Risk and time preferences of farmers in India and Indonesia

Arieska Wening Sawosri and Oliver Mußhoff

EFForTS discussion paper series Nr. 32

Sawosri, Arieska Wening ; Mußhoff, Oliver : Risk and time preferences of farmers in India and Indonesia
Göttingen : GOEDOC, Dokumenten- und Publikationsserver der Georg-August-Universität, 2020
(EFForTS discussion paper series 32)

Verfügbar:
PURL: http://resolver.sub.uni-goettingen.de/purl/?webdoc-4004

Bibliographische Information der Deutschen Nationalbibliothek

Die Deutsche Nationalbibliothek verzeichnet diese Publikation in der Deutschen Nationalbibliographie; detaillierte bibliographische Daten sind im Internet über <http://dnb.dnb.de> abrufbar.

Erschienen in der Reihe
EFForTS discussion paper series

ISSN: 2197-6244

Herausgeber der Reihe
SFB 990 EFForTS, Ecological and Socioeconomic Functions of Tropical Lowland Rainforest Transformation Systems (Sumatra, Indonesien) - Ökologische und sozioökonomische Funktionen tropischer Tieflandregenwald-Transformationssysteme (Sumatra, Indonesien)

Georg-August-Universität Göttingen
Johann-Friedrich-Blumenbach Institut für Zoologie und Anthropologie, Fakultät für Biologie und Psychologie

Abstract: This cross-country study compares risk and time preferences of farmers from two lower-middle income countries, India and Indonesia. Current literature mainly focuses on a single country context; however, this study involves more than one country. Hence, we could investigate whether the individual preferences of farmers from two countries with similar income level are the same. The preferences are key for the policymakers to make informed policy decisions regarding investments and acceptance of development programs. Our study involved 1,528 farmers. The risk and time preferences were elicited using incentivised experiments and simultaneously estimated following the joint-estimation-method by Andersen et al. (2008). Results show that the farmers in India show a higher level of risk aversion and lower discount rates, even though very high discount rates were encountered in both countries. As a result, policymakers should consider implementing policies to deal with high discount rates causing poverty and lack of investment.

Keywords: Cross-country dataset, lower-middle income countries, risk preferences, smallholder farmers, time preferences

Risk and time preferences of farmers in India and Indonesia

Arieska Wening Sawosri and Oliver Mußhoff

EFForTS Discussion Paper Series No. 32

April 2020

Ecological and Socioeconomic Functions of Tropical Lowland Rainforest Transformation Systems (Sumatra, Indonesia)

This publication was funded by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) – project number 192626868 – in the framework of the collaborative German-Indonesian research project CRC 990 (SFB): "EFForTS, Ecological and Socioeconomic Functions of Tropical Lowland Rainforest Transformation Systems (Sumatra, Indonesia)"

https://www.uni-goettingen.de/de/about+us/413417.html

SFB 990, University of Goettingen
Untere Karspüle 2, D-37073 Goettingen, Germany

ISSN: 2197-6244

Managing editors:

at the University of Goettingen, Germany:

Prof. Dr. Heiko Faust, Faculty of Geoscience and Geography, Division of Human Geography (Email: hfaust@gwdg.de)

Dr. Jana Juhrbandt, Environmental and Resource Economics, Department for Agricultural Economics and Rural Development (Email: jjuhrba@gwdg.de)

at the University of Jambi, Indonesia:

Prof. Dr. Zulkifli Alamsyah, Faculty of Agriculture, Dept. of Agricultural Economics (Email: zalamsyah@unja.ac.id)

Risk and time preferences of farmers in India and Indonesia

Authors:

1. Arieska Wening Sarwosri
   e-mail: asarwos@gwdg.de
   Phone: +49 (0) 551 – 3933881

2. Oliver Mußhoff
   e-mail: oliver.musshoff@agr.uni-goettingen.de
   Phone: +49 (0) 551 –394842

Complete affiliations:

Department of Agricultural Economics and Rural Development
Georg-August-Universität-Göttingen
Platz der Göttinger Sieben 5, D-37075, Germany
Fax: +49 (0) 551 – 3922030

Project descriptions:

Funded by the German Research Foundation (DFG) through the CRC 990 "EFForTS, Ecological and Socioeconomic Functions of Tropical Lowland Rainforest Transformation Systems (Sumatra, Indonesia)"

Risk and time preferences of farmers in India and Indonesia

Abstract

This cross-country study compares risk and time preferences of farmers from two lower-middle income countries, India and Indonesia. Current literature mainly focuses on a single country context; however, this study involves more than one country. Hence, we could investigate whether the individual preferences of farmers from two countries with similar income level are the same. The preferences are key for the policymakers to make informed policy decisions regarding investments and acceptance of development programs. Our study involved 1,528 farmers. The risk and time preferences were elicited using incentivised experiments and simultaneously estimated following the joint-estimation-method by Andersen *et al*. (2008). Results show that the farmers in India show a higher level of risk aversion and lower discount rates, even though very high discount rates were encountered in both countries. As a result, policymakers should consider implementing policies to deal with high discount rates causing poverty and lack of investment.

Keywords:

Cross-country dataset, lower-middle income countries, risk preferences, smallholder farmers, time preferences

1. INTRODUCTION

The knowledge of individual risk and time preferences of farmers is necessary to understand their investment decisions toward new technologies, farming practices, selection of crops, as well as applications for microcredits and agriculture insurance (Bauer *et al.*, 2013; Jin *et al.*, 2016; McIntosh *et al*., 2013; Ngwira *et al*., 2013). High-risk aversion is seen as one reason for poverty traps because risk-averse individuals often doubt to participate in various changes in economic situations (Knight *et al.*, 2003). Furthermore, a high discount rate promotes hesitation to make long-term investments because individuals put a low value on future rewards (Bauer and Chytilová., 2010). Thus, information about farmers' preferences is important for the implementation of governmental policies which might involve projects with uncertain returns and have long-term impacts (Harrison *et al.*, 2005).

The investigation of risk and time preferences in Low-Income Countries (LICs) could be a key information for policymakers to cope with slow adoption of changes and doubt in new technologies which are different with farmers in the countries with higher income (Harrison *et al.*, 2009; Lee, 2005). Farmers in LICs deal with limited access to credit and insurance while facing various types of shocks and high inflation rates (Fafchamps, 2003). Furthermore, the farmers are considered the most vulnerable groups who are most affected by poverty, price fluctuation of agricultural products, uncertain access to agriculture inputs, and the unclear status of land ownership (Barrett *et al.*, 2012; Lee, 2005). Regarding that, Liebenehm and Waibel (2014) investigated the risk and time preferences of farmers using a pooled dataset from two LICs in Africa, Burkina Faso and Mali. They found that farmers in these two countries had a high level of risk aversion, but on average had a relatively low discount rate. Despite the fact that farmers living in Lower-Middle Income Countries (LMICs) experience marginally better economic environment than in LIC, they still are characterised with high population growth, poverty, and slow development due to the reluctance to change and adopt new technologies (Ortiz-Ferrara *et al.*, 2007; Stevenson *et al.*, 2014; World Bank, 2017). Moreover, the

governments in LMICs are burdened with urbanisation problems causing severe poverty in cities.

To date there is a large body of country context specific data on risk and time preferences of farmers in LMICs globally. However, relatively there was little attention focused on investigating cross country comparisons. To the best of our knowledge, several studies investigating risk and time preferences of farmers in LMICs only involve a single country instead of utilising cross-country datasets. Such studies include Bauer *et al.* (2012) in India, and Nguyen (2011), and Tanaka *et al.* (2010) in Vietnam. Furthermore, Liebenehm and Waibel (2014) study utilised cross-countries dataset involved two LICs and hence, leaving a gap for a study into LMICs.

Therefore, this study investigated the risk and time preferences of farmers in two LMICs. More specifically, we focus on the two biggest LMICs in Asia in term of population, India and Indonesia. According to the World Bank (2018a), these two countries have a very high population growth, with 37% and 32% for India and Indonesia, respectively. Moreover, urban population growth is much higher than total population growth (World Bank, 2018a), which indicates rapid urbanisation (Bharath *et al.,* 2018; Ramachandra *et al.,* 2015; Zhu and Simarmata, 2015). With regards to possible effects of world market changes, the investigation of individual risk and time preferences was conducted at an almost simultaneous time frame (end of 2016 until beginning of 2017). Furthermore, we analysed the connection between risk and time preferences and the socioeconomic and demographic variables of the farmers.

The field experiment included 772 Indian and 756 Indonesian households. The experiments consisted of two tasks: (1) the Holt and Laury task (HL-task; Holt and Laury, 2002) to elicit risk preferences; and, (2) the Coller and Williams task (CW-task; Coller and Williams, 1999) to measure time preferences by estimating discount rates. These field experiments were broadly utilised to observe individual preferences (Charness, 2013). Incentivisation was used to encourage sensible and realistic decision making during the experiments (Hertwig and Ortman, 2001). Following Andersen *et al.* (2008), we estimated the risk and time preferences using the joint estimation method. This method incorporates the risk aversion on the estimations of the discount rate, instead of assuming risk-neutral individuals (Coller and Williams, 1999). By using the joint estimation method, Andersen *et al.* (2008) and Sauter and Mußhoff (2018) found that joint estimation leads to a lower value of discount rate. The values of discount rate varies by involving risk aversion on the estimation emphasise the importance of the corrected discount rate using the joint estimation method (Anderhub *et al.*, 2001; Laury *et al.*, 2012).

To the best of our knowledge, this is the first study estimating and providing a direct comparison of risk and time preferences of farmers in two LMICs. Hence, this study extends Liebenehm and Waibel (2014) which utilised the data from two LICs as pooled data in their cross-country investigation and other studies which used only a single context-specific country (*e.g.,* Bauer *et al.,* 2012; Nguyen, 2011; Tanaka *et al.*, 2010). Involving more than one country allowed us to investigate whether individual preferences of farmers from two countries with similar income level are the same. Finally, our research is an extension of Harrison *et al.* (2009) which compared only risk preferences of farmers in three countries with different categories of income. The same can be said for Wang *et al.*, (2016) study which compared the time preferences of people in many countries with different income categories but did not focus on farmers and leave the discussion of risk preferences.

This paper is structured as follows: Section 2 describes the data and presents the descriptive statistics. Section 3 provides the elicitation and estimation method of risk and time preferences. Section 4 explains the results and discussion. Finally, Section 5 provides a conclusion and the policy implications of the findings.

2. DATA AND DESCRIPTIVE STATISTICS

The experiments and surveys were used to gather socioeconomic and demographic information were carried out in India and Indonesia. The data collection in India was conducted in the rural areas surrounding Bangalore city, where 61 villages were randomly selected. Roughly, of which 15 – 20 people per village participated in the experiments. In total, 772 individuals from India participated in the survey which took place from December 2016 to May 2017. The participants in Indonesia were from the rural areas surrounding Jambi city. In total, 40 villages were randomly selected, with 8 – 24 people interviewed per villages. Data was collected in Indonesia from October 2016 until January 2017 and involved observations from 756 farmers. The participants were the head of households, who are generally the decision-makers of the family.

Table 1 presents the socioeconomic and demographic information of the participants from both countries. We captured data on participants' age, education, household size as well as several binary variables, including gender, farmer as the main occupation, and whether they had a loan from formal or informal institutions. , We utilised the Mann-Whitney U test and the Chi-square test to determine whether the participants from the two countries showed different socio-demographic characteristics. The Mann-Whitney U test was applied for the variables with continuous values and the Chi-square test was applied for the binary variables.

The Mann-Whitney U test showed that the variables age, education and household size, were statistically significantly different between the two groups of participants. This indicates that the farmers in India were on average younger than the farmers in Indonesia. They had a relatively short period of formal education (*i.e.,* around six years for Indians and eight years for Indonesians) and on average completed at least primary school. While the formal education of Indians was shorter, the size of the household was larger than in Indonesia.

Furthermore, the Chi-square test showed that the dummy variables, such as full-time farmer, gender, and loan ownership from either formal or informal institutions were also statistically significant. Most of the surveyed participants were full-time farmers. In this study, we defined full-time farmers as those who obtained more than 50% of their income from farming activities. Out of the sample 87% from Indonesia and 77% from India were full-time farmers. For Indonesia, most of the participants were male heads of household; however, more female participants were captured in India. On average, 32% of the participants in India had a loan from formal institutions, while 42% of the participants in Indonesia had a loan from formal institutions. Approximately 20% of farmers in India had received lending from informal institutions, and a relatively low percentage of farmers in Indonesia had a loan from the informal institutions

Table 1. Descriptive statistics of participants with the division of countries[a]

Variable (unit)	*Mean (st. dev) or share in %*		*p-value*[b]
	India	*Indonesia*	
Age (years)	45.15(13.96)	46.53(10.24)	0.00 ***
Education (years)	6.25(5.05)	8.36(3.57)	0.00 ***
Full-time farmer (1 = ≥ 50% income from farming)	77%	87%	0.00 ***
Gender (1 = male)	73%	97%	0.00 ***
Household size (number)	4.66(2.19)	4.27(1.43)	0.01 ***
Loan formal (1 = has loan from formal institutions)	32%	48%	0.00 ***
Loan informal (1 = has loan from informal institutions)	26%	2%	0.00 ***

Notes: [a]772 Indian, 756 Indonesian; [b]Significance levels: *** at 1%, ** at 5%, * at 10%

3. METHODOLOGY

To conduct the experiments, we hired field-assistants who speak the local language and held "one-by-one experiments", where one field-assistant helped one participant to perform the tasks. For practical reasons, we visualised the explanations of the experiments using pictures with colours to make it more easily understandable for the participants. The monetary incentives for HL-task and CW-task consisted of mobile recharge for Indian participants and a shopping voucher for daily groceries for the participants in Indonesia.

3.1. Experimental design

In the HL-task, there were ten rows of paired lotteries (Holt and Laury, 2002). Each row consisted of two options: *A* or *B,* each including a pair of payoffs: high payoff and low payoff. The difference between the payoffs in option *A* was less compared to the difference of payoffs in option *B*. Thus, option *A* was a so-called "safe-option" and, option *B* was a "risky-option." The probability of gaining high payoff increased while the participants moved down in the ten rows of the Multiple Price List (MPL) as presented in Table 2. The risk preferences were determined when the participants switched from selecting option *A* to option *B*. Even though the participants must make ten decisions, only one randomly selected was binding to determine the monetary incentives[1]. In India, after one binding decision was randomly selected, the die was thrown again to decide whether the participants obtain high or low payoff. In Indonesia, the participants could blindly take one coloured ball which portrayed the high or low payoff.

Table 2. Multiple price list of the HL-task

Row	*India*[a]			*Indonesia*[b]		
	Option A	***Choice***	***Option B***	***Option A***	***Choice***	***Option B***
1	10% of 100, 90% of 80	…	10% of 192, 90% of 5	10% of 4,000, 90% of 3,200	…	10% of 7,600, 90% of 200
2	20% of 100, 80% of 80	…	20% of 192, 80% of 5	20% of 4,000, 80% of 3,200	…	20% of 7,600, 80% of 200
3	30% of 100, 70% of 80	…	30% of 192, 70% of 5	30% of 4,000, 70% of 3,200	…	30% of 7,600, 70% of 200
4	40% of 100, 60% of 80	…	40% of 192, 60% of 5	40% of 4,000, 60% of 3,200	…	40% of 7,600, 60% of 200
5	50% of 100, 50% of 80	…	50% of 192, 50% of 5	50% of 4,000, 50% of 3,200	…	50% of 7,600, 50% of 200
6	60% of 100, 40% of 80	…	60% of 192, 40% of 5	60% of 4,000, 40% of 3,200	…	60% of 7,600, 40% of 200
7	70% of 100, 30% of 80	…	70% of 192, 30% of 5	70% of 4,000, 30% of 3,200	…	70% of 7,600, 30% of 200
8	80% of 100, 20% of 80	…	80% of 192, 20% of 5	80% of 4,000, 20% of 3,200	…	80% of 7,600, 20% of 200
9	90% of 100, 10% of 80	…	90% of 192, 10% of 5	90% of 4,000, 10% of 3,200	…	90% of 7,600, 10% of 200
10	100% of 100	…	100% of 192	100% of 4,000	…	100% of 7,600

Notes: [a]The amount of payoffs is in India Rupee (INR), 1$ is equal to 68.030 INR; [b]The amount of payoffs is in Indonesian Rupiah (IDR), 1$ is equal to 13,300 IDR.

[1] We used different tools to randomly select one decision. For the HL-task, in India, we used 10-sided die. In Indonesia we used 10-numbered coins to randomly select one binding decision and 10-coloured balls to depict high payoff and low payoff. For determining the monetary incentives in the CW-task, we used 10-sided die in India and 10-numbered coins in Indonesia.

Coller and Williams (1999) elicited time preferences by confronting participants with two options of payoffs: option *I* with an earlier yet smaller payoff, or option *II* with a later-but higher payoff. In our design, the option *I* was a payoff in a week for which the payoff amount was fixed. For the CW-task the payoffs in option *I* were 120 Indian Rupee (INR) and 50,000 Indonesian Rupiah (IDR); for Indian and Indonesian participants, respectively[2]. Option *II* included a payoff in three months, where the amount of payoffs changed based on an annual interest rate as presented in Table 3. In the ten rows of the CW-task, the annual interest rate was ranging from 10% to 100%. The CW-value was determined on the row where the participants switched from option *I* to option *II* for the first time, under the assumption of risk neutrality. This value was then used to obtain the range of the discount rate (δ) incorporated with the risk aversion coefficient (θ). The payoff of option *I* was delayed for one week for two reasons. First, the delay for both payoffs mitigated the immediate temptation, and thus, the participant should deal with the ascertained risk of both options that are given in the future (Andersen *et al*., 2008). Secondly, we needed to arrange a local shop for organising the transfer of mobile recharge and exchanging the shopping vouchers. To determine the real monetary incentives for the CW-task; one of the rows were selected at random. To randomly select the row, the participants in India threw a ten-sided die or randomly drew one ten-numbered coins in Indonesia. On the selected row, the participants received the payout according to his/her choice in the particular row.

Table 3. Matrix payoff of CW- task

Row	*India*[a]			*Indonesia*[b]		
	Option I (in one week)	***Choice***	***Option II (in three months)***	***Option I (in one week)***	***Choice***	***Option II (in three months)***
1	120	…	123	50,000	…	51,300
2	120	…	126	50,000	…	52,500
3	120	…	129	50,000	…	53,800
4	120	…	132	50,000	…	55,200
5	120	…	135	50,000	…	56,500
6	120	…	138	50,000	…	57,900
7	120	…	141	50,000	…	59,300
8	120	…	144	50,000	…	60,700
9	120	…	147	50,000	…	62,000
10	120	…	150	50,000	…	63,600

Notes: [a]The amount of payoffs is in India Rupee (INR), 1$ is equal to 68.030 INR; [b]The amount of payoffs is in Indonesian Rupiah (IDR), 1$ is equal to 13,300 IDR.

3.2. Joint estimation of risk and time preferences using the maximum likelihood estimation

Following Andersen *et al*. (2008), a power risk utility function with constant relative risk aversion (CRRA) as assumed:

$$U(X) = \frac{X^{1-\theta}}{1-\theta} \qquad (1)$$

[2] Per one US$ was approximately equal to 68.03 INR or 13,300 IDR. The amount of baseline payoff was daily wage of non-skilled labour in rural area, indicating that these values were not trivial amount of money.

Where U is utility, X is payoffs in the HL-task, and θ is the CRRA coefficient[3]. Each pair of lotteries in the HL-task consisted of a high payoff (h) with the respective probabilities (p_i) as presented in Table 2. The respective probability of low payoff (l) is $1 - p_i$. The expected utility (EU) of option A in row i of the paired lotteries of the HL-task was formulated as (Andersen *et al.*, 2008):

$$EU_{Ai} = p_i \cdot U(X_{Ah}) + (1 - p_i) \cdot U(X_{Al}) \quad (2)$$

and option B

$$EU_{Bi} = p_i \cdot U(X_{Bh}) + (1 - p_i) \cdot U(X_{Bl}) \quad (3)$$

Holt and Laury (2002) introduced a noise parameter (μ) based on Luce's error (Luce, 1959) to allow randomness of choice during the experiment. The probability to choose option A or B in row i of the HL-task is Pr_i^{HL}, thus the probability of choosing option A was (Holt and Laury, 2002):

$$Pr_i^{HL}(A_i) = \frac{EU_{A_i}^{\frac{1}{\mu}}}{EU_{A_i}^{\frac{1}{\mu}} + EU_{B_i}^{\frac{1}{\mu}}} \quad (4)$$

The probability to choose option B was similar to the equation (4). If y is participants' decision in row i, then $y_i = A$ if the participants choose option A. If the participants choose option B, $y_i = B$. The log-likelihood estimated the average of the risk preferences from the sample, where the participants were treated as homogeneous in their preferences (Liebenehm and Waibel, 2014). Moreover, the log-likelihood also involved the socioeconomic and demographic variables. If we denoted the socioeconomic and demographic variables as Z in the estimation, then the log-likelihood is (Andersen *et al.*, 2008):

$$\ln L^{HL}(\theta, \mu; y, Z) = \sum_i ((\ln(Pr_i^{HL}(A)) | y_i = A) + (\ln\left(1 - Pr_i^{HL}(A)\right) | y_i = B)) \quad (5)$$

For the CW-task, the payoff of option I, M_I, in time $t = 7$ days, and the payoff of option II, M_{II}, in time $t + \tau$ (where τ is the time differences between the timeline of option I and option II). Following the joint-estimation-method by Andersen *et al.* (2008), the risk preference coefficients was included in the estimation. With the involvement of participants' risk aversion, the Present Value (PV) of option I and option II in row i of CW-task are (Andersen *et al.*, 2008):

$$PV_{I_i} = \left(\frac{1}{1+\delta}\right)^t \cdot \frac{{M_I}^{1-\theta}}{1-\theta} \quad (6)$$

and

$$PV_{II_i} = \left(\frac{1}{1+\delta}\right)^{t+\tau} \cdot \frac{{M_{II}}^{1-\theta}}{1-\theta} \quad (7)$$

The probability to choose option I or II in the row i of CW-task was denoted as Pr_i^{CW} and the noise parameter of the time preferences is ϑ. Hence, the probability of a participant who choose option I in row i was defined as (Andersen *et al.*, 2008):

[3] Andersen *et al.* (2008) added background consumption (ω) to define the utility but assumed ω was equal to zero. Therefore, in our estimation, we also assumed that ω is zero.

$$Pr_i^{CW}(I) = \frac{PV_{I_i}^{\frac{1}{\vartheta}}}{PV_{I_i}^{\frac{1}{\vartheta}} + PV_{II_i}^{\frac{1}{\vartheta}}} \quad (8)$$

We denoted w for the participants' decision in row i, then $w_i = I$ if participants chose option I and, $w_i = II$ if choose option II. Following Andersen *et al.* (2008), the θ were incorporated to the log-likelihood while estimating the discount rate. Furthermore, similar to the estimation of risk preferences in equation (5), we also included the variables of socioeconomic and demographic (Z) in the estimation of discount rate. Thus, the log-likelihood equation for the discount rate was formulated as (Andersen *et al.*, 2008):

$$\ln L^{CW}(\delta, \theta, \mu, \vartheta; w, Z) = \sum_i ((\ln(Pr_i^{CW}(I)|w_i = I) + (\ln\left(1 - Pr_i^{CW}(I)\right) | w_i = II)) \quad (9)$$

4. RESULTS AND DISCUSSION

The risk and time preferences were estimated simultaneously without the socioeconomic and demographic information. The results are presented in Table 4. To interpret the estimated CRRA coefficient, there are three classifications: i1) the value of θ is not statistically significantly different from zero, then the individuals are risk-neutral, on average; 2) a statistically significant negative value of θ indicates risk-loving; 3) a statistically significant positive value implies risk-averse individuals.

Table 4. Joint estimation of risk and time preference of farmers in India and Indonesia[a]

	India[b]				*Indonesia*[c]			
	Coefficient	*Robust standard error*	*95% confidence interval*		*Coefficient*	*Robust standard error*	*95% confidence interval*	
			Lower	*Upper*			*Lower*	*Upper*
θ	0.17 ***	0.02	0.13	0.22	0.10 ***	0.02	0.07	0.13
δ	1.90 ***	0.14	1.62	2.19	2.71 ***	0.25	2.22	3.20

Notes: [a]Significance levels: *** at 1%, ** at 5%, * at 10%; [b]Number of observations = 15,440 (number of clusters = 772); [c]Number of observations = 15,120 (number of clusters = 756)

The risk aversion coefficient θ of the Indian farmers was on average 0.174, while the θ of the Indonesian farmers was on average 0.103. In both cases the estimated θ were positive and statistically significant different from zero, this thereby indicated slightly-risk-averse individuals based on the Holt and Laury classification (Holt and Laury, 2002). The estimated risk preference coefficients of farmers in our sample were lower compared to farmers in two LIC, *i.e.,* Burkina Faso and Mali in the study by Liebenehm and Waibel (2014). We found that the farmers in both countries were slightly-risk-averse, on average. Earlier, Binswanger (1981) concluded that Indian farmers were risk-averse individuals, on average. In their study, Skidmore *et al.* (2014) mentioned that the number of safe choices selected in the HL-task involving Indonesian farmers was 5.03, on average. Their finding indicated that the Indonesian farmers were on average slightly-risk-averse (Holt and Laury, 2002).

The estimated θ of the farmers in India was higher than in Indonesia, indicating higher level of risk aversion. We could compare the estimates of θ between the two groups of samples. To do so, first, one determined whether the lower and upper boundaries of the 95% confidence interval from both countries overlap (*e.g.,* Hermann and Musshoff, 2016). The upper level of the 95% confidence interval of θ of Indonesian participants (0.132) is slightly overlapping with the lower level of estimated θ for Indian participants (0.133). The θ is only slightly overlapping

with the upper or lower boundaries. To make sure there was difference, we examined the coefficients using the t-test. Thus, we carried out a t-test for two independent samples because we have the average estimated θ from Indian farmers and the estimated θ from Indonesian farmers. The p-value is 0.006 showing that the estimated θ from both samples are statistically different. Therefore, it can be concluded that farmers of our sample in India were more risk-averse than the farmers in Indonesia, on average.

Furthermore, the discount rates of the participants are presented in the value of estimated δ in Table 4. The estimated δ of farmers in India was 1.904, indicating a discount rate of 190% in annual term. While in comparison, the discount rate of farmers in Indonesia is 270% in annual term, on average. Similarly, to the procedure in the investigation of risk preference, we checked whether the upper and lower boundaries of the 95% confidence interval were overlapping and carried out a t-test to further examine the difference of discount rates between the two groups. The upper boundaries of the estimated δ of Indian farmers (2.186) intersected with the lower boundaries of the Indonesian (2.261). The result of the t-test (p-value = 0.005) showed that the discount rates of the farmers in both countries were statistically significantly different. This demonstrated that the discount rate of Indian farmers in our sample were lower than Indonesian farmers.

Utilising laboratory experiment by involving students in United States of America (USA), Coller and Williams (1999) found participants' discount rates are in the range of 17.5 – 20% annually. Conducting a study in Germany, Hermann and Musshoff (2016) found annual discount rates within the interval of 7.3 – 14.7% for students, and 8.8 – 12.9% for farmers, depending on the magnitude of baseline payoffs in the CW-task. Compared to those findings, the estimated annual discount rates of 190% and 270% in our samples are very high. However, compared to USA and Germany, India and Indonesia were much less developed countries and the discount rates in developing countries are higher compared to developed countries, on average (Poulos and Whittington, 2000). Involving Indian sample, Atmadja *et al.* (2017) also encountered very high discount rate, *i.e.*, 16.7% monthly. Furthermore, we attempted to dismiss possible methodological issues in the estimation by implementing two methodical approaches mitigating overestimated discount rates were applied. Firstly, the risk preferences were incorporated to estimate the discount rates. The joint estimation of the risk and time preferences resulted to lower discount rate (*e.g.,* Andersen *et al*., 2008; Sauter and Mußhoff, 2018). Secondly, we did not apply a very high upper border of interest rates in the CW-task. The highest interest rates range was 100%. In this circumstance, the very high estimated discount rate was not a consequence from utilising too high interest rate in the CW-task. Accordingly, these results were plausible even though the estimated discount rates were high. High discount rates within the context of developing countries were often revealed in the literature (Holden *et al.,* 1998). Therefore, the policymakers and farmers must deal with these high discount rates which imply wide-ranging impatience causing poverty and a lack of ability to maximise returns from the business. Many types of new technologies support development of rural areas such as contract farming, conservation and sustainable agriculture; offer long-terms benefits (Lee, 2005). If these benefits are offered too far in the future (*i.e.,* over the short horisons of the farmers future planning), then the adoption of the new technologies will be low (Stevenson *et al.,* 2014).

From the estimations of the risk preference coefficients and discount rate, we encountered that the farmers in India were more risk-averse with a lower discount rate compared to the farmers in Indonesia. To check the robustness of these findings, we utilised a dummy variable to indicate the effect of country to the estimated outcomes. Therefore, we pooled the samples from the two groups and created a dummy variable so-called "country", where 1 = India and 0 = Indonesia. Moreover, we involved participants' socioeconomic and demographic in this model to see their interaction with the preferences. The outcomes of the estimation are

presented in Table 5. Regarding risk preference, the variable country has a positive value and is statistically significant at the 1% level. This shows that the level of risk aversion is higher in India. Moreover, the variable country is also statistically significant for the discount rate at 1% level with a negative value. This implied that the discount rate was lower for farmers in India. Accordingly, these findings confirm that our results were robust.

Table 5. Model estimates of risk and time preferences with participants' socioeconomic and demographic[a]

Variable (unit)	*Risk preferences*[b]	*p-value*	*Time preferences*[b]	*p-value*
	Estimate (st. error)		*Estimate (st. error)*	
Country (1 = India)	0.12(0.03)	0.00 ***	-0.38(0.114)	0.00 ***
Age (years)	0.00(0.00)	0.01 ***	-0.01(0.00)	0.15
Education (years)	-0.02(0.00)	0.00 ***	0.03(0.01)	0.01 **
Full-time farmer (1 = ≥ 50% income from farming)	0.02(0.03)	0.49	0.17(0.13)	0.16
Gender (1 = male /0)	-0.03(0.04)	0.52	0.26(0.13)	0.06*
Household size (number)	-0.00(0.03)	0.58	0.00(0.03)	0.02**
Loan formal (1 = has loan from formal institutions)	-0.05(0.02)	0.04 **	0.14(0.10)	0.15
Loan informal (1 = has loan from informal institutions)	0.07(0.05)	0.15	0.16(0.15)	0.29

Notes: [a]Significance levels: *** at 1%, ** at 5%, * at 10%; [b]Number of observations = 15,440 (number of clusters = 772); [c]Number of observations = 15,120 (number of clusters = 756)

Furthermore, the results of estimation of the preferences involving socioeconomic and demographic of the farmers were presented in Table 5. From this estimation, we found that the variables age, education and loan from formal institutions statistically significantly correlated with risk preferences. Older participants seem to have a higher level of risk aversion, which is consistent with the findings of previous studies (*e.g.,* Liebenehm and Waibel, 2014; Tanaka *et al*., 2010). Regarding education, the literature found various effects of education on risk preferences. For example, Ihli *et al.* (2016) and Liebenehm and Waibel (2014) found that education is responsible to the lower level of risk aversion while Harrison *et al.* (2009) mention that education increases the risk aversion. Our estimation showed that education of farmers in India and Indonesia was associated with a lower level of risk aversion and is consistent with the research findings of Ihli *et al.* (2016) and Liebenehm and Waibel (2014). A higher level of education helped farmers to think more rationally and obtain more information, which encourages them to face risks. Finally, having a loan from a formal institution decreases the level of risk aversion. Loans may help the farmers to cope with risks and therefore this variable has a negative estimate.

The variables education, gender and household size are statistically significant and positively connected with the discount rate. The previous literature provided mixed conclusions on the effect of education on discount rates. Bauer and Chytilová (2013) found that a higher level of education decreased the discount rate, however, Sauter and Mußhoff (2018) did not find any correlation between education and discount rate. Furthermore, while Harrison *et al.* (2002) found that although the levels of education varied, the surveyed participants exhibited a low discount rate. Our results showed that farmers in India and Indonesia with higher levels of education have higher discount rates. Male participants also have higher discount rates, which is consistent with previous literature by Bauer and Chytilová (2013). Finally, we found positive correlation between household size and discount rate, indicating that as household size increases, so does the discount rate. Studies show that larger household size places higher

pressure on finances, and accordingly, the discount rate is also higher (*e.g.,* Harrison *et al.,* 2002; Liebenehm and Waibel, 2014; Tanaka *et al*., 2010).

5. CONCLUSION

This paper aimed to compare the risk and time preferences of farmers using cross country datasets from two lower-middle income countries. The study included observations from a sample of 1,528 farmers from both India and Indonesia to estimate the risk and time preferences simultaneously based on Andersen *et al.* (2008). The data revealed that Indian farmers are, on average, more risk-averse than farmers in Indonesia. However, the participants in these two LMICs showed a lower level of risk aversion compared to the farmers in LIC, such as Burkina Faso and Mali, in Liebenehm and Waibel (2014). A high level of risk aversion would be of concern for the policymakers as it potentially hinders farmers adoption of new technologies (Lee, 2005; Ortiz-Ferrara *et al.,* 2007). However, in the two countries of our study, the various governmental' projects, with various types of risks factors, should mildly inhibit the participation and/or adoption of farmers to new technologies or changes in economic situations.

Moreover, we found that the discount rates of Indian farmers were lower than the farmers in Indonesia, on average. However, the measured discount rates in these two countries were very high and thus, can potentially hinder the farmers involved in any long-term investments (Bauer and Chytilová., 2010). For example, potentially low participation of farmers in some agricultural programs such as contract farming and sustainable agriculture, which have only long-term benefits may be unsuccessful (Stevenson *et al.,* 2014). To overcome this problem, policymakers could consider providing economic incentives such as subsidies or cash payments (Barrett *et al.,* 2012, Lee, 2005). Another possible policy recommendation is to increase the income levels of rural areas. Tanaka *et al.* (2010) found that income levels in rural areas were correlated with lower discount rates of the people living there. Thus, the government can attempt to increase the income of rural areas through public investment. For example, in China, the public investments were successful in improving income of rural areas through the establishment of infrastructure, facilities and several programs of human development (Park, and Wang, 2010). Finally, future research could extend this study by investigating farmers' risk and time preferences in other LMICs in order to establish generality of our results. Indeed, it would also be of interest to extend this study by establishing a panel dataset of risk and time preferences from both countries. These panel data could be utilised to investigate whether risk and time preferences are changing over time using a cross-country dataset.

REFERENCES

Anderhub V, Güth W, Gneezy U, Sonsino D. 2001. On the interaction of risk and time preferences: An experimental study. *German Economic Review* **2**(3): 239-253. https://doi.org/10.1111/1468-0475.00036.

Andersen S, Harrison GW, Lau MI, Rutström EE. 2008. Eliciting risk and time preference. *Econometrica* **76**(3): 583-618. https://doi.org/10.1111/j.1468-0262.2008.00848.x.

Atmadja SS, Sills EO, Pattanayak SK, Yang JC, Patil S. (2017). Explaining environmental health behaviors: evidence from rural India on the influence of discount rates. *Environment and Development Economics* **22**(3), 229-248. https://doi.org/10.1017/S1355770X17000018

Barrett CB, Bachke ME, Bellemare MF, Michelson HC, Narayanan S, Walker TF. 2012. Smallholder participation in contract farming: comparative evidence from five countries. *World Development* **40**(4): 715-730. https://doi.org/10.1016/j.worlddev.2011.09.006.

Bauer M, Chytilová J. 2010. The impact of education on subjective discount rate in Ugandan villages. *Economic development and cultural change* **58**(4): 643-669. https://doi.org/10.1086/652475.

Bauer M, Chytilová J. 2013. Women, Children and Patience: Experimental Evidence from Indian Villages. *Review of Development Economics* **17**(4): 662-675. https://doi.org/10.1111/rode.12057.

Bauer M, Chytilová J, Morduch J. 2012. Behavioral foundations of microcredit: Experimental and survey evidence from rural India. *American Economic Review* **102**(2): 1118-1139. https://doi.org/10.1257/aer.102.2.1118.

Bharath HA, Chandan MC, Vinay S, Ramachandra TV. 2018. Modelling urban dynamics in rapidly urbanising Indian cities. *The Egyptian Journal of Remote Sensing and Space Science* **21**(3): 201-210. https://doi.org/10.1016/j.ejrs.2017.08.002.

Binswanger HP. 1981. Attitudes toward risk: Theoretical implications of an experiment in rural India. *The Economic Journal* **91**(364): 867-890. https://www.jstor.org/stable/2232497.

Charness G, Gneezy U, Imas A. 2013. Experimental methods: Eliciting risk preferences. *Journal of Economic Behavior & Organization* **87**: 43-51. https://doi.org/10.1016/j.jebo.2012.12.023.

Coller M, Williams MB. 1999. Eliciting individual discount rates. *Experimental Economics* **2**(2): 107-127. https://doi.org/10.1007/bf01673482.

Fafchamps, M. 2003. *Rural poverty, risk and development*. Edward Elgar Publishing Limited, United Kingdom.

Harrison GW, Humphrey SJ, Verschoor A. 2009. Choice under uncertainty: evidence from Ethiopia, India and Uganda. *The Economic Journal* **120**(543): 80-104. https://doi.org/10.1111/j.1468-0297.2009.02303.x.

Harrison GW, Lau MI, Rutström EE, Sullivan MB. 2005. Eliciting risk and time preferences using field experiments: Some methodological issues. *Field experiments in economics* **10**: 125-218. https://doi.org/10.1016/s0193-2306(04)10005-7.

Harrison GW, Lau MI, Williams MB. 2002. Estimating individual discount rates in Denmark: A field experiment. *American economic review* **92**(5): 1606-1617. https://doi.org/10.1257/000282802762024674.

Hermann, D., Musshoff, O. 2016. Measuring time preferences: Comparing methods and evaluating the magnitude effect. *Journal of Behavioral and Experimental Economics* **65:**16-26. https://doi.org/10.1016/j.socec.2016.09.003

Hertwig R, Ortmann A. 2001. Experimental practices in economics: A methodological challenge for psychologists? *Behavioral and Brain Sciences* **24**: 383-451.

Holt CA, Laury SK. 2002. Risk aversion and incentive effects. *American Economic Review* **92**(5): 1644-1655. https://doi.org/10.1257/000282802762024700

Holden ST, Shiferaw B, Wik M. 1998. Poverty, market imperfections and time preferences: of relevance for environmental policy? *Environment and Development Economics* **3**(1): 105-130. https://doi.org/10.1017/s1355770x98000060.

Ihli HJ, Chiputwa B, Musshoff O. 2016. Do changing probabilities or payoffs in lottery-choice experiments affect risk preference outcomes? Evidence from rural Uganda. *Journal of Agricultural and Resource Economics* **41**: 324-345.

Jin J, Wang W, Wang X. 2016. Farmers' risk preferences and agricultural weather index insurance uptake in rural China. *International Journal of Disaster Risk Science* **7**(4): 366-373. https://doi.org/10.1007/s13753-016-0108-3

Knight J, Weir S, Woldehanna T. 2003. The role of education in facilitating risk-taking and innovation in agriculture. *The Journal of Development Studies* **39**(6): 1-22. https://doi.org/10.1080/00220380312331293567.

Laury SK, McInnes MM, Swarthout JT. 2012. Avoiding the curves: Direct elicitation of time preferences. *Journal of Risk and Uncertainty* **44**(3): 181-217. https://doi.org/10.1007/s11166-012-9144-6.

Lee, D. R. 2005. Agricultural sustainability and technology adoption: Issues and policies for developing countries. *American journal of agricultural economics* **87**(5): 1325-1334. https://doi.org/10.1111/j.1467-8276.2005.00826.x.

Liebenehm S, Waibel H. 2014. Simultaneous estimation of risk and time preferences among small-scale cattle farmers in West Africa. *American Journal of Agricultural Economics* **96**(5): 1420-1438. https://doi.org/10.1093/ajae/aau056.

Luce, R.D. 1959. *Individual choice behavior: A theoretical analysis.* Wiley, United States of America.

Park A, Wang S. 2010. Community-based development and poverty alleviation: an evaluation of China's poor village investment program. *Journal of Public Economics* **94**(9-10): 790-799. https://doi.org/10.1016/j.jpubeco.2010.06.005.

Poulos C, Whittington D. 2000. Time preferences for life-saving programs: evidence from six less developed countries. *Environ. Sci. Technol.* **34**(8): 1445-1455. https://doi.org/10.1021/es990730a

McIntosh C, Sarris A, Papadopoulos F. 2013. Productivity, credit, risk, and the demand for weather index insurance in smallholder agriculture in Ethiopia. *Agricultural Economics* **44**(4-5): 399-417. https://doi.org/10.1111/agec.12024.

Nguyen, Q. 2011. Does nurture matter: Theory and experimental investigation on the effect of working environment on risk and time preferences. *Journal of Risk and Uncertainty* **43**(3): 245-270. https://doi.org/10.1007/s11166-011-9130-4.

Ngwira AR, Thierfelder C, Eash N, Lambert DM. 2013. Risk and maize-based cropping systems for smallholder Malawi farmers using conservation agriculture technologies. *Experimental Agriculture* **49**(4): 483-503. https://doi.org/10.1017/s0014479713000306.

Ortiz-Ferrara G, Joshi AK, Chand R, Bhatta MR, Mudwari A, Thapa DB, Suwan MA, Saikia TP, Chatrath R, Witcombe JR, Virk DS, Sharma RC. 2007. Partnering with farmers to accelerate adoption of new technologies in South Asia to improve wheat productivity. *Euphytica* **157**(3): 399-407. https://doi.org/10.1007/s10681-007-9353-2.

Ramachandra TV, Bharath AH, Sowmyashree MV. 2015. Monitoring urbanization and its implications in a mega city from space: Spatiotemporal patterns and its indicators. *Journal of environmental management* **148**: 67-81. https://doi.org/10.1016/j.jenvman.2014.02.015.

Sauter PA, Mußhoff O. 2018. What is your discount rate? Experimental evidence of foresters' risk and time preferences. *Annals of Forest Science* **75**(1): 10. https://doi.org/10.1007/s13595-017-0683-5.

Skidmore S, Santos P, Leimona B. 2014. Targeting REDD+: an empirical analysis of carbon sequestration in Indonesia. *World Development*, **64**(), 781-790. https://doi.org/10.1016/j.worlddev.2014.07.013

Stevenson JR, Serraj R, Cassman KG. 2014. Evaluating conservation agriculture for small-scale farmers in Sub-Saharan Africa and South Asia. *Agriculture, Ecosystem and Environment* **187**: 1-10. https://doi.org/10.1016/j.agee.2014.01.018.

Tanaka T, Camerer CF, Nguyen Q. 2010. Risk and time preferences: Linking experimental and household survey data from Vietnam. *American Economic Review* **100**(1): 557-71. https://doi.org/10.1257/aer.100.1.557.

Wang M, Rieger MO, Hens T. 2016. How time preferences differ: Evidence from 53 countries. *Journal of Economic Psychology* **52**: 115-135. https://doi.org/10.1016/j.joep.2015.12.001.

World Bank. 2017. GDP per capita. Accessed on 12.04.2019. Available at: https://data.worldbank.org/indicator/

World Bank. 2018a. Population. Accessed on 30.04.2018. Available at: https://data.worldbank.org/indicator/

World Bank. 2018b. Urban population. Accessed on 30.08.2018. Available at: https://data.worldbank.org/indicator/

Zhu J, Simarmata HA. 2015. Formal land rights versus informal land rights: Governance for sustainable urbanization in the Jakarta metropolitan region, Indonesia. *Land Use Policy* **43**: 63-73. https://doi.org/10.1016/j.landusepol.2014.10.016.