Intertemporal Choice and Development Policy: Cross Country Evidence on Time Inconsistent Discount Rates

C. Leigh Anderson and Mary Kay Gugerty
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Abstract

Using original data from Vietnam and Russia, we find that individual’s discount rates change over time, replicating earlier results from the United States and Israel. We find that commonly held beliefs about gender differences do not hold, and that agricultural populations have higher discount rates, but that they vary less over time than their urban counterparts. We argue that these behaviors have important implications for the design of savings and credit programs, and that they are more likely to influence resource allocation in developing countries because there are fewer formal institutions and competitive markets to temper their effects.

Keywords: discount rates, credit, policy, comparative, Vietnam, Russia (JEL O20)

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I. Introduction
An array of daily choices force individuals to allocate resources intertemporally: borrowing money, consuming natural resources, immunizing their children, migrating. Accumulating evidence is challenging the standard economic models that assume individuals discount the future at a constant rate when making these decisions. This evidence documents a tendency for short run discount rates to exceed long run discount rates, implying that individuals may have difficulty sticking to plans, such as for savings or loan repayment. Much of the available evidence on individual discount rates is from the United States (US) and Europe; there is little comparable work from developing or transition countries. Yet, as we argue, widespread poverty and weak institutions make this debate particularly relevant to popular savings and credit programs that target poor populations in these countries.

Our goal in this paper is to increase the evidence available on discounting in a developing country context, to compare it to findings in industrial country settings, and to generate insights about how this relates to the design of financial programs. We have several interesting findings. We find that the time varying discount rates documented twenty years ago in the US and Israel also applies to much different populations in Vietnam and Russia. But, contrary to commonly held beliefs, there are no significant gender differences. We also find that although agricultural populations have higher levels of discount rates, these rates change less over time than do their urban counterparts. We argue that time varying behaviors have important implications for designing saving and credit programs, and that they are more likely to influence resource allocation in developing countries because there are fewer formal institutions and competitive markets to temper their effects.

II. Discounting the future
The intertemporal choice theories of the classical economists were based on propensities to exercise self restraint, imperfect foresight, and fashion, condensed, as Frederick, Loewenstein and O’Donoghue (2002) recount, into a single discount rate by Paul Samuelson in 1937 (Rae, 1834; von Bohm-Bawerk, (1891); Fisher (1930). In Samuelson’s model, preferences are expressed by a utility function in which
individuals discount the future at a single constant rate. These preferences imply that when individuals plan a future choice, such as postponing consumption in order to save, when the future arrives their preferences will not have changed. They will continue to prefer saving over current consumption, implying that their marginal rate of substitution across time periods is constant and independent of the time period.

Evidence suggests, however, that discount rates are not constant over time. For many people, short-run discount rates are higher than long-run discount rates, hence trading off present for future consumption becomes increasingly expensive as the future date approaches. People with time inconsistent discount rates, lacking perfect self control, may pursue short-run actions that they had previously calculated were not in their best long-run interest.

Time inconsistency has been discussed at length in the literature, and is illustrated here with a simple example (Strotz, 1956; Loewenstein and Elster, 1992; Loewenstein and Prelec, 1992; Laibson, 1997; O’Donoghue and Rabin; Laibson, 1997). The standard model of behaviour is characterized by a maximization problem with utility summed over a number of periods and discounted by the discount factor $\delta$:

$$U_t(u_t, u_{t+1}, \ldots, u_T) = \delta^0 u_t + \sum_{\tau=t+1}^T \delta^\tau u_\tau$$

where $\delta$ lies between 0 and 1. The exponential discount function $F(\tau) = \delta^\tau$ implies a discount rate that is independent of time.

A common approach to modelling time inconsistent preferences is to use what Laibson (1997) calls “quasi-hyperbolic” utility. The utility maximization problem with quasi-hyperbolic utility is given by:

$$U_t(u_t, u_{t+1}, \ldots, u_T) = \delta^0 u_t + \beta \sum_{\tau=t+1}^T \delta^\tau u_\tau$$

In this case, $\delta$ represents long-run, time consistent discounting, while $\beta$ represents a bias for the present over the future. When $\beta=1$, preferences follow exponential discounting but when $\beta<1$, a person gives more weight to period $\tau$ when it arrives than she gave it in any prior period; the short-term discount rate is higher than the long-term discount rate (O’Donoghue and Rabin, 1999).

With $\delta=1$, leaving only the time inconsistent parameter $\beta$, utility simplifies to:
An individual with $\beta=0.7$, for example, would be willing to forego a sum of money in the future for a sum of money now that is only 70 per cent as large. Consider that individual taking, for example, a $100 loan on January 1st and agreeing to pay back $120 in three equal increments of $40 on the first of each of the following three months. Assume that utility declines simply by the amount of the loan repaid, and that any missed payment is charged a 20 per cent interest penalty and extends the loan by an additional month. When February 1st arrives, however, the individual then compares their disutility from paying back the loan on time (-40), to delaying for another month $0.7(-40*1.20) = -33.6$. They would prefer to delay, and incur the higher future additional payment. When March 1st and April 1st arrive the story is the same. On May 1st, they are facing three payments of $48, which they would similarly prefer to delay and roll over as additional future debt. An interest penalty of more than 70 per cent is required for this individual to prefer adhering to their original plan.

The policy implications of time inconsistent discounting depend in part on whether individuals are ‘sophisticated’ or ‘naïve’ about their preferences (O’Donaghue and Rabin, 1999). A sophisticated consumer can anticipate her inconsistency and potentially construct institutional mechanisms to help bind her to a future course of behaviour. Such is the implicit motive behind Christmas clubs and 401(k) savings plans. A naïve consumer, on the other hand, will not anticipate her time inconsistency and therefore may continue to repeat behaviours she has previously judged not to be in her long–term interest. Program design can mitigate these behaviours, however, through voluntary and mandatory commitment measures. Time variant discounting therefore has important implications for the design of savings and credit programs, particularly in environments without institutional mechanisms to help align short and long run preferences.

**III. Evidence on discount rates across countries**

Richard Thaler (1981) published the first experimental study of inferred discount rates obtained using hypothetical questions. He asked University of Oregon students to state the amount of money they would require to either postpone a fine or...
expedite the receipt of lottery winnings, assuming no risk. Benzion, Rapoport and Yagil (1989) conducted a similar study a few years later in Israel, with students at the University of Haifa and the Technion-Israel Institute of Technology. Their questionnaire recorded choices over four scenarios that included postponing or expediting a receipt or payment, across different time delays and amounts.

We report on the amount that individuals would be willing to pay in order to delay the repayment of a loan since those are the results we replicate in our study. The results for postponing payments in the US and Israel are presented in Table 1, which shows the median inferred discount rate for the different payment amounts and time periods offered to students. In the US, students were asked to imagine they had just been issued a traffic fine and asked how much they would pay to delay payment for three months, one year or three years, with no chance of avoiding payment. In Israel, students were asked how much they would be willing to pay to postpone a debt repayment to a public institute by five months, one year, two years or four years. Both studies suggest that discount rates decline markedly over time. In addition, discount rates for gains were higher than for losses, and they varied inversely with the size of the delayed payment; the smaller the postponed payment, the higher the discount rate.

– Table 1 here –

Poulos and Whittington (2000) presented some of the first evidence on time varying discount rates in developing countries (Ethiopia, Mozambique, Bulgaria and Indonesia). Their survey asked respondent to make choices over hypothetical health programs that could save a certain number of lives this year, versus programs that would save more lives, but not until a given date in the future. They find evidence of much higher discount rates in developing countries than those reported for similar life saving choice questions in the US, and also find that discounts rates decline over time.

Our goal was to assess whether these patterns held in the financial context of the Thaler and Benzion et. al experiments but across very different populations in Vietnam and Russia. We broadened the sample, increased the sample size, and collected additional information on respondent characteristics.

In 2000, interviewers from the Vietnam Institute of Sociology randomly sampled 240 individuals from two communes near Hanoi city: the urban commune of Quynh Mai and the more rural commune of Thach Ban.² Both communes are average
in terms of size and economic activity, better off than more remote and highland villages, but less affluent than urban centers. The mean income in the sample was US $890 per year. The interviewers constructed a list of all commune members with the assistance of local officials, divided the names into three income groups (low, middle and high), and made a random selection from each group. These individuals were then invited to a meeting and given the choice of filling out the survey themselves or receiving assistance from the Vietnamese interviewers. The questions used sums of Vietnamese Dong (VND) 100,000, 1,000,000, and 4,000,000, and time periods of one day, three months, and one year. At the time of the study, US $1 was worth about VND 14,500, so the survey amounts were approximately $7, $70 and $276.

The 2002 data from Russia is from the municipalities of Irkutsk and Novosibirsk in Siberia. Novosibirsk grew to prominence during WWII when the Kremlin relocated its military-industrial complex and the Academy of Sciences to the area. With over two million inhabitants, Novosibirsk is Russia’s third largest city after Moscow and St. Petersburg, and the Soviet-era legacy is apparent culturally, physically and institutionally. Irkutsk lies further to the east, near the world’s largest fresh water lake, Lake Baikal, and has a history dating from the mid-1600s. In 1898 the trans-Siberian railroad added to its role as a trading post between central Asia and the far East. It is populated with small businesses, traders, and its 650,000 inhabitants are more ethnically mixed (Carver, 2003).

Faculty from the University of Washington, Siberian Academy of Public Administration, and Irkutsk State University supervised teams of Russian-speaking U.S. graduate students and Russian graduate students who administered the survey to over 1000 adults in the two municipalities. We used sums of Russian rubles (RUR) 1500, 6000, and 30000 for the same time periods of one day, three months and one year as the Vietnam study. At the time of the survey, US $1 was worth about RUR 30, so survey amounts were worth about US $50, $200 and $1000.

The surveys were jointly developed by US and Vietnamese or Russian colleagues, and subjected to repeated pre-tests. The usual objections to, and defences of, stated preference surveys apply here (Schwarz, 1999; List, 2001). Though respondents were likely inexperienced with questions about hypothetical tradeoffs, we have no reason to assume that the Vietnamese and Russian respondents have a particular difficulty that would bias their answers in a different direction than the earlier studies. How well stated preferences reflect real choices is relevant to our
policy applications, but should not affect the comparison among countries since all studies are using a similar stated preference survey instrument (Carson et. al. 2000; Binswanger, 1980). The evidence is mixed as to whether using cash financial incentives during surveying improves outcomes, but based on Camerer and Hogarth’s (1999: 8) review, in this particular experiment incentives are not expected to “change average behaviour substantively”. Hence in keeping with the earlier studies, respondents in Vietnam and Russia were not paid for their participation.

While we replicated the questions in earlier studies as closely as possible, certain features of our field setting necessitated adjustments. First, in both countries, pre-tests suggested that responses to hypothetical payments from public organizations (used in the US and Israel survey), may have been related to respondent feelings about those organizations. Instead of public and government organizations, therefore, questions were written using non-governmental organizations (NGO). Respondents were asked to imagine that they had the opportunity to receive a loan from a NGO and that they had the choice of paying back the loan immediately or postponing the payment to a later date, at which time they would have to pay back a larger amount.

Second, the time periods used for the questions differ from the earlier studies. In pre-tests we found that the discount rate for respondents in Vietnam and Russia fell to almost zero after three months; respondents were unable or unwilling to differentiate among longer time periods. Borrowing for periods as short as one day, however, was meaningful. A shorter planning horizon in poorer countries is consistent with other findings (Khayum and Baffoe-Bonnie, 1994). Finally, the US and Israel studies did not use the same amounts of money, precluding a common baseline amount across the four surveys. While these differences preclude cross country comparisons of discount rate levels, comparisons of discount rate patterns within countries remains valid.

The discount rates elicited by our surveys in Vietnam and Russia are shown in Table 2. Consistent with the earlier studies, discount rates are decreasing with time and with the amount of the loan offered. Also consistent with earlier findings, the change in the discount rates from the first to the second time period varies with the loan amount. The difference in the mean discount rate for each time period decreases over the two time periods and as the size of the loan increases, with all differences significant at five percent. The greater the size of the loan amount, the less dramatic
is the change in the discount rate from period one to period two, and period two to period three.

-- Table 2 here --

The standard deviation of responses was much larger in the US and Russian results than in Israel and Vietnam, and median, rather than mean values are reported. Thaler (1981) speculates that the high variation may be due to the hypothetical nature of the study or the age of the respondents, though he cites similar results in Hausman’s (1979) study which did not use hypothetical questions, and Benzion et.al. (1989) have a similarly young sample. But as Thaler points out, what matters is the relative, not the absolute levels.

Figure 1 graphically illustrates the patterns for the four studies. Despite field and experimental differences and despite the vastly different demographics and circumstances of the respondents, the patterns all show discount rates that vary over time, counter to the commonly employed constant discount rate model. Respondents’ discount rates vary inversely with the time horizon and the size of the cash flow.

-- Figure 1 here --

IV. Variance in discount rates within countries

Traditional discounted utility models treat time preference as given, yet empirical patterns have emerged that support the hypothesis of a relationship between certain demographic and socio-economic variables and discount rates (Poulos and Whittington, 2000; Holden et. al., 1998; Pender, 1996). Although the Thaler and Benzion et. al studies involve non-random, fairly homogenous groups and do not measure respondent characteristics, our Vietnam and Russia data allow an initial exploration of these relationships. We begin by briefly recounting some alternative theories and empirical evidence addressing the observation that “not all individuals are equally patient” (Becker and Mulligan, 1997: 731).

In the seminal article formalizing time inconsistency, Strotz (1956, 177) wrote: “My own supposition is that most of us are ‘born’ with discount functions…Children are known to discount the future most precipitously, and …true discount functions become sublimated by parental teaching and social pressure…” Following Strotz’s supposition, many theories of time preference posit that age, or life expectancy, will affect discount rates.
Fisher (1930: 73) asserted that “a small income, other things being equal, tends to produce a high rate of impatience.” Lawrence (1991) found evidence of this in the United States with discount rates identified from estimating consumption Euler equations. One interpretation of her results is that impatience leads to poverty: individuals with high rates of time preference choose jobs with low and flat pay scales rather than ones that pay well only after additional training or education. Alternatively, poverty breeds impatience from living at or near subsistence.

In their review of the historical writings on time preference, Becker and Mulligan (1997, 731) conclude that “patience seems to be associated with income, development, and education.” In support, Eisenhauer and Ventura (2006) find that youth, poverty, education, and low-skilled employment are all associated with hyperbolic discounting in a sample of 3237 individuals in Italy.

Becker and Mulligan (1997) model a constant discount rate, but endogenize time preferences by introducing “future-oriented capital” as a choice variable that involves spending current intellectual, time, and monetary resources to focus one’s attention on the future. In their model, the marginal benefit of investing in this capacity depends, among other things, on life expectancy and future utilities. Poulos and Whittington (2000) apply this analysis to derive a discount factor based on time preferences for life-saving programs that depends on current consumption and mortality risk. The probability of survival is a function of consumption levels that fall below a threshold level, leading them to hypothesize that discount factors (rates) are lower (higher) in less developed countries. Though their results reject time invariant discount rates, they are unable to uncover the expected relationships between rates of time preference and income, age, and education.

Conventional wisdom holds that women, on average, tend to be more patient and more risk averse, particularly towards losses (Ansic and Powell, 1997; Davies and Lea, 1995). A study of over eight thousand newspaper readers in the Netherlands found no gender differences in attitudes towards risk, but that women have higher discount rates than men (van Praag and Booij, 2003). These gender differences in time preference have not been found in developing country studies (Poulos and Whittington, 2000; Holden et. al., 1998; Pender, 1996).

Within countries, Poulos and Whittington (2000) are also unable to find a consistent relationship between discount rates and gender, marital status, and the number of children. When they pool their data and use country dummy variables,
however, the results suggest that there are omitted country factors that may drive discount rate differences. Consistent with other results that suggest the differential risks associated with whether an individual lives in an urban or rural environment matter (Loayza et. al, 2000; Holden et. al., 1998), we posit that the location of respondents within a country is one of these omitted variables.

Our data allow us to examine the extent to which discount rates are correlated with a variety of these socio-economic characteristics. We use multivariate analysis to examine the impact of age, income, gender and rural versus urban residence on the level of inferred discount rates within country samples using our intermediate time horizons. Descriptive statistics for the two samples are given in the appendix.

Table 3 reports the ordinary least squares regression results for Vietnam. Rural residence and lower incomes are associated with higher discount rates, indicating less willingness to trade off current for future consumption. The magnitude of the residency effect is relatively large: individuals who lived rurally in our Vietnam sample were associated with mean discount rates approximately twice those of their urban counterparts. Controlling for age, individuals without children were also more likely to have higher discount rates.

– Table 3 here –

Weighted least squares estimates for Russia are given in Table 4. To address the household income heteroskedasticity suggested by diagnostics of the original least squares estimation in this sample, we ran regressions with variance-weighted standard errors. Unlike in Vietnam, rural (village) residents in Siberia have lower discount rates than town and city dwellers, indicating higher levels of patience. Differences in the source of rural income between the two countries provide one potential explanation for these differences. Rural residents in Vietnam are more likely to be engaged in risky agricultural production, with highly variant income flows. In contrast, relatively reliable factory employment is a more common source of income in the Russian rural sample. Residents in and around Irkutsk, perhaps on average more familiar with regular borrowing and lending practices, have lower discount rates than their counterparts in Novisibirsk. Family size and income are not significant in the Russia estimate, nor is education, most likely because overall levels are high and there is little variation in the highest completed grade.
When we split the Russian sample by gender age becomes a significant factor, with older women associated with lower discount rates. Overall, however, we find a low level of model explanatory power for Russia, similar to Poulos and Whittington (2000). Our Russian data do not contain agricultural populations, and the stronger explanatory power of the Vietnam model may arise from the greater variance between levels of urbanization and the more agrarian basis of rural respondents in the data.

– Table 4 here –

From a welfare perspective, however, it is the change in discount rates, rather than the level, that affects the ability to stick to consumption and investment plans over time. Higher discount rates may suggest more “impatience,” but if discount rates are constant, short run and long run welfare from intertemporal choices will coincide. When discount rates change as a function of time, however, individuals have an incentive to reject earlier plans; for example, to renege on a loan repayment schedule.

To examine the prevalence of time variance and characteristics associated with it, we use the changes in discount rates over a one day to three month horizon in the Russia and Vietnam samples for the intermediate amounts of loan size. We define time variance as having a difference in discount rates between these two periods that is greater than 4 per cent, which includes about three quarters of each country sample. Table 5 reports the bivariate relationship between time variance and gender, and time variance and residence, using a chi-squared test for independence.

– Table 5 here –

Our results contradict some commonly held notions. First, we find no relationship by gender to the decline in discount rates over this period in either Vietnam or Russia. Although individuals who are agriculturally based have higher levels of discount rates, their discount rates change less over time than urban residents. In both Russia and Vietnam there is a positive and significant relationship between urban residence and time varying discount rates. In Vietnam, the majority of rural residents (68 per cent) have time preferences that change by 4 per cent or more, but this is still significantly lower than in urban areas (87 per cent). For Russia, the figures are 66 and 76 percent. Perhaps it is experience and the seasonal nature of
rural livelihoods that lead to short and long run rates that more closely coincide: the ability to imagine the future as Becker and Mulligan (1997) postulate. Urban residents, on the other hand, may have been able to survive with less self-control and foresight. Regardless, whether or not one has time varying discount rates depends on where one lives. We discuss the implications of these findings below.

V. Time variant discount rates and savings and credit programs

The widespread scaling up of microfinance and other types of savings and credit programs represents a significant opportunity to test the assertion that relatively minor programmatic adjustments based on behavioural insights could have quite major welfare impacts for poor consumers (Bertrand et al., 2006).

Standard economic theory views credit and liquidity as an unambiguous good. Credit can help smooth consumption, arbitrage discount rate and risk preference differences, and provide opportunities to invest or finance large purchases that can improve one’s livelihood and possibly break the “poverty trap.” This view assumes that individuals can only be made better off by increased access to credit, since they can always choose not to avail themselves of it. In the presence of time varying discount rates, however, the optimal borrowing and payback plan of individuals can change over time, creating repayment difficulties and unsustainable debt, even when individuals enter programs with the best of intentions.

The possible link between time inconsistency and debt has received some attention in the US context. Laibson’s et al. (2000) model of time inconsistency explains over two thirds of the gap between actual average American household credit card debt ($4,600) and that predicted with the standard economic model ($900). Problems arising from easy access to credit has been implicated in the sharp increase in personal bankruptcy filings in the US and Canada since 1980 (Ausubel, 1991). Yet there are few restrictions on lenders targeting individuals with demonstrated payback problems – the naifs in our analysis: “The fastest-growing credit issuers in the past five years have been companies that specialize in loans to borrowers with poor credit histories, the so-called ‘sub–prime’ market. Although losses are substantial, effective interest rates of eighteen to forty percent make this kind of lending profitable” (Warren, 1998: 1099). The current mortgage crisis in the US demonstrates both the individual and economy-wide implications of these lending strategies. And the evidence suggests these policies are spreading. Credit card companies are now
moving into developing country markets. Citibank, Visa and other consumer finance companies are competing for low income customers in Asia, using tactics such as lay away plans and sign up prizes. Spending on credit cards in Thailand is growing at approximately 27 per cent a year, where a Bank of Thailand official notes: “They are like fish; they come to eat, and bite the hook and can’t go anywhere” (Arnold, 2004).

Microfinance has until recently has been embraced as a tool of poverty alleviation, without much empirical scrutiny. The result has been a massive increase in the supply of capital for lending programs, with UNDP estimates that the microfinance sector has grown between twenty-five and thirty percent over the past five years. The remarkable repayment rates cited by many microfinance organizations suggest that time variant discount rates are not an issue and individual debt loads are sustainable. But as Mullainathan (2005) notes, observing individuals borrowing funds and paying them back is not the same as observing increases in welfare. A number of studies now suggest increased competition among microfinance institutions are associated with high levels of indebtedness and increased incidence of default (Vogelgesang, 2003). Many individuals are paying back loans with new loans; as microfinance institutions proliferate, the industry is increasingly worried about the incidence of such ‘cross indebtedness’ (European Microfinance Platform, 2006). Tales of debt recycling and the occasional borrower uprising are increasingly common (Morduch, 1999; Pearl and Phillips, 2001; and Wiedmaier-Pfister and Von Stauffenberg, 2001). Moreover, the high volume of loans required for lending organizations’ financial sustainability can lead commissioned loan officers to pressure potential customers to borrow (Rahman, 1999; Wright, 2001). Unsustainable debt can create crippling loads for poor individuals, especially individuals who are not living in countries with bankruptcy or other laws to provide a fresh start.

Some evidence suggests that discount rates are higher and more inconsistent among the poor (Harrison et. al., 2002; Shapiro, 2005; Ventura, 2003), though developing country studies have less routinely uncovered this relationship. This may stem from the extraordinarily difficult task of measuring income and wealth in places where informal exchange and in kind consumption abound, and where detailed and audited tax records do not. If we look at cruder measures that may capture threshold effects, relationships do emerge. If the Vietnam sample is divided into above and below median income groups, time varying discount rates are significantly dependent
on being in the lower income group. Dividing the Russia income data into deciles, reveals discrete changes in responses to questions about the demand for credit for the three deciles below RUR 4,000 (just under one third of mean income), compared to the seven deciles above RUR 4,000. Groups below RUR 4,000 respond negatively to questions asking for their interest in receiving credit, if they have received credit, their optimism about the future, and their risk taking attitude toward success.

It may be, however, that the relationship is between discount rates and relative poverty. There is considerable evidence that individuals assess their own well-being at least partially by the wealth of those around them (Easterlin, 1996; McBride, 2001). Even within a poor, rural commune in Vietnam, for example, members will distinguish between who is “poor” and who is not.

It may also be that in wealthier countries with more opportunities to move out of poverty, differences in self-control may more easily sort individuals, such that time inconsistent individuals are more likely to remain poor. Despite this, as Bertrand et al (2006) note, poorer individuals and households have quite narrow margins of error and seemingly ‘irrational’ behaviors may lead to larger welfare effects and worse outcomes. For many individuals in developing countries, these margins of error are life-threatening.

The development literature often subscribes to the view that women are better credit risks than men and are more likely to use credit to benefit their children:

“…women have a longer vision than men. Men are more likely to enjoy what they've got right away, and they are generally more impulsive. But a woman is more likely to have a very consistent vision for the future. She wants a better life and to build security for her and for her family” (Yunus, 2002: 374).

Yet our Vietnam and Russia results suggest that women’s discount rates are no less time variant than men’s, nor do they appear to have higher average rates, consistent with other studies (Ashraf et al, 2006; Eisenhauer and Ventura, 2006; Harrison et al., 2002). Rather it is having a family that is significant in Vietnam, and other results suggest that having children elicits the same incremental change in savings behaviour for both genders (Anderson and Nevitte, 2006). Thus, if differences in financial behaviours between men and women are indeed real, they do not appear driven by innate differences in discount rates.

There is mounting evidence that well-designed, and relatively simple, institutional mechanisms can help individuals make intertemporal choices that are
more in line with their long-term preferences. Shipton (1992) documents the use of 
“lock boxes” in Africa in which individuals hire carpenters to construct a box with no 
opening, except a small slit to push money through. Small amounts of money cannot 
be removed, except by smashing the box. Rutherford (1999) and others cite several 
commitment devices that villagers in East Africa use to stick to savings plans, 
including buying a lock box and throwing away the key, and using “money guards” 
who hold their savings. Deposit collectors are another way of tying one’s hands: in 
many countries individuals pay someone to collect and hold their savings for them 
(Robinson, 1994; Rutherford, 1999; Wright, 1999). Ashraf et. al. (2006) demonstrate 
that individuals are willing to open a savings commitment account with very limited 
withdrawals. Gugerty (2007) provides evidence from Kenya that women join rotating 
savings and credit associations because the group helps to provide a savings self-
commitment mechanism. In other cases, individual welfare can be improved simply 
by changing the ‘default’ policy or program option. Individuals might have to “opt 
out” rather than “opt in” to 401(K) and other retirement savings plans. In the US, 
Thaler and Benartzi (2004) show how default options increase savings levels in their 
Save for Tomorrow™ plan.

Voluntary mechanisms, however, will only work for “sophisticates” who 
anticipate their intertemporal behavior. Hence improving policy and programs 
requires some decision on what, if not revealed preference, the standard for welfare 
analysis is. Strotz (1956, 179) argued that the policy implications of time 
inconsistency implied uncomfortable compromises to consumer sovereignty. 
“…ought we allow people to behave imprudently?” Bank of Thailand officials have 
decided no, and have imposed a maximum interest rate on credit cards, raised the 
minimum income to own one, and tightened limits on how much debt a person can 
accumulate (Arnold, 2004). As Bernheim and Rangel (2005) note, when individuals 
choose sub-optimally low levels of savings, there may be welfare improving policy 
interventions, even in the absence of market failure: a subsidy for savings financed by 
a lump-sum tax can be welfare-improving since it provides first-order improvements 
for those with self-control problems, but has only a second–order effect on those 
without. Camerer et. al. (2003) suggest “asymmetric paternalism”: regulations that 
create large benefits for those who are not fully rational, but impose little or no harm 
on those who are.
Our data suggest that time varying discount rates are the norm in areas in Vietnam and Russia, typically in the very populations being targeted for easier access to credit. Many microfinance organizations seek to reach the “poorest of the poor” and target women. And because small loans require high volumes of lending for financial sustainability, microfinance is most widespread in denser, less rural areas. Our results imply these demographic distinctions may aggravate repayment problems: men and women demonstrate similar time varying discount rates, and the poor and urban dwellers more so. Accounting for these empirical realities in the design of saving and credit programs could have high payoffs in terms of savings mobilization and asset accumulation in these economies.
References


Figure 1: Graphical comparison of discount rate patterns
## Appendix: Descriptive Statistics/

<table>
<thead>
<tr>
<th></th>
<th>Vietnam Mean (s.d.)</th>
<th>Russia Mean (s.d.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discount rate for 3 months, intermediate monetary amount</td>
<td>0.009 (0.008)</td>
<td>0.033 (0.038)</td>
</tr>
<tr>
<td>Age</td>
<td>45.01 (11.3)</td>
<td>34.50 (12.63)</td>
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<td>Gender male =1</td>
<td>0.50 (0.50)</td>
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<td>12320 RUR (18266)</td>
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<tr>
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<td>Live in Irkutsk region</td>
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<tr>
<td>Family y=1 n=0</td>
<td>0.43 (0.50)</td>
<td></td>
</tr>
<tr>
<td>Household size</td>
<td></td>
<td>3.29 (1.34)</td>
</tr>
<tr>
<td>Number of observations</td>
<td>238</td>
<td>378</td>
</tr>
</tbody>
</table>
### Table 1
**Inferred discount rates – US (median) and Israel (mean)**

<table>
<thead>
<tr>
<th>Original amount</th>
<th>Discount rate when later amount paid in:</th>
<th>Original amount</th>
<th>Discount rate when later amount paid in:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>U.S.A.</td>
<td>Israel</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3 months</td>
<td>5 months</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 year</td>
<td>1 year</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3 years</td>
<td>2 years</td>
<td>4 years</td>
</tr>
<tr>
<td>$15</td>
<td>277</td>
<td>3.4</td>
<td>21.9</td>
</tr>
<tr>
<td>$250</td>
<td>73</td>
<td>26.0</td>
<td>16.7</td>
</tr>
<tr>
<td>$3000</td>
<td>62</td>
<td>21.7</td>
<td>15.5</td>
</tr>
<tr>
<td>$5000</td>
<td></td>
<td>15.3</td>
<td>10.5</td>
</tr>
<tr>
<td>N = 20</td>
<td></td>
<td>N = 204</td>
<td></td>
</tr>
</tbody>
</table>

### Table 2
**Inferred discount rates – Vietnam (mean) and Russia (median)**

<table>
<thead>
<tr>
<th>Original amount</th>
<th>Discount rate (%) when later amount paid in:</th>
<th>Original amount</th>
<th>Discount rate (%) when later amount paid in:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Vietnam</td>
<td>Russia</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 day</td>
<td>1 day</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3 months</td>
<td>3 months</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 year</td>
<td>1 year</td>
<td></td>
</tr>
<tr>
<td>$7</td>
<td>66.9</td>
<td>34.7</td>
<td>3.22</td>
</tr>
<tr>
<td>$70</td>
<td>33.5</td>
<td>34.8</td>
<td>2.44</td>
</tr>
<tr>
<td>$276</td>
<td>18.3</td>
<td>34.8</td>
<td>1.64</td>
</tr>
<tr>
<td>N = 232</td>
<td></td>
<td>N = 375</td>
<td></td>
</tr>
</tbody>
</table>

\[^a\text{sample lowered to 372 by excluding value responses implying a discount rate over 1000%}\]
<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Est. coefficient (standard error)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>0.018*** (0.002)</td>
</tr>
<tr>
<td>Age</td>
<td>2.96 E-005 (0.000)</td>
</tr>
<tr>
<td>Income</td>
<td>-1.11 E-009** (0.000)</td>
</tr>
<tr>
<td>Family, yes=1</td>
<td>-0.001** (0.001)</td>
</tr>
<tr>
<td>Gender, male =1</td>
<td>0.000 (0.001)</td>
</tr>
<tr>
<td>Live in rural area</td>
<td>0.007*** (0.001)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number Obs.</th>
<th>235</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adj R²</td>
<td>0.38</td>
</tr>
<tr>
<td>F-test</td>
<td>28.73, p &lt; .01</td>
</tr>
</tbody>
</table>

Note: Significant at ***1%, **5%, *10%.
## Table 4
### Socioeconomic Characteristics and Discount Rates in Russia

**Weighted OLS Estimation**

**Dependent Variable:**
Level of reported discount rate for delay of 6000 RUR ($200) for 3 months

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>(1)</th>
<th>(2) Female only</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td>-0.0001</td>
<td>-0.0003*</td>
</tr>
<tr>
<td></td>
<td>(0.0002)</td>
<td>(0.0002)</td>
</tr>
<tr>
<td><strong>Income</strong></td>
<td>-7.33e-08</td>
<td>-9.46e-08</td>
</tr>
<tr>
<td></td>
<td>(1.11e-07)</td>
<td>(3.49e-07)</td>
</tr>
<tr>
<td><strong>Household size</strong></td>
<td>0.0001</td>
<td>0.0006</td>
</tr>
<tr>
<td></td>
<td>(0.001)</td>
<td>(0.001)</td>
</tr>
<tr>
<td><strong>Male</strong></td>
<td>0.0001</td>
<td>0.0001</td>
</tr>
<tr>
<td></td>
<td>(0.004)</td>
<td>(0.004)</td>
</tr>
<tr>
<td><strong>Live in Irkutsk</strong></td>
<td>-0.01*</td>
<td>-0.012**</td>
</tr>
<tr>
<td></td>
<td>(0.005)</td>
<td>(0.005)</td>
</tr>
<tr>
<td><strong>Live in a village</strong></td>
<td>-0.010***</td>
<td>-0.012*</td>
</tr>
<tr>
<td></td>
<td>(0.004)</td>
<td>(0.006)</td>
</tr>
<tr>
<td><strong>Constant</strong></td>
<td>0.036</td>
<td>0.053</td>
</tr>
<tr>
<td></td>
<td>(0.009)</td>
<td>(0.012)</td>
</tr>
<tr>
<td><strong>Number Obs.</strong></td>
<td>378</td>
<td>196</td>
</tr>
<tr>
<td><strong>Adj. R²</strong></td>
<td>0.02</td>
<td>0.04</td>
</tr>
</tbody>
</table>

Note: Significant at ***1%, **5%, *10% level.
Results are weighted by the standard deviation of household income.
<table>
<thead>
<tr>
<th>Gender</th>
<th>Percentage of Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vietnam</strong></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>21</td>
</tr>
<tr>
<td>Female</td>
<td>23.5</td>
</tr>
<tr>
<td>Pearson $\chi^2$</td>
<td>0.218</td>
</tr>
<tr>
<td><strong>Russia</strong></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>25.3</td>
</tr>
<tr>
<td>Female</td>
<td>26.5</td>
</tr>
<tr>
<td>Pearson $\chi^2$</td>
<td>0.078</td>
</tr>
<tr>
<td><strong>Rural – Urban Location</strong></td>
<td></td>
</tr>
<tr>
<td>Vietnam</td>
<td></td>
</tr>
<tr>
<td>Rural</td>
<td>31.6</td>
</tr>
<tr>
<td>Urban</td>
<td>13.2</td>
</tr>
<tr>
<td>Pearson $\chi^2$</td>
<td>11.64</td>
</tr>
<tr>
<td>Russia</td>
<td></td>
</tr>
<tr>
<td>Rural</td>
<td>34.4</td>
</tr>
<tr>
<td>Urban</td>
<td>24.3</td>
</tr>
<tr>
<td>Pearson $\chi^2$</td>
<td>2.74</td>
</tr>
</tbody>
</table>

Note: Columns report the percentage of observations in each category. Individuals are defined as “time varying” if the difference between inferred discount rates for one day and three months is greater than 0.04. Amounts reported are for 1,000,000 VND ($US 70) and 6000 RUR ($US 200).
Endnotes

1 We use “time varying” as the general phrase for discount rates that change according to the time horizon an individual is considering, and reserve “time inconsistency” for the specific case when one’s discount rate for a future tradeoff changes with the proximity of that tradeoff.

2 Additional information and survey results are given in Anderson et. al, 2004.

3 Ensure a fully random sample in the Russian cities was difficult. Older Russians were often suspicious and reluctant to answer the door. One local official assigned staff to complete surveys. Enumerators discarded surveys that clearly violated randomization, but we would nonetheless exercise caution in generalizing our results across Russia.

4 High tax rates and illegal activity in Russia may have biased income responses.

5 There is a clear break in the data at 0.04 in both country samples; raising the threshold for time variance to 0.06 does not alter the results.

6 In 2001 the BBC reported on Bolivian microcredit borrowers, dynamite strapped to their bodies, taking hostages and demanding that their debts be cancelled.

7 73% of above median individuals compared to 87% of below median individuals, with χ² = 6.2, 1df, significant at ρ=.013.