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On the Source of Risk Aversion in Indonesia Using Micro Data 2007

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Abstract
Many conventional economic analyses assume that risk preference is taken as given and do not give much scrutiny on it. However, empirical studies show that risk preference is not random: shocks and predetermined characteristics can determine risk preference. This study tried to see if these potential determinants together affect risk aversion in Indonesia using 2007 micro data. The author found that there is limited evidence that shocks and predetermined characteristics can affect risk preference. There is a preliminary indication that risk preference was not only driven by the individual's wealth and demographic factors (that can be easily controlled), but also by the individual's time preference.

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Keywords Risk aversion; preference; Indonesia; microeconometrics

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1 Introduction

Many conventional economic analyses assume that risk preference is taken as given and do not give much scrutiny on it. In microeconomic theory, for example, a utility maximiser individual is assumed to have a stable preference, either with regard to risk or non-risk preference. Otherwise, she will violate the axioms of consumer choice—especially the transitivity axiom—and analyses that are derived from this unstable preference will be inconsistent. In addition to that, risk preference is also thought to be one of the key ingredients in tastes formation, and tastes are mostly assumed as stable (Stigler and Becker, 1977). These arguments, however, does not imply that stable preference should hold overtime. It means that an individual's inconsistent behaviour can be attributed to *random* preference rather than *unstable* preference.

Nonetheless, some empirical studies suggest that risk preference is *not random*. For example, one of the most common assumptions when people are making decisions under uncertainty is that absolute risk aversion is decreasing with wealth, which implies that individuals are willing to pay less for insurance if their wealth increases (Pratt, 1964).[1] This assumption is proven empirically in lab experiment and in household survey as well (Guiso and Paiella, 2008, Holt and Laury, 2002).

In addition to the role of wealth in determining risk aversion, several studies have found that *shocks* such as natural hazards make people less willing to take risk in disaster prone countries such as Peru, Nicaragua, and Indonesia (Cameron and Shah, 2011, Dang, 2012, van den Berg et al., 2009). Other than natural hazards, economic shocks can also have a positive relationship with risk aversion as observed from the effect of the 1930's Great Depression on individual's unwillingness to take financial risk (Malmendier and Nagel, 2011). These findings are psychologically intuitive: individuals update their information when there is an abrupt change (shocks) in their environment, and this new information changes their risk behaviour. The question is, of course, if this relationship between shocks experienced and risk-taking attitude is consistent and perpetual.

Besides these shocks or temporary events, several studies argue that some *predetermined characteristics* such as genetic heritability can explain risk preference. Rubin and Paul (1979), for example, developed an evolutionary economics theory that links economic goods and "inclusive fitness", a biological utility function that is maximised by the individual as a result of natural selection. This biological utility function "punishes" individuals who are not willing to take risk in the form of having no offspring (genetically). Hence, this theory predicts that only those who are willing to take risk that will survive. This theoretical prediction is then developed by Ball et al. (2010) by arguing that the taste for risk should co-evolve with superior physical prowess (and indeed they found that a physically stronger individual tend to be more risk loving). This argument is

[1] Not only decreasing with wealth, but the shape of the curve is also important. See Figure A1 in the Appendix.

also supported by a finding in the US that shows that twins who are not genetically identical tend to have lesser similarity in risk preference than genetically identical twins (Cesarini et al., 2009).

Psychology can also explain the role of physical attributes. For example, taller people tend to get positive reinforcement from their environment and this translates into greater engagement in leadership role that required willingness to make risky choice (Korniotis and Kumar, 2012). Using data from the US and Europe, they found that taller people with normal weight are having greater likelihood to engage in the financial market and take risky portfolios. Across the Atlantic, in Germany, two studies also show that height could explain some of the variations in risk preference (Dohmen et al., 2009, Hübler, 2012).

Another possible determinant of risk preference is parental education, in which the more educated parents tend to have children who are less risk averse (Dohmen et al., 2009, Hübler, 2012, Hryshko et al., 2011). This is probably because the more educated parents are, on average, having better knowledge about risk, and this knowledge is passed on to their child. However, it should be acknowledged that there is a likelihood that there are unobserved traits of the parent—other than their education achievement—that can explain children's attitude toward risk.

This essay tried to answer the following question: *do these potential determinants of risk preference significantly affect individual's risk aversion in Indonesia?*

Indonesia—with more than 240 million people with wide array of diversity in its demographic, geographic and economic background—is an interesting subject for studying the determinant of risk preference. Cameron and Shah had done a similar study for Indonesia in 2011, but their contribution is limited to the impact of natural disaster on risk preference in rural area (especially East Java). My study took a *broader* look on any possible determinant of risk preference, which includes both the impact of shocks (such as natural disaster) and of individual's predetermined characteristics (such as physical attributes and parental education), in both rural and urban area in Indonesia. This is my main contribution in this subject area.

My second contribution is in giving more understanding on the exogeneity of risk preference. First, there are studies that tried to observe the impact of risk preference on individual behaviour (Cramer et al., 2002, Dow and Werlang, 1992, Gaduh, 2012, Guiso and Paiella, 2005) or earnings (Bonin et al., 2007, Le et al., 2011). Bonin et al., for example, found that people who are less willing to take risk tend to choose low-earning job. However, if an individual's risk preference is endogenously determined by wealth or income—as had been found in the regression results in this essay—then the estimated coefficients will be invalid. If this is the case, these studies might, for example, overestimate the impact of someone's risk preference on occupational choice if we exclude the fact that the person just recently experienced natural disaster.

With regard to the policy implication, one of the results from Cameron and Shah (2011) study is that they suggest a policy that can increase the access for a natural disaster related insurance. This follows from the finding that people who lived in villages that experienced disaster are more likely to engage in self-insurance. However, given the limited information outside East Java, this policy recommendation cannot be generalized for the whole Indonesia. Therefore my study adds to the debate on the importance of natural disaster insurance policy by taking a more general observation on Indonesia.

I used data from the latest wave of the Indonesia Family Life Survey (IFLS4) that was surveyed in 2007. The preliminary result shows that, except for time preference and father's education, only the usual demographic characteristics such as age, education, and sex that correlated with risk preference. Several subsample regressions resulted in the significance of height and disaster, but the pattern is scanty. There is also limited supporting evidence for disaster-related insurance promotion.

The organisation of this study is as follow: Section 2 discussed data descriptions, variable constructions, and estimation methodology. Section 3 discussed estimation results, robustness checks, and a simple investigation on the policy implication. Finally, last section concludes.

2 Estimation design

2.1 Data

I used data from the Indonesian Family Life Survey (IFLS) to construct a measure of risk aversion. The IFLS was conducted by RAND cooperated with local research institutions in Indonesia and available for free at the RAND website.[2] While the respondents for the IFLS only come from 13 (out of 26) provinces in Indonesia but they represent around 83% of Indonesia due to the heavy population distribution in these selected provinces. The first wave of the IFLS was in 1993 and it has been repeated in 1997, 2000, and 2007.

The IFLS consists of two blocks: household block and community block. The household block measures individual's and household's life such as consumptions, welfare, and health level, while the community block measures community/village life such as the availability of health facilities and school. Combined, there are 290 data files from these two blocks, each with specific information on the individual/household/community.

While the IFLS is a panel dataset rich with information on households and individual's behaviour, it is unfortunate that only in the latest available round (IFLS4) that it incorporates the questions on risk-taking behaviour. Nonetheless, I use information from IFLS2 (1997) and IFLS3 (2000) as well to construct several variables that I need in this essay.

In addition to the IFLS, I also use poverty rate data in 1996 and 1999 at district level later on in the sensitivity regression.[3]

[2] See http://www.rand.org/labor/FLS/IFLS.html
[3] I would like to thank to Robert Sparrow for providing me with this data.

2.2 Variable construction

Risk aversion

In IFLS4 there are questions that can be used to measure risk aversion under the "Risk and Time Preference" section. There are two games in this section, Game 1 and Game 2, in which they differ only in the amount of *hypothetical* money involved.[4] In this section, the respondent will be asked to choose between two gamble and if he/she chose the risky one then he/she will move to the next question (which gives different payoffs). In every question there is a "Don't Know" option that can be used to rule out respondent who do not understand the question. Here's an example of the gamble (see the Appendix for the full set of questions and description):

> *In Option 2 you have an equal chance of receiving either Rp1.6 million per month or Rp400 thousand per month, depending on how lucky you are. [On the other hand,] Option 1 guarantees you an income of Rp800 thousand per month. Which option will you choose?*

There are several methods that have been applied to construct risk aversion from the IFLS dataset:

1) Ordering based on the riskiness of the choice (Cipollone, 2011, Gaduh, 2012).
2) Binary variable, which simplifies risk choice into either risk loving or risk averse (Cameron and Shah, 2011).
3) Estimates the Arrow-Pratt index of Absolute Risk Aversion (*ARA*) (Permani, 2011).

By construction, Option 1) and 2) forced us to make two regressions based on Game 1 and Game 2. Option 1) is probably the second best option albeit difficulties in interpreting the coefficient if we use standard OLS to do the estimation. Option 2) is the simplest one in its construction, but it fits with Cameron and Shah experimental method since they do not use ordinal variable in the main part of their paper.

By and large, Option 3) gives the best option due to the following reasons: *first*, *ARA* took information from both of Game 1 and Game 2. *Second*, this measure is also linked directly with the theoretical underpinning of risk aversion (Pratt, 1964). *Third*, as can be seen in equation (1) below, *ARA* is a nonlinear, continuous variable that gives more variation in risk aversion. Therefore, I used *ARA* in the main regression where a higher value indicates a more risk-averse behaviour.

ARA is constructed based on the expected utility of an individual's participation in the gamble (after considering his/her initial wealth endowment as well). Taking the second order Taylor expansion of the expected utility around the initial wealth endowment

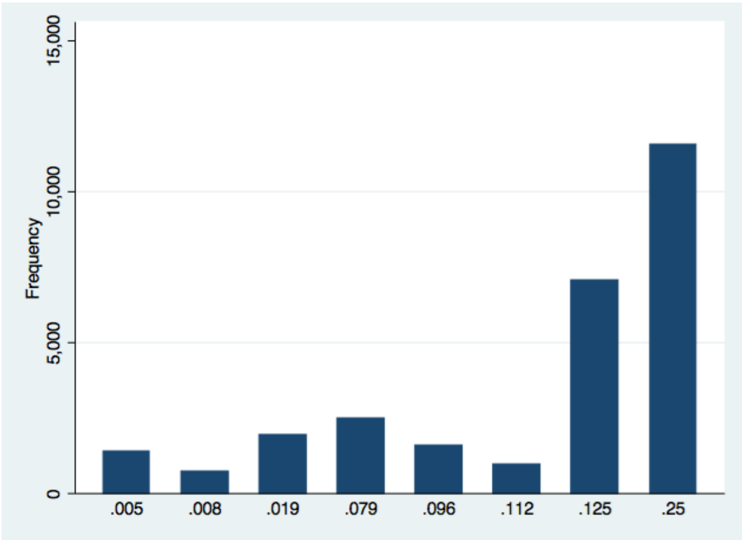
[4] This is probably the biggest drawback of using IFLS4 to construct risk aversion. With no stake involved, there is a chance that the respondent will choose randomly and even exaggerating their risk preference. However, IFLS is the most feasible dataset today in Indonesia that represents the largest population sample of Indonesia.

resulted in the following formula (where Z_H is the high payoff (Rp1.6 million in the example above) and Z_L is the low payoff (Rp400 thousand)):

$$ARA = \frac{Z_H+Z_L}{Z_L^2+(Z_H-Z_L)^2+Z_L(Z_H-Z_L)} \tag{1}$$

From 10 questions on risk preference, I found eight possible payoff combinations of Z_H and Z_L that translated into eight values of ARA. The frequency distribution of ARA is skewed toward those who are *very* risk averse (ARA = 0.25): 11,641 out of 27,717 observations (42%) are very risk-averse (with mean value of 0.15 and standard deviation of 0.09).

Figure 1: **Absolute Risk Aversion frequency distribution**



In addition to this measure of risk aversion, I also used Cameron and Shah's method in order to see how the regression result change if we use different methods to measure risk aversion (variable *RL1* for Game 1 and *RL2* for Game 2). *RL1* and *RL2* are binary variables that take the value of 1 if the respondent is risk loving. However, since this method forced us to make two regressions based on Game 1 and Game 2 then we cannot really make a fair comparison with the main regression (that use information from both games to make a single regression).

In order to overcome this problem, I developed an alternative way of measuring risk aversion: variable RA that takes the value of 0 (very risk averse) to 4 (very risk loving). This was done by giving a point for every risky decision that a respondent took. See the Appendix for further details on how to calculate these various measure of risk aversion.

Table 1: **Cross-correlations of various measure of risk aversion**

	ARA	*RA*	*RL1*	*RL2*
ARA	1.00			
RA	-0.76	1.00		
RL1	-0.51	0.81	1.00	
RL2	-0.39	0.63	0.35	1.00

Table 1 above shows that the cross-correlation between *ARA, RA, RL1*, and *RL2* is quite strong (particularly between *ARA* and *RA* that has -0.76 correlation coefficient). With regard to alternative measures of risk aversion, the mean for *RL1* is 0.16 (SD 0.36) and 0.05 (SD 0.22) for *RL2*, indicates that a great majority of the respondents are risk-averse. On the other hand, the average value of *RA* is 0.64 (SD 1.07) and 67% of total observation are very risk averse (*RA*=0). See Table 2 below.

Table 2: **Descriptive statistics**

Variable	Observations	Mean	Std. Dev.
Measures of risk aversion			
ARA	27717	0.15	0.09
RA	27717	0.64	1.07
RL1	27717	0.16	0.36
RL2	27717	0.05	0.22
Predetermined characteristics (**PC**)			
Height (cm)	27717	155	12
Weight (kg)	27717	54	11
Ideal (=1)	27717	0.62	0.49
Tall (=1)	27717	0.49	0.50
Father's education	27717	0.75	0.96
Mother's education	27717	0.53	0.79
Temporary events (**TE**)			
Disaster (number disaster experienced)	27717	0.15	1.70
Log of amount lost	27717	0.82	3.25
Log of assistance received	27717	0.57	2.71
Ecshock (=1 if in construction/financial sector in 1997)	8965	0.06	0.24
Change in poverty rate	27717	.58	.66
Ecshock × Change in poverty rate	8965	0.04	0.22
Other control variables (**X**)			
Log of assets	27717	17.18	1.84
Log of past assets	27717	16.12	2.48
Islam (=1)	27717	0.90	0.30
Javanese (=1)	27717	0.43	0.49
Rural (=1)	27717	0.48	0.50
Age (year)	27717	37	15
Male (=1)	27717	0.48	0.50
Married (=1)	27717	0.70	0.46
Dependency ratio (0-1, higher more independent)	27717	0.36	0.23
Time preference (1-5, higher more impatient)	27717	4.44	1.02
Education (0-4, higher more educated)	27717	2.00	1.15
Cognitive ability (0-1, higher smarter)	10642	0.74	0.24
Numerical ability (0-1, higher smarter)	10642	0.42	0.31

In this essay I categorise possible determinants of risk aversion into two main groups: individual *predetermined characteristics* and *temporary shocks*.

Predetermined characteristics variables

Variables in individual *predetermined characteristics* are height and parental education. I use height (in centimetres) as the main physical attributes variable and adding weight as a complement in the regression. The average height is 155cm (SD 12cm) while the average weight is 54kg (SD 11kg).

Parent's education is straightforward to observe and I made a categorical variable based on the highest (but not necessarily completed) educational level. Moreover, around half of the parents were never been in school, which might be attributed to the fact that these uneducated parents were, on average, born around 1944 when Indonesia as a nation was not even born.[5]

Temporary events/shocks variables

I simply included the number of natural disaster experienced by the household, which comprises more than just earthquake and flood as in Cameron and Shah's paper.[6] While there are data on the number of householder that was injured or killed because of the disaster but the variation is very small: more than 99% of the observation did not have their household member killed or injured due to the disaster. Including this in the regression will lead to large standard errors.

IFLS also reports the amount of household's belongings (business and non-business related belongings) that was lost due to the disaster. Many of the disaster victims also received financial assistance. I took the natural log of these and included as additional control variables.

Other control variables

The construction of other control variables such as wealth and education is standard and relatively straightforward. Nevertheless, there are several control variables worth discussed.

First, it is possible that the observed risk loving behaviour is due to cohort's *impatience* to get an immediate reward. Under the "Time Preference" section the respondents were asked to answer a series of questions regarding to hypothetical money won in a lottery. There are two games in this section that differs in the time when the respondent will get the money (in 1 year in Game 1 and in 5 year in Game 2). Then I constructed a categorical measure of time preference which values range from 1 (very patient) to 5 (very impatient). Here is an example (see the Appendix for the full set of questions and rules to generate this variable):

> *You have won the lottery. You can choose between being paid: 1. Rp1 million today or 2. Rp2 million in 1 year. Which do you choose?*

Second, in addition to the wealth variable I also enter a lagged of wealth variable based on the information from IFLS3 (2000). This variable is included to take into account any possible correlation between *past* endowments on *current* risk behaviour. For example, if two people have the same level of wealth in 2007 but the first person had lost much of his wealth (while the second person not), then the first person might become more risk averse than the second person.

[5] The average might be born before 1944 since the IFLS only asked about the age of the parent at the time of the survey was conducted or the age when they died.
[6] Still, earthquake and flood contribute for about 87% of all disasters in Indonesia.

Third, I also generate a dependency ratio by taking the ratio between the numbers of working householder(s) to the total number of people living in the household. Therefore, a household is more dependent (than other household) if there are fewer working people than non-working people in that particular household. It is reasonable to expect that someone who lived in a relatively *independent* household is willing to take *more* risky decisions.

2.3 Estimation methodology

Econometric method

I run the following model using OLS, control for subdistrict fixed effects, and cluster the standard errors also at subdistrict level:

$$ARA_i = \alpha + \mathbf{PC_i}\boldsymbol{\beta} + \mathbf{TE}_i\boldsymbol{\gamma} + \mathbf{X_i}\boldsymbol{\delta} + u_i \tag{2}$$

ARA is individual's measure of risk-aversion, **PC** is a set of predetermined characteristics variables (height, weight, parent's education level), **TE** is a set for temporary events variables (number of disaster experienced, amount money/asset lost, amount assistance received), **X** is a set of demographic and geographic characteristics (assets, lag of assets, age, age-square, sex, rural, religion, ethnicity, marital status, education level, household's dependency ratio, and time preference), and u_i is the error term that is expected to satisfy the usual assumptions.

Potential sources of error and bias

There are two potential sources of error and bias in this estimation.

First, potential source of measurement error. This is because there is a chance that people do not understand the questions on risk preference because of the confusing structure on the risk and time preference questions. While there is nothing we can do with regard to this error, but we can expect that the error is not systematic—otherwise the regression will be biased—because the IFLS had been conducted and redesigned since its first launch in 1993.

Second, potential sources of endogeneity, omitted variable bias, and reverse causality. Since the data is in cross-section then we might suspect that there is a time varying omitted variable bias. If the omitted variable correlated with one or more of the explanatory variables, this would then lead to endogeneity and omitted variable bias. For example, if there is a contemporary condition that correlates with both risk aversion and time preference and this variable is omitted from the regression, then the estimated coefficient for time preference is going to be overestimated. In addition to that, there is also a possibility for reverse causality from wealth: risk-averse individuals might tend to engage in low-earning jobs.

Ideally, we should find instrument(s) that can purge these endogenous variables and run an instrumental variable regression. However, finding such instrument is difficult. Guiso and Paiella (2008) suggest the use of parental education as an instrument for wealth, but previous studies argued that parent's education can explain variations in *ARA*, hence violates the exclusion restriction assumption. Hurst and Lusardi (2004) propose the use of regional housing capital gain to instrument wealth, but this measure might not appropriate for the context of Indonesia given the relative vast rural area where data on housing price is difficult to obtain and verify.

One can also add more relevant variables in the set **X**, but this might lead to multicollinearity among the explanatory variables. Therefore the estimation result must be carefully interpreted and does not necessarily imply causation.

In order to minimise the potential impact of omitted variable for education, I included abilities in the robustness check. Besides that, including abilities is expected to reduce the magnitude of the estimated education coefficient. I also made separate (subsample) regressions based on the quintile of assets and education level to control for possible endogeneity and reverse causality. If **PC** and **TE** are important in determining *ARA* then these variables should significant as well in the subsample regressions.

3 Empirical results

3.1 Summary statistics

Summary statistics by risk preference reveals some interesting information prior to our regression. In order to simplify the presentation, Table 3 summarise the full statistics based on *RA* (which consists of 5 values) rather than *ARA* (which consists of 8 values). Recall that *ARA* and *RA* are highly correlated (-0.76). From the information in the table we can see that the majority of the population (67%) are very risk averse. It seems also that an educated non-Javanese male with educated parents tend to be more willing to take risk.

One of the concerns regarding survey data is that there are people who do not understand the questions asked (measurement error). In this IFLS4 dataset, the proportion of respondent who admittedly chose "Don't Know" on risk preference questions for at least once is very small (less than 1% in each game). Thus the measurement error with regard to this is minimal.[7]

[7] Of course there are respondents who might not understand the questions but did not choose the "Don't Know" option, but the discussion with regard to this is beyond the scope of this paper.

Table 3: **Summary statistics by risk preference (*RA*)**

	Average	0 Very risk averse	1 Risk averse	2 Moderate	3 Risk loving	4 Very risk loving
Height (cm)	155	155	156	156	157	157
Father's education (0-4, higher more educated)	0.754	0.722	0.815	0.805	0.774	0.943
Mother's education (0-4, higher more educated)	0.528	0.504	0.571	0.573	0.533	0.653
Disaster (how often)	0.148	0.132	0.153	0.166	0.156	0.351
Javanese (=1)	0.428	0.450	0.410	0.385	0.364	0.300
Rural (=1)	0.478	0.479	0.459	0.497	0.494	0.441
Age (years)	37	37	35	36	35	35
Male (=1)	0.476	0.440	0.506	0.553	0.609	0.629
Time preference (1-5, higher more impatient)	4.435	4.523	4.217	4.294	4.192	4.322
Married (=1)	0.698	0.704	0.669	0.697	0.668	0.720
Education (0-4, higher more educated)	2.000	1.929	2.104	2.098	2.193	2.407
Observation (people)	27717	18623	3365	3703	1024	1002
Observation (percentage)	100%	67%	12%	13%	4%	4%

Notes: These are the mean values except for the number of observation.

3.2 Estimation result

In Table 4 I present the main estimation results with *ARA* as the dependent variable. I used several specifications that combine **PC**, **TE**, and **X**. The regressor in column (1) are **PC, TE**, and **X**; column (2) are **PC** and **TE**; column (3) are **PC** and **X**; column (4) are **TE** and **X**; column (5) only consists of **PC**, and finally; column (6) only consists of **TE**.

Throughout the following tables, the interpretations of the estimated coefficients for education (parent's education and own education) are *relative* to those with no education background. While the estimated coefficients for time preference are *relative* to those who are very patient.

Table 4: **Risk aversion regressions (dependent variable: *ARA*)**

	(1)	(2)	(3)	(4)	(5)	(6)
Predetermined characteristics (**PC**)						
Height	-0.0001	-0.0006***	-0.0001		-0.0006***	
	(0.0001)	(0.0001)	(0.0001)		(0.0001)	
Weight	-0.0000	-0.0001*	-0.0000		-0.0001*	
	(0.0001)	(0.0001)	(0.0001)		(0.0001)	
Father's education						
Elementary	-0.0018	-0.0024	-0.0018		-0.0024	
	(0.0014)	(0.0015)	(0.0014)		(0.0015)	
Junior high	-0.0015	-0.0053*	-0.0015		-0.0053*	
	(0.0027)	(0.0027)	(0.0027)		(0.0027)	
Senior high	-0.0007	-0.0081**	-0.0007		-0.0081**	
	(0.0027)	(0.0028)	(0.0027)		(0.0028)	
University	-0.0094*	-0.0200***	-0.0094*		-0.0200***	
	(0.0043)	(0.0043)	(0.0043)		(0.0043)	
Mother's education						
Elementary	-0.0006	-0.0001	-0.0006		-0.0001	
	(0.0016)	(0.0015)	(0.0016)		(0.0015)	
Junior high	-0.0038	-0.0052	-0.0038		-0.0052	
	(0.0030)	(0.0030)	(0.0030)		(0.0030)	
Senior high	-0.0012	-0.0052	-0.0012		-0.0052	
	(0.0037)	(0.0037)	(0.0037)		(0.0037)	
University	-0.0096	-0.0159*	-0.0096		-0.0159*	
	(0.0070)	(0.0071)	(0.0070)		(0.0071)	
Temporary events (**TE**)						
Disaster	0.0000	0.0002		0.0000		0.0002
	(0.0003)	(0.0002)		(0.0003)		(0.0002)
Log lost	0.0001	-0.0001		0.0001		-0.0001
	(0.0003)	(0.0003)		(0.0003)		(0.0003)
Log assistance	-0.0002	0.0001		-0.0002		0.0003
	(0.0004)	(0.0004)		(0.0004)		(0.0004)
Other control variables (**X**)						
Log assets	-0.0015***		-0.0015***	-0.0014***		
	(0.0004)		(0.0004)	(0.0004)		
Log past assets	-0.0003		-0.0003	-0.0003		
	(0.0003)		(0.0003)	(0.0003)		
Islam	0.0026		0.0025	0.0027		
	(0.0031)		(0.0031)	(0.0031)		
Javanese	-0.0012		-0.0012	-0.0012		
	(0.0023)		(0.0023)	(0.0023)		
Rural	-0.0027		-0.0027	-0.0025		
	(0.0030)		(0.0030)	(0.0030)		
Age	-0.0005**		-0.0005**	-0.0005**		
	(0.0002)		(0.0002)	(0.0002)		
Age^2	0.0000***		0.0000***	0.0000***		
	(0.0000)		(0.0000)	(0.0000)		
Male	-0.0186***		-0.0186***	-0.0196***		
	(0.0014)		(0.0014)	(0.0013)		
Married	0.0003		0.0003	-0.0005		
	(0.0013)		(0.0013)	(0.0013)		
Dependency	0.0034		0.0034	0.0034		
	(0.0027)		(0.0027)	(0.0027)		
Time preference						
Patient	-0.0147***		-0.0147***	-0.0148***		
	(0.0043)		(0.0043)	(0.0043)		
Somewhat impatient	-0.0115*		-0.0115*	-0.0115**		
	(0.0045)		(0.0045)	(0.0045)		
Impatient	-0.0119**		-0.0119**	-0.0120**		
	(0.0044)		(0.0044)	(0.0044)		
Very impatient	0.0185***		0.0185***	0.0184***		
	(0.0041)		(0.0041)	(0.0041)		
Education						
Elementary	0.0061**		0.0061**	0.0057*		
	(0.0023)		(0.0023)	(0.0023)		
Junior high	0.0035		0.0035	0.0028		
	(0.0025)		(0.0025)	(0.0025)		
Senior high	-0.0026		-0.0026	-0.0037		
	(0.0027)		(0.0027)	(0.0027)		
University	-0.0143***		-0.0143***	-0.0166***		
	(0.0032)		(0.0032)	(0.0032)		
Constant	0.2023***	0.2521***	0.2023***	0.1865***	0.2522***	0.1542***
	(0.0117)	(0.0080)	(0.0117)	(0.0091)	(0.0080)	(0.0003)
F-test	43.31	17.17	47.45	60.57	21.63	0.32
R^2	0.06	0.01	0.06	0.06	0.01	0.00
N	27717	27717	27717	27717	27717	27717

Notes: Robust standard errors in parentheses. *** statistically significant at 1% level, ** at 5% level, * at 10% level. OLS estimations include subdistrict fixed effects and the standard errors are clustered at subdistrict level.

Except those in column (6), the F-statistics in all specifications are statistically significant, which means that, together, all the estimated coefficients are not equal to zero. I found that there is a significant correlation between height, weight, and father's education on risk aversion (Table 4 Column (2) and (5)), and the direction is negative as expected. But, when I tried to control for other control variables **X**, the significance of these predetermined characteristics diminished (column (1)). We can also see that there is no significant correlation on temporary events variables (the number of disaster experienced, amount lost, and amount of assistance received) on *ARA* in all specifications.

Next, the estimated coefficients for assets and being male are negative and significant. It should be noted, however, that there is a possibility of reverse causality in assets, in which a person who loves to take risk tends to make more money. Past assets have no significant correlation with *ARA*. The coefficient for education is somewhat mixed: a person with elementary education tend to be risk averse, but if that person is educated at the university or equivalent then that person tend to be risk loving. There is no observed correlation between *ARA* and the dependency ratio.

Another variable within **X** that is significant is time preference, but again the result is mixed. It seems that if an individual's time preference is up until category 4 (impatient) he/she tends to be risk loving, but for an individual with category 5 (very impatient) he/she becomes risk averse. This situation is consistent across all specifications.

The coefficients for age and age-square are significant and has a U-shaped relationship with *ARA*, which suggests that people tend to love risk up until they reach the age of 26 (the turning point), which then they become risk averse. This is probably because people at age above 26 are already working and risky behaviour is less desirable. People with age above 26 are also more likely of being married and having a family, which makes them less willing to take risk. It should be noted that the estimated coefficient for age-square is very small, which indicates that the degree of risk aversion does not differ much from that before the turning point.

Coping with endogenous explanatory variables

Before doing subsample regressions by endowment, I ran subsample regressions of equation (2) by gender in Table 5 below. Different from previous estimations, I notice a negative and significant relationship between mothers educated at university level on their daughter's risk aversion. Nonetheless, I still cannot found any impact of height on both men and women. I also found that there are no anomalies regarding time preference for male (not displayed in the table), in which being impatient is associated with being risk-loving. This finding shows that female's behaviour is the significant contributor for the mixed result on time preference in the previous table.

Table 5: **Subsample regressions by gender (dependent variable: *ARA*)**

	By gender	
	Female	Male
	(1)	(2)
Predetermined characteristics (**PC**)		
Height	-0.0001	-0.0001
	(0.0001)	(0.0001)
Weight	0.0001	-0.0001
	(0.0001)	(0.0001)
Father's education		
Elementary	-0.0019	-0.0022
	(0.0019)	(0.0021)
Junior high	-0.0024	-0.0005
	(0.0036)	(0.0039)
Senior high	-0.0006	-0.0015
	(0.0037)	(0.0039)
University	-0.0089	-0.0081
	(0.0058)	(0.0067)
Mother's education		
Elementary	-0.0005	-0.0003
	(0.0021)	(0.0022)
Junior high	-0.0009	-0.0037
	(0.0041)	(0.0047)
Senior high	-0.0017	-0.0011
	(0.0049)	(0.0054)
University	-0.0213*	-0.0109
	(0.0093)	(0.0110)
Temporary events (**TE**)		
Disaster	-0.0002	0.0003
	(0.0005)	(0.0002)
Log lost	-0.0000	0.0002
	(0.0004)	(0.0004)
Log assistance	-0.0002	-0.0002
	(0.0005)	(0.0006)
Constant	0.1945***	0.1976***
	(0.0170)	(0.0167)
F-test	21.28	18.92
R^2	0.04	0.05
N	14516	13201

Notes: The regressions include all variables within **PC**, **TE**, and **X**. Variables in **X** are not displayed for reading convenience. Robust standard error is in parentheses. *** statistically significant at 1% level, ** at 5% level, * at 10% level. The estimations include subdistrict fixed effects and the standard errors are clustered at subdistrict level.

Next, as mentioned before in section 2, we might suspect that wealth and education are endogenous. In order to overcome this problem, I ran equation (2) by quintiles of assets and by education level (grouped into three categories). The first part of table 6 shows that disaster and the amount of assistance received (that related with the disaster) are, respectively, positively and negatively associated with risk aversion for individuals with assets at the second quintile (relatively poor in terms of assets value). This direction of these relationships is as expected. On the other hand, height is positively correlated with being risk-loving for individuals with assets at the third quintile (near poor). There is no consistent impact of parent's education on individual's risk aversion. With regard to time preference, I found that the anomalies (very impatient tend to be risk averse) occurred to people in the fourth and fifth assets quintiles (middle income and rich). Still, I cannot find a consistent relationship between **PC** and **TE** on *ARA*.

Table 6: **Subsample regressions by quintiles of assets and by education level (dependent variable: *ARA*)**

	By quintile of assets					By education level		
	Bottom quintile	Second quintile	Third quintile	Fourth quintile	Fifth quintile	Not/never school	Basic education	Higher education
	(1)	(2)	(3)	(4)	(5)	(6)	(9)	(10)
Height	0.0001	-0.0001	-0.0003**	-0.0002	-0.0001	-0.0004*	-0.0005***	-0.0003***
	(0.0001)	(0.0002)	(0.0001)	(0.0001)	(0.0001)	(0.0002)	(0.0001)	(0.0001)
Weight	0.0001	0.0001	-0.0002	0.0000	-0.0000	0.0001	0.0000	-0.0003**
	(0.0001)	(0.0002)	(0.0001)	(0.0001)	(0.0001)	(0.0002)	(0.0001)	(0.0001)
Father's education								
Elementary	-0.0033	-0.0019	-0.0016	-0.0021	0.0026	-0.0235**	-0.0024	0.0014
	(0.0036)	(0.0028)	(0.0034)	(0.0033)	(0.0034)	(0.0075)	(0.0018)	(0.0027)
Junior high	-0.0091	-0.0015	0.0057	0.0034	-0.0005	0.0086	-0.0052	0.0025
	(0.0061)	(0.0073)	(0.0062)	(0.0061)	(0.0051)	(0.0201)	(0.0043)	(0.0036)
Senior high	-0.0024	-0.0005	0.0033	-0.0024	0.0034	-0.0766***	-0.0066	0.0029
	(0.0067)	(0.0072)	(0.0085)	(0.0064)	(0.0050)	(0.0164)	(0.0057)	(0.0035)
University	-0.0070	0.0062	-0.0144	-0.0059	-0.0069		0.0014	-0.0070
	(0.0134)	(0.0140)	(0.0165)	(0.0105)	(0.0071)		(0.0183)	(0.0047)
Mother's education								
Elementary	0.0014	-0.0034	-0.0022	0.0022	-0.0021	0.0110	-0.0015	0.0015
	(0.0036)	(0.0035)	(0.0038)	(0.0036)	(0.0035)	(0.0138)	(0.0020)	(0.0027)
Junior high	-0.0076	-0.0046	-0.0028	-0.0047	0.0021		0.0082	-0.0048
	(0.0069)	(0.0082)	(0.0083)	(0.0071)	(0.0055)		(0.0062)	(0.0036)
Senior high	0.0101	-0.0006	0.0025	-0.0047	0.0008	-0.0016	0.0081	-0.0027
	(0.0088)	(0.0108)	(0.0108)	(0.0089)	(0.0060)	(0.0203)	(0.0093)	(0.0042)
University	0.0084	-0.0163	0.0123	0.0075	-0.0264*		-0.0466	-0.0105
	(0.0186)	(0.0221)	(0.0162)	(0.0182)	(0.0130)		(0.0748)	(0.0073)
Disaster	-0.0008	0.0011*	0.0001	0.0000	0.0020	-0.0068***	0.0001	0.0003
	(0.0006)	(0.0006)	(0.0005)	(0.0001)	(0.0043)	(0.0010)	(0.0003)	(0.0003)
Log lost	0.0004	0.0001	-0.0004	0.0004	0.0005	0.0028*	-0.0002	0.0003
	(0.0008)	(0.0008)	(0.0008)	(0.0008)	(0.0006)	(0.0013)	(0.0005)	(0.0005)
Log assistance	-0.0003	-0.0024*	0.0010	-0.0007	-0.0001	0.0025	-0.0008	0.0003
	(0.0011)	(0.0012)	(0.0011)	(0.0014)	(0.0010)	(0.0014)	(0.0006)	(0.0007)
F	10.63	10.88	10.38	8.46	18.59	.	13.95	17.01
R^2	0.05	0.05	0.06	0.06	0.08	0.05	0.04	0.04
N	5550	5539	5556	5536	5536	1882	15101	10734

Notes: The regressions include all variables within **PC**, **TE**, and **X** except assets (column (1) to (5)) and education (column (6) to (8)). Variables in **X** are not displayed for reading convenience. Robust standard error is in parentheses. *** statistically significant at 1% level, ** at 5% level, * at 10% level. The estimations include subdistrict fixed effects and the standard errors are clustered at subdistrict level.

The second part of Table 6 is for regression by education level. A person is categorised as having "Basic education" if that person is educated at elementary or junior high level as mandated by the Government Regulation 47/2008, and "Higher education" if educated at senior high school and above. I found many anomalies here especially with regard to those who never/not been in school, that might be attributed to the respondent's lack of understanding about the questions on risk aversion. Interestingly, height is significantly correlated with being risk-loving in all specifications, but this result might be caused by the omission of education from the regressions. This means that there is a positive correlation between education level and height.

It would be more interesting to see how the interaction between various levels of assets and education can have different impact on risk preference. One can logically infer that education and endowment level should move in the same direction and the findings in Table 6 should also hold. But when I made another four subsamples based on the combination of education (those educated at higher level) and assets level (those within the fifth quintile assets), there is still no significant impact of variables in **PC** and **TE** on *ARA*.[8]

One might suspect also that there is a reverse causality between *ARA* and time preference and married. There is another possibility as well that assets, lag of assets, rural, and impatience are influenced by the shock variables. I ran another regression that excludes those variables and found that while the estimated coefficients for height became significant, but the role of temporary events remains insignificant.

Overall, the regressions in Table 4, 5, and 6 show the greater importance of demographic characteristics over predetermined characteristics or temporary events in explaining the variations in *ARA*. Still, there are limitations in these such as the sensitivity over different methods of measuring risk aversion, different ways to incorporate physical characteristics, possible impact of past economic shock, and the impact of abilities. Section 3.3 below will take a closer look over these potential problems.

3.3 Robustness check

First, I checked for the sensitivity on the choice of the dependent variable by running full regressions as in equation (2), but using *RA, RL1,* and *RL2* instead of *ARA* as the dependent variable. I also ran an ordered logit model as another specification since *RA* is ordinal.[9] Recall that these alternative measures of risk aversion are *in reverse* direction of *ARA*, which means that higher value of *RA*, for example, is associated with being *risk-loving* (rather than being risk-averse as in the case of *ARA*) The results are summarised in Table 7.

[8] I do not display the tables of the subsample regressions that follow due to the large size of the table. The tables, however, are available upon request.
[9] We cannot directly interpret the estimated coefficient, rather we can only comment on the sign of the coefficient and see if it fits our hypothesis.

The OLS part of Table 7 shows that almost all predetermined characteristics and temporary events are not significant, supporting the results from the main regressions. Nonetheless, father's education at the university and mother's education at junior high school are significant in some of the regressions. Other variables such as age, age-square, higher degree education, and being very impatient remain significant and exhibiting the same direction as in the main regressions. In addition to that, except for being very impatient, other category of impatience loses its significance. Surprisingly, the constants seem to be not significant in all of these OLS specifications.

The result from the ordered logit gives more interesting findings. First, the cut-off points (equivalent to the constant in the OLS) are significant. Second, I found that religiosity and ethnic background play a significant role in explaining risk aversion (*RA*). In particular, being a muslim and non-Javanese is correlated positively with being risk-loving.

I also redid subsample regressions based on assets and education and the results are fairly similar. While *RL2* provides support for a positive relationship between height and risk loving behaviour for people on the third quintile, but in general the evidence that **PC** and **TE** can explain variations in risk aversion is limited.

Table 7: **Sensitivity in the dependent variable**

Dependent variable	OLS			Ordered logit
	RA	*RL1*	*RL2*	*RA*
	(1)	(2)	(3)	(4)
*Predetermined characteristics (***PC***)*				
Height	0.0002	0.0000	-0.0001	0.0003
	(0.0006)	(0.0002)	(0.0001)	(0.0014)
Weight	0.0011	0.0002	0.0003*	0.0007
	(0.0007)	(0.0002)	(0.0001)	(0.0016)
Father's education				
Elementary	0.0105	0.0052	-0.0041	0.0582
	(0.0168)	(0.0058)	(0.0037)	(0.0360)
Junior high	-0.0248	-0.0065	-0.0063	-0.0418
	(0.0310)	(0.0101)	(0.0065)	(0.0616)
Senior high	-0.0101	-0.0051	-0.0054	0.0078
	(0.0343)	(0.0116)	(0.0079)	(0.0663)
University	0.1683*	0.0326	0.0299	0.3252**
	(0.0681)	(0.0235)	(0.0160)	(0.1056)
Mother's education				
Elementary	0.0234	0.0099	0.0069	-0.0306
	(0.0186)	(0.0063)	(0.0037)	(0.0420)
Junior high	0.0938*	0.0258*	0.0114	0.1392*
	(0.0366)	(0.0118)	(0.0083)	(0.0699)
Senior high	0.0515	0.0228	-0.0029	0.0695
	(0.0492)	(0.0164)	(0.0111)	(0.0877)
University	0.1485	0.0180	0.0122	0.1126
	(0.0999)	(0.0314)	(0.0256)	(0.1577)
*Temporary events (***TE***)*				
Disaster	0.0024	0.0016	0.0016	0.0153
	(0.0086)	(0.0028)	(0.0024)	(0.0181)
Lost (ln)	-0.0019	-0.0010	-0.0004	-0.0055
	(0.0041)	(0.0013)	(0.0009)	(0.0086)
Assistance (ln)	0.0028	0.0004	0.0001	-0.0030
	(0.0056)	(0.0018)	(0.0013)	(0.0123)
*Other control variables (***X***)*				
Assets (ln)	0.0155**	0.0033*	0.0022*	0.0126
	(0.0047)	(0.0016)	(0.0010)	(0.0095)
Lagged assets (ln)	0.0027	0.0018	-0.0001	-0.0002
	(0.0033)	(0.0011)	(0.0008)	(0.0066)
Islam	0.0046	0.0011	0.0034	0.2374***
	(0.0403)	(0.0125)	(0.0079)	(0.0703)
Javanese	-0.0104	-0.0028	-0.0045	-0.3299***
	(0.0259)	(0.0080)	(0.0061)	(0.0727)
Rural	0.0095	0.0030	-0.0064	0.1276
	(0.0370)	(0.0125)	(0.0076)	(0.0730)
Age	0.0095***	0.0043***	0.0010*	0.0145**
	(0.0023)	(0.0008)	(0.0005)	(0.0049)
Age^2	-0.0001***	-0.0001***	-0.0000*	-0.0002***
	(0.0000)	(0.0000)	(0.0000)	(0.0001)
Sex	0.2411***	0.0669***	0.0294***	0.4560***
	(0.0161)	(0.0058)	(0.0033)	(0.0335)
Married	-0.0115	0.0003	0.0011	-0.0304
	(0.0171)	(0.0062)	(0.0034)	(0.0366)
Dependency	-0.0028	0.0073	-0.0107	-0.0385
	(0.0348)	(0.0121)	(0.0069)	(0.0748)
Time preference				
Patient	0.0681	0.0031	0.0156	0.0931
	(0.0533)	(0.0198)	(0.0127)	(0.0914)
Somewhat impatient	-0.0369	-0.0574**	-0.0078	0.0092
	(0.0557)	(0.0206)	(0.0123)	(0.0960)
Impatient	-0.0149	-0.0367	-0.0157	0.0820
	(0.0548)	(0.0197)	(0.0121)	(0.1005)
Very impatient	-0.2283***	-0.0586**	-0.0163	-0.5248***
	(0.0501)	(0.0181)	(0.0114)	(0.0905)
Education				
Elementary	-0.0377	0.0003	-0.0119*	-0.0151
	(0.0273)	(0.0104)	(0.0056)	(0.1016)
Junior high	-0.0289	-0.0084	-0.0000	0.0545
	(0.0311)	(0.0122)	(0.0066)	(0.1100)
Senior high	0.0040	0.0003	0.0028	0.1212
	(0.0333)	(0.0131)	(0.0072)	(0.1151)
University	0.1680***	0.0396*	0.0273**	0.4509***
	(0.0423)	(0.0154)	(0.0096)	(0.1229)
Constant	0.1399	-0.0151	-0.0050	
	(0.1445)	(0.0510)	(0.0293)	
F	21.852	10.137	7.668	
χ^2				705.455
R^2	0.04	0.02	0.01	
N	27717	27717	27717	27717

Notes: robust standard error is in parentheses. *** statistically significant at 1% level, ** at 5% level, * at 10% level. OLS estimations include subdistrict fixed effects and the standard errors are clustered at subdistrict level. Cut off points for ordered logit are not shown. Stata does not have a built-in command to accommodate subdistrict fixed effects for ordered logit estimation, which is unfortunate because we may suspect a time-invariant omitted variable bias.

Another robustness check is by using a dummy variable *Ideal* as a proxy for physical prowess that is derived from the body mass index (BMI). BMI is simply the ratio between the weight (kg) and the square of height (meter). The variable *Ideal* equals to 1 if the BMI is at normal range (between 18.5 to 25 as defined by the WHO).[10] Another alternative measure is relative height, which is a dummy variable *Tall*, which equals to 1 if the person is taller than the median of other respondents of the same sex living in the same district.[11] As can be seen in column (1) and (2) of Table 8, the use of either *Ideal* or *Tall* as an alternative measure of physical attribute cannot help explaining variations in *ARA*.

While economic shock is relevant for Indonesia (the country experienced the 1997/1998 Asian economic crisis) and there are studies that shows the impact of the crisis on different households or economic sectors (Fallon and Lucas, 2002, Waters et al., 2003, Wie, 2000), but the information on individual risk preference is only available in 2007. There are also various factors affecting the individual within that 10-year gap that might not be observed. It is also difficult to identify the impact of the crisis for different individuals or to know if an individual's observed behaviour is due to the crisis.

Nonetheless, I tried to control for the crisis by adding three variables: *Ecshock,* change in the poverty rate, and the interaction between these two. *Ecshock* is a dummy variable that equals to 1 if the respondent worked in the construction and financial sector in 1997 by utilising data from IFLS2. These two economic sectors got the hardest hit (based on the drop in real GDP growth) during the crisis (Wie, 2000). In Table 8 column (3) we can see that there is no observed impact of past crisis on current risk preference. It should be noted that since the number of respondent increased between IFLS2 and IFLS4 and not all respondent worked during the IFLS2 survey, the final number of observation is severely limited.

[10] See http://apps.who.int/bmi/index.jsp?introPage=intro_3.html

[11] I use median rather than mean to avoid measurement error due to the outliers.

Table 8: **Ideal posture, economic crisis, and abilities**

	Dependent variable: *ARA*			
	(1)	(2)	(3)	(4)
*Predetermined characteristics (***PC***)*				
Ideal	-0.0015			
	(0.0011)			
Tall		-0.0003		
		(0.0011)		
Height			-0.0002*	-0.0001
			(0.0001)	(0.0001)
Weight			0.0000	0.0000
			(0.0001)	(0.0001)
*Temporary events (***TE***)*				
Ecshock			0.0086	
			(0.0055)	
Change in poverty rate			-0.0029	
			(0.0044)	
Shock			-0.0053	
			(0.0069)	
Other control variables (**X**)				
Education				
Elementary	0.0061**	0.0060**	0.0040	0.0080
	(0.0023)	(0.0023)	(0.0032)	(0.0122)
Junior high	0.0035	0.0035	-0.0023	0.0058
	(0.0025)	(0.0025)	(0.0042)	(0.0123)
Senior high	-0.0028	-0.0027	-0.0041	0.0022
	(0.0027)	(0.0027)	(0.0045)	(0.0125)
University	-0.0145***	-0.0145***	-0.0112*	-0.0074
	(0.0033)	(0.0033)	(0.0052)	(0.0128)
Cognitive ability				0.0014
				(0.0049)
Numerical ability				-0.0161***
				(0.0035)
Constant	0.1887***	0.1875***	0.2381***	0.1936***
	(0.0092)	(0.0091)	(0.0234)	(0.0296)
F	44.82	44.79	14.46	15.78
R^2	0.06	0.06	0.06	0.05
N	27717	27717	8965	10642

Notes: The regressions also include all variables within **PC**, **TE**, and **X**. Variables in **X** are not displayed for reading convenience. Robust standard error is in parentheses. *** statistically significant at 1% level, ** at 5% level, * at 10% level. The estimations include subdistrict fixed effects and the standard errors are clustered at subdistrict level.

Again, subsample regressions cannot explain variations in *ARA* when I varied the measure for physical attributes (*Tall* and *Ideal*) or when I control for the impact of past shock.

Finally, I controlled for cognitive ability and numerical ability in Table 8 column (4) because I also used education as one of the explanatory variables in **X**. Excluding ability will bias the estimated coefficient of education. However, question on ability is limited only to respondent age 15-24, which reduces the number of observation. The estimation shows that education variable became insignificant and numerical ability is strongly and negatively correlated with *ARA*, indicating that people with high mathematical ability tend to be more risk loving. This result is confirmed when I used subsample regressions where the numerical ability is significant and negatively associated with risk averseness for people in the third and fifth endowment quintiles. This is somewhat an important result because we observe that the coefficients for elementary and higher degree education are statistically significant throughout all specification in the main regression (Table 4).

3.4 Insurance policy

Cameron and Shah (2011) observed that people who lived in disaster-prone area in East Java tend to self-insure through a rotating saving mechanism (*Arisan*) and they also found that receiving remittance offset some of the impact of natural disaster on risk aversion. In order to test this I included a dummy for the participation in *Arisan* and the amount of transfer received from outside the household (*Transfer,* in ln). Table 9 shows that people who experience disaster are, on average, have higher transfer and involve more in *Arisan*.

Table 9: **Self-insurance and natural disaster**

	Disaster	No disaster	Difference
Arisan	0.3865 (0.0113)	0.2230 (0.0026)	0.1635***
Transfer (ln)	8.6102 (0.2116)	7.7545 (0.0566)	0.8557***
N	1868	25849	

Note: *** significant at 1% level

I then interacted these variables with how often the individual experienced disaster (*Arisan* × *Disaster* and *Transfer* × *Disaster*) and included these in the full regression (equation (2)). If the estimated coefficient for *Transfer* × *Disaster* is negative and significant, it means that the larger the transfer, the less risk averse the individual when there is a shock (disaster). Hence, these additional variables can be seen as an informal proxy for the demand for a disaster-related insurance.

Table 10: **Self-insurance (dependent variable: *ARA*)**

	Full sample	Subsample	
		Not Arisan	Arisan
	(1)	(2)	(3)
Arisan	-0.0030*		
	(0.0014)		
Arisan × disaster	0.0008*		
	(0.0003)		
Transfer (ln)	-0.0002**	-0.0002*	-0.0002
	(0.0001)	(0.0001)	(0.0001)
Transfer × disaster	-0.0001	-0.0001	-0.0002
	(0.0001)	(0.0001)	(0.0001)
Constant	0.2046***	0.2074***	0.1825***
	(0.0117)	(0.0117)	(0.0117)
F-test	38.78	32.53	12.22
R^2	0.06	0.06	0.07
N	27707	21220	6487

Notes: The regressions also include all variables within **PC**, **TE**, and **X**. Variables in **PC, TE,** and **X** are not displayed for reading convenience. Robust standard error is in parentheses. *** statistically significant at 1% level, ** at 5% level, * at 10% level. The estimations include subdistrict fixed effect and the standard error is clustered at subdistrict level.

In Table 10 column (1), I found that while *Arisan* is negatively correlated with *ARA* but the coefficient for *Arisan* × *Disaster* is positive and significant. This means that after controlling for the direct impact of the *Arisan*, an individual tend to be more risk averse when he/she experienced (more) disaster. On the other hand, only the coefficient for *Transfer* is negative and significant, which suggests that only the direct effect of *Transfer* that drives risk aversion. Overall, these results give less support for a natural disaster-related insurance policy.

Nonetheless, we might suspect that *Arisan* has reverse causality with *ARA*: risk-averse individuals tend to involve more in such rotating saving mechanism to smooth their consumption. Therefore, I made subsample regressions by *Arisan* participation in column (2) and (3). The estimated coefficients do not differ much from those in column (1), thus support the previous claim that only *Transfer* that determines ARA.

4 Conclusion

Several studies point out to the important role of temporary shocks and predetermined characteristics on determining an individual's risk preference. My observation using IFLS4 data for Indonesia shows that this is not necessarily the case: only father's education at higher level that exhibits the expected sign and significance. The impact of natural disaster as found in Cameron and Shah (2011) diminished when I use full sample of both the rural and urban area. Physical attributes were showing significance and correlates negatively with *ARA* in regressions that contain predetermined characteristics and shock variables, but then fell down when I control for demographic variations and other variables. Nonetheless, there is a strong correlation as well between being impatient with low degree of *ARA* (risk-loving). These give preliminary indication that variations in risk preference are indeed random.

From the policy perspective, a simple proxy for the demand of a disaster-related insurance shows that only the direct effect of the transfer that drives risk aversion, which means larger transfer for people who experience disaster does not reduce the risk averseness of the individual. In other words, there is no observed demand for natural disaster-related insurance.

Nonetheless, the absence of evidence is not necessarily an evidence of absence. There has been a great concern on the use of utility function to reveal risk preference and on how the framing of the question, information processing, and reference point can affect risk preference (Schoemaker, 1993). The survey design itself does not elicit any use of real monetary payoff to the respondent, which might underestimate the observed degree of risk aversion of the respondent. It is possible also that the individual gives nonlinear probability on gain and loss, which explains why many people are risk-averse.

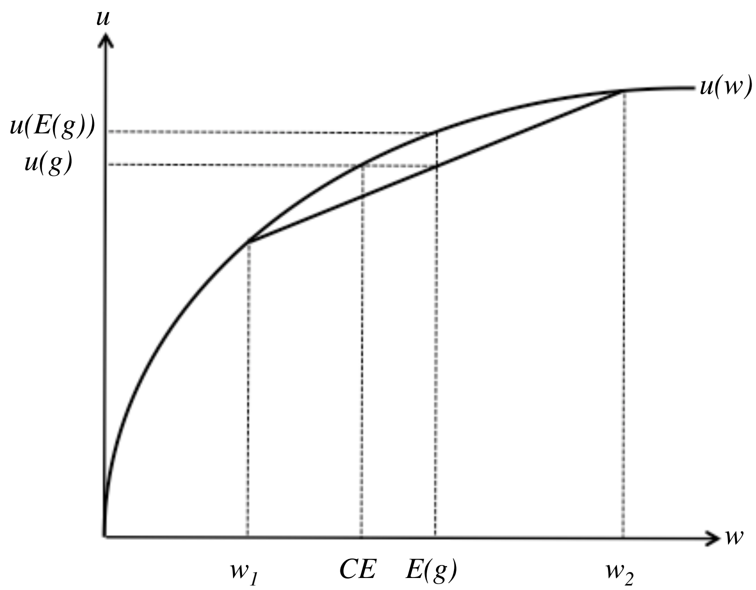
Finally, this study is just a brief introduction to studies on risk preference in Indonesia. A way forward is to take a closer look on how sensitive the result is if we observe that people see gain and loss differently. The construction of *ARA* rests on the expected utility theory that assign linear probabilities on gain and loss, but prospect theory—one of the cornerstone in behavioural economics—suggests that people give nonlinear weighting in the probability of gain and loss (Kahneman and Tversky, 1979), in which people tend to value loss more than they value gain. An excellent applied research in this topic is by Tanaka et al. (2010) where they found that poor villagers in Vietnam are not always fear of uncertainty in income variation, but they also fear of loss. This will be the future direction of this study.

Appendix

Risk-averse individual

Consider an individual that has a von Neumann-Morgenstern (VNM) utility function over wealth $u(w)$. Consider also that there is a simple gamble g that has an expected value of $E(g) = \sum p_i w_i$, where p_i is the probability of winning wealth w_i. Suppose that the person is asked to choose to either: (1) engaged in a gamble g, or (2) getting an amount $E(g)$ with certainty. A risk-neutral individual will have a linear utility function and sees these two options indifferently because the expected value from engaging in the gamble is simply equal to $E(g)$. However, for a person who is not risk-neutral, he/she should consider the *utility* for each possible wealth resulted from the gamble. Therefore, he/she compared $u(g) = \sum p_i\, u(w_i)$ of Option (1) and $u\big(E(g)\big) = u(\sum p_i w_i)$ of Option (2).

Figure A1: **A risk averse utility function**



A risk-averse individual is someone who choose (2) over (1), that is if $u\big(E(g)\big) > u(g)$, as shown in Figure A1 above. This is because a risk-averse individual will choose a certain amount of wealth CE that generates the same level of utility as $u(g)$, even though the gamble's expected value $E(g) > CE$.

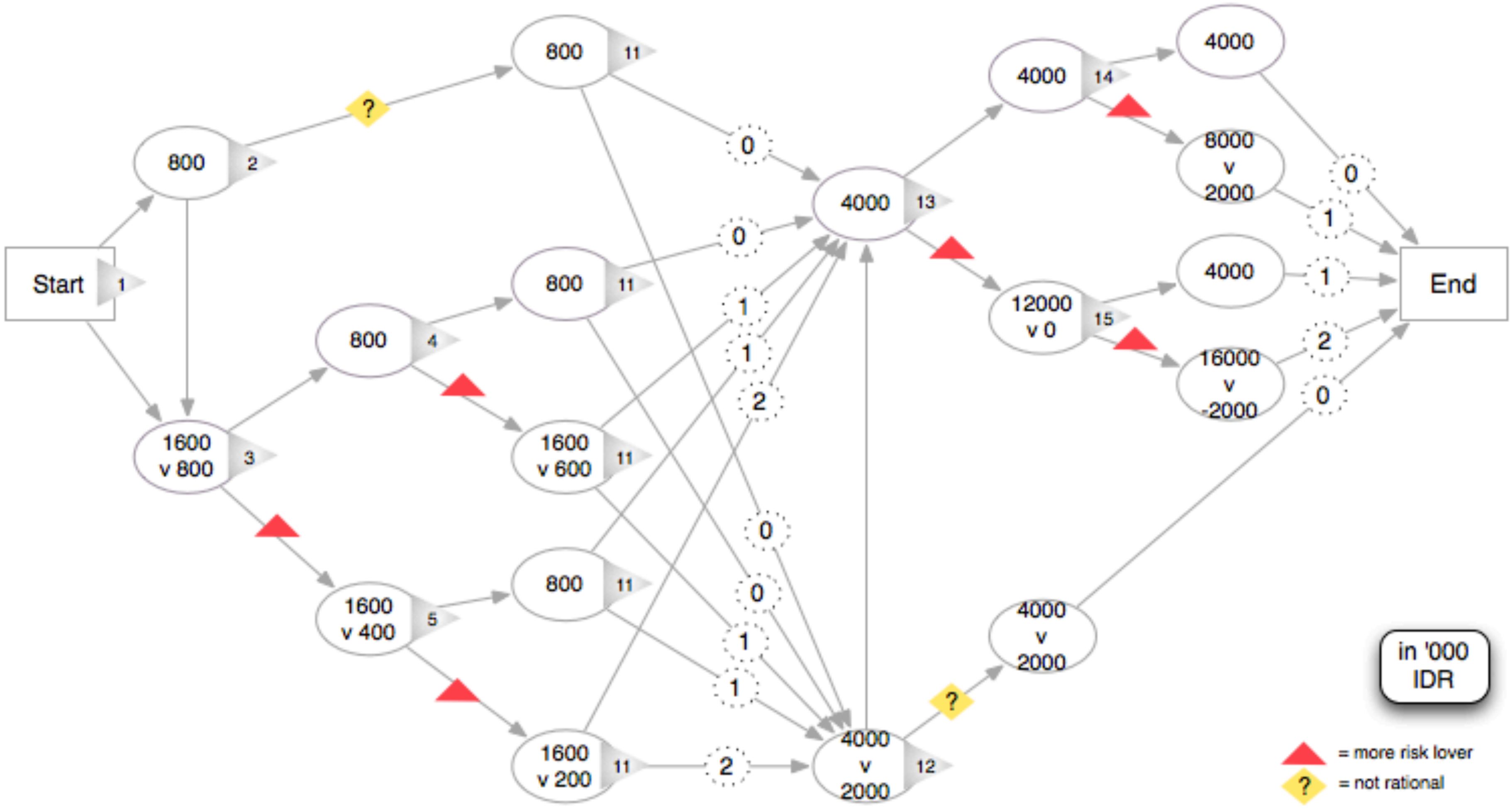
Table A1: **Questions on risk preference in IFLS4**

SECTION SI: RISK AND TIME PREFERENCES

SI01.	Suppose you are offered two ways to earn some money. With option 1, you are guaranteed Rp 800 thousand per month. With option 2, you have an equal chance of ither the same income, Rp 800 thousand per month, or, if you are lucky, Rp 1.6 million. per month, which is more. Which option will you choose?	1. Rp 800 thousand per month 2. Rp 1.6 million or Rp 800 thousand per month→ **SI03** 8. DON'T KNOW
SI02.	Are you sure? In option 2 you will get at least Rp 800 thousand per month and you may get Rp 1.6 million per month. In option 1 you will always get Rp 800 thousand per month.	1. Still picks option 1 → **SI11** 2. Switches to option 2 8. DON'T KNOW
SI03.	Now, in option 2 you have an equal chance of receiving either Rp. 1.6 million per month or Rp. 400 thousand per month, depending on how lucky you are. Option 1 guarantees you an income of Rp 800 thousand per month. Which option will you choose?	1. Rp 800 thousand 2. Rp 1.6 million or Rp 400 thousand → **SI05** 8. DON'T KNOW
SI04.	Now, in option 2 you have an equal chance of receiving either Rp 1.6 million per month or Rp 600 thousand per month, depending on how lucky you are. Option 1 guarantees you an income of Rp 800 thousand per month. Which option will you choose?	1. Rp 800 thousand 2. Rp 1.6 million or Rp 600 thousand 8. DON'T KNOW → **SI11**
SI05.	Now, in option 2 you have an equal chance of receiving either Rp 1.6 million per month or Rp 200 thousand per month, depending on how lucky you are. Option 1 guarantees you an income of Rp 800 thousand per month. Which option will you choose?	1. Rp 800 thousand 2. Rp 1.6 million or Rp 200 thousand 8. DON'T KNOW → **SI11**

SI11.	Suppose you are offered two ways to earn income. With option 1, you are guaranteed an income of Rp 4 million per month. With option 2, you have an equal chance of earning either the same income, Rp 4 million per month, or, if you are unlucky, Rp 2 million per month, which is less. Which option will you choose?	1. Rp 4 million→ **SI13** 2. Rp 4 million or Rp 2 million 8. DON'T KNOW
SI12.	Are you sure? In option 1you will always get Rp 4 million per month but in option 2 you may get Rp 4 million per month but you may get only Rp 2 million per month..	1. Still picks option 1 → **SI21** 2. Switches to option 2 8. DON'T KNOW
SI13.	Now, in option 2 you have an equal chance of receiving either Rp 12 million per month or nothing, depending on how lucky you are. Option 1 guarantees you an income of Rp 4 million per month. Which option will you choose?	1. Rp 4 million 2. Rp 12 million or Rp 0 → **SI15** 8. DON'T KNOW
SI14.	Now, in option 2 you have an equal chance of receiving either Rp 8 million per month or Rp 2 million per month, depending on how lucky you are. Option 1 guarantees you an income of Rp 4 million per month. Which option will you choose?	1. Rp 4 million 2. Rp 8 million or Rp 2 million 8. DON'T KNOW → **SI21**
SI15.	Now, in option 2 you have an equal chance of receiving either Rp 16 million per month or having to pay out Rp 2 million per month depending on how lucky you are. Option 1 guarantees you an income of Rp 4 million per month. Which option will you choose?	1. Rp 4 million 2. Rp 16 million or -Rp 2 million 8. DON'T KNOW → **SI21**

Figure A2: **Possible path taken by a respondent**



Alternative measure of risk aversion

RL1 and *RL2* are constructed based on Game 1 (question SI01-SI05) and Game 2 (SI11-SI15). Following Cameron and Shah, *RL1*=1 (*RL2*=1) if the respondent chose SI05=2 (SI15=2).

RA is constructed by assigning values to each step that the respondent took and summed it up. Figure A2 shows any possible path the respondent can choose based on questions in Table 1 (in total, there are 80 possible paths that a respondent can take). Every time a respondent choose a risky choice, he/she get 1 point and 0 otherwise (every risky choice is marked by a red triangle). Thus, the value of *RA* ranges from 0 (very risk averse) to 4 (very risk loving). See Table A2 below for examples.

Table A2: **Example of a respondent's path**

Path	Game 1		Game 2		*RA* =
	Choice	Score 1	Choice	Score 2	Score 1 + Score 2
1	SI01=2; SI03=2; SI05=2	2	SI11=1; SI13=2; SI15=2	2	4
2	SI01=2; SI03=1; SI04=2	1	SI11=1; SI13=2; SI15=1	1	2
3	SI01=1; SI02=2; SI03=2; SI05=1	1	SI11=2; SI12=1	0	1
4	SI01=2; SI03=1; SI04=1	0	SI11=2; SI12=2; SI13=1; SI14=1	0	0
⋮	⋮	⋮	⋮	⋮	⋮

Note: there is two mistranslations in question SI12: first, "1. Still picks option 1" should be read "1. Still picks option 2"; second, "2. Switches to option 2" should be read "2. Switches to option 1". Red means that the respondent took the risky choice.

Table A3: **Constructing time preference**

Respondent's choice	Forgone amount	Time preference	Definition
Rp1 million in 1 year	Rp1 million today	1	Very patient
Rp2 million in 1 year	Rp1 million today	2	Patient
Rp1 million today	Rp2 million in 1 year	3	Somewhat impatient
Rp6 million in 1 year	Rp1 million today	4	Impatient
Rp1 million today	Rp6 million in 1 year	5	Very impatient

Note: impatience was constructed based on Game 1 (question SI21)

Table A4: **Questions on time preference in IFLS4**

SECTION SI: RISK AND TIME PREFERENCES

SI21.	You have won the lottery. You can choose between being paid		
	A. 1. Rp 1 million today or 2. Rp 1 million in 1 year Which do you choose?	A 1. Rp 1 million today→**B**	2. Rp 1 million in 1 year→**E**
	B. 1. Rp 1 million today or 2. Rp 3 million in 1 year Which do you choose?	B. 1. Rp 1 million today→**C**	2. Rp 3 million in 1 year→**D**
	C. 1. Rp 1 million today or 2. Rp 6 million in 1 year Which do you choose?	C. 1. Rp 1 million today→**S122**	2. Rp 6 million in 1 year→**SI22**
	D. 1. Rp 1 million today or 2. Rp 2 million in 1 year Which do you choose?	D. 1. Rp 1 million today→**SI22**	2. Rp 2 million in 1 year→**SI22**
	E. Are you sure you prefer the same amount in the future although you get the same amount if you do not wait?	E. 1 . Yes→ **SI22**	3. No prefer Rp 1 million today→**B**

SI22.	You have won the lottery. You can choose between being paid		
	A. 1. Rp 1 million today or 2. Rp 500,000 in 5 years Which do you choose?	A 1. Rp 1 million today→**B**	2. Rp 0.5 million in 5 years→**E**
	B. 1. Rp 1 million today or 2. Rp 4 million in 5 years Which do you choose?	B. 1. Rp 1 million today→**C**	2. Rp 4 million in 5 years→**D**
	C. 1. Rp 1 million today or 2. Rp 10 million in 5 years Which do you choose?	C. 1. Rp 1 million today→**SECTION TR**	2. Rp 10 million in 5 years→**SECTION TR**
	D. 1. Rp 1 million today or 2. Rp 2 million in 5 years Which do you choose?	D. 1. Rp 1 million today→**SECTION TR**	2. Rp 2 million in 5 years→**SECTION TR**
	E. Are you sure you prefer the smaller amount in the future rather than a larger amount without waiting?	E. 1 . Yes→**F**	3. No prefer Rp 1 million today→**B**

Measuring ability

Both cognitive ability (*ca*) and numerical ability (*na*) is measured by assigning a value of 1 (and 0 otherwise) if the person chooses the correct answer from questions on logic in IFLS4 (section EK). There are 8 questions on cognitive ability in which the respondent (age 15-24) was asked to choose a shape that match with the 3 existing shapes in each question (see Figure A3 below). There are only 5 questions on numerical ability (Table A5) that asked standard mathematical problems of elementary-junior high school level.

Figure A3: **Cognitive ability**

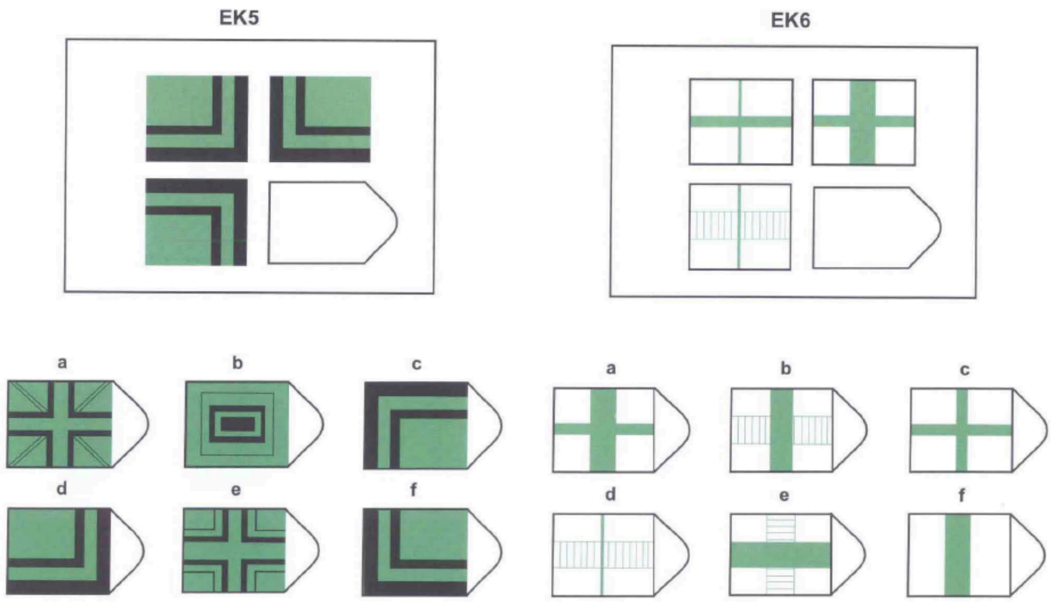


Table A5: **Numerical ability**

EK18. $\frac{56}{84} = \ldots$

a. $\frac{4}{7}$

b. $\frac{2}{3}$

c. $\frac{3}{4}$

d. $\frac{5}{6}$

EK19. (412 + 213) : (243 – 118)

a. 125

b. 75

c. 25

d. 5

EK20. 0,76 – 0,4 – 0,23

a. 0,11

b. 0,12

c. 0,13

d. 0,16

EK21. Jika 65 persen penduduk bercocok tanam, sedang penduduknya sejumlah 160 juta, maka banyaknya penduduk yang tidak bercocok tanam adalah...

a. 35 juta

b. 40 juta

c. 48 juta

d. 56 juta

EK22. Uang tabungan si Ali di bank Rp 75.000,00. Jika setahun kemudian bunganya 5%, maka besar bunga yang diterima Ali adalah...

a. Rp 7.500,00

b. Rp 3.750,00

c. Rp 750,00

d. Rp 375,00

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