

# Valuing Protection against Low Probability, High Loss Risks: Experimental Evidence

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## **Abstract**

The study investigates protective responses in low probability and high loss risk situations. Particularly, it (1) detects individual protection valuations to variations in probability versus to variations in loss for payment decisions and choice decisions, (2) elicits the threshold probability in individuals' minds that make them consider having protective measure, (3) calculates relative risk aversion. The results of the experiment indicate that as the probability of loss and loss amount increases, individuals tend to buy/pay more for protection. They are more responsive to the variation in probabilities than to the variation in loss amounts when they decide whether to buy the protective measure or not: choice decision. Yet, the opposite is true when they decide the amount of willingness to pay for buying the protective measure: payment decision. In addition, bid expected loss values have a bimodal distribution. Consistent with previous studies, individuals (particularly women) are found to be risk averse for low probabilities.

**Keywords:** experiments, risk, insurance.

**JEL Classification:** C91, D81

## **I. INTRODUCTION**

The low probability and high loss events (LPHL from now on) can be expressed as risky situations: the probability of occurrence is low, but the harmful effect can be very dreadful. In real life, people have inconsistent reactions to low probability, high loss events (e.g., natural disasters, terrorism, and some environmental hazards). While some individuals react as if no hazard exists, some overreact to small risks. For example, Indians near Santa Barbara, California, still live without any fear next to a liquefied natural gas terminal that is shown to be dangerous to health by experts. On the other hand, “isolated terrorist incidents periodically choke off the consumer demand, and Food and Drug Administration banned the sale of tens of millions of dollars of Chilean fruit based on evidence of low levels of cyanide injected into two grapes” (Viscusi and Evans, 1990).

Over the past thirty years, researchers have developed a theoretical framework concerning risk and the protective mechanisms chosen by individuals (e.g. insurance, seat belts, storm shelters) against low-probability, high-loss risk events (Kunreuther, 1978, 1996; Shogren and Crocker, 1999; Ehrlich and Becker, 1972; Shogren, 1990; Viscusi, 1992; Cook and Graham, 1975; Dong, Shah and Wong, 1996; Dixit, 1990; Arrow, 1996). A majority of these models are developed within the framework of Expected Utility Theory (EUT), and most of them attempt to explain the mechanism through which insurance is purchased, specific decision making processes individual go through, and the factors at play during this incidence (e.g., Friedman and Savage, 1948). While some individuals seem to be more supportive to use expected utility theory to describe the judgments and choices made in this particular risk situation (e.g., Brookshire, Thayer, Tschirhart, Schulze, 1985; Gould, 1969), others do not (e.g., Tversky, Sattath, and Slovic, 1988; Kunreuther, 1979; Slovic, 1987).

Expected utility theory does not predict a significant change in insurance behavior as probability changes (McClelland, Schulze, and Coursey, 1993). In addition, according to utility theory, individuals should prefer to insure against LPHL rather than HPLL<sup>1</sup> (Kunreuther, 1979). It is claimed that the theories other than the expected utility – rank-dependent utility theory (extended expected utility theories, generalized expected utility and prospect theory) have a tendency to overweight low-probability or be oversensitive towards it (Kahneman and Tversky, 1979; Machina, 1982; Karmakar, 1978). Also, according to the prospective reference theory, people overestimate the risk if the probability is below a particular threshold and underestimate when it is above the threshold probability, clarifying the difference between the actual versus perceived risk (Viscusi and Evans, 1990).

Since theoretical models are not fully adequate to describe people's reactions towards some uncertain and risky situations, particularly low-probability events (Camerer and Kunreuther, 1989), empirical investigations become crucial.

The main purpose of this study is to investigate protective responses in LPHL risk situations by using an economic experiment. Particularly, we aim to (1) find out protection valuation to variations in probability versus to variations in loss amounts for payment decisions (willingness to pay values for buying protection elicited by BDM; Becker, DeGroot, and Marschak (1964) elicitation mechanism and choice decisions (buy protection or not), (2) elicit the threshold probability in individuals' minds that make them consider having protective measure, (3) determine individual risk attitudes via relative risk aversion.

The paper is organized as follows: the next section reviews previous empirical studies related to the current research. Then the model that explains the empirical framework of the experiment is presented, followed by the hypotheses and experimental design. Finally, the paper ends with data description, statistical analysis results, and conclusion parts.

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<sup>1</sup> High probability and low loss events.

## II. RELATED LITERATURE

Numerous survey studies have examined individual protection decisions against LPHL (e.g., Brookshire et al., 1985; Slovic, 1987; McDaniels, Kamlet and Fischer, 1992; Slovic, Fischhoff, and Lichtenstein, 1980; Camerer and Kunreuther, 1989; Kunreuther, 1996). Some people are found to perceive the risk as if no hazard exists (e.g., flood study by Kunreuther, 1978), while others rate a low-probability risk equal to more frequent risk exposure (e.g. Smith and Devousges, 1987; McClelland, Schulze, and Hurd, 1990). Thus, bimodal responses to low probability events are found in most field studies (Kunreuther, Desvougues, and Slovic, 1988).

Most laboratory studies have been done to test how adequate the theories are or which theory is better in explaining individual insurance decisions (e.g., Schoemaker and Kunreuther, 1979; Hershey and Schoemaker, 1980). These studies have consistently demonstrated that insurance markets for high probability events can be expressed by standard expected utility and subjective expected utility theories; however, these theories are inadequate to explain decision making processes in low probability risk situations<sup>2</sup> (McClelland et al., 1993; Elliot, 1998; Ganderton, Brookshire, Stewart, and McKee, 1997).

In the studies investigating the shape of the expected utility function, weighting functions, and related to that, individual risk attitudes, as in expected utility theory, that assumes risk aversion for losses, many scholars found risk aversion for small probability of losses and risk seeking for high ones, in another way, overweighing low probability and under weighing high probability (concave utility function for low losses, convex for large losses) (Etchart-Vincent, 2004; Williams, 1966; Slovic, Fischhoff, Lichtenstein, Corrigan and Combs et al., 1977; Kunreuther, Ginsberg, Miller, Sagi, Slovic, Borkan, and Katz, 1978; Hershey and

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<sup>2</sup> The low probability is specifically mentioned to be below 0.2 and so by Camerer (Kagel and Roth, Ch 8, pg.641, 1995) and taken as 0.01 to test the validity of EU theory in McClelland et. al. (1993), further, between 0.001 and 0.36 (mostly below 0.01) in Ganderton et. al. (2000).

Schoemaker, 1980; Kachelmeier and Shehata, 1992). The prospect theory suggested that the conclusions being different for losses and for gains. Therefore, in the current literature, it is found that there exists fourfold pattern of risk attitudes: risk aversion for gains and risk seeking for losses at the high probability risk; risk aversion for losses and risk seeking for gains at low probability events (Tvesky and Kahneman, 1992; Di Mauro and Maffioletti, 2004; Harbaugh, Krause, and Vesterlund, 2002).

Different from the above studies, the results were contrary to EU (that says individuals should buy more insurance against low probability and high loss risks) for most experiments that took into account the size of loss in addition to the probability of loss<sup>3</sup>. They conclude that individuals have insurance preference for high probability, low loss risks over low probability, high loss events, when expected losses are the same (Slovic et al., 1977; Schoemaker and Kunreuther, 1979; Kunreuther and Slovic, 1978; Ganderton et al., 2000; Kunreuther and Pauly, 2004).

There are studies investigated the possible reasons of why people do not prefer to insure themselves against LPHL risks, particularly natural disasters. They suggested some factors such as the formulation of probability context, wealth effect, past experience with the risk, communication with others, and incapability to understand the probability context; bounded rationality (e.g., Kunreuther, 1979; Kunreuther, Novemsky, and Kahneman, 2001; Kunreuther et al., 2004, and Ganderton et al., 2000).

When we look at the insurance purchase decisions specifically for LPHL risk situations, there are two main studies that we are aware of. According to Ganderton et. al. (2000), probabilities have a dominant role in valuing insurance for low probability and high loss situations. Further, they concluded that the insurance bid-expected value ratio values are

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<sup>3</sup> Camerer (1992) “The frequency of EU violations appears to depend on the size of gamble payoffs. [...] There are more violations when payoffs are large in magnitude”.

not showing bimodality (for probabilities between 0.001 and 0.36, most below 0.01, 100 to 1000 token out of 200 tokens). McClelland et al. (1993), however, found bimodal distribution for willingness-to-pay for insuring, the ratio of insurance bid and expected value, at probability of 0.01 and loss of \$40 out of \$50.). It is important to note that while McClelland et al. (1993) used a competitive Vickrey auction (CE), Ganderton et al. (2000) used dichotomous question (choice) as an elicitation mechanism for insurance purchase.

The experiment in the current study consists of two parts. In the first part, we use pairwise choice (PC), willingness-to-pay (WTP) and willingness-to-accept (WTA) mechanisms. The purpose of this first part is not only will make them practice BDM<sup>4</sup> procedure but also will give subjects a “hard earned income” that they have to protect in the second part of the experiment, this would raise the salience of the incentive scheme since we believe subjects will perceive this income as their income and not as manna.

In the second part, the main objective is, firstly, to investigate the inconsistent results on protection purchase valuations. The experiment is designed to include both open-ended willingness to pay for protection questions<sup>5</sup> and dichotomous buy or not questions to examine whether Ganderton et al. (2000) conclusion about the relative importance of probability on individual insurance buying decision holds for both payment and choice decisions.

Secondly, we try to calculate the ratio of willingness to pay values to expected values and by that we not only determine relative risk aversion, but also compare the distribution of our data with McClelland et al (1993). It is important to note that we particularly work on the situations with the probability of 0.01 as it is the common low probability used in both McClelland et al. (1993) and Ganderton et al. (2000).

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<sup>4</sup> We choose to use BDM, because we wanted the subjects to get used to the mechanism that is also used in the second part.

<sup>5</sup> We intentionally choose to use BDM mechanism to elicit willingness to pay values, because we wanted the mechanism to be noncompetitive. That enables us to compare our results with the results of McClelland et. al. (1993) competitive auction study (see Ganderton et. al. (2000) for more discussions).

Thirdly, the inconsistency among individual reactions to LPHL risks can be because people overestimate the risk if the probability is below a particular threshold and underestimate when it is above the threshold probability, clarifying the difference between the actual versus perceived risk (Viscusi, 1990). In addition, each individual may have his/her own threshold level. In the current study, we aim to elicit threshold probability in individuals' minds that make them start to consider having insurance through BDM mechanism. Each individual should have a minimum probability level that he/she starts thinking of buying insurance which is consistent with (equal or lower than) the probability they face when they actually made their buying decision.

## II. THE RESEARCH MODEL

The first model represents the individual willingness to pay for the protective measure with  $B$  = value for the willingness to pay to buy the protection- the "bid". The loss event occurs with a probability of  $P$  and amount of loss  $L$ , the value of the willingness to pay to reduce risk,  $B$ , given the amount of endowment,  $W$ , the individual utility would be:

Without buying the protective measure:

$$PU(W - L) + (1 - P)U(W) \quad (1)$$

With the protective measure:

$$PU(W - B) + (1 - P)U(W - B) \quad (2)$$

where  $0 < P < 1$ ,  $L \geq 0$ ,  $B \geq 0$ , and  $W > 0$ .

For the relative risk attitude measurement is the values of  $B/EV$  ( $EV$  is the expected value) that is higher than 1 indicates risk aversion, lower than 1 indicates risk seeking, and the equality to 1 indicates risk neutrality.<sup>6</sup> We change  $P$  and  $L$  values for the experiment such as:

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<sup>6</sup> See McClelland et. al. (1993, pg. 98) for the proof.

$$\begin{aligned}
P &= p \quad \text{or} \quad \frac{p}{2} \\
L &= 1 \quad \text{or} \quad \frac{1}{2}
\end{aligned}
\tag{3}$$

Individual maximum willingness to pay to buy the protective measure can be found by setting Equation (1) equal to Equation (2) and solve for B.

In the second model, we detect the individual threshold probability of loss i.e. the minimum probability each person has for a given amount of loss.

Without buying the protective measure:

$$TU(W - L) + (1 - T)U(W) \tag{4}$$

With the protective measure:

$$TU(W - C) + (1 - T)U(W - C) \tag{5}$$

Where  $T$  = threshold probability of loss stated by individual,  $L$  = amount of loss,  $W$  = endowment,  $C$  = cost of the protective measure.

Specifically,

$$\begin{aligned}
L &= 1 \quad \text{or} \quad \frac{1}{2} \\
C &= p \quad \text{or} \quad \frac{1}{2} \quad \text{or} \quad \frac{p}{2}
\end{aligned}
\tag{6}$$

Individual threshold probability value or the minimum probability values can be found by setting equation (4) and Equation (5) equal and solving for T.

### III. HYPOTHESES

The hypotheses related the purpose of the current study is described below.

*Hypothesis 1:* Individuals perceive risk by focusing on the probability of loss rather than the loss amount for choice decisions (Ganderton et al., 2000) and by focusing on the loss amount when they make payment decisions (as explained in the preference reversal).



*Hypothesis 2:* Each individual should have a minimum probability level that he/she starts thinking of buying insurance which is consistent with (equal or lower than) the probability they face when they actually made their buying decision, as in prospective reference theory.

*Hypothesis 3:* Individuals have a risk averse attitude in overall consistent with the well-known fourfold pattern of risk attitudes stated in Prospect Theory: risk aversion for losses and risk seeking for gains at low probability events (Di Mauro and Maffioletti, 2004; Harbaugh, Krause, and Vesterlund, 2002).

*Hypothesis 4:* The ratio of WTP to expected values have a bimodal distribution at probability 0.01 consistent with McClelland et al. (1993), since we elicited the willingness to pay for protection values by open-ended questions<sup>7</sup> rather than dichotomous buy or not questions.

#### **IV. THE EXPERIMENTAL DESIGN**

The experiment was run in December 2005 at the lab of the Max Planck Institute of Jena. The software of the computerized experiment has been developed in z-Tree (Fischbacher, 1999). 96 students from Jena University, 32 in each of the 3 treatments, were recruited to participate in the experiment using the ORSEE software (Greiner, 2004). Participants received written instructions after being seated at a computer terminal.<sup>8</sup> Three out of 96 subjects earned a big payoff. In each of the 3 treatments we have 32 subjects divided in 2 groups in order to test for order effect. The experiment consists of two phases:

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<sup>7</sup> As it is mentioned by Ganderton et al. (2000), it may be the dichotomous question they used for buying insurance that did not allow them to see zero bids in the Vickrey auction mechanism used by McClelland et al. (1993).

<sup>8</sup> The original instructions were in German. One sample is illustrated at the end of the paper and other samples of instructions in English are available upon request.

Phase 1 differs for each treatment and Phase 2 consists of the same procedure for all three treatments. First, we will explain Phase 1 for each treatment. In the first session/treatment, 32 subjects are asked to choose their preferred lottery from 10 (pair-wise choice) lotteries. Then, one out of 10 decisions is chosen randomly by the computer and preferred lottery is played, that way, the subjects earn their initial endowment for Phase 2. In the second session, 32 subjects are given 500 ECU in the beginning of the experiment to use it for buying the same 10 lotteries. They are asked to state their buying price for each lottery. Whether they buy the lotteries or not is determined through BDM mechanism. One out of 10 decisions is chosen randomly by the computer to determine the endowment for Phase 2. In the last session, 32 subjects are given 10 lotteries and stated their selling price for each lottery and the conclusion of the selling process is determined through BDM mechanism. A randomly chosen decision is played to determine the initial endowment for Phase 2.

All the lotteries used in Phase 1 were composed by two of the four consequences 200 ECU, 300 ECU, 400 ECU, and 500 ECU. The probabilities of these consequences are recorded in Table 1. In the experiment the lotteries were presented as segmented circles on the computer screen.

[Table 1]

The subjects completed the first part of the experiment and got their initial endowments that they will use for the second part are divided equally into two randomly. Thus, 16 subjects stated willingness to pay for protection measure (WTP) for two different probabilities ( $p=0.01$  and  $0.005$ ) and two loss amounts (all the income and half of the income) and threshold probabilities with two loss amounts: all the income and half of the income and protection prices that are equal to the expected values. The other 16 subjects stated whether

they would buy the protection measure or not ( $p=0.01$  and  $0.005$ ,  $L=$  all the income and half of the income, and protection prices set equal to the expected values)<sup>9</sup>. The prices of the protective measure were equal to the expected values, ten times the expected values, twenty times the expected values, and finally fifty times the expected values.<sup>10</sup> For all decision making processes, BDM mechanism is used to elicit the valuations.

After all the decisions are made, one of the risky event scenario is selected randomly and played for real to determine subjects' money balances at the end of the experiment. During the experiment, amounts are denoted by ECU (Experimental Currency Unit) that is converted to euros at the end of the experiment for each session separately. One person in the entire group of respondents participating in each session (about 32 people) convert ECU to euros at the following exchange rate:  $1\text{ ECU} = \text{€}1$ , and for the others the rate is:  $1\text{ ECU} = \text{€}0.02$  (for example, for one person  $500\text{ ECU} = \text{€}500$ , for others  $500\text{ ECU} = \text{€}10$ ). To select that person, we draw a number (1 to 32), and if the number selected matches with the subject's seat number, that person actually receives a good amount of money.<sup>11</sup>

## **V. DATA DESCRIPTION AND ANALYSIS**

96 students were recruited to participate in the experiment of which 45 percent is male and 55 percent is female. The average age is 23 (min19 and max 39), average monthly income earned by the individual is 348 Euro (min 0 and max 1100). Table 2 represents the statistics for 48 individuals that stated their maximum willingness to pay for the protection in risky

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<sup>9</sup> We choose probability of 0.01 particularly because it is the common low probability used in both McClelland et al. (1993) and Ganderton et al. (2000). This is crucial in order to compare our results with theirs.

<sup>10</sup> The reason why these prices are chosen is that expected values are already very low as for the price of the protective measure that would eliminate all the loss (for example for the probability of 0.001 with the endowment of 500 ECU, the expected value would be only 5 ECU and this is the highest value for the price that can be stated), that, most people are expected to be willing to pay that price. However, it is interesting to detect how far they can pay for this protective measure that will enable us to determine the degree of their risk aversion.

<sup>11</sup> We wanted subjects to make their decisions considering a high loss by not giving them any information about who is going to be selected for the big payment. We had to go through this procedure of selecting only one person because we did not have enough budget to give every subject good amount of money.

situations where the expected values are the same. Thus, the subjects are expected to state the same willingness to pay values to buy the protective measure according to the theory.

[Table 2]

Interestingly, subjects stated higher WTP values for WTP2 than WTP3 in average, which indicates that they perceive the risk to be higher in the case of higher amount of loss rather than higher probability of loss. The result is also supported by t-statistics that conclude that the differences of the mean values for WTP2 and WTP3 are statistically significant.

Consistent with intuition, as the probability decreases from 0.01 to 0.005, loss amount being constant, mean values of WTP decreases from 131 to 125 ECU and from 106 to 102 ECU. As the loss size decreases from losing all the endowment to losing half of the endowment, probability being constant, average WTP values decreases from 131 to 106 ECU, and 125 to 102 ECU. The higher the value of WTP, the lower should be the threshold probability stated and the more likely the person being risk-averse in the lottery choice. However, the threshold probabilities, in average, are much higher than the probabilities used to calculate the expected values: 0.01 and 0.005. In fact the mean values for the threshold probabilities are 9%, 3.7%, 5.5%, and 4.5%.

As for the analysis of 48 subjects that stated whether they would buy the protective measure or not in part 2, as it can be seen from Table 3, 20.8% of the individuals said “yes” to the choice of buying the protective measure or not question when the probability of the occurrence of the loss event is 0.01, no matter what the loss amount is: all of the endowment or half of the endowment. Thus, the frequencies of the buy or not binary responses seem to support the dominance of the probability change rather than the loss amount change on the individual decision-making. Consistent with intuition, the higher the cost of the protective measure is, the lower the percentage of individuals that buy it. More specifically, until the cost

is twenty times the expected value, the number of individuals that buy was higher, for the cost that is twenty times the expected value; the percentages of subjects that buy and not buy were almost equal. Finally, when the cost is fifty times the EV, the percentage of the individuals that do not buy the protective measure becomes higher than the rate of the ones that buy it.

[Table 3]

The relative risk aversion is calculated as  $WTP/Expected\ value$  by using willingness to pay for protection values (see McClelland et al., 1993 for details). The higher the value of  $WTP/Expected\ value$  indicates higher level of relative risk aversion. For all individuals, the  $WTP/Expected\ value$  is above one, indicating risk aversion, which is consistent with the results of Di Mauro and Maffioletti (2004) study. A bimodal distribution is found for the ratio of the willingness to pay for protection in situations of probability 0.01 and loss of all endowment (Figure 1). That means while some individuals put 0 as their WTP value, others put values higher than expected value.

[Figure 1]

The review of the data in terms of correlations concludes that individual WTP increases as expected loss and also the endowment increases, consistent with Gardenton et al. (2000). As it is the case for many risk experiments' results, women are found to be relatively more risk averse. The individual threshold probabilities seem to have no significant correlation with any variable, however, as the sample size increases; it might be negatively correlated with the WTP values.

As of the final analysis, we checked the effects of endowment, gender, age, income, and threshold probability on individuals' willingness to pay amount to buy the protective measure for probability of loss that is equal to 0.01 and loss amount of all income by using a linear regression analysis. As a result, the more the endowment is, the higher the willingness

to pay amount stated (p-value is 0.000). In addition, women are found to state more values as their willingness to pay for the protection (p-value is 0.041).

Further, the binary logistic regression is used that takes buy the protective measure or not binary decision (for the risky events that has a 0.01 as the probability of loss and all income as the loss amount) as the dependent variable and endowment, gender, age, and income as the independent variables. According to that, gender is found to be the only statistically significant variable (p-value is 0.019) that influences buy or not decision and thus women are more tend to buy the protective measure. Regression analyses are summarized in Table 4.

[Table 4]

## **VI. DISCUSSIONS AND CONCLUSION**

The current paper aims to find out protection valuation to variations in probability versus to variations for individual payment decisions (loss amounts for willingness to pay values for buying protection) and choice decisions (buy protection or not). In addition, it tries to elicit the threshold probability in individuals' minds that make them consider having protective measure. Lastly, it calculates relative risk aversion and compares the distribution of the ratio of willingness to pay values to buy the protective measure to expected value with previous experimental results.

Different from previous experiments, both choice and certainty equivalent elicitation methods i.e. BDM and dichotomous question are used to investigate previous results. Further, the current experiment elicits not only the individual WTP for protective measures, but also individual threshold probability<sup>12</sup> that he/she considers buying a protective measure. This is

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<sup>12</sup> It is important to note that the reason of not giving some of the subjects threshold questions first and then the willingness to pay questions in order to test for the order effect is that we are concerned to determine the minimum (threshold) probabilities of individuals for specific risk situations, where the probability is low and the

important to have a broader investigation of individual reactions (bimodal distribution for insurance valuing) to low probability and high loss events. That way, we may conclude that the inconsistent reactions exist because some people focus on probability, while others focus on loss or because each individual has his/her own threshold probability that determines individual perceptions.

The results show that as the probability decreases and loss amount being constant, willingness to pay values decrease. As the loss size decreases and probability being constant, willingness to pay values decrease. Interestingly, for the payment decision, participants perceive the risk to be higher in the case of higher amount of loss rather than higher probability of loss decreases. However, for the choice decision, the frequencies of the buy or not binary responses seem to support the dominance of the probability of loss rather than the loss amount on the individual decision making. Gender is found to be significantly affecting both the buy or not decision and willingness to pay decision (thus, being a woman has a positive impact). Initial endowment of the individuals seems to have a positive impact on the value of their willingness to pay. The threshold probabilities, in average, are much higher than the probabilities used to calculate the expected values and seem to have no significant correlation with any variable. McClelland et al. (1993) bimodal distribution conclusion for the probability 0.01 is supported in our study. For all individuals, the ratio of the willingness to pay to the expected value is above one, indicating risk aversion, which is consistent with the results of Di Mauro and Maffioletti (2004) study.

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loss amount is high, further the main aim of the paper is to relate somehow the bids stated for this special occasions and the threshold probabilities. By asking the threshold questions initially, the only information that would be available to the subjects would be the high loss and the protection prices that have a high possibility of getting very high threshold probability values that would be out of the scope of our research objective.

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**Table 1 The probabilities & gains of the lotteries in part 1**

200 ECU	300 ECU	400 ECU	500 ECU
0	0	1	0
0	0.2	0	0.8
0	0.75	0.25	0
0	0.8	0	0.2
1	0	0	0
0	0.7	0	0.3
0.5	0.5	0	0
0	0.85	0	0.15
0	0	0.7	0.3
0	0.15	0	0.85
0.2	0	0.08	0
0.5	0	0	0.5
0.8	0	0	0.2
0.4	0	0.6	0
0	0.4	0	0.6
0	0	0.5	0.5
0	0.1	0	0.9
0	0.5	0.5	0
0	0.6	0	0.4

**Table 2 Statistical Analyses for Willingness-to-pay Values**

	<b>Subjects</b>	<b>Mean</b>	<b>Standard Deviation</b>
<b>WTP2</b>	48	125,7500	185,8499
<b>WTP3</b>	48	106,1458	136,1396

  

<b>One-Sample Test</b>	<b>t-statistics</b>	<b>Degrees of freedomf</b>	<b>Sig. (2-tailed)</b>
<b>WTP2</b>	4,688	47	,000
<b>WTP3</b>	5,402	47	,000

\*WTP2 is the value for willingness to pay when probability of loss= 0.005 and loss amount= all endowment, WTP3 is the willingness to pay value when probability of loss= 0.01 and loss amount= half of endowment.

**Table 3 Individual Choice Decisions**

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		<b>Frequency</b>	<b>Percent</b>
<b>BON1</b>	0	10	20.8
	1	38	79.2
<b>BON2</b>	0	9	18.8
	1	39	81.3
<b>BON3</b>	0	10	20.8
	1	38	79.2
<b>BON4</b>	0	7	14.6
	1	41	85.4

---

BON1= probability is 0.01 loss amount is all endowment, BON2= probability is 0.05, loss amount all endowment, BON3= probability is 0.01, loss amount is half of endowment, BON4= probability is 0.05, loss amount is half of endowment. "0" refers to "not buy" and "1" refers to "buy".

**Table 4 Regression Analyses**

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<b>Dependent variable: WTP1</b>			<b>Dependent variable= BON1</b>		
	Coefficient	p-value		Coefficient	p-value
Endowment	0.576	0.000	Endowment	0.000	0.943
Gender	94.123	0.041	Gender	2.304	0.019
Age	10.641	0.105	Age	0.3	0.204
Income	0.105	0.259	Income	0.003	0.163
Threshold	0.587	0.548	Wald= 14,109, df=1, Sig. = 0.000		
R-square=0.46, df=5, F-stat=7,258, Sig.=0.000					

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## **Instructions for pair-wise choice (part 1) and willingness to pay and threshold probability (part2)**

Welcome and thanks for participating in this experiment. This is an experiment in economic decision-making and if you follow the instructions carefully you can make money that will be paid to you in cash at the end. It is strictly forbidden to communicate with the other participants during the experiment. If you have any questions, please raise your hand.

The experiment consists of two parts. In the first part, you must decide on evaluating lotteries. The money you earn from Part 1 will be your initial money balance for Part 2. In Part 2, you will be presented with different risk situations. Each situation describes an occurrence of an event. If this event does occur, you will suffer a loss of money. However, you have an opportunity to buy a protective measure at some monetary cost. If you buy the protective measure, you will be able to prevent this possible money loss. In this part, you will be asked questions about how you value this protective measure in different loss situations. At the end of Part 2, one of the loss situations will be selected with a random device and that situation will be played out for real to determine your money balance.

During the experiment, amounts will be denoted by ECU (Experimental Currency Unit). ECU will be converted to Euro at the end of the experiment.

One person in the entire group of respondents participating in our experiment (about 32 people) will convert ECU to Euro at the following exchange rate: 1 ECU = €1, and for the others the rate will be: 1 ECU = €0.02 (for example, for one person 500 ECU = €500, for others 500 ECU = €10). To select that person, we draw a number (1 to 32), and if the number selected matches with your seat number, you are the one that will actually receive a good amount of money.

Now, please read the instructions for Part 1 carefully before making any entries.

## Part 1

You will face 10 pairs of lotteries and for each pair you are asked to choose the lottery that you prefer the most. Once you complete this task, one pair out of 10 will be chosen randomly and the lottery that you chose will be played for real to determine your cash payment.

Please click on the lottery you prefer for each pair that will appear on the computer screen.

When you finish, click “Done”.

## Part 2

In Part 2 you will make decisions concerning the money you earned in Part 1. You now face the possibility that you may lose part or all of the cash payment you earned in Part 1.

However, you can buy a protective measure that prevents the money loss. If you buy the protective measure, then you pay the price of the protective measure but you lose nothing. If you do not buy the protective measure then you must face the possibility of losing all or part of your money.

You will face 8 loss situations in total and one of the loss situations will be chosen randomly to determine your money balance that you will be converted to Euro and will be paid to you at the end of the experiment.

First, you will be presented 4 loss situations for which you must decide on this protective measure. For each situation, you will see a description of an event. You will indicate the upper price limit which you are willing to pay for the protective measure. Stating your upper price limit means that you consider any price exceeding your upper price limit as too costly for the protective measure.

Whether you get the protective measure will depend on whether your upper price limit is greater or equal to the random price. The random price will be determined in the following way:



A number is randomly chosen from 0 and the amount of money you earned from Part 1.

- If this number happens to be higher than the upper price limit you stated, the protection is too expensive for you and you do not buy it.
- If this number happens to be equal or lower than the upper price limit, then you buy the protection at the random price.

Please, do note that, under this procedure, you should state an upper price limit at which you are indifferent between buying and not buying the protective measure. The reasons are the following:

1. Suppose you state a too high price. Then the random price may fall between your upper price limit and your true valuation. In this case you have to buy the protection at a price that is higher than the price you really are willing to pay.
2. Suppose you state a too low lottery price. Then the random price may fall between your upper price limit and your true valuation. In this case you will not buy the protection even if its price is smaller than the price you are willing to pay.

#### WHAT YOU EARN

- With the protective measure                      money from Part 1- the random price
- Without the protective measure  
    If event occurs                                      money from Part 1 – the loss amount  
    If event does not occur                            money from Part 1

#### NOTE:

1. if you do NOT want to buy the protective measure, just put 0.
2. the random price for the protective measure is between 0 and your money from Part 1.
3. your upper price limit cannot be higher than your money from Part 1.

Now the first loss situation will come up on the screen, read it carefully and after you take your decision, click “SUBMIT”.

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**ON THE COMPUTER SCREEN**

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**LOSS SITUATION 1:** *You may lose all your money with a possibility of 1 out of 100. How much would you be willing to pay to buy a protective measure to protect all your money? \_\_\_\_\_ ECU*

**LOSS SITUATION 2:** *You may lose all your money with a possibility of 5 out of 1000. How much would you be willing to pay to buy a protective measure to protect all your money? \_\_\_\_\_ ECU*

**LOSS SITUATION 3:** *You may lose half of your money with a possibility of 1 out of 100. How much would you be willing to pay to buy a protective measure to protect all your money? \_\_\_\_\_ ECU*

**LOSS SITUATION 4:** *You may lose half of your money with a possibility of 5 out of 1000. How much would you be willing to pay to buy a protective measure to protect all your money? \_\_\_\_\_ ECU*

*You need to repeat the same thing for all 4 loss situations. When you finish up with all situations, click “DONE” and then proceed with the following instructions*

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Now, please read the instructions below to evaluate 4 more loss situations that you may lose part or all of the cash payment you earned in Part 1. For each loss situation, you can buy a protective measure that prevents the money loss. You will be told the price of the protective measure and how much of your money could be possibly lost in case the loss situation occurs. You will be asked to state the smallest probability of the occurrence of the loss situation for which you will buy the protective measure. Whether you get the protective measure will depend on whether your probability number is smaller or equal to the random number selected by the computer:

- If your probability number  $\leq$  randomly selected number, then you will be protected against possible loss and the predetermined price of the protection will be deducted from your money balance.
- If your probability number  $>$  randomly selected number, then you will face the possibility of losing part or all of your money.

#### WHAT YOU EARN

- With the protective measure                      money from Part 1- the price of the protective measure
- Without the protective measure

If event occurs	money from Part 1 – the loss amount
If event does not occur	money from Part 1

#### NOTE:

1. if you do NOT want to buy the ticket, just put “NOT BUY”.
2. the random number for the probability is between 0 and 1.
3. your probability number cannot be less than 0.

Now the first loss situation will come up on the screen, read it carefully and after you take your decision, click “SUBMIT”. When you finish, click “DONE”.

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**ON THE COMPUTER SCREEN**

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**LOSS SITUATION 1:** Imagine there are RED and WHITE balls in a bag. If RED ball comes up from the bag, the loss event occurs and you lose ALL the money. However, you can protect your money by buying a protective measure at a price of **(0.01\*money from part 1)**. How many RED balls out of 100 balls there should be in the bag (or what should be the probability of losing money) so that you would buy the protective measure?  
\_\_\_\_\_ balls.

**LOSS SITUATION 2:** Imagine there are RED and WHITE balls in a bag. If RED ball comes up from the bag, the loss event occurs and you lose ALL the money. However, you can protect your money by buying a protective measure at a price of **(0.005\*money from part 1)**. How many RED balls out of 1000 balls there should be in the bag (or what should be the probability of losing money) so that you would buy the protective measure?  
\_\_\_\_\_ balls.

**LOSS SITUATION 3:** Imagine there are RED and WHITE balls in a bag. If RED ball comes up from the bag, the loss event occurs and you lose HALF the money. However, you can protect your money by buying a protective measure at a price of **(0.01\*half of money from part 1)**. How many RED balls out of 100 balls there should be in the bag (or what should be the probability of losing money) so that you would buy the protective measure?  
\_\_\_\_\_ balls.

**LOSS SITUATION 4:** Imagine there are RED and WHITE balls in a bag. If RED ball comes up from the bag, the loss event occurs and you lose HALF the money. However, you can protect your money by buying a protective measure at a price of **(0.005\*half of money from part 1)**. How many RED balls out of 1000 balls there should be in the bag (or what should be the probability of losing money) so that you would buy the protective measure?  
\_\_\_\_\_ balls.

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The next screen will tell you which one of the 8 situations you faced in Part 2 is selected to play out for real and your earnings from the experiment.

Please remain quiet until the experimenter says that it is time to have exchange rate draw.