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## Eliciting Individual Discount Rates in Thailand: A Tale of Two Cities

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### Abstract

This paper aims to elicit individual discount rates (IDRs) from Thai citizens living in urban and rural areas, using real monetary incentives in a lab-in-the-field setting. This research investigates the differences in the discount rates in two districts with different socioeconomic characteristics. One represents a rural agricultural society governed by a district administrative organization, while the other represents an urban industrialized society governed by a city municipality. The researchers also compare the results from three different elicitation methods and across five time-horizons. This paper provides three main insights. First, the elicited discount rates for people living in a rural society are significantly lower than for those living in an urban society. Second, the discount rates also vary across time horizons, suggesting different risk considerations with respect to those time horizons. Lastly, the paper also addresses an intertemporal experimental design issue that results should be indifferent between elicitation methods and finds procedural invariants between the choice and matching tasks.

Keywords: discount rate, intertemporal decision making, time preference, lab-in-the-field experiment

JEL Classification: C99, D91

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## 1. Introduction

One of the main components of individual economic and financial decision-making is the comparison between present and future values. Discount rates play a central role in analyses of intertemporal consumption-saving choices. It is the rate at which an individual is willing to trade present costs or benefits with delayed consequences. In the existing literature, Coller and Williams (1999), Harrison et al. (2002), and Anderson et al. (2004) are examples of researchers who suggest that discount rates are different across individuals due to different characteristics. Hence, understanding individual discount rates (IDRs) is crucial for any individual who maximizes expected life-time utility, and therefore, for an economy as a whole. Applying incorrect or inappropriate discount rates in decision-making could lead to poor financial and economic judgments which cause sub-optimal consumption-saving choices.

To elicit IDRs, many studies apply incentivized experiments using real money which ask respondents to choose between money earlier or later (Coller & Williams, 1999; Harrison et al., 2002; Andersen et al. (2014); and Wegmann et al. (2022)). These studies define an IDR as a rate which makes earlier values and later values indifferent to the subjects. However, there are some arguments regarding this definition. Cohen et al. (2022) argues that elicited numbers are the required rates of return (RRRs) and not discount rates; but admittedly, the two terms are closely related. It shows that, with some assumptions, IDRs and RRRs are positively correlated, and that one can be converted to another so that it can be used interchangeably. This study refers to the number elicited as originating from the concept of making the present and future values indifferent as IDRs. This is along the same lines with a strain of literature such as found in the studies of Coller and Williams (1999) or Harrison et al. (2002). This paper aims to elicit IDRs from two districts, namely, the Hat Yai District of Songkhla Province and the Si Banphot District of Pattalung Province in southern Thailand. Hat Yai and Si Banphot represent urban and rural areas, respectively, because of their physical characteristics and local governance entities (i.e., city municipality for Hat Yai and district administrative organization for Si Banphot).

This study offers three major contributions. First, it compares the IDRs between people living in urban and rural areas. Empirical evidence suggests that the IDRs are well above the market interest rates (i.e., Warner & Pleeter, 2001; Harrison et al., 2022) and vary across individuals to a large extent (Coller & Williams, 1999). One of the key factors that researchers investigate as a determinant of heterogeneous IDRs is the difference in individual geographical locations, especially those living in rural and urban areas, as they are expected to have different socioeconomic characteristics. However, the relationship of locations and IDRs are still inconclusive. Anderson et al. (2004) and Wegmann et al. (2022) present evidence that people living in rural areas are more impatient (higher discounted rates) because of differences in wealth across locations. A rural area is associated with people with relatively lower income and these people are expected to be more impatient (income and discount rates are inversely related). Consequently, Ramsey (1931) states “the pressure of present needs blinds a person to the needs of the future” (p.72). Holden et al. (1998) conducted

studies comparing rural and urban areas in Indonesia and found that because of high credit constraints in the rural areas, people are poorer, have higher discount rates, and therefore, tend not to save or invest as much. D'Exelle et al. (2012), on the other hand, provide evidence that people in an urban area are more patient (i.e., lower IDRs) and people differently perceive time valuation in urban and rural areas. People living in urban societies are facing higher time constraints, and hence focus more on the present. Modernization causes urbanites to value their present time higher relative to rural populations. Regarding Thailand, the data from the World Bank suggests that the proportion of population in rural areas is continuously declining from about 80% in 1960 to 48% in 2021. Hence, about half of Thai the population are rural-dwellers and the other half (52%) are urbanites. This makes the case of Thailand interesting as people can be divided into two comparable groups by location. This paper's first hypothesis is that IDRs are different across people living in rural and urban areas.

The second contribution of this study is to verify if time preferences are time-consistent. Although the basic assumption in normative decision theories of neoclassical economics states that individual preference should be consistent over time (i.e., Friedman, 1953). Challenges have been made to this assumption. Harrison et al. (2002) shows that the discount rates are six percentage points higher during a six-month time horizon, while they are constant over one to three-year time horizons. This paper will provide further evidence to this topic as per its second hypothesis: the discount rate for a given individual does not differ across time horizons.

The final contribution is to compare IDRs from three different elicitation methods. In the existing literature, there are two prominent methods which have been extensively used, namely, the choice tasks and the matching tasks. Choice tasks normally present decision makers (DMs) with a series of binary comparisons with an aim to extract the indifference point which, in turn, is used to infer the discount rates. Sometimes choice tasks can be referred to as the multiple price list (MPL) tasks. Matching tasks often ask directly for the exact indifference point from DMs. Both are accepted methods (Freeman et al., 2016) in eliciting precise information about time preference as they are incentive-compatible. Frederick et al. (2002) reviews studies on time preferences and noted variability in elicitation methods where 52% of the studies reviewed used choice tasks, 31% used matching tasks, and 17% used others. This leads to the paper's third contribution. Although all these incentive compatible elicitation methods should yield insignificant differences in results according to the procedural invariance assumption, Freeman et al. (2016) finds that elicitation methods indeed affect the elicited discount rates. The matching method yields lower elicited discount rates than the MPL. Hence, the researchers have investigated the procedural invariant for their third hypothesis to add evidence regarding this procedural assumption.

This study directly elicits IDRs using financial instruments in order compare whether there are differences across individuals in urban and rural areas as well as time horizons. The research also employed different elicitation methods to investigate the procedural invariance in discount rates. This was applied to

both widely-used IDR elicitation methods, namely, the choice tasks and the matching tasks in the study. In addition, the researchers devised a simplified price list method as it was conjectured that this could reduce the complexity of the MPL to be more suitable for field subjects in a developing country environment. This study collects data using the lab-in-the-field experiments with real monetary incentives to elicit IDRs. The authors have applied lab-in-the-field experiments as one of their focuses as IDRs across locations and socio-economic differences can be large in developing economies. Most of the intertemporal studies in developing markets also opted for the field approach (i.e., Ashraf et al., 2006; Tanaka et al., 2010). Meanwhile, there are some studies using incentivized experiments to investigate time preferences of Thai populations in different contexts. Cassar et al. (2017) finds that Thai people are more impatient after a natural disaster. Boonmanunt et al. (2020) elicits the time preferences of Thai coastal villagers with a maximum time delay of four weeks, showing dispersed distributions of elicited discount rates with the highest concentration in the most patient-level bracket. This study employs different elicitation methods using different time horizons in two locations with different socio economic as well as political characteristics.

The results mainly show that the elicited IDRs from people in two districts are varied. One finds that IDRs elicited from the rural Thai sample are lower, meaning that they are more patient, than those from the urban area. This has important policy implications on consumption-saving policies to induce saving behavior for retirement. Designing a tailor-made policy is preferred to achieve specific targets within each socioeconomic position. Moreover, the discount rates also vary across time-horizons suggesting different risk considerations with respect to the time horizon. This is inconsistent with theoretical prediction but in line with many empirical studies (e.g., Harrison et al., 2002). Policymakers also have to consider the duration that policy targets are aimed at, and utilize appropriate discount rate horizons for the calculations. In terms of experimental design for intertemporal studies, one finds evidence supporting procedural invariant assumption between the choice and matching tasks in contrast to Freeman et al. (2016).

## 2. Literature Review

The discount function is based upon two important assumptions in the intertemporal choice setting. First, the consumption of today is preferred over consumption in the future. This was first conceptualized descriptively by Fisher (1930) who stated that the discount rate is the marginal rate of substitution between consumption at the present time and in the future; and that must be equal to market interest rates. The second assumption is that the discount rate is constant over time (Fishburn & Rubinstein, 1982). These are clearly elegant normative theories. However, empirical evidence has shown that they are not entirely and behaviorally accurate. Some earlier works tried to estimate a discount rate from savings or consumption behavior. However, there are other factors underlying an individual's saving behavior besides consumption-smoothing. Chernoff (1983) mentions individual factors such as risk, uncertainty, and liquidity which makes the implied discount rate differ from the market interest rate. Also, because of the difficulty in extracting the

true discount rate from actual consumption data, extensive economic experiments aim to elicit IDRs are done in a laboratory with university students as subjects.

The experimental findings are consistent with the traditional empirical studies in rejecting the classical approach; the discount rates are not equal to the market interest rates. Thaler (1981) elicits the discount rate using hypothetical choices and finds that the discount rates varied from 1% to 345%. Benzion et al. (1989) uses Economics and Finance students as subjects and generally found the same pattern as Thaler (1981), but the rates were substantially lower. They hypothesized that it is because of the economic literacy of the subjects. Harrison et al. (2002) uses real monetary incentives in the field sample (general population of Denmark). They found that the discount rates varied across socioeconomic characteristics, but they did not vary according to the time horizon. Further, the average discount rate over all of the subjects was approximately 2.8%. Warner and Pleeter (2001) utilized the large-scale actual payment to the US military service and found similar results in that the discount rates varied in the range of 10 to 54%. In general, previous studies have found that high income persons are more patient than poorer ones. Lawrance (1991) suggests that households with low permanent incomes, on average, have three to five percentage points lower discount rates than those of high permanent incomes. This could imply different patterns of life-cycle consumption and saving behaviors. Yesuf (2004) finds that household wealth in terms of physical assets is highly correlated to time preference. However, there exists some contradicting evidence. Kirby et al. (2002) does not find such a relationship in the case of Bolivia. In addition, it is widely (and almost implicitly) assumed that IDRs are consistent for all time horizons in intertemporal welfare analysis. The discount rates for a given individual are assumed to be equal across all time horizons. This assumption is partially confirmed empirically by Harrison et al. (2002). It reports that the discount rates for specific household types were constant over one-year to three-year time horizons. However, it finds that the short-term (6-month) discount rates were significantly higher. Furthermore, Anderson et al. (2004) showed time variant discount rates in the Vietnamese population. This paper investigates the relationship between IDRs and both social status and time horizons.

In terms of elicitation methods, Freeman et al. (2016) compares the MPL with the Becker-DeGroot-Marschak (BDM) procedures (which are matching tasks), within the second price auction as to whether they are 'procedural invariances.' Their study concludes the discount rates elicited using the MPL method are significantly lower than those using the BDM. This confirms the findings of previous studies that conclude that the choice tasks yield higher discount rates than the matching tasks Ahlbrecht and Weber (1997), Read and Roelofsma (2003). Hardisty et al. (2013) suggest different advantages to each method. Choice tasks perform better in predicting subsequent intertemporal choices, while matching tasks offer less experimenter bias, are faster to implement, and are better with the hyperbolic discounting model. There seems to be strong evidence faulting the general assumption that the elicitation method yields identical time preference distributions. This paper provides additional evidence on this topic from a developing country perspective.

One can see that most of the previous evidence is concentrated on using educated western populations. In terms of a developing market, Pender (1996) conducted a study in rural India where village moneylenders normally charged approximately 30% interest rate and the researcher found very high IDRs in these areas. Any sustainable policies for development are most likely to disregard this, since poverty and limited access to credit markets lead people to view consumption of resources only for the very short term. In Thailand, while there is a handful of literature that has elicited Thailand-based time preferences, this paper directly elicits IDRs, compares differences across individuals in urban and rural areas as well as time horizons, and compares different elicitation methods. Past studies involving intertemporal settings commonly employ the market interest rate as the benchmark. Tanaka et al. (2010) conducted field experiments in Vietnamese villages and found that people in richer villages are more patient. This paper not only provides new evidence in terms of the data in developing economies, but also contributes findings in terms of the comparison between different socioeconomic levels within the developing world.

### 3. Experimental Design

#### 3.1 Basic concepts

##### The choice tasks

The IDR ( $d$ ) theoretically can be found at the point where an individual is willing to give up a fixed amount of present consumption (income) for an equal amount of future consumption (income), plus some interest ( $int$ ). The basic question used in experiments to estimate the discount rate is a pairwise choice between:

- A) preferring xxx baht or
- B) preferring xxx baht +  $int$  in a given period ( $t$ ).

If A is preferred to B, the discount rate ( $d$ ) is more than  $int\%$ ; however, if B is preferred to A, then the discount rate is less than  $int\%$ . One can vary the amount of  $int$  to be as close to continuous as possible, and can infer that the rate  $int$  at the switching point is the IDR. By this means, one can give subjects pairwise choices, and therefore it can be referred to as a multiple price list. Secondly, one can vary the time horizon to test for the consistency of individuals over time. For example, one can give the pairwise choice of option A in one month and option B in four months and different pairwise choices, varying the payment time of option B. One can use the multiple price list (MPL) method as the foundation for these choice-task methods.

##### The matching tasks

The task asks for the exact indifference point. The questions posed to subjects are open-ended in this type of task; hence, they are subjected to less experimenter bias. This method is more common in psychology literature using hypothetical choices in which psychologists believe that the participants often give truthful answers. However, Benhabib et al. (2010) demonstrates that the matching BDM method is also incentive-compatible. The example of a question from this task is that it might ask the DMs to state the amount (xxx baht) they regard as indifferent to receiving yyy baht today.

### 3.2 Experiment in practice

Stratified sampling is applied in collecting the samples. This study collects information from the Hat Yai District of Songkhla Province and the Si Banphot District of Pattalung Province in the southern region of Thailand. Provinces are selected based on characteristics such as Gross Provincial Products (GPP) per capita level as well as the form of government administration in order to be representatives of urban and rural cities. Songkhla 2017's GPP per capita was 156,245 baht. This is ranked 23<sup>rd</sup> country wise and sixth in the southern region. Pattalung's GPP per capita was 71,298 baht which ranked 61<sup>st</sup> out of 77 provinces in the country, and 13<sup>th</sup> out of 14 southern provinces<sup>1</sup>. Pattalung's main income is from the agricultural sector with a value of 12 billion baht or 36.27% of GPP. Songkhla is more an industrialized province with the main Southern Industrial Estate situated in Hat Yai District. This industrial estate is linked directly to the northern border of Malaysia. The Si Banphot District of Pattalung Province has a population of 14,787 compared to 159,233 of the Hat Yai District of Songkhla Province. Statistics show that 25.6% of the population in Si Banphot are in the agricultural sector as compared to 6.5% in Hat Yai. This is with the agricultural area covering 35.79% and 24.77% of Si Banphot and Hat Yai respectively. The local governance entities for Hat Yai are city municipality, while Si Banphot has a district administrative organization. This study employs three elicitation methods in each province.

#### The traditional MPL method

Upon arrival at the experiment session, participants were verbally given basically the following information in the Thai language: "One person from your group will be randomly selected to receive a large sum of money. You have a choice of two payment options (Option A or B). If you choose Option B you will receive a sum of money xx months from today. If you choose Option A, you will receive a sum of money one month from today, but this Option A will pay a smaller amount than Option B. If you are the one chosen to receive the money, your choice of a selected alternative will be paid to you for real." The instructions were read aloud and also given in writing to the subjects<sup>2</sup>. Subjects were given time to clarify their questions with the experimenter team.

Each respondent received five multiple price lists denoting different time intervals between payments of Option A and Option B. The time intervals were set at 3, 6, 12, 24, and 36 months to test subjects' discount rates in different time horizons. In addition to the multiple price list tables, subjects also received information about various interest rates from various legal credit types (e.g., market lending rates, borrowing rates, and credit card interest rates). This was crucial as subjects could make informed decisions based on the

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<sup>1</sup> Data from the National Economic and Social Development Council.

[https://www.nesdc.go.th/ewt\\_dl\\_link.php?nid=5628&filename=gross\\_regional](https://www.nesdc.go.th/ewt_dl_link.php?nid=5628&filename=gross_regional)

<sup>2</sup> Readers may refer to full instructions of every method, question, and questionnaire in appendices A to D in the supplementary materials which are available upon request.

information of actual, available, legal alternatives or field opportunities<sup>3</sup>. Examples of the multiple price lists are provided as follows:

Table 1: Multiple price list for the three-month horizon

Payoff alternative	Payment option A in baht (pays amount below now)	Annual interest rate (AR in %)	Payment option B in baht (pays amount below in 3 month)	Preferred payment option (circle A or B)
1	4000	2.5	4025	A or B
2	4000	5.0	4050	A or B
3	4000	7.5	4075	A or B
4	4000	10	4100	A or B
5	4000	12.5	4125	A or B
6	4000	15.0	4150	A or B
7	4000	17.5	4175	A or B
8	4000	20.0	4200	A or B
9	4000	22.5	4225	A or B
10	4000	25.0	4250	A or B
11	4000	27.5	4275	A or B
12	4000	30.0	4300	A or B
13	4000	32.5	4325	A or B
14	4000	35.0	4350	A or B
15	4000	37.5	4375	A or B
16	4000	40.0	4400	A or B
17	4000	42.5	4425	A or B
18	4000	45.0	4450	A or B
19	4000	47.5	4475	A or B
20	4000	50.0	4500	A or B
21	4000	60.0	4600	A or B
22	4000	70.0	4700	A or B
23	4000	80.0	4800	A or B
24	4000	90.0	4900	A or B
25	4000	100.0	5000	A or B

Table 1 shows a multiple price list for the three-month time horizon. The list offers 25 scenarios for each respondent. The initial payments are 4,000 baht<sup>4</sup> for all cases. The alternative payments for Option B

<sup>3</sup> Rational subjects should not postpone their payment from the experiment at interest levels lower than that they can receive from the markets as they can take the payment and earn more by investing in market instruments. Therefore, providing this information reduces comparison errors. Subjects might attempt to compare lab and field investment opportunities; and if subjects have imperfect knowledge of the field rates, variability in discount rates might stem from the subject's variable knowledge of the field conditions.

<sup>4</sup> This amount is roughly 10 times the daily minimum wage of the two provinces. The researchers aimed to collect 100 samples for each treatment, so the probable payment is approximately 40 baht or roughly equal to the hourly minimum wage payment for an expected one-hour experiment. In addition, every subject received the show-up fee of 50 baht.

(4,000 baht plus xx baht) are obtained based on different annual interest rates (ranging from 2.5 to 100%) and are pro-rated for the same time span (in this case, three months). Annual interest rates (AR) were associated with individual decisions as reported. The last column contains respondents' stated preferences.

Table 2: Multiple price list for the six-month horizon

Payoff alternative	Payment option A in baht (pays amount below now)	Annual interest rate (AR in %)	Payment option B in baht (pays amount below in 6 months)	Preferred payment option (circle A or B)
1	4000	2.5	4050	A or B
2	4000	5.0	4100	A or B
3	4000	7.5	4150	A or B
4	4000	10	4200	A or B
5	4000	12.5	4250	A or B
6	4000	15.0	4300	A or B
7	4000	17.5	4350	A or B
8	4000	20.0	4400	A or B
9	4000	22.5	4450	A or B
10	4000	25.0	4500	A or B
11	4000	27.5	4550	A or B
12	4000	30.0	4600	A or B
13	4000	32.5	4650	A or B
14	4000	35.0	4700	A or B
15	4000	37.5	4750	A or B
16	4000	40.0	4800	A or B
17	4000	42.5	4850	A or B
18	4000	45.0	4900	A or B
19	4000	47.5	4950	A or B
20	4000	50.0	5000	A or B
21	4000	60.0	5200	A or B
22	4000	70.0	5400	A or B
23	4000	80.0	5600	A or B
24	4000	90.0	5800	A or B
25	4000	100.0	6000	A or B

Table 2 is similar to Table 1. The only difference is the time horizon (3 and 6 months for Tables 1 and 2, respectively). The instructions for 6-month table were be identical to the 3-month table except for the waiting period to receive a sum of money. The respondent was asked to provide responses for all five time-horizons. The respondent had the full right to respond to the multiple price list in any order, although the question set was stapled in a natural sequence of shorter to longer time horizons.

There were 126 possible payment outcomes with the lowest possible payment of 4000 baht (Option A of any payment plan) and the highest possible outcome was 16,000 baht (Option B of the 25<sup>th</sup> payoff alternative for the 36-month time horizon). The average payment for these possible payment outcomes was 5,982 baht.

#### The simplified MPL method

This method is a close variant of the traditional MPL. In principle, the traditional MPL task asks subjects to respond to each binary choice. Subjects should have a single switch point. Since one cannot rationalize subjects who switched more than once, most of the studies classified this type of response as inconsistent and was normally omitted from the analysis. However, this type of task can be viewed as unnecessarily tedious to subjects as they had to make a decision at each binary choice, especially in the field setting. Further, subjects also had a lower financial literacy background. Therefore, the researchers designed the simplified price list by letting subjects only respond once at the crossing or switching point. Instead of participants having to circle A or B in each row in the last column in the MPL tasks, they were asked to put an "X" only in the last column of the row at which was the smallest amount of payment Option B (later money). This indicated their change of mind from receiving the money now to receiving the money in the future. This study would like to compare whether discount rates elicited from this method differ from the traditional one. This would help ease the experimenter's task in explaining the experiment to subjects in remote areas with low literacy rates. In this experiment, subjects involved in this method faced similar types of tables to those in the traditional MPL methods. The only difference was the last column where the question asked was, "Please mark the row that makes you accept the money in column 3 in the future instead of receiving the money in column 2 today."

#### The matching method

The subjects were asked to fill in the blank with the amount of future money that would make them indifferent to a given amount of money to be received now. The traditional matching task was simplified by bounding the range of answers for subjects to coincide with other methods. However, for analytical convenience, upper and lower bounds were set, and increments of responses were set to coincide with those in the choice tasks.

The example of questions and topics presented to the subjects is approximately this, translated from the Thai language:

"What is the least amount you would prefer to receive three months from now over receiving 4,000 baht today? Please kindly identify an amount between 4,025-5,000 baht (the incremental amount within that range is 25 baht).

"The least amount of money that you prefer to defer, receiving your payment in three months from now is .....

In all tasks, the researchers used real monetary incentives in the lab-in-the-field setting. The lab-in-the-field experiments were used because it was desirable to estimate the discount rates of Southern Thailand's adult population, applying actual socioeconomic proportions to the sample that represents the society. Random incentive mechanisms were used to incentivize subjects by telling them that one of the subjects in their (method) group would be randomly selected for payment of one of the randomly-selected time horizons. Randomly selecting one choice, described as "pay one" in Charness et al. (2016) introduces a layer of risk to the experiment and potentially dilutes the incentives. However, the majority of the results in different experimental environments such as lottery choice or multiple price list, belief elicitation, or social preference elicitation, shown in Charness et al. (2016), suggests that the "pay-one" mechanism is equivalent to the "pay-all" method. Although there is no evidence of a direct comparison between selecting one time horizon for payment or paying for all time horizons in discounting tasks, selecting only one time horizon is widely employed in notable time-preference literature (e.g., Harrison et al., 2002; Andersen et al., 2014). As for paying a subset of subjects, there is a concern of an additional layer of risk that might psychologically affect a subject's motivation in completing the task or, in other words, the scale effect. The majority of evidence as reviewed by Charness et al. (2016) showed no significant difference in results between pay-all or pay-subset mechanisms. For discounting tasks in particular, Andersen et al. (2014) directly tested whether subjects probabilistically assessed their potential income in a discounting task. They varied the payment probability between 10% to 100% and found that the effect of probabilistic discounting was "non-existent or negligible" in their sample.

Credibility and trust issues for payment has been an issue for experiments examining discount rates. The most straightforward method to address this issue is to use a formal, legal contract in doing an experiment; however, a logistical issue could arise instead. Therefore, the most common method employed is to be as transparent and as credible to subjects as possible, such as in conducting an experiment under the auspices of a faculty member or a recognized government agency (i.e., Coller et al., 2012; Harrison et al., 2002; Andersen et al., 2014). The study reassured subjects by informing them and providing details that the study received a research grant for this research from a reputable research institute under a Thai government agency, as well as providing them details about the experimenters' university affiliations and contacts.

After completing the main task, additional survey questions about socioeconomic characteristics were asked for all the methods. The questions included individual and household information that is proven in the literature<sup>5</sup> to have influence on the discount rates. Socio-demographics, e.g., gender, age, marital status, number of household members, income, and occupation, were collected and included in the analysis.

The experiments were conducted in the period January to March 2020. The aim was to recruit 100 subjects per method. As a result, 120 subjects were registered for each method, though fewer than those registered showed-up for the experiments. Subjects were recruited in Hat Yai District by placing desks with

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<sup>5</sup> See Harrison et al. (2002), Pender (1996), and Loewenstein and Thaler (1989) for instance.

six research assistances together with experimenters at popular locations around the city (e.g., at banks, shopping malls, and wet markets). For Si Banphot District, subjects were recruited through the Village Health Volunteer system. These volunteers of the Public Health Department organize monthly meetings for health promotion. The village house volunteers performed the same function as the study's research assistants when recruiting subjects in Hat Yai District. This was for the purpose of spreading information for recruitment since, in Thailand's rural areas, this group of people are the ones who can gain access to most people in the villages. Potential subjects were informed that an experiment would be conducted at an assigned place, during allocated timeslots. In Hat Yai District, a common room at a university was used, while in Si Banphot District, the town hall was used. Subjects were registered at the start of the experimental session, assigning the subjects numbers as well as collecting their details for random incentive transfer purposes. When the subjects were all seated, the instructions were explained and they were informed that there was a 50-baht show-up fee which would be given to them when they finished all the tasks. They were further informed that there was a chance that they could earn more money<sup>6</sup> from the experiment, and that their participation was voluntary. The minimum wage was 340 baht and 335 baht per day, or 42.5 baht and 41.88 baht per hour, in Songkhla and Pattalung Provinces respectively. It was also stressed to the subjects that the research funds were received from a reputable government agency, while the experimenters' contact details and university affiliations were provided to try to gain subjects' trust in the random incentive payments. The experiments were done using pens and paper. Subjects could also read the instructions themselves after the verbal explanation. There was no time restriction for subjects to complete the experiment and they were free to ask questions throughout the process of the experiment.

At the end of each method's session, a random incentive mechanism was also applied. The time horizon was randomly selected, as well as the row showing the actual payment that would be made. Then, the subject number was chosen, using the random function in Microsoft EXCEL. Subjects used up to 50 minutes to complete the experiment (answering the main tasks and completing the questionnaire). The average for random, incentivized payments across three methods in two districts was 4,445.83 baht, including the show-up fees. The show-up fees were given out to subjects in cash while the random incentives were transferred to subjects via bank transfer.

## 4. Data Analysis

### 4.1 Data cleaning process

Table 3 below provides the data cleaning process, beginning with the actual numbers of collected observations by location and method.

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<sup>6</sup> Subjects were informed that the study would randomly select one participant from their respective method or treatment. Each method targeted the acquisition of at least 100 subjects which could result in more than one session, and one of the questions was selected for payment. The sessions within the treatment group were clustered together with a maximum of a three-day span between the first and the last session of each treatment.

Table 3: The number of observations by location and method at different cleaning stages

Location	Songkhla (Hat Yai)				Pattalung (Si Banphot)				
	Method	M	SPL	M	Total	MPL	SPL	M	Total
		PL							
Initial obs.	75	78	68	221	75	70	62	207	
Consistency	9	0	2	11	13	2	2	17	
Gross obs.	66	78	66	210	62	68	60	190	
Variable issues	3	3	1	7	7	7	6	20	
Net obs.	63	75	65	203	55	61	54	170	

From Table 3, initial observations for the multiple price list (MPL), simplified price list (SPL), and matching methods (M) collected from Hat Yai are 75, 78, and 68 individuals, respectively. Meanwhile, those from Si Banphot are 75, 70, and 62 individuals, respectively. Earlier, subjects who switched between A and B more than once in every method were removed.

The next row accounts for observations with discount rate consistency. 'Consistent' preferences must be increasing monotonically over time. For example, when a subject switching point is 4,500 baht in a one-year time horizon, their switching point in longer time horizons must be more than 4,500 baht. 'Time inconsistent' preferences occur when, for example, the amount of future money in a subject's switching point in a longer time horizon is less than the amount of future money in the same subject with a shorter time horizon. The number of observations which reported inconsistent preferences were dropped.

These numbers can indicate subjects' understandability of each elicitation method. The higher percentage of errors due to preference inconsistency implies that people have more difficulties in understanding the method. In Hat Yai, the price list method shows the highest percentage of error observations at 12 percent. The percentage for the matching method is 2.9 while it is nil for the simplified price list method. In Si Banphot, the pattern of errors is unchanged. The largest percentage can be observed from the authentic price list method at 17.3. The matching method shows 3.2 percent, and the simplified price list reports the smallest number at 2.9 percent. One expects to see a larger percentage in general for Si Banphot than Hat Yai since the average education level of people in the former location is lower, and the subjects are less familiar with numeric information.

Some important variables, e.g, age, education, occupation, and individual income, contain some issues such as missing values and illogical numbers. Observations with any of these errors are dropped (the number for each method as well as the total are presented in the penultimate row). The remaining numbers of Hat Yai observations for price list, simplified price list, and matching methods are 63, 75, and 65, respectively. Regarding Si Banphot, the final numbers for price list, simplified price list, and matching methods are 55, 61, and 54, respectively. Hence, the grand total number of observations left for the analysis is 373 individuals which can be group by location (203 individuals from Hat Yai and 170 individuals from Si Banphot).

## 4.2 Descriptive statistics

Since one of the main objectives was to inquire whether discount rates differed across individuals, different aspects of socioeconomic characteristics and present descriptive statistics of interested variables were collected and are presented in Table 4.

The total number of observations (373) and the subset of observations by district (203 for Hat Yai and 170 for Si Banphot) are as per the information presented in Table 3. The variable for gender indicates that most of respondents are females (61.6% for Hat Yai, 80% for Si Banphot, resulting in 70% total). The average age of respondents is about 43 years old (39.487 for Hat Yai and 47.506 for Si Banphot).

A variable for the number of children shows that both districts have approximately 1.4 children per family. In considering this variable separately, the average numbers of children of Hat Yai and Si Banphot are approximately 1.05 and 1.81 children per family, respectively. The next variable captures whether a respondent is indebted. On average, 72.7% of the total subjects observed are indebted. However, it is apparent that the rate of indebtedness of people is lower in Hat Yai compared to those in Si Banphot. The final variable in the estimation model is a dummy variable indicating if a respondent has any savings account. There were 81% of people in both districts who had some savings; the difference between the two districts is minute, at 1.8%.

Regarding an education variable, people with high school, undergraduate degree, and others shared 33.24%, 34.05%, and 27.61% of the total observations, respectively; the remaining were people with postgraduate degrees. In comparing between the two districts, the largest group of observations in Hat Yai were those with undergraduate degrees, followed by those with high school diplomas. On the other hand, the largest group of respondents in Si Banphot indicated "other education" while the second largest group was comprised of those who finished high school.

The variable for occupation shows that 64.12%, or most of subjects in Si Banphot, were working in the agricultural sector. The second largest group were those working in the public sector. On the other hand, occupations in Hat Yai were relatively equally distributed across all categories (ranging from 18.23% to 26.60%) except in the public sector (8.37%). Hence, in total, the largest group of occupations were agricultural-related (41.29%) followed by other occupations (18.50%) and business owners (18.23%).

With regard to the variable for marital status, in total, 59% of the subjects were married while the next largest group was single (28.15%). When considering sub-sample by location, the two largest groups of samples in Hat Yai were single and 44.83% were married. However, 77.06% of the subjects in Si Banphot were married while the next largest group was indicated as "others" (9.41%).

Table 4: Descriptive statistics for interested dependent variables

Variable	Hat Yai (203)				Si Banphot (170)				Total (373)			
	Mean	S.D.	Min	Max	Mean	S.D.	Min	Max	Mean	S.D.	Min	Max
Gender (Male=0; Female=1)	0.616	0.49	0	1	0.80	0.401	0	1	0.70	0.46	0	1
Age (Years)	39.48	15.41	20	87	47.51	9.614	23	71	43.14	13.68	20	87
Number of children (Persons)	1.05	1.21	0	5	1.81	0.97	0	5	1.39	1.17	0	5
Individual income (baht)	20781.28	28652.38	5000	250000	11350.91	10549.76	1000	60000	16483.26	22769.94	0	250000
Household member (Persons)	3.320	1.21	1	7	3.89	1.36	1	8	3.58	1.31	1	8
Indebtedness (No=0; Yes=1)	0.59	0.49	0	1	0.89	0.31	0	1	0.73	0.45	0	1
Saving (No=0; Yes=1)	0.818	0.387	0	1	0.800	0.4011	0	1	0.810	0.393	0	1
Education		%				%				%		
High school		33.50				32.94				33.24		
Undergraduates		45.32				20.59				34.05		
Postgraduates		3.94				6.47				5.09		
Others		17.24				40.00				27.61		
Occupations												
Public officers		8.37				14.12				10.99		
Business owners		26.60				8.24				18.23		
Private officers		18.23				2.35				10.99		
Farmers		22.17				64.12				41.29		
Others		24.63				11.18				18.50		
Marital status												
Single		44.83				8.24				28.15		
Married		44.83				77.06				59.52		
Separated		5.42				2.35				4.02		
Divorced		3.45				2.94				3.22		
Widow		1.48				9.41				5.09		

### 4.3 Statistical analysis

As mentioned above, respondents chose between Options A and B over 25 scenarios according to the multiple price list. These raw responses are coded as a number from 1 to 25 corresponding to the payoff alternative at which participants first preferred Option B to A<sup>7</sup>. In case a participant always selected payment Option A, the code was designated as 26.

The selected alternative was interpreted as an interest rate interval for that respondent. For example, if the respondent switched the preference to first preferring Option B over A at payoff alternative 7<sup>8</sup>, the IDR for him must be higher than 16.18% but not greater than 19.12%. Having mentioned that, this interval could be narrowed down by the censoring method (which will be explained later).

Next, an estimation is utilized to investigate characteristic effects on the discount rates. The general model takes the form as follows:

$$y_i^* = \beta x_i + \varepsilon_i$$

where,  $y_i^*$  is the subject  $i$ 's IDR,  $x_i$  designates a vector of explanatory variables that include socioeconomic characteristics, and  $\varepsilon_i$  is an error term.

while  $y_i^*$  is not directly observable, a variable  $y_i$ , which is either an interest rate interval around  $y_i^*$  or censored at some limit, and can be observed. Generally, researchers can observe

$$\begin{aligned} y_i = 1; & y_i^* \leq \varphi_1 \\ y_i = 2; & \varphi_1 < y_i^* \leq \varphi_2 \\ y_i = 3; & \varphi_2 < y_i^* \leq \varphi_3 \\ & \vdots \\ & \vdots \\ & \vdots \\ y_i = J; & y_i^* \geq \varphi_J \end{aligned}$$

where, the threshold values  $\varphi_j$  are observable from the multiple price list or censored interest rates.

In practice, subjects may be arbitrated between actual and experimental incentives. Therefore, the relationship between these two rates should be considered. One part of the debriefing questionnaire is to elicit the borrowing and lending interest rates (e.g., credit cards, overdraft accounts, and savings accounts) that subjects are facing. This information allows one to do a preliminary data analysis on censoring or bounding at borrowing and lending rates.

For instance, considering an individual with a true IDR of 25%. In the absence of actual substitutes for experimental incentives, Option B should yield 25% or higher in order to be selected. However, if this subject can borrow from the market at the rate of 15%, even though they require at least 25% to delay

<sup>7</sup> Inconsistent responses are removed (those that have more than one switching points).

<sup>8</sup> From table 1 or 2.

consumption at a rate between 15 and 25%, they are better off borrowing from the market at 15%, by choosing Option B in any scenario that yields higher than 15%. This way the subject saves money in the experiment with a yield that is greater than 15%. When the experimental payment is received, they are able to begin repaying actual debts to complete their arbitrage opportunities.

An individual's borrowing rate,  $r_B^i$ , is calculated by taking the lowest of an individual's  $i$ ' effective annual borrowing rate. If an individual does not have any line of credit or doesn't know the rate, the effective borrowing rate is set equal to an average bank lending rate. Censoring borrowing rates is done by investigating whether or not the IDR elicited from the experiment falls within the same interval as the market rate of the effective credit rate. If not, the IDR is designated to be within the interval. If true, the selected interest rate implies that the true IDR should be greater than the observed borrowing rate but less than the upper limit of the interval.

On the other hand, an individual's lending rate,  $r_L^i$ , is calculated by using saving rates to effectively establish an annual lending rate. If a respondent does not have any savings account or doesn't know the rate, the effective lending rate is assumed to be a general annual savings rate. Censoring lending rates is done by investigating whether or not the IDR falls within the same interval as the market rate of the effective lending rate. If the result is negative, the true IDR lies in that interval. If the result is affirmative, one can infer that the true IDR is not greater than the observed lending rate within the interval.

For example, take an individual with a true IDR of 2%. In the absence of arbitrage, an individual is expected to select Option B as the first alternative. If they are able to save money in the market at the rate of 4%, they will not postpone their payment in the experiment until the interest rate reaches at least 4%. Although the subject demands only 2% to delay their consumption, they are better off taking money from the experiment immediately, lending money to the actual market while earning 4%.

After accounting for censoring issues, the refined data is used in the estimation process. This study follows Harrison et al. (2002) by applying an interval regression model in estimating. Interval regression is the generalization of the model fit by Tobit models since interval regression is able to estimate a model with not only left-censored and right-censored data but also interval and point data (Raidani et al, 2016). Cameron and Trivedi (2010) discuss the differences among censored, truncated, and interval data. This is because these variables contain point, interval, and interval-censored values. In fact, one can identify the ordered category or interval each observation falls; however, the exact value of the observation is unknown. The average discount rate is, then, estimated from a parametric regression model in which independent variables include dummies of different time-interval, socio-demographic, behavioral, and individual economic characteristics.

## 5. Results and Discussions

There are two primary sub-sections in this part. First, there is the discussion of elicited IDRs. Second, there is a focus on the estimated results using the interval regression model.

### 5.1 Elicited individual discount rates

As mentioned in the experimental design session, IDRs are elicited directly from the lab-in-the-field questionnaires. This study reports results from different elicitation methods which include two widely-used methods and the modified method. The summarized information about elicited IDRs is reported in Table 5. This research interprets these as the elicited IDR intervals that are interpreted by Collier and Williams (1999).

Table 5: Elicited individual discount rates by location and method

District	Method	Time	Interval		
			AR (%)	AER (%)	
All	All	All	22.51-25	25.23-28.39	
	All	All	27.51-30	31.65-34.97	
	MPL		3	30.01-32.5	34.98-38.38
			6	32.51-37.5	38.39-41.88
			12	37.51-40	45.48-49.15
			24	35.01-37.5	41.89-54.47
			36	40.01-42.5	49.16-52.92
	SPL		3	7.51-10	7.80-10.52
			6	12.51-15	13.32-16.18
			12	15.01-17.5	16.19-19.12
			24	15.01-17.5	16.19-19.12
			36	17.51-20	19.13-22.13
	Hat Yai	M	3	32.51-35.0	34.98-38.38
			6	47.51-50	60.76-64.84
12			47.51-50	60.76-64.84	
24			37.51-40	45.48-49.15	
36			40.01-42.5	49.16-52.92	
All		All	17.51-20	19.13-22.13	
Si Banphot		MPL	3	27.51-30	31.65-34.97
			6	27.51-30	31.65-34.97
			12	22.51-25	25.23-28.39
			24	22.51-25	25.23-28.39
	36		22.51-25	25.23-28.39	

District	Method	Time	Interval	
			AR (%)	AER (%)
	SPL	3	7.51-10	7.8-10.52
		6	12.51-15	13.32-16.18
		12	15.01-17.5	16.19-19.12
		24	17.51-20	19.13-22.13
		36	20.01-22.5	22.14-25.22
	M	3	5.01-7.5	5.14-7.79
		6	12.51-15	13.32-16.18
		12	22.51-25	25.23-28.39
		24	12.51-15	13.32-16.18
		36	12.51-15	13.32-16.18

Table 5 reports descriptive statistics of elicited IDRs collected from two districts (Hat Yai and Si Banphot) using three different methods for five different time horizons. The first three columns indicate locations, methods, and periods, respectively. Each response row by subjects is reported as AR and AER intervals in the last two columns.

Overall, the median value of the IDRs (AER) from the sample (two districts) is between 25.23 and 28.39%. This is comparable to Harrison et al. (2002) who estimated IDRs of 28% for the Danish population. Considering IDRs by district, the elicited results show that the medians of the IDRs (AER) fall between 31.65% and 34.97% for Hat Yai and between 19.13% and 22.13% for Si Banphot, respectively.

One major observable pattern is that the responses elicited by SPL are generally the lowest among the three methods. Regarding the time horizon, the results from the SPL method indicate IDRs that have a positive relationship with time periods. One can observe slight oscillating patterns in the other methods.

## 5.2 Estimation results and discussions

This sub-section presents and discusses the estimation results regarding the determinants of IDRs as shown in Table 6.

Table 6: Regression analysis of discount rate responses

Variable	Coefficient	S.E.
Dependent variable: Individual AER interval between the upper and bounds		
Period (3 months category is set as the based case)		
6 months	5.805**	2.321
12 months	8.817***	2.321
24 months	7.894***	2.321
36 months	12.267***	2.322
Location (Hat yai=0; Si Banphot=1)	-15.979***	1.938
Method (Reference case: MPL)		
SPL	-13.673***	2.067
M	1.230	2.250
Gender (Male=0; Female=1)	-3.857**	1.750
Age (Years)	0.287***	0.084
Education (Reference case: High school)		
Undergraduate	10.341***	2.168
Postgraduate	19.607***	4.228
Others	5.079**	2.046
Occupation (Reference case: Agricultural sector)		
Public sector	-16.013***	3.083
Business-owned	-3.767	2.413
Private sector	-8.279***	2.994
Other	-4.741**	2.373
Marital status (Reference case: Single)		
Married	3.474	2.313
Separated	-1.234	4.167
Divorced	5.926	4.727
Widow	2.010	4.118
Number of children (Persons)	-5.062***	1.039
Individual Income (baht)	-5.13e-06	.000037
Household members (Persons)	1.080	0.669
Indebtedness (No=0; Yes=1)	1.392	1.965
Saving (No=0; Yes=1)	-4.503**	2.011
Constant	32.969***	5.601
N	1865	Log likelihood -6708.535

Note: \*\*\*, \*\*, and \* indicate statistical a significance at 1%, 5%, and 10%, respectively.

The total number of observations (N=1865) yielded from the number of individuals (373) corresponded to five sets of IDR elicitation (time horizons of 3, 6, 12, 24, and 36 months). One can apply the interval regression as mentioned in the methodology section; the dependent variable, hence, is the upper and lower bounds within which IDRs lie between. One can test for multicollinearity by using Variance Inflation Factor (VIF); and there is no multicollinearity concerns among the independent variables<sup>9</sup>.

For estimation results, the first focused variable is the time horizon. Compared to the three-month period, all periods are significantly greater. Besides the 24-month period, the longer the period is, the larger IDR is reported. This is inconsistent with the standard assumption that IDRs should be consistent regardless of the waiting time. This study's result is highly comparable to those of Harrison et al. (2002). One of the possible arguments for time-inconsistent IDRs could be that subjects are viewing this payment structure as risky prospects. Despite the experimenters' effort to convince subjects of the certainty of future payment, subjects could still have some degree of mistrust. Hence, it would require a greater amount of money for them in order to give up the sure amount that they could receive today for a future payment. However, the credibility issue should affect the elicited discount rates by some fixed amount over all time horizons. Therefore, this result shows that different discount rates over time horizons would stem from subject-internal factors, indicating that the subjects' time preferences are not consistent over time horizons.

Another main focus of this research is the difference of IDRs between two districts, namely, Hat Yai and Si Banphot, representing urban and rural areas, respectively. The estimation result suggests that the IDR in Hat Yai is about 16% greater than that in Si Banphot. This result differs from most of the findings from the existing literature in which most reported higher discount rates in the rural areas. However, it is consistent with D'Exelle et al.'s study (2012) which provides an explanation that people in urban areas value present time higher than those in rural areas. Another explanation given for lower rural area IDRs is that financial access by the people in rural areas is normally more difficult. They face difficulties in savings within formal financial institutions<sup>10</sup> and hence, their perception of generating income from savings is low enough so that it takes lower interest rates (discount rates) in order to convince them to accept future payment rather than the payment now. This finding also somewhat coincides with Boonmanunt et al. (2020) who found that although reports disperse distributions of discount rates in Thai coastal villagers, the highest concentration (31.97% of the participants) lies within the most patient bracket.

From the estimated results, MPL and Matching methods yield comparable responses, suggesting a procedural invariant in these two methods. This is inconsistent with previous empirical works where several studies suggested that the choice task normally yields higher discount rates (Freeman et al., 2016). This has an implication on the experiments where the financial literacy rate is not high, since the matching task is found to be easier to explain and is better understood by the subjects. The average time used for the matching

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<sup>9</sup> the VIF result is provided in Appendix E in the supplementary materials.

<sup>10</sup> This survey shows that 98% of the urban sample has savings accounts compared to 61% in the rural areas.

method in this study's experiment is also shorter<sup>11</sup>. However, responses elicited by using SPL were lower than those using MPL. More in-depth study is needed to understand this result. There is a hypothesis in the literature<sup>12</sup> that a choice task requires subjects to pay relatively more attention to waiting time while the matching task focuses more on the magnitude of the amount. One conjecture is that in the simplified price list method, a subject could be more careless as it requires the least mental effort out of the three methods<sup>13</sup>.

Regarding individual socioeconomic characteristics, many variables, including age, gender, education, and number of children, significantly affect IDRs. The result from the occupation variable suggests that people who work in the agricultural sector have the largest IDRs, implying that they are less patient than those in any other occupations. People who work in the public sector are, on the other hand, the most patient since the estimate suggests that their IDRs are the lowest among all occupations. This coincides with Harrison et al. (2002) who reports significantly lower discount rates for skilled labor compared to those of unskilled individuals. The estimated coefficient also suggests that people with any savings have smaller IDRs. This could be because people who save are those who delay their present consumption to future.

Another finding is that the level of education affects IDRs positively. The result suggests that having a bachelor's degree increases an IDR by about 10.34% compared to subjects who only graduated from high school. In addition, people who hold a postgraduate degree showed increased IDRs compared to those holding a bachelor's degree by a spread of about 9.27%. Although the result is inconsistent with Harrison et al. (2002), it is consistent with D'Exelle et al. (2012). A possible rationale behind the result is that people with higher education in Thailand have significantly larger consumption and investment opportunities. They can afford a larger set of goods and services as well as are subject to more consumerism. People with a higher level of education can access a larger set of financial investment since some financial products require a certain degree of financial literacy which is related to the level of education (Wagner, 2019). They might prefer receiving money right away to receiving a larger amount of money in the future in order to spend money to meet their needs or invest in other assets which yield a higher rate of return.

## 6. Conclusion

This study elicits IDRs from populations living in urban and rural districts of Thailand. It further investigates whether there are differences in discount rates in two areas with contrasting sociodemographic characteristics. One finds that the average discount rate reported was in the range of 25.23-28.39 AER percentage which is along the same line with other field studies using real monetary incentives such those of as Harrison et al. (2002). However, their study showed significant differences between market interest rates

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<sup>11</sup> Subjects used up to 35 minutes to complete the matching task compared to 45 and 50 minutes in SPL and PL tasks respectively.

<sup>12</sup> i.e., Hardisty et al. (2013)

<sup>13</sup> Subjects only needed to put an "X" at the switching row in the SPL treatment. In the PL treatment, subjects needed to answer each row. Also, subjects needed to write down a number in the matching task. However, this is only the authors' conjecture. Further research is needed to understand the judgment mechanism of subjects behind these methods.

and hypothetical experimental studies. One can also find that heterogeneity in discount rates is subject to both across different sociodemographic and time horizons. One also finds that IDRs elicited from samples of those living in rural areas is significantly lower--meaning that they are more patient--than those from urban areas. This implies that intertemporal policy analyses and policy implementations should be varied and take into account the difference between these groups. This research also finds that IDRs generally increase with time horizons. Furthermore, these experimental measures suggest a procedural invariant in both the choice task and the matching task. Hence, applying the matching task could provide convenience for both experimenters and subjects in field studies in developing markets. These results provide an exploratory framework, and suggest that there is still much to be done in understanding time preferences in developing markets.

## References

- Ahlbrecht, M., & Weber, M. (1997). An empirical study on intertemporal decision making under risk. *Management Science*, 43(6), 813-826.
- Anderson, C.L., Dietz, M., Gordon, A. & Klawitter, M. (2004). Discount rates in Vietnam. *Economic Development and Cultural Change*, 52(4), 873-887.
- Andersen, S., Harrison, G.W., Lau, M.I. & Rutstrom, E.E. (2014). Discounting behavior: A reconsideration. *European Economic Review*, 71, 15-33.
- Ashraf, N., Karla, D., & Yin, W. (2006). Tying Odysseus to the mast: Evidence from a commitment savings product in the Philippines. *The Quarterly Journal of Economics*, 121(2), 635-672.
- Benhabib, J., Bisin, A. & Schotter, A. (2010). Present-bias, quasi-hyperbolic discounting, and fixed costs. *Games and Economic Behavior*, 69(2), 205-223.
- Benzion, U., Rapoport, A. & Yagil, J. (1989). Discount rates inferred from decisions: An experimental study. *Management science*, 35(3), 270-284.
- Boonmanunt, S., Lauer, T., Rockenbach, B., & Weiss, A. (2020). Field evidence on the role of time preferences in conservation behavior. *Journal of Environmental Economics and Management*, 104, 102-368.
- Cameron, A. C., & Trivedi, P. K. (2010). *Microeconometrics using stata* (Vol. 2). College Station, TX: Stata press.
- Cassar, A., Healy, A., & Von Kessler, C. (2017). Trust, risk, and time preferences after a natural disaster: Experimental evidence from Thailand. *World Development*, 94, 90-105.
- Charness, G., Gneezy, U. & Halladay, B. (2016). Experimental methods: Pay one or pay all. *Journal of Economic Behavior & Organization*, 131, 141-150.
- Chernoff, H. (1983). Individual purchase criteria for energy-related durables: The misuse of life cycle cost. *The Energy Journal*, 4(4), 81-86.

- Cohen, J., Ericson, K.M., Laibson, D. & White, J.M. (2020). Measuring time preferences. *Journal of Economic Literature*, 58(2), 299-347.
- Coller, M. & Williams, M. B. (1999). Eliciting individual discount rates. *Experimental Economics*, 2, 107-127.
- Coller, M., Harrison, G. W., & Rutstrom, E. E. (2012). Latent process heterogeneity in discounting behavior. *Oxford Economic Papers*, 64(2), 375-391.
- D'Exelle, B., Van Campenhout, B. and Lecoutere, E. (2012). Modernisation and time preferences in Tanzania: Evidence from a large-scale elicitation exercise. *Journal of Development Studies*, 48(4), 564-580.
- Fishburn, P. C. & Rubinstein, A. (1982). Time preference. *International Economic Review*, 23(3), 677-694.
- Fisher, I. (1930). *The Theory of interest: As determined by impatience to spend income and opportunity to invest it*. New York: Macmillan.
- Frederick, S., Loewenstein, G., & O'Donoghue, T. (2002). Time discounting and time preference: A critical review. *Journal of Economic Literature*, 40(2), 351-401.
- Freeman, D., Manzini, P., Mariotti, M., & Mittone, L. (2016). Procedures for eliciting time preferences. *Journal of Economic Behavior & Organization*, 126, 235-242.
- Friedman, M. (1953). *Essays in positive economics*. Chicago: University of Chicago Press.
- Hardisty, D. J., Appelt, K. C., & Weber, E. U. (2013). Good or bad, we want it now: Fixed-cost present bias for gains and losses explains magnitude asymmetries in intertemporal choice. *Journal of Behavioral Decision Making*, 26(4), 348-361.
- Harrison, G. W., Lau, M. I. & Williams, M. B. (2002). Estimating individual discount rates in Denmark: A field experiment. *American Economic Review*, 92(5), 1606-1617.
- Holden, S.T., Shiferaw, B. and Wik, M. (1998). Poverty, market imperfections and time preferences: of relevance for environmental policy?. *Environment and Development Economics*, 3(1), 105-130.
- Kirby, K. N., Winston, G. C., & Santieseban, M. (2005). Impatience and grades: Delay-discount rates correlate negatively with college GPA. *Learning and Individual Differences*, 15(3), 213-222.
- Lawrance, E. C. (1991). Poverty and the rate of time preference: evidence from panel data. *Journal of Political Economy*, 99(1), 54-77.
- Loewenstein, G. & Thaler, R. H. (1989). Anomalies: intertemporal choice. *Journal of Economic Perspectives*, 3(4), 181-193.
- Pender, J. L. (1996). Discount rates and credit markets: Theory and evidence from rural india. *Journal of Development Economics*, 50(2), 257-296.
- Raidani, Pertiwi, L. S., Wulandari, D Y., & Zuhri. (2016). Tobit and interval censored regression model. *Global Journal of Pure and Applied Mathematics*, 12(1), 981-994.
- Read, D., & Roelofsma, P. H. (2003). Subadditive versus hyperbolic discounting: A comparison of choice and matching. *Organizational Behavior and Human Decision Processes*, 91(2), 140-153.

- Ruderman, H., Levine, M. & McMahon, J. (1984). *Energy efficiency choice in the purchase of residential appliances*. Lawrence Berkeley Laboratory, University of California.
- Tanaka, T., Camerer, C. F., & Nguyen, Q. (2010). Risk and time preferences: Linking experimental and household survey data from Vietnam. *American Economic Review*, 100(1), 557-571.
- Thaler, R. (1981). Some empirical evidence on dynamic inconsistency. *Economics Letters*, 8(3), 201-207.
- Wegmann, J., Hermann, D., & Musshoff, O. (2022). Assessing risk attitudes and time preferences on the rural–urban interface of Bengaluru, India. *Agricultural Finance Review*, 82(5), 828-846.  
<https://www.emerald.com/insight/content/doi/10.1108/AFR-04-2021-0040/full/html>
- Wagner, J. (2019). Financial education and financial literacy by income and education groups. *Journal of Financial Counseling and Planning*, 30(1), 132-141.
- Warner, J. T. & Pleeter, S. (2001). The personal discount rate: Evidence from military downsizing programs. *American Economic Review*, 91(1), 33-53.
- Yesuf, M. (2004). *Risk, time and land management under market imperfections: Applications to Ethiopia* (Doctoral dissertation, Gothenburg University, Sweden). Retrieved from <https://gupea.ub.gu.se/handle/2077/2942>