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MASTER IN FINANCE

MASTER FINAL WORK

DISSERTATION

HOW DOES RISK PERCEPTION AFFECTS ATTITUDES TOWARD RISK?
AN EMPIRICAL WORK IN MOZAMBIQUE CONTEXT

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I would like to dedicate this work to my parents. To my mother, for being always comprehensive and to support all my decisions. To my father, for all the advices and guidance along my all life. I will always be grateful for what both of you made for me. Thank you for preparing me for life, my success will always be yours.

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Abstract

The main purpose of this work it to infer a relationship between attitudes toward risk and risk perception to contribute to the determination of the role of risk perception in engaging in risky activities. The data was collected via a two-part questionnaire which was applied to a sample of 164 undergraduate and graduate students in Mozambique. The main data used derived from the first part of the questionnaire which was a 65-item DOSPERT scale, especially constructed to be applied in Mozambique, which was shortened via a Confirmatory Factor Analysis. The final scale used was a 30-item scale divided by 6 sub-domains of risk. This scale presented very interesting results in the chosen metrics of three domains evaluated: Unidimensionality; Reliability and Validity. The final scale should be fined tuned for future research purposes and was prepared to be applied to similar cultural contexts. The second part of the questionnaire was used to apply utility theory and a sample of 72 individuals were chosen. The questionnaire allows a comparison between two measures of attitudes toward risk (1) DOSPERT Scale; (2) Expected Utility Theory. Using the DOSPERT metrics, it was possible to perform a regression analysis, regressing expected benefits and risk perception as independent variables and attitudes toward risk as dependent variable. The results help to answer the proposed research question. For risk perception, results showed a negative relationship with attitudes toward risk for all sub-domains of risk except Health/Safety, being statically significant for the Financial/Gambling, Ethical and Recreational sub-domains of risk. Using utility theory, it was possible to compute the metric of curvature of the utility function (α). Performing the same regression but using α the lead to very poor results. The results contribute to hypothesize that the DOSPERT metrics and the utility metrics measure different things.

Keywords: Risk Perception; Risk Attitudes; Confirmatory factor analysis; DOSPERT; Utility

Resumo

O objetivo principal deste trabalho é inferir uma relação entre as atitudes perante o risco e a percepção de risco e sua importância deve-se a contribuir para a determinação do papel da percepção de risco no envolvimento em atividades de risco. Os dados foram recolhidos através de um questionário com duas partes que foi aplicado a uma amostra de 164 estudantes universitários em Moçambique. Os principais dados utilizados derivaram da primeira parte do questionário, que era uma escala DOSPERT de 65 itens, especialmente construída para ser aplicada em Moçambique, que foi encurtada através de uma análise factorial confirmatória. A escala final utilizada foi uma escala de 30 itens dividida por 6 subdomínios de risco. Essa escala apresentou resultados muito interessantes nas métricas escolhidas de três domínios avaliados: Unidimensionalidade; Confiabilidade e Validade. A escala final deve melhorada para futuro e foi preparada para ser aplicada em contextos culturais semelhantes. A segunda parte do questionário foi utilizada para aplicar a teoria da utilidade e uma amostra de 72 indivíduos foram escolhidos. O questionário permite uma comparação entre duas técnicas de atitudes perante o risco: (1) Escala DOSPERT; (2) Teoria esperada da utilidade. Usando as métricas DOSPERT, foi possível realizar uma análise de regressão, regredindo benefícios esperados e percepção de risco como variáveis independentes e atitude perante o risco como variável dependente. Os resultados ajudam a responder à pergunta de investigação proposta. Para a percepção de risco, os resultados mostraram uma relação negativa com as atitudes em relação ao risco para todos os subdomínios de risco, exceto Saúde / Segurança, sendo estaticamente significativo para os subdomínios de risco Financeiro /Aposta, Ético e Recreativo. Usando a teoria da utilidade, foi possível calcular a métrica de curvatura da função de utilidade (α). Além disso, e realizando a mesma regressão, mas usando α obteve-se para resultados muito fracos. Os resultados contribuem para a hipótese de que as métricas DOSPERT e as métricas da utilidade medem diferentes coisas.

Palavras-chave: Percepção de risco; Atitudes de Risco; Análise fatorial confirmatória; DOSPERT; Utilidade

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Acronyms list

AVE	*Average Variance Extracted*
CFA	*Confirmatory Factor Analysis*
CFI	*Comparative Fit Index*
CR	*Composite reliability*
CT	*Cultural Theory*
DOSPERT	*Domain Specific Risk Taking Scale*
DOSPERT-MZ	*Domain Specific Risk Taking Scale- Mozambique*
E	*Ethical sub-domain*
EU	*Expected Utility*
EB	*Expected Benefit*
FI	*Financial/Investing sub-domain*
FIML	*Full Information Maximum Likelihood*
FG	*Financial/Gambling sub-domain*
HS	*Health/Safety sub-domain*
MCAR	*Missing completely at random*
NNFI	*Nonnormed Fit index*
PT	*Prospect Theory*
R	*Recreational sub-domain*
RT	*Risk Taking*
S	*Social sub-domain*
EB	*Expected Benefit*
RMSEA	*Root mean squared error*
RP	*Risk Perception*
SEM	*Structural Equation Modeling*

Chapter 1:Introduction

Human decisions under risk and uncertainty are a topic widely studied, including in finance, both mainstream and behavioral. The foundations of the study of attitudes toward risk are attributed to the revolutionary work of Bernoulli (1738). The study of human decisions is always a difficult topic because in all traditional models one key assumption must be verified: Rationality. The fact that human decisions are always rational, especially in contexts of risk is not always verifiable. Additional factors (For example, the pleasure of gambling) must be taken in consideration which, most of the times, cannot be explained in a mathematical formula. Because of that, understanding the main drivers of human behavior may help to a better understanding of attitudes toward risk. One of the most studied driver is related to risk perception.

The definition of risk perception is not consensual. It can be considered as the subjective perception of the risk of a situation/activity. This is a subjective assessment that depends on the individual, which is assessing the risk, and so different people can assess the same risk differently. So, if people can assess risk in different ways, and this can derive from different risk perceptions of a situation/activity. Such means that risk perception can be a key determinant in explaining attitudes toward risk. This way of thought, lead to several studies of risk perception on the past decades. Moreover, and instead of only studying risk perception as a determinant of attitudes toward risk, many authors focused on studying the main determinants of risk perception and how can different people perceive the same situation/activity as more or less risky, which can be determined by different experiences or personality traits.

The purpose of this work is to understand and explain the relationship between attitudes toward risk and risk perception in Mozambique. This extends previous literature by

comparing two measures of attitudes toward risk in the context of Mozambique. We begin from a premise there is a negative relationship between risk perception and attitudes toward risk, since normally individuals tend to be averse to risk. The study was performed for a Mozambique sample of master and undergraduate students of diverse backgrounds. African countries have cultural particularities that should be taken in consideration. The existent literature is more focused in occidental contexts and so understanding and replicating the knowledge for distinct cultural contexts was one of the reasons for choosing Mozambique. One of the key decisions for performing this study is the choice of a properly measure of attitudes toward risk. The measure that is more important in this study derives from a version of the DOSPERT scale proposed by Weber et al (2002) were the foundation of the scale is the fact that individuals have differentiated attitudes toward risk in different sub-domains of risk. The DOSPERT scale was used by several reasons. First, because it allows to assess for a conjoint of items or activities in 3 different contexts, especially attitudes toward risk and risk perception. So, with this scale is possible to infer the main determinants needed for this study. The second objective is to define a scale that can be used as measure of attitudes toward risk for future applications in similar cultural contexts. For that purpose, and because the DOSPERT application must be culturally fined-tuned, some activities were constructed for a future application in similar contexts[1]. Additionally, it was used as measure of attitude toward risk an application of the utility theory, proposed initially by Bernoulli (1738) and axiomatized by Von Neuman and Morgenstern (1947). The objective of using this measure is to determine if DOSPERT scale and utility theory measure the same thing.

[1] The DOSPERT-MZ scale was developed in such a way that it can also be tested at Angola and to a certain extent in the remaining Portuguese speaking countries.

This document is organized as follows: chapter 2 reviews the literature; chapter 3 presents the data and elaborates on the methodology used; chapter 4 uncovers and discuss the results; and chapter 5 concludes.

Chapter 2: Literature Review

2.1. Definition of Risk

The word risk has several meanings and is used in different contexts and areas like medicine, psychology or finance. Some authors relate risk to an extent of a situation that puts an individual in jeopardy (see for example Fischer et al, 1991). Fischer et al (1991, p. 303) defines risk as a "*threat to health and safety*". Other authors relate risk to a loss. Taylor (1974) defined risk as a possible loss and Campbell (2005) defines risk as an expected harm weighted by its probability of happening.

Regardless the context, a distinction between risk and uncertainty should be emphasized. The beginning of this distinction can be attributed to Knight (1921). The author defined risk as "*a quantity susceptible of measurement" (*Knight, 1921, p. 19) and used uncertainty as a non-quantitative situation. Using Knight definition**, risk can be defined as the frequency probability of an outcome** and Uncertainty as an outcome that cannot be quantifiable with a frequency probability.

Despite that, some authors mix the concepts. Kaplan and Garrick (1981) classified risk as a sum of uncertainty and potential damage. Holton (2004) define risk as exposure and uncertainty, meaning that risk is the exposure of a non-certainty outcome.

Using Knight (1921) definition it is possible to differentiate individual's attitudes toward risk and attitudes toward uncertainty, as the individual decision about a risk or uncertainty situation, depending on knowing or not the probability of the outcome.

The measurement of risk is also an important topic. Using Knight (1921) definition to measure risk it should be the computed probability about the outcome itself. Risk can also be measured as the variability outcomes due to Pratt (1964) work. This variability can be measured by the variance or standard deviation of the possible outcomes.

2.2 Risk perception

Risk perception was first introduced by Bauer (1960). It was first classified as a subjective assessment about a negative consequence in a consumer perspective.

Risk perception is used in several contexts. It is used in evaluating potential hazards and his consequences (Slovic, 1987) in climate change risk (Linden, 2015) or even the role in attitudes toward risk for economic activities as farming (Wauters et al 2014) or fishing (Huchim-Lara et al 2016).

Risk perception can be classified has the subjective probability assessment of a negative outcome (Sjoberg et al, 2004) or extending Knight (1921), as a subjective assessment of a probability of an outcome, negative or not. This extension of Knight´s definition will be used as definition of risk for this work. Thus, the definition of risk perception adopted is:

Definition: Risk perception is the subjective assessment of a probability of an outcome, negative or not.

This suggest that individuals compute probabilities about specific events. This assessment of probabilities is subjective since it will depend on psychological restrains of the individuals that are evaluating the risk. Normally, risk perceptions are inferred from individual judgment about a consequence of an outcome (Sheeran et al 2013).

Kahneman and Tversky (1981) argue that in a risky situation, probabilities of the outcomes result from a subjective valuation of the risk. They argue that individuals tend to

overweight low probabilities and underweight high probabilities about risky outcomes. This problem in assessing probabilities was also studied by Lichtenstein et al (1978). The authors argued that that the individual capacity of determining the true frequency of an event will affect how individual perceive risk.

This can be derived by a communication problem. Budescu and Wallsten (1985) argue that individuals have more difficulties in dealing with nonnumerical risk than with numerical risk. More recently, Harris and Corner (2011) found a relationship between the perception of outcome severity and verbal communication of a risk.

Some authors focused on assessing the main determinants that affect risk perception. Johnson and Tversky (1983) concluded that mood about an event has a decisive influence on the perception of the risk. Kahneman and Tversky (1981) argue that the way in which the problem is framed also influences how individuals perceive risk. This is corroborated by Weber and Milliman (1997) which argue that previous outcome results and framing affect the perception of risk. The fact that past personal experience affect risk perception was also argued by Wachinger et al (2013).

An interesting topic is related to the gender differences in the perception of risk. Boverie et al (1995) found that there were differences in risk perceptions among genders. They found that "*females tended to cluster risks according to the gain(consequence) or the personal cost of engaging in the risk*" (Boverie et al, 1995, p. 301). For males, they also found this cluster but more dispersed by gains and losses.

There are two main theories that explain risk perception: Cultural Theory (CT) and Psychometric paradigm. CT was introduced by Douglas (1978). The theory relies on how individual embedded culture can affect risk perception.

One of the most prominent application of CT was proposed by Hsee and Weber (1998). The authors study the differences in risk preferences comparing China and United

States. They found that Americans respondents perceived the same situations as riskier that the Chinese respondents due to cultural differences. Additional cross-cultural studies performed with different benchmarks also enhanced differences in attitudes toward risk (see Nobre et al. 2016). Some critics were made to CT mainly criticizing the fact that that was difficult to use standard quantitative measures like questionnaires to evaluate the theory (Marris et al, 1998) which does not happen under the psychometric paradigm.

The fact that individual characteristics affect their risk perception is the basis of the psychometric paradigm. The foundations of the work are attributed to Starr (1969). The author introduced the "revealed preference" concept. This concept is related to the cost-benefit of social/technological activities that impact individual's life. Extending Starr work, Fischhoff et al (1978) develop a concept called "expressed preferences". The expressed preferences concept relies on applying psychometric questionnaires to individuals to measure general attitudes toward risk.

Davis-Berman and Berman (2002) argue that the perception of risk may affect attitudes toward risk. Weber and Bottom (1989) were one of the main developers of this relationship (and later Weber and Milliman, 1997). They argue that risk perception will not only affect the choice in the "evaluation-of-alternative stage" but in latter acquisition of information. With this relationship in mind the labeled individuals according to their risk perception. Using a pair of 28 lotteries they classified individuals as perceived risk seeking when they repeatedly choose the lottery which they perceived riskier and perceived risk averse when they repeatedly choose the lottery which they perceived less risky. When a clear set of preferences were not defined, the individuals were classified as perceived risk neutral.

Mellers et al (1997) also use risk perception about gambles with the same expected value but with different variance to classify individuals. They argue that "*two people make identical choices when they share both risk perceptions and perceived risk attitudes or when*

they share neither" Mellers et al (1997, p. 60). This mean different individuals can choose the same (different) gamble by a different (same) rationalization process. Schwartz and Hasnain (2002) argued that perceived risk attitudes help to explain individual's choices.

Sund and Svensson (2015) relate demographic determinants with risk perception. They found that some individual characteristics can be connected to a lower risk perception where the most important are "*being male, having a high level of education, being employed..." (*Sund and Svensson 2015, p.13).

An interesting study topic is to reflect on attitudes toward risk among entrepreneurs. Brockhaus (1980) concluded that entrepreneurs are not risk seeking individuals but instead moderate risk takers and the difference lies on the perception of the risk. Norton and Moore (2002, p. 281) argue that "*entrepreneurs do not necessarily possess character traits which predispose them to engage in behavior with widely-variable outcome but rather that entrepreneurs assess opportunities and threats differently from non-entrepreneurs*". This overconfidence of entrepreneurs should not be confused with risk seeking.

An identical approach could be used to evaluate CEO and portfolio managers' propensity to take risks. Miller et al (1982) argue that differences in top executives compared with low executives could be explained by the fact that top executives have internal locus of control and so a bigger propensity to take risk result from a different perception of the same risk. Corter and Chen (2006) showed that when the experience increases, portfolio managers showed a bigger propensity to take risks and hypothesize that this could derive from a difficulty in assessing probabilities

There is a general agreement over the literature about an existence of a relationship between risk perception and attitudes toward risk. This suggest that in evaluating attitudes toward risk in an economic/finance context, individual´s cognitive abilities should first be assessed (Dohmen et al 2010) which includes risk perception.

Sheeran et al (2013) argue that individual´s appraisal of a risk depends not only on risk perception, but depends on a relationship of 4 factors: (i)Risk perceptions;(ii) Anticipatory emotions (iii) Anticipated emotions (iv) Perceived severity.

Risk perception play a key role in decision making and can be used in several contexts, like portfolio theory. Understanding portfolio theory should not be done without understanding these psychological mechanisms as shown by Shavit et al (2016). The authors showed that familiarity with the risk increase the probability of engaging in risky assets.

2.3 Measure of attitudes toward risk and risk perception

For the purposes of this work, attitudes toward risk will be measured using two techniques. The first one is the utility theory first introduced by Bernoulli (1738) and axiomatized by Von Neuman and Morgenstern (1947). Utility theory allows to measure attitudes towards risk by stating that an individual will have a set of preferences and when choosing among alternatives will choose the alternative with the highest expected utility (Friedman and Savage, 1948). This allows to derive the utility function. The measurement of attitudes toward risk derives from the curvature of the utility function.

The second measure of attitudes toward risk used in the scope of this work is the Domain Specific Risk-Taking Scale (DOSPERT) first introduced by weber et al (2002). DOSPERT Scale states that individuals can have differentiated attitudes towards risk in different domains and measures risk by direct questioning to individuals, allowing each individual to have different risk profiles. The DOSPERT Scale has the interesting feature of allowing measuring also risk perception. Both theories will be explained ahead.

2.3.1 Utility Theory

The main normative theory in studying individual´s attitudes toward risk is the Utility Theory (Edwards,1996). The foundations of this topic started with works on gambling and insurance. Traditional mathematical theory argued that individuals make choices about risky situations based on the maximization of expected value but the line of thought change since the work of Bernoulli (1738).

Von Neuman and Morgenstern (1947) work on the mathematization of the theory, making its usage possible in theoretical modelling in different fields, including the financial one. The authors used a conjoint of axioms that would explain utility theory. To apply this theory, the individuals should be what some authors refer as an economic man. Edwards (1954) classify an economic man has being: Completely informed; Sensitive and Rational.

Using Von Neuman and Morgenstern work, Friedman and Savage (1948) studied the choices under risk in insurance and gambling to understand why an individual choose certainty over uncertainty when buying insurance and the same individual choose uncertainty instead of certainty when gambling. The authors argue that individuals have a set of preferences that can be translated in a numerical value (utility) and individuals will choose the alternative with the highest utility.

This was the first application of the maximization of the expected utility and where the utility maximization occurs in reference of wealth. According to the curvature of the utility function the authors differentiate three types of attitudes towards risk: risk averse, if individuals face a concave curve; risk neutral if individual face a linear curve and risk seeking if individuals face a convex curve. If we denote u(w) as the utility function and u''(w) as the second derivative of the utility function, we classify individuals as: (i) Risk averse, $u''(w) < 0$ (ii) Risk neutral, $u''(w) = 0$ (iii) Risk seeking, $u''(w) > 0$

Later, Markowitz (1952) continued to study the EU maximization with some differences, such as the fact that individuals do not focus only in total wealth but also by the changes in wealth. The author argues that if Friedman and Savage assumptions about the diminishing marginal utility for low and high incomes were applied then an individual will never accept a fair game (and so not an unfair game). This would not explain why people with low income gamble. The author hypothesis a utility curve with three inflection points. With this change of perspective Markowitz could explain why the same individual buys an insurance and a lottery ticket.

Allais (1953) was one of the main criticizers of the traditional utility theory introducing the Allais paradox. Especially, the author argues that the main assumption of rationality is not verified in real-life. When referring to gambling for example, additional factors should be taken in account like the pleasure of the gamble itself.

Some additional theories were then proposed by other authors. One of the most prominent was the Prospect Theory (PT) proposed by Kahneman and Tversky (1979). This theory relies on decisions under risk between prospects and is the main theory in behavioral decisions under risk. Despite that, it is not a normative theory since it does not provide an optimal decision. PT differentiates from the traditional utility theory by several reasons. Firstly, the authors argue that individual face what they called "*Certainty effect*" where subjects overweight outcomes that are certain and so, a weighting probability scheme could not be appropriate. The theory relies on Decision Weights that "*are inferred from choices between prospects much as subjective*" (Kahneman and Tversky, 1979, p. 280). Despite that, the most important result was what the authors called "*Reflection Effect*". The basis of this effect relies on the fact that individuals have opposite attitudes toward risk when facing gains and losses. They showed that individuals are risk averse in the gain domain and risk seeking

the loss domain. This theory was upgraded later. Tversky and Kahneman (1992) proposed the Cumulative prospect theory.

The maximization of EU and other derived theories are mainly used by economists to predict decisions under risk.

One of the main problems of studying human behavior is related with consistency. Eichberger et al (2003) used a two-stage mechanism to evaluate lotteries. They found that the consistency across repetitions were very limited. Another question is to understand if individuals are consistent in their inconsistency (gains and losses). Yechiam and Ert (2011) found a consistent pattern between gains and losses.

2.3.2 DOSPERT Scale

Individual´s face risk every day in different contexts from driving a car, buy a home insurance or buy a lottery ticket. The same individual can have differentiated attitudes toward risk in different contexts and situations. This thought is the foundation of the development of the DOSPERT Scale. The reasoning behind the scale is that individuals' risk attitudes are domain specific instead of general.

Weber et al (2002) introduced the DOSPERT scale. This is a psychometric scale which infer risk attitudes by direct questioning to respondents. This psychometric scale that the authors propose is composed by a set of 40 items divided by 5 domains: (i) Financial Decisions; (ii) Health/Safety; (iii) Recreational; (iv) Social; (v) Ethical. The respondents could rate each item "*on a five-point rating scale ranging from 1 ('Not at all risky') to 5 (´Extremely risky') (*Weber et al 2002, p. 268).

This conjoint of 40 items of risky activities is questioned three times to infer three different situations: Risk taking; Expected Benefit and Risk perception. The objective of the first scale is to infer respondents propensity to take risk by asking about the probability of

engaging on risky activities. The objective of the second scale is to evaluate the expected benefit that each risky activity provides for the respondents. The objective of the third scale is to evaluate how the respondent perceives the activity's risk. This last scale allows the identification of each individual perceived risk attitude.

With this psychometric questionnaire, the authors could classify individuals according to their attitudes toward risk: "*individuals were classified as risk seeking if their score on a subscale was more than one standard deviation above the mean, as risk averse if their subscale score was more than one standard deviation bellow the mean, and as risk neutral if their subscale score was in between." (*Weber et al 2002, p. 276). Moreover, using the risk perception scale the authors could compute perceived-risk attitudes.

The Dospert scale was revised by Blais and Weber (2006). The authors maintained the 5 domains of Weber et al (2002) but used a shorter version with 30 items using a 7-point rating scale. The scale was applied to English and French-speaking North American respondents and so the authors also contributed to a first translation to French.

The DOSPERT scale evaluate attitudes towards risk as a function of different domains and the attitude toward risk will depend on who is taking the risk and when the risk is taken (Figner and Weber, 2011). Traditional theory would argue that individuals display a general attitude toward risk but the authors argue that "*individual differences, contextual influences and their interaction in determining whether or not an individual will engage in risky behavior"* (Figner & Weber 2011, p. 212). More recently this was contradicted by Highhouse et al (2016). The authors found that even though the specific domains of the DOSPERT scale were the best predictors for the attitudes toward risk in that domain, there was evidence of a general attitude toward risk.

Despite that some of the literature that followed focused on developing the work of Weber et al (2002). Because of that some authors focused on translating and validating the

scale for different realities allowing a better questionnaire fit (see Schwartz et al 2013; Wu and Cheung 2014; Lozano et al 2017). The importance of the translation/validation of the scale happens due to cultural differences across countries, which does not allow to apply standard questionnaires.

Chapter 3: Data, Descriptive Statistics and Methodology

3.1. Data and Descriptive Statistics

For this study, data was collected via questionnaire. The questionnaire was applied directly to Mozambique master and undergraduate students and was divided in two parts that allow to cover the objectives of the study. The first part, was a version of the DOSPERT Scale. The second part of the questionnaire, was a conjoint of 10 gambles where in each individuals had to choose between two options, adapting Holt and Laury (2002). Respondents had to choose between Option A – a certain income – and Option B – a lottery. In the option A the certain income varies for the 10 games. In option B, the gamble outcomes are always the same but the probability of occurring varies. This conjoint of gambles was constructed to apply utility theory.

Using questionnaire data bring some challenges like missing data. Not dealing with missing data can lead to biases or inefficient results (White et al, 2010). In order to deal with missing data it was performed the Little's MCAR test (Missing completely at random). The MCAR test presented a $\chi 2$ of 17785, not being statistically significant which means that the missing data is missing in a completely random way allowing to proceed to imputations methods.

The problem of missing data was deal by two ways. First, the questionnaires with a significant level of missing data were eliminated and were not considered to the purpose of

this study, which resulted in a deletion of 22 questionnaires. This is a procedure called case deletion which consists in discarding units that are not complete (Schafer and Graham 2002).

After the case deletion, a total of 164 cases remained and where 116 cases (70,73%) were complete and 48 cases (29,27%) had missing values. The second procedure was to complete the data that was missing. For that purpose, missing data was dealt in different ways.

In SPSS, missing data was completed using a method of multiple imputation. For each respondent, this method fills missing values using estimates based in all available information about that same respondent (White et al, 2010). The estimated values were restrained to range between 1 and 7. This method was made using five imputations, resulting in five datasets. The analysis were conducted for the five datasets in simultaneous. When allowed by the statistical technique, results were present for each dataset as well as for the pooled data. In this case, we report the pooled results. Otherwise, the average outputs from the five datasets are reported.

For LISREL, the method that was used to complete missing data was the full-information maximum likelihood method (FIML) which is the most efficient method to parameter estimation in the context of confirmatory factor analysis (CFA) and Structural Equations Modelling (SEM) (Graham, 2003).

After dealing with missing data, the number of cases considered were 164, 93 women (56,7%) and 71 men (43,3%). The average age was 25,85 years ranging between a minimum of 17 years and a maximum of 55 years. From the 164 respondents, 143 (87,2%) were undergraduate students and 21(12,8%) were master students (see Appendix). The sample size seems to be adequate. A sample size greater than 100 respondents is acceptable for further Structure equation modeling (Bagozzi and Yi, 2012)). Nevertheless, it should be notice that the sample size can create a dilemma to the researcher. For one hand, a sample as large as

possible allow to better understand individual specificities but incorporates substantial costs. For the other hand, a small and cheaper sample will not allow to have strong statistical results (Dohmen et al 2011).

The number of responses of the second part of the questionnaire considered was smaller: a total of 72 individuals. This happen because only monotonic responses were considered (as explained in the methodology). Despite that, the sample seems adequate at the light of previous research. Several studies consistently report smaller samples (see for example Tversky and Kahneman, 1992, who used 25 subjects).

3.2. Methodology

3.2.1. Scale development

The objective of the first part of the empirical work was to develop a statistically sound version of the DOSPERT scale for Mozambique that could be extended to different Portuguese speaking African countries, namely Angola. For that purpose, some of the items included in the DOSPERT Scale were specifically developed to allow the development of a DOSPERT version that could be used in both countries.

The scale contains a conjoint of activities, divided in 6 sub-domains: (i) Financial/Gambling (ii) Financial/Investment (iii) Health/Safety; (iv) Recreational; (v) Social; (vi) Ethical. The version applied was a conjoint of 65 items with a 7-point rating scale, divided by the 6 sub-domains of risk, questioned three times to evaluate three different aspects: (i) Risk Taking; (ii) Expected Benefit; (iii) Risk Perception. The approach as well as the 7-point scale follow Blais and Weber (2006). This division is important in the scope of this work because it allows to gather information about attitudes toward risk and risk perception. The data effectively used derives from a 30-item scale which was a shorter version of the initial 65-item scale. This was shortened by a CFA. The CFA is part of SEM

and addresses a conjoint of casual relationships (Hair et al, 2009) with the objective of ensuring scale quality which is measured by Unidimensionality, Reliability and Validity. Factor analysis can be conducted also in an exploratory way (Hair et al, 2009). However, for the purpose of this work only CFA was performed because the objective was to assess if the model meets the expected structure and not to find new eventual risk domains (Hair et al, 2009).

Unidimensionality is the ability of a conjoint of items to explain the same construct (Hattie, 1985; Gerbing and Anderson, 1988). Normally, unidimensionality can be measured by $\chi 2$ statistic and other goodness of fit measures like Root Mean Squared Error (RMSEA), Nonnormed fit index (NNFI), Comparative fit index (CFI), Standardized root mean squared residuals (SRMR) (Bagozzi and Yi, 2012). The authors refer that the conjoint of these four measures allows to explain unidimensionality without depending on the sample size (which is not true for $\chi 2$). Instead, and to use a measure that does not depend on the sample size, it is proposed to use the measure of $\frac{\chi 2}{df}$ .The authors propose cutoff values which are: a cutoff value 0.93 for CFI/ 0.92 for NNFI/ 0.07 for SRMR and 0.07 for RMSEA. For $\frac{\chi 2}{df}$ the authors propose a value smaller than 3 to be adequate. The FIML method performed to deal with missing data does not allow to LISREL to compute all these standard measures. Actually, only RMSEA, $\chi 2$ and $\frac{\chi 2}{df}$ were computed.

Reliability measures the quality of the item or scale of items (Bentler, 2009) and is defined as the agreement between items or a scale of items (Bagozzi and Yi, 2012). Computing reliability measures is important because using only unidimensionality measures is not sufficient to ensure a quality of a scale (Gerbing and Anderson, 1988).

One of the standard measures of reliability is the Cronbach alpha (Cronbach, 1951). Despite that, Cronbach alpha has the problem of misestimating reliability (Sijtsma, 2009),

but it is still communally used. Other measures of reliability can be computed like composite reliability which is computed using the factor loadings and its variance (Bagozzi and Yi 2012) but the authors argue that computing reliability measures could be redundant "*because the information provided in factor loadings and error variances incorporates reliability so to speak"* (Bagozzi and Yi 2012, p. 16).

There is no agreement on cutoff values for reliability measures but values greater than 0.7 should be emphasized despite a minimum acceptable of 0.5 could be used (Bagozzi and Yi 2012). The reliability measures were computed for each sub-scale and for which of the 6 sub-domains. The Cronbach alpha measures were computed using SPSS and composite reliability measures were computing using standardized factor loadings and variance extracted directly from LISREL and using the following formula (Hair et al, 2009; Bagozzi and Yi, 2012)

(1) $$CR = \frac{(\sum\lambda)^2}{(\sum\lambda)^2 + \sum\theta}$$

Where λ is the standardized factor loading and θ the variance of the loading.

Validity is related to convergence in the sense it is the ability of the items or scale of items to measure properly its components (Hair et al, 2009) and not relate too much with other measures (Bagozzi and Yi 2012). The most common usages of validity are convergent validity and discriminant validity (Hair et al, 2009; Bagozzi and Yi 2012). Convergent validity can be measured using the factor loadings, which should be standardized, and have a cutoff value of 0.7 to ensure also reliability (Hair et al, 2009; Kline, 2010). Discriminant validity can be measured using average variance extracted (AVE) and it is common to define AVE with a minimum acceptable value of 0.5 (Hair et al, 2009) and measured also using factor correlations with a cutoff value of 0.5 (Kline, 2010). All the validity measures were computed/extracted for each sub-scale per sub-domains. Total-item correlations were

computed using SPSS. The standardized factor loadings and variance were extracted directly from LISREL and used to compute AVE using the following formula (Hair et al, 2009)

$$AVE = \frac{\sum(\lambda^2)}{\sum(\lambda^2) + \sum\theta} \quad (2)$$

Where λ is, the standardized factor loading and θ the variance of the loading.

3.2.2. Scale metrics and regression analysis

The second part of the work is to use the DOSPERT scale metrics. As mentioned, individuals rated a conjoint of 30 activities between 1 and 7 in the three sub-scales: Risk taking; Expected Benefit and Risk perception. Using individual's responses, it was computed average values for the 164 respondents. The average values were computed for each of the 6 sub-domains and for the three sub-scales referred.

Using the above information and the average values for the risk-taking scale it was possible to label individuals as: (i) risk averse if the average value is lower than 4 (ii) risk neutral if the average value is equal to 4 (iii) risk seeking if the average value is higher than 4. It was used rounded values for this profile classification. This approach is different from the proposed by Weber et al (2002) to be adopted to a financial context otherwise, and since 4 is the mid value and the standard deviation is computed in respect of this mid value, individuals would be label "on average" as risk neutral and that explains why the authors found a considerable proportion of individuals classified as risk neutral. Using the output from the risk perception scale the same methodology was used. With this information, it is possible to label individuals according to their risk perception using Weber and Bottom (1989) classification as: (i) perceived risk averse if the average value is lower than 4 (ii) perceived risk neutral if the average value is equal to 4 (iii) perceived risk seeking if the average value is higher than 4.

Using the previous metrics, the next step of the work is to understand if there is a relationship between attitudes toward risk with expected benefit and risk perception. For that purpose, a regression analysis for each sub-domain was made. The approach followed was the same as Weber et al. (2002) regressing expected benefit and risk perception as independent variables and risk-taking attitudes as dependent variable. The regression followed was of the type:

(3) $$RT = \theta_0 + \theta_1 EB + \theta_2 RP + \epsilon$$

Where:
RT= Risk Taking
EB= Expected Benefit
RP= Risk Perception
θ_0 = model constant
θ_1= Coefficient relating Expected Benefit to Risk Taking
θ_2= Coefficient relating Risk Perception to Risk Taking
ϵ = Residual

For this study, the regression analysis has two objectives. The first one is to infer a relationship between attitudes towards risk and the explanatory variables, expected benefits and risk perception. This relationship is measured by θ and the focus of interest is on the sign of the coefficient. The second objective is the strength of the relationship. For that purpose, and for each of the 6 regressions, several metrics were analyzed and interpreted. Beyond the coefficients of the regression it was analyzed the p-value and R^2 to analyze the strength of the coefficient and the regression. The measure of risk perception used further in this work is θ_2.

3.2.3. Utility application

As previously mentioned, the DOSPERT scale allows to label individuals according to their attitudes toward risk. Despite that, utility theory is one of the most prominent theory in explaining attitudes toward risk since the development by Von Neuman and Morgenstern work (Glimcher and Fehr, 2014). The data for applying utility theory was elicited with a sequence of 10 gambles. In each one, respondents must choose between options 1 and 2. Option 1 is a lottery between a certain amount (5000 MZN) with certain probability p_1 and 0 MZN with probability $p_2 = 1 - p_1$. Option 2 is a certain amount that ranges from 1500 MZN and 3750 MZN, increasing by 250 MZN in each new gamble. Probability p_1 increases along the 10 lotteries and in the 5th game $p_1 = p_2 = 50\%$ and were E[Lottery 5] = Certain Income. Between games 1 and 4 the probabilities were constructed to allow E[Lottery n] < Certain Income and between gambles 6 and 9 the probabilities were constructed to allow E[Lottery n] > Certain Income. In gamble 10 the lottery is also a certain to force extreme risk averse individuals to choose the lottery.

In order to comply with the axioms of the theory only questionnaires with monotonic responses were considered. This happen due to the need of computing certain equivalents using individual´s responses. The certain equivalent was computed as the average amount between the certain values from the gambles in which the respondent change from one option to the other, following Holt and Laury, 2002. Thus:

(4) $$\boldsymbol{C = \frac{CI_n + CI_{n-1}}{2}}$$

Where:

C= Certain equivalent
CI_n= Certain income from the gamble before the change
CI_{n-1}= Certain income from the gamble after the change

A certain equivalent C is the one which utility equals the expected utility of the lottery:

(5) $$U(C) = E[U(x)].$$

The utility function chosen is a power function $U(x) = x^{\alpha}$as it is the most used method to compute utility. Replacing in (5)

(6) $$c^{\alpha} = p_1 x_1^{\alpha} + p_2 x_2^{\alpha}.$$

We can simplify by acknowledging that x_2 is always *0* and by raising both sides of the equation to $\frac{1}{\alpha}$:

(7) $$(c^{\alpha})^{\frac{1}{\alpha}} = (p_1 x_1^{\alpha})^{\frac{1}{\alpha}}$$

$$c = p_1^{\frac{1}{\alpha}} x_1.$$

Solving in order to α we have:

(8) $$\alpha = \frac{\log_{10} p_1}{\log_{10}(\frac{c}{x_1})}.$$

The overall game is constructed in terms of gains. Although Kahneman and Tversky (1979) argued that individuals distinguish attitudes towards risk in the gains and losses domain, the objective of this work is only to infer attitudes toward risk in the gains domain. With the elicited data from the sequence of gambles it is possible to extract α as the measure of curvature of the utility theory allowing to label individuals' attitudes towards risk as following (Schunk and Betsch, 2006)_

- α > 1 indicates a risk seeking individual
- α = 1 indicates a risk neutral individual
- α < 1 indicates a risk averse individual

With such a measure of attitudes towards risk and given that both *RT* and α represent attitudes towards risk, it is possible to replace *RT* by α in Equation 3. Thus, it is possible to compare the attitudes toward risk measured by the DOSPERT Scale with the one measured by the utility theory. Since the utility measure was computed in a financial context, this comparison is performed using the regressions for the financial sub-domains of the DOSPERT. For that purpose, a regression analysis was made regressing α as a dependent variable and expected benefit and risk perception as independent variables (using the DOSPERT metrics previous computed), deriving the following regression:

$$(9) \quad \alpha = \theta_0 + \theta_3 EB + \theta_4 RP + \epsilon$$

Where:
α = Metric of curvature of utility function
EB = Expected Benefit
RP = Risk Perception
θ_0 = model constant
θ_3= Coefficient relating Expected Benefit to α
θ_4= Coefficient relating Risk Perception to α
ϵ = Residual

Chapter 4: Results and Discussion

4.1. Scale development

The first step of the empirical work was adapting a risk measure scale to Mozambique. For this purpose, the DOSPERT scale (Blais and Weber, 2006) was adapted taking into account the local culture and specificities. The scale was adapted with the help of local experts. The definitive version of the scale (DOSPERT-MZ) include 30 items as presented on the Appendix. The Recreational, Social, Ethical and Health/Safety sub-domains were constructed with 6 items each. The financial scale is divided in Gambling and Investing with 3 items each making the overall financial scale with 6 items. The proportion and number of items used was the same used by other authors (see for example Lozano et al, 2017; Blais

and Weber, 2006). Despite it is not mandatory to maintain the same number of items per sub domain, it is an approach that ensures more easily a scale with strong empirical power in the three main domains evaluated. The number of items per sub domain is also relevant. For that purpose, before reaching the final scale of 30 items, scales with more items per sub domains were tested particularly a scale with 10 items per sub-domain. The results and comparisons between both scales will be performed in this section.

Table 1: Unidimensionality measures for the 3 sub-scales

	n	Parameters	q	Chi 2	p-value	df	chi2/df	RMSEA
RT	164	30	75	695,25	0	390	1,78	0,069
EB	164	30	75	701,63	0	390	1,80	0,070
RP	164	30	75	681,70	0	390	1,75	0,068

Analyzing table I, it is possible to state that the scale seems to be adequate in terms of unidimensionality for each of the 3 sub-scales and for the computed measures. Both sub-scales present a value of $\frac{\chi 2}{df}$ lower than 3 and a RMSEA lower or equal than 0,07 respecting the cut-off points proposed by Bagozzi and Yi (2012). The expected benefits sub-scale presents a value of RMSEA on the limit, but still acceptable in terms of unidimensionality. There are no considerable differences in the 3 sub-scales in terms of unidimensionality but the Risk Perception results seems to be slightly more robust. Moreover, the conjoint of items chosen seems to adequately explain the same construct for each of the 3 sub-scales. Ensuring unidimensionality is an important part of the scale development since the final objective is to construct a conjoint of items questioned for the 3 sub-scales, divided in 6 sub-domains, that represent different effects: (1) Risk Taking; (2) Expected Benefits; (3) Risk Perception.

Table 2: Reliability measures: Composite Reliability

		Risk Taking	Expected Benefits	Risk Perception
Composite Reliability	**Social**	0,7	0,6	0,5
	Recreational	0,7	0,7	0,8
	Health/Safety	0,5	0,7	0,8
	Ethical	0,8	0,8	0,9
	Financial/Gambling	0,8	0,8	0,9
	Financial/Investing	0,7	0,8	0,6

The composite reliability measure is presented on table II. The composite reliability was computed using factor loadings and error variances retrieved from LISREL. The factor loadings and error variances are presented on the Appendix. In terms of composite reliability and analyzing table II we can see that the Financial/Gambling, Ethical and Recreational sub-domains present values greater than 0,7 for the three sub-scales. For all the remaining domains, the composite reliability is at least greater than the acceptable limit of 0,5. The social domain presents the poorer results. Cronbach alpha were also computed and the results are presented on the Appendix. The measure of composite reliability shows in overall terms more robust results than Cronbach alpha. This happens because composite reliability measures with more precision the reliability of a scale. For both measures of reliability, we can extrapolate some differences between the financial sub-domains. The measures for the Financial/Gambling sub-domain are stronger than for the Financial/Investing sub-domain.

Table 3: Discriminant Validity measures: Average Variance Extracted

		Risk Taking	Expected Benefits	Risk Perception
Average Variance Extracted	**Social**	0,3	0,2	0,2
	Recreational	0,3	0,3	0,4
	Health/Safety	0,2	0,3	0,5
	Ethical	0,4	0,4	0,6
	Financial/Gambling	0,5	0,5	0,7
	Financial/Investing	0,5	0,6	0,4

Item total correlation is presented on the Appendix. The item total correlation presents the average between the items of each sub-domain. Analyzing the results, we can see that Financial/Gambling and Ethical sub-domains present values greater than the cutoff point of 0,5 for the 3 sub-scales. The Financial/Investing and Health/Safety sub-domains also present strong results. The Financial/Investing sub-domain present results greater than the cutoff value in all sub scales expect for the RP sub-scale and the Health/Safety sub-domain present results greater than the cutoff value in all sub scales expect for the RT scale, which in overall are good results due to the difficulty in defining a scale that scores well in the 3 sub-scales. The poorest results are in the recreational and social domain. The recreational domain scores a value greater than 0,5 in the RP scale but the social domain present results smaller than the cutoff value for all the sub-scales. This is coherent with the reliability analyses.

Average Variance Extracted is presented in table III. The AVE was computed using the factor loadings and error variances presented on the Appendix. The results state different conclusions from the item total correlation. Analyzing AVE, we can see that the domains that score greater than the cutoff value of 0,5 are Financial/Gambling in all sub scales and Financial/Investing in all sub-scales except in the RP sub-scale. For the other sub-domains of risk only in the RP sub-scale for the Ethical and Health/Safety sub-domains presented values greater than 0,5. Overall, the RP scale present better results than the other sub-scales, which is coherent with the unidimensionality and reliability analysis.

Analyzing the results, it is possible to state that the 30-items scale that resulted from the CFA is a very acceptable one in respect of the three dimensions: Unidimensionality, Reliability and Validity. The results are not perfect and this arise from the difficulty of constructing a scale with strong empirical power for 3 different sub-scales divided in 6 different sub-domains. Despite that, these final scale presents some interesting features especially in the Financial and Ethical sub-domains. This scale can be seen as a starting point

that should be fine-tuned in the future. The social domain seems to be the one that requires further adjustments, especially because the scale was constructed to a future application in other environments.

These results concerning validity also suggest the existence of an underlying common risk attitude. However, this is outside the scope of this work and is left for future work.

Another important feature of the final scale is an overall better result of the risk perception sub-scale when compared with the other 2 sub-scales. One hypothesis that can help to explain these results is the fact that probably respondents have a good understanding of how risky a given situation might be. However, regardless of the riskiness of the situation, they hardly have the possibility to engage in such a situation, due to the development stage of their home country. Another conclusion that can be drawn is related to the financial sub-domains. For all the indicators, the financial/gambling sub-domain presents very interesting results. The results are consistently more robust than the one for the financial/investing sub-domain. One hypothesis that helps to explain these results is the general poverty of this population and the development of their financial system that prevents them from having access to sophisticated investment products. On the contrary, gambling can be a quite informal activity. In addition, the role of gambling on Mozambique culture may also leads it to be a more common situation than investing.

These results are more valorized when compared to other scale results. For the 10-item scale tested, it presented poorer results in terms of unidimensionality. Even though the $\frac{\chi 2}{df}$ presented values lower than 3 (but closer to the bound), the RMSEA for both of 3 sub-scales presented values bigger than 0,08. In terms of reliability, the 10-item scale presented very interesting results for Cronbach alpha and Composite reliability, similar in overall terms with the results from the 6-item scale, but with slightly better results for the

Financial/Investing sub-domain. In terms of validity, the 10-item scale presented results very similar to the 6-item scale.

4.2. Scale metrics and regression analysis

With the final 6-item scale it was possible to compute the DOSPERT metrics to further empirical work. Using the average values of the responses, it was possible to classify individual's attitudes toward risk using the RT sub-scale and to classify individuals according to perceived attitudes toward risk using the RP sub-scale. The results presented are average values for the 5 imputations used for missing data and are presented in table IV and V.

Table 4: Profile Classification: Risk Taking Scale

		Risk Taking					
		HS	S	R	E	FG	FI
Profile Classification	Risk Averse	128	35	130	143	140	35
	Risk Neutral	23	41	20	10	14	24
	Risk Seeking	13	88	14	11	10	105

Table 5: Profile Classification: Risk Perception Scale

		Risk Peception					
		HS	S	R	E	FG	FI
Profile Classification	Perceived Risk Averse	16	78	15	16	24	86
	Perceived Risk Neutral	16	52	23	11	14	47
	Perceived Risk Seeking	132	34	126	137	126	31

The results presented on table IV for the different sub-domains present the typical pattern of profile classification. A bigger percentage of individuals are labeled as risk averse when compared to the other two profile classification. The only exception is observed in the Financial/Investing domain. For the profile classification of the risk perception scale presented on table V we can identify a "mirror-effect" for the 6 sub-domains. This happens

because there is a bigger percentage of individuals classified as perceived risk-seeking when compared to the other two profile classification. These results are interesting and corroborate previous findings. Finucane et al (2000) showed that caucasians individuals present smaller scores on perceived risk attitudes when compared with non-caucasians individuals. This can help to explain the results obtained for Mozambique individuals since the respondents are non-caucasians. The author called this effect the "White male effect".

Another interesting result is the fact that for the Financial/Investing domain we observe an opposite pattern of the remaining sub-domains. For FI sub-domain we found more individuals classified as risk seeking individuals using the RT sub-scale and more individuals classified as perceived risk-averse individuals using the RP sub-scale. This is coherent with the previous results of the scale development and can be attributed to cultural influences. One hypothesis is the fact that individuals can understand the meaning and concepts of investing but have difficulties to translate to a practical situation. This happens even though the sample is derived from undergraduate and graduate students. This helps to explain the opposite results of the other sub-domains which may not derive from a rationalization process but instead due to a non-familiarity with the kind of activities proposed for the financial/investing domains. This does not happen for the Financial/Gambling domain because it is a more common situation in that culture. Nevertheless, it is important to state that all activities included in the 65 items were proposed specifically for the Mozambique and/or Angolan context and with the help of local experts, as mentioned before.

Using this metrics, the following step was to infer a regression analysis with the objective of studying the relationship between expected benefit and risk perception with attitudes toward risk. A regression for each of the 6 sub-domains were performed and the results are presented on table VI.

Table 6: Regression analysis divided by sub-domain

	Intercept	Expected Benefits	Risk Perception	R^2
Health/Safety	1,519***	0,624***	0,031	0,24
Social	2,333***	0,653***	-0,091	0,37
Ethical	1,581***	0,567***	-0,104*	0,29
Recreational	2,304***	0,471***	-0,149**	0,23
Financial/Gambling	2,400***	0,317***	-0,217***	0,23
Finanical/Investing	1,909***	0,657***	-0,028	0,46
Total	1,308***	0,721***	-0,038	0,47

***Statistically significant at 0,001
**Statistically Significant at 0,05
*Statistically Significant at 0,10

The results of table VI allow to extrapolate some conclusions. First, and considering R^2 the regression for each of the 6 sub-domains present not-neglectable values. For enhancing this result, a comparison with the regression provided by the utility theory will be performed. This allows to infer that expected benefit and risk perception help to explain attitudes toward risk. In terms of the regressors, different conclusions derive from the results. All the coefficients of Expected Benefits are positive and statistically significant at 0,001. This allow to infer firstly that there is a positive relationship between expected benefit and the likelihood of engage in a risky situation. For risk perception, it is possible to observe that for all sub-domains, expect Health/Safety, there is a negative relationship between perception of risk and attitudes toward risk. However, such a relationship is only statistically significant at the usual levels for the Ethical, Recreational and Financial/Gambling domains. Moreover, it despites very interesting results for the Financial/Gambling domain. Analyzing the results for the total scale the same pattern is verified. In terms of risk perception these results are coherent with the results provided by the scale itself.

The reported results shown for the Financial/Gambling, Ethical and Recreational sub-domains are statistically strong dismissing any need of future adjustments. However, the

remaining sub-domains could benefit from a limited revision and some fine-tunning. One possibility to do so is to merge the Financial/Investing and the Financial/Gambling domains, since the results suggest that it can make more sense from a cultural perspective. This implies the construction of a scale with 5 sub-domains with a unique financial sub-domain instead of two. It is also possible to achieve a better clarification of the activities to match better the local culture.

Even though the scale used need future fine-tuning, these results allow to answer the research question, especially for the Ethical, Recreational and Financial/Gambling sub-domains. For these domains we found that when the perception of a risk increases, the attitude toward risk (measured by the probability of engaging in a risky activity) decreases. In terms of expected benefits, these results allow to understand that for this context, individuals value immensely the expected benefit to derive attitudes toward risk. Analyzing the results, in terms of attitudes toward risk, expected benefits are in fact the most important factor in defining attitudes toward risk even though risk perception also plays a key role.

4.3. Utility application

As previous explained, the sample used for the utility application is a smaller sample of 72 respondents and for the results it was used the second part of the questionnaire which is a game where individuals had to choose between two options. With that information and with the derived formula above, it was possible to compute the certain equivalent and α as a measure of curvature of the utility function that is also a measure of attitudes towards risk. The results for each profile are presented on the Appendix. Using α, individuals were labeled according to the traditional categories of attitudes toward risk and the results are presented on table VII.

Table 7: Profile classification: Utility application

	Number of individuals	Criteria
Risk Averse	34	$\alpha < 1$
Risk Neutral	0	$\alpha = 1$
Risk Seeking	38	$\alpha > 1$

This results don´t exhibit the pattern provided by the DOSPERT and that can be attributed to the sample restrictions. This means that probably the sample of individuals that provided valid responses to apply utility theory may not be representative of the total sample of 164 individuals.

There are no individuals labeled as risk neutral. This derives from the game construction itself. The game is constructed such that in the 5th game risk neutral individuals should be indifferent between both options. This was constructed in this form to ensure rational decisions of individuals and to separate individuals that make decisions based on the expected values of the game and individuals who do not. For those reasons, of the total sample of 164 individuals, only individuals with a clear set of preferences were considered. Individuals with no monotonic responses or with not rational responses were removed leading to a final sample of 72 individuals.

The next step of the work was, for these sample of individuals to assess if the metric of curvature of the utility function relates in the same manner with the measures of expected benefits and risk perception provided by the DOSPERT Scale as the RT measure. The objective is to analyze if the DOSPERT scale and the utility theory actually measure the same thing.

Since utility were elicitated in a financial context, this analysis will focus only on the Financial/Gambling, Financial/Investing and for the total financial sub-domains. The regression performed was explained in the methodology. The results are present on table VIII.

Table 8: Regression analysis using α

	Intercept	Expected Benefits	Risk Peception	R^2
Financial/Gambling	1,272	-0,058	0,007	0,02
Financial/Investing	1,578	-0,049	-0,031	0,02
Financial	1,558	-0,089	-0,008	0,03

Analyzing the results from table VIII, we can arrive to some conclusions. First, for both domains these regressions have a very poor explanatory power presenting a R^2 lower than the ones provided in the regression using only DOSPERT. The second issue is related with the coefficients of expected benefits and risk perception. For the expected benefits for both sub-domains, the coefficient present a negative sign and are not statically significant for the usual significance levels. For the risk perception, the coefficient presents a negative sign, except for the Financial/Gambling sub-domain, but not statistically significant. Since now the dependent variable is the curvature of the utility function (α) and that higher α (greater than 1) are associated with risk seeking individuals, it is expectable that there is a positive relationship between the variables and this does not happen. These results suggest different conclusions of the ones provided by the DOSPERT scale, where the difference lies on the dependent variable. This is more evident because the regression was run for the financial sub-domains which presented significant results in the DOSPERT regression presented previously.

Additional conditions were tested to achieve a better understanding of these results. First, and because the sample used for the regression was a smaller sample of the total sample, a regression for the sample of 72 individuals was run using only the DOSPERT metrics, regressing expected benefits and risk perception as independent variables and risk-taking, measured by the DOSPERT, as dependent variable. The objective was to compare the results obtained with the ones obtained for the total sample. A regression for each of the 6 sub-

domains were performed to be able of comparison with the previous results. The results are presented on the Appendix.

The results compare with the ones presented on table VI. For the coefficients of expected benefits, the results of the smaller sample are consistent with the previous findings presenting a positive sign and being statistically significant for the usual significance levels. The only small difference lies on the Ethical and Social sub-domains, being now significant at a higher level but still significant at a 5% level. For the risk perception coefficient, the results are not in line with the previous findings. Even though for all regressions the coefficient sign is negative, it is only statistically significant at 5% level for the Recreational domain. Such a loss of statistical power is more evident for the Financial/Gambling domain. One hypothesis that would help to explain the poor results of the regression analysis using α as dependent variable can be attributed to the fact that the smaller sample is not totally representative of the full sample.

The sample used is less than half of the one used for the DOSPERT application. This suggest that respondents may not have understood the game proposed to elicit utility. It is possible to speculate that if the game is constructed in a different way or better explained, the results of the utility elicitation would be stronger.

Additional tests were performed. The first possible problem that was addresses concerns the eventual presence of outliers. For this reason, an outlier analysis was performed. A total of 20 cases were removed from the sample of 72 individuals and then the regression was re-run. The results obtained were in line with the ones of the sample of 72 individuals and so the problem of outliers was excluded.

Another teste that was performed was related to α. The objective was to analyze if the results that were found were consistent for risk averse and risk seeking individuals. For that purpose, the regression was re-run with only the risk averse individuals ($\alpha<1$) and

another regression with only the risk seeking individuals ($\alpha>1$). The results founded were in line with the ones obtained for the total sample of individuals, and so as expected there was no significant differences between both profiles.

So, and analyzing the different possibilities an additional conclusion can be extrapolated. The poor regression results can in fact result from the fact that the DOSPERT scale and the utility theory may measure different things. Highhouse et al (2016) had already made the distinction between a general attitude toward risk and a domains specific attitude toward risk. This can help to hypothesize that the DOSPERT Scale measure the level of risk aversion instead of the attitude toward risk by itself. If this hypothesis is valid, comparing the metric of curvature provided by the utility theory and a DOSPERT metric that measure the level of risk aversion will lead to different conclusions. Despite that, and because it is outside the scope of this work, this hypothesis was not tested and is left for future work.

Chapter 5: Conclusion, limitations and Future Research

The main objective of this master final work was to answer the question "How does risk perception affects attitudes toward risk?" The objective is to understand if risk perception affects attitudes toward risk and if it is a key determinant in explaining attitudes toward risk. This means that individual's distinct attitudes towards risk can result not from a bigger propensity to take risk by itself but instead by different perceptions of the same risk as hypothesized by Mellers et al (1997). Moreover, in order to reach this purpose, different measures of attitudes toward risk were used: (1) A measure of attitudes toward from the DOSPERT scale which was introduced by Weber et al (2002) whose foundation is that an individual can present different attitudes toward risk when considering different sub-domains; (2) A common measure of risk attitude in financial economics and decision theory

– Expected Utility theory, which is one of the most prominent theories in explaining attitudes toward risk since the work of Von Neuman and Morgenstern in 1947.

This study was conducted using a Mozambique sample of undergraduate and graduate students. The data that was used for this study derived from a two-part questionnaire. The data of the first part of the questionnaires provided valid responses from a sample of 164 respondents. Due to some restrictions to apply utility theory only a shorter sample of 72 individuals were considered.

To fulfil the objectives of this study, the first procedure followed was to develop a scale from the 65-items applied in the questionnaire to ensure strong statistical power, namely in terms of (1) Unidimensionality, (2) Reliability, and (3) Validity. For that purpose, a confirmatory factor analysis was performed and it resulted in a final scale of 30-items scale divided in 6 sub-domains. The final 30-items scale presented good scoring especially in what concerns unidimensionality and reliability. Even if not so strong in terms of validity, the scale presents acceptable values, especially if we consider total-item correlation. For future research purposes, additional factors must be taken into consideration to fine-tune the scale in order to improve its validity. The overall results suggest very robust results for the Financial domain. The results also show that the Financial/Gambling sub-domain presents more robust results than the Financial/Investing sub-domain which can be a consequence of local cultural issues. For future work, merging the two subdomains into only one may lead to more robust results

Using these final scale, it was possible to continue the empirical work to answer the research question. First, and using the DOSPERT results, it was possible to label individuals according two different sub-scales. The risk taking sub-scales and the risk perception sub-scales.

Using the DOSPERT Scale it was possible to answer the research question proposed in this work and for the context studied. The results show that there is a positive and statistically significant relationship between expected benefits and attitudes toward risk. For risk perception, a negative relationship with attitudes toward risk was found for all sub-domains expect Health/Safety. This relationship is statistically significant for the Financial/gambling, Ethical and Recreational sub-domains. This results also showed that the relationship between risk perception and expected benefit in relationship with attitudes toward risk is not neglectable due to the R^2. These results are coherent with the one provided by the CFA. The financial/investing sub-domain presented poor results which can be a consequence of local cultural factors, low levels of financial literacy and an unsophisticated financial market.

Concerning the relationship between risk perception and attitudes toward risk, we expect a negative relationship, implying that normally when an individual perceives a situation as riskier the probability of engaging in that activity decreases. This can allow to extrapolate that a risk seeking individual can engage with more probability in risky activities because it perceives that activity as less risky that another individual.

For the utility application, the relationship between expected benefits and attitudes toward risk were negative and not statistically significant and the relationship between risk perception and attitudes toward risk was negative and not statically significant. Such a weaker result of the utility application can derive from a bad interpretation of the game by the participants. Another possibility that can help to explain these results is regarding the fact that probably the DOSPERT scale does not measure attitudes toward risk but instead the level of risk aversion. The validation of this hypothesis and the clarification of the game is left for future work.

The key limitation of this work was the fact that due to logistic constrains it was not possible to apply a pre-test in Mozambique. This pre-test would help to test some activities and to fine-tune the scale before the application. For future research purposes a revised DOSPERT-MZ is in order to ensure stronger results.

Chapter 6: References

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Chapter 7: Appendix

Table A.1 – Descriptive Statistics

		Frequency	Percentage
Gender	Female	93	56,71%
	Male	71	43,29%
	Total	164	100,00%
Age	<20	72	43,90%
	21-25	33	20,12%
	26-30	13	7,93%
	31-35	20	12,20%
	36-40	13	7,93%
	41-45	7	4,27%
	46-50	3	1,83%
	51-55	3	1,83%
	Total	164	100,00%
Course	Undergraduate	143	87,20%
	Master	21	12,80%
	Total	164	100,00%

Table A.2 – DOSPERT-MZ Scale of 30 items (Mozambique)

Sub domain	*Code*	*Item*
Social	*S1*	Admitir que os seus gostos são diferentes de um amigo
	S4	Emitir a sua opinião sobre um tema contorverso numa reunião no trabalho
	S6	Começar uma nova carreira após os trinta anos
	S9	Mudar-se para uma cidade longe da sua família
	S10	Dizer ao seu melhor amigo(a) que a(o) mulher(marido) dele(dela) procurou seduzir-te
	S11AO	Discordar sobre um assunto importante com alguém de categoria superior
Recreational	*R6*	Fazer esqui aquático
	R9	Ir de férias sem reservar previamente o Hotel
	R10	Praticar um desporto perigoso
	R11AO	Fazer escalada em locais, cuja dificuldade está acima das suas capacidades
	R12AO	Fazer manobras perigosas com motorizada
	R15AO	Fazer corta mato numa zona desconhecida
Health and Safety	*H/S4*	Andar de moto sem capacete
	H/S13AO	Tomar banhos de sol sem protector solar
	H/S14AO	Fumar junto de não fumadores
	H/S15AO	Trabalhar num local sem equipamento de segurança
	H/S16AO	Banhar em lagoas e rios desconhecidos
	H/S17AO	Regressar a casa sozinho(a) a pé fora de horas
Ethical	*E1*	Falsificar a declaração de rendimentos entregue ao estado para pagar menos impostos
	E3	Apresentar um trabalho de outrém como sendo seu
	E6	Não devolver a carteira que encontrou e que contem 10.000 MT
	E7	Falsificar a assinatura de alguém
	E8	Roubar um objecto pequeno numa loja (Ex. chocolate ou uma caneta)

	E11AO	Deixar as suas crianças pequenas sozinhas em casa enquanto vai tratar de um assunto/recado
Financial/Gambling	*FG6AO*	Apostar o rendimento de um dia de trabalho num jogo de snooker
	FG11AO	Apostar o rendimento de um dia de trabalho numa corrida de carros, motorizadas ou bicicletas
	FG12AO	Apostar o rendimento de um dia de trabalho em lutas de cães ou galos
Financial/Investing	*FI1*	Investir 10% do seu rendimento anual numa nova oportunidade de negócio
	FI5AO	Investir 15% do seu rendimento anual numa actividade comercial, industrial ou de prestação de serviços
	FI7AO	Investir 25% do seu rendimento anual num depósito a prazo

Table A.3: Factor Loadings and Error Variances

	Factor Loadings						***Error Variances***					
Risk Taking												
Social	0,6	0,5	0,6	0,4	0,3	0,6	0,6	0,8	0,7	0,8	0,9	0,7
Recreational	0,3	0,3	0,6	0,5	0,7	0,6	0,9	0,9	0,6	0,7	0,5	0,7
Health and Safety	0,5	0,1	0,6	0,4	0,3	0,3	0,8	1,0	0,6	0,8	0,9	0,9
Ethical	0,6	0,7	0,5	0,6	0,6	0,6	0,7	0,6	0,8	0,6	0,6	0,6
Financial/Gambling	0,7	0,7	0,7				0,5	0,5	0,5			
Financial/Investing				0,7	0,8	0,5				0,5	0,4	0,7
Expected Benefits												
Social	0,4	0,6	0,4	0,4	0,2	0,7	0,9	0,6	0,8	0,9	0,9	0,6
Recreational	0,2	0,5	0,4	0,5	0,8	0,6	1,0	0,8	0,8	0,8	0,4	0,6
Health and Safety	0,6	0,2	0,7	0,7	0,5	0,5	0,6	1,0	0,5	0,5	0,7	0,8
Ethical	0,6	0,5	0,5	0,8	0,7	0,6	0,6	0,8	0,8	0,3	0,5	0,7
Financial/Gambling	0,8	0,7	0,7				0,4	0,5	0,5			
Financial/Investing				0,9	0,8	0,6				0,3	0,4	0,7
Risk Perception												
Social	0,1	0,5	0,4	0,3	0,4	0,6	1,0	0,7	0,8	0,9	0,8	0,6
Recreational	0,4	0,5	0,8	0,8	0,8	0,7	0,9	0,8	0,4	0,4	0,3	0,5
Health and Safety	0,9	0,6	0,6	0,8	0,6	0,7	0,2	0,6	0,6	0,3	0,7	0,6
Ethical	0,9	0,8	0,6	0,9	0,8	0,8	0,3	0,4	0,7	0,2	0,4	0,4
Financial/Gambling	0,8	0,9	0,9				0,3	0,3	0,3			
Financial/Investing				0,7	0,8	0,4				0,6	0,4	0,9

Table A.4: Reliability Measures: Cronbach alpha

	Cronbach alpha		
	Risk Taking	**Expected Benefits**	**Risk Perception**
Subscale			
Social	0,6	0,6	0,5
Recreational	0,6	0,7	0,8
Financial			
Investment	0,7	0,8	0,6
Gambling	0,7	0,8	0,9
Health/Safety	0,6	0,8	0,9
Ethical	0,8	0,8	0,9
Full Scale	0,8	0,8	0,9

Table A.5: Discriminant validity measure: Item total correlation

	Item-total correlation		
	Risk Taking	**Expected Benefits**	**Risk Perception**
Subscale			
Social	0,4	0,3	0,3
Recreational	0,4	0,4	0,6
Financial			
Investment	0,5	0,6	0,4
Gambling	0,6	0,6	0,8
Health/Safety	0,3	0,5	0,6
Ethical	0,5	0,5	0,7
Full Scale	0,3	0,4	0,5

Table A.6: Certain equivalent/ Utility application

Profile	Changer	Certain equivalent	α	Profile	Changer	Certain equivalent	α
2	5	2375	0,93	109	7	2875	1,25
7	4	2125	0,81	110	5	2375	0,93
13	10	3625	2,16	111	5	2375	0,93
21	2	1625	0,62	112	8	3125	1,47
26	6	2625	1,08	114	6	2625	1,08
27	2	1625	0,62	116	5	2375	0,93
30	10	3625	2,16	117	7	2875	1,25
39	3	1875	0,71	126	6	2625	1,08
41	2	1625	0,62	128	6	2625	1,08
43	10	3625	2,16	130	5	2375	0,93
45	10	3625	2,16	133	3	1875	0,71
49	10	3625	2,16	138	7	2875	1,25
50	2	1625	0,62	139	5	2375	0,93
54	10	3625	2,16	140	9	3375	1,76
58	2	1625	0,62	141	4	2125	0,81
60	2	1625	0,62	143	7	2875	1,25
62	3	1875	0,71	144	10	3625	2,16
67	6	2625	1,08	145	8	3125	1,47
68	8	3125	1,47	146	6	2625	1,08
69	5	2375	0,93	147	5	2375	0,93
70	7	2875	1,25	149	9	3375	1,76
71	5	2375	0,93	151	7	2875	1,25
72	5	2375	0,93	155	4	2125	0,81
74	3	1875	0,71	156	6	2625	1,08
77	10	3625	2,16	158	7	2875	1,25
82	10	3625	2,16	161	10	3625	2,16
83	5	2375	0,93	162	5	2375	0,93
85	7	2875	1,25	163	7	2875	1,25
94	5	2375	0,93	165	5	2375	0,93
97	9	3375	1,76	166	3	1875	0,71
98	9	3375	1,76	168	2	1625	0,62
100	5	2375	0,93	170	8	3125	1,47
101	5	2375	0,93	171	6	2625	1,08
102	5	2375	0,93	179	4	2125	0,81
103	5	2375	0,93	181	8	3125	1,47
108	9	3375	1,76	183	10	3625	2,16

Table A.7: Regression analysis divided by sub-domain (smaller sample)

	Intercept	Expected Benefits	Risk Perception	R^2
Health/Safety	1,862	0,541***	-0,016	0,49
Social	3,64	0,438**	-0,22	0,47
Ethical	1,851	0,349**	-0,99	0,46
Recreational	3,645	0,37***	-0,349**	0,51
Financial/Gambling	2,719	0,395***	-0,299	0,48
Financial/Investing	1,456	0,75***	-0,019	0,70
Total	2,141	0,601***	-0,158	0,65

***Statistically significant at 0,001
**Statistically Significant at 0,05
*Statistically Significant at 0,10