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Internal Inconsistency and Risk Aversion: Implications on Smoking Decisions*

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ABSTRACT

The main contribution of this paper is an analysis of the nature of the link between internal coherence and risk aversion. Both variables play an important role in individual decisions concerning risk behaviors. We compare the levels of internal consistency and risk aversion among smokers and non-smokers. To measure the individual internal coherence and risk aversion, we use a survey that includes lottery questions. Our results confirm that smokers are consistent in their decisions and they behave as risk averse. These results should be treated with circumspection as lottery questions are based on monetary expectations that depend on socio-economic conditions and they obviate other dimensions such as social recognition.

Keywords: Risk aversion; expected utility; decision-making; risk behaviors.

Consistencia interna y aversión al riesgo: implicaciones en la decisión de fumar

RESUMEN

La principal contribución de este artículo es analizar la naturaleza de la asociación entre la coherencia interna y la aversión al riesgo. Ambas variables juegan un papel principal en las decisiones individuales sobre comportamientos de riesgo, tal que como caso particular, comparamos los niveles consistencia interna y aversión al riesgo entre fumadores y no fumadores. Para medir la coherencia interna y la aversión al riesgo individual, recurrimos a una encuesta que incluye preguntas de loterías. Nuestros resultados confirman que los fumadores son consistentes en sus decisiones, y de hecho, se comportan como adversos al riesgo. Estos resultados hay que tomarlos con cautela, pues las preguntas sobre loterías se basan principalmente en expectativas monetarias que dependen de condiciones socio-económicas obviando otras dimensiones como el reconocimiento social.

Palabras clave: Aversión al riesgo; utilidad esperada; toma de decisiones; comportamientos de riesgo.

JEL Classification: D81

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1. INTRODUCTION

The state of health is an accumulative process that depends on both the health goods and services that citizens receive and their life styles. Risk behaviors, such as smoking, heavy drinking and lack of physical exercise reinforce the incidence of illnesses that, in most cases, could be avoided. The burden of risk habits imposes such a high costs to the individual and society in general that preventive policies are increasingly important in the structure of public budgets.

Anti-drug policies are essentially twofold: supply-side measures (taxes and control of trafficking) and demand-side measures (new endowments of information). Indirect taxes represent one of the most commonly applied instruments used to control alcohol and tobacco demand: higher tax rates increase prices and reduce purchasing power (Lewit Coate, 1982; Pogue Sgontz, 1989; Keeler et al., 1993; Saffer Chaloupka, 1994; Crawford Tanner, 1995; Chaloupka Wechsler, 1997; Crawford et al., 1999; Escario Molina, 2004). With regards to new endowments of information, informative campaigns are justified if consumers are currently misinformed about the characteristics of the goods they consume (Slovic, 2000; Duarte et al., 2006). For example, if smokers undervalue the dangers of tobacco products, once they are properly informed, they will reconsider their decisions about smoking. The new endowment of information will be effective if it changes the individual's structure of preferences. The effectiveness of providing more information to prevent drug use is disputed. Viscusi (1990) affirms that drug-consumers make decisions whilst aware of the risks they are taking, even though they might not have a clear idea of the magnitude of these risks.

Risk aversion indexes are fundamental measures to evaluate the degree of aversion with which citizens make decisions. Risk aversion indexes are based on individual optimal risk levels on a scale of preferences. Experiments such as those that require the answers to lottery games, offer social researchers a powerful tool for calculating individual levels of risk aversion. In lottery questions, participants usually reveal their preferences for a fixed amount of money or a lottery ticket. The expected utility framework has been implemented to analyze risk attitudes and behaviors with data drawn from lottery games (Blondel et al., 2007; Dave Saffer, 2007; Sasaki et al., 2006; Schunk Winter, 2007; Wärneryd, 1996).

The main advantage of using lottery questions is that they are characterized by informative transparency and uncertainty. A lottery game is defined by outcomes and probabilities so participants foresee the occurrence of an outcome and make the corresponding decisions. If they were wrongly informed about

outcomes and/or the probabilities, they would not be able to make correct decisions.

The authors believe that lottery questions are suitable for general indexes of risk aversion because, for example, smoking also implies the two dimensions: smoking generates illnesses to a degree of probability - a World Health Organization anti-tobacco campaign states that smokers have a 12-times higher probability of suffering from laryngeal cancer than non-smokers (WHO, 1998). Citizens know that smoking is dangerous but they might be wrongly informed about the dangers of smoking and/or the probability of occurrence.

What might seem a relatively easy mathematical exercise becomes more complex in reality because individuals are not always consistent with their scale of preferences. If people fail in ordering their preferences, the endowment of information (warning labels, anti-drug commercials or informative pamphlets etc.) might cause the expected effects, but probably not in the desired dimension. Given that governments allocate important economic resources in health policies aimed at promoting healthy habits (especially informative strategies), the implications of this research are important for policy makers. If smokers make mistakes when ordering preferences, demand-side measures might have limited impact on reducing tobacco consumption it might therefore be more useful to implement supply-side measures, such as higher taxes or tougher trafficking controls.

The main contribution of this paper is to explore the nature of the link between individual internal inconsistency and the degree of risk aversion. Both variables play an important role in individual decisions concerning risk behaviors. We compare the levels of internal inconsistency and risk aversion among smokers and non-smokers. We use lottery questions to measure the individual internal coherence and risk aversion. We use data from the German Personality and Daily Life Survey (2004) because it gives important information on internal coherence and risk aversion indexes. Our results confirm that smokers are consistent in their decisions, and they even behave as risk averse. It is clear that they perceive themselves as risk averse.

The rest of the paper is structured as it follows: Section 2 outlines the theoretical framework; Section 3 deals with the data base; Section 4 summaries the main results and Section 5 concludes the work with the main findings of our research and the corresponding policy implications.

2. THEORETICAL FRAMEWORK

Anyone who faces the choice of different options in a framework of uncertainty will consider the consequences of the choices and their corresponding probabilities. The expected utility theory offers a simple measure based on a set of information about a lottery L which is fully represented by

$(y_1, p_1; y_2, p_2; ...; y_n, p_n)$, where outcome y_i has the probability p_i $(i = 1,2,...,n)$ of occurring. We denote by $u(y_i)$ the utility of outcome y_i under the state of nature i. The standard theory of choice under risk assumes that the utility of each outcome is weighted by the corresponding probability:

$$EU(L) = \sum_{i=1}^{n} p_i u(y_i) \quad (1)$$

The expected utility hypothesis can be derived from three axioms: ordering, continuity and independence. The ordering axiom implies that individuals are able to determine their preferences from among different options, it requires completeness and transitivity. The continuity axiom determines that if there are three outcomes which are ordered by the level of preference, there is always a probability, a compound option with the most preferable and less preferable multiplied by this probability is indifferent to the second best option multiplied by one minus this probability. The independence axiom makes it possible to keep the structure of the preferences when relaxing the value of the probability (Lancsar Louviere, 2006; Starmer, 2000).

We assume, for reasons of simplicity, that the choices people face involve three different outcomes, y_{RH}, y_{RL} and y_S ($y_{RH} > y_S > y_{RL}$) thus $u(y_{RL}) = 0$, $u(y_{RH}) = 1$ and $u(y_S) = x$ with $0 < x < 1$. The expected utility criteria for choosing between two options, one that is of higher risk $R = (y_{RH}, p_{RH};\ y_{RL}, p_{RL};\ 0.1 - p_H - p_L)$ and one that is safer $S = (y_S, p_S)$ is to select that option that is associated with a higher expected utility:

$$S \succ R \Leftrightarrow xp_S > p_H \quad (2)$$

Expected utility theory helps economists to understand how people make decisions, it does, however, have some drawbacks, for example, in the context of probability weighting or loss aversion (Starmer, 2000). The fact that people exhibit inconsistencies when confronted with multiple options is not new (Hilton, 1989). Up to now the main contributions to the debate on expected utility and risk aversion lies in testing the hypotheses of expected utility theory with respect to income changes (McKee, 1989; Palacios-Huerta Serrano, 2006).

Researchers need to address the issue of inconsistency with expected utility to better predict individual behavior. To test theoretical hypotheses, researchers control experiments by altering the attributes of the game. In this paper we focus on individual inconsistencies with expected utility, assuming that money behaves as normal good for everybody, independently initial economic resources. To give an example of a failure in internal consistency, let's assume that an individual has revealed preferences for the fixed amount of money,

rather than for the lottery ticket. Given that money behaves as a normal good, if the researcher increases the fixed amount of money keeping constant the parameters of the lottery ticket, the internal consistency will guarantee that the individual will choose the fixed amount of money again. Consequently, we can assume that those individuals who preferred the fixed amount of money the first time and chose the lottery ticket the second were inconsistent in their preferences.

Risk aversion indexes based on lottery questions have been used recently to study risk attitudes (Sasaki et al., 2006; Schunk Winter, 2007). To extrapolate uncertainty to risk behaviors we must consider that uncertainty encompasses all decisions involving nontrivial, state-contingent outcome vectors, whether or not the preferences and beliefs associated with these decisions can be characterized by well-defined subjective probabilities. Events for which subjective probabilities are well-defined will be referred to as unambiguous. In consonance, events for which subjective probabilities are not well-defined will be referred to as ambiguous. Problems involving acts measurable with respect to unambiguous events will be said to involve risk (Grant Quiggin 2005). Taking into account these definitions, lifestyles are characterized by externalities with ambiguous probabilities.

Two recent research papers that have analyzed the consumption of drugs as risk behavior in a framework of expected utility (Blondel et al., 2007; Dave Saffer 2007), have shown that drug users are significantly more risk seeking than non-drug users. Dave and Saffer (2007) also confirm that risk aversion has a significant and negative effect on alcohol consumption, with the prevalence and consumption among risk-tolerant individuals being six to eight percent higher.

Experiments offer a new field for social researchers to identify the causation of different behaviors on health. Most research on risk behaviors typically examines lottery questions in computer laboratories in which participants must select an option from various choices that vary according to potential risks (Chapman et al., 2007).

In this research, we introduce two different measures of risk aversion. One risk aversion measure is self-reported by the interviewees and shows how averse they perceive themselves to be. The other is calculated through the answers of the lottery games. The reason why we consider two kinds of measures is that when we make a decision, we may take into account different points of view and not only the monetary criteria involved in the lottery games.

3. DATA AND METHODOLOGY

The German Personality and Daily Life Survey (German Institute for Economic Research, 2004) provided us with the variables required for this

research. The sample size is 1012 individuals from 14 to 90 years old (543 females and 469 males).

The reason why we selected this survey is because it offers individual information about socio-demographic characteristics, behaviors and risk attitudes that include lottery questions. However, we have not introduced regional dummy variables as explanatory variables because information about where people live is not available. These variables would improve the estimated coefficients of the model by summarizing regional differences.

There are two sets of lottery games. In the first set, the individual can choose between a fixed amount of money or a lottery ticket. The lottery ticket is characterized by a prize of 200 Euros with a winning probability of 50%. The game is repeated four times, thus the fixed amount of money increases from 40 to 130 Euros - 30 Euros each time. Consequently, the greater the fixed amount of money, the higher are the incentives to choose it because the characteristics of the lottery ticket remain constant. The main difference with the second set is that the individual might win 160 Euros but also lose 40 Euros. The probabilities of winning and losing money are the same (50%). The lottery ticket remains invariable, and the fixed amount of money increases from 0 to 90 Euros, 30 Euros each time.

The sample is equally distributed by gender. The average age of the interviewees was 48 years old and they have a monthly net salary of 515 Euros. The salary variable has a great dispersion because 45% of the interviewed are inactive (students, housewives and retired people).

31% of the interviewees smoke. The Spanish National Delegation on Drug Uses (2001) suggests that people who smoke more than 10 cigarettes per day are at risk of becoming nicotine addicts. We do not distinguish between high-risk smokers (individuals who smoke at least 10 cigarettes per day) and low-risk smokers (individuals who smoke less than 10 cigarettes per day) because most smokers (nearly 80%) are high-risk smokers.

With regards to the lottery questions, we noted that the greater the fixed amount of money, the greater was the percentage of people who chose it against the lottery ticket. For example, 44% of the interviewed chose the fixed amount of money in the game R1, whereas 78% chose it in the game R4.

The only difference in both games is that in the first, the fixed amount of money is 40 Euros whilst in the second it is 130 Euros. The percentages of people choosing the fixed amount of money are slightly higher for the second set where people might win or lose money if they choose the lottery ticket. In this case, 78% of the interviewees chose the fixed amount of money in game R5, 76% choose it in game R8.

Table 1
The survey**.**

Persönlichkeit und Alltag	Personality and Daily Life
A) Sozio-demographische Charakteristikum	**A) Socio-demographic characteristics**
Bitte geben Sie hier Geschlecht und Geburtsjahr: Männlich □ Geburtsjahr: Weiblich □	Please state your gender and year of birth: Male □ Year of birth: Female □
Wie hoch war Ihr Arbeitsverdienst im letzten Monat? Wenn Sie im letzten Monat Sonderzahlungen hatten, z.B. Urlaubsgeld oder Nachzahlungen, rechnen Sie diese bitte nicht mit. Entgelt für Überstunden rechnen Sie dagegen mit. Falls Sie selbständig sind: Bitte schätzen Sie Ihren monatlichen Gewinn vor und nach Steuer und Sozialversicherung Brutto: EURO / Netto: EURO	What was your salary last month? Please, include overtime pay but not any extra month's salary or delayed salary. In case you are self-employed, please value your monthly net and gross profit. Gross: EURO / Netto: EURO
B) Verhalten	**B) Behaviors**
Rauchen Sie gegenwärtig, seien es Zigaretten, Pfeifen oder Zigarren? Nein □ Ja □ Wieviel Zigaretten, Pfeifen oder Zigarren rauchen Sie pro Tag? Geben Sie bitte den täglichen Durchschnitt der letzten Woche an. Zigaretten: Pfeifen: Zigarren/Zigarillos:	Do you smoke cigarettes, a pipe or cigars? No □ Yes □ How many cigarettes, pipes or cigars did you smoke per day in the last week? Cigarettes: Pipes: Cigars:
C) Risiko Einstellungen	**C) Risk attitudes**
Wie schätzen Sie sich persönlich ein: Sind Sie im allgemeinen ein risikobereiter Mensch oder versuchen Sie, Risiken zu vermeiden? Bitte kreuzen Sie ein Kästchen auf der Skala an, wobei der Wert 0 bedeutet: "gar nicht risikobereit" und der Wert 10: "sehr risikobereit": 0 1 2 3 4 5 6 7 8 9 10	How do you describe your personality? Do you usually take risks or do you try to avoid them? Mark how risk averse or risk seeking you consider yourself to be (0 = "totally risk averse", 1 = "very risk seeking": 0 1 2 3 4 5 6 7 8 9 10

Table 1 (continuación)
The survey

Persönlichkeit und Alltag	Personality and Daily Life
Stellen Sie sich vor, Sie nehmen an einer Quizshow teil, bei der Sie auch Geld gewinnen können. Dabei entscheiden Sie selbst in welcher Form: Sie können entweder einen festen Geldbetrag bekommen oder an einer Lotterie teilnehmen. Bei der Lotterie gewinnen Sie mit einer Chance von 50:50 entweder 200 Euro oder Sie bekommen nichts. Bitte sehen Sie sich einmal Liste an. Dort steht in jeder Zeile, wie Sie sich entscheiden können. Treffen Sie Ihre Entscheidung bitte zunächst in Zeile 1, dann in Zeile 2 usw. Wie würden Sie sich entscheiden in Zeile 1? Fester Betrag 40 Euro oder Lotterielos in Zeile 2? Fester Betrag 70 Euro oder Lotterielos in Zeile 3? Fester Betrag 100 Euro oder Lotterielos in Zeile 4? Fester Betrag 130 Euro oder Lotterielos ZP kann sich nicht entscheiden und verweigert die Antwort □	Imagine you are taking part in a Quiz show in which you could win money. You have to choose between a fixed amount of money and a lottery ticket. The lottery prize is 200 Euros; the probability of winning the prize is 50%. Please look at the list of questions. Mark, in each line, if you prefer the fixed amount of money or the lottery ticket. Answer the question in order. What would you choose: in line 1? 40 Euros or the lottery ticket in line 2? 70 Euros or the lottery ticket in line 3? 100 Euros or the lottery ticket in line 4? 130 Euros or the lottery ticket I do not know / No answer □
Nun stellen Sie sich vor, in der Quizshow werden die Regeln etwas verändert. Wieder haben sie vorab die Wahl zwischen einem festen Geldbetrag und einer Lotterie. Bei der Lotterie können Sie mit einer Gewinnchance von 50:50 entweder 160 Euro gewinnen oder diesmal 40 Euro verlieren. Wie würden Sie sich entscheiden in Zeile 1? Fester Betrag 0 Euro oder Lotterielos in Zeile 2? Fester Betrag 30 Euro oder Lotterielos in Zeile 3? Fester Betrag 60 Euro oder Lotterielos in Zeile 4? Fester Betrag 90 Euro oder Lotterielos ZP kann sich nicht entscheiden und verweigert die Antwort □	Imagine that the Quiz show changes the rules of the game. Again you have to choose between a fixed amount of money and a lottery ticket. If you choose the lottery ticket you could win 160 Euros or loose 40 Euros with probabilities of 50%. What would you choose: in line 1? 0 Euros or the lottery ticket in line 2? 30 Euros or the lottery ticket in line 3? 60 Euros or the lottery ticket in line 4? 90 Euros or the lottery ticket I do not know / No answer □

Given the technical characteristics of the lottery questions considered in the German Personality and Daily Life Survey, we calculated the following indexes that encapsulate the individual inconsistency level and expected utility and risk aversion:

- **IEU** summarizes the individual internal inconsistency level with the expected utility. Those participants who chose a fixed amount of money in a game would be expected to choose it again if all the parameters were constant except for the fixed amount of money (that would be increased). For example, an individual who chose the fixed amount of money in game R2 would be expected to choose this option in games R3 and R4. Observing the number of reversals from the fixed amount of money to the lottery ticket in each set of games allows us to define this index as the number of times the individual changes decisions to risk options divided by the maximum number of changes. As the maximum number of changes is 8, IEU takes 9 different values from 0 (the individual is internally consistent) to 1 (the individual is internally inconsistent). The nature of the experiment maintains the consistency of preferences because participants do not learn from past experiences, they reply to lottery questions hypothetically. The data reveals that most participants are consistent with expected utility. The average level of inconsistency is around 11%, on a scale of 100. The data also reveals that the level of inconsistency is higher for the second set of games (13%) than for the first set (9%).

- **CRRA** summarizes the inconsistency level on the assumption of constant relative risk aversion. The **CRRA** means that preferences among risk prospects are unchanged if all payoffs are multiplied by a positive constant. The **CRRA** helps us to look for the deviations of the pattern. Such deviations would not necessarily reflect misunderstanding. A first step before defining the **CRRA** is to establish the proportions relative to each game. The value of these proportions is the fixed amount of money divided by the maximum prize of the lottery ticket. The proportions are 0.20, 0.35, 0.50 and 0.65 for the first set of games and 0, 0.19, 0.37 and 0.56 for the second set of games. Given these proportions, the ordered sequence of games is established as it follows: R5, R6, R1, R2, R7, R3, R8, R4. Given this ordering, an individual who chose the fixed amount of money in the game R7 could be expected to choose the fixed amount of money in games R3, R8 and R4. A violation of this ordering might be considered a failure of constant relative risk assumption. People are likely to be internally consistent in accordance with the assumption of constant relative risk: 48% showed degrees of inconsistency. This index revealed a much higher percentage of inconsistency than the previous one.

Table 2
Descriptive statistics.

Variable	Description	Mean	St. Dev.
Gender	This variable takes the value of 1 if the individual is male and 0 if female.	0.4634	0.4989
Age	This variable gives us the individual's age.	47.5549	18.3708
Smoker	This variable takes the value of 1 if the individual is smoker and 0 if a non-smoker.	0.3102	0.4343
Income	This variable gives us the individual's net monthly income.	514.8436	942.0700
Games			
R1	This variable tells us if the individual chose the safe option in the game: [40 , 1] or [200 , 0.5 ; 0 , 0.5]	0.4411	0.4967
R2	This variable tells us if the individual chose the safe option in the game: [70 , 1] or [200 , 0.5 ; 0 , 0.5]	0.4455	0.4972
R3	This variable tells us if the individual chose the safe option in the game: [100 , 1] or [200 , 0.5 ; 0 , 0.5]	0.6482	0.4777
R4	This variable tells us if the individual chose the safe option in the game: [130 , 1] or [200 , 0.5 ; 0 , 0.5]	0.7806	0.4140
R5	This variable tells us if the individual chose the safe option in the game: [0 , 1] or [160 , 0.5 ; -40 , 0.5]	0.3206	0.4685
R6	This variable tells us if the individual chose the safe option in the game: [30 , 1] or [160 , 0.5 ; -40 , 0.5]	0.4711	0.4994
R7	This variable tells us if the individual chose the safe option in the game: [60 , 1] or [160 , 0.5 ; -40 , 0.5]	0.6959	0.4605
R8	This variable tells us if the individual chose the safe option in the game: [90 , 1] or [160 , 0.5 ; -40 , 0.5]	0.7621	0.4259
Indexes			
IEU	Internal inconsistency in the two set of games: R1-R4 and R5-R8. This variable takes values of 0 (internally consistent) and1 (internally inconsistent).	0.1136	0.1775
IEU1	Internal inconsistency in the first set of games: R1-R4.	0.0903	0.2069
IEU2	Internal inconsistency in the second set of games: R5-R8.	0.1278	0.2452
CRRA	Internal inconsistency in the two set of games on the assumption of constant relative risk attitude.	0.4762	0.4996
Penalty	Penalty from the ordering violation related to the assumption of constant relative risk attitude.	0.3549	0.7054
IRA	Number of times that the subject chose the safe option divided by the number of games (0: risk-taker to 1: risk-averse).	0.5481	0.3281
IRA1	Number of times that the subject chose the safe option divided by the number of games: R1-R4.	0.5560	0.3831
IRA2	Number of times that the subject chose the safe option divided by the number of games: R5-R8.	0.5402	0.3400
DIRA	The distance of IRA to the middle value in absolute terms (from 0: risk neutral to 0.5: no risk neutral).	0.2796	0.1607
ISRA	Self-assessment level of risk aversion (0: risk-taker to 1: risk-averse).	0.4832	0.2559

- The penalty is measured as the difference in the proportions as a consequence of the ordering violation. For example, a subject who chose the fixed amount of money in R2 but the lottery ticket in R7 would only receive a

small penalty (0.37-0.35=0.02) compared to an individual who chose the fixed amount of money in R1 but the lottery ticket in R2 (0.19-0=0.19). The average penalty was 0.35 points.

- IRA summarizes the individual degree of risk aversion. It is measured as the number of games in which the subject chose the fixed amount of money, divided by the total number of games. That means that this variable takes values from 0 to 1. A '0' indicates that the individual is an absolute risk-taker and 1 that the individual is absolutely risk averse. On average, participants were moderately risk averse: in 55% of the games, the interviewee chose the fixed amount of money rather than the lottery ticket. The level of risk aversion is quite similar between both sets of games. This result is because the percentage of people who chose the fixed amount of money in game R5 is very low. If we had excluded R1 and R5 in the definition of IRA1 and IRA2, the average percentage of IRA2 would have been greater. Therefore, it is not unreasonable to think that people would be more risk averse if they could have lost money when they acquired the lottery ticket.

- DIRA measures the distance between IRA and the median value (0.5), and it measures how risk-neutral the individual is. The distance is considered in absolute values, so this variable takes values from 0 to 0.5. Values close to 0 mean that the individual is risk-neutral. The reason why we introduced this variable is to control the fact that risk-neutral people are less likely to be internally consistent, given the technical properties of the internally consistent indexes.

- ISRA summarizes individual self-perception of risk aversion. Interviewed subjects identified their grade of risk aversion on a scale of 0 to 1. '0' indicating that the individual perceives himself/herself as absolute risk taker and 1 as absolutely risk averse. On average, participants saw themselves as moderately risk averse.

The reason why we consider two indices of risk aversion lies in their nature. **IRA** reflects individual risk aversion from lottery questions, whereas **ISRA** is the corresponding individual self-perception. **ISRA** reflects how comfortable the participants feel at the time of confronting risks. Self-perception is conditioned by the individual's point of view. Self-reported answers are usually centered the individual, so for example, we believe that other people who take more risks than us are risk seeking.

In the following section, we summarize the main results. In Table 3, we show the correlation values between risk aversion and internal consistency indexes. One of the main contributions of this paper is to point out that even correlation parameters should be treated with care. In Table 4, we demonstrate that people who are risk neutral are also more susceptible to being inconsistent, given the technical properties of both indexes.

Table 5 validates the results shown in Tables 3 and 4. Table 6 shows that socio-demographic characteristics play an important role as explanatory variables of both indexes. Table 5 reinforces the results of Tables 3 and 4.

Finally, these results might have important consequences for the welfare economics, especially for the issue of risk behaviors. We conclude with Tables 6 and 7 as an applied example of tobacco consumption.

4. RESULTS

A basic table of correlations shows that people who are more consistent when taking decisions are also more risk averse. This relationship remains stable in sense and magnitude: people that take consistent decisions are more risk averse than people who take inconsistent decisions; the more consistent the individuals, the more risk averse they behave. In terms of self-perception, **IRA** and **ISRA** are correlated in a way that could be expected: people who consider themselves as risk averse, are more risk averse when they play lottery games.

Table 3
Correlation between inconsistency and risk aversion indexes (Spearman).

	IEU	CRRA	Penalty	IRA
IRA	-0.1763*	-0.2381*	-0.1213*	—
ISRA	-0.1347*	0.1175*	-0.1497*	0.2000*

* indicates that the parameter is statistically significant at the level 5%.

Table 4 provides further empirical evidence: both those individuals who are more risk averse and those who are greater risk takers are more consistent in their decisions. As a consequence, people who are risk-neutral are more susceptible to being inconsistent.

Table 4
Distribution of individuals by levels of internal inconsistency and risk aversion

IRA	IEU					
	0	**0.125**	**0.25**	**0.375**	**0.5**	**0.625**
0	121	0	0	0	0	0
0.125	22	0	0	0	0	0
0.25	3	42	1	32	3	0
0.375	4	85	0	1	1	0

Table 4 (continuación)
Distribution of individuals by levels of internal inconsistency and risk aversion

IRA	IEU					
	0	**0.125**	**0.25**	**0.375**	**0.5**	**0.625**
0.5	23	0	53	2	0	66
0.625	7	10	1	0	2	0
0.75	6	101	0	0	1	0
0.875	179	0	0	0	0	0
1	126	0	0	0	0	0

This result is derived from the fact that high levels of risk aversion or risk seeking prevent individuals from changing their minds. For example, when individuals have strong preferences for safe outcomes, their levels of risk aversion prevent them from selecting the riskier options. If they are more likely to choose the safe option independently of the possible outcomes, they will choose the risky option less often, and as a consequence, they will be more consistent with their decisions. Theoretically, there might be individuals with **IEU** levels of 0.75, 0.875 and 1, but in practice the highest level of internal inconsistency is 0.625. The 66 individuals who were the most internally inconsistent (**IEU** = 0.625), are risk-neutral (**IRA** = 0.5).

The results shown Table 4 are summarized and validated by Table 5.Those individuals who are more risk averse are more internally consistent, however the penalty they suffer from their internal inconsistency is lower. The further **IRA** is from the mean value (0.5) for **DIRA**, the greater is the internal inconsistency. In fact, the magnitude of the parameters reveals that the influence of the distance of **IRA** from the mean value is more important than **IRA** itself. This result is similar to that shown in table 4. The most risk averse and the higher risk takers are consistent in their decisions.

Table 5
Estimation of internal inconsistency (OLSQ)

	IEU		CRRA		Penalty	
	Coefficient	**Std. Err.**	**Coefficient**	**Std. Err.**	**Coefficient**	**Std. Err.**
IRA	-0.0469***	0.0125	-0.2596***	0.0375	-0.1479***	0.0602
DIRA	-0.7004***	0.0238	-1.7048***	0.0719	-1.8688***	0.1153
Intercept	0.3444***	0.0101	1.1025***	0.0298	0.9665***	0.0479

Number of observations = 1012

*** indicates that the parameter is statistically significant at the level 1%.

These results have important consequences for the analysis of risk behaviors. In this paper, we focus on how internal coherence and risk aversion interact with tobacco consumption decisions. Given that risk aversion, internal consistency and smoking might share some important determinants, we analyzed their correlation with socio-demographic variables. Age and being female is positively correlated with smoking, whereas income is negatively correlated. Results suggest that marginal utility of money is greater for smokers than for non-smokers. This last result is important because if those individuals who smoke had lower budgets, they would be more risk averse in lottery games in order to buy tobacco products. In fact smokers are more likely to choose the fixed amount of money rather than the lottery ticket.

With internal inconsistency, the empirical evidence is ambiguous. **IEU** is negatively correlated with the decision to smoke whilst **CRRA** is positively correlated. However as the index was based on the assumption of constant relative risk, we observe that the penalty for the ordering violation is negatively correlated with the decision to smoke, therefore, although smokers might be internally inconsistent, there may be non-smokers who are even less internally consistent. This result is revealing because, compared to non-smokers, smokers do not behave incoherently; what is more, they do not behave as risk takers but as risk averse.

Table 6
Correlation of indexes and individual characteristics (Spearman).

	IEU	CRRA	Penalty	IRA	ISRA	Smoker
Age	-0.3792*	-0.0865*	-0.2668*	0.1895*	0.2186*	0.0503*
Gender	0.0761*	0.0559*	0.0115	0.006	-0.2516*	-0.0301*
Income	-0.0987*	-0.0154	0.0605*	0.0533*	-0.0916*	-0.1857*
Smoker	-0.1168*	0.0565*	-0.0729*	0.0771*	0.0148	—

* indicates that the parameter is statistically significant at the level 5%.

We further observed that income is positively correlated with risk aversion and internal consistency, but negatively correlated with the perception of risk aversion. Age is positively correlated with internal consistency and risk aversion. Gender differences reveal that men are more internally inconsistent than women and they perceive themselves as risk takers.

The estimation of the probability of being a smoker also confirms these results. We repeated the estimation three times. We considered all games without making any distinction for those that belong to the first set or the second set (Model 1 and Model 3), and then took account of the fact that these

results might vary depending on the characteristics of wining and losing with the lottery tickets (Model 2). We also considered that the different internal inconsistency indexes were built under similar premises, so it is better to repeat estimations for **IEU** and **CRRA**/**Penalty** (Models 1 and 2 and Model 3) to avoid problems of m…ulticollineality.

Table 7
Estimation of Smokers (Probit)

	Model 1		Model 2		Model 3	
	Coefficient	**Mfx**	**Coefficient**	**Mfx**	**Coefficient**	**Mfx**
Gender	0.0321	0.0084	-0.0350	-0.0090	-0.0574	-0.0155
Age	-0.0078**	-0.0020	-0.0064*	-0.0016	-0.0072**	-0.0019
Income	-0.0004***	-0.0001	-0.0004***	-0.0001	-0.0004***	-0.0001
IEU	-2.2826***	-0.5978	—	—	—	—
IEU1	—	—	-0.6920**	-0.1765	—	—
IEU2	—	—	-1.7920***	-0.4572	—	—
CRRA	—	—	—	—	0.4718***	0.1292
Penalty	—	—	—	—	-0.2541***	-0.0687
IRA	0.7329***	0.1919	—	—	0.8133***	0.2195
IRA1	—	—	0.1947	0.0497	—	—
IRA2	—	—	0.4895***	0.1249	—	—
DIRA	-0.5655	-0.1481	-0.6767	-0.1727	1.0994***	0.2966
ISRA	-0.5808**	-0.1521	-0.5691**	-0.1452	-0.6263***	-0.1690
Intercept	-0.0257	—	0.0077	—	-0.8136***	—
Ps.-R^2 (%)	10.16		10.89		8.45	
Es. prob.	21.00		21.04		21.07	

Number of observations = 864. Real probability of smoker: 23.02%.
***, ** and * indicate that the parameter is statistically significant at the levels 1%, 5% and 10% respectively.

Results confirm that smokers are internally consistent and especially in games where they can also lose money. If we impose the assumption of constant relative risk, we observe that those individual who are internally inconsistent are more likely to be smokers, but the greater the penalty for this inconsistency, the lower is this probability. Again, smokers behave as risk averse. The results of Model 2 suggest that the influence of risk aversion is greater for lottery tickets that include a loss of money as a possible outcome. Individuals, who consider themselves as risk averse, are less likely to smoke. Once we allow for the different levels of penalty individuals suffer from

violating the constant risk attitude, the more risk averse and risk seeking the individuals are, the more likely they are to smoke.

With socio-demographic characteristics we found that younger individuals and those with lower incomes are more likely to smoke.

Finally, we would emphasize two tests of global significance. The three models slightly undervalue the probability of being a smoker by two percentage points. Estimated probabilities are very similar between models. According to the pseudo- R^2, Model 2 has the greatest explanatory power, followed by Model 1 and Model 3.

5. CONCLUSIONS AND POLICY IMPLICATIONS

This paper provides new empirical evidence on how expected utility determines individual risk aversion. Firstly, descriptive statistics demonstrate that although most individuals are consistent with previous decisions, there is also evidence that some individuals do not have a coherent scale of preferences. This is especially true when we consider the assumption of constant relative risk to define the internal inconsistency index. People who are more risk neutral seem to be less internally consistent, but this argument is derived from the fact that people who have strong levels of risk aversion or risk affinity are less likely to change their minds when they face different options.

With regards to risk behaviors, the main conclusion of these empirical results is that smokers are internally consistent and might even be risk averse. This result has important implications for policy making because if individuals are able to organize their decisions coherently, then providing information that is effective enough to change preferences might be useful to reduce the adoption of risk behaviors such as smoking.

Regarding the adequacy of lottery games to assess risk aversion levels, we are concerned that the indexes obtained may be biased. **IRA** basically summarizes the risk aversion from a monetary point of view and it obviates other dimensions such as the social pressure.

Another issue is that previous research has pointed out that risk aversion and risk affinity might vary substantially by ethnic background and socioeconomic position (Hahn et al., 2000). Cross-sectional data does not allow testing if the differences between two population groups are attributable to observed or unobserved variables.

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