An International Survey on Time Discounting

Mei Wang*
Marc Oliver Rieger†
Thorsten Hens‡

February 25, 2009

Abstract

We present results from an international survey on time discounting, risk preference, and culture dimensions in 45 countries/regions. We confirm that people discount the near future more than the long-term future, which is consistent with the pattern predicted by the hyperbolic discounting model. The heterogeneity of the subjective discounting rate on a cross-country level is high and cannot simply be explained by differences in interest or inflation rates. We find that 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. Within-country variation of time discounting is high as well. It seems that time preference is related to loss-aversion and risk preferences at the individual level. Further results suggest that differences in time discounting between countries can predict some macroeconomic phenomena, as we demonstrate on the example of innovation.

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

JEL classification: D90, F40

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

†Institute of Swiss Banking, 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

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, and 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 risk attitudes and time preferences. Moreover, some theoretical models attempt to incorporate such heterogeneity and explain what drives the different degrees of preference regarding time and risk.

In this paper, we present evidence from a survey of economics students in 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.

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 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 advantages of this sample selection: First and second year economic students understand better the numeric formulations of lottery and time preference questions than usual people, 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 as well as in the global market. The time and risk preferences we study here are relevant for those finance-related activities. Moreover, as Hofstede (1991) 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 here 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 risk and time preferences because it allows us to ask questions involving a long time span and large payoffs, including gains and losses (Frederick, Loewenstein & O'Donoghue 2002). Moreover, researchers who compared directly the real and hypothetical rewards did not find systematic differences (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 and the implicit discount rates. The cross-country differences are predictable from macroeconomic conditions. In particular we find wealth, growth rate, and educa-

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

[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 groups and the hypothetical-question group.

tion as significant predictors of the average level of time preference at the country level.

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 "one-month waiting question" in the rest of the paper.

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 the 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.

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.

[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, our survey design is too limited to draw any definite conclusions of these two elicitation methods.

In a separate paper, we will discuss how to use these data to fit Prospect Theory parameters. In this paper, we will check the relationship of time preference with two measures derived from the lottery questions. The first measure is the risk attitude in gains, measured by the average Relative Risk Premium (RRP) for two lotteries: (1) a lottery with 60% chance to win $ 100, otherwise nothing; (2) a lottery with 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 50% chance to loss $ 25 and 50% chance to win X; (2) a lottery with 50% chance to loss $ 100 and 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 Culture 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. He found five persistent dimensions of culture. 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 involving 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) 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) 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 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 high 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 5530 university students in 45 countries 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 5393 individuals for the data analysis. The average age of participants was 21.7 years (SD=3.95). Fifty-two percent participants were males.

The questionnaire was translated into local languages for each country

[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.

by professional translators or translators who have economic backgrounds[5]. The amount of monetary payoffs in the questions were adjusted according to each country's Purchasing Power Parity and the monthly income/expense of the local students.

The participants were given 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. They 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 to Wait

In this section, we evaluate the results from the one-month waiting question ($3400 this month or $3800 next month). The first column of Appendix A reports the percentage of the participants in each country who chose to wait for $3800 next month. We observed 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 in any of these countries. So the large variation across countries is hard to be justified only by the differences in market interest rates.

In particular, 68% of our U.S. sample chose to wait (N=71). For comparison, in the survey of Frederick (2005) using the same question with a relatively large sample (N=807) of U.S. undergraduate students from several universities, around 41% students chose to wait. Among those students who scored high in a separate Cognitive Reflection Test (CRT), there were 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

[5]Participants in several countries were fluent in English (e.g., Sweden), and we used the original English version with adjustment to the currency and Purchasing Power Parity.

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 large difference is hard to explain only by wealth, intelligence and the macro-economic situations.[6]

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 1 shows the perception of choosing to wait options when grouped by the cultural cluster. Germanic-Nordic are far more patient (more than 85% chose to wait) than other cultural clusters, Anglo, East Asia, and Middel East are similarly patient (around 70%), then followed by East Europe, Latin America and Latin Europe (around 50% to 60% percent). Africa has the lowest percentage of participants choosing to wait (less than 40%). We will discuss further 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 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.

[6]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 complained that the question was ridiculous because *everybody* would choose to wait for one month given the high implicit interest rate.

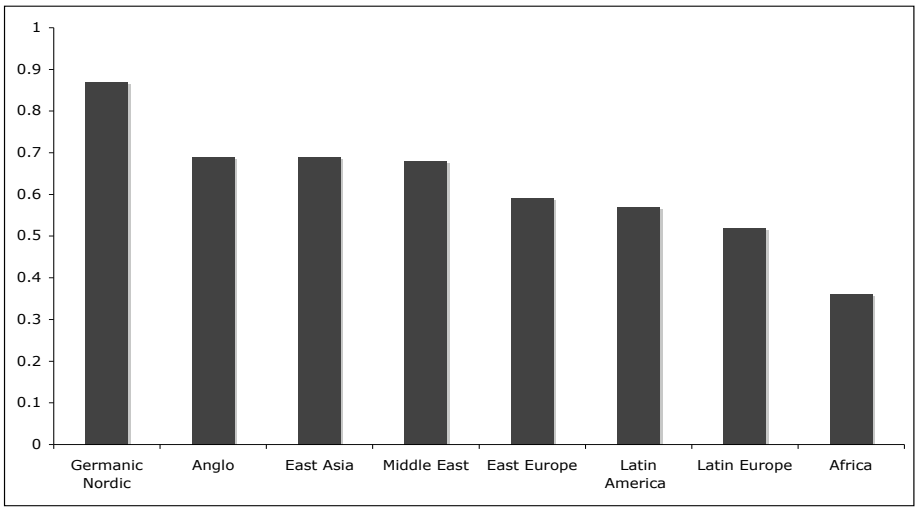

Figure 1: The percentage of choosing to wait grouped by cultural origin

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 group those culture 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 and all situations. Our results indicate that this is not the case. We observe substantial variations of implicit interest rate across individuals and across countries. The median R_{1year} is 100%, ranging from 11% in Australia to 17400% in Georgia, whereas median R_{10year} is 29%, ranging from 16% in Thailand to 70% in Georgia. 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, 86.7% participants had an implicit interest rate R_{1year} higher than R_{10year}. See the 3rd to the 6th columns in Appendix A for the median implicit interest rates for each country.

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. For example, Thaler (1981) and Benzion, Rapoport & Yagil (1989) both found the discount rates decline as the time necessary to wait increases, and decreases as the size of cashflow increases. The former 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 subsections.

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 & 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 we follow the *one-period-realization* model.

We had two questions to elicit the future value for one and 10 years:

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

It follows that

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

For all participants, the median value of the riskless interest rate i is 0.22 (Mean=0.26, SD=1.33). The median value of the risk-related discount rate d is 0.67 (Mean=8.92, SD=81.39).

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 $(1-\beta\delta)/\beta\delta$. As in the one-period realization implicit-risk approach, it 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 lack of control and 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=0.58, SD=0.56), and the median value of δ is 0.82 (Mean=0.82, SD=0.12). See Appendix B for parameter estimates of β and δ for each country. Note that the variation in β is much higher than $the variation in \delta$. The responses of the two matching questions are highly correlated (Spearman's ρ=0.781, 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.

As an example, Figure 2 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 a slight less patient attitude in the long term, but the difference is not as dramatic as that of the present-bias parameter.

Figure 3 shows graphically the median values of β and δ for each cultural cluster. East Europe has the strongest degree of present bias (i.e., the lowest β), followed by Africa, Latin America, and Middle East, whereas Anglo cultures have the least degree of present bias, followed by East Asia, and other Western European culture (Germanic-nordic and Latin Europe). Note that all cultural groups are very similar regarding the average value of the long-term discount factor δ.

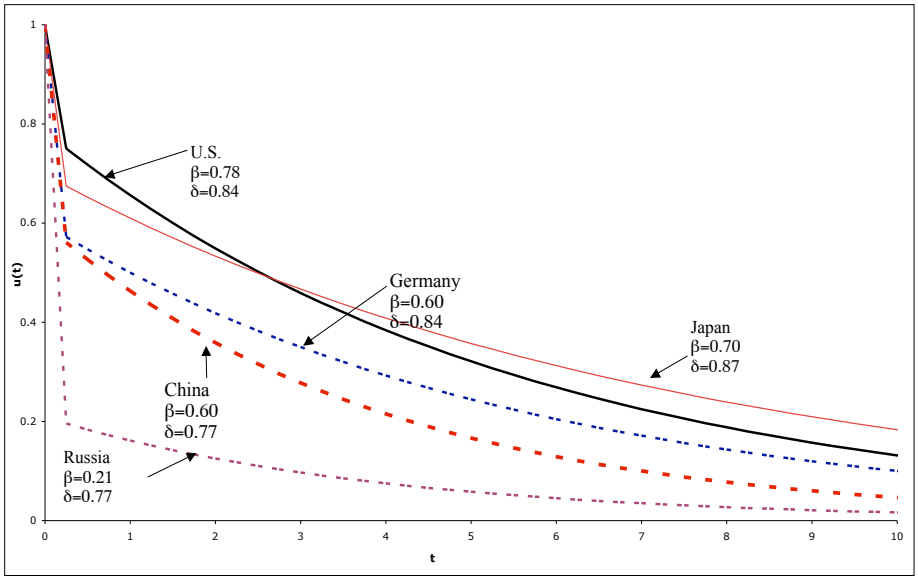

Figure 2: Median hyperbolic discounting functions for U.S., Germany,China, Japan, Russia

3.2 What correlate with time preference: Individual-level analysis

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

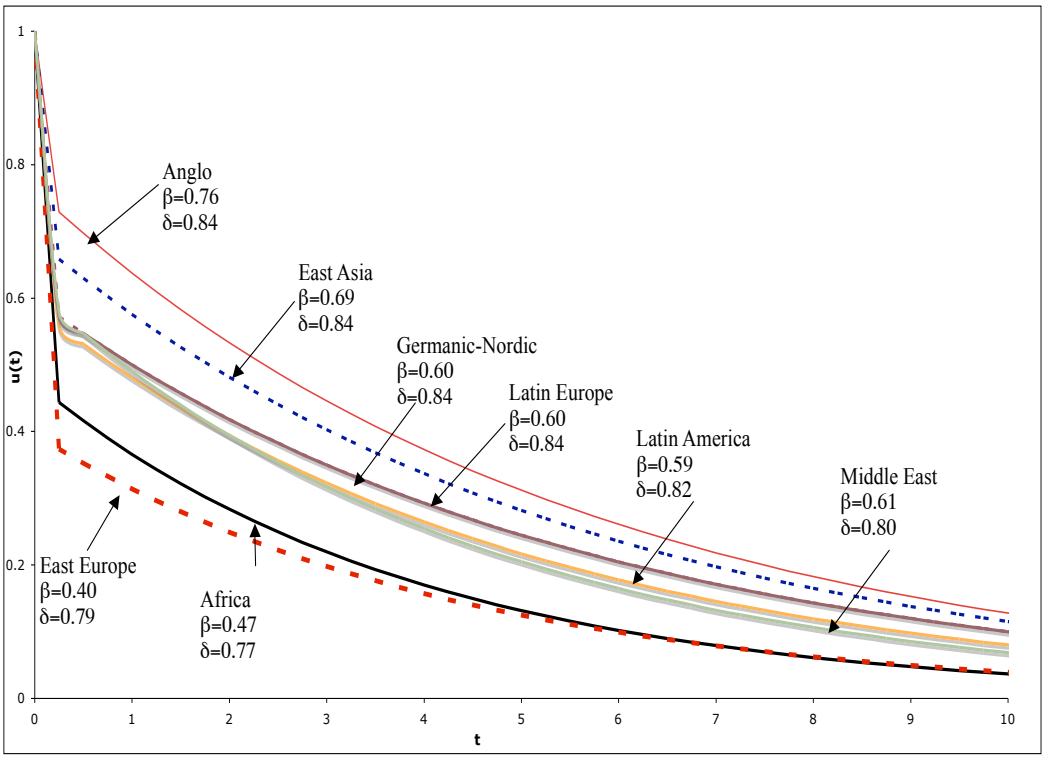

Figure 3: Median hyperbolic discounting functions for different cultures

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 1). 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 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) were 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). 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, seems to be 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 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, however, fail to support the conjecture by Mahajna et al. (2008). In both model (1) and (2) in Table 1, high individualism is correlated with the tendency to choose the more patient option. In addition, our

[7]The category "other" was excluded.

questionnaire included a "trust" question which asked participants to what extent they agree that "Most people can be trusted." We did not find any significant relationship between the answers to the trust question and to the one-month waiting question.

Uncertainty Avoidance may be another culture dimension that is relevant to the time preference. A society with higher Uncertainty Avoidance score 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 less patient answers in the one-month waiting question (the first two columns in Table 1).

For the fitted parameters in the hyperbolic discounting model (β and δ), we also used cultural clusters as instrumental variables for the three culture dimension variables. It seems that a higher score of Uncertainty Avoidance correlates with lower patience (model 4 and 6), consistent to what we have seen for the one-month waiting question. However, the predictive power of individualism and long-term-orientation is not as robust. They are either insignificant, or have the wrong sign.

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.

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 &

Table 1: Regression at the individual level: culture dimensions

	Binary choice (Wait =1)		Present bias β		Long-term discount factor δ	
	Logit	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)
Age	-0.014**	-0.012*	0.012***	0.013***	0.001***	0.001***
	(0.007)	(0.007)	(0.001)	(0.001)	(0.000)	(0.001)
Gender	0.010	-0.047	0.060***	0.051***	0.006**	0.003
(1=Male)	(0.059)	(0.059)	(0.010)	(0.010)	(0.003)	(0.003)
Immigrant	-0.165*	-0.174**	0.072***	0.075***	0.016***	0.017***
	(0.089)	(0.088)	(0.016)	(0.016)	(0.005)	(0.005)
Economic	0.065	0.172*	-0.002	0.025	0.010*	0.015***
major	(0.095)	(0.094)	(0.017)	(0.016)	(0.005)	(0.005)
Individualism	0.003***	0.052***	0.000	-0.006***	$3 \cdot 10^{-5}$	0.000***
(IV)	(0.001)	(0.006)	(0.000)	(0.001)	(0.000)	(0.000)
Uncertainty	-0.001**	-0.032***	0.000***	-0.016***	$5 \cdot 10^{-5}$*	-0.002***
avoidance (IV)	(0.000)	(0.008)	(0.000)	(0.001)	(0.000)	(0.000)
Long term	0.171***	1.838***	0.009*	-0.219***	0.002	0.008
orientation (IV)	(0.225)	(0.270)	(0.005)	(0.044)	(0.002)	(0.014)
Constant	1.148***	3.495***	0.380***	1.000***	0.780***	0.956***
	(0.225)	(0.690)	(0.040)	(0.124)	(0.013)	(0.040)
Observations N	5438	5657	5108	5288	5108	5288
Pseudo R-sq	1.8%	8.8%				
Adjusted R-sq			3.0%	5.9%	0.5%	1.0%

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 (1 represents the choice to wait). 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.

Gray 2008). From the regression analysis in Table 1, it seems that older participants are less likely to wait for one month but more patient in the one-year and ten-year questions. Given the relative small variation of age in our sample and the inconsistent pattern, the result is only tentative, and we are reluctant to give any post hoc explanations. We find no gender effects regarding the one-month waiting question, but male participants seemed to exhibit less present bias in the context of one-year and ten-year questions. The pattern regarding immigrants is again inclusive. Immigrants seem to be less likely to wait for one month, but more patient in the one-year and ten-year questions. We also did not find any consistent differences between economic students and non-economic students.

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 2 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 patient in our one-month waiting question, which is opposite to what we expected. However, higher risk premium, namely more risk-aversion, also 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 2 shows that higher loss-aversion, on the other hand, is correlated with more impatient answers for both one-month waiting question and present bias. This supports what has been found by Tanaka, Camerer & Nguyen (2007) from their field experiment in Vietnamese villages.

Table 2: Regression at the individual level: correlation with risk preference and loss aversion

	Binary choice (Wait =1) Logit (7)	Present bias β OLS (8)	Long-term discount factor δ OLS (9)
Age	-0.011	0.013***	0.001***
	(0.008)	(0.001)	(0.000)
Gender	0.031	0.056***	0.006*
(1=Male)	(0.060)	(0.010)	(0.003)
Immigrant	-0.120	0.070***	0.014***
	(0.092)	(0.017)	(0.005)
Economic major	0.086	-0.001	0.012**
	(0.097)	(0.017)	(0.005)
Individualism	0.003***	0.000	$3 \cdot 10^{-5}$
	(0.001)	(0.000)	(0.000)
Uncertainty avoidance	-0.001**	0.000**	$5 \cdot 10^{-5}$*
	(0.000)	(0.000)	(0.000)
Long term orientation	0.164***	0.006	-0.002
	(0.031)	(0.005)	(0.002)
Risk premium	0.283***	-0.043***	-0.008**
	(0.073)	(0.013)	(0.004)
Loss aversion	-0.004**	-0.002***	0.000***
	(0.002)	(0.000)	0.000
Constant	-0.060	0.362***	0.796***
	(0.242)	(0.043)	(0.014)
Observations N	5275	4975	4975
Pseudo R-sq	2.1%		
Adjusted R-sq		4.2%	1.0%

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 (1 represents the choice to wait). 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.

3.3 What correlates with time preference: Country-level Analysis

In this subsection, we investigate the correlation of time discounting with some macro-economic country-level variables. These correlations by no means imply any causal relationship. 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

Poverty seems to drive impatient behavior. For example, one observes more environmental degradation in under-developed countries or stages. 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).

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. Our results seem to support this common belief. Although we did not have information about the individual wealth level, we find that on average, participants from wealthier countries were more likely to wait (upper panel: Figure 4) and had less present bias, i.e., higher value of β (lower panel: Figure 4).

We used the measure "higher education and training" from the Global Competitiveness Report 2008-2009 by Porter & Schwab (2008) for a proxy of the country's education quality. Figure 5 plots this measure with our measured tendency to wait and the present bias. As we expected, the countries with better education quality were more likely to wait (upper panel) and exhibited less present bias (lower panel).

The first and fourth rows in Table 3 show the correlation of GDP per capita and "higher education and training" with our measured time discounting. Note that the correlation of subjective time discounting with education is even slightly stronger that the correlation with GDP per capita.

Moreover, Table 3 also suggests that GDP per capita has a stronger cor-

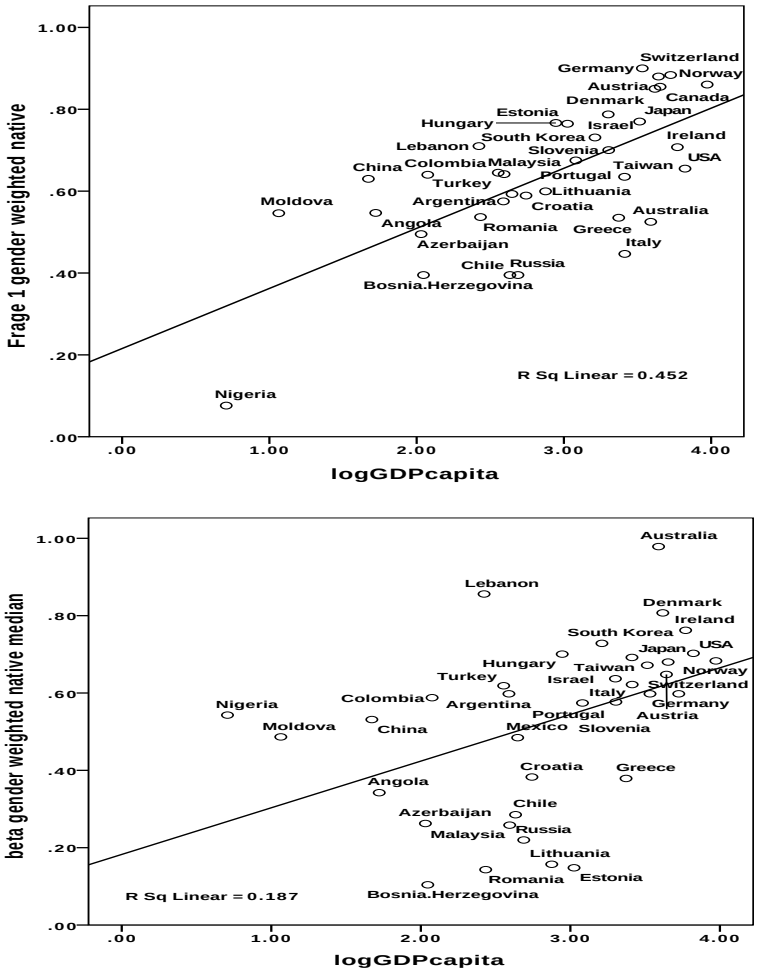

Figure 4: GDP per capita vs. time discounting measurements

relation with the percentage of choosing to wait in the one-month question (spearman's $\rho = 0.584$, $p < 0.001$) and median present bias β (spearman's $\rho = 0.588$, $p < 0.01$) than with the long-term discount factor δ (spearman's $\rho = 0.387$, $p < 0.01$). 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 and present bias than the long-term discounting factor.

Economic Growth and Inflation Rate

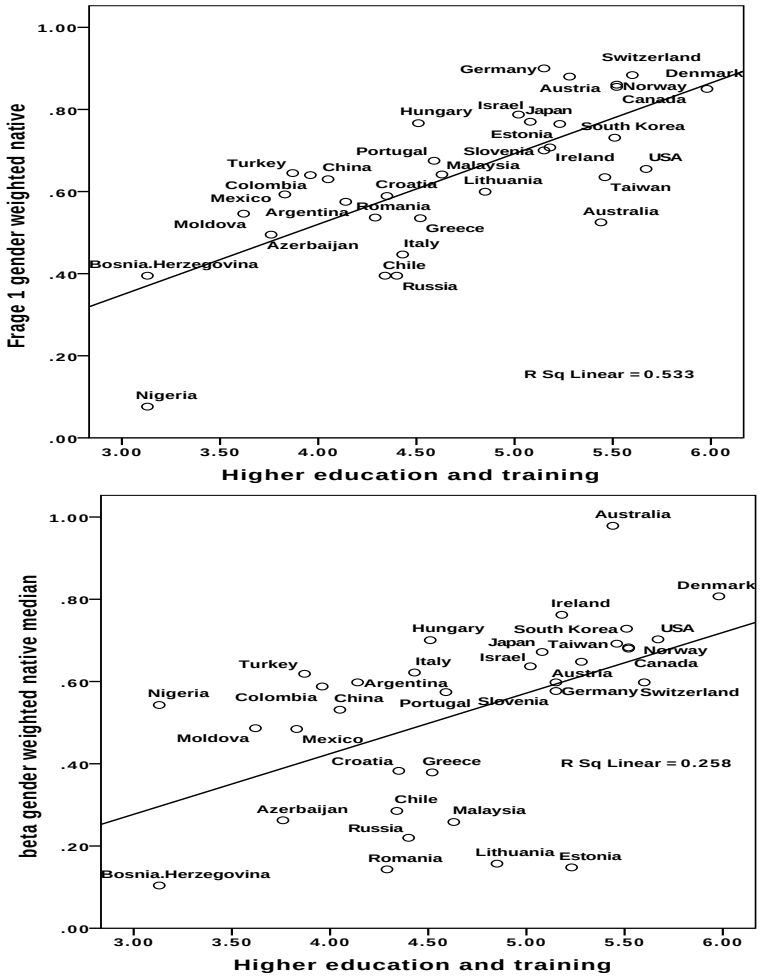

Figure 5: Higher education and training vs. time discounting measurements

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 might 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 found significant negative correlation between the median present-bias parameter and the log growth rate at the country level (see Figure 6).

The second and third rows in Table 3 compare the correlation of growth rate and inflation rate with the measured time discounting. It seems that in-

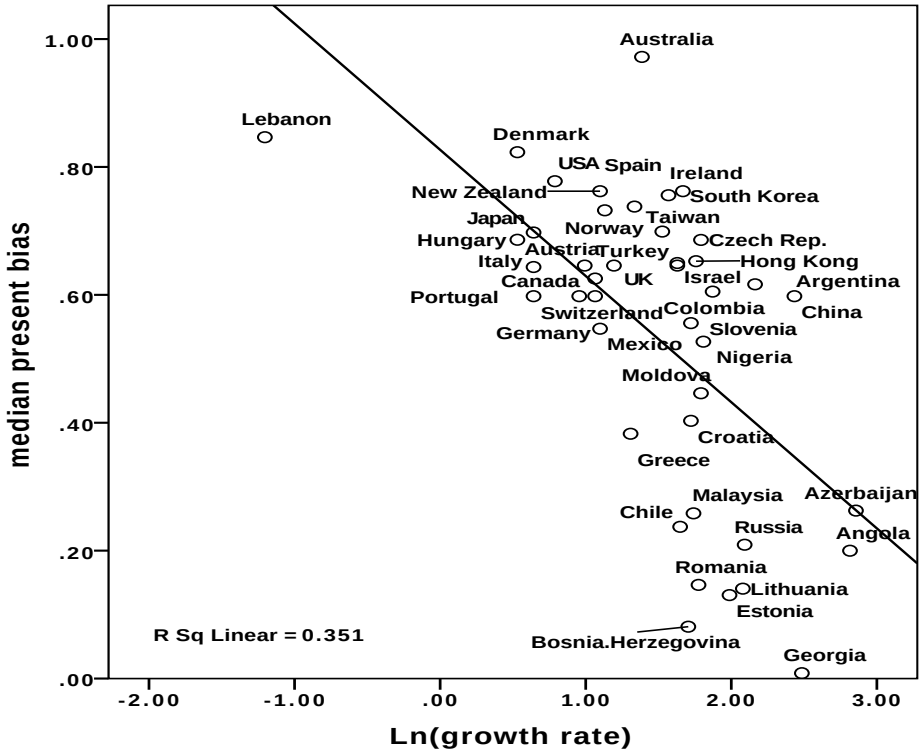

Figure 6: GDP growth rate vs. median β (present bias)

flation rate was only correlated with the one-month horizon question, whereas growth rate had a stronger correlation with the one-year and ten-year questions, although also correlated with the one-month question.

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 ρ=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 may 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 3 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, higher interest rate spreads are correlated with a lower percentage of choosing to wait, but not with the present bias or the long-term discount factor. "Easiness of access to loan" is measured by the responses from the business community to the question: How easy is it for a bank to obtain a loan in your country with only a good business plan and no collateral? (1=impossible, 7=very easy).This variable is correlated with all three measured time discounting variables. The soundness of bank is correlated with more patient answer to one-month waiting question and less present bias, but not very strong.

The lower parts of Table 3 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. Countries with high individualism, low uncertainty avoidance and high long-term orientation are more likely to wait. Uncertainty avoidance is also correlated with the present bias parameter.

Table 4 shows the regression results with the focus on three macroeconomic variables and the variable "higher education and training". 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 in the scatterplot (Figure 4) and correlation table (Table 3). After controlling the macro-economic variables (GDP per capita, growth rate, inflation rate), participants from countries with higher individualism are more likely

Table 3: 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)	0.602**	0.528**	0.416**	43
Ln(growth rate)	-0.390**	-0.596**	-0.468**	43
Inflation rate	-0.488**	-0.274	-0.247	43
Education				
Higher education and training	0.664**	0.574**	0.467**	41
Quality of education system	0.599**	0.515**	0.314*	41
Financial Market				
Interest rate spread (hard data)	-0.629**	-0.128	-0.259	41
Ease of access to loans	0.502**	0494**	0.388**	41
Soundness of banks	0.350*	0.321*	0.273	41
Financial market sophistication	0.501**	0.519**	0.421**	41
Property right	0.650**	0.518**	0.400**	41
Market efficiency	0.614**	0.565**	0.446**	41
Politics				
Political stability	0.523**	0.246	0.306*	43
Public trust of politicians	0.443**	0.396**	0.356*	41
Culture				
Individualism	0.504**	0.299*	0.112	43
Uncertainty Avoidance	-0.414**	-0.590**	-0.309*	43
Long Term Orientation	0.461**	0.353*	0.149	43

* 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."
3. Sweden and Vietnam are excluded because of the small sample size.

to wait, whereas countries with higher Uncertainty Avoidance are more prone to the present bias. Growth rate is found to be significantly correlated with present bias and the long term discount factor, but not with answers to the one-month waiting question.

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 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 correlated with the present bias parameter (as a function to response to the one-year question). According to Hofstede (1991), Uncertainty Avoidance reflects more concern about the situation, whereas other cultural dimensions are more driven by attitudinal differences.

4.1 Application: Relationship between patience and innovation

We have observed that our measured time discounting was correlated with the country's wealth level and education quality. 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

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)	(7)	(8)	(9)
Constant	0.107	-0.534	-0.155	0.329	-0.156	0.714**	0.239	-0.114	0.787*
	(0.266)	(0.385)	(0.133)	(0.254)	(0.378)	(0.353)	(0.295)	(0.801)	(0.449)
GDP per cap	0.176**	0.129**	0.133**	-0.021	-0.021	0.101*	0.140*	0.073	0.134
	(0.067)	(0.104)	(0.061)	(0.064)	(0.102)	(0.058)	(0.074)	(0.121)	(0.074)
growth rate	-0.042	0.003	-0.027	-0.173***	-0.171**	-0.163***	-0.132**	-0.089	-0.130**
	(0.058)	(0.082)	(0.052)	(0.056)	(0.081)	(0.050)	(0.065)	(0.095)	(0.064)
Inflation rate	-0.009	-0.012	-0.005	0.007	0.009	0.011	0.012	0.006	0.013
	(0.731)	(0.016)	(0.014)	(0.015)	(0.016)	(0.014)	(0.018)	(0.019)	(0.017)
Education		0.218**			0.195*			0.106	
		(0.100)			(0.098)			(0.116)	
Individualism			0.007**			0.001			-0.003
			(0.003)			(0.003)			(0.003)
Uncertainty			-0.004*			-0.007***			-0.005*
Avoidance			(0.002)			(0.002)			(0.003)
N	43	41	43	43	41	43	43	41	43
R^2	38.3%	45.9%	53.5%	40.0%	40.5%	54.6%	26.1%	26.2%	32.8%
Adjusted R^2	33.6%	39.9%	47.2%	33.9%	39.9%	48.5%	20.4%	18.0%	23.7%

* 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. The independent variable "Education" also named as "Higher Education and Training" in (Porter & Schwab 2008) measures secondary and tertiary enrollment rates as well as the quality of education as assessed by the business community. The independent variable "Easiness to access to loans" measures "How easy is it to a bank obtain loan in your country with only a good business plan and no collateral?" (1=impossible, 7=very easy). Both measures are taken from Global Competitive Report 2008-2009 (Porter & Schwab 2008).
3. 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. 4. Angola and Lebanon are excluded in regression 2, 4, and 6 because of the lack of data for "Higher education and training" and "Ease to access to loans."
5.Sweden and Vietnam are excluded for all regressions because the sample size is too small to be reliable.
6. The dependent variable are transformed to percentile estimate to reduce the impacts of outliers. Larger value of the dependent variables imply higher degree of measured patience.

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. Figure 7 shows a positive correlation between the response of our one-month waiting question with the innovation factor at the country level. Table 5 shows that after controlling GDP and education variables, the response to the one-month waiting question is still significant in predicting the innovation factor, but the two other time-discounting measures, namely present bias and long-term discount factor, are not significant. In the future, it is worthwhile to investigate whether a general attitude towards future is one of the fundamental driving factors of innovation, and what potential policy implications these findings have.

4.2 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 documents 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, we could not 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.

Table 5: Country-level OLS Regression for Innovation Factor

Dependent Variable: Innovation Factor						
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	3.324***	0.472	3.485***	0.250	3.667***	0.089
	(0.184)	(0.548)	(0.206)	(0.219)	(0.544)	
Choosing to wait	1.893***	0.660**				
	(0.311)	(0.306)				
Present bias β			1.706***	0.454		
			(0.376)	(0.305)		
Long term discount δ					1.288***	0.241
					(0.386)	(0.276)
GDP per cap		0.026		0.047	0.038	
		(0.170)		(0.175)	(0180)	
Education		0.727***		0.787***		0.848***
		(0.197)		(0.199)		(0.196)
N	41	41	41	41	41	41
R^2	48.6%	74.2%	34.6%	72.6%	22.2%	71.5%
Adjusted R^2	47.3%	72.1%	32.9%	70.3%	20.2%	69.2%

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

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. The independent variables "GDP per cap" and "growth rate" are the natural logarithm of GDP (PPP) per capita and growth rate in 2007.
3. The independent variable "Education" is named as "Higher Education and Training" in Global Competitive Report 2008-2009 (Porter & Schwab 2008). It measures secondary and tertiary enrollment rates as well as the quality of education as assessed by the business community.
4. Angola and Lebanon are excluded because of the lack of data for "Education" and "Innovation." Sweden and Vietnam are excluded for all regressions because the sample size is too small to be reliable.
5. The independent variable "choosing to wait," "present bias β," and "long-term discount" are transformed to percentile estimate to reduce the impacts of outliers. Larger value of the dependent variables imply higher degree of measured patience.

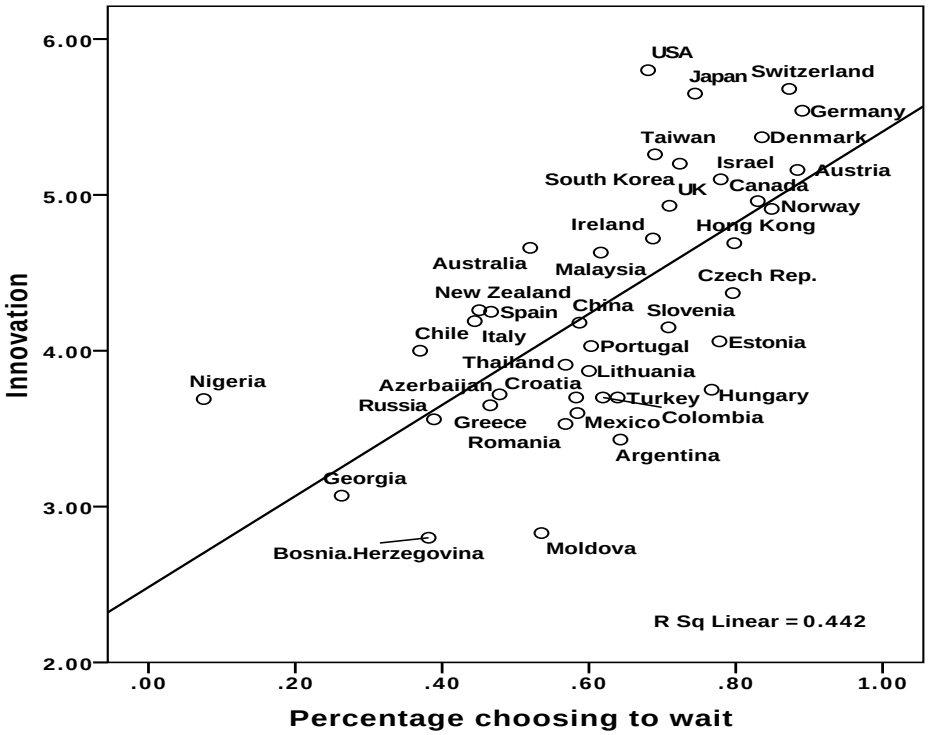

Figure 7: Tendency to Wait vs. Innovation Factor

Acknowledgements

We thank Volker Krätschmer and Herbert Dawid for their comments. We thank Julia Buge, Chun-houh Chen, Shiyi Chen, Wolfgang Härdle, Dana Liebman, Hersh Shefrin, Bodo Vogt, Xiao-Fei Xie, and numerous other people for generous help on data collection and translation. 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.

A Overview of all participated countries

			Implicit annual interest rate						
	Choosing to wait		One year		10 years				
Country		[rank]	Median	[rank]	Median	[rank]	N	Age (SD)	Males
Angola	54%	[32]	4.45	[39]	0.27	[24]	56	22.8 (2.18)	41%
Argentina	64	[20]	1.00	[23]	0.26	[14]	56	18.7 (0.90)	69%
Australia	52	[34]	0.14	[1]	0.26	[14]	144	21.1 (3.03)	51%
Austria	88	[2]	0.90	[16]	0.26	[14]	69	24.5 (3.37)	59%
Azerbaijan	48	[35]	4.00	[37]	0.48	[38]	112	22.0 (3.69)	64%
Bosnia and Herzegovina	38	[41]	13.58	[44]	0.71	[44]	74	21.1 (3.23)	53%
Canada	83	[6]	1.00	[23]	0.26	[14]	79	19.7 (1.18)	34%
Chile	37	[2]	4.00	[37]	0.26	[14]	100	21.0 (3.18)	61%
China	62	[26]	1.00	[23]	0.43	[35]	153	21.6 (2.30)	64%
Colombia	62	[22]	0.78	[15]	0.33	[30]	147	20.2 (2.13)	65%
Croatia	59	[28]	1.83	[33]	0.35	[32]	113	20.7 (2.28)	52%
Czech Rep.	80	[8]	0.67	[12]	0.26	[14]	49	20.9 (2.11)	45%
Denmark	84	[5]	0.50	[8]	0.26	[14]	73	23.1 (2.16)	66%
Estonia	78	[10]	9.00	[42]	0.58	[41]	125	19.2 (0.81)	34%
Georgia	26	[44]	149.00	[45]	0.86	[45]	38	21.1 (0.86)	58%
Germany	89	[1]	1.00	[23]	0.31	[28]	250	21.6 (2.38)	55%
Greece	47	[37]	2.50	[35]	0.56	[40]	57	20.7 (3.53)	28%
Hong Kong	80	[7]	1.00	[23]	0.30	[27]	99	20.1 (1.37)	43%
Hungary	77	[11]	0.71	[14]	0.26	[14]	261	20.5 (1.14)	44%
Ireland	69	[18]	0.50	[8]	0.26	[14]	193	20.7 (2.51)	52%
Israel	78	[9]	1.20	[30]	0.30	[26]	125	32.0 (9.23)	44%
Italy	44	[39]	1.00	[23]	0.35	[32]	81	20.5 (3.25)	37%
Japan	74	[12]	1.00	[23]	0.26	[14]	273	20.4 (1.51)	75%
Lebanon	71	[14]	0.32	[4]	0.18	[3]	99	19.9 (1.13)	48%
Lithuania	60	[25]	11.00	[43]	0.60	[42]	105	20.6 (1.78)	49%
Malaysia	62	[23]	4.00	[37]	0.47	[38]	98	21.7 (1.05)	25%
Mexico	58	[27]	1.20	[30]	0.33	[29]	89	20.5 (2.41)	60%
Moldova	54	[33]	2.00	[34]	0.45	[36]	99	21.2 (2.16)	57%
New Zealand	45	[38]	0.46	[8]	0.26	[14]	88	22.5 (3.98)	56%
Nigeria	8	[45]	1.50	[32]	0.42	[34]	89	26.3 (3.21)	50%
Norway	85	[4]	0.67	[12]	0.21	[4]	191	22.5 (2.55)	60%
Portugal	60	[24]	1.00	[23]	0.26	[14]	134	18.9 (1.36)	46%
Romania	57	[30]	7.33	[41]	0.67	[43]	336	21.2 (2.99)	22%
Russia	42	[40]	5.67	[40]	0.52	[39]	105	19.9 (2.12)	52%
Slovenia	71	[16]	1.00	[23]	0.29	[25]	95	22.2 (5.81)	44%
South Korea	72	[13]	0.70	[13]	0.25	[5]	104	23.1 (2.59)	69%
Spain	47	[36]	0.50	[8]	0.17	[2]	42	18.4 (0.53)	40%
Sweden	54	[31]	0.50	[8]	0.26	[14]	12	25.2 (4.02)	83%
Switzerland	87	[3]	1.00	[23]	0.26	[14]	437	21.6 (3.94)	67%
Taiwan	69	[17]	1.00	[23]	0.26	[14]	98	30.3 (7.60)	52%
Thailand	57	[29]	0.20	[2]	0.17	[2]	42	26.8 (2.33)	45%
Turkey	64	[21]	1.00	[23]	0.34	[31]	133	21.5 (1.36)	57%
United Kingdom	71	[15]	1.00	[23]	0.26	[14]	60	21.4 (1.58)	58%
United States	68	[19]	0.50	[8]	0.26	[14]	78	20.4 (1.61)	60%
Vietnam	33	[43]	0.25	[3]	0.26	[23]	8	29.4 (2.88)	43%
Total	66		1.00		0.30		5318	21.6 (3.94)	52%

B Parameter Estimates of Quasi-hyperbolic Discounting Functions

		β Present Bias				δ Long-term Discount Factor			
Country	Rank	Median	Mean	SD	Rank	Median	Mean	SD	N
Angola	[40]	0.20	0.51	0.49	[24]	0.83	0.83	0.14	49
Argentina	[24]	0.62	0.59	0.33	[18]	0.84	0.83	0.11	50
Australia	[3]	0.97	0.87	0.32	[25]	0.82	0.83	0.10	137
Austria	[20]	0.65	0.63	0.32	[8]	0.85	0.86	0.10	61
Azerbaijan	[36]	0.26	0.44	0.39	[40]	0.77	0.80	0.11	78
Bosnia and Herzegovina	[44]	0.08	0.32	0.44	[24]	0.77	0.82	0.17	63
Canada	[20]	0.65	0.65	0.30	[18]	0.84	0.83	0.11	69
Chile	[38]	0.24	0.44	0.43	[18]]	0.84	0.89	0.14	91
China	[28]	0.60	0.52	0.32	[40]	0.77	0.75	0.12	154
Colombia	[25]	0.61	0.59	0.44	[40]	0.77	0.80	0.14	133
Croatia	[34]	0.40	0.41	0.29	[27]	0.81	0.83	0.11	114
Czech Rep.	[16]	0.69	0.60	0.31	[9]	0.85	0.84	0.09	47
Denmark	[6]	0.78	0.82	0.29	[18]	0.81	0.82	0.10	73
Estonia	[43]	0.13	0.27	0.27	[40]	0.77	0.79	0.11	126
Georgia	[45]	0.01	0.01	0.02	[40]	0.88	0.89	0.19	36
Germany	[28]	0.60	0.60	0.35	[18]	0.84	0.83	0.11	241
Greece	[35]	0.38	0.41	0.31	[40]	0.77	0.78	0.10	54
Hong Kong	[17]	0.65	0.62	0.33	[32]	0.79	0.79	0.11	95
Hungary	[15]	0.69	0.64	0.31	[23]	0.84	0.84	0.09	254
Ireland	[8]	0.76	0.73	0.33	[11]	0.84	0.85	0.09	182
Israel	[18]	0.65	0.65	0.37	[26]	0.82	0.82	0.10	106
Italy	[22]	0.64	0.58	0.40	[33]	0.78	0.83	0.16	71
Japan	[14]	0.70	0.64	0.34	[5]	0.87	0.85	0.12	273
Lebanon	[5]	0.85	0.81	0.28	[2]	0.90	0.88	0.10	90
Lithuania	[42]	0.14	0.35	0.37	[40]	0.77	0.78	0.12	100
Malaysia	[37]	0.26	0.44	0.39	[40]	0.77	0.81	0.12	82
Mexico	[31]	0.55	0.50	0.35	[30]	0.80	0.82	0.10	84
Moldova	[33]	0.45	0.50	0.33	[40]	0.77	0.77	0.08	98
New Zealand	[8]	0.76	0.67	0.41	[18]	0.84	0.85	0.11	75
Nigeria	[32]	0.53	0.52	0.35	[40]	0.77	0.77	0.14	73
Norway	[12]	0.73	0.70	0.28	[3]	0.89	0.87	0.09	185
Portugal	[28]	0.60	0.86	2.69	[18]	0.84	0.85	0.16	123
Romania	[41]	0.15	0.23	0.21	[40]	0.77	0.76	0.11	321
Russia	[39]	0.21	0.44	0.41	[40]	0.77	0.77	0.14	145
Slovenia	[30]	0.56	0.57	0.33	[18]	0.82	0.84	0.09	94
South Korea	[10]	0.76	0.75	0.33	[10]	0.84	0.85	0.11	98
Spain	[11]	0.74	0.66	0.30	[1]	0.90	0.88	0.09	41
Sweden	[4]	0.85	0.81	0.20	[18]	0.84	0.86	0.09	13
Switzerland	[28]	0.60	0.59	0.37	[18]	0.84	0.83	0.10	432
Taiwan	[13]	0.70	0.60	0.38	[18]	0.84	0.84	0.14	98
Thailand	[2]	0.98	0.85	0.29	[8]	0.85	0.85	0.09	41
Turkey	[20]	0.65	0.58	0.32	[29]	0.80	0.80	0.10	129
United Kingdom	[23]	0.63	0.68	0.31	[6]	0.86	0.85	0.12	57
United States	[7]	0.78	0.69	0.40	[12]	0.84	0.82	0.11	71
Vietnam	[1]	0.99	0.93	0.18	[31]	0.80	0.84	0.09	8
Total		0.60	0.57	0.56		0.82	0.82	0.12	5015

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.

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.

Frederick, S. (2005), 'Cognitive reflection and decision making', *Journal of Econmic 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.

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 Deicision 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.

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. 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. (2007), Risk and time preferences: Experimental and household survey data from vietnam, Working paper, SSRN.

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.