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UNDERSTANDING RISK AVERSION: LINKING CHARACTERISTICS AND EMOTIONS TO PROSPECT THEORY

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To my mother,

For showing me that good things in life can be accomplished with hard work if you believe in yourself enough

With special thanks to:

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Cynthia Jímenez, thanks for the patience, the trust, and for ameliorating the journey,

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Abstract

This work presents the results of a field experiment on Cumulative Prospect Theory in Mexico, where it analyzes the effects of socio demographic characteristics over uncertain outcomes. It makes a new contribution to the analysis of emotions at the time of choosing a prospect. The experiment was conducted at both a public and private universities, the final experimental sample was of 570 individuals. We found that risk aversion on gain diminishes with age and income, but it increases with sadness. These results may have interesting implications for policy design, and the impact of it will be different depending on these varaibles. Loss aversion is affected by the type of university: being in a public school diminishes it. Loss aversion is also negatively influenced by anger; so an angry persons hates less lossing than wining, compared with a not affected person.

Contents

Chapter 1

Introduction

Understanding human preferences over uncertain outcomes is a key issue to many subjects in the field of economics. Risky attitudes can create speculative bubbles and crashes on financial markets (Long, Shleifer, Summers, and Waldmann (1991)).High risk aversion can explain why some countries do not invest on business opportunities, capital or human capital (see Shaw (1996), Hartog and Diaz-Serrano (2007) or Yesuf and Bluffstone (2009) for some empirical examples). In fact, the effects of a public policy differ depending on the level of risk aversion in a society (credit incentives, fiscal taxation programs, etc.). These are only a few examples of why we should care about decision making under uncertainty, and there are still many unanswered questions in the field.

Risk aversion is generally associated with the properties of the utility function, which are consistent with the Expected Utility Theory (EU) Harrison and Rutstrom (2008). When taking such a classical approach one might need to use assumptions in other economic theories that are not as realistic (e.g., agents are not always risk neutral when asking for a loan nor are they all risk adverse when biding at an auction). In recent literature there are many well-documented examples under diverse scenarios that suggest Prospect Theory (PT) as a better way for modelling choice under uncertainty, an important example can be found in List (2004), where participants in a well-functioning marketplace behave according to PT. Thus, to achieve a deeper knowledge of human preferences, a behavioral approach like PT seems essential. However, literature covering differences in specific characteristics at the time of decision making is still under development and remains mostly unclear.

One important aspect that has been left out is the role of emotions when talking about Prospect Theory, mainly because it is difficult to measure them. It is well documented that humans behave completely differently depending on their emotional status[1]. Under specific circumstances people, cities, or even countries can get emotionally affected. This massive emotional impact is one reason why economics should care about the effects emotions have when taking risky decisions. Public policy, market prognosis, or mechanism design may have different results when considering the risk emotional impact on under uncerainty behavior.

The general goal of this paper is to measure risk aversion using Prospect Theory. In order to achieve this, we conducted a controlled experiment in two universities in Mexico City. The experiment design allowed us to get the parameters of the Cumulative Prospect Theory (CPT) value function and the probability weights for each individual. The CPT function is characterized by three parameters: the curvature of the function that assigns value to the prospects (i.e. lotteries) (σ), the coefficient of loss aversion (λ), and the one parameter of Prelec's reweighing function (α).The average individual in our sample has values of .47, 2.29, and .71 for σ, λ, α respectively. Also, with this experiment, we were able to gather information about the respondent's socioeconomic variables, and how they felt emotionally after reading about different dramatic situations.

[1]For example, depressed people tend to overeat Smith (2009).

This paper tries to explain how some observable characteristics (age, gender, etc.) are related to the parameters of a Cumulative Prospect Theory function, and also how unobservable characteristics (such as emotions) can affect risky decision making from a behavioral economics' perspective. To our knowledge, this is the first paper with these characteristics, and it also may be the first risk aversion analysis for Mexico. This paper makes a contribution to the literature of Prospect Theory, the literature of behavioral economics, and to public policy design research, especially in Mexico's case. Literature of the relevant economic theory is reviewed in section 2, experimental design is explained in section 3, data analysis is presented in section 4, main results are shown in section 5, and finally, section 6 summarizes this paper. Appendices 1 and 2 detail the formal theory of EU and PT, respectively. Appendix 3 provides eliciting information and appendix 4 contains the actual questionnaire.

Chapter 2

Literature and Economic Theory review

2.1 Expected Utility Theory

It is well known that the classical way of modelling choice under uncertainly uses Expected Utility Theory, proposed by von Neumann and Morgenstern (1944). A key assumption of the EU is that the expected utility function must be linear in the probability weights[1]. In their separate seminal works, Arrow (1971)and Pratt (1964) proposed the concept of risk aversion, which is applied under EU (an agent is risk avert if his utility function is concave), and they also established a criteria for its measurement (an agent is more risk adverse than some other if their coefficient of relative or absolute aversion is greater). The general form of EU is described in the next equation:

$$U(\sum_{k=1}^{K} p_k x_k) = \sum_{k=1}^{K} p_k u(x_k) \tag{2.1}$$

for any K lotteries $x_k \epsilon \mathcal{X}$, $k = 1, \ldots, K$, and for probabilities $(p_1, \ldots, p_K) \geq 0$, $\sum_k p_k = 1$. $u(.)$ is a Bernoulli utility funcyion and $U(.)$ is a utility von Neunmann-Morgensten

Experiments must be conducted in order to get an empirical result of the previous measures (unless it is a natural experiment). Most of them are designed to recover the parameter of the Constant Relative Risk Aversion (CRRA) for the following utility function:

$$u(x) = \frac{x^{(1-r)}}{1-r} \tag{2.2}$$

where r is the Coefficient of Relative Risk aversion[2]

However, the methods for doing so vary depending on the available information or the experiment's nature. Harrison and Rutstrom (2008) identify five elicitation procedures that are frequently used in the literature. The first is Multiple Price List Design (MPL), was first proposed by Miller and Lanzetta (1969). In MPL each subject is presented with an ordered array of binary lotteries to choose all at once. The second is the Random Lottery Pairs (RLP) in which the subject picks one of the lotteries each in each pair, and faces multiple pairs in the sequence. The Third is Ordered Lottery Selection (OLS) in which the subject picks a lottery from an ordered set. Fourth is Becker-Degroot-Marshack (BDM), where the subject has to reveal his Certainty Equivalent in an auction. Finally the fifth is a hybrid of the others. According to Harrison and Rustrom these procedures are the most used in experiments; however, since these procedures are for recovering only one parameter and we needed to recover three, we used a more complex mechanism instead.

[1] This implies that an agent fully understands the laws of probability.

[2] $r > 0$ implies a person being risk avert, $r < 0$ implies risk seeking, and $r = 0$ risk neutral.

The most recent literature on EU is focused in testing the hypothesis of risk neutrality or risk aversion, and finding causal explanations towards risky attitudes. Harrison, Lau, and Rutstrom (2007) used the MPL method in a national representative controlled experiment on Denmark with 253 subjects. They were concerned about the assumption of risk neutrality, and they proved, in fact, that for Denmark this is assumption was wrong. With this method they were able to identify an individual domain for the CRRA coefficient (r =0.66 on average when symmetric kernel is used), they also estimated the effects of sociodemographic variables in the parameter, thus revealing that risk aversion decreases when age increases, and those studying or who completed a type of vocational training are more risk averse that those with less education.

Roel, Beetsma, and Schotman (2001) used a television game show data as a field experiment. The game show consisted in guessing the correct word, if the respondent answers correctly they earn an amount of money x. After that, the participants must choose playing again the lottery of guessing another word or they could go home with the previous amount of money earned. If the respondents guess correctly they earn $2x$ and if the participants guess incorrectly they lose everything earned before. This natural experiment allowed testing the hypothesis of risk neutrality with different levels of money on game. Using the CRRA they found that when an agent is endowed with 0, the r =0.42 ; when the initial wealth is increased to 20000, the $r = 3.13$, finally with a huge amount of initial wealth of 100000, r =13.08 . These results obviously contradict the hypothesis of risk neutrality and demonstrate a high variation of it with large payments.

A great synthesis of findings on differences in risk aversion levels over men and women can be found in Eckel and Grossman (2008). They concluded that in field experiments women are more risk averse that men; however in laboratory experiments the evidence is not conclusive. They argued that this is the result of bad controls for education, wealth, marital status, etc. that might bias the studies. We may not have this problem because our experiment is more of a controlled experiment than a pure laboratory experiment, and we have a relatively large random sample. We also included all of the controls suggested.

Migration is an interesting decision that may impact the degree of risk aversion in developing countries. In the paper of Halek and Eisenhauer (2001) the impact of several demographic characteristics on the CRRA is studied, and migration was one of them. They found out that, on average, r =3.75 using information on people that had life inssurance available on Wave I of Michigan Health and Retirement Study. It is worth noting that results showed that, on average, immigrants have 13.95 percent lower risk aversion than natives. They also found that the self-reported health variable, feeling depressed, and the Drinker behavioral variable, had no effect on risk aversion.

Holt and Laury (2002) argue some important considerations to take when doing experiments. In their paper they used MPL to recover the CRRA's coefficient over a 177 people sample using three different treatments. The first treatment consisted in a low but real payment for the respondent; the second in a high hypothetical payment; and the third in a high real payoff for the respondents. They concluded that individuals do not respond realistically when hypothetical payments are used; however, this is only true for high outcomes. We considered this at the time of implementing our experiment.

It is worth noting that experimental data has revealed scenarios where the EU's axioms do not hold. Allais (1953) provides an experimental example where the independence axiom does not get satisfied. When a third option is added in the system to the initial choice, the agent reverses his initial choice. The paradox of Machina (1982) is another example where EU cannot describe the real decisions made by agents

2.2 Prospect Theory

This evidence against the independence axiom reffered to above, and their findings in the psychology field (that humans beings do not have linear preferences; that humans are risk seekers over negative outcomes[3], and that there is source depending over the preferences, implying that agents concern not only about probabilities

[3] 1) When the prize is bigger. 2) When there is certain loss and a substantial probability of losing more.

but from the nature of the risk), led Kahneman and Tversky (1979) into developing Prospect Theory. From now on we will use the word prospect as a synonym for lottery, in order to better match with PT. This theory incorporates psychological factors to EU, distinguishing two phases at the time agents choose a prospect: the editing phase and the valuation phase.

In the editing phase agents reconstruct the prospects; for example, if they see in a prospect an outcome with a 70% probability they could reconstruct it as 90% or more[4]. In order to reshape the probabilities the agents first encode them (when observing a prospect a separation is made on gains or losses over a point of reference); then they combine prospects for simplification ; agents cancel the similarities in the different prospects[5], and finally, they cancel similitude in the different prospects [6]. During this phase agents may also round numbers or use the strict dominance criteria.

The valuation phase assigns a utility value for the prospects. As in EU, this phase allows the individuals to complete the utility's maximization problem; however, in PT prospects are valued separately for gains and losses over a certain reference point (usually it is zero). This separation is a key part of the theory because it allows different risk aversion attitudes depending on positive or negative outcomes.

The incorporation of the editing and valuation phases to the EU model produces two major modifications to classical utility form: PT first assumes a value function that can identify the prospects in two different ways, gains and losses; secondly, it assumes non linear weighting for probabilities. Nevertheless there are two main problems with PT that, in general, spark heated discussion among researchers: PT does not allow prospects with many outcomes (so it loses realism. in financial markets, for example, there are several many possible outcomes); and secondly, PT does not guarantee stochastic dominance (a very convincing tool when evaluating). So if we only use Prospect Theory our results might not be extrapolated in cases where many outcomes are presented, like in the financial problems cited above.

One refinement of the theory known as Cumulative Prospect Theory (CPT), proposed by Tversky and Kahneman (1992),eliminates the previous problems of the original model. The general model of CPT is described with the next equation

$$V(x_i) = \sum_{i=0}^{n} \pi_i^{+}(p)v(x_i) + \sum_{i=-m}^{0} \pi_i^{-}(p)v(x_i) \tag{2.3}$$

Where the first sum is over the positive prospects (prospect with only non negative outcomes) pondered by no linear probabilities weights (from 0 to n), and the second part is for the negative part of the prospects (only non positive outcomes,$-m$ to 0). Hence a parametric function of the CPT has parameters that identify the curvature of the value function of prospects, parameters that identify the weights of the probabilities, and parameters that indicate the degree of loss aversion. One popular parameterization of this equation is the following:

$$v(x) = \begin{cases} x^{\sigma} & for\ x > 0 \\ -\lambda(-x)^{\sigma} & for\ x < 0 \end{cases} \tag{2.4}$$

$$\pi^{+}(p) = \pi^{-}(p) = \frac{1}{exp[ln(1/p)]^{\alpha}} \tag{2.5}$$

Where σ captures the curvature of the value function, α is the no linear reweighing factor, λ is the loss aversion parameter and p is the real probability. Intuitively if σ increases implies that people is less risk averse on gains and less risk seeking on losses.[7] In this function if $\alpha = 1$ and $\lambda = 1$ we would return to the case of Expected Utility Theory, but with a perfect mirror of the function over the negative domain.

[4]These subjective "probabilities" are capacities and do not obey the rules of probabilities.
[5]The prospect (200,.25; 200,.25) could be reduced to (200, .5).
[6](200,.20 ;100,.50;-50,.30) and (200,.20; 150, .50; -100, 30) could be simplified to (100;.50;-50,.30) and (150,.50 ;-50, .30).
[7]Note that the function assumes perfect curvature reflexivity, this may not be the general case. However it makes the empirical identification much simpler.

Recovering the full information of a CPT function is much more complicated than recovering the information of the EU function because in EU typically has only one parameter to be identified, whereas, under CPT, there are at least three parameters needed (as in equations 4 and 5). Thus, CPT experiments take longer than EU experiments. One issue that may bring complexity for the implementation is that in PT and CPT experiments there must be negative outcomes on several prospects. It must be noted that there are no homogeneous methods for recovering the whole information, and many of them use very restrictive functional forms.

Abdellaoui, Bleichrodt, and L'Haridon (2008) proposed a method that concentrates on eliciting the certainty equivalent (CE) for gains, then they recovered the CE for losses, and finally, they linked both of them. In this procedure a subject is presented with two lotteries, one with certainty and one with risky. The first part is on the gain domain, so only positive prospects are shown; the second part offers a certain loss and a prospect with a low probability of losing less and a high probability of a major loss. Finally the third part is a mixture of both. We did not use this method because we believe that it is harder to reveal the actual certainty equivalent.

Kahneman and Tversky (1979) use the PL method, and they assume a very restrictive functional form in order to recover the full information. In the process of doing so, they fixed one parameter and then recovered the others. Nevertheless their results on the parameters are the reference point for most behavioral studies.

Tanaka, Camerer, and Nguyen (2010) proposed the CTN Eliciting Method. In CTN there are three ordered sequences of lotteries. In the first two they identify the parameter of the curvature in the gains domain, and the one parameter of Prelec (1998) probability weighting function. In the last sequence they identify the loss aversion parameter. This is a simpler procedure but it has some restrictive assumptions. Even though we are fully aware of these restrictions we used this method for our research and it will be fully detailed in section 3.

One important gruop of PT literature was finding evidence against EU. This empirical literature tests the hypothesis that the weighting parameters are different from 1, as in EU. The other part of the literature tries to explain how some individual characteristics affect the degree of loss aversion or risk aversion, and this is the approach that our paper takes, but we also reject Expected Utility Theory.

In Donkers, Melenberg, and Soest (2001), the authors used a large sample data (4000 individuals) coming from a national survey on Dutch population where they were able to identify some observable individual characteristics like age and income. They assumed equal probability weights for gains and losses; specifically, they found .435 for the reweigthing parameter, rejecting the hypothesis of it being 1. In average their national survey presents .615 of risk aversion, and 6.30 of loss aversion, very similar to the parameters estimated by Tversky and Kahneman (1992). With these results they showed important evidence against EU, because one of the shortcomings of CPT is that the experiments were made with small population samples.

In the experiment of Tanaka, Camerer, and Nguyen (2010), the elicited parameters were 2.65 for loss aversion and .59 for the curvature on positive gains, after calculating data from rural Vietnamese villages and a national survey. Their empirical regression allowed them to conclude that being Chinese rises the convexity of the loss function, and being older reduces the level of risk aversion. However, their experimental population comes from a very particular sample.

2.3 Emotions and Behavioral Economics.

Framing effects are quite useful to get relevant information from the agents. DellaVigna (2009) discusses many experiments where, by modifying the way a question is framed, the results vary completely. Benartzi and Thaler (2002)conduct an experiment where participants must choose a portfolio, but they framed the questions differently in order to lead participants towards choosing the rejected portfolio the second time presented. About risk aversion, Choi, Laibson, Madrianand, and Metrick (2009) presents a case where risk aversion gets highly affected when high outcomes are presented first, or when losses are presented at the beginning of the questionnaire.

Using the Wechsler Adult Intelligence Scale Dohmen, Falk, Huffman, and Sunde (2010) created a risk aversion experiment with cognitive implications. In their experiment, around 1000 people chose between ordered pair lotteries, allowing the authors to propose a measure of risk willingness. Then respondents were asked to take a cognitive exam, where the authors found a correlation of -0.2333 with the level of risk willingness. In our paper we asked the self-reported average grade of the respondent's last semester, allowing us to delve a little into the cognitive-risk aversion relationship in Mexico's case.

Under behavioral theories, emotions can affect the decisions made by the agents. Lerner, Gonzalez, Small, and Fischhoff (2003) shows that frightened people are more risk adverse and that people with anger are more risk seekers. In this same spirit, our paper makes a contribution to this subject by taking advantage of the unfortunate situation in Mexico, and by eliciting risk preferences under emotional treatments.

Feagin (1988) established the differentiation of an emphatic and a sympathetic reaction to feelings. There it is argued that people can imagine beliefs and, with those, generate an empathic emotion with a fictional character. People worry about the troubles of fictional characters mainly because they believe that something bad will happen to them. However, these beliefs are not real, they are just imagined, but this fictional beliefs lead to real emotions.

Experiencing emotions involves the perception of value, for example being afraid involves perceiving something as dangerous. However in Brady (2007) the role of recalcitrant emotions is analyzed. These emotions have the specific trait of being generated even when the perception is contrary to that feeling. Nevertheless, this concept may imply that some people may have no framing effect.

Our experiment tries to frame the respondents into a set of desired emotional states (angry, sad and afraid) in order to gauge how their risk or loss aversions vary. It is worth mentioning that hardly any questionnaire is free from external framing effects but usually randomization eliminates this issue.

Chapter 3

Experiment Design

Our experiment was conducted at two different universities in Mexico City during November 2011. All respondents were students of their corresponding universities. The main difference between both universities it is that one is public and the other is private. We went to classrooms and asked if we could conduct an experiment, if we got a positive answer we would return, usually 25 minutes before the class ended. We had no special order of selection; we walked randomly around the universities knocking on classroom's doors. However it is important to mention that our sample contains 38% economics major students[1]. The experiments took no longer than 20 minutes, and they were divided in three sections: social-demographic characteristics, emotional framing, and risk aversion.

The main part of the experiment consisted on choosing lotteries. In many experiments described in the literature, respondents are payed after completing them,[2] we decided against doing so, mainly because in Mexico's universities such procedures are rare or culturally inapropriate. We are aware that Holt and Laury (2002) found that behavior towards risk taking gets highly affected when really high incentives are offered as a possible outcome. Nevertheless, in our experiment the biggest payoff is only $1,700 pesos (around $130 US), which, although it is not a huge amount, is large enough to be very desirable but also very reasonable for a lottery contest (especially in students). In that sense we believe our experiment reflects accurately the main results.

It is worth mentioning that two pilot studies were conducted a month before the experiment. The first of the experiment's pilot took place in a classroom of the *Centro de Estudios Económicos at El Colegio de Mexico.* Some recommendations were made about the instructions and the pool of available answer[3]. With the student's responses and recommendations we constructed a new design of the experiment. The second pilot was conducted in another class of the *Centro de Estudios Económicos,* where no more improvements were suggested, implying that the respondents felt comfortable with the experiment.

3.1 Sociodemographic Characteristics.

The first part of the experiments consisted in several questions about personal socio demographic characteristics. With these questions we were able to identify the age, sex and their bachelor's major. These allow us to segregate the people in large groups for distinct interpretation of the parameters of the CPT function.

In order to find control variables, we asked for information about level of education the agent's parents had. Also, there were some income proxy questions, like the number of rooms or cars in their house[4].

[1] This was mainly because we were more acquainted with the professors that teach economics

[2] Sometimes the prize shown on the lottery, sometimes just for participating.

[3] One important methodological finding in this pilot was that the directions of the experiment were too long, consuming an important fraction from the time for comprehension.

[4] In Mexico most of the students do not know about their family's income.

Finally we asked about their future salaries expectations, the lapse between finishing the Bachelor degree and finding a job, and if they worked during the week. These answers helped us to identify the agent's actual disposition for taking the experiment; this will be better discussed on section 4.

3.2 Emotional Framing

To create an effective framing effect we took advantage of the actual social situation in Mexico. We only gave this framing treatment to two thirds of the experiment's sample. There were two kinds of framing treatment, a strong one and a moderate one. The strong one contained two questions, while the moderate one only contained one. The respondents were unable to identify if their peers received a different questionnaire.

In both treatment questions, the available answers were negative feelings (sadness, fear or anger). Our framing design is not infallible, so from time to time it would not work with some students. To identify this issue we included the indifferent answer, which helped reduce false answers.

The first question, available in both treatments, is as follows:

From 2006 and 2010 almost 40,000 people died, due mainly to the drug war. Insecurity levels haven't gone down in any state; on the contrary, the country is living the biggest violence wave ever seen. How does this mainly makes you feel?

The former question may be shocking, but not all students might be aware of its magnitude, mainly because they may be unrelated with the topic.[5]. To avoid this issue, in the strong treatment we added an even better known situation. The second question available (only in the strong treatment) reads as follows:

The financial crisis of 2008 has left ramshackle the international financial markets. The news paper, El Economista, published that 2010 showed the biggest unemployment rate of young people worldwide. Also, experts predict another economic recession for 2012. How does this mainly makes you feel?

We believe this question would impact in an acute way the students because most of them seek to enter the workforce after finishing their degrees (almost 97% of them, according to our survey). It is worth mentioning that these questions were asked before the risk aversion section, so we expect these questions to have a direct impact over the decisions made when choosing lotteries.

3.3 Risk Aversion

In order to elicit the parameters of the CPT function we conducted a replica of the experiment designed inTanaka, Camerer, and Nguyen (2010). As we have mentioned, the implementation is easy and simplifies the function to only three parameters. For the reweighing in the probabilities, Prelec's one parameter function is used. This function is derived axiomatically, and in the paper the author shows that it mostly replicates the main results from Khaneman and Tversky, and that sometimes it behaves better. One important assumption is that the agents rethink the probabilities in the same way for gains or losses. The probability weighting function is

$$\pi^{+}(p) = \pi^{-}(p) = \frac{1}{exp[ln(1/p)]^{\alpha}}$$

[5]In Mexico City the effects of the war against drugs are much less noticable than some parts of the country, so students that do not read or watch the news could be less comprehensive of the subject.

In this experiment the prospects only contain two possible outcomes, so the equation 3 simplifies to: $v(y) + \pi(p)(v(x) - v(y))$ (for $xy > 0$ and $|x| > |y|$) or $v(y) + \pi(p)v(x) + \pi(q)v(y)$ where p and q are the true probabilities of the outcomes x and y. Tanaka, Camerer, and Nguyen (2010) assume a piecewise power function defined as follow:

$$v(x) = \begin{cases} x^{\sigma} & for\ x > 0 \\ -\lambda(-x)^{\sigma} & for\ x < 0 \end{cases}$$

With this specification, σ and λ represent the concavity of the value function and the degree of loss aversion respectively. Also if $\alpha = 1$ (linearity on the probabilities) and $\lambda = 0$ we are under a EU scenario. In this particular case the relative risk aversion coefficient is $r = 1 - \sigma$

To elicit the three parameters we use the TCN method. First, the respondent faced three series of paired lotteries as shown in Table 1. Each row contained the possible outcome in Mexican Pesos for lottery A and lottery B. The outcome's probabilities in both lotteries were fixed throughout the series. The TCN experiment design enforced monotonic switching by asking the subjects in which question they would change from A to B. Respondents could change to lottery B in the first question or they could stay with lottery A throughout.

Table 1:Three series of Pairwise Lottery Choices (in Mexican Pesos)

Option A		**Option B**		**Expected payoff difference (A-B)**
Series 1				
$p = 3/10$	$p = 7/10$	$p = 1/10$	$p = 9/10$	
40	**10**	**68**	**5**	**7.7**
40	**10**	**75**	**5**	**7.0**
40	**10**	**83**	**5**	**6.0**
40	**10**	**93**	**5**	**5.2**
40	**10**	**106**	**5**	**3.9**
40	**10**	**125**	**5**	**2.0**
40	**10**	**150**	**5**	**-0.5**
40	**10**	**185**	**5**	**-4.0**
40	**10**	**220**	**5**	**-7.5**
40	**10**	**300**	**5**	**-15.5**
40	**10**	**400**	**5**	**-25.5**
40	**10**	**600**	**5**	**-45.5**
40	**10**	**1000**	**5**	**-85.5**
40	**10**	**1700**	**5**	**-155.5**
Series 2				
$p = 9/10$	$p = 1/10$	$p = 7/10$	$p = 3/10$	
40	**30**	**54**	**5**	**-0.3**
40	**30**	**56**	**5**	**-1.7**
40	**30**	**58**	**5**	**-3.1**
40	**30**	**60**	**5**	**-4.5**
40	**30**	**62**	**5**	**-5.9**
40	**30**	**65**	**5**	**-8.0**
40	**30**	**68**	**5**	**-10.1**
40	**30**	**72**	**5**	**-12.9**
40	**30**	**77**	**5**	**-16.4**
40	**30**	**83**	**5**	**-20.6**
40	**30**	**90**	**5**	**-25.5**
40	**30**	**100**	**5**	**-32.5**
40	**30**	**111**	**5**	**-39.5**
40	**30**	**130**	**5**	**-53.5**
Series 3				
$p = 1/2$	$p = 1/2$	$p = 1/2$	$p = 1/2$	
25	**-4**	**30**	**-21**	**6.0**
4	**-4**	**30**	**-21**	**-4.5**
1	**-4**	**30**	**-21**	**-6.0**
1	**-4**	**30**	**-16**	**-8.5**
1	**-8**	**30**	**-16**	**-10.5**
1	**-8**	**30**	**-14**	**-11.5**
1	**-8**	**30**	**-11**	**-13.0**

With the parametric function in the first series it is possible to find an interval for σ and α. It is worth noting that we only used round mid points for this interval. For example, a subject changing from A to B in the 7th scenario of the first series, would first have this rationalizable (α, σ) combinations: (0.4,0.4), (0.5,0.5), (0.6,0.6), (0.7, 0.7),(0.8, 0.8), (0.9, 0.9) or (1,1). Now if this same subject changes from A to B in the 7th scenario, in the second series his rationalizable combinations of (α, σ) are: (0.8,0.6), (0.7, 0.7), (0.6, 0.8), (0.5, 0.9) or (0.4, 1). By intersecting both parameters we get the approximation of the parameters$(\alpha, \sigma) = (0.7, 0.7)$. Appendix 3 shows the possible combinations of α, σ in each question.

Finally the loss aversion parameter $\lambda$is partially identified with the third series. For this the TCN method assumes that σ is correctly identified in the previous series. Using the value of σ we are able to identify λ in an interval. The series 3 was constructed to assure similar values of λ across different levels of σ. Table 2 shows examples of the interval of λ given some fixed values of σ

Table 2: Lamda Identification given Sigma

Switching Scenario	$\sigma = .1$	$\sigma = .5$	$\sigma = 1.5$
0	$\lambda <$**0.123**	$\lambda <$**0.184**	$\lambda <$**0.445**
1	**0.123**$< \lambda <$**1.237**	**0.184** $< \lambda <$**1.346**	**0.445** $< \lambda <$**1.771**
2	**1.237**$< \lambda <$**1.955**	**1.346** $< \lambda <$**1.733**	**1.771** $< \lambda <$**1.85**
3	**1.955** $< \lambda <$**2.371**	**1.733** $< \lambda <$**2.384**	**1.85** $< \lambda <$**2.91**
4	**2.371**$< \lambda <$**4.584**	**2.384** $< \lambda <$**3.281**	**2.91** $< \lambda <$**3.947**
5	**4.584**$< \lambda <$**5.717**	**3.281**$< \lambda <$**4.9**	**3.947** $< \lambda <$**5.49**
6	**5.717** $< \lambda <$**10.1693**	**4.9** $< \lambda <$**9.17**	**5.49** $< \lambda <$**11.7872**
7	**10.1693** $< \lambda$	**9.17**$< \lambda$	**11.7872** $< \lambda$

Chapter 4

Data Analysis

Over 700 subjects answered the experiment; however, at the time of data analysis, 93 questionnaires were discarded because they showed a clear disregard of the experiment's directions or an unwillingness to take the experiment seriously. The discarding process consisted in noticing inconsistencies over the sociodemographic questions[1] or by noting errors made during the risk aversion section of the questionnaire [2].

Our final experimental data consists of 607 subjects, where 53 percent of the sample comes from the private university and the rest from the public one. Using the whole experiment data we present summary statistics in Table 2. The means are predictable because our target is Mexican students. Fifty-five percent of the respondents are male and the average age reaches almost 21 years (in Mexico most students begin college at 18). Only 30 percent of our experimental sample had scholarships and, in average, worked 4 hours a week (the mean here is low because most of them do not work at all). On average, after they graduate they expect to earn $14,535 Mexican Pesos in a month. It is worth noting that the standard deviation is huge for the expected income, but we believe this occurs because of the difference in their majors.

Table 3: Descriptive Statistics

Variable	Mean/Mode (if Categorical)	Standard Deviation
Male	.55	.4984
Age	20.84	2.1590
Years before graduating	2.34	1.2242
Last semester's GPA	84.64	9.8223
Scholarship	.31	.4638
Number of siblings	1.62	1.1144
Hours worked that last week	4.73	11.0924
Desires to work after graduating	.96	.1878
Number of cars in the family household	2.18	1.6123
Number of bedrooms in the family household	3.56	1.3437
Expected number of months looking for a job	3.74	3.9366
Expected salary	14354.84	13421.87
Father's education level	College	/
Mother's education level	College	/
Major	Economics	/
Living with	Father and Mother	/
Who pays for their studies	Father	/

[1]For example, people that reported a huge expected salary for their first job or a ridiculous long time before graduating.
[2]For example, they marked multiple switching points when they should only mark one

Working with emotions or with unobservable variables is complicated, for many critics may argue that the respondents may not be actually feeling the emotions when answering. Nevertheless, some literature on psychology argues against that. Field studies on drama advertising likeEscalas and Stern (2003) finds high emotional reactions when reading a fictional dramatic situation. It also shows that the emotional response is sympathetic and empathic in contrast with the previous studies that only found empathic reaction. Shu, Gino, and Bazerman (2009) also found a change in moral behavior when an ethic code is read before taking a test. Also recall from Feagin (1988) that real emotions can be produced from fictional situations. With these observations in mind, our only concern may be the causality of the emotion over risky attitudes. To address this issue, we present Table 4 which contains the results of the test about means of the randomization on the emotional treatment (both treatments).

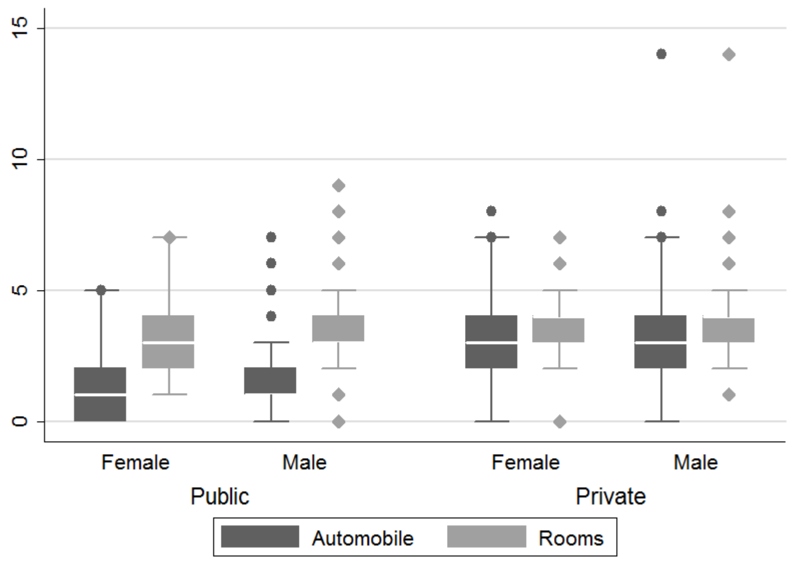
Table 4: Randomization Test At Means By Emotions

Variable	Control	Emotional Treatment
Age	20.77 (0.16161)	20.86 (0.1037)
Years before graduating	2.39 (0.088)	2.30 (0.060)
Last semester's average grade	85.00 (0.726)	84.46 (0.490)
Scholarship	0.31 (0.032)	0.31 (0.023)
Father's education level	3.33 (0.065)	3.43 (0.045)
Mother's education level	3.18 (0.067)	3.30 (0.044)
Number of siblings	1.62 (0.080)	1.62 (0.054)
Number of bedrooms in the family household	3.54 (0.105)	3.57 (0.062)
Number of cars in the family household	2.05 (0.106)	2.25 (0.082)
Hours worked that last week	5.10 (0.793)	4.50 (0.548)
Living with	1.74 (0.077)	1.76 (0.055)

Means of contol and agregate treatment group, standar errors are in parenthesis

Table 4 suggest that the treatment on emotions are indeed causal results, and the effects over the parameters will be indeed from the treatment. It is important to take into account that we do not randomize the whole experiment, thus income or age may differ between genders, universities or majors. Figure 1 describes the difference in income (proxy variables of automobiles and number of bedrooms) between male and female, and private and public schools.

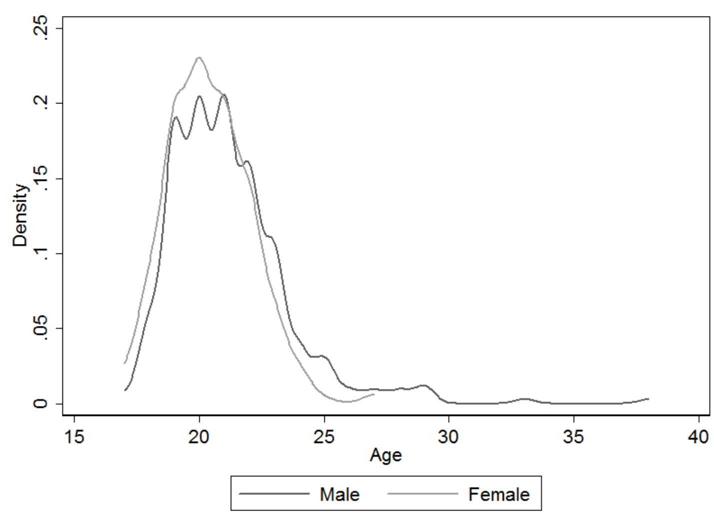
Figure 1: ***Difference in Proxy Income Variables***



Only the final data set is used in this figure, number of Aoutomoblile and Rooms onn th

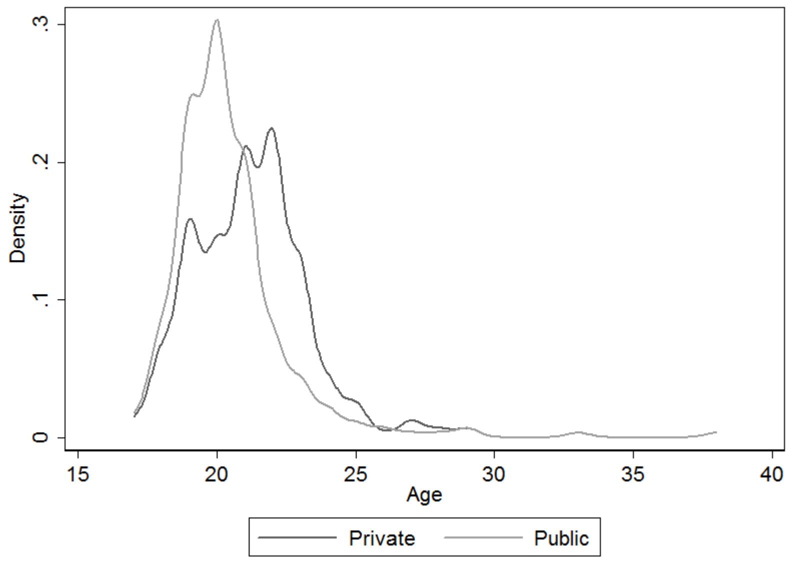
In general, there are similar patterns on the number of rooms, at least at the mean. Nevertheless, in the number of automobiles variable the difference between the public and the private universities is perceptible but not dramatic. With these variables we feel comfortable about the interpretation of the impact over the parameters of the CPT function. The next graph shows the kernel distribution of age between the same previous groups.

Figure 2: ***Age Kernel Distribution by Gender***



Gaussian kernels with the Silverman optimum bandwidth criteria, the distributions are from the final data set

Figure 3: ***Age Kernel Distribution by University***



Gaussian kernels with the Silverman optimum bandwidth criteria, the distributions are from the final data set

We found similar age distribution between the genders; however, the distribution for the provate university leans to the right. As it has been shown, the general difference in the experiment comes from the type of university rather than from the gender. This former evidence motivates the idea of conducting separate regression models in one university for robustness.

Chapter 5

Results

The average elicited value for the curvature of the value function (σ) is 0.471, which is reasonably close to the findings of Tanaka, Camerer, and Nguyen (2010) (.59). If we assume that the EU's axioms hold, the relative risk aversion coefficient (r) is .53. It suggests that an assumption on risk neutrality may not be accurate even in the expected utility frame work. A kernel distribution of the parameter is presented in Figure 4; the majority of the respondents are located around .5. This result is common in risk aversion literature and supports the correct implementation of our experiment. In order to make the link of the mentioned characteristics with the curvature of the CPT function we conducted the following OLS regression

$$\sigma = \theta + \sum X_i B_i + \sum E_i \gamma_i + U \tag{5.1}$$

Where X denotes observable characteristics and E denotes emotions and U is a classical error termx.

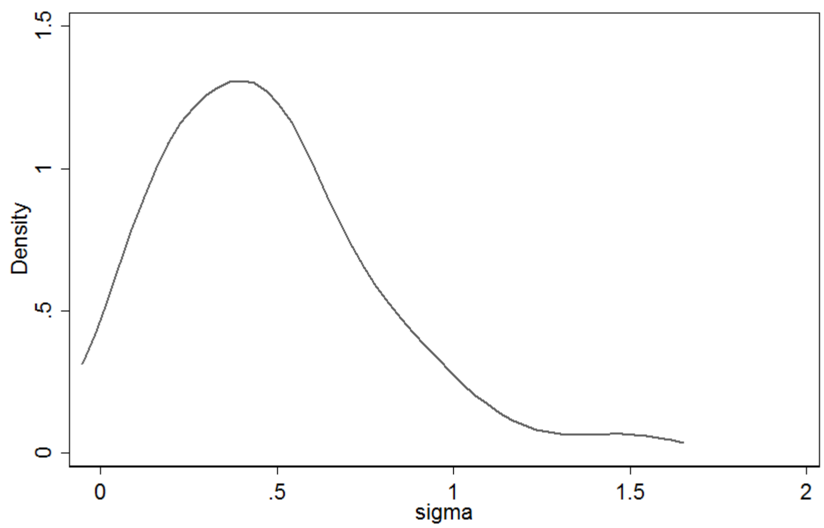
Table 5 presents the information of four different models:

- The first includes only sociodemographic characteristics (No Treatment).
- The second adds emotions referring to questions about violence (Low Treatment).
- The third model includes dummy variables of emotions reported in both questions (Both Treatments).
- The fourth model captures only the intersection of both questions (High Treatment).

It is worth mentioning that in High Treatment we only considered emotions when people answered the same emotion in both questions, otherwise they were considered as if the framing effect failed (i.e. an input of zero). We found that the former treatment is more suitable because it captures the same emotion of the respondents and it is not mixed, as in the third treatment. For that same reason we believe the third model is the less competent for our analysis.

We also conducted an OLS regression just with the dummy variable if the respondent revived a treatment; in both cases (one question or two) there were no significant effect. This response is due by the fact that emotional reactions may have opposite effects, sad people may be less risk averse but angry agents may be more risk lovers.

Figure 3: ***Sigma Kernel Distribution***



Gaussian kernel with a bandwidth of 0 .15 , the kernel estimation was conducted with 607 observations from the final data set where sigma was different from missing

In these three models there exists a positive impact from the age over the curvature of the value function, the coefficient increases in .01 for an additional year over the average agent. The same effect occurs with the years left to graduate (.02 for an additional year). Both effects can be interpreted as a decrease in risk aversion level when talking about gains, but also they may be interpreted as a decrease in risk willingness when talking about losses. These results are in agreement with the literature and they are very intuitive. The common explanation for this phenomenon comes from the idea that older people are more capable of taking more risks, due they have more expirience than yougn peope, when there is an opportunity of winning, but they also have the experience to know that sometimes it is not so terrible to lose a little when faced with the possibility of losing plenty.

Additionally, in the four models the level of σ increases with the proxy variables of income (automobiles or rooms). This result is congruent with the literature, so we feel comfortable with the interpretation. We believe this occurs because it is easier to bet when an individual has a solid patrimony, or it can be seen as a decrease in their need to pay risk premium in order to avoid a loss over a reference point. Nevertheless, this does not mean that rich people are risk lovers on gains or risk averse on losses, just less risk averse and less risk loving, respectively.

An important finding of the present paper is the link between sadness and σ (-0.10). On average, risk aversion over gains strongly increases when people are sad. As a consequence, the public policy relying on credit incentives or risky business opportunities may not have the desired acceptance if the populace is under some general depression. Our result may also imply that sad people will take more risks when trying to avoid losses. This effect might explain why people avoid taxes in economic recessions or cheat when retaking tests. Numerous situations in real life can get people sad: a natural disaster, an unemployment situation, economic crisis, etc. We believe it may be important when planning to implement a public policy to check the general animus of the population or the target population.

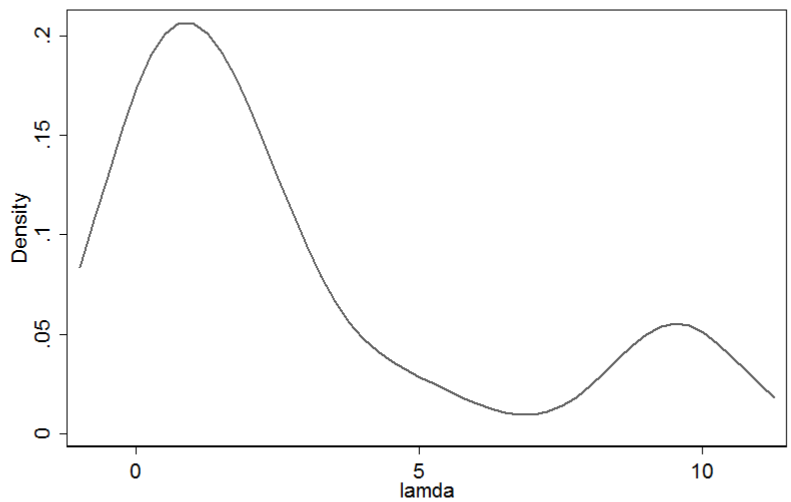
Table 5: Regression Analysis

VARIABLES	No Emotions	Low Treatment	Both Treatment	High Treatment
Gender	-0.0327	-0.0305	-0.0290	-0.0298
	(0.0255)	(0.0257)	(0.0250)	(0.0255)
Years From Graduation	0.0278**	0.0273**	0.0274**	0.0289**
	(0.0129)	(0.0127)	(0.0121)	(0.0126)
Age	0.0150**	0.0144*	0.0144*	0.0155**
	(0.00751)	(0.00738)	(0.00738)	(0.00733)
Last Semester Average Grades	0.00117	0.000951	0.000996	0.00116
	(0.000946)	(0.000969)	(0.00125)	(0.000927)
Number of Bedrooms	0.0224*	0.0229*	0.0235**	0.0236*
	(0.0129)	(0.0130)	(0.00943)	(0.0129)
Number of Automobiles	0.0192*	0.0186*	0.0192**	0.0188*
	(0.0103)	(0.0103)	(0.00802)	(0.0103)
Anger	/	0.0194	0.0225	0.0408
	/	(0.0320)	(0.0269)	(0.0352)
Sadness	/	-0.103***	-0.0954**	-0.104**
	/	(0.0389)	(0.0399)	(0.0495)
Fear	/	0.00370	0.00222	0.0173
	/	(0.0304)	(0.0253)	(0.0305)
Constant	-0.107	-0.0714	-0.0810	-0.129
	(0.202)	(0.201)	(0.212)	(0.198)
Observations	577	577	577	577
R-squared	0.034	0.047	0.046	0.045

The average λ elicited is 2.29, which is close to the parameter elicited in Tanaka Camerer Nguyen (2.4), but it is closer to the findings of Khaneman and Tversky (2.26). This parameter is statistically different from 0 at 99 percent of confidence, thus supporting Cumulative Prospect Theory against Expected Utility Theory. Figure 5 presents a kernel distribution of the lower limit of λ; it shows that agents have a loss aversion coefficient around 2.5, then it starts descending. So the hypothesis of Khaneman and Tversky, that states that people feel twice as strongly losing something than winning the same thing, seems appropriate for our experiment.

We found again no evidence of a significant change in λ just for receiving the treatment. The same argument was used and found no reaction because of the opposite reactions that may emerge just by reading the treatment.

Figure 5: Kernel density of λ



Gaussian kernel with a bandwidth of 1 .1 , the kernel estimation was conducted with 607 observations from the final data set where lamnda was different from missing

To estimate the relation between the characteristics and the loss aversion coefficient it is necessary to use an interval maximum likelihood regression.[1] Again, we present the same four models of equation 7, each one for different emotional treatment or none

$$\lambda = A + \sum X_i B_i + \sum E_i \gamma_i + U \tag{5.2}$$

The most notable effect is the difference between the degree of loss aversion from a public university and the private one. In particular, when the average agent comes from a private school the degree of loss aversion increases 1.25. This implies that people from private universities suffer more from a loss, relative to a gain, than people studying at a public college. This effect may be a cultural phenomenon or something correlated with the nature of the university. The particular private university that we studied continuously sells the idea that their students are the best students[2], and this idea might reinforce the student's self-confidence. In the doctoral thesis of Ahn (2010) the same effect over self-confidence is found in a repeated laboratory experiment [3]. For further research, it would be interesting to look if this effect does indeed persist once the individual has left college or if it vanishes with experience. High levels of self-confidence could be found in entrepreneurs or with the quants in Wall Street, we then expect that these individuals would suffer more the endowment effect[4]. Good examples can be found in On Amir and Carmonl (2010), Hossain and List (2009) and Daniel Kahneman and Thale (1990).

In the high emotional treatment (which is indeed the more accurate, given the fact that individuals report the same emotion in both questions) anger reduces the degree of loss aversion on 1.101. This implies that angry individuals are less sensitive to losses. The natural question emerges: why would angry people hate less a bet like (x;.5, -x;.5) than a neutral agent? This question cannot be easily solved and it is left up for discussion, however the implications are quite clear. For example, sometimes people choose a government

[1] Interval regression is a generalization of the Tobit model variable. If the value for the jth individual is somewhere in the interval [y_{1j} ; y_{2j}], then the likelihood contribution from this individual is simply $Pr(y_{12} < Yj < y_{2j})$. Let $y = Xb + \epsilon$ be the model. y represents continuous outcomes—either observed or unobserved. Our model assumes $\epsilon \sim N(0, \sigma^2 I)$. Observations $j \in I$ are intervals; we know only that the unobserved y_j is in the interval[y_{1j} ; y_{2j}]. The loglikelihood function is $lnL = \sum_{j \in I} log\{\Phi\left(\frac{y_{2j}-X\beta}{\sigma}\right) - \Phi\left(\frac{y_{1j}-X\beta}{\sigma}\right)$,where Φ is the standard cumulative normal. The estimated parameters are the values where the function reaches its maximum.

[2] This was actually part of their marketing campaign.

[3] In this experiment agents play the same game, eventually acquiring deeper understanding of the rules.

[4] The hypothesis that a person's willingness to accept compensation for a good is greater than their willingness to pay for it once their property right to it has been established.

that eventually disappoints them; angry people would perhaps be the first to try to revoke the government's power. So it would not be surprising that under electoral campaigns opposing parties tried to evoke anger against the current governing party. Economically, angry people suffer less from the endowment effect, so they would not hold their bonds too long when prices fall.

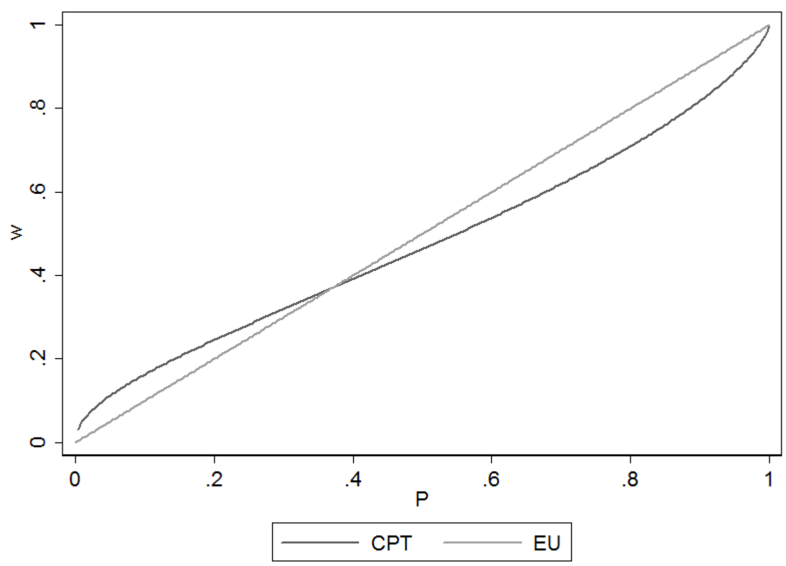
One proxy variable of income decreases the level of loss aversion. This effect goes in the same direction as in Tanaka, Camerer, and Nguyen (2010). In their paper they argue that richer villages tend to invest more, given the fact that they are less loss averse. In our wealthy group of student population that idea is indeed found, and even more so (recall from the findings of σ that they are also less risk averse over gains or less risk loving over losses). This suggests that poor people would be reluctant to try risky business opportunities and would dislike losing, so a greater compensation for losses is needed for poor people in terms of utility for taking those risks. This is an important implication for public policy; a greater effort must be done in order to make the poorest people invest or take risks.

Table 6: λInterval Regression Analysis

VARIABLES	No Emotions	Low Treatment	Both Treatment	High Treatment
Gender	0.591	0.596	0.558	0.542
	(0.402)	(0.404)	(0.398)	(0.404)
Years From Graduation	-0.122	-0.114	-0.117	-0.141
	(0.209)	(0.210)	(0.208)	(0.208)
Age	-0.0715	-0.0682	-0.0643	-0.0682
	(0.110)	(0.110)	(0.109)	(0.110)
Last Semester Average Grades	0.0225	0.0248	0.0252	0.0229
	(0.0159)	(0.0162)	(0.0163)	(0.0164)
Number of Bedrooms	-0.0601	-0.0664	-0.0608	-0.0558
	(0.145)	(0.144)	(0.144)	(0.145)
Number of Automobiles	-0.219*	-0.203	-0.242*	-0.225*
	(0.129)	(0.128)	(0.127)	(0.129)
University	1.306***	1.200**	1.234***	1.258***
	(0.483)	(0.482)	(0.479)	(0.482)
Anger	/	-0.369	-0.566	-1.101***
	/	(0.474)	(0.412)	(0.4969)
Sadness	/	1.172	1.054	.0590
	/	(0.821)	(0.704)	1.40379
Fear	/	0.583	0.947**	-0.0562
	/	(0.471)	(0.405)	(0.458)
Constant	1.468***	1.064***	1.469***	1.687***
	(2.975)	(2.990)	(2.962)	(2.962)
Observations	575	575	575	575

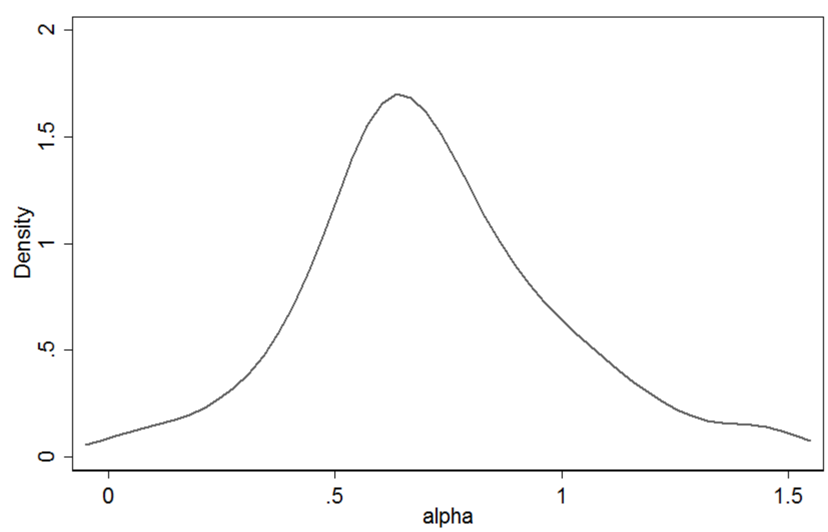
Finally, the average value of the Prelec's one reweighing parameter $\alpha$is .713, extremely close to the findings in Tanaka et al. (the average reweighing function is shown on Figure 6). It is clear that individuals overestimate probabilities before a probability of .4 (overestimating even more in probabilities near to zero), then they start to underestimate probabilities (underestimating more probabilities around .8). This parameter is statistically different from 1 at 99% of confidence so Expected Utility Theory is rejected here. The kernel distribution of α is presented in Figure 7, where it clearly shows a great accumulation around .7 and it diminishes in both sides.

Figure 6: Average reweighing function



Simple avergade of α taken from the final data set

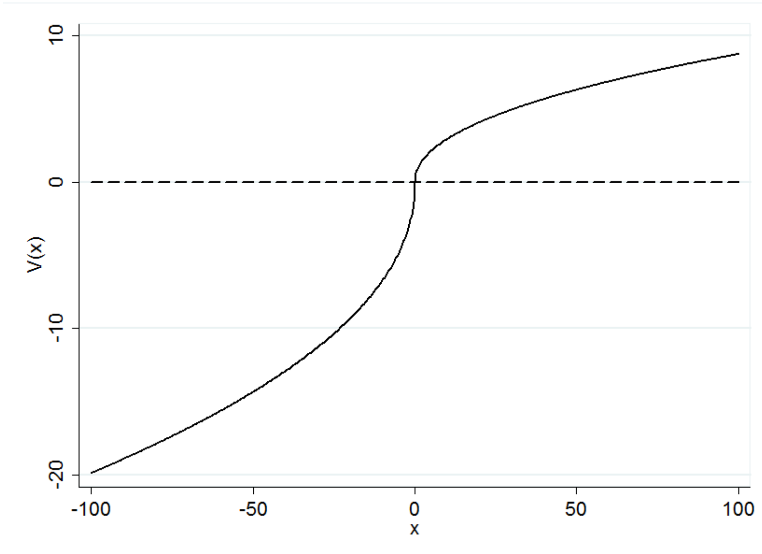
Figure 7: Average reweighing function



Gaussian kernels with a bandwidth of 1, the kernel estimation was conducted with 607 observations from the final data set where alpha was different from missing

We conduct the same regression analysis on α but we did not find any significant effect. We believe that the way humans observe and reconstruct probabilities is way more complicated that the attitudes towards risk, and it is a job probably best left for neuroeconomist to investigate. Figure 8 presents the average elicited CPT function, where it clearly shows concavity on the gains, convexity on negative values, and the function is steeper over losses, as in the original CPT paper.

Figure 8: CPT Average Function



Simple average taken from the final data set

Chapter 6

Discussion and Concluding Remarks

We conducted a controlled experiment in two universities to elicit the parameters of the value and reweighing function. On average we found $(\sigma, \lambda, \alpha) = (.471, 2.29, .713)$ implying that on average in our experiment people are risk averse on gains, risk loving on losses, they suffer from loss aversion and they do not use true probabilities at the time of evaluation. These parameters are very close to the findings of Khaneman and Tversky, Tanaka et al. and the vast literature on Prospect Theory. It is worth mentioning that these estimates of the parameters are the first values found for Mexico, and they are not far from international findings. These results imply that Economic Theory should take into account Prospect Theory in order to reflect reality more accurately.

Later in the paper we present a discussion around factors that might affect the process of taking risky decisions. In particular we found evidence that older and richer people are less averse and lean towards less risk taking. We believe this occurs due to their perspective about facing risk, whereas this could be due to their experience or that they are in a more comfortable position for making bets. This explanation is commonly shared between the core authors of behavioral economics. However, the evidence supporting that feelings may change the degree of risk aversion is still in development. This paper argues that sadness increases risk aversion over gains and increases risk loving behavior over losses, but we are still uncertain as for the why; further neuroeconomical investigation may be required to explain this phenomenon. This finding could explain some situations where people take more risk, or avoid them (e.j. to risk cheating to avoid a loss when unemployed seems a natural behavior).

We presented evidence that people from the public university are less loss averse than people from the private university. We believe this is due the degree of the student's confidence. If this is true, a natural question arises: If having a low degree of confidence affects the loss aversion behavior, then what are the economic implications? The literature suggests that people would be reluctant to invest more, and would be more competitive in order to avoid losses. However, in this paper we are far from establishing that public universities are less confident than private ones, we can only confidently say that the former are less loss averse than the latter. We would also need to know if this effect is persistent through life, or disappears (or conversely, grows) with age.

We found that anger diminishes loss aversion, thus implying that agents with these characteristics would present less endowment effect. History, Psychology and Philosophy have given numerous examples where angry repressed people tend to react faster than sad people. This work contributes with the causal finding that angry people will indeed be less loss averse; this could just be a sympathic reaction, or it could be that anger fuels the strength to quickly forget the loss and instead focus on the possible actions. Further neuroeconomical work may be needed to answer this question. We also found that income goes in the same direction; the vast literature supports this idea, and here we claim that Mexico is no exception.

Risk and loss aversion could explain why people do not invest more or why poor people remain poor. We found that wealthier people are less sensitive to losses and can take more risks; conversely sad people will take fewer risks. This finding should be very important for public policy design: if poor people need to risk in a public policy the effect would be even lower if they are sad.

Bibliography

Abdellaoui, M., H. Bleichrodt, and O. L'Haridon (2008): "A Tractable Method to Measure Utility and Loss Aversion under Prospect Theory," *Journal of Risk and Uncertainty*, 36(3), 245–266.

Ahn, H.-i. (2010): "Modeling and Analysis of Affective Inuences on Human Experience, Prediction, Decision Making, and Behavior," *MIT Thesis*.

Allais, M. (1953): "Le Comportement de l'Homme Rationnel devant le Risque, Critique des Postulats et Axiomes de l'Ecole Americaine," *Econometrica*, 21(3), pp. 503–546.

Arrow, K. J. (1971): *Essays in the theory of risk-bearing*.

Benartzi, S., and R. H. Thaler (2002): "How Much Is Investor Autonomy Worth?," *The Journal of Finance*, 57(4), pp. 1593–1616.

Brady, M. S. (2007): "Recalcitrant Emotions and Visual Illusions," *American Philosophical Quarterly*, 44(3), pp. 273–284.

Choi, J., D. Laibson, B. Madrianand, and A. Metrick (2009): "For Better or Worse: Default Effects and 401(K) Savings Behavior," *Perspectives on the Economics of Aging*, 21(3), pp. 81–121.

Daniel Kahneman, J. L. K., and R. H. Thale (1990): "The Dissociation between Monetary Assessment and Predicted Utility," *Journal of Political Economy*, 98(3), pp. 1325–1348.

DellaVigna, S. (2009): "Psychology and Economics: Evidence from the Field," *Journal of Economic Literature*, 47(2), 315–372.

Dohmen, T., A. Falk, D. Huffman, and U. Sunde (2010): "Are Risk Aversion and Impatience Related to Cognitive Ability?.," *American Economic Review*, 100(3), 1238 – 1260.

Donkers, B., B. Melenberg, and A. V. Soest (2001): "Estimating Risk Attitudes Using Lotteries: A Large Sample Approach," *Journal of Risk and Uncertainty*, 22(2), 165–195.

Eckel, C. C., and P. J. Grossman (2008): "Chapter 113 Men, Women and Risk Aversion: Experimental Evidence," *Handbook of Experimental Economics Results*, 1.

Escalas, J. E., and B. B. Stern (2003): "Sympathy and Empathy: Emotional Responses to Advertising Dramas," *Journal of Consumer Research*, 29(4), pp. 566–578.

Feagin, S. L. (1988): "Imagining Emotions and Appreciating Fiction," *Canadian Journal of Philosophy*, 18(3), pp. 485–500.

Halek, M., and J. G. Eisenhauer (2001): "Demography of Risk Aversion," *The Journal of Risk and Insurance*, 68(1), pp. 1–24.

Harrison, G. W., M. I. Lau, and E. E. Rutstrom (2007): "Estimating Risk Attitudes in Denmark: A Field Experiment," *Scandinavian Journal of Economics*, 109(2), 341–368.

Harrison, G. W., and E. E. Rutstrom (2008): "Risk Aversion in the Laboratory.," *Risk Aversion in Experiments (Research in Experimental Economics, Volume 12)*, 37(3), 41–196.

Hartog, J., and L. Diaz-Serrano (2007): "Earnings Risk and Demand for Higher Education: A Cross-Section Test for Spain," *Journal of Applied Economics*, 10(1), 1–28.

Holt, C. A., and S. K. Laury (2002): "Risk Aversion and Incentive Effects," *The American Economic Review*, 92(5), pp. 1644–1655.

Hossain, T., and J. A. List (2009): "The Behavioralist Visits the Factory: Increasing Productivity Using Simple Framing Manipulations," NBER Working Papers 15623, National Bureau of Economic Research, Inc.

Kahneman, D., and A. Tversky (1979): "Prospect Theory: An Analysis of Decision under Risk," *Econometrica*, 47(2), pp. 263–292.

Lerner, J. S., R. M. Gonzalez, D. A. Small, and B. Fischhoff (2003): "Effects of Fear and Anger on Perceived Risks of Terrorism: A National Field Experiment," *Psychological Science*, 14(2), 144–150.

List, J. A. (2004): "Neoclassical Theory versus Prospect Theory: Evidence from the Marketplace," *Econometrica*, 72(2), pp. 615–625.

Long, J. B. D., A. Shleifer, L. H. Summers, and R. J. Waldmann (1991): "The Survival of Noise Traders in Financial Markets," *The Journal of Business*, 64(1), pp. 1–19.

Machina, M. J. (1982): ""Expected Utility" Analysis without the Independence Axiom.," *Econometrica*, 50(3), pp. 277–323.

Miller, L. Meyer, D. E., and J. T. Lanzetta (1969): "Choice among equal expected value alternatives: Sequential effects of winning probability level on risk preferences," *Journal of Experimental Psychology*, 79(3), pp. 419–1423.

On Amir, D. A., and Z. Carmonl (2010): "The Dissociation between Monetary Assessment and Predicted Utility," *Marketing Science*, 27(3), pp. 1055–1064.

Pratt, J. W. (1964): "Risk Aversion in the Small and in the Large," *Econometrica*, 32(1/2), pp. 122–136.

Prelec, D. (1998): "The Probability Weighting Function," *Econometrica*, 66(3).

Roel, M. W., J. Beetsma, and P. C. Schotman (2001): "Measuring Risk Attitudes in a Natural Experiment: Data from the Television Game Show Lingo," *The Economic Journal*, 111(474), pp. 821–848.

Shaw, K. L. (1996): "An Empirical Analysis of Risk Aversion and Income Growth," *Journal of Labor Economics*, 14(4), pp. 626–653.

Shu, L., F. Gino, and M. Bazerman (2009): "Dishonest Deed, Clear Conscience: When Cheating Leads to Moral Disengagement and Motivated Forgetting.," *Personality and Social Psychology Bulletin*, 37(3), 330 – 349.

Smith, T. (2009): "Reconciling psychology with economics: Obesity, behavioral biology, and rational overeating," *Journal of Bioeconomics*, 11, 249–282, 10.1007/s10818-009-9067-8.

Tanaka, T., C. F. Camerer, and Q. Nguyen (2010): "Risk and Time Preferences: Linking Experimental and Household Survey Data from Vietnam," *American Economic Review*, 100(1), 557–571.

Tversky, A., and D. Kahneman (1992): "Advances in Prospect Theory: Cumulative Representation of Uncertainty," *Journal of Risk and Uncertainty*, 5(4), 297–323.

von Neumann, J., and O. Morgenstern (1944): "Theory of Games and Economic Behavior.," *Princeton University Press, Princeton, NJ*, 37(3).

Yesuf, M., and R. A. Bluffstone (2009): "Poverty, Risk Aversion, and Path Dependence in Low-Income Countries: Experimental Evidence from Ethiopia," *American Journal of Agricultural Economics*, 91(4), 1022–1037.

Chapter 7

Appendix

Appendix 1: Expected Utility Theory, a formal model.

This theory relies on four axioms that capture the essence of rational behavior (completeness, continuity and independence). The axiom of independence yields into linearity in the probability's weights.

A utility function $U : \mathcal{L} \to \mathbb{R}$ has an expected utility form if and only if it satisfies

$$U(\sum_{k=1}^{K} p_k L_k) = \sum_{k=1}^{K} p_k U(L_k)$$

for any K lotteries $L_k \epsilon \mathcal{L}$, $k = 1, \ldots, K$, and for probabilities $(p_1, \ldots, p_K) \geq 0$, $\sum_k p_k = 1$

The extension of EU to monetary outcomes can be equally expressed in a continuous way.

A utility function $U : \mathcal{L} \to \mathbb{R}$ has a continuous expected utility form if and only if it satisfies

$$U(F) = \int u(x) dF(x)$$

Here, $\mathcal{L}$ is the set of all distribution functions over non-negative amounts of money (i.e., an interval $[\alpha, +\infty)$), $u(x)$ assigns utility values for amounts of money and $F : \mathbb{R} \to [0, 1]$ is a distribution function over non-negative amounts of money.

In this framework, Arrow(1971) andPratt (1964) formalized the notion of risk aversion and its measurement.

The decision maker is risk avert if and only if

$$\int u(x) dF(x) \leq U\left(\int x dF(x)\right) \quad \vee F(.)$$

One implication for the last equation is that the function must be concave in order to be risk averse. Nevertheless, in order to do empirical work and compare risk aversion levels, it is common to use the absolute coefficient of risk aversion $r = -\frac{u''(x)}{u'(x)}$ or the relative coefficient of risk aversion $rr = -x\frac{u''(x)}{u'(x)}$.

Appendix 2: The Mathematics of Cumulative Prospect Theory

Define S as the finite set of possible states of nature. All the subsets of S are known as events. It is assumed that a state obtains what is unknown for the decision maker.

Define X as the set of outcomes. The authors, for simplicity, assumed only monetary outcomes. Set X contains a neutral outcome zero, the rest are gains or losses.

A prospect, f, is a function $f:\ S \to X$ that assigns a every state $s \in S$ a consequence $f(s) = x$ on X. This prospect is represented in a sequence of pairs (x_i, A_i) (the prospect gives x_i if A_i occurs), where $x_i > x_j$ if $i > j$ where $g(A_i)$ is a partition of S. A strictly positive prospect happens when all the outcomes are positive; similarilly a strictly negative prospect happens when all outcomes are losses; and a mixed prospect happens when both losses and gains occur. The positive part of a prospect is as follows: $f^+(s) = f(s)\ iff\ f(s) > 0$ and $f^+(s) = 0\ iff\ f(s) \leq 0$. An analogous procedure can be used to find the negative part.

The next representation is defined in terms of capacity, a set of functions that generalizes the standard notion of probability.

A capacity w is a function that assigns every $A \subset S$ a number $w(A)$, that satisfies

$w(\emptyset) = 0$, $w(S) = 1$and $w(A) \geq w(B)$ whenever $A \supset B$.

Cumulative PT establishes that there is a value function strictly increasing $V:\ F \to \mathbb{R}_e$ that satisfies $V(0) = 0$, and capacities $w^+$and w^- such that $f(x_{i,}A_i)$, $-m < i < n$

$$v(f) = v(f^+) + v(f^-)$$

$$v(f^+) = \sum_{i=0}^{n} \pi_i^+ v(x_i)\ = \sum_{i=-m}^{0} \pi_i^- v(x_i)$$

where $\pi_i^+ = w^+(A_i \cup ... \cup A_n) - w^+(A_{i+1} \cup ... \cup A_n)$

and $\pi_i^- = w^-(A_{-m} \cup ... \cup A_i) - w^-(A_{-m} \cup ... \cup A_{i-1})$

From the definition of π and w for negative or positive prospects they must add up 1, but for mixed prospects they could be more or less than 1 because the capacities are defined separately. Its important to remark that in PT value capacities and function parameters identify risk aversion. It is assumed that $v''(x) \leqq 0\ \ x > 0$ and $v''(-x) \geqq 0\ \ x > 0$, also $v(.)$ is steeper for losses than gains.[1]

[1]If there are no losses and the w is linear we are working with the EU scenario.

Appendix 3 : Eliciting Information

The following table shows the elicited values of α and σ of the switching point, from series 1 and series 3.

σ	Switching question in Series 1														
Series 2	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Never
1	1.50	1.40	1.35	1.25	1.15	1.10	1.00	0.95	0.90	0.85	0.80	0.75	0.65	0.55	0.50
2	1.40	1.30	1.25	1.15	1.10	1.00	0.95	0.90	0.85	0.80	0.75	0.70	0.60	0.55	0.50
3	1.30	1.20	1.15	1.10	1.00	0.95	0.90	0.85	0.80	0.75	0.70	0.65	0.55	0.50	0.45
4	1.20	1.15	1.05	1.00	0.95	0.90	0.85	0.80	0.75	0.70	0.65	0.60	0.50	0.45	0.40
5	1.15	1.05	1.00	0.95	0.90	0.85	0.80	0.75	0.70	0.65	0.60	0.55	0.50	0.40	0.35
6	1.05	1.00	0.95	0.90	0.85	0.80	0.75	0.70	0.65	0.60	0.55	0.50	0.45	0.40	0.35
7	1.00	0.95	0.90	0.85	0.80	0.75	0.70	0.65	0.60	0.55	0.50	0.45	0.40	0.35	0.30
8	0.95	0.90	0.85	0.80	0.75	0.70	0.65	0.60	0.55	0.50	0.45	0.40	0.35	0.30	0.25
9	0.90	0.85	0.80	0.75	0.70	0.65	0.60	0.55	0.50	0.45	0.40	0.35	0.30	0.25	0.20
10	0.85	0.80	0.75	0.70	0.65	0.60	0.55	0.50	0.45	0.40	0.35	0.30	0.25	0.20	0.20
11	0.80	0.70	0.65	0.65	0.60	0.55	0.50	0.45	0.40	0.35	0.30	0.25	0.20	0.15	0.15
12	0.75	0.65	0.60	0.55	0.50	0.50	0.45	0.40	0.35	0.30	0.25	0.20	0.20	0.15	0.10
13	0.65	0.60	0.55	0.50	0.45	0.45	0.40	0.35	0.30	0.25	0.20	0.15	0.15	0.10	0.10
14	0.60	0.55	0.50	0.45	0.40	0.35	0.35	0.30	0.25	0.20	0.15	0.10	0.10	0.10	0.05
Never	0.50	0.45	0.40	0.40	0.35	0.30	0.30	0.25	0.20	0.15	0.10	0.10	0.05	0.05	0.05

α	Switching question in Series 1														
Series 2	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Never
1	0.60	0.75	0.75	0.85	0.90	0.95	1.00	1.05	1.10	1.15	1.20	1.25	1.30	1.40	1.45
2	0.60	0.70	0.75	0.80	0.85	0.90	0.95	1.00	1.05	1.10	1.15	1.20	1.25	1.35	1.40
3	0.55	0.60	0.70	0.75	0.80	0.85	0.90	0.95	1.00	1.05	1.10	1.15	1.20	1.25	1.30
4	0.50	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.95	1.00	1.05	1.10	1.15	1.20	1.25
5	0.45	0.55	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.95	1.00	1.05	1.10	1.15	1.20
6	0.45	0.50	0.55	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.95	1.00	1.05	1.10	1.15
7	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.95	1.00	1.05	1.10
8	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.95	1.00	1.05
9	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.95	1.00
10	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.95
11	0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.75	0.80	0.85	0.90
12	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.75	0.80	0.85
13	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.75	0.80
14	0.05	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.75
Never	0.05	0.05	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.45	0.55	0.55	0.65	0.60

Appendix 5: The Actual Questionarie

24 de octubre de 2011 [EL COLEGIO DE MÉXICO]

Buenas tardes, la información solicitada tiene como propósito contribuir a un estudio científico sobre las perspectivas del salario de los estudiantes al ingresar al mercado laboral, por su aportación y tiempo, muchas gracias.

Primera Parte

Instrucciones

Conteste las siguientes preguntas de manera más sincera posible marcando únicamente una opción, o en su defecto contestando en el recuadro.

1) Indique por favor su sexo ____ Masculino _____Femenino
2) ¿Qué edad tiene? _____________
3) ¿Qué carrera profesional se encuentra cursando? _____________________
4) ¿Cuántos años le faltan para terminar su carrera? _____________________
5) ¿Cuál fue su promedio el semestre pasado? ________________
6) ¿Cuenta con alguna beca? _____Si _____ No
7) ¿Qué Grado de estudios completados tiene o tenía:

   Su Padre: ___Primaria o menos ___Secundaria ___Prepa ___Universidad o más

   Su Madre: ___Primaria o menos ___Secundaria ___Prepa ___Universidad o más
8) ¿Cuántos hermanos tiene o tenía? _______________
9) Sin incluir baños, cocina y sala ¿Cuántos cuartos para dormir tiene la casa de su familia nuclear? ______________
10) ¿Cuántos automóviles en total tiene toda su familia nuclear o inmediata? _______
11) De la semana anterior ¿Cuántas horas remuneradas trabajó? ___________
12) ¿Actualmente usted vive con?

    _____Padre y Madre _____Madre _____Padre _____Ninguno
13) ¿Quién de su familia es el principal responsable de sus gastos?

    ___Padre y Madre ___Madre ___Padre ___Hermano(s) ___Nadie (independiente)
14) ¿Desea trabajar cuando termine de estudiar? ____ Si _____ No
15) ¿En cuánto tiempo cree conseguir empleo (meses)? _______

16) ¿Cuánto dinero espera ganar en su primer trabajo al mes? ___________

Desde 2006 a 2010 han muerto cerca de 40,000 personas en el país debido a la guerra contra el narco, los niveles de inseguridad no se han reducido en ningún estado, por el contrario se está viviendo una ola de violencia como nunca antes se había visto en todo el país.

17) ¿Qué sentimiento principalmente le genera lo anterior?

____Enojo _____Tristeza _____Temor/Incertidumbre ___Indiferencia

La Crisis Económica de 2008 ha dejado a los mercados financieros e internacionales temblorosos. El periódico El Economista publicó una nota que el 2010 fue el año de mayor desempleo juvenil mundial en la historia. Asimismo, los expertos indican un riesgo de recesión económica en 2012.

18) ¿Qué sentimiento principalmente le genera lo anterior?

____Enojo _____Tristeza _____Temor/Incertidumbre ___Indiferencia

Segunda Parte

Instrucciones : *A continuación se presentan 3 series de loterías, cada serie contiene dos loterías (lotería A o lotería B) que asignan probabilidades a **ganancias o pérdidas en Dinero (Pesos)** en distintos escenarios. Su tarea es identificar en qué escenario deja de preferir la lotería A para preferir la lotería B. Marque el número del escenario donde usted comienza a preferir la lotería B, si nunca prefiere la lotería B no marque ningún número.*

Primera Serie

	Lotería A			*Lotería B*	
	Escenario	*Probabilidad de .3*	*Probabilidad de .7*	*Probabilidad de .1*	*Probabilidad de .9*
	1	40	30	68	5
	2	40	30	75	5
	3	40	30	83	5
	4	40	30	93	5
	5	40	30	106	5
	6	40	30	125	5
	7	40	30	150	5
	8	40	30	185	5
	9	40	30	220	5
	10	40	30	300	5
	11	40	30	400	5
	12	40	30	600	5
	13	40	30	1,000	5
	14	40	30	1,700	5

Segunda Serie

	Lotería A		Lotería B	
Escenario	Probabilidad de .9	Probabilidad de .1	Probabilidad de .7	Probabilidad de .3
1	40	30	54	5
2	40	30	56	5
3	40	30	58	5
4	40	30	60	5
5	40	30	62	5
6	40	30	65	5
7	40	30	68	5
8	40	30	72	5
9	40	30	77	5
10	40	30	83	5
11	40	30	90	5
12	40	30	100	5
13	40	30	110	5
14	40	30	130	5

Tercera Serie

	Lotería A		Lotería B	
Escenario	Probabilidad de .5	Probabilidad de .5	Probabilidad de .7	Probabilidad de .3
1	25	-4	30	-21
2	4	-4	30	-21
3	1	-4	30	-21
4	1	-4	30	-16
5	1	-4	30	-16
6	1	-4	30	-14
7	1	-4	30	-11