Locus of Control, Hyperbolic Preferences, and Demand for Commitment and Savings: Evidence from Rural Ethiopia

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Abstract

We investigate the implications of individuals' locus of control on time preferences in general and hyperbolic preferences in particular. We also investigate the implications of locus of control and hyperbolic preferences on demand for commitment and savings. The empirical analysis is based on a series of hypothetical time preference questions and choice exercises conducted on Ethiopian rural farmers. We find that locus of control significantly predicts discounting behavior in general and hyperbolic preferences in particular. We particularly find that individuals with an external locus of control are more likely to discount future payoffs hyperbolically. We further show that locus of control and hyperbolic preferences significantly predict demand for commitment devices and savings behavior. We find that those individuals with an external locus of control and those discounting future payoffs hyperbolically exhibit a higher demand for commitment device. These results provide interesting insights that may help in designing poverty reduction policies.

Keywords: Locus of control, intertemporal choice, discount rates, hyperbolic discounting, demand for commitment devices, saving behavior, poverty.

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1. Introduction

Understanding individuals' time preferences (discounting behavior) is crucial in designing various economic and behavioral policy interventions that involve intertemporal choices. This is particularly appealing in the context of developing countries where behavioral biases and internal constraints are believed to perpetuate poverty (Bertrand et al., 2004; Mullainathan and Shafir, 2009; Banerjee and Mullainathan, 2010; Bernheim et al., 2015). Among these behavioral anomalies, hyperbolic discounting has been the subject of considerable debate in the recent literature (Ainslie, 1991; Loewenstein and Prelec, 1992; Laibson, 1997; O'Donoghue and Rabin, 1999; Frederick et al., 2002). Hyperbolic discounting is characterized by declining discount rates (or impatience) as the time of reward becomes increasingly distant in the future. Consumers characterized by hyperbolic discounting are expected to discount future rewards at a greater rate when the delay occurs sooner in time. Hyperbolic preferences entail several far-reaching policy implications related to various economic outcomes. Hyperbolic discounting may lead to underinvestment (Laibson, 1997), and a poverty trap in developing countries (Banerjee and Mullainathan, 2010; Bernheim et al., 2015).

While hyperbolic discounting has been an attractive avenue of research for some time, little is known about what might explain this anomaly in intertemporal choices. More specifically, despite some theoretical attempts, there is scant empirical evidence on what explains hyperbolic discounting behavior. Some earlier theoretical studies associate hyperbolic preferences with self-control problems (Laibson, 1997; O'Donoghue and Rabin, 1999), whereas another strand of theoretical literature shows that different sources of uncertainty about the future may trigger hyperbolic discounting behavior (Sozou, 1998; Dasgupta and Maskin, 2005; Halevy, 2008). For instance, Halevy (2008) shows that inherent lifetime uncertainties, including the risk of mortality and a potential breach of future rewards, may lead to hyperbolic discounting (declining impatience). Despite some evolving theoretical predictions, empirical studies on the implications of hyperbolic preferences and other types of dynamically inconsistent preferences are also limited.

Following the above two theoretical lines for explaining hyperbolic preferences, we can theoretically envisage a time preference model which is a function of individuals' level of uncertainty and self-control. Building on this conceptual framework in mind, we postulate a testable hypothesis on the implication of individuals' locus of control on time preferences in general and hyperbolic preferences in particular. Locus of control stands for "a generalized attitude, belief, or expectancy regarding the nature of the causal relationship between one's own behavior and its

consequences" (Rotter, 1966). People with a higher level of internal locus of control believe that life events and outcomes are defined by own actions, while individuals with a higher level of external locus of control tend to believe that life events are beyond one's control, rather being a matter of bad or good luck. Previous psychological studies argue that locus of control is intrinsically related to (and is one component of) self-control (Rosenbaum, 1980), although one can also intuitively associate it with lifetime uncertainties. In this study, we hypothesize that if self-control problems and uncertainties of different nature affect time preferences, individuals' locus of control can affect the way in which they discount intertemporal choices. Intuitively, individuals with an external locus of control are more likely to be those with self-control problems (Rosenbaum, 1980) or those who are uncertain about the future, and hence can be expected to discount future payoffs hyperbolically.

We hypothesize that individuals' locus of control may predict their discount rates and the way in which they discount future payoffs. We aim to empirically test this hypothesis by combining a series of hypothetical time preference choice exercises and detailed observational data on individuals' locus of control. To our knowledge, this is the first empirical attempt to investigate the implications of individuals' locus of control on intertemporal choices and discounting behavior. Beyond explaining hyperbolic preferences and other dynamic inconsistencies in time preferences, we also aim to explore the implications of locus of control and hyperbolic preferences on individuals' demand for commitment and saving behavior. Thus, this study provides a two-fold contribution to the existing literature on individuals' intertemporal choice behavior and their implications. First, we empirically investigate the implications of individuals' locus of control in terms of predicting behavioral anomalies in intertemporal choices, particularly hyperbolic discounting behavior. In doing so, we provide new empirical evidence that may complement previous theoretical models that link self-control, uncertainty, and hyperbolic discounting. Second, we further examine the link between locus of control, hyperbolic preferences and individuals' demand for commitment and saving behavior. Thus, our study also provides further behavioral explanations for demand for commitment devices and saving behavior in the context of rural economies. In this respect, Ashraf et al. (2006) is closely related to our study as they show the implication of hyperbolic preferences on demand for commitment devices. Our study is also related to previous studies that highlight the benefits of non-cognitive skills (locus of control), on various economic outcomes, including human and physical capital investments (Coleman and DeLeire, 2003; Heckman et al., 2006; Cobb-Clark et al., 2013; Caliendo et al., 2015).

Our empirical analysis is based on a rich household survey and several hypothetical survey-based time preference questions and choice exercises conducted in a developing country context, on Ethiopian rural farmers. We elicit individual discount rates using a relatively simple multiple price list (MPL) procedure, which is commonly used in the existing literature (Binswanger, 1980; Coller and Williams, 1999; Harrison et al, 2002; Cole et al., 2013; Hill et al., 2013). We elicit farmers' locus of control using Rotter's (1966) scale with a contextualized list of 10 items (questions) that measure farmers' degree of perceived control over their life events.

We start the empirical analysis by characterizing individual discount rates, and hence showing that a good share of the farmers in our sample exhibit preference reversals that can be characterized by hyperbolic discounting. We further investigate the link between farmers' locus of control and these preference reversals, hyperbolic discounting behavior. Our findings show that locus of control significantly explains hyperbolic discounting behavior. Those farmers with an external locus of control (or a greater degree of it) are more likely to discount future payoffs hyperbolically. This is consistent with earlier theoretical studies that associate hyperbolic preferences with self-control problems, as well as with those recent studies that link lifetime uncertainty and hyperbolic preferences. We also find that those farmers with an external locus of control (or greater degree of it) and those with hyperbolic preferences have a higher demand for commitment devices. We finally find that farmers with an internal locus of control are more likely to save and more so, while the reverse is observed for those with an external locus of control. These findings have important implications in terms of understanding the implication of individuals' personality traits associated with their locus of control on intertemporal decision making behavior. Our results suggest that improving individuals' non-cognitive skills (psychological capital) can enhance their intertemporal choices and planning behavior, including demand for saving. The results particularly highlight the potential of behavioral instruments and commitment devices to improve saving behavior in developing countries (see also, Ashraf et al., 2006; Brune et al., 2016). Intuitively, these instruments may address poor households' behavioral biases and internal constraints, and hence alleviate ''behavioral poverty traps'' (Banerjee and Mullainathan, 2010; Bryan et al., 2010).Our results also provide some insights for microfinance institutions and savings cooperatives which are striving to mobilize domestic savings among rural households.

2. Concepts, Data and Survey Design

2.1 Locus of control and intertemporal choices

Considering the two theoretical explanations for hyperbolic discounting in the existing literature on time preferences, i.e., self-control and uncertainty, we can envisage a general conceptual time preference model that combines self-control problems (e.g., Thaler and Shefrin, 1981; Laibson, 1997; O'Donoghue and Rabin, 1999) and some form of uncertainty (e.g., Dasgupta and Maskin, 2005; Halevy, 2008). One could take this conceptual framework to empirically test the implication of self-control and uncertainties on intertemporal choice behavior. In this study, we are interested in examining the implication of individuals' locus of control, a psychological concept that is closely related to self-control and uncertainty, on intertemporal choice behavior. Psychologists argue that locus of control is one component of self-control (Rosenbaum, 1980) and the items commonly used to elicit individuals' locus of control are included in Rosenbaum's (1980) index of self-control. In particular, external locus of control is associated with low level of self-control (Rosenbaum, 1980). Some of the items commonly used to elicit individuals' locus of control may also capture perceived uncertainties about life events. Thus, we hypothesize that locus of control may influence intertemporal choice behavior through self-control and uncertainties about life events. We expect that individuals with an external locus of control, those with self-control problems or those who are uncertain about the future, are more likely to discount future payoffs hyperbolically.

In a slightly different perspective, poverty may affect individuals' locus of control and hence mediate the implication of locus of control on intertemporal choices. One may reasonably argue that individuals with external locus of control are poorer than those with an internal locus of control. Despite this potentially intuitive but unexplored link, recent studies propose general and specific channels through which poverty can affect intertemporal choices (Bertrand et al., 2004; Mullainathan and Shafir, 2013; Bernheim et al., 2015). Mullainathan and Shafir (2013) argue that poverty imposes substantial ''psychic costs'' which can imped individuals' cognitive functioning and decision making behavior, a process that may pronounce behavioral biases among poor households. Bernheim et al. (2015) theoretically show that poverty may also exacerbate individuals' self-control problems. More specifically, Haushofer and Fehr (2014) argue that poverty may involve psychological consequences that can affect individuals' time preferences and risk-taking behavior.

Although we are not aware of previous studies on the implication of locus of control on intertemporal choices, there are some indirect pieces of evidence that may lead to our hypothesis. For instance, some studies show that individuals with an internal locus of control are associated

with higher investment decisions, including human capital investment (Coleman and DeLeire, 2003; Heckman et al., 2006). Coleman and DeLeire (2003) incorporate individuals' locus of control in human capital investment decisions, arguing that differences in individuals' locus of control enter the human capital investment model by affecting the subjective probability of success of a specific investment type.

2.2 Data and survey design

The data we use here come from a randomized control trial conducted to evaluate the demand for weather index-based crop insurance in Ethiopia, collected by the International Food Policy Research Institute (IFPRI) and the University of Oxford. The randomization (and associated household survey) covers four *woredas* (districts) in Oromia region of Ethiopia, namely *Adama*, *Shashemene*, *Dodota*, and *Bako-Tibe*.[1] A total of 110 villages were randomly selected, from which 2,400 rural households were randomly selected. However, since the randomizations were made for a different purpose, it only provides us a random sample of households, and not random variation in locus of control. The survey we use here (baseline survey) was conducted in February–March 2011.[2] The survey extracted rich information on household demographic and socioeconomic characteristics.

The household survey employed a series of hypothetical questions to elicit farmers' behavioral decisions, including time preferences and risk aversion. The survey also extracted self-reported information on various behavioral attributes of farmers, including locus of control, self-reported measures of wealth, liquidity constraint, and levels of trust in various agents. As we are interested in individuals' behavior, we focus on household heads, excluding cases in which the respondent is not the household head. Following a common practice in experimental economics (Coller and Williams, 1999; Harrison et al., 2002; Holt and Laury, 2002; Dohmen et al., 2011), the survey employed simple but standard choice problems to elicit individual discount rates and risk preferences.[3] Due to the large size of our sample and related logistical reasons, we employed (hypothetical) survey-based questions rather than incentivized experimental methods. These

[1] These four sites are located close to each other (see, Berhane et al., 2013, for further details about the sampling design).

[2] Three follow-up surveys were added in later years. However, the information about time preferences and risk aversion is only complete in the baseline survey. For this reason, we use the first survey in this study. But we also exploit some information from these follow-up surveys to corroborate some of our findings.

[3] Simplifying the survey design and choice sets is crucial in our context as our respondents are rural household heads with limited education (Chuang and Schechter, 2015).

hypothetical survey-based questions are widely employed (Binswanger, 1980; Coller and Williams, 1999; Dohmen et al., 2011; Cole et al., 2013; Hill et al., 2013; Bernard et al., 2014). Previous studies have shown that properly-implemented survey-based questions can plausibly, and comparably with incentivized experiments, capture real-world behaviors (Dohmen et al., 2011; Falk et al., 2015a, 2015b; Lönnqvist et al., 2015; Ubfal, 2016).

2.3 Eliciting time and risk preferences

A simple survey-based multiple price list (MPL) procedure is used to elicit individual discount rates. Respondents were asked to choose between 100 Birr today and 100+*X* Birr (where *X* is some positive amount) after a month.[4] If a respondent chooses to take 100 Birr today, we infer that the individual's monthly discount rate is greater than *X* percent. Otherwise, if a respondent chooses 100 + *X* Birr after a month, we can deduce that his/her monthly discount rate is *X* percent or less. Based on this standard setting, we considered both varying levels of *X* and varying due dates (delay) for payments. In the first hypothetical experiment (choice exercise), we started from *X*=25 and sequentially increased it, holding the same due dates of today and a month later. If a farmer chose 100 Birr today over 125 Birr after a month, we inferred that the discount rate is greater than 25 percent. To obtain a closer rate, we asked a follow-up question, by increasing the amount after a month to 150 Birr. If the respondent chose 150 Birr after a month, we recorded a discount rate of 25–50 percent per month, exclusive of the lower bound. For those respondents who still chose 100 Birr today over 150 after a month, we asked how much he/she would have to be given in one month to choose to wait. We then recorded the amount and generated additional discount rate categories based on these values. Table 1 provides the details of the two (hypothetical) choice exercises and corresponding discount rates.

In the second experiment (choice exercise), we changed the due dates (delay) of the payoffs, retaining the same time difference of one month between payoffs, to investigate whether time preferences are dynamically stable. Thus, we offered respondents similar options, keeping the one month time gap and changing the time from today to 13 months from now. That is, we posed choice sets involving 100 Birr in 13 months and 100+*Y* (where *Y* assumes the same values as *X* in the first experiment) in 14 months. Similarly, for those choosing 100 Birr in 13 months over 125 Birr in 14 months, we increased the amount offered in 14 months to 150 Birr. Note that in both choice exercises we have the same time difference of one month between the immediate payment

[4] Birr is the Ethiopian currency and 1 USD ≈ 17 Birr during the survey year.

and the second payment choice. To assess the stability of time preferences, we compare the discount rates given by *X* and *Y*, and hence generate indicator variables for individuals discounting future payoffs exponentially or hyperbolically. The values of *X* and *Y* are not exact discount rates, but rather are upper bounds of these true discount rates. This is of little importance in our empirical setting as we are interested in comparing *X* and *Y* rather than estimating true discount rates. *Y* should be less than *X* for those individuals discounting future payoffs hyperbolically.

Table 1: Details of the Hypothetical Time Preference Questions and Choice Exercises

	Hypothetical choice exercise (experiment) 1			**Hypothetical choice exercise (experiment) 2**		
Payoff types	Payment option A (pays today)	Payment option B (pays in a month)	Monthly discount rate	Payment option A (pays in 13 months)	Payment option B (pays in 14 months)	Monthly discount rate
1	100 Birr	125 Birr	0–25%	100 Birr	125 Birr	0–25%
2	100 Birr	150 Birr	25–50%	100 Birr	150 Birr	25–50%
3*	100 Birr	150–300 Birr	50–200%	100 Birr	150–300 Birr	50–200%
4*	100 Birr	>300 Birr	>200%	100 Birr	>300 Birr	>200%

Notes: The ranges for the monthly discount rates exclude lower bounds.* The 3rd and 4th alternatives are extracted from respondents' responses when asked to state how much they would like to be given to choose to wait an additional month over 100 Birr immediately/sooner than a month.

Our respondents are rural household heads thought to be current budget (credit) constrained, which may affect the way in which they discount future payoffs. Controlling for liquidity constraint and (expected) wealth conditions may also help us capture (characterize) time-varying discounting behavior and related reversals (see, Halevy, 2015; Janssens et al., 2016). Thus, our survey also posed a series of questions aimed at capturing farmers' level of liquidity constraint, self-reported wealth status and cognitive ability. For instance, to elicit famers' liquidity constraint, we started by asking them the following question: "*If your household needed X Birr for an emergency, could the household obtain it within a week?*". By changing the values of *X* in the above question, we generate a three-level ordered measure of farmers' liquidity (credit) constraint, ranging from ''no liquidity constraint'' up to ''high level of liquidity constraint''. The survey also asked respondents' previous experience of shocks and their type, information that might help us capture the impact of shocks in explaining some of the anomalies in intertemporal choices.

To elicit individuals' risk preferences, respondents were given alternative (hypothetical) gambling choices with some involving progressively increasing risk levels (see, Holt and Laury, 2002; Dohmen et al., 2011). Individuals are supposed to choose among the multiple list items that show varying levels of risk. These options are framed in a contextual setting and involve substantial (hypothetical) payoffs for farm products. Respondents are offered five choices concerning a

hypothetical bag of maize they want to sell in a market, and these five level choices start from a safe option that yields 250 Birr up to a risky option that offers the potential for 1,000 Birr or 0 Birr, each with 50 percent probability. From these choices, we simply generate a five-level ordinal ranking of individuals' risk aversion.

2.4 Eliciting locus of control

We employed Rotter's (1966) scale (and the commonly employed items) to elicit farmers' responses concerning their internal and external locus of control. These items have been widely employed in previous studies that investigate the implication of individuals' locus of control in relation to various outcomes (Coleman and DeLeire, 2003; Heckman et al., 2006; Caliendo et al., 2015; Krutikova and Lilleør, 2015).[5] We employed contextually appropriate ten items from Rotter's scale, a list of these questions and associated descriptive statistics are given in Table A1 (in the Appendix). For each item respondents were asked to provide their responses on a four-level scale indicating agreement/disagreement.

Although we have some premises on which of these ten items measure internal and external locus of control, we employ factor analysis to confirm our a priori assumptions. Consistent with our expectations, factor analysis shows that the first four items load onto one factor, which we interpret as "internal locus of control", while the last six items load onto another factor, which we denote "external locus of control". Figure A1 (in the Appendix) plots the factor loadings of these ten items on the two factors. One example of the items (statements) capturing internal locus of control is: "*My life is determined by my own actions*". One of the items related to external locus of control is: "*To a great extent, my life is controlled by accidental/chance happenings*". Using iterative principal factor analysis, we construct two different indices for internal and external locus of control (for the distribution, see Figures A2 and A3 in the Appendix). We employ these indices in our regressions characterizing time preferences and related behavioral outcomes of interest. Such factor analysis has been used in many studies aiming to investigate the implications of locus of control on various behavioral outcomes (Coleman and DeLeire, 2003; Heckman et al., 2006; Caliendo et al., 2015; Krutikova and Lilleør, 2015). In some our robustness exercises, we also use the raw values for each item separately to confirm the empirical regularities established using the indices constructed by the factor analysis (see Table 8).

[5] These items have also been commonly used to elicit individuals' locus of control in many surveys in Sub-Saharan Africa, including in Ethiopia.

2.5 Eliciting demand for commitment device and saving behavior

We elicited farmers' demand for commitment by offering a hypothetical commitment device (product) that could help them alleviate their self-control (temptation) problems. This product is contextually framed and farmers are asked about their demand and willingness to pay for this product. Respondents are asked whether they would like to have a locked box in which to put their money, but they will have to travel to the nearby microfinance (or bank) to get it opened. Respondents are informed that by putting their money in this locked box they are adding some barriers and difficulties in terms of spending their money. In rural Ethiopia, where banks and other modern saving commitment devices are limited, the locked box is often used by rural households and is believed to serve as a commitment device to alleviate farmers' self-control/temptation problems.[6] This commitment device is similar to what is used by Ashraf et al. (2006), and Dupas and Robinson (2013). In addition to their demand for this locked box, respondents were also asked whether they are willing to pay for it and if so, the maximum amount. By doing so, we not only characterize farmers' demand for a freely available commitment device but also a more realistic demand for a product that involves some (hypothetical) cost.

We elicited farmers' saving behavior by directly asking whether they typically save or not, and how much they have saved last month.[7] Such self-reported measures of saving behavior are commonly employed in many countries where register-based saving rates are not available (see, e.g., Falk et al., 2015a, 2015b). Although there might be discrepancies between self-reported savings behavior and actual savings, we believe that the former can be a valid proxy and predictor of the latter.

Farmers' demand for commitment devices and saving behavior are expected to be correlated with their access to saving instruments, their knowledge about these instruments, and trust in financial institutions. Thus, we also attempt to capture farmers' access to saving instruments. The household survey elicited farmers' access to saving in rural saving cooperatives, their affiliation with other saving groups, such as *equib*, and whether they have bank accounts from a microfinance or other financial institution.[8] Exploring the association between these indicators of farmers' access to savings and their self-reported saving behavior may also help probe the power

[6] However, it is worth noting that although convenient and safe for deposits, the locked box provides no (weak) physical barrier as it can easily be broken.

[7] The latter measure is extracted from a follow-up survey as this is missing in the baseline survey. For this reason, the sample size for this variable is slightly smaller compared to the baseline sample.

[8] *Equib* is a form of "rotating credit and saving association" in Ethiopia, through which each member periodically contributes small sums to attain one large sum at some point in the future.

and relevance of the latter measures. Our survey also elicited farmers' subjective levels of trust in various agents. This information may shed light on the relationship between trusting and discounting behavior. Individuals' trust in various agents might also correlate with their locus of control, time preferences, and saving behavior. In particular, if uncertainty about future payoffs drives some of the large discount rates we observe in many studies, individuals' trust in various agents may also explain discounting behavior. To explore this, our survey contained a series of items eliciting respondents' levels of trust in various agents and institutions. Following some previous practices of eliciting trust levels (Tu and Bulte, 2010; Siziba and Bulte, 2012), we elicited individuals' "generalized trust" level using the statement: "*Most people can be trusted*", to which respondents indicated the extent of their agreement/disagreement on a four-level scale ranging from "strongly disagree" (assumes trust level 1) to "strongly agree" (assumes trust level 4). Similarly, respondents' trust in financial institutions was captured using agreement/disagreement with the statement: "*Most financial institutions can be trusted to offer good financial advice and services, and they keep money securely*".

3. Descriptive Statistics

Table 2 provides summary statistics of the characteristics of respondents in our sample. The table shows that around 85 percent of the respondents are male household heads and the average family size is 6, while the average land size amounts to 1.4 hectares. The average age of respondents is 43 years and most households have limited education, with an average education in the sample of 2.7 years of schooling.

Table 2: Summary Statistics of Sampled Households and Key Variables

Explanatory variables	Mean	Standard deviation
Demographic characteristics		
Gender (1=male)	0.851	0.356
Age (years)	42.506	14.393
Highest educational grade (years)	2.720	3.164
Household size	5.910	2.342
Religion: Muslim	0.490	0.500
Religion: Orthodox	0.286	0.452
Religion: Protestant	0.207	0.405
Social capital (number of people to rely on in time of need)	4.988	7.630
Religiosity (number of times attending religious gatherings)	8.779	14.696
Financially literate	0.305	0.461
Liquidity constraint level	1.090	0.846
Socioeconomic characteristics		
Self-reported relative wealth (1=poorest, 7=richest)	3.562	1.098
Land owned in hectares	1.372	1.477
Value of livestock owned (Birr)	8550.950	9559.432
Exposure to shocks		
Covariate shocks in the last 10 years (1=yes)	0.834	0.372
Idiosyncratic shocks in the last 10 years (1=yes)	0.432	0.495
Risk preferences and trust levels		
Risk aversion (five-level scale)	2.830	1.528
Generalized trust	2.411	0.790
Trust in financial institutions (institutional trust)	2.888	0.702
Access to saving instruments		
Access to saving services from rural cooperatives	0.038	0.191
Access to microfinance (have bank account)	0.069	0.253
Membership of *equib*	0.086	0.281
Number of observations	2056	

Notes: This table provides descriptive statistics of the explanatory variables considered in the analysis. The first column presents mean values while the second column reports standard deviations.

In Table 3 (Panel A), we provide the distribution of discount rates for both time preference (choice) exercises. In Panel B of this table, we report other outcome variables related to the time preferences in Panel A. The overall distribution of discount rates in Table 3 is comparable to those in previous studies based on Ethiopian rural farmers (see, Hill et al., 2013). We can see that 34 percent of the respondents choose 125 Birr over 100 Birr in the first choice exercise, while the corresponding figure for our second time preference exercise, the one that contrasts 100 Birr in 13 months and 125 in 14 months, is 53 percent. This shows that a good share of respondents exhibit preference reversal, implying declining impatience (present bias). The distribution of the discount

rates declines sharply when we move down to higher discount rates, especially for the second time preference experiment.

By comparing respondents' discount rates in the first and second choice exercises, we generate indicator variables for farmers discounting future payoffs exponentially or hyperbolically. The indicator variable for exponential discounting in Table 3 shows that 59 percent of the respondents exhibit constant discounting behavior, while 31 percent of our respondents exhibit hyperbolic discounting behavior. This evidence may highlight that most of our respondents discount future payoffs exponentially, while another good share of our respondents discount hyperbolically. This is consistent with the view that time preferences are stable for some groups of individuals, but inconsistent for some other groups (Harrison et al., 2002). Empirical identification of the type of individuals who discount future payoffs hyperbolically or exponentially is a potential avenue that needs further research, and is one to which this paper aims to contribute. However, another 10 percent of the respondents in our sample exhibit ''preference reversals'', which may apparently imply increasing impatience (or that they are making noisy choices). Previous studies in India (Bauer et al., 2012), Kenya (Dupas and Robinson, 2013), and the Philippines (Ashraf et al., 2006) report comparable figures on this type of reversal (or inconsistency). We postulate several explanations for this, including noise in survey responses, respondents' cognitive ability to understand the choice sets, and credit constraints (see, Ashraf et al., 2006, for similar explanations).

As expected, Table 3 indicates considerable demand for commitment device, showing that around 83 percent of the respondents in our sample would like to get the locked box, while 75 percent are willing to pay for it. These rates are comparable to those reported by Ashraf et al. (2006) for a similar commitment device (locked box) in rural areas of the Philippines. In our context, this may reflect the fact that rural households in developing countries face substantial barriers to saving and hence are willing to engage in reasonably costly saving practices (Rutherford, 2000). Respondents' average maximum willingness to pay for the locked box is also comparable to the market price of the locked box service provided by microfinance institutions in Ethiopia. Table 3 also shows that a large share of our respondents do make some form of savings, although the average monthly saving is low (173 Birr). Given the nature of the question used to elicit saving behavior, we have no information about the nature and purpose of these savings.

Table 3: Distribution of Time Preferences and Related Outcome Variables

Panel A: Distribution of Discount Rates		
	Hypothetical Experiment 1	**Hypothetical Experiment 2**
Monthly discount rates	Distribution of sample (%)	Distribution of sample (%)
0–25%	34.192	52.558
25–50%	21.409	19.614
50–200%	24.526	14.183
>200%	19.874	13.645
Panel B: Related Outcome Variables of Interest		
	Mean	Standard deviation
Respondent discounts exponentially	0.589	0.492
Respondent discounts hyperbolically	0.308	0.462
Respondent exhibits "increasing impatience"	0.104	0.305
Demand for commitment device (locked box)	0.829	0.377
Willing to pay for commitment device	0.752	0.432
Maximum amount (Birr) willing to pay	32.098	33.704
Self-reported saving behavior(1=yes)	0.686	0.464
Average savings last month (Birr)	172.819	594.792

Notes: The ranges for the monthly discount rates exclude lower bounds. Respondents are assumed to discount future payoffs exponentially if the discount rates in both scenarios are the same (or in a similar range). Respondents are assumed to discount future payoffs hyperbolically if the discount rate in the first experiment is greater than in the second, while the reverse holds for increasing impatience.

4. Estimation Results and Discussion

Empirical identification of the potential channels we discussed in Section 2.1 involves several empirical challenges. Despite these intuitive channels, quantifying the effect of locus of control on discounting behavior suffers from endogeneity problems arising from omitted behavioral attributes that might affect both individuals' locus of control and time preference. Such empirical identification may also suffer from reverse causality problems. For instance, the intricate relationship between poverty, self-control and cognitive functioning (Mullainathan and Shafir, 2013; Haushofer and Fehr, 2014; Bernheim et al., 2015) may confound the implication of locus control on intertemporal choices and related outcomes. However, given that we control for a large set of observables about farmers' socioeconomic status, we believe that our estimates may inform the direction of causality in the relationships between locus of control and discounting behavior. That said, the associational evidence between locus of control and intertemporal choice behavior offers useful insights to our understanding of the complex relationships at hand.

To start characterizing the discount rates in Table 3, we run simple ordered probit regressions, the estimates of which are shown in Table 4.[9] In the first two columns of Table 4, we regress the discount rates from the first (hypothetical) time preference experiment on farmers' locus

[9] Although the discount rates are intervals and hence more suited to interval regression, we can also consider these rates as ordinal outcomes, particularly given the fact that we are interested in explaining discount rates.

of control, risk preferences, and trust levels, as well as the demographic and socioeconomic characteristics of farmers. In the last two columns of Table 4, we regress the discount rates from the second (hypothetical) time preference experiment on the same attributes of farmers. This characterization helps us to identify potential factors that may lead to preference reversals.

The results in Table 4 provide interesting associations between discounting behavior and various observable characteristics of farmers. Farmers' behavioral attributes, including locus of control, risk preference, and trust levels, significantly predict time preferences. More interestingly, these behavioral attributes have different and sometimes contrasting implications in the two time preference experiments. We can observe that farmers with an external locus of control (or a greater degree of it) are more likely to discount future payoffs heavily if the alternative payoff is immediate (first scenario), while the reverse happens when the alternative payment is not immediate (second scenario). This is not the case for farmers with an internal locus of control, although they seem to have slightly lower discount rates in the second experiment. In line with our hypothesis, the results reasonably that locus of control explains discounting behavior. These estimates remain robust when we include a large set of demographic and socioeconomic characteristics of respondents.

The results in Table 4 also show that risk aversion and trusting behavior are associated with lower discount rates, particularly for the time preference experiment involving immediate payoff. Risk aversion is associated with lower monthly discount rates in the first experiment, but is almost insignificant in the second experiment. The former result is consistent with previous evidence (Anderhub et al., 2001; Sutter et al., 2013). Farmers' level of trust, particularly generalized trust, also significantly predicts time preference in the first experiment. Farmers' demographic and socioeconomic characteristics predict time preferences, although not consistently across both experiments. The association between farmers' education and discounting behavior goes against some previous studies that show a positive association between cognitive skills and patience (Dohmen et al., 2010). Although it is difficult to pin down the exact threshold at which cognitive skills can lead to higher patience, one could argue that the low levels of education in our sample might not be sufficient to induce patience.[10] The other results in Table 4 are intuitive and assume plausible sign. For instance, farmers with binding liquidity constraints are more likely to discount future payoffs heavily. Shocks, particularly idiosyncratic shocks are associated with higher discount rates in both hypothetical experiments (see also, Voors et al., 2012). This may highlight

[10] One could also attribute the positive association between education and discounting rates to the high returns to capital in developing countries (see, e.g., de Mel et al., 2008). For instance, the market returns to capital investment in the area might be greater than the implicit interest rate in our hypothetical experiments.

the potential for insurance markets in shaping individuals' preferences and discounting behavior in developing countries.

Table 4: Explaining Discount Rates: Estimation Results from Ordered Probit Models

	Current discount rates (Experiment 1)		Future discount rates (Experiment 2)	
Explanatory variables	(1)	(2)	(3)	(4)
Locus of control (internal, standardized)	-0.034	-0.018	-0.059**	-0.053*
	(0.026)	(0.027)	(0.027)	(0.028)
Locus of control (external, standardized)	0.068***	0.062**	-0.052**	-0.055**
	(0.025)	(0.026)	(0.026)	(0.027)
Risk aversion	-0.039**	-0.039**	-0.023	-0.028*
	(0.016)	(0.016)	(0.017)	(0.017)
Generalized trust	-0.084***	-0.073**	-0.050	-0.045
	(0.032)	(0.032)	(0.033)	(0.034)
Trust in financial institutions	-0.047	-0.052	0.049	0.043
	(0.035)	(0.036)	(0.037)	(0.038)
Gender (1=male)	0.092	0.159**	0.088	0.140*
	(0.072)	(0.075)	(0.075)	(0.078)
Age	0.002	0.003	0.001	0.002
	(0.002)	(0.002)	(0.002)	(0.002)
Education (highest grade)	0.042***	0.043***	-0.003	-0.001
	(0.009)	(0.009)	(0.009)	(0.009)
Household size	0.025**	0.032***	0.002	0.014
	(0.011)	(0.012)	(0.011)	(0.012)
Religion: Muslim		0.213		0.145
		(0.198)		(0.208)
Religion: Orthodox		0.154		0.276
		(0.198)		(0.209)
Religion: Protestant		0.261		0.182
		(0.201)		(0.212)
Social capital		0.003		-0.001
		(0.003)		(0.003)
Religiosity		-0.003		0.001
		(0.002)		(0.002)
Financially literate		-0.001		0.053
		(0.053)		(0.056)
Liquidity constraint level		0.055*		0.028
		(0.033)		(0.034)
Self-reported relative wealth		-0.028		-0.005
		(0.028)		(0.029)
Land owned in hectares		-0.035*		-0.059***
		(0.019)		(0.022)
Log (value of livestock owned)		0.004		-0.002
		(0.012)		(0.012)
Covariate shocks		-0.001		-0.030
		(0.066)		(0.069)
Idiosyncratic shocks		0.107**		0.137**
		(0.051)		(0.053)
Number of observations	2067	2034	2067	2034

Notes: This table reports the estimates of ordered probit models for explaining farmers' discount rates in both time preference experiments. In column 1, we run an ordered probit model for discount rates from the first experiment (the one involving immediate payoff) as a function of respondents' behavioral characteristics, including locus of control, trust, and risk preferences. In the second column, we add a large set of demographic and socioeconomic characteristics. Similarly, in columns 3 and 4, we report ordered probit estimates for the second time preference experiment (the one not involving immediate payoffs). Robust standard errors are given in parenthesis. *, **, and *** indicate statistical significance at 10%, 5%, and 1%, respectively.

Although characterizing the discount rates in Table 3 is interesting, we are more interested in explaining the significant inconsistency in time preferences between the two experiments. In contrast to the conventional constant discounting behavior, we can observe that a good share of farmers in our sample exhibit reversals that can be characterized by hyperbolic preferences, while a rather smaller share follow the opposite type of reversal, which may apparently sound increasing impatience. To characterize these inconsistencies in time preferences, we run simple probit models to explain farmers' discounting behavior or their consistency in time preferences. To this end, we mimic the empirical specification in Table 4, and provide probit estimates for indicator variables showing hyperbolic discounting and ''increasing impatience'' in Table 5. In all these regressions, the base outcome is exponential discounting (or consistency in time preferences).

The estimation results in Table 5 show some distinct features concerning the association between the various characteristics of farmers and their discounting behavior. More specifically, columns 1–3 of Table 5 show that farmers with an external locus of control (or a greater degree of it) are more likely to discount future payoffs hyperbolically. This evidence remains robust when we control for a large set of demographic and socioeconomic characteristics of farmers. To facilitate interpretation of these associations, we also estimate similar specifications using linear probability models (see Table A2 in the Appendix). These estimates show that an increase of one standard deviation in the external locus of control is associated with a 3–4 percentage points increase in the probability of discounting future payoffs hyperbolically. Farmers' internal locus of control does not significantly predict hyperbolic preferences. Recalling the potential association between internal locus of control and cognitive skills (see, Heckman et al., 2006), this evidence may suggest that this type of preference reversal is not driven by cognitive limitations. Although somewhat unexpected, the positive association between education and hyperbolic preferences strengthens this argument. Furthermore, the results in Table 5 show that trusting behavior, particularly trust in financial institutions, is negatively associated with hyperbolic discounting behavior. This may suggest that trust formation can shape individuals' intertemporal choices and discounting behavior.

More generally, the results in Table 5 show that those farmers with an external locus of control, i.e., those who perceive they have limited control or foresight about (future) life outcomes, are more likely to discount future payoffs hyperbolically. These results corroborate previous theoretical studies that attribute hyperbolic discounting as a manifestation of self-control problems among individuals without external commitment (Laibson, 1997; O'Donoghue and Rabin, 1999). Furthermore, given that some of the items commonly used to elicit (external) locus of control plausibly indicate individuals' level of (un)certainty about future life events, the results in Table 5 are also consistent with previous theoretical predictions on the implication of uncertainty on discounting behavior (e.g., Dasgupta and Maskin, 2005; Halevy, 2008). The results in Table 5 also show that farmers with a low level of trust in financial institutions are more likely to discount future payoffs hyperbolically.

Many of the household characteristics and risk preferences that are associated with higher discounting rates in Table 4 are not statistically significant in explaining hyperbolic discounting. While many of the socioeconomic characteristics of farmers significantly predict the discount rates in Table 4, none of them appears to be significant in explaining hyperbolic discounting (see also, Ashraf et al., 2006, for similar evidence). This empirical evidence may undermine the role of poverty in mediating the relationship between locus of control and hyperbolic discounting. Furthermore, such weak association between socioeconomic status and hyperbolic discounting might suggest that this type of reversal is not driven by expected change in wealth and liquidity constraint.[11] More generally, these pieces of evidence may suggest that discount rates and discounting type are distinct behavioral features that may not be explained by similar attributes. This also partially reinforces the notion that explaining hyperbolic discounting behavior is challenging and may require understanding of deep neuropsychological and cognitive mechanisms underlying intertemporal choices of individuals.

The next natural question would be: What explains those farmers who exhibit the opposite reversal, which might superficially imply increasing impatience? This accounts for about 10 percent of our sample, which amounts to only a third of the reversals we attribute to hyperbolic

[11] Halevy (2015) and Janssens et al. (2016) show the implication of expected change in wealth and liquidity constraint on different types of preference reversals (inconsistencies). To explore whether these expected changes are driving the hyperbolic type of reversals in our data, we also employ the follow-up surveys (rounds) of our data. Using these rounds we run probit models for the type of reversals in Table 5, including changes in wealth (livestock assets), consumption and liquidity constraint. These regressions confirm that our main results hold even when some level of expectations about future consumption, wealth and liquidity constraint are captured.

discounting.[12] Following Ashraf et al. (2006), we provide three explanations to justify why this type of reversal could arise in our sample. We provide several pieces of empirical evidence that support these arguments. The first reason is misunderstanding the survey questions. If misunderstanding the survey items drives this inconsistency, we should be able to see a negative association between education (or other related measures of cognitive ability) and this type of reversal. Columns 4-6 of Table 5 clearly show that those farmers with a strong internal locus of control and those who are more educated are less likely to exhibit such reversal in time preferences. An internal locus of control is widely used as a measure of non-cognitive skill and related to cognitive ability (Heckman et al., 2006). Hence, these associations reasonably justify that part of these reversals is driven by misunderstanding the survey questions. Second, as argued in Ashraf et al. (2006), credit constraints and risky (or uncertain) income flow may also encourage individuals be patient now but impatient at some defined future, and we can observe some evidence of this as liquidity constraints significantly predict this type of reversal. Finally, we also believe that part of the reversals is driven by "unsystematic noise" in survey response for two reasons: (a) the reversals in this direction comprise almost a third of the reversals suggesting hyperbolic preferences; (b) as we show in the next sections, while the preference reversal associated with hyperbolic preferences predicts various behaviors, particularly demand for commitment device, the reversal in the opposite direction does not predict any of these behavioral decisions. These pieces of evidence suggest that those reversals implying hyperbolic preferences are more systematic; in contrast, the reversal in the other direction seems to be the result of noise or misunderstanding the survey items (see also, Ashraf et al., 2006).

[12] While this might be unexpected, previous empirical studies report comparable figures for this type of reversal (Ashraf et al., 2006; Bauer et al., 2012; Dupas and Robinson, 2013).

Table 5: Explaining Hyperbolic Discounting and Other Inconsistencies in Time Preferences: Estimation Results from Probit Models

Explanatory variables	Impatient now, patient later (hyperbolic preferences)			Patient now, impatient later (increasing impatience)		
	(1)	(2)	(3)	(4)	(5)	(6)
Locus of control (internal, standardized)	-0.013	-0.035	-0.044	-0.109**	-0.121***	-0.149***
	(0.032)	(0.033)	(0.034)	(0.042)	(0.044)	(0.046)
Locus of control (external, standardized)	0.086***	0.120***	0.115***	-0.044	-0.054	-0.063
	(0.031)	(0.032)	(0.033)	(0.043)	(0.044)	(0.045)
Risk aversion	-0.011	-0.015	-0.008	-0.005	-0.017	-0.012
	(0.020)	(0.020)	(0.020)	(0.027)	(0.027)	(0.028)
Generalized trust	0.004	0.014	0.010	0.106*	0.099*	0.094
	(0.039)	(0.040)	(0.040)	(0.055)	(0.057)	(0.058)
Trust in financial institutions	-0.153***	-0.149***	-0.136***	-0.094	-0.084	-0.076
	(0.044)	(0.045)	(0.046)	(0.060)	(0.062)	(0.063)
Gender (1=male)		-0.001	0.001		0.243*	0.279**
		(0.092)	(0.095)		(0.125)	(0.130)
Age		0.003	0.003		-0.006*	-0.006*
		(0.002)	(0.002)		(0.003)	(0.003)
Education (highest grade)		0.051***	0.049***		-0.029*	-0.028*
		(0.011)	(0.011)		(0.016)	(0.016)
Household size		0.011	0.010		-0.014	-0.020
		(0.014)	(0.015)		(0.019)	(0.020)
Religion: Muslim		-0.037	-0.035		0.286	0.246
		(0.237)	(0.240)		(0.374)	(0.385)
Religion: Orthodox		-0.077	-0.125		0.361	0.310
		(0.240)	(0.240)		(0.376)	(0.385)
Religion: Protestant		-0.007	-0.048		0.115	0.064
		(0.243)	(0.245)		(0.381)	(0.391)
Social capital			0.011***			0.013**
			(0.004)			(0.005)
Religiosity			-0.004*			0.001
			(0.002)			(0.003)
Financially literate			-0.082			-0.036
			(0.067)			(0.092)
Liquidity constraint level			0.045			0.131**
			(0.041)			(0.057)
Self-reported relative wealth			-0.034			-0.036
			(0.035)			(0.048)
Land owned in hectares			-0.013			-0.015
			(0.024)			(0.032)
Log (value of livestock owned)			0.023			0.037*
			(0.015)			(0.020)
Covariate shocks			0.031			0.083
			(0.084)			(0.117)
Idiosyncratic shocks			-0.044			0.048
			(0.064)			(0.088)
Constant	-0.016	-0.340	-0.418	-1.044***	-1.183**	-1.573***
	(0.174)	(0.319)	(0.355)	(0.246)	(0.473)	(0.530)
Number of observations	1866	1854	1823	1446	1433	1407

Notes: This table provides estimates of binary probit models for indicator variables showing whether a farmer exhibits hyperbolic preferences or increasing impatience. In all regressions the comparison group is that comprising individuals

who discount future payoffs exponentially. The first three columns are estimates for farmers' probability of discounting hyperbolically, while the latter three columns are for farmers' propensity to exhibit increasing impatience (or making noisy choices). Robust standard errors are given in parenthesis. *, **, and *** indicate statistical significance at 10%, 5%, and 1%, respectively.

5. Demand for Commitment Device and Saving Behavior

In this section, we investigate the implications of individuals' locus of control and hyperbolic preferences on their demand for commitment device and saving. Understanding demand for commitment devices is crucial as appropriate commitment instruments may improve economic outcomes (Strotz, 1955), while a lack of them may imply slow saving rates (Laibson, 1997) and lead to poverty traps in developing countries (Banerjee and Mullainathan, 2010; Bryan et al., 2010).[13] This is particularly appealing as the rate of domestic savings in Ethiopia is one of the lowest in Africa, despite recent efforts to improve domestic capital accumulation.

Following previous psychological studies on the relation between locus of control and self-control, we postulate that an external locus of control may reflect self-control problems and hence trigger higher demand for commitment devices. Along a similar analogy, previous theoretical studies show that hyperbolic preferences may encourage demand for commitment devices (Laibson, 1997; O'Donoghue and Rabin, 1999). The theoretical rationale for these predictions rests on the notion that individuals are fully or partially sophisticated in terms of identifying (recognizing) their self-control problems (O'Donoghue and Rabin, 1999). Ashraf et al. (2006) empirically show that individuals with hyperbolic preferences have a higher demand for commitment devices. We further extend these empirical regularities by showing that both external locus of control and hyperbolic preferences predict higher demand for commitment devices.

In Table 6, we provide probit model estimates for individuals' demand for the hypothetical commitment device (first three columns) and their willingness to pay for it (last three columns).[14] We can observe that those farmers with an external locus of control, i.e., those who perceive that life events are out of their control (or uncertain), exhibit higher demand and willingness to pay for the hypothetical commitment device offered. The results are consistent across both outcomes, and are robust to the inclusion of a large set of demographic and socioeconomic characteristics of

[13] Bryan et al. (2010) provides a review of alternative forms of commitment devices and their implications in terms of improving individuals' welfare and poverty status. Mullainathan and Shafir (2009) particularly argue that lack of commitment device is more ''consequential'' for poor households.

[14] We also had regressions showing unconditional correlations between locus of control, hyperbolic preferences, and demand for commitment device. However, these unconditional correlations are literally similar to the conditional correlations in Table 6, and are hence not reported here to conserve space.

farmers. Linear probability model estimates (Table A3 in the Appendix) show that one standard deviation in external locus of control is associated with a 2.5–3 percentage point increase in the likelihood of demanding the commitment device. This is intuitive, particularly assuming that these individuals are fully (or partially) "sophisticated" enough to identify their self-control/temptation problems. On the other hand, an internal locus of control is not significantly associated with demand or willingness to pay for the hypothetical commitment device.

As expected, farmers with dynamically inconsistent preferences, i.e., those discounting future payoffs hyperbolically, show higher demand and willingness to pay for the hypothetical commitment device offered. This is consistent with the experimental evidence offered by Ashraf et al. (2006) and may imply that these individuals are at least partially sophisticated. Interestingly, the other type of inconsistency in time preferences, increasing impatience, does not predict farmers' demand or willingness to pay for the commitment device. This reinforces our argument that this type of inconsistency is mostly driven by noise in survey responses.

Many of the associations between the other variables and demand for commitment device in Table 6 assume plausible sign. For instance, those individuals who trust financial institutions have lower demand for the commitment device offered, potentially because they prefer and are used to saving in microfinances and rural saving associations. Similarly, younger and uneducated farmers show higher demand for the hypothetical commitment device offered.

In addition to farmers' demand for the hypothetical commitment device, we also analyze farmers' maximum willingness to pay for the product. By doing so, we corroborate the above results by exploiting the intensive margin of farmers' willingness to invest in commitment devices. In Table A4 (in the Appendix), we show the results from tobit models for farmers' maximum willingness to pay for the commitment device offered.[15] We can observe that those farmers with an external locus of control and those exhibiting hyperbolic preferences are willing to invest higher amounts of money for the commitment device we offer. This is consistent with the evidence in Table 6, and suggests that these individuals are not only willing to engage in commitment mechanisms but are also willing to invest in commitment devices. This evidence may support the argument that individuals usually engage and invest in costly commitment decisions to avoid self-control and temptation problems (Strotz, 1955).

[15] This variable is censored at zero because those willing to pay are expected to state an amount above zero, while those not willing to pay assume zero values.

Overall, the empirical exercises related with farmers' demand for commitment devices provide interesting insights that may help in designing anti-poverty policies in developing countries. In particular, the results may highlight the potential of commitment devices to improve individuals' welfare and poverty status, through their role in mitigating self-control and other types of control problems (including pressure to share among others) (Banerjee and Mullainathan, 2010; Bryan et al., 2010; Duflo et al., 2011; Brune et al., 2016).

Table 6: Explaining Demand for Commitment Device: Estimation Results from Probit Models

Explanatory variables	Demand for commitment device (locked box)			Willing to pay for commitment device (locked box)		
	(1)	(2)	(3)	(4)	(5)	(6)
Locus of control (internal, standardized)	0.015	-0.014	-0.013	0.079**	0.050	0.043
	(0.035)	(0.036)	(0.039)	(0.033)	(0.034)	(0.036)
Locus of control (external, standardized)	0.092***	0.105***	0.104***	0.099***	0.117***	0.114***
	(0.033)	(0.035)	(0.036)	(0.032)	(0.033)	(0.034)
Time preference: hyperbolic	0.173**	0.183**	0.215***	0.191***	0.191***	0.196***
	(0.076)	(0.077)	(0.080)	(0.072)	(0.074)	(0.076)
Time preference: increasing impatience	0.183	0.147	0.196	0.087	0.069	0.086
	(0.115)	(0.117)	(0.121)	(0.106)	(0.108)	(0.110)
Risk aversion	-0.002	-0.001	0.006	-0.013	-0.011	-0.004
	(0.022)	(0.022)	(0.023)	(0.021)	(0.021)	(0.021)
Generalized trust	-0.002	-0.015	0.002	0.003	-0.011	0.001
	(0.043)	(0.044)	(0.046)	(0.041)	(0.042)	(0.044)
Trust on financial institutions	-0.261***	-0.247***	-0.249***	-0.192***	-0.180***	-0.184***
	(0.049)	(0.050)	(0.052)	(0.047)	(0.048)	(0.049)
Gender (1=male)		0.200**	0.159		0.154*	0.124
		(0.097)	(0.103)		(0.093)	(0.098)
Age		-0.009***	-0.010***		-0.009***	-0.009***
		(0.003)	(0.003)		(0.002)	(0.003)
Education (highest grade)		-0.022*	-0.023*		-0.016	-0.019
		(0.012)	(0.013)		(0.012)	(0.012)
Household size		0.015	0.001		0.028*	0.009
		(0.015)	(0.016)		(0.015)	(0.016)
Religion: Muslim		-0.556	-0.454		-0.467	-0.334
		(0.350)	(0.376)		(0.312)	(0.322)
Religion: Orthodox		-0.609*	-0.603		-0.536*	-0.502
		(0.352)	(0.376)		(0.313)	(0.322)
Religion: Protestant		-0.763**	-0.714*		-0.704**	-0.602*
		(0.354)	(0.378)		(0.315)	(0.324)
Social capital			-0.012***			-0.009**
			(0.004)			(0.004)
Religiosity			-0.004			-0.002
			(0.002)			(0.002)
Financially literate			-0.087			-0.098
			(0.075)			(0.071)
Liquidity constraint level			-0.222***			-0.135***
			(0.047)			(0.045)
Self-reported relative wealth			-0.045			-0.008
			(0.038)			(0.036)
Land owned in hectares			0.072***			0.074***
			(0.028)			(0.027)
Log (value of livestock owned)			0.008			0.020
			(0.016)			(0.015)
Covariate shocks			0.399***			0.327***
			(0.088)			(0.085)
Idiosyncratic shocks			0.087			0.050
			(0.073)			(0.069)
Constant	1.664***	2.479***	2.553***	1.286***	1.965***	1.770***
	(0.202)	(0.425)	(0.482)	(0.191)	(0.386)	(0.426)

Number of observations	2077	2061	2028	2079	2063	2030

Notes: This table provides estimates of binary probit models for indicator variables showing farmers' demand for the commitment device (locked box) and their willingness to pay for it. The first three columns are estimates for farmers' demand for the commitment device (locked box), while the latter three columns are for farmers' willingness to pay. Robust standard errors are given in parenthesis. *, **, and *** indicate statistical significance at 10%, 5%, and 1%, respectively.

We also explore the implications of individuals' locus of control and dynamic inconsistency in time preferences on saving behavior. We hypothesize that those farmers who believe that (future) life events can be sufficiently affected by their actions will show a higher demand for savings, while those who believe that life events are out of their control and perhaps unforeseeable will exhibit a lower propensity to save. Furthermore, those individuals with an internal locus of control are expected to have better self-control mechanisms, while those individuals with an external locus of control are expected to suffer from self-control problems. Columns 1-3 in Table 7 provide interesting evidence associated with these hypotheses, namely that individuals with an internal locus of control (or a greater degree of it) are more likely to save, while the reverse holds for those with an external locus of control (or a greater degree of it). Furthermore, columns 4-6 in Table 7 show that individuals with an internal locus of control (or a greater degree of it) have higher amount of monthly savings. This is intuitive and consistent with the view that individuals with an internal locus of control perceive that future life events can be influenced by own actions, including through current savings. This also strengthens recent evidence on the implications of internal locus of control on saving rates and wealth accumulation (Cobb-Clark et al., 2013). On the other hand, individuals with an external locus of control view future life events as matter of bad or good luck, and hence current savings for future consumption carry higher present values.

The association between hyperbolic preferences and savings behavior is not statistically significant. A priori, the implications of hyperbolic preferences on saving behavior are expected to vary among individuals with varying levels of sophistication about their self-control problems and varying levels of access to commitment devices. Those individuals who are partially naïve about their time-inconsistent preferences and with limited access to commitment mechanisms are expected to save less. On the other hand, individuals with hyperbolic preferences who are sufficiently sophisticated to identify their self-control problems and have ample access to alternative commitment devices may engage in commitment mechanisms that enable them save more. In the absence of an actual commitment device and with limited information about

individuals' level of sophistication, the variation in one or both of these attributes might lead to imprecise associations between hyperbolic preferences and saving behavior. Ashraf et al. (2006) argue that even with the actual offer of a commitment device, those with hyperbolic preferences may not necessarily increase their savings as some may not be sufficiently sophisticated to use the device to improve their saving behavior.[16]

We can also observe that those farmers with better access to saving instruments are more likely to save and more so.[17] Those individuals who have access to saving services in their cooperatives, those who are members of *equib* networks, and those who have access to microfinance institutions are more likely to save. This evidence may support previous studies that argue access to saving and commitment instruments can improve savings behavior in developing countries (Rutherford, 2000; Ashraf et al., 2006; Dupas and Robinson, 2013; Brune et al., 2016). The positive association between access to saving instruments and saving behavior may also highlight the power and relevance of our self-reported measure of savings behavior.

Table 7: Explaining Saving Behavior: Estimation Results from Probit Models

Explanatory variables	Demand for saving (self-reported saving behavior)			Log (last month's savings)		
	(1)	(2)	(3)	(4)	(5)	(6)
Locus of control (internal, standardized)	0.094***	0.075**	0.081**	0.526***	0.424***	0.392***
	(0.028)	(0.032)	(0.035)	(0.061)	(0.064)	(0.065)
Locus of control (external, standardized)	-0.117***	-0.082***	-0.077**	-0.158**	-0.072	-0.059
	(0.029)	(0.031)	(0.033)	(0.061)	(0.067)	(0.067)
Time preference: hyperbolic		0.034	0.027		0.129	0.141
		(0.067)	(0.070)		(0.151)	(0.152)
Time preference: increasing impatience		-0.060	-0.035		-0.336	-0.276
		(0.099)	(0.103)		(0.228)	(0.228)
Demographic controls	No	Yes	Yes	No	Yes	Yes
Socioeconomic controls	No	No	Yes	No	No	Yes
Access to saving instrument	No	No	Yes	No	No	Yes
Constant	0.510***	0.766**	0.913**	2.064***	2.197***	1.846**
	(0.029)	(0.320)	(0.365)	(0.066)	(0.754)	(0.819)
Number of observations	2151	2064	2017	1484	1308	1284

Notes: This table provides estimates from binary probit and linear regression models for farmers' self-reported saving behavior. Columns 1-3 provide probit model estimates for individuals' self-reported saving behavior (whether an individual saves or not). Columns 4-6 provide OLS estimates for log of last month's savings. Robust standard errors are given in parenthesis. *, **, and *** indicate statistical significance at 10%, 5%, and 1%, respectively.

[16] As argued by O'Donoghue and Rabin (1999), and Ali (2011), individuals' learning of self-control and temptation problems might also be partial and incomplete.

[17] These results are suppressed to conserve space. However, they are available from the authors up on request.

More generally, the results in Tables 6 and 7 provide at least three interesting insights related to demand for commitment devices and savings behavior: (i) we show that psychological capital of individuals measured in terms of their locus of control may explain consumers' demand for commitment devices. This indirectly implies that improving individuals' non-cognitive skills and related psychological capital may improve rural households' welfare, particularly in the absence of commitment devices. Bernard et al. (2014) show some behavioral interventions that may improve farmers' aspirations and locus of control. Another channel of intervention for improving households' degree of control or self-efficacy may include insuring against shocks and other factors that may erode psychological capital (Krutikova and Lilleør).[18] (ii) We show that behavioral biases involving hyperbolic preferences and external locus of control may trigger higher demand for commitment devices. This implies that substantial welfare improvements could be gained by providing commitment devices to rural households, particularly for those households associated with the above behavioral attributes. Along this line, Duflo et al. (2011) show that the provision of commitment devices associated with savings for fertilizer applications substantially improves the welfare of rural farmers with inconsistent preferences. (iii) Our results provide interesting behavioral explanations for improving saving rates in rural economies. In particular, we argue that besides to the physical access to saving and commitment devices, individuals' locus of control can affect saving behavior. These results highlight that anti-poverty policies that only focus on improving poor households' physical access to markets may not sufficiently alleviate these psychological and behavioral biases, and associated behavioral poverty trap. The results also provide some insights into rural microfinancing operations and saving cooperatives that are struggling to improve their customers' saving rates. For instance, if rural microfinance institutions identify that their customers suffer from self-control problems (or inconsistent preferences), and if consumers are believed to be sufficiently sophisticated to recognize these problems, rural microfinances may benefit by providing appropriate commitment devices to their customers.

6. Potential Channels and Robustness Exercises

The potential sources of the associations between locus of control, hyperbolic preferences, and demand for commitment devices established here are of considerable interest. Following previous psychological evidence on the relationship between locus of control and self-control (Rosenbaum,

[18] Krutikova and Lilleør (2015) show that exposure to shocks at an early age affects individuals' locus of control and self-efficacy in adulthood.

1980), self-control problems are expected to drive some of the associations between locus of control and hyperbolic preferences. The positive associations between hyperbolic preferences, external locus of control, and demand for commitment device established in Table 6, reasonably suggest that self-control problems are driving the associations between locus of control and hyperbolic preferences. The same argument can be extended to the implications of locus of control on saving behavior (see also, Cobb-Clark et al., 2013).

However, as shown in Table 6 both external locus of control and hyperbolic preferences strongly predict demand for commitment, suggesting that self-control might not be the only channel driving these associations. We believe that uncertainty about future life events might also drive some of the association between external locus of control and preference reversals that can be characterized by hyperbolic preferences. Individuals with an external locus of control are those who perceive that they have limited control over life events and hence are potentially uncertain about future life events. However, we used an aggregate measure of external locus of control and it can be argued that some of the items used to elicit (external) locus of control are best suited for measuring individuals' level of uncertainty than others. Thus, we also use raw values for some of the questions to establish the association between these "measures of uncertainty" and hyperbolic preferences. We consider the raw values of the first two items that measure external locus of control: (i) *To a great extent my life is controlled by accidental/chance happenings*; (ii) *It is not always wise for me to plan too far ahead because many things turn out to be a matter of good or bad fortune.* We believe that these two items capture some level of uncertainty about future life events, and significant associations between these measures and time preferences may reflect the effect of uncertainty. Table 8 provides probit model estimates on the association between these "measures of uncertainty" and individuals' discounting behavior. While the raw values of these items significantly predict hyperbolic preferences, they are not significantly associated with the other type of inconsistency in time preferences in our data. This is consistent for both items and suggests that a higher level of uncertainty about future life events may also explain hyperbolic discounting.

As discussed in Section 2.1 poverty may also account for some of the empirical associations we establish in this study. For instance, although we controlled for farmers' economic status using household assets and self-reported wealth status, one may argue that locus of control is correlated with poverty status and hence the ''psychic cost'' of poverty may play a role in some of our associations. Mullainathan and Shafir (2013) argue that ''poverty imposes huge psychic costs which can limit individuals' mental bandwidth and distort decision making process''. Thus, if

individuals with external locus of control can be argued to be poorer, poverty may explain some of the associations between locus of control and intertemporal choices we establish in this study. This channel may particularly confound the associations between locus of control and saving behavior. Similarly, although we controlled for cognitive skills through education and financial literacy, it is expected that internal locus of control can be correlated with cognitive skills (Heckman et al., 2006). Hence, the positive associations between internal locus of control and savings behavior may reflect the implication of cognitive skills in intertemporal planning and decision making. These potential explanations particularly encourage correlational interpretation of the relationships between locus of control and savings behavior.

Table 8: Explaining Hyperbolic Discounting and other Inconsistencies in Time Preference using Raw Values for Items Measuring Locus of Control

	Impatient now, patient later (hyperbolic preferences)	Patient now, impatient later (increasing impatience)	Impatient now, patient later (hyperbolic preferences)	Patient now, impatient later (increasing impatience)
Explanatory variables	(1)	(2)	(3)	(4)
To a great extent my life is controlled by accidental/chance happenings (#5)	0.135***	-0.034		
	(0.046)	(0.064)		
It is not always wise for me to plan too far ahead because… (#6)			0.148***	-0.029
			(0.045)	(0.058)
Demographic controls	Yes	Yes	Yes	Yes
Socioeconomic controls	Yes	Yes	Yes	Yes
Constant	-0.791**	-1.055*	-0.744**	-1.107**
	(0.370)	(0.547)	(0.362)	(0.533)
Number of observations	1855	1430	1847	1423

Notes: This table provides estimates of binary probit models for indicator variables showing whether a farmer exhibits hyperbolic preferences or increasing impatience. In all regressions, the comparison group is that with constant time preferences. In this table, we use raw values from Rotter's (1966) scale used to elicit individuals' locus of control. We do this considering two alternative items (variables) that may capture some level of uncertainty. The first two columns use raw values for the first item used to elicit external locus of control, while the last two columns relate to the second item used to elicit external locus of control. *, **, and *** indicate statistical significance at 10%, 5%, and 1%, respectively.

7. Concluding Remarks

In this paper, we provide empirical evidence on the link between locus of control, time preferences, and demand for commitment devices and saving behavior. In the first phase of the analysis, we attempt to explain preference reversals that can be characterized by hyperbolic discounting and

other dynamic inconsistencies in time preferences. Thus, we complement previous theoretical studies by providing empirical explanations for hyperbolic discounting behavior. In the second phase of the analysis, we explore the implications of locus of control and hyperbolic preferences on individuals' demand for commitment devices and saving behavior. Our empirical analysis is based on a survey and hypothetical time preference questions and choice exercises conducted on Ethiopian rural farmers. We find that a third of the farmers in our sample exhibit preference reversals which can be characterized by hyperbolic preferences, while two-thirds of our sample discount future payoffs exponentially. This suggests that it is reasonable to assume that time preferences are stable for some groups of individuals, but inconsistent for some other groups.

The first phase of our analysis reveals that individuals' locus of control significantly explains hyperbolic discounting behavior. In particular, our findings show that those individuals with an external locus of control (or a greater extent of it) are more likely to discount future payoffs hyperbolically. Given that locus of control is intuitively related to self-control and life-time uncertainties, this result is consistent with earlier studies that associate hyperbolic preferences with self-control problems (Laibson, 1997; O'Donoghue and Rabin, 1999), as well as with those theoretical predictions that link lifetime uncertainty and hyperbolic preferences (Dasgupta and Maskin, 2005; Halevy, 2008). However, our findings also highlight that explaining hyperbolic discounting is empirically challenging as we find that many of the household demographic and socioeconomic characteristics that explain discount rates are not significantly associated with hyperbolic discounting behavior.

The second phase of our analysis shows that locus of control and hyperbolic preferences significantly predict demand for commitment devices and saving behavior. We find that those farmers with an external locus of control (or a greater degree of it), i.e., those who perceive future life events as being out of their control, exhibit higher demand and willingness to pay for the hypothetical commitment device offered. Furthermore, farmers with dynamically inconsistent (hyperbolic) preferences show higher demand and willingness to pay for the hypothetical commitment device offered. This is intuitive, particularly assuming that these individuals are fully or partially sophisticated enough to identify their self-control or temptation problems. This is consistent with the theoretical predication of Laibson (1997) and empirical evidence by Ashraf et al. (2006). Furthermore, the results show that individuals with an internal locus of control (or a greater degree of it) are more likely to save and more so, while the reverse is observed for those with an external locus of control. This is consistent with the view that individuals with an internal locus of

control perceive that future life events can be influenced by own actions, including through current savings. On the other hand, individuals with an external locus of control perceive that future life events are a matter of bad or good luck, and hence current savings for future consumption carry higher present values. These results complement previous related studies that argue psychological and behavioral explanations may account for heterogeneities in savings and wealth accumulation among individuals (Thaler and Benartzi, 2004; Cobb-Clark et al., 2013).

More generally, the overall results in this paper provide at least three interesting insights and policy implications on the relationship between personality traits, time preferences, demand for commitment devices, and saving behavior. First, our empirical analysis provides an empirical explanation for behavioral biases in intertemporal choices among rural households, particularly hyperbolic discounting behavior. We show that psychological capital of individuals, measured in terms of individuals' locus of control, significantly explains hyperbolic preferences. This indirectly implies that improving individuals' non-cognitive skills and related psychological capital may improve households' intertemporal planning and welfare, particularly in the absence of commitment devices. Along this line, emerging pieces of evidence suggest some simple (inexpensive) behavioral tools that can improve farmers' locus of control and forward-looking behavior (see, Bernard et al., 2014). Second, hyperbolic preferences and an external locus of control may encourage higher demand for commitment devices. This highlights the potential of commitment instruments in alleviating these behavioral biases and hence behavioral poverty trap (see also, Banerjee and Mullainathan, 2010; Bryan et al., 2010). Third, our results provide interesting behavioral explanations for improving saving rates in developing countries. The results from the hypothetical time preferences and commitment exercises provide suggestive evidence on how to improve saving rates in rural areas, a pressing agenda and priority of policymakers in developing countries, including Ethiopia. In particular, we show that in addition to physical access to saving and commitment devices, individuals' psychological capital in terms of perceived and subjective views of their future life events can affect saving behavior. These results highlight that anti-poverty policies that only focus on improving poor households' physical access to markets (e.g., saving, credit and insurance) may not sufficiently alleviate these psychological and behavioral biases, and associated behavioral poverty trap. The results also provide some insights for rural microfinance and saving institutions that are struggling to mobilize domestic savings in rural economies.

Although our study sheds light on the implication of individuals' psychological capital on their intertemporal choice decisions, it suffers from some limitations. The hypothetical nature of the time preference choice exercises is a concern that deserves further investigation. Despite the fact that these survey-based questions are shown to be consistent with incentivized experiments, and hence comparably predict real-world behaviors, further studies based on incentive compatible experiments could corroborate the empirical findings in this paper. Furthermore, despite the strong associations between locus of control and hyperbolic preferences, our results do not reveal much about the mechanisms in these associations. Similarly, although some of the associations may plausibly carry some causal interpretations, causal inferences concerning many of the associations are more complex.

References

Ainslie, G., 1991. Derivation of "rational" economic behavior from hyperbolic discount curves. *American Economic Review*, 81(2), 334–340.

Ali, S. N., 2011. Learning self-control. *Quarterly Journal of Economics*, 126, 857–893.

Anderhub, V., Guth, W., Gneezy, U., Sonsino, D., 2001. On the interaction of risk and time preferences: An experimental study. *German Economic Review*, 2(3), 239–253.

Ashraf, N., Karlan, D., Yin, W., 2006. Tying Odysseus to the mast: Evidence from a commitment savings product in the Philippines. *Quarterly Journal of Economics*, 121(2), 635–672.

Banerjee, A. V., Mullainathan, S., 2010. The Shape of Temptation: Implications for the Economic Lives of the Poor. National Bureau of Economic Research Paper 15973.

Bauer, M., Chytilová, J., Morduch., J., 2012. Behavioral foundations of microcredit: Experimental and survey evidence from rural India. *American Economic Review*, 102(2), 1118–1139.

Berhane, G., Clarke, D., Dercon, S., Hill, R. V., Taffesse, A. S., 2013. Insuring against the weather. ESSP Research Note 20.

Bernard, T., Dercon, S., Orkin, K., Taffesse, A. S., 2014. The future in mind: Aspirations and forward-looking behaviour in rural Ethiopia. CSAE Working Paper.

Bernheim, B. D., Ray, D., Yeltekin, S., 2015. Poverty and Self-Control. *Econometrica*, 83(5), 1877–1911.

Bertrand M., Mullainathan, S., Shafir, E., 2004. A behavioral economics view of poverty, *American Economic Review*, 94, 2, 419-423.

Binswanger, H. P., 1980. Attitudes toward risk: Experimental measurement in rural India. *American Journal of Agricultural Economics*, 62(3), 395–407.

Brune, L., Gine, X., Goldberg, J., Yang, D., 2016. Facilitating savings for agriculture: Field experimental evidence from Malawi. *Economic Development and Cultural Change* 64(2),187-220.

Bryan, G., Karlan, D.S., Nelson, S., 2010. Commitment devices. *Annual Review of Economics* 2, 671–698

Caliendo, M., Cobb-clark, D. A., Uhlendorff, A., 2015. Locus of control and job search strategies. *Review of Economics and Statistics*, 97(1), 88–103.

Chuang, Y., Schechter, L., 2015. Stability of Social, Risk, and Time Preferences over Multiple Years. *Journal of Development Economics*, 117: 151-170.

Cobb-Clark, D. A., Kassenboehmer, S., Sinning, M. G., 2013. Locus of control and savings. IZA Discussion Paper No. 7837.

Cole, S., Giné, X., Tobacman, J., Topalova, P., Townsend, R., Vickery, J., 2013. Barriers to household risk management: Evidence from India. *American Economic Journal: Applied Economics*, 5(1), 104–135.

Coleman, M., DeLeire, T., 2003. An economic model of locus of control and the human capital investment decision. *Journal of Human Resources*, 38(3), 701–721.

Coller, M., & Williams, M., 1999. Eliciting individual discount rates. *Experimental Economics*, 2(2), 107–127.

Dasgupta, P., Maskin, E., 2005. Hyperbolic discounting uncertainty. *American Economic Review*, 95(4), 1290–1299.

de Mel, S., McKenzie, M., Woodruff, C., 2008. Returns to capital in microenterprises: Evidence from a field experiment. *Quarterly Journal of Economics*, 23(4), 1329–1372.

Dohmen, T., Falk, A., Huffman, D., Sunde, U., 2010. Are risk aversion and impatience related to cognitive ability? *American Economic Review*, 100 (3), 1238–1260.

Dohmen, T., Falk, A., Huffman, D., Sunde, U., Schupp, J., Wagner, G.G., 2011. Individual risk attitudes: Measurement, determinants and behavioral consequences. *Journal of the European Economic Association* 9(3), 522–550.

Duflo, E., Kremer, M., Robinson, J., 2011. Nudging farmers to use fertilizer: Theory and experimental evidence from Kenya. *American Economic Review*, 101(6), 2350–2390.

Dupas, P., Robinson, J., 2013. Why don't the poor save more? Evidence from health savings experiments. *American Economic Review*, 103(4), 1138–1171.

Falk, A., Becker, A., Dohmen, T., Huffman, D., Sunde, U., 2015a. The preference survey module: A validated instrument for measuring risk, time, and social preferences. IZA DP No. 9674.

Falk, A., Becker, A., Dohmen, T., Enke, B., Huffman, D., Sunde, U., 2015b. The nature and predictive power of preferences: Global evidence. IZA DP No. 9504.

Frederick, S., Loewenstein, G., O'Donoghue, T., 2002. Time discounting and time preference: A critical review. *Journal of Economic Literature*, 40(2), 351–401.

Halevy, Y., 2008. Strotz meets Allais: Diminishing impatience and the certainty effect. *American Economic Review*, 98(3), 1145–1162.

Halevy, Y., 2015. Time consistency: Stationarity and time invariance. *Econometrica*, 83(1): 335-352.

Harrison, G. W., Lau, M. I., Williams, M. B., 2002. Estimating individual discount rates in Denmark: A field experiment. *American Economic Review*, 92(5), 33–53.

Haushofer, J., Fehr, E., 2014. On the psychology of poverty. *Science* 344 (6186), 862–867

Heckman, J.J., Stixrud, J., Urzua, S., 2006. The effects of cognitive and non-cognitive skills on human capital and social behaviors. *Journal of Labor Economics* 24, 411–482.

Hill, R. V., Hoddinott, J., Kumar, N., 2013. Adoption of weather-index insurance: Learning from willingness to pay among a panel of households in rural Ethiopia. *Agricultural Economics*, 44(4-5), 385–398.

Holt, C. A., Laury, S. K., 2002. Risk aversion and incentive effects. *American Economic Review*, 92(5), 1644–1655.

Janseens, W., Kramer, B., Swart, L., 2016. Be Patient When Measuring Hyperbolic Discounting: Stationarity, Time Consistency and Time Invariance in a Field Experiment. Working paper.

Krutikova, S., Lilleør, H. B., 2015. Fetal origins of personality: Effects of early life circumstances on adult personality traits. CSAE Working Paper (No. 2015-03).

Laibson, D., 1997. Golden eggs and hyperbolic discounting. *Quarterly Journal of Economics*, 112(2), 443–477.

Loewenstein, G., Prelec, D., 1992. Anomalies in intertemporal choice: Evidence and interpretation. *Quarterly Journal of Economics*, 107(2), 573–597.

Lönnqvist, J., Verkasalo, M., Walkowitz, G., Wichardt, P. C., 2015. Measuring individual risk attitudes in the lab: Task or ask ? An empirical comparison. *Journal of Economic Behavior and Organization*, 119, 254–266.

Mullainathan, S., Shafir , E., 2009. Savings policy and decision-making in low-income households. New York: Russell Sage Found.

Mullainathan, S., Shafir, E., 2013. *Scarcity: why having too little means so much.* New York, NY: Times Books.

O'Donoghue, E. D., Rabin, M., 1999. Doing it now or doing it later. *American Economic Review*, 89(1), 103–121.

Rosenbaum, M., 1980. A schedule for assessing self-control behaviors: Preliminary findings. *Behavior Therapy*, 11, 109–121.

Rotter, J.B., 1966. Generalized expectancies for internal versus external control of reinforcement. *Psychological Monographs, General Application*, 80 (1), 1–28.

Rutherford, S., 2000. *The poor and their money*. Oxford: Oxford University Press.

Siziba, S., Bulte, E., 2012. Does market participation promote generalized trust? Experimental evidence from Southern Africa. *Economics Letters*, 117(1), 156–160.

Sozou, P. D., 1998. On hyperbolic discounting and uncertain hazard rates. *Proceedings of the Royal Society of London (Series B-Biological Sciences)*, 265(1409), 2015–2020.

Strotz, R. H., 1955. Myopia and inconsistency in dynamic utility maximization. *Review of Economic Studies*, 23(3), 165–180.

Sutter, B. M., Kocher, M. G., Glätzle-rützler, D., Trautmann, S. T., 2013. Impatience and uncertainty: Experimental decisions predict adolescents' field behavior. *American Economic Review*, 103(1), 510–531.

Thaler, R.H., Shefrin, H.M., 1981. An Economic Theory of Self- Control. *Journal of Political Economy* 89: 392–406.

Thaler, R. H.**,** 1999. Mental accounting matters. *Journal of Behavioral Decision Making*, 12(3), 183–206.

Thaler, R. H., Benartzi, S., 2004. Save more tomorrow: Using behavioral economics to increase employee saving. *Journal of Political Economy*, 112(1), 164–S186.

Tu, Q., Bulte, E., 2010. Trust, market participation and economic outcomes: Evidence from rural China. *World Development*, 38(8), 1179–1190.

Ubfal, D., 2016. How general are time preferences? Eliciting good-specific discount rates. *Journal of Development Economics*, 118, 150-170.

Voors, M. J., Nillesen, E. E. M., Verwimp, P., Bulte, E. H., Lensink, R., Soest, D. P. V., 2012. Violent conflict and behavior: A field experiment in Burundi. *American Economic Review*, 102(2), 941–964.

Appendix

Table A1: Components of (or items eliciting) locus of control

		Strongly disagree	Disagree	Agree	Strongly agree	Mean (SD)
Internal						
1.	I have the power to make important decisions that change the course of my life	1.104	13.642	64.194	21.060	3.061 (0.615)
2.	When I make plans, I am almost certain/guaranteed to make them work	1.503	15.473	64.987	18.037	2.997 (0.612)
3.	When I get what I want, it's usually because I worked hard for it.	0.885	8.189	50.598	40.328	3.302 (0.644)
4.	My life is determined by my own actions	0.531	10.363	52.834	36.271	3.258 (0.644)
External						
5.	To a great extent my life is controlled by accidental/chance happenings	3.890	34.394	53.404	8.311	2.660 (0.678)
6.	It is not always wise for me to plan too far ahead because many things turn out to be a matter of good or bad fortune	5.812	38.021	49.157	7.010	2.583 (0.711)
7.	Often there is no chance of protecting my personal interests from bad luck	3.500	38.680	51.174	6.646	2.598 (0.657)
8.	When I get what I want, it is usually/mostly because I am lucky	4.209	23.438	53.833	18.520	2.871 (0.752)
9.	My experience in my life has been that what is going to happen will happen	1.105	17.905	67.065	13.926	2.932 (0.594)
10.	In order to have my plans work, I make sure that they fit in with the desire of others	3.320	28.287	57.016	11.377	2.768 (0.686)

Notes: This table provides summary statistics of the components of locus of control, given in percentages. The last column provides mean responses for these questions, with standard deviations given in parenthesis.

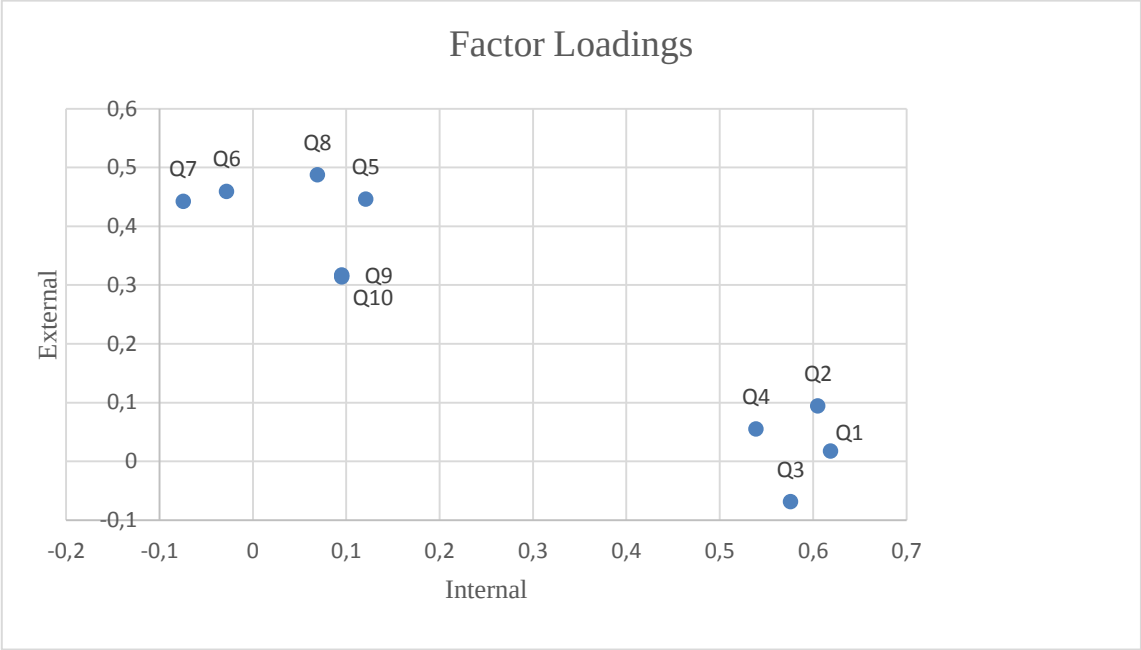
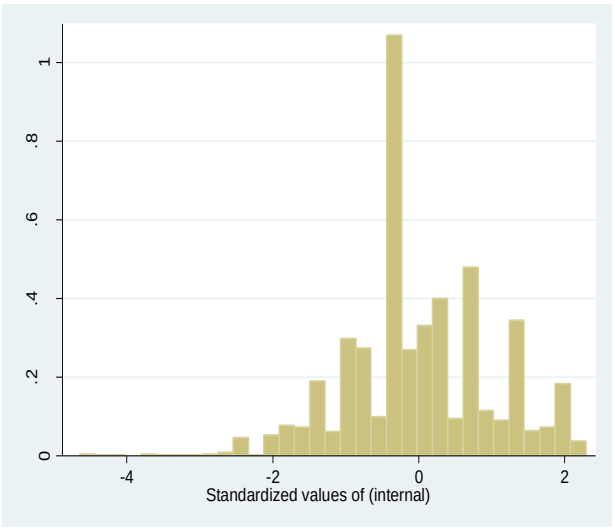


Figure A1: Cross-Plot of Factor Loadings of the Items from Rotter's (1966) Scale



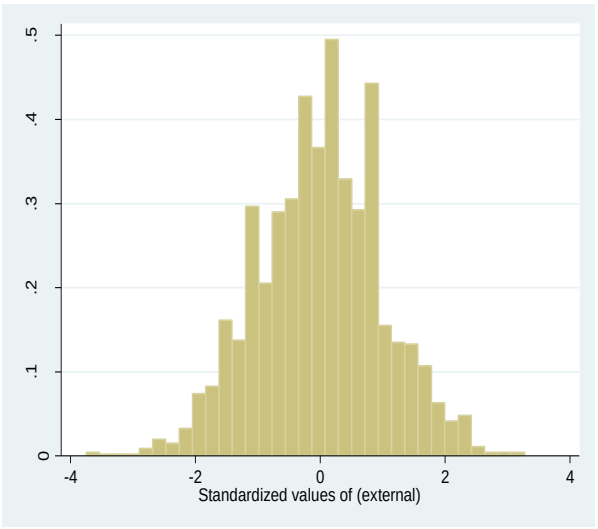


Figure A2: Histogram of Internal Locus of Control (Index). Figure A3: Histogram of External Locus of Control (Index)

Table A2: Explaining Hyperbolic Discounting and other Inconsistencies in Time Preference: Estimation Results from Linear Probability Models

	Impatient now, patient later (hyperbolic preferences)			Patient now, impatient later (increasing impatience)		
Explanatory variables	(1)	(2)	(3)	(4)	(5)	(6)
Locus of control (internal, standardized)	-0.004	-0.012	-0.016	-0.024**	-0.027**	-0.033***
	(0.012)	(0.012)	(0.013)	(0.010)	(0.011)	(0.012)
Locus of control (external, standardized)	0.031**	0.041***	0.039***	-0.010	-0.011	-0.013
	(0.013)	(0.013)	(0.012)	(0.009)	(0.009)	(0.009)
Risk aversion	-0.004	-0.005	-0.003	-0.001	-0.004	-0.003
	(0.008)	(0.008)	(0.008)	(0.006)	(0.006)	(0.006)
Generalized trust	0.002	0.005	0.003	0.024*	0.022*	0.020
	(0.015)	(0.015)	(0.015)	(0.013)	(0.012)	(0.013)
Institutional trust	-0.055***	-0.053***	-0.048***	-0.022	-0.020	-0.018
	(0.017)	(0.017)	(0.018)	(0.014)	(0.014)	(0.015)
Demographic controls	No	Yes	Yes	No	Yes	Yes
Socioeconomic controls	No	No	Yes	No	No	Yes
Constant	0.486***	0.370***	0.343**	0.153***	0.133	0.050
	(0.070)	(0.119)	(0.136)	(0.052)	(0.089)	(0.099)
Number of observations	1866	1854	1823	1446	1433	1407

Notes: This table provides estimates of linear probability models for indicator variables showing whether farmers exhibit hyperbolic preferences or increasing impatience. In all regressions, the comparison group is that with constant time preferences. The first three columns are estimates for farmers' probability of discounting hyperbolically, while the latter three columns address farmers' propensity for exhibiting increasing impatience. Standard errors are clustered at village level and given in parentheses. *, **, and *** indicate statistical significance at 10%, 5%, and 1%, respectively.

Table A3: Explaining Demand for Commitment Device: Estimation Results from Linear Probability Models

Explanatory variables	Demand for commitment device (locked box)			Willing to pay for commitment device (locked box)		
	(1)	(2)	(3)	(4)	(5)	(6)
Locus of control (internal, standardized)	0.002	-0.004	-0.005	0.021*	0.013	0.010
	(0.011)	(0.010)	(0.010)	(0.012)	(0.011)	(0.010)
Locus of control (external, standardized)	0.025**	0.027**	0.028***	0.028**	0.033***	0.033***
	(0.011)	(0.011)	(0.010)	(0.011)	(0.011)	(0.011)
Time preference: hyperbolic	0.041**	0.041**	0.046**	0.050**	0.049**	0.049**
	(0.020)	(0.020)	(0.020)	(0.022)	(0.021)	(0.021)
Time preference: increasing impatience	0.044	0.035	0.045	0.024	0.020	0.024
	(0.029)	(0.029)	(0.029)	(0.031)	(0.031)	(0.031)
Risk aversion	-0.001	0.001	0.001	-0.003	-0.002	-0.001
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Generalized trust	-0.001	-0.004	0.001	0.000	-0.003	0.001
	(0.012)	(0.011)	(0.011)	(0.012)	(0.012)	(0.011)
Institutional trust	-0.065***	-0.062***	-0.060***	-0.054***	-0.050***	-0.050***
	(0.015)	(0.014)	(0.014)	(0.015)	(0.015)	(0.015)
Demographic controls	No	Yes	Yes	No	Yes	Yes
Socioeconomic controls	No	No	Yes	No	No	Yes
Constant	1.004***	1.159***	1.116***	0.942***	1.08***	0.988***
	(0.050)	(0.075)	(0.075)	(0.060)	(0.085)	(0.091)
Number of observations	2077	2061	2028	2077	2061	2028

Notes: This table provides estimates of linear probability models for indicator variables showing farmers' demand for the commitment device (locked box) and their willingness to pay for it. The first three columns are estimates for farmers' demand for the commitment device (locked box), while the latter three columns are for farmers' willingness to pay. Standard errors are clustered at village level and given in parenthesis. Asterisks: *, ** and *** indicate statistical significance at 10%, 5% and 1%, respectively.

Table A4: Explaining Demand for Commitment Device: Results from Tobit Models

Explanatory variables	Maximum amount willing to pay for commitment device (locked box)		
	(1)	(2)	(3)
Locus of control (internal, standardized)	1.470	0.410	-0.547
	(0.977)	(0.991)	(1.016)
Locus of control (external, standardized)	2.484***	3.296***	3.366***
	(0.951)	(0.969)	(0.966)
Time preference: hyperbolic	4.090**	3.468*	3.518*
	(2.051)	(2.060)	(2.041)
Time preference: increasing impatience	-0.020	-0.356	-0.035
	(3.089)	(3.095)	(3.064)
Risk aversion	-0.687	-0.571	-0.749
	(0.605)	(0.605)	(0.602)
Generalized trust	-0.562	-0.354	-0.592
	(1.212)	(1.210)	(1.215)
Institutional trust	-2.366*	-2.657*	-2.218
	(1.358)	(1.359)	(1.367)
Demographic controls	No	Yes	Yes
Socioeconomic controls	No	No	Yes
Constant	32.064***	37.213***	46.620***
	(5.518)	(6.916)	(10.560)
Number of observations	2055	2040	2007

Notes: This table provides estimates from tobit models for farmers' maximum willingness to pay for a commitment device (locked box). *, **, and *** indicate statistical significance at 10%, 5%, and 1%, respectively.