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UNCERTAINTY, AMBIGUITY AND RISK TAKING: AN EXPERIMENTAL INVESTIGATION OF CONSUMER BEHAVIOR AND DEMAND FOR INSURANCE

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Uncertainty, Ambiguity and Risk Taking: 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 examine the behavior of people when faced with different situations with and without an insurance context: a risky situation (the probability of loss is known), an uncertain situation (there is no prior information on the probability of loss) or an ambiguous (the information provided is vague).

Keywords: Risk behavior; ambiguity aversion; insurance purchase.

JEL classification: C90, D81, D83, G22

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1. Introduction

"Is there, within each individual, a set of mental attitudes toward risk which consistently influence the risk taking behavior of that individual in a significant manner? To what extent do basic attitudes toward risk of individuals influence their risk taking behavior and in particular, insurance consumption behavior?" (Mark Greene, JRI 1964)

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

[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.

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 (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.

Recently, 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

[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).

[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).

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. In other words, people consider ambiguous situations as being inferior (Sarin and Weber, 1993).

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

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

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} .[8]

More recently, 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.[9]

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. Two urns are filled with red and black balls, Urn A containing 50 red and 50 black balls, and Urn B an unknown ratio of 100 red and black balls. Typically, 60–70% of decision makers prefer to draw from the risky Urn A, and experimental evidence has shown this effect to be powerful and robust (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).

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. The experiments were conducted with undergraduate students using a questionnaire similar to the one originally tested by Hershey and Schoemaker (1980) and Loubergé and Outreville (2001). 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.

[8] 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.

[9] 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.[10] 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.[11]

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.[12]

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

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

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

[12] 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 an enormous amount of changing information on 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.[13]

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).[14] 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

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

structure, influence how decision makers interpret uncertainty information. The 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.[15] 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:

[15] The range was selected after a few trials with different scales from [5,500] to [5,190]

> 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 knows that it is usually more than 8%.
> Do you buy a bottle: YES NO

3. The experiments: preliminary results

Experiments have been undertaken during the years 2012 and 2103 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 390, i.e. 265 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 or are inconsistent in their answer (they violate the assumption of monotonicity) were excluded from the sample.

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).[16]

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%).[17]

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?

[16] 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.
[17] Note that the known-risk situation (8.3%) is over the average value perceived by the groups.

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 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: 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*.

Second 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.

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.[18] 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%).

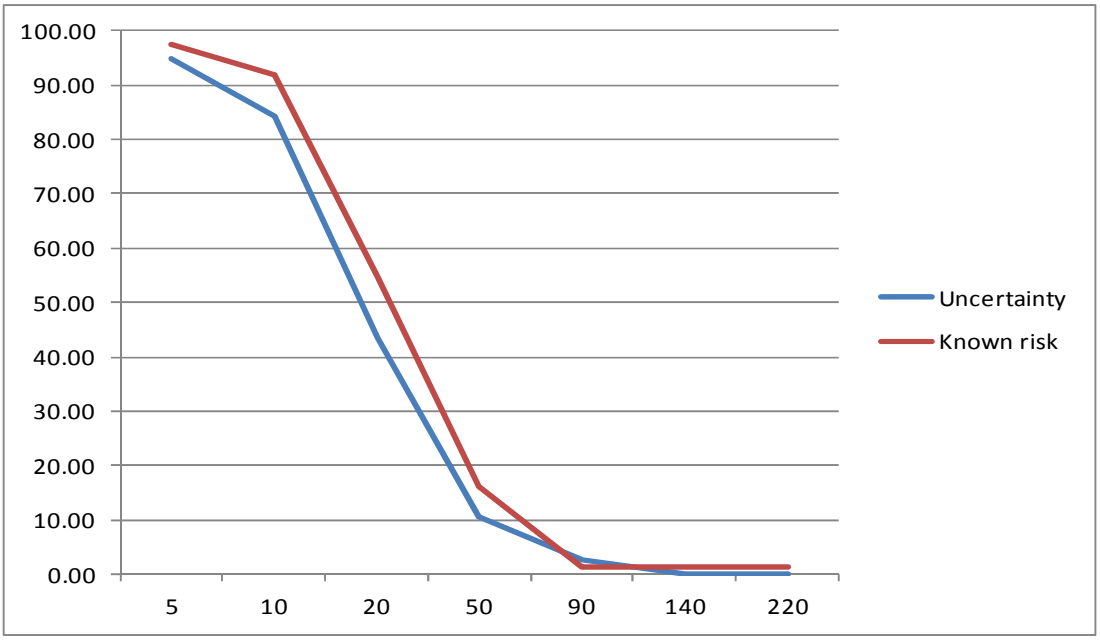
Insert figure 3.1 here

[18] 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).

Third experiment: a case of 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.

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. For both cases, two groups of experiments were performed in the fall term 2012 and the summer term 2013.

The results presented in figure 3.2 show no significant differences between the known-risk context and the ambiguity context.[19] 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;[20] and 2) the experiments are done within a non-comparative context. Ambiguity aversion is reduced when measured by

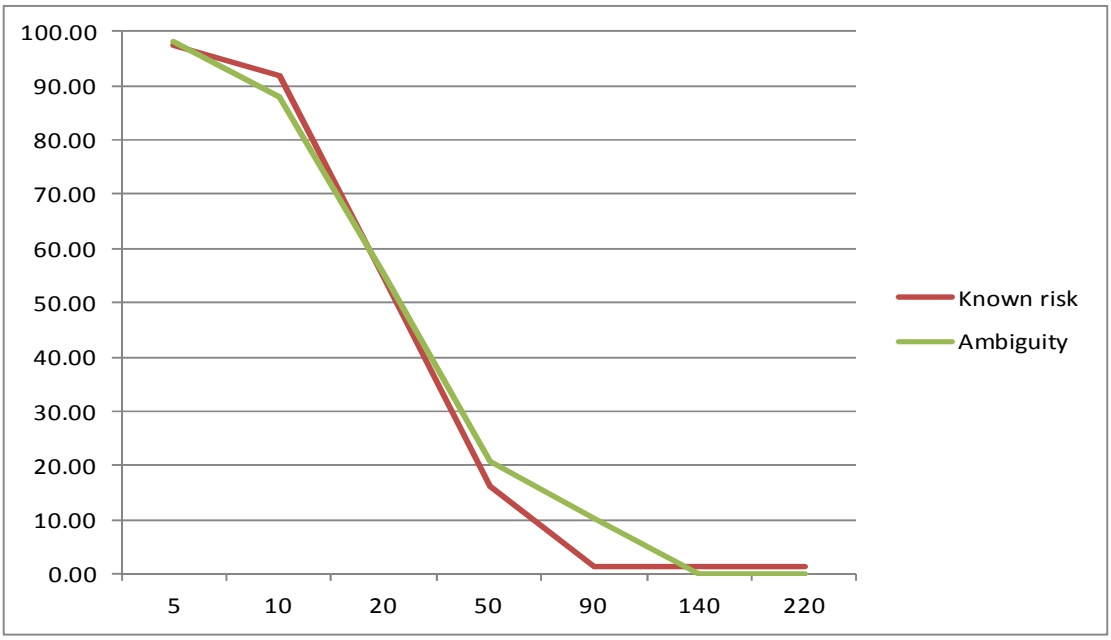
[19] This result contradicts the uncertainty effect demonstrated in Gneezy et al. (2006) or van Dijk and Zeelenberg (2003) showing that participants discount lotteries for uncertainty when facing the choice between a known situation and a range of probabilities for an uncertain outcome.

[20] 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

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 and the experiment was performed in September 2013.

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).[21]

[21] 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).

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 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.[22] 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).[23]

If an individual gives more weight on p_{max}, then the premium is higher in an imprecise situation than in a precise one. Conflict occurs when several experts are consulted to estimate the probability distribution, but they disagree on estimated values. Gajdos and Vergnaud (2013) have formalized decisions with conflicting information. In the insurance context with conflict, one expert gives a loss probability p_{min}, and the other p_{max}. There is no imprecise information but the decision maker is influenced by his/her attitude toward the experts' disagreement. Indeed, it reflects an arbitrage between the actuarial expected loss, which gives the same weight to both possible values of p, and p_{max} which allows to differentiate one expert over another.

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

[22] 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.
[23] Proof is given by the max-min expected utility model of Ghirardato et al (2004)

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 the first experiment 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

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

In the other experiments dealing with uncertainty and ambiguity, we assume that the probability of loss (a corked bottle) is decreasing with the value of the wine and therefore the insurance premium is held constant at $1 and is always equal to the expected value of the loss.

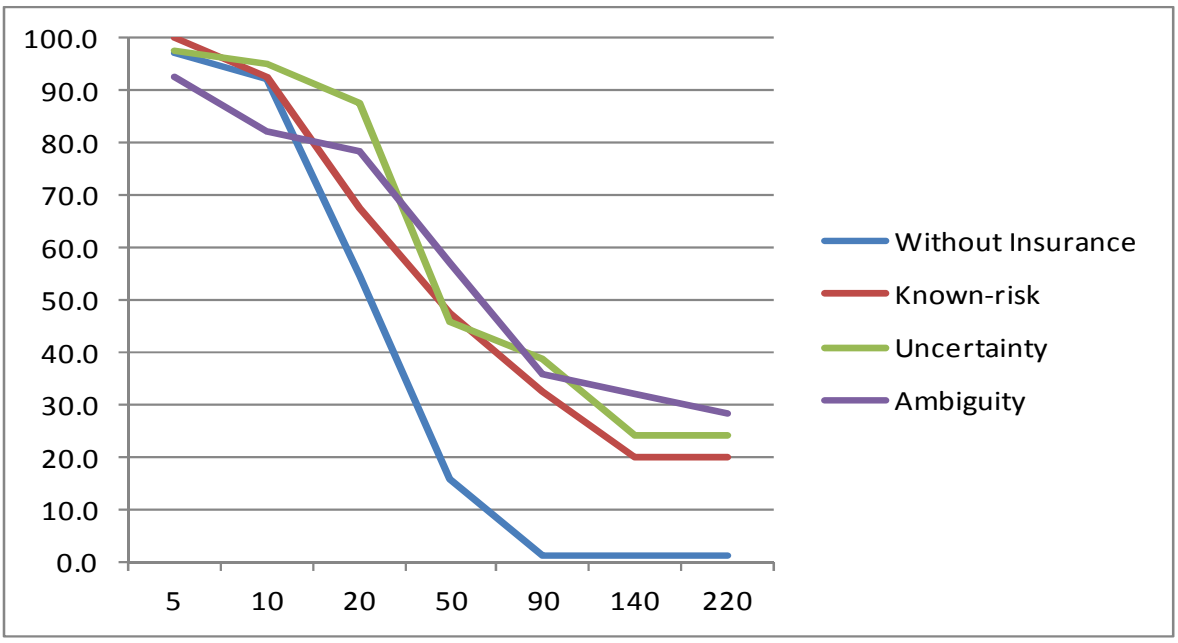
As pointed out by many authors in similar experiments (Slovic et al, 1977; Shoegren, 1990; Loubergé and Outreville, 2001; Schade et al., 2004; Laury at al., 2009), it is reasonable to assume that some individuals will not bother to take out insurance in two instances. First, according to the EU theory, 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. Second, subjects tend to neglect very small probabilities. In this case, they would refrain from insuring when the occurrence of loss seems remote.

It is important to invoke context effects. It has been observed that, in experimental studies, subjects exhibit more risk aversion when they are situated in an insurance context, rather than in a gamble context.[24] In our case, the content is unambiguously insurance-oriented. During the experiment, additional questions could be used to determine subjects' risk attitudes and consistency.

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 an unknown 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.

Insert figure 4.1 here

Figure 4.1: The demand for wine with and without insurance



Note: The experiments were performed in 2012 and 2013. The size of the groups are small and the number of subjects varied from 28 (ambiguity) to 40 (known-risk) and 42 (uncertainty).

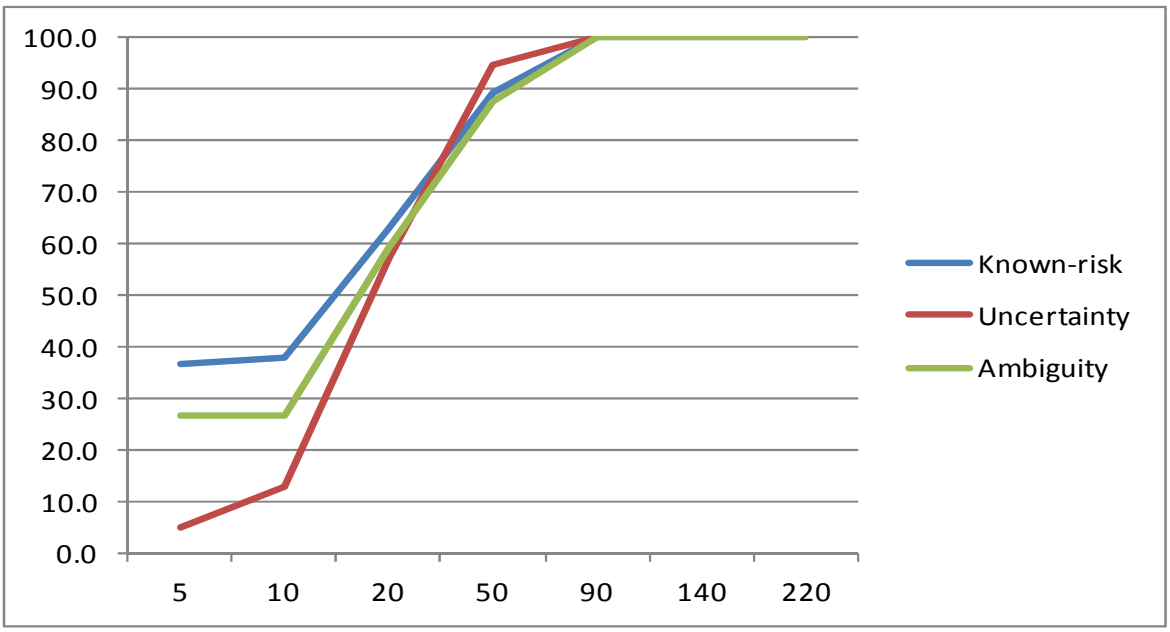
[24] Affect regarding the insured object may also have an impact on insurance decisions (Hsee and Kunreuther, 2000).

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 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.[25] In spite of this general tendency to assume risk, insurance-proneness increases sharply as the amount subject to loss grows.

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.

Insert figure 4.2 here

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



Note: The experiments were performed in 2012 and 2013. The size of the groups are small and the number of subjects varied from 28 (ambiguity) to 40 (known-risk) and 42 (uncertainty).
It remains unclear why individuals are buying insurance for very small claims.

[25] 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.

5. Preliminary conclusions

How people deal with conditions of ignorance or ambiguity is a relevant issue not only for the individuals who face such conditions but also for those who study how people make decisions. 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.

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 results must, however, be viewed in the context of the study's limitations. It does not necessarily imply that risk attitude is the same in all cultural environments.

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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% (*)				