

National Centre of Competence in Research
Financial Valuation and Risk Management

Working Paper No. 597

An International Survey on Time Discounting

Mei Wang

Marc Oliver Rieger

Thorsten Hens

First version: November 2009
Current version: November 2009

This research has been carried out within the NCCR FINRISK project on
“Behavioural and Evolutionary Finance”

An International Survey on Time Discounting

Mei Wang*

Marc Oliver Rieger†

Thorsten Hens‡

November 21, 2009

*Swiss Finance Institute and ISB, University of Zurich, Plattenstrasse 32, 8032 Zurich, Switzerland. Email: wang@isb.uzh.ch.

†ISB, University of Zurich, Plattenstrasse 32, 8032 Zurich, Switzerland. Email: rieger@isb.uzh.ch.

‡Swiss Finance Institute and ISB, University of Zurich, Plattenstrasse 32, 8032 Zurich, Switzerland and NHH Bergen, Norway. Email: thens@isb.uzh.ch

Abstract

We present results from the first large-scale international survey on time discounting, conducted in 45 countries. Cross-country variation cannot simply be explained by economic variables such as interest or inflation rates. In particular, we find strong evidence for cultural differences, as measured by the Hofstede cultural dimensions. For example, large levels of uncertainty aversion are associated with strong hyperbolic discounting. We also find relations between time preferences and risk preferences, like loss aversion. For instance, subjects with high loss aversion tend to show larger time discounting. Moreover, our analysis shows an impact of time preferences on the capability of technological innovations in a country and on environmental protection.

Keywords: Intertemporal decision; Endogenous preference; Cross-cultural; Growth

JEL classification: D90, F40

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 preferences 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 a large number of countries.

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 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 cul-

tural 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 China.

In this article, we present results from an international survey of economics students from 45 countries on time preferences. The relatively large number of countries included in our survey allows us to link the measured time preferences with the background of the countries. We elicit time discounting for different time horizons (one month, one year, and ten years). Our main findings are: (1) Time discounting for short time horizons exhibits much higher heterogeneity than for longer time horizons. (2) The discount rate for one year is much higher than the discount rate for ten years, which is consistent with hyperbolic discounting. (3) Participants from countries with higher GDP per capita, and more individualistic and long-term oriented cultures are more likely to wait for one month to get higher return, but these factors do not predict the time discounting for medium/long time horizons (e.g., one year or ten years). (4) Countries with higher growth rate and higher Uncertainty Avoidance tend to be more “impatient” for the medium/long-term future.¹ (5) We also find countries with higher pace of time (e.g., more punctuality and higher working speed) are more likely to choose the more patient option. (6) The measured time preferences, especially the tendency to wait, can predict fairly well the country-level innovation and environmental sustainability measures. (7) Individual-level analysis reveals age, gender, immigration, cultural dimensions, risk preferences and loss aversion are significantly correlated with time preference. In particular, higher Uncertainty

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

Avoidance and higher loss aversion decrease patience for all time horizons. Risk aversion, however, decreases the likelihood to wait for one month, but increases the patience for one-year and ten-year questions.

There could be two major concerns about the survey method we adopted here. The first point is that we only used university students as subjects, not a representative sample of the total population. There are, however, several advantages of this sample selection: (1) 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. (2) 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. (3) Moreover, as Hofstede (1991), a leading researcher in cross-cultural comparisons, emphasized: 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 about our survey method might be that we only asked hypothetical questions without offering real monetary incentives. This might raise the concern that the participants may not be motivated to give thoughtful answers. However, hypothetical questions have even some advantages in the domain of time preferences because they allow to ask questions involving a long time span and large payoffs (Frederick, Loewenstein & O'Donoghue 2002). Moreover, researchers who compared directly the real and hypothetical rewards did not find systematic differences, e.g., Johnson & Bickel (2002).²

²In a pilot study, we conducted the survey in different classes in the economic de-

The collected data on time preferences offers many potential applications. As examples, we demonstrate that the average country-level time preference measured from our survey is related to some general phenomena such as a country's innovation capability and environmental sustainability, even after controlling for macro-economic variables. Although the collected data do not allow us to analyze the direct causal relationship, our results can be very useful inputs to form hypotheses for further empirical investigation and theoretical modeling.

The rest of this article is organized as follows: In the second section, we discuss the survey methodology. In the third section we summarize the key results. In the final section we discuss applications to explain the effects of time preferences on innovations and environmental protection and outline possible future research directions for which this survey data could be used.

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

partment 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.

³Some 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.

(2005), which we refer to as the “wait-or-not” question in the rest of the article. The question is presented as follows:

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 years 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): 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.). The opposite of individualism is collectivism. 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.” A higher score implies that the past is valued less than the future, and people may look more forward. We measure this by asking participants to rate the important of the following question: (1) “In your private life, how important is ‘respect to tradition’ for you (1=of utmost importance; 5=of no importance)?” (2) “How important is ‘thrift’ for you (1=of utmost importance; 5=of no importance)?”

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. The average age of participants was 21.5 years (SD=3.82). Fifty-two percent participants were males. The survey yielded 5903 responses for the first time discounting question, 5632 for the second questions, and 5546 for the third questions.

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

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),

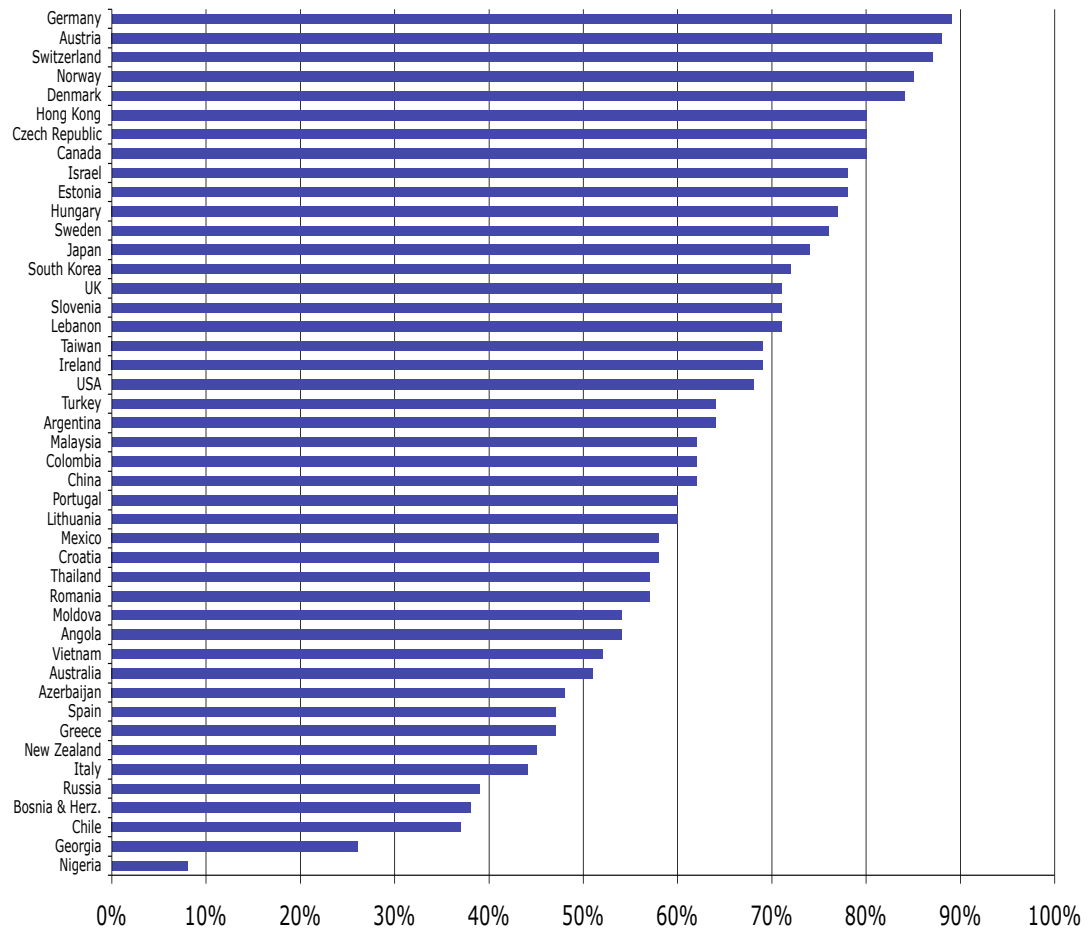


Figure 1: Percentage of Participants Who Choose to Wait

there were 60% choosing the waiting option, which is closer to our result. The potential reason is that our participants 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.⁴

⁴Even for the students from Princeton University, the percentage choosing the patient

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 percentage of choosing the wait option within each cultural cluster. In general, the Germanic-Nordic group are far more likely to wait (88% chose to wait) than other cultural clusters. Anglo, Middle East, and East Asia are similar (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 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.

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.

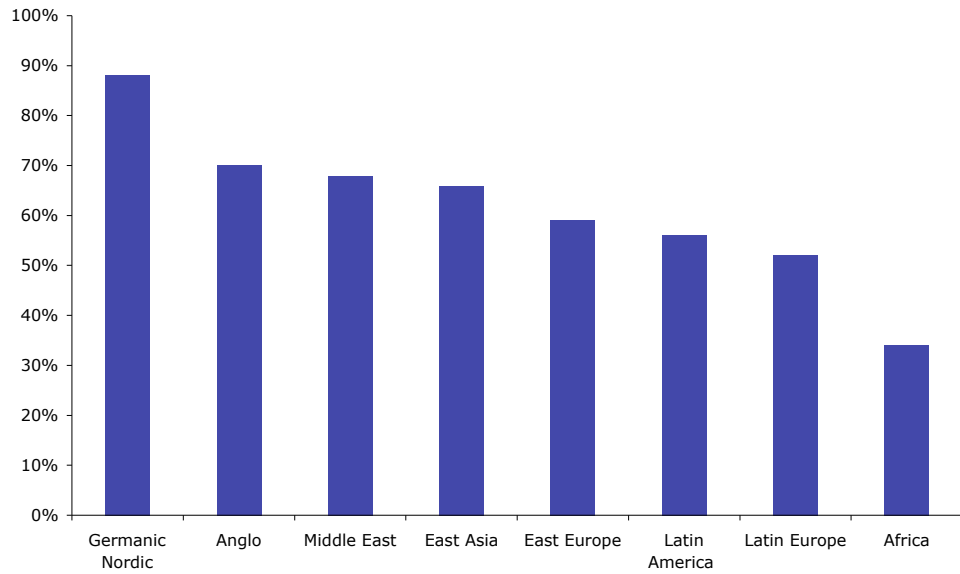


Figure 2: The percentage of choosing to wait grouped by cultural origin

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).

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 3 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.⁵ 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 findings, 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

⁵Georgia has an 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.

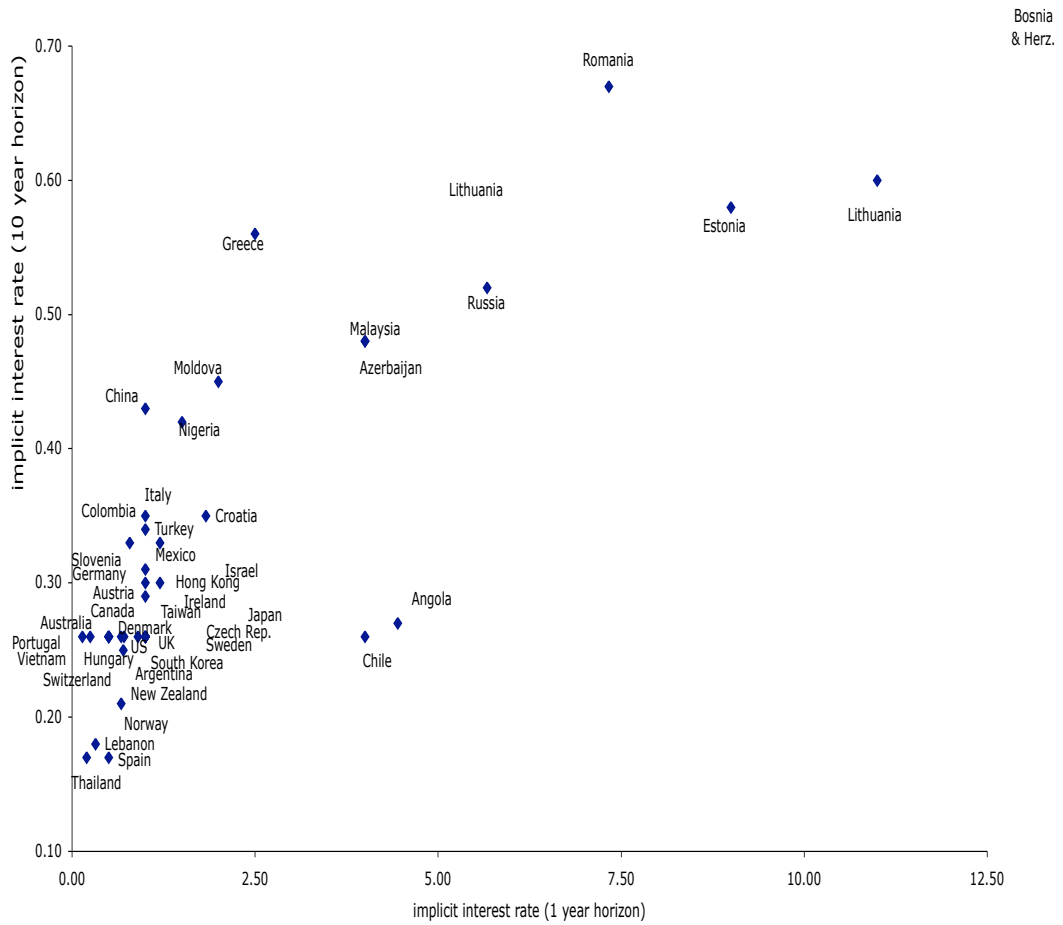


Figure 3: Implicit annual interest rate for 1-year and 10-year horizon

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 & 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 de-

layed 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:

$$\begin{aligned} F_{1year} &= 100(1 + d)(1 + i), \\ F_{10year} &= 100(1 + d)(1 + i)^{10}. \end{aligned}$$

It follows that

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

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:

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

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, the 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 $\beta=1$, 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} :

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

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

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 $\rho=0.78$, $p<0.001$). However, the present bias parameter β and the long-term discount factor δ are only moderately correlated (Spearman's $\rho=0.250$, $p < 0.001$), 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 ($\beta=0.71$). 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

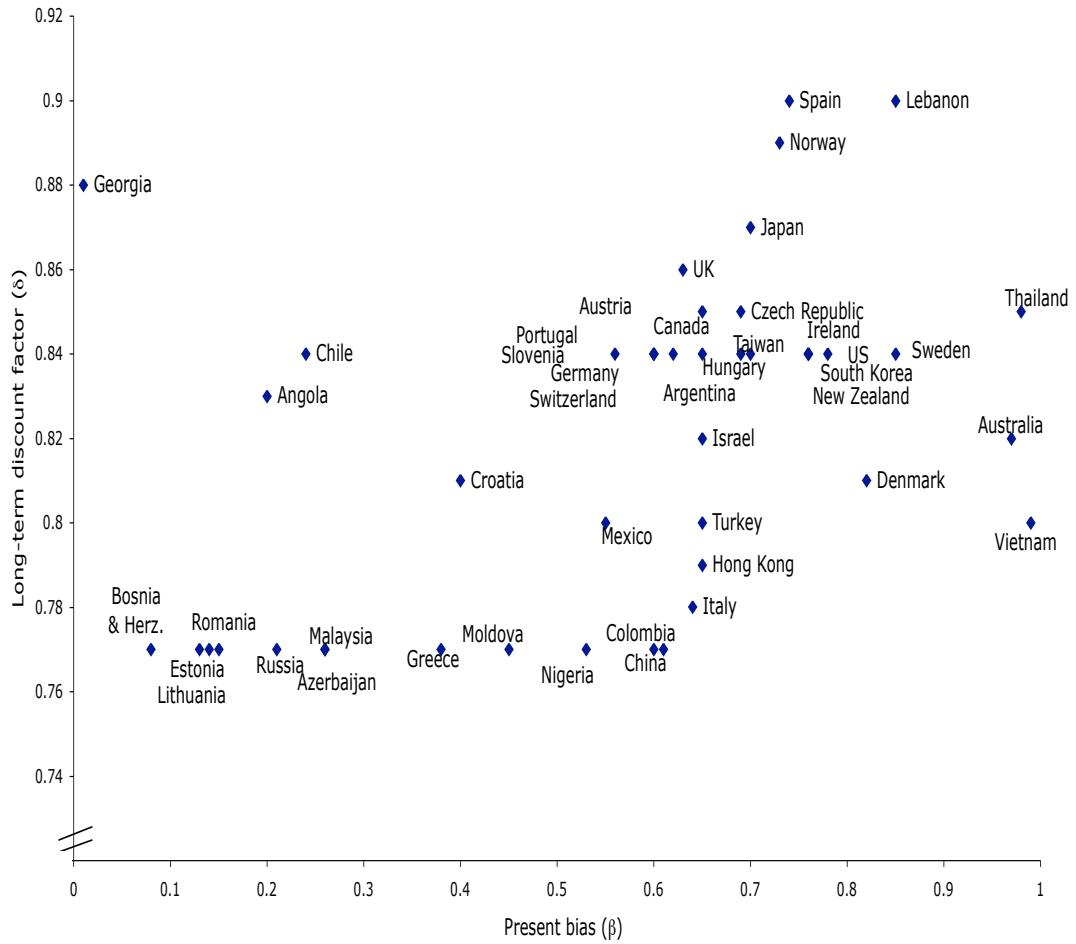


Figure 4: Median values of Parameters in Hyperbolic Discounting Model for All Countries

δ ($=0.77$), which is lower than the other three developed countries, implying 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. Here we use the self-reported cultural origins⁶, but if we use the nationalities as

⁶It corresponds to the question: “I consider myself to belong to the following culture: [](Country in which test is performed) [] others (please specify).”

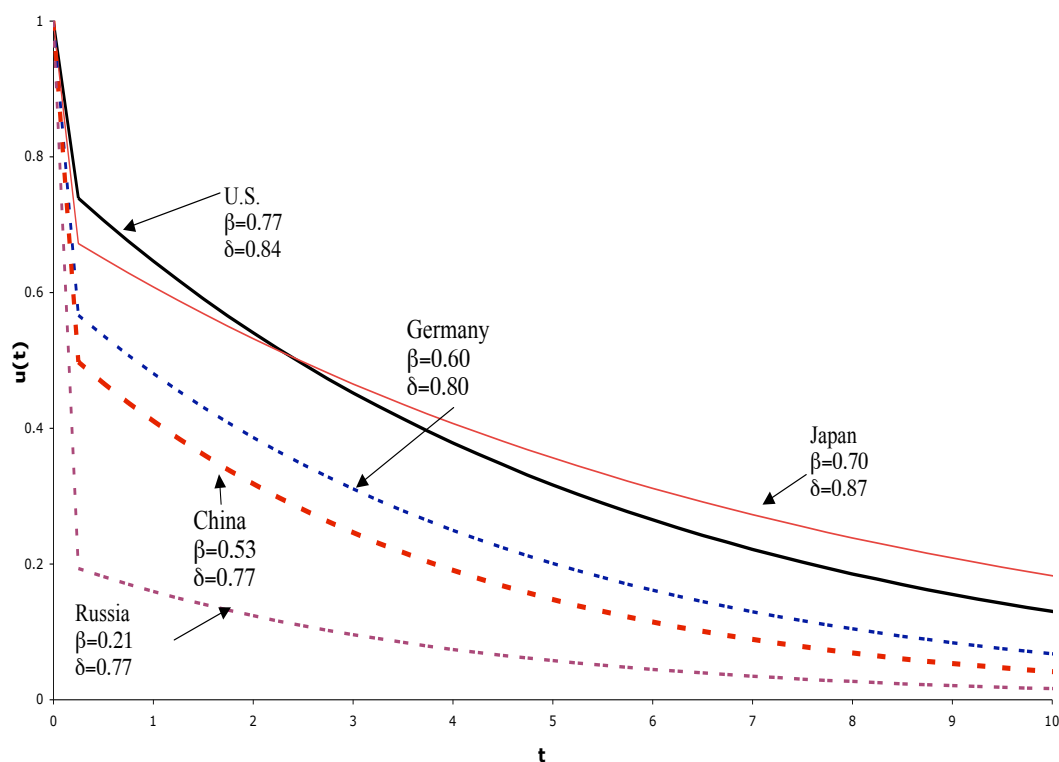


Figure 5: Median hyperbolic discounting functions for U.S., Germany, China, Japan, Russia (β : present bias; δ : long term discount factor)

the culture origin, the results are similar. 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 ($\beta=0.76$). The rest cultures have similar degree of present bias with β around 0.60. On the other hand, all cultural groups are very similar regarding the median value of their long-term discount factor δ (around 0.80).

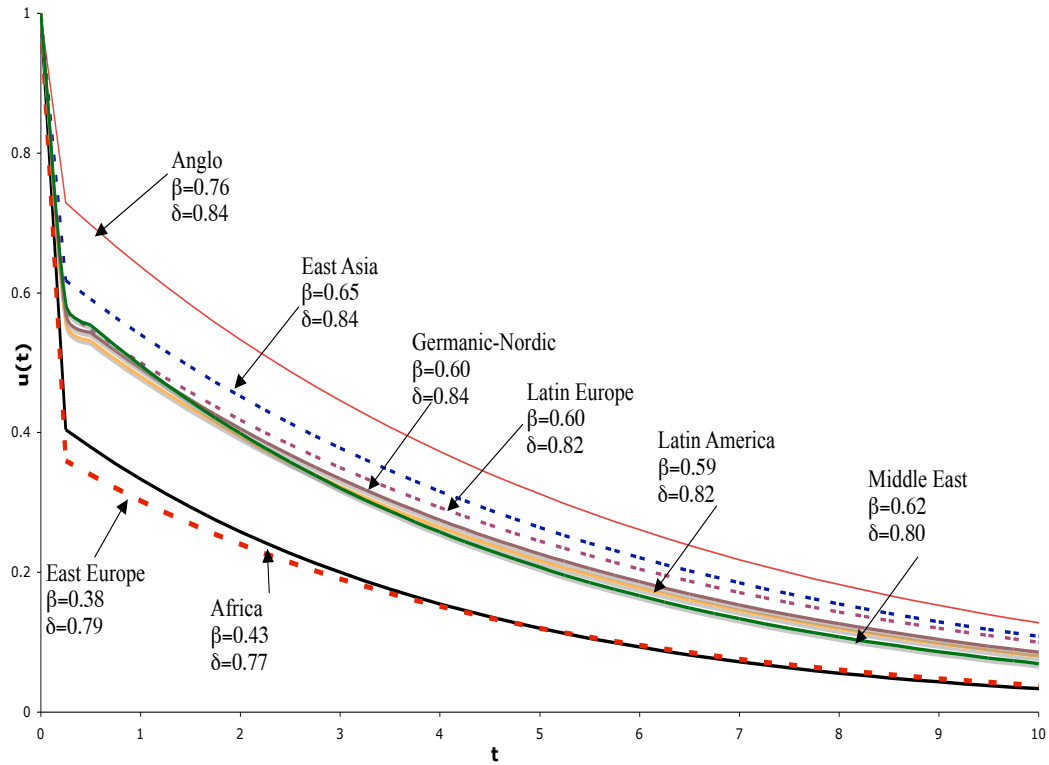


Figure 6: Median hyperbolic discounting functions for different cultures (β : present bias; δ : long term discount factor)

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.

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 *manaña* 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.

Table 1: Regression at the individual level

	Binary choice (Wait =1) Logit (1)	Present bias β OLS (2)	Long-term discount factor δ OLS (3)
Age	-0.015	0.111***	0.050***
Gender	0.071	0.067***	0.022
Native	0.149	-0.050***	-0.048***
Economic major	0.101	-0.009	0.024*
Individualism	0.003***	-0.010	0.015
Uncertainty Avoidance	-0.001**	-0.033**	-0.031**
Long Term Orientation	0.005***	0.001	-0.009
Risk Premium	0.270***	-0.067***	-0.034**
Loss aversion	-0.005**	-0.074***	-0.063***
Observations N	5142	5328	5328
Pseudo R^2	2.1%		
R^2		3.6%	1.2%

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

Note: The dependent variables for model (1) is the response to the question about whether the participant prefer \$3400 this month or \$3800 next month.

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, 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.

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 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 collectivist 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. In our survey, we find that at both individual and country level, high individualism is positively correlated with the tendency to choose the waiting option (see the first column in Table 1), but no relationship is found between individualism and the two parameters in quasi-hyperbolic models based on one-year and ten-year questions. The “cushion” hypothesis that predict more collectivist society discount future less is therefore not supported by our study.

Mahajna et al. (2008) conjecture that lower income and low trust may have stronger influence than the collectivist culture 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. In our questionnaire, we have included a “trust” question which asked participants to what extent they agree that “Most people can be trusted.” Therefore, we could test at the individual level, whether the degree of trust is related with the time discounting measurement, and no significant relationship has been found from our data. Although we do not have individual income data, in the next section we will show that at the country level, wealth is indeed highly correlated with the waiting question. To summarize, neither “cushion” nor “trust” finds support from our survey evidence.

Uncertainty Avoidance can be another culture dimension that is rele-

vant to the time preference. A society with higher Uncertainty Avoidance score tends to be less tolerant to uncertain situations. 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 measures of risk premium and loss aversion into the regression model. Our results are inclusive regarding the risk attitudes and time discounting. On the one hand, more risk-averse participants tend to wait for one month for the higher payoff. On the other hand, higher degree of risk aversion is associated with lower discount rate as reflected by the

present bias β and long-term discount factor δ that are derived from the medium/long term questions. This inconsistency seems to suggest again that waiting tendency in the short run evoke different considerations than the evaluation of long-term tradeoffs.

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 (2009) 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 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 can 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).

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 do not have individual wealth or income information, we use GDP per capita as the proxy for the national wealth.

The first row 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. However, GDP is not significant in predicting the responses of medium to long-term time discounting questions as measured by present bias and long-term discount factor.

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. 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. We found such indexes are correlated with our time discounting measures, especially with the one-month waiting question (spearman's $\rho = 0.609$, $p < 0.001$ for correlation between "higher education and training" and percentage to wait in each country). However, since education is correlated with GDP at the country level, and our sample are rather homogenous in educational background, no strong conclusion can be made regarding the relative impact of wealth and education.

Economic growth and inflation rate

Do countries with faster economic growth have higher or lower discounting rate? The answer to this question is not 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. Countries with higher growth rate tend to have lower average β and δ , i.e., they discount the future more. However, no relationship is found between growth rate and tendency to wait for one month (the second row in Table 2).

Although inflation rate is moderately correlated with the one-month horizon question, it is not any more significant when the wealth and growth rates are controlled (see the third row in Table 2).

Culture

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, the country with higher Uncertainty Avoidance score tend to discount the next year more.

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.

Table 2: Country-level OLS Regression for time discounting

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

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, postal speed, 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).

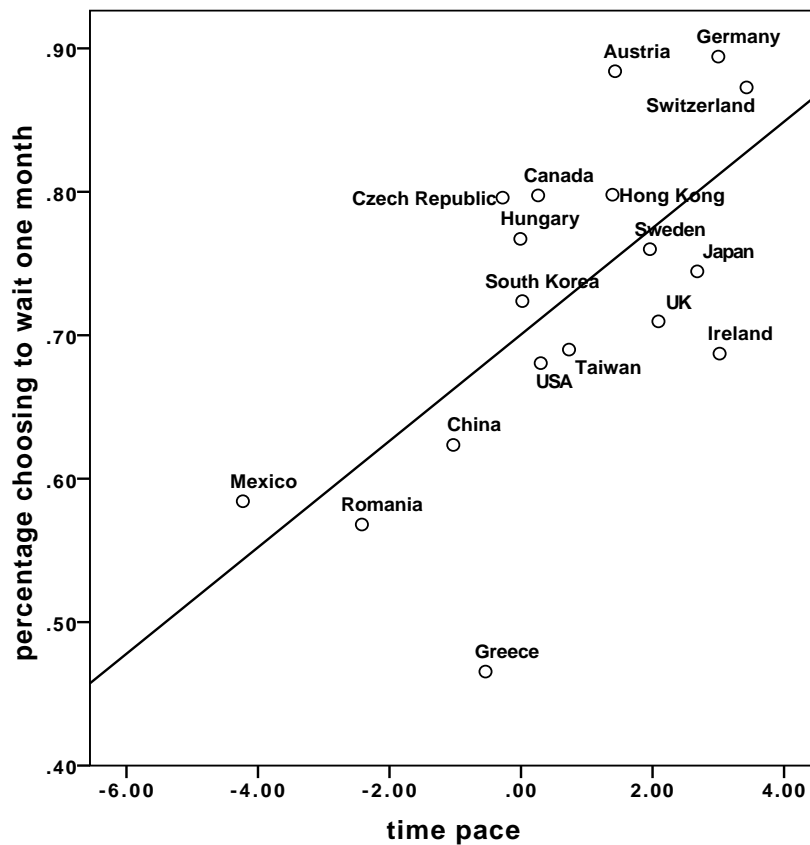


Figure 7: Correlation between Pace of Time and Waiting Tendency

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.

4 Discussion and Applications

4.1 General 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) The answers to the very short-term (one-month) question should reflect more the attitudinal differences, whereas the questions about intermediate time horizon such as our one-year question should be correlated with both attitudinal 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 conjectures. For example, at the individual level, the one-month waiting question is correlated with the 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 offers more insights to policy makers when they design mechanisms to enhance the long-term planning (e.g., retirement saving, conservation of natural

resources), and reduce myopic behavior (e.g., pollution).

4.2 Examples for possible applications

4.2.1 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” question with the innovation factor at the country level. Table 4 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. This result suggests that although the wealth level (and hence a general level of a country's economy) is crucial to stimulate innovation, the attitude towards future also plays an important role. For example, while 69% of Taiwanese participants prefer

to wait in the one-month question, 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.

4.2.2 Environmental sustainability

Studies have revealed that time preference is related to 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 the wealth level is one important determinant of time 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 for a sustainable environment. Column one in Table 5 demonstrates an interesting result in that our measured time preference has a significant impact on protected area at the country level, whereas GDP per capita is not significant in this model. Columns (3) and (4) show that the estimated parameter values from the hyperbolic discounting model, however, are not significant when GDP is controlled. Column (4) substitutes subjective time-preference measures with the objective inflation

Table 4: Country-level OLS Regression for Innovation Factor

	Dependent Variable		
	Innovation Factor		
	(1)	(2)	(3)
Constant	2.362*** (0.276)	2.254*** (0.286)	2.235*** (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*** (0.114)	0.557*** (0.112)	0.651*** (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 sectors, 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.

rate, which turns out to be insignificant. The relatively low R^2 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 (R^2 increases 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.⁷ Our finding is in line with the experimental study by Hardisty & Weber (2009), where they find that people discount environmental outcomes in a similar way to monetary outcomes. This would help policy makers to understand societal discount rates across countries.

4.3 Financial market and political institutions

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.

⁷The 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 5: Country-level OLS Regression for Environmental Sustainability

	Dependent Variable			
	Percentage of Protected Area			
	(1)	(2)	(3)	(4)
Constant	-0.001 (4.532)	-1.303 (4.800)	-1.022 (4.761)	5.176 (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 (1.870)	4.478** (1.883)	4.932** (1.812)	2.667 (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.

It follows that the inefficiency and frictions of the markets may alter discount rates. According to Boserup (1965), the degree of market access can have different effects on time preference. On the one hand, better access to markets may imply better investment opportunities, higher interest rate, and hence may increase the time discount rate. On the other hand, better access to markets and credits can lower the time discount rate by reducing the probability of credit constraints. Similarly, Holden, Shiferaw & Wik (1998) suggest 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. 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 rights, and market efficiency are correlated with all three measured time discounting variables. The soundness of banks has the weakest correlation with time preference. Since our survey are mainly conducted before the 2008 financial crisis, the soundness of banks 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 banks would influence investors' time and risk preference.

We also compared the measured time discounting with the index of "political stability" from the world bank governance indicators and "public trust of politicians." We find moderate correlation which implies that countries that are politically more stable and with more public trust to politicians are

more likely to wait.

However, our current survey data does not allow us to investigate in-depth the impacts of financial market and political institutions on time discounting, since many of these factors are slightly correlated with each other, making it difficult to disentangle them. We encourage research using panel data, field experiments, or other innovative approaches to study this important issue.

4.4 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, we hope that it can stimulate more in-depth cross-sectional studies in this direction. Further applications are conceivable. For example, Buiter (1981) presents a theoretical model using country-level time preference to

explain the capital movement between countries. The model has not been tested empirically. Shiller (1999) suggests intergenerational and international risk sharing in pension system, and emphasizes that the international risk sharing is rarely discussed. Empirical evidence of the degree of time discounting across countries can be an important input for such discussions. We believe that systematic investigations and documentations of time preference across countries will deepen our understanding of the discrepancies across countries, and provide policy makers with useful advice for development at the global level.

Acknowledgements

We thank Herbert Dawid, Erich Gundlach, Volker Krätschmer, Rolf J. Langhammer, and Daniel Schunk for their comments. We thank Julia Buge, Chun-houh Chen, Shiyi Chen, Anke Gerber, Wolfgang Härdle, Dana Liebman, Takeshi Momi, Koji Okada, Hersh Shefrin, Fangfang Tang, Bodo Vogt, Hannelore Weck-Hannemann, Xiao-Fei Xie, and numerous other people for generous help on data collection and translation.

The following universities participated: Catholic University of Angola, Universidad Torcuato Di Tella (Argentina), Universität Innsbruck (Austria), Alpen-Adria-Universität Klagenfurt (Austria), University of Adelaide (Australia), Khazar University (Azerbaijan), University of Windsor (Canada), University of British Columbia (Canada), Fudan University (China), Peking University (China), Renmin University (China), Universidad de Chile, Universidad de los Andes (Colombia), Buiseness College Vern' (Croatia), CERGE-EI (Czech Rep.), University of Southern Denmark, University of Copenhagen (Denmark), Tallinn University of Technology (Estonia), Universität Hamburg (Germany), Universität Trier (Germany), Universität Konstanz (Germany), Otto-von-Guericke Universität Magdeburg (Germany), University of Thessaly (Greece), Hong Kong Chinese University, Hong Kong Baptist University (Hong Kong), University of Pécs (Hungary), Ben Gurion University (Israel), NUI Maynooth (Ireland), Università degli Studi di Venezia (Italy), Foreign Trade University (Vietnam), Doshisha University (Japan), American University of Beirut (Lebanon), University of Malaya (Malaysia), Universidad de Guanajuato (Mexico), MAES Kishinev (Moldova), Massey University (New Zealand), University of Ibadan (Nigeria), NHH Bergen (Norway), University of Lisboa (Portugal), Bucharest Academy of Economic Studies

(Romania), Russian Customs Academy Vladivostok (Russia), University of Ljubljana (Slovenia), Seoul National University (South Korea), Universidad Pablo de Olavide (Spain), University of Zurich (Switzerland), National Sun Yat-sen University (Taiwan), Chulalongkorn University (Thailand), Middle East Technical University (Turkey), Bogazici University (Turkey), Keele University (UK), Emory University (USA), Santa Clara University (USA), Princeton University (USA).

Financial support by the National Centre of Competence in Research “Financial Valuation and Risk Management” (NCCR FINRISK), Project 3, “Evolution and Foundations of Financial Markets”, and by the University Research Priority Program “Finance and Financial Markets” of the University of Zürich is gratefully acknowledged.

References

- Anderson, C. L., Dietz, M., Gordon, A. & Klawitter, M. (2004), ‘Discount rates in Vietnam’, *Economic Development and Cultural Change* **52**(4), 873–888.
- Becker, G. S. & Mulligan, C. B. (1997), ‘The endogenous determination of time preference’, *The Quarterly Journal of Economics* **112**(3), 729–758.
- Benzion, U., Rapoport, A. & Yagil, J. (1989), ‘Discount rates inferred from decisions: An experimental study’, *Management Science* **35**(3), 270–284.
- Boserup, E. (1965), *The Conditions of Agricultural Growth: The Economics of Agrarian Change under Population Pressure*, George Allen & Unwin, London.
- Buiter, W. H. (1981), ‘Time preference and international lending and borrowing in an overlapping-generations model’, *The Journal of Political Economy* **89**(4), 769–797.
- Chen, H., Ng, S. & Rao, A. R. (2005), ‘Cultural differences in consumer impatience’, *Journal of Marketing Research* **42**, 291–301.
- Chhokar, J. S., Brodbeck, F. C. & House, R. J. (2007), *Culture and Leadership Across the World: The GLOBE Book of In-depth Studies of 25 Societies*, Routledge.

- Dohmen, T. J., Falk, A., Huffman, D. & Sunde, U. (2008), Are risk aversion and impatience related to cognitive ability?, Discussion Paper 6852, Center for Economic Policy Research, London, UK.
- Esty, D., Levy, M., Srebotnjak, T. & de Sherbinin, A. (2005), *2005 Environmental Sustainability Index: Benchmarking National Environmental Stewardship*, Yale Center for Environmental Law & Policy, New Haven.
- Frederick, S. (2005), 'Cognitive reflection and decision making', *Journal of Economic Perspectives* **19**(4), 25–42.
- Frederick, S., Loewenstein, G. & O'Donoghue, T. (2002), 'Time discounting and time preference: a critical review', *Journal of Economic Literature* **40**, 350–401.
- Graham, R. J. (1981), 'The role of perception of time in consumer research', *Journal of Consumer Research* **7**, 335–342.
- Green, L., Fry, A. F. & Myerson, J. (1994), 'Discounting of delayed rewards: A life-span comparison', *Psychological Science* **1**, 33–36.
- Hardisty, D. J. & Weber, E. U. (2009), 'Discounting the future green: Money versus the environment', *Journal of Experimental Psychology: General* **138**(3), 329–340.
- Harrison, G. W., Lau, M. I. & Williams, M. B. (2002), 'Estimating individual discount rates in denmark: A field experiment', *American Economic Review* **92**(5), 1606–1617.
- Hausman, J. A. (1979), 'Individual discount rates and the purchase and utilization of energy-using durables', *The Bell Journal of Economics* **10**(1), 33–54.
- Hesketh, B., Watson-Brown, C. & Whiteley, S. (1998), 'Time-related discounting of value and decision-making about job options', *Journal of Vocational Behavior* **52**, 89–105.
- Hofstede, G. (1991), 'The confucius connection: From cultural roots to economic growth', *Organization Dynamics* **16**(4), 4–18.
- Hofstede, G. (2001), *Culture's Consequences, Comparing Values, Behaviors, Institutions, and Organizations Across Nations*, Sage Publications, Thousand Oaks CA.

- Holden, S., Shiferaw, B. & Wik, M. (1998), 'Poverty, market imperfection and time preferences: of relevance for environmental policy?', *Environment and Development Economics* **3**, 105–130.
- Hsee, C. K. H. K. & Weber, E. U. (1999), 'Cross-national differences in risk preference and lay predictions', *Journal of Behavioral Decision Making* **12**, 165–179.
- Johnson, M. W. & Bickel, W. K. (2002), 'Within-subject comparison of real and hyperthetical money rewards in delay discounting', *Journal of the Experimental Analysis of Behavior* **77**, 129–146.
- Kirby, K. N., Godoy, R., Reyes-Garcia, V., Byron, E., Apaza, L., Leonard, W., Perez, E., Vadez, V. & Wilkie, D. (2002), 'Correlates of delay-discount rates: Evidence from tsimane amerindians of the Bolivian rain forest', *Journal of Economic Psychology* **23**, 291–316.
- Laibson, D. (1997), 'Golden eggs and hyperbolic discounting', *Quarterly Journal of Economics* **112**(2), 443–477.
- Lawrance, E. C. (1991), 'Poverty and the rate of time preferences: Evidence from panel data', *The Journal of Political Economy* **99**(1), 54–77.
- Levine, R. V. (1997), *A Geography of Time: The Temporal Misadventures of a Social Psychologist, or How Every Culture Keeps Time Just a Little Bit Differently*, Basic Books, A Member of the Perseus Books Group.
- Mahajna, A., Benzion, U., Bogaire, R. & Shavit, T. (2008), 'Subjective discount rates among Israeli Arabs and Israeli Jews', *The Journal of Socio-Economics* **in press**.
- Mink, S. (1993), 'Poverty and the environment', *Finance and Development* **30**(4), 8–10.
- Mischel, W. & Grusec, J. (1967), 'Waiting for rewards and punishments: Effects of time and probability on choice', *Journal of Personality and Social Psychology* **5**(1), 24–31.
- Phelps, E. S. & Pollak, R. A. (1968), 'On second-best national saving and game-equilibrium growth', *Review of Economic Studies* **35**, 185–199.
- Porter, M. E. & Schwab, K. (2008), The global competitiveness report 2008-2009, Technical report, World Economic Forum, Geneva, Switzerland.

- Read, D. & Roelofsma, P. H. M. P. (2003), 'Subadditive versus hyperbolic discounting: A comparison of choice and matching', *Organizational Behavior and Human Decision Processes* **91**(2), 140–153.
- Robicheck, A. A. & Myers, S. C. (1966), 'Conceptual problems in the use of risk-adjusted discount rates', *Journal of Finance* **21**, 727–730.
- Romer, P. M. (1990), 'Endogenous technological change', *Journal of Political Economy* **98**(2), S71–S102.
- Shamosh, N. A., DeYoung, C. G., Green, A. E., Reis, D. L., Johnson, M. R., Conway, A. R. A., Engle, R. W., Braver, T. S. & Gray, J. R. (2008), 'Individual differences in delay discounting: Relation to intelligence, working memory, and anterior prefrontal cortex.', *Psychological Science* **19**(9), 904–911.
- Shiller, R. (1999), 'Social security and institutions for intergenerational, intragenerational, and international risk-sharing', *Carnegie-Rochester Conference Series on Public Policy* **50**, 165–204.
- Shiller, R. J., Boycko, M. & Korobov, V. (1992), 'Hunting for *Homo Sovieticus*: Situational versus attitudinal factors in economic behavior', *Brookings Papers on Economic Activity* **1**, 127–181.
- Silverman, I. W. (2003), 'Gender differences in delay of gratification: A meta analysis', *Sex Roles* **49**(9/10), 451–463.
- Stevenson, M. K. (1986), 'A discounting model for decisions with delayed positive or negative outcomes', *Journal of Experimental Psychology: General* **115**(2), 131–154.
- Tanaka, T., Camerer, C. F. & Nguyen, Q. (2009), 'Risk and time preferences: linking experimental and household survey data from vietnam', *American Economic Review* . forthcoming.
- Thaler, R. H. (1981), 'Some empirical evidence on dynamic inconsistency', *Economic Letter* **8**, 201–207.
- Yesuf, M. & Bluffstone, R. (2008), Wealth and time preference in rural ethiopia, EfD discussion paper 08-16, the Environment for Development Initiative and Resources for the Future (www.rff.org), Washington DC.