Does Nurture Matter: Theory and Experimental Investigation on the Effect of Working Environment on Risk and Time Preferences

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ABSTRACT

Building upon the reference dependent preferences model, we develop a theoretical framework to examine the relationship between environment and preferences. To verify the model's prediction, we use a combined artefactual field experiment and household survey data in Vietnam to investigate whether involvement is risky and has long-run targeted benefits, thereby causing fishermen to exhibit different risk and time preferences than workers in other occupations. Using a structural model approach, we integrate prospect theory and hyperbolic time discounting into a single framework, to simultaneously estimate and correlate the parameters of both risk and time preferences with other demographic variables. The key finding that fishermen are found to be less risk-averse and more patient than others asserts the theoretical prediction about the influence of the working environment on preferences.

Key words: Endogenous Preferences; Experimental Economics; Prospect Theory; Hyperbolic Discounting; Risk Behavior; Vietnam Fishermen

JEL Classification: C93; D81; Q22

"My own supposition is that most of us are 'born' with discount functions . . . [but that] true discount functions become sublimated by parental teaching and social pressure." Strotz (1956)

The above quote by Strotz (1956) highlights an interesting aspect of people's time preferences: they are influenced by both nature and nurture. The same can be applied to risk preferences. It is a matter of great relevance, both from an academic and a policy perspective, to understand how human preferences interlink with the socioeconomic institutions with which they interact. The key insight from the works of Becker (1993, 1996), Becker and Madrigal (1994), Becker and Mulligan (1997) is that preferences are endogenous to the environment. However, formal frameworks for examining this interaction are scarce in modern economics (Palacios-Huarta and Santos, 2004).

While there may be different areas of research that can be pursued to examine the relationship between environment and preferences, the link between occupation and preferences provides an ideal setting. People spend considerable time in the work place; thus, it is possible for a significant interaction between working environment and workers' beliefs and attitudes. Will people choose occupations that match their innate preferences? Or will occupation influence people's preferences? The causality may go both directions. A number of studies in labor economics have shown that less risk-averse agents are more likely to choose higher risk jobs for better compensation (Viscusi and Hersch, 2001). For instance, King (1974) finds that individuals from wealthier families choose riskier occupations, while Cramer at al., (2002) show that less risk-averse agents are attracted to entrepreneurship, a more risky occupation.

This study looks at the other side of the same coin by exploring the possibility that working in certain occupations may influence people's risk and time preferences. Specifically, we are interested in the question: are workers in some occupations naturally more risk-averse or more patient? Or, are they trained to be that way? Why workers might have different risk and time preferences has been discussed but not tested by economists. Broadly speaking, those differences may be due to nurture, nature, or some combination of the two. For instance, businessmen are compelled to take risks daily, while government officials work in a much more stable and conservative environment. Thus, choices made by businessmen could be influenced by the nurturing received when they are confronted by the need to make risky choices. Similarly, the disinclination of government officials to take risks could be the result of the working environment, which encourages them not to do so.

We make a contribution by developing a theoretical framework to explain how preferences are endogenously determined by the environment and using a novel data set combining household and experimental data to verify the theory's predictions. In particular, we apply a model of reference dependent preferences to develop a theoretical framework to explain the interaction between environment, reference points for risk and patience, and risk and time preferences. We will show that having a higher reference for risk makes the agent more willing to make risky choices. Likewise, higher reference for being patient makes the agent opt for options that gain better outcomes in the future rather than an instant one with a lower pay-off. We also conjecture that references for risk and time preferences are shaped and adapted over time by the working environment. The longer the worker has been working in the same environment, the more his references for risk and patience are adapted to it. These references in turn play a key role in determining how much the agents are willing to make risky and future benefit-based decisions, and thus in determining risk and time preferences.

While the relationship between working environment and preferences has been studied in other fields such as sociology and demography, these studies rarely address the potential endogeneity that may exist in such a relationship as well as lack a theoretical framework to drive the empirical exercise. Empirically, it is important to find a setting that can enable researchers to effectively address the endogeneity, as well as an occupation in which the environment is distinguished from others in relation to its potential impact on workers' risk and time preferences. Fortunately, we found the natural setting of Vietnamese fishery nicely fit these two criteria.

We chose Vietnam's fishery because it has a unique characteristic in the sense that fishery is primarily a traditional occupation in Vietnam, and concentrated in certain areas.

People, particularly men from those areas, generally become fishers as adults; being a fisher is considered the only occupation option available to most men in these fishing villages. In other words, the selection bias in the decision to become a fisherman is largely controlled for. This unique characteristic provides us with a great advantage in studying the causal relationship between a fishing working environment and preferences. The other reason that makes fishing an ideal occupation for our study is because it exhibits a distinguishable working environment from other professions. Fishermen constantly make risky decisions and constantly face a trade-off between limiting fishing efforts today and receiving higher profits in the long run. Repeated exposure to such an environment is likely to build up a high level of reference for risk and patience which makes the agents more willing to make risky and patient choices.

It is worth mentioning that while focusing on fishery our study has much broader application in a number of aspects. Our theoretical framework can provide insights into habituation literature to answer questions such as why firms offer trial periods for using the product without any charge, or why consumers are increasingly willing to eat risky foods even if not intending to consume such food in the beginning, or why the take-up rate of insurance products in some developing countries is low. The answer is that the people adjust their reference points to more liking the products and to the environment as time go by. Our methodological approach can be applied in a broad setting. The combination of experimental and a large household data set provides a rich source of behavioral and socioeconomic information. Finally, the structural model approach we propose in this study to jointly estimate risk and time preferences can apply in any study on risk and time preferences to properly estimate the preferences parameters.

We organize the paper as follows: we first discuss relevant literature on the relationship between nurture and preferences. The next section presents a reference dependence based model for risk and time preferences. We then elaborate on the data and methodology used in this study. In this section, we also discuss the structural approach to estimate parameters of the utility function under prospect theory and quasi-hyperbolic discounting models within a single framework. In the following section, we present the major findings and their interpretations. Finally, we conclude the paper and offer potential extensions of this research.

2. A Literature Review on the Relationship between Nurture and Preferences

Our study relates to a number of studies on endogenous preferences. Becker and Mulligan (1997) develop a model of patience formation in which individuals spend resources to increase their appreciation for the future. They show how future utility flow is influenced by socioeconomic variables such as income, interest rate and other variables. In this study, we show how the agent's utility improves from one period to the next as a result of taking an action repeatedly. Sunstein (1993) and Posner (1997) discuss instances in which preferences may be a function of the initial allocation of legal entitlement, and the important positive and normative implications that derive from it. Bisin and Verdier (1998) present a theory of cultural transmission whereby interactions with peers, parents, and others determine the formation of cultural values. Mulligan's (1997) analysis centers on the role of endogenous altruism, whereby parents spend time and goods in order to enhance their care for children.

In addition to the above theoretical studies, there are empirical studies relating to ours. Pennings and Smitds (2003) investigate risk attitudes of hog farm managers. They find that the utility of the group that is more directly involved with the production closely resembles prospect theory. The other group has less sense for gain-loss. Alesina and Schuendeln (2007), using the natural setting of Germany, find that having lived under the communist regime for an extended period of time does impact the preferences and attitudes of East Germans toward the role that the government plays in society. Tanaka, Camerer and Nguyen's (2010) study suggests economic development could influence preferences; the wealthier the villages become, the less loss averse and more patient their villagers are. An interesting study by Gneezy, Leonard, and List (2008) find evidence on the role of culture in determining gender differences in competitive behavior. Booth and Nolen's (2009) study suggests that observed gender differences in behavior in an uncertainty environment found in previous studies might reflect social learning rather than inherent gender traits.

3. A reference dependence based framework for environment determined preferences

To guide the empirical exercise, we develop a simple model based on prospect theory, more specifically, the reference dependent preferences framework (Tversky and Kahneman, 1991). The reference dependence preferences model has been well received in a wide circle of researchers and supported by both empirical studies on taxi drivers (Crawford and Meng, 2010), fishery (Gine et al., 2009), professional golf players (Pope and Schweitzer, 2011) and experimental studies (Abeler et al., 2010 and Sprenger 2010). To develop the model we follow closely Kőszegi and Rabin's (hereafter K&R) (2006, 2007, 2009) approach. It is worth noting that we assume the exogeneity of the reference expectation which differs from the rational expectation assumption of Kőszegi and Rabin (2006) for the reference state for realized outcomes. Our assumption is supported by recent experimental research, which suggests that reference states do not quickly adjust to expectations (Matthey and Dwenger, 2007). The channel via which environment affects preferences is probably reference points. We will also show how the reference/endowment for risk and time preferences determines these preferences.

3.1. A reference based model of risk and time preferences

Reference dependence based risk preferences

In this section, we apply the reference dependent model developed by K&R (2006, 2007) as the framework for our study. The main factor that drives our result is a type of endowment effect for risk and patience: a person is less risk averse and more patient if she had a high reference for risk and patience. So a fisherman is less risk averse than a government official probably because the former has a greater endowment for risk and is more willing to face a risky choice.

We first give some sense of the effect of risk and patience endowment on preferences by an example. Suppose a fisherman and a government official are asked to choose between two options: option A receiving a guaranteed $1,000, which is assumed to be equivalent to a half month's salary for both the fisherman and the government official, and option B receiving $500 with a probability of 0.5 and $1,600 with a probability of 0.5. We are interested in how endowment for risk affects the choices made. As for the government official, given the certain level of salary he receives each month, he is more likely to attach the reference with a certain outcome i.e. receiving $1,000 for certain. The fisherman, on the other hand, may consider the prospect of receiving $500 with probability of 0.5 or receiving $1600 with the probability of 0.5 stochastically dominating a typical prospects relating to his fishing business he uses to form the references/endowments. As such, he is more likely to opt for option B which is riskier and has a higher expected payoff than option A. This example shows how workers in different occupations may have different risk endowment, and thus different risk preferences.

We develop the following 3 propositions[1]:

Proposition 1: Supposing the agent's risk endowment is the mean preserving spread of a given risky lottery with positive expected outcome, it is always better for him to opt for the risky lottery than a sure outcome.

Proposition 2: Agents with a higher endowment for risk are more willing to take a risky lottery[2] than those with lower risk references.

Proposition 3: The greater reference for patience the agent has, the higher incentive he has to opt for an option that requires longer to receive a greater outcome.

[1] All proofs are available from the author upon request.
[2] We relax the assumption in Proposition 1 by allowing the expected value of the risky choice to take any value.

3.2. A Model of preferences adjustment

Propositions 1, 2, and 3 show that reference for risk and patience can have an impact on preferences. The next question is how the environment influences the reference/endowment for risk and patience. This is directly related to a crucial question that is still open to discussion regarding prospect theory: how the reference point is formed. Our hypothesis is that the reference for risk and time preference is adjusted by repeated activities of the same risk and time preferences nature. Specifically, the agent adapts to the risk and time dimension of the environment in which he is involved. In this regard, our hypothesis is along the lines of Matthey (2008) who suggests that habituation plays a role in setting the reference for risk, i.e., they partly included it in their reference states. Along this line, we develop a simple dynamic reference dependence model to illustrate how the reference for risk and time preferences is adopted to the environment over time.

We will focus the analysis on risk preferences, which has direct application for the analysis of time preference. We will show that the more frequently the agent has taken an action (e.g., a risky and/or a patient action) over some periods, the more willing he is to take it in the next period, and the more he integrates outcomes of these actions into the reference points. For instance, the set of reference points for a government official probably includes mostly certain outcomes since he is involved in an activity that offers a certain amount of monthly salary. A stock trader, on the other hand, may have very stochastic reference points given the high variance of the stock price. It is possible that prior to starting to work in his respective occupation, the stock trader had reference points that are as certain as the government official has; thus, he might not be willing to make many risky trading decisions at the beginning of his career. As time goes by, he learns that his utility from taking the risky options improves in every period; thus, he is more willing to take the risky options. His reference points thus change from a set of certain outcomes to more stochastic ones. We state this formally in Proposition 4[3]:

Proposition 4: Consider a loss averse agent that in period t=0 first chooses action y. Then, the net utility that he derives from choosing action y relative to not choosing it is higher in t + 1 than in t. Put differently, the net utility from taking action y improves over time.

[3] The proof of proposition 4 is available from the author upon request..

4. Data

We use a combination of experimental study and household data. Specifically, we use artefactual field experiments[4] (Harrison and List, 2004) to directly measure preferences of individuals regarding risk and time. As Tanaka, Camerer and Nguyen (2010) point out, few field experiments have linked wealth, demographic variables and business practices to measured preferences; doing so requires conducting careful experiments *and* collecting time-consuming survey responses. A unique feature of this study is our ability to choose villagers previously surveyed in the 2002 Vietnam Living Standard Survey (VNLSS 2002), conduct experiments with those villagers, and link their responses to the earlier survey data. Having previous survey responses before the experiments were designed also enabled us to choose a sample of villages with a wide range of average incomes.

It is worth noting that these two types of data are collected in two different contexts, and for multiple purposes. The experimental data aims at understanding how agents make decisions under a controlled environment, while the household data observes how people make decisions in a real world context, and more precisely, the outcome of their decisions. We can ask if there is consistency in the behavior of the participants in these two different contexts (Harrison and List, 2004). One may argue the subjects are less serious under experimental conditions in comparison with real conditions, particularly when the subjects' reward is relatively small. Fortunately, participants in our experiment can receive rewards of up to several days of salary for reasonably

[4] For simplicity, hereafter we use the term field experiment to refer to artefactual field experiment. Basically, artefactual field experiments are laboratory experiments conducted with individuals in the field rather than with students in universities. Readers interested in more detailed discussion on the taxonomy of field experiments may refer to Harrison and List (2004).

made decisions.[5] Hence, participants have strong incentive to take their decision making seriously. That said, we agree with Levitt and List (2007) that human decisions are not only influenced by monetary payoffs, but also by other factors such as the process and context in which the decisions are made. Cross-situational consistency is still a matter of debate (Bouma, Bulte and Soest, 2008).

The baseline information is compiled from the 2002 living standard survey (VNLSS 2002), which covers a total of 75,000 households in Vietnam. The survey provides key information on socioeconomic characteristics of Vietnamese households and individuals. Experiments were conducted in July and August of 2005 with the members of those households previously interviewed during the VNLSS 2002 survey[6]. In particular, we chose nine villages: five villages in the south and four villages in the north, with substantial differences in mean income, inequality, and market access in order to permit statistically significant cross-village comparisons. We then combined the data using ID numbers of individuals who participated in both the experimental study and VNLSS 2002 household surveys as the linking variable.

As far as the selection of fishermen for the experiment is concerned, since we are interested in the effect of working environment on preference, there are two criteria. First, we focus on fishing villages that have a sufficient number of fishermen who have been working in fishery for a relatively long period for the learning effect to take place. Second, the working environment has to be relatively unique in the sense that it is both uncertain, and requires some

[5] The average experimental earning for three games was 174,141 dong (about 11 dollars), roughly 6 to 9 days' wages for casual unskilled labor (Tanaka, Camerer and Nguyen, 2009).

[6] Several households had moved during the period 2002-2005. As such, we finally had 184 participants in the experiments. Among these 184 participants, 3 participants didn't show up at the experiment or decided not to participate; however, we use information on their household income level to calculate the village's mean income and some other summary statistics.

waiting period for the workers to reap the benefits. As for the first criterion, we can notice from Table 1 that the experimental sites (the villages) can be clustered into two groups. In non-fishing villages S1, N1, N2 and N4, there are no fishermen. In the fishing villages including S2, S3, S4, S5 and N3, around half of participants are fishermen. Given that fishing is a male dominated occupation, we are further interested in the occupation distribution of male participants. Table 2 shows a clear concentrated pattern of fishing occupation. In fishing villages, more than 80% participants are fishermen; a much smaller proportion work in government or agriculture sectors. Also, it is noted that career changes in Vietnam, particularly in fisheries, are low compared to developed countries. Most fishermen remain in fisheries for the duration of their working life. Regarding the second criterion, we selected fishermen in the locations experiencing time closures for purposes of rebuilding stock, in which patience is important. We are also interested in fishers experiencing permanent area closures as a means to seed the fishery through "spillover." The reason being is that spillover benefits are highly uncertain and depend on many ecological and oceanographic characteristics, so risk aversion is quite important here. Spillovers also take time, as populations in the closed area may need to rebuild before spillovers can occur. So, here patience is important as well.

4.1. Experimental design

To develop an empirical strategy that can jointly estimate risk and time preferences parameters, we conducted two experiments addressing risk and time preferences respectively. Details of the experiments are reported in Tanaka, Camerer and Nguyen (2010); we summarize the most relevant points of these two experiments in what follows.

The risk preference experiment is designed to estimate the parameters of the utility function under prospect theory. We generated 35 scenarios. The participants are asked to choose one of the two options: A and B. As can be seen in Appendix 2, option B is riskier than option A. We then divided these 35 scenarios into three sub-components. The first two sub-components aimed at measuring the risk aversion and probability weighting function parameter. The third sub-component focused on estimating the loss aversion parameter.

The time preferences experiment is designed to enable us to estimate not only the discount rate (δ) on which most other studies focus, but also the present biased time preference parameter (β). There are 75 questions in the experiment. In each question, participants are asked to choose between option A: receiving x dong over t days in the future or option B: receiving y dong today. These 75 questions are divided into 15 groups of five questions each. After the participants finished making their choices, a bingo ball was picked randomly to determine which question would be played for real payment. Additionally, in every experiment we publicly announced and assigned a trusted agent to deliver payment to those who chose to receive their money in the future. This assignment also sought to eliminate any doubt participants had that they would not receive future payments if they chose this option.

5. Empirical Strategy:

Our study features the use of a structural model approach, where we incorporate risk and time preferences into a single framework of estimation. The standard approach to the estimation of time preference parameters is to ask participants to make a series of choices between receiving x dollars today or y dollars for t days in the future. The time preference parameters θ then are estimated based on the equation: $x = \varphi(\theta, t)y$, where $\varphi(\theta, t)$ is some time-discounting function. The shortcoming of this approach is that agents are actually interested in the utility received from having a certain amount of money rather than money itself. Thus, a more proper estimation equation would be $U(x) = \varphi(\theta, t)U(y)$. The conventional estimation equation $x = \varphi(\theta, t)y$ is true only if the agents are risk neutral. As Andersen et al. (2008) point out, assuming risk neutrality when estimating preference parameters may underestimate the discount rates. Moreover, as discussed later the joint estimation of risk and time preferences, coupling with experimental data, plays a key role in the identification of the behavioral parameters.

Given the binary choices in the risk and time experiments, we follow Train (2003) and Andersen et al. (2008) to build upon the random utility model to develop an empirical strategy. In the experiment, we ask the participants to choose between receiving x Vietnamese dong (VND) today (option A) or y VND for t days in the future (option B). U(x) is denoted as the utility the agent gains from having an amount of x VND and φ(t) as a time discounting function. His utility would be:

$$\begin{aligned} U_i^A &= U_i(x) && \text{if he chose option A} \\ U_i^B &= \varphi(\theta; t)U_i(y) && \text{if he chose option B} \end{aligned} \tag{1}$$

Only agent i knows U_i^A and U_i^B. As researchers we do not observe U_i^A and U_i^B; rather we assume that i's utility and time preferences take some functional forms. Additionally, we can observe i's demographic characteristics. Thus, we can write:

$$\begin{aligned} U_i^A &= PT_i(x;\ Z_i) + \varepsilon_i^A && \text{if he chose option A} \\ U_i^B &= D_i(\theta; t; Z_i)PT_i(y;\ Z_i) + \varepsilon_i^B && \text{if he chose option B} \end{aligned} \tag{2}$$

where PT and D are the utility and discount functions that we assume agent i follows respectively. Z_i is a vector of i's demographic characteristics; for example, being a fisher. ε_i^A and ε_i^B represent the error terms. By standard conventions, ε_i^A and ε_i^B are assumed to follow normal distribution, and are identically and independently distributed.

Next, we are going to specify the functional form for the utility PT and time discounting function D, according to which agent i may likely behave. The better PT and D describe the true risk and time preferences of the agent, the smaller the error terms. In this regard, our empirical model is more complete and comprehensive than other models in the time preferences literature, in two primary aspects. First, by incorporating the utility function into the time discount model, we take into account the risk preference parameters into the estimation of the time preference parameters. Most studies on time discounting implicitly assume the agents are risk neutral (Andersen et al., 2008). Secondly, we allow both the utility function and discount function to take more general forms. As for risk preferences, we assume the participants behave according to prospect theory which incorporates other elements of risk time preferences such as loss aversion and probability weighting. The discount function takes into account the present bias of time preferences, in addition to the standard discount factor. As Tanaka, Camerer and Nguyen (2010) point out, if standard models are an adequate approximation, then our enhanced instruments will deliver parameter values of the extra variables, affirming the virtue of the simpler models.

More specifically, as for the utility, we assume the agents behave according to cumulative prospect theory (Tversky and Kahneman, 1992) and the one-parameter form of Drazen Prelec's (1998) axiomatically-derived weighting function:

$$PT(x,p;y,q) = \begin{cases} v(y) + w(p)(v(x) - v(y)), & x > y > 0 \quad \text{or} \quad x < y < 0 \\ w(p)v(x) + w(1-p)(v(y)) & x < 0 < y \end{cases} \tag{3}$$

where $v(x) = \begin{cases} x^{\alpha} & \text{for} \quad x > 0 \\ -\lambda(-x^{\alpha}) & \text{for} \quad x < 0 \end{cases}$

and $w(p) = \exp[-(-\ln p)^{\gamma}]$

$U(x, y; p)$ is the expected prospect value over binary prospects consisting of the outcome (x, y) with the corresponding probability (p, 1-p).

As for the discounting function, applying Benhabib, Bisin and Schotter's (2007) model, and using the same set of data, Tanaka, Camerer and Nguyen (2010) find that the quasi-hyperbolic exponential discount function best fits the data. Applying this finding, we can formally write:

$$\varphi(\theta;t) \equiv \varphi(\beta,\delta;t) = \beta \exp(-\delta t) \quad (4)$$

where δ is the standard discount rate.

The observed choices made by each individual in the risk experiment allow us to estimate the utility according to (3), while observed choices in the time preference experiment enable us to estimate (4). Recall that in the experiment we ask participants to choose option A or option B for each of the scenarios in both risk and time preferences experiments. Considering participant i, let $U_i^{A;j}$ be the utility he receives from option A for scenario j. Using (2), we can specifically write:

$$U_i^{A;j} = PT_i^{A;j}(X_i;\ Z^{A;j}) + \varepsilon_i^{A;j} \quad (5)$$

where $PT_i^{A;j}$ is the utility under prospect theory defined in (5.3) that agent i receives from option A for scenario j; X_i is a vector of i's demographic characteristics such as age, education, etc.; $Z^{A;j}$ is information on scenario j including probabilities and payoffs for option A and B; $\varepsilon_i^{A;j}$ is the error term which captures either misspecification in the functional form of PT, or unobserved characteristics of agent i. By standard convention we also assume that $\{\varepsilon_1^{A;j}, \varepsilon_2^{A;j} ......\varepsilon_N^{A;j}\}$ are independently and identically distributed (i.i.d) and follow a normal distribution. We denote the joint density of this distribution as f (ε).

Likewise, we can write the following expression if agent i choses option B:

$$U_i^{B;j} = D(\theta; t; X_i)PT^{B;j}(X_i;\ Z^{B;j}) + \varepsilon_i^{B;j} \tag{6}$$

There are two important points worth noting before moving on. First, there is no discounting function in equation (5) because in the time experiment section, all option A's are given the opportunity of receiving the rewards immediately. Secondly, given that there is no time discounting in the risk experiment, equation (6) can be reduced to:

$$U_i^{B;j} = PT^{B;j}(X_i;\ Z^{B;j}) + \varepsilon_i^{B;j}$$

Similarly, in the time preferences experiment given that all payoffs are positive and received with certainty, the utility under expected utility becomes the standard utility. Thus, equation (3) can be simplified as: $PT(x) = x^{\alpha}$. This version of utility, in turn, greatly simplifies equation (3) and (.4).

Given scenario j and using (3) & (4), the probability that option A is chosen can be expressed as: $U_i^{A;j} = PT_i^{A;j}(X_i;\ Z^{A;j}) + \varepsilon_i^{A;j}$

$$\begin{aligned}
&\Pr(A) = \Pr\left\{PT_i^{A;j}(X_i;\ Z^j) + \varepsilon_i^{A;j} - D(\theta; t; X_i)PT^{B;j}(X_i;\ Z^{B;j}) - \varepsilon_i^{B;j} \geq 0\right\} \\
&\therefore \Pr(A) = \Pr\left\{PT_i^{A;j}(X_i;\ Z^j) - D(\theta; t; X_i)PT^{B;j}(X_i;\ Z^{B;j}) \geq \varepsilon_i^{B;j} - \varepsilon_i^{A;j}\right\} \\
&\therefore \Pr(A) = \Phi\left(PT_i^{A;j}(X_i;\ Z^j) - D(\theta; t; X_i)PT^{B;j}(X_i;\ Z^{B;j})\right) \\
&\text{where } \Phi(x) = \int_x f(\varepsilon)d\varepsilon \text{ is the cummulative distribution of the error term } \varepsilon
\end{aligned} \tag{7}$$

Next, we define the latent index for option A given scenario j as follows: $I_i^{A;j} = PT_i^{A;j}(X_i;\ Z^j) - D(\theta; t; X_i)PT^{B;j}(X_i;\ Z^{B;j})$. Likewise, the latent index for option B is defined as: $I_i^{B;j} = PT_i^{B;j}(X_i;\ Z^j) - D(\theta; t; X_i)PT^{A;j}(X_i;\ Z^{B;j})$. We can then write Pr(A) = $\Phi(I_i^{A;j})$ and Pr(B) = $\Phi(I_i^{B;j})$.

To apply the maximum log-likelihood estimation technique, we note that the conditional log-likelihood for each individual depends on the utility function parameters (α, λ, γ) under prospect theory (3) and the present bias parameter (β, δ) under the quasi hyperbolic exponential time discounting function (4), as well as the observed choices. More specifically, the conditional log likelihood for participant i can be expressed as:

$$\ln l^i(\alpha, \lambda, \gamma, \beta, \delta; y^j, X_i, Z^j) = \sum_{j=1}^{110} \{[\ln\varphi(I_i^{A;j}) | y_i^j = 1] + [\ln\varphi(I_i^{B;j}) | y_i^j = 0]\} \qquad (8)$$

where $y_i^j=1$ when individual i chooses option A in scenario j and $y_i^j=0$ when individual i chooses option B in scenario j; X_i is a vector of individual i's characteristics.

To address the correlation between the parameters (α, λ, γ; β, δ) and demographic variables, we allow each of the parameters to be a linear function of the latter as follows:

$$\begin{aligned} \psi &= \psi_0 + \tau_F X_F + \tau X + \xi \\ \theta &= \theta_0 + \varphi_F X_F + \varphi X + l\,T + \nu \end{aligned} \qquad (9)$$

where $\psi \equiv (\alpha, \lambda, \gamma)$ and $\theta \equiv (\beta, \delta)$;

X_F is a binary variable indicating whether the individual is a fisher: X is a vector of other socioeconomic and demographic variables including age, education, income, distance to market, involvement in trade, or work as a government official. T is a binary variable indicating whether the participant is the trusted agent in the trust experiment[7]; ξ and υ are the error terms which are assumed to be i.i.d and uncorrelated: Cov(ξ, υ)=0.

[7] In addition to risk and time preferences, we also conducted a trust experiment with the same participants.

The joint likelihood for all individuals can then be written as:

$$L(\varphi,\theta;y,Z)=\sum_{i=1}^{N}\ln l^{i}(\varphi,\theta;y^{j},Z^{j})=\sum_{i=1}^{N}\sum_{j=1}^{110}\{[\ln\phi(I_{i}^{A;j})\mid y_{i}^{j}=1]+[\ln\phi(I_{i}^{B;j})\mid y_{i}^{j}=0]\} \quad (10)$$

where N is the number of participants in the experiment.

The maximum likelihood estimation for $(\alpha,\lambda,\gamma;\ \beta,\delta)$ is therefore:

$$(\hat{\alpha},\ \hat{\lambda},\ \hat{\gamma};\ \hat{\beta},\ \hat{\delta})=\arg\max L(\alpha,\lambda,\ \gamma,\beta,\ \delta;y,Z) \quad (11)$$

Given that the index function in the underlying probit model becomes highly nonlinear in the parameters, we code our own estimator in Stata to approximate the correlation of the interested parameters with other socioeconomic variables based on (11), and accounting for potential intracluster correlation[8]. It is worth noting that we can derive (10) only under the assumption that the error terms for each individual are independent across scenarios. A more realistic assumption would be to allow for some correlation between these error terms. If such were the case, a cross-sectional time series approach would be more appropriate (de Palma et al., 2008). Following this approach, the likelihood distribution for each individual would be:

$$\int_{\phi}\prod_{i=1}^{N}\{\phi(I_{i}^{A})\mid y_{i}=1+\phi(I_{i}^{B})\mid y_{i}=1\}f(\phi)d(\phi)$$

where f(Φ) is the assumed joint distribution of the parameters to be estimated.

We can then apply the maximum simulated likelihood (MSL) technique (Train, 2003) to estimate the interested parameters allowing for heterogeneity in the preferences and socioeconomic characteristics.

8 We apply the cluster option in Stata which takes into account arbitrary intra-group correlation.

Identification Strategy

Given that risk and time preference parameters are jointly estimated based on experimental data, we can provide insights into the identification of these parameters. Our study improves on others because we have several experimental tasks to estimate the behavioral parameters of risk and time preferences jointly. The lottery choice task identifies the utility function parameters, and the time preference task identifies the discount rate and the present bias parameters, conditional on the utility function. These experiments are designed in such a way that all utility and discounting behavioral parameters are identified (Tanaka, Camerer and Nguyen, 2010). For example, following the time preferences experiment design by Benhabib et al., (2010) we can resolve the difficulty in identifying present bias and time discounting factors which is common on estimation of hyperbolic time preferences (Paserman, 2008).

The other main difference between our model and other structural models is that we can integrate the choice made by participants for risk and time preferences into the estimation. If we followed the standard approach to identify all with the latter task, we would have an identification problem since such estimation assumes a linear utility functional form. If we estimate the parameters jointly, the time delay task does have some effect on the utility function parameters. However, one can think of these as recursive systems since the lottery choice task does not depend on the time preference parameters. More specifically, in relation to the risk preferences parameters, because there is no time discounting involved in the risk experiment the participants' choices made in series 1 and series 2 are used to jointly estimate the level of risk aversion and the weighting probability parameters, whereas the loss aversion parameter is estimated using series 3. Having been estimated, these risk preferences parameters are used to estimate the time preference parameters based on the participants' choices made in the time preference experiment. Specifically, time preference parameters are estimated based on equation (10), which is conditional on the parameters of the prospect theory utility estimated above.

6. Main Findings

We first investigate the descriptive statistics of key variables used in the analysis. As mentioned, the most interesting pattern relates to the concentration of fishing occupation in some villages. Regarding the participants' education level, the mean year of schooling is approximately 7. This relatively high educational level is a crucial factor to ensure the participants' comprehension of the experiments (Tanaka, Camerer, Nguyen 2010). It is also worth noting several of the existing differences between participants in the North and the South. For example, Southern participants are generally wealthier. There is also a higher proportion of participants in the South working in fishery. On the other hand, a greater proportion of participants in the North work for the government. Given the differences between the South and the North, a natural question is whether preferences are influenced by regional differences, and how one may control for this influence when estimating the relationship between working environment and preferences. We will discuss this question further in the next section.

Next, to check whether the participants in our study are more likely to behave according to prospect theory and quasi-hyperbolic discounting rather than the expected utility and exponential discounting, we conduct hypothesis testing: Ho: $(\lambda, \gamma, \beta) = (1, 1, 1)$ where λ, γ, β are the common estimated means of the loss aversion, probability weighting, and present bias parameters respectively. These estimated means are the constant coefficients found in Table 3 and Table 4. All of the χ^2 statistics are significant at the level of 1%; thus, the data are not likely to be supported by standard expected utility and exponential discounting.

The estimation results of the utility parameters (equation 1) are shown in Table 3. Each parameter is estimated separately. Taking into account the potential issue of seemingly unrelated regressions (SUR), we use identical regressors in these estimation equations. Identical regressors ensure that separate estimation receives the same efficiency as that of the generalized least squares (GLS), which produce efficient estimators (Greene, 2003). We first look at the determinants of α, which is used as a proxy for risk aversion. A positive value of the coefficient implies that the corresponding variable has a negative impact on the risk aversion level; the greater this variable is, the less risk-averse the participant is. The most interesting finding is that fishermen are found to be less risk-averse than workers in other occupations (the base category). The specification test for the occupation coefficients also indicates that fishermen are less risk-averse than workers in other job categories are. This result verifies Proposition 2 and 3 in the theoretical section stating that participants in occupations involving high risk might have a higher reference point for risk and time preferences; and thus are less risk averse and more patient than others. However, fishermen do not necessarily prefer greater risk taking than people in other occupations (Smith and Wilen, 2005).

Another interesting finding is the significant impact that education has on the risk aversion level. The effect of education on risk aversion is consistent with that found in the study by Dohmen et al. (2005), but does not agree with Yesuf and Bluffstone (2007), who found that literate Ethiopian farmers are less risk-averse than illiterate ones. Additionally, the effect of market distance on risk aversion, though significant at 10%, is interesting. The closer the participant lives to the market, the less risk averse he or she becomes. It could be that living close to the market exposes the participant to the daily uncertainties of business activities, thereby acclimatizing the participant to income fluctuation.

Extending our discussion to loss aversion, we find that being a fishermen does not make the participant significantly less averse to loss; the key factor influencing loss aversion is the mean village income. The more wealth the villagers have, the better they can jointly support other village fellows facing economic loss. Accordingly, the more wealth the village has, the less loss-averse the villagers become. This finding is of great relevance to community/village-oriented cultures in Vietnam where risk sharing among villagers is typical. People in the North are also significantly less loss-averse than those in the South, which may be attributed to socio-historical reasons. Northerners have been under the socialist regime for a much longer period and have developed a stronger belief in the social safety network, which acts as a safety net during times of loss.

Next, we will address the correlation between time preferences and demographic variables. Table 4 presents the primary estimation results; the key finding indicates that fishermen have a significantly lower discount rate. Put differently, fishermen are found to be more patient than others. This finding is predicted by Proposition 3 from our theoretical model. Because fishermen face constant regulations, such as the stock recovery programs that require them to forego immediate profit in favor of earning a higher profit in the future, it is possible that fishermen are accustomed to developing greater endowment/reference for patience; and thus being more patient than other workers.

Yet other variables can have a significant effect on discount rates, although the effects are of less importance. For example, age seems to play a role in the development of patience, with older age groups indicating greater patience. This result supports the hypothesis that people seem to be more patient as they get older (Anderson et al., 2008). Conventional wisdom holds that women tend to have more patience than men; however, male participants in our study are found to be more patient than female participants. As expected, people living in wealthier communities are also more patient. This finding is consistent with that in Tanaka, Camerer and Nguyen's (2010) study. People with higher relative income, however, are found to be less patient. This finding is inconsistent with the hypothesis that wealthier people are more patient than the economically disadvantaged.

Regarding the correlation between present bias and demographics, we found that being a member of a rotating savings and credit association (Rosca) is the only variable, having a significant result at a level of 5%. Specifically, members of bidding Roscas are found to be more present biased. Members of Roscas in general, however, are found to be less present biased than non-members. The result is significant at a level of 10%.

Nurture or selection?

An important question that has not yet been addressed relates to the potential endogeneity of preferences: are they shaped by fishery management policies and working environments, or are people with less risk aversion and more patience more likely to choose fishery as occupation? This question remains difficult to answer. As mentioned earlier, most studies focus on the effect risk and time preferences have on occupation choice. For instance, a number of studies in labor economics have indicated that less risk-averse agents are more likely to choose higher risk jobs for better compensation (Viscusi and Hersch, 2001). King (1974) finds that individuals from wealthier families choose higher risk occupations; Cramer at al. (2002) show that less risk-averse agents are attracted to entrepreneurship, a higher risk occupation. Thus, it could also be the case that less risk-averse people would choose a higher risk occupation, such as fishery, to suit their preferences. However, it could also be that working in fishery makes people more accustomed to taking risks.

In the context of cross-sectional data like ours, it is not possible to solve all endogeneity problems. As such, we have been very cautious in discussing the main findings. At the same time, we believe that preferences are both biologically and environmentally influenced. Working in a specialized occupational environment, such as fishery, may affect fishermen's risk and time preferences. To re-quote Strotz (1956): "My own supposition is that most of us are 'born' with discount functions . . . [but that] true discount functions become sublimated by parental teaching and social pressure." It is possible that facing constant fishery regulations, which require postponing earning profits today for higher ones in the future, influences fishermen's reference for patience and therefore being more patient. Likewise, facing uncertainty on an almost daily basis makes them less averse to risk.

To solve the potential endogeneity of preferences, we look at a unique characteristic of Vietnam's fishers in the sense that fishery is mostly a traditional occupation concentrated in certain areas. People, especially men from those areas, almost automatically become fishers when they become adults, as being a fisher is considered the only occupation option available to most men in these fishing villages (Nguyen, 2002). Table 1 and 2 show a clear distinction of fishing villages from others as far as occupation is concerned. Most working men are involved in fishery in these villages; the occupation that has the second most workers is public service such as commune officials. A question that may arise here is whether people can avoid becoming fishermen by moving away from the villages or some people from non-fishing villages may choose to become fishermen by migrating to fishing villages. While this argument may hold some relevance, it is worth noting that migration and job mobility in Vietnam are very low compared to developed countries. This was especially true before the economic reform policy in the 1990's, during which migration from one location to another was strictly monitored by the government through the household registration system. Table 1 proves this point by showing the number of years living in the same village is almost the same as the participant's age in all experimental sites. Put differently, people stay in the same village most of their life.

Guided by Proposition 4 from the theoretical framework, to parse out selection versus learning in fishing, we can also reason as follows. If preferences were malleable, one would expect "years spent in the fishery business" to affect preferences; hence attitudes toward risks and timing of money flows should change with age. This means the older fishermen should have different preferences than younger ones. To check this hypothesis we use a difference-in-difference approach, interacting occupation with age, and checking whether the change in attitude parameters in older fishermen differ from those of aging people in other occupations. The estimation results are presented in Tables 5 and 6. The significant effect of the interaction term between age and fishery implies that the longer the fishers remain in the occupation, the less risk averse and more patient they become. Likewise, there is some evidence of the learning effect in business occupation: the longer the person is involved in business, the less risk averse he becomes. As for other occupations, the interaction terms of occupation and age are not significant. Put differently, we do not observe the same learning pattern of preferences as those in fishery.

Along the same line, another way to examine the effect of working environment on preferences is to check whether young fishermen, who have only been fishing for a relatively short time, have the same attitude parameters as young workers in other occupations. Our hypothesis asserts that if there is no ability to choose anything other than fishing as an occupation, these two groups will not have significant differences in terms of risk and time preferences. If these preferences become significantly different as fishers spend more time in fishing, then it is possible that fishers become less risk averse and more patient over time.

Because we do not have information on working experience, and because most Vietnamese fishers remain in this occupation until they retire, we use age as a proxy for fishing experience. We run a model with fishers under age 25 to determine whether younger fishermen have the same attitude parameters as young people in other occupations. Here, the coefficient for fishery is no longer significant. We then run the model for more experienced fishermen older than 35, where the coefficient for fishery is significant[9]. These two findings together imply that fishermen are less risk-averse and more patient, likely, because they learn to adapt over time to the working environment.

Regional differences and preferences:

As discussed above, there exist differences between the North and the South in a number of aspects, especially from political and historical viewpoints. Alesina and Schuendeln (2007), Tanaka, Camerer and Nguyen (2010) have shown that regional differences may influence people's preferences and attitudes including risk and time preferences. Taking into account these differences is necessary to ensure the robustness of our findings. To control for the potential confounding effect of regional differences, we interact the binary South variable with other variables in the model. Doing so is equivalent to running the model for the North and South separately. The results are presented in the working version of the paper. The key finding is that we received very similar results regarding the effect of being a fisherman on risk aversion and patience; fishermen are found to be less risk averse and more patient than workers in other occupations.

Results from the Maximum* Simulated *Likelihood

[9] The detailed result is available upon request.

One particular strength of this study was its use of experimental games with high stakes, which enabled us to reliably and accurately measure behavioral preference parameters. Most other studies use other variables to proxy for behavioral parameters; however, the use of proxy variables may lead to measurement error bias (DellaVigna and Paserman, 2005). Other studies use stated preferences to measure the behavioral parameters. A shortcoming of this approach is that it may not give as strong an incentive for the agents to reveal preferences as our experimental games, which used very real and high stakes.

Having said this, one aspect that has not been addressed thus far relates to unobserved heterogenenity. To accommodate unobservable heterogeneity in the preference parameters and observable heterogeneity in characteristics of individuals, we apply the maximum likelihood simulated (MSL) (Train, 2003). It is a natural way of addressing heterogeneity in data with multiple behavioral parameters and a small number of observations, like ours (Gaudecker, Soest and Wengstrom, 2009). Specifically, we consider the possibility that there is unobserved heterogeneity in preferences parameters ($\alpha, \lambda, \gamma;\ \beta, \delta$), such that they are better characterized as distribution. For simplicity, we assume that the distribution is multivariate normal. Then we can estimate the correlation between ($\alpha, \lambda, \gamma;\ \beta, \delta$) and socioeconomic variables by generating R simulations[10] of values of ($\alpha, \lambda, \gamma;\ \beta, \delta$). Next, we evaluate the likelihood of the data conditional on the simulated values, and report as the overall likelihood the average likelihood of these R simulations.

Table 7 and Table 8 present the estimated correlation between socioeconomic variables with the risk and time preference parameters respectively, using the MSL. The key findings are

[10] We apply the same procedure used in Train (2003) and Andersen et al. (2008) to draw random sequences in order to ensure good coverage of the intended density with minimal R. This makes it feasible to undertake the simulated maximum likelihood for small-dimensional data set (181 individuals with 18 observation per individual).

almost the same as before; fishermen are significantly less averse and more patient than workers in other occupations.

7. Conclusions

While the cross sectional data is currently not sufficient to rule out other explanations for the dynamic relationship between environment and preferences, it is fully compatible with the model, i.e., reference-dependent preferences offers a plausible explanation of the observed relationship. Over years, people may have accepted the risky and patient nature of the working environment. This means that the risk and patience has - to a small but significant degree - been included in people's reference states. Accordingly, the disutility from accepting the risk and having to wait have decreased, meaning people are more willing to engage in risky and patience-required activities. They become less risk averse and more patient during the merging process with the working environment.

A main message that we would like to convey in this study is the effect of the working environment on preferences via reference points of risk and time preferences. We have shown a feedback loop from the individual's behavior into her reference state and from her reference state into her behavior. However, we have not addressed much the linkage between references and the environment. The main reason is the lack of variable that can capture the reference points in our study. It is worth conducting studies that are able to test the hypothesis that environment causes reference to change. Such studies will provide insights into the central question of prospect theory: how the reference point is formed.

While a strength of this study's identification strategy is to focus on a distinguishing occupation in a unique setting of Vietnam's fishery, a natural question is whether we can address the relationship between preferences and environment in a dynamic setting and a broader context not only in fishing but also in other occupations. To do so requires a panel of decision makers such that a longitudinal research design is possible. Such a research design would also allow us to study decision makers that switched between occupations and investigate whether there is a corresponding change in risk and time preferences. A challenge for this type of research is that one needs a long time interval, as decisions to change an occupation are strategic in nature and hence are made for a relatively long time window.

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Table 1: Basic descriptive statistics

Experimental side		S1	S2	S3	S4	S5	N1	N2	N3	N4
Number of Subjects										
	Total	22	16	18	22	22	18	22	24	2[illegible]
Mean household income in 2002 (in 1 million dong)										
	Total	36.6	35.8	20.3	18.5	15	28	17.5	9.1	6.[illegible]
Age (mean)		47.7	44.6	48.8	43.1	48.3	54.1	42.5	49.9	48.[illegible]
Gender (1=male) (mean)		0.59	0.88	0.83	0.68	0.82	0.44	0.36	0.5	0.[illegible]
Education (mean) (years)		7.2	7.1	8.4	5.8	5	7.8	8	4.8	7.[illegible]
Number of illiterate subjects		1	1	1	1	2	2	1	4	[illegible]
Acquaintance ratio (mean)		0.42	0.86	0.76	0.74	0.82	0.62	0.91	0.98	0.[illegible]
Main occupation of the subject (%)										
Farming		0.00	8.97	5.49	21.34	9.35	40.08	0.00	32.73	55.5[illegible]
Livestock		4.07	13.10	4.57	9.15	5.39	5.08	42.86	4.55	7.4[illegible]
Fishery		0.00	64.83	63.58	55.78	62.85	0.00	0.00	39.73	0.0[illegible]
Trade		29.27	0.00	0.00	2.87	3.03	23.73	13.33	3.64	3.7[illegible]
Business		18.70	0.00	5.49	0.00	3.03	6.08	13.33	3.64	7.4[illegible]
Government officer		7.32	13.10	8.58	8.05	8.48	18.64	17.14	8.35	7.4[illegible]
Casual work		21.95	0.00	6.79	2.87	5.48	0.00	4.76	5.73	7.4[illegible]
Not working		18.70	0.00	5.49	0.00	2.45	6.37	8.57	1.64	11.1[illegible]
Years living in the same village		46.5	44.6	48.8	39.8	48.3	51.3	42.5	49.9	48.[illegible]
Data from the 2002 Living Standard Measurement Survey (sample: 25 households)										
Village Gini coefficients		0.44	0.19	0.3	0.36	0.38	0.29	0.38	0.28	0.3[illegible]
Distance to nearest market		0	5	0	4.2	0	0	1	3	0.[illegible]
Number of households receiving remittance from overseas										
		7	2	1	1	0	5	2	0	[illegible]
Daily wage for male labor for harvesting (1000 dong)										
		-	-	30	30	30	18	18	20	2[illegible]

Note: We conduct the experiment in 9 villages. The experimental sites are indexed as S and N for villages in the South and North respectively.

Table 2: Main occupation of the male participants (%)

	S1	S2	S3	S4	S5	N1	N2	N3	N4
Farming	0.00	1.97	1.49	2.65	5.65	5.08	25.69	5.85	61.00
Livestock	4.06	2.10	2.57	2.15	3.39	5.08	10.00	2.55	8.59
Fishery	0.00	88.00	83.48	84.00	76.35	0.00	0.00	79.21	0.00
Trade	35.28	0.00	0.00	2.87	0.00	23.73	21.33	0.00	3.81
Business	18.70	0.00	0.00	0.00	0.00	5.08	12.85	0.00	7.21
Government officer	7.32	8.18	6.58	6.15	8.48	18.64	17.14	6.88	7.41
Casual work	15.96	0.00	3.45	2.35	3.68	0.00	4.76	3.89	2.15
Not working	18.70	0.00	2.45	0.00	2.45	42.37	8.28	1.64	9.89

Table 3: Correlation between risk preferences parameters and demographic variables under Prospect Theory

	γ(Weighting function)		α (Value function)		λ (Loss aversion)	
	Coefficient	Std. Err	Coefficient	Std. Err	Coefficient	Std. Err
Age	-0.002	0.001587	0.003 *	0.001667	0.035	0.027
Gender (1=male)	-0.125**	0.058419	-0.004	0.003252	-0.607	0.4496
Education	0.002	0.001481	-0.021***	0.008345	0.163	0.1207
Farm/livestock	-0.029	0.028713	0.004	0.003333	-1.005	0.995
Fishery	0.051	0.037778	0.244***	0.119432	-0.205	0.1519
Trade	-0.003	0.002679	-0.01	0.007143	1.294	1.1554
Business	0.01	0.00885	-0.032	0.022069	-0.17	0.1504
Government officer	0.01	0.007194	0.082	0.052903	-1.771 *	1.0479
Relative income	0.027	0.021951	-0.034	0.022667	-0.477	0.3878
Mean village income	-0.005	0.003448	-0.002	0.001538	-0.406 ***	0.1574
Distance to market	-0.007	0.006731	-0.027*	0.016265	-0.145	0.1394
ROSCA[1]	-0.092	0.068657	0.123*	0.073214	-0.406	0.303
ROSCA*Bidding	0.2**	0.077439	-0.206**	0.090211	-0.029	0.0234
South	0.047	0.025	-0.003	0.002239	2.114 **	0.734
Constant	0.96***	0.4853	1.012***	0.423282	3.255	2.17
Number of clusters	181		181		181	

Note: [1] ROSCA stands for Rotating Savings and Credit Association
[*] Significant at the 10% level. [**] Significant at the 5% level. [***] Significant at the 1% level. We conducted robust regressions, and adjusted standard errors for correlations within individuals and villages.

Table 4: Correlation between time preferences parameters and demographic variables under quasi-hyperbolic discounting

	δ parameter		β Parameter	
	Coefficient	Std. Err	Coefficient	Std. Err
δ (Discount rate)	0.28	0.224	0.103	0.076
β (Present bias)	0.898***	0.3351	0.72**	0.307
Age	-0.002*	0.0012	0.003	0.003
Gender (1=male)	-0.087**	0.0367	0.048	0.036
Education	0.005	0.0041	-0.005	0.004
Acquaintance ratio	-0.022	0.0169	-0.131	0.101
Trusted agent	-0.045	0.0333	0.065	0.048
Farm/livestock	-0.028*	0.0167	0.059	0.052
Fishery	-0.112***	0.0389	0.059	0.053
Trade	-0.059	0.0461	-0.036	0.028
Business	0.228	0.1916	-0.126	0.106
Government officer	-0.062**	0.0263	-0.018	0.013
Relative income	0.067**	0.0291	-0.012	0.01
Mean village income	-0.004**	0.0017	0.009*	0.005
Distance to market	0.01	0.0079	0.001	8E-04
ROSCA	-0.121**	0.0521	0.147*	0.089
ROSCA*Bidding	0.227**	0.1133	-0.265**	0.136
Log (savings)	-0.001	0.0007	0.007	0.005
Exp/income ratio	0.002	0.0017	-0.001	9E-04
South	-0.014	0.0125	-0.022	0.02
Clusters	181		181	

Note: * Significant at the 10% level. ** Significant at the 5% level. *** Significant at the 1% level. We conducted robust regressions, and adjusted standard errors for correlations within individuals and villages.

Table 5: Correlation between risk preferences parameters and demographic variables under Prospect Theory with interaction of age and occupation

	γ		α		λ	
	Coefficient	Std. Err	Coefficient	Std. Err	Coefficient	Std. Err
Age	-0.001	0.02	0.0015*	2.50E-05	0.025	0.015
Farm/livestock	-0.028	0.021	0.0055	0.004	-1.015	0.965
Fishery	0.052	0.041	0.2455***	0.107	-0.215	0.1946
Trade	-0.002	0.002	-0.0085	0.006	1.284	0.9086
Business	0.011	0.009	0.0305	0.022	-0.18	0.132
Government officer	0.011	0.01	0.0835	0.062	-1.781*	0.844
Farm/livestock*Age	0.0002	1.00E-04	0.0365	0.027	-0.035	0.0249
Fishery*Age	-0.0012	0.001	0.035**	0.017	-0.04	0.0315
Trade*Age	0.001	1.00E-03	-1.00E-05	0.002	0.75	0.644
Business*Age	-0.0006	6.00E-04	0.022*	0.011	-0.02	0.0143
Govt official * Age	-0.0012	0.001	0.006	0.006	-1.12**	0.511
Control for other demographic variables	Yes		Yes		Yes	
Number of clusters	181		181		181	

Note: * Significant at the 10% level. ** Significant at the 5% level. *** Significant at the 1% level. We conducted robust regressions, and adjusted standard errors for correlations within individuals.

Table 6: Correlation between time preferences parameters and demographic variables under quasi-hyperbolic discounting with interaction of age and occupation

	δ		Β	
	Coefficient	Std.Err	Coefficient	Std.Err
Age	-0.001*	5E-04	0.0031	0.0023
Farm/livestock	-0.026*	0.016	0.0591	0.05039
Fishery	-0.11***	0.04	0.0591***	0.02302
Trade	-0.057	0.054	-0.0359	0.02483
Business	0.23	0.211	-0.1259	0.11353
Government officer	-0.06**	0.022	-0.0179	0.01595
Farm/livestock*Age	-0.006	0.005	1E-06	1E-06
Fishery*Age	-0.023**	0.009	0.0023**	0.00197
Trade*Age	-0.01	0.01	-3E-06	2E-06
Business*Age	0.034	0.028	0.0051*	0.00441
Government official * Age	0.003	0.002	2E-06	1.4E-06
Control for other demographic variables	Yes		Yes	
Number of clusters	181			

Note: * Significant at the 10% level. ** Significant at the 5% level. *** Significant at the 1% level. We conducted robust regressions, and adjusted standard errors for correlations within individuals.

Table 7: Correlation between risk preferences parameters and demographic variables under Prospect Theory using Simulated Maximum Likelihood

	γ		α		λ	
	Coefficient	Std.Err	Coefficient	Std.Err	Coefficient	Std.Err
Farm/livestock						
Mean	-0.012	0.009	0.008	0.007	-1.01	0.938
Standard deviation	0.008	0.008	0.013	0.012	0.88	0.444
Fishery						
Mean	0.023	0.021	0.344***	0.169	-0.415	0.303
Standard deviation	0.028	0.02	0.247	0.17	0.474	0.405
Trade						
Mean	-0.011	0.009	-0.04	0.029	1.31	1.006
Standard deviation	0.009	0.009	0.024	0.02	2.5	1.79
Business						
Mean	0.031	0.03	-0.132	0.120	-0.234	0.162
Standard deviation	0.033	0.03	0.239	0.165	0.164	0.161
Government official						
Mean	0.064	0.043	0.074	0.054	-1.82*	1.210
Standard deviation	0.123	0.104	0.092	0.07	2.987	2.268
Number of clusters	181		181		181	

Note: * Significant at the 10% level. ** Significant at the 5% level. *** Significant at the 1% level.

We conducted robust regressions, and adjusted standard errors for correlations within individuals.

The simulated maximum likelihood is implemented by using 1000 Halton draws. We specify a mean and a standard deviation representing the distribution for each behavioral parameter of risk and time preference. The mean and standard deviation is determined by demographic variables including occupation as presented here.

Table 8: Correlation between time preferences parameters and demographic variables under quasi-hyperbolic discounting using Simulated Maximum Likelihood

	δ		β	
	Coefficient	Std.Err	Coefficient	Std.Err
Farm/livestock				
Mean	-0.018	0.017	0.018	0.0136
Standard deviation	0.019	0.016	0.020	0.0175
Fishery				
Mean	-0.159***	0.054	0.061	0.0259
Standard deviation	0.25	0.241	0.053	0.0385
Trade				
Mean	-0.024	0.021	-0.236*	0.1209
Standard deviation	0.029	0.023		
Business				
Mean	0.354	0.278	-0.112	0.0919
Standard deviation	0.635	0.576	0.193	0.165
Government officer				
Mean	-0.074 **	0.029	-0.148*	0.0578
Standard deviation	0.125	0.1		
Number of clusters	181		181	

Note: * Significant at the 10% level. ** Significant at the 5% level. *** Significant at the 1% level.

We conducted robust regressions, and adjusted standard errors for correlations within individuals.

The simulated maximum likelihood is implemented by using 1000 Halton draws. We specify a mean and a standard deviation representing the distribution for each behavioral parameter of risk and time preference. The mean and standard deviation is determined by demographic variables including occupation as presented here.

APPENDIX

Table A.1: Variable definitions

Variable name	Description
Age	Age of the subject
Gender	Gender of the subject, 1=male
Education	Number of years the subject attended school
Acquaintance ratio	Number of other subjects the subject knows by name divided by the total number of subjects in the session
Farm/livestock	Subject's main occupation is farming or raising livestock
Fishery	Subject's main occupation is fishing
Trade	Subject's main occupation is trading
Business	The subject is engaged in household business
Government officer	The subject works for a local government
Relative income	Subject's household income divided by the mean household income of the village
Mean village income	Mean household income of the village (million dong)
Gini coefficient	Gini coefficient of the income among 25 households surveyed in 2002
Distance to market	Distance to the nearest local market (km)
ROSCA	1=the member of ROSCA, 0=otherwise
ROSCA*Bidding	1=the member of Bidding ROSCA, 0=otherwise
Binary (South)	1= field experiment in the South (non-student subjects)
Trusted agent	The subject is a trusted agent of delayed delivery of money
Log (savings)	Logged savings. Savings is measured as the total value of savings in cash, gold and savings accounts.
Exp/income ratio	Household expenditure divided by household income per year
Years of living in the same villages	Number of years the participant has been living in the current village

Appendix 2. Expected Payoff Difference of Pairwise Lottery Choices

Option A	Option B	Expected payoff Difference (A-B)
Series 1		
3/10 of 40,000 and 7/10 of 10,000	1/10 of 68,000 and 9/10 of 5,000	7,700
3/10 of 40,000 and 7/10 of 10,000	1/10 of 75,000 and 9/10 of 5,000	7,000
3/10 of 40,000 and 7/10 of 10,000	1/10 of 83,000 and 9/10 of 5,000	6,200
3/10 of 40,000 and 7/10 of 10,000	1/10 of 93,000 and 9/10 of 5,000	5,200
3/10 of 40,000 and 7/10 of 10,000	1/10 of 106,000 and 9/10 of 5,000	3,900
3/10 of 40,000 and 7/10 of 10,000	1/10 of 125,000 and 9/10 of 5,000	2,000
3/10 of 40,000 and 7/10 of 10,000	1/10 of 150,000 and 9/10 of 5,000	-500
3/10 of 40,000 and 7/10 of 10,000	1/10 of 185,000 and 9/10 of 5,000	-4,000
3/10 of 40,000 and 7/10 of 10,000	1/10 of 220,000 and 9/10 of 5,000	-7,500
3/10 of 40,000 and 7/10 of 10,000	1/10 of 300,000 and 9/10 of 5,000	-15,500
3/10 of 40,000 and 7/10 of 10,000	1/10 of 400,000 and 9/10 of 5,000	-25,500
3/10 of 40,000 and 7/10 of 10,000	1/10 of 600,000 and 9/10 of 5,000	-45,500
3/10 of 40,000 and 7/10 of 10,000	1/10 of 1,000,000 and 9/10 of 5,000	-85,500
3/10 of 40,000 and 7/10 of 10,000	1/10 of 1,700,000 and 9/10 of 5,000	-155,500
Series 2		
9/10 of 40,000 and 1/10 of 30,000	7/10 of 54,000 and 3/10 of 5,000	-300
9/10 of 40,000 and 1/10 of 30,000	7/10 of 56,000 and 3/10 of 5,000	-1,700
9/10 of 40,000 and 1/10 of 30,000	7/10 of 58,000 and 3/10 of 5,000	-3,100
9/10 of 40,000 and 1/10 of 30,000	7/10 of 60,000 and 3/10 of 5,000	-4,500
9/10 of 40,000 and 1/10 of 30,000	7/10 of 62,000 and 3/10 of 5,000	-5,900
9/10 of 40,000 and 1/10 of 30,000	7/10 of 65,000 and 3/10 of 5,000	-8,000
9/10 of 40,000 and 1/10 of 30,000	7/10 of 68,000 and 3/10 of 5,000	-10,100
9/10 of 40,000 and 1/10 of 30,000	7/10 of 72,000 and 3/10 of 5,000	-12,900
9/10 of 40,000 and 1/10 of 30,000	7/10 of 77,000 and 3/10 of 5,000	-16,400
9/10 of 40,000 and 1/10 of 30,000	7/10 of 83,000 and 3/10 of 5,000	-20,600
9/10 of 40,000 and 1/10 of 30,000	7/10 of 90,000 and 3/10 of 5,000	-25,500
9/10 of 40,000 and 1/10 of 30,000	7/10 of 100,000 and 3/10 of 5,000	-32,500
9/10 of 40,000 and 1/10 of 30,000	7/10 of 110,000 and 3/10 of 5,000	-39,500
9/10 of 40,000 and 1/10 of 30,000	7/10 of 130,000 and 3/10 of 5,000	-53,500
Series 3		
5/10 of 25,000 and 5/10 of -4,000	5/10 of 30,000 and 5/10 of -21,000	6,000
5/10 of 4,000 and 5/10 of -4,000	5/10 of 30,000 and 5/10 of -21,000	-4,500
5/10 of 1,000 and 5/10 of -4,000	5/10 of 30,000 and 5/10 of -21,000	-6,000
5/10 of 1,000 and 5/10 of -4,000	5/10 of 30,000 and 5/10 of -16,000	-8,500
5/10 of 1,000 and 5/10 of -8,000	5/10 of 30,000 and 5/10 of -16,000	-10,500
5/10 of 1,000 and 5/10 of -8,000	5/10 of 30,000 and 5/10 of -14,000	-11,500
5/10 of 1,000 and 5/10 of -8,000	5/10 of 30,000 and 5/10 of -11,000	-13,000