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Modernization and Time Preferences in Tanzania: Evidence from a Large-Scale Elicitation Exercise

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Abstract

Assumptions about individual time preferences are important for explanations of poverty and development. Data from a large-scale elicitation exercise in Tanzania show significantly higher levels of impatience in urban areas than in rural areas. This result remains robust to adding controls for socio-economic differences between rural and urban areas, which possibly correlate with time preferences. We attribute this to differences in 'modernization' between urban and rural areas, with modernization leading to increased impatience. This is corroborated by the observed positive correlation between impatience and education; the latter being an important vehicle of modernization to traditional societies in Tanzania.

I. Introduction

People continuously make choices that involve trade-offs between costs and benefits at different points in time. This is the case when decisions are made about investments, trade contracts, credit use (Pender, 1996; Meier and Sprenger, 2007), prevention of infectious diseases (Offe, 2001), and the exploitation of common pool resources (Fehr and Leibbrandt, 2008) among others. When making such decisions people may be influenced by their time preferences. Because of considerable heterogeneity among individuals on this and the importance of individual preferences for explanations of poverty, growth and development (Cardenas and Carpenter, 2008), it is useful for development scholars and policy makers to understand the key socio-economic correlates of individual time preferences.

Within economics literature it is commonly assumed that time preferences are correlated with poverty; with poor people having a preference for the short-term (Fisher, 1930; Lawrance, 1991; Holden et al., 1998). It is also argued that short-term time preferences keep poor people poor by discouraging long-term investments (Becker and Mulligan, 1997; Pennings and Garcia, 2005). Though empirical evidence on the relationship between poverty and time preferences in modern western societies is abundant, evidence for the African continent is scarce.

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3 In this paper, we present the results of a series of ‘choice’ experiments which elicited time
4 preferences for more than 1700 individuals in the urban and rural regions of Tanzania’s
5 Southern Highlands. We observed significantly higher levels of impatience in urban than in
6 rural areas. Given the commonly assumed positive correlation between poverty and
7 impatience, this result is intriguing as poverty is generally more widespread in rural areas. It
8 suggests that the positive correlation between poverty and impatience is overruled by other
9 characteristics that differ between urban and rural areas. Inspired by anthropological literature
10 on the African concept of time, we test the hypothesis that higher levels of impatience in
11 urban regions are related to higher degrees of ‘modernization’. Modern societies generally
12 place a greater emphasis on the efficient use of scarce resources including time. In traditional
13 African societies people place a relatively lower value on time control and availability
14 compared to modern African societies (Mbiti, 1968), which translates into lower impatience
15 levels.
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26 To test this hypothesis we proceed in the following way. First, to disentangle the effect of
27 living in urban (or rural) areas on time preferences from influences related to socio-economic
28 differences between these areas we make use of regression techniques. Also, after controlling
29 for different socio-economic characteristics discount rates in urban areas remain significantly
30 higher than in rural areas. This indicates that differences in time preferences between urban
31 and rural areas are due to ‘unobservable’ differences (i.e. differences we do not control for).
32 One such difference is modernization. Second, investigating additional determinants of
33 impatience, we observe that, contrary to the existing literature, education levels correlate
34 positively with individual discount rates. Considering education a primary vehicle of
35 modernization to traditional societies in Tanzania, this result supports the hypothesized
36 positive influence of modernization on impatience. By doing so, our study shows that caution
37 is warranted when making policy recommendations based on assumptions about time
38 preference and its correlates that lack cross-cultural validity. The rest of this article is
39 structured as follows. We first review literature from both economics and anthropology that
40 shed light on time preferences and its relation with individual socio-economic characteristics,
41 such as poverty, education and modernization. We then present the research design and
42 empirical results. A final section concludes.
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II. Literature

Poverty and Time Preferences

Economists have extensively studied time preferences (for a recent literature review see Frederick et al., 2002), an interest which goes back to Adam Smith who identified the importance of inter-temporal choice for the wealth of nations. When people decide between economic options at different points in time, it is assumed that they discount the future utilities of each option to the present and then choose the option with the highest discounted utility. The most commonly accepted model that describes such behaviour has been termed the 'discounted utility model.' For more than three decades, discount rates have been empirically measured either through elicitation exercises or through observation of real behaviour. A growing number of studies have looked for the correlates of individual time preferences, such as income and poverty.

This interest, however, is not new in the economics literature. Eighty years ago Fisher stated, 'A small income, other things being equal, tends to produce a high rate of impatience, partly from the thought that provision for the present is necessary both for the present itself and for the future as well, and partly from lack of foresight and self-control' (1930: 72). Numerous empirical studies have confirmed this (Hausman, 1979; Lawrance, 1991; Green et al., 1996; Harrison et al., 2002).

Field studies in developing countries have also found negative correlations between wealth-income and impatience. Kirby et al. (2002) elicited discount rates from the Tsimane in Bolivia and found that they decreased with recent income but not with wealth. Several studies from Southeast Asia reported similar results. Anderson et al. (2004) found large urban/rural differences in Vietnam. People who lived in rural areas had significantly higher discount rates. They attribute these differences to the higher poverty rates in rural areas. Another study on Vietnam (Tanaka et al., 2006) observed a similar pattern when comparing rich and poor villages. In the Philippines, Ashraf et al. (2006), using hypothetical choice questions which queried preferences between amounts to be received today or one month hence, observed a strongly negative influence of household income on impatience. Pender (1996), using a series of binary choice questions which offered a specified quantity of rice at a particular date, or alternative quantities at another, found that wealthier households in India also have lower discount rates.

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3 On the African continent, empirical evidence on the relation between poverty and time
4 preferences is scarce. Making use of hypothetical choice questions in Zambia, Holden et al.
5 (1998) did not observe any effect of income on impatience, but they did identify a
6 significantly positive effect of liquidity constraints on impatience. In Ethiopia, they found a
7 negative relationship between income and impatience. Also in Ethiopia, Klemick and Yesuf
8 (2008), making use of real financial incentives, found that impatience falls with greater
9 livestock wealth but increases with larger landholdings. These studies suggest that the relation
10 between time preferences and economic indicators, such as wealth, income or liquidity
11 constraints, is less straightforward in Africa than has been documented in studies on other
12 continents. A possible reason for this may be the low weight these studies attach to the
13 cultural dimension.
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24 *The Concept of Time in Traditional African Societies*

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26 Traditional African societies are culturally very distinct from the Western societies on which
27 time preference literature has generally focused. Anthropologists and sociologists have shown
28 how peoples' views of time are highly dependent on culture (Munn, 1992) and social
29 organization (Goody, 1991). Differences between modern and traditional African societies
30 regarding conceptions of time have been documented by Mbiti (1968). Two stereotypes are
31 distinguished: the concept of time of traditional African societies and the telos-driven linearity
32 of the modern concept of time. In the modern time concept, time is linear and mechanical
33 with the future arriving at a constant speed. In the traditional African concept of time, time
34 only comes into existence with the arrival of new events. When an event occurs it becomes
35 part of 'Zamani' (i.e. the past in Swahili). There is another element of time called 'Sasa' (i.e.
36 in Swahili, the immediate past, present, and immediate future). This term does not, however,
37 include the very remote future. Generally speaking, it is not common for people in Africa to
38 speculate too much about the future. Surrounded, as they are, by considerable uncertainty,
39 often with low levels of control over their lives, it is very unlikely that the future will be what
40 they expect.¹ Time control and availability are, therefore, not a matter of great concern.
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53 In modern societies, in contrast, there has been an increasingly more accurate
54 measurement of time (on this evolution, see Barnett, 1998). Accurate time measurement has
55 been a prerequisite of the complex social systems that mark industrial economies (Goody,
56 1991: 33). For the division of labour, as one of the key drivers of industrialization, to be
57 successful, coordination of time measurement was crucial. Whereas in traditional societies the
58 allocation of time is typically linked to nature which is often unpredictable, with
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3 industrialization and modernization mechanical time keeping has imposed a predictable pace
4 of time.
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7 What are the implications for discounting? One could hypothesize that the present bias in
8 the traditional concept of time would lead to higher discounting. This would be plausible if
9 there were a fixed amount of time. However, in the traditional concept of time no pre-existing
10 stock of time is assumed to exist. Time scarcity is not an issue (one cannot 'lose time')
11 leading to a complete absence of preferences over time, hence no discounting.
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15 It is important to emphasize that in most parts of Africa, modernization is neither
16 homogeneous nor uniform, so that the two stereotypes of traditional and modern views on
17 time tend to coexist. In most African societies, individual time preferences will therefore be
18 influenced by both views on time, but the weight each of them receives may strongly differ
19 depending on the modernization of the society people belong to, and with the modern view on
20 time being more prevalent in societies with higher levels of modernization. As modernization
21 is driven largely by urbanization and industrialization (Inglehart, 2001), a germane division of
22 time conceptions is between urban and rural areas. We therefore assume that the modern view
23 on time will receive a higher weight in urban than in rural areas, leading to higher
24 discounting.
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28 During our field stay, we could clearly observe how the pace of time in Tanzania varies
29 between urban and rural areas. In comparison with rural areas, public life in urban areas is
30 characterized by a high speed, 'fasta-fasta'. The photocopy shop that helped us with
31 reproducing the questionnaire used for our study was a good example. The owner was always
32 busy and rushing, almost never late, and he has modern photocopy machines that allow him to
33 maximize productivity. He also has individual personal computers with internet access that he
34 rented for a fixed price per time unit. The differences in time preferences between urban and
35 rural areas also correlate with differences in economic activities. Most dominant activities in
36 urban areas are trade and services. These activities are organized according to a fixed and
37 rather strict schedule (shops open and close at a specific moment in time). Economic activity
38 in rural areas, in contrast, is determined by the agricultural cycle and by unpredictable and
39 uncontrollable climate conditions.
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54 55 56 *Education and Modernization* 57

58 An important vehicle that brings modernization may be education. That education may lead to
59 modernization in the Tanzanian context is illustrated by the ethnographic study of Stambach
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3 (2000). She illustrates the influence of education on modernity and eventually impatience
4 based on a conversation with a stay at home mother
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7 '... who like many of her neighbours, compared and contrasted herself with madada
8 wa mjini – big sisters of the city. ... [who] had attended one or two years of
9 secondary schooling and in some cases had even graduated. Theirs was the world of
10 fast cars and VCRs, of disco dancing and Coca-Cola. To [Mama Stellah], many
11 students in the first graduating class at Mkufi were Big sisters of the city; they were
12 urban-oriented, fashion-conscious, and impatient with the ways of their mothers'
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14 (Stambach, 2000: 62).
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20 That education, through its influence on modernization, increases impatience contrasts
21 sharply with economic theory that actually predicts a negative influence of education on
22 impatience. In economics, discounting of future events, transactions, etc. relative to those in
23 the present, is attributed to a limited capacity of people to conceive or imagine the future;
24 which then leads to an underestimation of future wants. According to Pigou (1920), 'our
25 telescopic faculty is defective, and we, therefore, see future pleasures, as it were, on a
26 diminished scale.' This 'telescopic faculty' is assumed to be positively correlated with
27 education. Becker and Mulligan (1997) modelled this within a discounted utility framework,
28 taking account of the effort necessary to imagine future situations. Education then reduces the
29 minimum required effort to form a mental picture of the future, leading to lower impatience
30 levels.
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40 Recent empirical literature confirms these predictions. Harrison et al. (2002) found in
41 Denmark that peoples' degree of impatience declines as their education level increases.
42 Similar results have been found in developing countries. Kirby et al. (2002) found that
43 discount rates of the Tsimane in the tropical rain forests of Bolivia are negatively correlated
44 with education and literacy. Bauer & Chytilová (2010) found that education significantly
45 reduces the individual discount rates of men in Ugandan villages.
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50 Making the link between education and modernization, Fisher (1930: 81) concludes that
51 more traditional societies pay less attention to future states, because of their low levels of
52 education. That people with lower education pay lower attention to future states is also
53 implied by our 'modernization' hypothesis. An important difference, however, lies in its
54 implications for discounting, hence impatience. Whereas economic theory predicts that a
55 present bias lowers the value people give to future states, which then translates into *higher*
56 discounting, our hypothesis actually predicts *lower* discounting. We argue that a present bias
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3 in the African context is actually the *result* of a higher weight given to the traditional African
4 concept of time. As explained before, in the traditional African concept of time no pre-
5 existing stock of time is assumed ('you can never lose time', Mbiti, 1968), leading to a
6 complete absence of time preferences, hence discounting. Education as a primary conveyer of
7 modernization then induces people to give a higher weight to modern time conceptions,
8 leading to higher discount rates.
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13 14 15 **III. Design and Procedures** 16

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18 The most common approach to empirically elicit time preferences consists of a procedure
19 whereby participants are presented with a list of pair-wise options and asked to select one
20 from each pair (Coller & Williams, 1999; Harrison et al., 2002). The options in each pair
21 differ in the date of payment. When moving down the list, the amount of one option typically
22 increases while the other remains fixed. At a certain point the participant's preference
23 switches from one option to the other, thus giving an approximation of the indifference point
24 and the related discount rate.
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31 Although this is the most commonly followed approach in experimental economics, we
32 expected poorly educated participants to have difficulties with it as it is rather abstract and
33 requires considerable repetition. The few studies that elicited time preferences through such
34 experiments in Africa identified similar concerns and simplified procedures. Bauer and
35 Chytilova (2010) reduced the number of choices to five and Holden et al. (1998) only asked
36 up to the switching point. Klemick and Yesuf (2008) simplified even more by presenting
37 respondents only one pair of options.
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43 We decided to pursue an alternative approach that we expect to score high on both
44 simplicity and data richness. Our approach consists of a 'titration procedure' with only three
45 consecutive choices. Whereas for the first choice the two options were the same for all
46 participants, the options for the second and third choices were dependent on the previous
47 choices made.² Basically, each participant was asked to choose between receiving 1000 TSH
48 after one month (Option A) or a higher amount after three months (Option B). The options
49 presented in the second (third) choice were dependent on their answer to the first (second)
50 choice. If the participant preferred Option A (or B), for the next choice we increased (or
51 reduced) the amount of Option B, keeping the amount of Option A constant.³ Table 1 shows
52 how we changed Option B with each possible sequence of options chosen in the previous
53 choices.
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Table 1. Options used in the time elicitation exercise

Choice	Sequence of prior options chosen	Option A (after 1 month)	Option B (after 3 months)
1		1000 TSH	1500 TSH
2	A	1000 TSH	1750 TSH
2	B	1000 TSH	1250 TSH
3	AA	1000 TSH	1900 TSH
3	AB	1000 TSH	1600 TSH
3	BA	1000 TSH	1400 TSH
3	BB	1000 TSH	1100 TSH

TSH = Tanzanian Shilling; 1200 TSH = 1 US\$.

By conditioning the B options to the decisions made in the previous choices, with each choice we fine-tune the intervals of discount rates of each respondent. Each possible sequence of decisions corresponds to one specific interval of discount rates (Table 2).⁴ As a result, with participants making only three decisions we can cover a range of eight possible intervals of discount rates. For instance, one who prefers Option B in the three consecutive choices (category 1), hence prefers to receive 1100 TSH after three months above receiving 1000 TSH after one month has a monthly discount rate lower than 4.45%. This upper bound is calculated as the result of the difference between the A and B Options relative to the B Option, converted into a monthly rate. The latter is done by calculating $\sqrt{(1+r)} - 1$. However, one who prefers Option B in the two first choices but in the third choice prefers 1000 TSH after one month above 1100 TSH after three months (category 2), has a monthly discount rate that is higher than 4.45%. We also know that in the second choice receiving 1250 TSH after three months was preferred above 1000 TSH after one month. The upper bound of the monthly discount rate that corresponds to this choice is 9.54%, equal to $(1250 - 1000)/1250$, converted into a monthly rate. The other intervals are calculated by following the same procedure.

Note that both options were paid out in the future. The alternative would be to let the respondent choose between an 'instant' option and a future option. This was the procedure followed in the three African studies mentioned before (Bauer and Chytilova, 2010; Klemick and Yesuf, 2008; Holden et al., 1998). This, however, could bias the revealed discount rate if the future option involved additional costs; because of uncertainty about the experimenter's

credibility and/or transportation or transaction costs, among others. By using two options in the future, these costs would exert a similar influence on both option values and the elicited discount rates (Coller and Williams, 1999). This point becomes crucial if the size of these costs is correlated with individual socio-economic characteristics.

Table 2. Intervals of discount rates

Category	Sequence of options chosen	Monthly discount rate
1	BBB	< 4.45%
2	BBA	4.45% – 9.54%
3	BAB	9.54% – 13.39%
4	BAA	13.39% – 15.47%
5	ABB	15.47% – 17.26%
6	ABA	17.26% – 19.52%
7	AAB	19.52% – 21.40%
8	AAA	> 21.40%

As shown in recent literature, discount rates partially depend on the time frame used, with shorter time frames leading to higher discount rates; which is rationalized by models of hyperbolic discounting (e.g. Klemick & Yesuf, 2008). It is likely that the modernization hypothesis might be more easily confirmed for shorter (for example, a few days) than for longer time frames, as discounting will be more important for people who give a higher weight to the modern concept of time (alternatively, the time frame effect will be weaker for people who give lower weights to the modern concept of time). Using a two months difference between the two options therefore seems us a reasonable time frame.

Another methodological issue relates to how future (deferred) payments are guaranteed. With experimental studies in the West, this is relatively easy because of a sound banking system. Studies in field labs in developing countries, however, often face organizational and/or systemic problems that affect the credibility of such payments. Consequently, most elicitation studies in developing countries have made use of hypothetical questions, i.e. without real payments (Ashraf et al., 2006; Barr and Packard, 2000). Those studies that did use real payments either used a very small sample (Pender, 1996; Kirby et al., 2002) or only paid a random sub-sample of the participants (Bauer et al., 2008).

Recent exceptions are Klemick and Yesuf (2008) in Ethiopia and Bauer and Chytilová (2009) in India. To guarantee future payments, the first study used a certificate signed by the

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3 local peasant association redeemable on the date indicated in the experiment. The second
4 study guaranteed future payments with cash certificates signed by the chief of an NGO they
5 cooperated with, a local leader and a social worker familiar to the communities where they
6 organized the elicitation exercises. The social worker was responsible for delivering the
7 amount specified on the cash certificate on the given date. Both studies managed to obtain a
8 sample of around 400-500 individuals.
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12 We set up a similar payment system. We used cash certificates that the participants could
13 redeem in the office of a well-known local microfinance bank at a specific point in time (i.e.
14 after one or three months). The fact that our procedures put less weight on the research team⁵
15 (instead of relying on a social worker, participants themselves had to come and cash their
16 payments) allowed us to obtain a much larger sample (i.e. more than 1700 respondents). We
17 are aware, however, that the selection of a microfinance bank in the urban centre for
18 redeeming participant payment certificates may lead to differences in incentives between
19 urban and rural participants due to travel costs. To minimize these differences people did not
20 have to come personally to the bank and cash the certificates.⁶ Details of the parameters and
21 procedures involved are found in the Web appendix.
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26 The elicitation exercise was embedded in a large socio-economic household survey in the
27 Southern Highlands of Tanzania. In total, 1758 individuals participated: 406 in the urban
28 centre and 1353 in 11 surrounding rural villages. Whereas the rural respondents were
29 randomly selected from the total population of selected rural villages, the urban respondents
30 were randomly selected from current and former clients of a local microfinance bank. We did
31 so as there was no available census of residents in the area.
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34 35 36 37 38 39 40 41 42 43 44 **IV. Results**

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47 In this section, we present the empirical results of our study. We first compare discount rates
48 between urban and rural samples. In the next step, we use regression techniques to eliminate
49 possible biases due to socio-economic differences between urban and rural areas that might
50 correlate with individual discount rates. Thereafter, we estimate regressions for the urban and
51 rural samples separately in an attempt to find additional determinants of impatience and
52 provide further evidence for the modernization hypothesis.
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Rural-Urban Differences in Time Preferences

Figure 1 shows the distribution of time preferences for urban and rural samples, for men and women separately. We observe that around 10% of urban participants and 20% of rural participants preferred Option B in all three choices (category 1). Some of them may have done so because of having relatively low discount rates. Others may not have applied any discounting at all and preferred Option B in all choices simply because it has the largest payoff. As the group of participants that fall under category 1 is limited in size, we can conclude that most of the participants followed a discounting logic when comparing Options A and B.

Figure 1. Distribution of discount rates by area and sex

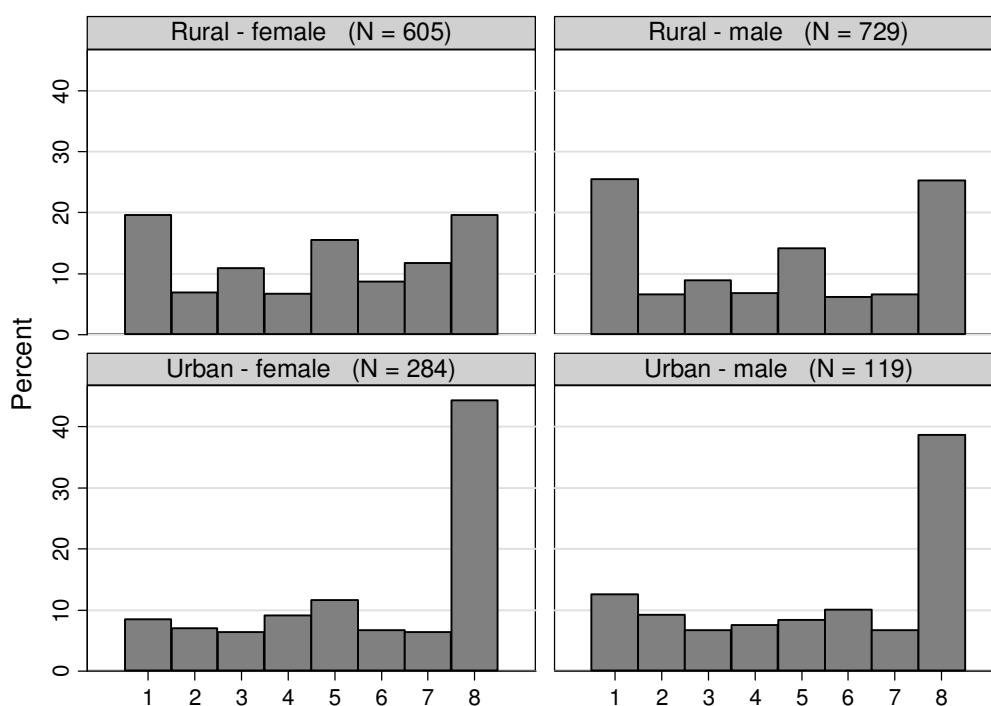


Figure 1 also shows that more than 20% of the rural participants and more than 40% of the urban participants preferred Option A in the three consecutive choices (category 8) which corresponds to a monthly discount rate of more than 21.40%. Differences in time preferences between men and women are negligible. According to a Mann-Whitney test, differences are statistically insignificant in the urban area ($Z = -1.248$; two-sided $P = .212$) and the rural area ($Z = -0.844$; two-sided $P = .398$). This is consistent with the findings of Kirby et al. (2002) and Anderson et al. (2004), who found no differences between men and women in Bolivia and

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3 Vietnam, respectively. Time preferences, however, do differ substantially between urban and
4 rural areas, with discount rates being substantially higher in the urban centre than in
5 surrounding rural villages. To test whether this difference is statistically different from zero,
6 we pool men and women (as differences between men and women in urban and rural areas are
7 insignificant) and apply a Mann-Whitney test. We find that this difference is statistically
8 significant ($Z = -7.613$; two-sided $P = .000$).

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10 Remember, however, that in the urban areas only individuals were selected who are or
11 had been clients of a particular local microfinance bank. When this program targets
12 individuals with specific characteristics possibly related to time preferences, there may be a
13 selection bias and the urban and rural samples may be incomparable. Since for the urban area
14 we only selected (ex) clients, education and wealth may be higher in the urban sample
15 compared to the total urban population (under the assumption that people with access to
16 microfinance services are, on average, less poor and have more education (Navajas et al.,
17 2000). However, to the extent that wealth and education reduce impatience, this would only
18 lead to an underestimation of observed differences between urban and rural samples. To
19 reduce any such bias, we compare the urban sample only with those individuals in the rural
20 sample that have access to microfinance services. According to a Mann-Whitney test, the
21 difference in time preferences remains statistically significant ($Z = -4.492$; two-sided $P =$
22 $.000$).

23
24 To disburse the money of the time preference elicitation exercise, we relied on the same
25 microfinance bank that was used to sample urban respondents. We are aware that this could
26 bias rural-urban differences. For instance, that urban participants have better access to the
27 institution's services, may lead to lower reported impatience levels if they are more confident
28 that they will really get the money. As this would underestimate impatience differences
29 between rural and urban samples (and thus lead to conservative estimates), we expect
30 differences to hold without any such bias. To test this, we compare the rural participant
31 sample with only the ex-clients in the urban sample. Applying a Mann-Whitney test, we
32 observe that differences in discount rates between urban and rural samples remain statistically
33 significant ($Z = -5.163$; two-sided $P = .000$).⁷

34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 *Controlling for Biases between Urban and Rural Samples*

The observed differences in time preferences between urban and rural samples may also be influenced by differences in key socio-economic variables that have been identified as important determinants of time preferences in the empirical literature (e.g. poverty, education,

age). It is important to disentangle the effect of living in urban (or rural) areas on time preferences from influences related to socio-economic differences between these areas. So far, we only looked at a few possible biases, and only looked at one possible bias at a time. To tackle these biases we will estimate a series of regression models that control for these socio-economic differences. If after adding these controls there remain differences between urban and rural samples on time preferences, these are likely due to 'unobserved' differences between urban and rural areas (i.e. differences we did not control for), such as modernization.

In particular, we estimate a regression model with the discount rate as dependent variable. As the dependent variable is not continuous but consists of several ranges, OLS regression would lead to inconsistent estimates, meaning that the coefficients will not necessarily approach the "true" population parameters as the sample size increases. An 'interval regression' specification is more appropriate as it deals econometrically with all types of censoring (left censoring, interval and right censoring) and by doing so guarantees that we get unbiased estimates. The large proportion of urban participants that are in the highest interval that is right-censored (Figure 1) would therefore not pose a problem for the estimated coefficients of socio-economic correlates. The interval regression has the following specification:

$$y_i^* = \beta_0 + U_i \cdot \beta_1 + \varepsilon_i \quad (1)$$

y_i^* is the latent dependent variable that measures the monthly discount rate. This variable is never observed; only the interval where it falls into. In other words, we assume a function $y_i = t(y_i^*)$ that links this latent variable to an observed category of discount factor y_i

$$t(y_i^*) = \begin{cases} 1 & \text{if } y_i^* \leq c_1 \\ 2 & \text{if } c_1 < y_i^* \leq c_2 \\ 3 & \text{if } c_2 < y_i^* \leq c_3 \\ 4 & \text{if } c_3 < y_i^* \leq c_4 \\ 5 & \text{if } c_4 < y_i^* \leq c_5 \\ 6 & \text{if } c_5 < y_i^* \leq c_6 \\ 7 & \text{if } c_6 < y_i^* \leq c_7 \\ 8 & \text{if } c_7 < y_i^* \end{cases}$$

U_i is a rural-urban dummy, the use of which allows us to estimate the influence of living in a rural/urban area on individual discount rates. However, the estimated coefficient of the rural-urban dummy will be biased if we omit covariates that correlate with time preferences

and are not evenly distributed in the rural and urban samples. There are different ways to tackle this problem. One way is to add these covariates as additional variables in the regression. Another approach is the use of propensity scores. Propensity scores are the conditional probabilities (propensities) of being in the treated group given a set of covariates. In our analysis we consider the urban sample as the treated group. The use of propensity scores allows us to balance the observations in such a way that assignment to the urban or rural samples is independent of the covariates conditional on the propensity score. There are different methods to use the propensity score to adjust the regression. One method is to simply add the propensity score as covariate (Rosenbaum and Rubin, 1983); another is to re-weight observations with the inverse of the propensity score (Imbens, 2000; Hirano and Imbens, 2001). We will make use of these different methods and compare the results as a robustness test.⁸

Table 3. Descriptive statistics of rural and urban samples

	Urban	Rural	P ^a
Age	33.64	43.06	.000
Education (years)	7.40	4.76	.000
Number of children	2.22	2.64	.000
Lack of food shortages (dummy)	55.3%	41.4%	.000
Sex (1 = male; 0 = female)	29.4%	54.6%	.000
Never migrated (dummy)	42.2%	74.3%	.000
Household size	4.97	5.47	.000
Self-employment (crop farming)	47.16%	99.93%	.000
Self-employment (livestock raising)	37.04%	70.69%	.000
Self-employment (non-farming)	73.83%	22.07%	.000
Paid employment	10.40%	3.33%	.000
Daily labourer	2.97%	19.54%	.000
	N = 405	N = 1349	

^a Two-sided P values of a t-test for comparisons of means in the case of continuous variables, or chi-square for comparisons of dichotomous variables.

To identify covariates that are not evenly distributed in the rural and urban sample while at the same time possibly correlate with time preferences, we look more closely at the socio-economic differences between the urban and rural samples (Table 3). We observe that respondents in rural areas are older, less-well educated and have more children than those in the urban centre. In the urban sample relatively fewer people faced food insecurity in the last

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3 two years, which is used as a proxy for poverty. This is consistent with their generally lower
4 poverty levels relative to rural areas. We also observe that in the urban sample we interviewed
5 relatively fewer men than in the rural sample. This is due to the higher proportion of female
6 clients in the microfinance program. Furthermore, we observe that the proportion of people
7 who have never migrated (and thus have lived their entire life in their village) is significantly
8 higher in the rural sample than in the urban sample. The average household size is also larger
9 in the rural than in the urban sample.

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16 Comparing the economic activities between the two samples, we find that self-
17 employment in crop farming and livestock raising is relatively more important in rural areas
18 whereas self-employment in non-farming activities (i.e. all types of services and commerce) is
19 relatively more important in the urban sample. We also find that the proportion of people that
20 obtain an income as a daily labourer is higher in rural areas, while paid employment (i.e. with
21 a fixed salary from local companies, governments and NGOs) is more important in urban
22 areas.

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28 According to existing literature, of all these socio-economic variables that differ between
29 the rural and urban samples the following are possibly correlated with time preferences: age
30 (Green et al., 1996); education (Bauer & Chytilová, 2010); number of children (Bauer and
31 Chytilová, 2009) and wealth/poverty (Hausman, 1979; Lawrance, 1991; Green et al., 1996;
32 Pender, 1996; Harrison et al., 2002). These variables will be used to adjust the basic
33 regression specified in equation 1.

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39 While we expect these variables to correlate with time preferences and to differ
40 significantly between rural and urban samples, we also consider variables on which both
41 samples differ but that based on existing literature are not directly expected to correlate with
42 time preferences. We will use these variables for the regressions adjustments as they may be
43 correlated with important unobservable characteristics that do influence time preferences. One
44 such variable is sex. Although the literature is silent about the influence of gender on time
45 preferences, women may have certain characteristics that may make them more or less
46 impatient. For the same reason, we control for the number of household members and we add
47 a dummy equal to one when the subject has never migrated before. By adding the latter
48 dummy variable we are able to control for unobservable characteristics that promote a
49 tendency to migrate and at the same time influence time preferences.

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58 Furthermore, urban-rural differences in the decisions made in the elicitation exercise may
59 be influenced by enumerator characteristics. Remember that the instructions were given by
60 different persons so that we cannot exclude the possibility of enumerator differences in

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3 demeanour or attitude influencing respondents' choices. To reduce such possible bias we add
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5 enumerator fixed effects.
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7 Finally, there may be additional selection biases because of the way how we implemented
8 the elicitation exercise. First, as the urban respondents were randomly selected from current
9 and former clients of a local microfinance bank whereas the rural respondents were randomly
10 selected from the total population of selected rural villages, there may be a bias in access to
11 finance, which possibly correlates with time preferences. Second, as the rewards of the
12 elicitation exercise were only redeemable at the local urban microfinance bank there may be a
13 non-random bias across rural and urban samples related to effort with the elicitation exercise.
14 To test and reduce any such biases we will add further control variables.
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21 Our strategy to estimate the determinants of time preferences and to deal with these biases
22 is the following. In Model 1 we estimate the basic model without any controls, i.e. equation
23 (1). In Model 2 we include all the confounding factors of time preferences discussed above. In
24 Model 3, we replace the rural-urban dummy with two dummy variables equal to one if the
25 respondent lives in a rural area and visited the urban centre at least once last month, and lives
26 in a rural area but did not visit the urban centre in the last month, respectively. We do so to
27 test whether there is a possible effort-related effect on the elicitation of time preferences. If
28 people in the urban centre would have to put less effort to cash their earnings (as the
29 institution that is used to cash receipts is located in the urban centre) and this would bias the
30 elicitation of their time preferences, we would also observe such an effect between rural
31 people who regularly visit the urban centre and those who do not. In Model 4 we also control
32 for access to finance, with a dummy variable equal to one if the respondent has had access to
33 microfinance. We do so to reduce a potential bias introduced by sampling the urban
34 respondents from clients of a local microfinance bank and the rural respondents from the total
35 population of selected rural villages.
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48 Models 5 and 6 use the propensity scores to adjust the regressions. For the calculation of
49 the propensity scores we estimate the likelihood of belonging to the urban sample with a
50 standard probit regression controlling for the above socio-economic characteristics. Table 1 in
51 the Web appendix shows the results. We observe that all coefficients are statistically
52 significant. Figure 1 in the Web appendix shows histograms of the propensity scores in the
53 urban and rural samples. Whereas in Model 5 we will use the propensity score as additional
54 covariate, Model 6 uses the propensity score to reweight the observations in the urban and
55 rural samples.
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Table 4. Determinants of individual discount rates

	----- Including covariates -----				Propensity scores as covariate		Propensity scores as weights	
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 5'	Model 6	Model 6'
Location (1 = rural; 0 = urban)	-4.400*** (0.92)	-3.482*** (1.03)	-	-	-	-	-	-
Rural and did not visit urban centre in the last month (dummy)	-	-	-3.498*** (1.11)	-3.714*** (1.40)	-3.234** (1.39)	-3.191** (1.41)	-2.570* (1.49)	-2.484* (1.48)
Rural and did visit urban centre in the last month (dummy)	-	-	-3.471*** (1.06)	-3.747*** (1.38)	-3.151** (1.38)	-3.207** (1.39)	-2.511* (1.48)	-2.295 (1.49)
Age	-	0.010 (0.03)	0.010 (0.03)	0.010 (0.03)	-	0.008 (0.03)	-	-0.011 (0.03)
Education (years)	-	0.283** (0.12)	0.284** (0.12)	0.288** (0.12)	-	0.103 (0.13)	-	0.284** (0.13)
Number of children	-	0.133 (0.29)	0.132 (0.30)	0.126 (0.30)	-	-0.058 (0.16)	-	-0.196 (0.20)
Lack of food shortages (dummy)	-	-1.022* (0.60)	-1.019* (0.60)	-1.033* (0.61)	-	-1.276** (0.61)	-	-0.814 (0.73)
Sex (1 = male; 0 = female)	-	-1.051* (0.61)	-1.049* (0.62)	-1.055* (0.62)	-	-	-	-
Never migrated (dummy)	-	0.619 (0.65)	0.620 (0.65)	0.613 (0.65)	-	-	-	-
Household size	-	-0.223 (0.22)	-0.222 (0.22)	-0.220 (0.22)	-	-	-	-
Access to finance (dummy)	-	-	-	-0.308 (1.05)	-0.395 (1.04)	-0.480 (1.05)	0.142 (1.15)	-0.340 (1.16)
Propensity of living in urban area	-	-	-	-	4.478*** (1.56)	4.359** (2.04)	-	-
Constant	16.899*** (1.25)	15.699*** (1.91)	15.693*** (1.91)	15.965*** (2.08)	14.931*** (1.70)	14.822*** (2.18)	15.288*** (1.65)	15.086*** (2.28)
Log-likelihood	-3458.45	-3321.34	-3321.34	-3310.18	-3312.78	-3310.37	-37423.57	-21233.30
Chi-squared	115.98	129.26	129.26	129.37	124.17	128.98	43.32	53.14
Prob. > chi2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0004	0.0001
N	1749	1685	1685	1680	1680	1680	1541	1541
right-censored observations	477	460	460	459	459	459	431	431
interval observations	925	891	891	888	888	888	798	798
left-censored observations	347	334	334	333	333	333	312	312

* p < 0.10, ** p < 0.05, *** p < 0.01; Standard errors between brackets; Model 6 and 6': observations have been reweighted by the propensity score (observations with weight > 20 were excluded). All models have enumerator fixed effects.

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5 Table 4 presents the results. In Model 1 we observe that people who live in the rural area
6 have a monthly discount rate that is on average 4.40% lower than people in the urban area. In
7 Model 2 that controls for possible confounding factors of time preferences this effect reduces
8 to 3.48%, but remains highly significant. Model 3 shows that there are no differences between
9 rural people who visited the urban centre at least once in the last month and rural people who
10 did not visit the urban centre in the last month ($\chi^2 = 0.00$; $P = 0.969$). This suggests that
11 possible differences in effort to cash the receipts of the elicitation exercise do not bias the
12 elicited time preferences. In Model 4 an additional control for access to finance is added by
13 using a dummy equal to one if one has had access to finance. The coefficients of the two rural
14 dummy variables remain robust to adding this control variable.⁹

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23 In Models 5 and 6 we make use of propensity scores to balance the observations in the
24 two samples. In Model 5 the propensity scores are added as a covariate. We observe that this
25 weakens the effect of living in a rural area, but that the coefficients of the rural-urban dummy
26 variables remain statistically significant at the 5%. The advantage of using propensity scores
27 in this way is that one can add a subset of the covariates used to estimate the propensity score,
28 to test the influence of these covariates on time preferences. This is done in Model 5', where
29 we add some of the variables that according to the literature possibly correlate with time
30 preferences. Our results confirm existing evidence on the positive relation between poverty
31 and impatience. People who have never had any food difficulties have on average a 1.28%
32 lower monthly discount rate.

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41 The propensity scores can also be used to reweight the observations in the samples
42 (Imbens, 2000; Hirano and Imbens, 2001). In Model 6 each observation in the urban sample is
43 reweighted by the inverse of the propensity score and each observation in the rural sample by
44 the inverse of one minus the propensity score. As observations with very low propensity
45 scores will get very high weights and therefore the results may become sensitive to the
46 inclusion of these observations, we exclude the observations that have a weight larger than 20.
47 We observe that the effect of living in a rural area is somewhat weaker in this model, while
48 the coefficients of the rural-urban dummy variables remain statistically significant at the 10%.

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Assuming that education is a primary vehicle of modernization to traditional societies in
Tanzania it is also relevant to look at the coefficient of the education variable. One might
expect, however, that the coefficient of education suffers from omitted variable bias, due to its
correlation with the types of economic activities the respondents are involved in. Economic
activities may exert an important influence on one's daily schedule and therefore also

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3 correlate with time preferences. Therefore, not controlling for economic activity might bias
4 the education coefficient. To test this, we re-estimate models 2, 3 and 4 (results shown in the
5 Web appendix) with five additional dummy variables equal to one if the respondent has one
6 of the following five economic activities: self-employment - crop farming; self-employment -
7 livestock raising; self-employment - non-farming; paid employment; daily labourer. We find
8 that the education coefficient remains robust to adding these variables.
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12 Looking at the estimated coefficients across the different specifications we observe that,
13 contrary to the predictions of economic theory, education increases discount rates. These
14 results are considered additional evidence in support of the hypothesized positive influence of
15 modernization on impatience.
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22 **V. Conclusion and Discussion**

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24 Individual time preferences may be important determinants of individual decision making that
25 involve trade-offs between costs and benefits at different points in time. Because of
26 considerable individual heterogeneity in time preferences and the importance of these
27 preferences for explanations of poverty, growth and development, it is useful for development
28 scholars and policy makers to understand the key socio-economic correlates of time
29 preferences.
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36 Many studies have elicited time preferences in industrialized countries with a growing
37 number in developing countries. Yet, only a few of them have been conducted in Sub-Saharan
38 Africa. In this paper, we elicited the time preferences of more than 1700 individuals in the
39 Southern Highlands of Tanzania. Comparing individual time preferences between urban and
40 rural areas, we observed considerably higher impatience in urban areas. This is intriguing
41 given the commonly assumed positive correlation between poverty and impatience (and with
42 poverty being generally more widespread in rural areas). Differences remain significant, after
43 adding further controls, necessary to eliminate possible omitted variable bias. As it is
44 impossible to influence where people live (and therefore this variable is impossible to
45 randomize) any studies on rural-urban differences are particularly vulnerable to such bias. It is
46 therefore important to control for any differences between urban and rural samples on socio-
47 economic characteristics that may influence time preferences and are not equally distributed
48 between urban and rural samples. Making use of different specifications (using propensity
49 scores and additional covariates) we observe that the difference between rural and urban areas
50 remains robust.
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3 Making use of the anthropological literature on the African concept of time, we attribute
4 this higher impatience in urban areas to higher degrees of ‘modernization.’ This is
5 corroborated by the observed positive correlation between impatience and education; with
6 education being a primary conveyer of modernization. Our results may have important
7 consequences for the policy recommendations made in the existing literature.
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11 First, it is generally assumed that higher discount rates lower the valuation of future
12 benefits, hence lower the utility of any decision that defers benefits to the future, as is the case
13 with environmental conservation (e.g. Holden et al., 1998), the use of savings products
14 (Ashraf et al., 2006) and the repayment of credit loans (Meier and Sprenger, 2007). Under this
15 assumption, the many studies that found a positive correlation between poverty and discount
16 rates tend to conclude that poverty stimulates behaviour that is detrimental to society. Our
17 study, in contrast, found that people in urban areas, where poverty levels are generally lower,
18 have actually higher discount rates. Identifying modernization in African societies as a much
19 stronger correlate of impatience than poverty, our results indicate that the existing evidence
20 on the relationship between poverty and impatience should be put into a broader perspective.
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24 Second, most evidence in the literature supports a *negative* correlation between education
25 and impatience. This is attributed to a positive effect of schooling on children’s appreciation
26 of future utility, which lowers their discounting, hence increases their patience. Based on this
27 result policymakers are recommended to invest in education as it reduces children’s
28 impatience levels. In our study, in contrast, we find a *positive* correlation between education
29 and impatience, which we attribute to the close link between education and modernization in
30 African societies, with modernization leading to higher impatience levels.
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34 The underlying assumption we have followed so far is that higher discount rates are less
35 optimal as they make people less willing to undertake long-term investments. Two further
36 observations on this are required, however. First, we should be aware that the optimal
37 discount rate might be different for different livelihoods. Discount rates are only one of the
38 important parameters in any exercise of utility or welfare maximization, as are (time)
39 constraints, preferences and time frames. For example, the fact that commercial activities
40 have a lower turnaround than agricultural activities makes short (long) run time discount rates
41 more (less) relevant for vendors than for farmers. Second, people tend to have higher discount
42 rates in short run than in long run time frames. Such time inconsistencies explain why people
43 often make choices in the short run that are detrimental to their long run interest. This has
44 been increasingly documented in the literature and may be very relevant for policy (Frederick
45 et al., 2002; Klemick and Yesuf, 2008).
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3 Undoubtedly, a further investigation on what discount rates are optimal under what
4 conditions, taking due consideration of variations across time frames and livelihoods, would
5 certainly be a promising extension to our research, provided it continues to pay sufficient
6 attention to cultural heterogeneity.
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Notes

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25 ¹ In Tanzania, wishes regarding the remote future are often combined with 'Mungu akipenda' (i.e. 'if Allah
or God wishes'). Also, when saying goodbye, people add the phrase 'Mungu akipenda'.

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28 ² We borrow this titration procedure from Henrich & McElreath (2002) who implemented it to elicit risk
aversion levels among two groups of small-scale farmers: the Sangu in Tanzania and the Mapuche in Chile.

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34 ³ Before proceeding to the next choice we removed both cards (from the table). We then presented the
reference card (Option A) and the new Option B and asked them to make a new choice. We did so in an
attempt to minimize possible autocorrelation between the three consecutive choices as a result of the
participants reacting, 'I already told you, I want this card!' if they had previously chosen Option A.

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40 ⁴ Such titration procedure also eliminates the problem of 'multiple switching,' commonly observed with the
standard method that consists of presenting a list of 'independent' pairs of options. Although the issue of
inconsistent preferences revealed by multiple switching may be interesting, as such (see e.g. Bauer et al,
2008), it is not the focus of our research.

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43 ⁵ Klemick and Yesuf (2008) did not provide any details about whether and how participants were supported
to redeem their payments.

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49 ⁶ According to anecdotal evidence, several weeks after our experiment in one of the most remote rural
villages a local trader accepted the payment certificates as temporal currency. To account for possible
transaction costs to cash the certificates in the urban centre he charged a cost on each received certificate.
This suggests that even in very remote areas our payment system produced very credible incentives.

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52 ⁷ Differences also remain significant when comparing ex-clients to rural participants who have access to
microfinance services ($Z = -4.492$; two-sided $P = .000$).

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60 ⁸ Propensity scores are commonly used in impact evaluation studies, often combined with matching
techniques or stratification to simulate random allocation to treatment and control group in observational
studies. The combination with regression analysis is somewhat less common, but more interesting for
scholars in development studies who are more familiar with regression techniques than with propensity
scores matching or stratification.

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⁹ We also estimate the same models with an alternative dummy equal to one if they *currently* have access to finance. The difference lies in the urban sample, where we distinguish current and ex-clients. All presented results are robust to using this alternative control variable.

For Peer Review Only

Web-appendix A: Time Preference Elicitation Instructions

“We will ask you some questions that will allow you to earn real money. We will ask you to make a choice between getting money after one month (i.e. in the month of September) and getting money after three months (i.e. in the month of November).

We will give you a paper on which we promise to pay you the amount you have chosen and we will specify the month when this amount can be withdrawn from our account at bank X (*name withheld*) in Mafinga. We will leave the original of this paper with you and give a copy of it to the bank. Upon presenting this original, the bank official will immediately pay you the amount written on the paper.

Note that you are not required to withdraw the money personally, you can also send a relative, friend, etc. with your original copy. In that case it is sufficient that this person shows the original paper and mentions your name.

You will have to make three choices.

The first choice you have to make is the following. You have to choose between getting 1000 TSH, which we will pay you after one month (i.e. in the month of September), or getting the total sum of 1500 TSH, which we will pay you after three months (i.e. in the month of November). What do you choose, 1000 TSH after one month or 1500 TSH after three months?

The second choice you have to make is similar. This time, you have to choose between getting the total sum of 1000 TSH, which we will pay you after one month (i.e. in the month of September), or getting the total sum of [fill in amount] TSH, which we will pay you after three months (i.e. in the month of November). So, what do you choose, 1000 shillings after one month or [fill in the amount] TSH after three months?

The final choice you have to make is again similar. This time, you have to choose between getting the total sum of 1000 TSH, which we will pay you after one month (i.e. in the month of September), or getting the total sum of [fill in amount] TSH, which we will pay you after three months (i.e. in the month of November). So, once again, what do you choose, 1000 TSH after one month or [fill in the amount] TSH after three months?”

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3 After the exercise the cheque was written out and given to the participant together with a
4 paper describing the procedures to cash the cheque:
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9 *With this paper you can withdraw this money from our account at microfinance bank X (name*
10 *withheld) in Mafinga. Upon presenting this paper, the bank official will pay you the amount written*
11 *on the paper. The following things are important:*
12

- 13
14 1. *It is important that you withdraw this money in the month specified on this paper; otherwise*
15 *the bank will not be able to pay this money.*
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17 2. *You are not allowed to write anything on this paper, as this might lead to the bank being*
18 *unable to pay the money.*
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20 3. *If you do not withdraw the money personally, but let a relative, friend, etc. do so, it is*
21 *sufficient that this person shows the paper and mentions your name.*
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Web-appendix B: Additional regressions

Table 2. Determinants of individual discount rates

	Model 2bis	Model 3bis	Model 4bis
Location (1 = rural; 0 = urban)	-3.111** (1.30)	-	-
Rural and did not visit urban centre in the last month (dummy)	-	-3.080** (1.33)	-3.362** (1.58)
Rural and did visit urban centre in the last month (dummy)	-	-3.155** (1.36)	-3.384** (1.59)
Age	0.006 (0.03)	0.006 (0.03)	0.006 (0.03)
Education (years)	0.275** (0.12)	0.277** (0.12)	0.280** (0.12)
Number of children	0.122 (0.30)	0.12 (0.30)	0.115 (0.30)
Lack of food shortages (dummy)	-1.015* (0.61)	-1.008* (0.61)	-1.033* (0.61)
Sex (1 = male; 0 = female)	-0.963 (0.62)	-0.958 (0.62)	-0.966 (0.62)
Never migrated (dummy)	0.607 (0.66)	0.608 (0.66)	0.601 (0.66)
Household size	-0.208 (0.22)	-0.207 (0.22)	-0.206 (0.22)
Self-employment (crop farming)	-0.109 (1.32)	-0.105 (1.32)	-0.101 (1.32)
Self-employment (livestock raising)	-0.621 (0.74)	-0.623 (0.74)	-0.602 (0.74)
Self-employment (non-farming)	0.545 (1.41)	0.553 (1.41)	0.594 (1.42)
Paid employment	-0.012 (0.73)	-0.009 (0.74)	0.051 (0.74)
Daily labourer	-0.182 (0.88)	-0.191 (0.88)	-0.267 (0.88)
Access to finance (dummy)	-	-	-0.351 (1.06)
Constant	16.094*** (2.10)	16.079*** (2.11)	16.385*** (2.26)
Log-likelihood	-3311.99	-3311.98	-3300.78
Chi-squared	130.70	130.71	130.89
Prob. > chi2	0.0000	0.0000	0.0000
N	1681	1681	1676
right-censored observations	459	459	458
interval observations	889	889	886
left-censored observations	333	333	332

* p < 0.10, ** p < 0.05, *** p < 0.01; Standard errors between brackets; All models have enumerator fixed effects.

Web-appendix C: Propensity scores

Table 1. Probit regression on living in urban area

	Coef.	S.E.
Age	-0.022***	0.004
Education (number of years)	0.166***	0.017
Number of children	-0.104**	0.042
Lack of food shortages (dummy)	0.170**	0.079
Sex (1 = male; 0 = female)	-0.708***	0.081
Never migrated (dummy)	-0.776***	0.080
Household size	0.042	0.033
Constant	-0.150	0.225
N	1694	
LR chi2	500.13	
Prob. > chi2	0.0000	
Pseudo R2	0.2697	

Figure 1. Distribution of propensity scores in rural and urban samples

