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

by

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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 in Thailand using real monetary incentives in the lab-in-the-field setting. We investigate the differences in the discount rates between two different districts with different socioeconomic characteristics. One represents rural agricultural society while another represents an urban industrialised society. We also compare the results between different elicitation methods. The paper provides two main insights. First, the elicited discount rates are significantly different between the two districts. Second, the discount rates also vary across time-horizon suggesting different risk consideration with respect to the time horizon. We also address an intertemporal experimental design issue that results should be indifferent between elicitation methods and find procedural invariant between the choice and matching tasks.

Keywords: Discount rate, Intertemporal decision making, Time preference, Lab-in-the-field Experiment

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1. Introduction

One of the main components of individual economic and financial decision making is the comparison of values between present and future. The discount rate plays a central role in analyses of intertemporal choices. It is the rate at which an individual is willing to trade present costs or benefits with delayed consequences. Using an incorrect or inappropriate discount rate could prove costly as it is the central concept of finance. For example, it could provide misleading project evaluations, opportunity costs, and capital costs. It could also cause misallocation of funds as a result of erroneous lending and borrowing rates. Policy makers could end up choosing an inappropriate investment choice which leads to tremendous financial and opportunity costs. In terms of individuals, if people are patient, they will be able to plan, save, and invest towards their own objectives. However, if they are impatient, they will engage in short-term gratification activities which result in sub-optimality utilization of their own resources. In developing countries, these could mean that parents do not invest sufficiently in their own healthcare or children education which partly explain why some people could not escape the poverty or the middle-income trap.

Theoretically, market interest rates are employed as the representative of individual discount rates in financial models. However, discount rates are most likely differed among individuals. Empirical evidences suggest that the individual discount rates are well above the market interest rates (i.e. Warner and Pleeter (2001), Harrison et al. (2002)) and vary in a very wide range (Coller and Williams (1999)). This paper aims to elicit individual discount rates in Thailand, accounting for differences in socioeconomics[1], using real monetary incentives in the survey. To the authors knowledge, this is the first paper that attempt to do so. Eliciting actual discount rates of people in the society will equip a government with a better tool. This could be used to design suitable and targeted policies toward specific member groups within the society. Our main hypotheses are firstly, the discount rates elicited from individuals differ from the market interest rate as well as differ across individuals and across socioeconomic characteristics. Secondly, the discount rate for a given individual do not differ across time horizons. We also employed different elicitation methods to investigate the procedural invariance in discount rates.

Thailand is traditionally an agricultural country. As the globalisation trend looms, it is inevitable that the country becomes more industrialised. Historically, long-term migration trend in Thailand mostly is from rural to urban areas. According to UNESCAP (2016), 50.50% of Thai population live in urban areas. This

[1] By socioeconomics, we refer to the different in 1. Socio-demographics 2. Behavioural characteristics and 3. Individual economic characteristics.

provides an interesting and contrast characteristic of the society. Half of the population lives in urban areas, providing labour for industries such as construction, manufacturing, and services. While another half is still in the agricultural sector in the rural areas. The social and economic circumstances facing these two main demographic groups are different, which in turn, potentially affect or differently influence their intertemporal decision making. Agricultural households face production risks such as adverse weather conditions. Moreover, these households also face limited credit or access to loan when compare to those live in the urban area (Pender, 1996). In contrast, industries face more of economic fluctuations or management risk but gain easier access to credit. One of the reasons that time preference varies among individual is because it is shaped by culture (Rogers (1994)). Hence, our hypothesis that the discount rates between these two main groups are different.

Although the basic assumption in normative decision theories states that individual preference should be consistent over time (i.e. Friedman (1953)). Challenges have been made to this assumption (i.e. Allais (1953), Ellsberg (1961)) and empirical evidences (i.e. Slovic and Lichtenstein (1968), Tversky et al. (1990)) have shown that preferences can be inconsistent. In term of time preference, there are inconclusive evidence. Harrison et al. (2002) shows that the discount rates are constant over one to three-year time horizons. However, Thaler (1981) finds that they vary sharply. This paper will provide further evidence to this topic as per our second hypothesis: the discount rate for a given individual do not differ across time horizons.

We conducted field experiments in two of Thailand districts to directly measure individual time preference and observe their relation to socioeconomics characteristics. Incentivised laboratory experiments have long been used to investigate individual discount rates. Several elicitation methods are incentive compatible. However, there are two prominent methods which have been extensively use, namely, choice tasks and matching tasks. Choice tasks normally present decision makers (DMs) with a series of binary comparisons which is aimed to extract the indifference point which, in turn, used to infer the discount rates. Matching tasks often ask directly for the exact indifference point from DMs. 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. We adopt and adjust the choice and matching methods to use in the field in Thailand to compare their results. Because socioeconomic differences can be large in developing economies, traditional student sample might not give us accurate estimation of parameters to represent the population. Field experiments are proven to be crucial in understanding individual decision making in this part of the world. Most of the intertemporal

studies in developing markets also opted for the field approach (e.g. Ashraf et al. (2006), Tanaka et al. (2010)).

This article is comprised of 6 sections. The next section, we review existing literature related to individual discount rate. In the third section, we discuss about the experimental design in detail. In the fourth section, we present data analysis including data cleaning process, descriptive statistics, and statistical analysis. The fifth section reports individual discount rate results from different elicitation methods as well as the estimation results. We conclude in the last section.

2. Literature review

The discount function is based upon two important assumptions in the intertemporal choice setting. First, that the consumption today is preferred over consumption in the future. This was first conceptualised descriptively by Fisher (1930) stating that the discount rate is the marginal rate of substitution between consumption today and consumption in the future and that must equal to the interest rate. Secondly, the assumption that the discount rate is constant over time (Fishburn and Rubinstein (1982)). These are clearly elegant normative theories. However, empirical evidences[2] have shown that they are not entirely and behaviourally accurate. Some earlier works[3] tried to estimate discount rate from saving or consumption behavior. However, there are many other factors underlying an individual's saving behavior and these studies could not entangled them. Chernoff (1983) mentions that because of factors such as risk, uncertainty, and liquidity that make it inappropriate to assume that the implied discount rate is equal to the market interest rate. And because of the difficulty in extracting the true discount rate from actual consumption data, extensive economic experiments aim to elicit individual discount rates are done in a laboratory with university students as subjects.

The existing 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 hypothesised that it is because of economic literacy of the subjects. Harrison et al. (2002) uses real monetary incentives in the field sample (general population all over Denmark). They find that the discount rates vary across socioeconomic characteristics,

[2] For useful review of studies using consumption data, we refer the reader to Rude
rman et al. (1984). For review of experimental studies, we refer reader to Coller and Williams (1999).
[3] i.e. Lawrance (1991)

but they do not vary according to the time horizon and the average discount rate over all subjects was approximately 28%. Warner and Pleeter (2001) utilises the large-scale actual payment to the US military service and find similar results, the discount rates vary between 10 to 54%.

In general, previous studies find that high income persons are more patient than poorer ones. Lawrance (1991) suggests that households with low permanent income on average has three to five percentage points lower discount rate than those of high permanent income. This could imply different pattern of life-cycle consumption and saving behavior. Yesuf (2004) finds that household wealth in term of physical asset are highly correlated to time preference. However, there are some contradicting evidence. Kirby et al. (2002) does not find such relationship in the case of Bolivia. It is also widely (and almost implicitly) assumed that individual discount rates 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 empirically confirmed by Harrison et al. (2002). This paper investigates the relationship between individual discount rates and both social status and time horizons.

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

We can see that most of the previous evidence are concentrated in using educated western population. In term of developing market, Pender (1996) conducts a study in rural India where villages' money lenders normally charge the interest rate around 30% and find very high individual discount rates in these areas. Any sustainable policies for development are most likely disregard since poverty and limited access to credit markets lead people to view consumption of resources only for the very short term. In Thailand, as for the author knowledge, this paper will be the first to elicit individual discount rates regardless of the method. Past studies involving intertemporal setting commonly employ market interest rate as the benchmark. Tanaka et al. (2010) conducted field experiments in Vietnamese villages and finds that people

in richer villages are more patience. This paper not only provides new evidence in terms of the developing economies data, it also contributes in terms of the comparison between different socioeconomics within the developing world.

3. Experimental design

a. Basic concepts

The choice task

The individual discount rate (*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*% while if B is preferred to A then the discount rate is less than *int*%. We can vary the amount of *int* to be as close to continuous as possible and we can infer that the rate *int* at the switching point is the individual discount rate. Secondly, we can vary the time horizon to test for consistency of individual over time. For example, we 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 the option B. We use the multiple price list (MPL) method as the foundation for our choice-task treatments.

The matching task

The task asks for the exact indifference point. The questions posed to subjects are open-ended in this type of task, hence, subjected to less experimenter bias. This method is more common in psychology literature using hypothetical choices in which psychologists believe that participants often give truthful answers. However, Benhabib et al. (2010) demonstrates that by pairing the matching task with the Becker, Degroot, and Marschak (1964) method, the task is incentive compatible. The example of a question from this task is that it might ask the DMs to state the amount *xxx* bahts they regard as indifferent to receiving *yyy* bahts today.

b. Experiment in practice

Stratified sampling is applied in collecting the samples. This study collects information from Hadyai, Songkla and Sribanpot, Pattalung which are located in the Southern region of Thailand. Provinces are selected based on their GPP per capita level in order to be representatives of urban and rural cities. Songkla 2017's GPP per capita were 156,245 baht. This is ranked 23rd country wise and 6th in the southern region. Pattalung's GPP per captita were 71,298 baht which ranked 61st out of 77 provinces in the country and 13th out of 14 southern provinces[4]. Pattalung's main income is from the agricultural sector with a value of 12 billion baht or 36.27% of the GPP. Songkla is more industrialised province with the main Southern Industrial Estate situated in Hatyai district. This industrial estate is linked directly to the northern border of Malaysia. Sribunpot district of Pattalung province has a population of 14,787 compared to 159,233 of Hatyai district of Songkla province. 25.6% of the People in Sribunpot are in the agriculture sector compared to 6.5% in Hatyai. With the agricultural area covering 35.79% and 24.77% in Sribunpot and Hatyai respectively. There are 3 treatments in each province. Each treatment corresponds different elicitation methods.

<u>The traditional MPL treatments</u>

Upon arrival at the experiment session, participants were given the information along this line in Thai: "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 *1* month from today, but this Option A will pay a smaller amount than Option B. If you are the chosen one to receive the money, your choice in a selected alternative will be paid to you for real". The instructions was also read aloud to subjects. Subjects were given time to clarify their questions with experimenter team.

Then, each respondent receives five multiple price lists denoting different time intervals between payment of option A and option B. The time intervals will be 3, 6, 12, 24, and 36 months to test subjects' discount rates in different time horizons. In addition to the multiple price lists table, subjects also receive information about various interest rates from various legal credit types i.e. market lending rates, borrowing rates, credit card interest rates, etc. This is crucial as subjects can make informed decision

[4] Data from the National Economic and Social Development Council.
https://www.nesdc.go.th/ewt_dl_link.php?nid=5628&filename=gross_regional

based on the information of actual available legal alternatives or field opportunities. 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 THB (pays amount below 1 month)	Payment option B in THB (pays amount below 4 month)	Annual interest rate (AR in %age)	Annual effective interest rate (AER in %age)	Preferred payment option (circle A or B)
1	4000	4025	2.5	2.53	A or B
2	4000	4050	5.0	5.13	A or B
3	4000	4075	7.5	7.79	A or B
4	4000	4100	10	10.52	A or B
5	4000	4125	12.5	13.31	A or B
6	4000	4150	15.0	16.18	A or B
7	4000	4175	17.5	19.12	A or B
8	4000	4200	20.0	22.13	A or B
9	4000	4225	22.5	25.22	A or B
10	4000	4250	25.0	28.39	A or B
11	4000	4275	27.5	31.64	A or B
12	4000	4300	30.0	34.97	A or B
13	4000	4325	32.5	38.38	A or B
14	4000	4350	35.0	41.88	A or B
15	4000	4375	37.5	45.47	A or B
16	4000	4400	40.0	49.15	A or B
17	4000	4425	42.5	52.92	A or B
18	4000	4450	45.0	56.79	A or B
19	4000	4475	47.5	60.75	A or B
20	4000	4500	50.0	64.82	A or B
21	4000	4600	60.0	82.12	A or B
22	4000	4700	70.0	101.24	A or B
23	4000	4800	80.0	122.36	A or B
24	4000	4900	90.0	145.69	A or B
25	4000	5000	100.0	171.46	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 4000 baht for all cases. The alternative payments for option B (4000 baht plus *xx* baht) are obtained based on different annual interest rates (ranging from 2.5 to 100 %) and pro-rated for the same time span (in this case, three months). Annual interest rate (AR) and annual effective interest rate (AER) associated with individual decisions are reported using daily compounding for the AER. The last column is where respondents state their preferences.

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

Payoff alternative	Payment option A in THB (pays amount below 1 month)	Payment option B in THB (pays amount below 7 month)	Annual interest rate (AR in %age)	Annual effective interest rate (AER in %age)	Preferred payment option (circle A or B)
1	4000	4050	2.5	2.53	A or B
2	4000	4100	5.0	5.13	A or B
3	4000	4150	7.5	7.79	A or B
4	4000	4200	10	10.52	A or B
5	4000	4250	12.5	13.31	A or B
6	4000	4300	15.0	16.18	A or B
7	4000	4350	17.5	19.12	A or B
8	4000	4400	20.0	22.13	A or B
9	4000	4450	22.5	25.22	A or B
10	4000	4500	25.0	28.39	A or B
11	4000	4550	27.5	31.64	A or B
12	4000	4600	30.0	34.97	A or B
13	4000	4650	32.5	38.38	A or B
14	4000	4700	35.0	41.88	A or B
15	4000	4750	37.5	45.47	A or B
16	4000	4800	40.0	49.15	A or B
17	4000	4850	42.5	52.92	A or B
18	4000	4900	45.0	56.79	A or B
19	4000	4950	47.5	60.75	A or B
20	4000	5000	50.0	64.82	A or B
21	4000	5200	60.0	82.12	A or B
22	4000	5400	70.0	101.24	A or B
23	4000	5600	80.0	122.36	A or B
24	4000	5800	90.0	145.69	A or B
25	4000	6000	100.0	171.46	A or B

Table 2 is similar to Table 1. The only difference is the time horizon (3 and 6 months for Table 1 and 2, respectively). The instructions for 6 months will be identical to the 3 months except for the waiting period to receive a sum of money. The respondent will be asked to provide responses for all five time horizons which will be presented to them simultaneously. The respondent has full right to respond to the multiple price list in any order.

There are 126 possible payment outcomes with the lowest possible payment of 4000 baht (option A of any payment plan) and the highest possible outcome is 16000 baht (option B of the 25th payoff alternative for the 36-month time horizon). The average payment for these outcomes is 5982 baht.

The simplified MPL (SMPL) treatments

This treatment is a close variant of the traditional MPL. In principle, traditional MPL task asks subjects to respond to each binary choice. Subjects should have a single switch point. Since we cannot rationalize subjects who switch more than once, most of the studies classified this type of response as inconsistent and is normally omitted from the analysis. However, this type of task can be viewed as unnecessary tedious to subjects especially in the field setting. Therefore, we simplified the list by letting subjects only response once at the crossing point. We would like to compare whether discount rates elicited from this treatment differs from the traditional one. This would help ease experimenter task in explaining the experiment to subjects in remote areas with a lower literacy rate. In our experiment, subjects in this treatment faced similar type of tables to those in the traditional MPL treatments. The only difference is the last column where the question asked is 'please mark the row that would make you indifferent between money received in column 2 (sooner) and money received in column 3 (later)'.

The matching treatments

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

The example of question subjects faced is along this line in Thai

'If you have a choice to receive the money today and in 3 months' time, the minimum amount of money that will make you switch from receiving 4000 baht now and in 3 months' time is …… baht. Please state the amount between 4025-5000 baht with 25 baht increment.'

In all tasks, we use real monetary incentives in the lab-in-the-field setting. This is because one of the reasons that previous experiments have found a wide range of discount rates could stem from hypothetical choices that many of them did use. We use natural field experiment because we want to estimate the discount rates of Thailand general adult population applying actual socioeconomics proportion to the sample that represent the society. We use random incentive mechanism to incentivise subject by telling them that one of the subjects in their (treatment) group will be randomly selected for payment of one of the randomly selected time horizons. Additional survey questions about socioeconomic characteristics were asked in all treatments. The questions include individual and household information

that is proven in the literature[5] to have influence on the discount rates. Socio-demographics e.g., gender, age, marital status, a number of household members, income, and occupation were collected and include in the analysis.

We aimed to recruited 80 subjects per each treatment. We recruited subjects in Hatyai district by placing desks with 6 research assistances together with experimenters at popular locations around the city e.g. in front of a bank, in a shopping mall, at a wet market. We explained the instructions and subjects were informed that there is a chance that they could earn actual money[6] and that the participation is voluntary. Subjects can also read the instructions themselves after the verbal explanation. There is no time restriction for subjects to complete the experiment and they are free to ask questions throughout the process of the experiment. For the Sribunpot district, we recruited subjects through the Village Health Volunteer system. These volunteers of the Public Health Department organize monthly meeting for health promotion. After their activities, experimenters and the research assistance team explain the experiment and hand out the questions for volunteer. At the end of the session, random incentive mechanism also applied. We randomly selected the time horizon, the row that the actual payment will be made, then, the subject number.

4. Data analysis

a. Data cleaning process

We targeted to obtain 80 observations for analysis for each treatment. Table 3 below provides the data cleaning process beginning with the actual numbers of collected observations by location and method.

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

Location	Songkla (Hatyai)				Pattalung (Sribunpot)			
Method	MPL	SMPL	M	**Total**	MPL	SMPL	M	**Total**
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**	67	68	60	**195**
Variable issues	3	3	1	**7**	12	7	6	**25**
Net obs.	63	75	65	**203**	55	61	54	**170**

[5] See Harrison et al. (2002), Pender (1996), and Loewenstein and Thaler (1989) for instance.

[6] We informed the subjects that we will randomly select one participant from their respective treatment to enter the random incentive mechanism procedure.

From Table 3, initial observations for multiple price list, simplified multiple price list, and matching methods collected from Hatyai are 75, 78, and 68 individuals respectively whilst those from Sribunpot are 75, 70, and 62 individuals respectively. We removed subjects that switched between A and B more than once in the traditional MPL method prior.

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 4500 baht in one-year time horizon, his switching point in longer time horizon must be more than 4500 baht. 'Time inconsistent' preferences occur when, for example, the amount of future money in a subject's switching point in longer time horizon is less than the amount of future money in the same subject shorter time horizon. Hence, the amount of observations reported inconsistent preferences are dropped.

These numbers can indicate subjects' understandability of each elicitation method. We conjecture that the higher percentage of errors due to preference inconsistency implies that people have more difficulties in understanding the method. In Hatyai, the MPL method shows the highest percentage of error observations at 12 percent. The percentage for the matching method is 2.9 whilst there is nil for the SMPL method. In Sribunpot, the pattern of errors is unchanged. The largest percentage can be observed from the authentic MPL method at 17.3. The matching method shows 3.2 percent, and the SMPL method reports the smallest number, 2.9 percent. We expect to see a larger percentage in general for Sribunpot than Hatyai since people in the average education level in the former district is lower and less familiar to numeric information.

Some important variables, e.g, age, education, occupation, and individual income, have issues such as missing values, illogical numbers, and so on. Observations with any of these errors are dropped (the number for each treatment as well as the total are presented in the penultimate row). The remaining numbers of Hatyai observations for MPL, SMPL, and matching methods are 63, 75, and 65, respectively. Regarding Sribunpot, the final numbers for price list, SPL, SMPL, 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 grouped by location (203 individuals from Hatyai and 170 individuals from Sribunpot).

b. Descriptive statistics

Besides eliciting individual discount rate, we collected different aspects of socioeconomic characteristics. Table 4 presents descriptive statistics of interested variables.

Table 4: Descriptive statistics for interested dependent variables

Variable	Hatyai		Sribunpot		Total	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Gender	1.616	0.488	1.800	0.401	1.700	0.759
Age	39.478	15.412	47.506	9.614	43.137	13.675
Education	2.227	1.378	2.941	1.773	2.552	1.608
Occupation	3.280	1.318	3.500	1.222	3.380	1.278
Marital Status	1.719	0.835	2.282	0.9983	1.976	0.954
Number of children	1.049	1.210	1.806	0.968	1.394	1.168
Individual income	20781.28	28652.38	11350.91	10549.76	16483.26	22769.94
Household member	3.320	1.207	3.894	1.359	3.582	1.308
Indebtedness	0.586	0.493	0.894	0.309	0.727	0.446
Saving	0.818	0.387	0.800	0.4011	0.810	0.393

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

The average values of categorical variables, including education, occupation, and marital status, are not straightforward. In fact, regarding an education variable, people with high school, undergraduate degree, and others share 33.24%, 34.05%, and 27.61% of the total observations, respectively; the remaining are people with a postgraduate degree. By comparing between two districts, the largest group of observations in Hatyai is those with undergraduate degree, following by those with high school qualification; on the other hand, the largest group of respondents in Sribunpot is other education whilst the second largest group is people finished high school.

The variable for occupation shows that most of observations in Sribunpot are working in an agricultural sector, 64.12%; the second largest group is people working in a public sector. On the other hand, occupation in Hatyai are relatively equally distributed across all categories (ranging from 18.23% to 26.60%) except a public sector (8.37%). Hence, in total, the largest group of occupation is agricultural related ones (41.29%) followed by other occupations (18.50%) and businessman (18.23%).

With regard to the variable for marital status, in total, 59% of observations are married whilst the next largest group is single (28.15%). When consider sub-sample by location, the two largest groups of samples in Hatyai are single and married at 44.83%. However, 77.06% of observations collected from Sribunpot is married whilst the next largest group is others (9.41%).

A variable for a number of children shows that both districts have about 1.4 children per family; By considering it separately, average numbers of children of Hatyai and Sribunpot 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 observations are indebted. However, it is apparent that the rate of indebtedness of people is lower in Hatyai compared to in Sribunpot. The final variable in our estimation model is a dummy variable indicating if a respondent has any saving account. 81% of people in both districts have some saving; the difference between two districts is minute, 1.8%.

c. Statistical analysis

As mentioned above, respondents choose between Option 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 prefer Option B to A[7]; in case a participant always selects payment Option A, the code is designated as 26.

The selected alternative is interpreted as an interest rate interval for that respondent. For example, if the respondent switches the preference to first prefer Option B over A at payoff alternative 7[8], the individual discount rate for him must be higher than 16.18% but not greater than 19.12%. Having mentioned that, this interval could be narrow down by the censoring method (which will be explained later).

After obtaining raw data, statistical model will be estimated to see characteristic effects on the individual 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 individual discount rate, x_i designates a vector of explanatory variables include socioeconomic characteristics, and ε_i is an error term.

[7] We will remove the inconsistent responses (those that have more than one switching points).
[8] From table 1 or 2.

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

$$y_i = 1;\ y_i^* \leq \varphi_1$$

$$y_i = 2;\ \varphi_1 < y_i^* \leq \varphi_2$$

$$y_i = 3;\ \varphi_2 < y_i^* \leq \varphi_3$$

$$\vdots$$

$$y_i = J;\ y_i^* \geq \varphi_J$$

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

In practice, subjects may arbitrage 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 saving account) that subjects are facing. This information allows us to do preliminary data analysis on censoring or bounding at borrowing and lending rates.

For instance, considering an individual with true individual discount rate of 25%. In the absence of actual substitutes for experimental incentives, the 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 he/she requires at least 25% to delay consumption, at rate between 15% and 25%, he/she is better off borrowing from the market at 1 %, choose option B anywhere that yield higher than 15%. This way the subject saves the money in the experiment yielding >15 % and when the experimental payment is received, repaying the actual debts to complete his/her arbitrage opportunities.

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

On the other hand, an individual's lending rate, r_L^i, is calculated by using saving rates to effective annual lending rate. If a respondent does not have any saving account or know the rate, the effective lending rate is assumed to be a general annual saving rate. Censoring at lending rates is done by investigating whether or not the individual discount rate falls within the same interval as the market rate of the effective lending rate. If the result is no, the true individual discount rate lies in that interval. If the result is yes, we infer that the true individual discount rate is not greater than the observed lending rate within the interval.

For example, an individual with a true individual discount rate of 2%. In the absence of arbitrage, an individual is expected to select Option B at the first alternative. If he/she is able to save money in the market at the rate of 4%, he/she will not postpone payment in the experiment until the interest rate reach at least 4%. Although he demands only 2% to delay his consumption, he/she is better off taking money from the experiment immediately, lending money to the actual market earning 4%.

After accounting for censoring issues, the refined data is used in the estimation process. We follow Harrison et al. (2002) by applying an interval regression model in estimating. This is because our variables contain point, interval, and interval-censored values. In fact, we can identify the ordered category or interval that each observation falls; however, the exact value of the observation is unknown.

5. Results

There are two primary sub-sections in this part. First, we discuss elicited individual discount rates. Second, we focus on the estimated result using an interval regression model.

a. Elicited individual discount rates

As mentioned in the experimental design session, individual discount rates are elicited directly from the lab-in-the-field questionnaires. We report results from different elicitation methods which include two widely used methods and our modified method. The summarised information about elicited individual discount rates is reported in Table 5. We interpret these as the elicited individual discount rate interval as done by Coller and Williams (1999).

Table 5: Elicited individual discount rate by location and method.

District	Meth.	Time	Median			Inter quartier range	P50 (%)	<P50 (%)
			Res.	Interval				
				AR (%)	AER (%)			
All	All	All	10	22.51-25	25.23-28.39	10.53-49.15	6.86	46.92
Hatyai	All	All	12	27.51-30	31.65-34.97	12.51-64.82	5.02	49.95
	MPL	3	13	30.01-32.5	34.98-38.38	13.32-64.82	4.76	47.62
		6	14	32.51-37.5	38.39-41.88	25.23-64.82	7.94	47.62
		12	16	37.51-40	45.48-49.15	25.23-64.82	4.76	53.97
		24	15	35.01-37.5	41.89-54.47	28.39-64.82	3.17	47.62
		36	17	40.01-42.5	49.16-52.92	38.39-82.12	7.94	46.03
	SMPL	3	4	7.51-10	7.80-10.52	2.54-22.13	22.67	28.0
		6	6	12.51-15	13.32-16.18	7.80-28.39	10.67	41.33
		12	7	15.01-17.5	16.19-19.12	7.80-31.64	6.67	44.0
		24	7	15.01-17.5	16.19-19.12	10.53-31.64	13.33	40.0
		36	8	17.51-20	19.13-22.13	10.5338.38	4.0	49.33
	M	3	14	32.51-35.0	34.98-38.38	13.32-64.82	7.69	46.15
		6	20	47.51-50	60.76-64.84	25.23-82.12	10.77	41.54
		12	20	47.51-50	60.76-64.84	22.14-101.24	13.85	44.61
		24	16	37.51-40	45.48-49.15	16.19-82.12	4.62	46.15
		36	17	40.01-42.5	49.16-52.92	22.13-82.12	1.54	49.23
Sribanpot	All	All	8	17.51-20	19.13-22.13	5.14-41.88	6.82	38.94
	MPL	3	12	27.51-30	31.65-34.97	19.13-41.88	16.36	43.64
		6	12	27.51-30	31.65-34.97	13.32-41.88	9.09	47.27
		12	10	22.51-25	25.23-28.39	13.32-41.88	12.73	43.64
		24	10	22.51-25	25.23-28.39	10.53-41.88	5.45	45.45
		36	10	22.51-25	25.23-28.39	10.53-41.88	7.27	47.27
	SMPL	3	4	7.51-10	7.8-10.52	0-22.13	11.48	45.90
		6	6	12.51-15	13.32-16.18	2.54-28.39	9.84	47.54
		12	7	15.01-17.5	16.19-19.12	5.14-38.38	3.28	47.54
		24	8	17.51-20	19.13-22.13	5.14-41.88	3.28	47.54
		36	9	20.01-22.5	22.14-25.22	5.14-64.82	3.28	49.18
	M	3	3	5.01-7.5	5.14-7.79	0-22.13	12.96	42.59
		6	6	12.51-15	13.32-16.18	2.54-28.39	12.96	48.15
		12	10	22.51-25	25.23-28.39	2.54-34.97	12.96	48.15
		24	6	12.51-15	13.32-16.18	2.54-45.47	5.56	46.30
		36	6.5	12.51-15	13.32-16.18	5.14-64.82	1.85	48.15

Note: M stands for the matching method.

Table 5 reports descriptive statistics of individual discount rates collected from two districts (Hatyai and Sribunpot) using three different methods for five different time-horizons. The first three columns indicate locations, methods, and periods, respectively. Next, medians of responses (rows in the price list method) by different groups are provided. We report median as the ranges defining our elicitation intervals are not

constant as well as the distributions of elicited numbers are right skewed. Each response is converted to AR and AER intervals. Next column (the 7th column) reports the interquartile ranges (between 25th and 75th percentiles) of AER. The penultimate column reports the percentage of the sample which locates exactly on the median (P50). The last column presents the percentage of the sample lying on the lower half of the distribution.

Overall, the median value of the individual discount rates (AER) from our sample (two districts) is between 25.23 and 28.39%. When we consider each district separately, the elicited results show that the medians of the individual discount rates (AER) fall between 31.65 and 34.97% for Hatyai and between 19.13 and 22.13% for Sribanpot, respectively.

One major observable pattern is that responses elicited by SMPL are generally the lowest among 3 methods. Whilst the responses collected by matching are clearly highest for Hatyai sample, those elicited by price list report the greatest for the other district. Regarding to time-horizon, the results from the SMPL method indicate individual discount rates that are with positive relationship with periods. We can observe slight oscillating patterns in other methods.

b. Estimation results

This sub-section presents the estimation result regarding the determinants of individual discount rate. The result is shown as per Table 6.

Table 6: Regression analysis of discount rate responses

Variable	Coefficient	S.E.	Prob.	95% confidence interval	
Period (3 months category is set as the based case)					
6 months	5.805**	2.321	0.012	1.257	10.354
12 months	8.817***	2.321	0.000	4.268	13.367
24 months	7.894***	2.321	0.001	3.345	12.443
36 months	12.267***	2.322	0.000	7.717	16.818
Sribunpot	-15.979***	1.938	0.000	-19.776	-12.181
Method (Multiple price listed is set as the based case)					
SMPL	-13.673***	2.067	0.000	-17.725	-9.622
M	1.230	2.250	0.585	-3.180	5.640
Female	-3.857**	1.750	0.027	-7.286	-.4276

Age	0.287***	0.084	0.001	0.123	0.451
Education (High school is set as the based case)					
Undergraduate	10.341***	2.168	0.000	6.092	14.59
Postgraduate	19.607***	4.228	0.000	11.320	27.893
Others	5.079**	2.046	0.013	1.068	9.089
Occupation (Agricultural sector is set as the based case)					
Public sector	-16.013***	3.083	0.000	-22.056	-9.971
Business own	-3.767	2.413	0.118	-8.495	0.962
Private sector	-8.279***	2.994	0.006	-14.148	-2.411
Other	-4.741**	2.373	0.046	-9.392	-0.089
Marital status (Single is set as the based case)					
Married	3.474	2.313	0.133	-1.060	8.008
Separated	-1.234	4.167	0.767	-9.402	6.934
Divorced	5.926	4.727	0.210	-3.339	15.191
Widow	2.010	4.118	0.625	-6.061	10.081
N of children	-5.062***	1.039	0.000	-7.097	-3.026
Inv. income	-5.13e-06	.000037	0.892	-0.0000793	0.0000691
HH member	1.080	0.669	0.106	-0.231	2.391
Indebtedness	1.392	1.965	0.479	-2.460	5.244
Saving	-4.503**	2.011	0.025	-8.445	-0.561
Constant	32.969***	5.601	0.000	21.990	43.948
N	1865		Log likelihood	-6708.535	

*, **, and *** indicate statistical significance levels at 10%, 5%, and 1%, respectively.

The total sample of 373 individuals responded to 5 sets of individual discount rate elicitations (time-horizon of 3, 6, 12, 24, and 36 months). The first focused variable is the time horizon; compared to the 3-month period, all periods are significantly greater. Besides 24-months period, the longer period is, the larger individual discount rate is reported. This is inconsistent with standard assumption that individual discount rate should be consistent regardless of the waiting time. One of the possible explanations could be that subjects are viewing this payment structure as risky prospects. Despite experimenters' effort to convince subjects of the certainty of future payment, subjects could still have some degree of mistrust.

Hence, it would require higher amount of money for them in order to give up the sure amount that they could receive today for future payment.

The other main focus of this research is the difference of individual discount rates between to districts, namely, Hatyai and Sribunpot, representing urban and rural areas, respectively. The estimation result suggests that the individual discount rate in Hatyai is about 16% greater than that in Sribunpot. Again, partial explanation for this result could be that subjects in Hatyai is doubtful of future payments from experimenter. People in the rural area are more closed knitted and the recruitment method are done through the trustworthiness organisation. From the estimated results, MPL and Matching methods yield comparable responses suggesting procedural invariant in these two methods. This is inconsistent with previous empirical works where several studies suggested that the choice task normally yield higher discount rates. This has implication on the experiments where financial literacy rate is not high as matching task is found to be easier to explain to and understand by subjects. However, responses elicited by using SMPL is lower than those by using MPL. More in depth study is needed to understand this result. There is hypothesis in literature[9] that 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 SMPL method, subject could be more careless as it requires the least mental effort out of the three methods.

Regarding individual socioeconomic characteristics, many variables, including age, gender, education and number of children, significantly affect individual discount rates. One individual characteristic we focus is occupation, especially agricultural related. The result suggests that people who work in an agricultural sector have the largest individual discount rates implying that they are less impatient than those having other occupations. People who work in a public sector is, on the other hand, most patient since the estimate suggest that their individual discount rate is the lowest among all occupations. This coincides with Harrison et al. (2002) which reports significant lower discount rate in skilled labour compared to those of unskilled individuals. The estimated coefficient also suggests that people with any saving have a smaller individual discount rate. This could be because people who save are those who delay their present consumption to future.

[9] E.g. Hardistry et al. (2013)

6. Conclusion

This study elicits individual discount rates in actual Thai population. We investigate whether there are differences in discount rates in two areas with contrasting sociodemographic characteristics. We find that average discount rates fell in the range of 25.23 and 28.39% which is along the same line with other field studies using real monetary incentives such as Harrison et al. (2002), although significantly difference from market interest rates and hypothetical experimental studies. We also find heterogeneity in discount rates subject to both across different sociodemographic and across time horizons. This implies that intertemporal policy analyses and policy implementations should be varied and take into account the difference between these groups. Our experimental measures also suggest procedural invariant in choice task and matching task. Hence, applying matching task could provide convenience for both experimenters and subjects in field studies in developing markets. These results provide exploratory framework and suggest that there are still much to be done in understanding time preference in developing market.

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