PRESENTATION OF RISK WARNING STATEMENT MODERATE THE RELATIONSHIPS BETWEEN RISK-TAKING TRAITS, RISK PREFERENCE, AND FINANCIAL RISK-TAKING BEHAVIOR

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ABSTRACT

Title of Dissertation	PRESENTATION OF RISK WARNING STATEMENT MODERATE THE RELATIONSHIPS BETWEEN RISK-TAKING TRAITS, RISK PREFERENCE, AND FINANCIAL RISK-TAKING BEHAVIOR
Author	Mr. Phatid Rongsirikul
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This research aimed to study the relationship between people's risk-taking traits, risk preference, and financial risk-taking behavior in the situation where the risk warning statements existed. The study was based on an online experiment conducted in Thailand. The results were taken from 640 participants joining and contributing their answers to the tests. In the context of experimental design, each participant was randomly assigned to different groups in order to investigate the effect of risk warning statements on the relationships. The results suggested that there existed a relationship between risk-taking traits, risk preference, and financial risk-taking behavior such that high risk-taking traits were linked to a low degree of risk aversion and then caused high financial risk-taking behavior of the people. Given the presentation of the risk warning statements, there was no significant effect found on reducing the financial risk-taking behavior; however, an effect was found on risk preference for a strong version of the risk warning statement. In terms of measurements, additionally, the research also proposed an alternative measure of people's risk preference based on the so-called Dollar Equivalence (DE) which was a tweaked concept of Probability Equivalence (PE). Regarding the results, the DE was proven to be a superior measure of risk preference compared with the PE.

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CHAPTER 1

INTRODUCTION

In the context of behavioral science, risk preference may refer to an attitude of people toward risk. Roughly speaking, it implies a perception of people upon unpredictable outcome which is derived from a risky event they have to incur. Because of people losing their accurate predictability in a given situation, the consequence seems to be unknown and uncertain. This is, however, simply because some crucial information could not be reached or unavailable which lead to sub-optimal in the decision-making process of people. To be precise, in terms of decision-making, people have to make up their minds given limited information and time constraint. The result, as a consequence of decision making, would be revealed in the future time or after the decision ended which is, of course, subject to some uncertainty due to the limitations and constraints. Since people lose their control over an uncertain outcome, they are likely to take some risk by making a decision. Nevertheless, given that the various choices are available with different levels of risk embedded in, people may choose differently.

In terms of neoclassical economics and standard financial theory, the assumption of rational investors – the so-called economic man – is essential so as to draw a conclusion upon economics study. This assumption simply assumes rational behavior for all individual investors, meaning that they actually know what they are doing rationally and tend to have invariant risk preferences. In this context, given an uncertain outcome, thus, people tend to make a choice based on their expectations. In other words, they reasonably and wisely make a comparison amongst each choice based on their expected utility which they are going to receive from anticipated outcomes. This

leads us to the theory of expected utility which is firstly introduced by Bernoulli (1738, as cited in Bernoulli, 1954)[1].

The theories are founded upon gambles and lotteries which represent the uncertainty of the outcome. Given all possible outcomes, expected utility can be measurable and estimated as an expected value (i.e. weighted average) of the utility of which an individual would receive from all uncertain outcomes. Due to uncertainty, the weights represent the probability of that particular outcome going to occur. Because an individual can rationally make a decision based on the expected utility of each choice, it cannot vary across people. Therefore, given the expected utility hypothesis, economically, it implies invariant risk preference amongst individuals in the decision-making process.

As the time elapsed, however, it raised a lot of criticism over its realistic implication. The curiosity began with questions involving human behavior. Based on the behavioral experiment, people tend to act differently in a given circumstance. Even with the same people, by giving them an identical expected payoff, they have a tendency to vary their decision if some environmental factors are changed which may not be consistent with the expected utility theory. Prospect theory coined by Kahneman and Tversky (1979), thus, came to play a role in order to explain this contradiction.

In the context of behavioral economics, prospect theory describes how people make a decision under uncertainty. Through experiments, it can be proved that an individual does not make a decision in accordance with expected utility theory. Rather than changing in his/her wealth, an individual's preference is relatively responsive to the initial reference point of income. Roughly speaking, given an equal amount of money, people value losses more than gains. On the one hand, people can be risk-loving when they are in the domain of loss, but on the other hand, they can be risk-averse when they are in the domain of gain. Specifically, people perceive losses and gains differently. This behavior, as a result, implies that individuals could have different utility functions as interpreted by expected utility theory.

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[1] This refers to the Latin version published in St. Petersburg. The paper is "Specimen theoriae novae de mensura sortis" or "Exposition of a New Theory on the Measurement of Risk" in English version translated and published in Econometrica 1954.

1.1 Motivation

Due to a massive expansion in Thai financial market after the crisis in 1997, the investment seems to play a vital role in people's life. There have been a lot of newcomers in the financial market both in terms of listed company and financial investors. The stock market (i.e. Stock Exchange of Thailand: SET), for example, has continuously experienced with a huge growth in its market size and value as shown in Figure 1.1 and Figure 1.2. In a similar way, fund investment has also demonstrated an upward and ongoing trend. The financial system has been developed over time as well as growing economy globally and domestically. As a result, investment activities are a lot simpler than ever. Retail investors, for instance, are able to invest in various kinds of asset classes e.g. gold, oil, and financial derivative products. Cross-border investment seems to be reachable for everyone through fund investment which is managed by the well-experienced fund manager. Long-term funds and retirement funds have been promoted and supported by Thai government via a tax benefit scheme. However, financial knowledge has been unlikely to catch up with this rapid growth.

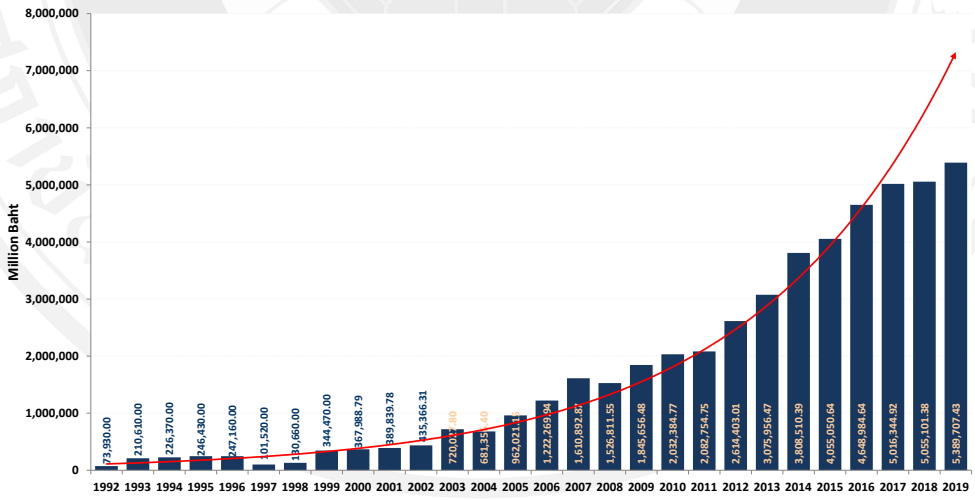

Figure 1.1 Size of Mutual Fund in Thailand

Note: Association of Investment Management Companies-Mutual

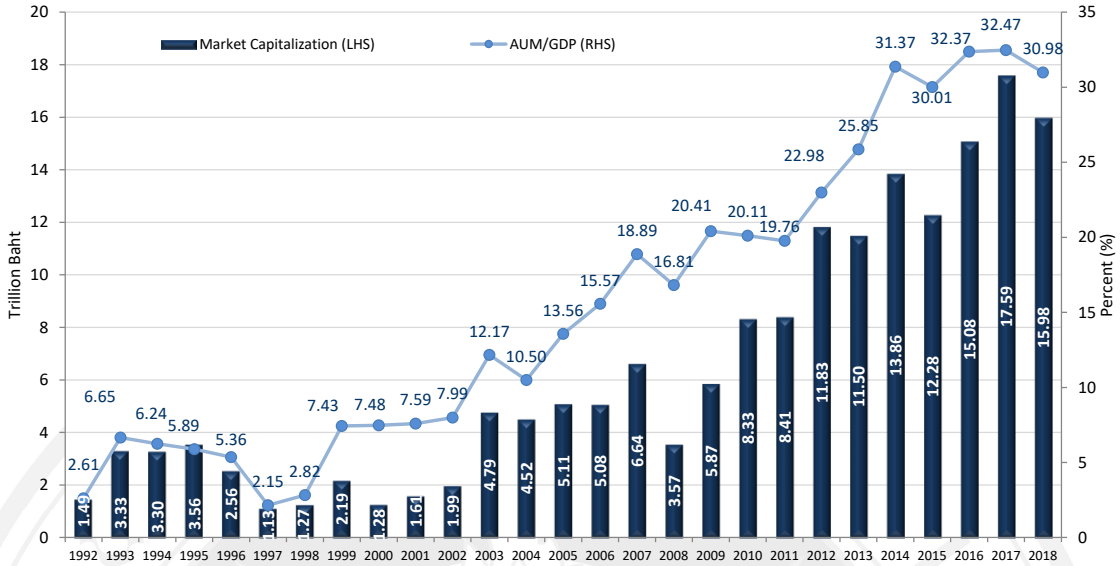

Figure 1.2 Total Asset Under Management in Asset Management Industry to Market Capitalization on SET and GDP

Note: 1. Association of Investment Management Companies-Mutual Fund NAV, Private Fund NAV and Provident Fund NAV

2. Office of National Economic and Social Development Board-GDP Gross Domestic Product at Current Market Prices

3. The Stock Exchange of Thailand -Market Capitalization Value

Individual and retail investors seek for the maximum rate of return. Due to abundance of investment choices, expected rate of return could be compared across different choices of investment. Unfortunately, the return has its cost which is another side of a coin that be neglected by most investors. The phrase “high risk, high return” seems to be a good rule of thumb for investors as it can explain well about the tradeoff between risk and return. As a result, investor has to take more risk in order for a higher return. It is sensible, for instance, in the case of risky asset that offers a higher rate of return compared with safety asset. Unlike return, a concept of risk is much more intangible. Risk, to some certain extent, could be defined as uncertainty. Specifically, it is a chance of return deviation given a targeted rate of return. The higher the risk is, the higher the chance of not getting a promised return. Therefore, the risk is perceived as an unfavorable thing that should be avoided. Still, it is quite difficult to find a standard measure of risk. Due to its complexity, investors may not be able to state

exactly how much risk they are going to accept in order to trade with a higher return. However, people could perceive and value risk differently, meaning that they might have a different acceptable amount of risk. This is, indeed, the concept of risk tolerance which Ricciardi (2007) defined as "sleep factor" – the level of risk an investor can tolerate and still be able to sleep at night. Because different invested assets carry different amount of risk, investors have to match their own risk appetite with those assets. Thus, investment decisions can be restricted by investors' risk attitude which varies across individual investors.

1.2 Investor's Risk Assessment (Know Your Client)

In order to protect individual investors from excessive risk-taking behavior, Securities and Exchange Commission of Thailand (SEC) announced and implemented regulations on investment[2], including suitability test. This regulation forced asset management companies, selling agents of both commercial banks and security companies to perform an assessment on their clients' risk tolerance before they could introduce financial investment products (e.g. mutual funds) to their customers. Basically, the suitability test relies on investors' self-evaluation of their own risk tolerance. Nevertheless, this test is roughly designed and, most of the case, unable to reveal an actual risk tolerance of an investor. Frankly speaking, due to self-report questionnaires, it is not difficult for client to make a false statement which definitely leads to a biased conclusion about risk attitude, then, excessive risk-taking behavior of investors.

An objective of the regulation announced by the SEC was to protect investors' benefit by doing an investor risk investigation. On the other hand, a financial consultant, by knowing an investor's risk tolerance, could do some advice based on the investor's risk score. Conceptually, this should benefit both investors and the sellers of financial products. The standard test is based on an investor self-report questionnaire which is divided into two parts. The first part involves investors' investment profile which will be used to estimate risk tolerance. The questions, for example, are about age,

[2] SEC announcement กลต.นจ. (ว) 17/2560 as of date April 28, 2017.

educational background, investment knowledge, investment experience, time of which investors do not have to use this invested money, the proportion of entire investment to assets, investment attitude (i.e. degree of loss tolerance), and investment objectives (i.e. degree to which investor want to compete with inflation by taking higher and higher risk). The second part of the questionnaire involves foreign exchange risk in order to certify whether or not investors could accept a loss caused by foreign exchange rate fluctuation when investing in foreign currency denominated assets. However, the questions could be slightly different amongst each investment selling agent. Some questions might be added but in order to comply with SEC the standard questions have remained.

The answers to the questions are in form of multiple choices (e.g. A, B, C, and D) which each of them have a different score. The higher the level of risk tolerance related answer is the higher the score, vice versa. For instance, the question about the age of an investor was based on the assumption that the older the people are the less risk they can accept. The answers were divided into four ranges of age (i.e. over 60 years old, 50-60 years old, 35-49 years old, and below 35 years old). Therefore, the younger investor would have a higher score for this type of question, meaning that a 35-year old investor would receive a higher score than a 60-year old investor by 3 points (i.e. each answer carries a score of 1-4 points). Still, each question may contain a different number of multiple choices. For example, in the question involving the educational background of an investor, there are only two choices which are below bachelor's degree or above. To this question, the concept of scoring is similar to the prior one that is higher educational background level will have higher score, vice versa.

After answering all of the questions in the questionnaire, the scores related to each selected choice will be added up. The total score (i.e. suitability score) will be compared with the fixed range of the scoring table which will give an interpretation of the investor’s risk tolerance. This table will separate investors into five groups based on their risk tolerance score, which are high risk tolerance, medium-high risk tolerance, medium risk tolerance, medium-low risk tolerance, and low risk tolerance. These five

groups will also be mapped to the eight levels of risky assets provided by SEC[3] – the so-called "risk spectrum". Therefore, financial consultants will be able to suggest appropriate financial products to their clients according to the degree of risk preference. Table 1 illustrates the result of investors' suitability test and risky assets which they can invest in based on the risk spectrum of the assets.

Conceptually, investors by knowing their own risk tolerance can only invest in the products which are suitable with their level of risk tolerance. For instance, an investor obtains a suitability score of 18 which indicates that his/her risk tolerance is medium-low. This investor can invest in mutual funds or financial assets classified as 1-4 risk score by the risk spectrum. However, according to SEC regulation, it does not perfectly keep investors out from investing in a higher level of risky assets than what is suggested by the table. In practice, if investors would like to invest in a higher level of risky assets, they have to give the banks or financial selling agents their written agreement which states their understanding and acceptance of risk exceeding the appropriate level suggested by the suitability test. Legally speaking, in such a case, the financial product seller does disclaim any responsibility for losses incurred by investors.

Table 1.1 Individual Suitability Test and Risk Spectrum

Suitability Score (pts.)	**Investors' Risk Tolerance**	**Risk Spectrum of Funds which can be Invested in**
Below 15	Low	1
15-21	Medium Low	1-4
22-29	Medium	1-5
30-36	Medium High	1-7
37 and above	high	1-8

Source: SEC announcement กลต.นจ. (ว) 17/2560 as of date April 28, 2017.

[3] SEC also classifies each asset into eight groups according to its embedded risk level. For example, mutual fund is classified into eight levels based on its risk. The safest one is money market fund (i.e. score of 1) whereas the riskiest one (i.e. score of 8) is alternative investment fund which includes fund investing in oil, property and gold.

1.3 Research Idea

According to the standard risk assessment mentioned earlier, one may question the reliability and effectiveness of the test. Due to its self-report design, it is possible for investors to make a false statement in order to achieve their investment return target by excessive risk-taking behavior. Rather than giving investors information about their true risk tolerance which is the main purpose of the test, it may work the other way around. Specifically, investors may actually set the level of their risk so as to match their required return, meaning that practically they look for the funds they would like to invest and then attempt to do the test just to obtain a sufficient score in order to enable them to invest in the selected fund. This behavior distorts the main objective of the test which is to reveal the risk attitude of investors.

Furthermore, the questionnaire itself may contain some questions which are difficult for an investor to answer. In other words, to some questions involving financial investment, inexperienced investors may not accurately be able to reveal their true preferences. In this case, investors unintentionally state the false statement by selecting a choice that does not truly reflect their own preference. To some certain extent, this problem may not seem to be significant at first. However, due to the excessive and rapid growth of the financial market together with globally low interest rate trends, investing in financial instruments beyond bank deposits will yield a higher rate of return which is definitely attractive for newbie investors. Statistically, the number of these investors has increased over time, as well as the number of investment funds and asset management companies as can be illustrated in figure 3. As a result, this shifting trend of investment has changed investors' behavior and this inevitably comes with the risk which investors must be aware of.

Although nowadays the suitability test is widely used and accepted as a guideline by financial selling agents in order to make an evaluation on clients' risk tolerance due to the regulation, one could doubt its reliability. The test could be thought of as preliminary information about investors' risk perception; however, the big question is whether it accurately refers to investors' risk tolerance as intended. In the case that financial consultants fail to identify clients' risk tolerance, they may suggest an inappropriate financial product to their customers. Specifically, it leads to excessive

risk-taking behavior which may cause systemic risk to the financial system as a whole suggested by Sharma (2012).

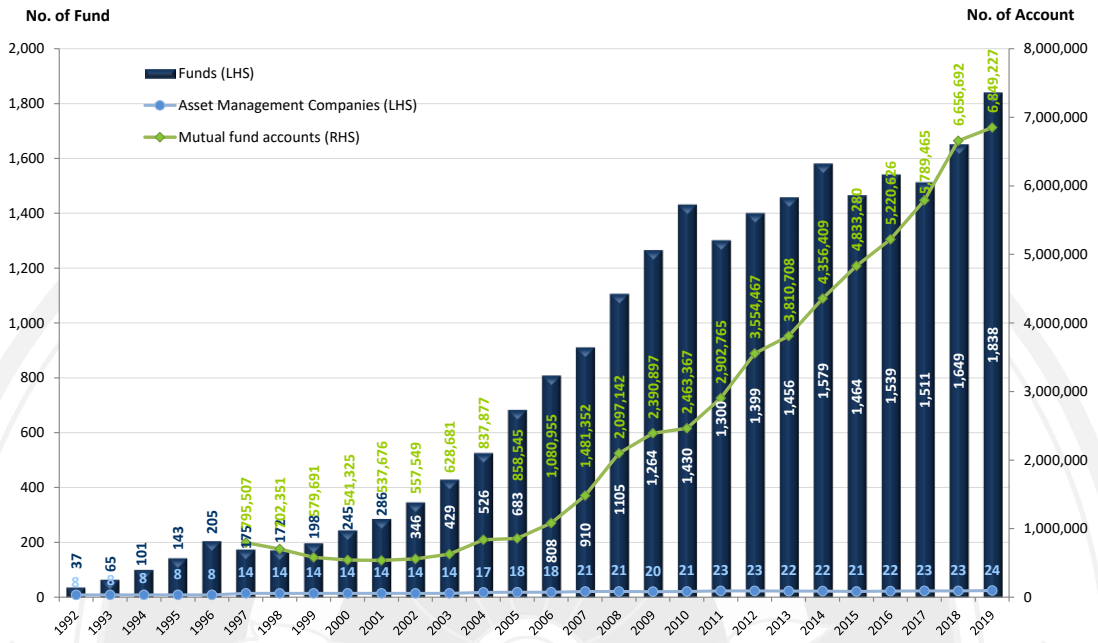

Figure 1.3 Number of Funds, Asset Management Companies, and Fund Investment Accounts

Note: 1. Association of Investment Management Companies- Management of Funds

2. The Securities and Exchange Commission of Thailand- and its management of funds

Due to the issues stated earlier, thus, there is room for some development. The SEC's standard suitability test could be a good starting point. Some questions in the test are useful and crucial for identifying investors' characteristics even though they may not be enough to conclude about investors' risk perception. By proving whether the suitability test is properly functional as a mean to classify clients' risk tolerance, it can build awareness in terms of using the test to both buyers and sellers of financial investment products. If there exist some limitations, regulators and especially the sellers should be cautious of its application. Moreover, to draw a conclusion on the risk tolerance of investors, an alternative method may be proposed which can be considered as worthwhile information helping to develop the financial investment industry.

Another point involving investors' risk preference and investment behavior is that nowadays the regulator (i.e. SEC) requires banks, asset management firms, and financial product selling agents to put risk warning statement (RWS) and investment disclaimers in advertising or marketing material of mutual funds and financial products. RWS could appear in many different phrases, for example, "the investment is not deposit/saving and subject to investment risk", "past performance is not a guarantee of future results", "investors should study product's features, conditions, and relevant risks before making investment decision", and "investing in mutual funds carries some certain risks and possibility of losing the principal amount entirely or partially". An intention for RWS is to caution investors about the risk that they have to involve from purchasing the financial products or mutual funds. Nevertheless, these statements are somehow not really effective. Generally speaking, they are mostly ignored by investors. Hypothetically, there could be many possible reasons to explain this ineffectiveness of RWS such as 1) the statements appearing in the forms are presented in relatively small font size than usual, 2) the risk warning stated via media advertising spot (e.g. television and radio) may appear too fast for investors to catch up, 3) investors may experience gains (rather than losses) on their prior investment position which reduce the credibility of the warning statement, and finally 4) the wording used for warning statements may be either ambiguous or inappropriate which cannot build a concern on investment risk.

These, as a result, lead to excessive risk-taking behavior of investors as well since the warning statements cannot effectively lessen investors' risk appetite. Specifically, they cannot alleviate an overconfidence effect for individual investors about their investment. This overconfidence leads to excessive investment as suggested by Pikulina, Renneboog, and Tobler (2017). In other words, investors are too much optimistic about their investment risk such that they tend to overweight their expected future return and underweight risk from losing their investment. However, the first two reasons (i.e. small font size and speedy advertisement) seem to be quite easy to handle whereas the other two are likely to share the same root cause and are more complicated to solve. Therefore, it would be beneficial to the financial sector as a whole if an improvement on the RWS could be made in order to gain its efficiency on shifting invertors' risk preference. Bear in mind that investors' risk personalities could not be changed; nonetheless, risk preferences and investment behavior might be affected by

RWS which would shift or change investors' risk perception and investment perspective.

Objective of Study

This study aims to investigate an individual personality that influences investors' risk preference and financial risk-taking behavior. Instead of using personal information e.g. demographic variables, income level, educational background, and investment experience as suggested by the standard suitability test, the study will focus on the risk-taking personality embedded inside of each individual. Rather than measuring individuals' risk preference alone, individuals' personality traits will also be evaluated and hypothesized to cause the risk preference. By this mean, the reliability of the standard test could be verified together with other different types of measurement for risk preferences. Furthermore, in order to certify the linkage between individuals' risk preference and financial risk-taking behavior will be assessed. This research will make an attempt to find a conclusive linkage amongst personality risk-taking traits, individual's risk preference, and financial risk-taking behavior. Furthermore, a new measurement for risk preference which may be applied together with a self-report questionnaire will be provided. The results will definitely be compared and contrasted with other measures in order to certify their effectiveness.

Upon the findings, investors will be classified into specific groups based on their risk preferences (i.e. risk-averse and risk-loving) which are caused by risk-taking personality (a.k.a. risk-taking traits). Financial consultant would be able to match a suitable financial investment product with their investors' risk attitude. Also, investors can actually review their own risk preferences more efficiently. Therefore, it could lead to less asymmetric information problems between buyers and sellers which cause a cost reduction for the financial investment business as a whole. From the financial regulator's point of view, by accurately identifying investors' risk preference, it could curb the severity and possibility of investment crisis as well as provide more effective protection to retail investors.

This study, furthermore, aims to make an investigation on the effectiveness of risk warning statement (RWS) or investment disclaimers required by SEC appearing in investment material and risk assessment form provided by banks or financial investment firms. Hypothetically, individuals' risk-taking personalities could be

viewed as internal identification and might not be easily changed whereas risk preferences and investment behavior should be considered as individuals' expressions which could be affected by external factors i.e. RWS. An alternative rephrasing RWS will be proposed in order to test if it can effectively build awareness of risk to investors in comparison with the standard version and, only if this is the case, the rephrasing version could be put in the financial advertising documents.

In summary, the objectives of this research can be addressed as follows:

1) To investigate the relationship between people's risk-taking traits, risk preference, and financial risk-taking behavior.

2) To improve and develop an alternative measurement of risk preference.

3) To observe an effect of RWS as shown in investment advertising or marketing documents on the relationship between risk-taking traits, risk preference, and financial risk-taking behavior.

CHAPTER 2

LITERATURE REVIEWS

Human behaviors and decision-making have long been studied and discussed over centuries. In the light of neoclassical economics theory, it is a virtue to assume the rational behavior of individuals for simplicity. To understand the decision-making in the economy, people including society have to act rationally, meaning that they simply pick the best solution for the sake of their own benefit. Individuals are able to reveal their own will and make a judgment to satisfy their demands. In other words, given a situation in which the decision has to be made, each choice can be rationally evaluable and measurable. People can compare amongst each of the choices and select the one with the highest value to satisfy their self-interest. Technically speaking, they are maximizing their utility function. Based on rational behavior, individuals must know the utility function and make a decision in accordance with this function. This concept is also linked to the expected value theory[4].

Let's assume for a moment that more is preferred to less (i.e. the higher the value, the higher the individual's utility). As suggested by the expected value criterion, given the situation where risky and safe choices are presented, an individual would logically choose the choice that yields the highest expected value regardless of his/her emotional preference over the choices. This also implies that the choice with a lower value would be considered as sub-optimum and cannot be selected because it will violate the assumption. However, according to the rationality axiom which an individual maximizes his/her utility, it does not seem necessary that one would pick the choice with the highest expected value. Rather than the value, individuals may concern

[4] Expected value can be computed by the summation of all possible outcomes weighted by probabilities.

about the utility which they can obtain from each selected choice. This implies that the choice with the highest expected value might not always guarantee the highest utility.

In the sense of individuals' decision-making, investment behavior is one of a kind which can obviously reflect what people's thinking process is in terms of making a choice. Conceptually, investment decisions of individuals are based on today's prospects about future return given the most available and up-to-date information. Because investors can probably end up with either losses or gains in the future, investments involve decision-making being subject to some uncertainty. Actually, investors have various investment choices which also have different risks embedded in them. Therefore, they can make a decision according to their expectation based on risk and return, for instance, deposit saving seems to be relatively safe and certain but lower return compared with investing in corporates' shares which probably gives significantly higher return but is subject to some risk and uncertainty. To make an investment choice, investors have to carefully and logically take all possible investment outcomes into their account which also have to match their risk preferences. This behavior, as a result, involves directly individuals' value and utility expectations in the decision-making process.

To clearly understand all the matters involving human risk-taking and investment behavior, it should begin with the relationship amongst three components in human decision-making and psychological thinking which are risk-taking personality traits, risk preferences, and investment risk-taking behavior. Hypothetically speaking, they possibly connect to each other in some sense which gives us a comprehensive explanation of what characteristics of people reflect risk preference and leads to risk-taking behavior. Finally, the conclusion on the existence of external factors (i.e. RWS) which affect people in the decision-making process in investment can be drawn.

2.1 Personality Traits and Risk-taking Traits

In psychology, trait theory–also known as a dispositional theory–is a method of studying human personality. The theory suggests that human personality can be

explained by traits that differ across people but are rather stable over time. Allport (1961) classified traits into three categories as follow:

1) Cardinal traits–These traits are the dominant traits that determine and shape an individual's life and behavior. Specifically, people with these traits are well-known for their outstanding characteristics and synonymous with others who share the same traits.

2) Central traits–These traits are rather common traits that form a fundamental character of the individual. They can be used to describe how a particular person is in terms of his/her personality. As suggested by Allport (1961), there exist 5 to 10 central traits in each individual and can also be applied to predict that person's behavior.

3) Secondary traits–These are the dispositions other than those two categories which are not quite generalized. Roughly speaking, these traits explain how people act differently from what they are under certain circumstances. They appear only when some situations have presented which lead to a deviation from common behavior.

Trait theory was used to create various kinds of personality tests, for instance, 16 personality factors questionnaire (16 PF), Eysenck's Personality Inventory (EPI), Minnesota Multiphasic Personality Inventory (MMPI). Amongst different formats of personality tests, the most popular approach which has been frequently referred to is the five-factor model (FFM) or Big Five personality traits. In the 1980s, the term Big Five was coined by Lewis Goldberg. These five factors which are the framework in describing an individual's personality can be defined as Openness to Experience, Conscientiousness, Extraversion, Agreeableness, and Neuroticism –the so-called OCEAN (McCrae & Costa, 1987). In terms of measurement, to examine an individual's Big Five personality traits, McCrae and Costa (1985) developed the NEO Personality Inventory (NEO PI) which was later updated to NEO PI-R (NEO-FFI for shorter version) and NEO PI-3.

Goldberg (2001) proposed an International Personality Item Pool (IPIP) being available on the internet website which can be freely used and accessed to the items pool by all researchers (Gow, Whiteman, Pattie, & Deary, 2005). As a result, it has been widely used and become more popular over time. The IPIP contains various inventories from different types and versions of personality tests, for example, original NEO PI and NEO PI-R of Costa and McCrae (1992) also an alternative IPIP version of NEO PI-R

or IPIP-NEO. Moreover, different number of items could possibly be selected (e.g. 50, 100, or full items)

2.2 Individual Risk Preferences

Risk involves uncertainty on the outcomes. The term risk preference has long been used in order to describe how people feel about risks (i.e. like or dislike) which can elaborate what kind of people are in terms of their perception of risks. Wen et al. (2014) defined risk preference as a people's attitude towards risks that influences the decision-making of investors. Risk preference can be categorized into three types which are risk-averse, risk-loving, and risk-neutral preference. In economics, these can be explained by the expected utility theory. Given the theory, the utility function of risk-averse agents is represented by a concave function whereas which of risk-loving is represented by a convex function. Individuals with risk-averse preferences are prone to avoid taking the risk and, as a result, value certainty more than uncertain outcomes given other things being equal. To make them choose the risky choice, thus, positive amount of risk premium is required. On the contrary, for those with risk-loving preference, uncertainty and risky choice is preferred. A negative risk premium can be shown in this particular case. To understand more on risk preferences, two related theories should be addressed.

2.2.1 Expected Utility Theory

The idea of expected utility came to play a role in economics since the early 18th century. The term was firstly initiated by Bernoulli (1738, as cited in Bernoulli, 1954) which illustrated that the utility function would be used to correct the expected value and it could be accounted for risk-averse behavior. Mathematically speaking, the utility function was proven to be a strictly concave-down function, for example, the logarithmic function which became a basic assumption in the study. This helps to explain the case where an individual does not pick the choice with the highest value as suggested by the expected value criterion, but the choice with the highest utility. Furthermore, the utility function could be shown to characterize the diminishing marginal utility which is broadly applied in economics. However, Bernoulli's

assumption seems to be violated easily in reality since risk-averse preference may not be the case for all people in society. For example, insurance companies which are another side of the insurance contract that write and sell insurance; as a result, they are taking the risk of damage.

In the context of expected utility, von Neumann and Morgenstern (1947) developed four axioms of rational behavior to explain that individuals when confronted with risky outcomes for different choices, individuals would prefer the choice that maximized their expected value of the utility. The utility could also be expressed in functional form also known as von Neumann-Morgenstern (VNM) utility function which is a fundamental idea in expected utility theory. As a result, individuals' risk attitudes can be different across people depending on their utility function. VNM utility theorem is also based on rational behavior. With this rational behavior, any individual who prefers a choice other than that suggested by maximizing expected utility would violate the axioms and be considered irrational. However, Tversky and Kahneman (1986) pointed out that the expected utility was the normative theory, meaning that it explained how individuals should behave rationally rather than how they actually did in reality which was expressed as positive theory[5].

2.2.2 Prospect Theory

The first introduction of prospect theory was presented by Kahneman and Tversky (1979). The theory was an alternative to conventional expected utility theory. It also proved that regarding expected utility there exist some violations in reality. Instead of the expected utility function, the application of the prospect theory value function has been employed. Conceptually, they are analogous and represent the same function. However, the prospect's value function is based more on actual evidence from decision-making. Therefore, unlike expected utility theory, prospect theory can be viewed as a positive or descriptive theory that explains human behavior observed in a real-world setting. Empirical evidences were shown so as to demonstrate how people actually act or react in a given situation.

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[5] As appeared in Ackert L. F. & Deaves R., Behavioral Finance Psychology, Decision Making, and Markets.

Prospect theory exhibited contradictory pieces of evidence from expected utility theory. This implies that people do behave inconsistently with expected utility. Interesting findings, for instance, showed that people perceived gains and losses differently. One of the famous phenomena which violated the expected utility theorem was an experiment asking respondents to choose between a certain amount of money and an uncertain expected amount which could be either a favorable amount or an unfavorable amount given some probabilities. Although the expected value of the two choices was approximately equal, the questions were presented in a different setting (i.e. one presented in gains, another in losses) and resulted in a different conclusion. In the event of gains (i.e. receiving certainty vs. uncertain outcomes with equivalent expected value), the majority of people chose certainty. On the contrary, in the event of losses (i.e. losing certainty vs. uncertain outcomes with equivalent expected loss), the majority of people chose uncertain outcomes. It is important to keep in mind that gains and losses, in such a case, are defined as the deviation from the reference point rather than simply the amount received or taken away.

The results imply that in the event of gains, people are risk-averse whereas, in the event of losses, they are risk-loving. The value function as demonstrated by Kahneman and Tversky (1979) is concave for gains and convex for losses also steeper for losses than gains. In other words, individuals are proved to be loss aversion. This provides a contradictory conclusion to the expected utility axioms.

2.2.3 Measurement of Risk Preferences

Donkers, Melenberg, and Van Soest (2001) proposed an idea to estimate individuals' risk attitudes by using lotteries. The main objective is to identify whether or not and how an individual's attitude towards risk varies with observed characteristics. The study was based on eight questions on lotteries which for five of these questions the respondents had to make a choice between two lotteries (i.e. first type) whereas the remaining three questions were probability equivalence questions (i.e. second type), meaning that the respondents had to state the probability of winning a given prize, which would have made them indifferent between receiving such a lottery and a certain amount of money. Those two types of questions had a risky (i.e. high

variance) and a safe (i.e. low or zero variance), which the authors used to discriminate high and low degrees of individuals' risk aversion.

For the first type of question, the answer for each would be collected and referred to by CH1, CH2…, CH5 where the respondents were required to choose between two lotteries i.e. low variance lottery (the safe option) and high variance lottery (the risky option). The risk-averse people would tend to select the safe lottery. For the second type of question, simulated scenarios were created where the individual had a certain amount of money and had to state whether how large the probability of winning the prize of a certain amount from another lottery ticket would make him/her feel comfortable to trade a certain amount for this lottery. The probability (%) obtained from each question in this type would be referred to by PE1, PE2, and PE3. The sure amount of money respondents obtained had been increased in each question such that amount of PE1 < amount of PE2 < amount of PE3. Therefore, a logical consistency required PE1 < PE2 < PE3, in the case that marginal utility of money is positive (i.e. more is preferred to less). Using the semiparametric model, this study imposed a single index restriction and a monotonicity condition, such that the index represented the respondents' risk aversion given a relationship with observed characteristics such as age, gender, education level, and income.

By applying semiparametric estimation techniques, the study found a significant relationship between the answer collected from questions on lotteries and age, gender, income, and education level. The results revealed that high negative attitudes towards risk were found mostly in females and older people whereas income and education level were positively related to attitude towards risk of an individual. The results exhibited the rejection of the null hypothesis meaning that the single index could not be used for all questions. However, the researchers found a positive relationship between the choices which had been made from the choice questions and the index derived from the probability equivalence questions. This implied that, to some extent, the index could be used as a general measure for risk aversion. Furthermore, an issue of lacking monetary incentives when answering the questions had been addressed. This could be considered as a drawback for this research. However, they could prove that real incentive may not be necessary in this case which was consistent with the study of Beattie and Loomes (1997).

Interestingly, in the study of Donkers et al. (2001), probability equivalent (PE) was used for respondents to state the chance of winning the prize which they were willing to accept given a certain cost of a lottery. Regarding expected utility theory, certainty equivalent (CE) is another measure of equivalence in decision-making between risky choice and certainty. Conceptually, CE is a certain amount of which someone feels indifferent between getting this amount and taking a bet. Hypothetically, this amount can satisfy an individual with exactly the same level of utility. Hershey and Schoemaker (1985) studied the two different methods in utility measurement (i.e. PE and CE) according to VNM utility functions. The experiment was conducted using a two-stage within-subject design in order to compare the result between PE and CE. Both gain and loss questions were also incorporated as well as the two sequences of the judgment PE-CE and CE-PE which as a result made it up to separate four experiments. The study did find inconsistent results between using PE and CE for each of the four experiments. Hence, possible explanations addressed in this research for these discrepancies could be for example psychological biases and heuristics as well as the random errors which induced systematic biases in the utility function.

A contradictory result was found by Ruggeri and Coretti (2015) through the study on two different techniques (i.e. PE and CE) in gambles involving life-years and quality of life. An objective of this study was to explore whether or not there exists an inconsistency between PE and CE techniques. The samples were collected from the interview process in an experimental setting. The results illustrated that there was no significant difference between the elicitation technique used in this study which implied that PE and CE could yield consistent conclusions on individuals' risk attitudes. Furthermore, they found that instead of the technique itself the results were sensitively caused by the different kinds of a gamble.

2.3 Financial Risk-taking Behavior and Portfolio Risk

In the context of economics and finances, investment has been involved directly with risk and return. By definition, return is what investors expected to receive from putting their money in some investment vehicles e.g. saving deposits, treasury-bills, corporate debentures, mutual funds, stocks, etc. Since investors anticipate obtaining the

investment return in the future time, it is inevitably subject to uncertainty. Thus, this creates some risk to an investor by probability or likelihood of not getting the return as expected. Specifically, risk can be defined as a possible deviation of return that causes investors to lose their initial investment. In financial investments, it may be the case that some secure investments, for example, government securities, have presumably no embedded risks because investors face no uncertainty about financial returns (Modigliani & Pogue, 1974). In reality, to some certain extent, the risk still exists due to the fact that government could be insolvent which causes a default on its debt; however, this is very unlikely and not a usual case for economics study. Therefore, in the financial context, treasury securities are relatively and hypothetically risk-free investments.

Further to single-asset investment which is unlikely to be in practice, portfolio investment can be illustrated as investing in multiple assets. Investors can put their money in various assets or asset classes at a time. Risk and return, therefore, will be estimated as a single portfolio. Markowitz (1952) proposed the idea of how each investment asset can contribute to a portfolio's risk and return as a whole. The idea is recognized as modern portfolio theory (MPT) or mean-variance analysis. In general, portfolio return, R_p, can be considered as changing in portfolio value from initial investment time to time t (Marling & Emanuelsson, 2012). According to MPT, given N securities in the portfolio, the return can be decomposed as a summation of return from each asset i times its investment portion or weight in a portfolio w_i (which add up to 1) illustrated as:

$$R_p = \sum_{i=1}^{N} w_i \cdot R_i \qquad (1)$$

By the definition, the conventional measure of risk is the standard deviation of return. Therefore, as suggested by MPT, portfolio risk can be estimated by the variance of portfolio return, σ_p^2, which is mathematically computed as follow:

$$\sigma_p^2 = \sum_{i=1}^{N} \sum_{j=1}^{N} \sigma_{i,j} \cdot w_i \cdot w_j \qquad (2)$$

The covariance of each asset pair, i, j is represented as $\sigma_{i,j}$ in equation 2. Therefore, portfolio risk which is the volatility of portfolio return can be calculated as:

$$\sigma_p = \sqrt{\sigma_p^2} \quad (3)$$

Given MPT, an investor is presumably risk-averse as he or she aims to maximize expected portfolio return for the lowest risk (Markowitz, 1952; Marling & Emanuelsson, 2012). Under the risk-return framework, one may construct an efficient set of portfolio investments –the so-called efficient frontier– which yields feasible and highest returns for a given risk level. As a result, the concept leads to portfolio optimization which is the case where the investor attempts to seek the investment portion for each asset such that the portfolio risk is minimized.

In addition to financial portfolio risk and return, a concept of information-search behavior has been applied to monitor risk-taking behavior. The idea of this is simply a study of the people's decision-making process in a specific circumstance. As described by Kuhlthau (1991), an information search process (ISP) was based on the six-stage model of the users' holistic experience in the process of information seeking. Those six stages included task initiation, selection, exploration, focus formulation, collection, and presentation which in each stage, it could be described as feelings, thoughts, and actions. In a decision-making process, people do the search to gather as much as possible information to ensure their decision. This happens because each decision contains uncertainty i.e. the risk-bearing decision. Therefore, in an investment decision, people come across an uncertain outcome which is in fact a perceived risk to them. This risk could be represented in many forms including financial risk (Lin, 2002). In this study, as a result, there will be two measures for individual financial risk-taking behavior (i.e. portfolio risk and information search).

Portfolio risk and information search, on the other hand, could relate to each other. Muhammad Zubair Tauni, Fang, and Iqbal (2016); Muhammad Zubair Tauni, Fang, and Yousaf (2015); M. Z. Tauni et al. (2017) investigated the relationship between information acquisition and trading behavior in financial markets by applying investors' big five personality traits as moderator. The results suggested that information acquisition led to an increase in stock trading frequency. However, the

study did not measure the risk level of investors' portfolios. Intuitively, if risk-averse investors are hypothesized to search more, this should suggest that a high information search could perhaps correspond with low portfolio risk. Nevertheless, it could be the case that searching leads to higher portfolio risk. Rana, Khan, and Baig (2014) investigated the linkage between incomes and risky-decision making by using information search as a mediator. The findings suggested that through information search, individual investors tended to select risky investment choices. The possible explanation was that searching actually increased individuals' confidence which caused them to be comfortable enough to pick riskier investment choices. In other words, searching may be viewed as a risk-reduction strategy (Tseng & Yang, 2011).

2.4 An Interrelationship between Personality Traits and Risk Preferences

To draw a connection between individual's personality and risk-taking preferences, Demaree, DeDonno, Burns, and Everhart (2008) conducted an experiment in slot-like games covering two-dimensional risk's spaces. In the study, there were two different slot-like games (i.e. W-game and P-game) which related with the amount of wager (W) in one game and chance of winning or probability (P) in another. Personality measurements were taken into account as independent variables which were hypothesized to affect risk-taking preferences. Therefore, the results from the two slot-like games were considered as dependent variables in two different dimensions. In an aspect of W-game, by assuming objective expected utility to be constant, participants were asked to adjust wager (W) for a given probability (P) which as a result would cause the jackpot amount (J) to change automatically since $J = W/P$[6] and utility from playing a slot-like game was zero (i.e. U=0). Likewise in W-game, participants were asked to adjust probability (P) for a given wager (W) in P-game and J would be adjusted correspondingly.

[6] According to Demaree et al. (2008), the games were designed such that utility of participant receiving from each slot-like game was zero, meaning that the wager was exactly equal to expected gain from wining a jackpot (i.e. $U = P \times J - W = 0$).

In terms of personality measurement, three different scales were used by asking participants to answer the questionnaires which could be listed as follow:

1) BIS/BAS Scales (Carver & White, 1994) – According to Reinforcement Sensitivity Theory (RST) proposed by Gray (1982, 1987), there are two systems that dominate human behavior i.e. Behavioral Inhibition System (BIS) and Behavioral Activation Systems (BAS). More specifically, BIS is associated with punishment, avoidance, and negative situations which leads to anxiety and unhappiness controlled by septohippocampal systems. On the contrary, BAS is linked to rewards, success, goals, and positive situations; thus, as a result of the brain's dopaminergic pathways embedded in mesolimbic system (Depue & Collins, 1999; Gray, 1994), it leads to happiness. Hence, Demaree et al. (2008) hypothesized that the ratio of BIS/BAS would increase as the risk-taking decreased.

2) Barratt Impulsiveness Scale, version 11 (BIS-11, Patton, Stanford, and Barratt (1995)) – Demaree et al. (2008) used this scale to measure impulsivity which was divided into three subscales i.e. Attentional Impulsiveness (AI), Motor Impulsiveness (MI), and Non-Planning Impulsiveness (NPI).

3) Zuckerman's Sensation-Seeking Scale, Form 5 (SSS-V, Zuckerman (1994)) – This measure can be divided into four subscales i.e. Boredom Susceptibility (BS), Thrill and Adventure Seeking (TAS), Experience Seeking (ES), and Disinhibition (D). However, the study eliminated some questions related to drug use and sexual conduct which reduced the total number of questions from 40 to 30.

The conclusion in this study illustrated that according to three scales used in an experiment, risk-taking was interconnected with BIS which was a concern over loss rather than BAS which was a yearning for gain. However, these two measures still contributed to an impact on risk-taking preferences. In terms of SSS, the study found out that it was more linked to the chance or probability of winning a game than the amount receiving (utility) in the case of winning. On the contrary, in either game, choice selections of the players were not influenced by impulsivity which Demaree et al. (2008) presumed that this might affect the choice to play or not to play at the beginning of the games already.

2.5 An Interrelationship between Risk Preferences and Financial Risk-taking Behavior

To investigate individuals' risk preference linked to financial investment, Corter and Chen (2006) attempted to assess investment risk tolerance of the individual investors by finding the relationship between investors' risk tolerance measured by Risk Tolerance Questionnaire (RTQ) and their investment portfolio. The research was based on a questionnaire taken from 63 graduate students in business. The average age was reported around 27-28 years old with 64% male and mostly had more than four years' work experience. This study developed the instrumental measure – the so-called RTQ – to assess several factors as possible which would potentially be the underlying risk aversion in the financial context e.g. decreasing marginal utility in the domain of gains, loss aversion, and a tendency to focus on expected losses rather than gains. The RTQ was adaptive in two dimensions (i.e. wealth scaling and adaptive question selection).

There were three questionnaires related to risk attitude assessment which would be randomized. The RTQ was also designed to assess the riskiness of respondents' current investment portfolios. The questionnaire, moreover, asked the respondents to specify the percentages of the assets allocation in their investment portfolio e.g. futures, hedge funds, naked options, equities, real estate, bonds, and cash. Portfolio risk (PR) for each participant was measured by multiplying the risk weighting score by the proportion of each individual invested in that asset class.

The study found proof of reliable measurement for an individual's risk attitude using RTQ. Its validity was confirmed by a significant positive correlation of risk tolerance score with the riskiness of respondents' portfolio. In accordance with the correlation results on sensation-seeking scale[7], the conclusion could be drawn such that the risk-taking behavior was a situation-specific behavior, not a general personality trait. However, they addressed this issue based on the fact that the study mainly focused on investment risks which could be different from other research findings that found

[7] Sensation-Seeking Scale (SSS) was developed by Zuckerman, Kolin, Price, and Zoob (1964) with the purpose of assessing the personality traits. The study had applied the SSS (Zuckerman, 1994) as one kind of risk attitude questionnaire.

some significant relations between sensation seeking and everyday financial risk e.g. Wong and Carducci (1991) and Horvath and Zuckerman (1993).

For information-search behavior, it is based on the topics of consumer behavior which explains the linkage between consumers' risk perception and the decision-making process to purchase products or services. There exists a piece of evidence that consumers make more searches when engaging in higher prices, more visible, and more complex products (Beatty & Smith, 1987). In terms of risk preferences, Moorthy, Ratchford, and Talukdar (1997) found a positive relationship between risk aversion and the amount of search for both directed search and random search. This implied that a higher degree of risk aversion led to more searches. The finding was consistent for both pre-purchasing and already-purchased cases; however, the effect was found significant for just pre-purchasing case. Information search itself could be viewed as risk-reduction scheme for risk aversive consumers in the sense that they did actually search in order to reduce the risk associated with the products (Byzalov & Shachar, 2004). There exists evidence that investors who pay for fee-based information intermediaries are more risk-averse than those who do not. Also, the use of intermediaries increased information search which could be a result of search efficiency (J. Lee & Cho, 2005).

Perceived risk for the product purchase could be viewed in two dimensions (Bauer, 1969; Laurent & Kapferer, 1985) i.e. the perception of the severity of negative consequences due to the poor choice and the perception of the probability of making a mistake. In terms of financial products, this still holds true such that an investor has to make his/her investment decision based on the fact that he or she might incur some amount of loss given some probability. Furthermore, perceived risk has been found to induce consumer involvement (Laurent & Kapferer, 1985). In the consumer behavior context, consumer involvement as defined by (Zaichkowsky, 1985); Zaichkowsky (1986) is a motivational variable used to describe the degree of consumer interest, search, or sophisticated decision making over a particular object in the marketplace (e.g. products, services, and advertisements). Martenson (2005) evidenced a significant relationship between involvement and risk willingness for investing in mutual funds and stocks. The result was consistent with Ramesh, Murthy, and Kumar (2016) which found that perceived overall risk accounted for 98% of the variation in involvement. In addition, involvement was positively related to information search (Beatty & Smith,

1987; Moorthy et al., 1997). Pandey, Sharma, and Mittal (2013) also found that high knowledge investors who had high risk aversion scores (i.e. risk controllers) search more for all age ranges (i.e. young, middle-aged, and old). As a result, a higher level of risk aversion should be corresponding with higher involvement and higher information search behavior which could cause those who are risk-averse spending more time on decision-making process.

2.6 An Interrelationship between Personality Traits and Financial Risk-taking Behavior

Bucciol and Zarri (2015) investigated the relationship between investors' personality and their portfolio risk. The study hypothesized that personality traits should provide some impact on investors' propensity to take risks which caused different investment decisions across individuals. The Big Five model was applied in order to measure individuals' personalities. In this particular case, the five traits (i.e. the OCEAN) were taken as fundamental characteristics which caused thoughts and feelings of individuals. It was also supported by the finding of Nyhus and Webley (2001) which discovered that people with relatively stable emotions and introversion were prone to save more and borrow less, on the contrary, people with high agreeableness did the opposite.

In the study of Bucciol and Zarri (2015), the observations were taken from people with the age between 50 to 80 years which they claimed that with this age the personality traits would become stable. The model framework used in the research was constructed such that financial risk-taking indicators were dependent variables whereas personality scores were independent and the control variables were socio-demographic indicators (e.g. age, gender, wealth, etc.). Specifically, dependent variables can be addressed as follow: risky asset holding (i.e. investment position in either bonds or stocks which is the dummy variable), risky asset share (i.e. percentage of investment in risky assets), and chance market up (i.e. the additional measure of beliefs on markets return expectation). In terms of personality measure, there were 13 personality scores consisting of five scores from the famous Big Five model plus other 8 more traits such as Cynical Hostility, Optimism, Pessimism, Hopelessness, Loneliness, etc.

The result conclusion was drawn such that two scores out of thirteen (i.e. Agreeableness and Cynical Hostility) significantly caused a change in financial risk-taking. More precisely, Agreeableness was negatively related to financial risks whereas Cynical Hostility contributed a positive effect on financial risks. Thus, people with either low Agreeableness or high Cynical Hostility (or both) tend to take more risk in terms of investment. As a result, the study suggested specific characteristics of self-centered and uncooperative which could be properly explained by either low Agreeableness or high Cynical Hostility. Bucciol and Zarri (2015) pointed out further that self-centered people relied less on others; thus, in order to earn their wealth, they had to take more financial risks. An investigation of the beliefs also suggested that changes in portfolio risk-taking were caused by Cynical Hostility due to a shift of people's beliefs in market returns. In summary, the study found some relationship between individuals' risk-taking and personality traits.

It might possibly be the case that portfolio risk can be observed and investigated by its return as well since risk and return are obviously correlated in terms of financial portfolio investment. Noe and Vulkan (2015) also studied the linkage between portfolio manager performance and personality. By conducting an experiment that mainly focused on aggression personality, they found a significant influence on institutional investor behavior. This was apparently explained by the shifting probability of the deviation from the market portfolio, given an increase in aggressiveness. Phung and Khuong (2016) explored the impact of Big Five traits on individual investors' portfolio performance. They showed that Conscientiousness, Openness to Experience, and Agreeableness directly affected investment performance. The study also found out that the investors' mood was a mediator in the connection between personality traits and investment performance.

In terms of information search, Heinström (2003) investigated the relationship between personality traits measured by NEO Five-Factor Inventory (NEO FFI) and information-seeking behavior. The finding explained the significant relationship between traits and information-seeking behavior in many aspects. Neuroticism was associated with a preference for confirming information. The trait of anxiety, vulnerability, and neuroticism was connected to the preference for acquiring documents which were in line with Kuhlthau (1993) who explained that by confirming information

with the previous knowledge reduced the feeling of anxiety at the confusing state in the information-seeking process. Extraversion was linked to informal information retrieval. Conscientiousness and openness to experience were related to the effort for acquiring information. Risk-taking personality also shares the same traits as appearing in the NEO Five-Factor. For example, those who have a high risk-taking personality would be associated with a low score on anxiety, high extraversion, high extraversion, and low conscientiousness (Anic, 2007).

2.7 Risk Warning Statement as a Moderator

To investigate further on the effectiveness of RWS, first of all, it is appropriate to review the theory involving behavioral change caused by some external factors. To find the linkage amongst RWS, personality traits, risk preference, and investment behavior, much literature involving psychology and human behavior has been researched. The theory which suggests the connection between human behavior and the results from behavior is the self-efficacy theory by Bandura (1977, 1986, 1997). The theory suggested that a person to achieve the goal requires to have a belief in his/her ability to act which leads to behavior as well as a belief in the success of the outcome caused by that particular behavior (see figure 2.1). The belief in one self is self-efficacy which relates to people's judgments of the capabilities in order to complete the tasks. It is a perceived competence that does not necessarily correspond with an actual ability (Bandura, 1986). More generally, only if people believe they can do, they will do which as a result causes a behavior. Furthermore, it also involves the expectation of the outcome in accordance with the action. Therefore, this leads to the concept of outcome expectation in relation to self-efficacy. Bandura (1977) suggested that people would also estimate that given the action it had to cause certain outcomes. Specifically, people have to believe that they can do as well as believe in what they do will lead to an expected result which causes an outcome.

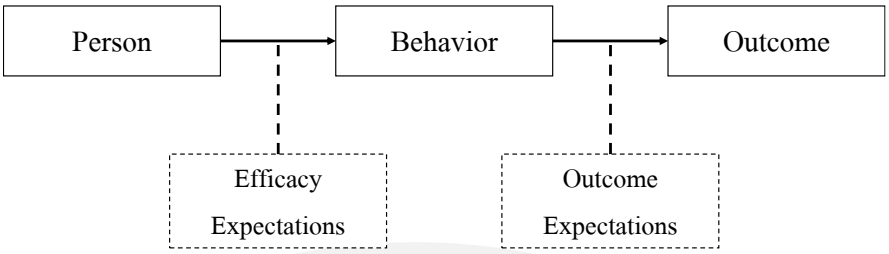

Figure 2.1 Bandura's (1977) Self-efficacy theory

Theoretically, RWS may somehow be considered as a discouragement of investment behavior which could create a negative effect on investment risk-taking. It is convincingly the case that individuals anticipate positive outcomes from their investment (i.e. profit). Hence, the existence of RWS such as warning on potential financial losses or losing on initial investment amount should lead investors to reduce the portion in risky investment; however, this is likely depending on the level of their risk tolerance.

Although hypothetically RWS should reduce the financial risk-taking behavior of investors, its effect on risk preference should be different. Unlike financial risk-taking behavior which is obviously a behavior or an action of the people, the risk preference involves attitude and perception of the people toward risk. The intention of the warning is to improve safety by providing sufficient information so as to build an awareness of the people. In terms of consumer products, we could come across various types of warnings, for example, the products that contain ingredients that may cause an allergy or harmful chemicals even in a very small portion. This is indeed a way that producers use to communicate with their consumers and let them make a decision over the products. At the first stage of the process, the warnings which carry sufficient information can create an understanding of the product to consumers which could lead to a positive perception of the products.

Mason, Scammon, and Fang (2007) studied the impact of warnings, disclaimers, and product experience on consumers' perceptions of dietary supplements. Their findings suggested that the warnings were able to impact consumers' safety perceptions and overall product evaluations. Based on the experiment, they found that to create safety perception, the heavy product users were significantly influenced by the

warnings. Y. O. Lee et al. (2016) also found that putting the warning label on e-cigarettes could influence perceptions about the dangers of these products. Thus, it pointed that there was an effect on the people's perception in particular due to the warning messages. Sanders-Jackson, Schleicher, Fortmann, and Henriksen (2015) found the effect of warning statements could significantly increase the perceived risk of e-cigarette on health. The study was based on an online experiment with young adults in the US. A general conclusion suggested that participants perceived that, given the warning, e-cigarettes were more harmful but less addictive. Despite of no studies involving directly the effect of warning statements over the risk preference of the people, the previous findings provided here do suggest that the warning statement affects the people's perception and attitude. Thus, the risk preference which can be viewed as an attitude or preference of the people toward risk has to be affected by the risk warning statements as well. Intuitively, by providing the RWS, only if the statement is clear enough, people should be more comfortable and feel more transparent about the situation and this finally should lead to a positive attitude or perception about risk.

In the context of empirical study, Mercer, Palmiter, and Taha (2010) explored the effectiveness of disclaimers appearing in the mutual funds' advertisements as required by SEC. For instance, the phrases: "past returns don't guarantee future returns" and "investors could lose money in the funds" could be shown to have no effect so as to build investors' risk awareness. Specifically, the study examined the effectiveness in two dimensions i.e. disclaimer content and disclaimer prominence. The disclaimer content is basically wording or phrasing used for a disclaimer in order to put a warning on the fund investment advertising. The standard content required by SEC was given as follows:

> Current performance may be lower or higher than the quoted past performance, which cannot guarantee future results. Share price, principal value, and return will vary, and you may have a gain or loss when you sell your shares.

According to the experimental results highlighted in the study, this statement was completely ineffective since it was proved that participants did not reduce their interest in fund investment. This is consistent with the finding of Hüsser and Wirth

(2013) which illustrated that disclaimers warning (i.e. “past performance does not guarantee future results”) was apparently ineffective given investors having limited time constraints to take this into their account. However, Mercer et al. (2010) suggested further that rephrasing the SEC’s standard content of disclaimer could help investors to capture the exact meaning of the warning and lead to a significant reduction in participants’ willingness to invest. Therefore, the strong content was illustrated as follows:

> Do not expect the fund’s quoted past performance to continue in the future. Studies show that mutual funds that have outperformed their peers in the past generally do not outperform them in the future. Strong past performance is often a matter of chance.

Regarding a given past performance of the fund, the study reported the 12% to 23% decreasing in participants’ willingness to invest according to this strong content. Also, it was illustrated that by showing participants the past fund’s performance together with the strong content disclaimer, they simply reduced their expectations on future returns of the fund. The results did not significantly vary across socio-demographic factors (e.g. participants’ student group, gender, financial literacy, and investment experiences). Moreover, according to the experiment, the strong content could even cause participants to entirely neglect the advertising of the historical performance. The key point raised by this study was that the strong content disclaimer effectively changed investors’ belief of past performance of the fund and caused their investment behavior. Although the study did not mention much about behavioral theory, it could be somehow linked to Bandura (1977) in such a way that the strong content disclaimer reduced investors’ expectation on the future outcomes.

Another point to add here about the rephrasing of the warnings is that, to some certain extent, the wording used to describe the situation should be clear, straightforward, and easy to understand. It has been found in numerous researches that using too many technical words or jargon could lead to confusion which makes people being unable to fully comprehend the messages. An ambiguity may somehow affect the perception of the people in two different ways. First, people may ignore the statements which of course leads to ineffectiveness of the warning. Second, people may feel

uncomfortable about the situation since they cannot fully understand the intention of the statements. As a result, it is possible for an unclear statement to create a negative perception and even discourage people's attitude toward a particular situation. Lepkowska-White and Parsons (2001) studied a warning vocabulary effect on the consumers' reaction to warnings. Their findings suggested that the consumers who were not able to comprehend the warnings due to the use of difficult vocabulary perceived differently about the safety of the products. Specifically, people perceived that the products labeling with simple words of warnings were safer than the products labeled with difficult words of warnings. Thus, the rephrasing RWS, in this case, should consider this point as well.

2.8 Research Hypotheses

In order to find conclusive results and statistical inferences, the research hypotheses are given as follow:

H_1: Individuals' risk-taking traits cause a variation in risk preference.

H_2: Risk preference causes people to have different financial risk-taking behavior.

H_3: Individuals' risk-taking traits cause people to have different financial risk-taking behavior.

H_4: RWS could moderate an interrelationship between individuals' risk-taking traits and risk preference.

H_5: RWS could moderate an interrelationship between risk preference and financial risk-taking behavior.

H_6: RWS could moderate an interrelationship between individuals' risk-taking traits and financial risk-taking behavior.

It is quite obvious in accordance with earlier literatures that H_1 to H_3 should illustrate a positive interrelationship, meaning that an individual who has relatively high risk-taking traits will have also high-risk preference (i.e. risk lover) which finally causes him/her to take more risk in terms of investment, vice versa. H_4 should demonstrate a positive impact on an interrelationship between risk-taking traits and risk preference due to the fact that the warnings could build a positive perception and attitude toward

risk to the people. In contrast, H_5 and H_6 should suggest a negative effect on the interrelationship between risk-taking traits and financial risk-taking behavior and between risk preference and financial risk-taking behavior because, given the presence of RWS, individuals should be more cautious and be aware of the risk. This, as a result, should reflect in the reduction of risk-taking behavior in their investment. Therefore, figure 5 shows the whole picture of the research framework and hypotheses.

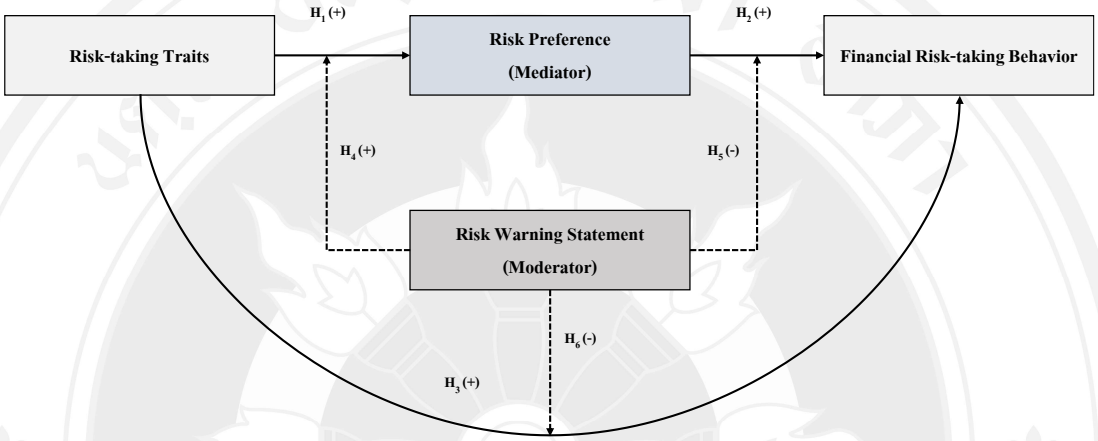

Figure 2.2 Research Framework

CHAPTER 3

RESEARCH METHODOLOGY

As mentioned in an earlier chapter, this study aims to make an investigation upon a relationship between risk-taking traits, risk preference, and financial risk-taking behavior. In this particular context, risk-taking traits are hypothesized to cause an individuals' risk preference (Demaree et al., 2008). This means that people with risk-taking characteristics (e.g. always participating in risky activities, adventure lovers, and enthusiasm for the challenge), in terms of risk preference, tend to expose themselves as risk lover. On the contrary, those who prefer being in safe and inoffensive situations (e.g. avoiding risky activities and dislike uncertainty) tend to expose themselves as risk-averse persons. Generally speaking, people's attitude about risk should reflect their risk-taking personality which could be revealed through their expression and behavior.

Risk preference which could be defined as risk-loving and risk-averse will affect what individuals do in terms of investment. Following the idea of Corter and Chen (2006) which found that people with higher risk-tolerance scores are prone to have higher portfolio risk, this suggests that risk preference leads to investment risk-taking behavior. Therefore, investment behavior should typically be dominated by investors' risk preferences. In other words, risk preferences will act as a mediator which passes on the effect from individuals' personality traits to portfolio risk. However, it could be the case that personality traits may directly cause individuals to have different portfolio risks (Bucciol & Zarri, 2015; Noe & Vulkan, 2015; Phung & Khuong, 2016). Although the prior literatures did find only some specific personality traits that influenced investment behavior, intuitively, it seems appropriate to draw a direct linkage between risk-taking traits and financial risk-taking behavior.

RWS, in this particular study, will be observed as a moderator, meaning that with the presence of RWS the relationships amongst each of the variables are expected to change. More specifically, it is hypothesized to negatively affect the

interrelationships. This is, however, different from the previous literatures by emphasizing more on to what extent in the relationship that RWS can cause an impact. Though Mercer et al. (2010) found that the presence of a standard disclaimer could not effectively cause individuals to reduce their willingness to invest and the stronger disclaimer was proposed instead, the study did not provide a clear explanation related to risk-taking and risk preferences of individuals. Also, the effect of RWS upon individuals' personalities and financial risk-taking has not yet been addressed. Hence, in this study, the existence of RWS will be investigated such that it may act as a moderator at any interconnection pairs.

3.1 Experimental Design

All the measures on risk-taking traits, risk preference, and financial risk-taking behavior are in form of questionnaires and tests. For the sake of convenience, an online testing platform is applied where all tests are divided into three parts according to the scope of this study (i.e. Part I: Test on risk-taking traits, Part II: Test on risk preference, and Part III: Test on financial risk-taking). However, there is a final part (i.e. Part IV: Financial knowledge assessment test) which is actually not a part of the model but it will act as a control to check on the financial objective knowledge of the participants in this test. In each part of the test, it will contain a set of questions that require participants to provide the answer based on given instruction. Participants would be able to join the test via provided URL or QR code. Firstly, they have to fill in their basic information on the registration page (e.g. gender, occupation, educational background, and monthly income) before entering into the test. After filling in all the required information on registration page, for those who were randomly selected by the program to be in the RWS groups, there will be an extra page which contains the RWS messages to be read and checked on each sentence in order to confirm reading. Then, the program will let them enter into the test starting with the part I. For the participants who do not belong to the RWS groups, they will be passed through to the part I right after they finish the registration page. All participants have to follow the testing sequence part-by-part from part I to part IV. To complete the test, participants are required to answer all the questions and follow all instructions.

RWS is applied in this experiment to investigate whether or not people act differently in the case of the presence of RWS vs. absence of RWS. Furthermore, as discussed in Mercer et al. (2010), RWS in this study will be separated into two cases which are standard RWS and strong RWS. This is in order to investigate whether there exists a different shift in people's risk preference or financial risk-taking behavior or not if the RWS has been posed differently. Hence, participants are randomly separated into three groups i.e. a group being subject to the strong RWS, a group being subject to the standard RWS, and a group not being subject to RWS which is a control group. Before entering into the test, those who are subject to RWS will be required to read the RWS (i.e. either strong or standard depending on randomization). During performing the test, the RWS will be shown in each part of the test as well. The standard RWS is a standard version of an investment disclaimer which people mostly come across when they have been advertised about financial investment. It is indeed required by SEC to put this disclaimer in the marketing materials or any advertisements. In other words, investment firms or banks have to warn investors about the risks and make them be more cautious about making an investment decision. In this study, as a result, the standard RWS is described as follows:

> Investments are risky. Investors should study the information before making an investment decision. Past performances do not guarantee future returns. The investments are not saving and do have embedded risk. Investors may in return receive less than the initial amount or may not receive the redemption amount within an agreed period.

The strong RWS, on the other hand, is a modified version that is rephrased from the standard version which aims to strongly stimulate people’s intention on the risk of investment. The statement emphasizes more on the loss of initial investment entirely or partially which may occur in the case of loss. As a result, the strong RWS should be more powerful and straightly hit to the point. Thus, in this study, the strong RWS is described as follows:

> This investment is not saving and may be subject to the risk of losing an amount of initial investment entirely or partially. Investors should not anticipate future returns by relying on past performances due to the difference of situations.

Investors must be aware of your level of risk tolerance and select an appropriate investment to fit your tolerance level.

As mentioned earlier, the final part of the test is the financial knowledge assessment test which aims to test respondents' financial knowledge. The assessment test is composed of nine questions involving different topics on both basic and intermediate financial knowledge i.e. type of financial products, characteristics of common stock, measurement of risk, understanding of risk vs. return, and portfolio risk and allocation. The test intends to measure objective knowledge which is based on participants' experiences or their knowledge background. The questions in the test are multiple-choice questions (i.e. 4 choices) with one correct answer. To complete the test, participants have to select only one answer to every nine questions. By giving a correct answer, the score will be counted as one which is then summed up to nine for a full score. The wrong answer would not be counted (i.e. zero scores). The participants will be required to do this part of the test once they have finished all the other parts of the test and after finishing this they are allowed to click complete the test. The results will be saved and the time used will be recorded[8]. In summary, the overall experimental design can be illustrated in figure 3.1.

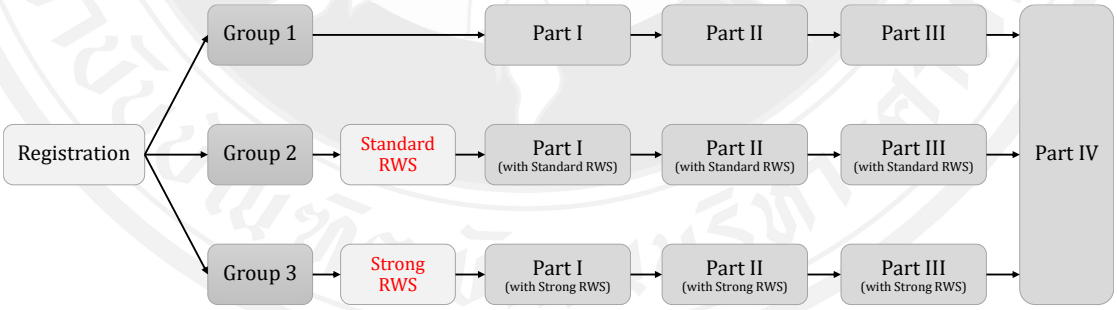

Figure 3.1 Overall Experimental Design

[8] Participants have 45 minutes to complete go through all parts and complete the test. Otherwise, the system will be timeout and the results will net be saved.

3.2 Testing on Personality Traits

In order to measure personality traits involving risk-taking behavior, the personality testing items are selected from IPIP (Goldberg, 2001). In order to be consistent with prior studies, Zuckerman's SSS will be applied to measure the risk-taking personality as well. Therefore, after reviewing the items in IPIP, there are two sets of measurements that seem appropriate to be used as a measure of risk-taking traits in this study. The first set of items comes from Sensation-Seeking: Dangerous thrill-seeking (Hoyle, Stephenson, Palmgreen, Lorch, & Donohew, 2002)[9] which consists of 10 items aiming to measure people's attitude toward dangerous circumstances. The second set of items is taken from Jackson Personality Inventory (i.e. JPI-R: Risk Taking)[10]. This measure consists of 10 items that focus on risky activities, for example, breaking the rules, or seeking adventure. Both measures contain both positive and negative items which the participants will be required to answer all the 19 items[11] of risk-taking traits. To each item, the participants are asked to provide the answer of "Very Inaccurate/ Most unlikely to be myself", "Moderately Inaccurate/ Moderately unlikely to be myself", "Neither Inaccurate nor Accurate", "Moderately Accurate/ Moderately likely to be myself", and "Very Accurate/ Most likely to be myself". As a result, this is a 1-to-5 score for each item.

3.3 Measuring Individuals' Risk Preference

Individuals' risk preference will be measured by four different measurements as follows:

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[9] The original reliability test on this measure was reported at 0.86 of Cronbach's Alpha.

[10] The original reliability test on this measure was reported at 0.78 of Cronbach's Alpha.

[11] There exist one item that appears in both Sensation-Seeking: Dangerous thrill-seeking and JPI-R. Thus, there are 19 items totally. The list of items is provided in Appendix A

1) The SEC's suitability test is the standard version required by the SEC. Actually, the suitability test that investors may come across when they contact banks or financial institutions could be slightly different from the standard version because what is provided by SEC is merely a guideline of the test and it is allowed to have an adjustment. In general, the test consists of two parts which are basically in the form of a questionnaire. The first part is the personal information of the individual (e.g. home address, spouse, occupation, monthly income, source of income, the purpose of investments, and beneficiary). However, according to the scoring method, answers in this part are not used to calculate the risk score. Thus, for the purpose of this study, there will be less benefit to have participants answer the questions in the first part.[12] The second part covers the questions related to investments and risk attitude which is used to calculate the risk score. There are 10 questions totally and each question has four choices. The score will be calculated and summarized according to the answer in each question which follows the SEC's standard method. The higher the score is, the higher the risk preference of an individual can be.

2) The lottery choices (Donkers et al., 2001) are the questions involving selection between two different risk-embedded lotteries. For example, let's consider the case where two lotteries with different payoffs are given such that lottery 1 (1,000; 1) and lottery 2 (2,000; 0.5)[13]. The expected payoff from these two lotteries is similar (i.e. 1,000); however, they both have different embedded risks (i.e. 0 vs. 1,000)[14]. There are 5 questions in this type of test which the participants are required to answer all of them. By choosing between the risky and safe lottery, the risk score will be calculated given

[12] Although the first part of the suitability test has not been incorporated in this test, the basis information and profile of the participants are collected upon registration which shares some information similar to the first part of the suitability test.

[13] Following the notation in Donkers et al. (2001), the (x; p) indicates that the lottery paying x amount with corresponding probability p and zero otherwise. Similarly, (x; p, y; q) further illustrates the case where paying y amount exists with corresponding probability q.

[14] The risk embedded for a lottery is measured by standard deviation of all possible payoffs.

a value of 1 for the risky option being selected and 0 for the safe option. Hence, the total score of 5 implies the highest degree of risk preference (i.e. risk-loving) from this test and vice versa.

3) The probability equivalent (PE) test (Donkers et al., 2001) consists of 5 questions. Participants are assumed to have a different amount of money as a reward for winning a game. They are asked to give that amount to purchase a lottery which they could earn either a certain amount of another reward in case of winning or nothing in case of losing. The participants are asked to state a minimum probability of winning the lottery that they felt comfortable enough to buy that lottery. In other words, with this probability, they are more willing to purchase the lottery than keeping that amount of money. The reward from winning a lottery is held constant across all 5 questions; however, the amount of money that the participant could use to buy a lottery would be increased from question 1 to 5. The purpose of this type of question is to capture a risk preference of individuals measuring by probability level (i.e. in percentage term). More specifically, those who state a higher probability tend to be more risk-averse since they require a higher chance of winning otherwise they would not buy a lottery.

4) The dollar equivalent (DE) test can be thought of as a tweak version of the PE. In fact, both PE and DE intend to measure people's risk preferences. However, the PE questions suggested by Donkers et al. (2001) were somehow not that easy to answer since the participants had to figure out the probability which they might not be familiar with. To answer, some might need even a further calculation on the expected return and work back the most acceptable level of probability. This would lead to a sophisticated process of thinking which in some cases participants could get confused and fail to give a proper answer. Generally speaking, participants might have some difficulty revealing their true answers involving probability. Rather than asking about a required probability of winning the lottery, participants are asked to put in the maximum amount that they would like to pay for the lottery given a fixed amount of reward and pre-defined probability of winning. This test is a reverse logic of the PE. For the sake of consistency, therefore, the numbers used in PE and DE questions reflect each other. Specifically, the probabilities used in each question of DE are computed correspondingly from the PE given a risk-neutral expected return. As a result, there are 5 questions in this DE test so as to be consistent with the number of PE questions. It can be said that respondents who

state a higher value of DE tend to be less risk aversive (i.e. more risk-loving) compared with the people who state a lower value of DE.

3.4 Measuring Financial Risk-taking Behavior

Financial risk-taking behavior is meant to elaborate on how people take the risk when they invest. In order to measure individuals' financial risk-taking behavior, following the methodology used in Corter and Chen (2006), portfolio risk for each individual will be measured by asking respondents to indicate the percentages (i.e. the weight) of investment assets into their hypothetical portfolios where a certain budget is given. More specifically, they have to perform asset allocation in order to reveal their financial risk-taking behavior. In this study, there are 30 given stocks available for participants to choose[15]. All stock prices are standardized to THB 100 per share to partial out the effect of high-low prices. However, they have different characteristics (i.e. embedded risk, historical average return, financial backgrounds, and forecasted price movement)[16]. All of this related information about each stock are provided and participants will be able to view them in this stock selection process. An initial amount of money is given at THB 100,000 which can be considered as a total budget for investment. Thus, the maximum amount of stocks that each participant can select into his/her portfolio is 1,000 units. Participants have to fill in the amount to each selected stock in order to do an allocation. Still, they also have a choice not to invest all or some part of the budget in stock. The remaining amount of budget will be considered as a saving that generates a small return but no risk. As a result, portfolio risk which is an

[15] The stocks provided here are actual stock listed in Stock Exchange of Thailand (SET) market (i.e. in SET50 to be precise). Therefore, information involving the stocks is actual data (e.g. PE ratio, volatility, historical return, and Beta). However, in order to prevent bias against specific stock, their names are blinded and given as code (i.e. A01 to A30) instead.

[16] Forecasted price movement for each stock is displayed by 3-year price chart based on the stock price simulation using Geometric Brownian Motions (GBM) method. See Appendix B for more detail.

attempt to gauge the risk of the portfolio itself can be measured by 1) the number of stocks in the portfolio, 2) portfolio standard deviation[17], 3) portfolio Beta, and 4) the percentage of cash in the portfolio. The higher the value of the first three is, the higher the degree of financial risk-taking of each individual should be[18]. On the contrary, a high percentage of cash left in the portfolio suggests a low degree of financial risk-taking.

Information search behavior, on the other hand, focuses on the behavior of respondents in the stock selection process which can be measured by 1) time used in stock selection[19], and 2) the number of clicks to open the stock price chart. A high value of these suggests that they are more careful in stock selection; hence, they are prone to have a low degree of financial risk-taking.[20]

Table 3.1 Variables and Measurements Summary

Variables	Measurements	Score/ Value Range
Risk-taking traits	SS	10 to 50
	JPIR	9 to 45
	SUIT	10 to 40
Risk preference	LOTT	0 to 5
	PE	0% to 100%

[17] See Appendix C for the calculation methodology for portfolio SD.

[18] Given modern portfolio theory (MPT), investor is presumably risk-averse as he or she aims to maximize expected portfolio return for the lowest risk (Markowitz, 1952; Marling & Emanuelsson, 2012). The measurement of risk in this case could be standard deviation of return (SD) and Beta of the portfolio. Intuitively, increasing in number of selected stock should imply that investors are willing to add risk in their portfolio.

[19] In the model, this measure is captured by SPEED which is one divided by time used.

[20] Referring to Moorthy et al. (1997), they found a positive relationship between risk aversion and amount of search for both directed search and random search.

Variables	Measurements	Score/ Value Range
Financial risk-taking behavior	DE	≥ 0
	NumStock	0 to 30
	SD	≥ 0%
	BETA	≥ 0
	CASH	0% to 100%
	SPEED	≥ 0
	CLICK	≥ 0
Financial knowledge assessment	FIN	0 to 9

3.5 Respondents and Observations

The participants for this study are randomly selected. They can easily access the testing platform via online by using their own electronic devices such as mobile phones, tablets, laptops, PC, etc. As long as those devices can connect to the internet, the participants can join the online testing via web browser by entering URL or simply scanning the QR code. The URL and QR code are distributed by various channels both online and on-field collection. Totally, there are 640 participants joining and providing the answers for the test. Based on the RWS group randomization, they are separated into three groups. As a result, 194 of them are subject to standard RWS, 220 of them are subject to strong RWS, and 226 of them are control group i.e. no RWS. The participants' general profile is illustrated in Table 3.2

Table 3.2 Profile of Participants

Profile	Detail	Participants
Gender	Male	280
	Female	360
Occupation	Government officer	65
	State-owned enterprise officer	24
	Corporate Employee	165

Profile	Detail	Participants
Level of Education	Self-employed	35
	Merchant	8
	College Student	298
	Freelance	16
	Retiree	4
	Other	25
	Undergraduate	83
	Vocational/ High Vocational Certificate	9
	Bachelor's degree	404
	Master's degree or higher	144
Income per Month	None	171
	Less than or equal to THB 15,000	130
	THB 15,001-30,000	153
	THB 30,001-45,000	82
	THB 45,001-60,000	36
	THB 60,001-75,000	23
	More than THB 75,000	45

According to the profile, participants are mostly college either bachelor's or master's degrees. The number of females is higher than males. Regarding the level of income, approximately 70% of them have an income per month equal to THB 30,000 or lower. It can be shown from the results that on average the participants spend 17:08 minutes going through all the tests. Most time is spent on part II of the test (i.e. risk preference) due to many questions compared with the other parts.

3.6 Measurement Model

To investigate the connection between risk-taking traits, risk preference, and financial risk-taking behavior, the model framework could be drawn such that risk-taking traits lead to risk preference and induce individuals' financial risk-taking behavior. More specifically, people with different risk-taking traits should have

different risk preferences. And therefore this difference in risk preference causes people to have different risk-taking behavior in terms of investment. Individual who has indicated as high (low) risk-taking in personality traits tends to be risk lover (risk-averse) in an aspect of risk preference and should be able to accept higher (lower) risk when he/she invests and seeks for investment return.

Each measurement as described earlier in 3.2, 3.3 and 3.4 will be brought together and the connection in accordance with the establishment of hypotheses will be used to shape up the model framework in this regard. In terms of behavior, as suggested by Bandura (1977), RWS will be taken into account as distortion in outcome expectation, meaning that the existence of RWS could lead investors to shift or change their financial risk-taking behavior. Hypothetically, the presence of RWS should reduce the financial risk-taking behavior of the people since they are warned about the risks which they have to come across when making an investment. On the other hand, in terms of preference and attitude, the risk preference could be shifted up due to the presence of RWS as it may encourage a positive perception of the people toward risk. In other words, the RWS could lead to a clear and comfortable feeling of the people which in turn positively affects the risk preference. Thus, the model framework can be illustrated in figure 3.2.

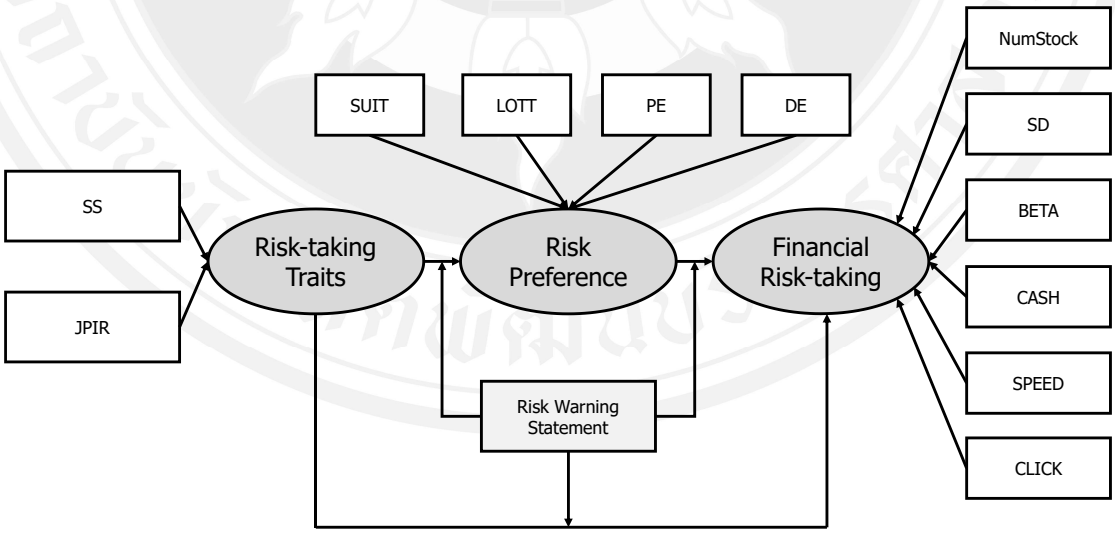

Figure 3.2 Model Framework

CHAPTER 4

RESULTS AND DISCUSSIONS

To meet the objectives of the study, by following the methodology as discussed earlier, the results and discussions from the experiment will be illustrated in this chapter. Descriptive results shall be discussed in order to provide an overview of the results from the experiment. Reliability tests are performed to illustrate the reliability score of each measurement. The statistical model will be estimated to give an explanation of the linkage between each variable.

4.1 Descriptive Results

4.1.1 Part I: Risk-taking traits

The first part of the test that participants have to encounter is to answer their risk-taking personality which will be captured by risk-taking traits. The test is composed of question items from SS and JPI-R. For each question, participants have to decide whether it is likely or unlikely to be their personalities or preferred activities. Specifically, they have to provide the answer ranging from “Very Accurate/ Most likely to be myself” to “Very Inaccurate/ Most unlikely to be myself” and, in accordance with this, the 5-point Likert score will be assigned (i.e. ranging from 5 to 1, respectively). The distribution of the answers given by all participants in the test is presented in Figure 4.1.

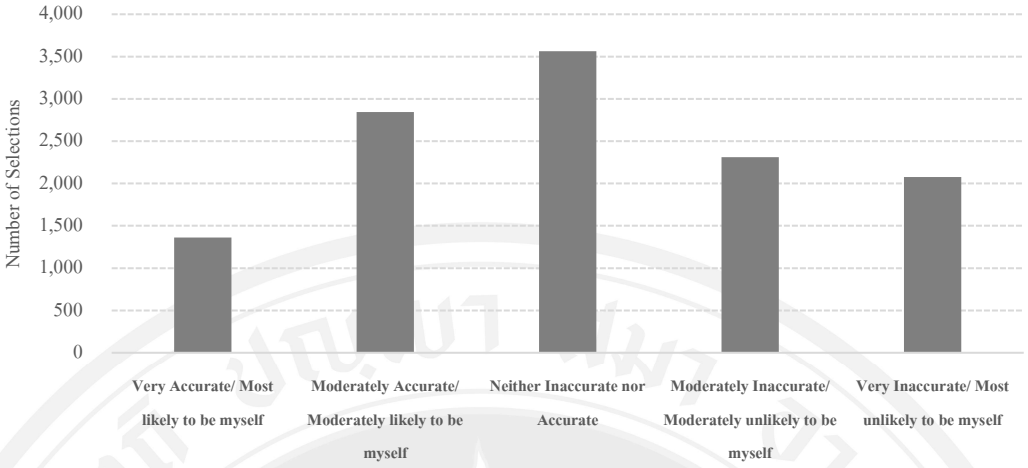

Figure 4.1 Distribution of Answers for Risk-Taking Traits

By dividing participants into three different groups according to RWS, on average, the result shows that the SS score and JPIR score for each group are about the same (i.e. insignificantly different). This can be presented by the mean scores presented in Table 4.1. According to the results, two points can be implied from here. Firstly, the randomization works quite well since the risk-taking traits score from each group is pretty close. Secondly, any type of RWS does not influence shifting in personality or risk-taking traits of the people which is what we expect to see in the first place.

Table 4.1 Mean Score for Risk-taking Traits Separated by Each RWS Group

Group RWS	**Number of Participants**	**Measurement**		**Total Score**
		SS	**JPIR**	
No	226	26.17	26.29	52.46
Standard	194	26.82	26.93	53.76
Strong	220	25.88	26.27	52.15

4.1.2 Part II: Risk Preference

In this part, the risk preference of participants is tested. The test comprises four types of questions that represent each of four different measurement methods upon risk preference (i.e. SUIT, LOTT, PE, and DE). For the suitability test, participants are provided the standard suitability test form as they could have come across when they

purchased any financial products at banks or asset management companies. This type of question contains 10 items which participants have to answer all of them. In each item, the score is ranged from 1 to 4 where 4 represents the highest risk tolerance level of the individuals and 1 for the lowest. The final score to this questionnaire would be the summation of all 10 items (i.e. the highest is 40 and the lowest is 10). On average, the suitability score for each group of RWS is roughly 25 which refers to a moderate risk tolerance according to the risk spectrum provided by SEC in Table 1. To these measurements, likewise in the case of risk-taking traits, there exists no significant difference in the score across different groups of RWS.

The next section of the test for individuals' risk preference is the lottery choices (i.e. "LOTT") which participants are asked to choose which choice they prefer most between two lotteries or games (i.e. between safe choice and risky choice). Thus, the score will be given as 0 and 1 corresponding to safe and risky choices respectively in each question. There are 5 questions for this type of questionnaire. An overall result is illustrated in Table 4.2. To this measurement, the average score for every three groups of RWS are 2.00, 2.11, and 2.06 for the group of no RWS, standard RWS, and strong RWS, respectively.

Table 4.2 Overall Selection Results for Lottery Choice Questions

No.	Choices	Number of Participants Selecting the Choice
1	Safe	463
	Risky	177
2	Safe	308
	Risky	332
3	Safe	334
	Risky	306
4	Safe	321
	Risky	319
5	Safe	434
	Risky	206

The probability equivalence questions (i.e. “PE”) have five items. In this type of question, the initial budget was given which participants could decide whether to keep or to use that amount to purchase the lottery and have a chance to win a prize (i.e. in this case the winning prize is THB 20,000). Participants are asked to state their minimum required probability of winning the prize (i.e. in percentage term) that they feel comfortable enough to put all initial budget in this lottery game rather than keeping it[21]. The prize is fixed across five questions whereas the amount of the initial budget varies from lowest in the first question to highest in the fifth question. Theoretically, the higher the stated probability, the higher degree of risk aversion participants are. The summary of the average probability that all participants gave to each question and the distribution are given in Table 4.3. To this type of measure, an average probability is reported at 45.01%, 45.63%, and 43.83% for the group of no RWS, standard RWS, and strong RWS, respectively.

Table 4.3 Average Probability and Results Distribution for PE Questions

No.	Amount of Money in THB	Avg. Prob. (%)	Number of Participants				
			0% < PE ≤ 20%	**20% < PE ≤ 40%**	**40% < PE ≤ 60%**	**60% < PE ≤ 80%**	**80% < PE ≤ 100%**
1	200	34.71	239	144	150	68	39
2	1,000	38.62	201	146	168	91	34
3	5,000	44.49	128	165	173	120	54
4	10,000	50.66	116	104	190	124	106
5	15,000	55.47	122	87	145	120	166

The last set of the test regarding risk preference is the dollar equivalence questions (i.e. “DE”). There are five questions so as to be consistent with the PE. As mentioned earlier, the questions are actually a tweak of the probability equivalence

[21] In other words, the initial budget that participants have to put all for buying a lottery can be thought of a price of a lottery itself that has a predefined amount of winning prize.

questions. More specifically, there is a given prize that is exactly the same amount as it is in the PE questions. Instead of stating the probability, however, participants are asked to state the amount of money that they feel comfortable enough to buy the lottery with a predefined probability of winning the prize. The amount that they would use to buy a lottery could be thought of as certainty since they can decide not to play a lottery game and keep it in their pocket. In general, the higher the stated amount to buy a lottery, the lower degree of risk aversion participants are. The probability of winning the prize varies across the items rather than the initial budget. The summary of the average amount that all participants give to each item and the distribution are given in Table 7. To each group of RWS, the average amounts that the participants are willing to pay for the lottery game are THB 1,513.22, THB 1,696.07, and THB 1,455.17 for the group of no RWS, standard RWS, and strong RWS, respectively.

Table 4.4 Average amount (THB) and Results Distribution for DE Questions

No.	Prob. of Winning	Avg. THB	Number of Participants				
			0 ≤ THB ≤ 4,000	4,000 < THB ≤ 8,000	8,000 < THB ≤ 12,000	12,000 < THB ≤ 16,000	THB > 16,000
1	1%	444.52	624	8	4	0	4
2	5%	597.33	618	14	4	0	4
3	25%	1,104.86	578	51	4	3	4
4	50%	2,154.43	509	59	63	3	6
5	75%	3,442.31	457	66	55	45	17

4.1.3 Part III: Financial Risk-taking Behavior

Participants are asked to perform portfolio allocation (i.e. stock selection) such that they have to select stock from a given list into their hypothetical portfolio. There are 30 given stocks (i.e. A01–A30) available for participants to choose. An initial amount of money is given at THB 100,000 which can be considered as a total budget for investment. As mentioned earlier, all stocks in the list are actual stocks listed in Stock Exchange of Thailand (SET). Participants can view them in this stock selection process. They have to fill in the amount to each selected stock in order to do an allocation. Still, they also have a choice not to invest all or some part of the budget in stock. The remaining amount of budget will be considered as a saving where

participants can earn a small but certain return. An overview of portfolio allocation in this part is illustrated in Table 4.5.

Table 4.5 List of Stocks and Overview of Portfolio Allocation

Stock	SD	Beta	Number of times being selected in Port.	Total THB Amount being selected in Port.	% Click to view the stock chart
A01	11.80%	0.29	158	2,282,400	9.41%
A02	13.94%	0.52	117	1,160,500	5.26%
A03	14.91%	0.42	220	2,741,200	6.98%
A04	16.33%	0.77	150	1,702,500	4.70%
A05	17.33%	0.69	199	2,291,600	4.36%
A06	17.41%	0.74	126	730,500	3.98%
A07	18.03%	0.67	140	1,212,600	3.46%
A08	18.93%	0.82	100	482,500	2.49%
A09	19.22%	0.81	127	957,500	3.32%
A10	19.40%	0.76	153	1,724,100	3.73%
A11	19.73%	0.90	119	848,200	2.70%
A12	19.92%	0.58	123	1,148,100	2.49%
A13	20.36%	0.32	91	511,100	2.04%
A14	21.00%	0.79	105	655,200	2.35%
A15	21.07%	0.86	86	343,100	2.01%
A16	27.77%	0.83	136	1,188,500	3.01%
A17	28.42%	1.15	81	242,500	1.76%
A18	28.93%	1.28	98	709,000	2.42%
A19	30.05%	1.56	116	899,700	2.73%
A20	30.71%	1.18	65	209,200	1.94%
A21	31.61%	1.05	88	601,400	2.84%
A22	33.73%	1.13	74	456,600	2.28%
A23	33.87%	1.30	65	226,300	1.97%

Stock	SD	Beta	Number of times being selected in Port.	Total THB Amount being selected in Port.	% Click to view the stock chart
A24	35.73%	1.06	123	1,870,300	3.35%
A25	35.94%	0.85	61	186,100	2.42%
A26	44.78%	1.14	58	328,900	2.35%
A27	45.44%	1.16	73	532,400	2.73%
A28	59.00%	1.79	101	597,000	3.42%
A29	69.22%	1.22	87	889,400	3.35%
A30	70.57%	1.71	125	1,749,100	4.15%

Please note that to measure financial risk-taking behavior, there are two major components in this case (i.e. portfolio risk and information search behavior). For portfolio risk, the number of stocks in the portfolio, portfolio standard deviation, portfolio Beta, and the portion of cash in the portfolio are computed based on the data provided by the participants. For information search behavior, the time duration that each participant use in this portfolio allocation process is recorded automatically by the program. However, this testing platform is designed to record the time in all parts of the survey. Table 4.6 demonstrates the average time participants spent on each page going through the test. Further to the time used, the number of viewing the stock chart is also recorded as a variable to measure information search behavior.

Table 4.6 Average Time Spent on Each Page of the Test

Page Number	Page Detail	Average Duration (minutes)
1	Registration	01:29
2	RWS*	00:38
3	Part I: Risk-taking traits	02:25
4	Part II: Risk preference	06:28
5	Part III: Financial risk-taking behavior	03:07

Page Number	Page Detail	Average Duration (minutes)
6	Part IV: Financial knowledge assessment	03:02

Note: * For participants who are subject to RWS (both standard and strong) only.

4.1.4 Part IV: Financial Knowledge Assessment

The financial knowledge assessment was added to the test in order to measure how well participants know about finances. Due to the fact that each of them may have a different financial background, the assessment may act as a control instrument to reveal more information about each participant. There were nine multiple-choice questions which the participants were required to answer all of them by selecting the right answer to each question. By getting it right, the score will be added by one point otherwise zero. According to the results, the average score taken from all participants is 3.30. An average score for each group of RWS is more or less the same which can ensure effectiveness of randomization.

4.1.5 Overall Results for each Group of RWS

By separating participants into three different groups according to RWS, scores from each part of the test are collected and summarized. After participants complete the test, all results and answers will be saved in the database separated by the group of RWS. Descriptive statistics (i.e. the mean and standard deviation) can be calculated and presented in Table 4.7.

Table 4.7 Descriptive Statistics of Test Results

Variables		Mean		
		No	**Standard**	**Strong**
Number of Participants		226	194	220
Part I: Risk-taking traits	SS	26.17	26.82	25.88
		(6.65)	(7.32)	(7.00)
	JPIR	26.29	26.93	26.27
		(4.59)	(5.24)	(5.08)
Part II: Risk preference	SUIT	25.31	25.55	25.57
		(4.89)	(5.07)	(4.99)
	LOTT	2.00	2.11	2.06
		(1.29)	(1.35)	(1.47)
	PE	45.01%	45.63%	43.83%
		(23.00%)	(22.96%)	(24.75%)
	DE	1,513.22	1,696.07	1,455.17
		(2,531.16)	(2,876.02)	(2,308.10)
Part III: Financial risk-taking behavior	NumStock	4.91	5.50	5.40
		(7.35)	(8.51)	(8.27)
	SD	9.50%	8.23%	7.96%
		(11.73%)	(10.54%)	(10.49%)
	BETA	0.43	0.38	0.37
		(0.44)	(0.42)	(0.42)
	CASH	50.93%	54.12%	56.88%
		(45.72%)	(45.55%)	(44.06%)
	SPEED	1,719.00	1,763.85	1,761.14
		(2,794.22)	(2,522.11)	(2,766.38)
	CLICK	2.73	3.19	4.16
		(5.95)	(7.18)	(8.00)
Part IV: Financial knowledge assessment	FIN	3.33	3.30	3.26
		(2.02)	(2.05)	(2.15)

Note: Numbers in parenthesis are standard deviations.

According to the numbers in Table 4.7, the mean score of the risk-taking traits measured by JPIR and SS is more or less equal across the groups of RWS. This implies that the participants which are randomly divided into a different group of RWS do share quite similar profiles regarding risk-taking traits and personality which is what we should look for in this study. The risk-taking traits are indeed characteristics embedded inside the people. Furthermore, since participants are subject to RWS at the beginning of the test, it implies that any type of RWS (i.e. either standard or strong) does not affect the traits of the people. In other words, RWS cannot cause a shift in risk-taking traits or personality.

For risk preference, the average scores as illustrated by SUIT, LOTT, and PE are relatively similar across the three groups of participants. This implies no significant difference in the risk preference of the participants whether or not they are subject to RWS (i.e. both standard and strong version). However, there exists a slight shift in the value of DE. For the group of strong RWS, the average DE is reported 1,455.17 which is lower than the group of standard RWS (i.e. 1,696.07) and the group of no RWS (i.e. 1,513.22). The DE gauges the risk preference by letting participants state the amount which they are willing to pay for the game and if they win, they will get the reward. Therefore, according to this concept, the lower amount of money the participants give, the higher the degree of risk aversive they are, vice versa. In the case of the presence of RWS, it is possible that it would affect the risk preference of the participant by making them be more cautious and give a lower amount of money. This is more obvious in the case of strong RWS than standard RWS; however, it may be too fast to draw any conclusion by just considering only the mean of the results. More statistical evidences should be further scrutinized.

For financial risk-taking behavior, in terms of portfolio risk, the number of the stock seems not to be significantly different between the three RWS groups. However, SD, BETA, and CASH report some differences between those three groups. The SD which is a measure of the standard deviation of portfolio stock return and directly captures the risk level of portfolio reports values of 9.50%, 8.23%, and 7.96% for the group of no RWS, standard RWS, and strong RWS, respectively. It possibly implies from the SD that there should be a downward shift in the case of the presence of RWS, especially in the strong RWS group. The lower value of SD suggests that the risk level of the portfolio is

lower. This could be caused by either the participants selecting more of the stocks with lower risk into their portfolio (i.e. they put more weight on the lower-risk stock) or they may increase the portion of cash in their portfolio. By considering the cash portion in the portfolio (i.e. CASH), there exists an upward shift in the percentage of cash in participants' portfolios. The CASH reports a value of 50.93%, 54.12%, and 56.88% for the group of no RWS, standard RWS, and strong RWS, respectively. Therefore, it implies that as the portion of cash increases, it could cause the risk level of the portfolio to fall. Furthermore, the portion of cash itself might reflect the fact that in the presence of RWS, participants are prone to rely more on cash which is a riskless asset and this effect is more obvious in the case of strong RWS than standard RWS. Regarding the BETA, likewise the SD, it seems to have a downward shift in the case where the RWS has been posted. This might suggest a lower risk level of the portfolio. However, there is almost no difference between the groups of standard RWS and strong RWS and overall, the number may be not that obvious as it is in the case of SD.

To investigate on the information search behavior, in the case of the presence of RWS there is a small upward shift in CLICK. For the group of strong RWS, an average number of clicks is reported at 4.16 compared with 3.19 and 2.73 for the group of standard RWS and no RWS, respectively. It may imply that in the case of the presence of strong RWS, the participants search for more information by clicking more on the available detail. On the contrary, SPEED seems not significantly different between the three groups which means that the participants might not spend time that much. However, this must be further investigated by other statistical methods before drawing a conclusion.

In addition, the study also collect the financial knowledge assessment score (i.e. the FIN) in order to see if there exists a significant difference across each group of RWS. The means and standard deviations of this are shown in Table 4.7. In case that there is a significant different in financial knowledge score, the results might be in doubt since the differences of the variables across the RWS groups could be caused by the different financial knowledge of the people in a particular group. Thus, to analyze on this, the statistical F-test is performed to check whether or not there exists a significant difference. Table 4.8 shows the result of the test. According to the result, the p-value of 0.949 implies that given 0.05 significant level, there is no significant difference in FIN

found across three different groups of RWS. This means that to each group of RWS, the participants have more or less similar financial knowledge background.

Table 4.8 Results of F-test on FIN

RWS Group	N	Mean	SD	F-test	P-value
No	226	3.33	2.02		
Standard	194	3.30	2.05	0.050	0.949
Strong	220	3.26	2.15		

4.1.6 Reliability Test

To scrutinize on the reliability of each measure, the reliability test is performed. For SS, JPIR, and SUIT, Cronbach's alpha was computed separately according to the RWS groups. For LOTT and FIN, the KR-20 method was applied. For PE and DE, Hoyt's reliability was used. Table 4.9 illustrates the reliability test for these variables.

Table 4.9 Results of Reliability Test

		Group RWS		
		No	Standard	Strong
SS	Reliability	0.781	0.797	0.804
	N Items	10		
JPIR	Reliability	0.621	0.729	0.720
	N Items	9		
SUIT	Reliability	0.640	0.671	0.672
	N Items	10		
LOTT	Reliability	0.384	0.438	0.563
	N Items	5		
PE	Reliability	0.904	0.902	0.906
	N Items	5		
DE	Reliability	0.828	0.871	0.812
	N Items	5		

		Group RWS		
		No	**Standard**	**Strong**
FIN	Reliability	0.552	0.588	0.654
	N Items		9	

According to the reliability test, in terms of risk-taking traits, the SS and JPIR for each group of RWS are in the range of 0.621 to 0.804 which is acceptable to good. For risk preference which is composed of SUIT, LOTT, PE, and DE, the LOTT has the lowest score amongst those measures which ranges from 0.384 to 0.563. The reliability score for the SUIT is acceptable. However, the PE and DE have quite high reliability scores such that all the values for the group of no RWS, standard RWS, and strong RWS are higher than 0.8. For the FIN which is a measure of financial knowledge of the participants and plays a role as a control variable in this study, the reliability ranges from 0.552 to 0.654.

4.2 An Analysis of the Dollar Equivalence

In order to investigate the effectiveness of the DE which is a proposed alternative way to measure risk preference, the correlation analysis will be applied. If the measure works well, we should observe a higher correlation compared with the others. In this particular study, measurements for risk preference are SUIT, LOTT, PE, and DE. However, the SUIT which is a suitability test is a standard practice in the financial investment business when investors contact the banks or investment firms for their investment. Therefore, it may be inevitable for investors to do the test as it is also required by the SEC. An alternative measure, as a result, shall be considered amongst the LOTT, PE, and DE with an aim to find a fine measurement to be used along with the suitability test.

Under this scope, we shall consider the linkage between risk preference and financial risk-taking behavior in particular to evaluate the effectiveness based on the correlation. The reason is that for the sake of the usefulness of the measures, it should lead to a conclusion on the financial risk-taking behavior of investors which is caused by different levels of their risk preference. Hence, the correlation matrices for each

group of participants being subject to different scenarios based on RWS are illustrated in Table 4.10 to Table 4.12.

Table 4.10 Correlation Matrix (Group: No RWS)

	LOTT	PE	DE	NumStock	SD	BETA	CASH	SPEED	CLICK
LOTT	1								
PE	0.0062	1							
DE	0.0819	0.0889	1						
NumStock	-0.0075	-0.0177	0.0742	1					
SD	-0.0037	0.0973	**0.2509**	0.1414	1				
BETA	0.0145	0.1197	**0.2685**	0.3729	0.8774	1			
CASH	0.0090	-0.1082	**-0.1724**	-0.3635	-0.7617	-0.9014	1		
SPEED	0.1073	-0.0004	0.0326	-0.3133	-0.3498	-0.4362	0.4681	1	
CLICK	-0.0335	0.0875	0.0553	0.0136	0.0834	0.1049	-0.1427	-0.2241	1

Table 4.11 Correlation Matrix (Group: Standard RWS)

	LOTT	PE	DE	NumStock	SD	BETA	CASH	SPEED	CLICK
LOTT	1								
PE	0.1170	1							
DE	0.0945	-0.0252	1						
NumStock	0.0204	-0.1070	-0.0269	1					
SD	**0.1832**	0.1379	0.1366	0.1117	1				
BETA	**0.2259**	0.0873	0.1381	0.2950	0.9050	1			
CASH	**-0.2379**	-0.1109	-0.1749	-0.2652	-0.7807	-0.8906	1		
SPEED	-0.0527	-0.0447	-0.1153	-0.3489	-0.3777	-0.4568	0.4783	1	
CLICK	0.0256	0.0108	-0.0294	0.2036	0.0911	0.1715	-0.1797	-0.2592	1

Table 4.12 Correlation Matrix (Group: Strong RWS)

	LOTT	PE	DE	NumStock	SD	BETA	CASH	SPEED	CLICK
LOTT	1								
PE	0.0406	1							
DE	0.0553	0.0546	1						
NumStock	-0.0552	0.1024	0.0789	1					
SD	0.1215	0.0413	**0.1586**	0.1654	1				
BETA	0.1183	0.0557	**0.1733**	0.3387	0.9218	1			
CASH	-0.0942	-0.0816	**-0.1777**	-0.3312	-0.7817	-0.9002	1		
SPEED	0.0048	-0.0851	**-0.1720**	-0.3299	-0.3521	-0.4218	0.4576	1	
CLICK	0.1322	0.0341	**0.2039**	0.0450	0.1010	0.1474	-0.1588	-0.2652	1

According to the results, as highlighted in the table, for the control group (i.e. the group of participants with an absence of RWS) and strong RWS group, in comparison with LOTT and PE, the DE demonstrates a higher correlation coefficient with respect to the measurements for financial risk-taking behavior. On the other hand, for the standard RWS group, the LOTT seems to overcome the others. Therefore, let's consider the results more in detail.

For the no RWS group, compared with PE and LOTT, DE has a higher interrelationship with the SD, BETA, and CASH. In fact, it is the only measure amongst the three measures of risk preference which illustrates relatively higher correlation between risk preference and financial risk-taking behavior (i.e. $r_{DE,SD} = 0.2509$ and $r_{DE,BETA} = 0.2685$) whereas the PE shows $r_{PE,SD} = 0.0973$ and $r_{PE,BETA} = 0.1197$ and the LOTT shows $r_{LOTT,SD} = -0.0037$ and $r_{LOTT,BETA} = 0.0145$. Thus, the DE seems to outperform the rest of the two measurements regarding risk preference. The positive value of the correlations between DE and SD and between DE and BETA suggests that participants with a lower degree of risk aversive (i.e. risk-loving) tend to have a higher risk in terms of a financial portfolio. It seems to be the case that they may select more risky stocks into their portfolio or put more weight on the risky stocks. In addition, the DE also shows a negative correlation with CASH (i.e. $r_{DE,CASH} = -0.1724$) which implies that people with a higher degree of risk aversive tend to put more money in cash saving

rather than stock investment which is considered to be riskier. This is indeed in line with our suggestion regarding a high risk level of portfolio for people having a low degree of risk aversive. For those who have low risk preference (i.e. high degree of risk aversive) which should have low risk level for their portfolio, it can be the case that they also increase their portion of cash in the portfolio, vice versa. As cash is a safe asset and bears no risk, the overall risk of the portfolio can be reduced. For the correlation between DE and CASH, the size is higher than the other two measures of risk preference (i.e. LOTT and PE) with CASH which may substantiate the more effectiveness of the DE over LOTT and PE.

For the standard RWS group, the LOTT seems to outperform the PE and DE in terms of correlation analysis. The DE, on the contrary, demonstrates a significant drop in terms of correlation values compared with the case of the no RWS group. As illustrated in Table 4.11, the $r_{LOTT,SD}$ is 0.1832 which is comparatively higher than 0.1379 and 0.1366 for $r_{PE,SD}$ and $r_{DE,SD}$, respectively. This is also the case for BETA which the correlation value between LOTT and BETA is way higher than between PE and BETA and between DE and BETA (i.e. $r_{LOTT,BETA} = 0.2259$, $r_{PE,BETA} = 0.0873$, and $r_{DE,BETA} = 0.1381$). The LOTT captures the risk preference by letting the participants choose between safe and risky choices. The higher the value of LOTT implies that a riskier choice has been made by participants. Thus, in terms of correlation, we expect to see a positive interrelationship between LOTT and the risk level of participants' portfolios as it is in the case of DE. In this analysis, it is illustrated by a positive correlation between LOTT and SD and between LOTT and BETA. Furthermore, there exists a negative interrelationship between LOTT and CASH. Similar to the case of no RWS group where we found a negative correlation between DE and CASH, in this situation, the correlation between LOTT and CASH shows a negative sign due to the fact that people can take more risk by reducing the cash portion in their portfolio, vice versa. Hence, the lower degree of risk aversive they are, the lower the cash portion in portfolio should be. Despite lower values of the correlation between DE and those measures on the risk of the portfolio, the correlation coefficient between DE and CASH is pretty close to the case of no RWS group (i.e. $r_{DE,CASH} = -0.1749$). Thus, we can still observe this consistent interrelationship between DE and CASH even if it may be not that obvious compared with the LOTT.

For strong RWS group, likewise the case of no RWS group, the DE is the only measure amongst the three that can illustrate a comparatively high correlation with financial risk-taking behavior although there exist lower correlation coefficients between DE and SD and between DE and BETA compared with an investigation on control group (i.e. $r_{DE,SD} = 0.1586$ and $r_{DE,BETA} = 0.1733$). However, the values are still higher than others measures (i.e. PE, and LOTT). In addition, there exists a significant increase in the correlation between DE and CLICK. With an absence of RWS and a presence of standard RWS, we do not see much of the relationship between risk preference and information search behavior. Nevertheless, with the presence of strong RWS, the correlation between DE and CLICK and also between DE and SPEED can be considerably observed. In fact, this explains a lot since, with the presence of strong RWS, people may be more cautious about investment selection. As a result, those who are more risk-loving tend to spend more time searching for more information before making a decision compared with the case where RWS has not been presented. This can be observed through the $r_{DE,SPEED} = -0.1720$. Moreover, to further support the information search behavior, a prominent positive correlation between DE and CLICK (i.e. $r_{DE,CLICK} = 0.2039$) implies that in the case of the presence of strong RWS, people do more search especially those who are more risk loving. In comparison with PE, and LOTT, therefore, DE can effectively capture a shift in search behavior of the people caused by the presence of strong RWS.

In summary, based on the correlation results, it suggests that the DE can do a better job than LOTT, and PE for no RWS group and strong RWS group. On the other hand, the LOTT seems to beat PE and DE for the standard RWS group. However, by considering the results from the reliability test in Table 4.9, the LOTT has quite low value on the test across all RWS groups. On the contrary, PE and DE evidence higher values and meet the standard of reliability test. In addition, according to the correlation results for the no RWS group and strong RWS group, LOTT cannot illustrate a clear picture of the interrelationship between risk preference and financial risk-taking behavior as DE does. Therefore, the DE should be a superior measure comparatively to LOTT, and PE. Moreover, given the results, it could imply that the strong RWS works better than the standard RWS since it can bring out a clear connection between risk

preference and financial risk-taking behavior of the people. If this is the case, it can refer back to the effectiveness of the strong RWS over the standard RWS.

4.2.1 Independent Test of Correlations

By focusing on two groups of RWS (i.e. no RWS and strong RWS), it should be appropriate to perform a statistical test to see if there exists a significant difference between the correlations of the two groups. This is in order to certify an ability to capture the effect from different RWS groups of three measures on risk preference (i.e. LOTT, PE, and DE). Therefore, the independent test of the correlations is applied in order to investigate the correlations between risk preference and financial risk-taking behavior. In this case, each measure of risk preference is compared in this analysis. The correlations (i.e. r) are mapped by using Fisher's Z Transformation[22] (i.e. Z) and statistically tested. Thus, the hypothesis is set such that $H_0 : \rho^{AR} = \rho^{PR}$ where ρ^{AR} represent the correlations from the group of participants not being subject to RWS (i.e. absence of RWS) and ρ^{PR} represent the correlations from the group of participants being subject to RWS (i.e. presence of RWS)[23]. The testing results are illustrated in Table 4.13.

[22] The Fisher Z Transformation technique was applied in order to transform the sampling distribution of Pearson's correlation coefficient (i.e. r) into a normally distribution. The formula is given as follows: $z = 0.5 \times ln\left(\frac{1+r}{1-r}\right)$. The Z transformation values of the correlations are illustrated in Table 4.13 and Table 4.14.

[23] Since we are considering only the case of no RWS and strong RWS, for the sake of simplicity, the groups of participants are denoted as absence of RWS (AR) and presence of RWS (PR).

Table 4.13 Results of Independent Test of Correlations

Financial Risk-taking Behavior	PE		DE		LOTT	
	Z score	P-value	Z score	P-value	Z score	P-value
NumStock	-1.263	0.103	-0.049	0.480	0.501	0.308
SD	0.591	0.277	1.012	0.156	-1.319	0.094*
BETA	0.677	0.249	1.051	0.147	-1.094	0.137
CLICK	0.562	0.287	-1.588	0.056*	-1.746	0.040**
SPEED	0.890	0.187	2.164	0.015**	1.079	0.140
CASH	-0.281	0.389	0.057	0.477	1.085	0.139

Note: ** = significant at 0.05, * = significant at 0.1

According to the testing results, it can be shown that, for DE, there exists a significant difference between two groups of participants found on its pairing with CLICK and as well as SPEED. There also exists a significant difference between two groups of participants regarding the correlation between LOTT and SD and between LOTT and CLICK. However, there is no significant difference found on the correlation pair of PE and any measure of financial risk-taking behavior. It is interesting enough that the significant differences of the correlations are found in the measure of information search behavior. As mentioned earlier, with the presence of RWS (i.e. strong RWS precisely), it could be the case that people might be more cautious about their decision making which would lead to an observable increase in the correlations between risk preference and the search behavior. Therefore, people take more time (i.e. represented by SPEED) and do more searches (i.e. represented by CLICK) if there exists a warning.

4.2.2 Dependent Test of Correlations

The results of the independent test of correlations do not suggest a significant difference in the correlation between DE and measures of portfolio risk (e.g. SD, and BETA). However, keep in mind that the independent test intends to test whether there exists a significant difference between correlations drawn from a different group of samples (i.e. in this case, group of participants being subject to strong RWS vs. not

subject to RWS). It can only tell us that given a different set of participants what correlation pairs are standing out. Hence, with the dependent test of correlations, we can do a further statistical test to see if there exists a significant difference amongst the correlations between the three measures of risk preference (i.e. LOTT, PE, and DE) and the measures of financial risk-taking behavior given the same group of participants. To be consistent with our scope, keep in mind that in this statistical test we shall focus on no RWS group and strong RWS group. Following the calculation formula and step suggested by Meng, Rosenthal, and Rubin (1992); Arnond Sakworawich (2003), the Chi-square (χ^2) results of the test and the Fisher Z transformation are illustrated in Table 4.14 and Table 4.15 for the case of absence of RWS and presence of RWS respectively. The null hypothesis is set such that for each measure of financial risk-taking behavior, there is no difference in the correlation across its pair of risk preferences. For instance, $H_0 : \rho_{SD,PE} = \rho_{SD,DE} = \rho_{SD,LOTT}$ is set to perform the test on the correlation between SD and each measure on risk preference.

Table 4.14 Fisher Z Transformation and the Dependent Test Results (Group: No RWS)

Fisher Z Transformation	**NumStock**	**SD**	**BETA**	**CLICK**	**SPEED**	**CASH**
PE	-0.018	0.098	0.120	0.088	0.000	-0.109
DE	0.074	0.256	0.275	0.055	0.033	-0.174
LOTT	-0.007	-0.004	0.014	-0.034	0.108	0.009
Chi-square	**1.235**	**8.242****	**8.225****	**1.911**	**1.487**	**4.151**

Note: ** = significant at 0.05

Table 4.15 Fisher Z Transformation and the Dependent Test Results (Group: With strong RWS)

Fisher Z Transformation	NumStock	SD	BETA	CLICK	SPEED	CASH
PE	0.103	0.041	0.056	0.034	-0.085	-0.082
DE	0.079	0.160	0.175	0.207	-0.174	-0.180
LOTT	-0.055	0.122	0.119	0.133	0.005	-0.095
Chi-square	**3.515**	**1.771**	**1.716**	**3.606**	**3.845**	**1.361**

According to the results, provided that the critical χ^2 for 1%, 5%, and 10% significant level are 9.21, 5.99, and 4.61 respectively, there exists a significant difference for SD and BETA in the group of participants not being subject to RWS. In this case, we can obviously observe that the DE is relatively high correlated with SD and also BETA than the PE and LOTT. Although the correlations between DE and CLICK and between DE and SPEED comparatively increase in the case that the strong RWS has been presented to participants, they are not sufficient to be statistically significant according to the testing results. As mentioned earlier, given the presence of strong RWS, the correlations between DE and SD and between DE and BETA drop, and no significant difference has been found in the dependent test. A possible explanation could be that, given the presence of strong RWS, people would try to reduce the risk in their portfolio by either choosing the less risky stock or putting more weight on cash saving provided that their risk preferences are held constant. This behavior may be evidenced by decreasing of an average portfolio's SD and BETA in the case of the presence of RWS compared with the case of absence of RWS. The average values are reported at 9.50% for the portfolio's SD and 0.43 for the portfolio's BETA in the case of the absence of RWS. These values are lower in the case of the presence of strong RWS to 7.96% for the SD and 0.37 for the BETA. Moreover, an average portion of cash saving increases from 50.93% in the case of the absence of RWS to 56.88% in the case of the presence of strong RWS.

4.3 An interrelationship between Risk-taking Traits, Risk Preference, and Financial Risk-taking Behavior

In this part, the relationship between risk-taking traits, risk preference, and financial risk-taking behavior will be studied. As mentioned earlier in chapter 2, given the research framework in this study, the risk-taking traits are hypothesized to cause the financial risk-taking behavior of the people through their risk preference. In other words, the risk preference is in fact can be seen as a mediator in the model. Therefore, risk-taking traits will indirectly affect financial risk-taking behavior. However, we also investigate whether there exists a direct effect from the risk-taking traits to the financial risk-taking behavior of the people. In this framework, RWS has been inserted into the picture as a moderator. It is hypothesized to reduce the effect of the risk-taking to risk preference and risk preference to financial risk-taking behavior and risk-taking traits to financial risk-taking behavior.

In order to investigate the relationship between those variables, statistical technics will be applied. The variables in this study are in fact cannot be obviously observed (i.e. latent variables). Thus, all measurements as described earlier in chapter 3 will be used to form up the variables and make it possible for us to draw a connection between each variable. Specifically, the risk-taking traits will be composed of observed variables as follows: SS, and JPIR. Risk preference will be composed of observed variables as follows: SUIT, LOTT, PE, and DE. Financial risk-taking behavior will be composed of observed variables as follows: portfolio risk (i.e. NumStock, SD, BETA, and CASH) and information search behavior (i.e. SPEED, and CLICK). The model, thus, is shaping up as described in Figure 3.2.

The statistical technique which is applied to evaluate the effect of the model is the Partial Least Squares Based Structural Equation Modeling (i.e. PLS-SEM). By considering all possible methods, this technique seems to be most fit with our model framework. The SEM technique is able to estimate the effect of each variable simultaneously as a system where the variables can cause from one to the others. Also, due to the formative structure of the measurement model, the PLS seems to be an appropriate approach to estimate the SEM model (J. F. Hair, Jr., Sarstedt, Hopkins, & Kuppelwieser, 2014).

It has been evidenced from the correlation analysis that the BETA is highly correlated with SD and CASH[24]. To further explain this, Table 4.16 illustrates the estimation result from the model along with VIF values to each variables. According to the VIF analysis, the results show that the BETA has a very high VIF value (i.e. 13.002) which is higher than acceptable value of 10 as suggested by J. F. Hair, Anderson, Tatham, and Black (1995). Apart from the VIF analysis, the results of model estimation in the first place could illustrate a significant weight of observed variables to their latent variables as provided in the Table x. Thus, in the model estimation, we decide to exclude the variable BETA and re-estimate the model since it could cause multicollinearity to the SEM due to its high VIF and correlation. In fact, BETA and SD measure the risk of the portfolio in a quite similar way. Specifically, The SD is computed from the standard deviation of the return of stock whereas the BETA is computed from the covariance of the stock return comparatively to the market return[25]. Therefore, the final observed variables for financial risk-taking behavior are NumStock, SD, CASH, SPEED, and CLICK. The results from the SEM model are illustrated in Table 4.17 and Table 4.18.

[24] See Appendix D for full correlation results.

[25] To be precise, $BETA = \frac{covariance(R_i, R_m)}{variance(R_m)}$ where R_i is individual stock return, R_m is market return.

Table 4.16 Model Estimation Based on All Observed Variables

Latent Variables	Observed Variables	Risk-taking Traits	Risk Preference	Financial Risk-taking Behavior	p-value	VIF
Risk-taking Traits	SS	0.552*			<0.001	1.7
	JPIR	0.552*			<0.001	1.7
Risk Preference	SUIT		0.547*		<0.001	1.156
	LOTT		0.488*		<0.001	1.118
	PE		0.239*		<0.001	1.015
	DE		0.316*		<0.001	1.029
Financial Risk-taking Behavior	NumStock			0.140*	<0.001	1.39
	SD			0.274*	<0.001	6.427
	BETA			0.301*	<0.001	13.002
	CLICK			0.079*	0.023	1.072
	SPEED			-0.199*	<0.001	1.396
	CASH			-0.292*	<0.001	5.522

Note: *p-value < 0.05

Table 4.17 Indicator Weight of Observed Variables to Latent Variables

Latent Variables	Observed Variables	Indicator Weight	p-value
Risk-taking Traits (RT)	SS	0.552	<0.001
	JPIR	0.552	<0.001
Risk Preference (RP)	SUIT	0.547	<0.001
	LOTT	0.489	<0.001
	PE	0.239	<0.001
	DE	0.316	<0.001
Financial Risk-taking Behavior (FRB)	NumStock	0.218	<0.001
	SD	0.345	<0.001
	CASH	0.143	<0.001

Latent Variables	Observed Variables	Indicator Weight	p-value
	SPEED	-0.313	<0.001
	CLICK	-0.385	<0.001

Table 4.18 Path Coefficient between Latent Variables and Moderator Effects

Path Direction	Path Coefficient	p-value
RT → RP	0.215**	<0.001
RP → FRB	0.255**	<0.001
RT → FRB	0.007	0.431
RT×D1 → RP	0.012	0.384
RP×D1 → FRB	-0.045	0.129
RT×D1 → FRB	-0.038	0.165
RT×D2 → RP	0.099**	0.006
RP×D2 → FRB	0.042	0.144
RT×D2 → FRB	0.029	0.229

Note: **p-value < 0.01

The model evaluation results report Average Adjusted R-Squared (AARS) = 0.069 at P = 0.02 which is significant at 0.05 level. Tenenhaus GoF (GoF) = 0.253 which is in the range of medium. Simpson's paradox ratio (SPR) = 0.778 which passes an acceptable criteria (i.e. greater than or equal to 0.7). R-squared contribution ratio (RSCR) = 0.977 passing an acceptable criteria (i.e. greater than or equal to 0.9). Statistical suppression ratio (SSR) = 1.000 which also passes acceptable criteria (i.e. greater than or equal to 0.7).

According to the results in Table 4.17, the indicator weight can give us information on how the latent variables have been formed up. Considering the risk-taking traits (RT), there exists a positive effect provided by JPIR and SS, meaning that the higher the scores of these are, the higher the risk-taking traits of the people are. The relationship is proven to be statistically significant given the p-value. For the risk preference (RP), the weights are all positive for SUIT, LOTT, PE, and DE. Except for

PE, all of these are showing rational direction. For SUIT, an increase in suitability score suggests more risk tolerance which implies a risk-loving preference. For LOTT, the higher score means a more risky choice has been made which implies a preference toward risk. For DE, a higher amount from DE basically means that people put more money to take risk given a probability of winning the prize. This also implies a low degree of risk aversive (i.e. risk-loving). However, for the PE, the higher probability required by individuals to win a given prize should imply a higher degree of risk aversive. Thus, an expectation of this direction toward risk preference should be negative. The financial risk-taking behavior has five variables (i.e. NumStock, SD, CASH, SPEED, and CLICK). For NumStock, SD, and CASH, they are a measurement regarding portfolio risk. According to the results, the weights for these variables are positive which means that financial risk-taking behavior will be high if these variables are high. For NumStock which represents the number of stocks being selected into portfolio, the more stock participants select, the more risk it should be in terms of portfolio risk, intuitively. For SD, this is quite obvious that the higher the SD is, the higher the portfolio risk. For CASH, on the contrary, this positive sign is something that counters our hypothesis. If the portion of cash in portfolio increases, it should reduce portfolio risk as a whole because cash can be considered a safe asset. However, the results suggest that as the cash portion increases, the financial risk-taking behavior of the people increases as well. Regarding SPEED and CLICK which capture an information search behavior of the people, a negative sign of both variables points us that they are increasing with the financial risk-taking behavior. For the CLICK, it makes some sense since people increase the click rates if they feel uncomfortable with the risk and then leads to lower financial risk-taking. However, for the SPEED, a positive sign has been expected in the first place since the reduction in speed of stock selection should suggest a lower financial risk-taking behavior.

Given the results of path analysis in Table 4.18, for the control group where RWS is not presented, RT which is an exogenous variable has a statistically significant positive impact on RP (i.e. coefficient is 0.215). Thus, the risk-taking traits cause a variation in risk preference such that participants who have high risk-taking traits should have high risk preference (i.e. low degree of risk aversive). This is consistent with Demaree et al. (2008) which found the personality differences (i.e. particularly,

risk-taking personality traits) affected risk-taking preferences via an experiment in slot-like games. The RP has a statistically significant positive impact on FRB (i.e. coefficient is 0.255), meaning that participants who have high risk preference should have high financial risk-taking behavior. In other words, people with a low degree of risk aversive should have high financial risk-taking behavior. This linkage can confirm the finding of Corter and Chen (2006) which found that a high risk-tolerance score led to high portfolio risk. There exists a small direct impact from RT to FRB but this is found to be insignificant (i.e. coefficient is 0.007). Bucciol and Zarri (2015), however, found the relationship between personality traits and investment decisions to be significant. That being said, their study had a bigger scope than our study. Specifically, their interest relied more on different kinds of personality traits whereas, given our scope of study, it focuses on risk-taking traits in particular. In summary, the model seems to be almost fully mediated, meaning that the risk-taking traits of the people can cause a change in financial risk-taking behavior only if it has been passed through the risk preference of the people.

By considering the effect of the presence of RWS, the D1 and D2 are added to the model which captures the case of the standard RWS group and strong RWS group, respectively. To consider if there exists a moderation effect from the RWS, the interaction terms will need to be considered and compared across each group of RWS. In the case where standard RWS has been presented to participants, an interaction between RT and D1 which is represented as RT×D1 is added to an interrelationship between RT and RP so as to investigate the effect of the presentation of standard RWS from RT to RP as well as RT to FRB. Also, the PR×D1 is added to an interrelationship between RP and FRB in order to see if there is a shifting effect caused by the presentation of standard RWS. Likewise in the case of standard RWS, the presentation of strong RWS is investigated if it can cause a shift or change in each interrelationship pair. Therefore, interaction terms (i.e. RT×D2 and RP×D2) are incorporated in the model to inspect if there exists an effect from the presentation of strong RWS.

According to the results in Table 4.18, the effects from the existence of standard RWS and strong RWS are estimated as the path coefficient from interaction terms to the dependent variables. In the case of the presentation of standard RWS, by considering an interrelationship between RT and RP, an effect of the presence of RWS

is 0.012, meaning that there exists a positive effect to the linkage between RT and RP given the presentation of standard RWS in comparison with other groups of RWS (i.e. no RWS and strong RWS). In other words, the total effect is computed at 0.227 which slightly increases from the case of no RWS and presence of strong RWS. For an interrelationship between RP and FRB, provided that standard RWS is presented, there exists a negative effect to this interconnection of -0.045 which, as a result, causes a decrease in total effect from RP to FRB at 0.21. However, these effects caused by the existence of standard RWS are proven to be statistically insignificant. Thus, it implies that the presentation of standard RWS cannot cause any significant shift or change to any interrelationship in the model[26].

Given the presentation of strong RWS, the interaction terms RT×D2 and RP× D2 are inserted into the model to observe the effect of existence of the RWS on each interrelationship between variables. According to the results, by considering the effect of RT×D2 on RP, it can be illustrated that the path coefficient is 0.099 which is positive and significant at 1% level. This implies that in the case where strong RWS is presented, there exists a positive effect to an interrelationship between RT and RP such that the total effect of RT to RP increases to 0.314 compared with the case of no RWS and standard RWS. However, the presentation of strong RWS does not cause any significant effect on an interrelationship between RP and FRB. The results show an insignificant positive linkage between RP×D2 and FRB given a path coefficient of 0.029. Thus, in summary, there exists a positive significant effect on the interrelationship between RT to RP whereas no significant effect is found on the interrelationship between RP to FRB given the presentation of strong RWS.

According to the findings above, it implies that in the case where there exists a presentation of standard RWS, there is no significant effect found to cause a shift or change on both interrelationships between RT and RP and between RP to FRB. In other words, the presence of standard RWS cannot create a different impact on the risk

[26] The effect of RWS on the interrelationship between RT and FRB should be ignored due to the fact that it has been proved to be statistically insignificant in the first place. Furthermore, according to Table 4.18, the effect of RT×D1 → FRB and RT×D2 → FRB are found insignificant.

preference or financial risk-taking behavior compared with the case where RWS is not presented and strong RWS is presented. On the other hand, the strong RWS is found to create a significant positive impact on the interrelationship between RT and RP, but it is not found significant on the interrelationship between RP and FRB. This implies that the presentation of RWS can cause a positive effect on the interrelationship between risk-taking traits and risk preference significantly and differently from the case where RWS is not presented and standard RWS is presented. Nevertheless, it cannot cause a different impact on the interrelationship between risk preference and financial risk-taking behavior compared with the case of no RWS and standard RWS. As a result, the standard RWS cannot moderate an interrelationship between risk-taking traits and risk preference and between risk preference and financial risk-taking. The strong RWS, however, can augment an interrelationship between risk-taking traits and risk preference whereas it cannot moderate an interrelationship between risk preference and financial risk-taking behavior.

As there exists a significant relationship of the strong RWS found, we should further confirm and scrutinize on the findings. Thus, it seems appropriate to examine the results in the case where the groups of participants are separated into two groups (i.e. strong RWS vs. non-strong RWS). The participants who expose to strong RWS are in the strong RWS group; however, those who expose to standard RWS and those who do not expose to any RWS are classified as the non-strong RWS group[27]. More specifically, linking back to the interaction and the dummy variables earlier, the strong RWS group can be indicated as D2 = 1 and the non-strong RWS group can be indicated as D2 = 0. The Table 4.19 illustrates the results from the model estimation by running the analysis of two different groups of participants separately.

[27] Since there are no significant effects found for the standard RWS, there are no need to separate out the participants who expose to the standard RWS from those who do not expose to any RWS.

Table 4.19 Path Coefficients Analysis

Direction	Group of non-strong RWS (D2 = 0)		Group of strong RWS (D2 = 1)	
	Path Coefficient	**p-value**	**Path Coefficient**	**p-value**
RT → RP	0.213**	<0.001	0.359**	<0.001
RP → FRB	0.225**	<0.001	0.317**	<0.001
RT → FRB	-0.039	0.21	0.058	0.19

Note: **p-value < 0.01

According to the results, there still exists a significant relationship found for the effect from RT to RP and RP to FRB for both group of strong RWS and non-strong RWS. The results are indeed in line with what have been found earlier by applying the interaction terms and extracting the results. To combine this picture with the model estimation based on the interaction terms, we can conclude that, according to the results, the presentation of strong RWS can cause a positive and significant shift on the relationship between RT and RP. This can be observed from the path coefficient of 0.359 for the strong RWS group in comparison with 0.213 for the non-strong RWS group. On the other hand, the presentation of the strong RWS has not been found to cause a significant effect of the relationship between RP and FRB and RT and FRB. Therefore, the results in the Table 4.19 cannot imply that there exists a significant difference between the group of strong RWS and non-strong RWS for those relationship pairs.

CHAPTER 5

CONCLUSION

As mentioned earlier in chapter 1, there are three objectives to this research study i.e. 1) to investigate the relationship between people's risk-taking traits, risk preference, and financial risk-taking behavior, 2) to improve and develop an alternative measurement for risk preference, and 3) to observe an effect of RWS to the relationship between risk-taking traits, risk preference, and financial risk-taking behavior. In accordance with the findings and results in chapter 4, we can summarize all the points to answer those three objectives one by one.

First, regarding the relationship between risk-taking traits, risk preference, and financial risk-taking behavior, the results illustrate that there exists a connection amongst those three variables. Given the model estimation results by PLS-SEM, people's risk-taking traits can significantly cause a variation in risk preference and the risk preference can significantly impact the financial risk-taking behavior. The best way to describe risk-taking traits is the risk-taking personality of the people. This personality or characteristic shapes up the people and perhaps it has been embedded deep down in people's minds. Roughly speaking, it is more or less like a habit. People who have high risk-taking traits are prone to have a high risk preference (i.e. risk lover) suggested by the findings. Risk preference, in general, is an attitude towards risk which influences the decision-making of the people. Intuitively, it makes great sense that people who have high risk-taking traits should have a positive attitude toward risk because it truly reflects who they are. In other words, they would prefer risky choices to safe choices, other things being equal. In terms of financial risk-taking behavior, according to the results, high risk preference people tend to have high financial risk-taking behavior. Unlike risk-taking traits and risk preference, risk-taking behavior has a more concrete form. We can explicitly observe people's risk-taking behavior through their actions and activities. Therefore, the financial risk-taking behavior can be observed via investment

activities of the people i.e. the way they invest, which assets they put their money in, and how they select those assets. The concept of a portfolio can help us to directly investigate this behavior. There is no, however, significant linkage from people's risk-taking traits to financial risk-taking behavior. As a result, it implies that the risk preference is indeed a mediator which passes through the effect from risk-taking traits to financial risk-taking behavior. Hence, up to this point, the hypothesis H_1 and H_2 can be supported. Although there are not enough significant results to support H_3 according to the findings, there exists a very small positive direct interrelationship between risk-taking traits and financial risk-taking behavior.

Second, regarding the alternative measure of risk preference, by comparing the correlation between the measures on risk preference (i.e. all alternative measures: LOTT, PE, DE) and financial risk-taking behavior across three different groups of RWS, the DE seems to outperform the LOTT and PE both in terms of reliability and correlation coefficient. By looking more closely into the detail, PE may suffer from the problem of difficulty to answer since people have to figure out the probability which is not that easy to come up with. In contrast, DE and LOTT seem to be easier to comprehend from most people's points of view. The questions are simple and straightforward. Thus, it is quite reasonable to see either DE or LOTT be a measure that can capture the relationship between variables more efficiently. However, the DE seems to be a more effective measure compared with LOTT due to the fact that it can illustrate a clearer relationship between risk preference and financial risk-taking behavior both in the case of absence and presence of risk warning statement. Moreover, the reliability test illustrates the higher score for DE than LOTT, meaning that it is more reliable measure. Therefore, the DE could be selected as an alternative measure for people's risk preferences.

Third, in the scenario where RWS has been presented, there exists some impact on the relationship between risk-taking traits, risk preference, and financial risk-taking behavior. According to the findings, the standard RWS which is the common version widely used by the banks and financial investment firms seems to cause a little and insignificant effect on the interrelationship in comparison with the case of no RWS and strong RWS. This implies that the current RWS which we have seen in advertising or marketing materials for financial investment products could not effectively change the

risk-taking behavior of investors. Furthermore, the attitude of people toward risk is not significantly affected by the existence of standard RWS as well. The modified version of the RWS which is a strong version aiming to further increase the power of warning also cannot cause a significant shift or change of people's financial risk-taking behavior. However, there exists a significant effect from strong RWS on an interrelationship between people's risk-taking traits and risk preference. Given the presence of strong RWS, there is a positive impact on the risk preference compared with no RWS and standard RWS. This can confirm our hypothesis that clear information of the risk warning should cause a positive attitude of people toward risk. In other words, to some certain extent, a strong version of RWS is found successful in making a clear point about risk and eliminating ambiguity about the risk warning statement in comparison with the standard version of RWS. Thus, H_4 is supported in the case of strong RWS.

The contributions of this study can be shown in two ways. Firstly, even though there have been numerous studies involving people's risk-taking traits, risk preference, and financial risk-taking behavior, we still have not much knowledge on the relationship among those three variables. This study proposes an interrelationship concept that draws the connection between them. Through an experiment, the findings can confirm the existence of the interrelationship in which the risk preference act as a mediator between risk-taking traits and financial risk-taking behavior. Therefore, if the financial regulators would like to control the financial risk-taking behavior of investors (i.e. preventing investors from excessive risk-taking behavior), the risk preference is key. The RWS (i.e. investment disclaimer) as a whole cannot effectively reduce the financial risk-taking behavior of investors according to an experiment. Secondly, given that the DE can work well as an alternative measure of risk preference, in the financial business industry, banks or financial investment firms may further adapt this tool to build on the test in order to gauge the risk preference of investors. Nowadays, the SEC's suitability test is the only tool that we have to investigate the risk tolerance of investors. Some information in the test is indeed useful for financial investment advisors or financial product sellers to preliminary investigate and screen out inappropriate investors given their selected investments. However, to effectively reveal the risk

preference of investors, it would be appropriate to add an alternative measurement of risk preference side-by-side with the standard test.

Finally, it is worth addressing the limitation of this study. The study is based on an online experiment in which there is no restriction on who can attend and do the test. However, due to an online platform, most participants are young adulthood (i.e. 35 years old or below) which in general they seem to be able to understand and handle the online testing platform more effectively. Particularly, they can walk through the test till completing it and have a higher success chance to experience the saved result page. Therefore, future research may focus especially on the development of experimental form which could be more suitable with a wide range of people's ages. In addition, in the case of RWS, the findings cannot suggest any effect on the financial risk-taking behavior even in the case of the strong version of RWS. Even though the strong RWS has an impact on people's risk preference, in order to apply RWS effectively in reality, the results should have suggested an impact on behavior. Hence, there is room for future research to explore further how to improve and develop a new version of RWS to be more effective and efficient.

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APPENDICES

Appendix A

List of Items for Risk-taking Traits

Table A Measurement items of JPI-R and SS

No.	Items	Type	References	Reliability
1	Enjoy being reckless.	Positive	Jackson Personality Inventory (JPI-R: Risk Taking)	α = 0.78
2	Take risks.	Positive		
3	Seek danger.	Positive		
4	Know how to get around the rules.	Positive		
5	Am willing to try anything once.	Positive		
6	Seek adventure.	Positive		
7	Would never go hang-gliding or bungee-jumping.*	Negative		
8	Would never make a high risk investment.	Negative		
9	Stick to the rules.	Negative		
10	Avoid dangerous situations	Negative		
11	Love dangerous situations.	Positive	Sensation-Seeking: Dangerous thrill-seeking (Hoyle et al., 2002)	α = 0.86
12	Like to do frightening things.	Positive		
13	Might actually enjoy being caught in an earthquake or tornado.	Positive		
14	Would like to try bungee jumping.	Positive		
15	Might enjoy the thrill of being lost at sea.	Positive		
16	Might enjoy a free fall from an airplane.	Positive		
17	Would enjoy being out on a sailboat during a storm.	Positive		
18	Prefer fear to boredom.	Positive		
19	Would fear walking in a high-crime part of a city.	Negative		
20	Would never go hang gliding or bungee jumping.*	Negative		

Note: * Duplicated item between JPI-R and SS

Appendix B

Simulation of Stock Price Paths

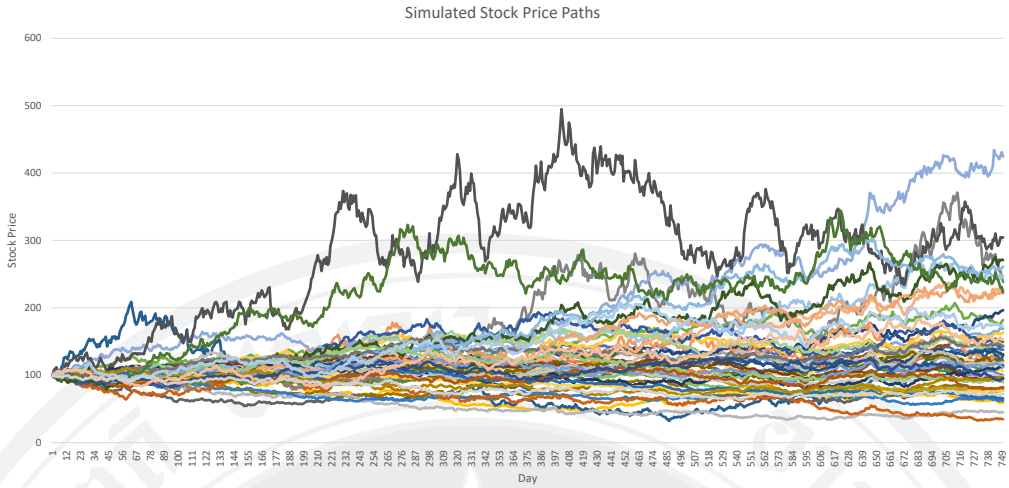
The simulation is computed by using the correlated Geometric Brownian Motions (GBM) method. Technically speaking, the GBM parameters are mean return and standard deviation of return for each particular stock where the generating function is based on a drift and random term. Basically, the drift term depends on the mean return of each stock whereas the random term relies on return deviation. The stochastic differential equation is given as follows:

$$dS_t = \mu S_t dt + \sigma S_t dW_t \quad (1)$$

where S_t is a stock price at time t, μ is mean return of the stock, σ is the standard deviation of stock return, and $W_t$is a Brownian motion (i.e. the Wiener process). The Wiener process, W_t, is normally distributed such that $W_t = \varepsilon\sqrt{dt}$ for continuous-time interval t where ε is a univariate random variable i.e. $N(0,1)$. The solution to the differential equation, thus, is summarized as follows:

$$S_{t+\Delta t} = S_t \cdot exp\left\{\left(\mu - \frac{\sigma^2}{2}\right)\Delta t + \sigma \cdot \varepsilon\sqrt{\Delta t}\right\} \quad (2)$$

By using the Monte Carlo simulation technique, the price path for each stock is generated in VBA Excel programming. Furthermore, in order to reflect the correlation effects amongst those stocks, the GBM generating process is computed by applying the Cholesky decomposition method. This, as a result, will create a set of correlated random numbers which is used to generate correlated GBM pricing paths. The results of 3-year pricing paths for all stocks are as follows:



Figures B Simulation Results of 3-year Stock Price

Appendix C

Computing Portfolio Variance

Given that portfolio of a participant comprises of n number of selected stocks. Thus, portfolio variance (σ_p^2) can be computed as follows:

$$\sigma_p^2 = \sum_{i=1}^{n}\sum_{j=1}^{n} w_i \cdot w_j \cdot \sigma_{i,j}$$

Where:

i and j are selected stocks in a particular portfolio.

w_i and w_j are the weight corresponding with each selected stock i and j.

$\sigma_{i,j}$ is the covariance of the historical return between stock i and j.[28]

Alternatively, in the matrix notation, the computation is as follows:

$$\sigma_p^2 = \begin{bmatrix} w_1 & \cdots & w_n \end{bmatrix} \begin{bmatrix} \sigma_{1,1} & \cdots & \sigma_{1,n} \\ \vdots & \ddots & \vdots \\ \sigma_{n,1} & \cdots & \sigma_{n,n} \end{bmatrix} \begin{bmatrix} w_1 \\ \vdots \\ w_n \end{bmatrix} = W^T \sum W$$

As a result, portfolio standard deviation (σ_p) can be calculated as: $\sigma_p = \sqrt{\sigma_p^2}$

[28] When i = j, the covariance will be $\sigma_{i,i} = \sigma_{j,j}$ which is exactly a variance of i and j.

Appendix D

Correlation Analysis

Table D.1 Full Correlation Matrix for no RWS group

	SS	JPIR	SUIT	LOTT	PE	DE	NumStock	SD	BETA	CASH	SPEED	CLICK	FIN
SS	1												
JPIR	0.6199	1											
SUIT	0.0916	0.2532	1										
LOTT	0.1122	0.1978	0.1751	1									
PE	-0.0150	0.0673	0.1691	0.0062	1								
DE	0.0889	0.0959	0.1601	0.0819	0.0889	1							
NumStock	-0.0186	-0.0124	-0.0384	-0.0075	-0.0177	0.0742	1						
SD	0.0248	0.0424	0.2018	-0.0037	0.0973	0.2509	0.1414	1					
BETA	0.0050	0.0796	0.2457	0.0145	0.1197	0.2685	0.3729	0.8774	1				
CASH	-0.0126	-0.0839	-0.1910	0.0090	-0.1082	-0.1724	-0.3635	-0.7617	-0.9014	1			
SPEED	0.0905	0.0605	-0.1047	0.1073	-0.0004	0.0326	-0.3133	-0.3498	-0.4362	0.4681	1		
CLICK	-0.0753	0.0057	0.0919	-0.0335	0.0875	0.0553	0.0136	0.0834	0.1049	-0.1427	-0.2241	1	
FIN	-0.0244	0.0426	0.4160	0.2267	0.1371	0.0794	-0.0183	0.2087	0.2741	-0.1825	-0.2112	0.1115	1

Table D.2 Full Correlation Matrix for Standard RWS Group

	SS	JPIR	SUIT	LOTT	PE	DE	NumStock	SD	BETA	CASH	SPEED	CLICK	FIN
SS	1												
JPIR	0.6590	1											
SUIT	-0.0426	0.2065	1										
LOTT	0.1708	0.3016	0.4475	1									
PE	-0.1055	-0.0006	0.0846	0.1170	1								
DE	-0.0083	0.0994	0.1771	0.0945	-0.0252	1							
NumStock	0.0072	0.0274	-0.0009	0.0204	-0.1070	-0.0269	1						
SD	-0.0572	0.0383	0.2729	0.1832	0.1379	0.1366	0.1117	1					
BETA	-0.0332	0.0873	0.2990	0.2259	0.0873	0.1381	0.2950	0.9050	1				
CASH	0.0364	-0.1136	-0.3315	-0.2379	-0.1109	-0.1749	-0.2652	-0.7807	-0.8906	1			
SPEED	0.1043	-0.0167	-0.1456	-0.0527	-0.0447	-0.1153	-0.3489	-0.3777	-0.4568	0.4783	1		
CLICK	-0.0067	0.0097	0.0685	0.0256	0.0108	-0.0294	0.2036	0.0911	0.1715	-0.1797	-0.2592	1	
FIN	-0.2199	-0.0343	0.4172	0.1736	0.0370	0.0700	-0.0086	0.3063	0.3190	-0.3006	-0.1947	0.1239	1

Table D.3 Full Correlation Matrix for Strong RWS Group

	SS	JPIR	SUIT	LOTT	PE	DE	NumStock	SD	BETA	CASH	SPEED	CLICK	FIN
SS	1												
JPIR	0.6422	1											
SUIT	0.1479	0.3026	1										
LOTT	0.2862	0.3073	0.3551	1									
PE	-0.0241	0.0242	0.1063	0.0406	1								
DE	-0.0091	0.0361	0.1614	0.0553	0.0546	1							
NumStock	0.0191	-0.0367	0.0192	-0.0552	0.1024	0.0789	1						
SD	0.1363	0.1605	0.3289	0.1215	0.0413	0.1586	0.1654	1					
BETA	0.1230	0.1613	0.3500	0.1183	0.0557	0.1733	0.3387	0.9218	1				
CASH	-0.1625	-0.1717	-0.3055	-0.0942	-0.0816	-0.1777	-0.3312	-0.7817	-0.9002	1			
SPEED	0.0248	-0.1232	-0.2879	0.0048	-0.0851	-0.1720	-0.3299	-0.3521	-0.4218	0.4576	1		
CLICK	-0.0424	0.0678	0.2446	0.1322	0.0341	0.2039	0.0450	0.1010	0.1474	-0.1588	-0.2652	1	
FIN	-0.1120	-0.0213	0.4209	0.0802	0.1071	0.2412	-0.0415	0.3282	0.3329	-0.3036	-0.2545	0.1591	1

Appendix E

List of Questions for Risk Preference

1) Standard SEC Suitability Test

Question No. 1-10 are to assess your Investment Suitability

1. How old are you?

a. more than 55 years old
b. 45-55 years old
c. 35-44 years old
d. less than 35 years old

2. At present, what is the proportion of your regular expenses (a mortgage or auto loan payment, other monthly expenses for yourself or your families etc.) compared with your total incomes?

a. more than 75%
b. 50-75%
c. 25-50 %
d. less than 25 %

3. What is your current financial condition?

a. Your assets value is less than your liabilities value.
b. Your assets value is equal to your liabilities value.
c. Your assets value is greater than your liabilities value.
d. You are confident that you can have sufficient savings or investments after retirement.

4. Have you ever received any information or had an experience on these kinds of investments?

a. Bank deposits
b. Government bonds and government bond funds
c. Corporate debentures or fixed income funds
d. Common stocks, equity funds or any other high-risk investments

5. How long do you think you do not need to spend this amount of money?

a. up to 1 year

b. 1-3 years

c. 3-5 years

d. more than 5 years

6. What is your objective when you are investing?

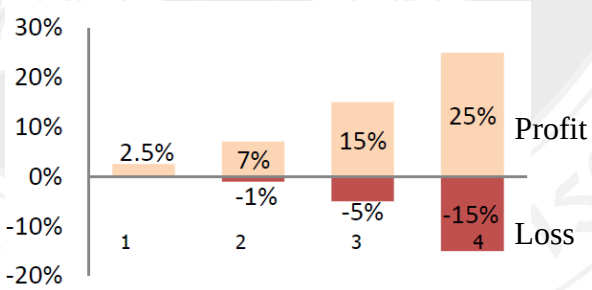
a. Protected investment principal and earning low but consistent return.

b. Possibility to receive consistent return with a chance to loss partial of investment principal.

c. Possibility to receive a higher return with a chance to loss some more partial of investment principal.

d. Maximizing return in the long-run with a chance to loss larger part of investment principal.

7. According to the pie chart below that indicates the proportion of profits and losses the investors are likely to experience from the 4 investment funds, which one of these types you decide to invest in?



a. The 1st investment plan which has a chance to earn 2.5% profit, and 0% loss.

b. The 2nd investment plan which has a chance to earn 7% profit, and 1% loss.

c. The 3rd investment plan which has a chance to earn 15% profit, and 5% loss.

d. The 4th investment plan which has a chance to earn 25% profit, and 15% loss.

8. If you decided to invest in a high-risk, high-return plan, what would you feel?

a. Be nervous and anxious about getting loss.

b. Be worried but understand the risk at some levels.

c. Understand and partially accept the risk.

d. Not worried about loss that may happen, still expect for a higher return.

9. If your investment value started to drop, at what level would you feel disturbing?

a. 5% or less

b. more than 5 to 10%

c. more than 10-20%

d. more than 20%

10. If you found that the value of the money that you had put in an investment dropped from last year, (suppose it was 100,000 to 85,000 baht), what would you feel?

a. Panic and want to sell the rest of your investments.

b. Worried and ready to change some of the investments to the less risky ones.

c. Hold onto the investment and wait for a positive sign.

d. Confident because you understand that the investment is a long-term result, so you plan to invest more to cover the loss.

2) Lottery Choice Questions

The following choices of answer involve approximately same amount of money but may have a different risk. You are free to choose your best answers. There is no right or wrong answer.

1. In one round of coin flipping game, you may choose between.

a. Receiving 1,000 baht no matter what will be the result.

b. Receiving 2,000 baht if head but 0 if tail.

2. You may choose between.
    a. A lottery with 80% chance of winning and receive 45 baht for the result (receive nothing if you lose).
    b. Receiving 30 baht instantly without gambling.

3. You may choose between.
    a. A lottery with 25% chance of winning and receive 100 baht (receive nothing if you lose).
    b. A lottery with 20% chance of winning and receive 130 baht (receive nothing if you lose)

4. You may choose between.
    a. A lottery with a 2% chance of winning and receive 3,000 baht (receive nothing if you lose)
    b. A lottery with a 1% chance of winning and receive 6,000 baht (receive nothing if you lose)

5. In one round of coin flipping game, you have been asked to play the game of which the rules are to gamble on your 1,000 baht. If the coin turned head, you win and you will get 1,500 baht. But if the coin turns tail, you will lose 1,000 baht. Will you choose to play this game?
    a. Yes
    b. No

3) Probability Equivalence Questions

1. You received 200 baht from the game you have won earlier. If you buy a lottery with that amount of money and win, you will get 20,000 baht. At least how many chance of winning do you think you need to have (ranging from 0-100 %, by estimation) in order to convince you to invest that money in a lottery?

2. You received 1,000 baht from the game you have won earlier. If you buy a lottery with that amount of money and win, you will get 20,000 baht. At least how many chance of winning do you think you need to have (ranging from 0-100 %, by estimation) in order to convince you to invest that money in a lottery?
3. You received 5,000 baht from the game you have won earlier. If you buy a lottery with that amount of money and win, you will get 20,000 baht. At least how many chance of winning do you think you need to have (ranging from 0-100 %, by estimation) in order to convince you to invest that money in a lottery?
4. You received 10,000 baht from the game you have won earlier. If you buy a lottery with that amount of money and win, you will get 20,000 baht. At least how many chance of winning do you think you need to have (ranging from 0-100 %, by estimation) in order to convince you to invest that money in a lottery?
5. You received 15,000 baht from the game you have won earlier. If you buy a lottery with that amount of money and win, you will get 20,000 baht. At least how many chance of winning do you think you need to have (ranging from 0-100 %, by estimation) in order to convince you to invest that money in a lottery?

4) Dollar Equivalence Question

Suppose you won a game and received the amount of money. You may choose whether to keep the money or to invest it in a lottery with some chance of winning and receive 20,000 baht under the circumstances as followed.

You may suggest the price of a lottery (need to be more than 0 baht) that give you a preference for a lottery buying rather than keeping the money (given that all the money you received from winning the game earlier can be exactly used to buy the lottery) The probability of winning and receiving the money from the lottery as follows:

1. The probability of winning the lottery equals to 1%. How much money for a lottery you are willing to pay approximately?
2. The probability of winning the lottery equals to 5%. How much money for a lottery you are willing to pay approximately?
3. The probability of winning the lottery equals to 25%. How much money for a lottery you are willing to pay approximately?
4. The probability of winning the lottery equals to 50%. How much money for a lottery you are willing to pay approximately?
5. The probability of winning the lottery equals to 75%. How much money for a lottery you are willing to pay approximately?

5) Financial Knowledge Assessment Question Test

Instruction: You may choose only one best answer to these questions.

1. Which one of these financial instruments has the lowest risk of losing the principal?
   a. A corporate debenture
   b. A common stock listed in stock exchange
   c. A bill of exchange issued by a commercial bank
   d. A government bond

2. Which one of these answers best describes financial instruments?
   a. Normally, corporate debenture pays return in form of dividend depending on the performance of a company.
   b. When the company goes bankrupt, a bond holders have a privilege claim on assets over stockholders.
   c. A preferred stock holder is a creditor of the company.
   d. A government bond offers a higher yield than a corporate bond given the same time to maturity due to the compensation for a liquidity risk.

3. Which one is the least likely the factor that affects the price of common stocks?
    a. The demands for the common stock
    b. The performance of the company that has offered the stocks
    c. The country's trade deficit/surplus with its neighbor countries
    d. The announcement of dividend payment of the stock

4. Which one of these is not a characteristic of a listed common stock?
    a. They are traded in an exchange market.
    b. The stockholders are considered the owners of the company
    c. The stockholders have voting rights in the shareholders' meeting.
    d. The stockholders will receive return at consistent rate, not varying according to the company's performance.

5. If a common stock "J" has a higher risk than a common stock "K", which one of these is true?
    a. The common stock "J" should have a lower Standard Deviation of Return than the common stock "K".
    b. The common stock "J" should have a higher Beta than the common stock "K".
    c. The common stock "J" should pay higher dividend than the common stock "K".
    d. The price of the common stock "J" should be lower than the price of the common stock "K"

6. The following choices are returns from the investment in an equity except one. Which one is not?
    a. Capital Gain
    b. Dividend
    c. Coupon
    d. Subscription Rights

7. The table below shows the Average Return and the Risk Value of the common stock W, X, Y, and Z.

Common stocks	Average Return	Risk Value
W	2%	4%
X	7%	7%
Y	4%	2%
Z	8%	10%

Which one of these statements is true?

a. The Sharpe Ratio of a common stock Z is higher than a common stock X's.
b. A common stock Y has highest return-to-risk ratio.
c. A common stock W has roughly the same return-to-risk ratio as common stock X.
d. The common stock X has higher return-to-risk ratio than common stock Y.

8. Which one of these statements is true about portfolio risk?

a. Portfolio risk depends on the weight of each investment assets in the portfolio.
b. The more various types of investment assets, the higher the overall portfolio risk is.
c. Investing in highly liquid assets will reduce the portfolio risk.
d. If there is no trading activity, portfolio risk will always be unchanged.

9. If you have portfolio investments in common stock and deposit, which one of these is the most effective way to reduce your portfolio risk?

a. Increase a proportion of investments in common stock, while reducing a proportion in deposit.
b. Decrease a proportion of investments in deposit, while increasing the investment in LTF funds.
c. Increase a proportion of investments in both deposit and common stock at the same portion.
d. Decrease a proportion of investments in common stock, while increasing the investment in short-term commercial paper.

BIOGRAPHY

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Academic Background
- Bachelor of Arts (Economics),
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Experience
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- 2009 - 2010
  Assistant Economist, Business Research Department,
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