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Seeun Jung* and Carole Treibich†

Abstract

We examine a Japanese Panel Survey in order to verify whether self-reported risk aversion varies over time. In most panels, risk attitudes variables are collected only once (found in only one survey wave), and it is assumed that self-reported risk aversion reflects individual's time-invariant component of preferences toward risk. Nonetheless, one may wonder whether financial and health shocks a person faces over his lifetime modify his risk aversion. Our empirical analysis provides proof that risk aversion is composed of a time-variant part and shows that the variation cannot be reduced to measurement error or noise given that it is related to income or health shocks. Then, we nonetheless find that time-invariant factors explain a bigger share of individual risk aversion than time-variant ones. Taking into account the fact that there are still time-variant factors in risk aversion, we investigate how often it is preferable to collect the risk aversion measure in long panel surveys. Our result suggests that the best predictor for current behaviors is the average of risk aversion, where risk aversion is collected every 3-4 years. The risk aversion measure is, therefore, advised to be collected every 3 or 4 years in long panel surveys.

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1 Introduction

Is risk aversion innate and immutable, as usually assumed in the economic literature, or rather time-variant and a function of the experiences faced by a person over his lifetime? More precisely, do individual preferences toward risk change with wealth accumulation? disease? job loss? parenthood? As literature in psychology suggests that personality could change over time (Lucas and Donnellan (2011), Boyce et al. (2013)), we wonder whether individual risk attitudes could also vary across the life span.

Risk preferences have been extensively used in empirical work in order to study individual decision making. Therefore, better understanding what is actually captured in surveys and whether this variable may vary across domains or over time is crucial. In other words, the concern researchers face when using risk attitudes derived from micro-level data surveys is the validity of the elicited risk aversion parameter. While a lot of the empirical literature on this issue focused on the measurement of risk tolerance and its stability across methodologies,[1] the question of the stability of risk aversion over time has rather been assumed than proven empirically.[2] Nevertheless, the sensitivity of risk aversion to financial or personal shocks can be problematic since it could cause endogeneity or reverse causality issues when preferences toward risk are used as an explanatory variable. For example, imagine one wins a lottery (positive income shock) which possibly drives down his risk aversion. If we only have one risk aversion measure which was collected when he was more risk averse, the coefficient that we estimate with this measure in order to predict the current behaviors would be biased toward zero (under-estimation). Therefore, investigating whether risk attitudes are stable or changing, and if changing, knowing what are the main factors of these variations are crucial steps in order to implement and properly use survey data.

[1] See for instance Binswanger (1980), Anderson and Mellor (2008), Ding et al. (2010), Dohmen et al. (2011) or Hardeweg et al. (2012)

[2] While Harrison et al. (2005), Baucells and Villass (2010), Sahm (2008), and Andersen et al. (2008) claim that risk aversion is stable over time, Staw (1976), Thaler and Johnson (1990), Weber and Zuchel (2005), Brunnermeier and Nagel (2008), and Malmendier and Nagel (2011) showed the change in financial risk-taking behaviors over time.

The main difficulty researchers face when investigating the time stability of individual risk tolerance is data availability. In economic theory, risk aversion is assumed to be innate and time invariant, i.e. it is considered as an exogenous characteristic of the person. This led many surveys to include risk attitudes questions only once:, namely, at baseline, when the individual enters the database. This is for instance the case of the British Household Panel Study (BHPS) or the Korean Labor Income Panel Study (KLIPS). Nonetheless, some surveys do measure repeatedly risk attitudes. For example, the Health and Retirement Study (HRS) includes hypothetical gambles over lifetime income in all its waves. Sahm (2008) used this feature of the data to investigate the stability of individual risk tolerance.

In this article, we use the Osaka Panel Study where individuals were followed annually from 2003 till 2010 and risk aversion questions were included in all waves. This framework allows us to explore whether risk aversion responses of individuals who experienced shocks are stable. More precisely, we aim at providing proof of the existence of a time-variant component of risk aversion and at shedding light on the factors influencing this dimension of risk preferences. Using panel data and a self-reported risk aversion measure, we bring empirical evidence that (i) survey risk aversion has a time-variant dimension and that (ii) individuals for whom elicited risk attitudes varied experienced specific shocks not faced by agents with stable risk preferences. We think that the expected and significant correlation between the observed variation in individual risk aversion and shocks (in terms of income, labor or personal matters) provides convincing evidence of the existence of a time-variant component of risk aversion besides possible measurement error (noise). More precisely, our results roughly show that (self-reported) risk aversion changes every year and is affected by income and health variations. This result makes us believe that variation over time is not only noise as it is correlated with recent shocks. Nevertheless, the variation in risk attitudes does not seem to significantly affect the change in risky behaviors, i.e. the time-variant component of risk preferences might be temporary and not important enough to modify one's behavior.

When collecting panel data, the assumption of risk aversion stability is used to support the choice of measuring preferences toward risk only once (often during the first wave). However, given that there are time-varying factors in risk aversion, collecting risk aversion several times could increase the quality of the analyses. Our findings show that using the average measure of risk aversion increases the predicting power on current behaviors in comparison to using the current risk aversion. It gives a guideline for longer panels: it may be useful to collect risk aversion several times as the age factor and the accumulation of changes in income and health also determine risk attitudes.

The remainder of the paper is organized as follows. The related literature is presented in section 2. Section 3 discusses the potential time-variant and -invariant factors of risk aversion and exhibits the data used in this paper. The existence of a time-variant component is highlighted in section 4 along with the respective importance of the two dimensions of risk aversion. This section also provides evidence as to the optimal times to collect risk aversion in panel surveys. Section 5 concludes.

2 Literature

Preferences toward risk is a key factor economists put forward to explain individual decisions. Numerous published articles have emphasized the influence of risk aversion on risky behaviors in financial matters (portfolio assets, savings, indebtedness), in the choice of occupation (sector of work, risky tasks) or in the health domain (smoking, drinking). At the same time, the adequate way to measure risk aversion, which is not a directly observable characteristic of individuals, has extensively been investigated. Many different methodologies have been implemented, going from qualitative scales and hypothetical questions to summated rating scores and lotteries. Furthermore, accompanying this methodological literature, many studies looked at the stability of risk aversion across methodologies in order to see whether some measures outperform others in their capacity to predict risky behaviors. On the contrary, the stability of individual preferences toward risk over time has not been so much investigated empirically. This could be explained by (i) the theoretical assumption that risk aversion is innate and immutable and (ii) the lack of data allowing to study this issue.

Despite the scarcity of research on time stability of risk preferences, a few theoretical and empirical studies do consider the potential time-variant dimension of risk aversion and its consequences on individual decisions and behaviors. We briefly present this literature below.

In Constantinides (1990) or Campbell and Cochrane (1999) theoretical models, risk aversion varies because of changes in wealth, changes in habits, and changes in background risk. Subsequently, within a consumption-based pricing model, Brandt and Wang (2003) included a time-varying aggregate risk aversion parameter and empirically tested that indeed aggregate risk preferences vary in response to news about inflation using DRI consumption data.

The empirical studies which looked at time-varying risk aversion considered different measures of risk aversion. Brunnermeier and Nagel (2008) used for instance asset allocation to proxy risk preferences. They showed that transitory increases in liquid wealth play no role in explaining changes in asset allocation for households that participate in the stock market. Using a repeated survey of a large sample of the Italian Bank customers, Guiso et al. (2013) measured individual risk attitudes with a Holt and Laury (2002) type of strategy. More precisely, the respondents were asked to choose between a fixed lottery and different safe amounts.[3,4] They investigated its stability via the 2008 financial crisis. These authors found that changes in risk aversion after the crisis are correlated

[3]In the risky prospect, individuals have a fifty-percent chance to earn 10,000 euros and a fifty percent chance to earn nothing. The sure amounts of money offered are ranged between 100 and 9,000 euros.

[4]While Holt and Laury (2002) offered two lotteries with different dispersions of pay-offs, Hardeweg et al. (2012) or Dohmen et al. (2010) also used a fixed lottery vs. safe amounts to capture risk aversion of rural Thai farmers and German citizens, respectively.

with portfolio choices, but not with wealth, consumption habits and background risk. A lab experiment where participants were exposed to a scary movie was subsequently conducted by these authors. It showed that this psychological factor - scary experience - might influence risk aversion to a greater extent than its 'classical standard' determinants. As for Sahm (2008), she used the hypothetical gambles over lifetime income from the Health and Retirement Study from 1992 to 2002 to investigate whether individuals changed their risk aversion over that period. She found that risk tolerance does change with age and macroeconomic conditions but argued that differences in risk aversion are mainly located across, and not within, individuals. She used a panel of 12,000 respondents over a decade and found relatively stable risk preferences. She showed that major life events such as job displacement or the diagnosis of a serious health condition do not permanently alter the willingness to take further risks.

However, other studies argued that individual risk tolerance might be altered following health shocks. De Martino et al. (2010) found that amygdala-damaged patients[5] take risky gambles more often than those without damage in brain. Tison et al. (2012) also investigated the influence of health shocks on an individual's preferences toward risk. They found that experiencing some diseases do change people's risk preferences. More precisely, they showed that facing a cancer (threat to individual's life, reduction of life expectancy) increases risk tolerance while diabetes (long-term disease, day by day care) increase risk aversion. A question raised subsequently by the authors is whether the observed change in risk aversion last in the future or whether it is only a temporary modification of risk attitudes, in which case risk aversion returns to one's initial level after some time. An additional question of interest that is not tackled by Tison et al. (2012), but which we will explore, is whether this change in risk aversion translates into changes in behavior, in particular health or financial risky behaviors.

In this paper, we use the information on risk aversion provided by the Osaka Panel

[5] Amygdala is a part of the brain which is associated with emotional events.

Study. Similarly to Sahm (2008), we investigate the existence and importance of a time-variant component of risk aversion. We show that variations in individual risk aversion are related to income and personal shocks. Sahm (2008) highlighted that a large share of the differences in risk aversion comes from differences across individuals, which implies a limited role of the time-variant component of risk preferences. We further investigate this dimension by studying whether variation in risk aversion translate into a modification of individual risky behaviors. We find that risk aversion indeed contains both time-invariant and time-variant factors. Time-variant factors are correlated with various changes such as income and age, which provides evidence that variations of risk aversion over time are not only noise. That is why risk aversion measures collected long time before (more than 5 years time in our sample) do not predict the current behaviors well enough to see its effect. We will discuss this in Section 4.

3 Methodology and Data

Time-invariant and time-variant components of risk aversion

Table 1 presents the factors influencing the different explanations of risk aversion. More precisely, we decompose risk aversion into a time-invariant and a time-variant components. While the former one may be determined by family background or early childhood education, the latter one may rather be the result of shocks and experiences faced by an individual all along his life. The ethnicity and gender are given from the birth. It has been widely proven that gender does partly explain the difference in risk aversion (Croson and Gneezy (2009) and Bertrand (2011)). There are two dimensions that can explain that women are more risk averse than men: (i) when born, women are innately/inherently more risk averse than men, (ii) the socialization they experience in the society they live in makes them become more risk averse. Furthermore, before being an adult, risk aversion may be influenced by family background, early childhood education and social norms. In other words, risk aversion can be affected when an individual builds his identity and personality. For example, those who were raised in a conservative society tend to declare a higher risk-aversion level. When we measure risk aversion from surveys, the samples are in general composed of adults. Therefore, in this case, the two factors such as innate characteristics and childhood socializations can be treated as time-invariant factors. On the other hand, the time-variant factors include socio-demographic characteristics and shocks which can vary over time. Risk aversion varies with age: the older, the more risk averse (Tymula et al. (2013)). Moreover, when an unexpected bad event, such as a health shock (accident, disease) or an income shock (job loss), occurs to someone, we may expect that this person become more risk averse as he experienced a negative situation which affects his initial wealth (Kihlstrom et al. (1981)). In our paper, we discuss the formation of the risk aversion function allowing for both time-varying and time-invariant factors. We will then see which part explains most of the risk-related behaviors.

Table 1: Factors Influencing the Different Dimensions of Risk Aversion

Time-invariant		**Time-variant**
innate/physical	social/early childhood	
ethnicity gender	family background initial education	**socio-demographic characteristics** - age/vocational training - health status - occupation characteristics (length in a sector, job security level, type of wage) **shocks** - income/debt/loan/inheritance - marriage/child birth/relative's death - labor/sector/occupation/unemployment - health

Data

In order to investigate the instability of risk aversion we use data collected by the University of Osaka, Ritsumeikan University, and Waseda University in Japan. This survey has been initiated[6] in order to examine the economic behaviors on preferences and degrees of life satisfaction. A representative sample has been chosen by a random sampling. The detailed information has been collected annually from 2003 till 2010 (8 waves).

The same individuals have been interviewed over this period, which enables us to control for unobserved heterogeneity through the use of a panel dataset. Besides extensive socio-demographic (age, gender, religion, marital status, education) and economic information (occupation characteristics, income, consumption expenditures), data on risky choices in finance (assets, loans, gamble), and health (exercise, smoking, drinking, height and weight) were asked to the respondents. The survey also collected data on individual risk preferences by asking gambling or lottery questions. We acknowledge that the exact formulation of these latter questions are unfortunately different in each wave of the survey. Nonetheless, the formulation of a few self-reported risk aversion questions remains unchanged from one year to another allowing us to use them in our panel analysis.

Table 2 presents a simple descriptive statistics summary of respondents' characteristics for each wave. On average, we observe more women (over 50%) in the sample, and the average age is around 50 years old. The panel is unbalanced as some individuals are lost over the years and new participants are recruited in 2004, 2006 and 2009. More precisely, the oldest respondents disappear from the sample.[7] In the sample, people have on average 2.1 children, and more than half of them are actively working. More than half of the Japanese people are participating in any type of gambling[8]. Also, more than a half of the sample (56%) reports that they drink, whereas the smoking rate is relatively small among the interviewees (less than 35%).[9]

[6]This survey has been launched by Yoshiro Tsutsui from Osaka University.

[7]This explains why the average age does not increase between 2003 and 2004. Also, until 2008, more male participants quit over years. In 2009, more men and more educated/employed participants are newly recruited in the sample.

[8]In the British Gambling Prevalence Survey, it is found that 73% of the adult population (aged 16 and over) participated in any form of gambling in 2009 in Britain. This equates to around 35.5 million adults.

[9]According to the World Health Organization Global Infobase 2005, the Japanese smoking rate was the 44th in the world (about 33.1%), which is lower than Germany (35%) and France (34.1%) and higher than other anglo saxon countries (Australia 19.5%). However, in 2010 the smoking rate in the world declined: France (23.3%), Germany (21.9%), United Kingdom (21.5%), EU27 (23%).

Table 2: Descriptive Statistics: Yearly

	2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Female	0.511	0.527	0.531	0.529	0.534	0.541	0.530	0.532
	(0.500)	(0.499)	(0.499)	(0.499)	(0.499)	(0.498)	(0.499)	(0.499)
Age (in years)	49.14	49.07	50.07	50.23	51.44	52.70	49.96	51.23
	(12.74)	(12.97)	(12.97)	(13.11)	(12.85)	(12.66)	(13.31)	(13.15)
Education (in years)	12.60	12.67	12.67	12.73	12.77	12.78	13.02	13.07
	(2.12)	(2.14)	(2.27)	(2.29)	(2.25)	(2.25)	(2.22)	(2.20)
Income (in mil Yen)	3.49	3.56	3.69	3.73	3.79	3.81	3.73	3.84
	(0.34)	(0.35)	(0.35)	(0.34)	(0.34)	(0.33)	(0.33)	(0.32)
Married	0.760	0.774	0.791	0.786	0.795	0.805	0.786	0.798
	(0.428)	(0.419)	(0.407)	(0.410)	(0.404)	(0.396)	(0.410)	(0.402)
Children	2.115	2.110	2.141	2.157	2.162	2.168	2.147	2.149
	(0.716)	(0.741)	(0.733)	(0.732)	(0.723)	(0.725)	(0.746)	(0.747)
Working	0.561	0.576	0.573	0.583	0.582	0.575	0.673	0.647
	(0.496)	(0.494)	(0.495)	(0.493)	(0.493)	(0.494)	(0.469)	(0.478)
Gamble	0.571	0.605	0.624	0.586	0.606	0.592	0.605	0.703
	(0.495)	(0.489)	(0.484)	(0.493)	(0.489)	(0.491)	(0.489)	(0.457)
Smoke	0.345	0.316	0.306	0.288	0.276	0.254	0.260	0.244
	(0.484)	(0.476)	(0.473)	(0.463)	(0.500)	(0.500)	(0.500)	(0.500)
Drink	0.572	0.561	0.566	0.556	0.564	0.558	0.554	0.531
	(0.408)	(0.416)	(0.415)	(0.410)	(0.402)	(0.398)	(0.401)	(0.426)
Observations	*1,418*	*4,224*	*2,987*	*3,763*	*3,112*	*2,731*	*6,181*	*5,386*
New Entry		*3,161*	*0*	*1,391*	*0*	*0*	*3,706*	*0*
Quit	*355*	*1,236*	*621*	*651*	*381*	*255*	*797*	

Notes: Standard Deviations in Parentheses. Annual Income is provided in million Yen.

Table 3: Pairwise Correlation between Socio-Demographics and (Risky) Behaviors

	occupational choices			**financial choices**		**risky behaviors**				
	Employed	Public	Self-Employed	Debt	Risky Asset	Gamble	Smoke	Smoke a lot	Drink	Drink Heavily
Woman	-0.343⋆	-0.002	0.056⋆	-0.016	-0.031⋆	-0.190⋆	-0.457⋆	-0.314⋆	-0.344⋆	-0.293⋆
Mother's Edu	0.061⋆	0.017	-0.110⋆	0.043⋆	0.029⋆	-0.051⋆	-0.055⋆	-0.056⋆	-0.002	-0.083⋆
Father's Edu	0.009	0.037⋆	-0.106⋆	0.002	0.060⋆	-0.044⋆	-0.061⋆	-0.066*	-0.003	-0.076⋆
Education	0.125⋆	0.174⋆	-0.181⋆	0.050⋆	0.094⋆	-0.034⋆	-0.027⋆	-0.061⋆	0.087⋆	-0.042⋆
Age	-0.229⋆	0.032⋆	0.243⋆	-0.245⋆	0.172⋆	-0.013	0.010	-0.040⋆	-0.040⋆	0.066⋆
Married	-0.078⋆	0.103⋆	0.089⋆	0.104⋆	0.031⋆	0.009	0.039⋆	-0.029⋆	0.042⋆	0.069⋆
Have Children	-0.090⋆	0.073⋆	0.099⋆	0.092⋆	0.029⋆	0.005	0.025⋆	-0.032⋆	-0.003	0.066⋆

Notes: ⋆ 5% significance.

Table 3 shows a pairwise correlation matrix on the socio-demographic variables and behaviors related to risk. Women are less active to be employed as wage-earners, but rather self-employed. All the following indicators are lower for women in comparison to men: investment on risky assets, gambling, smoking and drinking habits. If we look at the family background (father's and mother's educations variables), it is correlated with several choices: (i) parents' education increases employment and decreases the self-employment, (ii) it is positively correlated with the existence of debts and investments in risky assets,[10] (iii) it is negatively correlated with the gambling, smoking, and drinking behaviors of the children. Education *per se* has a similar impact as the parents' education one : it is positively correlated with employment, and negatively correlated with self-employment. A wealth effect seems to go through both parental and personal education: they are both positively correlated with financial choices. Also, people with higher education tend to gamble and smoke less, whereas they tend to drink more. Yet, if we look at the heavy drinkers, it is negatively correlated with education, indicating that more educated people do drink more often but moderately. Finally, as they get older, people are both less and less employed and employable, leading to more self-employment.

4 Empirical analysis

In this paper we aim at investigating the stability of risk aversion over time in order to derive recommendations regarding data collection in surveys. In particular, our analysis will provide evidence in favor of a periodical collection of risk aversion, rather than a systematic one or a unique one at baseline.

Our empirical analysis starts with evidence on the validity of our preferred risk aversion measure, self-assessment of own risk aversion. We then provide proof that risk aversion is composed of a time-variant part and show that the variation cannot be reduced to measurement error or noise given that it is related with income or health shocks. Finally, we investigate whether or not the variation in risk aversion translates into a modification of individuals' risky behaviors.

[10] However the correlation with the financial choices are mainly due to the wealth effect as more education in turn increases wealth.

4.1 Validity of our risk aversion measure

Risk aversion measurement is quite debated in the literature and many different methodologies have been proposed. A trade-off between the accuracy of the measure and the practicality of the data collection is at the core of choices made by survey designers.

Many different methodologies widely used in the literature have been implemented in the Osaka Panel Data: self-reported risk aversion in general, income prospect choices, lotteries, and the "taking umbrella" question. Unfortunately, the formulation of some of these questions varied from one year to another impeding us to use this wide range of measures. Self-reported risk aversion is actually one of the few methods that remained unchanged in all questionnaires. Using German and Thailand data Dohmen et al. (2010) and Hardeweg et al. (2012) showed that in predicting risky behaviors, survey data outperform experimental measures, such as real pay-out lotteries. In addition to the previous evidence in favor of this type of risk aversion measure, we show below that measures of individual risk aversion are actually highly correlated with one another.

In this section we present the different methodologies implemented in the Osaka Panel Study. Three main methodologies are actually used: (i) the income prospect choices (Barsky et al., 1997), (ii) the willingness to pay for lottery tickets, and (iii) self-reported risk aversion. Except the self-reported risk aversion measure, some of the risk aversion questions vary a bit across survey waves. While in most cases the formulation remains identical, the probabilities and amounts offered differ. We report below the questions implemented in the 2006 wave.

Barsky et al. (1997)'s measure

This first measure is based on hypothetical choices between betting on whether doubling the current income with some risk of having it cut by a certain percentage or whether benefiting from a small but constant increase of the current income.

Two sets of questions of this type have been asked to respondents. We present below one of them. The other one only differs by the size of the income loss.

1. *"In which of the following two ways would you prefer to receive your monthly income? Assume that your job assignment is the same for each scenario."*

   (a) Your monthly income has a 50% chance of doubling, but also has 50% chance of decreasing by **30%** → answer question 2.

   (b) Your monthly income is guaranteed to increase by 5% → answer question 3.

2. *"Of the following two jobs, which would you prefer?"*

   (a) Your monthly income has a 50% chance of doubling, but also has 50% chance of decreasing by **50%**

   (b) Your monthly income is guaranteed to increase by 5%

3. *"Of the following two jobs, which would you prefer?"*

   (a) Your monthly income has a 50% chance of doubling, but also has 50% chance of decreasing by **10%**

   (b) Your monthly income is guaranteed to increase by 5%

The answers given by the participants are gathered in four different groups. A four-categories variable of risk aversion can thus be built. The latter is increasing with risk aversion and takes the following values: 1 if the respondent answered (a) to question 1 and (a) to question 2; 2 if he answered (a) to question 1 but (b) to question 2; 3 if he answered (b) to question 1 and (a) to question 3 and finally 4 if he answered (b) to both questions 1 and 3.

Reservation prices

The second methodology used to derive the individuals' preferences towards risk elicits individual's willingness to pay for a lottery ticket.

Three sets of questions of this type have been asked to respondents. We present below one of them. The second one differ by the percentage chance of winning the lottery (1%) and the gain (100,000 yen). The third one uses the same lottery as the first set of questions but the individual is now in the position of selling the ticket instead of purchasing it.

1. *"Let's assume there is a lottery with a 50% chance of winning 2,000 yen and a 50% chance of winning nothing. If the lottery ticket is sold for 200 yen, would you purchase a ticket?"*
   (a) I would purchase a ticket → answer question 2
   (b) I wouldn't purchase a ticket → answer question 3
2. *"What is the most you would pay to purchase the lottery ticket mentioned in question 1?"*
   (a) Purchase if the price is less than 300 yen
   (b) Purchase if the price is less than 400 yen
   (c) Purchase if the price is less than 600 yen
   (d) Purchase if the price is less than 1,000 yen
   (e) Purchase if the price is less than 2,000 yen
   (f) Purchase even if the price is more than 2,000 yen
3. *"If the price of the lottery ticket was lowered, would you purchase it if..."*
   (a) The price is less than 190 yen
   (b) The price is less than 150 yen
   (c) The price is less than 100 yen
   (d) The price is less than 50 yen
   (e) The price is less than 1 yen
   (f) Wouldn't purchase even if the price is 1 yen

Based on the provided answers, all respondents can be gathered according to their level of risk aversion in a 12-category variable which is increasing with risk aversion. This variable will take value 1 for the participants who replied (a) to question 1 and (f) to question 2 and value 12 for individuals who said they wouldn't purchase such ticket even if the price was only 1 yen (i.e. option (b) in question 1 and option (f) in question 3).

Self-reported risk aversion

11-ladder Likert scales have been used in three risk aversion questions. The formulations used are reported hereafter. All the scales have been reversed in order to obtained variables that are increasing with risk aversion.

The "wise man" question - self-reported risk aversion in general *"As the proverb says, "Nothing ventured, nothing gained", there is a way of thinking that in order to achieve results, you need to take risks. On the other hand, as another proverb says, "A wise man never courts danger", meaning that you should avoid risks as much as possible. Which way of thinking is closest to the way you think? On a scale of 0 10, with 10 being completely in agreement with the thinking "Nothing ventured, nothing gained", and 0 being completely in agreement with the thinking "A wise man never courts danger", please rate your behavioral pattern."*

The "cautiousness" question *"When you usually go out, are you cautious of locking doors/windows and turning off appliances to prevent a fire? On a scale of 0-10 with 10 being the "last person to be cautious", and 0 being the "most cautious", please rate your level of cautiousness."*

The "umbrella" question *"When you usually go out, how high does the probability of rain have to be before you take an umbrella?"*

In Table 4, the pairwise correlations between different types of risk aversion measures are reported. We could compare the three different measures of risk aversion. All the

Table 4: Pairwise Correlation between Different Risk-Aversion Measures

		(1)	(2)	(3)	(4)	(5)	(6)	(7)
Barsky RA measures								
inc. prospect choice #1	(1)	1.000						
inc. prospect choice #2	(2)	0.636***	1.000					
Lotteries								
RA lottery #1	(3)	0.118***	0.120***	1.000				
RA lottery #2	(4)	0.107***	0.163***	0.587***	1.000			
Self-declared risk aversion								
SRRA in general	(5)	0.135***	0.085***	0.129***	0.1409***	1.000		
caution	(6)	0.030	0.024	0.046**	0.051**	0.1725***	1.000	
umbrella question	(7)	0.059**	0.041*	0.042*	0.013	0.089***	0.089***	1.000

Notes: *** 1%, ** 5% and * 10% significance.

described measures increase with risk aversion: a more risk-averse individual will get a higher value for each variable. Each method is significantly and positively correlated with one another. From Table 4, we note that the self-reported risk aversion (SRRA hereafter) in general variable is positively correlated with all the other measures. Based on this observation and given the formulation issues we face with the other methodologies, we decide to use SRRA as a good proxy for individuals' preferences towards risk in our study.

Table 5: Pairwise Correlation between Risk Aversion and Socio-Demographics

	Woman	Mother's Edu	Father's Edu	Education	Age	Married	Have Children
SRRA in general	0.116*	-0.070*	-0.055*	-0.064*	0.098*	-0.059*	0.045*
expected sign	+	-	-	-	+	?	+

Notes: ⋆ 5% significance.

From Table 5, we note that self-declared risk aversion is positively correlated with being a woman, being older and having children. It is negatively correlated with own education, parents' education and being married. All these results are in line with the existing literature.[11]

Table 6 presents the pairwise correlations between current self-reported risk aversion and risky behaviors. All our results are consistent with the expected sign. More precisely, self-assessed risk aversion is negatively correlated with health-related risky behaviors

[11]However, education could be an endogenous choice which could also be affected by the agent's risk aversion level or the level of education of his parents.

Table 6: Pairwise Correlation between Current Risk Aversion and (Risky) Behaviors

	SRRA in general	expected sign
occupational choices		
employed	-0.136⋆	-
public sector	0.0194	+ ?
self-employed	-0.019	- ?
financial choices		
debt	-0.038⋆	-
risky asset	-0.080⋆	-
risky behaviors		
gamble	-0.101⋆	-
smoke	-0.127⋆	-
smoke a lot	-0.093⋆	-
drink	-0.092⋆	-
drink heavily	-0.044⋆	-

Notes: ⋆ 5% significance.

(such as smoking and drinking) as well as financial choices (like debt and holding risky assets). Regarding occupational choices, the expected positive relation between public sector and risk aversion on the one hand and the negative association between the latter and self-employed on the other hand are found but they are not significant at the standard 5% level.

In view of these simple correlations between our risk aversion measures, socio-demographics and risky behaviors, it seems that the self-assessed risk aversion variable is correlated with socio-demographics with the expected sign and capturing well the individual behaviors. We will thus keep this measure for the core of our analysis.

4.2 Variation of risk aversion over time

Unlike many panel surveys that collect risk aversion information at baseline only, in the Osaka University Panel data, the respondents were asked questions relative to their risk aversion every year. This feature of our data allows us to investigate the stability of individuals' responses over time.

Figures 1, 2, 3 and 4 display yearly, biyearly, three-year and five-year variations in individual self-declared risk aversion. The solid line displays the 0 value which represents the 'no change' in risk aversion compared to the previous year. As for the dashed line, it shows the median value of change.[12]

While for most of the respondents no variation in risk aversion level is observed, still around 30% of interviewees declare a higher or a smaller level of risk aversion. For almost all years, we see a clear bell-shaped distribution with a median of 0, but also a lot of interviewees reporting different risk aversion levels across years. Nonetheless, in the first two graphs of figure 1, which present the variation in individuals' preferences towards risk between 2003 and 2004 and between 2004 and 2005, respectively, the median risk aversion change is different from 0, and it is first left- and then right-shifted. Therefore, it seems that something unusual occurred in 2004: people revealed in 2004 a lower risk aversion on average.

Let us denote Δ the difference in index between year t and year $t-1$. As the self-reported risk aversion has a 0-10 scale, the possible range of difference in risk aversion is from -10 to 10. The former value corresponds to an extreme risk-averse agent (SRRA = 10) becoming extremely risk lover (SRRA = 0) while the latter one can be derived from an extreme risk-seeking individual who becomes extremely risk averse. Δ^+ is a dummy for becoming more risk averse: he declares a higher risk aversion score at year t compared to year $t-1$. Δ^- is a dummy for becoming less risk averse: he declares a lower level of risk aversion at year t compared to year $t-1$. These two dummies take value one only when the difference in yearly risk aversion index is larger or equal to 2 in order to avoid the noise of respondents' measurement errors. In Table 7 the share of individuals who declare a different level of risk aversion from one year to the next are reported.[13] Living aside year 2004 and 2005, we note that around 15 and 20% of respondents declare a higher level of risk aversion than the previous year and a similar share of the sample

[12]If $RA_t = 4$ and $RA_{t-1} = 4$ then $\Delta RA_t = 0$. If $RA_t = 5$ and $RA_{t-1} = 4$ then $\Delta RA_t = 1$. Therefore, a positive number means that now he/she becomes more risk averse in comparison to last year's risk-aversion level.

[13]We only look at the variations of the participants who stay two years in a row. That is why the number of observations is smaller than the full sample size. For example, in 2004 we could only observe $1,041$ participants who were in 2003, although in 2004 the total sample size is 4,224.

declare a smaller level of risk aversion than in the previous survey wave.

Table 7: Yearly Change of Individuals' Self-Reported Risk Aversion

%	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Share of individuals							
with a higher RA (Δ^+)	8.74	60.29	19.13	19.31	16.75	20.37	16.33
with a lower RA (Δ^-)	52.83	7.40	19.13	17.77	20.04	14.00	20.89
Observations	*1,041*	*2,946*	*2,332*	*3,045*	*2,674*	*2,415*	*5,247*

Notes: 2004 refers to the variation between 2003 and 2004.

These figures provide some first evidence that individual risk aversion may vary over time, which is in contradiction with the risk stability assumption commonly used. To confirm that indeed the observed instability is capturing actual changes in individual characteristics and not only measurement error, we will investigate the relation between the yearly changes in self-declared risk aversion and shocks (such as job loss, income changes or health optimism) faced by individuals in the previous year. Such shocks may indeed explain the modified declared risk aversion from one year to the next.

4.3 Is the variation of risk aversion correlated with shocks?

Table 8 presents the pairwise correlation matrix for changes in risk aversion and shocks. We compare the changes in self-reported risk aversion with various shocks. As previously, Δ stands for the difference in index between year t and $t-1$. Job loss is a dummy variable created if he, his spouse, or both have lost their job between year t and $t-1$. As health variable is collected as index variables[14], we also created dummies for positive/negative changes. Personal job loss is not really significant with the SRRA, but spousal job loss is. When the spouse has lost the job (or both have lost their jobs) the individual declares a higher risk aversion level. When individuals are more anxious about their health, they also declare a higher risk aversion level. Also, becoming less risk averse is negatively correlated with health anxiety. Yet, when there is a positive health shock -becoming

[14] A question regarding health status is asked: "Are you anxious about your health?". Respondents answered in a scale 1 (absolutely agree) to 5 (do not agree at all).

less anxious about health- it is still positively correlated with both becoming more risk averse and becoming less risk averse, although the size is rather small. We can infer that the variation in health shock changes risk aversion anyway, regardless of the direction of the change. It could be that a health shock may fluctuate individual attitudes towards risk. When it comes to income variation, we can observe a significant correlation between difference in income and change in SRRA. If individual earns more income compared to the previous year, he becomes less risk averse, which is consistent with the wealth effect in the risk aversion literature. We then look at the sub-sample analyses between men and women. Men become more risk averse when they lose their own job, whereas women are more influenced by their spousal job loss. Moreover, women are more sensitive to an income change: if they become richer, they are less risk averse, while men are not very much influenced by an income change. In order to see the clearer correlation or even causation behind, we conduct the Mundlak random-effects model.

Table 8: Pairwise Correlation between Changes in Risk aversion and Shocks

SRRA	job loss			health		Income
in general	own	spouse	both	Δ^+	Δ^-	Δ
Δ	0.006	0.023**	0.019**	0.442***	0.000	-0.0140*
Δ^+	0.008	0.009	0.014	0.522***	0.021**	-0.0153*
Δ^-	0.001	-0.014	-0.007	-0.077***	0.029***	0.004
Δ^m	0.020***	0.016	0.032**	0.358***	0.037*	-0.002
Δ^f	-0.005	0.024*	0.011	0.363**	-0.006	0.0385*

Notes: * 10%, ** 5% and *** 1% significance.
Δ^+ refers to a positive change, Δ^- to a negative one.
Positive change means that the individual become more risk averse.
Δ^m refers to changes only for male respondents, Δ^f for female respondents.

4.4 Does the time-variant dimension represent an important share of risk aversion?

Correlated Random Effects (Mundlak, 1978) We set a statistical model following Sahm (2008) which formulates the risk aversion function $RA_{it} = x_{it}\beta + a_i$ disentangling the time-varying factors x_{it} and the time-invariant ones a_i. We can model the relationship between the time invariant factor a_i and the observable panel average $\bar{x_i}$ as $a_i = \bar{x_i}\lambda + u_i$. We assume $u_i|\bar{x_i} \sim N(0, \sigma_u^2)$. This approach follows the correlated random-effects model by Mundlak (1978). Also, as our self-reported risk aversion measure is on scale of 0 to10, we can assign a latent variable such that:

$$RA_{it} = x_{it}\beta + \bar{x_i}\lambda + u_i + \epsilon_{it}$$

$$SRRA_{it} = j,\ if\ \underline{RA_j} < RA_{it} < \overline{RA_j}\ (i = 1, ..., N; t = 1, ...T)$$

$SRRA_{it}$ is the self-reported category that an interviewee declared. If we rearrange the equation above, we can exhibit the within- and between-individual variations in the risk aversion function.

$$RA_{it} = (x_{it} - \bar{x_i})\beta + \bar{x_i}(\lambda + \beta) + u_i + \epsilon_{it} \tag{1}$$

RA_{it}: Self-Reported Risk Aversion Category at time t of individual i

$x_{it} - \bar{x_i}$: Income variation, Age variation, Health shock, Employment variation, Debt Variation, Marital change, Change in the Number of Children, Employment status change, and Education variation

$\bar{x_i}$: Panel average of Log income, Age, Health, Employment, Debt, Marrital status, Number of children, and Number of years of schooling

We test the impact of the panel average of time-varying variables for the same individual in order to track the between-subject effect as well as the impact of the current variation (the difference between the current variable with the panel average) to check the within-individual effect on the risk aversion parameter. More precisely, the first term $(x_{it} - \bar{x_i})\beta$ captures a change in the risk aversion parameter for a given individual (within-individual variation) and the second term $\bar{x_i}(\lambda + \beta)$ gives the between-individual variation. In order to estimate the parameters, we use the random-effects regression.

Table 9 presents the result of within-between analyses. Across the individuals (between-individual variation), the result shows that women declare a higher self reported risk aversion, as expected. Also, being employed is negatively correlated with the risk aversion measure.[15]

Column (1) presents the Mundlak Random-Effects model on log of self-reported risk aversion. The risk aversion measure shows that when an individual gets richer he becomes less risk averse as the log income variation is negatively correlated with the risk aversion measure. On the other hand, the age variation is positively correlated with risk aversion, meaning that when he gets older, he becomes more risk averse. If he loses his job, then he becomes more risk averse (negative correlation with a positive employment status change), and if he gets more education, he becomes less risk averse (negative correlation). However, these latter relations are not statistically significant. Across individuals, women, and older people are more risk averse as expected. Those who have concerns about their health status tend to declare a higher risk aversion level. Education is negatively correlated with risk aversion, and those who are indebted are less risk averse, and vice versa, i.e. risk-averse individuals do not like debt. Column (2) present the pooled OLS on log of self reported risk aversion. Putting logarithm allows us to obtain the percentage change in risk aversion associated with the different variables. An income change lowers risk aversion by 4.5% - 5.3% , whereas an age change increases risk aversion by 6.9% - 6.5%. Also, being women increases risk aversion by 5% - 3.8% and being anxious about health status increases the risk aversion measure by 2.9% - 3.4%, significantly.

4.5 How often should risk attitudes be collected in surveys?

Table 10 and Table 11 present the coefficients of self-reported risk aversion in predicting the current risky behaviors without and with socio-demographic controls, respectively. The current risky behaviors are smoking, drinking, gambling, investment in risky assets,

[15]Employment status: being unemployed assigns the value of 0, and being employed assigns the value of 1.

debt existence, employment status, self-employment, and public sector choice. Risk aversion is negatively correlated with all the given behaviors: risk-averse individuals smoke less, drink less, gamble less, invest less on risky assets, have less debt, and are less employed. Using the past lagged risk aversion measures gives quite similar results in predicting the current behaviors compared to the current risk aversion measure.

Similarly, Tables 12 and 13 present the coefficients of different average measures of risk aversion in predicting the current risky behaviors. The first two rows of each table indicate the total average risk aversion measures: the first one is the panel average risk aversion over time including the current risk aversion measure while the second one is excluding the current one. From the third row, we calculate the average of the current risk aversion at t and the past risk aversion measure at $t-i$ where $i = 1, 2, 3, 4, 5, 6$. Table 14 and Table 15 show the results for the sample of individuals who appear four consecutive years. When comparing the pseudo R^2 as well as the size of coefficients, they shows that the average of all four years predict better than the other averages that use two years of risk aversion. This suggests that having more information on time-variant dimensions of the risk aversion measure can increase the explanatory power. In addition, the current behaviors is more related to the recent risk aversion measures as we see that the risk aversion measured 3 or 4 years before could still well predict the current behaviors. For this reason, collecting risk aversion every year will definitely increase the quality of the use of the risk aversion measure in surveys. Alternatively, collecting the risk aversion measure at least every 3 or 4 years allows for a valid analysis, as the past risk aversion at $t-3$ or $t-4$ well predicts the current behaviors.

5 Conclusion

This paper questions the risk aversion stability over time. In various surveys, often it is taken for granted that risk aversion is innate and time-invariant, leading to a unique measure of individuals' preference towards risk. We wonder whether risk aversion collected only once could still be l a valid measure. In order to test this hypothesis, we first show that the existence of variance of risk aversion on yearly bases thanks to the Osaka panel where self-reported risk aversion is collected every year from 2003 till 2010. We subsequently present evidence that the time variation is not only noise, as it also varies with income, age, and health variation. As income increases, risk aversion decreases. As being more anxious about health, individuals become more averse to risk. The older, the more risk averse. Hence, we see that risk aversion is indeed formulated with time-varying components as well as time-invariant factors. Following Mundlak(1978)'s random-effects model, we find the determinants of risk aversion. In terms of within-individual variation over time, income variation is negatively correlated, and age variation is positively correlated with risk aversion. Between-variation across individuals are estimated by using the panel average of each variable such as gender, income, age, health status, employment status, debt existence, marital status, number of children, and education. The characteristics which explain the most the individuals' level of risk aversion are being women (+), being older (+), being anxious about health (+), having debts (-), and the education level (-). With these results, the time-varying and time-invariant components of risk aversion are clearly highlighted. Then our question is whether time-invariant factors play a big role when we predict the risk-related behaviors. If so, collecting the risk aversion measure only once would be problematic because it would create measurement errors. However, using various lagged risk-aversion variables and different averages, we find that lagged variables still have a predictive power on behaviors adopted by individuals. We may infer that what matters most when predicting behaviors is between-variation across individual, rather than the time-varying component within individuals. This means that we can still use the risk aversion difference between individuals as a good predictor in order to explain different behaviors across individuals. Yet, when using the average of risk aversion over years a better predictive power is obtained. This could shed light on a possible improvement of survey design, suggesting to collect risk aversion not only once but at least every 3 or 4 years, allowing to capture the time-varying component of risk aversion.

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Tables and Figures

Figure 1: Variation of Declared Risk Aversion : One Year Lag $\Delta RA = RA_t - RA_{t-1}$

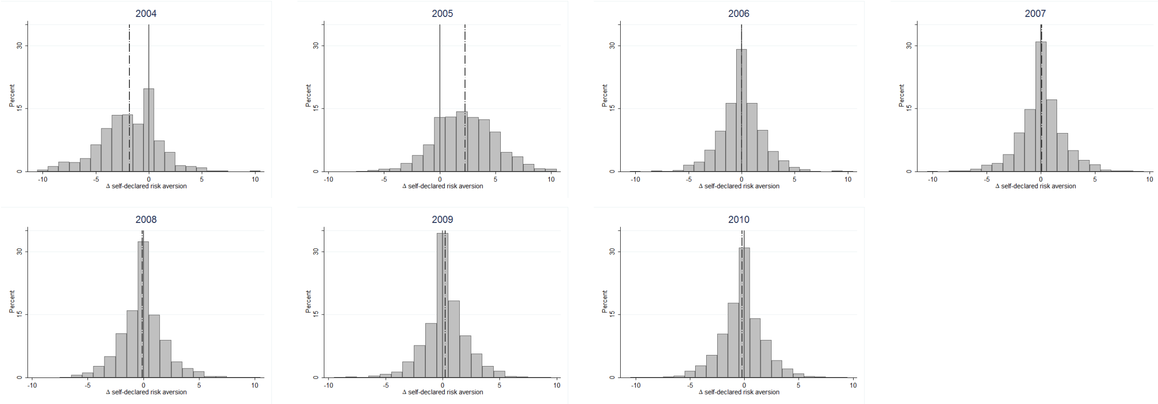

Figure 2: Variation of Declared Risk Aversion : Two Years Lag $\Delta RA = RA_t - RA_{t-2}$

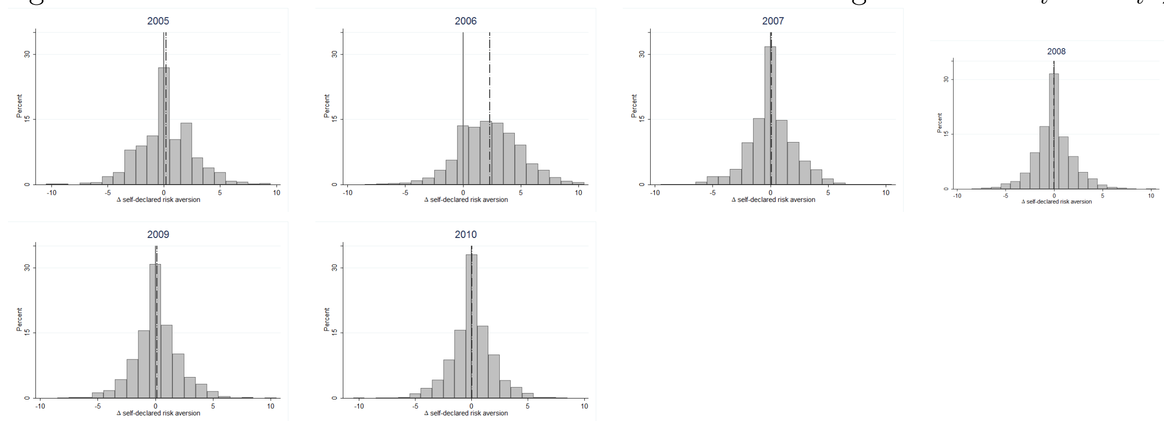

Figure 3: Variation of Declared Risk Aversion : Three Years Lag $\Delta RA = RA_t - RA_{t-3}$

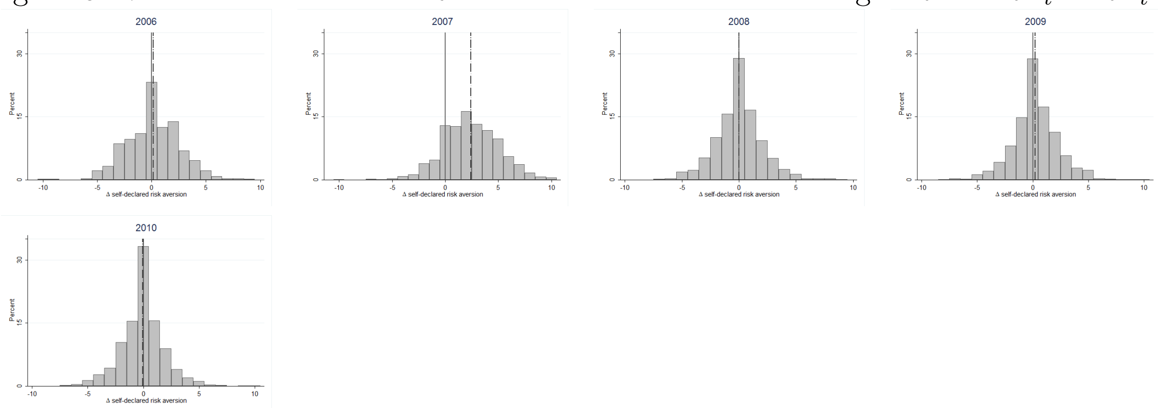

Figure 4: Variation of Declared Risk Aversion : Five Years Lag $\Delta RA = RA_t - RA_{t-5}$

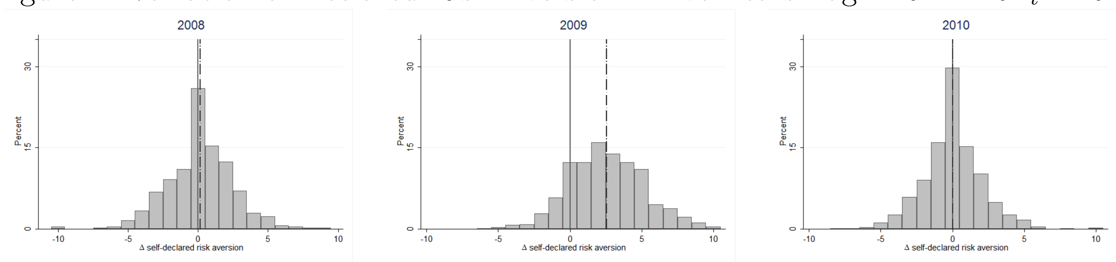

Table 9: Risk Aversion with Within and Between Variations

	(1) Random Effects	(2) Pooled OLS
Dependent Variable = Log(SRRA)		
Within Variation		
Loc Income Variation	-0.045***	-0.053***
	(0.01)	(0.01)
Age Variation	0.069***	0.065***
	(0.00)	(0.00)
Health Variation	-0.002	-0.003
	(0.01)	(0.01)
Employment Variation	-0.018	-0.019
	(0.01)	(0.01)
Debt Variation	0.006	0.003
	(0.01)	(0.02)
Marriage Variation	-0.004	0.006
	(0.04)	(0.04)
Child Variation	-0.003	-0.015
	(0.04)	(0.04)
Education Variation	-0.012	-0.015
	(0.01)	(0.02)
Between Variation		
Female (=1)	0.050***	0.038**
	(0.01)	(0.01)
Mean Log Income	-0.019	0.008
	(0.03)	(0.03)
Mean Age	0.002***	0.002***
	(0.00)	(0.00)
Mean Health	0.029***	0.034***
	(0.01)	(0.01)
Mean Employment	0.007	-0.002
	(0.02)	(0.01)
Mean Debt	-0.020	-0.025*
	(0.01)	(0.01)
Mean Marriage	-0.013	-0.013
	(0.02)	(0.02)
Mean Child	0.014	0.004
	(0.02)	(0.02)
Mean Education	-0.009	-0.010*
	(0.00)	(0.01)
Constant	1.755***	1.367**
	(0.45)	(0.47)
Observations	*13,301*	*13,301*
R^2		0.069
R^2 within	0.098	
R^2 overall	0.069	
R^2 between	0.038	

Notes: * 10%, ** 5% and *** 1% significance.
Standard errors are clustered at the individual level.
Mean Variable is the panel average for one individual.
Variable *Variation* is the difference
between current value and panel average.

Table 10: Analyses with Past Risk-Aversion Variables on Current Behaviors

Probit estimations without controls	Smoke	Drink	Gamble	Risky asset	Debt	Employed	Self employed	Public sector
$\mathbf{RA}_t$	-0.033***	-0.044***	-0.044***	-0.043***	-0.025***	-0.047***	0.003	0.004
Cluster SE	(0.004)	(0.005)	(0.004)	(0.008)	(0.005)	(0.004)	(0.007)	(0.008)
Pseudo R^2	0.002	0.004	0.004	0.003	0.001	0.005	0.000	0.000
observations	*29,438*	*29,438*	*29,438*	*8,597*	*28,423*	*28,446*	*17,347*	*13,424*
$\mathbf{RA}_{t-1}$	-0.028***	-0.042***	-0.039***	-0.012*	-0.027***	-0.044***	0.001	-0.002
Cluster SE	(0.005)	(0.006)	(0.005)	(0.006)	(0.005)	(0.005)	(0.008)	(0.010)
Pseudo R^2	0.002	0.004	0.003	0.000	0.002	0.004	0.000	0.000
observations	*19,890*	*19,890*	*19,890*	*8,574*	*19,259*	*19,201*	*11,670*	*8,961*
$\mathbf{RA}_{t-2}$	-0.014**	-0.038***	-0.032***	-0.009	-0.032***	-0.040***	0.007	-0.008
Cluster SE	(0.007)	(0.007)	(0.006)	(0.012)	(0.007)	(0.006)	(0.010)	(0.012)
Pseudo R^2	0.000	0.003	0.002	0.000	0.002	0.003	0.000	0.000
observations	*12,624*	*12,624*	*12,624*	*3,820*	*12,234*	*12,168*	*7,328*	*5,556*
$\mathbf{RA}_{t-3}$	-0.041***	-0.034***	-0.026***	-0.029***	-0.031***	-0.026***	0.006	-0.014
Cluster SE	(0.007)	(0.008)	(0.007)	(0.009)	(0.007)	(0.007)	(0.010)	(0.013)
Pseudo R^2	0.004	0.003	0.002	0.002	0.002	0.002	0.000	0.000
observations	*9,246*	*9,246*	*9,246*	*3,212*	*8,972*	*8,863*	*5,418*	*4,113*
$\mathbf{RA}_{t-4}$	-0.030***	-0.035***	-0.010	-0.000	-0.021***	-0.007	-0.002	-0.016
Cluster SE	(0.007)	(0.008)	(0.007)	(0.014)	(0.007)	(0.007)	(0.011)	(0.014)
Pseudo R^2	0.002	0.003	0.000	0.000	0.001	0.000	0.000	0.001
observations	*6,354*	*6,354*	*6,354*	*2,153*	*6,153*	*6,067*	*3,749*	*2,847*
$\mathbf{RA}_{t-5}$	-0.014*	-0.036***	0.014	-0.016	-0.017**	-0.016*	0.006	-0.010
Cluster SE	(0.008)	(0.009)	(0.009)	(0.018)	(0.009)	(0.009)	(0.013)	(0.016)
Pseudo R^2	0.000	0.003	0.000	0.000	0.001	0.001	0.000	0.000
observations	*3,766*	*3,766*	*3,766*	*1,198*	*3,656*	*3,552*	*2,278*	*1,737*
$\mathbf{RA}_{t-6}$	0.038***	0.008	0.001	-0.084***	-0.006	0.014	0.022	-0.036
Cluster SE	(0.013)	(0.014)	(0.013)	(0.020)	(0.013)	(0.013)	(0.018)	(0.027)
Pseudo R^2	0.003	0.000	0.000	0.010	0.000	0.000	0.001	0.003
observations	*2,056*	*2,056*	*2,056*	*1,195*	*1,998*	*1,948*	*1,233*	*941*
$\mathbf{RA}_{t-7}$	-0.067**	-0.022	-0.056*	0.013	-0.000	-0.023	0.063	0.069
Cluster SE	(0.030)	(0.033)	(0.031)	(0.034)	(0.029)	(0.030)	(0.042)	(0.055)
Pseudo R^2	0.008	0.001	0.006	0.000	0.000	0.001	0.007	0.009
observations	*456*	*456*	*456*	*343*	*445*	*439*	*268*	*205*

Notes: * 10%, ** 5% and *** 1% significance.

Table 11: Analyses with Past Risk-Aversion Variables on Current Behaviors

Probit estimations with controls	**Smoke**	**Drink**	**Gamble**	**Risky asset**	**Debt**	**Employed**	**Self employed**	**Public sector**
$\mathbf{RA}_t$	0.003	-0.027***	-0.035***	-0.041***	-0.011	-0.021***	-0.010	0.003
Cluster SE	(0.006)	(0.006)	(0.006)	(0.009)	(0.006)	(0.006)	(0.009)	(0.011)
Pseudo R^2	0.184	0.083	0.043	0.068	0.089	0.180	0.075	0.048
observations	*19,572*	*19,572*	*19,572*	*6,622*	*19,227*	*18,914*	*11,329*	*8,525*
$\mathbf{RA}_{t-1}$	0.020**	-0.021**	-0.022***	-0.020**	-0.009	-0.007	-0.016	-0.002
Cluster SE	(0.006)	(0.007)	(0.006)	(0.007)	(0.006)	(0.007)	(0.009)	(0.012)
Pseudo R^2	0.192	0.083	0.045	0.066	0.094	0.177	0.076	0.045
observations	*14,529*	*14,529*	*14,529*	*6,600*	*14,297*	*14,052*	*8,322*	*6,193*
$\mathbf{RA}_{t-2}$	0.037***	-0.018*	-0.018*	-0.004	-0.016*	-0.003	-0.011	-0.003
Cluster SE	(0.008)	(0.008)	(0.007)	(0.014)	(0.008)	(0.008)	(0.011)	(0.014)
Pseudo R^2	0.209	0.081	0.042	0.065	0.101	0.168	0.074	0.043
observations	*9,509*	*9,509*	*9,509*	*3,024*	*9,358*	*9,182*	*5,389*	*3,960*
$\mathbf{RA}_{t-3}$	-0.006	-0.016	-0.013	-0.035***	-0.018*	0.010	-0.021	-0.010
Cluster SE	(0.008)	(0.009)	(0.008)	(0.011)	(0.008)	(0.008)	(0.012)	(0.015)
Pseudo R^2	0.240	0.079	0.042	0.068	0.105	0.157	0.072	0.047
observations	*7,047*	*7,047*	*7,047*	*2,574*	*6,937*	*6,765*	*4,040*	*2,986*
$\mathbf{RA}_{t-4}$	-0.008	-0.017	-0.001	0.012	-0.009	0.024**	-0.018	-0.016
Cluster SE	(0.009)	(0.009)	(0.008)	(0.016)	(0.009)	(0.009)	(0.013)	(0.015)
Pseudo R^2	0.252	0.081	0.047	0.058	0.105	0.152	0.073	0.047
observations	*4,863*	*4,863*	*4,863*	*1,712*	*4,779*	*4,646*	*2,821*	*2,094*
$\mathbf{RA}_{t-5}$	-0.008	-0.029**	0.020*	-0.006	-0.018	-0.008	-0.005	-0.013
Cluster SE	(0.010)	(0.011)	(0.010)	(0.021)	(0.010)	(0.011)	(0.015)	(0.017)
Pseudo R^2	0.250	0.090	0.054	0.062	0.101	0.146	0.075	0.055
observations	*2,915*	*2,915*	*2,915*	*978*	*2,868*	*2,748*	*1,751*	*1,311*
$\mathbf{RA}_{t-6}$	0.037*	0.018	-0.005	-0.061*	0.005	0.031*	0.028	-0.033
Cluster SE	(0.017)	(0.017)	(0.016)	(0.024)	(0.016)	(0.016)	(0.022)	(0.029)
Pseudo R^2	0.253	0.090	0.081	0.067	0.099	0.163	0.083	0.062
observations	*1,601*	*1,601*	*1,601*	*977*	*1,570*	*1,514*	*953*	*714*
$\mathbf{RA}_{t-7}$	-0.036	-0.036	-0.019	0.017	-0.039	-0.030	0.083	0.011
Cluster SE	(0.042)	(0.041)	(0.039)	(0.041)	(0.036)	(0.037)	(0.045)	(0.059)
Pseudo R^2	0.270	0.096	0.099	0.070	0.074	0.146	0.174	0.034
observations	*346*	*346*	*346*	*265*	*341*	*332*	*207*	*154*

Notes: * 10%, ** 5% and *** 1% significance.

Table 12: Analyses with Average Risk-Aversion Variables on Current Behaviors

Probit estimations without controls	**Smoke**	**Drink**	**Gamble**	**Risky asset**	**Debt**	**Employed**	**Self employed**	**Public sector**
RA $_{\frac{\sum_{i=0}^{n} RA_{t-i}}{(i+1)}}$	-0.023***	-0.050***	-0.042***	-0.049***	-0.031***	-0.042***	-0.001	0.003
Cluster SE	(0.006)	(0.007)	(0.006)	(0.010)	(0.006)	(0.006)	(0.009)	(0.012)
Pseudo R^2	0.001	0.004	0.003	0.003	0.001	0.003	0.000	0.000
observations	*29,234*	*29,234*	*29,234*	*8,542*	*28,233*	*28,257*	*17,234*	*13,338*
RA $_{\frac{\sum_{i=1}^{n} RA_{t-i}}{(i+1)}}$	-0.054***	-0.078***	-0.067***	-0.049***	-0.044***	-0.082***	0.000	-0.004
Cluster SE	(0.010)	(0.011)	(0.009)	(0.010)	(0.010)	(0.010)	(0.014)	(0.018)
Pseudo R^2	0.003	0.007	0.005	0.003	0.002	0.007	0.000	0.000
observations	*19,684*	*19,684*	*19,684*	*8,541*	*19,084*	*19,015*	*11,566*	*8,891*
RA $_{\frac{t,t-1}{2}}$	-0.063***	-0.072***	-0.073***	0.026***	-0.041***	-0.085***	0.004	-0.000
Cluster SE	(0.008)	(0.009)	(0.008)	(0.005)	(0.008)	(0.008)	(0.012)	(0.015)
Pseudo R^2	0.005	0.007	0.007	0.001	0.002	0.010	0.000	0.000
observations	*19,700*	*19,700*	*19,700*	*19,700*	*19,102*	*19,025*	*11,576*	*8,899*
RA $_{\frac{t,t-2}{2}}$	-0.067***	-0.070***	-0.073***	-0.056***	-0.050***	-0.092***	0.015	0.001
Cluster SE	(0.010)	(0.011)	(0.010)	(0.006)	(0.010)	(0.010)	(0.015)	(0.019)
Pseudo R^2	0.006	0.007	0.007	0.004	0.003	0.011	0.000	0.000
observations	*12,487*	*12,487*	*12,487*	*12,487*	*12,123*	*12,042*	*7,256*	*5,511*
RA $_{\frac{t,t-3}{2}}$	-0.095***	-0.063***	-0.066***	0.093***	-0.051***	-0.078***	0.014	-0.017
Cluster SE	(0.011)	(0.012)	(0.011)	(0.008)	(0.011)	(0.011)	(0.016)	(0.021)
Pseudo R^2	0.011	0.006	0.006	0.011	0.003	0.008	0.000	0.000
observations	*9,136*	*9,136*	*9,136*	*9,136*	*8,879*	*8,760*	*5,357*	*4,073*
RA $_{\frac{t,t-4}{2}}$	-0.085***	-0.067***	-0.044***	-0.101***	-0.038**	-0.058***	0.008	-0.018
Cluster SE	(0.012)	(0.013)	(0.012)	(0.009)	(0.012)	(0.012)	(0.017)	(0.023)
Pseudo R^2	0.009	0.006	0.003	0.013	0.002	0.004	0.000	0.000
observations	*6,271*	*6,271*	*6,271*	*6,271*	*6,084*	*5,990*	*3,705*	*2,818*
RA $_{\frac{t,t-5}{2}}$	-0.070***	-0.076***	-0.021	-0.172***	-0.039**	-0.059***	0.016	-0.026
Cluster SE	(0.015)	(0.016)	(0.014)	(0.014)	(0.015)	(0.015)	(0.021)	(0.028)
Pseudo R^2	0.006	0.007	0.001	0.034	0.002	0.004	0.000	0.001
observations	*3,713*	*3,713*	*3,713*	*3,713*	*3,615*	*3,504*	*2,250*	*1,719*
RA $_{\frac{t,t-6}{2}}$	-0.017	-0.034	-0.044*	0.191***	-0.043*	-0.036	0.046	-0.047
Cluster SE	(0.020)	(0.021)	(0.020)	(0.020)	(0.020)	(0.020)	(0.028)	(0.040)
Pseudo R^2	0.000	0.001	0.002	0.034	0.002	0.001	0.002	0.002
observations	*2,027*	*2,027*	*2,027*	*2,027*	*1,976*	*1,921*	*1,217*	*931*
RA $_{\frac{t,t-7}{2}}$	-0.056	-0.060	-0.057	-0.110*	-0.033	-0.044	0.096	0.039
Cluster SE	(0.040)	(0.045)	(0.042)	(0.043)	(0.040)	(0.040)	(0.054)	(0.074)
Pseudo R^2	0.003	0.004	0.003	0.013	0.001	0.002	0.010	0.002
observations	*449*	*449*	*449*	*449*	*439*	*432*	*265*	*204*

Notes: * 10%, ** 5% and *** 1% significance.

Table 13: Analyses with Average Risk-Aversion Variables on Current Behaviors

Probit estimations with controls	Smoke	Drink	Gamble	Risky asset	Debt	Employed	Self employed	Public sector
$RA_{\frac{\sum_{i=0}^{n} RA_{t-i}}{(i+1)}}$	0.033***	-0.030**	-0.030***	-0.054***	-0.013	-0.007	-0.016	0.006
	(0.008)	(0.009)	(0.008)	(0.012)	(0.008)	(0.008)	(0.012)	(0.016)
Pseudo R^2	0.185	0.082	0.042	0.068	0.089	0.180	0.075	0.048
observations	*19,415*	*19,415*	*19,415*	*6,577*	*19,075*	*18,766*	*11,238*	*8,455*
$RA_{\frac{\sum_{i=1}^{n} RA_{t-i}}{(i+1)}}$	0.023	-0.044***	-0.042***	-0.054***	-0.021	-0.023	-0.024	-0.001
Cluster SE	(0.012)	(0.013)	(0.011)	(0.012)	(0.012)	(0.012)	(0.017)	(0.021)
Pseudo R^2	0.191	0.083	0.045	0.068	0.095	0.177	0.075	0.046
observations	*14,402*	*14,402*	*14,402*	*6,576*	*14,177*	*13,938*	*8,251*	*6,146*
$RA_{\frac{t,t-1}{2}}$	0.002	-0.041***	-0.050***	0.022***	-0.018	-0.031**	-0.021	-0.003
Cluster SE	(0.010)	(0.011)	(0.009)	(0.006)	(0.010)	(0.010)	(0.014)	(0.017)
Pseudo R^2	0.191	0.084	0.047	0.012	0.094	0.178	0.076	0.046
observations	*14,434*	*14,434*	*14,434*	*14,434*	*14,209*	*13,964*	*8,271*	*6,162*
$RA_{\frac{t,t-2}{2}}$	0.008	-0.038**	-0.050***	-0.065***	-0.028*	-0.035**	-0.011	0.004
Cluster SE	(0.012)	(0.014)	(0.011)	(0.007)	(0.012)	(0.012)	(0.017)	(0.022)
Pseudo R^2	0.206	0.081	0.044	0.009	0.102	0.170	0.073	0.044
observations	*9,436*	*9,436*	*9,436*	*9,436*	*9,295*	*9,115*	*5,348*	*3,935*
$RA_{\frac{t,t-3}{2}}$	-0.036**	-0.035*	-0.044***	0.099***	-0.031*	-0.022	-0.021	-0.018
Cluster SE	(0.013)	(0.014)	(0.012)	(0.009)	(0.013)	(0.013)	(0.019)	(0.024)
Pseudo R^2	0.240	0.079	0.044	0.019	0.106	0.157	0.072	0.048
observations	*6,982*	*6,982*	*6,982*	*6,982*	*6,880*	*6,705*	*4,004*	*2,964*
$RA_{\frac{t,t-4}{2}}$	-0.037*	-0.037*	-0.023	-0.115***	-0.021	-0.007	-0.022	-0.022
Cluster SE	(0.015)	(0.015)	(0.013)	(0.010)	(0.014)	(0.014)	(0.020)	(0.025)
Pseudo R^2	0.251	0.083	0.047	0.021	0.106	0.151	0.071	0.048
observations	*4,818*	*4,818*	*4,818*	*4,818*	*4,742*	*4,605*	*2,797*	*2,080*
$RA_{\frac{t,t-5}{2}}$	-0.028	-0.054**	0.004	-0.205***	-0.035*	-0.032	-0.014	-0.039
Cluster SE	(0.018)	(0.019)	(0.016)	(0.016)	(0.017)	(0.018)	(0.024)	(0.030)
Pseudo R^2	0.249	0.091	0.053	0.051	0.102	0.145	0.073	0.057
observations	*2,885*	*2,885*	*2,885*	*2,885*	*2,847*	*2,721*	*1,738*	*1,303*
$RA_{\frac{t,t-6}{2}}$	0.028	-0.006	-0.024	0.184***	-0.025	-0.004	0.034	-0.072
Cluster SE	(0.026)	(0.026)	(0.024)	(0.023)	(0.024)	(0.025)	(0.033)	(0.042)
Pseudo R^2	0.249	0.090	0.082	0.045	0.100	0.161	0.080	0.065
observations	*1,585*	*1,585*	*1,585*	*1,585*	*1,560*	*1,499*	*944*	*708*
$RA_{\frac{t,t-7}{2}}$	0.018	-0.074	-0.012	-0.102*	-0.059	-0.027	0.080	-0.063
Cluster SE	(0.054)	(0.056)	(0.052)	(0.052)	(0.049)	(0.049)	(0.061)	(0.079)
Pseudo R^2	0.264	0.103	0.095	0.055	0.077	0.142	0.162	0.038
observations	*343*	*343*	*343*	*343*	*339*	*329*	*205*	*153*

Notes: * 10%, ** 5% and *** 1% significance.

Table 14: Analyses with Average Risk-Aversion Variables on Current Behaviors - Restricted Sample

Probit estimations without controls	**Smoke**	**Drink**	**Gamble**	**Risky asset**	**Debt**	**Employed**	**Self employed**	**Public sector**
$\mathbf{RA}_t$	-0.089***	-0.052***	-0.070***	0.008	-0.037***	-0.086***	0.010	-0.007
Cluster SE	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Pseudo R^2	0.013	0.005	0.008	0.000	0.002	0.012	0.000	0.000
observations	*9,011*	*9,011*	*9,011*	*9,011*	*8,762*	*8,643*	*5,287*	*4,026*
$\mathbf{RA}_{t-1}$	-0.089***	-0.057***	-0.067***	-0.008	-0.040***	-0.082***	0.012	0.014
Cluster SE	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Pseudo R^2	0.013	0.006	0.008	0.000	0.003	0.012	0.000	0.000
observations	*9,011*	*9,011*	*9,011*	*9,011*	*8,762*	*8,643*	*5,287*	*4,026*
$\mathbf{RA}_{t-2}$	-0.052***	-0.059***	-0.055***	-0.026***	-0.033***	-0.058***	0.007	-0.000
Cluster SE	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Pseudo R^2	0.005	0.007	0.006	0.001	0.002	0.006	0.000	0.000
observations	*9,011*	*9,011*	*9,011*	*9,011*	*8,762*	*8,643*	*5,287*	*4,026*
$\mathbf{RA}_{t-3}$	-0.043***	-0.033***	-0.027***	0.101***	-0.031***	-0.025***	0.008	-0.010
Cluster SE	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Pseudo R^2	0.004	0.003	0.002	0.023	0.002	0.001	0.000	0.000
observations	*9,011*	*9,011*	*9,011*	*9,011*	*8,762*	*8,643*	*5,287*	*4,026*
$\mathrm{RA}_{\frac{t,t-1}{2}}$	-0.118***	-0.072***	-0.091***	-0.000	-0.051***	-0.112***	0.015	0.005
Cluster SE	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
Pseudo R^2	0.017	0.007	0.010	0.000	0.003	0.016	0.000	0.000
observations	*9,011*	*9,011*	*9,011*	*9,011*	*8,762*	*8,643*	*5,287*	*4,026*
$\mathrm{RA}_{\frac{t,t-2}{2}}$	-0.096***	-0.077***	-0.087***	-0.013	-0.049***	-0.099***	0.012	-0.004
Cluster SE	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
Pseudo R^2	0.012	0.008	0.010	0.000	0.003	0.012	0.000	0.000
observations	*9,011*	*9,011*	*9,011*	*9,011*	*8,762*	*8,643*	*5,287*	*4,026*
$\mathrm{RA}_{\frac{t,t-3}{2}}$	-0.095***	-0.062***	-0.068***	0.093***	-0.051***	-0.077***	0.013	-0.013
Cluster SE	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
Pseudo R^2	0.011	0.005	0.006	0.011	0.003	0.008	0.000	0.000
observations	*9,011*	*9,011*	*9,011*	*9,011*	*8,762*	*8,643*	*5,287*	*4,026*
$\mathrm{RA}_{\frac{t,t-1,t-2,t-3}{4}}$	-0.134***	-0.099***	-0.105***	-0.046*	-0.067***	-0.132***	0.024	-0.006
Cluster SE	(0.017)	(0.018)	(0.016)	(0.020)	(0.017)	(0.017)	(0.024)	(0.031)
Pseudo R^2	0.015	0.009	0.009	0.002	0.004	0.014	0.000	0.000
observations	*9,011*	*9,011*	*9,011*	*3,163*	*8,762*	*8,643*	*5,287*	*4,026*

Notes: * 10%, ** 5% and *** 1% significance.

Table 15: Analyses with Average Risk-Aversion Variables on Current Behaviors - Restricted Sample

Probit estimations with controls	**Smoke**	**Drink**	**Gamble**	**Risky asset**	**Debt**	**Employed**	**Self employed**	**Public sector**
$\mathbf{RA}_t$	-0.045***	-0.035**	-0.053***	0.005	-0.024*	-0.050***	-0.006	-0.012
Cluster SE	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
Pseudo R^2	0.242	0.080	0.047	0.007	0.107	0.160	0.071	0.049
observations	*6,888*	*6,888*	*6,888*	*6,888*	*6,789*	*6,615*	*3,949*	*2,927*
$\mathbf{RA}_{t-1}$	-0.039***	-0.030*	-0.047***	-0.010	-0.030*	-0.043***	-0.013	0.017
Cluster SE	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
Pseudo R^2	0.241	0.079	0.046	0.007	0.107	0.159	0.071	0.049
observations	*6,888*	*6,888*	*6,888*	*6,888*	*6,789*	*6,615*	*3,949*	*2,927*
$\mathbf{RA}_{t-2}$	-0.004	-0.038***	-0.042***	-0.031***	-0.020	-0.022*	-0.012	0.005
Cluster SE	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Pseudo R^2	0.239	0.080	0.045	0.008	0.106	0.158	0.071	0.049
observations	*6,888*	*6,888*	*6,888*	*6,888*	*6,789*	*6,615*	*3,949*	*2,927*
$\mathbf{RA}_{t-3}$	-0.009	-0.015	-0.014	0.106***	-0.017*	0.010	-0.019	-0.005
Cluster SE	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Pseudo R^2	0.239	0.078	0.043	0.031	0.106	0.157	0.072	0.049
observations	*6,888*	*6,888*	*6,888*	*6,888*	*6,789*	*6,615*	*3,949*	*2,927*
$\mathrm{RA}_{\frac{t,t-1}{2}}$	-0.057***	-0.044**	-0.067***	-0.004	-0.036*	-0.062***	-0.013	0.004
Cluster SE	(0.02)	(0.02)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.03)
Pseudo R^2	0.242	0.080	0.048	0.006	0.107	0.161	0.071	0.049
observations	*6,888*	*6,888*	*6,888*	*6,888*	*6,789*	*6,615*	*3,949*	*2,927*
$\mathrm{RA}_{\frac{t,t-2}{2}}$	-0.032*	-0.052**	-0.066***	-0.020*	-0.031*	-0.048***	-0.013	-0.004
Cluster SE	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.03)
Pseudo R^2	0.240	0.081	0.047	0.007	0.107	0.159	0.071	0.049
observations	*6,888*	*6,888*	*6,888*	*6,888*	*6,789*	*6,615*	*3,949*	*2,927*
$\mathrm{RA}_{\frac{t,t-3}{2}}$	-0.037**	-0.035*	-0.046***	0.099***	-0.031*	-0.022	-0.021	-0.012
Cluster SE	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
Pseudo R^2	0.240	0.079	0.045	0.018	0.107	0.157	0.071	0.049
observations	*6,888*	*6,888*	*6,888*	*6,888*	*6,789*	*6,615*	*3,949*	*2,927*
$\mathrm{RA}_{\frac{t,t-1,t-2,t-3}{4}}$	-0.053*	-0.060**	-0.078***	-0.042	-0.046*	-0.071***	-0.011	-0.007
Cluster SE	(0.021)	(0.022)	(0.018)	(0.023)	(0.020)	(0.020)	(0.028)	(0.035)
Pseudo R^2	0.241	0.081	0.047	0.067	0.107	0.160	0.071	0.049
observations	*6,888*	*6,888*	*6,888*	*2,538*	*6,789*	*6,615*	*3,949*	*2,927*

Notes: * 10%, ** 5% and *** 1% significance.