# Locus of Control, Hyperbolic Preferences, and Demand for Commitment and Savings:

## Evidence from Rural Ethiopia

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# 1.Introduction

- Understanding individuals' discounting behavior is crucial in designing various policy interventions
- Behavioral biases and internal constraints are believed to perpetuate poverty
    - (Bertrand et al., 2004; Banerjee and Mullainathan, 2010; Mullainathan and Shafir, 2009; Bernheim et al., 2015).
- Among these behavioral anomalies, hyperbolic discounting has been the subject of considerable debate

- Hyperbolic discounting is characterized by declining discount rates (or impatience).
  - May lead to underinvestment (Laibson, 1997).
  - Poverty trap in developing countries (Banerjee and Mullainathan, 2010; Bernheim et al., 2015).

- Little is known about what might explain this anomaly
  - Self-control problems (Laibson, 1997; O'Donoghue and Rabin, 1999)
  - Uncertainty about the future (Sozou, 1998; Dasgupta and Maskin, 2005; Halevy, 2008).

- Empirical studies on the implications of hyperbolic preferences are also limited

- We postulate a testable hypothesis on the implication of individuals' locus of control
    - "a generalized attitude regarding the nature of the causal relationship between one's own behavior and its consequences" (Rotter, 1966).
- We hypothesize that individuals' locus of control may predict hyperbolic preferences.
- We also explore the implications of locus of control and hyperbolic preferences on demand for commitment and saving

- Considering the two theoretical explanations for hyperbolic discounting, i.e., self-control and uncertainty,
- Psychologists argue that locus of control is one component of self-control (Rosenbaum, 1980).
- 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 also intuitively capture uncertainties about life events.

# 2.2 Data and survey (experimental) design

- A RCT conducted for evaluating the demand for weather-index insurance
- A total of around 2400 households are selected randomly from 110 villages
- The household survey employed a series of hypothetical experiments to elicit farmers' behavioral decisions, including time preferences and risk aversion.
- We focus on household heads, excluding cases in which the respondent is not the household head.

- 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.

**Table 1: Details of the Hypothetical Time Preference Experiment**

| | **Hypothetical Experiment 1** | | | **Hypothetical 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 a month over 100 Birr immediately.

- We employed Rotter's (1966) scale to elicit farmers' responses concerning their locus of control.
- We elicited farmers' demand for commitment by offering a hypothetical commitment device that would help them alleviate their self-control (temptation) problems.
    - Similar to what is used by Ashraf et al. (2006) and Dupas and Robinson (2013).
- We elicited farmers' saving behavior by directly asking whether they typically save or not, and how much they have saved last month

# 3. Descriptive Statistics

**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

**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 experiments 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 involve some empirical challenges
  - It suffers from endogeneity problems arising from omitted behavioral attributes.
- For instance, the intricate relationship between poverty, self-control and cognitive functioning (Mullainathan and Shafir, 2013; Haushofer and Fehr, 2014; Bernheim et al., 2015).
- Our estimates may (at least) inform the direction of causality in the relationships between locus of control and discounting behavior.
- The associational evidence between locus of control and intertemporal choice behavior insightful in itself.

**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

- 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 experiment),
- The reverse happens when the alternative payment is not immediate (second experiment).
- 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

**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 |

- Farmers with an external locus of control (or a greater degree of it) are more likely to discount future payoffs hyperbolically
    - Self-control problems (Laibson, 1997; O'Donoghue and Rabin, 1999).
    - Uncertainty (e.g., Dasgupta and Maskin, 2005; Halevy, 2008).
- Internal locus of control does not significantly predict hyperbolic preferences.
- What explains those farmers who exhibit the opposite reversal?-Ashraf et al. (2006)
    - Misunderstanding the survey questions
    - Credit constraints and risky (or uncertain) income flow
    - "Unsystematic noise" in survey response

# 5.Demand for Commitment Device and Saving Behavior

- We investigate the implications of individuals' locus of control and hyperbolic preferences
- Appropriate commitment instruments may improve economic outcomes (Strotz, 1955),
- While a lack of them may imply slow saving rates (Laibson, 1997)
- Lead to poverty traps in developing countries (Banerjee and Mullainathan, 2010; Bryan et al., 2010).
- Duflo et al. (2011) show that providing commitment devices to rural farmers can improve their welfare

**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 |

- Farmers with an external locus of control exhibit higher demand and willingness to pay for the hypothetical commitment device offered.
- Farmers with hyperbolic preferences show higher demand and willingness to pay for the hypothetical commitment device offered.
- Interestingly, the other type of inconsistency in time preferences, increasing impatience, does not predict farmers' demand or willingness to pay for the commitment device.

**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 logarithm of last month's savings. *, **, and *** indicate statistical significance at 10%, 5%, and 1%, respectively.

- Individuals with an internal locus of control are more likely to save,
- While the reverse holds for those with an external locus of control (or a greater degree of it).
    - Individuals with an internal locus of control perceive that future life events can be influenced by own actions, including current savings.
- This also strengthens recent evidence on the implications of internal locus of control on wealth accumulation (Cobb-Clark et al., 2013).

# 6. Potential Channels and Robustness Exercises

- Self-control problems are expected to drive some of the associations between locus of control and hyperbolic preferences.
- Uncertainty about future life events might also drive some of the association between external locus of control and hyperbolic preferences
- Poverty may also account for one or more of the empirical associations.
    - One may argue that locus of control is correlated with poverty status and hence the "psychic cost" of poverty may play a role (Mullainathan and Shafir, 2013).

# 7.Concluding Remarks

- The first phase of our analysis reveals that individuals' locus of control significantly explains hyperbolic discounting behavior.
    - Individuals with an external locus of control are more likely to discount future payoffs hyperbolically.
- The second phase of our analysis shows that locus of control and hyperbolic preferences significantly predict demand for commitment devices and saving behavior.

- Three key insights:
    1. Empirical explanation for behavioral biases in intertemporal choices among rural households
        - Improving individuals' psychological capital
    2. Hyperbolic preferences and an external locus of control may encourage higher demand for commitment devices
        - The potential of commitment instruments in alleviating behavioral poverty trap (Banerjee and Mullainathan, 2010).
    3. Behavioral explanations for improving saving rates in developing countries.
        - Individuals' psychological capital can affect saving behavior.

# THANK YOU