extraversion is positively associated with the probability of holding credit card debt whilst conscientiousness is inversely associated with the probability of holding this type of debt" (p.211).

Conlin et al. (2015) base their research on a unique sample made of 3,000 observations coming from two datasets, the Northern Finland Birth Cohort 1966 (NFBC1996) and the Finnish Central Security Depository (FCSD). The goal of their research is to analyze the relationship between personality traits and stock market participation. The sample allows to gain insights on personalities through the NFBC1996 survey because this survey includes a measure of personality traits, namely the Temperament and Character Inventory (TCI) proposed by Cloninger et al. (1993). Even though this model has not been described in the previous section, there is a general correlation of the TCI traits with the Big Five traits and a comparison of the two models is provided by De Fruyt et al. (2000). Conlin et al. conclude that some of the trait scores are significant indicators of stock market participation. The authors show that "exploratory excitability, extravagance, harm avoidance, sentimentality, and persistence are consistently related to stock market participation" (p.46). Even though the traits in this research are not exactly translatable to the Big Five traits, the results on this study contribute to the literature of using personality to predict economic behavior.

Pinjisakikool (2017) uses 4,026 data from the 2005, 2009, and 2013 Dutch DNB Household Survey. He selects these waves specifically because they are the only ones containing complete measure of the Big Five personality. The goal of his research is to identify the determinants of financial risk tolerance. The author proves that on this data

set the Big Five personality traits are significant predictor of financial risk tolerance. Specifically, "extraversion and intellect are positively related [to financial risk tolerance], while agreeableness, conscientiousness, and emotional stability are negatively related to financial risk tolerance" (p.42). Moreover, Pinjisakikool's research focuses on financial behavior. The author uses three financial assets ratios to categorize households in low-, medium-, and high-risk domains. The ratios are savings ratio, bond and mutual fund ratio, an equity ratio. Interestingly, the Big Five personalities fail to work as significant predictors of financial behavior. Therefore, the author concludes that "the Big Five personality traits are statistically 'good' instrumental variables for financial risk tolerance, which in turn can predict bond, mutual fund and equity investing behavior' (p.49).

The four studies presented are a small example of the abundant literature which applies personality theory to finance research. Even though this practice may be considered to depart substantially from the assumptions behind the *homo economicus* described in Chapter One, research has proved that such psychological traits have explanatory power on financial risk tolerance, financial behavior, and decision making. To the extent of this research, the personality theory utilized is The Big-Five theory by McCrae and Costa (1992), as it has become the theory of choice in the majority of financial research thus not only offering abundant studies on the topic, but also contributing to the development of several assessment tools which are described in the following section. Moreover, Pinjisakikool's (2017) findings are pivotal as the study focuses both on financial risk tolerance and Big Five personality traits. The present study will use as hypothesis the same relationships the author tested in his study, namely: extraversion and intellect (openness to experience) positively affect financial risk tolerance, and agreeableness, conscientiousness, and emotional stability negatively affect financial risk tolerance.

The discussion continues by providing an overview on the methodologies to assess the Big Five personality traits.

2.3.2 Measuring Personality Types

As illustrated in the previous section, personality types are relevant in financial research as there is plentiful literature proving their significant explanatory power. Moreover, among several personality theories, the Big Five framework enjoys considerable support and has become the most widely used and extensively researched model of personality.

Several rating instruments have been developed over the years to measure the Big Five dimensions, in this chapter a brief overview is provided, and the instrument utilized in this research is briefly introduced.

Personalities traits are measured with questionnaires. Questions may ask to evaluate yourself, self-reports, or someone else's personality traits, peer ratings. The modality in which a questionnaire is administered may vary. As Gosling et al. (2003) explain in their overview of Big Five instruments, the most comprehensive instrument to evaluate the Big Five personality domains is the 240-item survey proposed by Costa and McCrae in 1992 called NEO Personality Inventory Revised (NEO-PI-R). This revised instrument allows not only to measure the five dimensions, but also to identify six specific components within each domain. The NEO-PI-R main drawback is its long-windedness. Naturally, the need for brevity led to numerous alternatives. Costa and McCrae themselves proposed in 1992 a shorter version of their instrument, the NEO Five-Factor Inventory (NEO-FFI) which comprises 60 items. Moreover, Goldberg produced a 100-item instrument which comprised 100 trait descriptive adjectives. A personality scale of 50 items derived from Goldberg's instrument is used, for example, in the DNB survey which Pinjisakikool (2017) refers to in his work. A breakthrough is represented by the 44-item Big-Five inventory (BFI) proposed by John & Srivastava in 1999. Their instrument comprises 44 characteristics and asks the respondent to evaluate whether each proposition is applicable to himself on a scale from one to five, where the options are 'disagree strongly', 'disagree a little', 'neither agree nor disagree', agree a little', and 'agree strongly'. The BFI successfully measures the Big Five in approximately 5 minutes, a huge improvement since the 240-items and 45 minutes log NEO-PI-R.

At the time, the BFI seemed quite radical and sufficiently brief. However, time has changed and as researchers are faced with limited assessment time, 44 items are simply too many. Many efforts have been invested into the creation of extremely short assessment instruments because of the expended possibilities they present, such as brevity, potential to be included in large-scale surveys, and use as pre-screening packets. The methodology to validate shorter assessment instruments usually involves comparing responses to the new scale to the results measured with an established questionnaire like the BFI or NEO-PI-R. The main aspects to keep into consideration are the validity and reliability if the new instrument. In extremely simplistic words, it measures what it says it does (validity) and produces the same results when given more than once (reliability).

Gosling et al. (2003) propose both a 5-item and a 10-item measures of the Big Five. It may seem impossible to create an instrument capable to retain the breadth of coverage of 240-item scale, as well as representing both poles of each dimension, and successfully avoiding items that are redundant negations; however, the authors succeed. Their 10-item instrument, the Ten Item personality Inventory (TIPI) excels in brevity, validity, and reliability. The questionnaire comprises ten items, each of which consists of two descriptors, separated by a comma. The instruction states, 'I see myself as:' and the respondent has to evaluate each of the ten items on a 7-point scale ranging from 'disagree strongly' to 'agree strongly'. The major drawback of such a short instrument is its inability to measure individual facets of the five major domains.

To the extent of this research, the instrument of choice is the TIPI because of its brevity which allows to include it in the survey with the other sections, namely demographics, risk tolerance, and financial literacy, without adding too many items to the survey. The exact wording of the TIPI is presented in Chapter Three.

2.4 Remarks

In Chapter II an extensive literature review is provided on the factors associated with risk tolerance. The main categories presented, which are used for the present study, are demographics, financial literacy, and investors' personality types. Moreover, not only the findings from existing literature are presented, but also a review on the measurement instruments for each factor. Ultimately, the instrument of choice to measure financial literacy is the Five-item questionnaire proposed by Lusardi, while for the personality types, the TIPI ten-item instrument is the methodology selected.

In the next chapter, the empirical section of the present study begins. First, the data collection procedure is explained in detail. Then, the 40-item questionnaire specifically designed for this study is introduced. Each section of the questionnaire is presented in detail to highlight the soundness of the instrument. Lastly, descriptive statistics of the samples are presented and discussed, followed by some relevant comparisons to national data.

Chapter III The development and testing of an instrument

The first two chapters of the present study laid the theoretical foundations for the empirical work which is presented hereafter. The extensive literature review which has been proposed in the previous chapters methodically introduces the concept of financial risk and financial risk tolerance. After explaining and providing examples of previous studies, objectively measured and subjectively perceived financial risk tolerance are introduced. Then, Chapter II reviews the existing literature contributions on the factors affecting financial risk tolerance and proposes validated scales to measure financial literacy and personality types.

This chapter serves as an introduction to the more statistically dense Chapter IV. To begin with, the data collection procedure is explained, and the choice to conduct the research on two samples – Italian and American – is motivated. Then the 40-item questionnaire is presented. Lastly, the descriptive statistics of the Italian and American samples are explained and discussed, to highlight the peculiarities and limitations of the samples used in this study.

3.1 Data Collection Procedure

After an extensive literature review, the 40-item questionnaire is prepared ad run on a small pilot study consisting of 10 people. The pilot study is conducted in English only. The feedback is overall positive, and minor changes are made. Subsequently, the questionnaire is translated in Italian and the data collection process is started. The Italian translation was not self-produced, it utilizes the exact wording proposed by CONSOB in their financial risk tolerance and financial literacy questionnaire. For other sections of the questionnaire, translated resources proposed by the authors of the scales are utilized and later discussed.

Through the use of Qualtrics.com anonymous links are created for each language, and the links are shared through social media (Facebook and Instagram) and private messaging (Texts, WhatsApp and Messenger). Private messaging involved contacting friends and family directly, they were all invited to share the anonymous link with their own contacts. The data collection through social media was conducted in two separate ways. A permanent link was accessible for both the Italian and American questionnaire in the private account (CERMELab, Facebook, and Instagram) of the researcher. This allowed a modest visibility, mostly because the people contacted via private messaging

and the social media followers were the same. Additionally, to increase visibility, some Instagram pages were contacted to share the link in their stories, these pages are run by social media influencers. An influencer is a person who has a huge social media audience and has the ability to persuade others to act based on his recommendations. Usually, an influencer establishes credibility in a specific industry or community, in this case all the influencers contacted are creators of content on personal finances or on FI/RE which stands for financial independence and early retirement. Only three account managers agreed to participate, free of compensation, to the research and posted the link to the questionnaire. The three participants influencers are all sensitive to financial education and run pages in which their personal stories and experiences are shared with others to increase financial awareness and discuss financial topics. Interestingly, this can be viewed as a self-selection bias in which the participants decide to cooperate because they feel virtuous and prepared on the topic. The pages which decided to cooperate are all American, therefore leaving out the collection of Italian questionnaires from this additional exposure. Altogether, the three influencers can count on a total exposure of about 200,000 followers. Links, both on social media and private messaging, are accessible starting from April 13th, 2021, and the survey is closed on May 17th, 2021. The Instagram influencers which participated in the research posted on April 17th a story (available to the followers for only 24 hours) which redirected to the same anonymous link used by everybody else.

The decision to survey both Americans and Italians is motivated by the main objective to drive a comparison between the two groups. The intention is to be able to collect data representative of the two populations and numerous enough to conduct a full analysis on both groups. By doing so this study not only aims to contribute to existing literature on the factors influencing investors risk tolerance and confidence, but it also aims to highlight cross-country differences between individual investors in Italy and the United States.

3.2 Data Collection Instrument

Data is collected through a questionnaire specifically designed for this study. The questionnaire is anonymous, and it consists of a total of 40 questions, most of the questions have mandatory response, except for those inquiring about income and net worth. The estimated time commitment required to finish the survey is 12 minutes. In the following sections the structure of the questionnaire is described in detail to highlight the soundness of the instrument. The full questionnaire can be found in the Appendix.

The questionnaire begins with Q1, a consent question which prompts the start of the survey. If the respondent agrees to partaking the questionnaire, the answers are collected starting with those on subjective financial risk tolerance.

3.2.1 Subjective Financial Risk Tolerance

After receiving consent to participate in the anonymous study, the following block of two questions is dedicated to subjective financial risk tolerance. Question two is based on the DNB instrument and is therefore composed of six questions: Q2_1 through Q2_6. As discussed in previous chapters, this instrument is often utilized in research and examples have been provided like Dohmen et al. (2017), Van Rooij, Lusardi, and Alessie (2007), and Pinjisakikool (2017). The exact wording of the questions for the English questionnaire can be found in the Appendix. In this question, the respondent is asked to evaluate herself on six risk dimensions including safety of investments, investments in stock, and preparedness to lose money. The instruction states, 'On a scale from 1 to 7…' and the respondent must evaluate each of the six items on a 7-point scale ranging from 'strongly agree' to 'strongly disagree'. As reported in Kapteyn & Teppa (2011), the overall measure of FRT is the sum of the answers, remembering that Q2_3, Q2_5, and Q2_6 have reverse scoring so that for all six statements a higher category on the scale is related to more willingness to take risks. According to Dohmen et al.'s (2017) research, this scale had a satisfactory Cronbach's alpha of 0.68; this is a measure of reliability (p.98) which will be explained and compared with the data from the sample in later sections.

The following question of this block is Q3 and it is the famous SCF one-item risk tolerance question. The SCF one-item has been discussed in detail in previous sections and it is found in numerous studies like Chang, DeVaney, and Chiremba(2004), Grable & Lytton (1999), Yao, Sharpe, and Wang (2011), Chang, DeVaney, & Chiremba (2004),

and Yao, Gutter, and Hanna (2005). This question concludes the block on subjective financial risk tolerance. For the Italian version of the questionnaire, the translated items were retrieved from the CONSOB website. Grable and Schumm (2007) analyze the Cronbach's alpha of this one item instrument and perform five tests in an effort to determine the reliability of the measure. "Their results suggest an estimated range of 0.07 to 0.78 with the probable reliability estimate range existing from 0.52 to 0.59" (Gilliam et al., 2010, p.41).

3.2.2 Financial Literacy

After inquiring about subjective risk tolerance, the following block is dedicated to financial literacy. The instrument of choice is the five-item questionnaire proposed by Lusardi. The exact wording of the questions can be found in the Appendix, questions Q4 thorough Q8. As discussed in previous sections this instrument is widely used in research and it investigates both basic as well as advanced topics of financial knowledge. The questions are in the form of multiple choice, with only one correct answer for item. A correct answer has a score of one, while all other options have a score of 0. The sum of all five items allows to represent the total financial literacy of the respondent. In their study, Abdul Rashid et al. (2020) calculate a Cronbach's alpha of 0.378 for the 5-item instrument. In another study, Rieger (2020) calculates a Cronbach's alpha of 0.434 for the 3-item instrument, which considers only the first three questions inquiring on basic financial knowledge. These values are useful for comparison with the sample from this study.

3.2.3 Objective Risk Tolerance

After inquiring about financial literacy, the following block is dedicated to objective financial risk tolerance. The instrument of choice is the Grable and Lytton (1999) 13-item questionnaire. The exact wording of the questions can be found in the Appendix: questions Q9 through Q22. The respondent must answer 13 multiple choice questions which investigate several areas of financial risk tolerance. As the authors explain, there are seven dimensions of risk assessed by each item: guaranteed vs. probable gambles, choice between sure loss and sure gain, risk as experience and knowledge, risk as a level of comfort, speculative risk, prospect theory, and investment risk. Each specific question can measure more than one risk dimension at the time. The questionnaire proposes a variety of multidimensional financial scenarios and situations. Initially, the authors proposed a 20-item assessment tool which included two questions to measure general

risk choice, they ultimately excluded such generic inquiries on risk because they "lacked sufficient loadings to support the internal consistency of the factors" (p.177). This finding is consistent with other research stating that domain-specific questions regarding finance are more accurate predictor of financial risk tolerance than generic questions on risk such as smoking and driving behaviors. The Grable and Lytton questionnaire has proved high degree of reliability and validity. Several studies have investigated the Cronbach's alpha of this scale, notably Kuzniak et al. (2015) provide an extensive analysis on a dataset of 160,279 respondents. The authors calculate a Cronbach's alpha of 0.77 (p.177).

The score on the 13-item instrument is calculated by the sum of the answers, based on a scoring scale provided by the authors. The representative measure of objective financial tolerance ranges from 13 to 47. The total sum reflects the individual's objective financial risk tolerance, the higher the score the higher, the risk tolerance. For the Italian version of the questionnaire, the translated items were retrieved from the CONSOB website.

The feedback received by the trial study participants suggested that this module of questions was source of distraction and lack of attention. In an effort to check for attention, a control question is added in the middle of the 13-item questionnaire. The question, Q18, begins as another inquiry on bonds and ends with the prompt to select a specific answer. Participants who answered with an answer different from the one suggested may have incurred in a lack of interest and attention.

3.2.4 Personality types

After inquiring about objective risk tolerance, the following block of questions is dedicated to personality types. The instrument of choice is the Ten Item personality Inventory (TIPI) proposed by Gosling et al. (2003), because of its brevity, validity, and reliability. The exact wording of the questions for the English questionnaire can be found in the Appendix at Q23. For the Italian questionnaire, the TIPI's translation provided by Chiorri et al. (2014) is used, as indicated by Gosling's directions.

In this section of the questionnaire the respondent is asked to evaluate herself on ten items, each of which consists of two descriptors, separated by a comma. The instruction states, 'I see myself as:' and the respondent must evaluate each of the ten items on a 7-point scale ranging from 'strongly agree' to 'strongly disagree'. As discussed in previous sections, the TIPI is an incredibly versatile measurement instrument of the Big Five Personality traits. Specifically, out of the ten questions, items one and six produce a

measure of Extraversion (E), items two and seven of Agreeableness (A), three and eight of Conscientiousness (C), items four and nine of Emotional Stability (ES), and items five and ten of Openness to Experience (OE). According to Gosling et al. (2003) calculations, "the Cronbach alphas were .68, .40, .50, .73, and .45 for the Extraversion, Agreeableness, Conscientiousness, Emotional Stability, and Openness to Experience scales respectively" (p. 516).

3.2.5 Demographics

After inquiring about personality types, the last block of questions is dedicated to demographics questions. The following information is recorded: year of birth, gender, race/ethnicity, education level, employment status, country and state of residence, marital status, presence of any dependent child, age of dependent child if any, income, and net worth. Additional questions investigate the household responsibilities of the respondent, information on how she gathers financial news, and other information on financial matters such as budgeting, paying off a mortgage, and unexpected income drop. The exact wording of the questions for the English questionnaire can be found in the Appendix starting at Q24.

3.3 Descriptive Statistics

After providing a detailed explanation of every question in the survey, it is possible to look at data while appreciating the soundness of the scales utilized. Over one month of data collection, a total of 500 respondents submitted the questionnaire. The sample is composed of 346 respondents for the American survey and 154 for the Italian one. Not all the respondents finished the questionnaire, in fact 153 respondents, corresponding to 30% of the total, did not complete the survey. The total of completed questionnaires equals to 347; of which 245 from American respondents and 102 form Italian ones. *Table 1* and *Table 2* provide a summary of the main descriptive statistics collected in this study.

Table 1
Descriptive Statistics - Percentages

Variable	American Sample (n= 245)			Italian Sample (n=102)		
	PERCENT	SE	n	PERCENT	SE	n
Male	33.47	3.01	82	48.00	5.00	48
Female	64.90	3.05	159	52.00	5.00	52
Other	1.63	0.81	4	0.00	0.00	0
White	66.53	3.01	163	100.00	0.00	102
Other	33.47	3.01	82	0.00	0.00	0
Marital Status						
Married	40.00	3.13	98	24.00	4.27	24
Single	41.63	3.15	102	49.00	5.00	49
Other	18.37		45	27.00		27
Education						
High school or less	2.86		7	64.28		36
Bachelor or some college degree	56.32		138	30.36	6.14	17
Graduate or professional degree	40.82	3.14	100	5.36	3.01	3
Employment Status						
Employed full-time	62.04	3.10	152	46.00	4.98	46
Employed Part-time	6.12	1.53	15	10.00	3.00	10
Student	8.16	1.75	20	9.00	2.86	9
Retired	6.12	1.53	15	6.00	2.37	6
Self-employed	7.76	1.71	19	10.00	3.00	10
Unemployed	6.12		15	10.00		10
Other	4.49		11	9.00		9
Control Question						
Correct	86.07	2.22	210	94.00	2.37	94
Incorrect	13.93	2.22	34	6.00	2.37	6

Noticeably, in the American sample, consisting of 245 observations, respondents are predominantly women; roughly two thirds of the respondents are women and only one third are men. Age ranges from 21 to 75 years old, the average year of birth is 1982.31 corresponding to 39 years old. The sample is predominantly white and quite evenly split among married and singles, 40% each, with 20% of remaining respondents falling in other marital status categories. The American sample represents a highly educated group in which only 2.86% of respondents has a high school degree or less. Regarding the employment status, 62.04% of respondents are employed full-time and 6.12% part-time

while students represent the 8.16% of the sample. For the American respondents, average scores on Financial Literacy, DNB six-item, SCF one-item, and Grable &Lytton 13-item are respectively 3.78, 23.77, 2.42, and 28.10. The most eye-catching score is the financial literacy one which is extremely high. The average personality traits are summarized in the Table, and they rank in descending order as follows: Conscientiousness, Openness to Experience, Agreeableness, Emotional Stability and lastly Extraversion.

On the other hand, the much smaller Italian sample consists of 102 observations. Respondents are quite evenly split among the two sexes, with 52% of female and 48% of male. Age ranges from 20 to 72 years old, the average year of birth is 1984.11 corresponding to 39 years old. The sample is 100% white and 49% of respondents are single. The married group accounts for 24%, while 27% of remaining respondents falls in other marital status categories. The Italian sample differs greatly from the American one when analyzing the education levels. 64.28 % of respondents in the Italian sample have a high school degree of lower level of education, 30.36% hold some type of college degree, and only 5.36% have a graduate or professional degree such as PhD or Masters. Regarding the employment status, 46% of respondents are employed full-time and 10% part-time while students represent the 9% of the sample. For the Italian respondents, average scores on Financial Literacy, DNB six-item, SCF one-item, and Grable &Lytton 13-item are respectively 2.75, 20.37, 2.46, and 26.46. The average personality traits are summarized in the Table, and they rank in descending order as follows: Conscientiousness, Emotional Stability, Openness to Experience, Agreeableness, and lastly Extraversion.

Lastly, in *Table 2* it is also possible to compare the percentages of correct and incorrect answers to the control question: respondents to the Italian questionnaire had a level of attention superior to the American sample.

Table 2
Descriptive Statistics - Means

Variable	American Sample (n= 245)			Italian Sample (n=102)		
	MEAN	SD	n	MEAN	SD	n
Age	1982.31	14.66	245	1984.11	12.70	100
Income	219,285.40	705,716.00	140	38,803.92	20,388.02	73
Financial Literacy	3.78	1.22	245	2.75	1.22	102
DNB	23.77	5.88	245	20.37	6.44	100
SCF	2.42	0.68	245	2.46	0.86	100
Grable Lytton	28.10	4.41	245	26.46	4.26	100
Household responsibilities	14.45	4.30	245	12.07	4.97	100
Extraversion	4.28	1.58	244	4.14	1.22	99
Agreeableness	4.66	1.16	244	5.15	1.12	97
Conscientiousness	5.46	1.10	245	5.36	1.02	97
Emotional Stability	4.54	1.28	245	4.64	1.25	98
Openness to Experience	5.15	1.05	245	4.56	1.01	97

3.4 Comments on Descriptive Statistics

The differences among the American and Italian samples come at no surprise. A multitude of studies have been conducted over the last few decades to cover the variations among countries on topics such as financial literacy, financial consumer behaviors, and demographics more in general. Organizations such as the World Bank, the Organization for Economic Co-operation and Development (OECD), and several national entities have invested resources to shed more light on relevant financial topics. To the extent of this research, resources produced by the OECD International Network on Financial Education (OECD/INFE) on their 2020 report and the Standard & Poor's Ratings Services Global Financial Literacy Survey on their 2015 report are utilized to compare the present study's findings on financial literacy to national data.

When considering financial literacy, the comparison is stark: An average score of 3.78 for the American sample, and of 2.75 for the Italian sample. As reported by Klapper, Lusardi, and Van Oudheusden (2015) in the Standard & Poor's report, a financially literate person is defined as having at least three correct answers in the five-item

Lusardi's questionnaire. According to the study, the world average is 33% while the European average is 52%. The authors report average adult financial literacy of 57% for the United States and 37% for Italy. In the present study, 86.5% of the American respondents answer correctly to at least three questions; for the Italian sample, the percentage drops to 59.8% of financially literate respondents. Both percentages in the present study are higher than the national averages, however, the ranking persists with the American sample being more financially literate than the Italian one.

Regarding education levels, the OECD (2020) report "Education at a Glance 2020" provides meaningful indicators. In the report, tertiary education refers to post-secondary education, namely bachelor's, master's, and doctorate or equivalent. According to the report, in Italy, 20% of adults between the age of 25 to 64 years old attained a tertiary education level. For the same age group, for the American population, the percentage is 49%. When comparing these national averages to the present study, differences arise. 97% of the American sample holds tertiary education, while for the Italian one the percentage is 36%. Also in this instance, percentages in the sample are higher than the available data on population, however the ranking persists with the Americans being more educated than the Italians.

Another interesting factor to consider is financial risk tolerance. Ferreira (2018) conducts an analysis in which she shows that there are significant differences in attitudes to financial risk across a selection of 15 countries. The author investigates several measures of financial risk perception and tolerance, among which she examines the average risk propensity and the percentage of individuals holding investment products by country. The United States are the country with the highest percentage of individuals owning shares, mutual funds, or bonds and whose risk propensity is the highest. Italy is ranked much lower. When looking at the present study's sample data, the American sample has higher average score for both the Grable & Lytton scale and the DNB one, however the Italian sample has a higher average SCF score. These measures will be investigated further in later sections.

At this point in the research, it is important to stress a few comments regarding the Italian and American samples. The American sample consists of 245 respondents while the Italian one consists only of 102. It is safe to assume that it will be easier to conduct statistical analysis on the larger sample. Moreover, as highlighted in previous paragraphs,

these samples appear to not be representative of both the American and Italian population. Especially for the American sample, the respondents are mostly female, highly educated, and extremely financially literate individuals. Nonetheless, it will be interesting to investigate the data and to compare findings to existing literature. Both issues, number of respondents and representativeness of the sample, could have been resolved through a better data collection procedure. By contacting friends and family via private messaging, many respondents ended up representing the same demographics. Even the social media exposure may have contributed to this self-selection bias since, presumably, those following the Instagram pages on personal finance may be also highly educated.

Chapter IV Empirical Results

In the previous chapter, after providing a detailed explanation of the 40-item instrument designed for the present study, descriptive statistics for the American and Italian samples were presented and commentated. As discussed, the two samples are different is size, the American is more than twice as large than the Italian one, and when comparing them to national statistics, they are not truly representative of the population they come from.

Nonetheless, the analysis proceeds methodically for both samples. In this chapter, first the distributions of the variables are analyzed and tested for normality. Then a four-quadrant analysis is proposed, then the study continues with an estimation of the following models on each sample, when possible: a regression model, a simple mediation model, and a moderated mediation model.

4.1 Normality Tests and Mann Whitney test

The American and Italian samples have peculiar characteristics that differ from each other. Before embarking upon the model estimation journey, it is good practice to take a closer look to all the variables, which are: Age, Education, Sex, Financial Literacy score, DNB score, SCF score, Grable & Lytton score, Extraversion, Openness to Experience, Conscientiousness, Emotional Stability, Agreeableness, and Home Responsibility score. The histograms of all the variables are graphed to check for outliers and the summary statistics are calculated (omitted).

Next, the normality of distributions of the main variables is investigated with the Shapiro-Wilk test for normality (STATA command `swilk`). The null hypothesis of this test is that the population is normally distributed. Thus, if the p value is less than the chosen alpha level, then the null hypothesis is rejected and there is evidence that the data tested are not normally distributed. The main variables investigated are: age, education, sex, Grable& Lytton Score, Financial Literacy Score, SCF score, and DNB score. The results of the Shapiro-Wilk test for normality are reported in *Table 3*.

Table 3
Shapiro-Wilk test for normality

Variable	American Sample (n= 245)				Italian Sample (n=102)			
	z	Prob>z	n	Normality	z	Prob>z	N	Normality
Age	7.853	0.0000	245	No	5.396	0.0000	100	No
Education	7.239	0.0000	245	No	4.051	0.00003	56	No
Sex	6.930	0.0000	245	No	-6.865	1.0000	100	Yes
Financial Literacy	14.589	0.0000	245	No	-2.900	0.99814	102	Yes
DNB	-1.766	0.96134	245	Yes	-0.287	0.61280	100	Yes
SCF	1.353	0.703	245	Yes	-2.930	0.99831	100	Yes
Grable Lytton	0.661	0.25438	245	Yes	0.571	0.28412	100	Yes

α=0.05

When comparing two independent samples, and when the outcome is not normally distributed and the samples are small, a nonparametric test is appropriate. A popular nonparametric test to compare outcomes between two independent groups is the Mann Whitney test (STATA command `ranksum`). This test is used to check whether two samples are likely to derive from the same population, or not. The null hypothesis of this test is that the two independent samples are drawn from the same population. Thus, if the *p* value is less than the chosen alpha level, then the null hypothesis is rejected and there is evidence that the data tested are not from the same population. The investigated variables are age, education, sex, Grable& Lytton Score, Financial Literacy Score, SCF score, and DNB score. The results of the Mann Whitney test are reported in *Table 4*.

Table 4
Mann Whitney test

Variable	Mann Whitney test				
	N American	N Italian	z	Prob>z	Same Population
Age	245	100	-0.857	0.3913	Yes
Education	245	56	8.339	0.0000	No
Sex	245	100	2.646	0.0081	No
Financial Literacy	245	102	7.331	0.0000	No
DNB	245	100	4.291	0.0000	No
SCF	245	100	-0.751	0.4529	Yes
Grable Lytton	245	100	3.238	0.0012	No

α=0.05

Interestingly, even though DNB, SCF, and Grable Lytton are normally distributed both for the American and Italian sample, the Mann Whitney test is significant only for the SCF. As addressed in earlier sections, the American sample is more numerous than the Italian one. Merging both groups in a single population to analyze is not only theoretically inconsistent with the goal of this study to highlight differences between the investors from the two countries, but as seen with the Mann Whitney test, statistically incorrect. Ultimately, after considering all the results, the test confirms that the two samples are not drawn from the same population. For these reasons, the analysis on the data proceeds keeping the American and Italian samples separate in all the following analysis.

4.2 Reliability

To begin with, reliability checking of instruments is conducted. The validated scales used in this research project and widely discussed in previous sections are analyzed by sample in *Table 5*. Cronbach's alpha is a measure of internal consistency, that is, how closely related a set of items are as a group. It is used as a measure of scale reliability. Cronbach's alpha can be written as a function of the number of test items and the average inter-correlation among the items. The alphas are calculated (STATA command `alpha`) and compared to existing literature results. The American sample appears to provide more satisfactory data; the numbers in bold represent alphas higher than the values found in existing literature.

Table 5
Cronbach's alpha

Scale	Number of items	Cronbach's alpha American Sample	Cronbach's alpha Italian Sample	Cronbach's alpha Existing Literature
Financial Literacy	5	**0.6320**	**0.4332**	0.34
DNB	6	**0.6860**	**0.7672**	0.68
Grable Lytton	13	0.6442	0.6001	0.77
Extraversion	2	**0.7527**	0.5619	0.68
Openness to Experience	2	0.3753	0.3381	0.45
Agreeableness	2	**0.4036**	0.2500	0.40
Conscientiousness	2	**0.5720**	**0.5144**	0.50
Emotional Stability	2	0.6189	0.4777	0.73

Even though some of the Cronbach's alpha values in the table may seem low, they are considered satisfactory after comparing them with existing literature. Low-to-moderate alphas are a common finding when using short measures. As Gosling et al. (2003) and Nunes et al. (2018) explain, multi-item scales can increase the Cronbach's alpha by boosting the number of items inquiring about the same content. Short scales do not have this luxury, especially when considering the TIPI questionnaire with only two items for each personality trait, it is more important to collect information on temporal stability and convergence with longer measures in order to properly assess reliability rather than judging solely on the Cronbach's alpha values. This is the price to pay for brevity.

4.3 Correlation Analysis

To determine the relationship among all variables a correlation analysis is conducted. The correlation results are shown in *Table 6* and *Table 7* (STATA command `pwcorr`). For the American sample, the results show that there is a significant moderate positive association between the DNB and the Grable & Lytton Scale (β=0.5791). The relationship between SCF and Grable & Lytton is also moderately positive (β=0.5587), but less strong than the previous one. Interestingly, the DNB scale and SCF scale, which in the present study are meant to measure the same trait of subjective financial risk tolerance, have only a moderate positive correlation of β=0.5472. Moreover, the correlation between Financial Literacy and Financial risk tolerance measured with the Grable & Lytton scale is positive but weak (β=0.3684).

Table 6
Correlation Analysis – American sample

American	DNB	SCF	G. & L.	FL	E	OE	A	C	ES
DNB	1.0000								
SCF	**0.5472***	1.0000							
G. & L.	**0.5791***	**0.5587***	1.0000						
FL	0.3526*	0.2198*	**0.3684***	1.0000					
E	0.0956	0.0681	0.0687	-0.0350	1.0000				
OE	0.0106	0.0761	0.0894	-0.0979	0.2427*	1.0000			
A	-0.2133*	-0.2004*	-0.1265	-0.0530	0.0073	0.1836*	1.0000		
C	0.0271	-0.0138	0.0595	0.0822	-0.0640	-0.0850	0.1081	1.0000	
ES	0.1403	0.0580	0.1752*	0.1043	0.0830	0.1348	0.1246	0.1858*	1.0000

p<.025*

For the Italian sample, the overall results are similar to the American sample. The Grable & Lytton has a stronger relationship with the DNB ($\beta=0.5246$) than the SCF ($\beta=0.4836$). Both values show that there is a moderate positive association. Also in the Italian sample, the DNB scale and SCF scale have only a moderate positive correlation of $\beta=0.5467$. Moreover, the correlation between Financial Literacy and Financial risk tolerance measured with the Grable & Lytton is positive but weak ($\beta=0.1967$), much weaker than in the American sample.

Table 7
Correlation Analysis – Italian sample

Italian	DNB	SCF	G. & L.	FL	E	OE	A	C	ES
DNB	1.0000								
SCF	**0.5467***	1.0000							
G. & L.	**0.5246***	**0.4836***	1.0000						
FL	0.2307*	0.2230	**0.1967**	1.0000					
E	0.0848	-0.0899	0.1630	0.1228	1.0000				
OE	0.1484	0.1431	0.1107	-0.0012	0.3049*	1.0000			
A	0.0879	0.0685	0.2125	0.1028	-0.0807	0.1423	1.0000		
C	0.0899	0.1316	0.3336*	0.0815	0.0999	-0.0038	0.2957*	1.0000	
ES	0.0261	0.0963	0.2763*	0.0723	0.1585	-0.0114	0.2063	0.1250	1.0000

$p<.025*$

As Kuzniak et al. (2015) report in their study, the relationship between the SCF and Grable & Lytton has long been investigated. Grable and Lytton (1999) reported in their first study that the two scales were found to be positively correlated with a coefficient $\beta=0.54$. Later studies from Grable and Schumm (2010) reported a statistically significant correlation of $\beta=0.60$. The correlation calculated for the American sample falls within the range found in existing literature. The same is not true for the Italian sample.

Gilliam et al. (2010) in their study compare the two empirical measures, SCF and Grable & Lytton, and conclude that the 13-item scale has greater explanatory power. When calculating the correlation between SCF and the Grable & Lytton scale, they find the same significant positive correlation of 0.60 found in the Grable and Schumm (2010) paper. Gilliam's study investigates further this relationship between the two very popular scales. First the authors analyze the correlation between the SCF and every single item in the Grable & Lytton instrument. They find that the question with the highest correlation to the SCF is Item 12, with a significant correlation of 0.61. Item 12 is an

investment inquiry; it asks the respondent to pick among three possible allocations for a $20,000 investment. Then, the authors divide the Grable & Lytton instrument in three components: investment risk tolerance (item 4,5,8,11,12), financial risk tolerance (item 1,3,6,7,13), and speculative risk tolerance (item 2,9,10). Once again, they investigate the correlations between SCF and the three sub-instruments of the Grable & Lytton. The results prove that the highest and most significant correlation exists between the SCF and the investment component of the Grable & Lytton questionnaire, with a positive significant correlation of 0.62. When conducting the same type of investigation on correlations in the American sample of the present study the highest correlation is the one found between SCF and the investment risk tolerance component of the Grable & Lytton; the correlation is positive and significant of 0.4660. The financial risk tolerance component follows with 0.4594, and lastly speculative risk tolerance component trails with 0.2574 (*Table 8)*. The Italian sample does not support the work of Gilliam et al. because SCF correlates most with the financial risk tolerance component. Gilliam et al. therefore confirm the hypothesis initially proposed by Grable and Lytton themselves in 2001, in which they suggested that the moderate correlation between SCF and their scale was mostly explained by the fact that SCF is "a proxy for the more narrow aspect of investment risk tolerance within the broader concept of financial risk tolerance " (Gilliam et al., 2010 p. 41).

As mentioned in previous sections, both the DNB six-item and the SCF one-item instruments are used in the present study to measure subjectively perceived financial risk tolerance. The Grable & Lytton 13-item is used to objectively measure financial risk tolerance. In conclusion, after previous investigations, the correlation between SCF and Grable & Lytton (significant positive correlations of 0.5587 for the American and 0.4836 for the Italian) represents the relationship between subjectively perceived *investment* risk tolerance and the broader aspect of financial risk tolerance objectively measured.

Next, it is important to investigate the correlation between DNB and Grable & Lytton. As illustrated in previous sections, the relationship between the Grable & Lytton scale and the DNB instrument is stronger than with the SCF. The nature of the questions on the DNB six-item questionnaire is mostly focused on investment. By adopting the Gilliam et al. (2010) method, the correlations between the DNB and the three components of the Grable & Lytton instrument are investigated. Results are shown in *Table 8*. According to the results, DNB is more correlated than SCF with the investment risk

tolerance component of the Grable & Lytton. In conclusion, for this reason and because of the overall higher correlation with the Grabel & Lytton instrument, the DNB scale is the preferred scale to measure *subjectively perceived investment risk tolerance*.

Table 8
Correlation Analysis – DNB vs. SCF

	American Sample		Italian Sample		Gilliam et al. (2010) study
	DNB	SCF	DNB	SCF	SCF
Investment risk tolerance component of G&L	0.5711*	0.4660*	0.4021*	0.3520*	0.62
Financial risk tolerance component of G&L	0.3979*	0.4594*	0.4914*	0.4411*	0.48
Speculative risk tolerance component of G&L	0.2440*	0.2574*	0.2369*	0.2512*	0.22
Grable & Lytton	0.5791*	0.5587*	0.5246*	0.4836*	0.60

p<.001*

Lastly, it is interesting to look at the correlations among personality traits and financial risk tolerance. In *Figure 4,* the findings from Pinjisakikool's (2017) study on the influence of personality traits on households' financial risk tolerance are summarized. When looking at the American sample, only three correlations are significant. Agreeableness has a significant negative correlation with the DNB measure of risk tolerance of -0.213 and the same personality trait has a significant negative correlation with the SCF measure of -0.2004. This finding on Agreeableness is consistent with Pinjisakikool's study. On the other hand, some correlations are in contrast with the study's findings. Emotional Stability has a significant positive correlation with Grable & Lytton measure of financial risk tolerance, both for the Italian and American samples, and Conscientiousness has a significant positive correlation with Grable & Lytton for the Italian sample only.
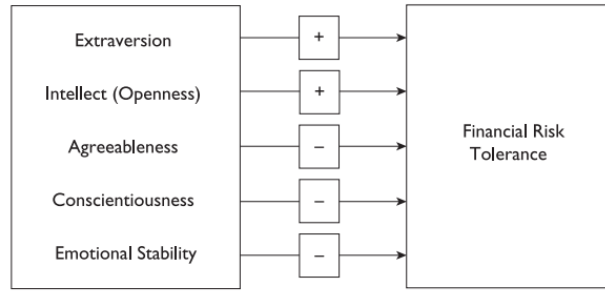
Figure 4 *– Impact of the Big Five on Financial Risk Tolerance. (Pinjisakikool, 2017)*

4.4 Four Quadrant Analysis

After having identified DNB as a measure for *subjectively perceived investment risk tolerance*, and the Grable and Lytton scale for *objectively measured financial risk tolerance*; the analysis of the present study proceeds with a four-quadrant analysis as developed by Allgood & Walstad (2013) and Asaad (2015).

Allgood and Walstad (2013) in their cross-sectional analysis by age on financial literacy and credit card behavior specify a model on four different groups. The four groups are based on two levels of *perceived* financial literacy, high and low, and on two levels of *actual* financial literacy, high and low. High and low represent values above and below the mean of the respective variable. The data is then divided into: high perceived financial literacy and high actual financial literacy, high perceived financial literacy and low actual financial literacy, low perceived financial literacy and high actual financial literacy, and low perceived financial literacy and low actual financial literacy. The authors explain how these combined variables show considerable differences across the age groups.

Asaad (2015) in her study on "Financial literacy and financial behavior: Assessing knowledge and confidence" creates a composite knowledge measure based on two variables: knowledge and confidence. Knowledge above average is categorized as high, and below average as low. The same procedure is applied to the confidence measure. Then, four additional variable groups are created: knowledge high and confidence high, knowledge high and confidence low, knowledge low and confidence high, and knowledge low and confidence low. The author also labels the knowledge low and confidence high as overconfident.

In the present study, following the same methodology, subjectively perceived investment risk tolerance and objectively measured financial risk tolerance are used to create a

composite measure. As previously discussed, DNB six-item instrument and Grable & Lytton 13-item instrument are used to assess investment and financial risk tolerance, respectively. The means of the variables are calculated, and the four groups are labeled as: overconfident investor, hesitant investor, realistic high-risk investor, realistic low-risk investor. *Table 9* gives visual representation of this grouping process.

Table 9
Four Quadrant analysis - labeling

		Subjectively perceived investment risk tolerance	
		LOW DNB	HIGH DNB
Objectively measured financial risk tolerance	**LOW G&L**	Realistic low-risk investor (low G&L - low DNB)	Overconfident investor (low G&L - high DNB)
	HIGH G&L	Hesitant investor (high G&L - low DNB)	Realistic high-risk investor (high G&L - high DNB)

The four-quadrant analysis is performed first on the American sample. As shown in *Table 10*, the American sample is composed of 34.29% realistic low-risk investors, 20% overconfident investors, 13.47% hesitant investors, and 32.24% realistic high-risk investors. Next, it is interesting to take at look at the differences in gender among the four groups. Recalling that the American sample is composed only for one third of men, it is striking that even in this highly educated sample the highest percentage of males is found in the Overconfident investors. This finding is coherent with the literature review proposed in Chapter II covering how males are more risk tolerant tan women as well as more overconfident. Next, the most financially literate group is represented by the realistic high-risk investors. This finding makes sense because it highlights the importance of financial literacy whether it was gained through education or and experience. This finding agrees with the findings highlighted in the literature review in Chapter II. On the other hand, the age factor seems to disagree with existing literature; the oldest group of investors is the realistic high-risk group, while it is usually believed that younger investors have a higher risk tolerance.

Next, the five personality traits are summarized and discussed. As reported in Pinjisakikool's (2017) study and several others, extraversion (E) and openness to experience (OE) positively affect financial risk tolerance, while agreeableness (A), conscientiousness (C) , and emotional stability (ES) affect it negatively. In the American

sample there is low compliance with this set of assumptions; The measure of Extraversion is the highest for overconfident investors, agreeableness is the highest among realistic low-risk investors, and emotional stability is the highest among hesitant investors. However, the traits of Openness to Experience and conscientiousness assume the highest values for investors group which oppose to previous research.

Table 10
Four Quadrant analysis – American sample

American	Realistic Low-Risk		Overconfident		Hesitant		Realistic High-Risk	
Total 245	N=84	(34.29%)	N=49	(20.0%)	N=33	(13.47%)	N=79	(32.24%)
	Male	23.84%	Male	**42.86%**	Male	27.27%	Male	40.51%
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Age	1982.12	15.94	1982.96	14.10	1985.46	14.82	**1980.81**	13.50
FL	3.1786	1.3457	3.8980	1.1226	3.8181	1.1580	**4.3164**	0.8249
E	4.2410	1.5799	**4.4082**	1.4240	4.3181	1.4459	4.2215	1.7627
A	**4.8614**	0.9948	4.6531	1.1824	4.6818	1.0519	4.4367	1.3189
C	5.4048	1.2284	5.2347	1.1506	5.5757	1.1396	**5.6139**	1.2977
ES	4.2321	1.2060	4.5408	1.4536	**4.8939**	1.0365	4.7215	1.0000
OE	5.0655	1.1107	5.1633	0.8743	**5.3484**	0. 9959	5.1582	1.1195

Next, the four-quadrant analysis is performed first on the Italian sample. As shown in *Table 11*, the Italian sample is composed of 38% realistic low-risk investors, 15% overconfident investors, 11% hesitant investors, and 36% realistic high-risk investors. There are gender differences among the four groups; the highest percentage of males is found in the Realistic high-risk investors while the highest percentage of female in found in the realistic low-risk investors group. These findings are coherent with the literature supporting that males are more risk tolerant thyan women. Similarly to the American sample, the most financially literate group is represented by the realistic high-risk investors which is consistent with existing literature. Moreover, the age factor seems to agree with existing literature; the youngest group of investors is the realistic high-risk group, while the oldest one represents the realistic low-risk investment risk tolerance.

The five personality traits behave almost exactly according to literature. As reported in the table, in the Italian sample the measure of Extraversion and Openness to Experience are the highest for realistic high-risk investors, while agreeableness and

conscientiousness are among hesitant investors. Only the traits of Emotional Stability does not reflect literature results, with the highest value for investors group with realistic high-risk tolerance.

Table 11
Four Quadrant analysis – American sample

Italian	Realistic Low-Risk		Overconfident		Hesitant		Realistic High-Risk	
Total 100	N=38	(38.0%)	N=15	(15.0%)	N=11	(11.0%)	N=36	(36.0%)
	Male	36.84%	Male	46.67%	Male	45.45%	Male	**61.11%**
	Mean	SD	**Mean**	SD	**Mean**	SD	**Mean**	SD
Age	**1982.12**	15.94	1985.47	10.83	1985.43	11.21	1987.39	11.90
FL	2.5789	1.2221	2.6666	1.3452	2.6364	0.9244	**2.9736**	1.2624
E	4.0945	1.0263	3.6333	1.3557	3.6363	1.0269	**4.5555**	1.3026
A	4.9729	0.9926	4.9666	1.1412	**5.5454**	1.1281	5.3088	1.2248
C	5.2027	1.0169	5.2333	1.0153	**5.7272**	1.0090	5.4558	1.0325
ES	4.4189	1.3411	4.5000	1.1649	4.8181	1.4012	**4.8857**	1.1251
OE	4.4864	0.9536	4.1000	0.8062	4.4090	1.0681	**4.8970**	1.0855

In light on the comments made in previous sections on the non-representativeness of the American and Italian samples it is remarkable how such a simple composite variable four-quadrant analysis can highlight an abundance of trends which are confirmed by previous studies.

The analysis of the data proceeds with a more conservative estimation process, a multiple linear regression analysis.

4.5 Regression Analysis

Before trying to imagine complex relationships among the variables, a multiple linear regression analysis is conducted. This procedure is applied to both the American and Italian samples separately. The **American** sample is analyzed first.

The first step for this model estimation is identifying a dependent variable. In this study the **dependent variable** is the subjectively perceived investment risk tolerance of the respondents. As explained in earlier sections, the scale utilized to measure it is the DNB six-item score. The **independent variables** considered for the specification of an initial general model are Grable & Lytton, Financial Literacy, Age, SCF, Extraversion, Agreeableness, Conscientiousness, Emotional Stability, Openness to Experience,

Education, Home Responsibility, Sex, and Income. As explained in previous sections, all these variables have been found to influence individuals financial risk tolerance in existing literature. Sex is a categorical independent variable, for this reason a dummy variable is created for female (SEX=2).

Since there are no assumptions in any linear model about the distribution of the independent variables, a simple graphical analysis is conducted on the independent variables checking for outliers. The results of the general model estimation are illustrated in *Table12 (*`regress` command in STATA). Noticeably, many variables are not statistically significant. One by one, the not statistically significant variables are eliminated from the regression. At each step, the Akaike's information criterion and the Bayesian information criterion are computed (`estat ic`) as well as the Shapiro–Wilk test for normality on the residuals (`predict e, residual` then `swilk e`). The final regression model is described in *Table13.*

Table 12 - *American Sample: Initial Regression Model*

American Sample – Initial General Model			
Number of obs.	140	R-squared	0.4866
F(13, 126)	9.19	Adj R-squared	0.4336
Prob>F	0.0000		

DNB	Coefficient	Std. err.	t	P>|t|
G&L	0. 4725618	0.1200428	3.94	0.000
FL	1.07627	0. 4037479	2.67	0. 009
AGE	-0. 0005319	0. 0301823	-0. 02	0. 986
SCF	1.58842	0. 7065409	2.25	0.026
E	0. 5601682	0. 2426748	2. 31	0. 023
A	-0. 2225361	0. 3702014	-0. 60	0. 549
C	0. 0162492	0. 381505	0.04	0.966
ES	0. 2690376	0. 2968251	0. 91	0.366
OE	-0. 2340428	0. 3720599	-0.63	0.530
EDUCATION	0. 5755485	0. 3867152	1.49	0.139
RESPONSIBILITY	0. 115212	0. 0911238	1.26	0.208
INCOME	-3.67e-07	5.51e-07	-0.66	0.507
FEMALE	-0.8682907	0.8520352	-1.02	0.310
Constant	2.369758	0.0951245	24.91	0.000

Residuals	Shapiro-Wilk test for normality		
Variable	Obs.	Z	Prob>z
e	140	-0.587	0. 72156

Table 13 - American Sample: Final Regression Model

American Sample – Final Regression Model					
Number of obs.	245		R-squared	0.4584	
F(5,239)	40.46		Adj R-squared	0.4471	
Prob>F	0.0000				
DNB	**Coefficient**	**Std. err.**	**t**	**P>|t|**	**Beta**
G&L	0.4551228	0.0804992	5.65	0.000	0.3408712
FL	0.5943341	0.2525826	2.35	0.019	0.1228059
SCF	2.616531	0.5078241	5.15	0.000	0.3008792
EDUCATION	0.6257139	0.2756624	2.27	0.024	0.1121236
FEMALE	-1.960102	0.6142756	-3.19	0.002	-0.1593261
Constant	0.4816554	2.249451	0.21	0.831	
Residuals	Shapiro-Wilk test for normality				
Variable	Obs.	Z	Prob>z		
e	245	1.100	0.13559		

Looking at the final estimation of the multiple regression model it is important to notice that the sample size increased from 140 to 245 observations, this is due to the variable Income which is included in the general model and excluded from the final one. As explained in earlier sections, the question on income did not require a mandatory answer.

In the comparison between the general model and the final one it can be seen that the coefficient R^2 decreases from R^2=0.4866 in the general model to R^2=0.4584 in the final one. While the coefficient $\bar{R}^2$ increments from $\bar{R}^2$= 0.4336 in the general model to $\bar{R}^2$= 0.4471 in the final model. This is a clear indication that irrelevant regressors have been eliminated from the model for the explanation of the dependent variable. These values of R^2 and $\bar{R}^2$ let assume that there may be other explanatory variables to improve the overall efficacy of the regression model.

When looking at the final model, the Shapiro–Wilk test for normality on the residuals has a p=0.13559, the *p* value is greater than the alpha level 0.05, therefore the null hypothesis is rejected and there is evidence that the residuals are not normally distributed. It is worth mentioning that the normality of residuals is only required for valid hypothesis testing, meaning that, the normality assumption ensures that the p-values for the t-tests and F-test will be valid. Normality is not necessary to attain unbiased

estimates of the regression coefficients. OLS regression simply necessitates that the residuals be identically and independently distributed.

Before commenting the results of the regression, a few additional tests are run to check on multicollinearity and linearity of the relationships in the system. As discussed in previous chapters, Grable & Lytton and the SCF measure similar characteristics of risk tolerance, although not the same ones; moreover, the two measures show high significant correlation with each other (see *Table6).* When two or more independent variables in a multiple regression model have high intercorrelations the phenomenon is called multicollinearity. Multicollinearity can lead to misleading regression results. In STATA, the `vif` command allows to calculate the variance inflation factor. If the VIF is greater than 10 or the tolerance (1/VIF) is lower than 0.1 the incriminated variable may be considered as a linear combination of other independent variables. After running the command on Grable & Lytton, Financial Literacy, SCF, Education and Sex=female the results are satisfactory, and multicollinearity is excluded.

The assumption of linearity is at the basis of multiple linear regression as well as a necessary condition for the mediation model and moderated mediation model which will be presented in later sections. If the assumption is violated, the regression results will be misleading. In STATA, the `scatter` command allows to plot the standardized residuals against each of the predictor variables which are used in the regression model. The results are satisfactory (graphs omitted), in none of the scatter plots signs of nonlinearity are detectable, such as a big wave-shaped curve. The assumption of linearity is deemed not to be violated.

Finally, after noticing that in the final model all the independent variables are significant with *p*<0.025 and after having analyzed the residuals, it is possible to draw some comments on the model. The independent variables that explain subjectively perceived investment risk tolerance are Grable & Lytton, Financial Literacy, SCF, Education and Sex (female). In the last column of *Table13,* the values corresponding to beta refer to the standardized beta coefficients which are the regression coefficients obtained by first standardizing all variables to have a mean of 0 and a standard deviation of 1. The larger beta is the one for Grable & Lytton, beta=0.3409; this finding suggests that the larger contribution to subjectively perceived investment risk tolerance is made by objectively measured financial risk tolerance. Follows the SCF score with a beta of 0.3008792.

Interestingly in third position is the dummy variable Sex=female with negative beta=0.1593261. This finding is consistent with the literature review on gender done in Chapter II in which it was explained that there is high consensus in literature that males are more risk tolerant than women. Lastly, both Financial Literacy and Education enter the model highlighting how they both influence the individual's self-perception.

Next, the same exact procedure for model estimation is applied to the **Italian** sample.

Exactly as for the American sample, the analysis for the linear regression on the Italian sample begins with setting the DNB as the **dependent variable** which measures the subjectively perceived investment risk tolerance of the respondents. As done above, the **independent variables** are Grable & Lytton, Financial Literacy, Age, SCF, Extraversion, Agreeableness, Conscientiousness, Emotional Stability, Openness to Experience, Education, Home Responsibility, Sex (female), and Income. A simple graphical analysis is conducted on the independent variables checking for outliers. Then a general model is estimated with all the independent variables (table omitted). Similarly to the American sample, also in the Italian initial general model several variables are not statistically significant. One by one, the not statistically significant variables are eliminated from the regression. At each step, the Akaike's information criterion, the Bayesian information criterion, and the Shapiro–Wilk test for normality on the residuals are computed. The final regression model is described in *Table14*.

Looking at the final estimation of the multiple regression model it is important to notice that the sample size consists of 71 observations, this is even smaller than the total of 102 respondents to the Italian questionnaire, this is due to the inclusion of the variable Income in the final model.

In the comparison between the general model and the final one it is worth mentioning that the coefficient R^2 decreases from R^2=0.5736 in the general model to R^2=0.5112 in the final one. While the coefficient $\bar{R}^2$ increments from $\bar{R}^2$= 0.3519 in the general model to $\bar{R}^2$= 0.4816 in the final model. This is a clear indication that irrelevant regressors have been eliminated from the model for the explanation of the dependent variable. These values of R^2 and $\bar{R}^2$ let assume that there may be other explanatory variables to improve the model.

Table 14 - Italian Sample: Final Regression Model

Italian Sample - Final Regression Model

Number of obs.	71		R-squared	0.5112	
F(4,66)	17.26		Adj R-squared	0.4816	
Prob>F	0.0000				

DNB	**Coefficient**	**Std. err.**	**t**	**P>|t|**	**Beta**
G&L	0.8142219	0.1589863	5.12	0.000	0.5305359
SCF	1.490512	0.7463067	2.00	0.050	0.2047268
ES	-0.802946	0.4567178	-1.76	0.083	-0.1601769
INCOME	0.0000715	0.0000293	2.44	0.017	0.2218276
Constant	-4.174513	3.706966	-1.13	0.264	

Residuals	Shapiro-Wilk test for normality			
Variable	Obs.	Z	Prob>z	
e	71	0.197	0.42182	

When looking at final model, the Shapiro–Wilk test for normality on the residuals has a $p=0.42182$, therefore the null hypothesis is rejected at the 95% value and there is evidence that the residuals are not normally distributed.

Multicollinearity and linearity of the relationships are checked also in this sample. The VIF is computed on the final regression model and the results are satisfactory, therefore multicollinearity is excluded. Next, with the `scatter` command, the standardized residuals are plotted against each of the predictor variables which are used in the regression model. The graphical results are satisfactory, and the assumption of linearity is believed not to be violated.

Finally, after noticing that in the final model all the independent variables are significant with *p*<0.10 and after having analyzed the residuals, it is possible to draw some comments on the model. First, the threshold for the *p-value* is much higher than the one considered for the American model; this choice was made in order to avoid having a too concise model. The independent variables that explain subjectively perceived investment risk tolerance for the Italian sample are Grable & Lytton, SCF, Emotional Stability and Income. Some of these were found as explanatory variables also for the much larger American sample. In the last column of *Table14,* the values corresponding to the

standardized beta coefficients show that the Grable & Litton score with a beta=0.5305 is the variable influencing subjectively perceived investment risk tolerance the most. In second place, with a beta=0.2218 comes the variable Income. Then SCF followed by Emotional Stability. This personality trait has a negative coefficient, which is in agreement with the findings from Pinjisakikool's (2017) study.

After having presented two multiple linear regression models, one for the American sample and one for the Italian one it is in the interest of this present study to draw a **comparison**. Before starting the comparison, it is important to be reminded that these two samples are not representative of the American and Italian population, nevertheless it is interesting that even in such small samples some findings are consistent with existing literature. Focusing on the similarities, both models have relatively low values of R^2 and $\bar{R}^2$, therefore suggesting that other variables not included in the present study may have explanatory power, or a different model specification may be useful. More interestingly, both models include the Grable & Lytton score as the variable with the highest standardized beta coefficient; this finding is crucial because, as suspected, the subjectively perceived investment risk tolerance is affected by the objectively measured financial risk tolerance proving that without knowledge, the individual is oblivious of her risk tolerance level. The other explanatory factor which appears in both regressions is the SCF. Not surprisingly, this is another objective measure of financial risk tolerance therefore it makes sense that, just like the Grable & Lytton, it affects the perceived measure of risk tolerance.

Looking at the differences, for the American sample Education and Financial Literacy enter the model, while for the Italian one Income does. Recalling that the American sample is extremely highly educated compared to the Italian one, these models seem to suggest that when awareness of financial risk tolerance is not taught or learned from someone, it is acquired with experience, meaning that those with a higher income are probably faced with more financial decisions therefore they are more aware of their investment risk tolerance.

As briefly addressed before, each model presents an explanatory variable with a negative coefficient. For the American sample, the female dummy variable has a negative standardized beta coefficient of beta=-0.1593261. The fact that female investors are more risk adverse than men is widely supported in existing literature, however this coefficient

should be discussed further. The dependent variable the regression model tries to explain is subjectively perceived investor risk tolerance, which describes both risk tolerance and self-perception or self-awareness. It is possible that female investors are not only less risk tolerant but also less confident, or less aware, of their tolerance levels than their male counterpart. Moreover, the American sample is predominantly composed of female respondents, two thirds, which raises the problem that maybe this dummy is intercepting other latent factors which are common to the respondents. A great example of this phenomenon is provided in Montford and Goldsmith's (2016) study investigating how gender and financial self-efficacy influence investment risk taking. As explained in their study, financial self-efficacy refers to an individual's " belief about their capability of organizing and executing courses of action to achieve a goal" (p.102). Self-efficacy has great influence on several financial related contexts. The authors conclude that when both gender and financial self-efficacy are examined simultaneously, the gender difference almost vanishes.

For the Italian sample, the independent variable with a negative standardized beta coefficient is Emotional Stability with a beta=-0.1601769. As Pinjisakikool's (2017) reports in his study, emotional stability as a negative effect on financial risk tolerance therefore it is interesting to see a personality trait enter the regression and even more so with a coefficient which reflects existing literature results.

In this section two multiple linear regression models where proposed, one for the American and one for the Italian sample. Results are summarized in *Table 13* and *Table 14* and similarities and differences are described in detail. At this point in the research, because of the abundance of variables which did not enter the final linear regression model specification and because of the moderate R^2 and $\bar{R}^2$ achieved, the specification of a simple mediation model is attempted and discussed in the next section.

4.6 Simple Mediation Analysis

Preacher, Rucker, and Hayes (2007) describe mediation analysis as the examination of a process which allows to investigate by what means X exerts its effect on Y. As illustrated in *Figure 5, X* is the independent variable, *Y* is the dependent variable, and *M* is the Mediator. In the path diagram, it can be seen that according to this model, X affects Y because X affects M, and M, in turn, affects Y.

The following equations describe the three-variable system of simple mediation.

$$M = a_0 + a_1 X + r$$

$$Y = b_0 + c'X + b_1 M + r$$

$$Point\ Estimator\ of\ indirect\ effect = \hat{a}_1 \hat{b}_1$$
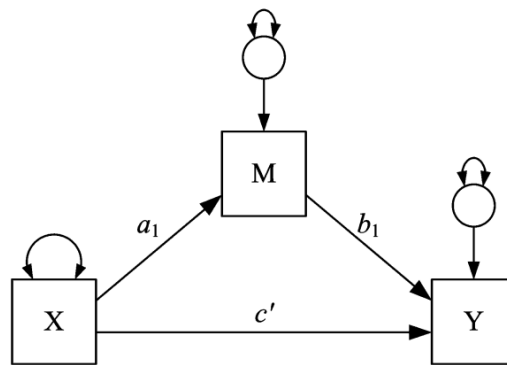
***Figure 5** – Simple mediation (Preacher, Rucker, and Hayes, 2007)*

In the figure, c represents the effect of X on Y without the presence of a mediator. The indirect effect can be quantified as $c - c'$, which is equivalent to $a_1 b_1$. The coefficients a_1 and b_1 are used to assess the presence, strength, and significance of the indirect effect of X on Y via M (p.188).

The authors review several procedures to assess the extent and significance of indirect effects. They describe in detail two separate strategies: product of coefficients and bootstrapping methodology. Bootstrapping falls within the broader category of resampling strategies for estimation and hypothesis testing, in other words, it describes the process of drawing random samples with replacement from a data set. Unlike the product of coefficients strategy, which requires the product of $\hat{a}_1 \hat{b}_1$ to be normally distributed in order to be able to compute the CI for the hypothesis testing; the bootstrapping technique requires no assumptions about the shape of the sampling distribution of the statistic when conducting inferential tests (p.190). In their study, the authors explicitly advocate for the use of bootstrapping whenever circumstances permit it. When using bootstrapping the only assumptions required when testing conditional indirect effects are linearity of the relationships in the system and independence of the observations. Additionally, the authors recommend using asymmetric confidence

intervals, this strategy is preferable because by doing so they explicitly incorporate information on the skew of product distributions (p.217).

In practice, bootstrapping requires very time-consuming calculations which thanks to increased computer processors' speed can be calculated quite easily. In the present study, STATA is utilized, and the bootstrapping script is based on free resources created by the UCLA Institute for Digital Research & Education. With the `sem` command followed by the `vce(bootstrap)` option, the sampling of N units with replacement from the original sample is repeated a total of k times. In the present study, k=1000 because Preacher, Rucker, and Hayes (2007) demonstrate in their paper that bootstrapping has a higher power and closer-to-accurate the Type I error rates with 1000 repetitions. At each resample, $\hat{a}_1\hat{b}_1$ is computed; then the thousand $\hat{a}_1\hat{b}_1$ products are sorted from low to high and the upper and lower bounds of a 95% CI for a_1b_1 are defined. The lower bound of the CI is defined as the 25th value and the upper bound is the 976th value of this sorted distribution. Often the CI is asymmetric, reflecting the skewness of the sampling distribution of $\hat{a}_1\hat{b}_1$. Hypothesis testing is based on the following rationale: the null hypothesis of no indirect effect H_0: $a_1b_1 = 0$ is rejected at the $\alpha = 0.05$ level of significance if 0 lies outside of the CI.

After having provided a review of the theory behind simple mediation models and a thorough explanation of the method utilized to apply this methodology, it is useful to provide a brief literature review on the use of this models on relevant existing literature.

Sadiq and Khan (2019) study the mediating role of "risk behavior" on the relationship between the five personality traits and investment intention, both on short and long-term investment intention, on a sample of Pakistani students. The authors find that "risk behavior" partially mediate the relationship of all five personalities with short term investment intention. Additionally, they find that for the long-term investment intention "risk behavior" is a much stronger mediator for the "Neuroticism" personality than all other personality types.

Giardone and Migliavacca (2018) study the mediation of "knowledge transfer" on the relationship between the typology of independent financial advisor and financial literacy displayed by the client, on a sample of Italian investors. The authors find that the presence of an advisor increases the financial literacy of the client via the knowledge transfer. The authors describe this as a total mediation.

In the present study, it is investigated the mediation of financial literacy on the relationship between objectively measured financial risk tolerance and subjectively perceived investment risk tolerance. The decision to utilize only one independent variable in this mediation model is motivated by the fact that the measure for objectively measured financial risk tolerance is the common most important independent variable both for the American and the Italian sample in the linear regression models. In *Figure6*, the path diagram summarizes the model. As discussed extensively in previous sections, objectively measured financial risk tolerance is measured with the Grable & Lytton 13-item score, subjectively perceived investment risk tolerance is measured with the DNB 6-item score, and financial literacy is measured with the 5-item Lusardi questionnaire.

As always, two separate estimation models are conducted, one for the American sample and one for the Italian one.
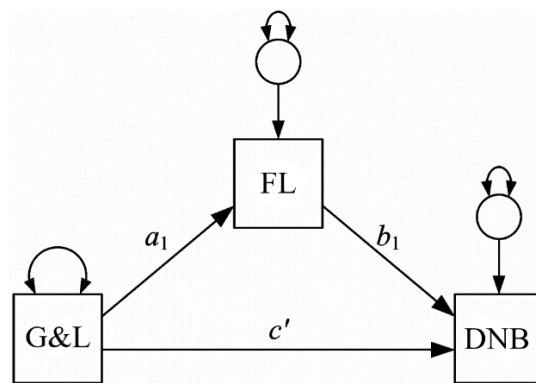
Figure 6 – Simple Mediation Model

The model estimation output for the **American** sample is reported in *Appendix C* and the meaningful coefficients are summarized in *Table15*.

The total effect of objectively measured financial risk tolerance (G&L) on subjectively perceived investment risk tolerance (DNB) if there was no mediator corresponds to 0.7731885 and it is significant at the $\alpha = 0.05$ level. This corresponds to c, as explained in earlier sections. The direct effect of objectively measured financial risk tolerance (G&L) on subjectively perceived investment risk tolerance (DNB) in presence of a mediator (FL) is 0.6939348 and it is significant at the $\alpha = 0.05$ level. This corresponds to c'. The indirect effect of objectively measured financial risk tolerance (G&L) on subjectively perceived investment risk tolerance (DNB) corresponds to 0.0792537 and it is significant at the $\alpha = 0.05$ level. This corresponds to $\hat{a}_1\hat{b}_1$. The significance of this

coefficient is accepted, and the null hypothesis of no indirect effect is rejected because the confidence interval created with the 1000 repetitions bootstrap method does not include 0. The mediation of financial literacy is significant but limited. In fact, the proportion of total effect mediated amounts to 10.25% (calculated as 0.0792537/0.7731885).

Table 15 – American sample: Simple Mediation Model summary

American Sample – Simple Mediation Model						
Number of obs.	245			Replications	1000	
Log likelihood	-1814.7312					
	Observed Coefficient	**Bootstrap std. err.**	**Z**	**P>|Z|**	**95% conf. interval**	
Structural						
FL						
G&L	0.1016392	0.0182452	5.57	0.000	0.0658793	0.1373991
constant	0.9192408	0.5404359	1.70	0.089	-0.1399942	1.978476
DNB						
FL	0.7797551	0.2695997	2.89	0.004	0.2513494	1.308161
G&L	0 .6939348	0.0860867	8.06	0.000	0.525208	0.8626616
Constant	1.326471	2.184805	0.61	0.544	-2.955669	5.608611
Direct Effects						
DNB						
G&L	0.6939348	0.0860867	8.06	0.000	0.525208	0.8626616
Indirect Effects						
DNB						
G&L	0.0792537	0.0278307	2.85	0.004	0.0247066	0.1338008
Total Effects						
DNB						
G&L	0.7731885	0.0784696	9.85	0.000	0.619391	0.926986

The same exact mediation analysis is then applied to the **Italian** sample. Output results are reported in *Appendix D* and in *Table16*.

Table 16 - Italian sample: Simple Mediation Model summary

Italian Sample – Simple Mediation Model						
Number of obs.	100			Replications	1000	
Log likelihood	-751.92726					
	Observed Coefficient	**Bootstrap std. err.**	**Z**	**P>|Z|**	**95% conf. interval**	
Structural						
FL						
G&L	0.0541552	0.0273248	1.98	0.047	0.0005997	0.1077108
constant	1.367052	0.7246696	1.89	0.059	-0.0532741	2.787379
DNB						
FL	0.7288271	0.5160792	1.41	0.158	-0.2826696	1.740324
G&L	0.7539045	0.118092	6.38	0.000	0.5224484	0.9853606
Constant	-1.61903	3.251806	-0.50	0.619	-7.992452	4.754393
Direct Effects						
DNB						
G&L	0.7539045	0.118092	6.38	0.000	0.5224484	0.9853606
Indirect Effects						
DNB						
G&L	0.0394698	0.0322591	1.22	0.221	-0.0237568	0.1026965
Total Effects						
DNB						
G&L	0.7933743	0.1155045	6.87	0.000	0.5669897	1.019759

The results for the Italian sample are very different from the American one. The indirect effect of objectively measured financial risk tolerance (G&L) on subjectively perceived investment risk tolerance (DNB) corresponds to 0.0394698 and it is not significant. The significance of this coefficient is rejected, and the null hypothesis of no indirect effect $H_0: a_1 b_1 = 0$ is accepted at the $\alpha = 0.05$ level because the confidence interval created with the 1000 repetitions bootstrap method is (-0.0237568; 0.1026965) and it does include 0.

In conclusion, the mediation of financial literacy (FL) on the relationship between objectively measured financial risk tolerance (G&L) and subjectively perceived investment risk tolerance (DNB) is significant at the $\alpha = 0.05$ level for the American sample, but it is not significant for the Italian sample. Moreover, the proportion of the total effect of objectively measured financial risk tolerance which is mediated amounts

to 10.25%. Thanks to this model specification it is possible to appreciate by what means objectively measured financial risk tolerance exerts its effect on subjectively perceived investment risk tolerance. There is a large portion of direct effect as well as a significant indirect effect which is mediated by financial literacy. What this study proposed is that the relationship between an investor's real level of risk tolerance and his perception of it is partially mediated by his financial literacy. Providing an objectively measured risk tolerance assessment of the individual increases the subjectively perceived investors risk tolerance via the financial literacy. As previously discussed, the estimation of a simple mediation model for the Italian sample was unsuccessful and the mediation role of financial literacy his does not apply to relationship between objectively measured financial risk tolerance and subjectively perceived investment risk tolerance for the Italian sample.

4.7 Moderated Mediation Analysis

At this point in the research, a moderated mediation model is proposed. This model is analyzed in light of the abundance of variables, such as data on personality types, which did not enter either the liner regression model or the simple mediation model.

Preacher, Rucker, and Hayes (2007) explain that moderated mediation occurs when the strength of an indirect effect depends on the level of some variable (p.193). Moderated mediation describes a process in which a moderator variable interacts with a mediator variable. This resulting effect is called conditional indirect effect, that is, the value of the indirect effect is conditional on the value of the moderator variable.

A moderator variable can affect in several ways an interaction with another variable in the model; Preacher, Rucker, and Hayes (2007) summarize five different models of moderated mediation which are represented in *Figure7*, the authors provide theoretical background and framework for each model of moderated mediation.
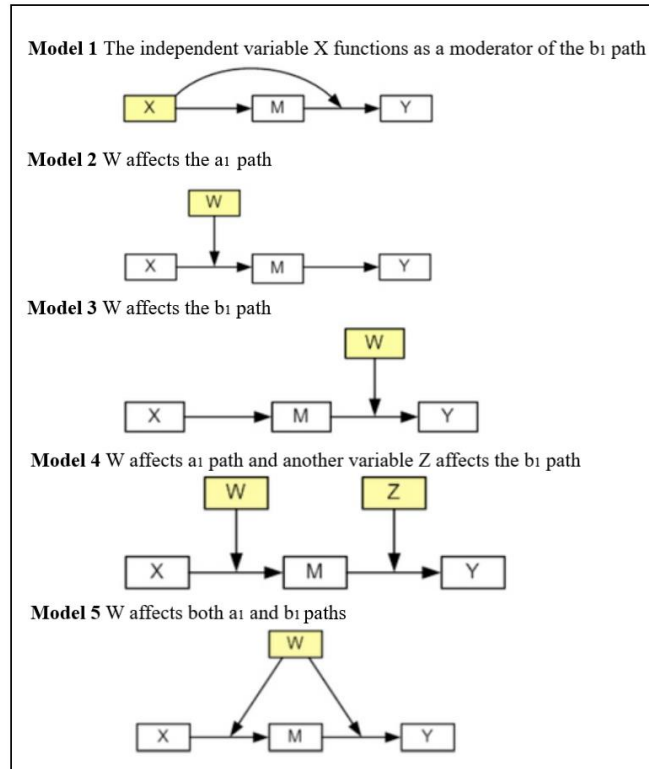
Figure 7 – *Models 1 through 5 of moderated mediation (Preacher, Rucker, and Hayes, 2007)*

The point estimator used to test the presence of conditional indirect effect varies according to the model chosen to conduct the analysis. For the present study, the most important model of moderated mediation is Model 5. Model 5 describes a moderator variable (W) which influences both the a_1 and b_1 paths of the mediating relationship. The equations and the path graph describing the relationships among the variables are presented hereafter.

$$M = a_0 + a_1X + a_2W + a_3XW + r$$

$$Y = b_0 + b_1M + b_2MW + c_1'X + c_2'W + c_3'XW + r$$

$$Point\ Estimator\ of\ conditional\ indirect\ effect = (\hat{a}_1 + \hat{a}_3W)(\hat{b}_1 + \hat{b}_2W)$$
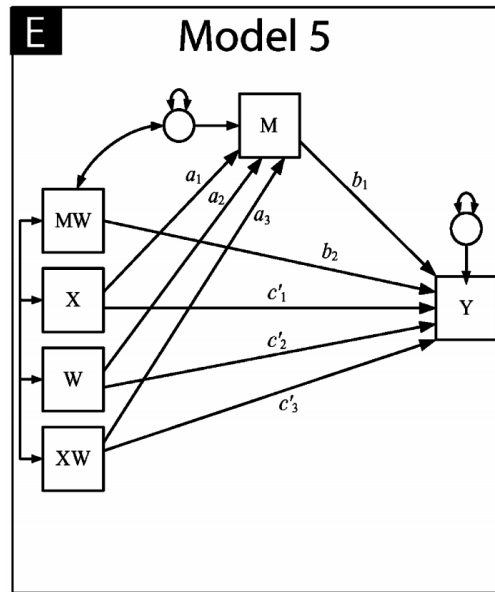
Figure 8 – Moderated mediation Model 5 (Preacher, Rucker, and Hayes, 2007)

As for the simple mediation, the authors present and discuss several methodologies for hypothesis testing. Ultimately, they advocate for the use of the bootstrapping technique to compute the lower and upper bounds of the confidence intervals. In the present study, the bootstrapping technique is applied with 1000 repetitions. In practice, the computation of the conditional indirect effects requires the estimation coefficients of two different models: one model with the mediator as the response variables and another model with the dependent variable as the response variable. The `sem` command in STATA allows to perform these calculations. Subsequently, the conditional indirect effects are obtained by multiplying the `sem` coefficients with selected value of the moderator variable. Also in this instance, the bootstrapping script is based on free resources created by the UCLA Institute for Digital Research & Education.

Similarly to the simple mediation model, the moderated mediation model's hypothesis testing is based on the following rationale: the null hypothesis of no conditional indirect effect is rejected at the $\alpha = 0.05$ level of significance if 0 lies outside of the CI. It is important to stress once again that the confidence intervals are created with the bootstrapping technique because it requires no assumption on the characteristics on the distribution of the point estimator. The confidence intervals are often asymmetric and are based on percentile calculations. The point estimator of conditional effect is tested at three different values: low moderator, medium moderator, and high moderator. These

values are one standard deviation below the mean, the mean, and one standard deviation above the mean of the point estimator, respectively.

Similarly to simple mediation models, moderated mediation models are used in research to investigate the causality of relationships among variables; a brief selection of relevant studies is presented.

Aren and Aydemir (2015) study the mediating and moderating role of "risk averseness in general" on the relationship between financial literacy and risky investment intention on 112 Turkish postgraduate respondents. In their study they also propose a moderated mediation model in which financial literacy is both a mediator and a moderator; this theoretical framework corresponds to Model 1 from *Figure7*.

Giardone and Migliavacca (2018) study the moderated mediation of "knowledge transfer" on the relationship between the typology of independent financial advisor and financial literacy displayed by the client, on a sample of Italian investors. The authors propose a moderated mediation model in which the "relationship length" works as a moderator. Their theoretical framework corresponds to Model 3 from *Figure7*.

Sadiq and Khan (2019) study the moderated mediation of "risk behavior" on the relationship between personality traits and investment intention on a sample of 284 students. The authors propose a moderated mediation model in which financial literacy works as a moderator. Their theoretical framework corresponds to Model 3 from *Figure7*.

This study contributes to existing literature by investigating the role of financial literacy (M) in mediating the relationship between objectively measured financial risk tolerance (X) and subjectively perceived investment risk tolerance (Y) and the moderating role of personality types (W). The moderated mediation model chosen to describe the moderating effect of personality types is Model 5. In the present study it is suspected that personality traits may affect both the a_1 and the b_1 path of the mediation model.

In *Figure9*, the path diagram summarizes all the relationships in the model. Objectively measured financial risk tolerance is measured with the Grable & Lytton 13-item score (G&L), subjectively perceived investment risk tolerance is measured with the DNB 6-item score (DNB), financial literacy is measured with the 5-item Lusardi questionnaire (FL), and personality traits are measured with the TIPI 10-item questionnaire. The TIPI

questionnaire does not group individuals according to a specific classification, instead it assigns to each respondent five values describing each one of the five personality traits of Extraversion (E), Agreeableness (A), Conscientiousness (C), Emotional Stability (ES), and Openness to Experience (OE). Therefore, a total of 10 moderated mediation models are estimated: each one of the five personally traits acts as a moderator for both the American and Italian samples. As Preacher, Rucker, and Hayes (2007) explain, "a significant unconditional indirect effect does not constitute a prerequisite for examining conditional indirect effects" (p.211); therefore, it should not be excluded a priori that a significant moderated mediation model may be estimated for the Italian sample solely based on the fact that the estimation of a simple mediation model was unsuccessful.
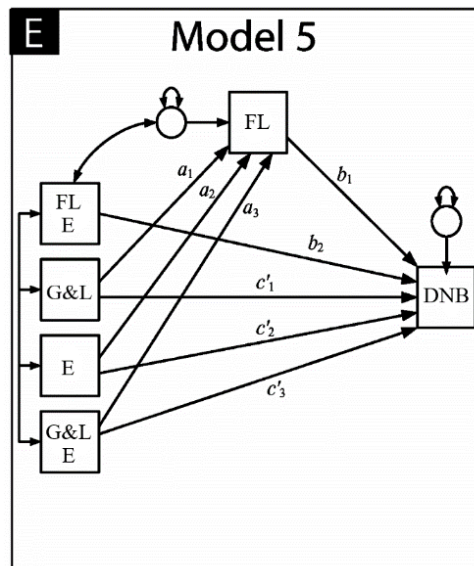
Figure 9 - Moderated mediation Model 5 with Extraversion

The moderated mediation model for the **American** sample is presented first. The bootstrapping script is repeated five times therefore allowing the moderator variable (W) to represent each one of the five personality traits.

The results summarized in *Table 17* represent the only personality trait which produces a conditional indirect effect which is significant at the $\alpha = 0.05$ level of significance: Extraversion. All other personality traits produce conditional indirect effect that are not significant.

Table 17 - *America Sample: Moderated Mediation Model with <u>Extraversion</u>*

America Sample – Moderated Mediation Model: <u>Extraversion</u>				
Number of obs.	245			
Replications	1000			
	Observed Coefficient	**Bootstrap std. err.**	**95% conf. interval**	
Low moderator	0.10332459	0.05065914	0.010511	0.2171321
Medium moderator	0.08858533	0.02998147	0.0343318	0.1570187
High moderator	0.07435184	0.03983332	0.0024657	0.1616802

In this instance, the conditional indirect effect decreases as the value of the moderator variable increases, meaning that as the value of the moderator variable Extraversion increases, the moderating effect on the a_1 and b_1 paths of the mediating relationship decreases. Noticeably, none of the confidence intervals contains the value 0.

Having provided evidence that the personality trait of Extraversion has a moderating effect on the a_1 and b_1 paths of the mediating relationship, this study decides to investigate even further. As seen in *Figure7*, Model 5 can be interpreted as a combination of Model 2 and Model 3; that is, Model 2 describes the effect of the moderator variable on the a_1 path, Model 3 describes the effect of the moderator variable on the b_1 path, and Model 5 describes the effect of the moderator variable both on the a_1 and b_1 paths of the mediating relationship. For this reason, it is reasonable to expect that both the Model 2 and 3 specifications of moderated mediation should be significant for the personality trait of Extraversion. When tested empirically these finings are confirmed.

In model 2, the point estimator of conditional indirect effect is $\hat{b}_1(\hat{a}_1 + \hat{a}_3 W)$. The conditional indirect effect if Extraversion on the a_1 path of the mediating relationship is significant at the $\alpha = 0.05$ level of significance. The conditional indirect effect slowly decreases as the value of the moderator variable increases, meaning that as the value of the moderator variable Extraversion increases, the moderating effect on the a_1 path slowly decreases.

In model 3, the point estimator of conditional indirect effect is $\widehat{a_1}(\hat{b}_1 + \hat{b}_3 W)$. The conditional indirect effect if Extraversion on the b_1 path of the mediating relationship is significant at the $\alpha = 0.05$ level of significance. The conditional indirect effect slowly decreases as the value of the moderator variable increases; Exactly like in Model 2 but for the b_1 path.

To gain an even better understanding of the moderated mediation process, Model 2 and Model 3 were tested also for Agreeableness, Conscientiousness, Emotional Stability, and Openness to Experience on the American sample.

For Model 3, no one of the four remaining personality traits has conditional indirect effects significant at the $\alpha = 0.05$ level of significance, meaning that 0 is included in at least one of the moderator point estimators' (low, medium, high) confidence intervals for all four personalities. For this reason, the null hypothesis $H_0: \widehat{a_1}(\hat{b}_1 + \hat{b}_3 W). = 0$ is accepted at the $\alpha = 0.05$. Among the five personality traits, the only significant moderator on the relationship between financial literacy (the mediating variable M) and subjectively perceived investment risk tolerance (the dependent variable Y) is the Extraversion trait.

For Model 2, all the personality traits have significant conditional indirect effects at the $\alpha = 0.05$ level of significance, meaning that 0 is not included in any of the moderator point estimators' confidence intervals. For the personality traits of Agreeableness, Conscientiousness, Emotional Stability, and Openness to Experience the conditional indirect effect slowly decreases as the value of the moderator variable increases, meaning that as the value of the personality trait increases (moderator variable), the moderating effect on the mediating variable (financial literacy) on the a_1 path slowly decreases.

In summary, the personality traits of Agreeableness, Conscientiousness, Emotional Stability, and Openness to Experience have a significant moderating effect on the a_1 path of model in which financial literacy works as a mediator of the effect of objectively measured financial risk tolerance on subjectively perceived investment risk tolerance. The personality trait of Extraversion has a significant moderating effect on both the a_1 and b_1 paths of the same mediated model.

This interesting finding can be explained by looking at the typology of assessment utilized: Grable & Lytton, Lusardi's questionnaire, and TIPI are scales designed to objectively measure certain traits of level of knowledge. On the other hand, the DNB questionnaire asks the respondent to express a level of agreement regarding the six statements which emprise the questionnaire; this is a self-assessment.

On the American sample, the analysis on the three different types of moderated mediation models seems to suggest that no matter the investor's personality traits, financial literacy mediates the effect of objectively measured financial risk tolerance for the investor.

However, the extent to which the awareness attained through an objective measure of risk tolerance and financial literacy affects the subjective perception of the individual is moderated only by the personality trait of Extraversion. People with high level of Extraversion are talkative and enjoy being the center of attention. It seems reasonable to believe that such Extroverted investors, once obtained an objective proof of their financial risk and financial literacy level they may be willing to share with their peers such results with an enthusiastic and outgoing spirit which is characteristic of this personality trait. This boosts the investor's awareness and subjectively perceived level of investment risk tolerance. Further discussion in this topic is provided in the conclusions.

Next, the same estimation approach is applied to the **Italian** sample.

Starting from Model 5, five different moderated mediation models are estimated to analyze the moderator role of each one of the five personality traits. None of the five personality traits has conditional indirect effects significant at the $\alpha = 0.05$ level of significance, meaning that 0 is included in at least one of the moderator point estimators' (low, medium, high) confidence intervals. For this reason, the null hypothesis $H_0: (\hat{a}_1 + \hat{a}_3 W)(\hat{b}_1 + \hat{b}_2 W) = 0$ is accepted at the $\alpha = 0.05$.

Even when checking whether the model 2 and 3 specifications of the moderated mediation were able to prove the moderating effect of any of the five personality traits significant, the hypothesis testing failed. Ultimately, in the present study the estimation of a simple mediation model and the estimation of a moderated mediation model on the Italian sample were unsuccessful.

Conclusions and implications

In this study it is empirically demonstrated that *objectively measured financial risk tolerance, financial literacy, and personality types are factors which affect the subjectively perceived level of investment risk tolerance of the investor*.

These results are obtained through the four-quadrant analysis and the estimation of a multi linear regression model. Even though the American and Italian samples are not representative of the respective populations, the four-quadrant analysis highlights important trends which are coherent with existing literature. Overconfidence and realistic high-risk investors are predominantly male, financial literacy has a positive correlation with financial risk tolerance, and the positive effect of the personality traits of Extraversion and the negative effect of Agreeableness on risk tolerance behave according to literature for both samples. Additionally, the specification of a regression model on the American and Italian samples highlights how the most important predictor of subjectively perceived investment risk tolerance is objectively measured financial risk tolerance, for both groups of investors.

Moreover, in this study it is demonstrated that *financial literacy has a mediating effect on the relationship between objectively measured financial risk tolerance and subjectively perceived investment risk tolerance*.

This result is obtained through the use of simple mediation analysis on the American sample. The specification of a simple mediation model highlights by what means objectively measured financial risk tolerance exerts its effect on subjectively perceived investment risk tolerance. In this study it is shown that there is a significant indirect effect which is mediated by the financial literacy variable, demonstrating that financial literacy serves as a medium to align perception and reality on risk tolerance. The estimation of a simple mediation model for the Italian sample is unsuccessful and the mediation role of financial literacy does not apply to this sample.

The fact that financial literacy serves as a mediator of the transfer of the risk tolerance awareness is encouraging. Investors with higher financial literacy, therefore with better understanding of concepts of finance as well as math and market dynamics, are better equipped to truly understand their level of financial risk tolerance and are more capable than financially illiterate ones to adjust their perception of risk. Thus, financial literacy

not only increases individuals risk tolerance but also helps in the process of internalizing and growing confidence and awareness of someone's risk tolerance level.

Lastly, in this study it is also demonstrated that *personality types have a moderating effect on the mediating role of financial literacy.*

This result is obtained through the use of a moderated mediation specification model on the American sample. The analysis on three different types of moderated mediation models seems to suggest that no matter the investor's personality traits, financial literacy mediates the effect of objectively measured financial risk tolerance for the investor. However, the extent to which the awareness attained through an objective measure of risk tolerance and financial literacy affects the subjective perception of the individual is moderated only by the personality trait of Extraversion. The estimation of a moderated mediation model for the Italian sample is unsuccessful and the moderating role of personality types does not apply to this sample.

The moderating effect of personality types on the mediating role of financial literacy is perhaps the more interesting result of this research. In essence, when looking at the mediating effect of financial literacy on subjective perception of risk tolerance, only the trait of Extraversion is significant. In a way, this result highlights once again the importance of financial education. Financial education can improve the awareness on risk tolerance of all investors, financial literacy's effect is ubiquitous and does not discriminate across personality traits. Even though certain personality traits negatively affect risk tolerance, financial literacy can be the medium utilized by financial advisors to educate on risk tolerance and sensitize on the importance of taking a healthy amount of risk to achieve financial goals. Another important result of this research is the importance of Extraversion. The trait of extraversion describes investors who are friendly, gregarious, outgoing, talkative, and like to socialize; these investors should be identified and treated in a tailored way to emphasize their strengths and to protect them from herding behaviors.

The analysis carried out in this study is relevant to practitioners, policy makers and scholars and leads to several *implications*. First, this study emphasizes the fact that objective and subjective risk tolerance are not always aligned; some investors are more prone than others to misjudge their own level of investment risk tolerance. Secondly, this study corroborates the importance of assessing risk tolerance levels and specifically of

including personality types and financial literacy in the client's assessment made by professionals in the financial advisory field to provide tailored advice. Lastly, this study identifies Extrovert investors as a group that responds differently than others to financial education and which may be exposed to different learning habits and threats.

The importance to understand the results of an objective evaluation on risk assessment cannot be stressed enough. Simply applying a label, such as "moderate" or "aggressive" or "conservative" investor, is not sufficient to truly align goals and expectations of the investor. The presence of a financial advisor could greatly enhance the results of this process. When the objective risk assessment is followed by an explanation of the results and by an understanding of the practical implications of this measure, the investor is capable of better aligning her perception to her actual risk tolerance level. For the investor, this justifies reaching ouch to a professional, and for the advisor it incentivizes spending time with each client to help them assess their personal level for risk and to comprehend the risk associated with different investment options.

Moreover, this study sheds a light on the causality among the factors affecting subjectively perceived investment risk tolerance. Providing investors with financial education is instrumental to their financial success in the long term. Engaging the client to interact with other investors can be contributory to the growth of her understanding and self-efficacy on risk tolerance. Even when considering advisory relationships without the presence of financial advisors, that is for example robo advisory services, the presence of a community of investors could lead to beneficial results for the investor. Peer-to-peer interaction does not substitute the advisory role of the professional but provides a useful occasion of debate in which financial concepts are discussed and useful inquisitions are arisen. As stressed before, those investors with high levels of Extraversion may not need to be pushed into this social behavior, but on the other hand they should be protected from misinformation and herding tendences more than others.

This research identifies several areas for *future studies* and suggests several propositions. While the generalizability of this study's findings is limited, encouraging aspects remain. To one extent, the importance of analyzing national data and its departures from other populations is crucial in understanding country-specific trends. This study was only partially successful in describing the Italian sample and further research is desirable. Moreover, the educating role of financial advisors regarding financial literacy should be

subject of detailed attention and the added value this relationship provides should be explained and accounted for in their service fees. Lastly, the impact of focus groups/ communities could be tested in a trial study and quantified in order to provide evidence of the interaction among objectively measured knowledge and socially gained confidence.

From a technical point of view, this research contributes to existing literature on financial risk tolerance, personality types, and financial literacy. Finally, this research proposes a moderated mediation framework and allows to expand the knowledge on the multiple interactions occurring among the variables of interest.

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Appendix A

Table 1.2 Factors associated with financial risk tolerance

Individual characteristic	Assumed to be more risk tolerant	Level of support in the literature[a]
Gender	Male	High
Age	Younger	Moderate
Marital status	Single	Moderate
Marital/gender interaction	Single male	High
Ethnicity	Non-Hispanic White	Moderate
Income	High	Moderate
Net worth	High	High
Financial satisfaction	High	High
Financial knowledge	High	High
Education	Bachelor's degree or higher	Moderate
Employment status	Employed full-time	Moderate
Occupation	Professional	Moderate
Income source	Business owner	High
Income variability	Stable and predictable	High
Household size	Large	Moderate
Homeownership	Owner	Low
Religiosity	Less religious	Moderate
Self-esteem	High	High
Locus of control	Internal	Low
Personality	Type A	High
Sensation seeking	High	High
Mood	Happy	High

Coding (approximate percent of reviewed articles supporting assumed relationship): high—80–100 %; moderate—50–79 %; low—0–49 %

[a]Statistics compiled from a review of 125 studies published between 1960 and 2006. Some studies dealt only with one or a few characteristics. In some cases, the number of studies was small (e.g., $n < 5$)

Appendix B

Survey

Q1 You are invited to participate in a research study presented by Ca' Foscari University of Venice - Italy. The study investigates financial risk tolerance. You will be asked to fill in a survey. TIME INVOLVEMENT: The estimated completion time of this survey is about 10 minutes.

PARTICIPANT'S RIGHTS: If you have read this form and have decided to participate in this project, please understand your participation is voluntary and you have the right to withdraw your consent or discontinue participation at any time without penalty. The alternative is not to participate. The results of this research study may be presented at scientific or professional meetings, published in scientific journals, or used for future research studies. Your individual privacy will be maintained in all published and written data resulting from the study.

CONTACT INFORMATION: This study is presented by the Department of Management of Ca' Foscari University of Venice. Contact: Gloria Levorin 974521@stud.unive.it.

By clicking the button below, you acknowledge that your participation in the study is voluntary, you are 18 years of age, and that you are aware that you may choose to terminate your participation in the study at any time and for any reason.

- ○ I consent, begin the study. (4)
- ○ I do not consent; I do not wish to participate. (5)

Q2 On a scale from 1 to 7...
Strongly agree (13) - Agree (14) - Somewhat agree (15) - Neither agree nor disagree
(16) - Somewhat disagree (17) - Disagree (18) - Strongly disagree (19)

I think that it is more important to have safe investments and guaranteed returns than to take a risk to have a chance to get the highest possible return (1)	○	○	○	○	○	○	○
I do not invest in shares, because I find it too risky (2)	○	○	○	○	○	○	○
If I think an investment will be profitable, I am prepared to borrow money to make this investment (3)	○	○	○	○	○	○	○
I want to be certain that my investments are safe (4)	○	○	○	○	○	○	○
If I want to improve my financial position, I should take financial risk (5)	○	○	○	○	○	○	○
I am prepared to take the risk to lose money, when there is also a chance to gain money (6)	○	○	○	○	○	○	○

Q3 Which of the following statements on this page comes closest to the amount of financial risk that you are willing to take when you save or make investments?

- ○ Take substantial financial risk expecting to earn substantial returns. (1)
- ○ Take above-average financial risks expecting to earn above-average returns. (2)
- ○ Take average financial risks expecting to earn average returns. (3)
- ○ Not willing to take any financial risks. (4)

Q4 Suppose you had $100 in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow?

○ More than $102 (1)

○ Exactly $102 (2)

○ Less than $102 (3)

○ Don't know (4)

○ Prefer not to say (5)

Q5 Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, how much would you be able to buy with the money in this account?

○ More than today (1)

○ Exactly the same (2)

○ Less than today (3)

○ Don't know (4)

○ Prefer not to say (5)

Q6 If interest rates rise, what will typically happen to bond prices?

○ They will rise (1)

○ They will fall (2)

○ They will stay the same (3)

○ There is no relationship between bond prices and interest rate (4)

○ Don't know (5)

○ Prefer not to say (6)

Q7 A 15-year mortgage typically requires higher monthly payments than a 30-year mortgage, but the total interest paid over the life of the loan will be less.

○ True (1)

○ False (2)

○ Don't know (3)

○ Prefer not to say (4)

Q8 Buying a single company's stock usually provides a safer return than a stock mutual fund.

○ True (1)

○ False (2)

○ Don't know (3)

○ Prefer not to say (4)

Q9 In general, how would your best friend describe you as a risk taker?

○ A real gambler (1)

○ Willing to take risk after adequate research (2)

○ Cautious (3)

○ A real risk avoider (4)

Q10 You are on a Tv game show and can choose one of the following. Which would you take?

○ $1,000 in cash (1)

○ A 50% chance at winning $5,000 (2)

○ A 25% chance at winning $10,000 (3)

○ A 5% chance at winning $100,000 (4)

Q11 You have just finished saving for a "once-in-a-lifetime" vacation. Three weeks before you plan to leave, you lose your job. You would:

○ Cancel the vacation, part of the bookings are refundable. (1)

○ Take a much more modest vacation (2)

○ Go as scheduled, reasoning that you need the time to prepare for a job search (3)

○ Extend your vacation, because this may be your last chance to go first-class (4)

Q12 If you unexpectedly received $20,000 to *invest*, what would you do?

○ Deposit it in a bank account, money market account, or an insured CD (1)

○ Invest it in a safe high quality bonds or bond mutual funds (2)

○ Invest it in stock or stock mutual fund (3)

Q13 In terms of experience, how comfortable are you investing in stocks or stock mutual funds?

○ Not at all comfortable (1)

○ Somewhat comfortable (2)

○ Very comfortable (3)

Q14 When you think of the word "risk" which of the following words comes to mind first?

○ Loss (1)

○ Uncertainty (2)

○ Opportunity (3)

○ Thrill (4)

Q15 Some experts are predicting prices of assets such as gold, jewels, collectibles, and real estate (hard assets) to increase in value; bond prices may fall, however, experts tend to agree that government bonds are relatively safe. Most of your investment assets are now in high interest government bonds. What would you do?

- ○ Hold the bonds (1)
- ○ Sell the bonds, put half the proceeds into money market accounts, and the other half into hard assets (2)
- ○ Sell the bonds and put the total proceeds into hard assets (3)
- ○ Sell the bonds, put all the money into hard assets, and borrow additional money to buy more (4)

Q16 Given the best and worst case returns of the four investment choices below, which would you prefer?

- ○ $200 gain best case; $0 gain/loss worst case (1)
- ○ $800 gain best case; $200 loss worst case (2)
- ○ $2,600 gain best case; $800 loss worst case (3)
- ○ $4,800 gain best case; $2,400 loss worst case (4)

Q17 In addition to whatever you own, you have been given $1,000. You are now asked to choose between:

- ○ A sure gain of $500 (1)
- ○ A 50% chance to gain $1,000 and a 50% chance to gain nothing (2)

Q18 Most of your investment assets are now in government bonds, the Federal Reserve announces it will lower interest rates, what will you do? This is a control question meant solely to check your attention level. Select the answer " Do nothing " to prove that you are carefully engaging in the questionnaire.

- ○ Hold the bonds (1)
- ○ Sell the bonds (2)
- ○ Do nothing (3)

Q19 In addition to whatever you own, you have been given $2,000. You are now asked to choose between:

- ○ A sure loss of $500 (1)
- ○ A 50% chance to lose $1,000 and a 50% chance to lose nothing (2)

Q20 Suppose a relative left you an inheritance of $100,000 stipulating in the will that you have to invest ALL the money in ONE of the following choices. Which one would you select?

- ○ A savings account or money market mutual fund (1)
- ○ A mutual fund that owns stocks and bonds (2)
- ○ A portfolio of 15 common stocks (3)
- ○ Commodities like gold, silver, and oil (4)

Q21 If you had to invest $20,000, which of the following investment choices would you find most appealing?

- ○ 60% in low-risk investments 30% in medium-risk investments 10% in high-risk investments (1)
- ○ 30% in low-risk investments 40% in medium-risk investments 30% in high-risk investments (2)
- ○ 10% in low-risk investments 40% in medium-risk investments 50% in high-risk investments (3)

Q22 Your trusted friend and neighbor, an experienced geologist, is putting together a group of investors to fund an exploratory gold mining venture. The venture could pay back 50 to 100 times the investment if successful. If the mine is a bust, the entire investment is worthless. Your friend estimates the chance of success is only 20%. If you had the money, how much would you invest?

- ○ Nothing (1)
- ○ One month's salary (2)
- ○ Three month's salary (3)
- ○ Six month's salary (4)

Q23 How strongly do you agree or disagree with the following statements describing your personality?
Strongly agree (13) - Agree (14) - Somewhat agree (15) - Neither agree nor disagree (16) - Somewhat disagree (17) - Disagree (18) - Strongly disagree (19)
I see myself as ...

... extraverted, enthusiastic. (1)	○	○	○	○	○	○	○
... critical, quarrelsome. (2)	○	○	○	○	○	○	○
... dependable, self-disciplined. (3)	○	○	○	○	○	○	○
... anxious, easily upset. (4)	○	○	○	○	○	○	○
... open to new experiences, complex. (5)	○	○	○	○	○	○	○
... reserved, quiet. (6)	○	○	○	○	○	○	○
... sympathetic, warm. (7)	○	○	○	○	○	○	○
... disorganized, careless. (8)	○	○	○	○	○	○	○
... calm, emotionally stable. (9)	○	○	○	○	○	○	○
... conventional, uncreative. (10)	○	○	○	○	○	○	○

Q24 What is your year of birth?

_____

Q25 How do you describe yourself?
- ○ Male (1)
- ○ Female (2)
- ○ Non-binary / third gender (3)
- ○ Prefer to self-describe (4)

  _____

- ○ Prefer not to say (5)

Q26 Which of the following best describes you? Please select all that apply.
- ○ Hispanic or Latino (1)
- ○ Native American (2)
- ○ Alaskan Native (3)
- ○ Asian (4)
- ○ Black or African American (5)
- ○ Native Hawaiian (6)
- ○ Other Pacific Islander (7)
- ○ White (8)
- ○ Other / Unknown / Prefer not to say (9)

Q27 What is the highest level of education you have completed?
- ○ Some high school or less (1)
- ○ High school diploma or GED (2)
- ○ Some college, but no degree (3)
- ○ Associates or technical degree (4)
- ○ Bachelor's degree (5)
- ○ Graduate or professional degree (MA, MS, MBA, PhD, JD, MD, DDS) (6)

Q28 What is your current employment status?
- ○ Employed full-time (40+ hours a week) (1)
- ○ Employed part-time (less than 40 hours a week) (2)
- ○ Unemployed (currently looking for work) (3)
- ○ Unemployed (not currently looking for work) (4)
- ○ Student (5)
- ○ Retired (6)
- ○ Self-employed (7)
- ○ Unable to work (8)
- ○ Homemaker or stay-at-home parent (9)
- ○ Other (10)

Q29 In which country do you currently live?

▼ Afghanistan (1) ... Zimbabwe (1357)

Display This Question:
If List of Countries = 187

Q30 In which state do you currently live?

▼ Alabama (2) ... Other US Territories and Military Bases (54)

Q31 What is your current marital status?
- ○ Married (1)
- ○ Widowed (2)
- ○ Divorced (3)
- ○ Separated (4)
- ○ Single (Never been married) (5)
- ○ In a domestic partnership (6)

Q32 Do you have any dependent children that you care for?
- ○ None (1)
- ○ One or more (2)

Q33 How old is the oldest dependent child?

_____

Q34 In your household, how much responsibility do you have...
None or almost none (1) - Some (2) - Shared equally with other household members (3) - Most (4) - All or almost all (5)

... for paying monthly bills (1)	○	○	○	○	○
... for making decisions about saving and investments (3)	○	○	○	○	○
... for doing regular shopping for the household (4)	○	○	○	○	○
... for making decisions about other household financial matters (6)	○	○	○	○	○

Q35 What is your household yearly income, which is the sum of all household members' yearly income (no commas and no decimal numbers)?

_____

Q36 What does your own personal income rank within your household?

- ○ Highest in my household (1)
- ○ About equal to the highest (roughly the same as another household member) (2)
- ○ Second highest (3)
- ○ Third highest or lower (4)

Q37 Do you know your household net worth? (Net worth= total assets - total liabilities)

- ○ Yes (4)
- ○ No, I have never calculated it (5)

Q38 What is your household net worth? (if negative write for example -30000, no commas and no decimal numbers)

_____

Q39 Select all that apply

- ○ I have recently experienced a large, unexpected drop in income (1)
- ○ I budget and track income and expenses (2)
- ○ I am paying off a mortgage (3)
- ○ I am good at dealing with checking accounts, credit and debit cards (4)
- ○ I am good at math (5)
- ○ I have recently lost my job (6)
- ○ I am up to date with the latest financial news (9)

Q40 When I need help on financial matters ... (select all that apply)

- ○ I ask for advice to my friends and colleagues (1)
- ○ I do my own research (2)
- ○ I reach out to a professional (3)
- ○ I rely on information from trusted social media accounts (4)
- ○ I rely on information from newspapers and the news (5)
- ○ Others (7)

End of Block: Demographics

End of Survey

Appendix C

```
Structural equation model                         Number of obs =    245
Estimation method: ml                             Replications  = 1,000

Log likelihood = -1814.7312
```

	Observed coefficient	Bootstrap std. err.	z	P>|z|	Normal-based [95% conf. interval]	
Structural						
finlit						
grablelytton	.1016392	.0182452	5.57	0.000	.0658793	.1373991
_cons	.9192408	.5404359	1.70	0.089	-.1399942	1.978476
dnb						
finlit	.7797551	.2695997	2.89	0.004	.2513494	1.308161
grablelytton	.6939348	.0860867	8.06	0.000	.525208	.8626616
_cons	1.326471	2.184805	0.61	0.544	-2.955669	5.608611
var(e.finlit)	1.272255	.1492663			1.010898	1.601182
var(e.dnb)	22.1426	1.776165			18.92124	25.9124

```
. estat teffects
```

Direct effects

	Observed coefficient	Bootstrap std. err.	z	P>|z|	Normal-based [95% conf. interval]	
Structural						
finlit						
grablelytton	.1016392	.0182452	5.57	0.000	.0658793	.1373991
dnb						
finlit	.7797551	.2695997	2.89	0.004	.2513494	1.308161
grablelytton	.6939348	.0860867	8.06	0.000	.525208	.8626616

Indirect effects

	Observed coefficient	Bootstrap std. err.	z	P>|z|	Normal-based [95% conf. interval]	
Structural						
finlit						
grablelytton	0 (no path)					
dnb						
finlit	0 (no path)					
grablelytton	.0792537	.0278307	2.85	0.004	.0247066	.1338008

Total effects

	Observed coefficient	Bootstrap std. err.	z	P>|z|	Normal-based [95% conf. interval]	
Structural						
finlit						
grablelytton	.1016392	.0182452	5.57	0.000	.0658793	.1373991
dnb						
finlit	.7797551	.2695997	2.89	0.004	.2513494	1.308161
grablelytton	.7731885	.0784696	9.85	0.000	.619391	.926986

Appendix D

```
Structural equation model                    Number of obs =    100
Estimation method: ml                        Replications  = 1,000

Log likelihood = -751.92726
```

	Observed coefficient	Bootstrap std. err.	z	P>|z|	Normal-based [95% conf. interval]	
Structural						
finlit						
grablelytton	.0541552	.0273248	1.98	0.047	.0005997	.1077108
_cons	1.367052	.7246696	1.89	0.059	-.0532741	2.787379
dnb						
finlit	.7288271	.5160792	1.41	0.158	-.2826696	1.740324
grablelytton	.7539045	.118092	6.38	0.000	.5224484	.9853606
_cons	-1.61903	3.251806	-0.50	0.619	-7.992452	4.754393
var(e.finlit)	1.307361	.1579412			1.031722	1.656641
var(e.dnb)	29.06115	4.077415			22.07422	38.25959

```
. estat teffects


Direct effects
```

	Observed coefficient	Bootstrap std. err.	z	P>|z|	Normal-based [95% conf. interval]	
Structural						
finlit						
grablelytton	.0541552	.0273248	1.98	0.047	.0005997	.1077108
dnb						
finlit	.7288271	.5160792	1.41	0.158	-.2826696	1.740324
grablelytton	.7539045	.118092	6.38	0.000	.5224484	.9853606

```
Indirect effects
```

	Observed coefficient	Bootstrap std. err.	z	P>|z|	Normal-based [95% conf. interval]	
Structural						
finlit						
grablelytton	0	(no path)				
dnb						
finlit	0	(no path)				
grablelytton	.0394698	.0322591	1.22	0.221	-.0237568	.1026965

```
Total effects
```

	Observed coefficient	Bootstrap std. err.	z	P>|z|	Normal-based [95% conf. interval]	
Structural						
finlit						
grablelytton	.0541552	.0273248	1.98	0.047	.0005997	.1077108
dnb						
finlit	.7288271	.5160792	1.41	0.158	-.2826696	1.740324
grablelytton	.7933743	.1155045	6.87	0.000	.5669897	1.019759