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Are risk preferences stable?

-An interdisciplinary analysis of context-invariance risk preferences in a hypothetical investment scenario.

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Abstract

The objectives of this paper was to; examine if risk preferences are stable across different distribution contexts, in line with the prediction of the expected utility theory (EUT); if the range frequency theory (RFT) (Parducci, 1965) can account for observed choice behaviour in a hypothetical investment scenario; and lastly, analyse the potential factors that can account for the individual differences in the degree of risk preference stability. In order to tackle these issues, primary data was obtained through a questionnaire, where respondents had provided their certainty equivalent (CE) value for each hypothetical investment gamble (CE values are used as a proxy for risk preferences). The results obtained did not present a general tendency for the stability of risk preferences, rather support for both context-invariance and context-dependence risk preferences. Furthermore, RFT successfully could account for the movement of choice behaviour, however, the scaling of the prediction was not consistent. The effect of ordinal rank was found to influence risk preference stability most extensively. Results from the regression analysis suggest that risk preferences become more context-dependent with age, and more context-invariant with financial literacy. Those who scored high on financial literacy were also found active in the stock market. With an increasingly sophisticated financial markets and consumer sovereignty, the consequences of agents with high context-dependent risk preferences might be poorly made decision. This might have devastating effect for the individual agent, in addition, from a macroeconomic perspective can the aggregation of the individual decisions affect the national economy.

Keywords**:** *Stability of risk preferences, Choice under risk, Expected Utility Theory, Range Frequency Theory, Numerical ability, Financial literacy.*

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1 Introduction

The analysis of choice under uncertainty is a cornerstone in a number of domains in economics, such as macroeconomics, finance, labour economics and insurance. Traditional economics theory has explained human choice behaviour by concepts such as: rationality, internally derived and stable preferences; and maximisation of expected utility. von Neumann and Morgenstern (1944) put forward an axiomatic formulation of expected utility theory (EUT) which through a number of properties facilitated the derivation of well behaved cardinal utility function. Numerous economic models and analyses have been founded on the frameworks of the axiomatic expected utility functions to account for a vast range of situations, such as the insurance market, the layout of health insurance plans and pension schemes, which all of them plays a significant role for wellbeing on an individual level. These models tend to lead to the theoretical predictions that the economic agent will make the highest optimal choice as he has the capability to perform accurate calculations and base his choice on rational grounds (see e.g. Simon, 1955).

The ambition of the traditional choice theories is to provide a normative account of choice behaviour by describing how agents ought to make decisions, as well as providing a descriptive account by describing how they actually make decisions. The axioms of the EUT has been shown very successful in the creation of normative theories, however the issue arise when it is attempted to account for observed behaviour as it often fail to predict actual behaviour. Traditional economist tend to discard any deviating behaviour from the optimal by suggesting that competition favours the rational and this notion provides the agent with incentive to learn from experience - which leads to higher efficiency, hence choice transforms to a maximisation process. More significantly, they propose that a minority of rational agents can influence and impose rationality on the whole market. However, the literature on alternative theories for choice under uncertainty has rapidly been growing which can be interpreted as a strong sign of the limited ability of the traditional theories to account for actual observed behaviour. For instance, Tversky and Kahneman (1986, p 252) argued:

> *…the deviations of actual behaviour from the normative model are too widespread to be ignored, too systematic to be dismissed as random error, and too fundamental to be accommodated by relaxing the normative system.*

Motivated by this notion, the first aim of this study is to examine the empirical validity of the classical hypothesis of stable risk preferences, in a hypothetical investment scenario constructed in particular for this study. Above all, the focus is on independence axiom which states that an agents risk preferences over prospects are stable across different type of decision contexts ("prospect" represent outcomes that are associated with probabilities). That is, inclusion of a third (or more) alternative in the decision set should not influence the preference ordering (von Neumann and Morgenstern, 1944). This implies that an economic agent will exert the same level of risk preference irrespective of the nature of the decision context and the available choice alternatives in the relevant decision set.

Furthermore, the second aim of the present study is to extend the analysis of risk preference stability to test the ability of the range frequency theory (RFT) (Parducci, 1965) of explaining observed choice behaviour. In contrast to the assumptions of the EUT, the theoretical prediction of RFT is that the alternative prospects in the decision context *will* influence agents' acceptance level for risk (i.e. risk preferences). Hence, the distribution of the alternative prospects will provide the context which the target prospect is evaluated against. According to the model, judgment of any prospect is determined by two principles. First, the range principle, which influence the evaluation of a prospect based on the prospects relative position to the highest and the lowest prospects (i.e. the endpoints) in the decision set. Second, the frequency principle (or rank in more natural terminology) is concerned with ordinal rank of the target prospect in relation to the alternative prospects in the decision set. Thus, the implications of RFT are that risk preferences are neither stable nor internally derived. To the knowledge of the author, only a very few number of studies have employed the RFT to field of economics, and even fewer have applied it to risk preferences. As a result, this paper contributes to the existing literature by formally integrating the economic and psychology discipline in an attempt to further explore alternative theories that can account for observed choice behaviour[1].

[1] Similar integrations have previously been carried out, such as the derivation of the Prospect Theory (Kahneman & Tversky, 1979; Tversky & Kahneman, 1992), which has successfully accounted as a descriptive theory of individual choice under uncertainty.

In standard economic, based on the assumptions assigned to the agent (e.g. ability to perform accurate calculations, rational), theorists believe that the individual will be better off (i.e. obtain higher welfare) if decisions are determined by the agent itself. However, an emerging literature has shown that understanding financial concepts and the ability of performing simpler calculations is correlated with risk preferences (see e.g. Vlaev, Chater & Stewart, 2009; Barseghyan, Prince & Teitelbaum, 2011) and those who score high on those attributes tend to perform according to the expected value, that is, make the most optimal choices (Donkers, Melenberg, & Van Soest, 2001). Thus, the mere acquisition of information cannot increase individual welfare, rather it is contingent on the literacy[2] level of the economic agent. Despite of this, the author found no literature on the relationship with respect to stability of risk preferences. As a result, the third aim of this study was set to analyse potential correlation between risk preference stability and demographic attributes, with particular focus on numeracy and financial literacy.

These issues are addressed by assembling and applying new data set on recorded individual attitude over risks. Throughout the study it will be assumed that the economic agent has full information on the consequences and probabilities for each potential prospect, hence, the agent will have a set of preference over risk. In the literature there are two additional contexts; uncertain and ambiguous. An uncertain context is defined as the agent not knowing the precise probabilities, yet can draw some assumptions regarding the probabilities. Ambiguity, which is positioned at the opposite of the spectrum to risk, is by definition a context where the agent cannot infer the probabilities at all. Moreover, the benchmark specification of this study is the expected utility theory and the concept of certainty equivalent (CE) was applied during data collection. CE is defined as the certain amount the economic agent equally prefers to the gamble and the concept of CE was used as a proxy for risk attitudes as it enabled the derivation of the participants´ risk preferences.

The data sample was collected in connection to a hypothetical investment scenario that resembled a gamble (or a lottery). The data is unique as it records risk preferences across six different distribution contexts, replicated from the study by Brown, Gardner, Oswald and Qian (2008). This method makes the data suitable for directly test the assumption that risk preferences are stable across decision sets that enclose different choice alternatives at different probability rates. In addition to data on numerical ability and financial literacy, data

[2] Note that throughout this paper, the author uses the word literacy as a collecting word to refer to financial literacy and numerical ability.

was also obtained on participants demographic attributes such as gender, education and income.

Together, the results did not provide a general tendency for the stability of risk preferences as support for both context-invariance and context-dependence for choice under risk was obtained. The results supported that the frequency principle influences the stability of risk preferences, and the opposite result was found for the range principle. When both principles were tested together in a skewed distribution, the results indicated that mutually they principles also influence the stability of risk preferences significantly. These findings suggests for the relevance of the RFT for explaining choice and supports its ability to account for risk preference stability despite that the results for risk preference stability were inconclusive in the test. In addition, a simple test of the fit of the RFT to the data was carried out and it was found that the model successfully can predict the movement of the data, however, the scale of the predictions were not consistent. Again, this can be seen as further support for the relevance of the RFT.

Moreover, results from the regression analysis implied for no differences in preference stability between the genders. Age and risk preference stability showed an inverse relationship which is in line with established fact that cognitive ability in general decreases with age. It was also found that those who scored high on financial literacy display greater preference stability. Surprisingly numerical ability was not found significant thought it was expected significance based on earlier studies on risk preferences mentioned before. Nevertheless, items from Fredrick´s (2005) Cognitive Reflection Test (CRT) were found almost significant ($p=0.089$) at the 5 per cent significance level. Another interesting finding was that those who exerted higher preference stability were also more often active in the investment market. This result might be explained by that these individuals also hold greater knowledge on financial products (as the results suggest) which is necessary to avoid too great monetary losses. Moreover, explanatory variables such as education, if one owns a house and income were not found statistically significant.

This paper is organised as follows. Section 2 covers the theoretical frameworks which provide the foundation that this study is built on. Section 3 reviews the empirical studies that has prompted researcher to seek for alternatives and to integrate the field of economics and psychology to derive an adequate model that can account for observed choice behaviour under risk. Section 4 describes the methods that have been employed throughout this study in order

to undertake the issues of this paper. Section 5 will outline the results and the statistical applications that have been applied to obtain them. Section 6 seeks to discuss the implications of the results, followed by Section 7 which will present a brief conclusion.

2 Theoretical Framework

The theoretical frameworks that have been applied in this study will be outlined and discussed in this following section. Firstly, will a review of the EUT, the classical choice theory in economics, be outlined. Secondly, the features of the RFT and its theoretical prediction regarding choice will be presented, followed by a theoretical discussion of the role of information acquisition in decision making.

2.1 Expected Utility Theory

The EUT has been vastly applied in economic analysis to predict choice behaviour under risk. The theory was formulated by Daniel Bernoulli (1738) as a response to the traditional theory of expected values regarding the puzzle on how much a rational economic agent would be willing to accept to pay in order to enter a gamble. The general view was that the price one should be willing to pay to enter a gamble with payoffs (x_1,...., x_n) and probabilities (p_1,...., p_n), should equal the *expected value*, $\bar{x}$, of the gamble; $\bar{x} = \sum_{i=1}^{n} x_i p_i$. In other words, a rational agent would base his choice with respect to the magnitude of the outcome and the probability of obtaining each outcome. Note, for consistency, all payoffs are treated as monetary in the present paper.

Bernoulli presented a game, known as the *St. Petersburg paradox*[3], to demonstrate for the rejection of expected value, which states: suppose a fair coin is tossed repeatedly until tail comes up, which will end the game. For each toss the probability for heads or tail is p=0.5 and the value of the gamble is given by $\$2^k$, where k (=0, 1, 2,....,n) is the total number of tosses until tails came up in the game. Based on the traditional naive assumption of linear utility for money (i.e. risk neutrality), the expected value is infinite[4]. According to the conventional definitions of choice behaviour (i.e. expected value), it was predicted that the game should be accepted at any price. However, empirical studies did not find support for that prediction, and

[3] The name is derived from the fact that it was first published by Bernoulli in the *St. Petersburg Academy Proceedings* (1738; English trans. 1954).

[4] Suppose that $\$2^k$ is the payoff, then the expected value is $\frac{1}{2}(2) + \frac{1}{4}(4) + \frac{1}{8}(8) + ...= 1 + 1 + 1... = \infty$.

not either a willingness to pay for any finite price, rather the agent will accept the game only over a small price usually around a couple of dollars (see e.g. Hacking, 1980; Bottom, Bontempo & Holtgrave, 1989; and Hayden & Platt, 2009).

Bernoulli suggested the concept of diminishing marginal utility of wealth to account for the results derived with the St. Petersburg paradox (Bernoulli, 1738; Hayden & Platt, 2009). The argument follows that all economic agents do not evaluate a gain of $100 necessarily twice as much as a gain of $50. This notion suggests that individuals place subjective values (or utilities) on monetary outcomes, which also is the key concept in the EUT. The theoretical implications are that the utility of money must not be linear and that from the curvature of expected utility function one can elucidates risk preferences. Hence, in Bernoulli´s reformulated version, individuals will choose that prospect that will maximise their *expected utility*, $\bar{u} = \sum_{i=1}^{n} U(x_i)p_i$.

The theory received great attention after it was axiomatised by John von Neumann and Oskar Morgenstern (1944)[5] and is often referred to as the von Neumann-Morgenstern (vNM) utility function. Holding the theorem on the existence of a utility function as true[6], one can obtain a continuous utility function, u, which depicts the economic agent´s preferences over a set of gambles which can be written as:

$$p \circ x \oplus (1-p) \circ y \succ q \circ w \oplus (1-q) \circ z \tag{1}$$

if and only if,

$$u(p \circ x \oplus (1-p) \circ y) > u(q \circ w \oplus (1-q) \circ z] \tag{2}$$

where (x, y, q, z) represents the payoffs of the gamble, and with probabilities (p, q). At this stage the form of the gamble is unknown and operators ($\circ$,$\oplus$) were applied to indicate that there is a relation between the variables, although unknown. In addition, the utility function is yet not uniquely different from the utility in standard consumer theory, however, the vNM utility function (3) holds the convenient property that up to an affine transformation with the form $v(\cdot) = au(\cdot) + c, (a > 0)$ the axioms of EUT are satisfied and the utility function is determined by:

[5] A number of versions of EUT have been proposed, however the focus of this present study is on the vNM function as it is the most applied version in economic modelling. For a review on alternative versions please see Starmer (2000) for a review.

[6] For proof, please see any microeconomics textbook on an advance level, e.g. Varian (1992) "*Microeconomic Analysis*".

$$u[p \circ x \oplus (1-p) \circ y] = pu(x) + (1-p)u(y) \quad (3)$$

For a decision to be in line with the predictions of the EUT, four axioms (*completeness*, *transitivity*, *continuity*, and *independence*) must be satisfied in order to be defined as a vNM utility function. Suppose that an economic agent has preferences over a prospect X, then $x \succcurlyeq y$ denotes that the agent *weakly* prefers outcome *x* to *y*, and $x \succ y$ denotes that the agent *strictly* prefers *x* to *y*. With the following denotations the axioms will be outlined.

The *completeness* axiom implies that any two prospects can be compared in a decision set *X*. Hence, for all *x* and *y* in *X*, the agent prefers either alternative ($x \succcurlyeq y$, or $y \succcurlyeq x$), or both ($x \succcurlyeq y$ and $y \succcurlyeq x$). The axiom of *transitivity* is fundamental for the creation of ordinal ranked risk preferences as it states that in any gamble *X*, there must be one outcome that is better than the other as the indifference curves are not allowed to intersect. That is, for all *x*, *y*, and *z* in *X*, if $x \succcurlyeq y$ and $y \succcurlyeq z$ then $x \succcurlyeq z$. Together, these two axioms provide sufficient restrictions to create an ordinal ranking between any preferences. Furthermore, the third axiom, *continuity*, requires that for all prospects *x*, *y*, and *z* in *X*, when $x \succcurlyeq y$ and $y \succcurlyeq z$ then there exists some *p* that (*x*, *p*; *z*, 1-*p*) ~ *y* (where ~ indicates the relation of indifference), that is, no reversal in the preference relation. The *independence* axiom implies that the ordering between two lotteries is independent from a third lottery, that is, if $x \succcurlyeq y$, then (*x*, *p*; *z*, 1-*p*) $\succcurlyeq$ (*y*, *p*; *z*, 1-*p*). The independence axiom provides a rather strong prediction on the precise form of the preferences. In addition, it is the axiom that has enabled the EUT to be accounted as a descriptive theory and is of particular relevance for the present study. On the whole, these axioms lead to the convenient property of the vNM expected utility. Furthermore, one can infer that preferences are internally derived, thus stable irrespective of the alternatives in the environment (i.e. decision set).

As mentioned earlier, the shape of the utility function has behavioural implications on choices that involve risk. The curvature of the utility function correlates with the extent an economic agent is willing to accept risk in any gamble. Risk preferences are categorised in to three sub-groups: risk avert, risk neutral and risk loving. An agent is said to show risk avert preferences if the utility of *the expected value* of the gamble is preferred over the utility of the gamble:

$$u(px + (1-p)y) \succ u(p \circ x \oplus (1-p) \circ y) \quad (4)$$

which displays a concave utility function (or diminishing marginal utility of wealth). This notion can also be expressed as that a risk avert individual will prefer a certain outcome to an

uncertain one with the same expected value. A risk loving agent would in contrast prefer the utility of the gamble over the expected value of the gamble (convex utility function), whereas a risk neutral agent would be indifferent between them (linear utility function). Note that the action of a risk neutral agent is in line with the predictions of expected value. The concept of risk aversion was the attribute of the EUT that has had the greatest implication on economic analysis as most people have exhibited those preferences in real life.

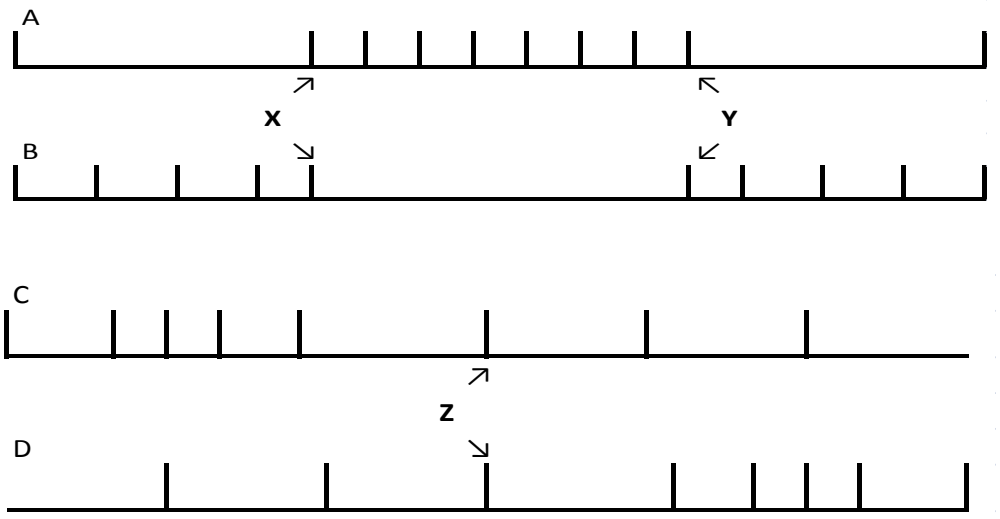
2.2 Range Frequency Theory

Albeit the intuitive appeal of the EUT, empirical findings of actual observed risk behaviour raises questions regarding the foundation which the theory has been derived from. As a response to previous empirical findings, this present study has chosen to test the ability of the RFT to account for risk preferences. The theoretical attributes of the RFT will be outlined in this section.

In 1965, Parducci proposed the RFT as a response to the, at that time, prevailing Adaption-Level (AL) theory by Helson (1947) concerning judgement; and as an extension to the Range Theory by Wolkman (1951). According to the AL theory, a prospect is evaluated within a frame of references which represents all prior as well as current experiences. The simple application if the theory made it popular, nevertheless, it suffered severe limitation as it failed to account for choice behaviour when the distribution of the decision set held the same mean or were skewed (for review see Parducci, 1965; Niedrich *et al*., 2001). Moreover, Wolkman´s suggestion of the importance of the end-points influence on choice was seized by Parducci, however, he suggested that the rank (frequency in theoretical terminology) also portrayed an influential role. Hence, the core idea which the RFT has been established on is that human beings value the position of a prospect in relation to the alternative options in a sample set (Brown *et al*., 2008). According, in order to evaluate a prospect, the alternatives prospects in the immediate decision context are retrieved for comparison. Specifically, it is suggested that the evaluation of a prospect is contingent on a dual process comprising the range and the frequency (in more natural terminology the rank ordinal position) principle which “locates” the position of the particular stimulus in the decision set (Parducci, 1965). This process of retrieval is assumed to be automatic and occurring without the consciousness of the individual.

FIGURE 1.

Two hypothetical distributions pairs for the illustration of how the range and the frequency principle will influence decision making according to RFT.



The conceptual idea behind the RFT is illustrated by Figure 1. The first distribution pair *A* and *B* represents a *unimodal* and a *bimodal* distribution, respectively. Consider the scale of each distribution along any continuum of your choice (e.g. probabilities, quality level, weights, loudness of a tone etc), where the scale increases as moving from left to right along the distribution. Consider the point *X* for both distribution; how will the points in each distribution be evaluated? The significance of this particular distribution pair is that point X in both distributions shares the same arithmetical values; that is, the points have the same distance from the mean, from the midpoint and from the endpoints in both distributions (Brown *et al*., 2008). Hence, it allows for a straightforward demonstration of the frequency principle. According to the RFT, the point *X* for distribution *B* should be evaluated holding a greater value than the point in *A* as it is the fifth in the ordinal rank relative to point for *A* that is second (an analogues effect is expected in the reverse condition denoted *Y*) (Parducci, 1965; Stewart *et al.*, 2006; Niedrich *et al.*, 2009). This expected outcome is based on the theoretical prediction of the frequency principle that a prospect will be evaluated based on its position relative to the alternative choices in the decision set. Consequently, when the majority of the alternatives lie below the target prospect it will be evaluated higher, and evaluated lower in the opposite context.

The second distribution pair *C* and *D* represents the *low range* and the *high range* distribution which allows for the clear demonstration of the range principle. According to the range principle, the evaluation of the prospect is determined by its position relative to the end-points (i.e. anchors) (Wolkman, 1951; Wedell & Parducci, 1988). Hence, the closer the target prospect is to the last prospect in the decision context, the higher will the prospect be valued than if it would be close to the first prospect. From the theoretical prediction, one can derive that point Z in Figure 1 should be valued higher in the distribution *C* relative to *D*.

Furthermore, the RFT rests on the idea that evaluation of a stimulus is determined by both its ordinal position and its position within the range. This can be expressed as follows. Assume an ordered set if *n* prospects:

$$\{x_1, x_2, \dots x_i, \dots x_n\}$$

where $x_i$represents each of the prospect in the distribution context holding a value along any continuum (for the present study, the x_i represented probability rate for each prospect to obtaining a sum of SEK 25.000 – for detail outline see *Section 4.2.1*). Then the derivation of the range values, R_i, of stimulus *i* is given by,

$$R_i = \frac{x_i - x_1}{x_n - x_1} \tag{5}$$

where x_i at this stage represent the target prospect for evaluation, x_1 and x_n represents the minimum and the maximum prospect values in the decision set. For clarity, a R_i value is obtained for each prospect in the decision set. Moreover, the frequency principle suggests that judgement of a prospect is equal to the proportion of the total number of prospects lying below it, thus its percentile[7] rank divided by 100. The derivation of the frequency value, F_i, of stimulus *i* is given by

$$F_i = \frac{r_i - 1}{N - 1} \tag{6}$$

[7] Percentile is a value that represents a percentage position in a range. Although there doesn't exists a standard definition of percentile, a common approach to obtain the *P*-th (0 < P < 100) percentile of *N* ordered value is trough: $n = \frac{P}{100} * N + \frac{1}{2}$, where the *n* is rounded to the closest integer. The value obtained corresponds to the rank position.

where r_i denotes the target prospects rank ordinal position within the decision set, and N represents the total number of prospect in the decision set. According to the principle, the differentiation of the evaluation depends on the distribution of the stimulus in the decision set, hence, the skeweness or normality. This suggests that holding endpoints constant and identical across contexts, the target stimulus evaluation depends on the proportion of the context stimulus that lies below or above it (Wedell & Parducci, 1988).

The following step is to integrate the range R_i and the frequency F_i principle in order to obtain the model prediction of subjective evaluation of the target prospect, which is demonstrated by;

$$J_i = wR_i + (1 - w)F_i \tag{7}$$

which represents a combination between the weighted average of the range and frequency principle which provides us with the a theoretical prediction (J_i) of the agents subjective evaluation of the target prospect. This is obtained by substitution values derived from equation (5) and (6) into equation (7). The weight parameter *w* provides the relative weight between the two principles, thus their respective strength of influencing the evaluation of a prospect, and it holds a value between zero and one. The overall proposal of Parducci (1965) was that each subjective evaluation of a prospect is a function of its position relative to the overall range of prospects and its ordinal rank.

2.3 Role of Information Acquisition in Decision Making

In standard economic modelling many analyses are based on the assumption that the economic agent is rational implying that the agent possesses the knowledge relevant to understand and calculate the cost and benefits of any decision (see e.g. Simon, 1955; Hammond, 1997; Kahneman, 2003a). Then the agent will base its decision on the option that suits his ordered and stable preferences function (von Neumann & Morgenstern, 1946) According, an agent´s welfare will increase if the choice is made individually without inferences (Almberg & Widmark, 2011). The notion has an intuitive appeal, and might perhaps account for its prevalence in traditional economic theory.

With respect to information acquisition in choice, it can be interpreted as a positive linear correlation between “optimal” decision making and information - the better informed the

economic agent is, the better and more rational choices is he able to make. This relationship can be true if the agent has the appropriate knowledge to be able to make use of the acquired information. An underlying assumption that exists in this context is that the agent also has both the time available as well as cognitive effort to go over each piece of information it holds at the particular time (see e.g. Simon, 1955; Kahneman, 2003b). Furthermore, the treatment of information in the theoretical literature has further reinforced the assumption. In microeconomics, information is treated as a commodity, like any other conventional good, however, it holds somewhat peculiar attributes. Commonly, goods are traded in the market based on demand and supply, and assumed scarce at some level. For information, scarcity can be interpreted as information that is kept from other agents in the market, as information is abundant and trade of it is infinite (Stiglitz, 2000). As the creation and distribution of information is uncomplicated and undemanding, the economic agent should not face much problem to acquiring it, hence, facilitating for deriving to the optimal choice.

However, Herbert Simon (1955) put forward a new perspective on how the abilities of the "economic man" should be portrayed in economic analysis. In particular, he emphasised on the psychological limitations that the human (biologically) is constrained by. Simon called this concept for "bounded rationality" and suggested that rational choice should be analysed by taking into account the limitations of cognitive capacity, availability of information and the constraint of time for reflection. This implies that even when reasoning underlies any choice that the agent will make, choice may not fulfil the assumptions of rationality in traditional economic meaning (Simon, 1955; Kahneman, 2003b).

3 Literature Review

In this section, a review of the empirical literature will be outlined and discussed. The findings from previous studies will be presented in the order accordance to the research questions. First the research on risk preference stability will be presented, followed by earlier studies application of RFT and their obtained results, and lastly findings on variables that influence risk preferences will be discussed. Though a formal integration of the disciplines in economics and psychology has been adopted in this study, this will also be reflected in the following sections.

3.1 Previous Studies on Risk Preference Stability

Only a couple of decades ago the EUT with the von Neumann-Morgenstern axioms was renowned as a ground breaking economic analysis that could adequately account for choice behaviour under risk. However, since then the validity of the theory as a descriptive choice theory has been questioned on frequent basis as empirical studies have found (and are finding) choice behaviour in numerous situations that deviates from the predictions of EUT. One of the earliest proposals that often is mentioned in the literature of choice theory is the renowned *Allais Paradox* (Allais, 1953). The game clearly demonstrated the shortage of the EUT which directly links to the independence axioms. It has been found that participants of the game systematically violated the linear relationship in the probability rates, which is inconsistent with the predictions of the EUT.

The game is presented with the numerical formulation by Machina (1987). The first step of the game is that the economic agent chooses the option that is preferred between the pair of gambles $a_1$and a_2, followed by a similar choice between the second pair of gambles, a_3 and a_4:

$$a_1: 1.00 \text{ chance of } \$\,1{,}000{,}000 \quad \text{versus} \quad a_2: \begin{matrix} 0.10 \text{ chance of } \$\,5{,}000{,}000 \\ 0.89 \text{ chance of } \$\,1{,}000{,}000 \\ 0.01 \text{ chance of } \$\,0 \end{matrix}$$

a_3: 0.10 chance of \$ 5,000,000 / 0.90 chance of \$ 0 versus a_4: 0.11 chance of \$ 1,000,000 / 0.89 chance of \$ 0

were the gamble outcome are be defined as $\{x_1, x_2, x_3\} = \{\$0;\ \$1{,}000{,}000;\ \$5{,}000{,}0000\}$. According to the theoretical predictions of the EUT, a rational agent either would prefer a_1 and a_4 or $a_2$and a_3 as each of these pairs indicates that the agent has a consistent preference over risk. However, a number of studies have found that a majority of subjects chooses a_1 in the first pair and a_3 in the second pair, which violets the predictions of the EUT (see e.g. Allais, 1953; Morrison, 1967; Slovic & Tversky, 1974). As mentioned earlier, findings like this one are often criticised by traditional economist who defend the EUT by suggesting that the economic agent will behave "correctly" once he is informed of this deviating choice behaviour (Savage, 1954), however, studies have not been able to support this notion (see e.g. Slovic & Tversky, 1974).

Kahneman and Tversky (1981) put forward a similar game as Allais (1953), except their emphasis is on the description invariance assumption of the EUT, i.e. that choice should not be affected by the manner the information is presented. They put forward an interdisciplinary and a descriptive theory called *Prospect Theory* (Kahneman & Tversky, 1979) which suggests that risk preferences over prospects will alter depending on whether the context is "framed" as loss or as gain relative to the agent's reference point in the decision context. This implies that risk preference are variable as the economic agents tend to exhibit risk aversion when facing a high probability for win, and risk seeking when facing a high probability for loss. This notion also challenges the assumption of the existence of well behaved preference functions which is the core of the vNM utility function. Tversky and Kahneman (1981) illustrated this by the following game:

Imagine that the U.S. is preparing for the outbreak of an unusual Asian disease, which is expected to kill 600 people. Two alternative programs to combat the disease have been proposed. Assume that the exact scientific estimates of the consequences of the programs are as follows:

(*Options in group 1*)

If Program A is adopted, 200 people will be saved. (72%)

If Program B is adopted, there is a 1/3 probability that 600 people will be saved and a 2/3 probability that no people will be saved. (28%)

(*Options in group 2*)

If program C is adopted, 400 people will die. (22%)

If program D is adopted, there is a 1/3 probability that 60people will be saved and a 2/3 probability that 600 people will die. (78%)

By design, the options in group 1 and 2 are stochastically equivalent, and only the "framing" of the options are differently as the former emphasises on how many might be saved and the latter on how many might die (Starmer, 2000). Kahneman and Tversky found that a clear majority of the respondents´ exerted risk avert preferences as 72 per cent chose Program A. According to the predictions of the EUT, for group 2 respondents should prefer Program C to D as it holds the identical probability as A. However, they found that only 22 per cent chose C, concluding that a shift in risk preferences from risk aversion to risk loving occurred. Hence, the descriptive validity of the EUT was not supported as expected utility preferences were not established, as according to theory one would then expect that respondents would prefer the "safe" option or the "risky" option for both choices in the game.

Now the focus will be switched from laboratory to natural experiments in order to review choice behaviour in the real world. Blavatsky and Pogrebna (2008) examined risk preferences of the participants in the television game show *Deal or No Deal*. At the start of the game the participants receives a sealed box which holds an unknown yet a potentially large sum, and throughout the game the contester is provided with information on the probability of the box holding a large prize. The authors found that participants who were told that the box held a large prize with a probability of 80 percent were willing to trade it to a similar prize offer (that they knew they would receive for certain) as those participants that were told their box held a large prize with only a 20 per cent probability. Again, this finding contradicts the prediction of the EUT as same risk preferences are shown for both large and small probabilities.

A more recent study by Barseghyan, Prince, and Teitelbaum (2011) examined the stability of risk preferences with regards to deductible household insurance choices within the context of auto and home insurance. The significance of this study was that it records several risky choices made by the same sample set in slightly different markets. Hence, this enables for the direct testing of the context-invariance of risk preferences. Their results clearly indicated that risk preferences are not stable across contexts, although they found that the households (participants of the study) showed a tendency of exhibiting greater level of risk aversion for house insurance relative to the auto insurance.

The studies that have been presented in this section only represent a fraction of the literature for the topic of choice under risk. The purpose have been to outline studies covering different situations in order to highlight how the EUT fails to account as a descriptive choice theory across a range of different contextual situations.

3.2 A Range Frequency Account for Choice Behaviour

In psychophysics, the concept of contextual environment affecting judgement of a stimulus became established a couple of decades ago. This section will start with a review of a study that has been the starting point for many studies that have explored the effects of decision context on choice. Garner (1954) conducted a psychophysical study where participants' evaluation of loud noise was examined. Each participant was given a 90-dB tone as their reference point and was asked to state when another tone is more or less than half as loud as the reference tone. Participants were assigned between three groups, were each group were presented with tones that ranged between different level of loudness, 55-65 dB, 65-75 dB and 75-85 dB. Garner found that the participants failed to judge the tones on their actual magnitude of the loudness; instead judgement was made in relation to the choice options available to the participants. Similar results have also been found for judgement of weights (Lim, 1995) and for a discussion on other relating findings see Laming (1997).

Based on the outcome of Garner´s study, researchers from other disciplines than psychophysics have been motivated to explore whether the findings of lack in ability to judge stimulus on an absolute magnitude are transferable to their fields. For instance, Birnbaum (1992) examined if decision making also is influenced by the choice options available. He tested this notion in the context of finding the choice-based CE by asking participants to state

if they would prefer a certain sum over a lottery. The contexts were manipulated where "Context 1" held a positively skewed distribution (i.e. when most values are small) and "Context 2" held a negatively skewed distribution (i.e. most values are large). The findings of this study indicated that choice under risk was in fact influenced by the context as the CE values in the second context were larger than in the first context. As a consequence, the result rejects the notion that gambles are evaluated based on invariant utilities over prospects.

So far has none of the studies explicitly examined the effects of both the range and the frequency principles of the RFT on decision making. Janiszewski and Lichtenstein (1999) however, tested the range principle on the participants´ price perception. The participants were provided with different brands of one type of good together with a price that corresponds to a specific brand. They found that the range of the initial prices for all of the brands did in fact influence how attractive they perceived the new price for a particular product. Moreover, Mellers, Ordóñez, and Birnbaum (1992) examined participants "buying price" (i.e. represents the sum an agent is willing to pay in order to be able to take part in a gamble with payoff X) which is highly relevant to the present study as the concept of "buying price" is also adopted, however denoted CE instead. Mellers *et al* examined participants in relation to a positive and negative skewed distribution (note, has been applied by the previous studies outlined in this section) and the authors found that the alternative prospects in the context did influence participants "selling price" as prospects were valued higher in the negatively skewed distribution. Despite that the study shares a similar scenario of hypothetical investments; there exist a significant difference between them based on the actual practicalities of the data analysis. The current study derives the theoretical prediction of the RFT model and tests it by comparing it to the obtained data, adopting the format of Brown, Gardner, Oswald and Qian (2008).

Brown *et al.* (2008) examined the RFT in relation to individuals' satisfaction of relative wage level. The assumption of the theory was that satisfaction is contingent on the alternative wage levels available in the decision set. In particular, examined the ability of the theory to account for observed choice behaviour for six different distribution types and found that both the range and the frequency (i.e. ordinal rank) principle influenced the agents' perceived satisfaction. Similar results on wage satisfaction were also found by Seidl, Traub and Morone (2003).

3.3 Numeracy and Financial Literacy: A Must for Choice?

Decisions regarding finances tend to be complicated in nature, and information on the topic is often provided in numerical form. It can with be assumed with confidence that the agent may needs to have at least some understanding of the fundamental principles of mathematics and basic familiarity with some financial concepts. Theoretically when modelling decision making, the derivation of differences in financial choices across economic agents is accounted to be a result of the individuals' subjective preference of risk and intertemporal substitution (see e.g. Frederick, 2005). The factors that influences risk preferences have only more recently been receiving greater attention which might be a result of the increasing awareness of the EUT limitation to account for descriptive choice behaviour. It has been shown that numeracy and financial literacy do in fact have a determining role. For instance, Almenberg and Widmark (2011) found that individuals with a higher numerical ability showed tendencies to accept more risk when participating in the financial market, such as, high numerical individuals' hade to a greater extent mortgages with a variable interest rate relative to the lower numerical individuals who preferred fixed interest rates. In addition, they also found that those who were financially educated did fewer mistakes in choices regarding finance.

Furthermore, Peters *et al.* (2006) suggested that those scoring low on numerical ability have difficulties in understanding more complex financial information, which might lead to that less optimal choices are made as these individuals miss out on the relation between financial products. In addition, Peters *et al.* found that highly numerical agents were less susceptible to the context which the decision was made in as they more often put into use the numerical information they were provided relative to low numerical individuals. Moreover, formal education has also been found to positively correlated to more risk acceptance (Donkers, Melenberg, & van Soest, 2001; Frederick, 2005).

These studies indicated that the mere provision of information does not guaranty an informed decision, which is a crucial finding as it implies that the quality of choice is vital for finances of a household. In addition, some decision regarding the private finances also plays a role for the stability of an economy on a national level, especially in developed countries where the credit market is vast and well established (Almenberg & Widmark, 2011). Campbell (2006) found that in US, a majority of households paid a significantly higher rate of interest on the house mortgages than necessary. Thus, their disposable income was reduced as a result of

poorly made decisions or by the mere fact that individuals neglected remortgaging. These findings clearly demonstrate that although information is easily available, it is not employed by all individuals to derive to the best possible outcome.

4 Method

The methods applied in a study are an essential aspect of any research as the reliability of the results is determined by the procedure adopted. The aim of this section is to provide the reader with information regarding the different segment of the study that has been applied to obtain an answer to the issues that has been raised, along with an evaluation of the strengths and weaknesses of the individual procedures. A particular vital aspect of any study is the data selection as the data integrity determines the credibility of the results derived by the study. More specifically, the tasks of determining appropriate data type, source and instrument(s) is a central issue as these variables remedies the possibility to adequately answer the research question (Dahmström, 1991).

For the present study, the author has applied a deductive reasoning method to test the theory against reality, which is known as a "top-down" approach as the research question is constructed upon a domain (such as theory, principle etc) and then tested against empirical data to either confirm or reject the hypotheses (Bryman & Bell, 2007). This approach has been carried out by the assembling of quantitative data on the sample set through a questionnaire, and applying it for statistical analysis, in order to obtain results that can provide clarity in the issue of risk preferences raised in the present paper. In the following subsections will each aspect of that process by outlined.

4.1 The Characteristics of the Survey

The aim of the present study was to obtain a large number of observations in order to enable for the derivation of generalise results for the entire population which the sample has been draw upon. A self-completion questionnaire was employed which does not require the researcher to be present, resulting in that the distribution could be more extensive. A further benefit might be that a greater heterogeneity of sample can be obtained – which is the aim of the data selection of this study. In addition, the survey was created both as an electronic and paper version to assist for the possibility of distributing in several manners, which will be discussed in the following subsection. Nevertheless, as the researcher were not going to be

present the layout of the questionnaire and the information that is provided become even more essential to facilitate that as many and complete questionnaires are retuned (Bryman & Bell, 2003). A covering letter was distributed together with the questionnaire where it describing the intent of the research and contact details to the researcher. Furthermore, close-ended questions were used motivated by that the study is of quantitative nature where a short answer will be sufficient.

In total, the survey contains three sections. The first section records respondents CE values for an investment prospect that involves risk. Thus, from CE values one can derive the stability of respondents risk preferences and susceptibility to the principles of RFT. The second section is concerned with participants´ numerical ability and financial literacy. The third section obtains information on participants' demographic attributes and stated savings behaviour.

4.1.1 Distribution of the Survey

The survey was distributed through two channels as both an electronic and a paper version was constructed, which allows one to benefit from both methods. Firstly, the electronic version was constructed at the online survey platform *www.SurveyMonkey.com*. The benefits of an online based questionnaire are that it eliminates physical barrier (i.e. distance) of reaching a potential respondents and that the respondents themselves can forward it to other potential respondents. However, the disadvantage is that one cannot reach those who do not own or have access to a computer and internet (Dahmström, 2011). An URL address enabled the potential respondents to access the survey, and it was distributed to respondents directly by the researcher at public facilities, by email and through social online platforms.

The apparent disadvantage of the employed method was that the sample obtained might suffers from biased as the e-mails addresses and the social online platforms are somehow related to the researcher as no independent e-mail data base were used (as no such base with heterogeneous individuals were available to the researcher). Thus, this might impede the collection of a diverse sample that represents the population it has been derived from, as the respondents might share similarities in socio-economic status, education level etc, relative to the researcher.

To balance it off, a paper version of the questionnaire was conducted. This version was also distributed directly by the researcher to potential respondents, however, at public and

university libraries in Malmo and Lund. Although this method of distribution can increase the randomness and the heterogeneity of the sample, one must be aware of that the surveyor itself might be biased to only contact individuals who look "approachable" (Bryman & Bell, 2003). However, by being attentive to this point, the bias might be eliminated. A postal questionnaire could have amended these issues however, due to the cumbersome cost of posting and providing postage free envelop for respondents to use when returning the questionnaire (as the questionnaire were 12 pages in total), combined with the low rate of responses often correlated with it (Barcley *et al*., 2002), an alternative approach were found more suitable.

4.1.2 The Survey Population

In order to generalise the results of the study on the whole population, the aim was to obtain a heterogeneous sample that represents the population which it was drawn from. Optimally, the sample is derived from the entire population, however this is seldom the case as neither time nor sufficient resources are available to the investigator to be able to carry out research of that extent. The same applies for this study, hence a data sample has instead been obtained which will be analysed in order to make conclusion about the population from which it was drawn.

The questionnaire was constructed to record the choice behaviour of Swedish speaking participants. A benefit of reducing the span to one single population might be that effect of respondent living in similar contextual environment (e.g. educated under the same school system, experienced similar cultural influences, and sharing similar social norms) can be resembled to a "natural" control of some environmental variables that might have an effect on risk preferences. Nevertheless, the overall target was to obtain a sample that had an even spread in age, gender, education level and so on, in order to obtain a sample that represented the population from which it has been drawn from.

4.2 A Comprehensive Outline of the Questionnaire

In the following subsections a detailed outline of the questionnaire will be provided. The questionnaire contained three sections which each of them will be discussed individually.

4.2.1 Decision Task

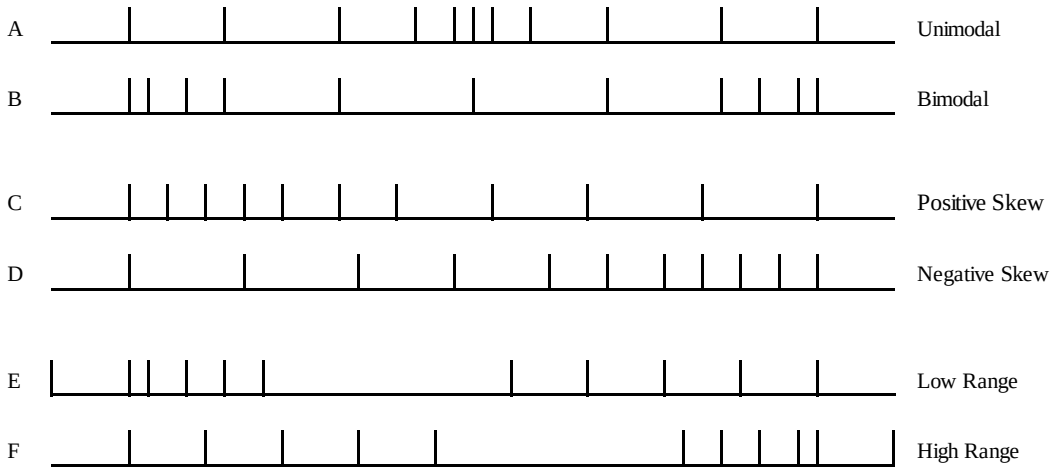
The first part of the questionnaire comprises six decision tasks which are constructed in a manner to collect data on respondents' CE value for each prospect across six distributions. With this information, one can derive whether risk preferences are stable or variant across different decision contexts. As mentioned earlier, certainty equivalent is the sum that you are indifferent between entering a gamble with a risky prospect and a gamble with no risky prospect. Hence, it is defined as a certainty amount that is equally preferred to the alternative.

The participants were provided with only written instructions and the questionnaire was answered individually. Each distribution contained eleven prospects where the uniqueness of the distributions lies in that none of them shared the same spread of prospects; please see Figure 2 for a demonstration. Moreover, the distributions represented a probability magnitude between zero (p=0) and one (p=1) and presented in relation with hypothetical investment scenarios which the respondents made their decisions upon. The same scenario was adopted for all of the six decision tasks and was as follows. Each prospect represents an investment gamble where the outcomes are *SEK 25.000 and SEK 0* with probability p and 1-p. Hence, each of the investment prospect, *I,* are represented by $I = p(25000) + (1-p)0$. The probability rate that correlates with each prospect is given by the individual prospects position on the distribution, taken that p always lies in the interval [0,1]. The task was to evaluate every prospect individually and state the maximum sum one is prepared to pay in order to enter each of the investment gambles.

Only probability values for the endpoints of the distribution were stated explicitly in the questionnaire, that is p=0 (left end) and p=1 (right end). Hence, prospects lying between these endpoints do not have their probabilities stated. This layout was conducted in order to reduce the influence of primacy and recency effect (Eysenck, 2005) in respondents' derivation of their subjective CE values. That is, by not providing explicit probabilities for each prospect it would become more difficult for respondents to remember value they stated for prospect holding similar positions on the distribution across the six decision tasks. The purpose was to facilitate for CE values to be derived independently for each prospect. The optimal research design would have been to record CE values for each distribution at six different occasions, however, due to time constraint an alternative approach was adopted.

Figure 2

The six types of distribution contexts employed to measure respondents risk preferences



In the hypothetical scenario of the investment gamble the economic agent is faced with two options: 1) not to invest and hold its initial wealth for certain, 2) invest and get a return with probability *p* or get nothing with probability 1-*p* on the investment. Note that the scenario is identical to a lottery, which is why it is called an investment gamble. The author intentionally avoided to present the investment scenario as a lottery due to remove any possible stigma that is associated with lotteries. By adopting this approach, the author seeks to "nudge" the respondents to base their decision on the hypothetical scenario provided rather than their subjective perceptions of lotteries.

The following distributions spreads given by Figure 2 was employed. The distributions are outlined in pairs based on the properties they hold, which are relevant when the RFT is tested (replicated from Brown *et al*.,2008)[8]. Distribution pair *unimodal* (A) and *bimodal* (B) were constructed in particularly to measure for rank dependence (i.e. frequency principle). Between the distribution pair, there are five pair of prospects that share identical position on the distribution, i.e. hold the same probability rate. For *positive skew* (C) and *negative skew* (D) distribution, three prospect pairs hold the same probability rate. This pair allows for the examination of the explanatory power of the model in a case when the distribution holds a negatively skewed spread of investment prospects. The third pair is *low range* (E) and *high range* (F) distribution which test whether a prospects position up the range has any influence

[8] In their study, they derived these distributions in order to establish if RFT can account for the workers wage satisfaction.

on participants risk preferences. In this distribution, two prospect pairs share the same probability. The use of these attributes will become clearer when presenting the results of this study in Section 5.

4.2.2 Numerical ability

For the assessment of participants' numeracy level, respondents were asked to respond to seven mathematical problems that were given in text format, as demonstrated in Table 1. The question that was implemented in the questionnaire was replicated from the *English Longitude Study of Ageing* (ELSA) (Steel *et al*., 2003) and from Frederick´s (2005) *Cognitive Reflection Test* (CRT). The results from both of the studies have shown that the value derived from the questions corresponds with participants' numerical ability. In particular, support has been found for the prevalence of a positive correlation between numerical ability and risk preferences. Furthermore, the benefit of adopting previously tested questions is that the results from the subsequent study can be compared to the current one. If similar results are obtained with a different sample set it indicates for the validity of the results and reliability of the method (i.e. the questions), or otherwise indicate for a rejection.

Out of the seven questions, four were taken from ELSA (from an original set of six). The author did not apply all of the questions, motivated by the results derived from the study by Almenberg and Widmark (2011) that also tested these particular questions on Swedish speaking subjects. For the questions that have been omitted, a failure rate of maximum five per cent was obtained and the author believed that a more significant result could be obtained if the questions range of difficulty were more equally distributed. Consequently, if the difficulty of the questions is unequal, the results might reflect a correlation based on an incorrect sampling technique, hence one will obtain biased results. The remaining three questions were taken from the CRT (from a total of three) which can be evaluated as being in the upper range with respect to difficulty.

Table 1

The questions employed for measuring respondents numerical ability level

Q1	If the chance of getting the disease is 10 per cent, how many people out of 1,000 would be expected to get the disease?
Q2	A second-hand car dealer is selling a car for £6,000. This is two-thirds of what it cost new. How much did the car cost new?
Q3	If 5 people all have the winning numbers in the lottery and the prize is £2 million, how much will each of them get?
Q4	Let´s say you have £200 in a savings account. The account earns 10 per cent interest per year. How much will you have in the account at the end of two years?
Q5	A bat and a ball cost $1.10 in total. The bat costs $1.00 more than the ball. How much does the ball cost?
Q6	If it takes 5 machines 5 minutes to make 5 widgets, how long would it take100 machines to make 100 widgets?
Q7	In a lake, there is a patch of lily pads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how long would it take for the patch to cover half of the lake?

Although the questions employed all measures numerical ability, they can yet be sub-grouped based on some characteristics. There exist some agreement amongst researchers that cognitive processes of reasoning can be divided into two processes: the undemanding, instant and automatic process; and the deliberate, effort and attention demanding process (see e.g. Epstein, 1994) which are commonly named as “System 1” and “System 2” respectively (Stanovich and West, 2000). System 1 represents the cognitive ability of recognising for example an apple in a basket with other fruits, whereas System 2 represents solving for $\sqrt{19163}$ without the aid of a calculator. The mathematical questions applied in this study fall under the category of “System 1” as an instant intuitive answer are retrieved (a response that one does not expected from “System 2” processes). Yet, a further distinction can between the question, as the intuitive answer that firstly springs to mind for

the CRT questions have been documented to be wrong in the majority of cases (Fredrick, 2005). The outcome is opposite for the ELSA questions were the derivation of an answer is

cognitively straight forward. Therefore, for the data analysis in this study, each sub-category of numerical ability will be presented as an individual independent variable.

Moreover, because the study was performed on Swedish speaking respondents all the material used in the questionnaire was in Swedish. The translation by Almenberg and Widmark (2011) for the ELSA questions was employed, however, the CRT questions were translated by the author[9]. Thus, material that was in another language has been translated to Swedish in order to remove any potential biases due to respondents' language skills in English.

4.2.3 Financial Literacy

Similar as for numerical ability, previous studies have found that economic agents' financial literacy is correlated with individuals risk preferences (as discussed in *Section 3.3*). The measuring of respondents' literacy was carried out by asking them to respond with the correct answer (according to their beliefs) to seven question concerning financial products. The question for this section were replicated from studies by Almenberg and Widmark (2011) and Lusardi and Mitchell (2006 and 2007), demonstrated in Table 2. The nature of the questions range from basic concepts to more sophisticated level, however, all of them can be classified as "common knowledge". By employing these questions, it is believed that a good representation of respondents understanding of financial products and their interaction, such as the relation between risk and return, and investment type with interest rates, can be derived. The language which the questions were represented in was also Swedish for this section. Again, the translation done by Almenberg and Widmark (2011) was applied in the questionnaire.

In the literature, there exists some ambiguity concerning the definition of the numeracy and financial literacy, and often are they used interchangeably as they complement each other in a financial context. Nevertheless, some consensus prevails and financial literacy is generally suggested to correspond to having knowledge on financial concepts and understanding the relationship between different products (e.g. interest rates and bonds, risk and return). Numeracy is in contrast defined as having the cognitive ability to performed simpler mathematical derivations, probabilities, and making sense of information in numerical form. These following definitions have been applied for this study.

[9] The questionnaire has been included in Appendix 1, where the questions can be reviewed in Swedish.

Table 2

Questions employed to measure respondents´ financial literacy

Q1	Imagine that the interest rate on your savings account was 1 per cent per year and inflation 2 per cent per year. After 1 year, would you be able to buy more than, exactly the same as, or less than today with the money in this account?
Q2	Do you think the following statement is true or false? "Buying a single company stock usually provides a safer return than a stock mutual fund."
Q3	Do you think the following statement is true or false? "In the long run, variable interest rates are lower than fixed interest rates."
Q4	If the interest rate falls, what would happen to bond prices?
Q5	Considering a long time period (for example 10 or 20 years), which asset normally gives the highest return? [stocks/bonds]
Q6	Normally, which asset displays the highest fluctuations over time? [stocks/bonds]
Q7	Do you think the following statement is true or false? "An investment that gives a higher return than average probably involves higher risk than the average investment."

4.2.4 Demographic Attributes and Savings Behaviour

The final section of the questionnaire was devoted to collect data on respondents´ demographic attributes; such as age, education, country of birth, and level of income. This data can provide insight on the respondents´ individual differences that may have influences or correlates with decision making and risk preferences. The respondents were also asked to state their answers on questions regarding their savings and investment behaviour. The purpose was to get an indication of what choices the respondents have made in real life, however, note that the answers are still only stated and one have no real understanding of respondents' actual behaviour. Hence, it is a well known phenomenon that respondents´ tend to convey their intended behaviour rather than actual behaviour when responding to questionnaires (Eysenck, 2005; Dahmström, 2011).

In contrast to the questions in the rest of the questionnaire was these questions constructed by the author. As before, the respondents were asked these questions in Swedish. The following questions in Table 3 were employed:

Table 3

Questions employed to measure respondents saving and investment behaviour

Q1	How much do you save on monthly basis?
Q2	Do you save in a bank account? [Yes/No] *If yes*, how large share of your savings do you have in a bank account?
Q3	Do you save in stocks? [Yes/No] *If yes*, how large share of your savings do you have in stocks?
Q4	Do you save in stock mutual funds? [Yes/No]
Q5	*If yes*, how large share of your savings do you have in stock mutual funds?
Q6	Do you save in any other form? Please give the form of that saving. If yes, how large share of your savings do you have in this saving form?
Q7	Do you 1) own your house; 2) rent your house; 3) live with parents/other? *If you have a house mortgage*, please state the size of the mortgage share that is with fixed interest rate.

The different savings and investment options can be differentiated by a number of factors. The present study has emphasised on differences concerning risks levels and magnitude of return that corresponds with each type. Historically, saving in a bank account has been shown to be a relative riskless[10] option, followed by bonds, stock mutual fund and lastly stocks.

4.3 Order Effect

It is important for the results of this study to acknowledge the "order effect" that might arise due to that participant were presented and asked to evaluate the six set of distributions on one single occasion. Sequential presentation has been proven by prior studies to influence judgement, in particularly by the primacy and recency effects (see e.g. Hogarth and Einhorn,

[10] There is an element of risk with this method, in particular in the long run (e.g. 20 years). That is, if the average interest rate is lower than the average inflation rate during the savings period. Of course, it is assumed that any rational individual would stop the saving, however this covers a case when the money cannot be moved due to an agreement with the bank.

1992, Eysenck, 2005). Which effects that is dominant depends on the characteristics of the decision task such as required cognitive effort, information quantity, and number of objects for evaluation. Furthermore, the order of the presentation of the six different distribution contexts was determined randomly in order to avoid potential biases. Note that the distributions were not randomly ordered for each participant, the random distribution were constant throughout the research. Although the optimal would had been a rotating presentation of the distribution to avoid biases, the software used for the electronic version of the questionnaire did not provided that service, therefore a static presentation was carried out for all of the surveys.

5 Results

In this section, the result of the data analyses will be outlined. First, an analysis of risk preferences were carried out were the predictions of each of the EUT and the RFT were tested in order to find out if they could account for the choice behaviour of the sample set employed. Second, a simple test of the overall ability of the RFT to predict choice when involving risk was carried out. Lastly, the correlation between stability of risk preferences and characteristics of the decision maker was examined, including data on respondents' numerical and financial literacy. In order to provide some clarity in the methods of statistical analysis employed, they will be discussed in relation to the results obtained.

By the means of the survey employed, the present study obtain data from 47 respondents (N=47). That target was to obtain as many responses as possible (with respect to the time constraint), and it is believed that the size of the sample set of this study is sufficient to obtain reliable results. This is based on the fact that Brown *et al.*, (2008) had a sample set of N=24 when they tested the RFT to account for relative wage satisfaction. Moreover, the age of the sample set ranged between 18-69 years old with a mean and median age[11] of 37 years and 35 years, respectively. The spread between the genders were fairly equal, 44 per cent (N=21) of the respondents were females and 56 per cent (N=26) were male.

5.1 The Stability of Risk Preferences

Between each of the distributions pair applied in this study (please see Figure 2 in page 30), there exist a number of common points which hold the identical probability rate for obtaining the payoff SEK 25.000. The distribution pair *unimodal* (Uni) and *bimodal* (Bi) have five data points in common, *positive skew* (PS) and *negative skew* (NS) distribution has three, and *low range* (LR) and *high range* (HR) distribution has two. Each data point is labelled with its distribution type and ordinal rank position within its distribution (e.g. Uni2 and Bi4). The purpose is to test the EUT prediction of stabile risk preferences and the RFT prediction of

[11] In the questionnaire, the respondents were asked to tick the age range they belonged to therefore is the exact age of the participants unknown.

context dependent risk preferences, if they can account for the choice behaviour of the sample in a hypothetical investment scenario.

The data on respondents CE values for each of the paired prospects, enabled for a convenient method to test each prediction. The EUT predicts that those prospects that share identical probability rates and payoffs also should share the same averaged CE values, which implies stable risk preferences. Contrary to the EUT, the key idea of the RFT is that economic agents are subjected to the context which their choices are made in, therefore are preferences non-stable. Due to the design of the study, each data point was obtained from a unique distribution type, which can be interpreted as a direct test of the independence axiom. Each pair is presented in Table 4 together with the theoretical prediction for these data points by each theory, the averaged CE values for respective point, and the values obtained from the significance test.

By the mere review of the averaged CE values one can conclude that (Uni6, Bi6) and (LR11, HR10) did not support the prediction for neither of the two theories. The remainder of the pairs showed support for the predictions of the RFT; that the context which choice is made in will influence the risk level which the economic agents is prepared to accept. Following, a significance test was carried out in order to establish if the means of each data pair were statistically equal at the significance level of 5 per cent (p=0.05). A paired sample t-test was employed based on the fact the same participants have responded to each of the six distributions context (Zimmerman, 1997). The hypothesis for the paired sample t-test can be written as:

H_0: $\mu = 0$ (*There is no differences in mean values for the paired prospects*)

H_1: $\mu \neq 0$ (*There is differences in mean values for the paired prospects*)

where the null hypothesis, H_0, states that the means of the sample sets are equal at the 95 per cent[12] confidence level. Thus, the alternative hypothesis, H_1, states the contrary. If H_0 is accepted, the test will show support for the EUT, whereas if it is rejected (i.e. accept H_1) the results support the RFT. Furthermore, the degrees of freedom for each pair is given by N-1= 46.

[12] i.e. 100(1-0.05)%

Table 4

A table demonstration of the theoretical predictions of EUT and RFT, the obtained CE value and the results of the paired sample t-test

Distribution pair	*Prediction of EUT*	*Prediction of RFT*	*Averaged CE values*	*Significance test with p=0.05*
(Uni2, Bi4)	U2ni = Bi4	Uni2 < Bi4	944, 1288	t(46) = - 1.80, *p*=0.0394
(Uni3, Bi5)	Uni3 = Bi5	Uni3 < Bi5	1429, 1900	t(46) = - 2,0, *p*=0.0257
(Uni6, Bi6)	Uni6 = Bi6	Uni6 = Bi6	2638, 2910	t(46) = -1.08, *p*=0.1428
(Uni9, Bi7)	Uni9 = Bi7	Uni9 > Bi7	4206, 4060	t(46) = 0.73, *p*=0.2336
(Uni10, Bi8)	Uni10 = Bi8	Uni10 > Bi8	5536, 4791	t(46) = 1.75, *p*=0.0438
(PS5, NS2)	PS5 = NS2	PS5 > NS2	888, 881	t(46) = 0.06; *p*=0.4761
(PS8, NS4)	PS8 = NS4	PS8 > NS4	2741, 2303	t(46) = 1.79; *p*=0.0394
(PS10, NS7)	PS10 = NS7	PS10 > NS7	5054, 4580	t(46) = 1.78; *p*=0.0405
(LR2, HR1)	LR2 = HR1	LR2 > HR1	526, 404	t(46) = 1.24; *p*=0.1099
(LR11, HR10)	LR11 = HR10	LR11 > HR10	7221, 7298	t(46) = - 0.3, *p*=0.3823

The results of the significance test suggest that for the context of a hypothetical investment scenario, stability of risk preferences over gambles is inconclusive. The results regarding Uni and Bi distribution can be interpret as support for the concept that the ordinal ranking of a prospect within the decision set does influence the level of risk the individual is prepared to accept. Out of the five common data points, the outcome derived from the t-test for four of the pairs supported the RFT. Note that (Uni6, Bi6) is a special case as both theories share the

same predictions. However, the outcome of the t-test is not interpreted as support to the prediction of the EUT as this can be an artefact of the distribution context. Although points (Uni9, Bi7) lead to the acceptance of the H_0, the averaged CE values shows the relation, Uni9 > Bi7, as RFT predicted.

Distribution pairs LR and HR allows for the direct testing of the range effect. The sample means of both data pairs are shown not statistically different from zero, which leads to the acceptance of H_0 – that risk preferences are stable across different distribution context. The implication of these results is that the range principle does not influence respondents risk preferences. Further support for EUT is given by that fact that the averaged CE values does not reflect the predicted relation of LR11 > HR10, proposed by the RFT.

The distribution of PS and NS enables by design for the testing of the predictive power of both theories when distributions are skewed. For the two data pairs, the H_0 can be rejected as the samples means where statistically different from zero at the significance level of 5 per cent, implying that risk preferences have not remained stable. In addition, CE values for all of the data pairs hold the same relation as predicted by the RFT. Furthermore, the data pair (PS5, NS2), which their means were not found statistically different at 5 per cent level, are at the beginning of the distribution and can be interpreted as an indication that prospects at the lower end of the distribution are not influenced by the context to the same degree as the prospects at the higher end. Overall, across all of the distributions pairs, roughly an equal number of data pairs suggest for the invariance and variance of risk preferences.

5.2 Best-Fitted Parameter Estimation

In the range frequency model, the weight parameter *w* was the only unknown parameter in the equation (7). The parameter gives the rate of influence each individual principle (range and frequency) exert on choice. In order to enable the test of the fit of the RFT to obtained data on subjective CE values, the unknown parameter *w* has to be obtained. This was executed by applying the method of ordinary least squares (OLS) which is the best know method to derive the predicted weight parameter that is relatively close to the true parameter of the sample. The aim is to find the parameter value that minimise the sum of the squares of the residuals between the data points and the trend line (Thomas, 1996).

An averaging of the individual CE values were performed in order to produce one value for each prospect across the six distributions, which gives the sample size of sixty-six (N=66). The study adopted the same conservative approach used by Brown *et al*. (2008) as only one value of the weight parameter was estimated for the whole sample set. The obtain estimate of the unknown parameter w for the sample of this study was w=0.226 with an adjusted R^2 of 0.97. The obtained result suggests that for the sample of this study, both range and frequency influenced the respondents' evaluation of each prospect i.e. their risk preferences. In addition, one can derive that for the hypothetical investment scenario employed, the sample of the present study were influenced by the frequency principle (i.e. ordinal rank) at a greater extent than by the range principle. Moreover, Brown et al. (2008) found w=0.36 in the context of perceived relative wage satisfaction, and an earlier study by Wedell, Parducci and Lane (1990) found that range and frequency had a fairly equal level of influence (w=0.5) on rating of the psychopathology for clinical case histories.

Although further research is required before a confident inference can be drawn, one can predict that the nature of the context as well as the item under evaluation can determine subjects' susceptibility of the range and frequency principle.

5.3 The Fit of the Range Frequency Theory

In the above section, the unknown parameter w was derived, which enables for testing the overall ability of the RFT to account for the observed behaviour concerning risk preference. This is a simple test which is carried out by graphing the J_i values from equation (7), which represents the theoretical prediction of RFT for each prospect, against the respondents´ averaged subjective CE value for each prospect in every distribution pair. In total, there exist 66 prospects across the distribution (11 prospects × 6 distributions) in this study where each represents a hypothetical investment gamble. Moreover, in order to achieve consistency, the J_i values were constrained to values ranging between [0,1].

The fit between the model and the data is given by the distance between them which is represented by the solid line and the symbols, respectively. In the graphs, the x-axis gives the ordinal rank of each prospect and the primary y-axis (left) gives the averaged subjective value assigned to each prospect. In addition, a secondary y-axis is included which give the

prediction of the model, that is, the normalised J_i values. In Figure 3, the graphs for each distribution pair is illustrated individually.

The *unimodal* (Uni) and *bimodal* (Bi) distribution pair allows, by design, for a straight forward analysis of the ability of the frequency principle (i.e. ordinal rank) to account for observed choice behaviour. From graph 1.a, one can infer that the fit of the rank dependence principle to the data does not match perfectly, although the match is greater for prospects at the lower end of the ordinal rank comparing to the higher end. However, one can conclude that in overall the theory could successfully predict the trend of subjective value, hence indicating for the existence of rank effect on the respondents risk preferences.

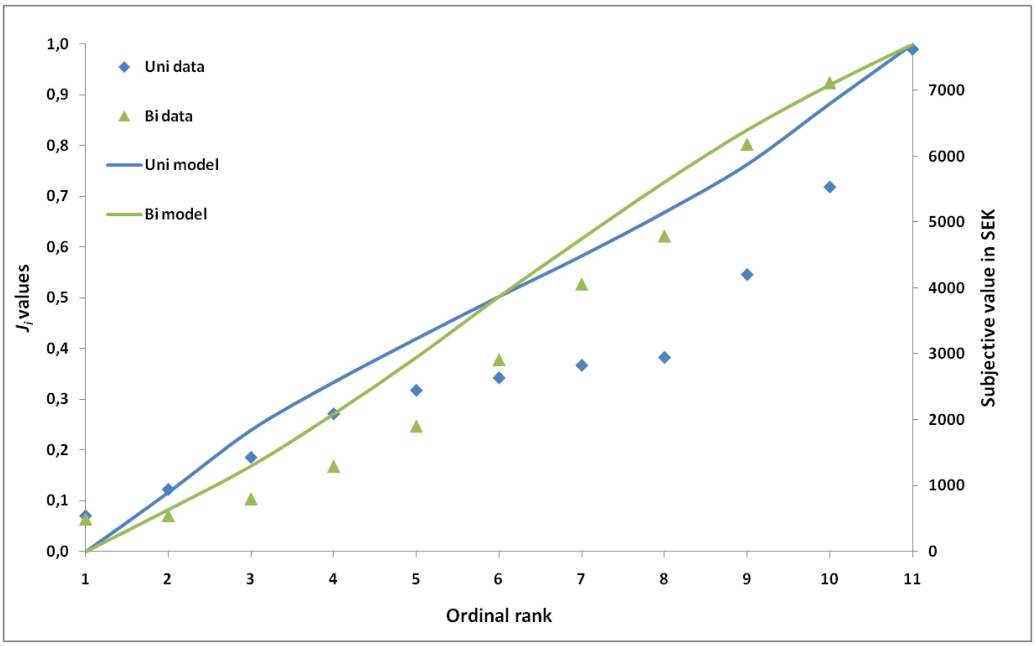
The second distribution pair represents the *negative skew* (NS) and *positive skew* (PS). As stated earlier, the distributions warrant for testing of the model when a distribution is skewed. The match between the data and model prediction correlating to NS shows to be high, however, the opposite is true for PS. This indicates that although the RFT can account for some choices, there might be other factors influencing choice that is not included in the model.

The last distribution pair, *low range* (LR) and *high range* (HR), allows for the testing of the significance of the range principle. The simple test showed that the model could predict the trend, but yet again the scaling does not correspond very highly. The overall results from this simple test has shown that the overall match is satisfactory in order to claim that the range and the frequency principle can account for choice under risk in a hypothetical investment scenario.

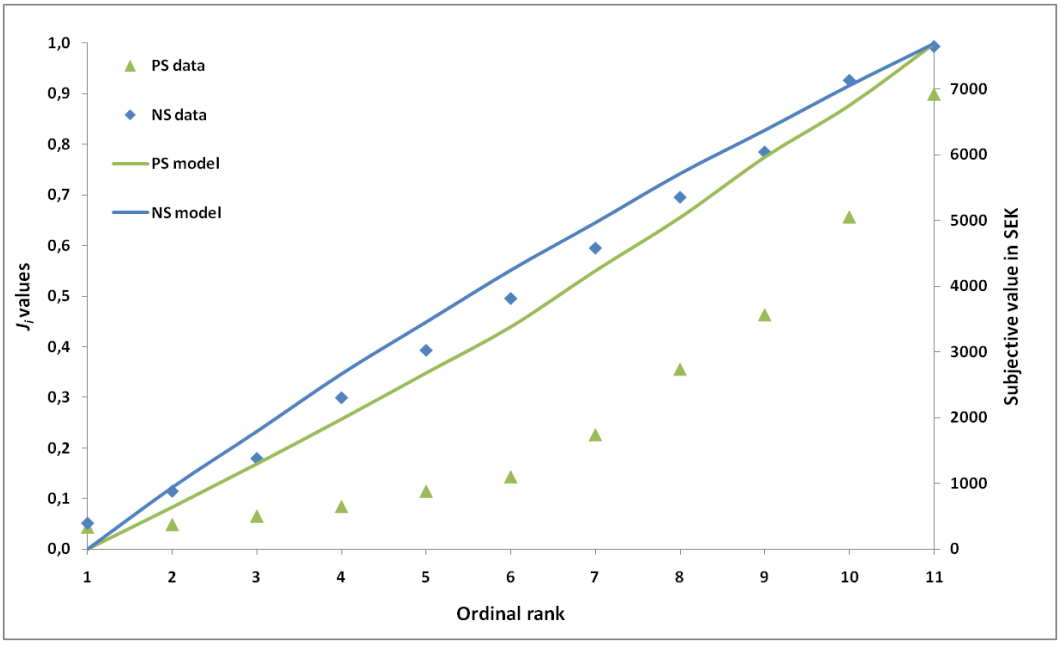
Figure 3

The fit of range frequency model to the data obtained from the sample set

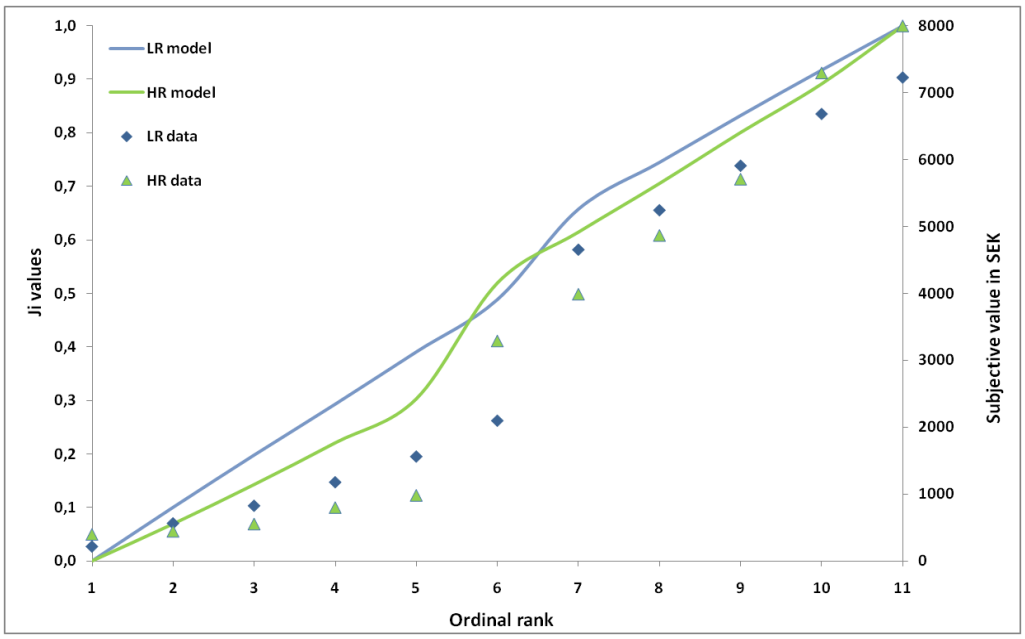
1.a Unimodal and bimodal



1.b Positive skew and negative skew



1.c Low range and high range



5.4 Susceptibility of the Distribution Context

Across the six distributions employed in this study, by design, there is in total ten prospect pairs where the prospects in the pair share identical positions on the distribution. This implies that the prospects in the pairs also share identical probability rate for obtaining the return in the hypothetical investment scenario. The design of the study allows for the measure of the extent which each participant has been influenced by the principles of RFT, that is, range and frequency. If the participants´ subjective values (i.e. CE values) for both prospect in a pair held the same value, it indicates that participant was not influenced by the distribution context. However, if the values in a pair were different from each other, this provides a strong indication that the participant was influenced by the principles of RFT.

As before, only data points from the distribution pairs (*unimodal* and *bimodal*; *positive* and *negative skew*; and, *high* and *low range*) will be compared against each other. The value assigned to each respondent was derived based on how many out of the ten data pairs that were evaluated similarly, and will represent the extent of risk preference stability which ranged from zero (fully influenced by RFT) to ten (not influenced by RFT). Though it is far

too strict to demand that the respondents must provide an identical value for both prospects in the pair to be considered having stable preferences, the author evaluated sensitivity by allowing for a deviation of 5 per cent between the prospects. Moreover, the sample size for this test was *N*=47, and the results showed that the average rate of preference stability was 5.6 and the median was 6 (of a maximum of 10). The approach of median split was adopted in order to turn the continuous variables into a categorical form. Accordingly, participants that hold a value above the median are categorised as showing "low susceptibility" to the decision context and the remaining as showing "high susceptibility". In total, 18 respondents held a value of 7 or higher (approximately one third of the sample size) and only 3 respondents (6.4 per cent) showed no influence of the context in their responses.

This indicates yet again that the prediction of the EUT is not in line with the empirical findings, implying for its deficiencies as a prescriptive theory. To the contrary, these findings suggest for the influence of the distribution context when making a choice under risk. Consequently, individuals risk preferences are not derived internally and thereby not stable, instead the layout of the relevant decision set determines human beings evaluation process.

5.5 Influences behind the Degree of Risk Preference Stability

The purpose of this section was to investigate potential factors that might explain the individual differences behind the degree of risk stability. This was carried out by employing regression analyses, where the values for individual risk preference stability are stated as the dependent variable. The values obtain for each respondent regarding their susceptibility of the context at the previous section are employed again (please see *Section 5.4* for the exact derivation of the dependent variable values). The aim is to obtain results from which we can derive answers to the following question: "Are there any factors that influences the degree which an individual holds stable risk preferences across different distribution contexts for choice involving risk?" All regressions were carried out with a significance level at p=0.05 and a sample size of *N*=47.

The explanatory (i.e. independent) variables are introduces in Table 5. For clarification, the "Housing" variable measured if respondents owned or let their home, and "Stocks" measure for participation in the stock market. The former variable can be perceived as a proxy for greater risk acceptance as owning a house often means that the individual has taken a

mortgage which has an element of risk involved, relative to renting a house. In addition, both "Stocks" and "Gender" are dummy variables, where the benchmark statements are, "do not own any stocks" and "male".

Table 5

Regression Analysis on Potential Factors Influencing Risk Preference Stability

	Reg 1	Reg 2	Reg 3	Reg 4	Reg 5
Gender	0.543				0.673
	(0.645)				(0.392)
Age	-0.576			-0.374	-0,465
	(0.058)*			(0.141)	(0.099)
Education	0.538				0.209
	(0.481)				(0.775)
Income	0.631				0.498
	(0.202)				(0.282)
Numeracy		-0.969			
		(0.155)			
CRT		0.638		0.243	0.263
		(0.089)		(0.442)	(0.438)
Financial lit.		0.646		0.591	0.598
		(0.023)*		(0.024)*	(0.026)*
Housing			-0.742		
			(0.377)		
Stocks			0.025	1.883	1.677
			(0.034)*	(0.36)	(0.07)
Adjusted R^2	0.044	0.131	0.071	0.212	0.187

***=** significant

In total, five regression analyses were carried out and the results for each regression are given in the table above. The first three regression analyses (*Reg 1-3*) were done in groups based on their attributes; such as demographics, literacy and behaviour in real life. Across these three categories, the highest coefficient of determination (i.e. R^2) was obtained by the second regression, indicating the relevance of literacy for preference stability.

Furthermore, in *Reg 4* only those variables that were shown significant at the 5 per cent level in the previous regressions were employed. At this stage only financial literacy remained significant, in addition, the highest R^2 value was obtained at 21.2 per cent. For *Reg 5*, the following strategy had been adopted: 1) if the variable is not statistically significant and yet has the expected sign, it will be kept; and 2) if the variable is not statistically significant and does not have the expected sign it will be dropped. The obtained R^2 is slightly lower than the previous regression despite that more variables are included. This implies that the some variables that are included in the model might not be relevant. Again, only the variable for financial literacy is shown significant.

All the variables in the regression analysis have shown expected signs except for "Numeracy" and "Housing" who both found was negatively correlated with preference stability, contrary to theoretical predictions. Furthermore, although "Numeracy" and "CRT" both measure some aspect of numerical ability, "CRT" variable holds the expected sign as well as a relatively low p-value (p=0.089), indicating that higher skilled mathematical ability are required for taking more consistent choices when risk is involved. Overall, these regression analyses suggested that age, financial literacy and participation in the stock market are factors that are correlated with the economic agent's preference stability. Data was collected on more variables than those employed here, however they have been omitted as very few responses were obtained for those.

6. Discussion

Together the results of this study suggest that choice under risk is not completely context-invariant as support has been found for the notion that risk preferences alter in relation to the distribution context which choice is made in. However, the results are not coherent as support for risk stability, in line with the predictions of the EUT, has also been found. Thus, the inconclusive nature of the results suggests that there might be other factors that determines for decisions in a hypothetical investment gamble than this paper has covered.

Furthermore, the findings of this study suggest that the frequency principle has the greatest influence on stability of risk preferences. The significance of the rank was further supported by that fact that the averaged CE values matched the prediction of the RFT regarding the relation of the prospects in each pairs. Regarding the significance of the range principle on choice was not supported by the data, rather support for the axioms of the EUT, especially the independence axiom, was found. However, finding on the range and rank corresponds to the weight parameter, *w*, as the value of w=0.226 indicates that for the data obtained for this study, the influence of the rank is 0.774 (given by 1-*w*) relative to the range principle that is 0.226 (given by *w*). This particular relation is given by the range frequency model in equation (7). On the other hand, in the skew context, both principles of the range frequency model are tested which supports the relevance of the range principle, perhaps only in relation to the frequency principle. In addition, when the context distribution is skewed, risk preferences have been found to be not stable except at the lower end of the distribution. Overall, the results suggest that the range principle alone might not have a sufficient influence on choice, however, together with the frequency principle it has.

Corresponding to the results of context dependent choice, the author suggests the nature of the context, which the sample has been recorded in relation to, as a plausible explanation for the inconclusiveness of the findings of this paper. To collect information on risk preference stability, the respondents were asked to stat the sum which they are indifferent between and a gamble with probability *p* (i.e. CE value). The participants derived their evaluation of a prospect on a probability distribution ranging between p= [0,1], from which the probability of each prospect is derived based on its position (see Appendix 1 for the questionnaire or Section

4.2.1 for only the distribution type). The fixed range of the distribution in combination with the potential influence of the order effect, might have led to that respondents have not based their evaluation of the prospect on only the corresponding distribution, but also based it on what answer he "remembered" giving to a prospect position similarly in previous distribution contexts. The effects of a distribution context is contingent on that choice is based on the possible choices the respondent is faced with, therefore might its full effect on choice not been recorded by the data of this study. As mentioned in *Section 4.3*, the optimal would have been to record behaviour at different points in times to reduce the "noise" of order effect. However, note that the point is not to exclude effects of memory, rather create a setting that resembles when choices are made in real life.

Furthermore, the simple test on the overall fit of the RFT to the data sample showed that the model could successfully predict the trend of observed choice behaviour for this sample set. However, the scale of the prediction was not equally satisfying which is explained by the fact that no general tendency for risk preferences stability was found in the present papers analysis. With regards to the continuous debate between normative and descriptive choice theorists, the results of this study contributed by extending the alternatives approaches which choice under risk can be examined. Albeit the results were not conclusive, one can conclude that context which choice is made in does influence the degree which the economic agent is prepared to take risk, and the RFT is a contender for accounting for observed risk behaviour on choice under risk.

Besides examining if risk preferences are context-invariant, and the ability of the RFT to account for any instability, the purpose of this paper was to analyse the potential factors that can account for the individual differences in the degree of risk preference stability. In the regression analyses, results showed that age, financial literacy and participation in the stock market is correlated with how stable the agent´s risk preferences are across different distribution contexts. Financial literacy and engagement in the stock market showed both a positive correlation to risk preference stability. This result might be explained by that those individuals who hold greater knowledge on financial products also are more active in the stock market as knowledge on financial concepts is necessary for avoiding the risk of making a great monetary loss. Furthermore, the CRT variable was not statistically significant at the 5 per cent significance level as the value obtained was p=0.089. The value is fairly close to the breaking point and should base on that not be dismissed just yet. Other studies have examined individual differences behind risk preferences (that is; risk aver, risk loving and risk neutral)

however, to the knowledge of the author, the factors behind preference stability has not been investigated. In line with existing literature, similar explanatory variables are shown significant as in this study (c.f. Peters et al., 2006; Frederick, 2005; Almenberg & Widmark, 2011) implying that there is a strong correlation between individuals risk preferences, risk preference stability and the distance of actual choice from the optimal one.

With regards to some earlier discussions regarding information acquisition and decision making, from the results of the regression analysis, one can conclude that the economic agent cannot utilise information by the mere acquisition of it. In order to make sense of the information, some basic concepts of math and financial concepts are pre-requisite in order for a more informed choice to be derived that are financial in nature. This notion is a potential explanation behind why the degree of risk preferences stability are positively correlated with financial literacy (and CRT) variable. That is, individuals who scored low on literacy might evaluate the prospect based on merely the position of the prospect to the endpoints and its ordinal rank, hence be more susceptible to the context. On the other side, the high scoring individuals primarily bases their evaluation on facts such as probability rate and magnitude of the payoff which leads to that they hold a more context-invariant risk preference.

This leads one to the following question: "What implications do these results have on real life?" Poorly taken decisions can have devastating and negative implications for a household, leading to a decrease in their welfare in the long run. The current market is changing as the financial market is getting increasingly more sophisticated and lay people have access to numerous types of products and services through several instances in the market. In addition, a vast number of economies (mainly developed countries) have altered the pension schemes, providing its population greater sovereignty (OECD, 2005). The consequences of a highly context-dependent risk preferences is that choice are not based on how much risk one can "afford", based on ones current wealth, rather will be bases on the options one is presented with. Perhaps would this not be considered as a problem if the alternatives for X in the whole universe were within the decision set, however this is usually not the case. Often are decisions based only on a fraction of all of the existing alternatives.

With the increasing responsibility on the individual household to make their own choices, it requires a profound understanding of trade-off between risk and return, the pros and cons with different types of interest rates and types of investments, such as bonds and stock mutual funds. In a macroeconomic perspective, the aggregation of the decisions by the households

affects the national economy. Financially educated and high savings rate are found to be positively correlated, as well as the magnitude of saving. Thus the association between high literacy and high savings rate supports the notion that the quality of household decisions, based on their literacy, has a direct impact economic growth and investment levels (OECD, 2005). In addition, they are better at protecting themselves as well as "guard" the financial market. Thus, having a clear account on how people make choices when risk is involved, as well as the factors influencing the decision process, is a vital knowledge policy makers must hold as decisions on a macro level can have great implications (negative or positive) on an individual level.

7 Conclusion

The present study examined if risk preferences are stable throughout different distribution contexts, which was a response to the traditional economic theory of stable and internally derived risk preferences. The results obtained suggested for an inconclusive answer though support was found for both context-dependent and context-invariance risk preferences. This might imply that there are more factors that must be incorporated into the model. Alternatively, that this finding is coherent with the hypothetical investment scenario employed during data collection. More research is therefore needed before obtaining a definite answer.

In the search for a model that could adequately account for observed choice behaviour, this study examined the RFT. Its overall ability to predict the movement of risk preferences were shown significant, however, the scaling of the prediction were not satisfactory. Moreover, the effect of ordinal rank (i.e. frequency principle) was found to influence risk preference stability most extensively. Results from the regression analysis suggest that risk preferences become more context-dependent with age and more context-invariant with increased financial literacy. Those who scored high on financial literacy were also found active in the stock market. Thus, these results indicate that although information is accessible it does not imply that it can be employed when making a choice as familiarity with financial concepts is necessary.

In modern societies, making choices that involves risk has become a common element. Poor decision making can have devastating effect for the individual agent and the aggregated behaviour in a nation can impact the national economy. This study suggests for additional research on this topic in order to further explore the factors that influence risk preference stability, both on an individual differences level as well as on a contextual level. The recommendations of this study are that the sessions when risk preferences are being measured should be separated in order to reduce the order effect. In addition, testing in other contexts could lead to a greater generalisation of the RFT and the concept of context-dependent choice, that is, if findings support the predictions. Furthermore, employing the theoretical predictions in a natural experiment is the ultimate method of testing the reliability and validity of context-dependent choice and RFT.

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Appendix 1.

Influenser bakom beslutstagande under risk

– undersökning för en magisteruppsats

Denna enkät syftar till att skapa en överblick över de faktorer som påverkar individers beslut att delta i situation med olika nivåer av risk. Risk finns i de flesta beslut vi tar i vår vardag, medan vissa beslut inte har någon större effekt på vårt liv, så kan andra ha en direkt inverkan. Dessa beslut kan gälla t.ex. bindningstiden på bolånet eller vilka fonder att placera pensionssparandet i. Kunskaper om detta kan underlätta för lagstiftare att anpassa lagar och policyn till att skydda konsumenter.

All information som samlas in i denna undersökning kommer främst att användas i min magisteruppsats som jag skriver vid Lunds universitet. Medverkan är frivillig och du som deltar är anonym. Du kan därför närsomhelst avsluta enkäten eller att välja att inte svara på en fråga/frågor utan en förklaring. Enkäten är uppdelad i tre sektioner och tar ca 15 min att komplettera.

Om ni har några frågor gällande undersökningen eller magisteruppsatsen, var god och kontakta mig på: Elnaz.Sarvioskouey.432@student.lu.se

Tack för din medverkan!

Elnaz Sarvioskouey

Del 1. Beslutstagande – En investering

I denna del vill vi undersöka hur mycket varje individ är beredd att betala för att delta i en investering med ett specifikt vinstbelopp. Tänk på att det inte finns ett rätt eller fel svar, vi är intresserade av din personliga värdering.

Fråga 1.

Anta att du skall göra en investering som antingen ger dig 25.000 kr eller 0 kr. Sannolikheten för att få 25.000 kr för en enskild investering anges av en punkt på linjen nedan. Sannolikheten för att få 25.000kr går från 0% (som noteras som p=0) till 100% (som noteras som p=1). Detta innebär att chansen att erhålla 25.000 kr ökar ju längre till höger på linjen man är. Vid p=0 är det säkert att man inte vinner något och vid p=1 får man 25.000kr med säkerhet.

en investeringsmöjlighet med en sannolikhet för att få 25.000 kr. **Du skall nu för varje investeringsmöjlighet (bokstav på linjen) ange hur mycket du maximalt skulle vara beredd att betala för att få göra en sådan investering.** Tänk på att det är naturligt att beloppet man är beredd att betala stiger ju längre till höger investeringsmöjligheten ligger på linjen då chansen att vinna blir större. En investering som ger 25.000kr med sannolikheten 10% är ju normalt sett mindre attraktiv än en som ger samma vinst fast med sannolikheten 90%. Det är dock du som skall fråga dig själv hur du tror du hade agerat i en sådan situation och inga svar är fel.

Var god och ange den högsta summan du skulle vara beredd att betala för varje gult streck i dess respektive ruta nedan.

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Fråga 2.

Anta att du skall göra en investering som antingen ger dig 25.000 kr eller 0 kr. Sannolikheten för att få 25.000 kr för en enskild investering anges av en punkt på linjen nedan. Sannolikheten för att få 25.000kr går från 0% (som noteras som p=0) till 100% (som noteras som p=1). Detta innebär att chansen att erhålla 25.000 kr ökar ju längre till höger på linjen man är. Vid p=0 är det säkert att man inte vinner något och vid p=1 får man 25.000kr med säkerhet.

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Fråga 3.

Anta att du skall göra en investering som antingen ger dig 25.000 kr eller 0 kr. Sannolikheten för att få 25.000 kr för en enskild investering anges av en punkt på linjen nedan. Sannolikheten för att få 25.000kr går från 0% (som noteras som p=0) till 100% (som noteras som p=1). Detta innebär att chansen att erhålla 25.000 kr ökar ju längre till höger på linjen man är. Vid p=0 är det säkert att man inte vinner något och vid p=1 får man 25.000kr med säkerhet.

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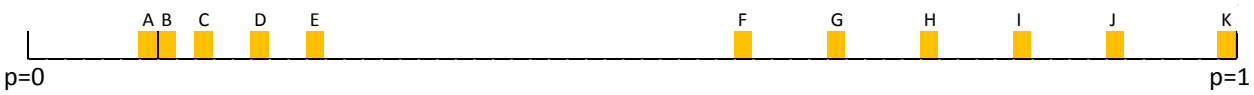

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Fråga 4.

Anta att du skall göra en investering som antingen ger dig 25.000 kr eller 0 kr. Sannolikheten för att få 25.000 kr för en enskild investering anges av en punkt på linjen nedan. Sannolikheten för att få 25.000kr går från 0% (som noteras som p=0) till 100% (som noteras som p=1). Detta innebär att chansen att erhålla 25.000 kr ökar ju längre till höger på linjen man är. Vid p=0 är det säkert att man inte vinner något och vid p=1 får man 25.000kr med säkerhet.

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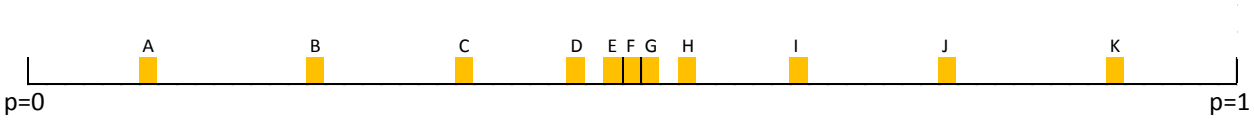

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Fråga 5.

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Fråga 6.

Anta att du skall göra en investering som antingen ger dig 25.000 kr eller 0 kr. Sannolikheten för att få 25.000 kr för en enskild investering anges av en punkt på linjen nedan. Sannolikheten för att få 25.000kr går från 0% (som noteras som p=0) till 100% (som noteras som p=1). Detta innebär att chansen att erhålla 25.000 kr ökar ju längre till höger på linjen man är. Vid p=0 är det säkert att man inte vinner något och vid p=1 får man 25.000kr med säkerhet.

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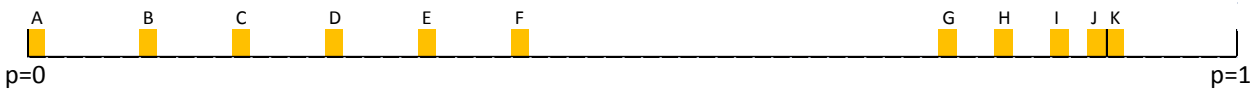

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Del 2. Räknefärdigheter och finansiell förmåga

2.1 - Räknefärdigheter

1. Om sannolikheten att få en sjukdom är 10 %, hur många av 1000 personer kan förväntas få sjukdomen?

   Svar: ……..

2. En bilhandlare erbjuder en begagnad bil för 60 000 kr. Det är två tredjedelar av vad den kostade som ny. Hur mycket kostade bilen som ny?

   Svar: ……

3. Fem personer vinner ett lotteri och ska dela på vinsten. Om vinsten de ska dela på är 2 miljoner, hur mycket får var och en?

   Svar: ……

4. Anta att du har 200 kr på ett sparkonto. Räntan är 10 % om året och sätts in på samma konto. Hur mycket har du på kontot efter två år?

   Svar: ……

5. En bok och ett bokmärke kostar totalt 110 kr. Boken kostar 100 kr mer än bokmärket. Hur mycket kostar bokmärket?

   Svar: ……

6. Om det tar 5 personer 5 månader att spara 50.000 kr, hur många månader skulle det ta 100 personer att spara totalt 1 000.000 kr?

   Svar: ……

7. I en sjö finns det näckrosor. Varje dag fördubblas arean som täcks av näckrosor. Om det tar 48 dagar för att täcka hela sjön, hur många dagar skulle det då ta för näckrosorna att täcka halva sjön?

   Svar: ……

2.2 - Finansiell förmåga

1. Anta att ränta på ditt sparkonto är 1 % och inflationen är 2 %. Om du låter dina pengar stå på kontot i ett år, kommer du kunna köpa mer, lika mycket eller mindre för pengarna på kontot vid årets slut?

Svar: ……

2. ”Att köpa aktier i ett enstaka företag är vanligtvis säkrare än att köpa andelar i en aktiefond.” Sant eller falskt?

Svar: ……

3. ”På lite längre sikt brukar rörliga bolåneräntor vara lägre än bundna bolåneräntor.” Sant eller falskt?

Svar: ……

4. Obligationer är värdepapper som löper med fast ränta under viss tid. Om räntan går ner, vad händer med obligationspriserna?

Svar: ……

5. Vilket har historiskt sett gett högst avkastning på lång sikt, aktier eller obligationer?

Svar: ……

6. ”Aktier brukar gå upp och ner i värde mer än vad obligationer gör.” Sant eller falskt?

Svar: ……

7. ”En investering som ger högre avkastning än genomsnittet har sannolikt högre risk än genomsnittet.” Sant eller falskt?

Svar: ……

Del 3. Demografi

Var god och ringa in dem alternativen som stämmer in bäst för varje kategori. Tänk på att svaren är anonyma!

Kön

Kvinna Man

Ålder

18-29 30-39 40-49 50-59 60-69 70 +

Högsta utbildningsnivå

Grundskola	Gymnasial utbildning	Eftergymnasial utbildning t.ex. yrkesutbildning
Universitet-/högskoleutbildning upp till kandidatexamen	Magister/masternivå eller motsvarande	Doktors / Licential nivå

Födelseland

Sverige	Norden utom Sverige
Europa utom Norden	Övriga länder

Är någon av dina föräldrar födda i ett annat land än Sverige? Ja Nej

---

Inkomst före skatt

Mindre än 15 000 kr	15 000 kr – 19 999 kr	20 000 kr – 24 999 kr	25 000 kr – 29 000 kr
30 000 kr – 34 999 kr	35 0000 kr – 39 999 kr	40 000 kr eller mer	

Sparande och sparande form

Hur mycket sparar du i månaden? Ange belopp: ……kr.

Sparar på bankkonto? Ja Nej

Om du svarade ja: Hur stor andel av ditt sparande har du på bankkonto?.....(%)

Sparar du aktier? Ja Nej

Om du svarade ja: Hur stor andel av ditt sparande har du i aktier?.....(%)

Sparar du i aktiefonder? Ja Nej

Om du svarade ja: Hur stor andel av ditt sparande har du i aktiefonder?.....(%)

Har du annat sparande? Ange vilken form: ……

Hur stor andel av ditt sparande har du i denna form?.....(%)

Boende

Äger en bostad Hyr bostad Bor hos föräldrar / annat

Om du har bostadslån. Ange hur stor andel av lånet du har till fast ränta: ……(%)

Tack för din medverkan!