An International Survey on Time Discounting

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1

Abstract

We present results from an international survey on time discounting in 45 countries/regions. Consistent with the pattern predicted by the hyperbolic discounting model, most participants discount the near future more than the long-term future. The tendency to wait and the subjective discount rates are highly heterogeneous on a cross-country level and this cannot simply be explained by economic variables such as interest or inflation rates. The measured level of time discounting is correlated not only with factors like the wealth level of the countries, growth rate, and education, but also with cultural factors like individualism, uncertainty avoidance and long-term orientation. Within-country variation of time discounting is high as well. It seems that time preference is also related to loss-aversion and risk preferences at the individual level. Further results suggest that differences in time discounting between countries can be used to predict some macroeconomic phenomena, as we demonstrate on the examples of innovation and environmental preservation.

1 Introduction

The discount rate is one of the most fundamental concepts in finance and economics. It has been widely applied in asset pricing, project evaluation, decisions on investment and saving, among many others. Most standard economic models assume that time discounting or time preference are exogenous. A discount rate reflects the marginal rate of substitution between current and future consumption. It is assumed that in a perfect capital market where individuals can borrow and lend freely, the personal taste concerning time preference or patience should not matter, because intertemporal choices can be made such that the discount rate corresponds to the interest rate in the market, in order to avoid arbitrage opportunities. Therefore, in finance literature the discount rate is typically a measure of the market interest rate, and is independent of individual patience, risk attitudes, and other personal factors.

Recently, surveys and experiments provide abundant evidence that people differ in time preferences. Moreover, some theoretical models attempt to incorporate such heterogeneity and explain what drives the different degrees of preference regarding time and risk. However, we are not aware of any systematic studies that compare time preferences across large numbers of countries.

In this article, we present evidence from an international survey of economics students from more than forty countries on time preferences. We find that the measured level of time preferences is heterogeneous both at individual and at country level. Furthermore, we investigate to what extent economic situations, cultural factors, and individual risk preferences could vary with time preferences.

Most cross-cultural studies involve very few countries for comparison,

and have inherent difficulties in distinguishing socio-economic and cultural factors. For example, the United States and China are different in many dimensions, including economic situation, political system, and cultural roots. It is hard to deduce what causes the observed differences in risk preferences and time discounting. To study more systematically the impacts of country-level factors, it would be helpful to include countries like Japan, with similar cultural roots as China but similar economic development and political system as the U.S., and countries in East Europe, with European cultural roots but similar modern political experiences as in China.

The relatively large number of countries included in our survey allows us to link the time preference with the background of the countries, since these countries are highly heterogenous in their economic and political situations, as well as in their cultural roots. In particular, we find that time preferences are systematically correlated with the countries' wealth level. Participants from wealthier countries, i.e., countries with higher GDP per capita, tend to be more "patient" in our measurements[1]. On the other hand, countries with higher growth rate tend to be more "impatient." We also find that the measured time preference correlates with other country-level variables such as market efficiency, political stability, and education system, as well as cultural factors such as individualism, uncertainty avoidance and importance of tradition.

There are two major concerns about the survey method we adopted here. The first concern is that we only used university students as sample, not a representative sample to the total population. However, there are several

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[1]In this article, we use the term time discounting, time preference, and patience interchangeably for convenience, although strictly speaking, the three concepts are not identical.

advantages of this sample selection: First and second year economic students understand better the numeric formulations of lottery and time preference questions than the general public, but can still answer the questions intuitively. Students from economics can also be expected to play an important role in economics and financial markets in each country and in the global market. The time and risk preferences we study here are relevant for those finance-related activities. Moreover, as a leading researcher in cross-cultural comparisons, Hofstede (1991) emphasizes that, to make a cross-national comparison, it is important to recruit homogeneous, comparable groups from each country in order to control the background variables as much as possible.

The second concern for the survey method is that we only asked hypothetical questions without offering real monetary incentives. This raises concerns that the participants may not be motivated to give thoughtful answers. However, hypothetical questions even have some advantages in the domain of time preferences because it allows us to ask questions involving a long time span and large payoffs (Frederick, Loewenstein & O'Donoghue 2002). Moreover, some researchers who compared directly the real and hypothetical rewards did not find systematic differences, e.g., Johnson & Bickel (2002).[2].

Although our participants came from a relatively homogeneous group in terms of their age and educational background, we documented large individual and cross-country differences in their time preferences. The cross-country differences are predictable from macro-economic conditions. In particular we find wealth, growth rate, and education as significant predictors of the av-

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[2]In a pilot study, we conducted the survey in different classes in the economic department at the University of Zurich. For the lottery questions, we also used monetary incentives following the BDM procedure. No significant differences were found across different classes and between the monetary-incentive group versus the hypothetical-question group.

erage level of time preference at the country level. We also find that time preference are related to cultural dimensions, such as individualism, uncertainty avoidance, and long term orientation. In addition, loss aversion and risk preference also correlate to time preferences.

As examples of potential applications, we demonstrate that the average country-level time preference measured from our survey seem to be related to some general phenomena such as a country's innovation capability and environmental sustainability, even after controlling the national wealth level. Although the collected data do not allow us to further analyze the direct causal relationship, we find our results can be used as very useful inputs to form hypothesis for further empirical investigation and theoretical modeling.

The rest of this article is organized as follows: In the second section, we explain survey instrument. In the third section we present the results. In the final section we discuss potential application and future research direction.

2   Methodology

2.1   Measuring Time Preference

In our survey, we asked three hypothetical questions to measure time preferences.[3] The first question is a binary choice question taken from Frederick (2005), which we refer to as the "wait-or-not" question in the rest of the article. The question is presented as follows:

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[3]Some studies have reported differences between elicitation methods such as matching and choice, e.g., Read & Roelofsma (2003). Although we asked time preference questions in both decision modes (i.e., choice and matching), our survey design did not mean to draw any definite conclusions of these two elicitation methods, because we focus more on systematic cross-country variations instead of cross-question variations.

Which offer would you prefer?

A. a payment of $3400 this month

B. a payment of $3800 next month

To measure the implicit discount rate more directly, in the next two questions, we asked participants to give the amount of a delayed payment which makes them indifferent with an immediate payment. We refer to these two questions as the "one-year matching question" and the "ten-year matching question," respectively. These two questions are:

Please consider the following alternatives

A. a payment of $100 now

B. a payment of $ X in one year from now

X has to be at least $ __, such that B is as attractive as A.

Please consider the following alternatives

A. a payment of $100 now

B. a payment of $ X in 10 year from now

X has to be at least $ __, such that B is as attractive as A.

2.2   Measuring Risk Preference and Loss Aversion

We also measured risk preferences in a different section of the questionnaire by asking the participants' willingness to pay to some hypothetical lotteries. In a separate paper, we will discuss how to use these responses to fit Prospect Theory parameters. In the present paper, we check the relationship of time preference with two measures derived from the lottery questions. The first

measure is the revealed risk attitude in gains, measured by the average Relative Risk Premium (RRP) for two lotteries in the gain domain:

(1) a lottery with a 60% chance to win $100, otherwise nothing;

(2) a lottery with a 60 % chance to win $400, otherwise nothing.

The RRP is calculated as $(WTP - EV)/EV$. We refer the mean RRP of the two lottery questions as Risk Premium in our regression analysis later. The second measure is the loss-aversion parameter θ based on the elicitation of following questions:

In the following lotteries you have a 50% chance to win or lose money. The potential loss is given. Please state the minimum amount $X for which you would be willing to accept the lottery.

The two lotteries for measurement of loss aversion are:

(1) a lottery with a 50% chance to loss $25 and a 50% chance to win X;

(2) a lottery with a 50% chance to loss $100 and a 50% chance to win X.

The Loss-Aversion parameter is the mean of $X_1/2$ and $X_2/2$, where X_1 and X_2 are the responses to the two lottery questions, respectively.

2.3   Measuring Cultural Dimensions

Culture is typically defined as something stable over time that distinguishes different groups. One of the most influential measurements for culture has been developed by the Dutch sociologist Geert Hofstede during his long-term research on cross-national organizational culture. Five persistent cultural dimensions were found across different nations and different times (Hofstede 2001). In the second part of our questionnaire, we used the Values Survey Module (VSM94) developed by Hofstede and his colleagues to measure the cultural dimensions (Hofstede 2001). In particular, we will report the results that involve the following three cultural dimensions:

- Individualism (IDV): The opposite of individualism is collectivism. IDV measures the degree to which the society reinforces individual or collective achievement, and the extent to which people are expected to stand up as an individual as compared to loyal affiliation to a life-long in-group (e.g., extended family, friends, etc.). For example, the U.S. has an individualistic culture, whereas Japan has a collectivistic culture. The index is calculated from four questions in our questionnaire where the participants were asked to rate the importance of the described feature for an ideal job (1=of utmost importance; 5=of very little or no importance) : (1) sufficient time for your personal or family life; (2) good physical working conditions (good ventilation and lighting, adequate work space, etc.) (3) security of employment; (4) an element of variety and adventure in the job.

- Uncertainty Avoidance (UAI): A high score of UAI indicates that a society is afraid of uncertain, unknown and unstructured situations. It is derived from four questions. The first question is "How often do you feel nervous or tense at work (1=never; 5=always)?" The rest of the questions asked the participants to what extent they agree with each of the following statements (1=strongly agree; 5=strongly disagree): (1) One can be a good manager without having precise answers to most questions that subordinates may raise about their work; (2) Competition between employees usually does more harm than good; (3) A company's or organization's rules should not be broken – not even when the employee thinks it is in the company's best interest.

- Long Term Orientation (LTO): When using a Chinese Value Survey in East Asia, Hofstede and Bonds (1980) identified a fifth dimension

"long-term-orientation," or Confucian Dynamism, which captures the society's time horizon. It reflects to what extent a society has "a dynamic, future-oriented mentality." We measure this by the following question: "In your private life, how important is 'respect to tradition' for you (1=of utmost importance; 5=of no importance)?" A higher score implies that the past is valued less than the future, and people may look more forward.[4]

2.4   The Survey Instrument

A total of 5912 university students in 45 countries/regions participated in our survey. Most participants were first or second-year students from departments of economics, finance and business administration. We excluded those surveys with a completion rate less than 50%, resulting in 5903 individuals for the data analysis. The average age of participants was 21.5 years (SD=3.82). Fifty-two percent participants were males.

Each participant was asked to fill in a questionnaire that included 14 decision making questions (three time preference questions, one ambiguity aversion question, and 10 lottery questions), 19 questions from the Hofstede VSM94 questionnaire, a happiness question and some information about their personal background, nationality and culture origin. The questionnaire was translated into local languages for each country by professional translators or translators who have economic backgrounds. The amount of monetary payoffs in the questions were adjusted according to each country's Purchasing

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[4]We also included another question from VSM94 for this dimension: "How important is 'thrift' for you (1=of utmost importance; 5=of no importance)?" However, the response to this question was too noisy and not correlated with the time preference question. Therefore we excluded it from the index calculation.

Power Parity and the monthly income/expenses of the local students. The participants were instructed that there are no wrong or correct answers of those questions, and that the researchers are only interested in their personal preferences and attitudes. In most cases, the survey was conducted during the first 15 to 20 minutes of a regular lecture under the monitor of the local lecturers and experimenters.

3 Results

3.1 Measured level of time discounting

3.1.1 To Wait or Not

In this section, we evaluate the results from the "wait-or-not" question ($3400 this month or $3800 next month). Figure 1 shows the percentage of the participants in each country who chose to wait for $3800 next month. We observe a wide range of variation on the country level – the percentage of students who chose to wait ranged from only 8% in Nigeria to 89% of Germany. Note that the the implicit interest rate in this question is as high as 11.8% per month (i.e., an annual discount rate of 280%), which is far higher than the market interest rate and inflation rates in any of these countries. Therefore, the large variation across countries is hard to be justified purely by the differences in market interest rates or inflation rates.

In particular, 68% of our U.S. sample chose to wait (N=72). For comparison, in the survey by Frederick (2005) where he used the same question with a relatively large sample (N=807) of U.S. undergraduate students from several universities, only around 41% students chose to wait. Among those students who scored high in a separate Cognitive Reflection Test (CRT), there were
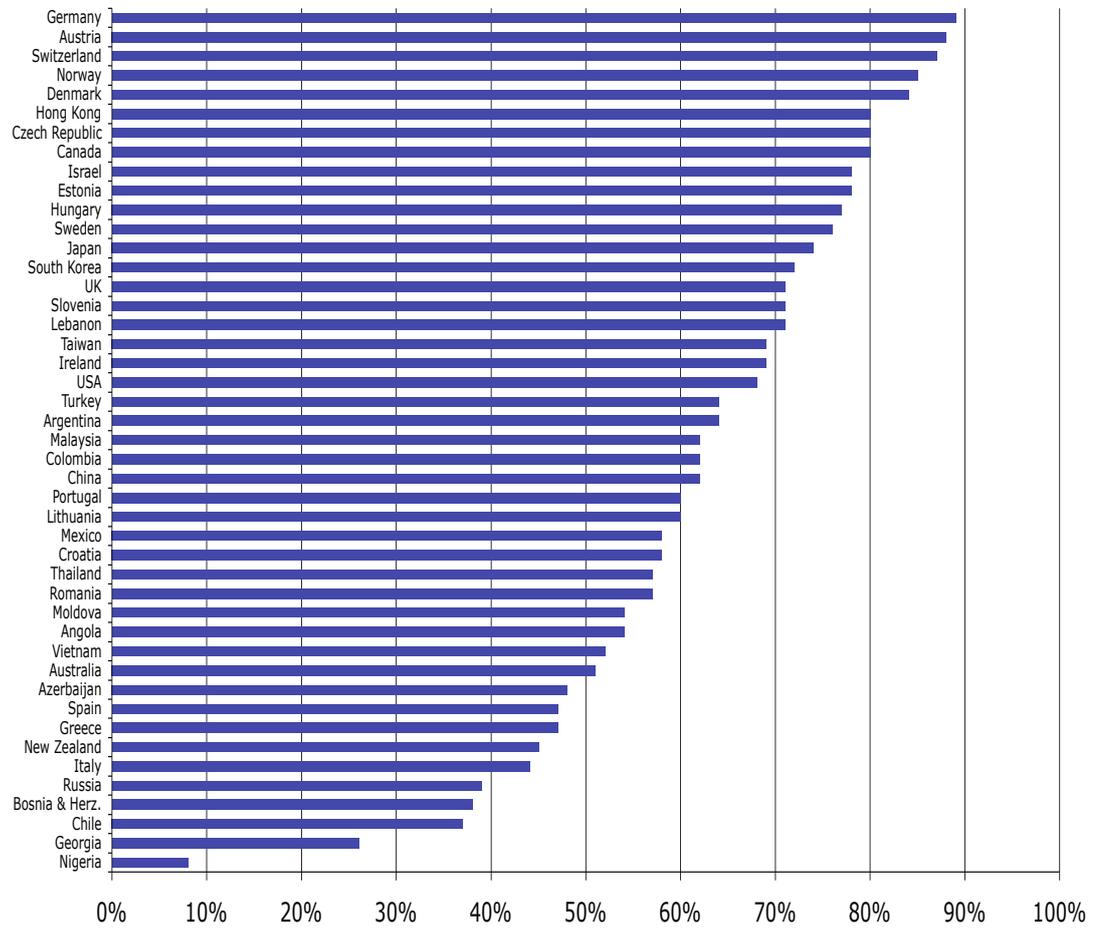
Figure 1: Percentage of Participants Who Choose to Wait

60% choosing the patient option, which is closer to our result. Several reasons might explain the higher percentage in our U.S. sample: First, the survey was conducted in relatively small classes during the lecture time, so that the students might have given more thoughtful answers; Second, our students were studying economics, and thus more likely to take the market interest into account. On the other hand, even 68% for the U.S. sample is still significantly lower than the percentage in Germanic-Nordic countries like Germany

(89%), Austria (88%), Switzerland (87%), and Norway (85%). This difference is hard to explain only by wealth, intelligence and the macro-economic situations.[5]

Each participant has stated not only their nationality, but also the culture they feel they belong to. Then we classified each participant into one of seven cultural clusters, using the classification scheme suggested by Chhokar, Brodbeck & House (2007). Figure 2 shows the perception of choosing to wait options when grouped by the cultural cluster. In general, the Germanic-Nordic group are far more patient (88% chose to wait) than other cultural clusters. Anglo, Middle East, and East Asia, are similarly patient (around 66% to 70%), then followed by East Europe, Latin America and Latin Europe (around 52% to 59%). Africa has the lowest percentage of participants choosing to wait (34%). We discuss more about the culture origins later.

3.1.2   Measured Subjective Discount Rate

Inferred Discount Rate: The Classical Approach

To infer discount rates from intertemporal decisions, we use the relationship between the present value of a cashflow, denoted by P, and its future value, denoted by F. Formally,

$$F = P(1 + R)^t,$$

where R is the discount rate and t is the time to be waited. Since both P and t are given in our questions, the inferred discount rate can be obtained

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[5]Even for the students from Princeton University, the percentage choosing the patient option is lower than the percentage of German students (80% vs. 89%). Actually some students from our Norway survey even complained that the question was ridiculous because *everybody* would choose to wait for one month given the high implicit interest rate.
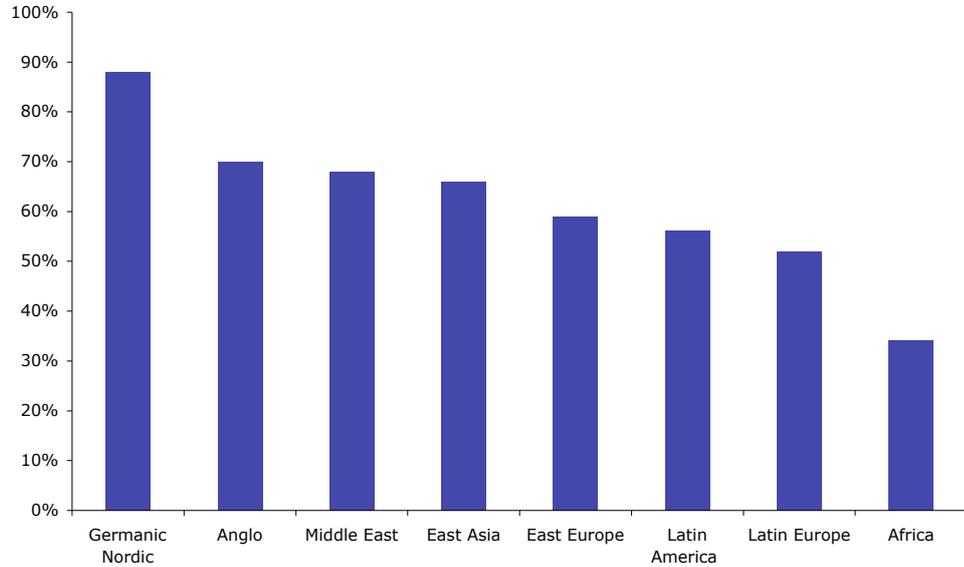
Figure 2: The percentage of choosing to wait grouped by cultural origin

Note: The column shows the percentage of participants who chose to the $3800 option when they were asked to choose between $3400 this month or $3800 next month. The respondents were asked about which culture they thought they belong to. We exclude those participants who do not live in their own countries. We group the countries into seven cultural clusters based on the classification from Chhokar et al. (2007).

easily from

$$R = (F/P)^{(1/t)} - 1.$$

We have two questions to infer the subjective discount rate, where t equals to 1 year and 10 years, respectively.

The classical approach states that there is only one "market riskless discount rate", which is supposed to be the same for all individuals. Our results indicate that this is not the case. Figure **??** shows that implicit annual interest rate for one-year and 10-year matching questions. We observe substantial

variations of implicit interest rate across individuals and across countries. The median R_{1year} is 100%, ranging from 14% in Australia to 1358% in Bosnia & Herzegovina, whereas median R_{10year} is 29%, ranging from 7% in Thailand and Spain to 71% in Bosnia & Herzegovina.[6] For all countries except for Australia, the median R_{1year} is higher than R_{10year}, which is consistent with the typical empirical findings that discount rates decrease with longer time horizons. This is also true at the individual level. In total, 87% participants had an implicit interest rate R_{1year} higher than R_{10year}.

The Classical Discounted Utility Model assumes consistent time preferences by using an exponential discounting model. It implies that the time preference between any adjacent periods should hold constant. Our results, consistent with previous empirical finding, show that most people discount the near future more than the far future, e.g., Thaler (1981) and Benzion, Rapoport & Yagil (1989). This pattern can be elegantly modeled by the implicit risk approach and the (quasi-)hyperbolic discounting function, which we will discuss in more details in the following sections.

The Implicit Risk Approach

The above results indicate that even for a single person, the subjective discount rate varies for different time intervals. In particular, most people appear to be more impatient for the one-year interval than for the ten-year interval. Hence we apply alternative models, namely, the implicit risk approach and the hyperbolic discounting model, which describe better the empirical results. According to the implicit risk approach (Mischel &

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[6]Georgia has extremely high implicit rate, especially for one-year-matching question (14900% for the one-year question, and 86% for the ten-year question). The potential reason is that the survey was conducted two months before the outbreak of Russia-Georgia war. The feeling of uncertainty may induce high discount for the near future.
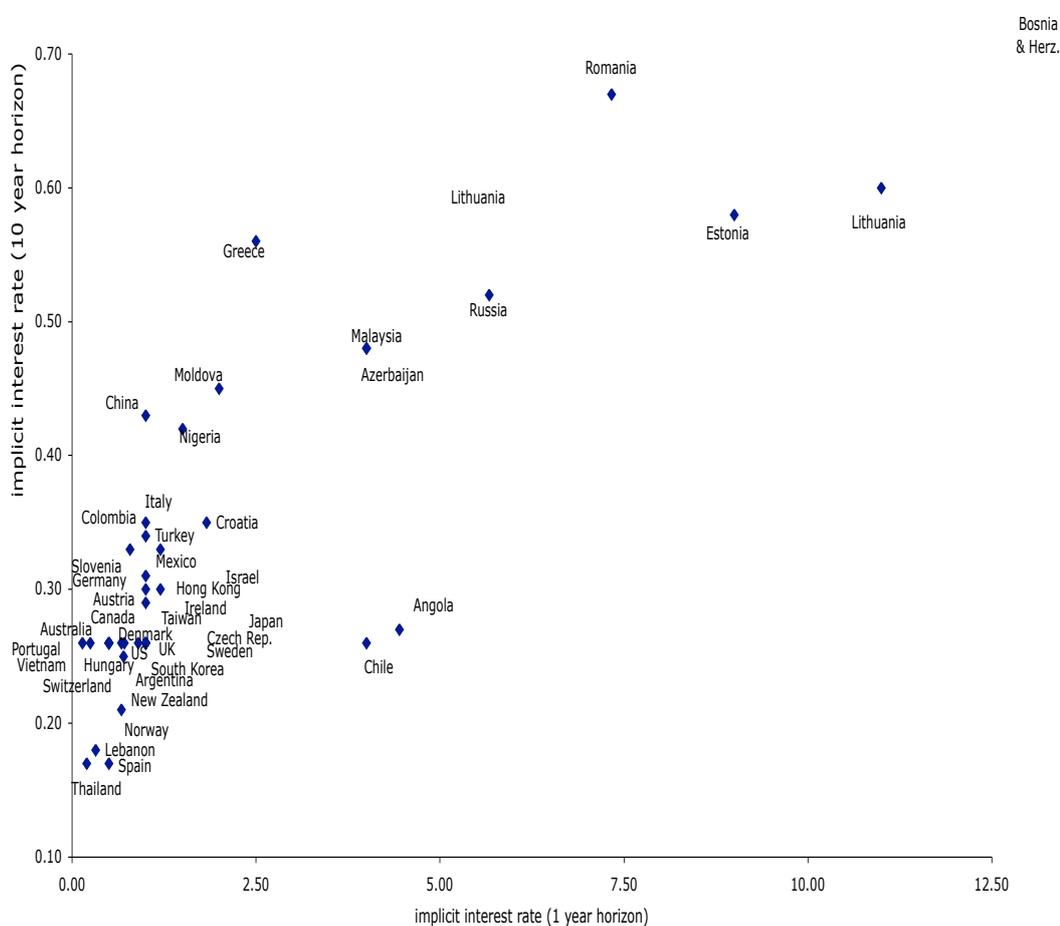
Figure 3: Implicit annual interest rate for 1-year and 10-year horizon

Grusec 1967, Stevenson 1986), risk and time are conceptually separated. It is assumed that the individual believes that there is a chance that the delayed outcome will not happen, which is associated with an implicit risk premium. People try to avoid delayed positive consequences and prefer delayed negative consequences, because both are less certain. Therefore, the subjective discount rate has two components: a pure, riskless discount rate, and a risk-related discount rate.

Two extreme hypotheses concerning the effects of risk can be formulated within the implicit risk approach (Benzion et al. 1989, Robicheck & Myers 1966). In the *one-period-realization of risk* hypothesis, risk depends on the time of the receipt or payment but not on the length of the time period. Therefore, in addition to the riskless discount rate, denoted by i, there is a one-time discount rate factor for the implicit risk, denoted by d. Formally,

$$F = P(1 + d)(1 + i)^t.$$

In contrast, the *multiple-period-realization of risk* hypothesis assumes that risk increases proportionally in time, and the standard equation takes the form:

$$F = P[(1 + d)(1 + i)]^t = P(1 + d)^t(1 + i)^t.$$

Note that in this formulation, the effective implicit discount rate is (1+d)(1+i), which is the same for the one-year and the ten-year period. It is inconsistent with our observation. Therefore the *one-period-realization* model is more plausible.

We had two questions to elicit the future value for one and ten years:

$$F_{1year} = 100(1 + d)(1 + i),$$
$$F_{10year} = 100(1 + d)(1 + i)^{10}.$$

It follows that

$$i = \left(\frac{F_{10year}}{F_{1year}}\right)^{1/9} - 1,$$
$$d = \frac{F_{1year}}{100(1 + i)} - 1.$$

For all participants, the median value of the riskless interest rate i is 0.23 (Mean=0.25, SD=0.20). The median value of the risk-related discount rate

d is 0.67 (Mean=8.62, SD=77.91).

Quasi-hyperbolic Discounting Model

The Quasi-hyperbolic Discounting model is mathematically equivalent to the above one-period-realization implicit risk approach, but conceptually different. It is usually defined in discrete time periods as follows:

$$u(x_0, x_1, ..., x_T) = u(x_0) + \sum_{t=1}^{T} \beta \delta^t u(x_t).$$

This discount function has been used by Phelps & Pollak (1968) to study intergenerational discounting and by Laibson (1997) to intra-personal decision problems. When $0 < \beta < 1$ and $0 < \delta < 1$, people appear to be more patient in the long run and less patient for the immediate future. The per-period discount rate between now and the next period is $(1 - \beta\delta)/\beta\delta$ and the per-period discount rate between any two future periods is $(1 - \delta)/\delta$, which is less than $(1 - \beta\delta)/\beta\delta$. Same as in the one-period realization implicit-risk approach, quasi-hyperbolic discounting model assumes a declining discount rate between this period and the next, but a constant discount rate thereafter. In fact, $\delta = 1/(1 + i)$ and $\beta = 1/(1 + d)$. However, unlike the implicit risk approach which rationalizes the time inconsistent preferences, the quasi-hyperbolic discounting model has often been discussed in the context of irrationality, such as lack of control, and thus used to justify the need for commitment devices. In particular, β refers to the degree of "present bias". Larger β implies less present bias. When β=1, the quasi-hyperbolic discounting model coincides with the standard exponential discounting model. We call the other parameter δ the long-term discount factor.

When we assume a linear utility function, the two matching questions

about time discounting can be represented as:

$$100 = \beta\delta F_{1year},$$

$$100 = \beta\delta^{10} F_{10year}.$$

Thus δ and β can be inferred from the responses F_{1year} and F_{10year}:

$$\delta = (\frac{F_{1year}}{F_{10year}})^{1/9},$$

$$\beta = \frac{100}{\delta F_{1year}}.$$

For all participants, the median value of β is 0.60 (Mean=0.56, SD=0.41), and the median value of δ is 0.81 (Mean=0.82, SD=0.12). See Figure 4 for a plot of parameter estimates of β and δ for each country. Note that the variation in present bias β is much higher than the variation in long-term discount factor δ. The responses of the two matching questions are highly correlated (Spearman's ρ=0.78, p<0.001). However, the present bias parameter β and the long-term discount factor δ are only moderately correlated (Spearman's ρ=0.250, $p < 0.001$), indicating that the two components from the quasi-hyperbolic model may correspond to different psychological constructs or risk perceptions.

As an example, Figure 5 exhibits the discounting function for a median participant in the U.S., China, Germany, Russia, and Japan. Among these countries, the U.S. has the highest value of β (=0.78), i.e., the lowest present bias, followed by Japan (β=0.71). Germany and China have the same β value (=0.60). Russia has by far the lowest value of β (=0.21), implying a very impatient attitude for one-year horizon.

Regarding the long-term discounting, the U.S., Germany and Japan have similar values of δ (around 0.85). Russia and China have the same value of δ (=0.77), which is lower than the other three developed countries, implying
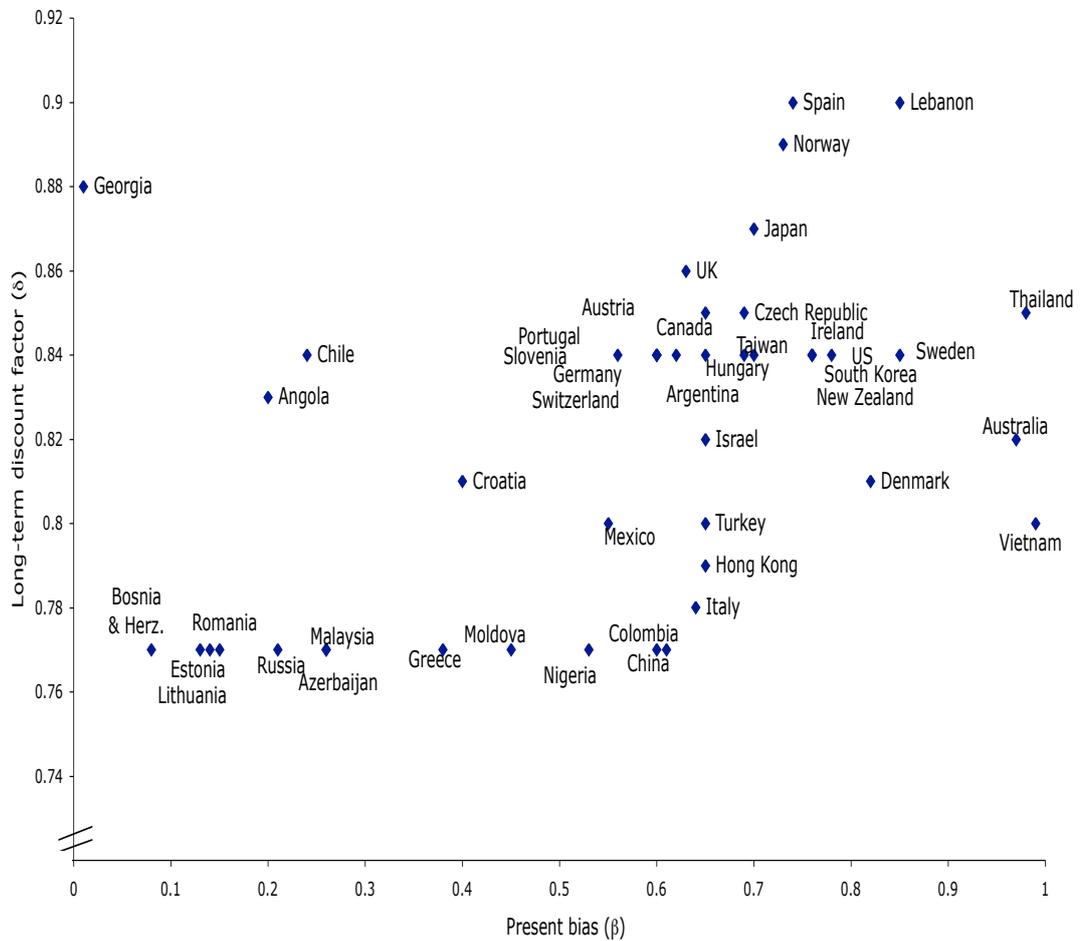
Figure 4: Median values of Parameters in Hyperbolic Discounting Model for
All Countries

a slight less patient attitude in the long term, but the difference is not as
dramatic as that of the present-bias parameter.

Figure 6 plots the median values of β and δ for each cultural cluster. East
Europe and Africa has the strongest degree of present bias with β around
0.40, whereas Anglo cultures have the least degree of present bias (β=0.76).
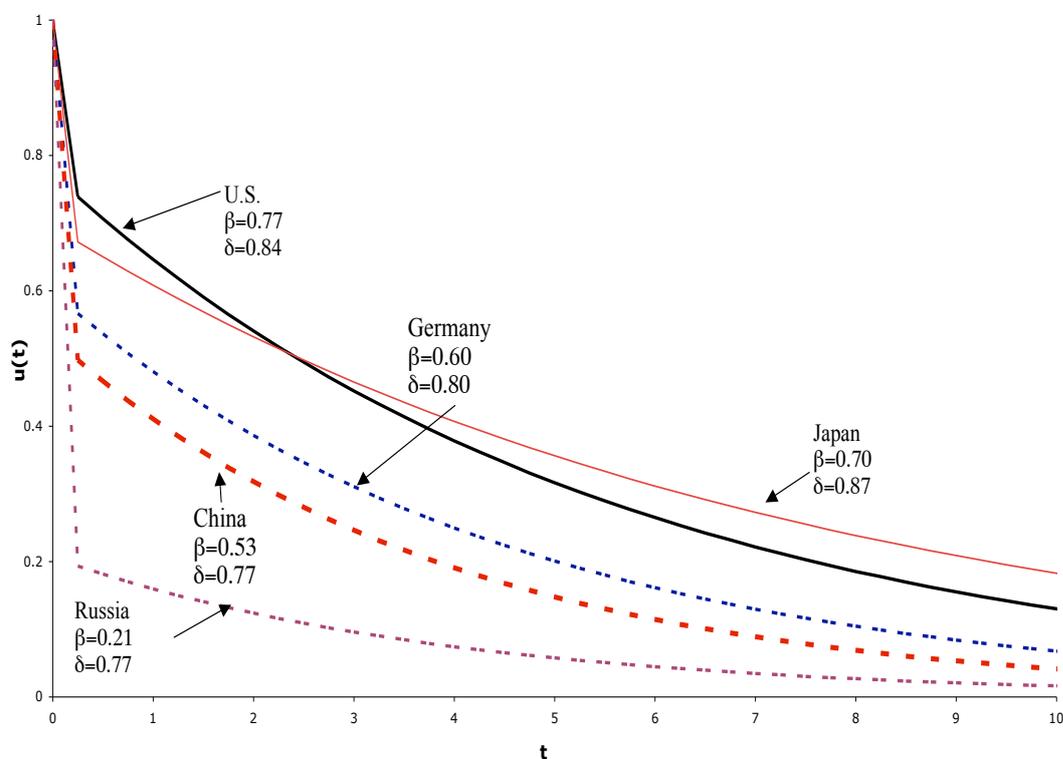The rest countries have similar degree of present bias with β around 0.60.

Figure 5: Median hyperbolic discounting functions for U.S., Germany,China, Japan, Russia (β: present bias; δ: long term discount factor)

On the other hand, all cultural groups are very similar regarding the median value of their long-term discount factor δ (around 0.80).

3.2   What correlates with time preference: Individual-level analysis

We have demonstrated that our measured time preference is very heterogeneous across countries. Now we would like to explore the factors that correlate with the measured time preference. First we conduct individual-level analysis, then we proceed with country-level analysis.
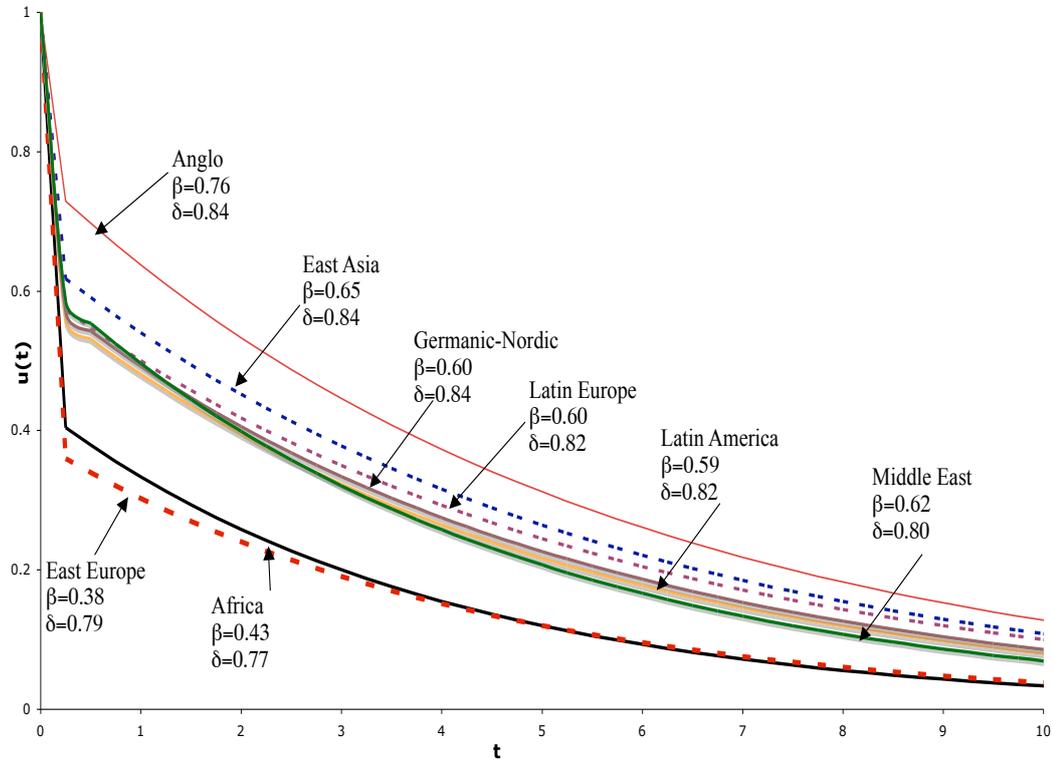
Figure 6: Median hyperbolic discounting functions for different cultures (β: present bias; δ: long term discount factor)

Age, gender, immigrants, economic major

A number of experimental and survey studies find that the time preference is correlated with some personal characteristics, such as gender (Silverman 2003), age (Green, Fry & Myerson 1994), anxiety (Hesketh, Watson-Brown & Whiteley 1998), and even intelligence and working memory (Frederick 2005, Shamosh, DeYoung, Green, Reis, Johnson, Conway, Engle, Braver & Gray 2008). From the regression analysis in Table 1, it seems that age, gender, immigrant status, and economic major do not have significant impacts on the waiting tendency elicited from one-month wait-or-not questions. However,

for the one-year and ten-year matching questions, older participants, males, and immigrants seem to be more patient. Moreover, students in economic majors seem to be more patient for the long-term (i.e., higher δ).

Culture

The perception of time is carried as part of culture. According to Graham (1981), the concept of time value of money is rooted from "linear-separable" views in Anglo-American cultures, who view time as a continuum from past to present to future. In these cultures, time is considered to be an essential component of money (e.g., via discount rate/interest rate), which we encountered frequently in the modern economic and finance textbooks. Other cultures, however, may have dramatically different views of time. In particular, Graham (1981) explains that Latin American cultures perceive time as a circular concept that repeats itself with a cyclical pattern. This "circular-traditional" view of time is the root of the mañana attitudes in Mexico and other parts of Latin America, where people's activities orient much more to the present than to the future. Therefore, immediate rewards are preferred. This may explain the low percentage who chose to wait in our Latin Europe and Latin American sample (Figure 2), even though Latin Europe is more similar to Western Europe regarding the economic conditions. However, we should be cautious to equate this lower percentage to impatience. As Graham (1981) points out, due to the large difference in the perception of time, in some cultures, when a person is forced to choose between immediate and future rewards, he may view it differently and do not perceive it as evaluating alternatives: "He was essentially asked if he wanted something or nothing"– because future rewards were perceived as of no real value, thus "what one person views as a choice situation, another views as mandated action." (Graham 1981, p.341) In the one-year and ten-year matching questions,

Table 1: Regression at the individual level

	Binary choice		Present bias		Long-term discount factor	
	(Wait =1)		β		δ	
	Logit	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)
Age	-0.011	-0.011	0.012***	0.013***	0.002***	0.002***
	(0.008)	(0.008)	(0.002)	(0.002)	(0.000)	(0.000)
Gender	0.050	-0.017	0.056***	0.045***	0.006*	0.003
(1=Male)	(0.060)	(0.061)	(0.012)	(0.011)	(0.003)	(0.003)
Native	0.123	0.137	-0.067***	-0.074***	-0.016***	-0.015***
	(0.093)	(0.091)	(0.019)	(0.018)	(0.005)	(0.005)
Economic	0.091	0.152	-0.001	0.029	0.011**	0.015***
major	(0.097)	(0.098)	(0.019)	(0.019)	(0.006)	(0.005)
Individualism	0.003***	0.055***	-0.000	-0.006***	$3 \cdot 10^{-5}$	-0.001***
(IV)	(0.001)	(0.007)	(0.000)	(0.001)	(0.000)	(0.000)
Uncertainty	-0.001**	-0.028***	-0.000**	-0.016***	$5 \cdot 10^{-5}$*	-0.002***
avoidance (IV)	(0.000)	(0.008)	(0.000)	(0.002)	(0.000)	(0.000)
Long term	0.008***	0.084***	0.000	-0.008***	-0.000	0.000
orientation (IV)	(0.002)	(0.014)	(0.000)	(0.003)	(0.000)	(0.001)
Risk Premium	0.286***	0.229**	-0.086***	-0.103***	-0.012**	-0.013***
	(0.091)	(0.092)	(0.018)	(0.018)	(0.005)	(0.005)
Loss aversion	-0.005***	-0.004**	-0.002***	-0.002***	-0.000***	-0.000***
	(0.002)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	-0.173	-10.754***	0.406***	2.595***	0.803***	1.044***
	(0.252)	(2.127)	(0.056)	(0.388)	(0.016)	(0.112)
Observations N	5270	5467	4972	5136	4972	5136
Pseudo R^2	2.1%	9.1%				
R^2			3.4%	5.9%	1.3%	1.7%

Note: The dependent variables for model (1) and (2) are the response to the question about whether the participant prefer \$3400 this month or \$3800 next month. Instrumental variables are the cultural cluster that the participant belongs to. The symbols ***, **, and * mean that the coefficient is statistically different from zero at the 1%, 5%, and 10% level respectively.

when students were asked to state the amount of money that makes them indifferent, Latin European exhibited similar preference as Germanic-Nordic cultures, whereas Latin Americans were slightly less patient. It somehow hints that the one-month waiting question reflects more about a general attitude, whereas the one-year and ten-year matching questions may be more treated as evaluative questions.

The first column of Table 1 presents the result of binary logistic regressions with the dependent variable as responses to the waiting question. The three cultural variables, namely Individualism (IDV), Uncertainty Avoidance (UAI), and Long Term Orientation (LTO) are all significant. We used the dummy variables of cultural clusters as instrumental variables to run a two-stage regression. In the first stage, we run a regression for each of the cultural dimension variables on the dummy variables of each cultural cluster (Africa, Anglo, Germanic-Nordic, East Asia, East Europe, Latin America, Latin Europe)[7]. Then we replaced the cultural dimension variables by the predicted value of the first-stage regression. In this way, we only study impacts of cultural differences that are caused by the difference of cultural groups (presumably a more exogenous variable). See Guiso, Sapienza & Zingales (2006) for similar methods when they study the impacts of trust on enterpreneurship. The results are shown in the second column of Table 1. The pattern is very similar to the previous standard logit regression. The predictive power, however, is improved.

A high score of Individualism implies that individuals are loosely connected to the society, and are expected to take care of themselves. In comparison, in a society with collectivistic culture, people can be protected by some strong cohesive groups throughout the lifetime as a reward to their

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[7]The category "other" was excluded.

unshakeable loyalty. Therefore, the social connection in a collectivist culture may provide its citizen a "cushion" or safety net for potential losses (Hsee & Weber 1999), with which people can afford to be more risk-seeking and more patient. To test the impacts of a collectivistic culture, Mahajna, Benzion, Bogaire & Shavit (2008) compared the subjective discount rates and risk preferences for Israeli Jews and Arabs with bank customers as participants. They examined two competing hypothesis: If the "cushion" hypothesis were right, then in a collectivistic society as Israeli Arabs, a person would exhibit lower subjective discount rate and lower risk-aversion. In contrast, the "trust" hypothesis states that Israeli Arabs, who suffer from low trust due to the discrimination, would exhibit higher subjective discount rates and higher risk aversion. Their results show that Israeli Arabs have higher subjective discount rates, and higher risk-aversion, which is inconsistent with the "cushion" hypothesis. The authors conjecture that lower income and low trust may have stronger influence on the time and risk preference, but since income data were not collected and there were no measurements for trust, this hypothesis could not be tested directly.

Our results are consistent with Mahajna et al. (2008) in that we find high individualism is correlated with the tendency to choose the more patient option (see model (1) and (2) in Table 1). The "cushion" hypothesis is therefore not supported in this case. However, we do not find any significant relationship between the answers to the trust question and to the one-month waiting question.[8]

Uncertainty Avoidance may be another culture dimension that is relevant to the time preference. A society with higher Uncertainty Avoidance score

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[8]In addition, our questionnaire included a "trust" question which asked participants to what extent they agree that "Most people can be trusted."

tends to be less tolerant to uncertain situation. Presumably, people from such cultures should prefer immediate rewards because of the uncertainty about the future rewards. To our knowledge, no empirical studies have investigated this relationship yet. Our result suggests that high Uncertainty Avoidance indeed correlates with lower likelihood to wait (the first two columns in Table 1).

Hofstede (1991) finds that the Long Term Orientation Score is typically high in East Asian, especially Confucians culture, implying that people there value future more than present, and they are likely to be more patient. Moreover, the concept of "rebirth" in the dominant religions (e.g., Buddhism and Hinduism) in Southeast Asia reflects the belief that the current life is only a small portion of the whole existence. In an interesting experiment, Chen, Ng & Rao (2005) tested whether Eastern culture makes people more patient than Western culture. By studying the bicultural Singaporean participants, they find U.S.-primed participants valued immediate consumption more than did Singaporean-primed participants, hence supported indirectly the hypothesis that high LTO leads to patience. Our results support this conjecture more directly: The first two columns of Table 1 show that those people who thought that "respect for tradition" is less important (i.e., a higher LTO score), are more likely to wait.

Although all three cultural dimensions (i.e., Individualism, Uncertainty Avoidance, and Long Term Orientation) correlate with the one-month waiting question, we only find consistent relationship between Uncertainty Avoidance with the fitted parameters in the hyperbolic discounting model (β and δ). People who are more afraid of uncertain situation tend to be more impatient in all three time-preference questions. However, the predictive power of Individualism and Long Term Orientation is not as robust for the one-year

and ten-year questions. They are either insignificant, or have the wrong sign. This suggests that the short-term waiting tendency which reflects some general attitude, has a stronger relationship with cultures than the medium- to long-term evaluative questions.

Risk preference and loss aversion

Frederick (2005) and Dohmen, Falk, Huffman & Sunde (2008) find that people with higher cognitive ability tend to be more patient and less risk-averse. Dohmen et al. (2008) point out that in the EUT framework, greater concavity of utility could lead to more impatient behavior. Consider a person is indifferent between the payment x_t at time t and the payment $x_{t+\tau}$ at time $t + \tau$. When we assume concavity plays no role, then

$$1 + \delta = \frac{x_{t+\tau}}{x_t}.$$

If this person has a concave utility function $u(x)$, then

$$1 + \delta = \frac{u(x_{t+\tau})}{u(x_t)}.$$

Since $\frac{u(x_{t+\tau})}{u(x_t)} < \frac{x_{t+\tau}}{x_t}$, a greater concavity in utility function lead to more patient behavior, i.e., the $x_{t+\tau}$ has to be larger.

Table 1 includes measure of risk premium and loss aversion into the regression model. It seems that people who requested a higher risk premium (i.e., more risk-averse) are more likely to wait in our one-month question, which is opposite to what we expected. On the other hand, higher risk premium correlates with more impatient answers for the one-year and ten-year questions (higher β and δ), which is consistent with what we expected.

Again, this seems to suggest that medium to long-term matching questions reflect more about evaluations, whereas the wait-or-not question may reflect more of a fundamental attitude about present and future.

Table 1 shows that higher loss-aversion, on the other hand, is correlated with more impatient tendency for one-month waiting question, present bias, as well as long-term discount. This supports what has been found by Tanaka, Camerer & Nguyen (2007) from their field experiment in Vietnamese villages.

3.3 What correlates with time preference: Country-level analysis

Now we go on and investigate the correlation of time discounting with some macro-economic country-level variables. These correlations by no means imply any causal relationships. The true relationship can lie anywhere between spurious correlations to genuine causal relationships. But we do observe from our data a number of correlations that are consistent with past findings or theoretical predictions. We think such investigation will help us to gain insights on time preference and to form further hypothesis.

Wealth and education

Becker & Mulligan (1997) proposed a model to capture endogenous time preferences. It states that the more resources we use to imagine the future, the more patient we are. It follows that wealth and education leads to patience. Most studies find wealthier people are more patient (Hausman 1979, Lawrance 1991, Harrison, Lau & Williams 2002, Yesuf & Bluffstone 2008). Poor farm households, for example, tend to have shorter planning horizons and hence are reluctant to invest in conservation for natural resources (Mink 1993). But there are also a few studies that find no relation between wealth

and discount rates (Kirby, Godoy, Reyes-Garcia, Byron, Apaza, Leonard, Perez, Vadez & Wilkie 2002, Anderson, Dietz, Gordon & Klawitter 2004). Education is also believed to increase patience. Kirby et al. (2002) found the negative correlation between the education level and discount rate in their survey on Tsimane' Amerindians from villages of the Bolivian rain forest.

As a complement to the above results at the individual level, our survey offers an opportunity to have an overview at the country level. Although we did not have about the individual wealth/income information, we use GDP per capita as the proxy for national wealth level. We use the measure "higher education and training" and "quality of education system" from the Global Competitiveness Report 2008-2009 by Porter & Schwab (2008) for a proxy of the country's education quality.

The first rows in Table 2 show that the higher GDP per capita a country has, the more patient the participants from that country are, which support the previous evidence that wealth increases with patience. The fourth and fifth rows indicates a strong positive relationship between education and patience. Note the measured time preference sometimes even more strongly correlate with education than with GDP per capita.

Moreover, Table 2 also suggests that GDP per capita has a stronger correlation with the percentage of wait-or-not question (spearman's $\rho = 0.609$, $p < 0.001$) than with median present bias β (spearman's $\rho = 0.440$, $p < 0.01$) and the long-term discount factor δ (spearman's $\rho = 0.413$, $p < 0.01$). Similarly, the education quality and enrollment rate ("higher education and training") is more correlated with the one-month question and the present-bias parameter than with the long-term discount factor. In other words, wealth and education can predict better the waiting tendency than the medium- to long-term discount factors.

Table 2: Spearman's ρ of Macro-economic Variables with Time Discounting Measurement

	Percentage choosing to wait	Median β Present bias	Median δ Long-term	N
Macroeconomic (Hard Data)				
Ln(GDP per cap)	0.609***	0.440***	0.413***	45
Ln(growth rate)	-0.398***	-0.513***	-0.489**	45
Inflation rate	-0.519***	-0.252*	-0.259*	45
Education				
Higher education and training	0.662***	0.502***	0.467***	43
Quality of education system	0.612***	0.434***	0.311**	43
Financial Market				
Interest rate spread (hard data)	-0.627***	-0.150	-0.273*	43
Ease of access to loans	0.511***	0453***	0.386***	43
Soundness of banks	0.368**	0.273*	0.287*	43
Financial market sophistication	0.504***	0.468***	0.419***	43
Property right	0.655***	0.518**	0.418***	43
Market efficiency	0.623***	0.517***	0.449***	43
Politics				
Political stability	0.526***	0.264*	0.332**	45
Public trust of politicians	0.458***	0.404***	0.354**	44
Culture				
Individualism	0.573***	0.251*	0.136	45
Uncertainty Avoidance	-0.428***	-0.563***	-0.284*	45
Long Term Orientation	0.449***	0.214	0.200	45

*Significant at 10% (2-tailed) **Significant at 5% (2-tailed) ***Significant at 1% (2-tailed)

1. "Higher education and training" measures secondary and tertiary enrollment rates as well as the quality of education as assessed by the business community. "Quality of math and science education" measure the quality of math and science education in each country's schools (1=lag far behind most other countries, 7=are among the best in the world." "Easiness to access to loans" measures "How easy is it for a bank to obtain loan in your country with only a good business plan and no collateral?" (1=impossible, 7=very easy). "Goods market efficiency" measures the openness of markets (by limiting entry and exit barriers, such as state monopolies); level of distortive government intervention in the market. "Property right" measures in the property rights in the country, including over financial assets are (1=poorly defined and not protected by law, 7=clearly defined and well protected by law). "Interest rate spread" is the difference between typical lending and deposit rates. "Public trust of politicians" is the public trust in the financial honesty of politicians in the country (1=very low, 7=very high). "Soundness of Banks" measures the banks in the country are (1=insolvent and may require a government bailout, 7=generally healthy with sound balance sheets). All these measures are taken from Global Competitive Report 2008-2009 (Porter & Schwab 2008)

2. "Political stability" is one of the six world bank governance indicators "political stability and absence of violence/terrorism."

Economic growth and inflation rate

Are countries with fast economic growth more patient? The answer to this question is not so obvious. On the one hand, patience may lead to economic growth by saving and investment, and we may observe a positive correlation of growth and patience. On the other hand, fast economic growth implies more investment opportunities, which can increase the time discount rate, leading to a negative correlation between growth and patience. Our survey seems to capture the latter case. We find significant negative correlation between the median present-bias parameter and the log(growth rate) at the country level ((spearman's $\rho = 0.513$, $p < 0.001$. See the second row in Table 2).

The third rows in Table 2 suggests that inflation rate was only correlated with the one-month horizon question. Later we will show that inflation rate is not any more significant when the wealth and growth rates are controlled.

Financial market, politics, and culture

In the introduction, we have stated that from a normative point of view, in an idealized perfect capital market, discount rates reflect the market interest rate. In our survey, however, both implicit interest rates R_{1year} and R_{10year} were much higher than the interest rate of savings and loans at the local countries. The median implicit interest rate for 10 years is moderately correlated with the bank loan interest rate at each country (Spearman's $\rho=0.405$, p<0.01, N=34). However, local interest rates of bank loans/savings were not found to be correlated with implicit one year interest R_{1year} or the tendency to wait for the one-month question.

It follows that the inefficiency and frictions of the markets may alter dis-

count rates. According to Boserup (1965), the degree of market access can have different effects on time preference. On the one hand, better access to market may imply better investment opportunities, higher interest rate, and hence may increase the time discount rate. On the other hand, better access to market and credit can lower the time discount rate by reducing the probability of credit constraints. Similarly, Holden, Shiferaw & Wik (1998) suggested that liquidity constraints and market imperfection can cause variation of time preferences in a consumption smoothing problem. In particular, they found that in the rural households of Indonesia, Zambia and Ethiopia, cash liquidity constraints or poverty in assets were correlated with higher rates of time preferences (i.e., impatience).

We have used several measures from the Global Competitiveness Report 2008-2009 by Porter & Schwab (2008) as proxies for the efficiency of financial markets. Table 2 shows these financial-market related variables with our time discounting measures. In general, our result suggests that in more efficient markets, people seem to be more patient. In particular, ease of access to loans, financial market sophistication, property right, market efficiency are correlated with all three measured time discounting variables. The soundness of bank has the weakest correlation with time preference. Since our survey are mainly conducted before the 2008 financial crisis, the soundness of bank was not a big consideration for the public at that time. It would be interesting to study after the crisis, in which way the perceived soundness of bank would influence investors' time and risk preference.

The lower parts of Table 2 demonstrate the country-level correlations of time discounting with political stabilities, public trust of politicians, and cultural dimensions. We observe that countries that are politically more stable and with more public trust to politicians are more likely to wait. Coun-

tries with high individualism, low uncertainty avoidance and high long-term orientation are more likely to wait. Similar to the individual analysis, we find that all three cultural dimensions correlate with the waiting tendency at the country level, but not with the one-year or ten-year matching questions, except for that Uncertainty avoidance is significantly correlated with the present bias parameter.

Pace of time

Social psychologist Robert Levine has measured so-called "pace of time" in his field study across 31 countries. An overall-pace measure is calculated out of three measures: walking speed, postalspeed, and clock accuracy (Levine 1997). Interestingly, we find this measurement is highly correlated with our measured time preference ($r = 0.647$, $p = 0.002$). See Figure 7. Furthermore, regression analysis shows that the time pace measure is significant even when we control the GDP per capita (see Table 3).

Table 3: Time Pace and Waiting Tendency

	Percentage choosing to wait
GDP per cap	0.015
	(0.056)
time pace	0.034**
	(0.016)
Constant	0.654**
	(0.178)
N	18
R^2	42.1%

* Significant at 10% **Significant at 5% *** Significant at 1%

1. The independent variables "GDP per cap" is the natural logarithm of GDP (PPP) per capita in 2007.
2. The independent variable "time pace" is measured by Levine (1997) in his field study to capture the tempo and punctuality in a country. The higher score implies higher speed and more punctuality.
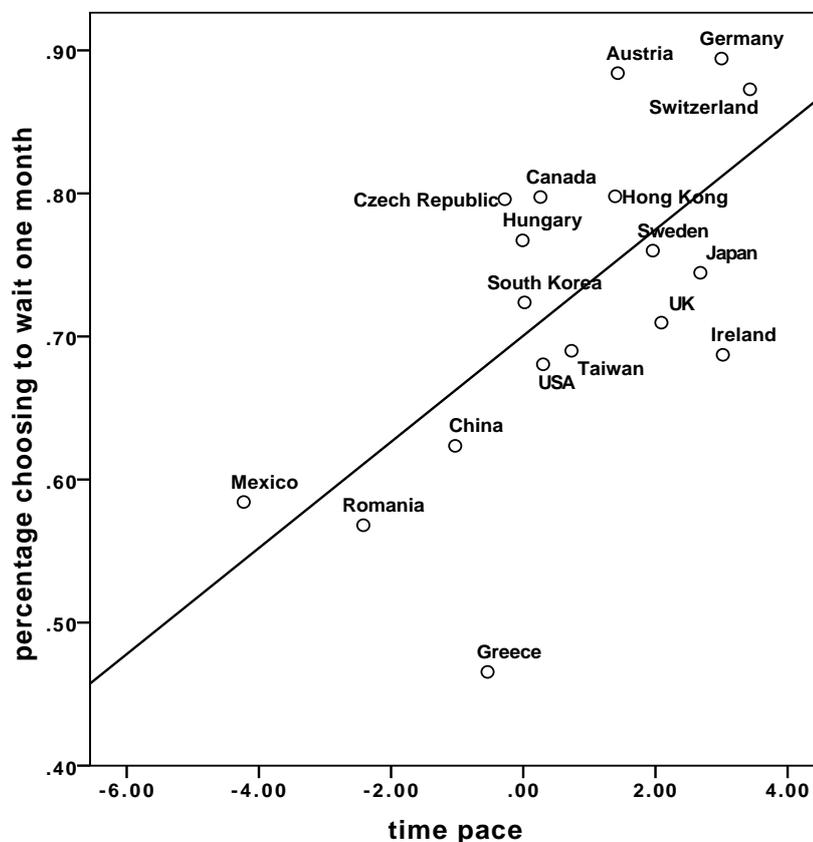
Figure 7: Correlation between Pace of Life and Waiting Tendency

Regression analysis at the country level

Since many variables in Table 2 are correlated with GDP per capita, we would like to see after controlling the national wealth wealth level, whether other variables are still significant predictors. In particular, we focus on growth rate, inflation rate, education, and cultural dimensions.

Table 4 shows the regression results with the focus on three macroeconomic variables. The first column shows that GDP per capita is a significant predictor for the responses of one-month waiting question, consistent with what we have seen the correlation table (Table 2). After controlling the

macro-economic variables (GDP per capita, growth rate, inflation rate), participants from countries with higher degree of Individualism and Long Term Orientation are more likely to wait. In contrast,for the present bias and long-term discount factor, GDP per capita is not more significant. Instead growth rate is found to be significantly correlated with these two measures (β and δ). Moreover, the country with higher Uncertainty Avoidance score tend to have more present bias.

In summary, it seems that we need different models for waiting tendency and medium/long-term discount factor. The waiting tendency depends more on the fundamental economic variables such as the country's wealth level, and on general attitudes in a society such as individualism and the mentality towards past and future. In comparison, the medium/long-term discount factor depends more on the dynamic factors such as growth rate, and the attitudes toward uncertainty.

4   Discussion

It is often assumed that time preferences are homogenous among individuals, even across countries. However, empirical evidences exhibit a wide variation on measured subjective discounting rate. Shiller, Boycko & Korobov (1992) distinguished the differences in economic behavior between situational versus attitudinal factors. Accordingly, attitudinal factors relate to "psychological traits, personality, and culture," whereas situational factors relate to "people's perceptions of their economic situation."(p128) We expect that the answers to the very short-term (one-month) question reflects more the attitudinal differences, whereas the questions about intermediate time horizon such as our one-year question should be correlated with both attitudinal

Table 4: Country-level OLS Regression for time discounting

	Percentage choosing to wait		Median β Present bias		Mean δ Long-term	
	(1)	(2)	(3)	(4)	(5)	(6)
GDP per cap	0.108***	0.071**	0.024	0.012	0.073	0.019*
	(0.036)	(0.034)	(0.059)	(0.049)	(0.121)	(0.010)
growth rate	-0.014	-0.013	-0.158***	-0.161***	-0.021**	-0.022**
	(0.034)	(0.030)	(0.056)	(0.043)	(0.009)	(0.009)
Inflation rate	-0.008	-0.004	-0.005	0.002	0.002	0.003
	(0.009)	(0.008)	(0.015)	(0.012)	(0.002)	(0.002)
Individualism		0.003**		-0.001		-0.000
		(0.002)		(0.002)		(0.000)
Uncertainty Avoidance		-0.001		-0.010***		-0.000*
		(0.001)		(0.002)		(0.000)
Long Term Orientation		0.008**		0.003		-0.000
		(0.004)		(0.006)		(0.001)
Constant	0.367**	-0.566	-0.156	1.106	-0.114	0.911***
	(0.147)	(0.468)	(0.378)	(0.673)	(0.801)	(0.133)
N	45	45	45	45	45	45
R^2	42.8%	58.3%	27.1%	59.2%	27.5%	34.1%

* Significant at 10% **Significant at 5% *** Significant at 1%

1. The independent variables "GDP per cap" and "growth rate" are the natural logarithm of GDP (PPP) per capita and growth rate in 2007.
2. Individualism and uncertainty avoidance are two Hofstede cultural dimensions, based on the average score for each country as calculated from the second part of our questionnaire.

and situational differences. The long-term questions (e.g., our ten-year question), however, should be more correlated with the expectation of long-term situation in the country, and less related to personal attitudes.

Our results seem to support, at least partially, the above conjecture. For example, at the individual level, the one-month waiting question is correlated with all three cultural dimensions (Individualism, Uncertainty Avoidance, and Long Term Orientation). However, among the three cultural factors, only Uncertainty Avoidance is found to be consistently correlated with the present bias parameter and long-term discount factor. According to Hofstede (1991), Uncertainty Avoidance reflects more concern about the situation, whereas other cultural dimensions are more driven by attitudinal differences.

Understanding the impacts of situational factors and attitudinal factors offer more insights to policy makers when they design the mechanism to enhance the long-term planning (e.g., retirement saving, conservation of natural resources), and reduce myopic behavior (e.g., pollution). For example, one observes more environmental degradation in under-developed countries or stages. Although poverty seems to be the main driver of such behavior, education and more efficiency in financial markets may also help to improve the situation.

4.1   Application 1: Innovation

In this section, as an example for possible applications of our data, we investigate whether we can predict a country's innovation capability by the measured patience. Technological change and innovation are often treated as exogenous variable in economic modeling. However, Romer (1990) argues that it can be endogenously determined. He points out that an increase in patience will increase research and economic growth, which is consistent

with the intuition that one must forego some immediate benefits to invest in research and innovation, in order to get larger rewards in the future.

We test the relationship of patience with the "innovation factor" from the Global Competitive Report 2008-2009 (Porter & Schwab 2008). It measures the technological innovation of a country, in particular investment in research and development (R & D) in the private sector, the presence of high-quality scientific research institutions, collaboration in research between universities and industry, and the protection of intellectual property. We find a positive correlation between the response of our "wait-or-not" with the innovation factor at the country level. Table 5 shows that after controlling the wealth level of the country, the response to the waiting question is still highly significant in predicting the innovation factor, so is the present bias parameter, but the long-term discount factor is not significant. Although this result is only suggestive, it seems that although wealth level is crucial to stimulate innovation, the attitude towards future also play an important role. For example, while 69% of Taiwanese participants prefer to wait in the one-month questions, only 44% of our Italian students prefer to wait. The two countries have the same GDP per capita in 2007, but Taiwan scored much higher in the innovation factor than Italy (5.26 vs. 4.19). It is worthwhile to investigate further to what extent and under what mechanism a general attitude towards future is related to the innovation activity.

4.2 Application 2: Environmental Sustainability

Studies have revealed that time preference is related with the practice of environmental conservation. For example, farmers who discount the future more strongly were less likely to use soil conservation measures (Yesuf & Bluffstone 2008). Since wealth level is one important determinant of time

Table 5: Country-level OLS Regression for Innovation Factor

	Dependent Variable		
	Innovation Factor		
	(1)	(2)	(3)
Constant	2.362***	2.254***	2.235***
	(0.276)	(0.286)	(0.306)
Choosing to wait	1.099***		
	(0.319)		
Present bias β		0.887***	
		(0.325)	
Long term discount δ			0.388
			(0.344)
Log(GDP per cap)	0.483***	0.557***	0.651***
	(0.114)	(0.112)	(0.118)
N	43	43	43
R^2	65.1%	61.8%	56.1%

* Significant at 10% **Significant at 5% *** Significant at 1%

Notes:

1.The dependent variable "innovation factor" is from Global Competitive Report 2008-2009 (Porter & Schwab 2008). It measures the technological innovation of a country, in particular investment in research and development (R & D) in private sector, the presence of high-quality scientific research institutions, collaboration in research between universities and industry, and the protection of intellectual property.

2.Angola and Lebanon are excluded because of the lack of data for "Innovation factor."

3.The independent variable "choosing to wait," "present bias β," and "long-term discount" are transformed to Blom's proportion estimate to reduce the impacts of outliers.

preference, one may argue that we should focus on poverty reduction to make people discount future less. However, it is not clear to what extent time preference per se is a driven factor for lack of concern for environment. We illustrate a regression analysis to examine the relative impacts of a country's wealth level (as measured by GDP per capita) and the average patience level (as measured by our first survey question). The dependent variable is the "percentage of total land area under protected status" from the report of Environmental Sustainability Index by Esty, Levy, Srebotnjak & de Sherbinin (2005). This measure represents an investment by the country in biodiversity conservation, which is important to sustainable environment. Column one in Table 6 demonstrates an interesting result in that our measured time preference has an significant impact on protected area at the country level, whereas GDP per capita is not significant in this model. Column (3) and (4) shows that the estimated parameter values from the hyperbolic discounting model, however, are not significant when GDP is controlled. Column (4) substitute subjective time-preference measures with the objective inflation rate, which turns out to be insignificant. The relatively low R-square can be attributed to measurement errors, as well as other important variables that are not included in the model. On the other hand, it is clear that our measured waiting tendency improves the model substantially (from 15% to 25%). We also used an alternative measure from the report of Environmental Sustainability Index by Esty et al. (2005), namely "the ratio of gasoline price to world average" as dependent variable, and obtained similar results, although at less significant level. [9]

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[9] The logic behind this index is that unsubsidized gasoline prices are an indicator that appropriate price signals are being sent and that environmental externalities have been internalized. High taxes on gasoline act as an incentive for public transportation use and development of alternative fuels.

Table 6: Country-level OLS Regression for Environmental Sustainability

	Dependent Variable			
	Percentage of Protected Area			
	(1)	(2)	(3)	(4)
Constant	-0.001	-1.303	-1.022	5.176
	(4.532)	(4.800)	(4.761)	(8.572)
Choosing to wait	12.530**			
	(5.313)			
Present bias β		-1.784		
		(5.263)		
Long term discount δ			-4.811	
			(5.242)	
Inflation Rate				-0.510
				(0.566)
Log(GDP per cap)	1.557	4.478**	4.932**	2.667
	(1.870)	(1.883)	(1.812)	(2.294)
N	43	43	43	43
R^2	24.6%	14.4%	15.9%	15.9%

* Significant at 10% **Significant at 5% *** Significant at 1%

Notes:

1.The dependent variable "Protected area" is taken from the report of 2005 Environmental Sustainability Index by Esty et al. (2005). It measures the percentage of total land area under protected status. The logic is that the percentage of land area dedicated to protected areas represents an investment by country in biodiversity conservation .

2. Hong Kong is excluded because of the lack of data for "Protected area." Colombia is excluded because of its extremely high value which distorts the model.

3.The independent variable "choosing to wait," "present bias β," and "long-term discount" are transformed to Blom's proportion estimate to reduce the impacts of outliers.

4.3   Future directions

Our survey is a first step to collect empirical data on country-level variations of preferences. It is to our knowledge the largest international survey of this kind and we have documented the systematic variation in time preferences, as compared to the situational and cultural factors of the countries. Several independent variables in our regression models were endogenous. Ideally, the parameters should have been estimated by using a simultaneous equation system. With our cross-section data, it is difficult to identify instrumental or lagged variables for such analysis. If time series data could be collected in the future, then one may gain more insights about the causal relationships. To compare our findings with parallel studies on the cross-country comparisons on market-level behavior (e.g., equity premium, price kernel, volatility) would be extremely helpful for cross-validation and generalization of what has been found. We have illustrated two applications that use time preference to predict more general phenomena at the country level, such as innovation and environmental preservation. Although the analysis illustrated above is simple in its kind, our main purpose is to stimulate more in-depth cross-sectional studies in this direction. Further applications are conceivable. For example, Shiller (1999) suggests intergenerational and international risk sharing in pension system, and emphasizes that the international risk sharing is rarely discussed. The empirical evidence of the degree of time discounting across countries can be important inputs for such discussion. We believe that systematic investigation and documentation of time preference across countries will deepen our understanding of the discrepancy across countries, and provide policy makers useful advice for development at the global level in the long run .

Acknowledgements

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