KOCHI UNIVERSITY OF TECHNOLOGY

Social Design Engineering Series *SDES-2018-1*

Time preferences between individuals and groups in the transition from hunter-gatherer to industrial societies

Yayan Hernuryadin
School of Economics and Management, Kochi University of Technology
Ministry of Marine Affairs and Fisheries, Republic of Indonesia

Koji Kotani
School of Economics and Management, Kochi University of Technology
Research Institute for Future Design, Kochi University of Technology

Yoshio Kamijo
School of Economics and Management, Kochi University of Technology
Research Institute for Future Design, Kochi University of Technology

4th June, 2018

School of Economics and Management
Research Institute for Future Design
Kochi University of Technology

Time preferences between individuals and groups in the transition from hunter-gatherer to industrial societies

Yayan Hernuryadin[*,†] Koji Kotani[*,‡,§,¶,‖] Yoshio Kamijo[*,‡]

June 2, 2018

Abstract

Three societies of the hunter-gatherer, the agrarian and the industrial represent the course of human history for cultural and economic development. In this course, each society exhibits distinct cultures and daily life practices that shape human behaviors and preferences, characterizing temporal actions and consequences at individual and group levels. We examine individual and group time preferences as well as their relation across the three societies. To this end, we conduct a field experiment of eliciting individual and group discount factors in the societies of Indonesia: (i) the fisheries, (ii) the farming and (iii) the urban ones as a proxy of the hunter-gatherer, the agrarian and the industrial, respectively. We find that both individual and group discount factors are the lowest (highest) in the fisheries (agrarian) society among the three, while those in the urban are in the middle. We identify that the determinants of group discount factors differ across societies; members of the lowest and middle discount factors in a group play an important role in forming a group discount factor in fisheries societies, while only the member with the middle discount factor is a key in agrarian and urban societies. Overall, our results suggest that individual and group discount factors non-monotonically change as societies transition from fisheries to agrarian and from agrarian to urban ones, and comparatively shortsighted people (the lowest and middle) are more influential than farsighted people in forming group time preferences.

Key words: discount factors; individual and group time preferences; fisheries; farming; urban

[*]School of Economics and Management, Kochi University of Technology
[†]Ministry of Marine Affairs and Fisheries, Republic of Indonesia
[‡]Research Institute for Future Design, Kochi University of Technology
[§]Urban Institute, Kyusyu University
[¶]College of Business, Rikkyo University
[‖]Corresponding author, E-mail: kojikotani757@gmail.com

Contents

Nomenclature

BPS Badan Pusat Statistik

DKI Daerah Khusus Ibukota

SVO Social value orientation

1 Introduction

Three societies of the hunter-gatherer, the agrarian and the urban have shaped the course of human history through economic and cultural development (Massey, 2002). In this course, each society exhibits distinct cultures and daily life practices that characterize temporal actions and consequences at individual and group levels. Ma et al. (2015), Shahrier et al. (2016, 2017) and Timilsina et al. (2017) suggest that a transition of societies from the rural to the urban affects social preferences and behaviors. Moreover, such changes in preferences and behaviors are claimed to be

related to people's temporal actions and consequences at individual and group levels. For example, Indonesian fishermen work in a group to spot fishing grounds and catch fish in a competitive and harsh environment, farmers coordinate their efforts with other farmers for irrigation, planting, growing and harvesting in an uncertain climate condition, and urban people live or work in an environment which is surrounded by technologies and detached from nature. This paper addresses individual and group time preferences as well as their relation across different societies.

Several works have examined how sociodemographic and environment factors characterize time preferences (Harrison et al., 2002, Casse and Nielsen, 2005, Reimers et al., 2009, Tanaka et al., 2010, Nguyen, 2011, Duquette et al., 2011, Johnson and Saunders, 2014). Harrison et al. (2002), Reimers et al. (2009) and Tanaka et al. (2010) demonstrate that age, income and education are correlated with time preferences. Another group of researches show that individual time preferences are explained by environments and occupations. Nguyen (2011) presents that fishermen with experiences of participating in resource conservation programs are more future-oriented than those with other occupations. Johnson and Saunders (2014) demonstrate that divers are more future-oriented than fishermen since divers are required to be patient for maintaining healthy ocean for sustainability in their daily job. In addition, Casse and Nielsen (2005) and Duquette et al. (2011) examine farmers' time preferences, suggesting that farmers with more future-oriented preferences tend to adopt the best management practices in earlier stages or never perform slash-and-burn agriculture.

The relationships between individual and group time preferences have been studied by several researchers. Charlton et al. (2013), Denant-Boemont et al. (2017), Gillet et al. (2009) and Sutter (2007) show that people tend to be more impatient in individual decisions than in group ones. However, Yang and Carlsson (2016) find that individual decisions are not different with joint decisions in terms of time preferences. Another group of works such as Ito et al. (2011), Ma et al. (2015) and Osinski and Karbowski (2017) examine time preferences and social preferences, presenting that more patient subjects are likely to share payoffs with other people in a social-dilemma situation. Ambrus et al. (2015) and He and Villeval (2017) demonstrate that a "median" member

(who has a median social preference in a group) has a significant influence on group decisions since the highest and the lowest ones tend to be attracted to the median.

None of the past studies have addressed individual and group time preferences focusing on the transition of societies in cultural and economic development. We examine individual and group time preferences as well as their relation across the hunter-gatherer, agrarian and industrial societies reflecting the course of human history. To this end, we conduct a field experiment regarding individual and group discount factors for three societies of Indonesia: (i) the fisheries, (ii) the farming and (iii) the urban as a proxy of the hunter-gatherer, the agrarian and the industrial societies, respectively.[1] Our empirical analysis yields two main results. First, we find that both individual and group discount factors are the lowest (highest) in fisheries (agrarian) societies among the three, while those in urban ones are in the middle. Second, we also identify that the determinants of group discount factors differ across three societies; members with the lowest and middle discount factors in a group play an important role in making a group discount factor in fisheries societies, while only the member with the middle discount factor is a key in agrarian and urban societies. Overall, our results imply that individual and group discount factors non-monotonically shift as societies change from fisheries to agrarian and from agrarian to urban societies, and comparatively short-sighted people (the lowest and middle) are more influential than farsighted people in determining group time preferences.

2 Methods and materials

2.1 Study areas

The questionnaire surveys and experiments were conducted in Karawang and Jakarta with three different societies, fisheries and agrarian villages in Karawang and an urban city in Jakarta. Karawang regency is located in the north part of Jawa Barat Province. Karawang is located be-

[1] Barry et al. (1959) and Uskul et al. (2008) characterize fisheries societies as hunter-gatherer societies because of their daily life practices.

tween 107°2′ and 107°40′ east longitude, and 5°56′ and 6°34′ south latitude. The population in 2015 is 2 273 579 with its density of 1094 km^2 (BPS-Statistics of Karawang Regency, 2016), and 168 901 or 18.15 % of the working population work at agriculture and fishery sectors (Karawang Regency Government, 2015). Jakarta is the most densely populated and capital city in Indonesia where a majority of people engage in government, business and service sectors. It is located between 6°12′ south latitude and 106°48′ east longitude. The population in 2016 is 10 277 628 with its density of 15 517 km^2, and 3 136 531 or 64.51 % of the working population work as a regular employee in public and formal private sectors (BPS-Statistics of DKI Jakarta Province, 2017).

[Figure 1 about here.]

2.2 Experimental setup

2.2.1 A discounting elicitation experiment

Several studies elicit individual time preferences through a multiple-price list procedure (Coller and Williams, 1999, Harrison et al., 2002, Tanaka et al., 2010). The procedure normally requires subjects to provide bank account or to arrange another meeting for receiving experimental payments. However, this procedure is difficult to be implemented for fishermen, farmers and urban people in Indonesia due to environmental and traffic conditions. We observe that subjects in our pilot experiments have difficulty to follow a multiple-price procedure in previous studies since subjects's education is limited in fisheries and agrarian villages. Therefore, we employ a different experimental procedure to elicit individual time preferences in the fields, we call a discounting elicitation experiment.

We conduct the discounting elicitation experiments for each subject and a group of 3 subjects so that time preferences at both individual and group levels are estimated as individual and group discount factors, respectively. First, we elicit individual time preferences through the discounting elicitation experiment where subjects are asked to make a decision about whether to receive money today or to receive money in the future. As most subjects are not educated, have limited literacy

and cannot come back to the experimental field at specified time and date, we institute simple experiments our subjects can understand and the associated experimental payments can be received on the spot. The discounting elicitation experiment begins by asking a question of whether each subject chooses options A or B in the following manner:

Option A: You get 20000 Rp today.

Option B: You get $20000 + m$ Rp one month later.

The value of m in option B begins with $m_0 = 4000$. When the subject chooses option A, we proceed to the next question in which the value of m is added by 4000 for option B, i.e., $m = m_1 = m_0 + 1 \cdot 4000 = 4000 + 4000 = 8000$. Then, the subject is asked whether she prefers option A or B. As far as the subject keeps choosing option A, she proceeds to the next question where the value of m for option B is increased by 4000. This updating procedure for m in option B to be $m_k = 4000 + k \cdot 4000$ continues arbitrary k times as far as a subject prefers option A to B. Now, suppose that the subject chooses option B to A at the nth trial. Then, we end the updating process and ask the subject a series of questions to identify her threshold value of $\overline{m}$ between m_{n-1} and m_n to be indifferent from receiving 20 000 Rp today.

We paid each subject the experimental reward just after the experiment. For this, we prepare a lottery where 20 cards are red and $20 + \frac{\overline{m}}{1000}$ cards are yellow. When the subject picks a yellow card, she can get the reward of $20000 + \overline{m}$ Rp, otherwise zero. In other words, the lottery is considered to have the probability $\rho = \frac{20000}{20000+\overline{m}}$ of successfully getting the value of $20000 + \overline{m}$ Rp by picking a yellow card and the probability $1 - \rho$ of getting nothing by picking a red card. As most subjects in this research do not understand the concept of probabilities, the number of yellow and red cards are counted in front of each subject before inserting them into the bag. After seting up the number of cards in the bag, we request each subject to choose between surely receiving 20 000 Rp and going for the lottery to possibly get $20000 + \overline{m}$ Rp. A subject who chooses the lottery receives the payment according to the outcome of a random draw from the bag on the spot. A subject who does not choose the lottery gets 20 000 Rp. In preparing the lottery and asking each subject to choose

whether to go for the lottery or not, we also identify subjects' risk preferences such as risk-averse or risk-taking behaviors.

After finishing a discounting elicitation game at individual level, we proceed to the experiment at group level. We randomly choose 3 subjects and assign them as a group. We now implement the same procedures of asking a group of three people whether to choose option A or B as we did at individual level. The difference at group level is that the decision between options A and B at every trial and whether to go for the lottery or not must be discussed among group members. We ask group members to reach concensus through discussion for every group decision without relying on majority voting. After the group decisions between options A and B as well as whether to going for the lottery or not, the group members was asked to decide how to split the payment among the members in the same group.

2.2.2 Social value orientation games

We use a social value orientation (SVO) game suggested by Murphy et al. (2011) to measure subjects' social preferences. This method categorizes an individual value orientation into altruism, prosociality, individualism or competitiveness depending upon their choices in the SVO game. In this game, subjects are asked to choose among nine options in each of six primary questions (See figure 2). Subjects are randomly paired where the subjects do not know each other. Each question consists of a problem where a subject decide to allocate points to herself and to the other in her pair by choosing one among nine options. After each subject has made her choices in all of the six questions, she is asked to write the resulting distributions of money between oneself (you) and the other on the spaces provided on the right-hand side of the SVO instruction sheets (figure 2).

Subjects are informed that they get paid on the basis of their earnings from the SVO game in the following manner. The total amount of points a subject is allocated by herself and by the other in her pair are calculated by summing the points from all twelve items (six items from each person in a pair). The points are converted into real money with an experimental exchange rate. In our experiment, we use 1 points equivalent to 200 Rp. The average payment in the SVO game was

28 000 Rp (approximately 2.10 USD). After the game, we identify a subject's SVO by computing the mean allocations for oneself $\bar{A}_s$ and for the other $\bar{A}_o$, respectively, from her choices of six items. Then, 50 is subtracted from each of $\bar{A}_s$ and $\bar{A}_o$, and the inverse tangent of the ratio between $\bar{A}_s - 50$ and $\bar{A}_o - 50$ is calculated as her SVO angle, i.e., SVO $= \arctan \frac{\bar{A}_o - 50}{\bar{A}_s - 50}$. The subject can be identified as the altruist if her SVO angle is greater than $57.15°$, the prosocial if it is between $57.15°$ and $22.45°$, the individualist if it is between $22.45°$ and $-12.04°$, and the competitive if it is less than $-12.04°$.

[Figure 2 about here.]

2.3 Experimental procedures

We implemented field experiments and surveys by employing different approaches of random sampling to fisheries and agrarian societies in Karawang as well as urban societies in Jakarta because they have different economic and socio-demographic characteristics. In Karawang, we first contacted the local government office to get approval for conducting the field research where 3 fisheries and 9 agrarian villages approved us, respectively. We obtained a list of residents from their local government offices and randomly chose a required number of households based on the population of each village. Subsequently, we invited an income-earning member from each household to participate in our experiments by sending them invitation letters. In total, 200 fishermen and 197 farmers participated in our field research.

In Jakarta, we randomly chose subjects based on occupations. First, we collected information about a proportion of each occupational category in total population of the Jakarta areas by referring to BPS-Statistics of DKI (Daerah Khusus Ibukota) Jakarta Province. Hereafter, we randomly chose a number of organizations or companies for each category, and contacted their office to get approval for conducting our field research. We invited individuals from these companies and organizations based on their compliance. In total, 200 urban people participated in our field research, and the experiments were conducted at community halls in each area of Jakarta. Overall,

597 subjects participated in our experiment (197 farmers, 200 fishermen and 200 urban people). We asked each subject to leave the experimental site soon after completing all the tasks to prevent unnecessary interactions among subjects.

In each session of our field experiments, we prepared a printed experimental instruction (a discounting elicitation experiment and the SVO game) to subjects in the Indonesian language (Bahasa). Furthermore, we explained the experimental procedures and rules by verbal presentation and ensured that subject understood. We first conducted the SVO games and then proceed to discounting elicitation experiments at individual and group levels with questionnaires. To motivate subjects to seriously participate in our experiments, we stated that subjects would get paid with the real money based on their performances. Each subject earned the average experimental earnings from SVO games, discounting elicitation experiments and the participation fee was 90 000 Rp ($\approx$ 6.5 USD). Approximately, $15 \sim 20$ subjects participated in each session of our experiment and took $3 \sim 4$ hours.

2.4 Empirical method

We employ betafit regressions to identify factors that characterize group discount factors. The betafit models can be mathematically expressed as::

$$g_i = \beta_0 + \boldsymbol{\beta}_1 \mathbf{x}_i + \beta_2 z_i + \epsilon_i, \tag{1}$$

where subscript i represents each group's ID, g_i is a group discount factor estimated, $\mathbf{x}_i$ is a vector of independent variables of categories of individual discount factors (the lowest, middle, and highest), and sociodemographic information such as age, education, household income and a number of household members, and occupation dummy. In addition, since the SVOs is categorized as the altruist, the prosocial, the individualistic and the competitive, and only 18 samples or 3.01 % in our data are identified as the altruist and competitive. We merge the individualistic and competitive orientations into the "proself," and altruist and prosocial into the "prosocial" for simplicity of

analysis. Therefore, z_i is a dummy variable of SVOs that takes 1 when subject i is a proself and is otherwise 0. The β_0 ($\boldsymbol{\beta}_1$) and β_2 are the associated parameters (of vectors) to be estimated. Table 1 presents the definitions of the variables used in the regression analysis.

The betafit regression developed by Ferrari and Cribari-Neto (2004) accommodates a group discount factor that is bounded between 0 and 1 as a dependent variable with the assumption that group discount factors g_is follow a beta distribution:

$$f(g_i;\mu,\phi) = \frac{\Gamma(\phi)}{\Gamma\mu\phi\Gamma((1-\mu)\phi)} g_i^{\mu\phi-1}(1-g_i)^{(1-\mu)\phi-1}, \quad g_i \in (0,1),$$

where $\mathbb{E}(g_i) = \mu$, $\mathrm{Var}(g_i) = \frac{\mu(1-\mu)}{1+\phi}$, ϕ is an accuracy parameter and $\phi - 1$ is a distribution parameter. Various combinations of μ and ϕ determine types of beta densities such as J shaped, inverted J shaped and U shaped (Ferrari and Cribari-Neto, 2004). Application of betafit regressions appear to be valid because the distributions of group discount factors estimated in our experiments are identified to be U shaped and inverted J shaped (see figure 2(a) and figure 2(b)). The maximum likelihood method is used to recognize the unknown parameters $\beta_0, \boldsymbol{\beta}_1, \beta_2$ in equation (1) with which a marginal effect of an independent variable on the group discount factors, g_is is obtained.

[Table 1 about here.]

Table 1 presents the definition of the variables that are hypothesized to affect group discount factors. We rank individual discount factors of three subjects in a group into the lowest, the middle and the highest discount factors. A group discount factor is the elicited value of discounting the future value at group level, as described in section 2.2.1. We are interested in how individual discount factors and the associated rankings shall affect group discount factors. The average age, income, household members at group level are also considered to affect group time preferences, following Harrison et al. (2002) and Reimers et al. (2009). In addition, a number of proself members in a group are included in the models to capture how individual social preferences influence group time preferences. Finally, we define a dummy variable for agrarian and urban societies, resepectively, taking the reference group as the fishery society. We consider the dummy variables to see how a

transition of societies from the fisheries to the farming and from the farming to the urban may have affected individual and group time preferences as well as their relations.

3 Results

Table 2 provides the summary statistics of individual discount factors, group discount factors and other variables used in the analysis. The median individual (group) discount factors of fisheries, agrarian and urban societies are 0.100 (0.045), 0.500 (0.417) and 0.333 (0.278), respectively. These results reveal that both individual and group discount factors are the lowest in the fisheries society, and those in the agrarian society are higher than those in the urban society. In other words, both individual and group discount factors non-monotonically change as societies transition from fisheries to agrarian and from agrarian to urban ones. The result also shows that the overall median (average) of group discount factors is 0.111 (0.353), while the overall median (average) of individual discount factors is 0.317 (0.414). This result implies that group discount factors tend to be lower than individual discount discount factors. The median (average) group discount factors of group members with the lowest, middle and the highest are 0.040 (0.134), 0.100 (0.322) and 0.598 (0.556) in the fisheries society, 0.091 (0.184), 0.500 (0.505) and 0.909 (0.809) in the agrarian society, and 0.067 (0.154), 0.352 (0.397) and 0.727 (0.646) in the urban society, respectively. This reflects the fact that individual discount factors in the fisheries society are consistently the lowest for every rank of individual discount factors in a group (the lowest, middle and the highest group members).

Regarding age, the overall average age of the subjects is 43 years old. The average age of farmers is the oldest because farmers tend to work longer than fishermen and urban people. This finding can be seen in the "max" row under age in table 2 where the maximum age of farmers is 68 years old. Moreover, the average ages of fishermen and urban people are not significantly different from one another since fishermen need to work in a labor intensive manner and the urban society attracts young people from rural areas to seek better jobs and opportunities. Table 2 also shows

the median household income is the highest (3.300) in the urban, the second-highest (3.100) in the agrarian and the lowest (2.500) in the fisheries society. The income range is the widest in the urban society, which is consistent with the fact that the standard deviation (SD) of household income (2.773) in the urban is the highest among the three. This indicates that Jakarta is highly capitalistic to have high income gap. The average number of household members is the largest (4.875) in the urban, the second-largest (4.485) in the fisheries and the lowest (4.222) in the agrarian societies, respectively. This reflects the fact that that most of farmers' children do not live with their parents since they usually move to urban areas for better jobs and opportunities. In summary, individual and group discount factors in the fisheries society are consistently the lowest, and fishermen are relatively young and earn low income as compared with farmers and urban people.

[Table 2 about here.]

[Figure 3 about here.]

Figures 2(a) and 2(b) show the frequency distributions of the individual and group discount factors for fisheries, agrarian and urban societies, respectively. The vertical axis denotes the percentage of frequencies and the horizontal axis denotes the discount factor. Regarding individual discount factors, figure 2(a) demonstrates that the highest spike in the frequency distributions for the fisheries and urban societies occurs around 0, while the highest spike for the agrarian societies occurs around 1. On the other hand, figure 2(b) shows that the highest spike in the frequency distribution of group discount factors occurs around 0 for every society, while the spike in the fisheries society are higher than those in the agrarian and urban societies. These findings in the frequency distributions of individual and group discount factors across the three societies are in line with the summary statistics in table 2. On the basis of the summary statistics, figures 2(a) and 2(b), we run a Mann-Whitney test to examine whether the distributions of the individual and group discount factors for any pair of the fisheries, agrarian and urban societies are the same. The null hypothesis is that the distributions are independent of the three different societies. The results mostly reject

the null hypothesis for individual (group) discount factors at the 1 % (1 %), 5 % (1 %) and 5 % (18 %) significance levels for the fisheries vs. the agrarian, the fisheries vs. the agrarian and the agrarian vs. urban societies, respectively. Overall, the individual and group discount factors can be considered dependent on the three societies.

The summary statistics, frequency distributions and Mann-Whitney test suggest that individual and group discount factors vary among three societies. To further characterize the relationship between group and individual discount factors, we run betafit regressions together with other independent variables. Table 3 presents the marginal effects of independent variables on the group discount factors with several model specifications. Model 1 in table 3 is considered a baseline regression including all the independent variables except society dummy variables. The result shows that group members with the lowest discount factors, middle discount factors and the number of proself members exhibit statistical significances, playing important roles on forming group discount factors. In addition, a number of household members influences group discount factors to a certain extent. In particular, the results imply that a group discount factor decreases by 0.0185 (0.054) when the lowest (middle) individual discount factor in a group declines by 0.100. Likewise, a group discount factor decreases by 0.024 (0.036) together with an increase in a number of household members (in a number of prosocial members in a group).

[Table 3 about here.]

To check the robustness of our results, we include the agrarian and urban as dummy variables with the reference of the fisheries society as model 2 in addition to the baseline specification in model 1. Model 2 is estimated to examine how the transition of societies from the fisheries to the agrarian and from the agrarian to the urban may influence group time preferences. In model 2, the same qualitative results are observed as in model 1 even with society dummy variables of the agrarian and urban. The results in model 2 of table 3 also consistently present that a group discount factor decreases by 0.021 (0.054) when the lowest (middle) individual discount factor in a group declines by 0.100, respectively. An increase of a number of household members in a group might lead to a 0.025 decrease in a group discount factor. Furthermore, the society dummy variables

are identified to be significant in the sense that a group discount factor in the agrarian (the urban) is likely to be 0.096 (0.086) higher than that in the fisheries. This result shows that although we include societies dummy variables in regression, the lowest and middle discount factors of group members remain to affect group discount factors, and the types of societies characterize group time preferences, being consistent with Nguyen (2011) and Johnson and Saunders (2014).

We separately run regressions as models 3, 4 and 5 in table 3 for the fisheries, agrarian and urban societies, respectively, because we find that farmers and urban dummy variables are significant in model 2, enabling us to examine whether the determinants of group discount factors differ across the three societies. Model 3 in table 3 exhibits a qualitatively identical result with model 1 of the baseline specification, implying that a group discount factor decreases by 0.028 (0.056) in the fisheries society when when the lowest (middle) individual discount factor in a group declines by 0.100. On the other hand, the results in models 4 and 5 are similar in that the middle discount factor in a group is the only significant determinant. The result of model 4 in table 3 shows that a group discount factor decreases by 0.048 when the middle discount factor in a group declines by 0.100, and that an increase in a number of household members decreases a group discount factor by 0.055. Finally, model 5 demonstrates that a group discount factor decreases by 0.038 when the middle individual discount factor in a group declines by 0.100.

Overall, our statistical analysis demonstrates that individual and group discount factors in the fisheries (agrarian) society is the lowest (highest), while those in the urban society is the middle. Table 3 demonstrates that comparatively short-sighted people with the lowest and middle individual discount factors in a group remain consistently significant in both models 1 and 2, while the society dummy variables are statistically and economically significant in model 2. The fisheries society (model 3) exhibits the same qualitative result with models 1 and 2 of the baseline specification in that the lowest and middle individual discount factors that play significant roles in forming group discount factors. The agrarian and urban societies (models 4 and 5) consistently show that the middle individual discount factor is the only significant variable to characterize group discount factors. Although we have tried a variety of different regression specifications, our results in mod-

els 1-5 remain consistent and robust with respect to the roles of individual discount factors on group discount factors. Some socioeconomic variables and other factors such as age, a number of household members, a number of proself members in a group and so on are also identified to be statistically and economically significant depending on the specifications of betafit regressions.

There are some possible explanations for our findings with respect to the roles of individual discount factors in forming group discount factors. First, fishermen in our study region (Karawang) are known to catch fish and earn income on a daily basis. They typically spend all of their daily income within that day, and do not have motivations to save money for their future since they simply expect that they can go fishing the next day to generate money for living. Also, most fishermen in that region believe that fish stock is inexhaustible because God always provides fish in the sea (We find that 80.5 % of the fishermen believe so in our questionnaire survey). Therefore, the daily life practices, such belief about inexhaustible fish stock and their cultures shall nurture fishermen to be more shortsighted than farmers and urban people. This is in line with the argument in Johnson and Saunders (2014) demonstrating that fishermen are more shortsighted than divers since divers are required to be patient for maintaining healthy ocean and environment.

Fishermen in Karawang work in a fishing vessel as a group of 3 to 20 fishermen. In this environment, fishermen face two types of competitions: intra-vessel and inter-vessel competitions. In intra-vessel competitions, each fisherman in the same vessel has different kinds of tasks and job levels, competing each other to get promoted. On the one hand, inter-vessel competitions occur when a group of fishermen in a vessel compete with other groups in different vessels for better fishing spots and more harvests. Carpenter and Seki (2011) and Huang and Smith (2014) illustrate that groups of fishermen compete each other to catch more fish where the actions taken by groups of fishermen depend on other groups' actions. Because fishermen in our study region is under severe intra-vessel and inter-vessel competitions, they become familiar with being or tend to be shortsighted at individual and group levels in the way that comparatively short-sighted members in a group are more influential in forming a group discount factor.

Farmers in Karawang need to have patience and consideration for future in nature, because

farmers must wait six months for a series of cultivating and growing to harvest crops as one cycle. At the same time, they need to deal with huge uncertainty. The major sources of uncertainty for farmers are natural disasters since they can destroy all agricultural productions in the field. Although fishermen face the same type of risks and uncertainty that come from natural disasters, they can go to sea and fish within a few days after natural disasters. This is a fundamental difference between farmers and fishermen. In addition, farmers need to maintain their arable land for cultivating and harvesting since the land is on their own property. Therefore, farmers in Karawang are motivated to save, invest and accumulate capital and wealth by saving gold as a preparation for an uncertain future. These daily practices and cultures appear to induce farmers to be patient or farsighted. Farmers typically work as a group to coordinate their efforts for irrigation, planting, growing and harvesting to tackle uncertain climate conditions. For example, a group of farmers should cooperate, coordinate and wait based on an irrigation schedule for fairness, avoiding the shortage of water among other groups of farmers. In a nutshell, the aforementioned practices and cultures of the agrarian society in Karawang appear to induce farmers to be the most farsighted at individual and group levels.

Finally, urban people in Jakarta usually live or work in an environment which is surrounded by technologies and detached from nature. Urban people in Jakarta does not usually feel the limitation or constraints of basic needs on a daily basis such as food, electricity and water, while the fisheries and agrarian societies have some experiences of tackling nature and feeling the limitation of various resources. In urban life of Jakarta, rice, meat and fish can be readily available in supermarkets or department stores, and such stores usually never run short of any product because of national and international trades. In addition, by simply switching on a button, every energy source such as electricity becomes effective. This type of life implies that basic needs urban people may want to demand tends to be readily available or becomes effective soon after their requests, compared to fisheries and agrarian societies. On the other hand, urban people need to wait one month to get salaries, and also need to study and grow themselves to be capable and competitive in the workplace of urban life. Therefore, urban life comes with a mixture of being shortsighted on

the basic needs and being farsighted on their career for survival. Therefore, we conjecture that individual and group discount factors in urban societies are in the middle between fisheries and agrarian societies.

Another interesting finding is that comparatively shortsighted people (the lowest and middle) are more influential than farsighted people in forming group time preferences in models 1, 2 and 3. This result is in line with Ambrus et al. (2015) and He and Villeval (2017) to a certain extent that elicit individual and group social preferences based on gift exchange, ultimatum and modified dictator games by asking subjects to allocate the resources to themselves and others. In eliciting individual social preferences, each subject plays a series of the games indicated above. In eliciting group social preferences, a group of 5 members (Ambrus et al. (2015)) or 3 members (He and Villeval (2017)) is formed where each group member is ranked with respect to social preferences on the basis of his choices in individual games. Each group determines how to share resources between their groups and other groups. Ambrus et al. (2015) and He and Villeval (2017) find that a member with the median social preference in a group has a significant effect on group social preferences because the highest and lowest subjects in a group tend to get attracted to the median member. In our case, however, the lowest individual discount factor is identified to be significant, which is different from Ambrus et al. (2015) and He and Villeval (2017). It is early to conclude that the unique result in our analysis on group time preferences is generalized, however, at least, it may be the case that group time preferences are attracted to the relatively lower individual discount factors in a group.

In summary, our results reveal that individual and group discount factors non-monotonically change as societies transition following a course of human history through cultural and economic development. More specifically, both individual and group discount factors increase as societies transition from the fisheries to the agrarian, and then decrease as societies transition from the agrarian to the industrial in the way that individual and group discount factors are the lowest (highest) in the fisheries (agrarian) society, while those in the industrial one are in the middle. Our regression results also show that comparatively shortsighted people (the lowest and the middle) play important

roles in characterizing group time preferences. These results can be considered one of important evidence for the factors to influence resources sustainability and economic development processes in each type of societies as well as further evolution of human time preferences in the future.

4 Conclusion

Previous researches claim an importance to consider a transition of societies from the rural to the urban in order to analyze social preferences and behaviors, demonstrating that people in the urban societies are becoming more proself (Ma et al., 2015, Shahrier et al., 2016, 2017, Timilsina et al., 2017). This paper considers three societies of the fisheries, the farming and the urban as a proxy of the hunter-gatherer, the agrarian and the industrial, well representing the distinct cultures and daily practices that might shape human time preferences and behaviors. We have conducted a field experiment of eliciting individual and group discount factors in the three societies of Indonesia. We find that both individual and group discount factors are the lowest (highest) in the fisheries (agrarian) society among the three, while those in the urban are in the middle. We also identify that the determinants of group discount factors differ across the three societies; members of the lowest and middle discount factors in a group play crucial roles in forming a group discount factor in the fisheries society, while only the member with the middle discount factor is a key in agrarian and urban societies. Overall, our results suggest that individual and group discount factors non-monotonically change as societies transition from the fisheries to the agrarian and from the agrarian to the urban, and comparatively shortsighted people (the lowest and middle) are more influential than farsighted one in forming group time preferences.

We finally note some limitation and possibilities of future studies. In this research, statistical analysis is a main tool to characterize group time preferences through utilizing the ranking of individual discount factors in a group. However, we have not examined the details of how group members determine or agree on group discount factors through their discussions in our field experiments. If we use a qualitative-deliberative analysis in psychology on transcribed group discussions,

we should be able to identify how group members reach an agreement or compromise about group discount factors. If such analysis is successfully conducted, we should be able to further clarify the detailed dynamic process of how people with the lowest or the middle discount factors in a group influece group time preferences and to check the consistency with our statistical results. These caveats notwithstanding, it is our belief that this field experiment is an important first step to examine individual and group time preferences as well their relation. Our results indicate that individual and group time preferences as well as their determinants evolve as societies change.

5 Bibliography

Ambrus, A., Greiner, B., and Pathak, P. A. (2015). How individual preferences are aggregated in groups: An experimental study. *Journal of public economics*, 129:1–13.

Barry, H., Chid, I. L., and Bacon, M. K. (1959). Relation of child training to subsistence economy. *American anthropologist*, 61:51–63.

BPS-Statistics of DKI Jakarta Province (2017). Karawang regency in figures 2016. Technical report, BPS-Statistics of DKI Jakarta Province.

BPS-Statistics of Karawang Regency (2016). Karawang regency in figures 2016. Technical report, BPS-Statistics of Karawang Regency.

Carpenter, J. and Seki, E. (2011). Do social preferences increase productivity? Field experimental evidence from fishermen in Toyama bay. *Economic inquiry*, 49:612–630.

Casse, T. and Nielsen, U. (2005). Farmer strategies and forest conservation: A case study from south-western Madagascar. *International journal of social economics*, 32:704–716.

Charlton, S. R., Yi, R., Porter, C., Carter, A. E., Bickel, W., and Rachlin, H. (2013). Now for me, later for us? Effects of group context on temporal discounting. *Journal of behavioral decision making*, 26:118–127.

Coller, M. and Williams, M. B. (1999). Elicting individual discount rates. *Experimental economics*, 2:107–127.

Denant-Boemont, L., Diecidue, E., and l'Haridon, O. (2017). Patience and time consistency in collective decisions. *Experimental economics*, 20:181–208.

Duquette, E., Higgins, N., and Horowitz, J. (2011). Farmer discount rate: Experimental evidence. *American journal of agricultural economics*, 94:451–456.

Ferrari, S. L. P. and Cribari-Neto, F. (2004). Beta regression for modelling rates and proportions. *Journal of applied statistics*, 31:799–815.

Gillet, J., Schram, A., and Sonnemans, J. (2009). The tragedy of the commons revisited: The importance of group decision-making. *Journal of political economy*, 93:785–797.

Harrison, G. W., Lau, M. I., and Williams, M. B. (2002). Estimating individual discount rates in denmark: a field experiment. *American economic review*, 92:1606–1617.

He, H. and Villeval, M. C. (2017). Are group members less inequality averse than individual decision makers. *Journal of economic behavior and organization*, 138:111–124.

Huang, L. and Smith, M. D. (2014). The dynamic efficiency costs of common-pool resource exploitation. *American economic review*, 104:4071–4103.

Ito, M., Saeki, D., and Green, L. (2011). Sharing, discounting, and selfishness: An Japanese-American comparison. *Psychological record*, 61:59–75.

Johnson, A. E. and Saunders, D. K. (2014). Time preperences and the management of coral reef fisheries. *Ecological economics*, 100:130–139.

Karawang Regency Government (2015). Information on report performance of Karawang District Government 2015 (in Indonesia). Technical report, Karawang Regency Government.

Ma, Q., Pei, G., and Jin, J. (2015). What makes you generous? The influence of rural and urban rearing on social discounting in China. *PLoS ONE*, 10:e0133078.

Massey, D. S. (2002). A brief history of human society: The origin and role of emotion in social life. *American sociological review*, 67:1–29.

Murphy, R. O., Ackermann, K. A., and Handgraaf, M. J. J. (2011). Measuring social value. *Judgment and decision making*, 6:771–781.

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*, 43:245–270.

Osinski, J. and Karbowski, A. (2017). Delaying rewards has greater effect on altruism when the beneficiary is socially distant. *PLoS ONE*, 12:e0170387.

Reimers, S., Maylor, E. A., Stewart, N., and Chater, N. (2009). Associations between a one-shot delay discounting measure and age, income, education and real-world impulsive behavior. *Personality and individual differences*, 47:973–978.

Shahrier, S., Kotani, K., and Kakinaka, M. (2016). Social value orientation and capitalism in societies. *PLoS ONE*, 11:e0165067.

Shahrier, S., Kotani, K., and Saijo, T. (2017). Intergenerational sustainabilty dillemma and the degree of capitalism in societies: A field experiment. *Sustainability science*, 12:957–967.

Sutter, M. (2007). Are teams prone to myopic loss aversion? An experimental study on individual versus team investment behavior. *Economics letters*, 97:128–132.

Tanaka, T., Camerer, C. F., and Nguyen, Q. (2010). Risk and time preferences: Linking experimental and household survey data from vietnam. *American economic review*, 100:557–571.

Timilsina, R., Kotani, K., and Kamijo, Y. (2017). Sustainability of common pool resources. *PLoS ONE*, 12:e0170981.

Uskul, A. K., Kitayama, S., and Nisbett, R. E. (2008). Ecocultural basis of cognition: Farmers and fishermen are more holistic than herders. *Proceedings of the National Academy of Sciences of the United States of America*, 105:8553–8556.

Yang, X. and Carlsson, F. (2016). Influence and choice shifts in households: An experimental investigation. *Journal of economic psychology*, 53:54–66.

List of Figures

Figure 1: The study area: Karawang and Jakarta

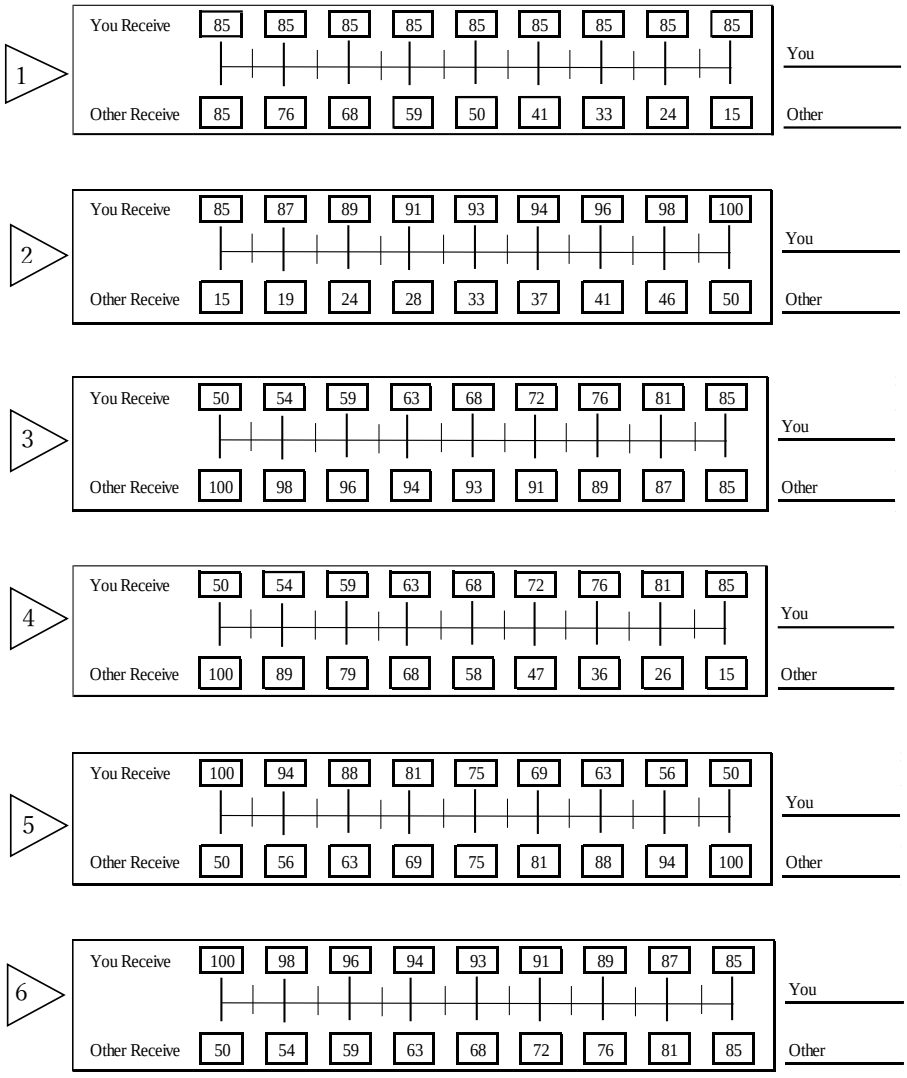
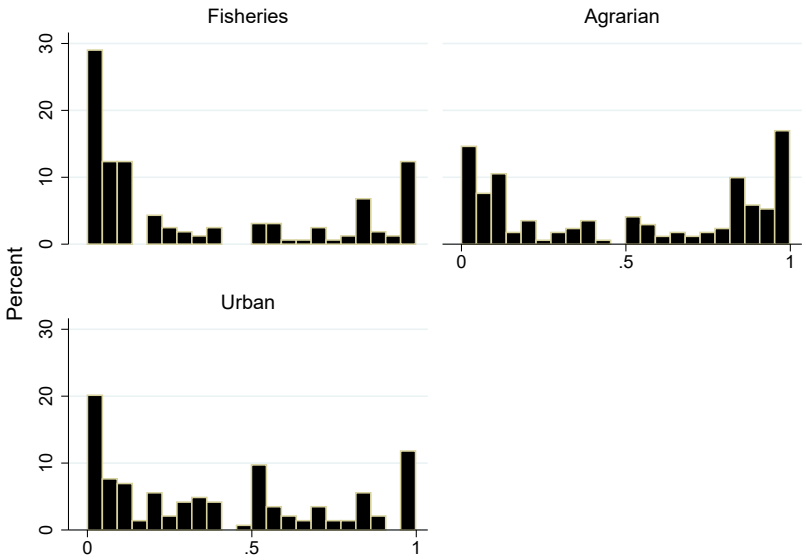


Figure 2: A social value orientation (SVO) game developed by Murphy et al. (2011)

(a) Frequency distributions of individual discount factors across the three societies of the fisheries, the agrarian and the urban



(b) Frequency distributions of group discount factors across the three societies of the fisheries, the agrarian and the urban 2

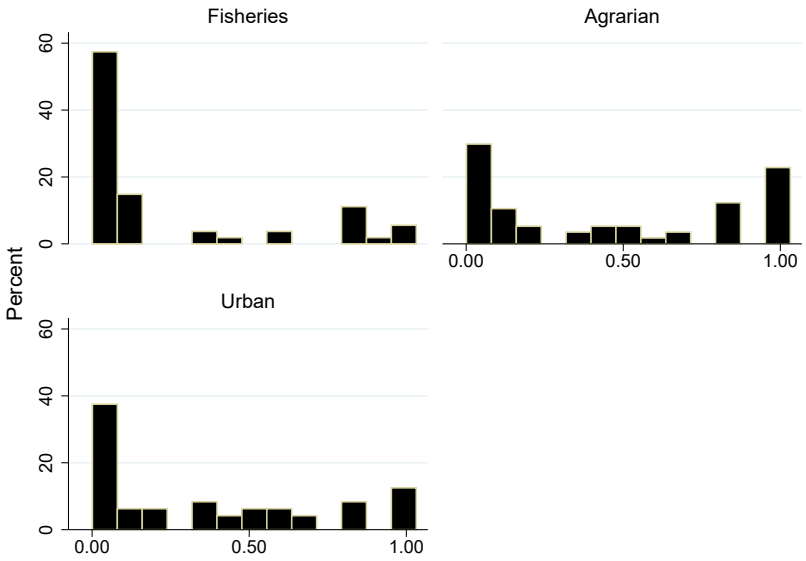


Figure 3: Frequency distributions of individual and group discount factors across three societies

List of Tables

Table 1: Definitions of the variables used in the analysis

Variables	Description
Individual discount factor	Percentage rate of discounting the future monetary value that will surely be received one month later in such a way that the discounted future value equals the value of receiving 20 000 Rp today.
Lowest individual discount factor	The individual discount factor that is the lowest among the three members in a group.
Middle individual discount factor	The individual discount factor that is the middle among the three members in a group.
Highest individual discount factor	The individual discount factor that is the highest among the three members in a group.
Group discount factor	Percentage rate of discounting the future monetary value as a group of three people that will surely be received one month later in such a way that the discounted future value equals the value of receiving 20 000 Rp today.
Age	Average age of members in a group.
Household income	Average household income of group members per month in 1 million rupiahs.
Household members	Average number of household members in a group.
Number of proself members	Number of proself members in a group.
Society dummy variables (The reference = the fisheries)	
Agrarian dummy	It takes one when the group of three people is in the agrarian soceity, otherwise zero.
Urban dummy	It takes one when the group of three people is in the urban society, otherwise zero.

Table 2: Summary statistics of field experiments and socioeconomic characteristics: 159 groups with 477 observations

	Fisheries	Agrarian	Urban	Overall
Group discount factor				
Median (Average)[1]	0.045 (0.233)	0.417 (0.452)	0.278 (0.371)	0.111 (0.353)
SD[2]	0.335	0.383	0.347	0.366
Min	0.001	0.002	0.007	0.001
Max	0.952	0.952	0.952	0.952
Individual discount factor				
Median (Average)	0.100 (0.337)	0.500 (0.499)	0.333 (0.399)	0.317 (0.414)
SD	0.360	0.373	0.331	0.362
Min	0.001	0.003	0.000	0.001
Max	0.870	0.952	0.833	0.952
Lowest individual discount factor				
Average (Median)[3]	0.134 (0.040)	0.184 (0.091)	0.154 (0.067)	0.158 (0.067)
SD	0.233	0.237	0.188	0.222
Min	0.001	0.003	0.000	0.000
Max	0.952	0.952	0.952	0.952
Middle individual discount factor				
Average (Median)	0.322 (0.100)	0.505 (0.500)	0.397 (0.352)	0.410 (0.333)
SD	0.339	0.344	0.289	0.333
Min	0.007	0.010	0.013	0.007
Max	0.952	0.952	0.952	0.952
Highest individual discount factor				
Average (Median)	0.556 (0.598)	0.809 (0.909)	0.646 (0.727)	0.674 (0.833)
SD	0.365	0.221	0.301	0.317
Min	0.013	0.100	0.067	0.013
Max	0.952	0.952	0.952	0.952
Age				
Average (Median)	40.839 (39.000)	48.877 (48.333)	40.250 (40.500)	43.543 (43.667)
SD	7.405	8.071	9.043	9.048
Min	30.000	29.667	23.000	23.000
Max	59.000	68.000	56.667	68.000
Household income				
Average (Median)	2.777 (2.500)	3.771 (3.100)	4.253 (3.300)	3.579 (3.000)
SD	1.351	2.357	2.773	2.289
Min	1.167	1.733	1.100	1.100
Max	12.667	7.967	18.333	18.333
Number of household members				
Average (Median)	4.485 (4.333)	4.222 (4.000)	4.875 (4.667)	4.508 (4.333)
SD	1.233	1.365	0.942	1.226
Min	2.000	2.333	3.333	2.000
Max	8.000	11.667	7.667	11.667
Number of proself members				
Average (Median)	1.945 (2.000)	1.719 (2.000)	1.500 (1.000)	1.730 (2.000)
SD	0.897	0.940	0.923	0.932
Min	0.000	0.000	0.000	0.000
Max	3.000	3.000	3.000	3.000

[1] Average in parentheses for group and individual discount factors.
[2] SD stands for standard deviation.
[3] Median in parentheses for the variables except group and individual discount factors.

Table 3: Marginal effects of individual discount factors on group discount factors in betafit regressions

Variables	Model 1	Model 2	Types of societies		
			Model 3 (Fisheries)	Model 4 (Agrarian)	Model 5 (Urban)
Individual discount factors					
Lowest individual discount factor	0.185**	0.208***	0.277***	0.193	0.208
	(0.074)	(0.075)	(0.095)	(0.150)	(0.183)
Middle individual discount factor	0.542***	0.539***	0.562***	0.476***	0.382**
	(0.086)	(0.086)	(0.131)	(0.137)	(0.180)
Highest individual discount factor	0.075	0.052	−0.098	0.249	0.253
	(0.068)	(0.068)	(0.073)	(0.153)	(0.174)
Age	−0.001	−0.002	0.000	−0.006	−0.001
	(0.002)	(0.002)	(0.003)	(0.005)	(0.004)
Household income	0.004	0.000	0.014	0.009	0.004
	(0.006)	(0.006)	(0.013)	(0.014)	(0.009)
Number of household members	−0.024*	−0.025*	−0.010	−0.055**	−0.011
	(0.014)	(0.014)	(0.015)	(0.023)	(0.025)
Number of proself members	−0.025*	−0.029	−0.038	−0.057	0.032
	(0.020)	(0.019)	(0.026)	(0.036)	(0.034)
Society dummy variables (The reference = the fishery)					
Agrarian		0.096**			
		(0.049)			
Urban		0.086*			
		(0.046)			
Observations	159	159	54	57	48

***significant at the 1 percent level, **significant at the 5 percent level and *significant at the 10 percent level