

## Do “gut feelings” affect insurance demand?

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### Abstract

*This paper investigates whether an individual’s emotional profile affects their insurance decision making. We explore how the emotional reaction in conditions of ambiguity and the fear of the unknown affect insurance choices. We conducted psychophysiological experiments on a sample of 645 individuals and find evidence that these emotional variables offer contributions by increasing the predictive power of models for insurance demand, alongside traditional socioeconomic variables and psychographic traits. A selective role of emotional influence has been proven to exist when comparing different insurance policies, such as life, health, casualty and indemnity insurance.*

**Keywords:** insurance demand, ambiguity, emotional profile, neuroeconomics, psychophysiological experiment

## Introduction

How do “gut feelings”, or purely visceral factors (Loewenstein, 1996), affect insurance decisions? Almost all extant studies into insurance economics have neglected such questions. Theoretical papers, beginning with seminal works by Arrow (1963), Mossin (1968) and Smith (1968), omit the influence of emotions on insurance decisions. They mainly transfer assumptions of the Expected Utility Theory (EUT - Von Neumann and Morgenstern, 1944) to insurance choices. This neoclassical literature therefore assumes that individuals act as *rational* agents when selecting those alternatives with the highest expected utility, or value. Conversely, recent research in the nascent field of “neuroeconomics” (Loewenstein, 2000; Camerer, Loewenstein and Prelec, 2004; Rustichini, 2005; Camerer, 2008) has highlighted the role emotions play in decision making. Emotions are also referred to visceral factors, or “gut feelings”. Technology offers clinical instruments to deepen researchers’ knowledge of individual economic behaviour.

Empirical studies on insurance demand thus far are, in a sense, coherent with the neoclassical theoretical framework (Zietz, 2003); they tend to explain insurance behaviour by selecting those variables which indicate the rational participation of agents in the insurance market—e.g., demographic and economic features of individuals as an expression of a latent need for insurance. A few studies have followed an alternative approach. Burnett and Palmer (1984) enlarged the set of explanatory variables for insurance demand in order to include some psychographic drivers. They introduced a mix of personality, attitude and behavioural constructs, while still disregarding the role of emotions in insurance purchasing behaviour.

This paper empirically investigates whether a relationship exists between an individual's emotional profile and decision making related to the purchasing of insurance. Our purpose here is to learn if psycho-physiological measures of emotions can improve the predictability of customers' demand for insurance, alongside traditional socioeconomic variables and psychographic traits, already explored.

When thinking about events potentially covered by insurance (such as the likelihood of death, illness or robbery), individuals face a situation of *ambiguity* rather than one of risk, in which the probabilities of possible outcomes are measurable and known. In fact, ambiguity, as originally defined by Knight (1921), is that specific point of uncertainty from which probabilities of possible outcomes are “unknown” (a “not-measurable” uncertainty). We believe that ambiguity is a condition which best fits with insurance-related decision making. Actually, individuals, unlike insurance companies, may not have perfect confidence in the perceived probability of possible outcomes due to the simple lack of experience, or the lack of available information, or data with which to make an informed decision (Hogarth and Kunreuther, 1989).

Coherently, we analyse the *emotional reaction in a condition of ambiguity* and look for evidence that this personal condition is able to predict the willingness of an individual to buy (or not to buy) an insurance, taking socioeconomic and personality features under control. Moreover, we observe a proxy for the individual *fear of the unknown*, following neuroeconomics evidence of Camerer, Loewenstein and Prelec (2004), who found a differential emotional activation in gambles with “unknown” probabilities.

We exploit clinical instruments developed in the field of neurology (Bechara, Damasio and Damasio, 2000; Bechara and Damasio, 2002) in order to obtain grounded

measurements for our new potential drivers of insurance demand -the *emotional reaction in condition of ambiguity* and the *fear of the unknown*. We made use of the Iowa Gambling Task (IGT) coupled with the Skin Conductance Response (SCR), a validated experimental task for observing “gut feelings” which affect decision making. This device appears particularly pertinent to this study because the experiment is technically divided into two phases (Suhr and Buelow, 2009): an early phase during which individuals learn to make choices but without yet possessing any explicit knowledge about contingencies to guide their decision (*decision under ambiguity*), and a later phase in which the risks are more explicit (*decision under risk*). The first phase of the task, from which we derived our emotional indicators, replicates in a laboratory setting that side of uncertainty (*ambiguity*) that is more consistent with the individual insurance behaviour.

Our contribution to the existing literature is two-fold. Firstly, we explicitly promote an interdisciplinary approach to study insurance decision making by adding a set of psycho-physiological variables to the traditional socioeconomic determinants in order to predict insurance demand, as well as to the personality traits already explored. Secondly, the variety of insurance products may indicate different hedging behaviours in relation to different ambiguous expected events. Coherently, we separately examine the demand for both life and non-life insurance; additionally we distinguish among non-life products on the basis of the underlying pure risk covered (life, health, casualty and indemnity insurance). Previous studies instead focused primarily on life insurance (see Zietz, 2003), thus precluding the drawing of valid comparisons across different insurance behaviours.

The remainder of this article is organized as follows. In the following, we offer a review of studies which have dealt with the demand for insurance, from both theoretical and empirical perspectives. Then, we describe the methodology followed in our experiments and formalize our predictive models of insurance demand. Afterwards, we discuss results and conclude.

## **The role of emotions in the demand for insurance**

The demand for insurance products has been investigated from both a theoretical and an empirical point of view. In both cases, however, the role played by the emotions of subjects has been implicitly disregarded.

From a theoretical perspective, the assumption that the demand for insurance products follows a rational cognitive model has prevailed for a long time. The theoretical foundation of insurance demand is based on the EUT, where the optimal choice is arrived at by computing the expected utility for each alternative and then selecting the one which possesses the highest value (Von Neumann and Morgenstern, 1944). The underlying assumption is that decision making involves rational Bayesian maximization of expected utility, where humans are supposed to be equipped with unlimited knowledge, time and information-processing power. In such a theoretical framework, it has been well established that a risk-averse individual will purchase full-insurance when the insurance contract is fairly priced and less-than-full-insurance when the premium includes some additional costs (Mossin, 1968). The “Prospect Theory” of Kahneman and Tversky (1979) casts doubt over this long-standing, normative view of economic decision making by suggesting that people tend

to make decisions on the basis of deviations (gains or losses) from a reference point (value function), as opposed to basing them on their final wealth (utility function). Moreover, it poses that people tend to be risk averse in the gain domain and risk seeking in the loss domain. Such a framework acts to make insurance less attractive than if one were to employ a utility function since the decision involves comparisons being made in the loss domain, where a person is assumed to be risk-prone. Other theorists have identified psychological processes, such as regret or disappointment, as important factors in explaining individuals' insurance choices. Braun and Muermann (2004) proposed a theoretical model for insurance demand, for instance, which was meant to illustrate how individuals with regret-theoretical preferences adjust away from the extremes of full-insurance and no-insurance coverage. Huang, Shih and Tzeng (2012) explore similar choices under the state of disappointment. All of these studies, however, share essentially similar cognitive foundations, and they do not depart from the fundamental cognitive assumption of the EUT—i.e., the maximization of the utility/value attributed to each event, with a restricted meaning of the utility/value to be maximized. In fact, the original foundation of what came to be known as EUT was based on the idea that people established their *values for wealth* on the basis of the pain and pleasure those values would give them; however, these “emotional” notions of pleasure and pain were eliminated from subsequent utility/value economic models, with such models subsequently neglecting their own conceptual bases (Bechara and Damasio, 2005).

Extant empirical studies on insurance demand are, in a sense, coherent with the prevailing cognitive theoretical foundation. Such studies examine the determinants of households' insurance demand using micro-level data on (or changes

in) the amount of insurance purchased as a function of various predictor variables (e.g., Goldsmith, 1983; Gandolfi and Miners, 1996; Lin and Grace, 2007; Li, Moshirian, Nguyen and Wee, 2007; Gutter and Hatcher, 2008; Liebenberg, Carson and Dumm, forthcoming). A common feature of these studies is their focusing of attention primarily on the demographic and economic factors which underpin insurance demand, with a specific focus on life insurance products. Furthermore, empirical results are not always consistent across studies and, in many cases, the influence of socioeconomic variables on insurance demand has been found to be positive, negative or not significant, depending on the model or the specific subset of variables (for a review, see Zietz, 2003).

Despite the growing body of empirical literature regarding the determinants of insurance consumption, the role played by emotions and feelings has attracted limited attention, mainly due to the trickiness of detecting these interpersonal differences in a sample of individuals. These subjective features are generally referred to as psychographic variables and they have been employed successfully in a few insurance-related empirical studies (Anderson and Nevin, 1975; Ferber and Lee, 1980; Burnett and Palmer, 1984). The most comprehensive work is that of Burnett and Palmer (1984), which takes into account 21 separate psychographic variables considered to be influential in determining life insurance demand, defined by combining personality, attitude and behavioural constructs. This study concluded that owners of large amounts of life insurance tend not to be opinion leaders, to be geographically stable, to be greater risk takers, not to be price conscious, to have low self-esteem, to be less assertive, not to believe in fate, not to be brand loyal and not to depend heavily on the government. The authors also underline the fact that, by including psychographic

variables alongside traditional demographic ones, the explanatory power of the model in predicting the amount of life insurance owned was enhanced. No emotional indicators were included in the psychographic set of variables, however, leaving the question of how emotional processes influence insurance choices still not investigated.

On the contrary, emerging neuroeconomic evidence suggests that sound and rational decision making also depends on prior accurate emotional processing (Bechara and Damasio, 2005). Loewenstein, Weber, Hsee and Welch (2001) have argued that decision making is influenced by “hot/cold” states. In the “hot” state decisions are driven by affect, while in the “cold” state decisions are driven by cognition. The crucial point is to think of behaviour as resulting from the interaction of affective and cognitive processes—i.e., a module that chooses and a module that gauges whether the choice sounds “good” or “bad” based on underlying schemes (Camerer, Loewenstein and Prelec, 2004). A widely-cited study by Bechara, Damasio, Tranel and Damasio (1997) illustrates such a collaboration between affective and cognitive systems: persons who are lowest in emotional activity (or even those who have a disconnection between affective and cognitive processing) are also less effective (or even unsuccessful) at learning to avoid disadvantageous choices. Theoretical models (e.g., Loewenstein and O’Donoghue, 2004; Berhabib and Bisin, 2005) as well as empirical instruments have therefore been developed to investigate how these affective features impact choices (see Camerer, Loewenstein and Prelec, 2004). An effort to study affective influences in purely monetary decisions was reported on by Hsee and Kunreuther (2000); the affection people have for an object was found to be a further factor influencing utility and choices, alongside the monetary value of the item. This paper offers an incremental contribution to the knowledge of these

interactions, observing individual psycho-physiological behaviours under conditions of ambiguity and focusing on those economic choices that relate to insurance decisions.

## **Methods**

We observed the emotional and insurance behaviour of an assorted and qualified sample of individuals: customers of banks/financial advisors, traders, bankers, financial advisors and asset managers. More than 800 individuals were asked to take part in the experiment and 645 did so, with neither obligation nor reward. The unique criterion for accepting people to the experiment was that they recognize themselves as being responsible for insurance decisions for themselves and their families (properly, households). The width of the sample is relevant considering our use of psycho-physiological tests. Lo and Repin (2002), for example, examined 10 subjects for a similar experiment; Lo, Repin and Steenbarger (2005) considered 33 individuals; Bechara and Damasio (2002) compared 46 substance-dependent individuals, 10 subjects with lesions of the ventromedial prefrontal cortex and 49 normal controls.

The individual's emotional profile has been investigated with a psycho-physiological test—namely, the Iowa Gambling Task (IGT) combined with the measurements generated using the Skin Conductance Responses (SCR), as was done by Bechara and Damasio (2002). By doing so we were able to evaluate subject's physiological responses while they made ambiguous/risky choices. Individuals were asked to make a sequence of 100 decisions from four alternative decks with different risk/reward combinations. According to the qualification stipulated by Bechara and

Damasio (2002:1677), two of these decks (deck A and deck B) were defined as being, '*in the long run disadvantageous*', because the risks they contained were not adequately rewarded and, at the end of the task, individuals who preferred these decks 'lost'; conversely, decks C and D were defined as '*advantageous*', because the risks these decks contained were adequately rewarded. Study participants who preferred those decks were considered to have 'won' the task. No real money was given to participants. However, a similar performance pattern emerges when real money instead of fake money is given, as shown by Bowman and Turnbull (2003). Note that gains obtained by the IGT decks are very small, in this fake money; while losses are frequently of considerable amount.

During the first 20 choices, individuals behaved in a condition of complete *ambiguity* (Suhr and Buelow, 2009) because they neither knew the typical risk/reward combination of each deck nor the probability of its outcomes; the following 80 choices are considered to have been made under risk because individuals, coherent with the Somatic Marker Hypothesis (SMH; Damasio, 1994), learned from their somatic activations which deck to prefer, pursuant to their emotional risk aversion (Brighetti, Lucarelli and Uberti, 2012).

Our data set was then integrated with additional information collected by means of a traditional questionnaire. The questionnaire comprised two main sections: one was addressed to investigate some personality traits, also by the use of Barratt Impulsiveness Scale (BIS-11; Patton, Stanford and Barratt, 1995)<sup>1</sup>; the other one aimed at collecting information on the socioeconomic condition of the individual, including specific item on current insurance coverage. Here, the question was made in such a way as to exclude compulsory insurance coverage (such as vehicle insurance).

## Models and variables

We build four probit models which include an incremental set of explanatory variables organized in matrices/vectors: matrix **S**, which includes some of the most relevant socio-demographic variables observed in the extant literature; matrix **P**, which embraces variables describing certain personality traits; vector **U**, which consists of our proxy for the *fear of the unknown*; and finally, matrix **E**, which comprises indicators for the *emotional reaction in conditions of ambiguity*.

$$\text{Models } 1_j \text{ (M1}_j\text{): } \Pr (I_j = 1|S) \quad (1)$$

$$\text{Models } 2_j \text{ (M2}_j\text{): } \Pr (I_j = 1|S, P) \quad (2)$$

$$\text{Models } 3_j \text{ (M3}_j\text{): } \Pr (I_j = 1|S, P, U) \quad (3)$$

$$\text{Models } 4_j \text{ (M4}_j\text{): } \Pr (I_j = 1|S, P, U, E) \quad (4)$$

$I_j$  indicates the underwriting of different insurance contracts, where  $j$  goes from 1 to 4, with the following meaning:

$I_{1 (j=1)}$ : life insurance

$I_{2 (j=2)}$ : health insurance

$I_{3 (j=3)}$ : casualty insurance

$I_{4 (j=4)}$ : indemnity insurance

### ***Socio-economic drivers of insurance demand***

Matrix **S** considers the socioeconomic variables which are generally used to explain or predict insurance demand. Table 1 sorts the lists of these vectors/variables, which kind of condition is observed in the estimated probit model and the main descriptive features of our sample.

*<insert Table 1 around here>*

The relationship between *age* and insurance is ambiguous. Berekson (1972), Showers and Shotick (1994), Baek and DeVaney (2005), for instance, have all found that the effect of age on life insurance demand is positive and significant, whereas Ferber and Lee (1980), Bernheim (1991), Chen, Wong and Lee (2001) and Lin and Grace (2007) have demonstrated a negative and significant relationship. Hammond, Houston and Melander (1967), Duker (1969), Anderson and Nevin (1975) and Burnett and Palmer (1984), meanwhile, have argued that age is not a significant factor in the decision to purchase life insurance. We can assume that insurance demand increases up to a certain age and then decreases as individuals get older; this is because, at first, an individual needs more protection when he/she is first married or first has children. As they age, however, their accumulated wealth may come to be sufficient for the needs of the survivor and the subject is increasingly less likely to have a dependent to protect. Furthermore, as Burnett and Palmer (1984) outlined, although older people may want to leave an inheritance, they may be faced with budget constraints due to their approaching retirement. Since age may thus exert conflicting effects, we assume that age is not a significant determinant of insurance purchasing.

The literature on *gender* implies the existence of meaningful differences between husbands and wives in their demand for life insurance functions (Gandolfi and Miners, 1996). Although income is the most significant determinant of life insurance holdings for both husbands and wives, there is evidence that contributions to household production also influence the purchasing of life insurance.

Furthermore, *degree* has been added as a variable because most researchers (e.g., Hammond, Houston and Melander, 1967; Ferber and Lee, 1980; Burnett and Palmer, 1984; Gandolfi and Miners, 1996; Baek and DeVaney, 2005; Li, Moshirian, Nguyen and Wee, 2007; Lin and Grace, 2007) have agreed that there is a positive relationship between education and life insurance demand, as education tends to be a good predictor of long-term earning ability. Browne and Kim (1993) have explained that a higher level of education results in a greater awareness of the importance of risk management, thereby highlighting the benefits of insurance coverage. Anderson and Nevin (1975), however, identified a negative association between education and the amount of life insurance purchased, while Goldsmith (1983) concluded that households in which the wife has received more education are less likely to purchase insurance on their husband's lives. The overall effect of education on insurance holdings thus remains uncertain.

As far as working condition (*Employee/Management professional/Stable contract variables*), previous studies have consistently concluded that if household heads (or husbands) are employed, more life insurance will be purchased by individuals or households (e.g., Hammond, Houston and Melander, 1967; Mantis and Farmer, 1968; Duker, 1969; Ferber and Lee, 1980; Fitzgerald, 1987; Liebenberg, Carson and Dumm, forthcoming). Prompted by these evidences, we developed a

further hypothesis which distinguishes between the type of occupation and type of labour contract. As far as the former distinction, we differentiated between those individuals who are employees and those who have management positions. Thereby, we try to investigate if the responsibility position within the labour market might act to induce people to be more security-conscious and more interested in insurance coverage. As far as the latter distinction, we separated those who have stable labour contacts from those who do not in order to see if insurance consumption might serve as a substitute for government or labour union assistance. We expected a positive sign for the variable related to managing profession and a negative sign for those with a stable labour contract.

We also added a variable which considers the absence or presence of *dependents* (*No family weight*), as family size and number of children were found to be significant explanatory variables in determining the demand for life insurance in many studies (e.g., Hammond, Houston and Melander, 1967; Ferber and Lee, 1980; Burnett and Palmer, 1984; Showers and Shotick, 1994; Li, Moshirian, Nguyen and Wee, 2007; Liebenberg, Carson and Dumm, forthcoming). Burnett and Palmer (1984) noted that, as the number of children increases, the amount of insurance purchased also increases. The exceptions relative to this position are marginal (see, e.g., Anderson and Nevin, 1975). We therefore assume that the protection of dependents against financial hardship is a remarkable force in driving life insurance consumption and insurance consumption in general; by extension, we expected a negative sign for those individuals without dependents (family weights).

Among the socioeconomic variables considered, we included those which indicate the economic power or stability of the individual in terms of income, financial

wealth and real estate. *Income* is commonly found to be positively related to the demand for life insurance when other factors are held constant (e.g., Duker, 1969; Ferber and Lee, 1980; Burnett and Palmer, 1984; Truett and Truett, 1990; Showers and Shotick, 1994; Gandolfi and Miners, 1996; Li, Moshirian, Nguyen and Wee, 2007; Liebenberg, Carson and Dumm, forthcoming). Along with serving to increase the affordability of insurance products—specifically in reference to life insurance—a large income results in a greater need for income replacement in the event of an unexpected death of or other hardship to the household’s major wage earner. We have also assumed that, as income increases, new types of risk arise; for example, consumers may buy more expensive houses or incur greater professional responsibilities than they had previously. We thus may assume a positive relationship between income and insurance demand.

The role of *financial wealth* in the demand for insurance is less clear. Some studies have suggested that there is a positive relationship between financial worth and the decision to purchase life insurance (e.g., Duker, 1969; Anderson and Nevin, 1975; Hau, 2000); the underlying assumption is that the risk aversion of an individual increases with wealth (*increasing relative risk aversion – IRRA*), so that an increase in wealth will increase an individual’s willingness to insure. Conversely, other empirical studies have supported the idea that the relationship between financial wealth and insurance demand is negative, especially in the area of life insurance (Fortune, 1973; Lewis, 1989); the reason being that households with greater wealth may have a greater ability to hedge against the financial losses which might result from an adverse event, thereby reducing the individual’s willingness to insure (*decreasing absolute risk aversion – DARA*; see, Chavas, 2004). The mingling of these two effects

leaves the relationship between financial wealth and insurance demand still ambiguous to us.

Home ownership (*real estate value*) has been found to be positively related to the amount of insurance held (Anderson and Nevin, 1975; Ferber and Lee, 1980; Gandolfi and Miners, 1996). We assume that the real wealth of an individual, however, should not be expected to positively influence all types of insurance in the same way; we expect a positive influence only for those policies focused on the protection of material assets, with an increasing effect as the value of real wealth increases.

### ***Psychographic drivers of insurance demand***

Matrix **P** includes variables which attempt to capture the effects of certain personality traits, selecting only certain items from the list of Burnett and Palmer (1984). Restrictions were imposed due to time constraints - the span of the psychophysiological experiment as the IGT/SCR test takes more than thirty minutes- and for reasons of parsimony.

We selected the variable *woe* to testify to any peculiar psychological attitude due to the memory of bad odds eventually realized in recent times, in terms of accidents, misfortune or disgrace. These negative events may result in a more vivid need to insure, while exacerbating pessimism and fear for the future. Secondly, we included the variable *trust* to directly testify as to whether the individual holds a sense of trust for the future, as Burnett and Palmer (1984) found a link between a condition of general trust and participation in the insurance market. Third, we included the variable *impulsivity*, as some clinical studies have suggested a link between

impulsivity and decisions made under conditions of uncertainty (Franken, Van Strien, Nijs and Muris, 2008). The extant literature suggests that highly impulsive individuals are biased toward immediate rewards during option evaluation and are less sensitive to the negative consequences of their choices (Martin and Potts, 2009). With specific reference to financial decisions, the lack of self-regulation and a lower propensity for considering future outcomes of current behaviours are found to be negatively influencing long-term financial decisions (Howlett, Kees, Kemp, 2008). As stated above, we had study participants complete the BIS-11 questionnaire of Patton, Stanford and Barratt (1995). The BIS-11 is based on 30 items and is designed to assess general impulsiveness by taking into account its multifactorial nature. In our model, we opted to omit the total score of impulsivity and to introduce instead the component scores which measure different aspects of impulsivity: 1) non-planning impulsiveness (*bisnpln*), which reflects a lack of planning for the future; 2) motor impulsiveness (*bismotn*), which reflects a tendency to act without forethought; and, 3) attentional impulsiveness (*biscogn*), which is largely characterised by a selective concentration on one aspect of the environment while ignoring other aspects. Impulsivity scores have been normalized within a [0–1] range. Table 2 offers basic descriptive information on the variables included in our model.

*<insert Table 2 around here>*

### ***Behaviours under ambiguity: the fear of the unknown***

Vector **U** and Matrix **E** refer to our innovative variables that indicate the individual's behaviour under conditions of ambiguity. Following the approach used by

both Suhr and Buelow (2009) and Bechara, Tranel, Damasio and Damasio (1996), we split the overall IGT/SCR experiment, based on 100 choices, into two sub-periods. We computed our variables by selecting only observations referred to in the sub-period of the first 20 decisions, which has been defined as a condition of *choice under ambiguity*. Knight (1921) maintained that ambiguity (or “unmeasurable uncertainty”) prevailed in situations in which the decision maker ignored the statistical frequencies of events relevant to the decision; or, when a priori calculations were impossible; or, when the relevant events were in some sense unique. This is precisely the case of individual decisions concerning insurance—such decisions are often made with only a vague knowledge of the probabilities of loss, as outlined separately by Hogarth and Kunreuther (1989) and Koufopoulos and Kozhan (2010).

Literature discussing ambiguity intensifies with Ellsberg’s paradox (Ellsberg, 1961), in which people were found to generally prefer gambles with *known* rather than *unknown probabilities*—that is, people preferred to participate in risky rather than ambiguous choices. Ambiguity aversion has been subsequently confirmed in a variety of experimental settings, as reported, for example, by Einhorn and Hogarth (1985), Sarin and Weber (1993), and Chow and Sarin (2002). Di Mauro and Moffioletti (2001) found that additional information about event probabilities might influence, at least marginally, the propensity of individuals to insure themselves. Neuroeconomic evidence also supports the assumption of differential activation when people face choices under conditions of certainty rather than as ambiguous gambles (Hsu and Camerer, 2004), thus suggesting a neurological basis for “fear of the unknown” to influence choices (Camerer, Loewenstein and Prelec, 2004).

Hence, we include the vector  $\mathbf{U}$  as a proxy for the *fear of the unknown*. This variable summarizes the willingness an individual shows to explore unknown alternatives when the IGT task remains ambiguous. Given that IGT offers four alternative decks (A, B, C and D), our *fear of the unknown* indicator is related to the variation among these choices, within the first 20 decisions made. We assume that, if an individual is strongly “afraid of the unknown”, they should repeatedly select from the same deck, disregarding the others (variance of choices’ frequency = 0.25). Conversely, if an individual is scarcely “afraid of the unknown” and wishes to exploit ambiguous situations, they would be expected to select equally from among each of the four decks (variance of choices’ frequency = 0.0), as shown in Table 3:

*<insert Table 3 around here>*

Our indicator for the *fear of the unknown* ( $fu$ ) has been normalized to range from 0 to 1 and has been defined as follows:

$$fu_i = \frac{\text{var}(\text{CHOICES}_{i,t_a})}{\text{var}_{\max}(\text{CHOICES}_{t_a})} \quad (5)$$

Where:

$fu_i$  = *fear of the unknown* for individual  $i$ ;

$\text{var}(\text{CHOICES}_{i,t_a})$  = variance of choices’ frequency made by individual  $i$  among the four decks (A, B, C and D) within the period of ambiguity,  $t_a$ , referring to the first 20 decisions;

$\text{var}_{\max}(\text{CHOICES}_{t_a})$  = maximum variance of choices’ frequency among the four decks (A, B, C and D), within the period of ambiguity,  $t_a$ , referring to the first 20 decisions (i.e. = 0.25).

We would expect that the higher the fear of the unknown of an individual, the higher the probability they ask for insurance coverage in order to be contractually protected from their “state of mind”. Table 4 offers some basic descriptive statistics of this variable drawn from our sample.

*<insert Table 4 around here>*

### ***Behaviours under ambiguity: the emotional reaction under ambiguity***

Finally, Matrix **E** includes those variables that indicate the *emotional reaction in condition of ambiguity*. During the first phase of the experiment (under ambiguity), individuals began to somatically learn from their experience of gratification and regret, according to Damasio’s SMH (Damasio, 1994). Their skin conductance response (SCR) reacted to gains and losses after they became apparent; but individuals could profile neither whether some deck was able to ensure a persistent risk/reward combination nor the likelihood of gain and loss associated with each choice. Hence, in this way we reproduced a laboratory setting of ambiguity. We computed the mean and the standard deviation of the SCR signals recorded after gains (*mscrg20* and *dsscrg20*, respectively) and after losses (*mscrl20* and *dsscrl20*, respectively) within the period of the first 20 choices made, and we assumed that these variables were indicative of individual emotional reactions under the condition of ambiguity. We felt the inclusion of both moments of the SCR distribution (the first and the second) was justified because the ambiguity period is quite short (20 choices) and gains/losses are not always so frequent; we thus enlarged our dataset by including mean and dispersion measures of the individuals’ somatic activations. Moreover, we considered somatic

activations after both gains and losses even if insurance behaviour is driven primarily by negative events. We assume that the greater the emotional reaction to losses, the higher the interest in or request for insurance, as a consequence of a sort of “fear of ruin/loss” (for a theoretical definition of “fear of ruin/loss”, see Li, 2010); conversely, the higher the emotional reaction to gains (small gains, in our case), the less the demand for insurance due to individuals perhaps being unwilling to pay what is asked by insurance contracts in premiums (even a coin, for them, is emotionally relevant). Values for these variables are shown in Table 5.

## Discussion of results

This paper seeks evidence that emotions affect an individual’s willingness to hedge a pure risk—i.e., mainly to ask for an insurance contract. We therefore estimate models from (1) to (4) and investigate any capability of our innovative variables (mainly vector  $\mathbf{U}$  and matrix  $\mathbf{E}$ ) to predict individual insurance choices. Moreover, we explore some peculiar pure risk hedging behaviour in relation to those situations which individuals can expect to face with regard to life, health, casualty and indemnity insurance, respectively.

Probit estimations of our models are provided in Table 6, by insurance product (Table 6.a, life insurance; Table 6.b, health insurance; Table 6.c, casualty insurance; and, Table 6.d, indemnity insurance).

*<insert Tables 6.a 6.b 6.c 6.d around here>*

Overall, personality traits, fear of the unknown and emotional reactions to gains/losses under conditions of ambiguity clearly improve the predictability of insurance behaviours. This evidence is shown by the incremental R-square ( $R^2$ ) of our estimated models when adding Matrices **P**, **U** and **E**, to the plain-vanilla model **S** (see Table 7). The most relevant contribution in terms of increase in the predictive power of our models, on average, comes when we add matrix **E** (models SPUE show an  $R^2$  average increase of 2.10% as compared to models SPA). This means that, among the psycho-physiological variables, emotional reactivity under ambiguity is the most relevant to explaining or predicting the willingness to hedge a pure risk—i.e., the willingness to buy insurance protection.

*<insert Table 7 around here>*

The relevance of emotions varies, moreover, in relation to the peculiar sides of pure risk being hedged—i.e., according to different insurance contracts. For *health insurance*, for example, pseudo  $R^2$  jumps up noticeably when considering personal traits (**P** matrix, plus 1.25% in pseudo  $R^2$ ). Table 6.b shows that this is due primarily to the (minor) impulsivity of individuals. Both BIS motor, used in models 2 and 3, and BIS not planning, from model 4, significantly affect the probability of an individual seeking out a health insurance contract. This implies that, when underwriting such insurance contracts, a relevant driver is the ability to control impulsive decisions and to plan for the future; this is more relevant than any other consideration about fear of the unknown or emotional reactivity to ambiguous gains/losses, which never result significant in health insurance models.

The individual emotional reaction to gains/losses in condition of ambiguity conversely appears to be particularly relevant for *casualty* and *indemnity* insurances

(marginal pseudo  $R^2$  contributions of 3.18% and 2.67%, respectively, when comparing SPUE models with SPU models). This implies that the more individuals somatically activate themselves (suffer) for losses in condition of ambiguity (i.e., being unable to forecast the likelihood of these losses), the more likely it is that they will seek to hedge the risk damages pose to their wealth, or the risk of being sued pursuant to their professional responsibilities. Finally, our indicator for the fear of the unknown increased the  $R^2$  of SPU models, compared to SP ones, only when considering *indemnity* insurance. In fact, models in Tables 6 show that the *fu* variable holds a significant and positive effect (as expected) only on asking for or seeking out *indemnity insurance*. This might be due to the fact that, for this kind of pure risk (damages sought due to professional responsibility), the willingness to avoid the “unknown” plays a significant role.

Signs of relationships between insurance behaviours and emotional variables are in line with expectations. In order to discuss our results, remember that the IGT pay-off is set according the general rule that losses are of large amount, and gains are of small amount.

Limited to *life* and *casualty* insurance contracts, we find an important evidence: that the more individuals experienced fluctuations of their somatic activations after losses (i.e. they emotionally reacted to losses)<sup>2</sup>, the higher the probability they underwrite an insurance contract. This means that, *ceteris paribus*, an emotional profile inclined to suffer for losses drives the demand for *life* and *casualty* insurance contracts.

Moreover, for *casualty* insurance an interesting (negative) relationship of insurance underwriting and reaction to gains is also remarkable. This means that,

*ceteris paribus*, an emotional profile inclined to rejoice even for *small* gains (the ones of the IGT experiment) may restrain the request for insurance; we suppose that this should be due to their emotional reluctance to spend money on an insurance premium.

Individuals with a strong degree of *trust* in the future are found to prefer self-protective measures (rather than market insurance), renouncing external protections for their wealth (negative sign of variable trust, Table 6.c). On the contrary, trust seemed to intensify insurance requests when considering *life insurance* (in line with Burnett and Palmer, 1984), perhaps because individuals correlate “good projections about the future” with increased values of reimbursement related to life insurance investments.

We also note that relationships observed here between insurance behaviours and socio-demographic variables are mostly in line with those noted in the existing literature. Firstly, the absence/presence of dependents (*familial weight*) is systematically significant in predicting the likelihood of hedging any kind of pure risk. In our model, by moving from having to not having familial weight, we observed a reduction in the likelihood of buying a life insurance policy, from 12% to 15%; from 19% to 22% for the purchase of health insurance; from 17% to 23% for buying casualty insurance; and, from 14% to 16% for buying indemnity insurance.

Secondly, variables indicating the *professions* of individuals often served to predict the likelihood that they might seek out an insurance contract. Engagement in a managerial career tended to be a significant predictor of the hedging of *life* and *indemnity risk*; the chance of being a manager increases the probability of buying a life or an indemnity insurance contract. This is in line with Koeniger (2004) where householders with higher labor income risk spend more on insurance. Conversely,

being an employee or pensioner reduces the likelihood of hedging against health care risk. In the first case, because being an employee moves the burden of the risk to the public sector; in the second case, because ageing makes the hedging against this kind of risk too costly. This last explanation is supported by the income variable, being significantly and positively related to the probability of hedging the health risk, at least in the first two models (S, and S,P; Table 6.b).

Finally, variables indicating *economic* and *financial power* are seldom significant. For example, the availability of relevant financial wealth is never significant in predicting insurance demand. This is coherent with suggestions that financial wealth “is” one possible means of hedging pure risk that works as a substitute for insurance (e.g., Fortune, 1973). Conversely, the availability of valuable real-estate significantly predicts the hedging of *casualty risk* (that is, the risk related to damages to wealth). The chance of holding real estate over the median value of our sample increases the probability of buying casualty insurance from 22% to 24%. This result is obvious, in retrospect, as holding the source of the risk (wealth) “is” the reason to hedge that risk and indirectly supports the results of Hsee and Kunreuther (2000), who had previously suggested the relevance of consumer affection for the object to be insured.

## **Concluding remarks**

How do “gut feelings” affect insurance decisions? This paper opens with this question and empirically investigate whether there is any relationship between individual emotional profile and insurance decision making. We have submitted

psycho-physiological experiments on a large and qualified sample of more than 600 individuals. We propose two proxies of individual behaviours relevant in insurance choices: the *emotional reaction in condition of ambiguity*, measured by the skin conductance response experienced by individuals after gains and losses in condition of ambiguity; and the *fear of the unknown*, measured by their attitude of exploring “unknown” alternatives, among a given set. We find evidence that these variables offer a contribution by increasing the predictive power of models for insurance demand, especially when deployed alongside traditional socioeconomic variables and psychographic traits previously explored. Nevertheless, large differences among policies are uncovered. In fact, a selective role of emotions exists when comparing different kinds of pure risk to be hedged—i.e., different insurance policies to underwrite.

Health insurance, for instance, seems not to be influenced by emotional variables, but the individual’s psychological attitude in planning for the future is shown to play a strong role. Conversely, fear of the unknown plays a significant role for indemnity insurance, indicating this fear exerts a dominant influence in driving such hedging behaviour. The emotional reaction to loss has been found to significantly affect insurance behaviour as far as life and casualty policies are concerned. The more deeply individuals somatically (emotionally) suffer for losses, the more likely they are to hedge out of fear of losing their life, or suffering robberies/damages to their wealth.

Overall, our findings hold a strong relevance for insurance economics because we contribute in understanding interactions of rationality and emotion, and their mixed role in affecting decision making under ambiguity. More over, the proof that emotions affect the insurance demand should be of interest also at the operational

level: on the individual side, because self-consciousness, together with knowledge and education, is the way to increase the consumer financial self-protection; on the institutional side, because the awareness of emotional drivers in the financial decision making should be incorporated in modern insurance policy measures.

**Table 1- The socioeconomic variables (Matrix S)**

Variables of matrix S	Observed condition					
		Obs	Mean	Std. Dev.	Min	Max
age	Age relative to 100	645	0.44	0.12	0.18	0.82
				<b>Freq.</b>	<b>Percent</b>	
		<b>Overall sample</b>		<b>645</b>	<b>100</b>	
gender	Male as opposed to female	Males		509	78.91	
		Females		136	21.09	
degree	College graduate compared to not	Not degree		313	48.53	
		Degree		332	51.47	
empl_pens	Employees and pensioners as opposed to other professions	Other professions		422	65.43	
		Employ.s and pensioners		223	34.57	
managing_prof	Managers and professionals as opposed to other professions	Other professions		440	68.22	
		Manag.s and professionals		205	31.78	
no_famw	Being free of familial weights as opposed to holding them	With family weights		357	55.35	
		Free of family weights		288	44.65	
stable_wcont	Having a stable working contract as opposed to not	No stable work.contract		332	51.47	
		With stable work.contract		313	48.53	
HInc	High income (higher than the median)	Low income		322	49.92	
		High income		323	50.08	
HFW	High financial wealth (higher than the median)	Low financial wealth		349	54.11	
		High finan. wealth		296	45.89	
HVRE	High value of real estate ((higher than the median)	Low real estate value		414	64.19	
		High real estate value		231	35.81	

**Table 2- Personality traits (Matrix P)**

Variables of matrix P	Observed condition	Overall sample					Freq.	Percent
		Obs	Mean	Std. Dev.	Min	Max	645	100
woe	Having suffered a recent disgrace or similarly adverse event versus not	Absence of personal woe					549	85.12
		Presence of personal woe					96	14.88
Trust	Having trust in the future versus not	No trust in the future					100	15.5
		Trust in the future					545	84.5
bisnpln	Normalized BIS score non-planning impulsiveness	645	0.25	0.04	0.15	0.36		
bismotn	Normalized BIS score motor impulsiveness	645	0.19	0.03	0.11	0.34		
biscogn	Normalized BIS score attentional impulsiveness	645	0.14	0.03	0.08	0.24		

**Table 3- The computation of the fear of the unknown- an example**

	Choices					Choices' frequency				Variance of Choices' frequency
Max fear of the unknown	20	0	0	0	1	0	0	0	0	0.25
Min fear of the unknown	5	5	5	5	0.25	0.25	0.25	0.25	0.25	0.00

**Table 4- Fear of the unknown (Vector U)**

Vector U	Description of the variable	Obs	Mean	Std. Dev.	Min	Max
fu	Fear of the unknown	645	0.125	0.1628	0	1

**Table 5- Emotional risk attitude (Matrix E)**

Variables of matrix E	Description of the variable	Obs	Mean	Std. Dev.	Min	Max
mscr20	Mean SCR recorded after gains, within the IGT phase under ambiguity (first 20 choices sub-period)	645	22.413	18.464	0.713	100.449
dsscr20	Standard deviation of SCR recorded after gains, within the IGT phase under ambiguity (first 20 choices sub-period)	645	16.064	13.142	0.276	122.053
mscr120	Mean SCR recorded after losses, within the IGT phase under ambiguity (first 20 choices sub-period)	628	30.100	31.017	0.290	299.866
dsscr120	Standard deviation of SCR recorded after losses, within the IGT phase under ambiguity (first 20 choices sub-period)	527	12.854	14.636	0.000	122.168

**Table 6.a Probit regression, reporting marginal effects – Life insurance**

	M1 Matrix S		M2 Matrices S, P		M3 Matrices S, P, U		M4 Matrices S, P, U, E	
	dF/dx	Std.Err.	dF/dx	Std.Err.	dF/dx	Std.Err.	dF/dx	Std.Err.
gender#	-0.084 *	0.050	-0.093 *	0.050	-0.094 *	0.050	-0.097 *	0.055
agen	0.011	0.208	0.027	0.211	0.033	0.211	0.092	0.236
degree#	-0.036	0.042	-0.037	0.043	-0.035	0.043	-0.015	0.049
empl_pens#	-0.068	0.052	-0.051	0.053	-0.049	0.053	-0.016	0.059
managing_prof#	0.120 **	0.048	0.131 ***	0.048	0.129 ***	0.048	0.160 ***	0.053
no_famw#	-0.131 ***	0.042	-0.128 ***	0.043	-0.128 ***	0.043	-0.151 ***	0.047
stable_wcont#	-0.081 *	0.045	-0.089 **	0.045	-0.089 **	0.045	-0.091 *	0.050
Hinc#	0.052	0.047	0.044	0.048	0.043	0.048	0.025	0.054
HFW#	0.046	0.047	0.049	0.047	0.046	0.047	0.069	0.052
HVRE#	0.010	0.048	0.009	0.049	0.011	0.049	0.001	0.055
woe#			-0.021	0.057	-0.024	0.057	-0.043	0.064
trust#			0.134 **	0.056	0.135 **	0.056	0.120 *	0.063
bisnpln			-0.458	0.629	-0.419	0.630	-0.876	0.736
bismotn			-0.395	0.691	-0.408	0.691	-0.375	0.777
biscogn			0.090	0.821	0.050	0.822	0.432	0.920
fu					0.109	0.128	0.073	0.136
mserg20							-0.003	0.003
dsserg20							0.004	0.005
mscrl20							-0.002 *	0.001
dsscrl20							0.005 **	0.002
Number of obs =	645		645		645		527	
LR chi2(10) =	47.46		54.57		55.30		57.82	
Prob > chi2 =	0.0000		0.0000		0.0000		0.0000	
Log likelihood =	-423.347		-419.793		-419.427		-336.303	
Pseudo R2 =	0.053		0.061		0.062		0.079	

**Table 6.b Probit regression, reporting marginal effects – Health insurance**

	M1 Matrix S		M2 Matrices S, P		M3 Matrices S, P, U		M4 Matrices S, P, U, E	
	dF/dx	Std.Err.	dF/dx	Std.Err.	dF/dx	Std.Err.	dF/dx	Std.Err.
gender#	-0.039	0.050	-0.053	0.051	-0.053	0.051	-0.043	0.056
agen	-0.006	0.210	-0.007	0.214	-0.007	0.214	-0.022	0.237
degree#	-0.006	0.043	-0.009	0.043	-0.009	0.044	-0.026	0.049
empl_pens#	-0.129 **	0.052	-0.126 **	0.052	-0.126 **	0.053	-0.146 **	0.058
managing_prof#	-0.012	0.049	-0.010	0.049	-0.010	0.049	-0.015	0.055
no_famw#	-0.196 ***	0.042	-0.195 ***	0.042	-0.195 ***	0.042	-0.229 ***	0.046
stable_wcont#	0.065	0.045	0.053	0.046	0.053	0.046	0.035	0.050
Hinc#	0.117 **	0.047	0.111 **	0.047	0.111 **	0.047	0.074	0.054
HFW#	-0.016	0.047	-0.028	0.047	-0.028	0.047	0.004	0.052
HVRE#	0.045	0.048	0.046	0.049	0.046	0.049	0.024	0.055
woe#			-0.093	0.057	-0.093	0.057	-0.094	0.063
trust#			0.063	0.058	0.063	0.058	0.028	0.066
bisnpln			-0.914	0.631	-0.914	0.632	-1.644 **	0.737
bismotn			-1.206 *	0.696	-1.206 *	0.696	-1.019	0.780
biscogn			0.790	0.822	0.790	0.823	1.279	0.915
fu					-0.001	0.126	0.008	0.133
mserg20							-0.002	0.003
dsserg20							0.005	0.004
mscrl20							-0.0002	0.001
dsscrl20							0.0001	0.002
Number of obs =	645		645		645		527	
LR chi2(10) =	53.49		64.68		64.68		58.71	
Prob > chi2 =	0.0000		0.0000		0.0000		0.0000	
Log likelihood =	-420.330		-414.735		-414.735		-335.817	
Pseudo R2 =	0.060		0.072		0.072		0.080	

**Table 6.c Probit regression, reporting marginal effects – Casualty insurance**

M1 Matrix S			M2 Matrices S, P		M3 Matrices S, P, U		M4 Matrices S, P, U, E	
	dF/dx	Std.Err.	dF/dx	Std.Err.	dF/dx	Std.Err.	dF/dx	Std.Err.
gender#	0.055	0.050	0.052	0.050	0.052	0.050	0.101 *	0.054
agen	-0.003	0.209	-0.050	0.211	-0.053	0.211	-0.263	0.237
degree#	-0.042	0.042	-0.051	0.043	-0.052	0.043	-0.063	0.049
empl_pens#	0.016	0.052	0.011	0.053	0.010	0.053	-0.004	0.059
managing_prof#	0.016	0.049	0.015	0.049	0.016	0.049	0.018	0.055
no_famw#	-0.176 ***	0.042	-0.178 ***	0.042	-0.178 ***	0.042	-0.236 ***	0.046
stable_wcont#	0.054	0.045	0.051	0.045	0.051	0.045	0.018	0.050
Hinc#	0.063	0.047	0.067	0.047	0.067	0.047	0.070	0.054
HFW#	-0.052	0.046	-0.058	0.047	-0.057	0.047	-0.051	0.052
HVRE#	0.241 ***	0.047	0.247 ***	0.047	0.246 ***	0.047	0.223 ***	0.054
woe#			-0.012	0.057	-0.010	0.057	0.000	0.063
trust#			-0.082	0.058	-0.083	0.058	-0.129 *	0.066
bisnpln			-0.161	0.627	-0.181	0.628	-0.649	0.727
bismotn			-0.225	0.692	-0.221	0.692	-0.735	0.779
biscogn			-0.821	0.827	-0.800	0.828	-0.511	0.926
fu					-0.058	0.124	-0.088	0.131
mscrg20							0.003	0.003
dsscrg20							-0.009 *	0.005
mscrl20							0.001	0.001
dsscrl20							0.003 *	0.002
Number of obs = 645			Number of obs = 645		Number of obs = 645		Number of obs = 527	
LR chi2(10) = 69.10			LR chi2(15) = 73.08		LR chi2(16) = 73.29		LR chi2(20) = 82.47	
Prob > chi2 = 0.0000			Prob > chi2 = 0.0000		Prob > chi2 = 0.0000		Prob > chi2 = 0.0000	
Log likelihood = -408.161			Log likelihood = -406.172		Log likelihood = -406.064		Log likelihood = -318.701	
Pseudo R2 = 0.078			Pseudo R2 = 0.083		Pseudo R2 = 0.083		Pseudo R2 = 0.115	

**Table 6.d Probit regression, reporting marginal effects – Indemnity insurance**

M1 Matrix S			M2 Matrices S, P		M3 Matrices S, P, U		M4 Matrices S, P, U, E	
	dF/dx	Std.Err.	dF/dx	Std. Err.	dF/dx	Std. Err.	dF/dx	Std. Err.
gender#	-0.004	0.045	-0.008	0.045	-0.009	0.045	0.045	0.047
agen	-0.138	0.184	-0.124	0.185	-0.112	0.186	-0.047	0.206
degree#	-0.025	0.036	-0.025	0.037	-0.023	0.037	-0.028	0.041
empl_pens#	-0.023	0.046	-0.012	0.046	-0.009	0.046	-0.007	0.052
managing_prof#	0.105 **	0.043	0.112 ***	0.043	0.108 ***	0.043	0.114 **	0.049
no_famw#	-0.143 ***	0.036	-0.140 ***	0.036	-0.139 ***	0.036	-0.166 ***	0.040
stable_wcont#	-0.071 *	0.038	-0.076 **	0.038	-0.077 **	0.038	-0.092 **	0.042
Hinc#	0.086 **	0.040	0.074 *	0.040	0.074 *	0.041	0.075	0.046
HFW#	-0.043	0.040	-0.045	0.040	-0.050	0.040	-0.032	0.044
HVRE#	0.070 *	0.042	0.071 *	0.042	0.074 *	0.042	0.055	0.048
woe#			-0.011	0.048	-0.005	0.048	0.006	0.054
trust#			0.098 **	0.044	0.100 **	0.043	0.090	0.050
bisnpln			-0.630	0.532	-0.566	0.533	-1.450 **	0.619
bismotn			-0.326	0.587	-0.345	0.587	-0.200	0.663
biscogn			0.228	0.695	0.170	0.694	0.433	0.767
fu					0.171 *	0.103	0.161	0.109
mscrg20							-0.00001	0.003
dsscrg20							-0.001	0.004
mscrl20							0.0005	0.001
dsscrl20							-0.0003	0.002
Number of obs = 645			Number of obs = 645		Number of obs = 645		Number of obs = 527	
LR chi2(10) = 56.56			LR chi2(15) = 63.08		LR chi2(16) = 65.82		LR chi2(20) = 70.80	
Prob > chi2 = 0.0000			Prob > chi2 = 0.0000		Prob > chi2 = 0.0000		Prob > chi2 = 0.0000	
Log likelihood = -341.653			Log likelihood = -338.393		Log likelihood = -337.026		Log likelihood = -270.685	
Pseudo R2 = 0.077			Pseudo R2 = 0.085		Pseudo R2 = 0.089		Pseudo R2 = 0.116	

*Notation for all Tables 6:* Explanatory variables are defined as follows: *gender* equals 1 for males, 0 for females; *agen* is equal to the individual's age, relative to 100; *degree* equals 1 for college graduate, 0 for not; *empl\_pens* equals 1 for employees and pensioners, 0 for other professions; *managing\_prof* equals to 1 for managers and professionals, 0 for other professions; *no\_famw* equals to 1 for individuals who are free from familiar weights, 0 otherwise; *stable\_wcont* equals to 1 if the individual has a stable working contract, 0 otherwise; *Hinc* equals to 1 for individuals with an income higher than the fiftieth centile of the sample, 0 otherwise; *HFW* equals to 1 for individuals with a financial wealth higher than the fiftieth centile of the sample, 0 otherwise; *HVRE* equals to 1 for individuals with a value of real estate higher than the fiftieth centile of the sample, 0 otherwise; *woe* equals to 1 if the individual has suffered for recent disgraces, 0 if not; *trust* equals to 1 if individual has trust on future, 0 otherwise; *bisnpln* is the normalized BIS score for non planning impulsiveness; *bismotn* is the normalized BIS score for motor impulsiveness; *biscogn* is the normalized BIS score for cognitive impulsiveness; *fu* equals to the empirical measure for the fear of the unknown of the individual; *mscr<sub>g</sub> 20* is the mean Skin Conductance Responses (SCR) recorded after gains, within the Iowa Gambling Task (IGT) phase under ambiguity (first-20 choices-sub-period); *dsscr<sub>g</sub>20* is the standard deviation of the Skin Conductance Responses (SCR) recorded after gains, within the Iowa Gambling Task (IGT) phase under ambiguity (first-20 choices-sub-period); *mscr<sub>l</sub>20* is the mean Skin Conductance Responses (SCR) recorded after losses, within the Iowa Gambling Task (IGT) phase under ambiguity (first-20 choices-sub-period); *dsscr<sub>l</sub>20* is the standard deviation of the Skin Conductance Responses (SCR) recorded after losses, within the Iowa Gambling Task (IGT) phase under ambiguity (first-20 choices-sub-period). # Column dF/dx is for discrete change of dummy variable from 0 to 1. Statistical significance at the 1, 5, and 10 percent levels is evidenced by \*\*\*, \*\*, and \*, respectively.

**Table 7. Incremental pseudo-R<sup>2</sup> by Models**

	Comparisons with the initial (plain) model based only on socio-demographic variables			Comparisons with the previous (M-1) model	
	Model S,P compared to Model S	Model S,P,U compared to Model S	Model S,P,U,E compared to Model S	Model S,P,U compared to Model S,P	Model S,P,U,E compared to Model S,P,U
I <sub>1</sub> : life insurance	0.79%	0.87%	2.61%	0.08%	1.74%
I <sub>2</sub> : health insurance	1.25%	1.25%	2.06%	0.00%	0.81%
I <sub>3</sub> : casualty insurance	0.45%	0.48%	3.66%	0.03%	3.18%
I <sub>4</sub> : indemnity insurance	0.88%	1.25%	3.92%	0.37%	2.67%
<b><i>Average contribution</i></b>	<b>0.84%</b>	<b>0.96%</b>	<b>3.06%</b>	<b>0.12%</b>	<b>2.10%</b>

*Note:* Model S is a probit model including a set of sociodemographic characteristics as explanatory variables; Model S,P is a probit model including a set of sociodemographic characteristics and personality traits as explanatory variables; Model S,P,U is a probit model including a set of sociodemographic characteristics, personality traits and fear of the unknown as explanatory variables; Model S,P,U,E is a probit model including a set of sociodemographic characteristics, personality traits, fear of the unknown and emotional reaction in condition of ambiguity as explanatory variables.

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