TIME PREFERENCES FOR SUSTAINABILITY IN INDONESIA

by

Yayan Hernuryadin

Student ID Number: 1216009

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Assessment Committee:

Supervisor: Prof. Koji Kotani

Co-Supervisor: Prof. Tatsuyoshi Saijo, Kochi University of Technology

Co-Supervisor: Prof. Yoshio Kamijo, Kochi University of Technology

Co-Supervisor: Associate Prof. Yutaka Kobayashi, Kochi University of Technology

Co-Supervisor: Associate Prof. Hiroaki Shigemasu, Kochi University of Technology

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ABSTRACT

Resource sustainability issues are a growing concern today due to the overexploitation of natural resources with increasing population, market demand and mass production. For example, Indonesia is the second largest marine capture producer, contributing to food security in the world (FAO Fisheries and Aquaculture Departement, 2016). However, some important fish stock in Indonesia is reported to have been severely depleted due to overexploitation. One of the main reasons for overexploitation is that fishermen tend to choose environmentally unfriendly fishing gear or advanced technology to catch more fish for immediate profits without considering fish stock sustainability. To ensure resource sustainability and food security, it is important to understand the possible myopic behavior or time preferences of societies; therefore, this study seeks to address these issues by conducting field experiments.

Our research starts with the analyzing individual time preferences fishermen and farmers as two main occupations that produce food utilizing natural resources. In the second stage, we analyze individual and group time preferences among fishermen, farmers and urban people. Finally, we analyze individual time preferences of married couples in a fishing society. The first experiment which is presented in the second chapter of this dissertation examines individual time preferences fishermen and farmers. We conduct a discounting elicitation experiment for fishermen and farmers in Indonesia. The statistical analysis shows that fishermen are much more shortsighted than farmers, implying that fishermen should be induced to nurture a culture of cultivating and growing for sustainability of fish stock.

In chapter 3, we present the second experiment which examine individual and group time preferences and their relation across the three societies. We conduct a field experiment to elicit individual and group discount factors in three societies of Indonesia—(i) the fisheries, (ii) the farming and (iii) the urban societies—as proxies of the hunter-gatherer, agrarian and industrial societies, respectively. We

find that both individual and group discount factors are the lowest (highest) in the fisheries (agrarian) society, while those in the urban society are in the middle. We also observe 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 determining the group discount factor in the fisheries society, while only the members with the middle discount factor are 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 and shortsighted people (the lowest and middle) are more influential than farsighted people in determining group time preferences.

The results in the first and second experiment show that fishermen are more shortsighted than farmers and urban people. Therefore, we analyze individual time preference in a fishing society in third experiment to identify what factors induce fishermen to be sufficiently farsighted to ensure the sustainability of marine resources that is presented in chapter 4. We conduct an experiment to elicit individual discount factors with 200 married couples (200 fishermen and 200 fishermen's wives) in an Indonesian fishing society, Karawang regency. We find that the fishermen's discount factors are slightly higher than those of their wives on average, with a positive correlation between the two. We also find that their incomes have idiosyncratic influences on the individual time preferences of a couple. Fishermen's incomes weakly influence only their wives' time preferences, while wives' incomes significantly and positively cause both fishermen's and wives' time preferences to be farsighted. This result suggests that the economic empowerment of fishermen's wives is important for the sustainability of marine resources and societies in Indonesia. From these findings, effective policies or new education systems, such as training/conservation programs or institutions to change people's cultures to be more patient, are essential along with economic empowerment of fishermen's wives. Without such a policy, the resource sustainability in Indonesia might pose a greater danger in the future.

Key Words: discount factors; individuals and groups; fisheries society; farming society; urban society.

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Chapter 1

Introduction

Resource scarcity and food security are becoming two important issues due to the overexploitation of natural resources with increasing population, high market demand and mass production. For example, Indonesia is the second largest marine capture producer, contributing to food security in the world (FAO Fisheries and Aquaculture Departement, 2016). However, some important fish stock in Indonesia is reported to have been severely depleted due to overexploitation. One of the main reasons for overexploitation is that fishermen tend to choose environmentally unfriendly fishing gear or advanced technology to catch more fish for immediate profits without considering fish stock sustainability.

Time preferences have been intensively studied in the past including finance to understand people behavior, preferences toward money value, investment, etc. However, along with this, time preferences are also important factor to characterize societies. In the societies those who are food producers where the resources are abundance, understanding the possible myopic behavior or time preferences in this societies give us the ideas about sustainability where the resources are there. In addition, understanding time preferences in urban society is also important since their consume the resources. To ensure resource sustainability and food security, therefore, it is important to understand time preferences of food producers and urban society as consumers;

Several works have examined how sociodemographic and environmental 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; Galor and Ozak, 2016). 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 researchers show that individual time preferences can be 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 to maintain healthy ocean for sustainability in their

daily occupation. In addition, Casse and Nielsen (2005) and Duquette et al. (2011) examine farmers' time preferences and find that farmers with more future-oriented preferences tend to adopt the best management practices in earlier stages or never perform slash-and-burn agriculture. Galor and Ozak (2016) demonstrate that people tend to have long-term orientations when they live in a region with higher crop yield.

Another group of research focuses on estimating the time preferences of food producers by conducting field surveys or experiments. Nguyen (2011) estimates and compares the time preferences of fishermen and other occupations in Vietnam and concludes that fishermen are more patient than other occupations, especially because they participate in resource stock conservation programs. Johnson and Saunders (2014) compare the time preferences of fishermen and divers. They find that divers are more farsighted than fishermen because divers are required to be patient to secure a healthy ecosystem and environment for their jobs. Akpalu (2008) and Fehr and Leibbrandt (2011) examine the time preferences of fishermen in relation to fishing activities and find that shortsighted fishermen tend to use small mesh size and to violate fishing regulations to catch more fish. Casse and Nielsen (2005) and Duquette et al. (2011) focus on the time preferences of farmers, illustrating that farmers who adopt the best management practices in earlier stages or never perform slash-and-burn agriculture are more farsighted. These studies establish that the time preferences of food producers correlate well with daily production practices.

The relationships between individual and group time preferences have been studied by several researchers. Sutter (2007); Gillet et al. (2009); Charlton et al. (2013) and Denant-Boemont et al. (2017) show that people tend to be more impatient in individual decisions than they are in group decisions. However, Yang and Carlsson (2016) find that individual decisions are not different from joint decisions in terms of time preferences. Another group of works, including Ito et al. (2011); Ma et al. (2015) and Osinski and Karbowski (2017), examine time preferences and social preferences, finding that more patient subjects are likely to share payoffs with other people in a social-dilemma situations. 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

members tend to be attracted to the median.

None of the past studies have addressed individual and group time preferences in three societies, focusing on food producers, the transition of societies in cultural and economic development, and the married couples in a fishing societies. Therefore, in this research, first we analyzing individual time preferences of food producers (fishermen and farmers) as two main occupations that produce food utilizing natural resources. In the second stage, we analyze individual and group time preferences among fishermen, farmers and urban people. Finally, we analyze individual time preferences of married couples in a fishing society.

The later parts of this dissertation have organized as follows: Chapter- 2 entitled "Time preferences of food producers: Does "cultivate and grow" matter?" presents the details of the experimentation of the daily life practices and production modes related to the occupations of farmers and fishermen characterize their individual time preferences. The study of determinant factors and evolution of human time preferences by modes of production in societies at individual and group levels has been presented in chapter- 3 entitled "Time preferences between individuals and groups in the transition from hunter-gatherer to industrial societies;" chapter- 4 puts forward the examination of the individual time preferences of married couples (fishermen and their wives) and seek to identify what factors induce them to be sufficiently farsighted to ensure the sustainability of marine resources, this chapter titles "Individual time preferences of married couples in a fishing society." Finally, chapter- 5 renders the conclusion.

Chapter 2

Time preferences of food producers: Does "cultivate and grow" matter?

2.1 Introduction

Resource scarcity and food security are becoming two important issues due to the overexploitation of natural resources with increasing population, high market demand and mass production. For example, Indonesia is the second largest marine capture producer, contributing to food security in the world (FAO Fisheries and Aquaculture Departement, 2016). However, some important fish stock in Indonesia is reported to have been severely depleted due to overexploitation. One of the main reasons for overexploitation is that fishermen tend to choose environmentally unfriendly fishing gear or advanced technology to catch more fish for immediate profits without considering fish stock sustainability. To ensure resource sustainability and food security, it is important to understand the possible myopic behavior or time preferences of food producers; therefore, this paper seeks to address these issues by conducting field experiments.

Past literature empirically analyzes individual time preferences in relation to sociodemographic factors by means of questionnaire surveys or experiments. Reimers et al. (2009) establish the correlation between individual time preferences and age, income, and education, demonstrating that younger people with less income and education prefer smaller immediate rewards to larger future rewards. Similarly, Tanaka et al. (2010) demonstrate that household sociodemographic characteristics influence individual time preferences in Vietnam and, specifically, people in poor villages tend to be less patient. Harrison et al. (2002) also show that sociodemographic characteristics affect people's discounting behavior in Denmark, reporting that age, income and education are highly correlated with individual discount rates. Overall, these works suggest that sociodemographic factors are important determinants for shaping individual time preferences and discounting behavior, irrespective of the country or location.

Another strand of research focuses on estimating the time preferences of food producers by conducting field surveys or experiments. Nguyen (2011) estimates and compares the time preferences of fishermen and other occupations in Vietnam and concludes that fishermen are more patient than other occupations, especially because they participate in resource stock conservation programs. Johnson and Saunders (2014) compare the time preferences of fishermen and divers. They find that divers are more farsighted than fishermen because divers are required to be patient to secure a healthy ecosystem and environment for their jobs. Akpalu (2008) and Fehr and Leibbrandt (2011) examine the time preferences of fishermen in relation to fishing activities and find that shortsighted fishermen tend to use small mesh size and to violate fishing regulations to catch more fish. Teh et al. (2014) examine fishermen's time preferences in two different fishery management system in Malaysia and Fiji, and demonstrate that fishermen in open access management are more farsighted than those customary marine tenure management. Duncan et al. (2011), Ekeland et al. (2015) and Da-Rocha et al. (2016) report that non constant discount factors are correlated with time preferences of resources users in fisheries, showing that harvesting strategies and the associated trajectories of fish stocks are determined by such non constant discount factors of resource users. Casse and Nielsen (2005) and Duquette et al. (2011) focus on the time preferences of farmers, illustrating that farmers who adopt the best management practices in earlier stages or never perform slash-and-burn agriculture are more farsighted. Galor and Ozak (2016) show that people who have experience with high return to agricultural investment or crop yield tend to be farsighted. These studies establish that the time preferences of food producers correlate well with daily production practices.

Fishing and farming have been the two main occupations that produce food by utilizing natural resources, and it is crucial to understand fishermen's and Farmers' time preferences for food security and resource sustainability. The production modes of fishermen and farmers are distinct in that fishermen harvest, whereas farmers cultivate, grow and harvest, and such differences in their production modes of fishermen and farmers may characterize their time preferences or discounting behaviors, leading to different daily life style and culture.[1] In Indonesia, farmers need to wait or "cultivate and grow" six

[1]Access to credit and financial environment such as banks, microfinance and mortgage institution

months for their "harvest" while fishermen catch or "harvest" fish every day and typically use up their daily income. This implies that farmers may require more patience than fishermen for survival. Thus, it could be hypothesized that farmers are more farsighted than fishermen in Indonesia. To test this hypothesis, a discounting elicitation experiment was conducted for fishermen and farmers in Indonesia, where the ethnicity, language and sociodemographic factors are relatively homogeneous.

2.2 Methods and materials

2.2.1 Study areas

The questionnaire surveys and field experiments were conducted in three rural fishing villages and nine rural farming villages within Karawang district (figure 2.1). The district is located in the northern part of Jawa Barat Province between 107°2′ and 107°40′ east longitude and 5°56′ and 6°34′ south latitude. The total land area is 1753.27 km^2. Karawang has fertile soil for agriculture. The population in 2015 is 2 273 579 with a density of 1094 km^2 (BPS-Statistics of Karawang Regency, 2016), and 168 901 or 18.15 % of the inhabitants work in the agriculture or fishery sectors (Karawang Regency Government, 2015). Most fishermen in Karawang engage in day-to-day fishing in which they take 3 or 4 hours to reach the fishing grounds, whereas most farmers cultivate paddy, which requires 6 months from soil preparation to harvest. These villages are located within 30 km of each other, and we selected the Karawang district for our study because the ethnicity, language and sociodemographic factors are relatively homogeneous: only the production mode varies between fishermen and farmers.

2.2.2 Discounting elicitation experiment

We employ a discounting elicitation experiment to elicit individual time preferences following Hernuryadin et al. (2019). This method is different from a multiple-price list (MPL) as employed by Coller

is not different between fishermen and farmers in Indonesia. The Indonesian government designs some regulations and programs to provide credit access extensively for farmers and fishermen (National Development Planning Agency Republic of Indonesia, 2014a).

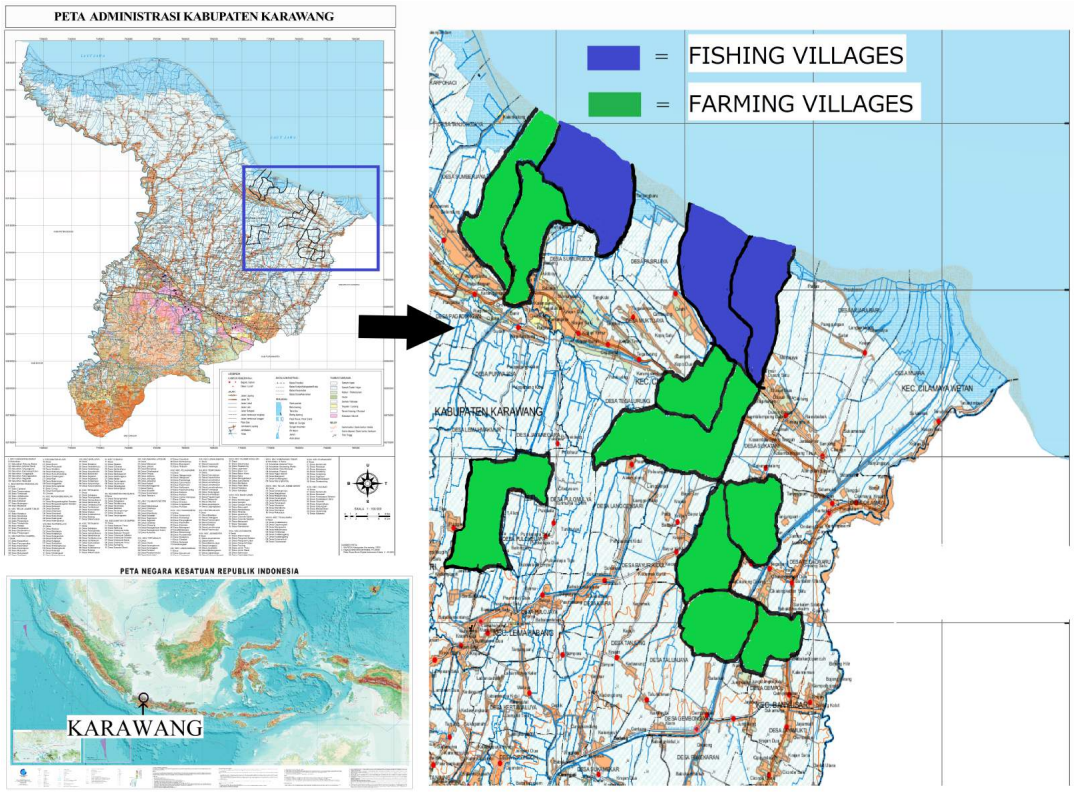


Figure 2.1: The study area: Karawang

and Williams (1999); Harrison et al. (2002); Tanaka et al. (2010). The MPL consists of payoff tables with series of questions including interest rate information. The MPL procedure usually requires subjects to have a checking (bank) account or to return to an experimental site at a different date and time to receive experimental rewards.[2] However, the subjects in our experiments are farmers and fishermen in Indonesia, and it is impossible for us to make such binding arrangements due to their living conditions, daily lifestyle and culture.[3] A majority of our subjects also claim that they encountered difficulty in understanding and following the MPL procedure in the pilot experiment because the procedures do not match their life practices and their education are limited.[4] Therefore, we designed and instituted a simple discounting elicitation experiment that consists of face-to-face interviews to elicit individual time preferences from fishermen and farmers following the same method used by Hernuryadin et al. (2019). We applied a face-to-face interview under complete privacy for discounting elicitation because the procedure is reported to establish an environment of trust and confidentiality, and enables us to effectively elicit people's true thoughts and preferences, even when subjects are not fully motivated to express their thinking or preferences by monetary incentive or when the scenario is presented to be hypothetical in experiments (Matlay, 1999; Frederick et al., 2002; Opdenakker, 2006; Cardenas and Carpenter, 2008; Zappes et al., 2013; Leavy, 2014; Falk et al., 2018; Hernuryadin et al., 2019).

Before we started eliciting time preferences, we informed that this experiment is conducted under public support and consent from Indonesian government and local community authorities and that subjects would receive 20 000 Rp ($\approx$ 1.50 USD), on average, as long as they seriously and honestly answered a series of questions and tasks in a face-to-face interview, reflecting their daily money senses and life. We did not purposely detail how experimental rewards would be paid to the subjects at a certain time and date. After this announcement, we began eliciting time preferences by conducting a

[2]More than 70 % of our subjects do not have a bank account.

[3]The MPL procedure was initially considered for our experiment because many studies in the field experiment employ it to identify time preferences (Tanaka et al., 2010; Nguyen, 2011; Johnson and Saunders, 2014; Javaid et al., 2016).

[4]Many subjects in the MPL pilot experiment had difficulty understanding the questions and gave many inconsistent answers. The same type of occurrences in MPL experiment is reported in Andersen et al. (2006, 2007) and Duquette et al. (2011).

face-to-face interview in the discounting elicitation experiment in which subjects are asked to answer a series of questions. As subjects in our experiment are fishermen and farmers who have limited literacy, we designed simple experiments and instructions that the subjects could easily follow and understand.

In the discounting elicitation experiment that consists of face-to-face interviews, an interviewer starts asking each subject separately in an interview room under complete privacy, a simple question of whether he prefers one of two options consisting of option:

Option A: You receive 20000 Rp today.[5]

Option B: You will receive $20000 + h$ Rp one month from now.

Here, the value of h starts at $h_0 = 4000$. When the subject prefers option A to option B, the question is updated by increasing the value of h by 4000 for option B, in other word, $h = h_1 = h_0 + 1 \cdot 4000 = 4000 + 4000 = 8000$. Then, the subject is again asked whether he prefers option A or option B. This process continues an arbitrary n times so that h is $h_n = 4000 + n \cdot 4000$ as long as the subject prefers option A to option B. We stop the update process when the subject chooses option B for the first time at the $h+1$th question at which point the value of h in option B is updated with $h_{n+1} = h_0 + (n+1) \cdot 4000$. In this case, we consider that subject's preference regarding options A and B is reversed between the nth and $n + 1$th questions, and there should exist a threshold future value of $\overline{h}$ between h_n and h_{n+1} that makes the subject indifferent between receiving 20 000 Rp today and $20000 + \overline{h}$ Rp one month later. Therefore, as a final step, we interview the subject and ask him some final questions by gradually adjusting the value of h between h_n and h_{n+1} up until each interviewer identifies the threshold future value of $\overline{h}$. Following a definition of discount factors introduced by Sanni et al. (2009) and Smith (2014), the subject's individual discount factor is calculated to be $\rho = \frac{20000}{20000+\overline{h}}$.[6]

To confirm whether elicited $\overline{h}$ values in the individual discounting elicitation experiment are within a reasonable range, we prepare a lottery game in which a deterministic option and a probabilistic option

[5] 1 USD $\approx$ 13 350 Rp in January 2017.

[6] As defined in Sanni et al. (2009) and Smith (2014), a discount factor is the present value of one unit of currency at a stated future date. Since our experiment focuses only on time preferences, not on curvatures of utility functions, we follow the simple definition of discount factors in this field experiment without assuming any utility function.

are provided with the same expected payoff at the end of each session. After subjects finish their tasks in the discounting elicitation experiment, we explain that a lottery game has been prepared and is based on the $\overline{h}$ values in the discounting elicitation experiment.[7] We organize a lottery with a probability $\rho = \frac{20000}{20000+\overline{h}}$ of successfully obtaining the value of $20000 + \overline{h}$ Rp by picking a yellow card in the bag and a probability $1 - \rho$ of receiving no payment by picking a red card with the expected payoff of 20 000 Rp. This lottery is composed of yellow and red cards, where the number of yellow cards is always 20 and the number of red cards is $\frac{\overline{h}}{1000}$. Since fishermen and farmers in our experiments are not familiar with the concept of probability, we count the number of yellow and red cards in front of each subject before putting them into a bag.

After preparing the lottery, we explain the lottery's rules and ask each subject whether he selects a probabilistic option of the lottery to possibly receive $20000 + \overline{h}$ Rp or a deterministic option of certainly receiving 20 000 Rp. Those who select the lottery will receive the reward based on the outcome of the lottery, and those who do not select the lottery are given 20 000 Rp. The ρ values estimated in our experiment could be considered appropriate as probability for our lottery, even under an expected utility framework in choice under uncertainty (see, e.g., Mas-Colell et al., 1995). Assume that $u(20000)$ is the expected utility when a subject obtains 20000, and $u(20000 + \overline{h})$ is the expected utility when a subject gets $20000 + \overline{h}$. If our discounting elicitation is sufficiently reasonable for subjects to truthfully reveal $\overline{h}$s and the associated ρs following Sanni et al. (2009) and Smith (2014), the subjects in our experiment will have two options with the same expected payoff of 20000: (1) a deterministic option in which the subjects obtain an expected utility of $u(20000)$ and (2) a probabilistic option in which the subjects obtain an expected utility of $\rho \cdot u(20000 + \overline{h})$.

Past literature consistently shows that approximately 40 % $\sim$ 60 % of subjects prefer to select a deterministic option rather than a probabilistic option in the lottery games under "reasonable" range with an equal expected payoff (Wang and Johnston, 1995; Ronnlund et al., 2005; Huang and Wang,

[7] For the first time, subjects come to know about the existence of the lottery game after their task in the discounting elicitation experiment is completed. Therefore, the $\overline{h}$ values elicited in our experiment are never contaminated by the lottery games.

2010; Winskel et al., 2016; Stark et al., 2017; Fan, 2017; Korn et al., 2018a). On the other hand, another group of works, including Grossman and Eckel (2015); Astebro et al. (2015) and Coricelli et al. (2018), shows that when the range of a lottery game is highly skewed and asymmetric (for example, purchasing lottery tickets with a high reward with tiny probability), many subjects prefer to select a probabilistic option rather than a deterministic option. Our lottery can be considered such a skewed and asymmetric case when subjects report $\overline{h}$ to be unreasonably high (and the corresponding ρs become very small) particularly when they tell lies or keep saying that option A is preferred to option B. We consider that approximately 40 % $\sim$ 60 % of subjects in our lottery games should choose a deterministic option as long as the elicited $\overline{h}$ values are within a reasonable range, being consistent with the previous findings in lottery games under reasonable range. If the $\overline{h}$ and ρ values are unreasonable, many subjects in our lottery might choose a probabilistic option, consistent with the results in skewed and asymmetric lotteries.

The pilot experiments of the discounting elicitation experiment and lottery procedures were implemented in fishing and farming societies with 30 subjects in each society. We ensured that our subjects understood what we require in a face-to-face interview to elicit $\overline{h}$. In particular, we identified that subjects did not have any incentive to tell a lie or any motivation to keep saying they preferred option A to option B when they are interviewed by experimenters in the pilot experiment. In fact, this is because we successfully created a separate room under complete privacy for each subject during the discounting elicitation experiment and that our subjects trusted us by noting that our discounting elicitation experiments were conducted under public support and approval from Indonesian government and local communities authorities. After the discounting elicitation in the pilot experiments, we announced that a lottery game based on the $\overline{h}$ in discounting elicitation would be conducted by asking subjects whether they would choose a deterministic option or a probabilistic option as explained above. The result was that 47 % of subjects selected a deterministic option, which is in line with previous literature of lottery games under reasonable range. Therefore, we judge that subjects did not lie or have incentive to manipulate $\overline{h}$ values in discounting elicitation, and we decided to apply a current experimental design.

In the MPL procedures, subjects are asked to answer a series of questions in survey formats, each of

which consists of two options associated with immediate and future rewards, respectively (i.e., immediate and future options). Specifically, they are asked to reveal their preferences between the immediate and future options with various time frames and reward structures for a different number of such questions in a payoff table, depending on the context of each research (see,e.g., Coller and Williams, 1999; Harrison et al., 2002; Johnson and Saunders, 2014; Teh et al., 2014). A subject's discount factor (or discount rate) is characterized by the choice at which the subject switches to prefer the future option ($= x + \Delta$) to the immediate one ($= x$). It is approximated by the switching interval bounded between x and $x + \Delta$ via $\rho \approx \frac{x}{x+\Delta}$ or a midpoint of $\frac{x+(x+\Delta)}{2}$ $\left(= x + \frac{\Delta}{2}\right)$ via $\rho \approx \frac{x}{x+\frac{\Delta}{2}}$ (Coller and Williams, 1999; Harrison et al., 2002; Johnson and Saunders, 2014; Teh et al., 2014). The MPL procedures do not always identify the switching question or interval, because subjects sometimes keep choosing the immediate options for all questions in a payoff table, leading to a problem of censoring or bound assumptions (Johnson and Saunders, 2014; Teh et al., 2014; Javaid et al., 2016).

Our discounting elicitation consists of face-to-face interviews and the interview format is designed to identify individual time preferences of fishermen and farmers, following the same method used in Hernuryadin et al. (2019). To ensure that subjects understand and follow the discounting elicitation experiment, we explain the rules and ask each subject a question between the immediate and future rewards by an individual interview with complete privacy (instead of presenting a payoff table). We ask a subject whether he prefers option A (20000 Rp today) to B ($20000 + h$ Rp one month later). As long as the subject prefers option A to B, the question process continues along with an update of increasing the value of h by 4000. We stop the update process when the subject chooses option B for the first time. As a final step, we closely interview the subject by gradually adjusting the value of h to identify the threshold value, $\overline{h}$, at which the subject becomes indifferent between options A and B. As the result, the subject's discount factor shall be calculated to be $\rho = \frac{20000}{20000+\overline{h}}$. In this way, our elicitation does not face the "inconsistent choice" problems and censoring issues that arise in the MPL procedures. These are the fundamental differences between MPL and our methods, and we appear to successfully identify people's discount factors without relying on certain approximations and/or assumptions.

2.2.3 Experimental procedure

We first contacted the village offices to obtain consent to conduct our experiments. Among the 13 fishing villages and 296 farming villages in Karawang, 3 fishing and 9 farming village authorities gave us permission to conduct experiments. As mentioned earlier, these villages are within 30 km of each other. We obtained a list of households and residents from the village offices, and based on the population of each village, we randomly selected the required number of households. We invited one wage-earning member from each of the selected households to participate in our experiment by sending an invitation letter. A total of 397 subjects participated in our experiment, including 200 fishermen and 197 are farmers. We conducted our experiments at the village halls in each location. To avoid possible biases from interaction among participants, we ensured that each respondent left the experimental hall soon after participation in the experiment.

In each experimental session, we provided written experimental instructions of our discounting elicitation experiment to the respondents in the Indonesian language of Bahasa. Additionally, an experimenter made an oral presentation of the instructions in a gathering room and confirmed each subject's understanding by giving a series of quizzes about our experimental rules and procedures after the explanation. After we finished the oral presentation, we randomly chose a subject and guided him to a separate room under complete privacy. In a discounting elicitation room, we explained that 20 000 Rp ($\approx$ 1.50 USD) Rp would be paid to each subject, on average, as long as subjects honestly and truthfully answer a series of questions and tasks reflecting their daily money senses and life, in a face-to-face interview. Before we started the discounting elicitation experiment, we clarified one more time whether the subjects understood the procedure. We began the discounting elicitation experiment by asking subjects a series of questions. After subjects completed their tasks in the discounting elicitation experiments, we conducted the lottery game to confirm whether $\overline{h}$ would be reasonable and to determine the experimental rewards of discounting elicitation experiments. After the lottery game, we collected sociodemographic information for each subject by conducting a field questionnaire survey for each session. Each subject received 35 000 Rp ($\approx$ 3 USD) as an experimental reward including the partici-

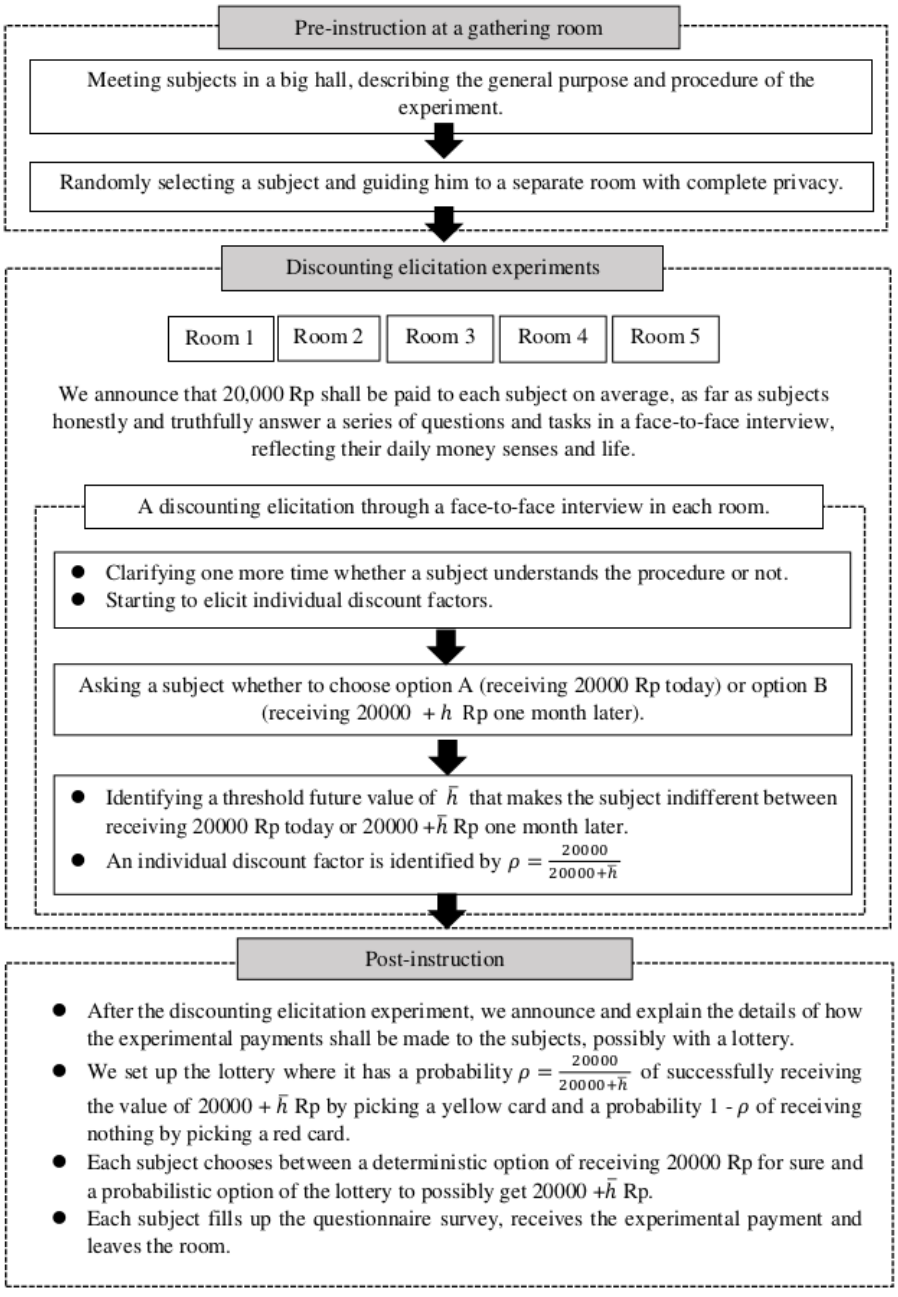


Figure 2.2: The discounting elicitation experiment procedure

pation fee of 15 000 Rp on average. Figure 2.2 summarizes the experimental procedure for discounting elicitation. Each session in our experiment included $15 \sim 20$ participants and took $2 \sim 3$ hours.

2.2.4 Empirical method

We apply betafit and median regressions to characterize the determinants of individual discount factors.[8] Betafit (median) model can be mathematically expressed as:

$$d_i = \beta_0 + \boldsymbol{\beta}_1 \mathbf{x}_i + \beta_2 z_i + \epsilon_i, \tag{2.1}$$

where subscript i represents each subject's ID, d_i is an individual discount factor estimated in the discounting elicitation experiments, $\mathbf{x}_i$ is a vector of independent variables of sociodemographic information, such as age, education, household income, children under 12, number of household members and family structure, and z_i is a dummy variable of occupations that takes 1 when subject i is a farmer and is otherwise 0. β_0 ($\boldsymbol{\beta}_1$) and β_2 are the associated parameters (of vectors) to be estimated. The definitions of the variables used in the regression analysis are summarized in table 2.1. The betafit regression developed by Ferrari and Cribari-Neto (2004) is employed for our analysis since individual discount factors are bounded between 0 and 1. To check the robustness, we employ the quantile regression approach developed by Koenker and Basset (1978) and Koenker and Hallock (2001), following the specification of equation equation (2.1) (See appendix for more explanation about empirical method).

All the variables in table 2.1 are expected to be determinants of individual discount factors. In particular, our main focus is on the occupation dummy to determine how individual discount factors vary between fishermen and farmers. Our hypothesis is proven to be true when the dummy variable consistently exhibits statistical and economic significance in affecting individual discount factors. We test different specifications of the models in addition to the models presented in this paper by including the interaction terms of two independent variables and different sets of independent variables. However, the results do not differ significantly, and the results presented in the following section remain

[8] In addition to betafit and median regressions, we also apply the fractional regression, following Papke and Wooldridge (1996), as a further robustness check. We obtain qualitatively the same result as with the betafit and median regressions.

Table 2.1: Definitions of variables

Variables	Description
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.
Occupation dummy	Farmers (1) and fishermen (0).
Age	Years.
Education	Categorical variable (Illiterate (0), elementary level (1), junior high school level (2), senior high school level (3), college degree (4) and university degree (5)).
Household income	Household income per month in 1 million rupiahs.
Children under 12	Number of children under 12 years of age in a household.
Member of household	Number of household members.
Family structure	Single family structure is coded as 1, otherwise 0.

consistent.

2.3 Results

Table 2.2 presents the summary statistics of the major independent variables and individual discount factors for fishermen, farmers and the total sample. The overall average age is 45 years (see the "overall" column in table 2.2); however, the farmers are an average of 8 years older than fishermen. Fishing is more labor intensive than farming; thus, fishermen tend to retire earlier than farmers. Regarding education, farmers are more educated than fishermen. Farmers usually receive a junior high school degree, whereas fishermen usually have only primary education. One the other hand, there is no difference in the median education of fishermen and farmers. The difference in the mean and median education can be explained by the standard deviation (SD) of education. The SD of farmers' education is 1.13, which is twice the SD of fishermen's education. This finding indicates that some farmers are highly educated, for instance, they have a university degree (see the "max" row under education in table 2.2). The range of education is relatively low in fishing societies: the fishermen who are the most educated are senior high school graduates.

Farmers earn more than fishermen: farmers' average monthly income is approximately 1 million rupiahs higher than that of fishermen. The income range among farmers is higher than that of fishermen: the SD of farmers' monthly income is almost twice as much as the SD of fishermen's income. This

Table 2.2: Summary statistics of the field experiments and socioeconomic characteristic of fishermen and farmers: 397 observations (fishermen: 200 observations, farmers: 197 observations)

	Work setting		Overall
	Fishermen	Farmers	
Age			
Average (Median) [1]	40.955 (40.000)	48.741 (47.000)	44.819 (45.000)
SD [2]	12.100	10.871	12.135
Min	18.000	23.000	18.000
Max	72.000	80.000	80.000
Education			
Average (Median)	1.025 (1.000)	1.584 (1.000)	1.302 (1.000)
SD	0.535	1.134	0.926
Min	0.000	0.000	0.000
Max	3.000	5.000	5.000
Household income			
Average (Median)	2.852 (2.000)	3.953 (3.000)	3.399 (2.600)
SD	2.434	4.164	3.444
Min	0.500	0.700	0.500
Max	20.000	30.000	30.000
Number of children under 12			
Average (Median)	0.965 (1.00)	0.589 (0.00)	0.778 (1.00)
SD	0.903	0.684	0.856
Min	0.000	0.000	0.000
Max	5.000	3.000	5.000
Number of household members			
Average (Median)	4.535 (4.00)	4.264 (4.00)	4.400 (4.00)
SD	1.954	1.933	1.946
Min	1.000	1.000	1.000
Max	12.000	18.000	18.000
Family structure			
Average (Median)	0.600 (1.00)	0.695 (1.00)	0.647 (1.00)
SD	0.491	0.461	0.478
Min	0.000	0.000	0.000
Max	1.000	1.000	1.000
Discount factor			
Average (Median)	0.302 (0.100)	0.482 (0.500)	0.391 (0.204)
SD	0.344	0.374	0.370
Min	0.001	0.003	0.001
Max	0.952	0.952	0.952

[1] Median in parentheses.

[2] SD stands for standard deviation.

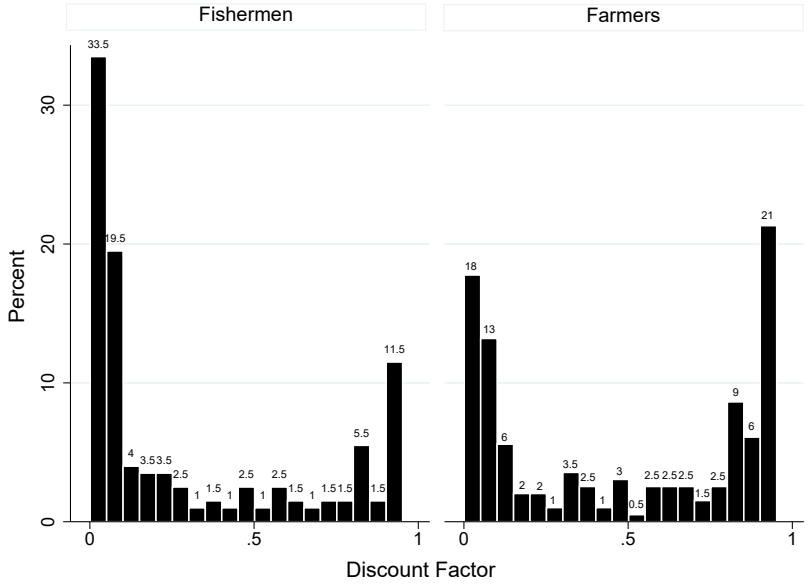


Figure 2.3: Frequency distributions of the discount factors of fishermen and farmers

finding indicates that some farmers' earnings are significantly higher than those of the majority, whereas fishermen experience less income disparity and a lower standard of living. The number of children under 12 years of age per household, the number of household members and family structure do not vary between farmers and fishermen. In summary, farmers are relatively old and highly educated compared with the fishermen, and farmers' income is higher and more variable than that of fishermen.

The median (mean) discount factors of farmers and fishermen are 0.500 (0.482) and 0.100 (0.302), respectively, which represent a significant difference in the estimated individual time preferences of farmers and fishermen, implying that fishermen discount their future more heavily than farmers.[9] Figure 2.3 shows the frequency distributions of the individual discount factors of fishermen and farmers. The vertical axis denotes the percentage and the horizontal axis denotes the discount factor. The highest spike in the frequency distribution for farmers occurs at discount factors close to 1, whereas the highest

[9]Some researchers may argue about a possibility of reverse causality in our experiment, where people who are shortsighted tend to be fishermen, while people who are farsighted tend to be farmers, representing the above results. However, this situation does not occur in our field experiments because migration among both societies is very low reflected by the fact that fishermen and farmers have lived approximately 23 and 21 years in the same society, respectively. In addition, their fathers and grandfathers had been fishermen and farmers in each society.

spike occurs at 0 for fishermen. The findings in figure 2.3 are in line with the summary statistics. On the basis of the summary statistics and figure 2.3, we run a Mann-Whitney test to examine whether the distributions of the discount factors of fishermen and farmers are the same. The null hypothesis is that the distributions are independent of occupation. Our test rejects the null hypothesis at the 1 % significance level, which indicates that the discount factor distributions of farmers and fishermen differ.

The summary statistics, frequency distributions and Mann-Whitney test suggest that individual discount factors vary between farmers and fishermen. To further characterize the relationship, we run betafit and median regressions. Table 2.3 presents the marginal effects of the independent variables on individual discount factors in the betafit and median regressions with several model specifications, respectively. Firstly, we include only farmers as dummy variables with fishermen as the reference in Model 1 (Model 4) of table 2.3 in the betafit regression (the median regression) to account for possible concerns about effects of posttreatment variables. Montgomery et al. (2018) describe that when treatment dummies are included in a regression together with any independent variables that are affected by the treatments, posttreatment effects exist as a bias for the estimates of treatment variables. A likelihood of posttreatment effect in our study may be claimed by some researchers in our study since we consider occupation dummy variables as treatments, and the occupation dummy variables might be considered to affect sociodemographic variables. We find that occupation dummy variables in Model 1 (Model 4) are observed to be significant where individual fishermen's discount factors are 13.0 % (40.0 %) lower than those of farmers.

We then exclude occupation dummy variables in Models 2 and 5 in table 2.3 to focus on examining how sociodemographic variables affect individual discount factors. Model 2 (Model 5) in the betafit regression (the median regression) shows that an additional year increase in age is associated with a 0.5 % (1.1 %) increase in individual discount factors. Although this effect might be considered to be small, the discount factor in the betafit regression (the median regression) is estimated to increase by 6.0 % (13.2 %) for a one standard deviation increase ($\approx$ 12 years) in age. The result reveals that younger people tend to discount the future more heavily than older people, which is consistent with previous studies (Green et al., 1994; Harrison et al., 2002; Reimers et al., 2009). It is claimed that as

Table 2.3: Marginal effects of individual discount factors in the betafit and median regressions

Variables	Betafit regression			Median regression		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Age		0.005***	0.003***		0.011***	0.006
		(0.001)	(0.001)		(0.003)	(0.003)
Edu		0.055***	0.036**		0.127***	0.037
		(0.015)	(0.017)		(0.046)	(0.043)
Household income		–0.007**	–0.008**		–0.016***	–0.011
		(0.003)	(0.003)		(0.006)	(0.010)
Children under 12		–0.010	–0.015		–0.006	0.014
		(0.015)	(0.012)		(0.037)	(0.031)
Number of household members		–0.012*	–0.012*		–0.026*	–0.024
		(0.007)	(0.007)		(0.014)	(0.016)
Family structure (base group=joint family)		–0.019	–0.026		–0.032	–0.049
		(0.027)	(0.027)		(0.071)	(0.062)
Occupation dummy (base group=fishermen)	0.130***		0.093***	0.400***		0.238***
	(0.027)		(0.033)	(0.089)		(0.090)
Observations	397	397	397	397	397	397

***significant at 1 % level, **significant at 5 % level and *significant at 10 % level

people age, their level of self-control increases and they become more generative and think more about future generations up to the age of 60 years (Green et al., 1994; McAdams et al., 1993).

The effect of education demonstrates that getting more education causes people to care more about the future: the betafit regression (the median regression) estimates a 5.5 % (12.7 %) increase in discount factors in relation to an increase in education category. Harrison et al. (2002) and Reimers et al. (2009) show that more educated people tend to be future-oriented or farsighted, and our result is in line with this finding. Similar to the effect of age, education should enhance self-control mechanisms and cognitive abilities (Bauer and Chytilova, 2010). Moreover, education is known to train people to think logically nd simulate and organize the future, helping to achieve a balance between present and future events.

To check the robustness of our results, we include all the independent variables in the betafit regression (the median regression) as well as farmers as dummy variables with fishermen as the reference in Models 3 and 6, in addition to the baseline specification of Models 2 and 5. Models 3 and 6 show the effect of occupation on discount factors, more precisely, how the time preferences of farmers and fishermen differ, controlling for other sociodemographic variables. The occupation dummy is identified to be an important predictor of individual discount factors in both the betafit and median regressions, with 1 % statistical and economic significance. The betafit regression estimation shows that the farmers' discount factors are 9.3 % higher than those of fishermen, whereas the median regression estimates 23.8 % higher discount factors for farmers than for fishermen. Consistent with our summary statistics, both regression estimations confirm that fishermen tend to discount their future more heavily than farmers.[10] Although we have tried a variety of different regression specifications, our results in models 1-6 generally remain consistent and robust with respect to the occupation dummy variables in determining individual discount factors. Some socioeconomic variables such as age, education, household income

[10]This finding appears to be inconsistent with that of Nguyen (2011), who shows that in Vietnam, fishermen are more patient than people with other occupations. However, one key difference between our study and Nguyen (2011)'s is that the fishermen in Vietnam participated in resource conservation programs, such as permanent area closures to recover fisheries, while the Indonesian fishermen in our study do not participate in any conservation or training programs for resource sustainability. We argue that the conservation program induces Vietnamese fishermen to become more patient.

and number of household members are also identified to be statistically and economically significant in the betafit regression and the median regression depending on the specifications of the betafit regression and the median regression.

Several past studies demonstrate that occupations and the associated life practices are important determinants to characterize individual behaviors and preferences, such as social preferences and competitiveness (Hoekstra, 1985; Casse and Nielsen, 2005; Henrich et al., 2005; Akpalu, 2008; Duquette et al., 2011; Fehr and Leibbrandt, 2011; Nguyen, 2011; Leibbrandt et al., 2013; Johnson and Saunders, 2014). Given the literature, our study could be considered additional evidence of the effect of occupation on "time preferences" for the specific case of food producers (fishermen and farmers) in Indonesia. Now, a key question is why occupations of farmers and fishermen have significantly different time preferences? We argue that the difference is a result of daily life practices and production modes, which are distinct between farmers and fishermen. In other words, farmers "cultivate, grow and harvest" crops, while fishermen only "harvest" fish as their means of food production. These differences characterize their discounting behaviors.

Fishermen in Karawang typically fish every day and receive daily income by selling fish in their local auction markets. They easily expect that they can go fishing the next day or the following day to earn money for living whenever their money is short. Because of the income generating practices of daily fishing, they are neither accustomed to nor motivated for saving. In our experiments, we confirm that fishermen use most of their total daily earnings on the same day. Therefore, their saving is identified to be very low based on our data and individual questionnaires (the median saving in fishermen sample is zero). In addition, in our survey, we asked the fishermen whether they believe that fish stocks are exhaustible. Surprisingly, 80.5 % of the fishermen respond that "God" always provides fish in the sea, and therefore, that the fish stock is inexhaustible. In summary, the daily "earn and burn practices" of fishing and the belief of an "inexhaustible" fish stock remain part of the culture in fishing villages, inducing fishermen to be shortsighted.

Farmers in Karawang need to cultivate and grow paddy and wait six months to harvest; therefore, they are motivated to save, invest and accumulate for survival. In our study areas, farmers cultivate

arable land, which is basically their own property, for their livelihood, and they maintain or even accumulate capital and wealth by saving gold as a preparation for an uncertain future. Natural disasters and calamities are the main sources of uncertainty for farmers because they can destroy complete agricultural productions in a region. By contrast, fishermen can go fishing within a few days after natural disasters. This is one example of the differences in the production modes of fishermen and farmers that affect the motivations of how to prepare for the future. The data also show that farmers' saving is much higher than that of fishermen, which is consistent with the result of individual time preferences. We conjecture that farmers' daily practices and the mode of production for cultivating, growing and harvesting crops require farmers to wait, save and invest for the future, resulting in farmers being farsighted as part of their culture.

The motivation to maintain and transfer capital and wealth to the next generations could vary between farmers and fishermen due to their production modes. In farming villages, maintaining and transferring capital and wealth, such as land and irrigation, from one generation to the subsequent generations is very important as a common practice for survival, because these two factors are crucial in cultivating and growing crops. On the other hand, in fishing villages, fishermen do not have specific capital and wealth to maintain and transfer to subsequent generations, except their hands-on experience and skills for harvesting as human capital, because fishing is mainly labor intensive. Therefore, the differences in motivation to maintain and transfer capital and wealth to future generations may be attributed to the production mode, explaining why farmers are more farsighted than fishermen.

Galor and Ozak (2016) theorize that evolution of people's time preferences is affected by a production mode, presenting that an endowment mode of production induces people to evolve being shortsighted, and an investment mode leads people to be farsighted. Based on the definitions of production modes introduced by Galor and Ozak (2016), fishermen are considered to employ an endowment mode because they harness the existing resources, while farmers are considered to employ an investment mode because they cultivate, grow and harvest crops. Following this interpretation, our study could be considered an important empirical test for the theory developed by Galor and Ozak (2016). Our results are quite consistent with Galor and Ozak (2016) in that farmers (fishermen) "cultivate and grow" six

months for their harvest in an investment mode of production (catch or "harvest" fish every day in an endowment mode of production), inducing themselves to be farsighted (shortsighted).

Past studies demonstrate that daily practices, history and environment, as components of culture, affect human behavior and preferences (Boyd and Richerson, 1985; Schultz et al., 1997; Henrich et al., 2005; Tomasello et al., 2005; Dawkins, 2006; Gilbert and Wilson, 2007; Richerson and Boyd, 2008; Wilson et al., 2009; O'Brien et al., 2010; Moya et al., 2015; Gerlach et al., 2014; Szpunara et al., 2014; Shahrier et al., 2016; Timilsina et al., 2017; Shahrier et al., 2017). We demonstrate that the daily life practices and production modes related to the occupations of farmers and fishermen characterize their individual time preferences. At the same time, this research brings some new questions and hopes for people's behavior in the future. Some effective policies or new education systems, such as training/conservation programs or institutions that change people's cultures to be more patient, are essential. For this, "cultivate and grow" is important based on our findings. In fishing, it is necessary for fishermen to be farsighted to ensure sustainable fisheries. To this end, nurturing a new culture of fishermen in Indonesia for "cultivating and growing fish" through public education or programs is an important first step.

2.4 Conclusions

Previous studies show how daily practices, history and environment, as components of culture, influence human behavior and preferences. As the main food producers, fishermen and farmers play important roles in food security and resource sustainability. The production modes of fishermen and farmers are distinct in that fishermen (farmers) harvest (cultivate, grow and harvest), leading to different daily lifestyles and culture. It is hypothesized that such differences in the daily practices and production modes of fishermen and farmers characterize their time preferences and discounting behavior. To examine this hypothesis, we have conducted a discounting elicitation experiment for fishermen and farmers in Indonesia.

The results of this study indicate that fishermen are much more shortsighted than farmers. The

betafit and median regressions illustrate that the discount factors of farmers are 9.3 % and 23.8 % higher than those of the fishermen, respectively, controlling for other sociodemographic factors. We argue that this difference is a result of the daily life practices and production modes associated with farming and fishing. The results reflect the fact that farmers cultivate and grow paddy and wait six months for harvest, and they tend to save a portion of their income for the future. By contrast, fishermen catch fish every day and spend most of their daily income. Although the same policies have been uniformly implemented for these two occupations,[11] the government may need to develop new approaches and education for fishermen to nurture a culture of "cultivating and growing" fish stock and make fishermen more farsighted, thereby promoting long-term conservation behavior to sustain fisheries and their lives.

This research was conducted in small-scale fisheries under the open access and top-down management system in Indonesia. The fishermen in the experiments have never participated or been involved in any type of resource conservation program or management, so they catch fish every day under the belief that the stocks are inexhaustible. However, in reality, fishermen in other countries participate in such programs or engage in different types of fisheries, such as large-scale or industrialized fisheries, and potentially have different ways of thinking, behavior and preferences. Therefore, our results should be considered with caution. Future research should focus on other types of fishing societies or the effects of resource conservation and training programs of "cultivate and grow" on individual time preferences of fishermen as well as people with other occupations, considering various production modes.

2.5 Appendix: Empirical methods

We apply betafit and median regression to characterize the determinants of individual discount factors. Betafit (median) models can be mathematically expressed as:

$$d_i = \beta_0 + \boldsymbol{\beta}_1 \mathbf{x}_i + \beta_2 z_i + \epsilon_i, \tag{2.2}$$

[11] Fisheries and farming are important sectors to provide food and are a priority sector in Indonesia since they provide 41.2 million ton of rice and 11.4 million ton of fish in 2013 (National Development Planning Agency Republic of Indonesia, 2014a). Same policies for food security have been uniformly implemented on these two sectors by Indonesian government in the way that the government facilitates fishermen and farmers to increase production through subsidies and governmental aids.

where subscript i represents each subject's ID, d_i is an individual discount factor estimated in the discounting elicitation experiments, $\mathbf{x}_i$ is a vector of independent variables of sociodemographic information, such as age, education, household income, children under 12, number of household members and family structure, and z_i is a dummy variable of occupations that takes 1 when subject i is a farmer and is otherwise 0. β_0 ($\boldsymbol{\beta}_1$) and β_2 are the associated parameters (of vectors) to be estimated. In our sample, the age variable could also be interpreted as the number of years of farming or fishing because all the subjects in Karawang started and continued their career with the same occupation as farmers or fishermen until the present. The definitions of the variables used in the regression analysis are summarized in table 2.1.

The betafit regression developed by Ferrari and Cribari-Neto (2004) is employed for our analysis since individual discount factors are bounded between 0 and 1. The method assumes that individual discount factors d_is follow a beta distribution:

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

, where $\mathbb{E}(d_i)=\mu$, $\mathrm{Var}(d_i)=\frac{\mu(1-\mu)}{1+\phi}$, ϕ is a precision parameter and $\phi-1$ is a dispersion parameter. Different combinations of μ and ϕ can describe various types of beta densities, including J-shaped, inverted J-shaped and U-shaped (Ferrari and Cribari-Neto, 2004). Since the distributions of individual discount factors estimated in our experiments are U shaped, we use betafit regression. The maximum likelihood method is applied to identify the unknown parameters $\beta_0,\boldsymbol{\beta}_1,\beta_2$, which are used to derive and estimate the marginal effect of an independent variable on the individual discount factors, d_i.

To check the robustness, we employ the quantile regression approach developed by Koenker and Basset (1978) and Koenker and Hallock (2001), following the specification of equation (2.2). The quantile regression estimates one parameter vector for each quantile under a weak assumption that each quantile of the error terms is zero, i.e., $\mathrm{Quant}_\theta(\epsilon_i)=0$ for $\theta\in(0,1)$, where θ represents a quantile level. Quantile regression is based on the least absolute distance; therefore, it can efficiently estimate a set of unknown parameters $\beta_0,\boldsymbol{\beta}_1,\beta_2$, even under non-normal and skewed distributions with outliers. Since the distributions of the individual discount factors in our experiments are identified to

be non-normal and bi-modal around 0 and 1 (see figure 2.3), quantile regression is considered to be appropriate. Additionally, we perform median regression with $\theta = 0.5$ for the comparison with the betafit regression.

Chapter 3

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

3.1 Introduction

Three societies, namely, 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 rural to 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 the 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 uncertain climate conditions; and urban people live or work in an environment that 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 environmental 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; Galor and Ozak, 2016). 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 researchers show that individual time preferences can be 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 to maintain healthy ocean for sustainability in their daily occupation. In addition, Casse and Nielsen (2005) and Duquette et al. (2011) examine farmers' time preferences and find that farmers with more future-oriented preferences tend to adopt the best management practices in earlier stages or never perform slash-and-burn agriculture. Galor and Ozak (2016) demonstrate that people evolve to have long-term orientations when they have lived in a region where high return to agricultural investment or crop yield is expected. Some studies, such as Duncan et al. (2011), Ekeland et al. (2015) and Da-Rocha et al. (2016) suggest that time preferences of resource users are characterized by non constant discount factors, demonstrating that such non constant discount factors of resource users significantly affect harvesting strategies and the associated trajectories of resource stocks.

The relationships between individual and group time preferences have been studied by several researchers. Sutter (2007); Gillet et al. (2009); Charlton et al. (2013) and Denant-Boemont et al. (2017) show that people tend to be more impatient in individual decisions than they are in group decisions. However, Yang and Carlsson (2016) find that individual decisions are similar to joint decisions in terms of time preferences. Another group of works examine time preferences and social preferences, finding that more patient subjects are likely to share payoffs with other people in a social-dilemma situations (Ito et al., 2011; Ma et al., 2015; Osinski and Karbowski, 2017). 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 members 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 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) fisheries, (ii) farming and (iii) urban, as proxies of hunter-gatherer, agrarian and industrial societies, respectively.[1] Our empirical analysis yields two

[1]Barry et al. (1959) and Uskul et al. (2008) characterize fisheries societies as hunter-gatherer soci-

main results. First, we find that both individual and group discount factors are the lowest (highest) in fisheries (agrarian) societies, while those in urban ones are in the middle. Second, we observe that the determinants of group discount factors differ across the 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 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 and that comparatively shortsighted people (the lowest and middle) are more influential than farsighted people in determining group time preferences.

3.2 Data and methodology

3.2.1 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 (figure 4.1). Karawang regency is located in the north part of Jawa Barat Province. Karawang is located between 107°2′ and 107°40′ east longitude, and 5°56′ and 6°34′ south latitude. The population in 2015 was 2 273 579 with a density of 1094 km^2 (BPS-Statistics of Karawang Regency, 2016), and 168 901, or 18.15 % of the working population, work in agriculture and fishery sectors (Karawang Regency Government, 2015). Jakarta is the most densely populated and capital city in Indonesia, where most people engage in the government, business and service sectors. Jakarta is located at 6°12′ south latitude and 106°48′ east longitude. The population in 2016 was 10 277 628 with a density of 15 517 km^2, and 3 136 531, or 64.51 % of the working population, work as regular employees in the public and formal private sectors (BPS-Statistics of DKI Jakarta Province, 2017).

eties because of their daily life practices.

Figure 3.1: The study area: Karawang and Jakarta

3.2.2 Experimental setup

A discounting elicitation experiment

We employ a discounting elicitation experiment to identify individual and group time preferences. Our experiment is different from a multiple-price list (MPL) procedure as done by Coller and Williams (1999); Harrison et al. (2002), and Tanaka et al. (2010). Subjects in MPL are given payoff tables with many questions including the information of interest rates. The MPL procedure requires subjects to have bank accounts, enabling them to receive experimental reward at later dates.[2] However, most of our subjects are local farmers and fishermen who do not have bank accounts. Also, such subjects claim that they could neither understand nor follow the MPL procedure in the pilot experiments, because the procedures do not match their lifestyle and their educations.[3] Therefore, we design and institute a simple discounting elicitation experiment that consists of face-to-face interviews to ask subjects to choose between receiving money today and more money one month later. We employ a face-to-face interview under complete privacy for discounting elicitation because the method is reported to create an environment of trust and confidentiality and enables us to effectively elicit people's true thoughts and preferences, even when subjects are not fully motivated to express what they think and prefer by monetary incentive or when the scenario is explained to be hypothetical in experiments (Matlay, 1999; Frederick et al., 2002; Opdenakker, 2006; Cardenas and Carpenter, 2008; Zappes et al., 2013; Leavy, 2014; Falk et al., 2018).

We conduct the discounting elicitation experiments for each subject and a group of 3 subjects to identify individual and group discount factors. First, we announce that our elicitation experiments are conducted with public support and approval from Indonesia government and local community authorities, and thus, $20000\,\text{Rp}$ ($\approx 1.50\,\text{USD}$) of experimental rewards would be paid to each subject and to

[2]We initially considered application of the MPL procedure, because most field experiments that seek to estimate time preferences have employed it (Tanaka et al., 2010; Nguyen, 2011; Johnson and Saunders, 2014; Javaid et al., 2016).

[3]Many subjects in the MPL pilot experiments randomly answer or have difficulty understanding the questions. The same type of problems and high inconsistency that comes from respondents' random answers are reported in Andersen et al. (2006, 2007), Duquette et al. (2011) and Clot et al. (2017).

each group on an average, respectively, as far as subjects and groups honestly and truthfully answer the questions in a face-to-face interview, reflecting their daily money senses and life.[4] In this announcement, we do not purposely detail how experimental payments shall be made to the subjects at a specific time and date. Second, we start eliciting individual time preferences through a discounting elicitation experiment where subjects are asked to answer a series of questions. As most subjects are not well educated and have limited literacy, we institute simple experiments and instructions that our subjects can understand.

In a face-to-face interview in the discounting elicitation experiments, an interviewer begins by asking a question of whether each subject would choose option A or B with complete privacy of a separate room in the following scenario:

Option A: You get 20000 Rp today.[5]

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 increased by 4000, 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 long as the subject continues to select option A, the experiment continues, with the value of m for option B increasing by 4000. This updating procedure for m in option B, i.e., $m_k = 4000 + k \cdot 4000$, continues an arbitrary k times for as long as a subject prefers option A to B. We shall end the update process when the subject chooses option B for the first time at the $k + 1$th question where the value of m in option B is updated with $m_{k+1} = m_0 + (k + 1) \cdot 4000$. In this case, we consider that her preference over options A and B is reversed between kth and $k + 1$th questions, and there should exist a threshold future value of $\overline{m}$ between m_k and m_{k+1} that makes the subject to be indifferent between receiving 20 000 Rp today and $20000 + \overline{m}$ Rp one month later. Therefore, as a final process, we interview the subject and ask her some final questions by gradually adjusting the value of m between m_k and m_{k+1}

[4] All groups decide to split the group experimental rewards into three.

[5] 1 USD $\approx$ 13 350 Rp in January 2017.

up until each interviewer identifies the threshold value of $\overline{m}$. The subject's individual discount factor shall be estimated to be $\rho = \frac{20000}{20000+\overline{m}}$, which follows a definition of discount factors introduced in Sanni et al. (2009) and Smith (2014).[6]

After completing a discounting elicitation game at the individual level, we proceed to the experiment at the group level. We randomly choose 3 subjects and assign them to a group. We then implement the same procedures as we did at the individual level and ask the group whether to choose option A or B. The difference at the group level is that the decisions between options A and B in each trial must be discussed among group members. We ask group members to reach a consensus through discussion for every group decision without relying on majority voting. When the group chooses option B for the first time at the $k+1$th question, we end the updating process and ask the group a series of questions to identify the group's threshold value of $\overline{m}$ that makes the group to be indifferent between receiving 20 000 Rp today and $20000 + \overline{m}$ Rp one month later. Therefore, the group's discount factor shall be estimated in the same way we did for individual discount factors.

To confirm whether identified $\overline{m}$s in discounting elicitation at individual and group levels are within a plausible range, we finally announce and prepare a lottery game where a certain option and a probabilistic option are given with the same expected payoff at the end of each session. After both individual and group discounting elicitation experiments finish, we announce that a lottery game is prepared and implemented on the basis of individual and group $\overline{m}$s.[7] In the lottery game, 20 cards are yellow and $\frac{\overline{m}}{1000}$ cards are red, these cards are counted in front of subjects (or groups) and put into a bag.[8] In this lottery, when a subject (or group) picks a yellow card, she receives the reward of $20000 + \overline{m}$ Rp, otherwise zero. Mathematically, the lottery has a probability $\rho = \frac{20000}{20000+\overline{m}}$ of successfully receiving the value of

[6]Sanni et al. (2009) and Smith (2014) define a discount factor to be the present value of one unit of currency at some future date. Since our focus is on time preferences, not on curvatures of utility functions, we follow the simple definition of discount factors in this field experiment without assuming any utility function.

[7]Subjects come to know, for the first time, an existence of the lottery game after individual and group discounting elicitation experiments. Therefore, $\overline{m}$s identified through discounting elicitation are independent of the lottery games.

[8]Most subjects do not understand the concept of probabilities. Therefore, we count the number of red and yellow cards in front of them.

$20000 + \overline{m}$ Rp by picking a yellow card and a probability $1 - \rho$ of receiving nothing by picking a red card with the expected payoff of 20 000 Rp.

After counting the cards in front of subjects and setting them in the bag, we explain and ask each subject (each group) to choose between certainly receiving 20 000 Rp (a certain option) and going for the lottery to possibly receive $20000 + \overline{m}$ Rp (a probabilistic option). A subject (group) who chooses the lottery receives the payment according to the outcome of a random draw from the bag; a subject (group) who does not choose the lottery certainly receives 20 000 Rp.[9] The ρs that we have identified in our experiment could be considered appropriate as probabilities for our lotteries even under expected utility framework in choice under uncertainty (see, e.g., Mas-Colell et al., 1995). Suppose there are two utility levels, $u(20000)$ and $u(20000 + \overline{m})$, correspond to the payoff of 20000 and $20000 + \overline{m}$ for each subject. If our discounting elicitation is reasonable enough for subjects to truthfully reveal $\overline{m}$s and the associated ρs following Sanni et al. (2009) and Smith (2014), subjects in our experiment have two choices in the lottery with the equal expected payoff of 20000: (1) a certain option in which the subject obtains an expected utility of $u(20000)$ and (2) a probabilistic option in which she obtains an expected utility of $\rho \cdot u(20000 + \overline{m})$.

Past literature consistently demonstrates that approximately $40\,\% \sim 60\,\%$ of subjects prefer to choose a certain option to a probabilistic option in lottery games under "reasonable" support with the same expected payoff (Wang and Johnston, 1995; Ronnlund et al., 2005; Huang and Wang, 2010; Winskel et al., 2016; Stark et al., 2017; Fan, 2017; Korn et al., 2018b). Also, some other literature shows that when the support of a lottery game is highly skewed and asymmetric (e,g., huge return with tiny probability such as buying lottery tickets), most subjects prefer to choose a probabilistic option to a certain option (Grossman and Eckel, 2015; Astebro et al., 2015; Coricelli et al., 2018). Such a skewed and asymmetric lottery corresponds to the cases in our lottery where $\overline{m}$s are reported to be unreasonably high by subjects or groups (or corresponding ρs become so small) especially when they tell lies or keep

[9]Regarding the payment to each group, a group is asked to discuss and decide between a certain option and a probabilistic option as well as how to split the payment among themselves. The total payment each subject receives from the experiments is the sum of the payments from individual elicitation and the split from group one.

saying that option A is preferred to option B. We consider that approximately 40 % $\sim$ 60 % of our subjects should choose a certain option in our lottery game as far as the identified $\overline{m}$s in our elicitation are within a plausible range, being consistent with the previous results in lottery games under reasonable supports. Otherwise, most of our subjects might choose a probabilistic option, being consistent with the results in skewed and asymmetric lotteries.

In fact, we conducted the pilot experiments with 30 subjects and 10 groups in each society consisting of discounting elicitation and lottery procedures. We confirmed that subjects and groups understood what we ask in a face-to-face interview to reveal $\overline{m}$s. In particular, it appeared that they had neither incentives to tell a lie nor intentions for higher $\overline{m}$s by continuously saying that option A is preferred to option B in discounting elicitation. This may be because we successfully established a private space for each subject and each group in discounting elicitation and subjects trust us by noting that our experiments are conducted under public support and consent from Indonesia government and local community authorities. After discounting elicitation in the pilot experiments, we announced and implemented a lottery game based on $\overline{m}$s by asking subjects (groups) to choose between a certain option and a probabilistic option. The result was that 45 % (43 %) of subjects (groups) chose a certain option, being consistent with past literature of lottery games under reasonable support. Therefore, we judge that subjects neither tell a lie nor have any specific incentive to manipulate $\overline{m}$s in elicitation, and decide to implement a current experimental design.

Social value orientation games

We use the 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 for each of six primary questions (See figure 3.2). Subjects are randomly paired such that subjects do not know each other. Each question consists of a problem in which a subject decides to allocate points to herself and to the other subject in her pair by choosing one of nine options. After each subject has made her choices in all six questions,

she is asked to write the resulting distributions of money between herself and the other subject on the spaces provided on the right-hand side of the SVO instruction sheets (figure 3.2).

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, 1 point is equivalent to 200 Rp. The average payment in the SVO game is 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 $\bar{A}_o$, from the choices on the 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 the SVO angle, i.e., SVO $= \arctan \frac{\bar{A}_o - 50}{\bar{A}_s - 50}$. The subject is identified as an altruist if her SVO angle is greater than $57.15°$, prosocial if the angle is between $57.15°$ and $22.45°$, individualist if the angle is between $22.45°$ and $-12.04°$, and competitive if the angle is less than $-12.04°$.

3.2.3 Experimental procedures

We implemented field experiments and surveys by employing different approaches of random sampling to fisheries and agrarian societies in Karawang and to urban societies in Jakarta because they have different economic and sociodemographic characteristics. In Karawang, we first contacted the local government office to get approval to conduct field research, and 3 fisheries and 9 agrarian villages gave us approval. We obtained a list of residents from their local government offices and randomly selected the 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 an invitation letter. 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 the proportion of each occupational category in the total population of the Jakarta area by referring to the BPS-Statistics of DKI (Daerah Khusus Ibukota) Jakarta Province. Then, we randomly selected

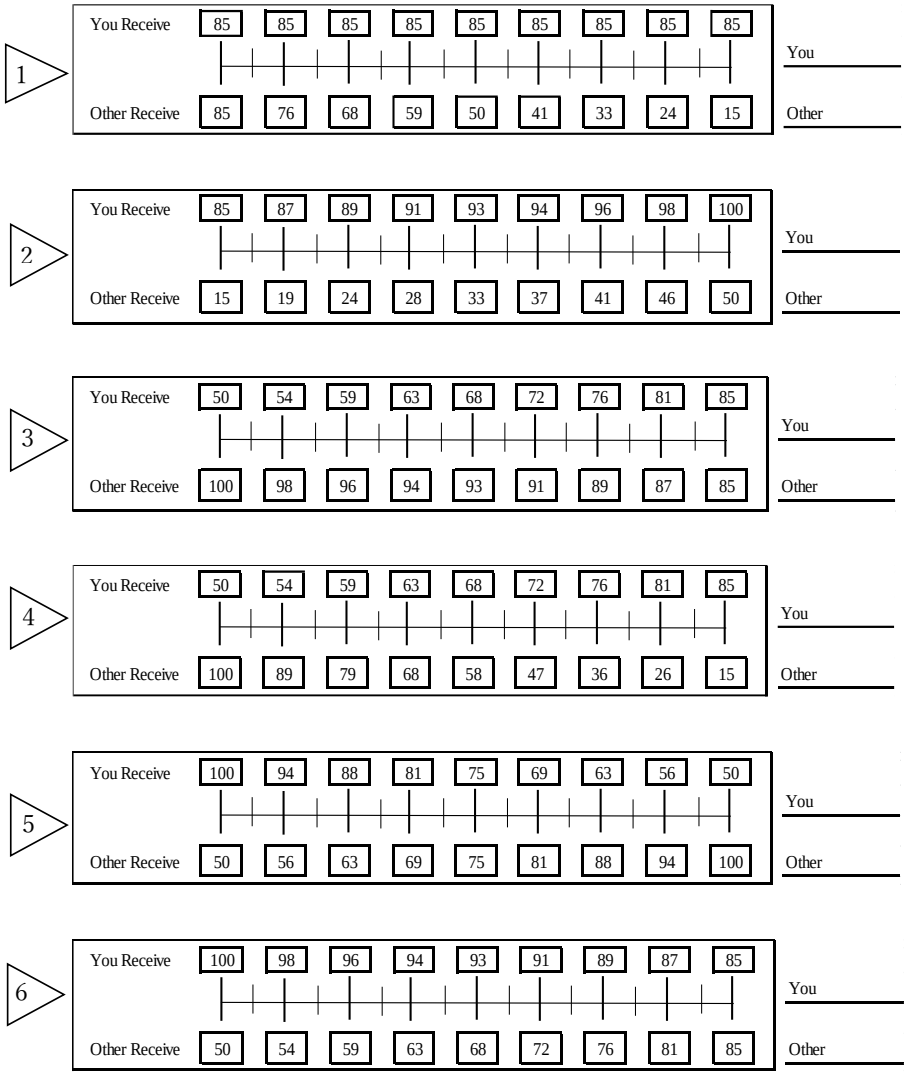


Figure 3.2: A social value orientation (SVO) game developed by Murphy et al. (2011)

several organizations or companies for each category and contacted their office to get approval to conduct 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) for subjects in the Indonesian language (Bahasa). The first author in this research explained the experimental procedures and rules by verbal presentation at a gathering room, and we also confirmed each subject's understanding by giving a series of quizzes about our experimental rules and procedures after the presentation. We first conducted the SVO games and then proceeded to the discounting elicitation experiments at the individual and group levels. In the discounting elicitation experiments, we randomly selected a subject and guided him/her to a separate room with complete privacy. We announced that 20 000 Rp ($\approx$ 1.50 USD) Rp shall be paid to each subject (each group) on an average, as far as subjects (groups) honestly and truthfully answer a series of questions and tasks in a face-to-face interview, reflecting their daily money senses and life. Before we started the discounting elicitation experiment, we clarified one more time whether subjects understood the procedure or not. We implemented the same procedures as we did at the individual level and ask the group whether to choose option A or option B. After completing a group discounting experiment, we conducted the lottery game to confirm whether $\overline{m}$ would be reasonable or not and to determine the experimental payments of discounting elicitation experiments. Finally, we conducted a field questionnaire survey to collect sociodemographic information each session. Each subject earned the average total experimental earnings of 70 000 Rp ($\approx$ 5.2 USD) from the SVO games, individual and group discounting elicitation experiments and the participation fee of 15 000 Rp ($\approx$ 1.1 USD). Figure 3.3 summarizes the experiment procedure for discounting elicitation. Approximately, $15 \sim 20$ subjects participated in each session of our experiment, and each session took $3 \sim 4$ hours.

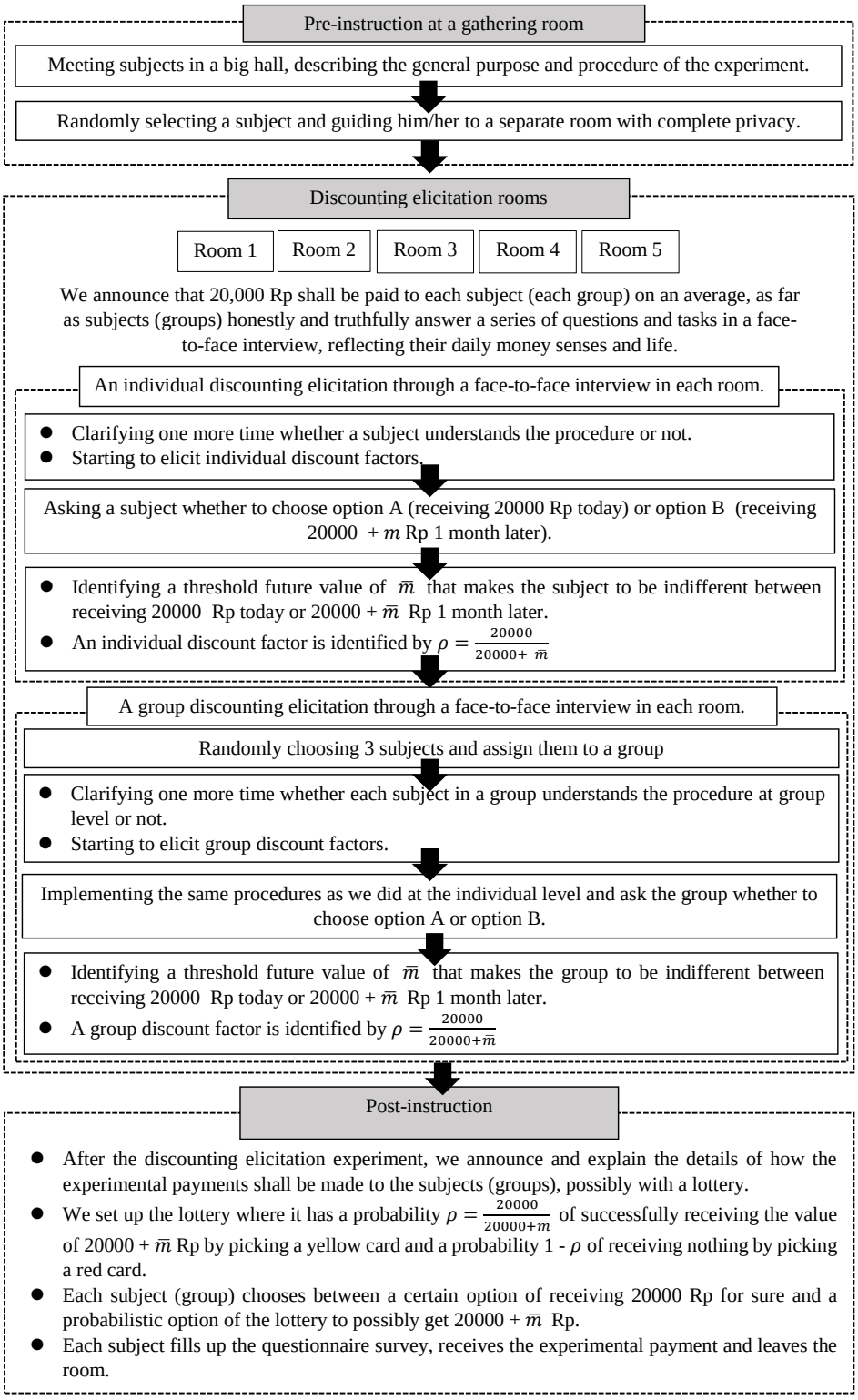


Figure 3.3: The experimental procedure for discounting elicitation

Table 3.1: Definitions of the variables used in the analysis

Variables	Description
Individual discount factor	Percentage rate of discounting the future monetary value that will definitely 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 definitely 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	Takes a value of one when the group of three people is in the agrarian society, otherwise zero.
Urban dummy	Takes a value of one when the group of three people is in the urban society, otherwise zero.

3.2.4 Empirical method

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

$$g_i = \beta_0 + \boldsymbol{\beta}_1 \mathbf{x}_i + \beta_2 z_i + \epsilon_i, \tag{3.1}$$

where subscript i represents each group's ID, g_i is an estimated group discount factor (the discount factors of the group to which individual i belongs) , $\mathbf{x}_i$ 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, number of household members, and occupation dummy. In addition, since the SVO categorizes individuals as altruist, prosocial, individualistic and competitive, and only 18 samples or 3.01 % of our data are identified as altruist or competitive, we merge the individualistic and competitive orientations into a "proself" category and merge altruist and prosocial into a "prosocial" category for simplicity of the analysis. Therefore, z_i is a dummy variable of SVO that takes a value of 1 when subject i is proself and is otherwise 0. β_0 ($\boldsymbol{\beta}_1$) and β_2 are the associated parameters (of vectors) to be estimated. Table 3.1 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 the types of beta densities, such as J shaped, inverted J shaped and U shaped (Ferrari and Cribari-Neto, 2004). The application of betafit regression appears to be valid because the distributions of the group discount factors estimated in our experiments are identified to be U shaped and inverted J shaped (see figure 3.4(a) and figure 3.4(b)). The maximum likelihood method is used to determine the unknown parameters $\beta_0, \boldsymbol{\beta}_1, and \beta_2$ in equation (2.1), with which the marginal effect of an independent variable on the group discount factors g_is is obtained.

The variables in Table 3.1 are hypothesized to affect group discount factors. We rank the individual discount factors of 3 subjects in a group into the lowest, middle and highest discount factors that are included as independent variables in equation (2.1). A group discount factor is the elicited value of discounting the future value at the group level, as described in section 3.2.2 and taken as a dependent variable in equation (2.1). We are interested in how individual discount factors and the associated rankings affect group discount factors. The average age, income, and number of household members at the 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. We define dummy variables for agrarian and urban societies, taking the fishery society as the reference group. The dummy variables are considered to see how a transition of societies from fisheries to farming and from farming to urban may have affected individual and group time preferences as well as their relations.

3.3 Results

Table 3.2 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 (highest) in the fisheries (agrarian) society, and those in the urban society are in the middle. In other words, both individual and group discount factors non-monotonically change as societies transition from fisheries to agrarian and from agrarian to urban. Some researchers may claim a possibility of reverse causality in the sense that short-sighted (far-sighted) people tend to be fishermen (farmers) reflecting the above results. However, this is not the case in our field experiments because migration among three societies is very low illustrated by the fact that fishermen, farmers and urban people have lived in 23, 21 and 20 years, in the same society, respectively and their fathers and grandfathers had been fishermen and farmers in fisheries and farming societies.

The results also show 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 indicates 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 discount factors 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 results reflect 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 highest group members).

Regarding age, the overall average age of the subjects is 43 years. The average age of farmers is the highest because farmers tend to work longer than fishermen and urban people. This finding can be seen in the "max" row under age in table 3.2, where the maximum age of farmers is 68 years. Moreover, the average ages of fishermen and urban people are not significantly different from each another since fishermen need to work in a labor-intensive manner and urban society attracts young people from rural areas to seek better jobs and opportunities. Table 3.2 also shows that 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 societies. 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 society is the largest. This

result reflects the fact that Jakarta is highly capitalistic and has a 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, which reflects the fact that most farmers' children do not live with their parents since they usually move to urban areas for better jobs and opportunities. In summary, the individual and group discount factors in the fisheries society are consistently the lowest, and fishermen are relatively young and earn low incomes compared with those of farmers and urban people.

Figures 3.4(a) and 3.4(b) show the frequency distributions of the individual and group discount factors for fisheries, agrarian and urban societies. The vertical axis denotes the percentage of frequencies, and the horizontal axis denotes the discount factor. Regarding individual discount factors, figure 3.4(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 3.4(b) shows that the highest spike in the frequency distribution of group discount factors occurs around 0 for every society, and the spikes 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 3.2. Based on the summary statistics, figures 3.4(a) and 3.4(b), we run a Mann-Whitney test to examine whether the distributions of the individual and group discount factors for any pair of 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 fisheries vs. agrarian, fisheries vs. urban and 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 tests suggest that individual and group discount factors vary among the three societies. To further characterize the relationship between group and individual discount factors, we run betafit regression together with other independent variables. Table 3.3 presents the marginal effects of independent variables on the group discount factors

Table 3.2: Summary statistics of the 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

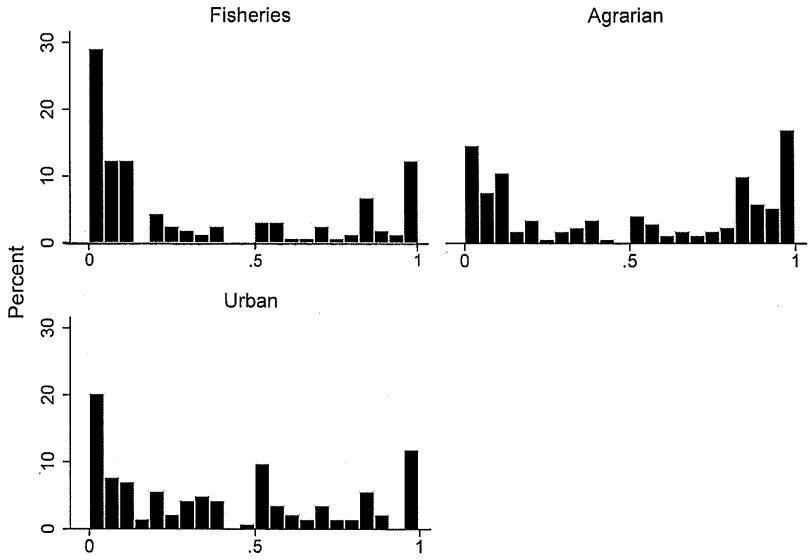
[1] Average in parentheses for group and individual discount factors.

[2] SD stands for standard deviation.

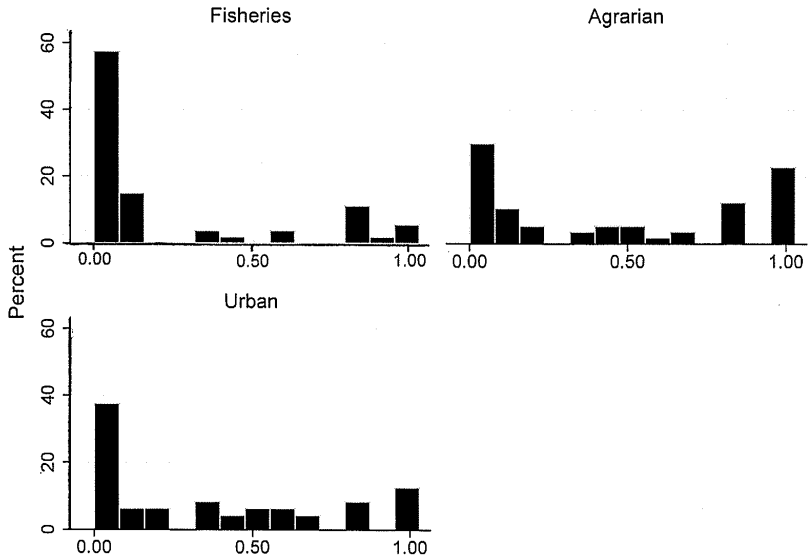
[3] Median in parentheses for the variables other than the group and individual discount factors.

Figure 3.4: Frequency distributions of individual and group discount factors across the three societies

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



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



with several model specifications. At first, we include only the agrarian and urban societies as dummy variables with fisheries as the reference in model 1 in table 3.3 to account for possible concerns about effects of posttreatment variables. Previous literature explains that posttreatment effects occur as a bias for the estimates of treatment variables when any independent variable that get affected by the treatments is included in a regression together with treatment dummies (Montgomery et al., 2018). Some researchers may claim a possibility of posttreatment effects in our research, we consider society dummy variables as treatments that might be considered to influence sociodemographic variables. In model 1, we find that society dummy variables are observed to be significant where a group discount factor in the fisheries society is 0.185 and 0.128 lower than the agrarian and urban societies, respectively.

We now exclude society dummy variables in model 2 in table 3.3 to focus on examining how sociodemographic variables and the ranking of individual discount factors in a group affect group discount factors. The results show that group members with the lowest discount factors and middle discount factors and the number of proself members are statistically significant, playing important roles in determining the group discount factors. In addition, the number of household members influences group discount factors to a certain extent.[10] In particular, the results indicate that a group discount factor decreases by 0.0185 (0.0542) 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) with an increase in the number of household members (in the number of prosocial members in a group).

To check the robustness of our results, we include all the independent variables as well as the agrarian and urban societies as dummy variables with fisheries as the reference in model 3, in addition to the baseline specification of model 2. Model 3 is estimated to examine how the transition of societies

[10]For the robustness check, we have tried to include household members as an independent variable in the regression, using the organization for economic cooperation and development (OECD) equivalence scale. While the OECD equivalence scale uses a criterion of children aged under 14, our data only contains the information about children aged under 12 within a household. This is because children in the fisheries society in Indonesia aged 12 graduate from elementary schools and they start to help their parents by working in fishery markets or other fisheries activities. Despite the difference in definition of children data between our research and OECD scaling, we have run a regression for robustness check using the OECD equivalence scale by considering the children aged under 12 as those aged under 14 in OECD scales, and we confirm that the results remain consistent and robust.

Table 3.3: Marginal effects of individual discount factors on group discount factors in betafit regressions

Variables	Model 1	Model 2	Model 3	Types of societies		
				Model 4 (Fisheries)	Model 5 (Agrarian)	Model 6 (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)	(0.014)	(0.023)	(0.025)
Number of proself members		−0.036*	−0.029	−0.038	−0.057	0.032
		(0.020)	(0.019)	(0.026)	(0.036)	(0.034)
Society dummy variables (The reference = the fisheries)						
Agrarian	0.185***		0.096**			
	(0.049)		(0.049)			
Urban	0.128***		0.086*			
	(0.047)		(0.046)			
Observations	159	159	159	54	57	48

***significant at 1 % level, **significant at 5 % level and *significant at 10 % level

from fisheries to agrarian and from agrarian to urban may influence group time preferences. In model 3, the same qualitative results are observed as those in model 2, even with the agrarian and urban society dummy variables. The results in model 3 of table 3.3 consistently show that a group discount factor decreases by 0.0208 (0.0539) when the lowest (middle) individual discount factor in the group declines by 0.100. An increase in several household members in a group leads to a 0.025 decrease in the group discount factor. Furthermore, the society dummy variables remain significant in the sense that a group discount factor in the agrarian (urban) society is likely to be 0.096 (0.086) higher than that in the fisheries society. This result shows that although we include society dummy variables in the regression, the lowest and middle discount factors of group members continue to affect the group discount factors, and the types of societies characterize group time preferences, which is consistent with Nguyen (2011) and Johnson and Saunders (2014).

We run separate regression models as models 4, 5 and 6 in table 3.3 for fisheries, agrarian and urban societies, respectively, because we find that the farmer and urban dummy variables are significant in models 1 and 3, enabling us to examine whether the determinants of group discount factors differ across the three societies. Model 4 in table 3.3 exhibits a qualitatively identical result with that of baseline specification in model 2, indicating that the group discount factor in the fisheries society decreases by 0.028 (0.056) when the lowest (middle) individual discount factor in a group declines by 0.100. On the other hand, the results in models 5 and 6 are similar in that the middle discount factor in a group is the only significant determinant. The result of model 5 in table 3.3 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 the number of household members decreases a group discount factor by 0.055. Finally, model 6 demonstrates that a group discount factor decreases by 0.038 when the middle individual discount factor in the group declines by 0.100.

Overall, our statistical analysis demonstrates that individual and group discount factors in the fisheries (agrarian) society are the lowest (highest), while those in the urban society are in the middle. Table 3.3 demonstrates that comparatively short-sighted people with the lowest and middle individual discount factors in a group remain consistently significant in models 2 and 3, while the society dummy

variables are statistically and economically significant in models 1 and 3. The fisheries society (model 4) exhibits the same qualitative result as those of model 3 in that the lowest and middle individual discount factors play significant roles in determining group discount factors. The agrarian and urban societies (models 5 and 6) consistently show that the middle individual discount factor is the only significant variable characterizing the group discount factors. Although we have tried a variety of different regression specifications, our results in models 1-6 generally remain consistent and robust with respect to the roles of individual discount factors and society dummy variables in determining group discount factors. Some socioeconomic variables and other factors such as number of household members and number of proself members in a group are also identified to be statistically and economically significant depending on the specifications of the betafit regressions.

There are some possible explanations for our findings with respect to the roles of individual discount factors in determining 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 their entire daily income within that day and do not have motivation to save money for their future since they simply expect that they can continue fishing the next day to generate money for living. Additionally, most fishermen in the region believe that the fish stock is inexhaustible because God always provides fish in the sea (our questionnaire survey finds that 80.5 % of the fishermen hold this belief). Therefore, the daily life practices, the belief of an inexhaustible fish stock and their cultures make fishermen more shortsighted than farmers and urban people. This result 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 to maintain healthy ocean and environmental conditions.

Fishermen in Karawang work in a fishing vessel as a group of 3 to 20 fishermen. In this environment, fishermen face two types of competition: intra-vessel and inter-vessel. In intra-vessel competitions, each fisherman in the same vessel has different types of tasks and job levels, competing with each other to get promoted. On the one hand, inter-vessel competition occurs when a group of fishermen in a vessel compete with other groups in different vessels for better fishing spots and larger harvests. Carpenter and Seki (2011) and Huang and Smith (2014) illustrate that groups of fishermen compete

with each other to catch more fish and that the actions taken by groups of fishermen depend on the actions of other groups. Because the fishermen in our study region are under severe intra-vessel and inter-vessel competition, they become familiar with being or tend to be shortsighted at the individual and group levels in the way that comparatively short-sighted members in a group are more influential in determining the group discount factor.

Farmers in Karawang need to have patience and consideration for the future because farmers must wait six months for a series of cultivation and growth to harvest crops as one cycle. Moreover, they need to address substantial uncertainty. The major sources of uncertainty for farmers are natural disasters, which can destroy all agricultural production in a field. Although fishermen face the same type of risks and uncertainty from natural disasters, they can return to the sea and fish within a few days after a natural disaster. This is a fundamental difference between farmers and fishermen. In addition, farmers need to maintain their arable land for cultivation and harvesting since the land is their own property. Therefore, farmers in Karawang are motivated to save, invest and accumulate capital and wealth by saving gold in 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 address 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. Overall, the aforementioned practices and cultures of the agrarian society in Karawang appear to induce farmers to be the most farsighted at the individual and group levels.

Finally, urban people in Jakarta usually live or work in an environment that is surrounded by technology and detached from nature. Urban people in Jakarta do not usually feel the limitations or constraints of basic needs, such as food, electricity and water, on a daily basis, whereas the fisheries and agrarian societies have some experience with tackling nature and feeling the limitations of various resources. In urban life in Jakarta, rice, meat and fish are readily available in supermarkets and department stores, and such stores usually do not run short of any product because of national and international trade. In addition, by simply pressing a button, every energy source, such as electricity,

becomes effective. This type of life implies that the basic needs of urban people tend to be readily available or become effective soon after their requests, which is not the case in fisheries and agrarian societies. On the other hand, urban people need to wait one month to receive salaries and also need to study and improve themselves to become capable and competitive in the workplace of urban life. Therefore, urban life comes with a mixture of being shortsighted with regard to basic needs and being farsighted with regard to their career. Therefore, we conjecture that the individual and group discount factors in urban societies are in the middle between those of fisheries and agrarian societies.

Galor and Ozak (2016) theorize that a production mode characterizes evolution of people's time preferences, deriving that an endowment (investment) mode of production induces people to evolve being short-sighted (far-sighted). Following the definitions of production modes explained in Galor and Ozak (2016), a fisheries (farming) society is considered to employ an endowment (investment) mode of production, while an urban society is considered to employ a mixture of both endowment and investment modes. With such interpretations of production modes in each society, our results follow their theory, because we find that individual and group discount factors both increase as societies transition from an endowment mode (fisheries) to an investment mode (agrarian) and then decrease as societies transition from an investment mode (agrarian) to a mixture of endowment and investment modes (industrial one). Thus, the results in our experiments can be considered an important evidence to demonstrate and explain determinant factors and evolution of human time preferences by modes of production in societies at individual and group levels.

Another interesting finding is that comparatively shortsighted people (the lowest and middle) are more influential than farsighted people in determining group time preferences in models 2, 3 and 4. This result is in line, to a certain extent, with Ambrus et al. (2015) and He and Villeval (2017), which elicit individual and group social preferences based on gift exchange, ultimatum and modified dictator games by asking subjects to allocate resources to themselves and others. To elicit individual social preferences, each subject plays a series of the games indicated above. To elicit group social preferences, a group of 5 members or 3 members is formed, and each group member is ranked with respect to social preferences on the basis of his choices in the individual games (Ambrus et al., 2015; He and Villeval, 2017). 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 be 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 too early to conclude that the unique result in our analysis of group time preferences is generalizable; however, it may at least 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 the course of human history, through cultural and economic development. More specifically, individual and group discount factors both increase as societies transition from fisheries to agrarian and then decrease as societies transition from agrarian to industrial in that individual and group discount factors are the lowest (highest) in the fisheries (agrarian) society while those in the industrial society 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 to be important evidence of the factors influencing resource sustainability and economic development in each type of societies and of the further evolution of human time preferences in the future.

3.4 Conclusion

Previous research claims importance in considering the transition of societies from rural to urban to analyze social preferences and behaviors, demonstrating that people in urban societies are becoming more proself (Ma et al., 2015; Shahrier et al., 2016, 2017; Timilsina et al., 2017). This paper considers three societies, namely, fisheries, farming and urban, as proxies of hunter-gatherer, agrarian and industrial societies, well representing the distinct cultures and daily practices that might shape human time preferences and behaviors. We have conducted a field experiment to elicit individual and group

discount factors in the three societies of Indonesia. We find that individual and group discount factors are the lowest (highest) in the fisheries (agrarian) society, while those in the urban society are in the middle. We also find that the determinants of group discount factors differ across the three societies: members with the lowest and middle discount factors in a group play crucial roles in determining the group discount factor in the fisheries society while only the member with the middle discount factor is 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 and that comparatively shortsighted people (the lowest and middle) are more influential than farsighted people in determining group time preferences.

Finally, we note some limitations and possibilities for future studies. In this research, statistical analysis is the main tool used to characterize group time preferences through using 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 the qualitative-deliberative analysis from psychology on the transcribed group discussions, we should be able to identify how group members reach an agreement or compromise about group discount factors. If such an 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 influence the 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 examining individual and group time preferences and their relation. Our results indicate that individual and group time preferences, as well as their determinants, evolve as societies change.

Chapter 4

Individual time preferences of married couples in a fishing society

4.1 Introduction

The overexploitation of marine resources in Indonesia and the rest of the world is becoming a more serious concern over time. FAO Fisheries and Aquaculture Departement (2018) reports that 33.1 % of fish stock is caught at biologically unsustainable levels, and some important fish resources have declined due to their overexploitation. Akpalu (2008) and Fehr and Leibbrandt (2011) show that fishermen's time preferences are important for the sustainability of fish stocks because shortsighted fishermen take more fish by using nonselective gears, more advanced technologies and/or illegal methods without considering sustainability. While the fishing practices of fishermen are demonstrated to be linked with their own time preferences, it may also be the case that fishermen's time preferences are influenced by their wives and other factors, or vice versa, through their interactions and daily life at the household level. In other words, one of the main reasons for the overexploitation of marine resources is directly linked to shortsightedness of fishermen and their wives together within their relationship. Therefore, this paper addresses the individual time preferences of married couples (fishermen and their wives) in a fishing society as they relate to the conservation and sustainability of marine resources.

Past studies show that household economic decisions and situations regarding risks, savings and education are highly correlated with household members' time preferences (Tanaka et al., 2010; Carlsson et al., 2012; Eckel et al., 2013; Yang and Carlsson, 2016). Tanaka et al. (2010) examine household time preferences in Vietnam, showing that people who have more income tend to be farsighted. Eckel et al. (2013) find that time preferences among poor households in Canada are associated with educational investments, reporting that farsighted people tend to invest more in household members' education. Carlsson et al. (2012) and Yang and Carlsson (2016) investigate the time preferences of married cou-

ples associated with household joint decisions in China. They report that individual time preferences of husbands and wives do matter, but wives are less influential than husbands in determining joint decisions.

Several works focus on examining fishermen's time preferences. Akpalu (2008) and Fehr and Leibbrandt (2011) analyze the correlation between fishermen's time preferences and fishing practices, and they find that shortsighted fishermen are likely to infringe fishing regulations by using nonselective gears and/or other illegal methods. Javaid et al. (2016) find that shortsighted fishermen in Zanzibar tend not to invest in fishing capabilities such as vessels, gears and technologies, so that such shortsighted fishermen are not successful in harvesting fish efficiently. Johnson and Saunders (2014) estimate and compare time preferences of fishermen and divers, finding that fishermen are more shortsighted than divers, since divers are accustomed to be farsighted for the preservation of a healthy ocean in sustaining their job. Nguyen (2011) compares the time preferences of fishermen and other occupations such as farmers, traders, businessmen and government officers in Vietnam and shows that fishermen that participated in conservation programs for fish stock are more farsighted than people with other occupations. Teh et al. (2014) examine fishermen's time preferences in relation to types of fishery management system in Fiji and Malaysia and demonstrate that fishermen in customary marine tenure management are more shortsighted than those in open access management. In summary, these previous findings suggest that working environments and experiences characterize fishermen's time preferences and fishing practices.

None of the previous studies have addressed time preferences of fishermen and their wives in a fishing society, despite the importance of their impact for the sustainability of marine resources. Given this state of affairs, we empirically and experimentally characterize the individual time preferences of married couples (fishermen and their wives) and seek to identify what factors induce them to be sufficiently farsighted to ensure the sustainability of marine resources. To this end, we conduct an experiment to elicit individual discount factors with 200 married couples (200 fishermen and 200 fishermen's wives) in an Indonesian fishing society, Karawang regency (see figure 4.1).[1] We find that

[1]In Karawang regency, small-scale fisheries are dominant and vital to supporting families and com-

fishermen's discount factors are slightly higher than those of their wives on average, with a positive correlation between the two. We also find that the couple's incomes have idiosyncratic influences on their individual time preferences. While fishermen's incomes weakly influence only their wives' time preferences, wives' incomes significantly and positively cause both fishermen's and wives' time preferences to be farsighted. The betafit regression demonstrates that a wife's (fisherman's) discount factor increases by 5.1 % (5.6 %) when a wife's income increases by 1 million Rp. This result suggests that economic empowerment of fishermen's wives is important for the sustainability of marine resources and societies in Indonesia.

4.2 Overview of fisheries in Indonesia

Indonesia is the world's largest archipelagic country. It has the second longest coastline, with 17 504 islands and 99 093 km of coastline. The total area of Indonesia water is 6 315 222 km^2, and the available fish resources are 12.5 million ton per year (Ministry of Marine Affairs and Fisheries Republic of Indonesia, 2015a). The large availability of fish places Indonesia as the second largest seafood producer in the world. However, it is reported that such a great resource does not necessarily lead Indonesian fishermen to be more prosperous. The number of Indonesian fishermen in 2015 is 2 275 139 with an average income of 1 032 080 Rp per month, which is below the regional minimum income (1 997 819 Rp). Approximately 25 % of all poor people in Indonesia are from fishing societies (BPS-Statistics Indonesia, 2017).

Our study field is Karawang regency in the north part of Jawa Barat Province, Indonesia (see figure 4.1). This regency is located between 107°2′ and 107°40′ east longitude, and 5°56′ and 6°34′ south latitude. The population in 2016 was 2.3 million people with the density of 1309 people per km^2 (BPS-Statistics of Karawang Regency, 2017), and 168 901 people are working in agriculture and fishery sectors (Karawang Regency Government, 2015). Fishermen in Karawang are categorized to be in

munities because they provide food and nutrition, employment opportunities and other multiplier effects to economic development in coastal communities. In fact, 90 % of all fishermen and fish workers in capture fisheries around the world are reported to engage in small-scale fisheries, and approximately 50 % of fish workers are female (FAO, 2015).

small-scale fisheries since they operate fishing vessels less than 10 gross tonnage and catch fish on a daily basis (Goverment of Indonesia, 2016).

Most fishermen are accustomed to using up their daily salary because they believe that they will earn money by fishing the next day and do not have a strong motivation to save their income for future (Muflikhati et al., 2010; Yasin, 2013; National Development Planning Agency Republic of Indonesia, 2014b). It is also reported that fishermen tend to buy luxury goods in a good harvest season, while they sell the luxury goods for survival when they face or continue to have a bad season (Nugroho, 2004). In the worst-case scenario, such fishermen borrow from a loan shark when they have nothing in their home. Such harvest seasonality and fishermen's shortsightedness in fishing villages cause fishermen to be poorer and to harvest more marine resources without considering sustainability, representing a typical lifecycle or pattern in Indonesian fisheries.

It is established that the role of fishermen's wives is crucial since they take care of their children and support their husbands in fisheries (Zhao et al., 2012; Harper et al., 2013; Febri et al., 2017). In most cases, they are also in charge of managing household financial matters, and they are more knowledgeable and sensitive to household financial situations than their husbands. Depending on their financial situation, fishermen's wives are motivated to contribute to households by generating additional income (Febri et al., 2017). Table 4.1 summarizes the information regarding occupation types of fishermen's wives in our study field, Karawang. Out of 200 wives, 142 are housewives (not working), whereas the rest of 58 wives are working as traders, fish processors, entrepreneurs, net menders, trap fishers and other occupations. In general, fishermen's wives in Karawang usually face difficult economic situations to control and allocate money for daily needs, children's education and household appliances under tight budget limitations.

Figure 4.1: The study area: Karawang

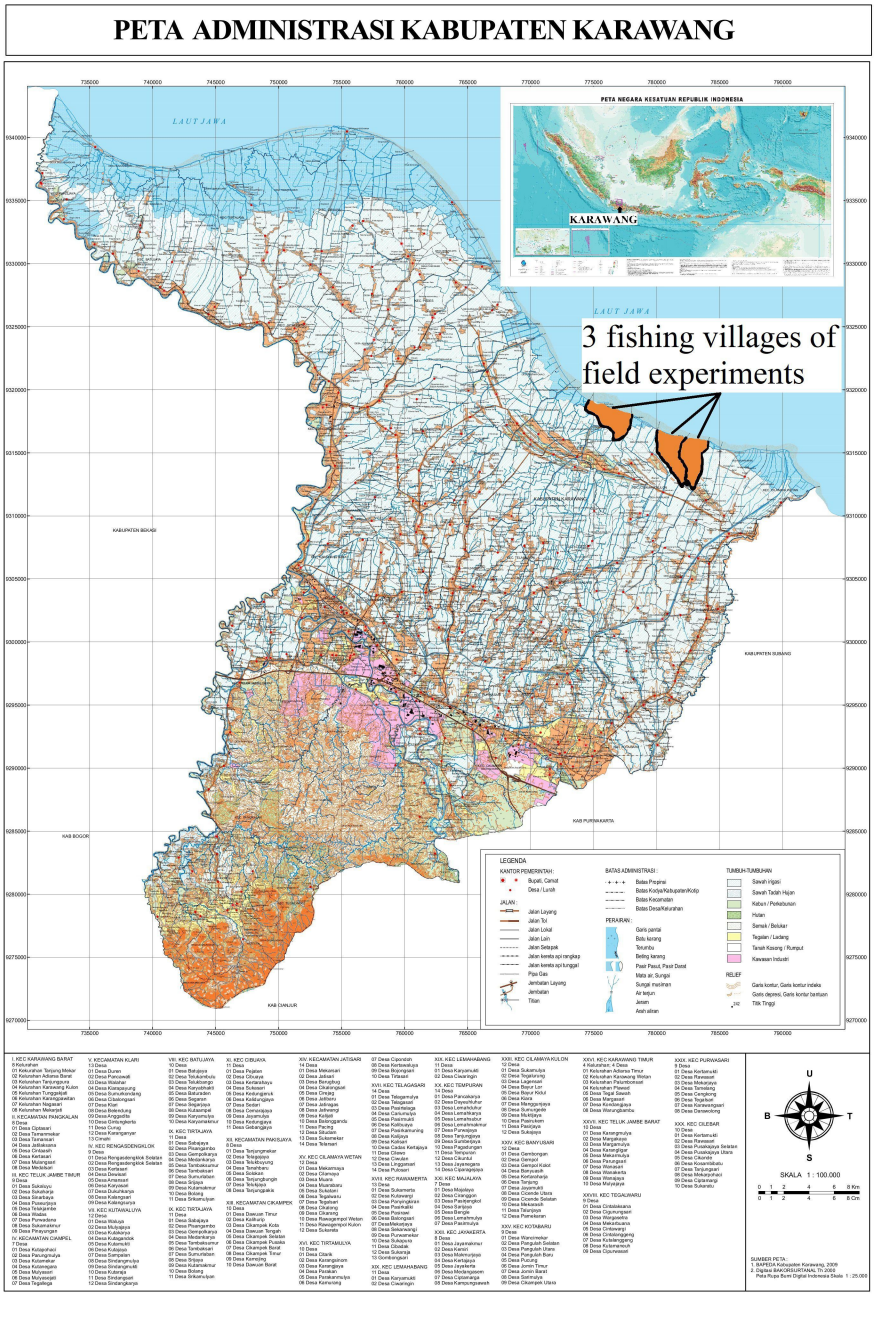


Table 4.1: Occupation types of fishermen's wives

Occupation types	Number of wives	Percentage
Entrepreneurs	4	2.00
Fish processors	12	6.00
Net menders	3	1.50
Traders	36	18.00
Trap fishers	1	0.50
Other occupations	2	1.00
Housewives (not working)	142	71.00
Total	200	100.00

4.3 Experimental design and procedure

4.3.1 A discounting elicitation experiment

We employ an experimental procedure to elicit individual time preferences, called a discounting elicitation experiment, following Hernuryadin et al. (2019, 2020). This procedure is different from a multiple-price list (MPL) procedure as implemented by Coller and Williams (1999); Harrison et al. (2002) and Tanaka et al. (2010). The MPL procedure provides payoff tables with a list of questions and interest rate information. The MPL procedure normally requires subjects to have a bank account, enabling them to receive experimental payments in the future. We initially sought to employ the MPL procedure since a majority of field experiments implement the MPL to elicit time preferences (Tanaka et al., 2010; Nguyen, 2011; Johnson and Saunders, 2014; Javaid et al., 2016).

In an Indonesian fishing society, it is difficult to apply the MPL procedure due to the working schedule and daily lifestyle of fishermen and their wives (for instance, only 30 % of fishermen households have bank accounts). To make matters worse, in the pilot experiment, subjects could neither follow nor understand the MPL since the procedures do not match their life practices (or experiences), and their educations are limited. Most subjects in the MPL pilot experiment had difficulty following the questions and gave many inconsistent answers. The same type of occurrences in the MPL is reported in some previous research such as Andersen et al. (2006, 2007) and Duquette et al. (2011). Therefore, we design and institute a simple discounting elicitation experiment that consists of face-to-face interviews

to ask fishermen and wives to choose between receiving money today and more money one month later following the same procedure employed in Hernuryadin et al. (2019, 2020).

We employ a face-to-face interview under complete privacy for discounting elicitation because the method is reported to establish an environment of trust and confidentiality and enables us to effectively elicit people's true thoughts and preferences, even when subjects are not fully motivated to express their thinking or preferences by monetary incentive, or when the situations in experiments are hypothetical (Matlay, 1999; Frederick et al., 2002; Opdenakker, 2006; Cardenas and Carpenter, 2008; Zappes et al., 2013; Leavy, 2014; Falk et al., 2018; Hernuryadin et al., 2019, 2020).

At the beginning of the experiment, we explain that the experiment is conducted under public support and consent from Indonesian government and local community authorities and that subjects would receive 20 000 Rp ($\approx$ 1.50 USD) on average as long as they seriously and honestly answer a series of questions and tasks in a face-to-face interview based on their daily money senses and life. In this explanation, we do not purposely detail how experimental payments shall be made to the subjects at a specific time and date. After this explanation, we start conducting a discounting elicitation experiment by asking the subjects a series of questions. Since our subjects are fishermen and their wives in a fishing society who have limited education, we are careful to be concise and easy to follow in conducting experiments and explaining the instructions.

In the discounting elicitation experiment that consists of face-to-face interviews, an interviewer starts eliciting a subject's time preference in a separate room under complete privacy where he or she is asked to make a choice between options A and B:

Option A: You receive 20 000 Rp today.[2]

Option B: You receive $20000 + z$ Rp in one month.

Here, the initial value of z, denoted by z_0, starts with 4000. When a subject prefers option A to option B with $z = z_0 = 4000$, we proceed to the next question, where the value of z in option B is increased by 4000, i.e., $z_1 = z_0 + 1 \cdot 4000 = 4000 + 4000 = 8000$, and the subject is again asked to answer

[2] 1 USD ($\approx$ 13 350 Rp) in January 2017.

the question with the updated value of $z_1 = 8000$. This process of asking the subject a series of questions by updating the value of $z = z_n = z_0 + n \cdot 4000$ continues for arbitrary n times, as long as she keeps choosing option A up to the nth questions. We shall stop the process when the subject chooses option B for the first time at the $n+1$th question, where the value of z in option B is updated with $z_{n+1} = z_0 + (n+1) \cdot 4000$. In this case, we consider that her preference over options A and B is reversed between nth and $n+1$th questions, and there should exist a threshold future value of $\overline{z}$ between z_n and z_{n+1} that makes the subject indifferent between receiving 20 000 Rp today and $20000 + \overline{z}$ Rp one month later. Therefore, as a final process, we interview the subject and ask her some final questions by gradually adjusting the value of z between z_n and z_{n+1} up until each interviewer identifies the threshold value of $\overline{z}$. The subject's individual discount factor shall be calculated to be $\rho = \frac{20000}{20000+\overline{z}}$, which follows a definition of discount factors defined by Sanni et al. (2009) and Smith (2014).[3]

To confirm whether the $\overline{z}$s we have elicited in the discounting elicitation are within a plausible range or not, a lottery game, where a deterministic option and a probabilistic option with the same expected payoff are prepared, is implemented at the end of each session. We explain that a lottery game is organized and employed on the basis of the $\overline{z}$s after subjects complete their tasks in the discounting elicitation experiment.[4] We set up the lottery where it has a probability $\rho = \frac{20000}{20000+\overline{z}}$ of successfully obtaining the value of $20000 + \overline{z}$ Rp by picking a yellow card in the bag and a probability $1 - \rho$ of receiving no reward by picking a red card with the expected payoff of 20 000 Rp. For this purpose, we prepare 20 yellow cards and $\frac{\overline{z}}{1000}$ red cards in the lottery depending on the individual threshold value of $\overline{z}$ and count these cards in front of each subject before putting those cards into a bag.[5] After we finish counting and setting the cards in the bag, we explain the lottery's rules and ask each subject whether

[3]The definition of a discount factor is the present value of one unit of currency at a specific date in the future (Sanni et al., 2009; Smith, 2014). Because our experiment only focuses on time preferences, not on curvatures of utility functions, we follow the definition without assuming any utility function in this research.

[4]Subjects get to know, for the first time, about the existence of the lottery game after the discounting elicitation experiment. Therefore, the lottery games never contaminate the $\overline{z}$s elicited in the discounting elicitation experiment.

[5]Most subjects are not familiar with the concept of probabilities. Consequently, we show and calculate the number of yellow and red cards in front of them.

he or she chooses a deterministic option of receiving 20 000 Rp for sure or a probabilistic option of the lottery to possibly get $20000 + \overline{z}$ Rp.

A subject who chooses the deterministic option receives 20 000 Rp for sure, while a subject who picks the lottery will receive the reward based on the outcome of the lottery. The ρs elicited in this research could be considered appropriate as probabilities for our lotteries even under expected utility framework in choice under uncertainty (see, e.g., Mas-Colell et al., 1995). Suppose that $u(20000)$ and $u(20000 + \overline{z})$ are the utility levels when a subject receives 20 000 Rp and $20000 + \overline{z}$ Rp, respectively. If our discounting elicitation is sufficiently reasonable for subjects to truthfully reveal $\overline{z}$s and the associated ρs following Sanni et al. (2009) and Smith (2014), the subjects in our lottery game will face two options with the same expected payoff of 20000: (1) a deterministic option in which the subject gains an expected utility of $u(20000)$ and (2) a probabilistic option in which he or she gains an expected utility of $\rho \cdot u(20000 + \overline{z})$.

Previous studies reveal a consistent result that the percentage of subjects choosing a deterministic option to a probabilistic option is approximately $40\,\% \sim 60\,\%$ in lottery games under "plausible" range with the same expected payoff (Wang and Johnston, 1995; Ronnlund et al., 2005; Huang and Wang, 2010; Winskel et al., 2016; Stark et al., 2017; Fan, 2017; Korn et al., 2018b). On the other hand, another group of studies demonstrates that most subjects choose a probabilistic option when the structure of lottery games is highly skewed and asymmetric (e,g., a high reward with a tiny probability, such as buying lottery tickets) (Grossman and Eckel, 2015; Astebro et al., 2015; Coricelli et al., 2018). Our lottery can be considered such a skewed and asymmetric case when subjects report $\overline{z}$s to be unreasonably high (and the corresponding ρs to be very small) or subjects just keep choosing option A in the discounting elicitation. In our lottery, we consider that a deterministic option should be chosen by subjects with approximately $40\,\% \sim 60\,\%$ when $\overline{z}$s elicited from subjects are in a reasonable range, being in line with the previous results in the lottery games under plausible range. If the $\overline{z}$s and ρs are unreasonable, a probabilistic option shall be more likely to be chosen by subjects, being in line with the previous results in skewed and asymmetric lotteries.

The pilot experiment of the above discounting elicitation and lottery procedures was conducted

with 40 subjects as a trial. We confirmed that what we inquire in a face-to-face interview to elicit $\overline{z}$s was well understood by subjects in this trial. In particular, it appeared that subjects did not have any incentive to tell a lie or any motivation to keep choosing option A for higher $\overline{z}$s. This may be due to the fact that we successfully created a private space for each subject during discounting elicitation and that subjects trusted us by noting that our experiments are conducted under public support and consent from Indonesian government and local community authorities. After subjects completed their task in the trial discounting elicitation, we also informed them that a lottery game based on the $\overline{z}$s would be conducted by asking subjects to select between a deterministic option and a probabilistic option as explained above. The result was that 49 % of subjects chose a deterministic option, consistent with previous literature in lottery games under reasonable range. Therefore, we judge that subjects neither lie nor have any specific incentive to manipulate $\overline{z}$s in elicitation and decide to employ a current experimental design.

In the MPL procedures, a list of question which consists of immediate and delay payment is provided to subjects in survey formats. The subjects are asked to reveal their preferences between immediate and delay payments with various time horizons and payment structures for a different number of such questions in a payoff list, depending on the context of each study (see,e.g., Coller and Williams, 1999; Harrison et al., 2002; Johnson and Saunders, 2014; Teh et al., 2014). The choice at which the subject switches to prefer the delay option ($= m + \Delta$) to the immediate one ($= m$) is calculated as a subject's discount factor (or discount rate). The subject's discount factor (or discount rate) is approximated by the switching interval bounded between m and $m + \Delta$ through $\rho \approx \frac{m}{m+\Delta}$ or a midpoint of $\frac{m+(m+\Delta)}{2}\left(= m + \frac{\Delta}{2}\right)$ through $\rho \approx \frac{m}{m+\frac{\Delta}{2}}$ (Coller and Williams, 1999; Harrison et al., 2002; Johnson and Saunders, 2014; Teh et al., 2014). The MPL procedures do not always elicit the switching question or interval, because subjects sometimes keep choosing the immediate options for all questions in a payoff list, leading to a problem of censoring or bound assumptions (Johnson and Saunders, 2014; Teh et al., 2014; Javaid et al., 2016).

We design the face-to-face interviews and the interview format to elicit individual time preferences of fishermen and wives in our discounting elicitation, following the same method used in Hernuryadin

et al. (2019, 2020). To ensure that subjects understand and follow the discounting elicitation experiment, we explain the rules and ask each subject a question between the immediate and delay payments by an individual interview with complete privacy (instead of presenting a payoff list). We ask a subject whether he or she choose option A (20000 Rp today) or B ($20000 + z$ Rp one month later). As long as the subject chooses option A to B, we continue the question process along with an update of increasing the value of z by 4000. When the subject chooses option B for the first time, we shall stop the update process. As a final step, we closely interview the subject by gradually adjusting the value of z to identify the threshold value, $\overline{z}$, at which the subject becomes indifferent between options A and B. As the result, the subject's discount factor shall be calculated to be $\rho = \frac{20000}{20000+\overline{z}}$. In this way, our elicitation does not face the "inconsistent choice" problems and censoring issues that arise in the MPL procedures. These are the fundamental differences between MPL and our methods, and we appear to successfully identify people's discount factors without relying on certain approximations and/or assumptions.

4.3.2 Experimental procedure

To conduct a field experiment in an Indonesian fishing society, we first visited the fishing village offices to obtain consent. Among the 13 fishing villages in Karawang, 3 fishing village offices gave us approval and provided a list of households of fishermen. We randomly picked a required number of households based on the population of each village. We invited a married couple from each household to take part in our experiment by delivering letters. In total, 200 married couples (200 fishermen and 200 fishermen's wives) participated in our field experiment.[6] The field experiments were held at the fishing village halls in each place. We conducted a discounting elicitation experiment and a field questionnaire survey to get sociodemographic information in each session. After completing the experiment, we asked each subject to leave the experimental site quickly to avoid interactions between subjects.

A printed instruction of the discounting elicitation experiment was provided to subjects in the In-

[6]Due to our budget limitation, we employed only 200 couples. Some couples showed up in the experimental site but could not participate in the experiment due to our budget issue. In such a case, we gave them a payment for showing up and asked them to go home.

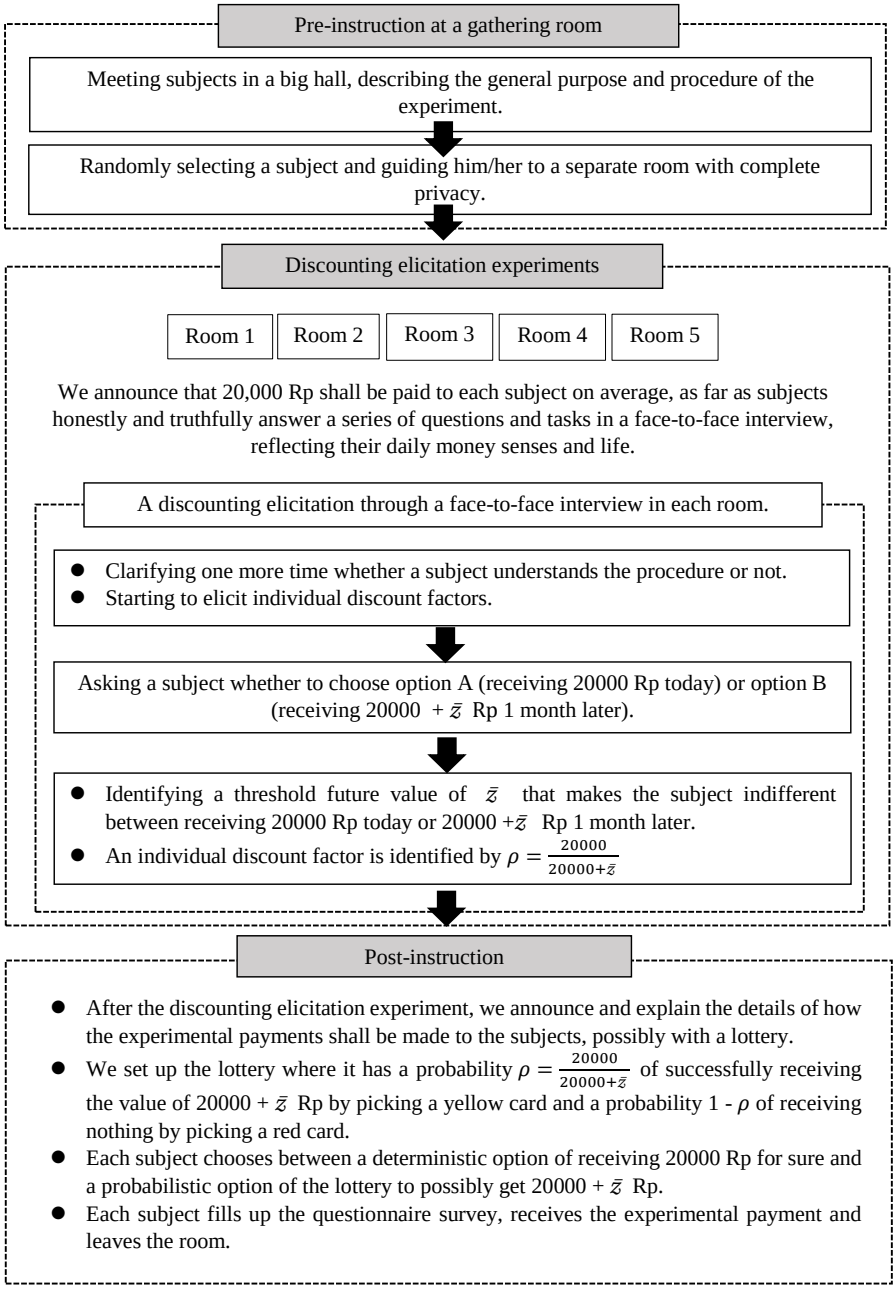


Figure 4.2: The experimental procedure for discounting elicitation

donesian language (Bahasa). At a gathering room, the instruction was explained by a verbal presentation of the first author of this research, and we also confirmed each subject's understanding by giving a series of quizzes about our experimental rules and procedures after the presentation. After we finished the verbal presentation, we randomly selected a subject and guided him or her to a separate room with complete privacy. We announced that 20 000 Rp ($\approx$ 1.50 USD) Rp shall be paid to each subject on average, as long as subjects honestly and truthfully answer a series of questions and tasks reflecting their daily money senses and life in a face-to-face interview. Before we started the discounting elicitation experiment, we clarified one more time whether or not subjects understood the procedure.

After completing the discounting elicitation experiments, we conducted the lottery game to confirm whether $\overline{z}$ would be reasonable or not and to determine the experimental payments of the discounting elicitation experiments. Each subject earned 35 000 Rp ($\approx$ 3 USD) as an experimental reward including show-up payments of 15 000 Rp on average. Figure 4.2 summarizes the experimental procedure for discounting elicitation. Each session consisted of $7 \sim 10$ married couples as subjects and took $2 \sim 3$ hours.

4.4 Empirical methods

Betafit regression, established by Ferrari and Cribari-Neto (2004), is applied to characterize the determinants of fishermen's and their wives' discount factors since our dependent variables of individual discount factors are bounded between 0 and 1, and the regression can take account of various nonnormal distributions. [7] The specifications are as follows:

$$m_{ik} = \beta_{0k} + \boldsymbol{\beta}_{1k}\mathbf{x}_i + \epsilon_{ik}, \tag{4.1}$$

where subscript i represents the ID of each subject and subscript k ($= \{f, w\}$) is an index to represent fishermen's discount factors by $k = f$ or wives' discount factors by $k = w$. The m_{ik}s represent fishermen's and their wives' discount factors elicited from the experiment denoted by m_{if} and m_{iw},

[7] In addition to betafit regression, we also apply for the multivariate approach, as a further robustness check. We obtain qualitatively the same result as with the betafit regression.

Table 4.2: Definitions of variables used in statistical analysis

Variable	Description
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.
Fisherman's discount factor	Percentage rate of discounting the future monetary value of a fisherman 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.
Wife's discount factor	Percentage rate of discounting the future monetary value of a fisherman's wife 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.
Fisherman's income	Fisherman's income in 1 million Rp ($\approx$ 74.9 USD).
Wife's income	Fisherman's wife's income in 1 million Rp ($\approx$ 74.9 USD).
Fisherman's age	Years.
Wife's age	Years.
Fisherman's (wife's) education	Categorical variable (Illiterate (0), Elementary Level (1), Junior High School Level (2), Senior High School Level (3) College Degree (4) and University Degree (5).
Household members	Number of household members.

respectively. A dependent variable of individual discount factors, $m_{ik}, k = \{f, w\}$, is assumed to follow a beta distribution:

$$f(m_{ik}; \mu_k, \phi_k) = \frac{\Gamma(\phi_k)}{\Gamma(\mu_k\phi_k)\Gamma((1-\mu_k)\phi_k)} m_{ik}^{\mu_k\phi_k - 1}(1 - m_{ik})^{(1-\mu_k)\phi_k - 1}, \quad m_{ik} \in (0, 1),$$

where $\mathbb{E}(m_{ik}) = \mu_k$, $\mathrm{Var}(m_{ik}) = \frac{\mu_k(1-\mu_k)}{1+\phi_k}$, ϕ_k represents a precision parameter and $\phi_k - 1$ represents a dispersion parameter. Various combinations of μ_k and ϕ_k can accommodate nonnormal J-shaped, inverted J-shaped and U-shaped distributions for the discount factors of fishermen and their wives.

The $\mathbf{x}_i$ is a set of independent variables of fishermen's and their wives' sociodemographic information such as age, education, income and a number of household members (Table 4.2 summarizes the definitions of all the variables applied in the statistical analysis), while we do not include a wife's (fisherman's) discount factor as an independent variable in the regression to characterize a fisherman's (wife's) discount factor due to an issue of simultaneity in endogenous problems as noted in Wooldridge (2010). The betafit regressions are considered to be appropriate for our dataset because the distributions of our individual discount factors are observed to be inverted J-shaped (see figure 4.3). The maximum likelihood method is applied to identify the unknown parameters β_{0k} and $\boldsymbol{\beta}_{1k}$ in betafit regressions for $k = \{f, w\}$, generating the marginal effect of an independent variable on the individual discount factors of fishermen or of their wives, m_{ik}.

The independent variables in table 4.2 are hypothesized to influence fishermen's and/or their wives' discount factors, following Harrison et al. (2002), Reimers et al. (2009), Tanaka et al. (2010) and Nguyen (2011). In this experiment, a fisherman's (a wife's) discount factor is represented as a 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, as explained in section 4.3.1. We are interested in how fishermen's and/or their wives' discount factors are characterized by the sociodemographic variables of fishermen, their wives and households within a single analytical framework. Therefore, we keep the same set of independent variables for both regressions of fishermen's and their wives' discount factors. Doing so enables us to quantify how a change in one factor within a household or a married couple affects the time preferences of fishermen and their wives.

4.5 Results

Table 4.3 provides summary statistics of the sampled couples in a fishing society, Karawang, Indonesia. Fishermen's and their wives' average monthly incomes are 2.495 million Rp ($\approx$ 186.9 USD) and 0.367 million Rp ($\approx$ 27.5 USD), respectively. This indicates that fishermen earn much more money than their wives, being consistent with the fact that fishermen's income is usually a main source of their household income. We see in table 4.3 that fishermen's and their wives' median monthly incomes are 1.900 million Rp ($\approx$ 142.3 USD) and 0.000 million Rp, respectively, implying that more than half the wives do not earn money. The average (median) discount factors of fishermen and their wives are 0.302 (0.100) and 0.252 (0.100), respectively. These results demonstrate that married couples in fishing society are generally shortsighted, and fishermen's discount factors are slightly higher than those of their wives on average. The average (median) ages of fishermen and their wives are 41 (40) and 38 (37) years, respectively. Table 4.3 also presents that fishermen have only primary education on average because most fishermen usually think that a high level of education is not necessary in an Indonesian fishing society (In our sample, fishermen's and their wives' education levels happen to be identical).[8]

[8]We do not include wives' education in the summary statistics because it is identical to fisherman's education.

Table 4.3: Summary statistics of the variables with 400 observations

	Average (Median)[1]	SD[2]	Min	Max
Dependent variables				
Fisherman's discount factor	0.302 (0.100)	0.344	0.001	0.952
Wife's discount factor	0.252 (0.100)	0.310	0.002	0.952
Independent variables				
Fisherman's income	2.495[3] (1.900)	2.247	0.500	20.000
Wife's income	0.367[4] (0.000)	0.714	0.000	4.000
Fisherman's age	40.955 (40.000)	12.100	18.000	72.000
Wife's age	38.395 (36.500)	11.363	17.000	70.000
Fisherman's education[5]	1.025 (1.000)	0.535	0.000	3.000
Number of household members	4.535 (4.000)	1.954	1.000	12.000

[1] Median in parentheses.
[2] SD stands for standard deviation.
[3] 2.495 million Rp ($\approx$ 186.9 USD).
[4] 0.367 million Rp ($\approx$ 27.5 USD).
[5] Regarding education, we identify that fishermen's education is identical to that of their wives. Therefore, we only report fishermen's education in this table.

The average and median number of household members are 4.5 and 4 people, respectively, confirming that household members typically consist of a fisherman, his wife and their children.

Figure 4.3 shows frequency distributions of the discount factors of fishermen and their wives elicited in our discounting elicitation experiment. The vertical axis denotes the frequency percentage, and the horizontal axis denotes the discount factors. Figure 4.3 reveals that the distributions of the discount factors of fishermen and their wives are not normally distributed and are not significantly different from each other. Both distributions of the discount factors of fishermen and their wives have the same degree of skewness with two modes at the boundaries of 0 and 1. The highest spike in both distributions is found around 0, while the spike in the fishermen's distribution is slightly lower than that of their wives, which implies that fishermen's discount factors are comparatively higher than those of their wives, consistent with the means and medians presented in table 4.3. Overall, the distributions of the discount factors of fishermen and their wives share almost the same features, such as the shape, location of the highest spikes and skewness, while fishermen's discount factors are slightly higher than those of their wives.

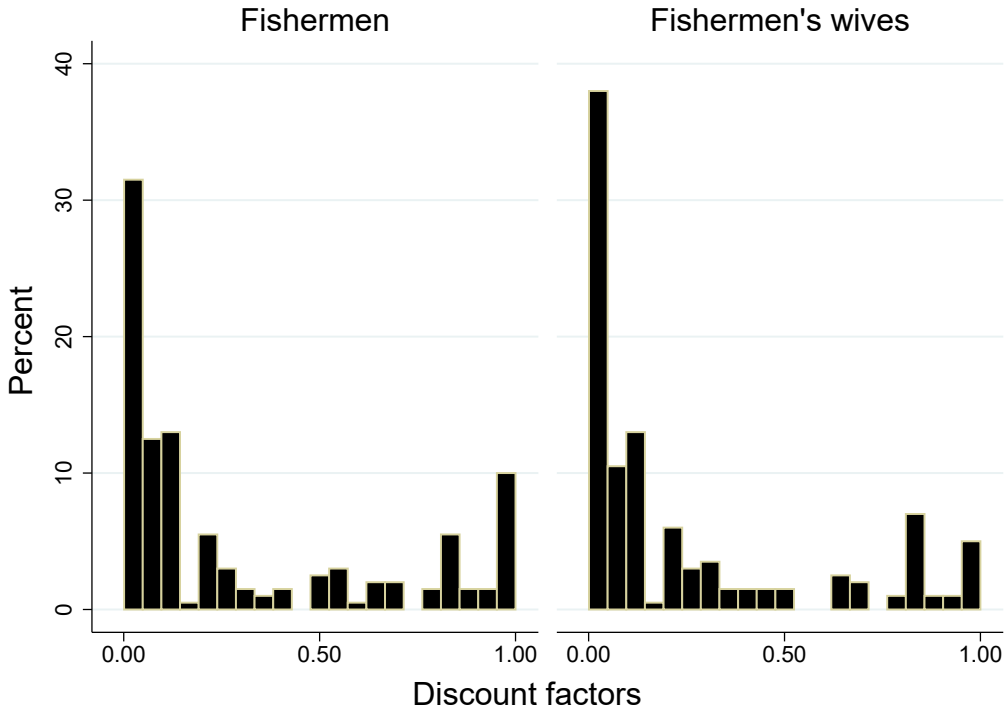
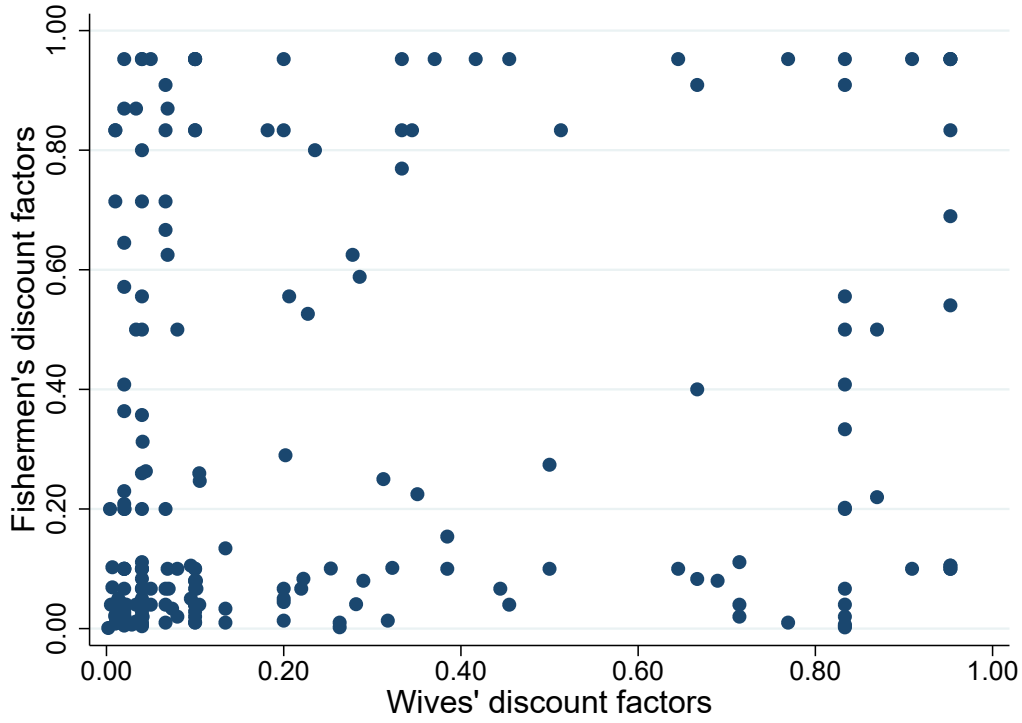


Figure 4.3: Frequency distributions of discount factors of fishermen and their wives

Figure 4.4: Scatter plot of discount factors of fishermen and their wives



On the basis of the summary statistics in table 4.3 and figure 4.3, we statistically examine whether the distributions of the discount factors of fishermen and their wives are the same by running a nonparametric Mann-Whitney test (Conover, 1999). The null hypothesis is that the distributions are independent of (or identical between) fishermen and their wives. The test does not reject the null hypothesis, implying that the distributions of the discount factors of fishermen and their wives do not differ from one another. Figure 4.4 shows a scatter plot between the discount factors of fishermen and their wives, demonstrating that there is no clear linear relationship between the discount factors of fishermen and those of their wives. This finding is due to the fact that most observations of discount factors concentrate around the origin or corners of 1.00 in either axis. However, we confirm that there is a positive correlation around 0.2 between the discount factors of fishermen and their wives by implementing several different correlation analyses that accommodate the concentrations of observations at the corners and/or boundaries.

To characterize individual time preferences of fishermen and their wives in relation to sociodemo-

graphic factors, we run the betafit regressions. Models 1 and 2 of table 4.4 present the marginal effects of the independent variables on the discount factors of fishermen and their wives, respectively. Model 1 demonstrates that wives' incomes and a number of household members are significant in characterizing fishermen's discount factors. Model 2 in table 4.4 shows that fishermen's and wives' incomes are significant predictors of wives' time preferences. The estimated coefficients on wives' incomes could be interpreted as follows: an increase in wives' incomes by 1 million Rp ($\approx$ 74.9 USD) positively affects the discount factors of fishermen and their wives by 5.6 % and 5.1 % as demonstrated in Models 1 and 2, respectively. On the other hand, fishermen's incomes weakly influence only wives' time preferences. That is, an increase in fishermen's incomes by 1 million Rp ($\approx$ 74.9 USD) is associated with a 0.9 % rise in wives' discount factors as illustrated in Model 2. As a robustness check, several other regression specifications have been tested, and we confirm that our main results in Models 1 and 2 in table 4.4 remain consistent and robust with respect to the role of incomes in characterizing individual time preferences of fishermen and their wives. These results corroborate that incomes are important factors to determine individual time preferences, which is consistent with previous studies, such as Harrison et al. (2002); Reimers et al. (2009) and Tanaka et al. (2010). That is, having a higher income generally leads couples to be more farsighted. However, our original finding is that their incomes exhibit idiosyncratic influences on the time preferences of fishermen and their wives.

The most important finding in our statistical analyses is that wives' incomes have stronger influences on the couples' time preferences being farsighted than those of fishermen (or husbands). In Indonesia, a majority of fishermen are known or reported to use up their daily income or splurge on drinking, gambling and prostitution, sometimes bringing little money to their home (Muflikhati et al., 2010; Yasin, 2013; National Development Planning Agency Republic of Indonesia, 2014b).[9] In other words, fishermen's incomes do not contribute to household incomes or wealth in a practical manner in the sense that what their wives can receive at home is only part of what fishermen earn on a daily basis. As

[9]We tried to elicit the share of daily income fishermen bring home in the pilot questionnaire. However, most fishermen rejected answering the questions. Thus, we stopped asking this type of question because it is too private and sensitive.

Table 4.4: Marginal effects of the betafit regression for discount factors of fishermen and their wives

Independent variable	Model 1 (Fishermen)	Model 2 (Fishermen's wives)
Fisherman's income	0.006	0.009*
	(0.007)	(0.005)
Wife's income	0.056**	0.051**
	(0.028)	(0.024)
Fisherman's age	0.003	–0.003
	(0.002)	(0.002)
Wife's age	–0.001	0.010
	(0.002)	(0.002)
Fisherman's education	0.058	–0.008
	(0.040)	(0.030)
Number of household members	–0.015*	–0.007
	(0.008)	(0.006)

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

mentioned earlier, fishermen's wives are in charge of managing household financial matters. However, it is common that they do not have sufficient money to control and to allocate for households' daily needs as well as for the betterment of their future due to the aforementioned reasons. In this type of situation, fishermen and their wives usually share the same opinion and recognize their household financial problems in the bigger picture. However, wives, as managers of household financial matters, appear to be more knowledgeable and sensitive to how much money their households need on the basis of our survey, reflecting that fishermen's discount factors are slightly higher than those of their wives.

When wives earn additional incomes, the wives' incomes practically contribute to households under their 100 % control. As evidenced by our survey, we identify that wives who generate additional incomes have 3.41 grams more gold as part of their saving than do wives who do not generate incomes. When wives work and generate additional incomes, fishermen (husbands) also know that their wives' incomes practically contribute to their households, part of which is saved as gold.[10] Therefore, fisher-

[10]In an Indonesian fishing society, as mentioned earlier, 70 % of fishing households do not have bank accounts. Therefore, gold is usually saved in the various forms of ornaments such as rings, bracelets, and necklaces.

men shall be secured and induced to be farsighted by their wives' incomes, while they know how their daily incomes by fishing have been spent without being saved. While wives' incomes are usually considered supplementary in fisheries, it might be surprising that an increase in wives' incomes shall more practically and strongly contribute to fishing couples' time preferences. This is qualitatively consistent with other findings of previous works, such as Thomas (1990); Browning et al. (1994); Lundberg et al. (1997); Phipps and Burton (1998); Duflo (2003); Namoro and Roushdy (2009); Carlsson et al. (2012) and Yang and Carlsson (2016), reporting that people that handle and manage incomes and/or revenues in an organization or a household can influence other members' behaviors and preferences.

Fishermen in many countries have the same tendency as Indonesian fishermen to spend a considerable portion of their income or splurge on drinking, gambling and prostitution as reported in Entz et al. (2000); Samsuddin et al. (2011) and Duy (2015). Therefore, the result established in this research may apply to other countries' fisheries as a possible guide for policies toward the sustainability of marine resources. Currently, much research in various different fields of social science suggests that women's empowerment is important as a process in which women elaborate and recreate what they can be, can do, and can accomplish in a given circumstance (see, e.g., Duflo, 2012; Ashraf et al., 2010). In this context, our research can be considered an important evidence of how "economic empowerment for wives in fisheries" has a practical significance on couples' time preferences. For example, the Indonesian government provides and promotes vocational training programs and policies for women's economic empowerment in fishing villages, such as food processing, financial skills and so on (Soero et al., 2014; National Development Planning Agency Republic of Indonesia, 2014a; Ministry of Marine Affairs and Fisheries Republic of Indonesia, 2015b). Based on our results in this research, such training programs and policies should be continued and further promoted to enhance wives' skills and abilities for income-generating activities. More importantly, this would be one of the most practical steps toward the sustainability of local fisheries and their societies.

4.6 Conclusion

We have conducted an experiment to elicit individual discount factors with 200 fishermen and 200 fishermen's wives in an Indonesian fishing society. We find that fishermen's discount factors are slightly higher than those of their wives on average, and their incomes have idiosyncratic influences on individual time preferences of couples. While fishermen's incomes weakly influence only their wives' time preferences, wives' incomes have strong influences on the time preferences of both fishermen and wives. The betafit regression reveals that a wife's (fisherman's) discount factor increases by 5.1 % (5.6 %) when a wife's income rises by 1 million Rp ($\approx$ 74.9 USD). This result can be considered important evidence of how "economic empowerment for wives in the fisheries" has a practical significance on couples' time preferences in fisheries of emerging and developing countries. For example, the Indonesian government provides and promotes vocational training programs and policies for women's empowerment in fishing villages for food processing, financial skills and so on. Based on our results in this research, such training programs and policies targeting fishermen's wives should be further promoted to enhance wives' skills and abilities to generating more income. These policies will induce both fishermen and their wives to be farsighted, practically contributing to the sustainability of local fisheries as well as their societies.

Finally, we note some limitations of our research and directions for future research. This research was conducted in small-scale fisheries of Indonesia. To generalize the findings, we should conduct further experiments in other countries and/or in different types of fisheries, such as large-scale or industrialized fisheries in developing countries that suffer from overexploitation of marine resources and related problems. At the same time, we expect that the qualitatively same results established in this research shall be obtained as far as the basic natures and behaviors of fishermen do not differ from those in Indonesia. Although we admit that there may be some other limitations of this research and future avenues of further research with respect to time preferences of fishermen and their household members, it is our strong belief that our results shall remain important. This is because small-scale fisheries still occupy approximately 50 % of global fish production in developing countries and will remain so over

the next 20 to 30 years (Franz and Stamoulis, 2015; FAO, 2015).

Chapter 5

Conclusion

Previous studies show how daily practices, history and environment, as components of culture, characterize human behavior and preferences. As the main food producers, fishermen and farmers play important roles in food security and resource sustainability. We first analyze how the daily life practices and production modes related to the occupations of farmers and fishermen characterize their individual time preferences. The production modes of fishermen and farmers are distinct in that fishermen (farmers) harvest (cultivate, grow and harvest), leading to different daily lifestyles and culture. The results of this study find that fishermen are much more shortsighted than farmers. The results reflect the fact that farmers cultivate and grow paddy and wait six months for harvest, and they tend to save a portion of their income for the future. By contrast, fishermen catch fish every day and spend most of their daily income. For this, "cultivate and grow" is important based on our findings. In fishing, it is necessary for fishermen to be farsighted to ensure sustainable fisheries. To this end, nurturing a new culture of fishermen in Indonesia for "cultivating and growing fish" through public education or programs is an important first step.

Second, we examine individual and group time preferences as well as their relation across hunter-gatherer, agrarian and industrial societies, reflecting the course of human history. Our results show that individual and group discount factors non-monotonically shift as societies change from fisheries to agrarian and from agrarian to urban and that comparatively shortsighted people (the lowest and middle) are more influential than farsighted people in determining group time preferences. These results can be considered to be important evidence of the factors influencing resource sustainability and economic development in each type of societies and of the further evolution of human time preferences in the future.

Based on the findings from these two research papers, we conclude that fishermen are more shortsighted than farmers and urban people. Therefore, we empirically and experimentally characterize the individual time preferences of married couples (fishermen and their wives) and seek to identify what

factors induce them to be sufficiently farsighted to ensure the sustainability of marine resources. We find that fishermen's discount factors are slightly higher than those of their wives on average, with a positive correlation between the two. We also find that the couple's incomes have idiosyncratic influences on their individual time preferences. This result suggests that economic empowerment of fishermen's wives is important for the sustainability of marine resources and societies in Indonesia. From these findings, effective policies or new education systems, such as training/conservation programs or institutions to change people's cultures to be more patient, are essential along with economic empowerment of fishermen's wives. Without such a policy, the resource sustainability in Indonesia might pose a greater danger in the future.

NOMENCLATURE

BPS Badan Pusat Statistik

DKI Daerah Khusus Ibukota

FAO Food and Agriculture Organization of the United Nations

MMAF Ministry of Marine Affairs and Fisheries Republic of Indonesia

Rp Indonesia rupiahs

SD Standard deviation

SVO Social value orientation

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