Uncertainty, Ambiguity and Conflict: an experimental investigation of consumer behavior and demand for insurance *

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Abstract:

The purpose of this paper is to examine whether people treat all forms of uncertainty in the same way. Studies investigating known-risk gambles and ambiguous gambles have systematically used the urn context. Little systematic research has investigated differences in expressed attitude as a function of the manner in which vague probability information is communicated to a decision maker. The experiments reported in this paper are based on questionnaires distributed to 450 participants in multiple samples and examine the behavior of people when faced with different information on the probability of loss. The context is the decision to purchase a bottle of wine (the price of which varies from $5 to $220) assuming that there is a probability (defined in the question) that the wine may have a functional risk (it is corked or corky).

Keywords: Risk behavior; ambiguity aversion; insurance purchase.

JEL classification: C90, D81, D83, G22

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1. Introduction

Different people will respond to similar risky situations in very different ways. Early experiments have been undertaken by psychologists and others in an attempt to define profiles of risk-taker and risk-averse persons.[1] Differences in the behavior of individuals facing similar risky situations could be partially explained by the individual's family background, gender, age, education, position, prior experience, and geographical location (Dohmen et al., 2011). Determinants of risk attitudes are also impacted by the context of the decision process. Cognitive psychologists have documented many patterns regarding how people behave. Some of these patterns are known as heuristics or rules of thumb, overconfidence, mental accounting, framing, conservatism, disposition effect, i.e. the differences between losses and gains.[2]

In normative decision theory, uncertainty about the occurrence of an event is treated by the single dimension of probability (Chow and Sarin, 2002). The distinction between known and unknown probabilities dates back to Knight (1921) and Keynes (1921). The famous Ellsberg paradox demonstrates that the uncertainty about probabilities (ambiguity or vagueness) can affect people's decision behavior (Ellsberg, 1961). Uncertainty has behavioral consequences that violate the axioms of EU and SEU formulations.[3] Under uncertainty, several experiments following Tversky and Fox (1995) have shown that the individual probability judgments affect the shape of the utility function in both gain and loss domains (Health and Tvesrky, 1991; Di Mauro and Maffioletti, 2001; Abdelllaoui et al., 2005; Maffioletti and Santoni, 2005).[4]

Evidence on differences in attitude towards ambiguity across gains and losses can also be found in some earlier works by Einhorn and Hogarth (1985, 1986), Cohen et al. (1987), Kahn and Sarin

[1] MacCrimmon and Wherung (1986) provide an extensive early survey of the theoretical and empirical studies directed towards the understanding of risk behavior.
[2] More analysis can be found in Barberis and Thaler (2003).
[3] The review paper by Camerer & Weber (1992) provides an in-depth and thorough survey.
[4] In the prospect theory formulated by Kahneman and Tversky (1979), the behavior of people may at the same time exhibit overweighting of low probabilities and underweighting of high ones (see Laibson and Zeckhauser, 1998 for a survey).

(1988), Hogarth and Einhorn (1990) and Eisenberger and Weber (1995).[5] Regarding whether attitude towards risk and ambiguity are correlated, the experiments conducted by Lauriola and Levin (2001) report a positive correlation. However other experiments, like Cohen et al. (1985, 1987), Curley et al., (1986), Hogarth and Einhorn (1990), Schoemaker (1991) and Di Mauro and Maffioletti (2004) found that individual attitudes towards risk and attitudes toward ambiguity are not closely associated.

Several studies confirm that people prefer known risk to uncertainty (Casey and Scholz, 1991; Einhorn and Hogarth, 1985; Hogarth and Kunreuther, 1989; Curley and Yates, 1986; Frisch and Baron, 1988; Rode et al. (1999); Chow and Sarin (2001); Lauriola and Levin (2001); Pulford and Colman (2007 and 2008). Other studies have challenged these results. Heath and Tversky (1991) produce evidence suggesting that ambiguity aversion disappears when people believe they have sufficient knowledge or skill in the relevant domain. Fox and Tversky (1995) document ambiguity aversion in comparative and non-comparative contexts and find that ambiguity aversion is only significant in comparative contexts.[6] Viscussi and Chesson (1999) find that subjects react differently to different degrees of ambiguity. The presentation of a risk range leads to higher risk perception for low probabilities and lower risk perceptions for higher probabilities. Liu and Colman (2009) find that in a single urn condition like in Ellsberg (1961) there is significant ambiguity aversion but in repeated urn choices, a majority of participants choose the ambiguous options. More recent papers by Charness et al. (2013) and Keck et al. (2014) report ambiguity aversion, ambiguity seeking but also neutral attitudes which raise some controversial issues regarding the consistency of choices.

Rubaltelli et al. (2010) find that people's affective reactions help explain the evaluation of decisions when they have more or less information about the outcome. Studies on the comparative ignorance hypothesis have shown that people's preferences are heavily influenced by the affective reactions they experience toward the alternative they have to make.[7] Ambiguity aversion depends on affective reactions; a risky and familiar bet being more attractive than an ambiguous and unfamiliar one (Chew et al., 2012). In other words, people consider ambiguous

[5] A strong intuition about preferences is that people treat gains and losses differently (Hershey and Schoemaker, 1980, 1985). Recent studies showed a more pronounced overweighting of small probabilities in the loss domain than in the gain domain. This is verified within a risky situation context (Abdellaoui, 2000; Lattimore et al., 1992; Wu and Gonzales, 1996) or within a situation of uncertainty (Abdellaoui et al., 2005; Etchart-Vincent, 2004).

[6] See also Sarin and Weber (1993), Fox and Weber (2002), Du and Budescu (2005).

[7] For a review, see Peters (2006).

situations as being inferior (Sarin and Weber, 1993). Ambiguity aversion also has implications for financial decisions even when controlling for financial literacy (Dimmock et al., 2013).

Within an insurance context, Hogarth and Kunreuther (1985, 1989, and 1992) find that valuation of insurance protection by consumers and/or firms is sensitive to the presence of uncertainty, but this result is not confirmed by the work of Camerer and Kunreuther (1989). Einhorn and Hogarth (1986) reveal that sellers of insurance exhibit more ambiguity aversion than buyers of insurance. Di Mauro and Maffioletti (2001) study the impact of different definitions of ambiguity on the willingness to buy insurance but they do not notice major differences between different representations of ambiguity. Schade et al. (2004) observe a higher number of people willing to insurance when adding ambiguity to the situation. Wakker et al (2007) and Cabantous (2007) find ambiguity seeking in the willingness to take insurance, because people prefer the more familiar option and that normal decisions are made without extra statistical information. More recent papers provide conflicting evidence. Cabantou et al. (2011) provide evidence that insurers are ambiguity-averse when pricing risks because they have strong a priori expectations associated with different kinds of hazards. Dupont-Courtade (2012) provide evidence that consumers buying insurance consider ambiguous situations as inferior and the willingness to pay decreases in situation of ambiguity (imprecision or conflict).

The review of the literature reveals also some confusion in concepts and terminology. In most research papers, writers use *ambiguity* to refer to imprecise probabilities. Ambiguity is a term that has been used with the modal usage equating it with *vagueness* (see Budescu, Weinberg and Wallsten, 1988). Ambiguity arises from the perception of missing information (Frisch and Baron, 1988). Chow and Sarin (2002) find that people prefer when probabilities are precise (known information) and they feel insecure when they are ambiguous (unknown information), because they think someone else possesses the information. Very few studies venture any further into imprecision or ignorance (Hogarth and Kunreuther, 1995). Curley and Yates (1985 and 1986) clarify the measurement of ambiguity by examining the possible range of probabilities and the effect when varying the centers and the range of the intervals between the lowest possible probability p_{min} and the highest possible probability p_{max} . Curley and Yates (1985) show that ambiguity aversion increases when the range of the interval increases. Bowen et al (1994) replicate the same effect and observe strong individual differences. Kuhn (1997) examines how the behavior of people is affected when communicating uncertainty with vague probabilities of events. Smithson (1999) elaborates on the distinction between two different sources of ambiguity:

imprecision and conflict. *Conflict* refers to disagreement over states of reality that cannot hold true simultaneously. Smithson suggests using *conflict* to refer to disagreement among sources and *ambiguity* in cases where a source provides conflicting or uncertain evidence.[8]

How people deal with different conditions of ignorance or ambiguity is a relevant issue assuming that people exhibit a general preference for precision. The purpose of this paper is to examine whether people treat all the forms of uncertainty in the same way. Studies investigating known-risk gambles and ambiguous gambles have systematically used the urn context (Camerer and Weber, 1992; Pulford and Colman, 2007 and 2008). Research in the loss domain has developed considerably (L'Haridon, 2009), but no study (to our knowledge) has ever investigated the behavior of people when faced different situations with and without an insurance context: a risky situation (the probability of loss in known), an uncertain situation (there is no prior information on the probability of loss) or an ambiguous (the information provided is vague). Also, little systematic research has investigated differences in expressed attitude as a function of the manner in which vague probability information is communicated to a decision maker.

The experiments reported in this paper try to shed some light on this issue by analyzing choices within the framework of a purchase decision. It provides an example of a study of human behavior when aversion towards loss is considered. Rather than using the usual urn context, the experiments were constructed in a more consumer oriented decision of the purchase of a product (a bottle of wine) based on the posted price. Buying a bottle of wine is often marked by expectations and uncertainty as to its quality and subjects were given some background information on possible functional risks associated with the purchase of a bottle and only some groups were given the possibility to hedge the risk with the purchase of an insurance contract. The experiments reported in this paper are based on questionnaires distributed to 450 participants in multiple samples.

Even though there is no unanimous agreement on a precise definition of ambiguity, the imprecise information can either be with respect to the underlying probabilities or to the range of possible outcomes (Budescu et al., 2002; Du and Budescu, 2005; Onay et al., 2013). In this paper, the experiment assumes there is no ambiguity on the range of possible outcomes.

[8] Cabantous (2007) is to our knowledge the first paper to examine the comparative effects.

The paper is organized as follows. In the next two sections, we present a detailed explanation of the context that is used for the experiments and the experimental designs. We continue in section 4 with a discussion of our findings. Finally, in section 5, we draw conclusions and discuss the practical impact of our findings.

2. The context

Contrary to the rational choice theory of consumer behavior (Green, 2002), the agent in our analysis does not have a full set of alternative choices but only a limited choice, i.e. yes or no. Nevertheless, he/she is assumed to have his/her own utility function in a sense that he/she is assumed to make feasible choices that result in the highest possible value of his/her utility function. Monotonicity and transitivity are also assumed.[9] The framework of the analysis is static since it does not allow the agent to revise his/her decision in a second evaluation. Similar to the rational choice theory, the analysis allows for uncertainty about the choice.[10]

The experiments are conducted with undergraduate students using a questionnaire similar to the one originally tested by Hershey and Schoemaker (1980) and Loubergé and Outreville (2001). The context is the decision to purchase a bottle of wine (the price of which varies from $5 to $220). The purchase is considered in a tax-free zone of an airport rather than in a wine shop where the consumer usually can bring back the bottle. In a basic rational choice model the agent knows perfectly all the qualities of the goods under consideration. Buying a bottle of wine is often marked by expectations and uncertainty as to its quality. Risks include functional, such as the taste of the wine or the physical aspects of the product, social, such as being embarrassed is the quality is not adequate, financial because of the cost of the product. Gluckman (1990) contends that the act of purchasing wines is clouded with insecurity and many wine purchases therefore involve risk-aversion (Mitchell and Greatorex, 1988, 1989). Spawton (1991) suggests that with the exception of a few connoisseurs, most wine purchasers are highly risk-sensitive and their subsequent purchases are governed by risk-reduction strategies.[11]

In an experimental design, it is not possible to be completely confident that all subjects do indeed believe that the situation they are dealing with represents an unknowable uncertainty. Consumers

[9] On transitivity, see Birnbaum and Schmidt (2008).

[10] Readers are referred to Loomes et al, (2009) for more information on uncertainty in consumer choice

[11] Risk-reduction strategies in the purchase of wines include, selecting a known brand, recommendations, advice from retail assistants, undertaking wine appreciation education, pricing, packaging and labelling, getting reassurance through trials such as tastings and samples (Mitchell and Greatorex, 1989).

are also confronted with their own appreciations on the quality of wines, brands and vintages, which impacts on perceived risk (Speed 1998).

Accumulated theoretical and empirical evidence suggests that wine prices depend on quality, reputation and sensory characteristics (Combris et al., 1997 and 2000; Oczkowski, 2001; Jones and Storchmann, 2001; Schamel and Anderson, 2003; Cardebat and Figuet, 2004; Lecocq and Visser, 2006). Because wine is an experience good (Nelson, 1970; 1974), the quality of a bottle of wine is not directly observable in advance of purchase. Generally, price is also an important cue for quality when there is some degree of risk of making a wrong choice (Cox and Rich, 1967; Szybillo and Jacoby, 1974; Horowitz and Lockshin, 2002). In their model, Bagwell and Riordan (1991) conclude that if consumers lack information about quality, then a high quality product may signal its true type by its price.[12]

Similarly, the influence of price has been studied as one of the most important cues used consistently by consumers to predict quality, across a wide range of products (Verdú Jover et al., 2004; Kardes et al., 2004).[13] This price/quality relationship reflects consumers' strongly held belief that 'you get what you pay for' (Lee and Lou, 1996). Beyond the attributes of the wine and the situation, different consumers choose wine differently. Therefore, given the incomplete information on quality, price is probably used in this context by some students to overcome any perceived risk.

To assess the extent of risk taking related to the price of a bottle, subjects are required to indicate whether they accept to buy L Dollars a bottle of wine against the functional risk of buying a corked bottle and losing eventually *L* Dollars. The experiment is divided in two parts: 1) there no possibility to hedge the potential loss (no insurance) and 2) there is a possibility to buy an insurance contract (the price is determined in the question) to cover for the loss. For each part several experiments are conducted with more or less information given to the participants on the probability that the wine may have a functional risk (it is corked or corky). Little systematic research has investigated differences in expressed attitude as a function of the manner in which vague probability information is communicated to a decision maker (Kuhn, 1997). It is less known if changes in message presentation, without any change in the underlying problem

[12] See Roberts and Reagans (2007).
[13] See Veale and Quester (2008).

structure, influence how decision makers interpret uncertainty information. All experiments are distributed to different groups to avoid any memory or anchoring effect.

To assess the extent of risk taking related to the price of a bottle, subjects are required to indicate whether they accept to buy L Dollars a bottle of wine against the functional risk of buying a corked bottle and losing eventually *L* Dollars. The risky prospect is suggested by cases of 12 bottles that may or may not contain one corked bottle. A series of seven questions is used with wines valued $5, $10, $20, $50, $90, $140, $220. The high value is selected to be sure that the demand will be close to zero.[14] Each question required a choice between buying and not buying one bottle in a case. The answer is a statement of preference for which there is no right or wrong answer *per se*. The information given concerning the probability of having some risk of buying a corked bottle in a case is different in each experiment.

In this paper, *uncertainty* is defined as the lack of information concerning the source and probability of a potential functional risk (in the sense of Frisch and Baron, 1988). It is analogous to the urn problem defined in Ellsberg (1961). To illustrate this situation, consider the following set of the first three questions when no information is provided to the participants:

1) You want to buy a bottle of wine valued $5 in a case in which you do not know if there is a possibility that you may buy one corked bottle.
   Do you buy a bottle: YES NO

2) You want to buy a bottle of wine valued $10 in a case in which you do not know if there is a possibility that you may buy one corked bottle.
   Do you buy a bottle: YES NO

3) You want to buy a bottle of wine valued $20 in a case in which you do not know if there is a possibility that you may buy one corked bottle.
   Do you buy a bottle: YES NO

Known risk is defined as a situation of a known probability of buying a corked bottle, i.e. 1/12. The set of questions will provide known information about the probability as follows:

[14] To force the demand curve to reach zero for high values, the range was selected after a few trials with different scales from [5,500] to [5,180]

> You want to buy a bottle of wine valued $5 in a case in which the manager of the shop knows for sure that there is always one corked bottle (1/12).
> Do you buy a bottle: YES NO

Ambiguity is defined as a situation where there is *imprecision or vagueness* concerning the probability. It is similar to the definition by Curley and Yates (1985, 1986). The set of questions will provide known information about the probability as follows:

> You want to buy a bottle of wine valued $5 in a case and the manager of the shop knows that usually the probability of having a corked bottle varies between 2% and 8%.
> Do you buy a bottle: YES NO

Conflict is defined as a situation where there is controversy about the probability of the risk. Smithson (1999) introduces the distinction between ambiguity and conflict and Cabantous (2007), Cabantous et al. (2011) conducted similar kinds of experiments. The set of questions will provide known information about the probability as follows:

> You want to buy a bottle of wine valued $5 in a case and there is disagreement on the probability of the risk. One sale person knows that usually the probability of having a corked bottle is less than 2% but the other asserts that it is usually more than 8%.
> Do you buy a bottle: YES NO

3. The experiments: results

Experiments have been undertaken from October 2012 to May 2014 at the Business school at Sherbrooke University, Québec, Canada, with students enrolled in the undergraduate program, Finance classes. Each experiment was performed in different classes and therefore the context is a non-comparative environment as described in Fox and Tversky (1995). The total number of participants amount to 450, i.e. 325 questionnaires had no insurance context and 125 were designed in the same manner but within an insurance context. 36 students who did not want to buy wine at all. Only a few questionnaires were excluded from the sample because of inconsistent answers violating the assumption of monotonicity.

During the experiments, additional questions are used to determine subjects' risk attitudes and consistency among the different groups. Attached to each questionnaire are questions dealing with price habits (how much do you pay for a bottle of wine?), knowledge of the risk (a corked wine), perceived risk for a corked bottle and sex and age.

The average age in each group was between 21 and 22 years old (51% men). There is no significant difference among all the groups. To control for homogeneity among the groups a question was asking how much they would be willing to pay for a bottle of wine if invited by friends for a dinner. The average value per group varies from CAD$ 18.3 to CAD$ 20.8 with a mean of CAD$ 19.8.

It is interesting to note that the value given by the respondent could be considered as an arbitrary anchor. However, it is assumed that participants' relative valuations of the different amounts are orderly, coherent and that demand curves can be derived from the questions (Ariely et al., 2003).[15]

In this experimental design, it is possible that all subjects do indeed believe that they have some knowledge in the domain and that the situation they are dealing with is known to some extent so that ambiguity is less than expected (Heath and Tversky, 1991). Participants were asked if they had prior experience with a corked bottle of wine (on average 39% of participants answered positively) and to reveal their perceived probability of a bottle of wine to be corked (the average probability was 6.1% with a range of 5.0% - 7.8%).[16]

Participants were also asked to grade on a 5-point Likert scale how they perceived themselves compared to the group for three types of trait of character/personality:

1) Are you a risk-averse/risk-seeking person?
2) Are you careful with money/spending easily money?
3) Are you an optimist/pessimist person?

The impacts of these variables on the willingness to buy a bottle and on the willingness to pay for a bottle of wine are analyzed in appendix 1. Price habits is the only significant variable

[15] Ariely et al. (2003) report experiments with wine and note that subjects were able to know the difference between wine categories and they did know the relative ordering of the values of wine.
[16] Note that the known-risk situation (8.3%) is over the average value perceived by the groups.

explaining the willingness to buy a bottle of wine. The willingness to pay for a bottle is positively related to the price habits and negatively related to the perceived risk. Sex (Male) and the risk seeking behavior also influence positively the willingness to pay.

First experiment: a risky prospect

To assess the extent of risk taking when there is a known functional risk, subjects are required to indicate whether they accept to buy L Dollars a bottle of wine against the risk of buying a corked bottle and losing *L* Dollars with probability *P*. It is assumed that all of the students are familiar with the concepts of expected values and probabilities.

The risky prospect is suggested by a case of 12 bottles containing for sure one corked bottle (a probability of 1/12, a value slightly larger than the average value perceived by the participants). It is equivalent to an urn containing red and blue balls in known amounts. This first experiment is considered as the base-line situation in this paper

Second experiment: uncertainty or ignorance

The risky prospect is suggested by a case of 12 bottles that may or may not contain one corked bottle. The probability of having some risk of buying a corked bottle in this case is unknown. Each question required a choice between buying and not buying one bottle in this case. The answer is a statement of preference for which there is no right or wrong answer *per se*.

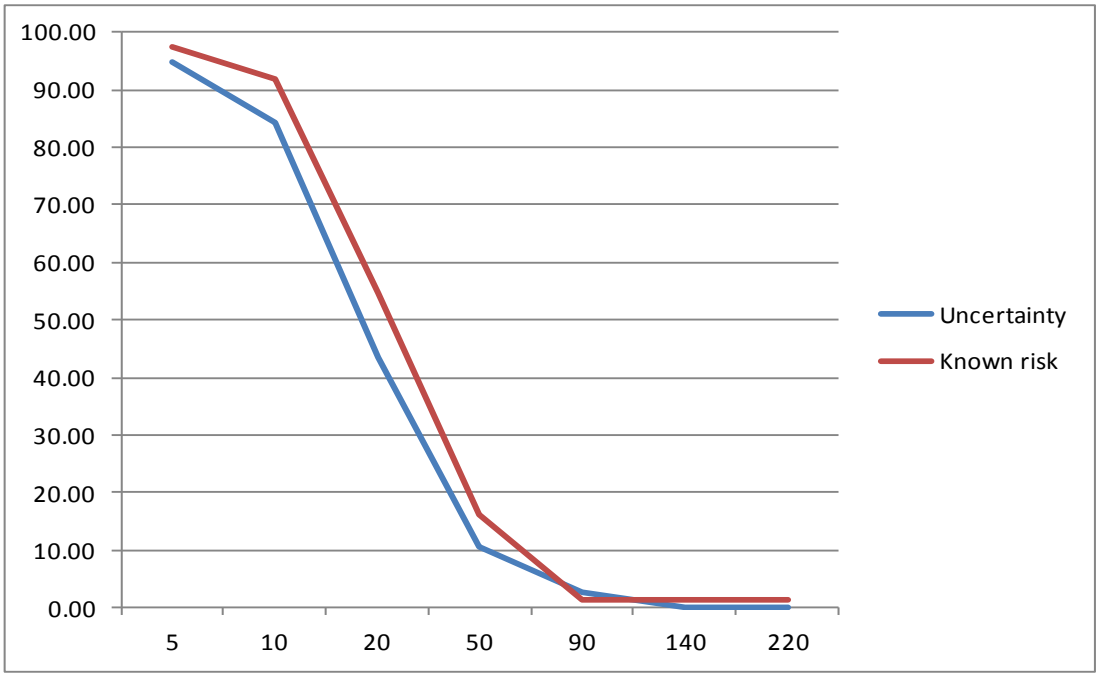
Results of experiment 1 and 2

As shown in figure 3.1 below, the demand function is negatively related to the price of a bottle and as expected by design tends towards zero. When potential buyers are facing a known functional risk, the demand curve is shifting upward as expected if people prefer a known situation to an unknown prospect.[17] A check of the average perceived risk for each group even shows that the average value for the known-risk situation is larger (7.4%) than the average value for the uncertainty situation (6.0%).

Insert figure 3.1 here

[17] Please note that the difference between the two curves is not significant for the lowest value ($5) not for the highest values ($90 and over).

Figure 3.1: The demand as a function of price with and without a risky prospect



Note: For the experiment with uncertainty the number of subjects is 76; for the experiment with a known risk the number of subjects is 75.

Third experiment: ambiguity

To assess the extent of risk taking when there is ambiguity about the occurrence of a functional risk, subjects are required to indicate whether they accept to buy L Dollars a bottle of wine against the risk of buying a corked bottle and losing *L* Dollars with given information about a possible range of probabilities. The probability of having some risk of buying a corked bottle is given as a range from 2% to 8%, below the known-risk situation.

The results presented in figure 3.2 show no significant differences between the known-risk context and the ambiguity context.[18] This result is explained by two possible reasons: 1) the maximum value in the ambiguity case (8.0%) is fixed just below the known-risk value (8.3%) in the second experiment. If subject anchor to the maximum value the difference between the known-risk situation and the ambiguity situation would be small;[19] and 2) the experiments are done within a non-comparative context. Ambiguity aversion is reduced when measured by

[18] This result contradicts the uncertainty effect demonstrated in Gneezy et al. (2006) or van Dijk and Zeelenberg (2003) showing that participants discount lotteries for uncertainty when facing the choice between a known situation and a range of probabilities for an uncertain outcome.

[19] Note that the average value of the perceived risk for the group dealing with the ambiguity situation (5.2%) is less than the average value for the group dealing with the risk-known situation (7.4%).

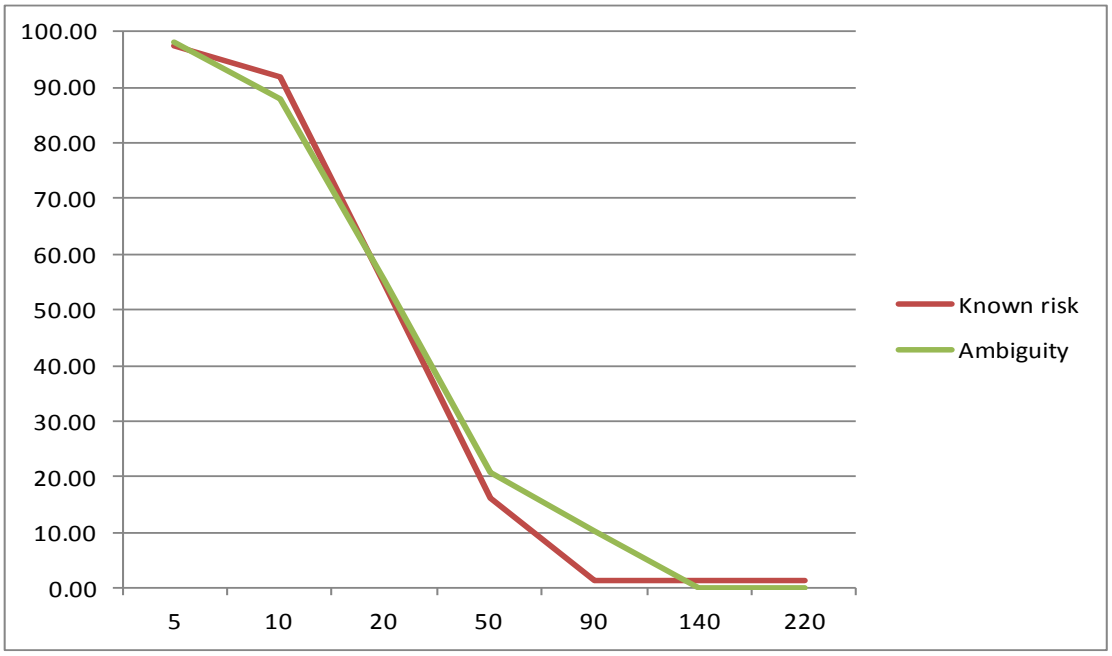
separate rather than by joint evaluations (Chow and Sarin, 2001; Fox and Weber, 2002; Du and Budescu, 2005) and according to Fox and Tversky (1995) ambiguity aversion is only significant in comparative contexts. Furthermore, when the context of the decision makes people feel confident about the situation, they become vagueness seeking.

Insert figure 3.2 here

To verify the effect of the range of probabilities on the level of ambiguity (Viscusi and Chesson, 1999; Di Mauro and Maffioletti, 2004), the probability of having some risk of buying a corked bottle is given as a range from 7% to 15%, over the known-risk situation. The results are presented in figure 3.3 and show a significant effect of the range of probabilities on ambiguity. Contrary to previous results, if subjects anchor to the risk-known situation, then the level of ambiguity is high.

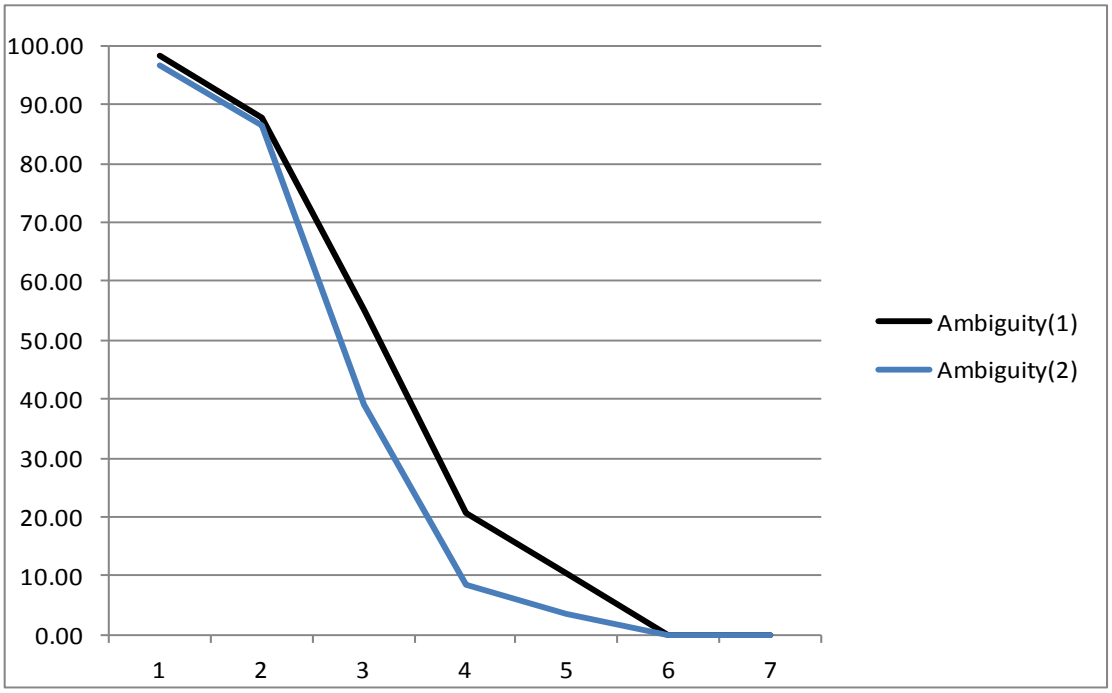
Insert figure 3.3 here

Figure 3.2: The demand as a function of price with an ambiguous situation



Note: For the experiment with a known-risk the number of subjects is 75 (as in figure 3.1). For the ambiguity situation the number of subjects is 58.

Figure 3.3: The demand as a function of price with two ambiguous situations



Note: Ambiguity (1) refers to the previous case (probabilities range 2-8%). Ambiguity (2) refers to the case of higher probabilities (range 7-15%). The number of subjects is identical.

Fourth experiment: conflict

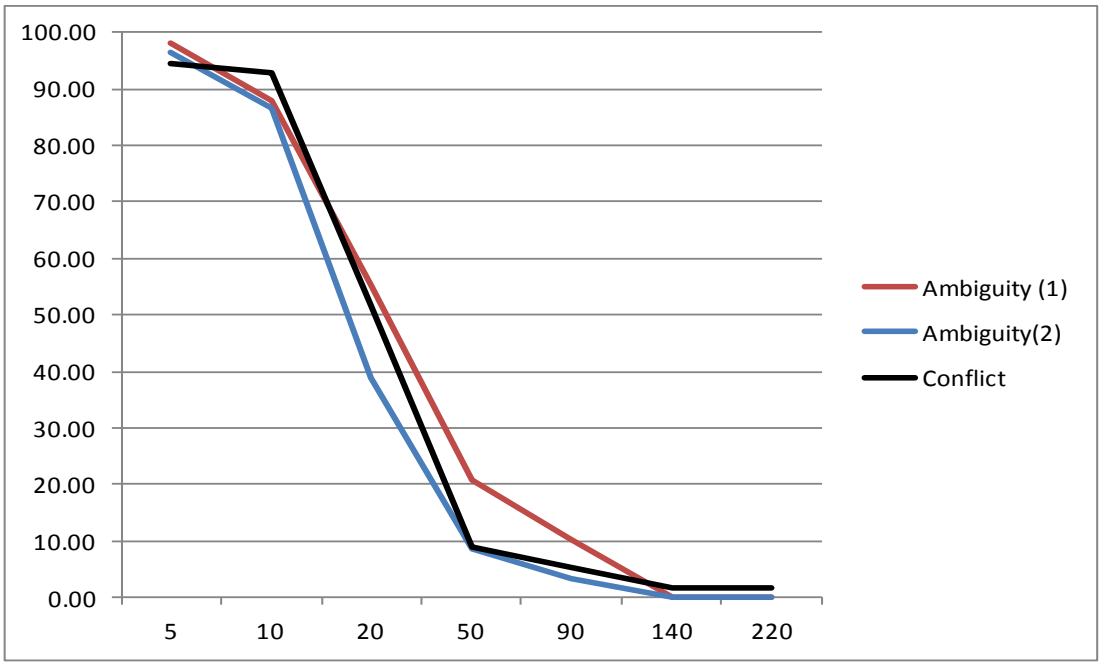
To assess the extent of risk taking when there is ambiguity and conflict about the occurrence of a functional risk, subjects are required to indicate whether they accept to buy L Dollars a bottle of wine against the risk of buying a corked bottle and losing *L* Dollars with given information about a possible range of probabilities.

The probability of having some risk of buying a corked bottle is given as a range from 2% to 8%, below the known-risk situation. However the source of information is given by two different experts: one sale person knows that usually the probability of having a corked bottle is less than 2% but the other asserts that it is usually more than 8%.

The results presented in Figure 3.4 show the impact of conflict when compared with the ambiguity (1) situation for the same range of probabilities. This confirms the hypothesis that people prefer ambiguity to conflict (Cabantous, 2007; Cabantou et al., 2011) for the same level of information on probabilities.

Insert figure 3.4 here

Figure 3.4: The demand as a function of price with there is conflicting information



Note: For the conflict situation the number of subjects is 56 and this experiment was the last performed in May 2014.

4. The impact of an insurance coverage

The analysis of insurance demand behaviors allows comparing the results when the information provided to the subjects is different. How does the insurance demand for ambiguous risks stand in comparison to insurance demand for well-known risks? This paper aims to reveal insurance demand behaviors, separating the attitudes toward risk, uncertainty and ambiguity (vagueness).[20]

In situations of known risk, the decision maker has enough information to estimate the probability distribution (p; 1-p). For risk adverse individuals and SEU preferences, the willingness to pay a premium π for full coverage of the loss L pay is strictly higher than the expected loss (pL*)* and there exists only one π that maximizes preferences (Mossin, 1968). In situations of ambiguous risk, the decision maker has an imprecise knowledge of the probability distribution. The information is defined as a set P of probability distributions in which lies the

[20] Related to this issue, behavioral aspects have also been considered to explain the impact of insurance prices on decision-making (Laury and McInnes, 2003), the choice in insurance purchasing (Szrek and Baron, 2007) or the preference for full-coverage policies (Shapira and Venezia, 2008).

true probability. The decision maker only knows that the probability of loss ranges between p_{min} and p_{max}. Several models have been proposed in order to model ambiguous situations.[21] With max-min preferences, the decision maker will only take into account the worst probability distribution and in terms of willingness to pay, a risk averse individual will have a maximum premium $\pi > p_{max}$ (Dupont-Courtade, 2012).[22]

According to these models of risk, imprecision and conflict, the decision maker should always prefer a precise situation over an imprecise one. Furthermore, he/she should always prefer an imprecise situation over a conflicting one. Therefore, the maximum premium the individuals are willing to pay should be the lowest in presence of risk, and it should increase with imprecision and even more with conflict.

In this section of the paper the same format is used for the questions. To alleviate the functional risk (in our experiment a corked bottle), an insurance policy is proposed and would reimburse the cost of the bottle. Subjects are required to indicate whether they accept to buy a bottle and insure against the risk of losing *L* Dollars with probability *P*. Each question also proposes a choice between buying and not buying the insurance contract when buying one bottle in the case.

In these experiments the probability of loss is known and the price of the insurance contract is the probability of loss multiplied by a transaction cost of 20%. The set of questions will provide known information as follows:

1. You want to buy a bottle of wine valued $5 in a case in which the manager of the shop knows for sure that there is always one corked bottle (1/12). Fortunately, there is an insurance policy which would reimburse your purchase if the bottle is corked.
   The cost of the insurance policy is 50 cents.
   Do you buy a bottle: YES NO
   Do you purchase the insurance policy with the bottle: YES NO

[21] Papers by Ghirardato et al. (2004) and Gajdos et al. (2008) review the expected utility models solving the decision maker problem in case of ambiguity aversion.
[22] Proof is given by the max-min expected utility model of Ghirardato et al (2004)

2. You want to buy a bottle of wine valued $10 in a case in which the manager of the shop knows for sure that there is always one corked bottle (1/12). Fortunately, there is an insurance policy which would reimburse your purchase if the bottle is corked.
   The cost of the insurance policy is $1.
   Do you buy a bottle: YES NO
   Do you purchase the insurance policy with the bottle: YES NO

As pointed out by many authors in similar experiments (Slovic et al, 1977; Shoegren, 1990; Loubergé and Outreville, 2001; Schade et al., 2004; Laury at al., 2009), it is reasonable to assume that some individuals will not bother to take out insurance for small losses. According to the EU theory, the utility cost of not purchasing insurance is higher for large unlikely losses than for small probable losses. Hence, insurance-proneness should decrease, as the possible loss becomes smaller.[23]

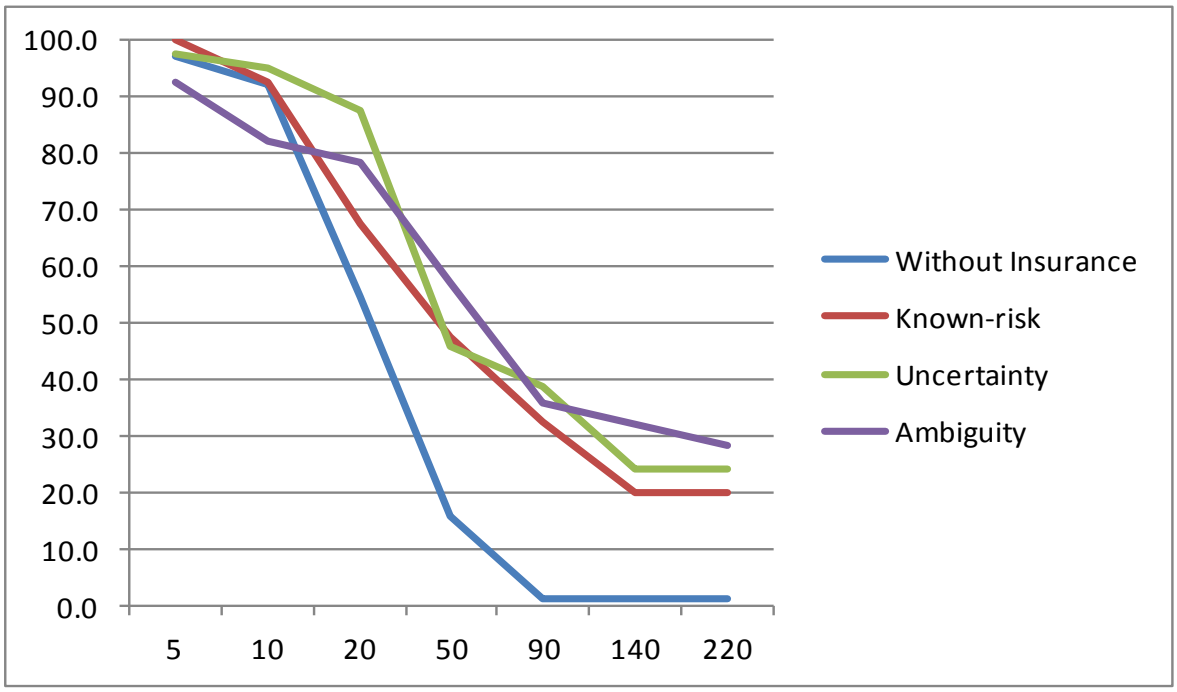
An analysis of the willingness to buy an insurance policy and on the willingness to pay for an insurance policy is presented in appendix 2. The willingness to buy an insurance policy is only significantly related to the willingness to pay for a bottle of wine. The willingness to pay for insurance is positively related to the willingness to pay for a bottle and negatively related to the risk-seeking behavior of the respondents.

When insurance coverage is introduced in a risk situation, the demand is increased. In our results the demand is shifted upward compared to the original situation with known risky prospect without insurance (figure 4.1). It is also interesting to note that the demand curve do not tends towards zero as in the previous situation without insurance. However, results do not show any significant difference between the risk-known situation, the uncertainty and ambiguity cases. The demand curves are not smoothly decreasing and small samples may be one reason for these results.

Insert figure 4.1 here

[23] Affect regarding the insured object may also have an impact on insurance decisions (Hsee and Kunreuther, 2000).

Figure 4.1: The demand with and without insurance



Note: The size of the groups are small and the number of subjects varied from 28 (ambiguity) to 40 (known-risk) and 42 (uncertainty).

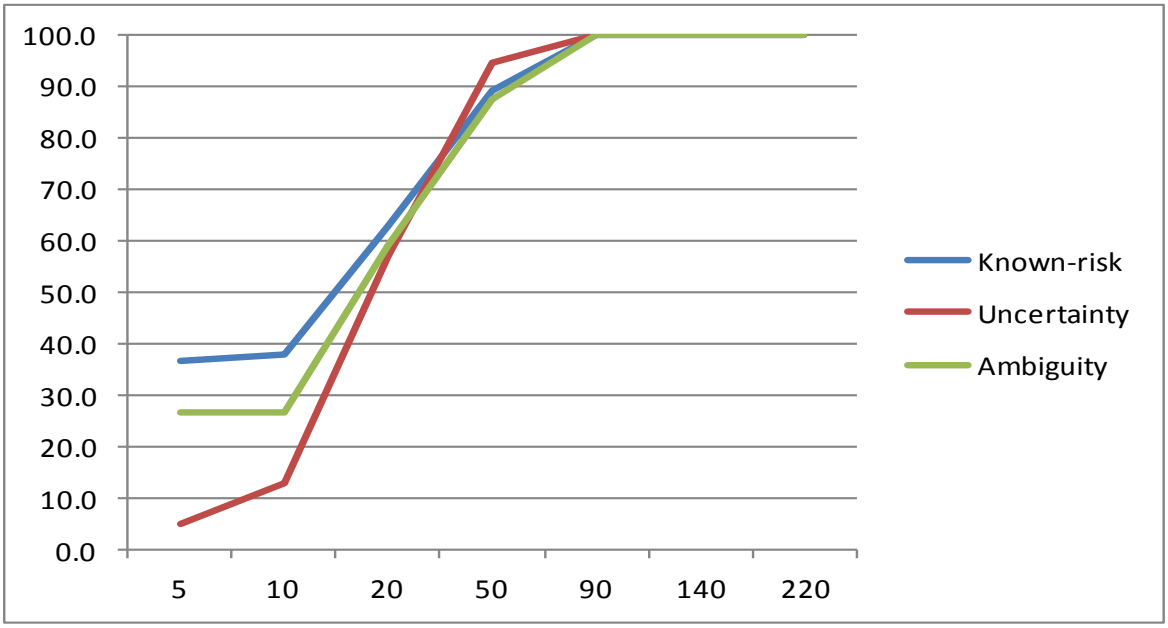
Among the 110 answers, only 28 (25.5%) never buy any insurance coverage. Although the price of insurance is increasing with the increased expected loss, the demand for insurance also increases with the expected loss (figure 4.2). All subjects buy the insurance policy with the bottle for values over $90. There is significant risk-taking for small expected losses but it remains unclear why individuals are buying insurance for very small claims as experimented in Huysentruyt and Read (2010).[24] Insurance-proneness increases sharply as the amount subject to loss grows. Hogarth and Kunreuther (1995) and Schade et al., (2004) find that valuation of insurance protection by consumers and/or firms is sensitive to the presence of uncertainty. Contrary to expectations, the comparative results do not provide support to ambiguity aversion but on the contrary provide support to the opposite literature. Di Mauro and Maffioletti (2001) study the impact of different definitions of ambiguity on the willingness to buy insurance and do not find significant differences between different representations of ambiguity. Wakker et al (2007) and Cabantous (2007) find ambiguity seeking in the willingness to take insurance, because

[24] Ciccheti and Dubin (1994) report the example of insurance for internal wiring protection (see also Rabin and Thaler, 2001). Cutler and Zeckhauser (2004) argue that insurance practice diverge from insurance in theory and provide examples where risks are insured that should not be and sometimes at excessive prices.

people prefer the more familiar option and that normal decisions are made without extra statistical information. Dupont-Courtade (2012) provide evidence that consumers buying insurance consider ambiguous situations as inferior and the willingness to pay decreases in situation of ambiguity (imprecision or conflict).

Insert figure 4.2 here

Figure 4.2: The demand for insurance, comparison between uncertainty and known-risk



Note: The size of the groups are small and the number of subjects varied from 28 (ambiguity) to 40 (known-risk) and 42 (uncertainty).

5. Discussions and conclusions

Not surprisingly, ambiguity has attracted quite a lot of attention from both economists and psychologists since real decision makers are often confronted with a decision environment where the probabilities of potential outcomes are not explicitly stated.

People exhibit a general preference for precision. If we assume that most people typically prefer options with precise information, a greater concern for avoiding losses may provide motivation for have a negative behavior towards vague or imprecise probabilities. Unlike the vast majority of previous work and laboratory gambles, this study explicitly compares numerical range of uncertainty within the same framework. The frame effect on preferences observed with verbal

qualification of point estimates also allows us to verify the effect of the range of probabilities on the ambiguity situation and the effect when there is conflicting information.

The experiments reported in this paper provide some evidence on the risk-taking behavior of consumers when information about the probability of loss is known, uncertain or ambiguous. The framing effect was obtained over a range of decisions and various sources of ambiguity The present study demonstrates that changes in the manner in which ambiguity or vagueness (in the sense of Kuhn, 1997) are presented, without any underlying change in problem structure, affects observed preferences.

The study also investigates the behavior of people when facing the same framework but different situations with and without an insurance context. When insurance coverage is introduced in a risk situation, the demand is increased. However, results do not show any significant difference between the risk-known situation, the uncertainty and ambiguity cases. Contrary to expectations, the comparative results do not provide support to ambiguity aversion but to ambiguity seeking. People prefer the more familiar option of a known-risk and normal decisions are made without extra statistical information (as in Wakker et al., 2007).

The results must, however, be viewed in the context of the study's limitations. Whether or not it is rational for people's decisions to be affected by probability uncertainty is a separate question. It does not necessarily imply that risk attitude is the same in all cultural environments. Further work could also possibly analyze the sensitivity of decisions to a variation in the range of probabilities.

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Appendix 1: The impact of knowledge and character on the willingness to buy and to pay for a bottle

Attached to each questionnaire are questions dealing with *price habits* (how much do you pay for a bottle of wine?), *perceived risk* for a corked bottle and sex and age. Participants were also asked to grade on a 5-point Likert scale how they perceived themselves compared to the group for three types of trait of character/personality:

1) Are you a risk-averse/risk-seeking person? (*risk-seeking)*
2) Are you careful with money/spending easily money? (*big spender)*
3) Are you an optimist/pessimist person? (*pessimist)*

Based on a sample of 152 subjects answering the questionnaires, a regression analysis was performed with a binary Logit analysis to estimate the willingness to buy a bottle of wine.

Table 1 appendix: The willingness to buy a bottle of wine
Method: Binary Logit-ML
Nb of observations: 152

Variable	Coeff	Z-Stat	Prob	
C	-0.7106	-0.47	0.638	
Price habits	0.1628	3.582	0.0003	***
Perceived risk	-0.0338	-0.587	0.557	
Male	-0.3101	-0.449	0.653	
Risk-Seeking	0.5657	1.387	0.165	
Big-spender	-0.4091	-1.213	0.225	
Pessimist	0.2541	0.7294	0.466	
Note: significant at 1% (***), 5% (**), 15% (*)				

Based on a sample of 136 subjects willing to buy a bottle, a regression analysis was performed with a Censored Tobit analysis (Maximum likelihood) because we are excluding individuals who are not interested in buying a bottle of wine (i.e., the dependant variable is censored). Results are presented in the following table.

Table 2 appendix: The willingness to pay for a bottle of wine
Method: Censored Tobit-ML
Nb of observations: 136

Variable	Coeff	Z-Stat	Prob	
C	1.449	3.104	0.002	
Price habits	0.0428	3.346	0.0008	***
Perceived risk	-0.0375	-2.172	0.029	**
Male	0.586	2.896	0.004	**
Risk-Seeking	0.1539	1.453	0.146	*
Big-spender	0.0533	0.468	0.626	
Pessimist	-0.1052	-0.979	0.327	
Note: significant at 1% (***), 5% (**), 15% (*)				

Appendix 2: The impact of knowledge and character on the willingness to buy and to pay for insurance

Based on a sample of 82 subjects answering the questionnaires, a regression analysis was performed with a binary Logit analysis to estimate the willingness to buy an insurance policy.

Table 3: Willingness to buy insurance
Method: Binary Logit-ML
Nb of observations: 82

Variable	Coeff	Z-Stat	Prob	
C	-1.5764	-0.884	0.376	
WTP for a bottle	1.4576	3.549	0.0004	***
Male	-0.1670	-0.242	0.808	
Risk-Seeking	-0.2533	-0.644	0.519	
Big spender	-0.2528	-0.760	0.447	
Pessismist	-0.1039	-0.337	0.736	
Note: significant at 1% (***), 5% (**), 10% (*)				

Based on a sample of 62 subjects willing to buy a bottle with the insurance contract, a regression analysis was performed with a Censored Tobit analysis (Maximum likelihood) because we are excluding individuals who are not interested in buying insurance (i.e., the dependant variable is censored). Results are presented in the following table.

Table 4: Willingness to pay for insurance
Method: Censored Tobit-ML
Nb of observations: 62

Variable	Coeff	Z-Stat	Prob	
C	-0.0392	-0.579	0.563	
WTP for a bottle	1.0154	123.620	0	***
Male	0.0700	2.135	0.033	
Risk-Seeking	-0.0710	-3.149	0.0016	***
Big spender	0.0376	2.282	0.023	**
Pessismist	0.0049	0.317	0.752	
Note: significant at 1% (***), 5% (**), 10% (*)				