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Stability of Preference against Aging and Health Shocks: A comparison between Japan and the United States*

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Abstract

This study explores stability of preference against aging and health shocks. Contrary to a vast amount of literature assuming that risk attitude is unchanged over time, we utilize JSTAR (Japanese Study of Aging and Retirement), which provides longitudinal data on the middle aged and elderly comparable with the Health and Retirement Study (HRS)/English Longitudinal Study of Ageing (ELSA)/Survey of Health, Ageing and Retirement in Europe (SHARE), to examine how aging and past health experiences systematically affect risk attitude. We find that while there is empirical evidence that aging gradually causes individuals to be more risk averse, health shocks do not seem to affect risk preference systematically.

Keywords: Risk preference, Aging, Health shock, JSTAR.
JEL classification codes: D01; I10.

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1. Introduction

Economic theory places a central role on individual preference in decision making and risk attitude is a parameter of most importance along with time discounting. In particular, econometric analysis treats utility function as a structural parameter and assumes that individual risk attitude is time invariant. This may be appropriate for a short run analysis but may be a problem in a longer run analysis related to wealth accumulation, health investment, or retirement. While there have been some studies investigating how past consumption experiences affect current utility via habit formation, in this study, we investigate how aging and past health experiences systematically affect risk attitude.

While individual preferences are not directly observable, there is a large literature on measuring the preference which encompasses the parameters of risk attitude, discount factor, and intertemporal substitution. Among them, Barsky, et al. (1997) proposed an experimental approach to measure risk tolerance, time preference, and the elasticity of intertemporal substitution in Health and Retirement Study (HRS) and showed risk tolerance was significantly associated with demographic, socio-economic status, and smoking behavior. It should be emphasized that most of the previous studies implicitly assume stability of individual preferences over time. Indeed, Barsky, et al. (1997) and the subsequent studies explicitly assumed that the revealed preferences are time invariant, and the change in the response over time is basically attributed to random measurement error. For example, Kimball, et al. (2008) revised estimation of cardinal proxy of risk tolerance, with consideration of “measurement error”, assuming consistency of risk preference over time.

In this regard, the individual preferences are treated as innate or are acquired and shaped very early in the life course, affecting the choice in the following life course and the consequent series of choices will finally result in the disparity in earning, educational achievement, and health status. Most of the previous works which related individual preferences and individual behavior assumed some specific forms of utility function (Constant Relative Risk Aversion (CRRA) or Constant Absolute Risk Aversion (CARA)) and examined the effect of the preferences on behavioral consequences. For example, Picone, et al. (2004) also used HRS data, and further included risk and time preferences and expected longevity to explain the demand for preventive medical tests among women. Most recently, Anderson and Mellor (2008) empirically exploited the direct measure of risk tolerance and showed clearly that measured risk attitude is correlated with the risk taking behavior such as smoking and seatbelt nonuse.[1]

However, there is no persuasive reason to make an assumption that individual

[1] Since these studies adopted the measurement of financial risk choice, but not of health risk, the results described above strongly suggest that there is a generic property of preference applicable to a broader set of risk choice behaviors.

preferences are stable over time. According to some recent studies on neural basis of risk preference (Christpolous, et al. 2009), activity in inferior frontal gyrus was significantly associated with “risk aversive” choice in the sense of “mean-preserving increase in the variance (the Rothchild-Stiglitz definition). The striatum was responsive to changes in magnitude and dosal-antereior cingulate was involved in mainly objective risk coding, both of which are related to risky choice behavior. Moreover, recent studies revealed a possibility that risk preference is changeable through learning. The dorso-lateral prefrontal cortex adjacent to the inferior frontal gyrus is known as the highest cortical area responsible for the integration of sensory and mnemonic information and the regulation of intellectual function and action. Thus, risk aversive attitude may not be an innate property, but rather be acquainted through learning hard lessons (Bruno, et al. 2010), which is particularly relevant for decision making of the middle and the old aged people.

In this study, we will use individual level data from the Japanese Study of Ageing and Retirement (JSTAR) and HRS data, which share the common aim and structure. Since those data sets are longitudinal, we utilize the information on individual preferences in a two year interval. In particular, we empirically examine if aging and health shocks affect revealed risk preference systematically over time. The implication of this study is not trivial since one’s later life is full of such shocks. If the individuals in their later life revise their risk attitude, the economic model of behaviors in savings, retirement and labor participation, and health enhancement will accordingly need revisions since risk preference is determined endogenously with health status.

This paper proceeds as follows. Section 2 reviews some related literature on individual preference. Section 3 explains the questions of JSTAR and HRS. Section 4 provides basic statistics of the sample data. Section 5 examines using JSTAR data a cross-sectional association of risk preference with socio-economic, functional, and behavioral variables, and then explores the longitudinal change in the individual preference and its association with health and retirement shocks. A similar analysis using HRS data compares the results in JSTAR and HRS. The final section concludes.

2. Background and related previous studies

Recent debate in economics papers proposed that the time preference should be endogenous (Becker and Mulligan, 1997) and modifiable after health shocks (Smith, et al. 2001). More recently, neuro-economics studies identified that the inferior frontal gyrus, a dorso-lateral part of the frontal lobe of the brain, is associated with a risk aversive behavior (Christpolous, et al. 2009). Experimental disruption of activity of this area with Transcranial Magnetic Stimulation confirmed the change in risk attitudes

(Knoch, et al. 2006). Since the dorso-lateral prefrontal cortex adjacent to the inferior frontal gyrus is known as the highest cortical area responsible for the integration of sensory and mnemonic information and the regulation of intellectual function and action, it is speculated that the risk attitude is an individual's expression of integrated information processing. Indeed, another experiment with preschool children suggests that risk aversive attitude may not be an innate property, but rather be acquainted through learning hard lessons (Bruno, et al. 2010). As these latest studies suggest, the brain collects and integrates the information on different decision parameters to reach the choice, and the resulting behavior is observed as a revealed risk preference. Thus, preference may be varying, revisable, and updated according to exogenous conditions.

With the neuro-physiological basis of risk preference, it is also theoretically plausible that ageing will affect one's risk preference because of physiological change in cerebral neurons and consequent change in information processing. It is already identified that aging affects the ability to process information, especially on processing speed and monitoring (Chaytor N, Schmitter-Edgecombe M, 2004). With deteriorated sensory capability due to physiological ageing (e.g. hearing and eye visions), the quality and quantity of available information to the aged individuals become more limited, which force him/her to make a choice under more uncertain conditions. Ageing is also related to the higher chance to suffer from psychological distress and depression. An experimental comparison confirmed that depressive individuals are more likely to be risk aversive (Smoski, et al. 2008). Indeed, Feinstein and McFadden (1989), Venti and Wise (1989), and Sheiner and Weil (1992) show that the elderly is less mobile and save more than they need in housing stock, suggesting that the aged person tend to become risk-aversive.[2]

3. Measurement of risk attitude

This section of the paper summarizes the measurement of risk attitude through questionnaire survey administered in the community nonexperimental setting. Barsky et al. (1997) was the first of this kind that quantitatively assessed risk preference among HRS respondents. In their first version of the questionnaire, they asked the respondents to make a choice in the following gamble;

> "Suppose that you are the only income earner in the family and you have a good job guaranteed to give you your current (family) income every year for

[2] Another critique against treating the risk attitude as a structural variable comes from repeated scientific reports that the individual's degrees of risk taking in financial, health, ethical, and social decisions are far from stable across situations, suggesting that the risk attitude is more domain-specific. (Hanoch, et al. 2006).

> life. You are given the opportunity to take a new and equally good job, with a 50-50 chance it will double your (family) income and a 50-50 chance that it will cut your (family) income by a third. Would you take the new job?"

According to the response to the above question, the respondents were further followed by alternatives of 50% loss or 20% loss. This version of questionnaire was criticized since it may be susceptible to "status quo" bias. Instead, a revised questionnaire was newly adopted since wave 4, which goes as follows;

> "Suppose that you are the only income earner in the family. Your doctor recommends that you move because of allergies, and you have to choose between two possible jobs. The first would guarantee your current total family income for life. The second is possibly better paying, but the income is also less certain. There is a 50-50 chance the second job would double your total lifetime income and a 50-50 chance that it would cut it by a third. Which job would you take -- the first job or the second job?"

The question was followed by the alternative choice of 75% loss, 50% loss, or 20% loss and 10% loss depending on the responses. This made a 6-level response for risk aversion. Based on the response, Kimball, et al.(2008) estimated a cardinal proxy score of risk aversion $1/\Theta$, by assuming

$$0.5^* U(2Y) + 0.5^*U((1-p) Y) \geqq U(Y)$$

where $U(Y) = Y^{1-1/\Theta} / (1-1/\Theta)$ and p=0.25, 1/3, 0.5, 0.8 and 0.9.

Coefficient of relative tolerance $\Theta = - U'/YU''$ following Pratt (1964) .

There is a room for debate on these assumptions since

1) Some individuals may make an irrational choice. For example, Kubota and Fukushige (2009) shows that about 20% of individuals revealed inconsistent preference.
2) The assumed shape of utility function is very restrictive.
3) The way the question is framed, it is not clear whether the respondent's discount factor plays a role in the answer or not.

Based on the considerations above, we adopted a new question to measure risk aversion in the Japanese Study of Aging and Retirement (JSTAR).[3] The questionnaire reads as follows;

> "Suppose you are offered a new payment choice only valid for the next month. You have two options. Assume whether your income will increase or not in total independent of your efforts and capability, and the change in the payment holds only in the next month. Which will you choose;
>
> 1. 50% gain in your payment for certain
> 2. 10% gain in your payment for certain

The question will be followed by replacing the first option with the following ones until the respondent changes his/her response to 10% gain for certain, which will make 11 –level response of risk preference;

> 90% chance to have 50% gain, and 10% chance to have 5% gain
>
> 80% chance to have 50% gain, and 20% chance to have 5% gain

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[3] See the next section for the detail description of JSTAR. To our knowledge, there is no corresponding question to ask risk preference in English Longitudinal Survey on Ageing (ELSA) or Survey on Health, Aging, Retirement in Europe (SHARE). Thus, we focus on a comparison between JSTAR and HRS.

10% chance to have 50% gain, and 90% chance to have 5% gain

5% gain for certain

The similar questionnaire is repeated by replacing the 10% increase certainty alternative by “20% gain in your payment for certain.” Thus, we could detect non-monotonic response by comparing the responses for the first and second questions.

The JSTAR questions identify bounds of the utility levels at 110% and 120% of the current income. We postulate the expected utility maximization behavior with additive separable preference over time and assume homothetic preference so that individual income level does not affect the choices. Note that CRRA preference satisfies this condition so that this approach includes the parametric approach in the literature as a special case. Since an Affine transformation leaves the choices unchanged, without a loss in generality we normalize

$$U(1.05)=0 \text{ and } U(1.5)=1.$$

Suppose for the first question (110% increase certainty as an option) at p one prefers the lottery but that at p-0.1, one prefers the certainty offer. Then

$$(1-p)U(1.05)+pU(1.5)>U(1.1) \text{ and}$$

$$(1.1-p)U(1.05)+(p-0.1)U(1.5)<U(1.1).$$

Using the normalization, we have

$$p>U(1.1)>p-0.1.$$

Analogously, using the second question (120% increase certainty as an option), if at q one prefers the lottery but that at q-0.1 one prefers the certainty offer, then

$$q>U(1.2)>q-0.1.$$

Monotonicity is violated if p-0.1>q or p-q>0.1. About 10% of the population violates monotonicity in each period. About 20% violates monotonicity in either period. A man is more likely to become non-monotonic as he ages whereas a woman does not have this tendency.

Next, we turn to the concavity issue. Since the line connecting (1.05, U(1.05)) and (1.2, U(1.2)) evaluated at 1.1 needs to come below U(1.1), $U(1.1)>1/3U(1.2)$. Also, the line connecting (1.05, U(1.05)) and (1.5, U(1.5)) evaluated at 1.1 needs to come below U(1.1), so that $U(1.1)>1/9$. Analogously, the line connecting (1.1, U(1.1)) and (1.5, U(1.5)) evaluated at 1.2 needs to come below U(1.2), $3/4U(1.1)+1/4U(1.5)<U(1.2)$. Also, the line connecting (1.05, U(1.05)) and (1.5, U(1.5)) evaluated at 1.2 needs to come below U(1.2), so that $U(1.2)>1/3$.

These conditions simplify to

$1/9<U(1.1)$ and $1/3<U(1.2)$ and

for $1/9<U(1.1)<1/3$, $3/4U(1.1)+1/4 < U(1.2) < 3U(1.1)$ and

for $1/3<U(1.1)$, $3/4U(1.1)+1/4 < U(1.2) < 1$.

It turned out that there are only 10% of the sample who satisfy the concavity in each wave, and only 1% satisfy in both periods. Since the requirement of global concavity over the hypothetical income range may be unrealistic, we restrict the income range within 20% of the current income. In this case, the only restriction is $U(1.2)<3U(1.1)$ under the monotonicity restriction. In this case, the local concavity holds for about 96%

of the sample who met monotonicity. If a person has monotonic preference and $U(1.2)<3U(1.1)$ in both periods and U(1.1) becomes higher, then one is more risk averse in this region.

In the similar way, we can examine bounds on the utility function using HRS data. In the HRS setup, we normalize U(2)=1 and U(1)=0. Other relevant utilities are U(2/3), U(0.8), U(0.9), U(0.5), U(0.25). Potential answers and their implications are one of the following:

(i) $0.5U(2)+0.5U(2/3) < 1$ and $0.5U(2)+0.5U(0.8) > 1$

(ii) $0.5U(2)+0.5U(2/3) < 1$, $0.5U(2)+0.5U(0.8) < 1$ and $0.5U(2)+0.5U(0.9) > 1$

(iii) $0.5U(2)+0.5U(2/3) < 1$, $0.5U(2)+0.5U(0.8) < 1$ and $0.5U(2)+0.5U(0.9) < 1$

(iv) $0.5U(2)+0.5U(2/3) > 1$, $0.5U(2)+0.5U(0.5) < 1$

(v) $0.5U(2)+0.5U(2/3) > 1$, $0.5U(2)+0.5U(0.5) > 1$ and $0.5U(2)+0.5U(0.25) < 1$

(vi) $0.5U(2)+0.5U(2/3) > 1$, $0.5U(2)+0.5U(0.5) > 1$ and $0.5U(2)+0.5U(0.25) > 1$.

Since the probability is fixed at 0.5, the revealed choices only reveal if the turning point utility level is below or above -1. For example, if one prefers 2y and 2/3y's combination over the certainty y but does not over 2y and 0.5y's combination. Then

$$0.5U(2)+0.5U(2/3)>U(1)$$

$$0.5U(2)+0.5U(0.5)<U(1)$$

our normalization imply that the turning point at which the utility level is higher than -1 is 2/3

$$U(2/3)>-1 \quad \text{and} \quad U(0.5)<-1.$$

As one can see, the monotonicity is implied in the HRS question. If the turning point of an individual shifts toward right over the panel data, then this implies that the person is more risk averse. We use this measure to investigate the effect of aging and health shocks on the preference.

4. JSTAR and HRS samples

We use two sets of panel data on the middle and the old for the analyses in this study; JSTAR and HRS. Together with other “family” world standard surveys such as ELSA and SHARE, they share the same motivation and philosophy to understand a variety of levels of aging, from individuals to countries, from an international perspective (Ichimura et al (2009)). They share the same structure of the survey and are mutually comparable and thus suitable for an international comparison study.

The first wave of JSTAR was conducted in the first half of 2007 and collected data on individual living circumstances of 4,200 persons in five municipalities scattered in the eastern geography of Japan. A variety of variables related with economic, health and social status were asked through CAPI (Computer-aided personal interview) by professional interviewers. JSTAR's sampling design is different from other family surveys in that JSTAR did not use the standard national representative random sampling but chose to conduct stratified random sampling within each municipality after selecting the five municipalities. The second wave of JSTAR was conducted in 2009, two years after the first wave. The respondents in the first wave and those in two municipalities which entered newly in 2009 was interviewed. In this study, we limit those respondents who answered two questions in each year in both waves. The number of the respondents is 1,334.

The other data set is HRS. HRS is a well known longitudinal data on the middle and the older Americans, which began in 1992. The "income gamble" questions were included from the first wave but has not been always asked for all the individuals in the sample. The "status quo free" questions were introduced in the forth wave in 1998 for one-tenth of the initial HRS sample (born in 1931-1941) who were first interviewed in 1992 and subsequently every two years and for all the individuals in the CODA (Children of Depression) cohort (born in 1924-1930) and in the WB (War Baby) cohort (born in 1942-1947). The sample in the CODA and WB were first interviewed in 1998 and subsequently every two years. In the fifth wave, the questions were asked for a part of those interviewed in 1998 and again only for those aged less than 65 in 2000, though the sample design of the income gamble was not clear.[4] Instead, we use the sample of the Early Baby Boomer (EBB) cohort (born 1948 to 1953), which was first interviewed in 2004. Since the question was not asked for those aged 65 or over in 2006, we limited our sample to an individual who were interviewed in both years.[5] Since the sample contains younger respondents, presumably younger female spouses in the sample, we limited those aged 50 and over for comparative purpose with JSTAR sample .The number of individuals in our sample is 1,397. Descriptive statistics of the sample used is presented in Table 1.

We start with identifying in the JSTAR sample the predictors of "irrational

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[4] The income gamble question was asked for those who were randomly chosen among those aged less than 65, and who were interviewed in 1998 or in the 1998 experimental module. However, according to the codebook provided by RAND (2010), the sample of the question in 2000 were one-twelfth of those who were randomly chosen regardless of age. The sample design of the income gamble question allows us to have two observations in the forth (1998) and fifth (2000) wave or the fifth (2000) and sixth wave (2002) but we do not use those observations.

[5] The income gamble question was not asked in 2008.

response” which is defined as the violation of monotonicity and local concavity.. We assume that irrational response is an expression of suboptimal cognition of risk information, or of any disturbance in processing the risk parameters. Thus, it is hypothesized that lower educational achievement, cognitive dysfunction, and/or psychological depression would be a strong predictor of the “irrational response.” For this purpose, we used a probit regression analysis with a dummy variable of “irrational response” as the target outcome.

By excluding the cases with irrational response, we limited our sample for further analysis of the cross-sectional association between risk preference, risk behaviors, and socio-demographic factors. Since we assume non-parametric rather than parametric utility function, we first present the probability distribution of risk preference, which showed a bimodal distribution (Figures 1a and 1b). We chose to re-categorize the responses into four categories; risk-seeking, risk-aversion, and somewhat between them. Using these preference dummies as main explanatory variables, we conducted a probit regression again to predict risky behaviors, e.g failed health check-up in the past year, current smoking status, etc. as outcome variables with covariate adjustment for age, gender, education, income, working status, and baseline health status.

We then take a descriptive analysis of preference change between survey waves by simple tables. Then for comparative purpose, we prepare three category of preference change; no shift, move toward risk aversive, and move toward risk taking. Using this preference change as 3-level outcomes, we conducted multi-nominal logistic regression taking “no-shifters” as a reference outcome with covariates such as baseline socio-demographic characteristics, and change in working status, household income, and health shocks such as newly diagnosed stroke, heart diseases, cancer, and diabetes.

5. Empirical results

1) Violation of monotonicity and local concavity

Table 2 shows the frequency distribution of two types of questionnaires in JSTAR wave1 to detect “irrational/inconsistent” responses. Those in the upper diagonal answered more risk seeking attitude to the certain alternative of 20% gain compared to that to 10% certain gain (marked in gray), which is regarded as the violation of monotonicity. Those who answered risk-seeking attitude in 10% certain gain, but risk-aversive in 20% certain gain (marked in orange) is regarded as the violation of local concavity. In total, about 13% of the respondents were categorized as “irrational” in wave 1. A similar analysis in wave2 detects another 10% of irrational cases. In total, about 23% of respondents violate monotonicity and/or local concavity in either wave.

Table 3 shows the results of probit regression analysis to identify factors predicting violation of monotonicity/local concavity in wave 1. The oldest age category (aged 70 and over) and the depressive are more likely to show irrational response, while high school and university graduates are less likely to be irrational compared to their counterpart respondents with educational achievement less than high school. Those who had limitations in cognitive function (orientation), and mobility also showed positive coefficient as expected, though their magnitude did not reach significant level.

Interestingly, there is a considerable difference across regional dummies; those in city 5 are significantly less likely to show irrational response, while those in city 4 are more likely to show the violation, even after adjusting for demographic, socio-economic, and functional characteristics. City 2 (reference city) is a metropolitan city in the northern part of Japan, city 4 is a miner city in the northern Japan, and city 5 is a small rural forestry town in the middle Japan. The difference seems in accordance to the difference in response rate across cities; those with higher response showed a higher probability to answer rational response. Thus it may reflect the difference in sincerity and commitment to the survey.

Another noteworthy finding was that the unemployed at the time of 1st wave survey shows a significantly positive coefficient. A plausible interpretation may be that this is due to a reverse causation, or that those unemployed had a difficulty in rational risk assessment, which may cause the higher chance to lose their job. If we drop this work variable from the model, the magnitude of coefficient in remained variables were almost the same, suggesting that unemployment-irrationality association is independent of other measured variables such as age, educational achievement, and cognitive, mental, and physical functions.

For further analysis, we exclude those who violated monotonicity and/or local concavity among the JSTAR sample.

2) Risk attitude and demographics, socio-economic, and functional characteristics

Figures 1a and 1b show the probability distribution of risk attitude categories in JSTAR and HRS data. The distribution of JSTAR respondents shows a bimodal distribution with the largest peak in the left (the most conservative preference) and the second peak in the middle of the category range.

Barsky et al. (1997) reported that risk attitude was significantly related to several demographic and socio-economic characteristics of the respondents. Table 4 presents corresponding results in JSTAR subjects. Older respondents were significantly more likely to present risk-aversive attitude. Gender did not discriminate the risk attitude. Striking difference was observed across the range of educational attainment; those with less than high school education was the most risk aversive while those with university and over showed the most risk-taking behaviors, as expected. Although we hypothesized that the deterioration in physical, mental, and cognitive functions would be related to more risk-aversion due to limited capacity in information processing, the functional limitation did not significantly discriminate the risk attitude. Interestingly but expectedly, the risk attitude varies significantly across residential regions. Those in large cities (cities 2, 3, and 6) showed more risk-taking attitude, compared to their counterparts in rural municipalities (cities 4 and 5).

Table 5 exhibits the risk attitude across working status, income and wealth quartiles. Retired individuals were the most likely to answer the most risk-aversive category, while the unemployed had the largest share of the most risk-taking category. Quartiles in household income and liquid assets wealth (saving deposit, bond, and stock) showed the expected gradient where the high income/wealth holders were more likely to answer more risk-taking attitudes. Since the share of stock holders were very low in JSTAR respondents (11.9% in total respondents), we simply divides stock holders and non-holders to compare their risk attitude. The stock holders showed some tendency to exhibit risk-taking attitude, though the difference was not significantly observed across stock holding status.

Those results in Tables 4 and 5 suggest that the measured risk attitude was associated with demographic and socio-economic characteristics as theoretically expected, which supports the measurement validity of the used scale.

3) Cross-sectional relation of risk attitude with health behaviors.

Next, we tested whether the risk attitude measured in JSTAR questionnaire was related to the likelihood of risk-related health behaviors such as current smoking and failure to have annual health check-up in the previous year. In the Japanese unique context where several laws provide virtually all the citizens with a chance to have an annual health check-up without out-of-pocket payment, the failure to have one in the previous year is supposed to be a good marker of “risk taking” behavior. We re-categorized 11 categories of the risk attitude scale into four (1, 2-3, 4-6, 7-11). Score 1 means the most conservative attitude preferring a certain choice. A larger score means more risk-taking attitude.

Table 6 shows the probit regression results predicting ever smoking status. Since these subjects are in the age cohort where social norm on gender roles strongly shaped smoking behaviors, we conducted analysis stratified by gender. Unexpectedly, the risk taking attitude was not related to the less chance to be an ever-smoker. To the contrary, the middle category of risk taking attitude was negatively associated with the ever-smoking status. The U-shape association of risk-taking attitude and ever-smoking was notable among female, but not in male subjects. Most likely the older age per se is associated with less smoking but that given age, higher risk aversion leads to less smoking. Our current sample size is unable to detect this intricate relationship. When the third wave becomes available, we come back to this issue. Higher educational attainment was negatively associated with ever smoking among male, but not among females. Higher income was negatively associated with ever smoking among females, but not among males. If we use current-smoker status instead of ever-smoking status, obtained results are similar (data not shown in the table).

Table 7 shows the model predicting failure to have health check-up in the previous year. Again, the risk attitude is not significantly related to the targeted outcome variable. Older, those not-employed, those with higher income, and those living in other than city 2 were more likely to failed health check-up in the previous year. In Japan, since every employer is mandated to offer annual health check-up to his employees by the occupational safety law, the employed have a better access to health check-up compared to non-employed citizens. It is well known in this country that the municipal authority of city 2 has long been taking a strong policy on preventive services, and has developed a community health check-up system to cover community residents other than work places. With this background, the results of probit regression analyses of health-related behaviors as shown above seem plausible, except for a non-significant relationship with "risk attitude." The results in JSTAR sample suggests that obtained risk attitude failed to predict health behaviors, in spite of its expected relationship with age, work status, and wealth.

4) Change in the risk attitude over time

Figure 2a shows the change in scores in risk attitude between Wave 1 and Wave 2 in JSTAR while Figure 2b shows that in Wave7 and Wave 8 in HRS.

For comparative purpose, Table 8 and 9 show the change in risk-aversive category over waves in JSTAR and HRS. In JSTAR sample who answered both 1st and 2nd wave questionnaires on risk attitudes, 36.3% changed their scores towards more risk-aversion, while 41.0% changed toward risk-taking direction. In HRS sample who answered both 7th and 8th wave questionnaire, 31.3% moved towards risk-aversion, and another 31.2% moved towards risk-taking direction. Figures 3a and 3b show the distribution of category change in the two samples.

Table 10a shows the results of multi-nominal logistic regression to predict the shift in risk attitude over the waves, regressed on baseline characteristics, and change in health and work status among male respondents. JSTAR sample showed no significant effect of baseline age and educational attainment on the likelihood of shift to risk aversion over the waves. New onset of diseases such as cancer, stroke or heart disease (_I dis_sho~a1) showed a significant negative coefficient towards risk aversion. That is, those who newly experienced cancer, stroke or heart disease since the last interview were more likely to shift to risk-seeking preference. To the contrary, newly onset of mobility limitation (_Idel_mob~a2) showed a significant negative coefficient towards risk taking, suggesting that those who experienced a newly onset of mobility limitation since the last interview was more likely to shift towards risk-aversive preference. It is striking to find a similar effect of a newly onset of mobility limitation on risk-aversive shift in preference even among the HRS male sample. In addition to mobility limitation, higher educational attainment at baseline showed a significant effect on shift towards risk-taking preference.

Table 10b shows the corresponding results among female samples in JSTAR and HRS. Among JSTAR female respondents, higher income (income_m) and stock (d_stock) holding at baseline was related to the higher chance to shift towards risk taking preference. It was noteworthy that retirement since the last interview (_Idelta_w~a1) showed a significant negative coefficient to risk-seeking change, or that newly experience of retirement made change in the respondents preference towards risk-aversive preference. To the contrary, HRS female respondents showed a significant, yet positive coefficient of _Idelta_w~a1, suggesting that newly experienced retirement affects preference shift towards risk taking direction.

6. **Discussion**

In this paper, our contribution is three-folds as follow;

(1) Our newly developed measurement of risk preference indicates that assumption of monotonicity and concavity often fails. Previous measurement and parameterization of risk preference was heavily dependent on the assumption, and may need re-evaluation.

(2) Risk preference measured in financial decision making did not predict risky health behaviors such as smoking and failed health check-up, suggesting that risk preference is shaped in a domain-specific manner, rather than as a generic property.

(3) Our analysis using JSTAR and HRS samples indicates that risk preference will be systematically changing by age.

To the contrary to our original hypothesis, we did not detect any significant association of risk preference and its change with age and cognitive disfunction. Since age at baseline reflects physiological status as well as cohort effect, we should use another wave pairs to test whether the cohort effect confounds the change in risk preference. Since any available pairs of waves in HRS and other sister studies measured comparable measurement of risk preference, other than wave7 and 8 we used in this study, this must need consideration in future waves.

The results we presented in this paper may suggest that the current economic model of behaviors in savings, retirement and labor participation, and health enhancement will accordingly need revisions since risk preference may be determined endogenously with health and financial shocks in a long range.

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APPENDIX variable definition

Variable name	Contents
_Iagea2	age 60-64 vs. age 50-59
_Iagea3	age 65-69 vs. age 50-59
_Iagea4	age 70 and over vs. age 50-59
_Isex_1	Female vs. Male
_Iworka2	Unemployed vs. employed
_Iworka3	Retired vs. employed
_Iworka4	Homemaker vs. employed
_Ieduca2	High vs. less than high school
_Ieduca3	Junior college/vocational school vs. less than high school
_Ieduca4	University and over vs. less than high school
income_m	Annual household income (in \10,000 JPY or roughly $100 USD)
d_stock	if stock holder
_Id_dep_1	1 if depression (CESD>=16)
_IIADLlim_1	1 if any IADL limiatation
_IFlag_tdo_1	1 if any disorientation (cognitive function)
_Imobillim_1	1 if any mobility limitation
_Idis_sho~a1	1 if new onset of cancer/stroke/heart disease since the last interview
_Idis_sho~a2	1 if cancer/stroke/heart in the lst interview
_Idel_IAD~a1	1 if new limitation in IADL since the last interview
_Idel_IAD~a2	1 if limitation in IADL in the last interview relieved
_Idel_IAD~a3	1 if continuing limitation in IADL since the last interview relieved
_Idel_mobi~1	1 if new limitation in mobility since the last interview
_Idel_mob~a2	1 if limitation in mobility in the last interview relieved
_Idel_mob~a3	1 if continuing limitation in mobility since the last interview relieved
_Idelta_w~a1	1 if new retirement since the last interview
_Idelta_w~a2	1 if back to work since the last interview
_Idelta_w~a3	1 if remaining retired since the last interview
_Icity_3	JSTAR city dummy
_Icity_4	do
_Icity_5	do
_Icity_6	do
Risk attitude variable	
_Icat_RA2_4	JSTAR;Second category of risk attitude (2-4)
_Icat_RA5_6	JSTAR: Third category of risk attitude (5-6)
_Icat_RA7_11	JSTAR; The most risk-taking category of risk attitude (7-11)

Table 1 Description of JSTAR w1-2 and HRS w7-8 samples

Baseline characteristics of JSTAR and HRS samples

		JSTAR wave1-2	HRS wave7-8
Sample size	total	1334	1397
Age	average [SD]	63.51 [7.03]	52.8 [1.78]
	range	50-75	50-56
Gender (female proportion %)		0.478	0.548
Education (high school or less %)		0.284	0.071
Income median (in US dollar, 1USD=100JPY)		40000	78780
Work status	employed	0.622	0.788
	unemployed	0.028	0.037
	retired	0.132	0.085
Baseline	Subjective health status (less than good)	0.489	0.475
	ADL limitation	0.034	0.067
	IADL limitation	0.336	0.063
	Mobility limitation	0.134	0.253
	depression*	0.149	0.080
	heart disease	0.111	0.090
	stroke	0.027	0.024
	cancer	0.042	0.041
	diabetes	0.094	0.110
Current smoker (%)		0.239	0.183
Failed health checkup in previous year**		0.481	0.173
Follow-up	Subjective health status (less than good)	0.532	0.443
	ADL limitation	0.022	0.087
	IADL limitation	0.335	0.059
	Mobility limitation	0.138	0.302
	depression*	0.156	0.104
	heart disease (new (	0.021	0.019
	stroke (new onset)	0.009	0.005
	cancer (new onset)	0.011	0.013
	diabetes (new onset	0.026	0.027

* JSTAR adopted 20 item version of CESD, score>=16 was regarded as depressive.
HRS asopted 8 item version of CESD, score>=5 was regarded as depressive

** JSTAR asks any health check-up in the previous year.
For HRS, chorelsterol lab check or flu-shot in the previous year was regarded as "preventive behavior"

Table 2

Distribution ot two types of questionnaires in JSTAR wave 1 to detect "irrational response."

risk attitude to 10% gain	risk attitude to 20% gain 1	2	3	4	5	6	7	8	9	10	11	total
1	26.86	1.34	1.19	0.52	0.3	0.22	0.15	0.07	0.07	0.07	0.07	30.88
2	4.24	2.6	0.97	0.45	0.15	0.07	0.07	0	0	0	0	8.56
3	1.49	2.16	2.53	0.52	0.15	0.07	0.07	0.07	0	0	0	7.07
4	1.12	1.19	4.46	3.13	0.67	0.07	0.07	0.07	0	0	0	10.79
5	0.74	0.97	2.08	3.35	3.42	1.04	0	0.07	0	0.07	0	11.76
6	0.45	0.37	1.04	1.93	3.13	2.68	0.45	0	0	0.07	0	10.12
7	0.15	0.3	0.52	1.04	1.12	1.71	0.97	0.15	0	0.07	0	6.03
8	0.15	0.3	0.07	0.89	0.37	1.86	1.04	0.74	0.07	0.07	0	5.58
9	0.07	0	0	0.22	0.37	0.07	2.16	0.15	0.45	0.07	0	3.57
10	0.15	0.15	0.22	0	0.3	0.22	0.74	0.67	0.3	2.46	0	5.21
11	0	0	0	0	0.07	0.07	0.07	0	0	0.22	0	0.45
Total	35.42	9.38	13.1	12.05	10.04	8.11	5.8	2.01	0.89	3.13	0.07	100

(grey) violation of motononicity
(yellow) violation of local concavity

Table 3

Probit regression analysis to predict "irrational response"

Probit regression	Number of obs = 1234
	LR chi2(19) = 56.03
	Prob > chi2 = 0.0001
Log likelihood = -641.2701	Pseudo R2 = 0.0419

irrational response	Coef.	Std. Err.	P>|z|	[95% Conf.	Interval]
_Iagea2	0.073	0.135	0.589	-0.192	0.338
_Iagea3	0.053	0.148	0.721	-0.238	0.343
_Iagea4	0.325	0.149	0.029	0.033	0.617
_Isex_1	-0.082	0.126	0.517	-0.329	0.166
_Iworka2	0.669	0.244	0.006	0.192	1.147
_Iworka3	-0.084	0.162	0.603	-0.402	0.233
_Iworka4	0.188	0.147	0.202	-0.101	0.476
_Ieduca2	-0.259	0.130	0.047	-0.514	-0.004
_Ieduca3	0.080	0.163	0.623	-0.240	0.400
_Ieduca4	-0.204	0.179	0.255	-0.555	0.147
income_m	0.000	0.000	0.999	0.000	0.000
_Id_dep_1	0.239	0.128	0.062	-0.012	0.490
_IIADLlim_1	-0.014	0.104	0.895	-0.218	0.191
_IFlag_tdo_1	0.241	0.209	0.249	-0.169	0.650
_Imobillim_1	0.128	0.136	0.349	-0.140	0.395
_Icity_3	-0.235	0.153	0.125	-0.535	0.065
_Icity_4	0.244	0.145	0.091	-0.039	0.528
_Icity_5	-0.477	0.163	0.003	-0.796	-0.158
_Icity_6	-0.067	0.147	0.651	-0.355	0.222
_cons	-1.082	0.200	0.000	-1.475	-0.690

Table 4

Risk-attitude by demographic, education, and functional groups

Groups	I (certain taker)	II	III	IV (most risk taking)	Number of responses	p value (chi-square test)
	percent choosing response					
Age 50-59	25.5	22.8	28.0	23.7	482	
Age 60-64	30.9	30.0	19.7	19.3	233	
Age 65-69	31.2	29.8	21.3	17.7	215	
Age 70 &over	39.9	25.8	17.8	16.5	248	<0.001
Female	31.2	24.5	22.8	21.5	619	
Male	30.0	27.9	23.3	18.8	559	0.480
Less than high	40.9	29.7	18.0	11.4	333	
High school	28.1	26.0	24.5	21.4	530	
Junior college	27.9	25.2	23.8	23.1	147	
University & over	20.9	19.6	27.0	32.5	163	<0.001
Not depressive	30.1	25.7	23.4	20.8	972	
Depressive	33.5	27.3	21.1	18.0	161	0.688
No limitation in IADL	29.1	26.2	24.5	20.1	766	
Any limitation	34.5	25.9	19.4	20.2	386	0.150
No limitation in orientati	30.7	26.1	23.3	20.0	1130	
any limitation	29.2	27.1	18.8	25.0	48	0.797
No limitation in mobility	30.0	26.1	23.8	20.2	1027	
any limitation	35.1	26.5	17.9	20.5	151	0.374
_Icity_2	27.6	26.0	23.4	23.0	261	
_Icity_3	19.4	32.9	24.5	23.2	216	
_Icity_4	31.5	21.6	25.9	21.0	162	
_Icity_5	45.1	29.0	14.2	11.7	317	
_Icity_6	23.9	18.9	31.5	25.7	222	<0.001

Table 5

Risk-attitude by work status, income, and wealth

Groups	I (certain taker)	II	III	IV (most risk taking)	Number of responses	p value (chi-square test)
	percent choosing response					
employed	29.0	26.1	25.3	19.6	746	
unemployed	25.9	22.2	25.9	25.9	27	
retired	36.8	25.8	16.1	21.3	155	
home maker	30.7	27.5	20.9	20.9	225	
others	47.8	21.7	13.0	17.4	23	0.396
Income quartile						
1st	33.5	24.9	22.6	19.0	221	
2nd	35.2	24.5	20.5	19.8	273	
3rd	29.9	29.3	21.0	19.8	324	
4th	24.3	26.3	27.0	22.4	308	0.191
wealth quartile						
1st	28.7	30.2	21.7	19.4	129	
2nd	29.9	23.6	29.2	17.3	144	
3rd	32.7	27.3	20.0	20.0	150	
4th	18.8	30.3	22.4	28.5	165	0.061
Stock (+)	29.9	27.5	22.3	20.3	789	
Stock (-)	22.1	32.1	23.7	22.1	131	0.325

Table 6

Risk attitude and ever-smoking status

	Male			Female		
Ever smoker	Coef.	Std. Err.	P>|z|	Coef.	Std. Err.	P>|z|
_Icat_RA2_4	0.130	0.167	0.437	-0.378	0.210	0.072
_Icat_RA5_6	-0.127	0.169	0.455	-0.333	0.214	0.119
_Icat_RA7_11	0.311	0.186	0.095	-0.211	0.220	0.339
_Iagea2	0.021	0.184	0.909	-0.313	0.194	0.107
_Iagea3	-0.268	0.187	0.152	-0.902	0.266	0.001
_Iagea4	-0.429	0.206	0.037	-0.617	0.270	0.023
_Iworka2	0.554	0.586	0.344	0.057	0.450	0.899
_Iworka3	0.062	0.183	0.736	-0.245	0.462	0.597
_Iworka4				-0.440	0.180	0.015
_Iworka5	0.120	0.491	0.807			
_Ieduca2	-0.117	0.174	0.502	-0.193	0.206	0.349
_Ieduca3	0.070	0.270	0.796	0.047	0.241	0.845
_Ieduca4	-0.404	0.210	0.054	-0.457	0.425	0.282
income_m	0.000	0.000	0.746	-0.001	0.000	0.006
_Id_dep_1	0.255	0.191	0.183	0.213	0.206	0.302
_IIADLlim_1	-0.114	0.131	0.382	0.349	0.169	0.039
_IFlag_tdo_1	-0.188	0.287	0.511	-0.818	0.545	0.133
_Imobillim_1	-0.124	0.206	0.548	0.246	0.219	0.262
_Icity_3	-0.135	0.204	0.507	0.250	0.222	0.260
_Icity_4	-0.116	0.212	0.583	0.125	0.256	0.625
_Icity_5	-0.275	0.200	0.168	-0.652	0.262	0.013
_Icity_6	0.039	0.209	0.852	0.317	0.223	0.156
_cons	1.148	0.281	0.000	-0.086	0.316	0.786

	Male	Female
Number of obs	= 566	= 491
LR chi2(21)	= 22.32	= 70.96
Prob > chi2	= 0.3814	= 0.0000
Pseudo R2	= 0.0389	= 0.1568

Table 7

Risk attitude and failure to have health check-up in the previous year

Probit regression	Number of obs	=	1076
	LR chi2(22)	=	85.41
	Prob > chi2	=	0.0000
Log likelihood = -626.20647	Pseudo R2	=	0.0638

failed health check-up	Coef.	Std. Err.	P>|z|	[95% Conf. Interval]	
_Icat_RA2_4	0.040	0.109	0.718	-0.175	0.254
_Icat_RA5_6	-0.118	0.119	0.321	-0.352	0.116
_Icat_RA7_11	-0.063	0.123	0.611	-0.304	0.179
_Iagea2	0.059	0.117	0.615	-0.170	0.288
_Iagea3	0.138	0.125	0.271	-0.108	0.383
_Iagea4	0.165	0.134	0.221	-0.099	0.428
_Isex_1	0.036	0.105	0.732	-0.169	0.241
_Iworka2	0.140	0.289	0.628	-0.427	0.707
_Iworka3	0.267	0.143	0.062	-0.014	0.548
_Iworka4	0.421	0.129	0.001	0.168	0.673
_Iworka5	0.829	0.309	0.007	0.224	1.434
_Ieduca2	-0.174	0.112	0.121	-0.393	0.046
_Ieduca3	-0.255	0.152	0.094	-0.552	0.043
_Ieduca4	-0.088	0.159	0.578	-0.399	0.222
income_m	0.000	0.000	0.095	0.000	0.000
_Id_dep_1	-0.015	0.120	0.898	-0.250	0.220
_IIADLlim_1	0.158	0.091	0.082	-0.020	0.336
_IFlag_tdo_1	-0.080	0.203	0.694	-0.478	0.318
_Imobillim_1	0.141	0.126	0.265	-0.107	0.388
_Icity_3	0.288	0.135	0.033	0.023	0.552
_Icity_4	0.603	0.143	0.000	0.324	0.883
_Icity_5	0.259	0.137	0.059	-0.010	0.528
_Icity_6	0.415	0.136	0.002	0.149	0.681
_cons	-0.837	0.194	0.000	-1.216	-0.457

Table 8.

Score change over time (for 10% certain alternative); JSTAR wave 1 and 2

	Wave 2										
	1	2	3	4	5	6	7	8	9	10	Total
Wave 1											
1	12.78	3.00	3.78	2.90	3.39	3.19	0.29	1.06	0.87	0.39	31.66
2	2.61	0.77	1.06	0.97	0.87	0.68	0.19	0.19	0.19	0.00	7.55
3	2.42	0.39	0.58	0.77	0.87	0.68	0.58	0.48	0.39	0.10	7.26
4	3.00	0.97	1.36	1.74	1.26	1.45	0.97	0.48	0.39	0.19	11.81
5	2.13	0.39	1.06	1.45	2.23	1.74	1.06	0.97	0.48	0.29	11.81
6	1.36	0.68	0.58	1.26	2.13	2.03	1.16	0.68	0.68	0.10	10.65
7	0.58	0.39	0.39	0.77	0.87	0.77	0.87	0.87	0.68	0.10	6.29
8	1.16	0.19	0.10	0.77	0.68	0.97	0.97	0.58	0.19	0.10	5.71
9	0.39	0.10	0.19	0.29	0.68	0.19	0.39	0.39	0.58	0.29	3.48
10	0.29	0.29	0.39	0.29	0.39	0.48	0.39	0.19	0.58	0.48	3.78
Total	26.72	7.16	9.49	11.23	13.36	12.20	6.87	5.91	5.03	2.03	100.00

Excludes those who violated monotonicity and local concavity assumption.

Table 9

Score change over time; HRS 7th and 8th waves

		Wave 8						
Wave 7		1	2	3	4	5	6	**total**
1		21.44	7.8	4.44	3.04	1.64	1.04	39.4
2		7.28	6.32	4	1.76	0.96	0.56	20.88
3		4.88	4.36	5.04	2.68	0.92	0.52	18.4
4		2.36	1.64	1.76	2	1	0.44	9.2
5		1.48	0.84	1.12	1.44	1.56	0.44	6.88
6		1.4	0.56	0.44	0.64	1.12	1.08	5.24
Total		38.84	21.52	16.8	11.56	7.2	4.08	100

Table 10a

Multinomial logistic regression of risk attitude change over waves (Male)

	JSTAR			HRS		
	Number of obs = 193			Number of obs = 572		
	LR chi2(32) = 102.93			LR chi2(26) = 263.16		
	Prob > chi2 = 0.0000			Prob > chi2 = 0.0000		
	Log likelihood = -153.7976			Log likelihood = -488.9881		
	Pseudo R2 = 0.2507			Pseudo R2 = 0.2120		

* both samples are limited to those who had no disability and comorbidity at baseline

	Coef.	Std. Err.	P>|z|	Coef.	Std. Err.	P>|z|
Shift to risk aversion						
_Iageb2	-0.466	0.687	0.497			
_Iageb3	0.516	0.776	0.506			
_Iageb4	-0.823	0.947	0.385			
_Ieducb2	-0.400	0.687	0.560	-0.047	0.447	0.916
_Ieducb3	-0.044	1.006	0.965	0.491	0.445	0.270
_Ieducb4	-0.579	0.785	0.461	-0.077	0.430	0.858
income_m	0.000	0.001	0.919	0.000	0.000	0.733
d_stock	-1.433	0.645	0.026	-0.339	0.262	0.197
_Idis_sho~a1	-1.838	1.114	0.099	-0.618	0.701	0.378
_Idel_IAD~a1	0.143	0.572	0.803	0.767	1.028	0.455
_Idel_mob~a2	0.400	0.920	0.664	0.190	0.332	0.566
_Idelta_w~a1	0.547	0.761	0.472	-0.056	0.439	0.899
_Idelta_w~a3	-0.053	0.861	0.951	-0.408	0.291	0.161
_cons	-21.935	0.956	0.000	-22.773	0.456	0.000
Shift to risk taking						
_Iageb2	-0.173	0.596	0.772			
_Iageb3	-0.106	0.684	0.877			
_Iageb4	-0.273	0.741	0.712			
_Ieducb2	-0.224	0.561	0.690	0.151	0.420	0.719
_Ieducb3	0.579	0.858	0.500	0.912	0.413	0.027
_Ieducb4	0.485	0.685	0.479	0.698	0.405	0.085
income_m	0.001	0.001	0.291	0.000	0.000	0.656
d_stock	-0.647	0.511	0.205	-0.317	0.228	0.165
_Idis_sho~a1	-0.912	0.853	0.285	-0.382	0.566	0.499
_Idel_IAD~a1	-0.535	0.498	0.283	0.519	1.039	0.618
_Idel_mob~a2	-1.564	0.805	0.052	-0.608	0.319	0.056
_Idelta_w~a1	0.000	0.677	1.000	0.299	0.374	0.424
_Idelta_w~a3	-0.245	0.714	0.731	-0.277	0.260	0.287
_cons	0.995	0.673	0.140	-0.554	0.382	0.147

*JSTAR; further adjusted for wave1 risk attitude and regional dummy variables
*HRS; further adjusted for wave7 risk attitude

Table 10b

Multinomial logistic regression of risk attitude change over waves (Female)

	JSTAR	HRS
	Number of obs = 205	Number of obs = 601
	LR chi2(32) = 146.85	LR chi2(26) = 278.92
	Prob > chi2 = 0.0000	Prob > chi2 = 0.0000
	Log likelihood = -144.10782	Log likelihood = -831.35474
	Pseudo R2 = 0.3375	Pseudo R2 = 0.2116

* both samples are limited to those who had no disability and comorbidity at baseline

	JSTAR Coef.	JSTAR Std. Err.	JSTAR P>|z|	HRS Coef.	HRS Std. Err.	HRS P>|z|
Shift to risk aversion						
_Iageb2	1.229	0.675	0.069			
_Iageb3	0.655	0.906	0.470			
_Iageb4	1.023	0.817	0.211			
_Ieducb2	-0.668	0.620	0.281	0.157	0.496	0.752
_Ieducb3	0.416	0.826	0.615	0.118	0.490	0.810
_Ieducb4	0.724	1.267	0.568	0.183	0.502	0.715
income_m	-0.001	0.001	0.037	0.000	0.000	0.474
d_stock	0.383	0.800	0.632	-0.131	0.255	0.608
_Idis_sho~a1	-0.491	1.416	0.729	1.100	0.800	0.169
_Idel_IAD~a1	0.721	0.808	0.372	-1.374	1.228	0.263
_Idel_mob~a2	-0.209	1.060	0.843	0.934	0.436	0.032
_Idelta_w~a1	-0.094	1.083	0.931	0.317	0.702	0.651
_Idelta_w~a3	-0.243	0.598	0.685	0.205	0.416	0.623
_cons	-22.474	0.856	0.000	-23.199	0.503	0.000
Shift to risk taking						
_Iageb2	0.424	0.584	0.468			
_Iageb3	1.263	0.768	0.100			
_Iageb4	-0.600	0.726	0.409			
_Ieducb2	0.558	0.549	0.309	-0.262	0.392	0.503
_Ieducb3	1.047	0.721	0.147	0.060	0.389	0.878
_Ieducb4	-0.268	1.158	0.817	-0.012	0.408	0.977
income_m	0.000	0.001	0.642	0.000	0.000	0.033
d_stock	1.285	0.751	0.087	0.232	0.229	0.311
_Idis_sho~a1	-1.735	1.609	0.281	0.014	0.699	0.984
_Idel_IAD~a1	0.874	0.801	0.275	-0.327	0.703	0.642
_Idel_mob~a2	0.200	0.860	0.816	-0.518	0.398	0.193
_Idelta_w~a1	-1.618	0.839	0.054	1.041	0.536	0.052
_Idelta_w~a3	0.006	0.536	0.992	-0.178	0.342	0.602
_cons	0.146	0.621	0.814	-0.286	0.354	0.419

*JSTAR; further adjusted for wave1 risk attitude and regional dummy variables

*HRS; further adjusted for wave7 risk attitude

Figures 1a and 1b

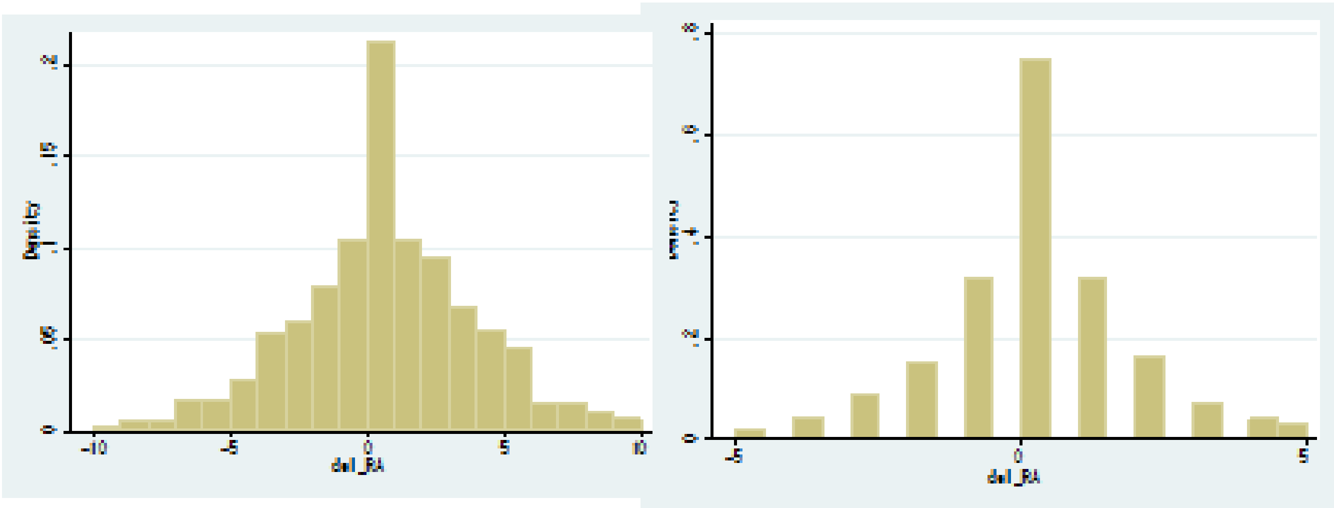
Kernel density of risk preference

JSTAR

HRS

Figure 2a and 2b

Score change in risk preference



JSTAR wave 1 vs. wave 2 HRS wave 7 vs. wave 8