TIME AND RISK PREFERENCES

A BRIEF OVERVIEW OF INFLUENCING FACTORS

Bachelor thesis

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TABLE OF CONTENTS

1. INTRODUCTION

Economic science is characterized by the use of economic models to model reality. Assumptions about time and risk preferences play a big role in determining these economic models. From this perspective time and risk preferences are a major component of economic science. Ones time preference is reflected by the relative valuation placed on a good or service at an earlier date when compared with its valuation on a later date. Ones risk preference reflects an individual's tendency to choose a risky or less risky option. Time and risk preferences apply to any decision that one makes involving time and risk, respectively.

A classic example where time and risk preferences come into play is the choice between going to college versus finding a job. Herein lies both an aspect of time and of risk. One who chooses to start working will start earning money right now, while one choosing to go to college will not earn money now and only after a few years. Here one has to make an intertemporal choice. Besides this time aspect there is also an aspect of risk. One with a job is sure that he earns a certain amount of money right now, while one choosing to go to college isn't sure what his earnings will be after education. First, it is uncertain whether one has sufficient capabilities to complete college. In addition, it is uncertain what the economic situation will be after completion of college.

A real-life example where time and risk preferences played an important role is found in the bankruptcy of Lehman Brothers. Among others, the downfall of this global financial services firm in 2008 created a snowball effect that resulted in the infamous financial crisis. The causes of the downfall of Lehman Brothers are often related to the investment that it did in the years before the downfall. The firm invested major parts of its resources in housing-related assets, because the housing market was 'booming' at the time. On this market it could make 'quick money'; relatively high returns on relatively short-term investments. Lehman Brothers borrowed substantial amounts of money to fund these investments. This made the investments quite risky and the firm quite vulnerable. The so-called leverage ratio of the firm - the ratio of its assets to its equity - increased sharply during the years before the downfall. The deterioration of the housing market hit the vulnerable Lehman Brothers hard, and the

firm eventually went bankrupt. The focus on 'quick money' (time preferences) and risky investments (risk preferences) led to their downfall. The impact of the bankruptcy and the following financial crisis are still felt and are clearly enormous. Time and risk preferences within a small portion of an economy can thus have clear and big implications for the economy as a whole.

A better understanding of time and risk preferences can eventually help us make more accurate predictions about economic behavior. If a certain subgroup of the population is more sensitive to time or risk than others, this will be reflected in all aspects of their decision making, including schooling, investment decisions, choice of profession, and what products and services to buy and when to buy them. A better understanding of time and risk preferences can eventually help in designing economic models and in developing both government and corporate policies.

The examples above illustrate that time and risk preferences vary by individual. Both are dependent on a lot of factors. In order to make the assumptions about these preferences more realistic and to get an overview of the determining factors a lot of experimental research already has been done. Therefore it is interesting to take a closer look at these studies. This thesis will focus on the factors that influence time and risk preferences. Therefore the main research question is: '*In what way are time and risk preferences influenced?'*

If for instance women exhibit time and risk preferences different than men this will have significant implications for an economy. If women prefer more long-term and less risky options, more women in the executive board of Lehman Brothers could have altered the investment decisions and thus the financial situation of the firm. Given the main question it is of primary interest to first identify if this and other factors are related to time and risk preferences. This leads to the first subquestion: *'What factors influence time and risk preferences?'*

The next aspect that emerges lies in the way these factors influence time and risk preferences. It is important to check whether the influencing factors are positively or negatively related to

time and risk preferences, but also whether the factors affect time and risk preferences temporarily or permanently. This leads to the second subquestion; *'Are the factors previously mentioned temporarily or permanently affecting time and risk preferences?'* The third and final aspect that may affect time and risk preferences is the correlation between the two. Outside factors can have a certain influence on time and risk preferences, but is it not inconceivable that time and risk preferences are mutually correlated. Therefore the third and final subquestion is; '*Are time and risk preferences correlated?'*

The main goal of this thesis is to find influences on time and risk preferences. One can of course think of numerous factors which may have affect these preferences. Therefore it is essential to limit this thesis to a number of factors. I focus on gender, age, wealth, cognitive ability, violence, and religion. Famous stereotypes exist on gender differences in socio-economic behavior. Observations from economists and policymakers indicate that these differences hold in a number of domains, for instance in choice of profession and consumption habits. Gender differences could therefore also apply to time and risk preferences. Stereotypes on behavioral differences of children and adults are known as well. If true, these differences might have important implications. Many decisions made at young age namely have considerable long-term consequences. These decisions are, at least partly, influenced by time and risk preferences. Ones wealth can have important implications for economic behavior as well. Financial resources play a decisive role in the choices one makes. Kenneth Arrow (1971) already argued that it is of great importance to acknowledge that risk measures may vary with ones wealth, where in turn measures of risk preference may predict ones economic behavior in the presence of uncertainty. In the same way wealth may influence measures of time preference and in turn economic behavior. Jensen (1998) showed that behavior in general is influenced by ones cognitive ability. Those with higher cognitive ability for instance earn more, have larger working memories and faster reaction times. In the same vein decision-making in economic models is fundamentally affected by cognitive ability. Another potential influencing factor concerns violence. Violence is a topical issue in many countries, with both civilians and soldiers returning from violent regions with severe traumas. One can imagine the impact violent experiences and related traumas may have on (economic) behavior. A second topical issue concerns religion. In Europe a number of

politicians heavily debate the Islam, and some Islamic fanatics fight Western people on religious grounds. This religious jousting makes it interesting to see if their exist any religion differences in economic behavior, i.e. time and risk preferences.

In order to answer the research questions I will first present a theoretical framework on time and risk preferences. This will be in section 2. I will review researches done on the six above described factors in section 3. From these studies I will present the relevant results. Provided that sufficient research exists on some subtopic (e.g. the influence of gender on time preferences), I will examine multiple researches on a subtopic and analyze these. In addition, I will link the found results of these separate studies. My primary focus will be on typical experimental economic researches. In general these contain hypothetical and incentivized experiments, with relatively small groups of subjects, in an abstract setting, and with a large internal validity. I will come back to the features of experimental research in the theoretical framework. Finally, section 4 contains a conclusion of the results, while section 5 concludes this thesis with a discussion.

2. THEORETICAL FRAMEWORK

To have a clear theoretical framework before I start reviewing the relevant researches I would like to focus on the next questions first:

- What are time and risk preferences?
- What research methods are used in experimental research on time and risk preferences?
- To what extent do the researches conducted approach actual time and risk preferences? (Do individuals with a relatively high risk (time) preference also act relatively more risk-seeking (impatient) in real life decision-making?)

After making up this theoretical framework I will focus on answering the subquestions. These will together answer the main question.

2.1 INTRODUCING TIME AND RISK PREFERENCES

2.1.2 Time preferences

A lot of psychological motives and social aspects jointly influence time preferences. There is one model which summarizes all of these influencing factors into a very simple function. Paul Samuelson (1937) introduced the so-called 'discounted utility model' (DU model). A central assumption of this model is that all of the disparate motives and aspects underlying intertemporal choice can be condensed into a single parameter – the discount rate. Samuelson made reservations about the normative and descriptive validity of his model, but it was immediately accepted and used by a lot of economists because of its simplicity. Besides that, it turned out to be a very normative standard for public policies as well as a descriptively accurate representation of actual behavior. Even nowadays it's still used in lots of economic textbooks because of these reasons.

The actual model takes this form:

$$U^t(c_t,\ldots,c_T) = \sum_{k=0}^{T-t} D(k)u(c_{t+k})$$

$$\text{where } D(k) = \left(\frac{1}{1+\rho}\right)^k$$

In this formulation, u(ct + k) represents ones cardinal instantaneous utility function - his well-being in period t + k - and D(k) represent ones discount function— the relative weight he attaches, in period t, to his well-being in period t + k. Finally, ρ represents ones discount rate, which is meant to reflect all the collective effects influencing intertemporal choices (Frederick et al., 2002). A main assumption of the model is that this discount factor is constant over time. The constant discount rate assumption leads to an exponential and dynamically consistent discounting function. Dynamically consistent because utility is discounted in a consistent way over time, i.e. at the same discount rate. This means that the weighting placed on a certain utility is the same at any point in time. Or in other words, preferences do not change over time. If an individual prefers a relatively large reward (option B) paid in ten weeks from today versus a smaller reward (option A) paid in nine weeks from today, dynamic consistency implies that this individual should also prefer the

same large reward (option B) when paid in one week from today versus the same small reward (option A) paid today. Dynamic consistency thus implies this individual will always prefer option B versus option A at any point in time. Dynamic consistency is typical for rational choice theory; in this case the individual sees the more patient option B as the optimal choice when considering a relatively large time horizon (ten weeks) and this preference will remain unchanged as time progresses and the payment moment approaches.

Although economists use the DU model because of its simplicity there are models which are a more accurate description of human behavior. Empirically observed discount rates tend to decline over time, which is not in line with the exponential time-consistent discount rate of the DU model. Research on animal and human behavior showed that discount functions are approximately hyperbolic (Ainslie et al., 1992). Hyperbolic discount functions are characterized by a relatively high discount rate over short time horizons and a relatively low discount rate over long time horizons. The discount structure sets up a conflict between today's preferences, and the preferences that will be held in the future (Laibson, 1997).

This leads to a hyperbolic discounting model of this form:

$$U^t(c_t,\ldots,c_T) = \sum_{k=0}^{T-t} D(k)u(c_{t+k})$$

$$\text{where } D(k) = \Pi_{n=0}^{k-1}\left(\frac{1}{1+\rho_n}\right)$$

Like before, u(ct + k) represents ones cardinal instantaneous utility function and D(k) ones discount function. The discount function has changed, since ρ_n now represents ones per-period discount rate for period *n* (Frederick et al., 2002). This implies the discount factor isn't necessarily constant over time as in the DU-model, but may vary per period. Hyperbolic discounting implies that within this formulation ρ_n is declining in *n*, i.e. ones discount rate is declining over time. The declining discount rate now leads to a dynamically inconsistent or time-inconsistent discounting function. Inconsistent because utility is discounted in an inconsistent way over time. In other words, preferences change over time. In the case of exponential discounting this means that the weighting placed on a certain utility decreases over time. Meaning that ones discount rate today is higher than ones discount rate

tomorrow, and ones discount rate tomorrow is higher than ones discount rate in two days from now, and so on. If an individual prefers a relatively large reward (option B) paid in ten weeks from today versus a smaller reward (option A) paid in nine weeks from today, and the same individual prefers the relatively small reward (option A) paid today over the large reward (option B) when paid in one week the individuals preferences are said to be dynamically inconsistent. Here dynamic inconsistency implies that the individual prefers option B over option A when the individual has to decide for the future, but his preferences change when payment moment approaches. Then the time-inconsistent individual prefers the more impatient option A over option B.

Another influential model is that was first introduced by Phelps and Pollak (1968) and later applied to empirically observed behavior by David Laibson (1997). They described a model which captures both aspects of exponential as well as hyperbolic discounting. This model is said to be quasi-hyperbolic. Quasi-hyperbolic discounters will tend to choose relatively patient when choosing for the future and impatiently when choosing for the present. So, for short time horizons the discount rate will be hyperbolic. But after a specific point in time the discount rate will become exponential. Empirical results show that this model captures actual human behavior even better then the pure hyperbolic model. The empirical review made by Frederick et al. (2002) indicate that when studies with relatively short time horizons, those under one year, are excluded from their analysis they find no significant correlation between the discount factor and the time horizon. Which indicates that discount rates eventually become exponential.

The quasi-hyperbolic model takes this form:

$$U^t(c_t,\ldots,c_T) = \sum_{k=0}^{T-t} D(k)u(c_{t+k})$$

$$\text{where } D(k) = \begin{cases} 1 & \text{if } h = 0 \\ \beta\delta^k & \text{if } k > 0. \end{cases}$$

Here again, u(ct + k) represents ones cardinal instantaneous utility function and D(k) ones discount function. This model assumes that the per-period discount rate between now and the next period is [(1 − βδ) / βδ], whereas the per-period discount rate between any two

future periods is [(1 − δ) / δ]. Hence, this *(β,δ)* formulation implies a declining discount rate for short time horizons and a constant discount rate for long time horizons. (Frederick et al., 2002) The variable discount rate implies that the discount function is dynamically inconsistent or time-inconsistent for the near future and exponential and dynamically consistent for the further future. This variability in discount rates is due to *β*, which represent the present bias in discounting. One will patiently delay gratification in the further future, but will impatiently choose to immediately gratify his needs in the near future. For instance, one will prefer option A (larger reward at time *t+11*) over option B (smaller reward at time *t+10*) when one has to decide on these future options today (at time *t*). But the same individual will prefer option B (smaller reward at time *t*) over option A (larger reward at time *t+1*) when the same options are set to decide on today (at time *t*). One changes his mind when the moment actually arrives. This mechanism causes time preferences to be present-biased.

2.1.2 Risk preferences

Two main theories in the field of risk preferences exist that try to describe and capture human behavior. The first is expected utility theory (EU theory). John von Neumann and Oskar Morgenstern (1944) developed this theory. This theory distinguishes between expected value of wealth and expected utility of wealth. This is important because now we're able to represent ones risk preferences in a model. Its central premise is that people choose the alternative that has not the highest expected value of wealth but the highest expect utility of wealth. In terms of uncertain outcomes (gambles) expected utility is the expected value of utility over all possible outcomes. Expected utility can be represented as a function of expected value of all possible outcomes. This is called the utility function. In EU theory risk preferences are solely characterized by the shape of a utility function. For most individuals this function is concave, which indicates one is risk averse. Risk averse means one avoids risks. Or in practical terms, a risk-averse individual rather receives a relatively low but completely certain payoff than playing a gamble with a higher but uncertain *expected* payoff.

There has been considerable criticism on EU theory. Although it was a very useful and simple model it wasn't a very accurate description of human behavior. Kahneman and

Tversky (1979) where the ones who developed a theory that was widely accepted as an improved version of EU. They came up with their so-called prospect theory. According to their theory risk preferences are characterized by the concavity of a utility function (as in EU theory), by non-linear weighting of probabilities and by the aversion to losses compared to gains. Non-linear weighting concerns the phenomenon that people tend to overestimate, or under-react to, small probabilities and underestimate, or over-react to, large probabilities. In practical terms this means that one values an increase of probability from 3% to 4% more than an increase from for instance 53% to 54%. Loss aversion is the phenomenon that people weigh losses much heavier in their decision-making compared to gains. Or again in practical terms, a negative payoff (loss) of €100 decreases utility more than a positive payoff (gain) of €100 increases utility. Finally, in prospect theory Kahnemann and Tversky discuss the so-called 'certainty effect'. When probabilities change from certain (0% or 100%) to probable (any probability not being 0% or 100%) this results in a relatively strong change in risk-taking behavior; stronger than for changes of equal size for any probability (not being certain). In other words, certain outcomes (0% and 100% chance) are perceived as categorically different and weighted more heavily than uncertain outcomes.

Still prospect theory had one main problem; it violates the so-called 'stochastic dominance'. Imagine one could choose between a gamble (a prospect) or a gain with certainty. The prospect contains many possible outcomes with all outcomes having small probabilities. The expected value of the prospect is €50. The other option is a gain of €50 with complete certainty. Prospect theory predicts people will choose the prospect over the gain with certainty since people tend to overestimate all small probabilities. This principle is the underlying mechanism that causes prospect theory to violate stochastic dominance. The solution provided by cumulative prospect theory (Tversky & Kahneman, 1992) lies in cumulative probabilities. A cumulative probability describes the probability for receiving an outcome or anything better than that outcome. The use of this kind of probabilities makes it possible to model the overestimation of extreme outcomes with small probabilities and not (necessarily) the overestimation of all small probabilities. Empirical data shows that overestimating small chances with extreme outcomes and underestimating a group of small probabilities with 'average' outcomes is a more accurate description of decision-making

(Fennema et al., 1997). This makes cumulative prospect theory a better theory to model real decision-making.

2.2 RESEARCH METHODS

Experimental economic research inhabits some characteristic features that I will discuss here. These features are applicable to research on both time and risk preferences. Hereafter I will review actual research methods and research measures separated on first time preferences, and later on risk preferences.

Proper experimental economic research in the first place requires good explanation of the test respondents have to complete. When explaining the test research assistants have to balance between too much explanation and too few. Too much explanation can possibly lead to an overload of information, and more importantly the opinion of the research assistant may resound in his explanation. Both can in turn lead to biased results. Too few explanation can possibly lead to a lack of understanding the test and thus in turn to biased results as well.

A second issue in experimental economics concerns the way subjects are incentivized. In general terms, incentives should be seen as 'triggers' which motivate people to perform a certain task. In the context of experimental research incentives should work as a stimulus for subjects to react as serious and realistic as possible to questions and choice alternatives. Economic research on time and risk preferences almost always uses financial incentives, because it focuses mainly on decisions that involve monetary consequences. Financial incentives exist in varying types; the two extremes are completely hypothetical payoffs and completely real payoffs. In case of hypothetical payoffs subjects face hypothetical questions and choice alternatives, but them will not be paid any money. The experiment is completely hypothetical. In order to get realistic responses from subjects (decisions that subjects would make in real-life decision-making as well) is it important that they can empathize with the situation well. Intrinsic motivation to answer realistically and empathize well plays an important role in empathizing. In case of real payoffs subjects again face questions and choice alternatives, but now them will be paid real money based on their answers and

choices. One of the main advantages of real payoffs is that subjects more or less automatically respond realistically. The answers they give and the choices they make does have implications for their financial situation. This type of experiment therefore is considerably realistic.

In between these two extremes lie varying other forms of incentivization and payoff methods. Subjects can for instance be incentivized by handing them a vast amount of money; a compensation for their participation. The payoff is in this case thus independent of the responses subjects give. Subjects are stimulated to participate in the experiment, but not necessarily stimulated to answer fairly realistic. Their responses do have namely not affect their payoff. Yet another incentivization method is to reward only a limited number of subjects with real payoffs. Crucial is to not tell subjects in advance if they are the ones that will be paid real money. This has to be announced after the experiment is completed, and can be done by for instance rolling a dice or by any other random generator. This type of experiment triggers respondents to respond as serious and real as possible, because their responses might have real implications for their financial situation. The big advance is that researchers do not have to reward a lot of subjects with real money.

A very similar payoff method is found in experiments that only reward subjects real payoffs on a limited number of questions or choice alternatives. Again is it crucial to announce after the experiment which part of the experiment will be completed with real money. This type of incentivization holds the same advantages as the one just described. Which payoff method is preferable depends heavily on the circumstances in which the experiment is conducted and on the interest of the researchers. Financial restrictions and financial situations of the research area play a big role in this choice. If financial resources are limited researchers have to weigh matters; they either have to work with a limited number of subjects, a limited numbers of real payoffs or a mixture of both. An important finding in this context is that Laury (2005) states that when subjects are informed that possibly part of the test will be completed with real money, this gives very comparative results to the alternative of paying each subject with certainty. Finally, it is important to note that practically every time and risk preference research that uses real rewards in their experiment makes use of a notary, a

notary statement or any other credible person. These serve to make subjects clear that them will actually be paid real money when promised in the experiment.

The sample size (number of subjects) has already been mentioned. Typical experimental research is characterized by relatively small sample sizes. This is first of all caused by financial restrictions. As described above subjects will be paid an amount of money (real incentives or participation compensation), and researchers and research assistants have to be paid wages. Conducting experiments takes relatively long time compared to ordinary survey data researches, this in turn increases financial costs. The relatively lengthy duration of experimental research also makes time a restricting factor. If research has to be conducted within a specified period of time this restricts researches to stick to a limited number of subjects as well. A similar restricting factor is found in another distinctive feature of experimental research. As the term experimental implies research has to be conducted in a fixed and equal environment. This takes more time relatively to others forms of research and thus more money as well.

Another typical feature of experimental economic research is that it is conducted within a laboratory and abstract setting. Subjects have to complete the experiment within a setting that is the same for every subject. In practice subjects complete the test in a class room or computer lab. As a result experimental research meets the so-called ceteris paribus condition. This makes that internal validity is often very high. Internal validity concerns the extent to which the reasoning within the research is carried out correctly. It is important that the reasoning and the corresponding results are valid for the group studied. It is obviously highly desirable that the results can not be ascribed to research artifacts. External validity on the contrary is often relatively weak in experimental economic research. External validity concerns the extent to which the results of a research are generalizable. If results are externally valid, this means that the results are generalizable and will apply to a larger group than just the test group. External validity will be discussed in more depth in section 2.3.

2.2.1 *Time preferences*

All economic experimental studies reviewed in this thesis present subjects a number of intertemporal choice alternatives of this form: "Receive x in t days, or receive y in τ days". The parameters x and y are the payoffs subjects can receive (where $x \leq y$), t and τ together form the time horizon subjects have to consider (where $t < \tau$). The parameters x, y, t and τ vary for each research and within each research, and these depend on what the researcher(s) aim for. Researchers that for instance want to examine short time horizons will choose t and τ to be close to one another. Researchers that for instance want to examine time preferences for large sums of money will choose x and y to be relatively large payoffs.

Subjects face a number of intertemporal choice alternatives presented in rows. For each row they have to reveal if they prefer the sooner-smaller reward or the larger-later reward. To see the possible variations researchers can apply it is useful to take the most comprehensive experiment on time preferences (Tanaka et al., 2010) as an example. Here subjects had to reveal their preferred option for 75 different intertemporal choice alternatives. They used 15 combinations of y and τ in their experiments (i.e. 30,000, 120,000 and 300,000 Vietnamese dong with delays of one week, one month and three months, and 60,000 and 240,000 Vietnamese dong with delays of three days, two weeks and two months) For each (y,t) combination they used five combinations of x, with x equal to 1/6, 1/3, 1/2, 2/3, and 5/6 of the value of y. This experiment nicely illustrates that x, y and τ vary per question. Within this experiment t is 0 and represents today for every choice alternative, but t may obviously represent a later date as well.

Researchers infer ones time preferences by looking at which row one changes his option of choice. This can best be considered by an example; see table 1, which is adapted from Dohmen et al. (2010). Within this example t represents today, τ represents they day exactly one year from today, x is set to be €100 in for every row and y varies per row. This experiment is relatively easy to understand for subjects and very tractable for researchers. Inferring ones time preferences by looking at which row one changes implies individuals' preferences need to be monotonic. Monotonic means that if one changes row, he will not change back. The relatively most patient respondents will prefer option B in all situations,

the relatively most impatient respondents will always prefer option A. Researchers derive ones patience by looking at which point respondents change from option A to option B, as most respondents will change at some point. For instance, an individual preferring option A in situation 1 till 4 and after this point preferring option B, has a annual exponential discount rate between 0.102 (10.2%) and 0.128 (12.8%).

Table 1: A typical time preference experiment

	Option A		Option B
1	€100 today	or	€102.5 in 12 months
2	€100 today	or	€105.1 in 12 months
3	€100 today	or	€107.6 in 12 months
4	€100 today	or	€110.2 in 12 months
5	€100 today	or	€112.8 in 12 months
6	€100 today	or	€115.5 in 12 months
7	€100 today	or	€118.2 in 12 months
8	€100 today	or	€121.0 in 12 months
9	€100 today	or	€123.7 in 12 months
10	€100 today	or	€126.5 in 12 months
11	€100 today	or	€129.3 in 12 months
12	€100 today	or	€132.2 in 12 months
13	€100 today	or	€135.1 in 12 months
14	€100 today	or	€138.0 in 12 months
15	€100 today	or	€141.0 in 12 months
16	€100 today	or	€144.0 in 12 months
17	€100 today	or	€147.0 in 12 months
18	€100 today	or	€150.0 in 12 months
19	€100 today	or	€153.1 in 12 months
20	€100 today	or	€156.2 in 12 months

2.2.2 *Risk preferences*

When examining ones risk attitude typical experimental economic studies make use of a lottery or multiple lotteries. Some of the most common methods are reviewed here. These types of experimental methods are simple enough for subjects to be understandable, and on the other hand they are highly tractable and analyzable for researchers.

The first method requires subjects to choose one preferred lottery out of a number of lotteries. Chai et al. (forthcoming) for instance use this method. Their risk experiment is shown in table 2. This experiment consist of six lotteries, where each row represents such a lottery and subjects have to reveal their preferred lottery. Each lottery has a low and high payoff, both with a probability of ½.The first row represents a 'sure payment' of PhP 300, because both prizes to be won are PhP 300 (PhP = Philippine Peso). The farther down the table, higher payoffs and more uncertainty are at stake. Again, researchers derive ones risk attitude by simply looking at ones option of choice. The relatively most risk averse individuals will prefer 1, the relatively most risk-seeking individuals will prefer option 5. This method enables researches to very easy analyze if a certain subgroup of the sample is less risk-averse than others.

Table 2: A simple risk preference experiment

Option	Prize A *(50%-chance)*	Prize B *(50%-chance)*	Expected pay-off
1	PhP 300	PhP 300	PhP 300
2	PhP 250	PhP 400	PhP 325
3	PhP 200	PhP 500	PhP 350
4	PhP 150	PhP 600	PhP 375
5	PhP 50	PhP 700	PhP 375
6	PhP 0	PhP 750	PhP 375

A second method derives ones risk attitude in a reasonably similar way. Subjects here have to choose between a sure payment (option A) and a gamble (option B) for a number of lotteries. These lotteries are presented in rows, in table 3 which is adapted from Dohmen et al. (2011) there are twenty. Researchers infer ones risk preferences by looking at which row

one changes. This again implies individuals' preferences need to be monotonic. This means that if one changes row, he will not change back. The relatively most risk-averse respondents will always prefer the sure payment, the relatively most risk-seeking respondents will always choose playing the gamble. Risk-neutral respondents are the ones that are indifferent between option A and option B in lottery 16. Note that in these lotteries the column with expected pay-offs will not be listed when asking respondents for their favorite option.

Table 3: A more extensive risk experiment

	Option A	EP^A	Option B	EP^B
1	€0 for sure	€0	50%-chance at €300 and 50%-chance at €0	€150
2	€10 for sure	€10	50%-chance at €300 and 50%-chance at €0	€150
3	€20 for sure	€20	50%-chance at €300 and 50%-chance at €0	€150
4	€30 for sure	€30	50%-chance at €300 and 50%-chance at €0	€150
5	€40 for sure	€40	50%-chance at €300 and 50%-chance at €0	€150
6	€50 for sure	€50	50%-chance at €300 and 50%-chance at €0	€150
7	€60 for sure	€60	50%-chance at €300 and 50%-chance at €0	€150
8	€70 for sure	€70	50%-chance at €300 and 50%-chance at €0	€150
9	€80 for sure	€80	50%-chance at €300 and 50%-chance at €0	€150
10	€90 for sure	€90	50%-chance at €300 and 50%-chance at €0	€150
11	€100 for sure	€100	50%-chance at €300 and 50%-chance at €0	€150
12	€110 for sure	€110	50%-chance at €300 and 50%-chance at €0	€150
13	€120 for sure	€120	50%-chance at €300 and 50%-chance at €0	€150
14	€130 for sure	€130	50%-chance at €300 and 50%-chance at €0	€150
15	€140 for sure	€140	50%-chance at €300 and 50%-chance at €0	€150
16	€150 for sure	€150	50%-chance at €300 and 50%-chance at €0	€150
17	€160 for sure	€160	50%-chance at €300 and 50%-chance at €0	€150
18	€170 for sure	€170	50%-chance at €300 and 50%-chance at €0	€150
19	€180 for sure	€180	50%-chance at €300 and 50%-chance at €0	€150
20	€190 for sure	€190	50%-chance at €300 and 50%-chance at €0	€150

A third method that is often used in experimental risk measurement is very similar to the method reviewed above. Holt and Laury (2002) provide a method in which subjects face subsequent choices between two uncertain payoffs (see table 4), as opposed to possibility of a sure payment in the previous method. Researchers again infer ones risk preferences by looking at which row one changes, and thus again monotonic preferences are required. The relatively most risk-averse respondents will always prefer option A, the relatively most risk-seeking respondents will always prefer option B. Risk-neutral respondents are the ones that are change from option A to option B at lottery 5. Note that the column with difference in expected pay-offs will not be listed when asking respondents for their favorite option.

Table 4: A risk experiment with varying probabilities

	Option A	Option B	Difference in EP
1	1/10 of \$2.00, 9/10 of \$1.60	1/10 of \$3.85, 9/10 of \$0.10	\$1.17
2	2/10 of \$2.00, 8/10 of \$1.60	2/10 of \$3.85, 8/10 of \$0.10	\$0.83
3	3/10 of \$2.00, 7/10 of \$1.60	3/10 of \$3.85, 7/10 of \$0.10	\$0.50
4	4/10 of \$2.00, 6/10 of \$1.60	4/10 of \$3.85, 6/10 of \$0.10	\$0.16
5	5/10 of \$2.00, 5/10 of \$1.60	5/10 of \$3.85, 5/10 of \$0.10	- \$0.18
6	6/10 of \$2.00, 4/10 of \$1.60	6/10 of \$3.85, 4/10 of \$0.10	- \$0.51
7	7/10 of \$2.00, 3/10 of \$1.60	7/10 of \$3.85, 3/10 of \$0.10	- \$0.85
8	8/10 of \$2.00, 2/10 of \$1.60	8/10 of \$3.85, 2/10 of \$0.10	- \$1.18
9	9/10 of \$2.00,1/10 of \$1.60	9/10 of \$3.85,1/10 of \$0.10	- \$1.52
10	10/10 of \$2.00, 0/10 of \$1.60	10/10 of \$3.85, 0/10 of \$0.10	- \$1.85

2.3 EXTERNAL VALIDITY

External validity concerns the extent to which the results of a research are generalizable. If results are externally valid, this means that the results are generalizable and will apply to a larger group than just the test group. In the context of this thesis external validity concern the issue to what extent the researches conducted approach actual time and risk preferences. Or in other words, whether individuals with a relatively high risk (time) preference will act relatively more risk-seeking (impatient) in their everyday economic decision-making. External validity is known to be a caveat in experimental research, since the experiments are

typically conducted in abstract contexts, on small groups of subjects and with a mixture of hypothetical and real incentives.

Abstract environments in experimental economic research imply that researchers do not specify the context on which the questions relate to. However, in psychology preferences are thought to be context-dependent (Slovic, 1972; Weber et al., 2002; Ert and Yechiam, 2010). Within the context of this thesis this would imply that ones time and risk preference would differ per situation while the choices would, except for the context, be exactly the same. In economics it is common to think of individuals having behavioral preferences that are similar in all contexts, however. Dohmen et al. (2011) tested this assumption for risk preferences by leaving the abstract environment typical for experimental economic research and studying respondents risk preferences within specified contexts as car driving and smoking. They found risk preferences to be strongly but not perfectly correlated across different contexts. This implies that ones risk preferences are roughly the same in any context, but 'roughly' also suggests that there is some extent of context-dependency. Neither study so far has extensively studied the extent to which time preferences are dependent on the context of the research questions. The results by Dohmen et al. for risk preferences give reason to suspect that time preferences are context-dependent as well. It is advisable for future economic research to examine this preconception.

Incentivization methods have already been mentioned in section 2.2. Researchers can either complete their experiments completely with real payoffs, completely with hypothetical payoffs or a mixture of both. An important drawback of researches that only use hypothetical payoffs is the 'hypothetical bias' that goes with this form of incentives. This bias is caused by the fact that people can not sufficiently imagine how they would behave in their real decision-making. Various factors like self-serving biases, inattention, and strategic motives make that respondents make choices that are significanly different from their real-world behavior (Dohmen et al., 2011). In this context, Holt and Laury (2002) find a significant and important difference between hypothetical and real payoffs for risk preferences. When using hypothetical conventional relatively small payoffs their results indicate that most respondents are risk averse and few are risk-seeking. When they significantly increase their

hypothetical payoffs the results hardly change. When they significantly increase their real payoffs however, risk aversion significantly increases among respondents. This observation implies respondents experience hypothetical and real choices differently. In other words, subjects cannot itself sufficiently empathize with hypothetical situations to get to similar results as in real situations. A similar observation was made by Coller and Williams (1999) in the context of time preferences. They tested the effect of real versus hypothetical payoffs on ones time preference. They found that variation in elicited time preferences was significantly lower when subjects were presented real payoffs than when payoffs were hypothetical. This implies that respondents experience intertemporal hypothetical and real choices differently as well.

Conventional experimental economic research seem to have an important shortcoming in focusing on one measure of preferences in one setting. Experimental research which make use of pure hypothetical questions has an extra shortcoming in their lack of sense of reality. Despite all this, more recent studies seem to capture real-life decisions better than somewhat older studies.

3. RESULTS

The main objective of my thesis is to examine the factors which are of influence on time and risk preferences. Lots of research has been conducted in these fields. I restrict myself by focusing on gender, age, wealth, cognitive ability, violence, ethnicity and religion influences. All of the results combined will give a brief overview of influencing factors. In the first part I will first present the results on time preferences, followed by the results on risk preferences, concluded by the correlation between these two.

3.1 TIME PREFERENCES

Experimental economic research on time preferences give highly varying results. Frederick et al. (2002) in a comprehensive review report that annual discount rates vary between zero percent and far exceeding thousand percent. Although this thesis will not focus on actual

discount rates, this finding indicates that there is still a lack of clarity in this field. My aim is to review literature and contribute to the research on factors that are of influence on time preferences.

3.1.1 Gender

In biology and psychology evolutionary theories indicate that women are more patient than men, i.e. have lover discount rates than men (Barkow et al., 1992; Campbell, 2002). Within economics there is not a clear prejudice about gender difference when it involves time preferences. Some studies do find differences between men and women however.

Findings by Coller and Williams (1999) show results in line with evolutionary theories; men are significantly but marginally more impatient. Exactly opposite to this Dohmen et al. (2010) present women as the, again only marginally, more impatient sex. An important difference between these two studies lies in the time horizon considered. The former studies a time horizon of two months (payment of amount x in one month versus payment of amount $x+y$ in three months), the latter a time horizon of one year (payment of amount x today versus payment of amount $x+y$ in twelve months). Lampi and Nordblom (2011) also study a time horizon of one year, only they find no significant differences between the two sexes. Harrison et al. (2002) also indicate that men and women aren't significantly different. They considered varying time horizons of 6, 12, 24 and 36 months.

The results above suggest that there are no strong gender differences for time preferences. If there are any it looks as if men have a higher discount rate on somewhat short time horizons and women probably one somewhat longer time horizons. McLeish et al. (2007) present a nice study in this context. They took a time horizon of five weeks in which the choices differed between a payoff now or one within 5 weeks up to and including a payoff within 6 weeks or within 11 weeks. Because of changing the starting point of time horizons they were able to look at consistency of intertemporal choices and also at aspects like hyperbolic discounting and the present bias. They report no significant differences for single period discount rates, but do find an interesting dynamic inconsistency. Men's discount functions are characterized by a present-bias occurring on a very short time horizon (between today

and two weeks) and women have a present-bias occurring later in time (between five and nine weeks into the future). This suggests that men and women use a different pattern of quasi-hyperbolic discounting.

The conclusion is that gender differences for time preferences are or not present in most studies. If there are any, women appear to have a higher discount rate on long time horizons and men within the shorter ones. This is emphasized by the fact that the present bias turns up later for women compared to men.

3.1.2 Age

Children tend to behave rather impatient. For example, if they want to play a video game, they want to play it instantly and cannot wait another hour. Do younger people behave this impatient in financial matters as well? Surprisingly, there is little experimental economic literature available on age and time preferences. The three studies mentioned below do answer the questions though.

Harrison et al. (2002) try to elicit discount rates based on an exponential discounting model. They argue that for the time horizons used, which are fairly large (6 till 36 months) and with the first payoff always delayed one month, this model is appropriate. Their results indicate that discount rates significantly decline with age, at least after middle age. Tanaka et al. (2010) focus on shorter time horizons, varying from 3 days to maximally 3 months with the first payoff rewarded today. They use a model that enables them to test on both exponential, hyperbolic and quasi-hyperbolic discounting. They find strong evidence that certain socio-demographic factors influence ones discount function, including age. The exponential discount rate r declines on average as people get older. Concerning the present-bias parameter β they again find evidence that age is an influencing factor; older people are less present-biased. Results on discount rates are stronger than on the present-bias, however. Meier and Sprenger, finally, focus on time horizons of one month with the first payoff either being paid out immediately or within six months. This enables them to focus on present-biasedness as well. They also find that age is an influencing factor. They report that younger people have a significantly higher individual discount factor (IDF), which is similar to the

exponential discount rate r, than older people. And just as Tanaka et al. found, age is associated with significantly less present bias. From these last two researches it becomes obvious that older people are more patient in both aspects of quasi-hyperbolic discounting.

Although experimental economic literature on age and time preferences is limited the three studies described above point out that age is a clear influencing factor on time discounting. Harrison et al. (2002) focused on Europe, i.e. Denmark, Tanaka et al. (2010) focused on Asia, i.e. Vietnam, and finally Meier and Sprenger (2010) focus on North-America, i.e. the United States. Although these studies all focus on different continents the results are similar to one another. This makes the results even more strong. Both the conventional discount rate r and the present-bias parameter β diminish with age. That is to say, age is positively related with patience in both aspects of the quasi-hyperbolic model.

3.1.3 Education and intelligence

Intelligent people, either those with a higher IQ or more education, are presumably more patient. Their education or their higher cognitive skills enables them to make more rational decisions. Since high discount factors are not very rational, the more intelligent should be more patient. This is my hypothesis, but how do education and intelligence really affect ones discount factor? Education and intelligence can be reviewed here in one section because higher cognitive ability is typically associated with higher education (Card, 1999). Dohmen et al. (2010) stress this by finding that their subjects with higher cognitive ability are significantly more educated.

Just as in many research fields students are a popular choice of study. Benjamin et al. (2005) relate scores by Chilean students on the math section of the SAT test to their intertemporal choices in an experiment. Students with lower scores make more impatient choices; they exhibit higher exponential discount rates. Frederick (2005) examines students time preferences in a similar way. He relates ones cognitive reflection test (CRT) score to ones time preferences. The CRT's purpose is to assess a specific cognitive ability. It assesses ones ability to suppress an intuitive and spontaneous wrong answer in favor of a reflective and deliberative right answer. Frederick divides his sample into two groups, those with high and

those with high CRT scores. The second group is significantly more patient for time horizons of one month up to one year; they choose the larger-later reward much more often than do the other group. Harrison et al. (2002) take a slightly different approach. They examine ones level of education from a representative sample of the Danish population and find that more educated individuals are more patient in terms of the exponential discounting model. Dohmen et al. (2010) examine a portion of the German population and find that those with higher cognitive ability are again more patient in terms of the exponential discounting model. All studies above confirm the preconception that more intelligent and higher educated people are more patient. In their meta-analysis on intelligence and discount factors Shamosh and Gray (2008) stress this by finding a positive relationship between cognitive ability and patience in the majority of the studies they reviewed.

It is now obvious that the more educated and more intelligent have a lower discount factor in terms of the exponential discounting model, since all of the studies above use this model. Burks et al. (2008), Meier and Sprenger (2010) and Tanaka et al. (2010) use the quasi-hyperbolic model by Laibson (1997) when evaluating subjects from the United States and Vietnam. The first of these three studies finds individuals with more cognitive ability to be more patient in both aspects of the model, i.e. in discount factor r and present bias β. The latter two find higher educated to be more patient in terms of discount factor r, but more impatient in terms of present bias β. Contrary to the former, here higher education is associated with more present bias. This difference can possibly be explained by the fact that Burks et al. (2008) examine cognitive ability while the other two studies examine levels of education. A second explanation may be found in the sample. Meier and Sprenger (2010) and Tanaka et al. (2010) use a representative sample of a population while Burks et al. (2008) only examine trainee drivers. This group might have certain characteristics that are typical for them and points at a lack of representativeness. This in turn might bias the results.

The discount factor in exponential models is clearly lower for higher educated or more intelligent people, as multiple studies indicate. The ordinary discount factor (r) of the quasi-hyperbolic model is also lower for the higher educated and more intelligent according to three relatively recent studies. The extent to which present bias (β) is related to education

and intelligence is unclear, and needs further research. Ultimately, I need to stress that the results found are not necessarily causal. Ones discount rate could be low because he or she is better educated, or education might be higher because one behaves more patient. For instance Becker and Mulligan (1997) found that investment in own education reduces ones discount rate. This implies the relationship could be either way.

3.1.4 Wealth and income

When examining time preference one will rapidly think of wealth as a potential influencing factor. For instance, Fisher (1930) already thought of economic variables like income to have an affect on time preferences. Sufficient research exists on this potential relationship to take a closer look at the issue. There is only one caveat concerning the issue; if there is any relationship, the question remains if discount rates are affected by wealth and income or vice versa. Unlike the previous age and gender influences and just as in the intelligence section before, wealth and income are possibly endogenous and thus clear causality is not ensured.

Field data from the United States (Hausman, 1979; Lawrance, 1991) find a negative relationship for discount rates and wealth. Experimental studies (Harrison et al., 2002; Pender, 1996; Nielsen, 2001; Yesuf, 2004) examining both developed, i.e. Denmark, and developing nations, i.e. India, Madagascar and Ethiopia, find evidence of the same nature. According to all of these studies discount rates are lower (lower 'r') for rich individuals then for poorer ones (higher 'r'). Coller and Williams (1999), Kirby et al. (2002) and Anderson et al. (2004) find experimental evidence inconsistent with this relationship. According to them the relationship is exactly opposite, namely positive. Arguments against this findings are that Coller and Williams did only study a student sample which is obviously characterized by fluctuating incomes and income uncertainty, and the latter two studies did only study a sample in which income variation between the subjects was not very large. This might entangle the results. Above this, in all three studies the reported results for longer time horizons are less strong, which indicates that a present bias might be involved and also entangle the results.

All of the studies above examined discount rates by using the either the exponential discounting model or the hyperbolic discounting model, while the theoretical framework of this thesis and the results above point out that the quasi-hyperbolic discounting model tends to model reality better. Two relatively recent studies analyze wealth influences on discount rates by using the latter model. Tanaka et al. (2010) and Meier and Sprenger (2010) both find that richer individuals in respectively Vietnam and the United States have a significantly lower discount rate (r) than poorer individuals, but they do not find significant differences for the present bias (β). These studies point out that a present bias does exist for the full sample. This implies, that since present bias isn't significantly different for different income groups, all people are present biased irrespective of their earnings.

Briefly, the studies focusing on wealth and discounting by using the exponential or the hyperbolic discounting model find wealth to be a significant influencing factor, but conclusions on the relation are mixed. The studies based on the more valid quasi-hyperbolic model bring forth stronger results. Richer people are significantly more patient in sense of the hyperbolic discount rate (lower r), but are not significantly more present-biased (similar β). In the end, a clear causal relationship isn't ensured here, since people might have become rich because they are more patient or they might have become more patient because they are richer.

3.1.5 Violence

Violence, conflict and war have been present in practically all nations through time. This resulted in considerable economic research on the causes of war (Blattman and Miguel, 2010; Collier and Hoeffler, 1998) and on shifts in social preferences (Bauer et al., 2011; Gneezy and Fessler, 2012). The latter two prove that war provides for shifted behavior in terms punishment and altruism respectively. The only experimental economic study known to date that examines possible shifts in time preferences caused by violence is performed by Voors et al. (2012).

This study focuses on Burundian residents that are either or not exposed to high levels of violence. The preference elicitation experiment shows that residents that had to deal with

high levels of violence are significantly more impatient, in terms of the hyperbolic discounting model, than ones that didn't had to deal with these levels of violence. This finding is robust when controlled for a broad variety of household and community variables. Important to note is that violence of the Burundian civil war took place between 1993 and 2003 and that the results are from 2009. This implies that the shifts in time preferences might well be permanent, or at least long-standing.

3.1.6 Religion

Early in the twentieth century Max Weber (1905) already argued that economic behavior is influenced by religious believes. Although his work did not follow contemporary scientific guidelines, his study was influential. My aim here is to investigate if his findings are still valid according contemporary scientific guidelines. The amount of literature on time discounting and religion is relatively limited though.

Two experimental studies implicitly focus on religion and time preference. Chai et al. (forthcoming) conducted field experiments in the Philippines to investigate the relationship between social preferences and religion. They find no significant differences between Muslims and Christians in terms of patience. Muslims and Christians didn't differ in their choices between a smaller-today reward versus a larger-later (in six months) reward. Benjamin et al. (2012) used priming techniques[1] on U.S. students to investigate the potential association between religion and numerous social-economic preferences. For very short time horizons (the choice alternatives had to be made between a smaller reward today versus a larger reward in one week, and between a smaller reward in one week versus a larger reward in two weeks) they also find no significant discounting differences for the various religions, in this case Catholicism, Protestantism and Judaism. Both studies used an exponential discounting model to analyze their sample.

The above results point out that religious people do not have significant individual differences, since different religions do not influence time preferences significantly. It

[1] Benjamin et al. (2012) describe the concept of 'priming' as follows: "Behavior in a given moment is more powerfully affected by the norms of categories that are salient than the norms of categories that are not salient. If an environmental cue, or a "prime," makes a certain category temporarily more salient, behavior shifts towards the salient category's norm."

remains open however if religiosity in itself influences discount rates. In this context H'Madoun and Nonneman (2012) indeed find that religious people are on average more patient, again based on the exponential discounting model. This experiment focused on two time horizons, one of three months and one of a year. A second study on this issue using the hyperbolic discounting model (Carter et al, 2012) finds similar results; less religious people tend to exhibit a stronger preference for sooner rewards than the religious ones. Here subjects had to choose between a payoff today or larger one within six months. They also mention that the reported patient behavior by more religious people is due to see the future as more salient. Patience pays in religious environments. A drawback is that these two and the former two studies only focus on exponential and hyperbolic discount rates and do not use quasi-hyperbolic discounting.

Four recent studies review the issue that was already mentioned by Max Weber early in the twentieth century. Differences in religious believes in itself do not contribute to significant differences in time preferences, religiosity does however. More religious people are more patient.

3.2 RISK PREFERENCES

People's risk preferences are reflected in nearly all (economic) choices. Choice of profession, choice as to whether or not to start a study and grocery shopping for instance all contain an element of risk. Among others public and private policy makers, corporations and marketers will be interested about which factors affect risk preferences. My aim is, just as with time preferences, to review literature and contribute to the research on factors that are of influence on risk preferences.

3.2.1 Gender

The common perception on gender is that women act more risk averse than man in their financial decision-making. But is this really the case? Eckel and Grossman (2008) present a nice overview of studies on systematic differences in the risk attitudes of men and woman. They separate results on field studies (gambling and investment behavior) versus

experimental studies, gains versus losses and studies with abstract versus contextual environments.

They conclude that in field studies woman are the risk averse sex, while in experimental studies results are more mixed. In the gain domain women are the risk averse sex in almost all studies, except for a few where no significant differences where found. For the loss domain results are mixed; sometimes woman are more risk averse, sometimes no differences are found and sometimes men are more risk averse. For abstract environments results are very mixed, while for contextual environments findings are less mixed. In the latter either no differences were found or women were the more risk averse sex.

In cumulative prospect theory IRRA (increasing relative risk aversion) is mentioned. For IRRA, again, men and women might differ in their risk attitudes. Indeed Holt and Laury (2002) find that risk aversion increases with real payoffs for both men and women. However, in low-payoff decisions women are more risk averse than men, but on the other hand no sex differences were found in high-payoff decisions.

Dohmen et al. (2005) find evidence of heterogeneity across individuals, and show that willingness to take risks is negatively related to being female when respondents are asked for their willingness to take risk. When using a more experimental lottery question similar results are found. The influential experimental work by Harrison et al. (2007) does however not find a significant effect of sex. They used an experiment based on that by Holt and Laury (2002) in which subjects had to subsequently choose between two lotteries with varying probabilities; one lottery had relatively few variation in the payoffs ($1.60 versus $2.00) and one had more variation ($0.10 versus $3.85).

Concluding on gender differences, women tend to be slightly more risk averse than men. However results are sometimes mixed, depending on what kind of measure or study is used. In experimental studies, within the loss domain and in abstract environments gender differences are less strong or not apparent. Typical experimental economic research is

obviously experimental in nature and conducted in abstract environments. In this field no strong significant sex differences are apparent.

3.2.2 Age

For risk attitudes and age, again, a prevalent stereotype exists; younger people are less risk averse and risk aversion increases with age. Cook and Bellis (2001) and Gardner and Steinberg (2005) both indicate that risk taking decreases with age, as risk is measured with respectively health and psychological measures. It is interesting though how age and risk are related in financial matters.

In their paper Dohmen et al. (2005) report that willingness to take risks decreases significantly with age for both survey and experimental data. Within the survey they simply asked respondents to state their willingness to take risk. This method is ofcourse very susceptible to biases; respondents might give inaccurate answers, as explained in the theoretical framework of this thesis. Therefore they included a experiment to test if their survey data is in line with incentivized experimental data. The risk attitudes of subjects in the experiment, consisting of a subsequent choices between a sure payment versus playing a lottery, are in fact in line with the survey data. These results are in line with the experimental findings of Harbaugh et al. (2002), who report that children have a very strong tendency to underweigh low probabilities and overweigh high probabilities. This is contrary to empirical findings that people tend to overweigh low probabilities and underweigh high probabilities, as described by the non-linear weighting phenomenon in the theoretical framework of this thesis. Harbaugh et al. indeed report that this striking tendency by children diminishes with age. The implication of their findings is that children are more likely to play a risky gamble versus a certain payment than do older individuals. A number of other studies (Levin and Hart, 2003; Levin et al., 2007; Rakow and Rahim, 2010; Weller et al., 2011) focusing on risk attitudes and age find similar results; older individuals are more risk averse then younger ones.

Given the similar results in this quite big amount of studies it seems safe to conclude that the prejudice existing on age and risk preferences is correct; risk aversion increases with age.

However, Mather et al. (2012) bring up something interesting. They find a greater preference for sure gains and greater avoidance of sure losses for older people than for younger people. Therefore they argue that it is not necessarily risk aversion that decreases with age. According to their findings it is the so-called 'certainty effect' that increases with age. As described in the theoretical framework, the 'certainty effect' covers the observation that certain outcomes (0% and 100% chance) are perceived as categorically different and weighted more heavily than uncertain outcomes (Kahneman & Tversky, 1979).

A big amount experimental studies point in the direction of the prevalent thought that risk aversion decreases with age. Therefore it looks safe to conclude that risk-taking and age are negatively correlated. Given the results by Mather et al. (2012) we need to examine in more depth if it is really risk-aversion that increases with age or if it is the longing for certainty that increases with age.

3.2.3 Interaction gender/age

The previously mentioned results for age and gender do need to be taken into a broader context. Because it is sometimes assumed that gender differences in financial risk attitudes are not constant for an entire lifetime but vary with age. And this is exactly what Brinig (1995) finds. Her experiment was conducted with three jars. Subjects were informed about the winning chances and payoffs, and had to draw one ball from a jar. One jar had a 90%-winning chance with a small reward, another jar had a 20%-winning change with a slightly larger reward and the final jar had 5%-winning chance with a large reward. Although this way of experimenting is possibly a little outdated and not compatible with typical experimental economic research the findings are interesting. At young age no significant differences in risk attitudes are present, but at the age of 30 men are significantly more risk-seeking than women. After the age of 30 gender differences in risk attitudes slowly fade away. This finding is consistent with evolutionary theories that men are more risk-taking during the period in which they are trying to attract mates, and women are more risk-averse during the child-bearing years. Both of these arguments are more or less consistent with the paper by Dohmen et al. (2005). This paper reviews a large survey dataset and validate their found results with a smaller incentivized experiment. They notify a steady decline in risk-

taking behavior for men during their entire lifetime, but a less steady decline in risk-taking behavior for women. Women's risk aversion increases rapidly until the age of thirty, then is relatively constant during their thirties and forties, and afterwards increases rapidly again. This makes men the less risk-averse sex during the thirties and forties, just as in the study by Brinig. Arenson (1978) studied risk-taking behavior of 5 to 13 year olds. The children had to subsequently insert a stylus in one of three boards. The first board had a winning payoff with probability ½, the second a winning payoff with probability ¼, and the final board a winning payoff with probability ⅛. Expected value of winning was the same for all three boards. His most important finding was that gender differences are not significant for boys and girls at the age within this age group.

The results found by the studies above are in line with one another. Gender differences in risk-taking don't seem to exist at young age, these differences peak at the age of 30, and decrease after this age and fade away slowly. A downside is that two of the studies above are relatively old and their research methods are not in line with contemporary experimental economic research. It is advisable that future economic research on risk preferences reviews the interaction between age and gender.

3.2.4 Education and intelligence

The amount of literature on risk preferences and intelligence is relatively limited. This is probably why there is not a widely accepted presumption on this topic. I hypothesize individuals with higher cognitive ability to make more rational choices, because higher cognitive ability implies that individuals reasoning is faster and more punctual. Since these individuals have more time to think and more accurate knowledge about the alternatives and consequences this in turn will lead to more rationality. This means I expect them to be less risk-averse in the gain domain and less risk-seeking in the loss domain.

The results of Frederick (2005) are exactly in line with this thought. He relates ones cognitive reflection test (CRT) score to ones risk preferences. The CRT's purpose is to assess a specific cognitive ability. It assesses ones ability to suppress an intuitive and spontaneous wrong answer in favor of a reflective and deliberative right answer. Frederick divides his sample

into two groups, those with high and those with high CRT scores. The group of people with a higher scores on the CRT (cognitive reflection test) are indeed less loss-averse for the gain domain and less risk-seeking for the loss domain. Prospect theory expects people to change from risk-averse to risk-seeking when prospects change from positive to negative. For the group with lower cognitive ability this is true, for the other group this is not.

Dohmen et al. (2010) find the same in their research. Higher cognitive ability is related to willingness to take risk in the gain domain for both survey data and within an experimental design. This experiment required subjects to choose between a certain outcome and a gamble. Benjamin et al. (2005) find that Chilean high school students with higher standardized test scores (SAT) for math are also more likely to play a gamble then to choose a certain outcome. Thus they also find that those with higher cognitive ability are less risk-averse in the gain domain.

The results above underline my presumption; cognitive ability is related to rationality, when rationality means that individuals are less risk-averse in the gain domain and less risk-seeking in the loss domain. Multiple studies show that those with higher cognitive ability are less risk-averse in the gain domain. Frederick (2005) finds the opposite for the loss domain, there the ones with lower cognitive ability are more risk-seeking.

3.2.5 Wealth and income

Risk aversion can be divided in absolute risk aversion (ARA) and relative risk aversion (RRA). The ARA measure indicates ones risk preferences over absolute amounts of money, the RRA measure over relative amounts of money, i.e. proportions of ones wealth or income. Both measures can be constant, decreasing of increasing. Constant means the measure has the same value for all (absolute or relative) amounts of money. Increasing means the measure increases with the amount of money, decreasing means it decreases. For the correlation between wealth and risk preferences again a clear prejudice exists; wealthier people on average tend to take more risk than poorer people. In other words, risk taking is positively related with wealth. This prejudice is in line with decreasing absolute risk aversion (DARA) as in EU theory.

Dohmen et al. (2005) find a positive correlation for wealth and risk in their before described paper that analyzes both survey and experimental data for Germans, emphasizing the prediction for the gain domain. Tanaka et al. (2010) find similar results in a study that I already described before as well. They combine experimental and survey data conducted in Vietnam. One of their conclusions is that in villages with a higher mean income residents are less loss-averse. Guiso and Paiella (2008) use an Italian survey to examine respondents willingness to pay for a risk security against potential losses. They find that risk aversion is a concave function of wealth. They also indicate that people in an environment with a relatively high risk of low income behave more risk averse. This study obviously focuses at the loss domain. Paravisini et al. (2010) look at the behavior of investors in the gain domain. Their preferences are consistent with decreasing relative risk aversion (DARA). Besides this they find that investors who have experienced a negative wealth shock become more risk averse.

Concluding on wealth, both for gains and losses wealthier people exhibit less risk aversion. Uncertainty about income and negative wealth shocks make individuals even more risk averse. The prejudice is right; wealthier people on average tend to take more risk than poorer people. The results are in line with both decreasing absolute risk aversion and decreasing relative risk aversion.

3.2.6 Violence

A very actual field of study lies in violence and behavioral preferences. Western media daily report about wars in which even Western countries are active, about rapes and other forms of violence. It is interesting to investigate how people who are exposed to violence act in financial risky decisions. This data gives policymakers interesting information because they align their policy with behavior of civilians, and thus also with behavior of civilians who were exposed to violence.

Voors et al. (2012) investigate the effect of civil war on behavioral preferences in Burundi. They compare pre-war survey data and their own found experimental after-war results. The

experiment consists of a choice between a certain outcome and a simple gamble. The switching point of subjects determines the respondent's degree of risk aversion. The conclusion is that a positive correlation for war intensity and risk-seeking behavior exists. People who are exposed to violent conflict are significantly more risk-seeking in the gain domain, and have unchanged preferences for the loss domain. The subjects are observed over a period of six years, so the changed preferences may well be definitively.

The more psychological research by Moya (2012) considers influence of exposure to violence and the prevalence of emotional trauma on risk preferences. He also compares survey and experimental data about risk aversion. The experiment is very much like that in table 4 of the theoretical framework; it consist of a choice between a relatively sure smaller expected payoff and a relatively uncertain but higher expected payoff. He thus looks at the gain domain. His main finding is that violence and emotional trauma are correlated with more risk averse behavior; people exposed to violence and emotional trauma prefer the 'safer' and smaller option more often. Moya further reports that this relationship seems to fade away within a few years time. The desire for more certainty and the fading away of this effect is exactly opposite to what Voors et al. (2012) found.

Callen et al. (2013) do find similar results to Moya in their economic study of violence and risk preferences. They use primes to recall fear under Afghanistan people. Their study also focuses on the gain domain and uses a experiment similar to that of Moya (a safer-smaller option and a risky-larger option). They find that individuals exposed to violence have a significant desire for more certainty. Recency and intensity of exposure to violence are both significantly correlated with preference for certainty.

Results for violence and risk preferences are mixed. Voors et al. (2012) find more risk-seeking behavior in the gain domain when exposed to violence, while Moya (2012) and Callen et al. (2013) find the exact opposite. Voors et al. (2012) are the only ones who examine the loss domain. Here they find no significant difference between people who were exposed to war and ones who were not. In summary, the field of violence and risk is relatively young and has yet to evolve. This might explain why the results so far are mixed.

3.2.7 Religion

Although the amount of research on religiosity and risk is limited, there are some researches on this topic. Some older researches focus on survey data (Miller, 2000; Freese, 2004). However, as mentioned in the introductory part of my thesis I would like to focus on typical experimental researches. These give some interesting results.

The first question that arises and which is highly applicable to the research question is if religion and risk attitudes are related. Liu (2010) analyzes hypothetical risk preference decisions for a large Taiwanese sample. Dohmen et al. (2011) review survey data from a large German sample and validate the results in this section by finding similar results in an smaller incentivized experiment. The experiment consisted of trials, where subjects have to choose between a lottery that paid €0 or €300 with equal probability (50%) and a sure payoff that differed by trial. Noussair et al. (2012) also focus on religiousness and risk attitudes and do so by analyzing a large Dutch survey sample and a smaller experimental sample. The experiment consisted of trials, where subjects have to choose between a lottery that paid €5 or €65 with equal probability (50%) and a sure payoff that differed by trial. All of the three studies above report that more religious people have a stronger willingness to avoid risks. These recent researches find a strong correlation between religiousness and risk aversion.

Second, it is interesting to take a closer look at the different religions and their influence on risk attitudes. Most experimental research in this field is conducted in Western nations, and logically focuses on the most prevalent Western religion, i.e. Christianity. Results on this are mixed however. The just discussed study by Noussair et al. (2012) find evidence that Protestants show more risk-averse behavior than their Catholic counterparts. In the paper by Barsky et al. (1997) subjects are questioned by an interviewer, which poses hypothetical questions about job opportunities and associated salaries. They also find Protestants to be more risk-averse than Catholics. And thirdly, Benjamin et al. (2012) find the exact same in their experiment. They used priming techniques and risk experimental decision tasks with real monetary payoffs on U.S. students to investigate the potential association between religion and numerous social-economic preferences, and thus find Protestants to be more risk-averse than Catholics. The other study discussed in the paragraph above (Dohmen et al., 2011) finds the exact opposite. One of their conclusions based on both survey and

experimental measures is that Catholics are more risk-averse than Protestants. Renneboog and Spaenjers (2011) rely on an statistical analysis of a large Dutch survey sample and find, just as Dohmen et al., Catholics to be more risk-averse than Protestants. In addition to this 'religion issue' Chai et al. (forthcoming) conducted a field experiment in the Philippines. Their subjects had to participate in one of six lotteries presented. Each lottery had a low and a high amount (1=300,300; 2=250,400; 3=200,500; 4=150,600; 5=50,700; 6=0,750), each with a probability of ½. They conclude that no significant differences in risk behavior between Muslims and Christians exists. The survey-based study by Bartke and Schwarze (2008) find Muslims to be more risk-averse then Christians, however. They analyzed data from the large, representative German Socio-Economic Panel (SOEP).

The mixed and not conclusive results above suggest that the evidence between religion and risk aversion is spurious. This means risk aversion is not necessarily related to religion, the real cause more likely lies in religiousness. Just as multiple researches indicate. Noussair et al. (2012) stress this by finding data in line with the latter relation. More profound research is advisable to confirm this spuriousness.

3.3 CORRELATION TIME AND RISK PREFERENCES

In the introductory part I continuously mentioned time and risk preferences in one single breath. In the latter parts of this thesis time and risk preferences were split up in different chapters or paragraphs. Question is, how do these two behavioral characteristics relate to one another? Psychological research (Ida and Goto, 2009) did find, for instance, find a relationship between addictive behavior like smoking, drinking and gambling and high discount rates combined with low risk aversion. Economic research suggest that time and risk preferences might be correlated as well. Tanaka et al. (2010) namely figured that the amount of money subjects won in the risk game in the first part of their experiment is significantly related with lower discount rates. Meaning that subjects who won higher payments in the risk game are more patient. Furthermore, Lampi and Nordblom (2011) found a relationship based on survey data. In their study men's time and risk preferences are significantly related, while this is not true for women.

In this context Andersen et al. (2008) designate something interesting. In their study they try to elicit discount rates. They show that estimations of discount rates only become plausible if time and risk preferences are simultaneously estimated. Estimates of discount rates become significantly biased when one makes assumptions about subjects risk preferences that are not tested explicitly. Their results imply that time and risk preferences should be elicited simultaneously to prevent the mentioned bias. These findings strongly suggest that time and risk preferences are in some way influencing one another and thus related.

Some of the experimental studies that I reviewed in the separate parts on time and risk preferences enable me to check whether or not there exists a relationship between the two. Dohmen et al. (2010) looked at the influence of cognitive ability on time and on risk preferences and found both to be influenced by cognitive ability. This suggests there is a connection between the two preferences, while both may be endogenous. Time and risk preferences seem to be correlated, meaning here that a higher discount rate (impatience) is associated with a higher risk aversion. Their results do however not confirm a clear causal relationship, but indicate that the relationship between time and risk preferences is possibly spurious. Cognitive ability, time and risk preferences here form a triangular relationship.

Burks et al. (2008) find similar results when examining cognitive ability. Their study shows that consistency in the risk experiment is correlated with patience, both in terms of present bias (β) as in terms of the hyperbolic discount rate (δ). Besides this they indicate that consistency in the risk experiment is negatively correlated with risk aversion. In summary, impatience and risk aversion are correlated. Interestingly, they add that the two measures of the quasi-hyperbolic discounting model , β and σ, are correlated as well. This implies that one that is relatively impatient on the short run on average also is relatively impatient on the long run, and vice versa.

Finally, there are two studies that do not study the correlation as part of a broader research, but that more explicitly examine the relationship between time and risk preferences. The first of these two (Keren and Roelofsma, 1995) argue that the main influencing factor for time preferences is the degree of risk that is involved. This of course suggest a strong correlation

between time and risk preferences. Their research was designed to add a risk aspect to their intertemporal choice experiment. When subjects had to choose between a certain outcome paid now and an uncertain outcome paid later they preferred the immediate reward significantly more often than when outcomes were completely certain. This implies that a high discount rate is mainly a result of risk aversion since a sooner reward decreases the level of uncertainty.

The second of the two studies is performed by Anderhub et al. (2001). They conducted an experiment in which subjects had to state how much their were maximally willing to pay (WTP) or minimally willing to accept (WTA) to respectively pay or require for a certain lottery. The subjects had to state this for lotteries with varying time intervals of zero, four and eight weeks in advance. Just as Keren and Roelofsma (1995) they added a risk aspect to the intertemporal choice experiment, in the form of the lotteries. The results by Anderhub et al. show again that time and risk preferences are correlated. They find that more risk averse persons are also more likely to discount the future more strongly. They conclude that a risk-averse person might be more unwilling to postpone a gratification. And just as Keren and Roelofsma argued they also think that a high discount rate is mainly a result of risk aversion, where risk aversion is caused by more heavily discounting of future payoffs to compensate for the uncertainty involved. The fact that the correlation is independent of the research method used (WTP or WTA) makes the results even stronger.

Summarizing, several studies have researched the existence or otherwise of a relationship between time and risk preferences. These all point in the direction of the existence of this relationship. Two studies have explicitly researched the possible relationship and found strong results that underline that time and risk preferences are indeed related to one another. It remains unclear however if the relationship is clearly causal. It could well be that other influences, just as the influences studied in the middle part of this thesis, are influencing both time and risk preferences in a similar way. Although these possible alternative explanations for the relationship exist, no one can deny that time and risk preferences are correlated.

4. CONCLUSION

The main goal of this thesis was to investigate in what way time and risk preferences are influenced. I therefore in the first place made up a theoretical framework on time and risk preferences and the related experimental research. Secondly, I reviewed existing experimental research in this field on gender, age, wealth, intelligence, violence and religion influences. The aim was to combine and link the relevant results and conclude what factors influence time and risk preferences, and in what way. Finally I reviewed literature on the whether or not existing relationship of time and risk preferences.

The reviewed studies on time preferences indicate that gender differences are not very strong. If there are any, women appear to have a higher discount rate on long time horizons and men within the shorter ones. This is emphasized by the fact that the present bias turns up later for women compared to men. Since men and women do not change sex very often these slight gender differences have to be permanent. Age is clearly not a constant factor for any individual, implying this factor is clearly not of a permanent and constant influence. The found results on age influences are strong however. These point out that age is positively related with patience in both aspects of the quasi-hyperbolic model. Both the discount rate r and the present-bias parameter β diminish with age.

A fair number of researches studied the influence of intelligence within the exponential or hyperbolic discounting model. Their collective conclusion is that more intelligent and higher educated people are more patient. Studies using the quasi-hyperbolic model are unanimous that the higher educated and more intelligent are more patient in terms of the discount rate r, but are not conclusive on the present-bias parameter β. Education and to a lesser extent intelligence are constant per individual and thus are in any case of permanent influence. In addition, I need to stress that the results found are not necessarily causal. Ones discount rate could be low because he or she is better educated, or education might be higher because one behaves more patient. The same reasoning applies to wealth influences, since people might have become rich because they are more patient or they might have become more patient because they are richer. Studies on wealth influences indicate that wealth and patience are

related when examining the hyperbolic or exponential discount model, but the nature of the relation is inconclusive. Within the quasi-hyperbolic model richer people are significantly more patient in sense of discount rate *r*, but are not significantly more present-biased.

The hyperbolic model is the only model used when evaluating violence influences, since there is just one study (Voors et al, 2012) that focuses on this. They find that residents that were exposed to high levels of violence are significantly more impatient than ones that were exposed to less violent situations. The fact that the time in between the experiments and the violence of the civil war is between 6 and 16 years implies that the shifts in time preferences might well be permanent, or at least long-standing. Finally, influences by religion are considered within the exponential and hyperbolic model. The main conclusion here is that differences in religious identity in itself do not contribute to significant differences in time preferences, but religiosity does however. More religious people are more patient. Nothing is said about people who changed religion, so no inference can be made about the permanency of this influence.

Just as with time preferences gender differences are not very strong for risk preferences. Women tend to be slightly more risk averse than men, depending on what kind of measure or study is used. Within typical experimental economic research no significant sex differences are apparent. A relatively big number of experimental studies report that risk-taking and age are negatively correlated, implying older people are more risk-averse. Age is certainly not permanent, so this influence will logically be varying. Three studies that investigated the correlation between gender and age also conclude that gender differences are not constant for an entire lifetime. Gender differences in risk attitudes don't exist at young age, peak at the age of 30 and slowly decrease after this age.

For the solid factors education and intelligence experimental research indicate that those with higher cognitive ability are less risk-averse in the gain domain, and more risk-averse in the loss domain than lower educated or less intelligent individuals. Research on wealth influences gives other results. Here, both for gains and losses wealthier people exhibit less risk aversion. The fact that negative wealth shocks make individuals even more risk averse

and the fact that wealth is variable from time to time indicates that wealth influences are certainly not permanent, but vary with past experiences.

Results for violence and risk preferences are rather mixed. Voors et al. (2012) find more risk-seeking behavior in the gain domain when exposed to violence, while others find the exact opposite. Within the loss domain no significant wealth differences were found. Finally, the influence by religion is likely to be spurious. A combination of studies lead to the conclusion that risk preferences are not clearly influenced by religion, but are influenced by religiousness itself. More religious individuals exhibit more risk-averse behavior.

Finally, I checked the whether or not existing relationship of time and risk preferences. All studies that studied this matter, both as part of a broader research and more concentrated, report that the relationship exists. It remains unclear however if the relationship is clearly causal. It could well be that other influences are influencing both time and risk preferences in a similar way. Although these possible alternative explanations for the relationship exist, no one can deny that time and risk preferences are correlated.

5. DISCUSSION

The previous chapter concluded on whether the factors specified in the introduction influence time and risk preferences. Here the implications of this influence, the shortcomings of this thesis and recommendations for future research are examined.

Gender differences are empirically observed in economic behavior. This thesis illustrates that the differences are not due to gender differences in terms of time and risk preferences, as these do not exist. Age does however affect both measured time and risk preferences. Since choices made at young age sometimes have considerable long-term consequences this is an important finding. Wealth is also found to be an influencing factor on time and risk preferences, so the way wealth is distributed amongst a society thus has important implications for the economic behavior within these societies. In the same vein cognitive

ability and education play an important role in economic behavior within a society. Those with higher cognitive ability and higher education are more patient and act more rationally in their risk-taking. Societies that inhabit a relatively large amount of individuals with high cognitive ability and education are more likely to achieve prosperity. Influences by violent experiences may affect behavior and in turn prosperity as well. This thesis points out violent experiences do not clearly affect risk attitudes, but that is does however cause people to get more impatient. Finally, the claim by some European politicians that ones religious believes influence ones (financial) behavior is rejected. It is the religiousness itself, irrespective of which religion, that influences ones time and risk preferences.

An important shortcoming of this thesis is that it focuses mainly on non-context-specific measures which are typical for experimental economics. As already discussed in the theoretical framework time and risk preferences may vary when different contexts are specified. For future research it is advisable to add some context-specific questions to control for context-dependency. Another shortcoming of typical experimental economic research is that is focuses on just one or a few factors that possibly influence ones time and or risk preferences. Ideally a research would consider and control for any possibly influencing factor.

A third shortcoming is found in the causality of relationships. Ones wealth, cognitive ability and education might explain why one has certain time and risk preferences, but ones time and risk preferences might also explain why certain individuals have become wealthy or better educated. Future research can overcome this 'endogeneity problem' by using priming instruments. Priming enables researchers to assign an exogenous treatment to a sample. If this treatment is assigned randomly, this eliminates the endogeneity problem, thus allowing researchers to estimate the causal relationship between a factor and time and risk preferences (Nazir, 2013). A final point of attention for future research is found in the results on influence of violence on time and risk preferences. The amount of literature is limited and the found results are rather mixed. More future research on the influence of violent experiences on time and risk preferences is desirable to get a better and more complete view of this potential influencing factor.

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