Irrational Financial Decision Making? Evidence From a Field Experiment in Rural Nigeria

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Abstract

Time inconsistent behavior of farmers in developing countries has puzzled researchers as it implies foregoing highly profitable opportunities: farmers keep postponing profitable investments which they were determined to do. The reasons for this are not yet well understood. Many researchers have pointed at self-control problems. Recently, in an important paper Giné et al. (2012) have proposed that other factors such as shocks may also be responsible for people's changes of plan. They carried out a field experiment to investigate whether shocks determine plan revisions but did not find evidence for it. This paper provides deeper insight into this issue by repeating Giné et al.'s experiment and improving the methodology in three important aspects. First, by using financial diaries we were able to measure shocks much more precisely. Second, we show that their estimating equation is wrongly specified. Finally, we take into account the boundary conditions implicit in the experiment. Contrary to Giné et al. we find a large effect of shocks on plan revisions.

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1 Introduction

The past years have seen a major increase in the academic interest in time-inconsistent preferences. Intertemporal choice plays an important role in determining people's level of welfare and particularly so for the rural poor in developing countries. A farmer who harvests only once a year needs to carefully plan his expenses for the coming year to ensure that his family will be able to consume sufficiently throughout this period, also at the very end. A well-known example of time-inconsistent behavior that does not seem in people's best interest concerns farmers' fertilizer use. Despite clear evidence of its profitability, farmers in developing countries often do not use fertilizer on their plots even if it was initially planned for (Duflo, Kremer & Robinson, 2011). Standard economic theory generally assumes exponential discounting, which entails a constant discount factor for future payoffs. People do not have incentives to deviate ex-post from their initial plans. However, when people have not committed themselves, it is often observed that they do not stand by these initial plans and decide to change their planned stream of expenditures if they get an opportunity to do so. Such dynamic time inconsistency thus violates standard economic theory and the underlying processes that cause people to do so are not yet well understood.

The reasons for this seemingly counterintuitive behavior have been the topic of debate. Hyperbolic discounting (or declining impatience) is commonly mentioned as an important underlying factor. This theory stems from behavioral economics and it implies that the discount rate over a given time interval decreases as that time interval is more distant. If a person with hyperbolic discounting gets an opportunity to revise previously made plans, he will assign more money or consumption to the immediate future as compared to his initial choice. Strotz (1955) was the first to describe a formal model to explain inconsistent planning for people who have such present-biased preferences and who have the freedom to revise earlier plans. Hyperbolic discounting has a very intuitive appeal as everyone personally has experienced a situation in which initial plans were abandoned in favor of immediate utility and this appeal has contributed to its popularity in behavioral economics and psychology. Existing evidence for hyperbolic discounting is, however, not yet clear-cut.

Alternative explanations for time inconsistent behavior have also been suggested. Giné, Goldberg, Silverman and Yang (2012) suggest three possible underlying causes of time inconsistent behavior: social interaction, shocks and misunderstandings. Particularly in rural areas in developing countries, there is a strong communal sense in which community members assist each other financially when any of them faces a shock. Furthermore, experiencing such a shock can influence one's optimal path of consumption. Finally, it is possible that during the initial elicitation of time preferences a respondent did not properly understand the procedure or made a mistake for which he might want to correct when given that opportunity. All of these factors can therefore contribute directly to observations that people in longitudinal field experiments frequently choose to revise their initial decision. Giné et al.

set up an experiment to test these empirically, but they did not find a significant association between revision behavior and social pressure, household shocks or financial sophistication. Particularly the absence of a significant relationship between shocks and time inconsistent behavior is counterintuitive and it requires further research. The current paper adds to this discussion using data from a field experiment in rural Nigeria.

This study is closely linked to the field experiment Giné et al. (2012) carried out in Malawi. Giné et al. first elicit individual time preferences in an experiment using a method labelled convex time budget (CTB) by Andreoni and Sprenger (2012a) where stakes equalled a month's salary. In half of the offers participants had to allocate vouchers between $t = 1$ and $t = 31$ days, which represents the near time frame, and in the other half between $t = 61$ and $t = 91$ days, the far time frame. The experiment involved a number of offers with different rates of return. In each household, one of the two spouses was randomly selected to be paid out one of their choices. If the selected offer was in the far period, the person was revisited by an interviewer some days before the disbursement of the first payment and was given the opportunity to revise his initial decision at the same rate of return as his initial decision. The number of days between the revisit and the first disbursement was randomly determined to be able to draw causal inferences from the effect of this time lag to disbursement on a person's decision to revise. Importantly, during this revision the old allocation was clearly shown to the respondent. The data from this experiment can be used to investigate both static and dynamic preference reversals.

This paper provides further insight into this issue by improving the methodology of Giné et al. in three important aspects. Firstly, weekly financial and health data and data on social events provide a detailed account of any possible shocks that respondents might have come across, which is used to verify whether the presence of such shocks influences a person's decision to revise. Secondly, the equation that is estimated in this paper is directly derived from utility maximization and turns out to be different from the equation estimated in Giné et al. Finally, in this paper the boundary conditions that are ingrained in the design of this experiment are taken into account. In the allocations that people have to decide on, consumption that is allocated to any period is restricted to be non-negative and not greater than amounts implied by the experimental budget. As a result, the allocations selected do not represent people's optimal levels of consumption if it involves a corner allocation and it is important to take this into account in the analysis. Contrary to Giné et al. we find a large effect of shocks on plan revisions.

In the theoretical part of this paper, an equation is derived by maximizing the respondents' utility function subject to the experimental budget. This equation importantly differs from the one used in previous research such as Giné et al. who used a more ad-hoc approach. Throughout the analysis a CARA utility function is assumed with intertemporal reference points. These intertemporal reference points are determined by people's situation, which

upon revisit includes the shocks that people have undergone. Estimating this equation further takes corner allocations into account by estimating a censored regression model, which is also an improvement as compared to previous specifications. Finally, the carefully measured data from the financial diaries provide evidence that shocks have a significant effect on people's decisions to revise earlier plans, in particular. Data from these financial diaries illustrate that time inconsistent behavior is often related to shocks that people were exposed to. This illustrates that in addition to previously proposed irrational explanations of time inconsistent behavior, including hyperbolic theory, rational explanations of time inconsistent also play an important role.

The remainder of this paper is organized as follows. The next section provides a literature review on the topic at hand. Subsequently, section three describes the design of the experiment and the sample of this study. The fourth section presents the theoretical framework, followed by empirical analyses in section five and the sixth section concludes.

2 Literature Review

2.1 Measuring Time Preferences

Most experiments have used multiple price lists (MPLs) to measure people's time preferences. In MPLs, participants have to choose which of the two available options is preferred: a smaller sooner payment or a larger later payment. Such choices are made a number of times with monotonically increasing interest rates. For very low interest rates, people tend to choose the smaller sooner payment, while most people will choose the larger later payment in the case of a very high interest rate. As the interest rate increases, there will be a point at which people switch from the smaller sooner payment to the larger later payment. To calculate individual discount rates based on this switching-point, linear utility and time-separable stationary preferences need to be assumed.
Commonly, discount rates from studies that use MPLs are extremely high: elicited discount rates often surpass 100% on an annual basis. Andreoni and Sprenger (2012a) discuss that violation of linear utility can result in upwards-biased discount rates when utility is in fact concave. The choice between two payments that participants face in an MPL is similar to having a discontinuous budget for the two time periods in an intertemporal optimization problem, as it can be summarized as

$$((1+r)c_t, c_{t+k}) \in \{(m,0),(0,m)\}$$

where r is the interest rate, k is the length of the delay between the first and the second payment dates (the time between c_t and c_{t+k}) and m is the experimental budget. The discontinuity of this budget does not limit choices of a person who has linear utility, but

choices are limited for a person with concave utility. This is because under concave utility the budget constraint is binding and people select a corner solution. Previous research on people's risk attitudes has indicated that while for moderate amounts of money people's utility tends to be linear, the utility becomes concave for larger amounts of money as people on average display significant risk aversion (Wakker, 2010). Therefore experiments in an MPL setting are likely to overestimate discount rates due to violation of the assumption of linear utility and this bias increases as the stakes involved in the experiment are larger.

Andreoni and Sprenger (2012a) propose to convexify the budget that people face in the elicitation of time preferences. In this way possible biases due to non-linear utility functions can be avoided. They propose a method they label the Convex Time Budget (CTB) method. In this approach, the questions asked are standard intertemporal constrained optimization problems, where the budget constraint can be described as

$$(1+r)c_t + c_{t+k} = m$$

where r, k and m are defined as in the MPL situation. In a CTB environment, the curvature of the utility and the shape of the discount function can be measured simultaneously by combining variations in delay length k and interest rate r. In their experiment using CTB, Andreoni and Sprenger find reasonable levels of discounting and curvature. The average level of the annual discount rate they found was 30%, which is indeed much lower than previous studies. They further reject linear utility on an aggregate level, although there is significant heterogeneity in the individual level of curvature of the utility function.

A recurring issue in the measurement of time discounting is the level of understanding of the participants as well as any possible errors they might make. In MPL settings it is generally found that 10-50 percent of the respondents switches more than once between the smaller sooner payment and the larger later payment (Andreoni & Sprenger, 2012a), and this poses a problem for analyses. In a CTB setting, errors and confusions are due to the more continuous nature of the questions more easily detected. An increase in the interest rate effectively reduces the relative price of vouchers allocated to the later period. A natural assumption to make here is that consumption in both periods is a normal good and therefore more is preferred to less. This yields the prediction that an increase in the interest rate ceteris paribus causes a monotonic increase in the amount allocated to the later period, so if $r_1 < r_2$, then $c_{1,t+k} \leq c_{2,t+k}$, where r_i is the interest rate and $c_{i,t+k}$ the amount allocated to the later period.

Furthermore, the majority of studies that measure time preferences are of a cross-sectional nature. In cross-sectional studies, people are asked to make decisions between a smaller sooner and a larger later payment for different front-end delays.[1] In such an experiment,

[1] A front-end delay is the number of days between the experiment and the first payout.

some offers require people to choose between a smaller payment at $t = 0$ and a larger later payment at $t = t_1$, while other offers involve a trade-off between a smaller sooner payment at $t = t_2$ and a larger later payment at $t = t_1 + t_2$ using different rates of return in the different offers. Some experiments additionally vary the length of the delay, i.e. the time between the first and the second payout to obtain additional information regarding the shape of the discount function. In a longitudinal approach, on the other hand, initially offers are provided with a certain front-end delay (for example the smaller sooner payment will be at $t = t_1$ and the larger later payment at $t = t_1 + t_2$). After some time has passed this same person is asked at $t = t_1$ to choose again between a smaller sooner payment at $t = t_1$ and a larger later payment at $t = t_1 + t_2$.

Only few studies have used a longitudinal design (e.g. Ainslie & Haendel 1983; Read & Van Leeuwen 1998). These studies differ in their design in a number of important details. Some studies clearly present the respondent with the previously chosen allocation upon revisiting, while others do not and this introduces differences in the interpretation of respondents' choices upon revisiting. Also, some studies consist of an initial set of choices and a subsequent opportunity to revise, while others repeat this process of choosing and revising for multiple rounds. The downside to this latter design is that participants may anticipate getting an opportunity to revise and this may influence people's decisions: they may not think as carefully about their initial choices because they know that they can still change this choice later. Moreover, until recently most of the longitudinal time preference studies used non-monetary rewards, but the use of monetary payments has been on the rise (e.g. Gine et al 2012; Yang & Carlsson 2012). The question is whether present bias should be expected ex ante in experiments that involve monetary rewards since from a psychological perspective the concept of present bias deals mostly with utility that stems from consumption rather than from money (O'Donoghue & Rabin, 1999). Finally, previous longitudinal experiments have mostly been carried out using a sample from a very specific population, for example drug abuse patients in Ainslie and Haendel (1983) or a class of MBA students in Sayman and Öncüler (2009). Although these two studies were designed identically, Ainslie and Haendel found that those who decided to revise their initial decision most frequently switched from the larger later to the smaller sooner payment, while Sayman and Öncüler found the exact opposite. Social background and social interaction in the period between the initial interaction and the revisit might have worked in exactly opposite directions in these two groups: while drug abuse patients might convince each other to get the smaller sooner rewards, MBA students might be persuaded to revise to the larger later payment after all. It is thus important to control for such factors.

Decision-making is often influenced by the opinions of other people in one's direct environment, for example other members in their household. The specific effect of others on a person's final decision in a time preference experiment depends on a number of things including the person's position in the household. Yang and Carlsson (2012) measured individual

and joint decisions of husband and wife in an experiment with a CTB design in rural China. They concluded that the husband's influence on joint decisions is stronger than the wife's and that the relative influence of the wife increases with her level of education, the length of their marriage and the number of children they have.

In a cross-sectional design a direct effect of calendar date is likely to influence people's behavior. For example, if a respondent realizes he has to pay school fees for his children in two days he may choose the smaller payment tomorrow to pay the fees rather than the larger payment in one month. In the absence of such an event, this same respondent might prefer the larger later payment. Such a static preference reversal can thus not readily be attached to a hyperbolic discounting function (Read , Frederick & Airoldi, 2012).

Additionally, an important challenge to the interpretation of behavior observed in experiments with a longitudinal design is that it is necessary to assume that all changes in the respondent's situation in the period between the original decision and the point of revision are observable. This is important because such changes might have affected their preference regarding the two different outcomes. If this is not controlled for, researchers might erroneously conclude that the respondents display hyperbolic discounting (Read et al., 2012).

Unlike almost all previous research on this topic, Giné et al.'s experiment and the one described here actually combine a cross-sectional design with a longitudinal design. A crucial observation at this stage is that different issues limit the conclusions that can be drawn from cross-sectional and longitudinal experiments and the next section will look into this difference in more detail.

2.2 Time Inconsistent Preferences

Many experiments measuring people's time preferences find that these are often not entirely consistent. Halevy (2012) distinguishes between three types of consistent behavior: stationarity, time invariance and time consistency.

Stationarity entails that preferences over temporal allocations depend on the difference in time between the first and the second payment moment, but not on the length of the period between the experiment and the first payment. Formally, stationary preferences $\succeq_t$ can be defined as[2]

$$(1) \qquad (x, t + \Delta_1) \sim_t (y, t + \Delta_2) \Leftrightarrow (x, t' + \Delta_1) \sim_t (y, t' + \Delta_2)$$

which holds for every $t, t' \geq 0, x, y \in \Re$ and $\Delta_2, \Delta_1 \geq 0$. Stationarity rules out static preference reversals in which people decide differently in a decision dealing with 'tomorrow' and 'in one month' as compared to 'in 2 months' and 'in 3 months'. This can be tested in a standard cross-sectional experiment that uses different front-end delays.

Time invariance implies that preferences are not a function of calendar time, so that only

[2] $\sim_t$ is used to denote that a person is indifferent between two options at time t.

the time difference between the two payments matters and not the moment at which this decision is taken. Formally, preferences $\{\succeq_t\}_{t=0}^{\infty}$ can be defined formally as time invariant if

$$(x, t + \Delta_1) \sim_t (y, t + \Delta_2) \Leftrightarrow (x, t' + \Delta_1) \sim_{t'} (y, t' + \Delta_2) \tag{2}$$

which again holds for every $t, t' \geq 0, x, y \in \Re$ and $\Delta_2, \Delta_1 \geq 0$. Hence this implies that one's allocation between 'tomorrow' and 'in one month' does not vary if one has to make this decision today or in 5 months.

Finally, *time consistency* refers to the dynamic stability of preferences, i.e. that a person's allocation between two periods in time is identical, independent of when this decision is made. Formally, preferences $\{\succeq_t\}_{t=0}^{\infty}$ are defined as time consistent if

$$(x, t + \Delta_1) \sim_t (y, t + \Delta_2) \Leftrightarrow (x, t + \Delta_1) \sim_{t'} (y, t + \Delta_2) \tag{3}$$

The experiment described here can analyze all three types of time inconsistent preferences.[3]

There is an important difference between inconsistencies measured in a cross-sectional design, which can shed some light on the validity of stationarity and reveal static present bias, and inconsistencies measured in a longitudinal design which may reveal time invariance or time inconsistencies. This difference, however, is not always consistently captured by previous studies (Read et al., 2012). Giné et al. (2012) find that dynamic preference reversals are significantly more frequently observed for those who also exhibited static preference reversals at the baseline measure, suggesting that although the two concepts are different there is some connection between the two.

Previous evidence for time inconsistent behavior is mixed. Meta-analysis of previous research shows that time consistent behavior is the most prevalent finding and that the intertemporal inconsistencies that are observed are in fact of diverse nature and likely to be heterogeneous in the population: while present-bias preferences are slightly more prevalent, both in a static an in a longitudinal setting, there is also always a fraction of people that do display future bias (Sayman & Öncüler, 2009). Present bias involves choices where for offers further into the future the larger later payment is preferred, but in offers with payouts closer to the present preferences shift to the smaller sooner outcome (e.g. Ainslie & Haendel, 1983; Read et al., 2012), while future bias implies that a person prefers the smaller sooner outcome for offers that are further into the future, but shifts preferences to the larger later outcome when deciding about offers that are closer in time. Such future bias tends to be found more

[3]Stationarity can be tested from the initial elicitation of time preferences by looking at differences in behavior between the 'near' and the 'far' time frame. Time inconsistent behavior is readily tested by checking whether respondents take the opportunity to revise their initial decision. Finally, time invariance can be checked by comparing the allocation selected upon revisit to the corresponding offer from the original elicitation, since at the time of the revisit the choice that people face resembles the choice between 'tomorrow' and 'in one month,' identical to the situation during the initial collection.

in experiments with a short front-end delay and a short delay between the two payments (typically less than a week). Sayman and Öncüler propose that people's notion of the present is extended to include moments that take place within the next week.

Recently a debate has started on whether the finding of static present bias in previous research is a result of people truly having present-bias preferences or whether it is in fact a result of differential transaction costs between the two payment periods as perceived by the respondents. Such differences can be due to physical costs and payment risks associated with receiving the payments. When the sooner payment is paid out immediately, people may face lower transaction costs than when they will have to collect their payment at a later point in time. Furthermore, respondents might have a higher confidence that an immediate payment will actually be paid out as agreed as compared to future payments. Sozou (1998) shows that the risk of the experimenter defaulting increases little as the moment of payment is further into the future. These factors alone might contribute to people preferring the sooner option when it is immediate, while they prefer the later option in the far time frame. Commonly however this is interpreted as evidence in favor of hyperbolic discounting. Lately, some experiments have been designed specifically to reduce the problem of differential transaction costs. Apart from taking measures to increase people's trust in actually receiving their payment, front-end delays are used. By ensuring that the sooner payment is no longer immediate, differences in transaction costs between the two periods are avoided. An example of an experiment using a front-end delay is Andreoni and Sprenger (2012a) whose most immediate payment takes place the next day and they do not find evidence for static time inconsistencies. All the same, not finding evidence for present-bias preferences when using a front-end delay may be due to the reduction of perceived differential costs. It might also be because the choices people face no longer include the notion of 'present' so that present bias does not play a role, which holds for example under quasi-hyperbolic preferences. This, however, directly contradicts Sayman and Öncüler's notion of the extended present. Andreoni and Sprenger (2012b) reintroduce differential risk into their experiment, meaning that the two payments would each be paid out with a certain probability and this probability was varied across treatments. When these risks differ across the two periods within a treatment participants indeed display present bias, while again they do not when there is no differential risk. The authors explain this by referring to people's disproportionate preference for certainty as was previously recorded among others by Allais (1953). Nonetheless, Cheung (2012) challenges this and claims that Andreoni and Sprenger's findings are directly due to the specific design of their experiment, as he finds that slightly changing the methods used, e.g. using an MPL set-up rather than a CTB, takes away the effect discussed by Andreoni and Sprenger entirely. Consensus thus has yet to be reached regarding the optimal design to measure risk and time preferences and how to effectively separate these two.

An alternative model for time inconsistencies is quasi-hyperbolic discounting, also known as $\beta - \delta$-discounting. In this model, the regular discount factor δ is used to discount future

consumption proportionally; on top of that there is an additional factor β that comes into play as a constant additional discount for all payoffs that do not take place in the present. Coller, Harrison and Rutstrom (2012) estimate a mixture model and find that in their sample the behavior of approximately half of the subjects follows the exponential discounting model, while the other half is consistent with a quasi-hyperbolic model. The authors, however, only looked at discounting behavior and did not include possible violations from expected utility theory, which can affect the results because of differences in curvature of the utility function across people. Read et al. (2012) further propose two possible alternative explanations for time inconsistencies beyond hyperbolic discounting: visceral arousal theory and temporal construal theory.[4] Both of these theories mainly focus on explaining time inconsistencies of consumption goods rather than monetary rewards and they do therefore not explain time inconsistencies found frequently in experiments using monetary rewards.

Finally, Read et al. (2012) in their longitudinal study also collected qualitative data on people's motives to revise earlier decisions or not. Most of these explanations were not related to any temporal change in their preferences. Many respondents who displayed impatient behavior by revising their initial choice of the larger later payment to the smaller sooner payment referred to "unanticipated needs or circumstances" (Read et al., 2012, p. 183) in their explanations. This introduces the possibility that time inconsistent behavior that is observed in experiments can in fact be the result of shocks that people come across rather than the effect of hyperbolic discounting. In such a situation, time inconsistent behavior might actually be a rational consequence of changes in one's situation, which opposes the previously proposed irrational explanations such as hyperbolic discounting.

2.3 Financial Diaries

As mentioned in the previous section, time inconsistent behavior can be the result of many different factors. Although commonly studies look at the shape of the discount function, the qualitative results from Read et al. (2012) suggest a role for external factors or shocks that people face in the period between the initial and the later visit. Such a shock might have changed the optimal intertemporal allocation. If a respondent has faced a large financial shock (e.g. the death of a family member) and the costs related to this shock were incurred just days before, this person might revise his initial decision by allocating more money to the sooner period to be able to compensate for the large expense.

Previous studies have been able to control for such shocks only to a limited extent. For exam-

[4] Visceral arousal theory proposes that the presence of stimuli can cause people to reverse their initial preference. For example, people might prefer a salad over a hamburger in the more distant future and this might still be the case in the present, *except* for when they are presented with the smell or the sight of bacon when they are given the option to revise. Temporal construal theory on the other hand puts forward that distant events are represented in an abstract way, while events that are closer in time are represented concretely. Goals of a higher order are then given more weight in the more distant future as compared to the present or near future.

ple, Giné et al. (2012) collected information on one's social interactions and their expected level of income for the next few months during the initial visit. Additionally, upon revisiting information was collected on whether actual income matched expected income and whether the household had encountered the death of a friend or family member since the initial visit. Although it is likely that such factors influence people's decisions to revise their time preferences, Giné et al. do not find any significant relations. The lack of a significant relation between household shocks and revision of intertemporal choices is somewhat unexpected, as unforeseen changes in one's situation in theory might very well change one's allocation of resources over time. It is possible that the lack of association between household shocks and revision behavior is due to the definitions used or the way it is measured. Also, there are also other types of shocks that might cause people to change their behavior.
In this study, financial diaries are used to measure shocks that people have faced. For these diaries, health and social events from all adult participants in the sample were collected; every week each household in the sample is visited by an interviewer who separately asks every adult household member detailed questions on all financial transactions of this person since the previous visit. These financial diaries provide detailed information on the financial flows, social events and shocks in the households that have taken place between the initial collection of the time preference data and the moment they are given the option to revise their decision. This detailed information can then be related to a person's decision to revise or not in order to gain further understanding of individual decision making in these situations.

3 The Experiment

3.1 The Sample

This experiment was done in the context of a larger study that examines the role of savings and risk in the demand for community-based health insurance. Hygeia Community Health Care (HCHC) provides low-cost community-based health insurance to the rural farming community in Northern Kwara state in Nigeria, funded by the Health Insurance Fund (HIF) with technical support from PharmAccess Foundation. Currently nearly 35,000 low-income people have enrolled in the scheme. The research project is set up with the aim to understand determinants of people's demand for health insurance which can further improve the design of the scheme.
Therefore a sample of 240 households was drawn from the local government area Edu in Northern Kwara State in Nigeria and it was stratified by insurance status, by village and by urban or rural status. The households in this sample were randomly split between the treatment and the control group. In the treatment group, households were visited on a weekly basis by an interviewer who collected financial diaries for the period of one year. For the 120 households in the control group only the baseline and endline questionnaire were

collected to quantify the direct effect of the financial diaries instrument. The sample for the experiment discussed here is limited to the treatment group from whom the financial diaries were collected as this data is used in the analyses. It therefore consists of 28 households in the area of Bacita, 50 around Lafiagi and 42 households in the area of Shonga and all of these three areas are located in the local government Edu. Villages that were more than 15 kilometers away from the urban centers were excluded from the sample. As the research questions of the larger study are related to the demand for health insurance, the villages in the sample need to be relatively closeby the program's health clinics, which are based in the urban centres. Villages with too few people were also excluded from the sample.

A household in this study is defined as people who eat and live together in the house for at least half the time and who share a collective fund with others in the same household. All adult members of the households in the sample were targeted to be interviewed.[5] In Nigeria, polygamous marriages are very common, and in most cases the children of the different wives all belong to the same household, which can cause households to be fairly large. Furthermore, in many cases sons and daughters over the age of 18 still live with their parents and so do other relatives. As a result, the number of people interviewed within a household varies widely across the participating households from a minimum of 1 to a maximum of 7 adult household members.

Altogether, 303 adult household members were targeted to be in the study. Out of these, 293 persons (96.7%) were successfully interviewed in the first round.[6] Although all respondents were revisited for the second round of the experiment, the option to revise their earlier decision was provided only to the 90% of the participants for whom the computer selected an offer from the far time frame to be paid out.[7] In this study this amounted up to 255 respondents. Out of this targeted group, 242 respondents (94.9%) were successfully revisited in the second round. The reason that the attrition in this experiment is so low is that all participants had agreed to participate in the larger study on the demand for community-based health insurance. As a result, all households in the sample were visited on a weekly basis by a financial diary interviewer in the period between the first and the second round of the games. Furthermore, the payments that the participants could earn in this experiment were described as the compensation for participating in the financial diaries. This made the participants eager to take part in the experiment. During the data collection, partici-

[5] Adult members who are still pursuing their education are excluded from the sample because they do not yet have significant individual financial flows. Nonetheless, in case the head of the household or one of the spouses happens to be a student, this person is still included in the sample, as it is expected that they have individual financial flows important to the household.

[6] In the first round, 298 people in the targeted sample were interviewed, but due to a problem on the first day of data collection, five interviews are deemed of insufficient quality to continue with. The remaining 5 participants could not participate for different reasons.

[7] This probability had to be lower than 100% as we had indicated to the participants that the computer could select any of the questions they answered. If households in the sample would interact and realize that all of them were paid out in the late period, this could have affected their level of trust in the experiment and it could have affected the responses of the people who had not yet participated in the experiment.

pants expressed their satisfaction with participation in the experiment and especially to have earned an amount of money. Finally, the sample size of this experiment is somewhat smaller compared to similar previous studies (e.g. Giné et al., 2012) due to the frequent nature of the visits (i.e. the weekly interviews with regards to the collection of the financial diaries).

3.2 Baseline and First Round

Figure 1 presents the timeline of the data collection in this study. During the experiment, two sets of interviewers concurrently collect data as is illustrated by the red and the blue squares in the figure. The blue squares represent the financial diary (FD) interviewers who started with the collection of the baseline questionnaire and continued to visit the households on a weekly basis for the financial diaries study, while the red squares indicate the activities of the games interviewers who did data collection for the first and second round of the games. The data collection took place between April and July 2012.[8]

The first round of games consisted of the collection of the time preference games and the expectation game. The time preference game aimed at measuring both static and dynamic time inconsistencies using Andreoni and Sprenger's (2012a) Convex Time Budget (CTB) method; the details of the experiment are summarized in Table 1[9]. In each offer, the respondent was asked to divide ten vouchers between a bowl that represented a sooner payment (the 'sooner' bowl) and another one representing a later payment (the 'later' bowl); this setup is illustrated in Figure 2, where an offer from the Near time frame (questions 1-4) was used as example. Vouchers put in the 'later' bowl (a_{t+k}) were consistently worth 200 Nigerian Naira (which is approximately equal to 1 Euro), while vouchers put in the 'sooner' bowl (a_t) were valued differently in the different offers, as illustrated in the fifth column of Table 1. The gross interest rates implied by these different voucher exchange rates are thus 0%, 33%, 67% and 100% respectively.[10] However, these were not mentioned explicitly to the participants during the experiment.

The four offers in the 'Near' (questions 1-4) and the 'Far' time frame (questions 5-8) are identical except for the periods involved; while the Near time frame asked people to divide the vouchers between 'tomorrow' and 'in 1 month', the Far time frame asked about 'in 2 months' and 'in 3 months'. The experiment always started with the offers from the Near time frame, then there was an intentional break during which the expectation game was played (this will be explained shortly) and finally the Far time frame offers were asked. This

[8]The baseline was collected in March, the first round of games in April and early May and the second round in June and early July.

[9]Most data were collected in April, so that the delay between 'tomorrow' and 'in 1 month' was 29 days and the delay between 'in 2 months' and 'in 3 months' was 30 days. However, data collection still continued for a few days in May, so that for those respondents who were interviewed in May, the delay between the two payments was in fact 30 days in the first four offers and 31 days in the last four. Controlling for this difference in delay does not influence the results.

[10]The gross interest rate is defined as $r = \frac{a_{t+k}}{a_t} - 1$. These percentages were determined based on the results from a pilot study.

break was intended to reduce the participants' efforts to appear consistent across the near and the far time frame by consciously giving the same answers in the two parts. The order of the Near and the Far time frame was always the same, and so was the order of the offers within the time frame, but previous research (e.g. Andreoni & Sprenger, 2012a and 2012b; Giné et al., 2012) concluded that this does not bias the results.

The offers in the time preference game were incentive-compatible as participants knew that at the end of the experiment one of their answers would be randomly selected to be paid out in cash, either in the Near or the Far time frame. This random-lottery method is extensively used in experimental economics and it has been shown that the answers given in experiments applying the random-lottery method are not biased in comparison to a design in which each choice is paid out (e.g. Starmer and Sugden, 1991). A final advantage of this random-lottery method is that it avoids having problems due to income effects of previous offers since people will not know which offer was selected until the end of the experiment. The stakes in this experiment are fairly high: the maximum possible payout of 2,000 Naira is equal to approximately three days of work for business men and people employed otherwise.

Serious measures were taken to ensure that there were no perceived differential risks involved with the different payment methods. Since all participants were visited on a weekly basis by an interviewer from the Financial Diaries study, there was a high level of trust that these vouchers will actually render the amount of money that is promised to them. Payments were made by a visit from the interviewer on the specific day to exchange the voucher they had received after playing the game for cash. This voucher contained the contacts of the coordinator of the study to make sure that the respondents could easily contact him in case of any problems. In line with similar previous studies, there was a front-end delay of one day before the earliest payment to further reduce any possible perceived differences in the level of trust and the transaction costs across the near and the far time frame. This implies that the closest time of disbursement was designed to be the next day, rather than that same day.

After the first half of the time preference game, the expectation game was played. In this game, the participants were asked some questions regarding their expectations towards their income over the coming period if the respondent was a business man or employed otherwise. In case the respondent was a farmer, he was asked when the next harvest was expected and how much this would be approximately. Respondents were provided with four intervals that were based on their estimated minimum, average and maximum income and were asked to divide ten beans over these four intervals to illustrate the expected distribution of their income.

In sum, in this time preference experiment the front-end delay (i.e. the timing of the earliest payout in the question) and the gross interest rate were varied and a question in the Far time frame was selected for payout in 90% of the cases. This percentage was chosen to ensure that the sample was large enough for the analyses of the plan revision data from this follow-up visit. Finally, after the completion of each of the time frame, people were asked to indicate

why they had chosen those specific allocations.

3.3 Second Round

Two days before the first payout of the Far time frame was due, all respondents were visited again unexpectedly to participate in the second round of the games.[11] Data from the financial diaries illustrate that none of the farmers harvested between the initial visit and the second round. The financial situation of most people had therefore tightened, as the economy in this area is highly dependent on farming products. Harvesting was expected to start within a few weeks after the revisit though.

The second round started off with the revision game. In a setting identical to the one in Figure 3, the interviewer clearly showed the respondent his initial allocation and the respondent had to select his preferred allocation again and was asked to motivate this choice. In line with Giné et al.'s design, but contrasting most other longitudinal studies that looked at dynamic time inconsistencies, the old allocation was presented saliently to the respondent at the time of the revision. In this way the interviewer bias is limited, since it balances the encouragement to reproduce the initial allocation, shown clearly and easily reproducible for the respondent on the one hand and the encouragement to change one's allocation on the other hand. Respondents might think that a revision is expected from them since they are revisited and given the opportunity to revise in the first place. Those respondents that had already been paid out for the time preference game, i.e. whose offer selected was in the near time frame skipped this part.

Subsequently the expectation game, which was similar to the expectation game in the first round, was played with all respondents, followed by a risk attitude game. This game was designed along the lines of Holt and Laury (2002) and involved 15 questions in which people had to choose between a risky lottery and a safe lottery. Across the different questions, the probability of obtaining the high outcome in the risky or the safe situation varies, although the order at which this is presented is the same for everyone. While the first five questions were framed explicitly as a gain, the next set of five questions was framed as a mixed gamble: participants were told that they would get some amount of money for sure, and the lottery they select would determine how much they would get on top of that or how much they would lose from it. The last five questions were framed as losses: the certain amount participants would receive is now larger, and the lottery that the participant chose determines how much he would consequently have to return. Across all 15 questions, the net amounts involved in the two lotteries were the same and at the end, the computer selected one question that would determine how much the participant had earned to ensure that questions were truthfully answered. Finally, a stock-taking questionnaire was administered

[11] Ideally the interviewer would have gone to the household the day before the first payout was due, but due to the unannounced nature of the visit, the interviewers went there two days in advance giving them an extra day to meet the person in case that person was not present initially.

with the participants, which provides some indication on the change in the financial situation of the household and the respondent as compared to the baseline.

3.4 Differences with Giné et al.'s design

There are some important differences in design between Giné et al.'s study and the present one. In the first place, the time lag between revisit and disbursement is not randomly determined in this study, but is always 2 days. This is due to the fact that this study uses a smaller sample which would significantly reduce the power of the test.[12] Moreover, during the initial elicitation of time preferences, the present experiment also uses a condition in which the rate of return that people face is 0, i.e. an offer in which a voucher is worth as much tomorrow as it is in one month. This allows us to check the common assumption of impatience, entailing that consumption is ceteris paribus preferred sooner rather than later. Given the limited financial system present in the study area, it is possible that people use the delayed payout moments in this experiment as an informal savings mechanism, meaning that the payments from this experiment are used to smooth their consumption. Analyses will shed further light on this. It also provides some indication of the level of trust people have in actually receiving their payment: if people decide to allocate money to the later period in this offer even if it does not yield any interest it indicates that the perceived risk across the different moments of payout is relatively similar. Finally, in this experiment each person whose time preferences are elicited during the initial visit is paid out, rather than only one payout per household. As compared to Giné et al.'s experiment, this is likely to further reduce the impact of social interactions within a household as each person receives payments according to his own preferences. In their experiment people were paid according to the preference of one of the spouses, which is likely to be cause of a discussion after the initial visit. Also, while Giné et al.'s experiment was only carried out with husband-wife pairs, the current experiment was carried out with all adult members that were part of the household.

4 Theoretical Framework

In this analysis, we assume a time-separable utility function with a quasi-hyperbolic discount function, which is in line with other studies that have studied time preferences (e.g. Andreoni & Sprenger 2012a; Yang & Carlsson 2012). The maximization problem that a respondent

[12] The costs of collecting financial diaries did not allow for a larger sample size.

faces when taking any decision on intertemporal choice can be described as follows:

$$\max_{c_1,c_2\geq 0} \quad U(c_1,\omega_1,c_2,\omega_2) = \beta_1 u(c_1,\omega_1) + \beta_2\delta u(c_2,\omega_2) \tag{4}$$

$$\text{s.t. } (1+r)c_1 + c_2 = m$$

(5)

where $u(\cdot)$ is the instantaneous utility function, m is the experimental budget, and c_1 and c_2 are the monetary rewards from the experiment in the different time periods, meaning that in the Near time frame they represent consumption tomorrow and in 1 month, and in the Far time frame in 2 months and in 3 months. ω_t can be interpreted as the expected intertemporal reference point at time t. Furthermore δ is the regular discount factor, assumed to be strictly positive, $\delta > 0$, and β_t is the present-bias parameter, which takes a value 1 when utility is immediate and a constant value β for any future payment $0 < \beta \leq 1$. This function thus nests exponential discounting when $\beta = 1$, while $\beta < 1$ indicates present bias. In the later period, this present-bias parameter always take the values $\beta_2 = \beta$, while for the sooner period the value of β_1 depends on the time frame of the specific offer.

The first order conditions of this specification can be derived and combined to the Euler equation:

$$\left.\begin{aligned} \beta_1\frac{\partial u(c_1,\omega_1)}{\partial c} &= (1+r)\lambda \\ \beta\delta\frac{\partial u(c_2,\omega_2)}{\partial c} &= \lambda \end{aligned}\right\} \quad \frac{\partial u(c_1,\omega_1)}{\partial c} = \delta(1+r)\frac{\beta}{\beta_1}\frac{\partial u(c_2,\omega_2)}{\partial c} \tag{6}$$

where λ is the Lagrange multiplier. To obtain a specification that can be tested empirically, it is necessary to make an assumption regarding the shape of the utility function. To ensure the most flexible specification of the intertemporal reference point, a CARA utility function shall be assumed with intertemporal reference points. As compared to the CRRA specification, the advantage of a CARA specification is that it is not necessary to restrict the possible allocations people select to $c_i \geq \omega_i$. The utility function is assumed to be

$$u(c,\omega) = -\frac{1}{\rho}\exp(-\rho(c-\omega)) \qquad \text{with} \qquad \frac{\partial u(c,\omega)}{\partial c} = \exp(-\rho(c-\omega))$$

where ρ is the risk aversion parameter. The combined first order conditions in Equation 6 can be rewritten:

$$(-\rho(c_1-\omega_1)) - (-\rho(c_2-\omega_2)) = \ln(\delta) + \ln(1+r) + \ln\left(\frac{\beta}{\beta_1}\right)$$

$$c_2 - c_1 = \frac{1}{\rho}\ln(\delta) + \frac{1}{\rho}\ln(1+r) + \frac{1}{\rho}\ln\left(\frac{\beta}{\beta_1}\right) - (\omega_2-\omega_1) \tag{7}$$

The intertemporal reference point ω_t is a function of a number of background characteristics,

the coefficients of which vary between consumption allocated to the sooner and to the later period and an individual fixed effect that differs over time. The last term in Equation 7 therefore equals

$$\omega_{2i} - \omega_{1i} = \Delta\omega_i = \gamma X_i + \Delta\mu_i \tag{8}$$

The coefficients γ are not restricted to be equal across time frames. Also, from the budget constraint it is known that $c_1 = (m - c_2)/(1 + r)$, so that $c_2 - c_1 = ((2 + r)c_2 - m)/(1 + r)$. Therefore, Equation 7 can be rewritten to

$$\frac{2+r}{1+r}c_2 - \frac{m}{1+r} = \frac{1}{\rho}\ln(\delta) + \frac{1}{\rho}\ln(1+r) + \frac{1}{\rho}\ln\left(\frac{\beta}{\beta_1}\right) - \gamma X - \Delta\mu \tag{9}$$

The discussion presented so far only holds for interior allocations. By design of the experiment, the amount respondents can allocate to the later period is restricted to be non-negative and not greater than the experimental budget, 2,000 Naira, so $0 \leq c_2 \leq 2,000$. Thus, if one's optimal allocation is at or outside these bounds, a corner allocation is selected. It is important to take the possibility of corner allocations and its effects into account in the empirical model. Throughout this paper, that shall be done by estimating a censored regression model where the dependent variable $y = ((2 + r)c_2 - m)/(1 + r)$ is censored to be between $-2,000/(1 + r) \leq y \leq 2,000$.[13] This is an important advance compared to Giné et al.'s paper who ignored the presence and the impact of corner allocations.

This optimization is done by every respondent for every offer where an allocation over two periods has to be decided upon (both in the initial experiment and in the revisit). In the revisit, however, data from the financial diaries, X^2, have been added to people's background characteristics, X^1. The empirical specification of this model is

$$\begin{aligned} y_{il} =& a + b_1\ln(1+r_l) + b_2\text{Near}_l + v_1 X_i^1 + v_2\text{Near}_l X_i^1 + w\text{Rev}_l X_i^2 + \nu_i + \varepsilon_{il} \\ \text{where} \quad y_{il} =& \frac{(2+r_l)c_{2il} - m}{1+r_l} \qquad a = \frac{1}{\rho}\ln(\delta) \qquad b_1 = \frac{1}{\rho} \qquad b_2 = \frac{1}{\rho}\ln\left(\frac{\beta}{\beta_1}\right) \end{aligned} \tag{10}$$

where l represents the offer and i the individual. X^1 are the variables collected at baseline that come into play in all decisions, while X^2 are data from the financial diaries on shocks that have occured in the period between the initial experiment and the second round. Furthermore, Near and Rev are dummy variables that take a value 1 when the offer under consideration is respectively in the Near time frame or the revision opportunity. The equation is estimated for each offer l of each individual i. Finally, the specification is estimated using a Tobit model with two-sided censoring of the dependent variable. The introduction of the individual fixed effects can be interpreted here as dropping the restriction that the

[13] A future research extension to the present study shall be to estimate the full optimization of this problem, including estimation of all Kuhn-Tucker conditions.

discount factor δ is equal for the entire sample. Given that the discount factor represents a subjective valuation of future income, it could differ across people. The full model including fixed effects is used to test the robustness of the results in this study.[14] The main model analyzed in the next section is therefore Equation 10 without the fixed effects ν_i.

The specification derived here thus illustrate that changes in people's perception of their intertemporal reference points between the initial experiment and the revisit can change the optimal allocation upon revision. Time inconsistent behavior can result from changes in reference point, which can be considered a rational source of time inconsistencies, or they can result from hyperbolic discounting, which is an irrational source of time inconsistency. The analysis will shed more light on this in the next section by looking at the specific determinants.

This model can test the types of time inconsistent behavior discussed in Section 2.2.
Stationarity was previously defined as:

$$(x, t + \Delta_1) \sim_t (y, t + \Delta_2) \Leftrightarrow (x, t' + \Delta_1) \sim_t (y, t' + \Delta_2)$$

In this experiment, stationarity implies that the optimal intertemporal allocations from the allocations in the near and the far time frame are identical. This can readily be assessed by testing whether the total effect of Near in Equation 10 is equal to zero, i.e. $b_2 + v_2\bar{X}^1 = 0$. In a situation where the interactions between time frame and controls are linearly transformed to have a mean of 0, this requires that $v_2 = 0$ and $b_2 = 0$, which implies that $\beta_1 = \beta$. Under stationarity people do not discount the future differently than they discount the present.
Time invariance ensures that people's decisions about the near time frame are independent of when these decision are taken.[15] The formal definition of time invariance is

$$(x, t + \Delta_1) \sim_t (y, t + \Delta_2) \Leftrightarrow (x, t' + \Delta_1) \sim_{t'} (y, t' + \Delta_2)$$

In terms of Equation 10, time invariance requires that $w = 0$, meaning that there is no influence of the change in background variables on a person's allocation.
Finally, time consistency is defined as

$$(x, t + \Delta_1) \sim_t (y, t + \Delta_2) \Leftrightarrow (x, t + \Delta_1) \sim_{t'} (y, t + \Delta_2)$$

[14] In this model that includes the individual fixed effects, people who always select one of the corner allocations (always allocate everything to the later period or always everything to the earlier period) are dropped from the analysis since for these people the individual discount factor is not identified. It is well-known that in a non-linear model such as the Tobit model, the introduction of fixed effects biases the estimated parameters in a dataset where the number of observations per person is limited (Heckman, 1981). Greene (2002) however illustrate that for datasets with at least 8 observations per person the bias is fairly limited in a Tobit model.

[15] The same holds true for the allocations in the Far time frame, but that cannot be tested in this study.

This entails that people make identical allocations regarding payouts in June and July independent of whether this is decided upon in April or in June. Empirically this is in fact a combination of stationarity and time invariance, so that time consistency holds if $b_2 = 0$, $v_2 = 0$ and $w = 0$ (in a situation where all controls are transformed to have a zero mean). All three types of time inconsistent behavior shall be tested in the following analyses.

Finally, Giné et al. (2012) in their paper looked at the difference in intertemporal allocations in the initial experiment and in the second round to test for time consistency. When both allocations are interior, this difference is expected to be 0 when behavior is consistent. Any variable that correlates significantly with this difference therefore contributes to inconsistencies. This specification has the advantage that if both allocations are interior, the individual fixed effects drop out of the equation.
This equation is composed of the difference between the allocation to the later period upon revision and initially regarding the one option randomly selected to be paid out to a respondent. Using the expression in Equation 9 for the two different allocations, this can be written as

$$\frac{2+r}{1+r}(c_2^{REV} - c_2^{R1}) = \frac{1}{\rho}\ln(\beta) + \Delta\omega^{REV} - \Delta\omega^{R1} \tag{11}$$

Importantly, this difference is only a valid result of the previously presented optimization problem if both the original and the revised allocation are interior allocations. Giné et al. ignore this fact and actually estimate a different specification that is not derived from utility maximization. The empirical specification that shall be estimated here is:

$$\frac{2+r_i}{1+r_i}(c_{2i}^{REV} - c_{2i}^{R1}) = a + cX_i^1 + dX_i^2 + \varepsilon_i \tag{12}$$

where c_{2i}^{REV} is the consumption allocated to the later period during the revision, and c_{2i}^{R1} the corresponding consumption to the later period during the initial experiment for the question selected for payout. In this estimation the interest rate varies at an individual level, since only one observation per person is included.
It is important to realize nonetheless that under time consistent behavior this specification is only 0 in expectation for interior allocations. If the allocation from the initial experiment or upon revision is a corner allocation, the individual effect does not drop out and it is therefore impossible to conclude readily that variables that are correlated with the dependent variable contribute to time inconsistent behavior.

It is useful to directly compare the specifications presented here to those estimated by Giné et al. in their paper. Assuming a CRRA utility function, the two main equations Giné et

al. estimate are:

$$\ln(c_{2il}) - \ln(c_{1il}) = a + b_1 r_l + v X_i^1 + \varepsilon_{il} \tag{13}$$

$$c_{1i}^{REV} - c_{1i}^{R1} = b_1 r_i + v X_i^1 + w X_i^2 + \varepsilon_i \tag{14}$$

where Equation 10 and Equation 13 are related and so are Equation 12 and Equation 14. The most notable difference in the specifications that the equation in this paper involves the way that the interest rate enters the specifications: in the current paper, this happens primarily through a linear transformation of one side of the equations with the fraction $(2+r)/(1+r)$. Additionally, the interest rate enters as an explanatory variable in Equation 10, but it does so in a non-linear way. In Giné et al.'s specification, however, the net interest rate simply enters linearly as one of the explanatory variables, which could lead to substantial differences in the results. Furthermore, as mentioned previously, Giné et al. handle corner allocations differently. In the estimation of Equation 13, corner allocations are omitted because of the specification ($\ln(0)$ is not identified), while in the estimation of Equation 14, the issue of corner solutions is entirely ignored. This can further introduce a significant bias in the results.

5 Experimental Results

The data collected in this study can be divided in some subgroups and the summary statistics for these variables are shown in Table 2. Due to the large proportion of households with a polygamous marriage (60%), the sample consists only of 40% men. Detailed summary statistics further show that the median respondent is 37.5 years, lives in a village with 1,770 inhabitants, does not hold any formal education and lives in a household with five children below the age of 18. A large majority of the sample is Muslim and belongs to the main ethnic tribe in this region, the Nupe. The median and average age are somewhat lower than in comparable studies as this sample is not restricted to married couples only but also includes adult children that still live in the household. Few people in the sample use formal financial instruments such as bank accounts, whereas informal financial instruments are widely used. This is illustrated by the fraction of people who is a member of a cooperative or an ajo (an informal saving and microfinance mechanism) as well as by the fraction of people that indicates they could borrow 20,000 Naira (roughly 100 Euros) from people in their social network in case of an emergency.

Explanations of how the different variables were constructed can be found in Appendix 1. For some variables further explanation is required. The initial baseline and the stocktaking questionnaire during round 2 included questions about different types of assets and liabilities that people hold, which allows us to calculate a household's net worth (by subtracting the liabilities from the assets). For completion the total assets and liabilities are also looked

at. As aforementioned, the sample consists of rural areas where people's economic situation heavily depends on farming; even those who are employed or in business often work in relation to farming, for example selling the farming products. Between the baseline and the second round of the games, none of the farmers harvested; this is clearly visible from the differences in liabilities and assets as shown in Table 2b. People's assets have decreased over this period, while their liabilities tend to have increased, both of which cause the net worth to go down. These numbers further illustrate that the experimental budget of 2,000 Naira per person is significant as it is equal to the assets of the median respondent. People were also asked to indicate how many of a list of different assets they own, including the number of watches, chairs and sewing machines. Together with data on prices of the different goods, this provided information about the value of their fixed assets. These fixed assets are not taken into account in the net worth, as they enter separately into this analysis as people's wealth. The wealth variable is at a household level while the data on assets and liabilities are on an individual level. Furthermore, the baseline questionnaire contained a section that aimed at measuring the way respondents deal with their financial situation, from this four variables are created (*planning*); a more detailed description can be found in the Appendix.[16]

Table 3 shows the distributions of the amounts of money that are allocated to the later period in the different offers. Since the vouchers allocated to the 'later' bowl are consistently worth 200 Naira, the amounts listed in this table can easily be converted back into the number of vouchers the person allocated to the later period (and thus also the number allocated to the sooner period). As aforementioned, the first four offers deal with the near time frame, while questions 5-8 concern the far time frame. The detailed statistics illustrate that as the interest rate increases, the average amount allocated to the later period increases monotonically. The table further shows that the allocated amounts at the later period are rather similar across time frames at given interest rates (i.e. the amounts in question 2 are similar to those in question 6). Nonetheless, for all strictly positive interest rates the average amount of money allocated to the later period is marginally higher in the 'far' time frame than it is in the 'near' time frame. This indicates that the aggregate results mildly suggest static present bias, but this evidence is not yet convincing. Another observation is that at the questions in which allocating vouchers to the later period did not yield any interest (questions 1 and 5), more than half of the participants allocated a positive number of vouchers to the later period. Most utility functions include the assumption of impatience which would imply that people prefer their consumption immediately. Therefore the fact that people do mix their allocations can be interpreted as evidence that the transaction costs across the two time periods have successfully been equated and that people's level of trust in actually receiving

[16]In the questions from which the different *planning* variables were created, there were a few subquestions that had a nonresponse. In the current analysis, the mean has been imputed for these nonresponse questions, but the results are similar when these observations are omitted.

their payments is significant.
Table 3 reports the fraction of answers that involve a corner allocation. Overall, interior and corner allocations were almost equally prevalent in the selected allocations by the respondents, suggesting that participants understood that they were not limited to either type of choice. Table 4 further delves into this by looking at the number of corner allocations chosen by each person. Although a significant number of respondents (88 respondents, so 30%) chose corner allocations in all offers, 53 of them (18%) only selected interior allocations. The majority however varied between corner allocations in some offers and interior allocations in others and this finding is comparable to results from other experiments (e.g. Andreoni and Sprenger, 2012a). This heterogeneity in choices thus provides further evidence that it is important to measure the curvature of people's utility functions when studying people's time preferences. Additionally, it stresses the importance of specifying an empirical model that can account for the presence of corner allocations, as was discussed in the previous section. Also, in the introduction it was already mentioned that errors and confusions are more easily detected in the present CTB setting since checking for non-monotonicities is straightforward. In the data, we can identify pairs of choices where the only change is the increase of the interest rate to the next level. An example of such a pair is the combination of question 1 (0% interest) and question 2 (33% interest) and our data provide us with 6 combinations for each participant. Out of these 1758 pairs, as many as 1722 pairs (98%) show a non-decreasing relation between the interest rate and the number of vouchers allocated to the later period. Furthermore, although there is some individual heterogeneity in the number of consistent pairs as illustrated in Table 5, this is limited for all inconsistent pairs come from 25 participants, which is 8.5% of the whole sample. This suggests that the level of understanding of the experiment is good among the participants.
The next subsection will test for the different types of time inconsistent behavior as described in Section 2.2 and the Theorerical Framework.

5.1 Time Inconsistent Behavior

To get a first idea about the validity of stationarity in the sample, four combinations can be identified for each person where only the time frame changes: an example of such a pair is question 1 and question 5. Out of 1,172 such pairs, 650 (55%) are identical and 882 (75%) differ by a voucher or less. Of the 522 non-identical pairs, 305 (58%) are present biased, meaning that *fewer* vouchers are allocated to the sooner period in Far time frame than there are in the Near time frame. The remaining 217 pairs (42%) are future biased meaning that in the far time frame *more* vouchers are allocated to the sooner period as compared to the near time frame. An extreme example of an allocation that displays *present bias* is when a person decides to allocate all his money to 'tomorrow' in the near time frame (so 10 vouchers are allocated to 'tomorrow' and 0 to 'in 1 month'), while in the far time frame this person decides to allocate everything to the later period (thus 0 vouchers to 'in 2 months'

and 10 vouchers to 'in 3 months'). Lastly, in line with previous research, the fraction of static consistent pairs increases as the interest rate increases; while at 0% interest, 45% of the pairs are consistent across the time frames, this fraction increases to 53% at the interest rate of 33%, and even 65% at the interest rate of 100%. The majority of people's allocations adhere to stationarity, but a large number of choices can nevertheless be classified as present biased or future biased.

A similar exercise can be done for time invariance: out of 242 people that were revisited, 102 (42%) selected the same allocation during this second round than they had for a similar question during the initial experiment. Of the 140 people who chose a different allocation, 90 people (64%) allocated more to the later period in the initial experiment than they did in the revisit.

Regarding time inconsistency, 105 people out of the 242 who were revisited (44%) chose to revise their initial decision. For those who revised, 76 people (72%) allocated fewer vouchers to the later period upon revision than they had done initially. The magnitude of the revisions people made varies widely.

These numbers thus indicate that a significant share of the data displays time inconsistent behavior. To investigate this more rigorously and look in more detail into factors that are correlated with time inconsistent behavior, Equation 10 from the theoretical framework shall be estimated:

$$(15) \qquad y_{il} = a + b_1 \ln(1 + r_l) + b_2 \text{Near}_l + c_1 X_i^1 + c_2 X_i^1 \text{Near} + d X_i^2 \text{Rev}_l + \nu_i + \varepsilon_{il}$$
$$\text{where} \quad y_{il} = \frac{(2 + r_l) c_{2il} - m}{1 + r_l}$$

This equation is estimated for all offers answered by all participants (so 9 observations per person for those who were revisited and 8 observations for the others). The model is estimated using a few different specifications, the results of which are shown in Table 6.

It is instructive to first test the three different concepts of time consistent behavior as defined in Section 2.2. Stationarity, which requires that the coefficient on the time frame and those on the interactions of the controls and the time frame are jointly 0, is rejected in an F-test ($p = 0.0369$): respondents discount tradeoffs in the future different from the way they discount tradeoffs closer to the present. Next, the hypothesis for time invariant preferences, $w = 0$ in Equation 15, is also rejected ($p = 0.0039$), which implies that people do not choose the same allocation in the first round as they do in the second round on an offer in the Near time frame. Finally, time consistency, which requires $b_2 = v_2 = w = 0$ in Equation 15, also does not hold ($p = 0.0020$), suggesting that people revise their behavior if they are provided an opportunity to. Therefore on an aggregate lvel all notions of time inconsistent behavior are violated, and these conclusions are in line with the descriptive statistics presented

previously. The question is then whether the sources of these violations can be qualified as rational or as irrational, which is what shall be investigated next.

The different columns in Table 6 are different specifications that work towards the estimation of Equation 15. Column 1 presents the results of the estimation when only the interest rate and the time frame dummy are used as explanatory variables and the errors are clustered at the individual level. Both coefficients work in the expected direction: a higher interest rate raises a person's consumption in the later period and in the Near time frame, more money is allocated to the earlier period than in the far time frame, suggesting present bias.
In Column 2, individual fixed effects are added to the specification from Column 1. The results are very similar to those in Column 1, although the constant changes somewhat. This results from the fact that the constant is now the discount factor of the omitted individual from the fixed effects.
Column 3 presents the main specification of this model, as it contains all control variables, but not the individual fixed effects (which due to the possible bias is only used as a robustness check of this model). The error terms are again clustered at the individual level. The control variables included in this model are time invariant controls from the baseline, their interactions with the time frame and also the shocks from the period between the initial experiment and the revisit. Due to space limitations, the coefficients of the control variables from the baseline are not reported. The coefficient on the interest rate remains highly significant, but the introduction of the controls causes the coefficient on the time frame to become highly insignificant. As mentioned before, stationarity is nonetheless violated because of significant interactions between the controls and the time frame. Column 3 further shows that people's allocations are significantly affected by certain shocks that they face over time. People who have lost their job in the period since the baseline allocate significantly more money to the sooner period when they are given the option to revise and so do people whose net worth has gone down as compared to the baseline survey. Although the coefficient of this variable is small, the range of this variable is wide (the minimum is around -2,000 and the maximum is around 1,000), so that the economic significance of a change in net worth on allocation to the later period can still be substantial. In sum, the results suggest that people significantly change their behavior as a result of the shock they face, and that some significant interactions of controls with the time frame capture the differences in decisions between the different time frames. These sources of time inconsistent behavior can thus be partially be qualified as rational and partially as irrational.
The other control variables that are included in this specification (full estimation results are available upon request) further provide information on the characteristics that are associated with higher allocations to the later period. People over the age of 50, people who have a source of income, people with more children, and those who are part of the ethnic majority, the Nupe, allocate more money to the later period. People who are more risk averse as

judged from the risk attitude experiment allocate significantly less money to the later period. Nevertheless, there is no significant difference in allocations between the time frames, which excludes the possibility that more risk averse people allocate less to the later period because they doubt that they shall receive their payment. Finally, Muslims allocate significantly more money to the later period in the far time frame than they do in the near time frame.[17] People who are less aware of their spendings and how often they run out of money (*planning*2) allocate less to the later period in the far time frame and so do people who borrow money more easily (*planning*1). These latter results point at static present bias of preferences, but interestingly also points at sophistication on this from the respondent's side.

Throughout this analysis, it is important to keep in mind that only the effect of the interest rate and that of the time frame can be interpreted in a causal manner as a result of the experimental setup. The remaining relationships are only associations.

Finally, as a robustness check the full model in Equation 15 is estimated including the fixed effects in Column 4. Due to the limited number of observations per person, the estimated coefficients in Column 4 are not necessarily consistent. It is a reassuring finding, however, that the patterns of the coefficients and the standard errors found in Column 3 persist in Column 4 and have even become a bit stronger.

Additionally, Giné et al. do a separate analysis for the revisions. On the one hand they analyze what factors are correlated with people's decision to revise their initial decision and on the other hand the magnitude of a person's revision is analyzed. The equation estimated in the column on the right is:

$$\frac{2+r_i}{1+r_i}(c_{2i}^{REV} - c_{2i}^{R1}) = a + cX_i^1 + dX_i^2 + \varepsilon_i \tag{16}$$

As mentioned in the Theoretical Framework, this specification effectively only holds for those people where both the initial and the revised decision are interior allocations. Ideally, one would estimate this equation both for the full sample and for those respondents with only interior allocations to see the effects on the estimates and the standard errors from ignoring the presence of corner allocations, but in the current sample there are only 34 respondents. This number is too small for a meaningful analysis, so for a direct comparison of the results in this study with Giné et al., the entire sample is included in the analysis presented here.

The results are presented in Table 7. In Column 1, the dependent variable is a dummy variable that takes a value 1 if a respondent's allocation is different from the initial allocation. The results show that if the interest rate in place is higher people decide to revise less frequently. Muslims, people living in bigger villages, people who are the financial decision makers in their household and those who are employed or working as a business man tend

[17] This might be related to the start of the fasting Ramadan, that started around the time of the last payout ('in 3 months') in July 2012.

to revise more frequently ceteris paribus. Again, someone who has lost his job is much more likely to revise, and so is someone where a relative or close friend has recently gotten married. Interestingly, people in whose household someone reported a loss or damage of an asset revise less often. Finally, there is a large and significant effect of the change of a person's source of income. This suggests again that shocks play an important role in a person's decision to revise, but that other background characteristics also play a role.
Column 2 looks further into the magnitude of these revisions and estimates Equation 16, where the dependent variable is the magnitude of the person's revision to the later period. The results illustrate that people in larger villages choose to allocate less to the later period than they did initially and so do Muslims and people in households with fewer children. Also, the fraction of vouchers that people allocated to the later period across all offers in the initial time preference elicitation (tot_later_TP)[18] is negatively correlated with the magnitude of the revision. This fraction measures a person's patience and someone who already showed more patience during the initial elicitation has less scope for further revision. It therefore adds up that the coefficient of this variable is negative and significant. Furthermore, people who receive a payout from an ajo or cooperative (in which case the variable $cat\_fin\_instrum\_hh$ becomes more negative) decides to allocate more money to the later period upon revision as compared to the initial allocation, which is a natural response as due to the payout which might or might not be fully anticipated the person has more cash at hand and can afford to allocate the money to the later period. Finally, people who indicated they lost their job since the initial visit again allocate much more money to the sooner period than during the initial experiment. The degree of risk aversion does not affect the decision to revise or the magnitude by which people decide to revise their initial behavior. This is in line with what can be expected ex ante, as people's perception of the differential risk between the two payout moments in the experiment is unlikely to have changed since the baseline elicitation. In sum, although some variables are strong enough to be significant in both, there are some important differences between the results in the model that was derived from utility maximization in column 3 of Table 6 and the model that is specified after Giné et al.'s model in the right column in Table 7. All in all, it can be concluded that shocks play a significant role in determining people's revision behavior, which illustrates that a substantial part of observed time inconsistencies of people in developing country is in fact rational.

6 Conclusion

This paper adds to the literature on time inconsistent preferences and particularly in developing countries. We derived a model from utility maximization and estimated its predictions. Using a Tobit model, we were able to also take corner allocations into account in the analysis

[18]This excludes the share of vouchers allocated to the later period in the selected offer, to avoid a mechanical relationship between the two variables (Giné et al. 2012).

which is an important improvement compared to previous specifications. This holds particularly true in the current sample that has a lot of corner allocations.
The descriptive analysis show that there are only a few non-monotonicities in the data, where people decide to consume less in the later period as the interest rate rises, and this implies that people understood the setting well. Furthermore, even at the offer without any interest, people allocated a significant number of vouchers to the later period, suggesting that people trusted that they would be paid out and did not experience significant differences in the transaction costs associated with the different periods.
All three types of time inconsistent behavior (stationarity, time invariance and time inconsistency) are rejected on an aggregate level. The estimation results illustrate that this is due to a combination of rational and irrational factors. The introduction of shocks and control variables into the specification takes away the significance of the effect of the time frame. We find a large effect of shocks: after losing one's job, experiencing a reduction in the household's net worth and not being able to work for a number of days because of sickness, people significantly change their behavior by reducing the amount allocated to the later period upon revision. This is a very rational response where the change in optimal consumption results from a change in the person's intertemporal reference point.

The results of this research shed light on the optimal design of commitment devices and financial instruments. People display time inconsistent behavior for different reasons and commitment devices may have a positive or a negative impact on their ex-post welfare depending on the actual source of the time inconsistent behavior. For example, if time inconsistent behavior results from present bias preferences or pressure from one's social group to assist a distant relative, commitment devices have the potential to increase individual ex-post welfare. However, if time inconsistent behavior comes about when a person faces a shock which changes his optimal consumption path, a commitment device might actually be harmful to a person's level of welfare. From the perspective of a policy maker or a financial institution, it is thus very important to understand what drives individuals to display time inconsistent behavior. This study showed that shocks play an important role in people's time inconsistent behavior, while evidence for present bias is more limited. These conclusions should be taken into account in the discussion about the importance of commitment devices as well as the optimal design of these products.

Further research extensions to the present study should shed further light on the results found in this paper. A full maximization of the utility function including the estimation of the Kuhn-Tucker conditions should be derived which will improve the way the corner solutions are taken into account in the analyses. Additionally, looking into the determinants to allocate more to the later period in the offer without interest will provide further information on people's savings behavior. Finally, the results from the risk attitude game, particularly the

prospect theory aspects, can be taken into account further in this game by estimating people's loss aversion parameters separate from the risk aversion parameter to further investigate the interplay between risk and time preferences.

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A Appendix 1: Variable Definitions

A.1 Variables Collected in the Baseline Questionnaire

Unless specified differently, all variables are measured at the individual level. *Years_schooling* is a continuous variable that represents the number of years a person has gone to school. Three subcategories: *Primary* which equals 1 if someone has attended school for 6 or less years, and *More Primary* if the person attended school for more than 6 years (so the omitted category is that someone never attended school).
Male is a dummy variable that equals 1 if the person is a male.
Age is a continuous variable representing the person's age and again there are three subcategories: *Age 30-50* for someone who is between 30 and 50 years old, which is generally the age in which people have young children that still live at home and for whom they have to fence; and *Age Over50* for someone who is over 50, when a person decision-making might have changed because the children have grown up and moved out (the omitted variable is a person under 30).
Muslim is a dummy variable that equals 1 if the person is a Muslim.
Bacita (village) and *Shonga (village)* are two of the three areas where the experiment takes place. *Village Size* denotes the number of inhabitants in the village a respondent lives in.
Fin Dmaker is a dummy variable that is equal to 1 if a person is the financial decision maker in the household.
Children is a continuous variable that represent the total number of children below the age of 18 that live in the household.
Work Farming and *Work Business* are dummy variables that categorize a person's employment. People with a fixed salary and other types of business are included in *Work Business*. (The omitted category is a person that does not work.)
Polygamous (hh) is a dummy variable that equals 1 if there is a polygamous marriage in the household; at the household level.
Nr Persons Games (hh) is a continuous variable that represents the number of people in the household the games were played with; at the household level.
Married is a dummy variable that takes a value 1 if the person is married.
Parent is a dummy variable that is equal to 1 if the person is the head of the household or the spouse to the household head.
Urban is a dummy variable which is 1 if the person lives in a more urban area in the local area.
Fin_dmaker is a dummy variable that equals 1 if it was indicated that this person is the financial decision maker in the household.
Ethnic Nupe is a dummy variable that equals 1 if the person is part of the major ethnic tribe in the area, the Nupe.
Wealth is calculated using the number of different assets people indicated that they own and

these numbers are multiplied by the specific prices of these assets at that time; measured at household level.

Insurance is a dummy variable that equals 1 if the person has any form of formal insurance.

Borrow Emerg is a dummy variable that equals 1 if the person indicated that s/he is able to borrow 20,000 Naira (100 Euros) in case of an emergency.

Coop or Ajo is a dummy variable that equals 1 if a person is a member of a cooperative or an ajo, an informal savings club.

Bank is a dummy that takes value 1 if the person has a bank account.

Liab (r1) is the total of the liabilities that a person holds, as measured by the total amount the person borrowed from someone, both in terms of goods/services and directly in terms of money, and the outstanding amount of a loan from a cooperative; measured at the household level (in thousands of Naira).

Assets (r1) is the total of the assets that a person holds, which is the addition of the total amount the person lent to others, again both in terms of goods/services and in terms of money, the amount that is currently saved in a cooperative, the amount of money that is set aside somewhere, and the amount that is currently saved in an ajo; measured at the household level (in thousands of Naira).

Networth (r1) is the total of the assets minus the liabilities, measured at the household level (in thousands of Naira).

Planning1 is predicted using the largest factor from factor analysis on four questions about people's awareness of what they spend and how often they run out of money. (Questions: (1) How well do you know how much money you receive and spend during a month? (2) If you have any money left just before the next income arrives, what do you usually do with it? (3) How many times during the last 12 months did you run out of money? (4) What do you usually do when you run out of money?)

Planning2 is predicted using the largest factor from factor analysis on five statements that ask people to what extent they agree with questions about their saving culture. (Statements: (1) Buying goods on credit in the shop is a convenient solution when I do not have sufficient cash for food. (2) If I need some money, I feel comfortable asking friends or relatives for a loan. (3) I am not saving much today but I will save more in the future. (4) I do not like to be in debt. (5) If I have money set aside in the house for a certain purpose, it is difficult not to spend it on other things.)

Planning3 is a categorical variable for which people were asked to identify themselves with one of three possible types of people regarding their financial planning. (Question: I am now going to show you a scale with three people. The person on the left sets goals to set aside money for certain things and also really sets aside this money as planned every month. The person on the right never sets aside money. The person in the middle only sets aside money in case s/he has money left. Which of these 3 persons is most like you?)

Planning4 is the total of the 'Sphere of Control Scale' (Paulhus & Van Selst, 1990) that

asked people whether they felt they are in charge of the things that happen to them or not. (Statements: (1) I can usually achieve what I want if I work hard for it. (2) Once I make plans, I am almost certain to make them work. (3) I usually do not set goals for myself. (4) I can learn almost anything if I set my mind to it. (5) I find it difficult to follow through on goals that I set for myself. (6) Bad luck often prevents me from achieving things. (7) Almost anything is possible for me if I really want it. (8) Most of what happens in my life is beyond my control. (9) I give up working on something that is difficult for me.)

A.2 Variables Collected during the Financial Diaries

In this section, all variables are measured at the household level.
Death (hh) is a dummy variable that equals 1 if anyone in the household reported the death of a friend or family member between the baseline and the revisit.
Wedding (hh is a dummy variable that equals 1 if anyone in the household reported that a friend or family member got married in the period between the baseline and the revisit.
Nr Sick Days (hh) reports the total number of days that anyone in the household was unable to work in the period between the baseline and the revisit due to a health problem.
Assets Damaged (cat,hh) is a categorical variable about the value of the assets that anyone in the household lost or damaged. This variable takes value 1 when anyone reported a loss or damage of more than 2,000 Naira, and it takes value 2 when the reported loss was more than 10,000 Naira. Finally, value 0 indicates that no one in the household reported a significant loss or damage that exceeded 2,000 Naira.
Soc Assist (cat,hh) is a categorical variable about the social assists that people engaged in between the baseline and the revisit, and this social assistance includes money lent out, but also remittances received and advances made. The variable takes value -3 when the total social assistance of a household is lower than -100,000 Naira, -2 when this value is between -25,000 and -100,000 Naira, -1 between -10,000 and -25,000 Naira, 0 between -10,000 and 10,000, 1 between 10,000 and 25,000 and finally value 3 when the total amount of social assistance provided exceeds 100,000 Naira.
Finally, *Fin Instrum (cat,hh)* is also categorical variable that deals with amounts of money that are deposited or withdrawn from different accounts. This, however, also includes people's payouts from the different informal financial instruments that people use. The scale of the categorical variable is the same as the one of the previous variable *Soc Assist (cat,hh)*.

A.3 Variables Collected during the First Round of the Games

Corner is the number of corner allocations that people chose during the time preference game, which included allocating all the vouchers to the earlier and allocating all of them to the later period.

Law_demand counts the number of pairs in which a person's allocations are consistent with the law of demand. The pairs in this situation are made up of a question and the question with the next lowest level of interest rate; an example of a pair is question 2 and question 3, so that there are 6 pairs for each individual. Such a pair is then consistent with the law of demand if the number of vouchers allocated to the later period is as least as large in the question that involves a higher interest rate.
Consistent is the fraction of pairs per individual where the allocations in the near time frame are exactly identical to the allocations in the far time frame. The pairs in this situation are made up of two identical questions across the two time frames, so for example question 2 and question 6.
Pres Biased is for each individual the fraction of pairs where the amount allocated to the later period is smaller in the near time frame than it is in the far time frame. *Pres bias (nonimpl)* is identical to *Pres Biased*, but it excludes the question that is paid out.
Fut Biased is for each individual the fraction of pairs where the amount allocated to the later period is larger in the near time frame than it is in the far time frame.
$ln(1+r)$ is the logarithm of the gross interest rate. Finally, *Near* is a dummy variable that takes value 1 if the question of interest is in the near time frame (question 1-4, dealing with 'tomorrow' versus 'in 1 month').
Tot Frac Later is the fraction of vouchers allocated to the later period across all questions in the time preference game except for the question that is selected for payout.

A.4 Variables Collected during the Second Round of the Games

In the stocktaking questionnaire, information was once again collected on people's assets and liabilities, and along the same line as in the baseline description variables were created on this.
Diff Networth (hh) is the difference in net worth between the revisit and the baseline (in thousands of Naira).
Lost_work is a dummy variable that takes a value 1 if a person in the household indicates that since the time of the baseline he has changed his source of income which is now reported to be 'nothing', while *Got_work* takes value 1 if someone in the household indicates that while at the time of the baseline there was no source of income, there is one now.
Rev Later Magn represents the magnitude of a person's revision. It is made up of the difference in allocation to the later period between the revision and the initial situation in monetary terms multiplied by the transformation as specified in Equation 11(transformation $\times$ revised allocation later - initial allocation later).
Interest (Impl) is the interest rate in the question that was selected for payout.
Safe Choices is the number of times that the safe lottery was chosen during the risk attitude elicitation (out of a maximum of 15).

Figure 1: Timeline of the Study

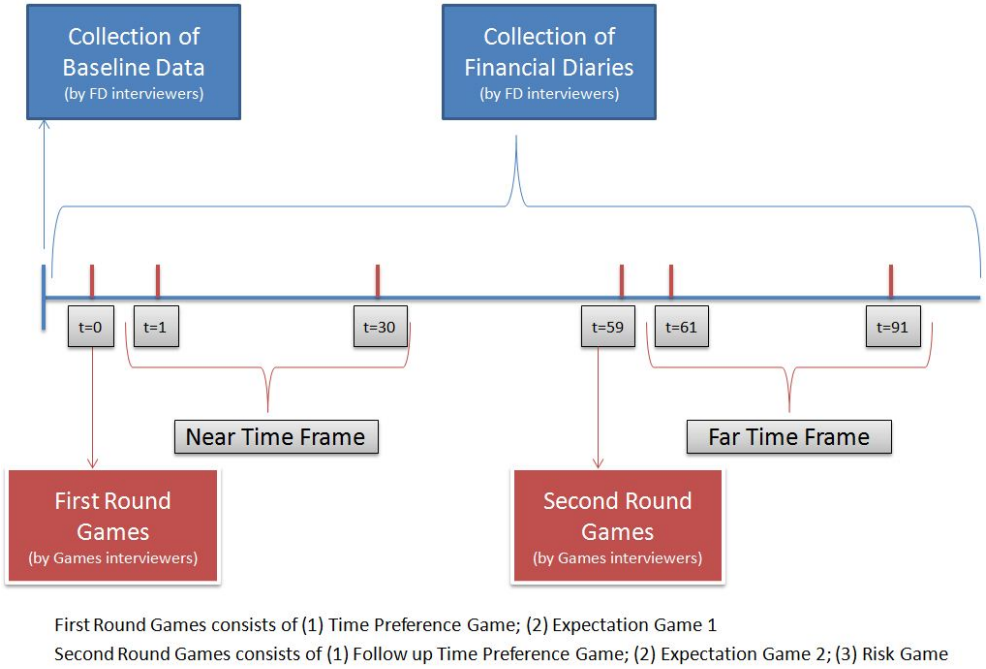

Figure 2: Time Preference Experiment

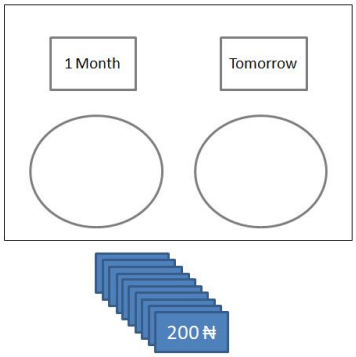

Figure 3: Revision Experiment

Table 1: Choice Sets Available in the Time preference Game

Question	t (start date)	k (delay)	Vouchers	a_t	a_{t+k}	$(1+r)$	Daily Rate
1	1	29	10	200	200	1.00	0.0%
2	1	29	10	150	200	1.33	1.0%
3	1	29	10	120	200	1.67	1.8%
4	1	29	10	100	200	2.00	2.4%
5	61	30	10	200	200	1.00	0.0%
6	61	30	10	150	200	1.33	1.0%
7	61	30	10	120	200	1.67	1.7%
8	61	30	10	100	200	2.00	2.3%

Table 2: Summary Statistics for all Different Groups of Variables

(a) Demographic Variables (Round 1)

	(1)		
	Mean	Std.Dev.	50%
Age	40.0	14.8	38
Years School	3.78	5.45	0
Age 30-50	0.42	0.49	0
Age over 50	0.18	0.39	0
Primary	0.16	0.37	0
More Primary	0.26	0.44	0
Male	0.40	0.49	0
Muslim	0.92	0.27	1
Bacita (village)	0.22	0.41	0
Shonga (village)	0.38	0.49	0
Children	5.23	3.39	5
Work Farming	0.38	0.49	0
Work Business	0.49	0.50	0
Safe Choices	9.34	1.87	9

(b) Financial Situation (Round 1)

	(1)		
	Mean	Std.Dev.	50%
Wealth (hh)	1092.8	1755.0	574.3
Insurance	0.26	0.44	0
Coop or Ajo	0.55	0.50	1
Bank	0.079	0.27	0
Borrow emerg.	0.79	0.41	1
Planning1	0.0090	0.81	-0.2
Planning2	-0.088	0.80	-0.1
Planning3	1.66	0.54	2
Planning4	18.2	2.77	18
Networth (hh)	136.7	254.8	64.7

(c) Social Interaction (Round 1)

	(1)	
	Mean	Std.Dev.
Polygamous (hh)	0.60	0.49
Nr People Games (hh)	2.97	1.21
Married	0.86	0.34
Village Size	3942.1	4715.6
Fin Dmaker	0.39	0.49
Ethnic Nupe	0.92	0.26

(d) Shocks (Round 2, HH level)

	(1)	
	Mean	Std.Dev.
Diff Networth	-0.081	0.29
Death	0.13	0.34
Wedding	0.14	0.35
Nr Sick Days	2.67	4.06
Assets damaged (cat)	0.017	0.18
Soc Assist (cat)	0.62	1.20
Fin Instrum (cat)	0.17	1.22
Got Work	0.047	0.21
Lost Work	0.043	0.20

(e) Detailed Time Preference Data

	(1)						
	Mean	Std. Dev.	Min	10%	50%	90%	Max
Consistent	0.55	0.39	0	0	0.8	1	1
Pres Bias (all)	0.26	0.32	0	0	0	0.8	1
Pres Bias (nonimpl)	0.27	0.35	0	0	0	0.7	1
Fut Bias	0.19	0.27	0	0	0	0.8	1
Law Demand	0.98	0.074	0.50	1	1	1	1
Tot Frac Later (r1)	7.24	1.63	0	5.6	7.1	8.9	10
Revision	0.43	0.50	0	0	0	1	1
Rev Later Magn	-345.5	805.0	-2000	-2000	0	200	2000

Table 3: Distribution of the Number of Vouchers Allocated to Later Period; Split by Interest Rate and by Time Frame.

		Interest	Mean	Std.Dev.	Corner
Near	Question 1	0%	690.1	664.2	47%
	Question 2	33%	1589.8	458.1	45%
	Question 3	67%	1708.5	412.9	50%
	Question 4	100%	1789.8	407.5	59%
Far	Question 5	0%	572.0	659.7	55%
	Question 6	33%	1655.3	455.5	53%
	Question 7	67%	1749.5	405.3	56%
	Question 8	100%	1825.3	388.2	67%

Table 4: Distribution of the Number of Corner Allocations Chosen per Person

	Freq	pct
0	53	18.09
1	37	12.63
2	18	6.14
3	21	7.17
4	22	7.51
5	16	5.46
6	15	5.12
7	23	7.85
8	88	30.03
Total	293	100.00

Table 5: Distribution of the Number of Pairs that is Consistent with the Law of Demand

	Freq	pct
3	2	0.68
4	7	2.39
5	16	5.46
6	268	91.47
Total	293	100.00

Table 6: Determinants of Allocations to the Later Period Following Equation 10

	(1)		(2)		(3)		(4)	
	y_{il}		y_{il}		y_{il}		y_{il}	
$\ln(1+r)$	6109.3***	(337.020)	6286.5***	(163.229)	6013.2***	(342.628)	6165.4***	(161.706)
Near	-263.7***	(74.625)	-272.7***	(75.833)	201.3	(837.014)	403.4	(920.588)
Diff Networth					1.785**	(0.847)	1.891***	(0.542)
Death					184.0	(719.605)	230.1	(410.387)
Wedding					-576.6	(588.633)	-414.9	(405.030)
Nr Sick Days					-83.67*	(48.707)	-96.66***	(33.276)
Soc Assist					-99.27	(166.975)	-136.3	(113.818)
Fin Instrum					-172.3	(166.300)	-155.0	(109.141)
Got Work					-230.5	(1000.674)	-730.8	(570.041)
Lost Work					-2846.3**	(1231.973)	-3857.2***	(713.212)
Constant	-670.0***	(103.010)	-1559.4***	(581.156)	-2432.9**	(1226.082)	-506.1	(936.994)
Individual Fixed Effects	No		Yes		No		Yes	
Time Invariant Controls	No		No		Yes		No	
Controls × Near	No		No		Yes		Yes	
N	2586		2500		2447		2369	

The dependent variable is $y_{il} = ((2 + r_l)c_{2il} - 2000)/(1 + r_l)$.
Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7: Determinants of People's Decision to Revise Their Initial Allocation
Column 1: Decision to Revise (Dummy) and Column 2: Magnitude of Revision

	(1)		(2)	
	Dummy: Revision?		Magnitude of Revision	
Interest (Impl)	-0.299***	(0.078)		
Age 30-50	-0.0467	(0.084)	50.86	(269.267)
Age Over50	0.0131	(0.102)	-408.1	(377.153)
Primary	0.0261	(0.084)	56.57	(319.738)
More Primary	-0.0345	(0.096)	97.35	(359.978)
Male	-0.0233	(0.110)	-583.0	(470.640)
Muslim	0.498***	(0.116)	-1389.1***	(489.210)
Bacita (village)	0.227*	(0.121)	-604.3	(543.339)
Shonga (village)	0.144	(0.101)	-412.0	(429.324)
Children	-0.0160	(0.017)	167.0**	(66.700)
Work Farming	0.197	(0.136)	-597.3	(472.703)
Work Business	0.273**	(0.125)	-510.2	(420.523)
Pres bias (nonimpl)	0.143	(0.087)	-607.4*	(324.937)
Tot Frac Later (r1)	-0.0274	(0.021)	-243.4**	(99.001)
Wealth (hh)	-0.00000298	(0.000)	0.0326	(0.084)
Insurance	0.102	(0.072)	-155.4	(281.345)
Coop or Ajo	0.0502	(0.072)	-315.7	(255.617)
Bank	0.0926	(0.111)	534.3	(485.417)
Borrow Emerg	-0.0858	(0.095)	421.8	(386.481)
Planning1	0.0226	(0.052)	-48.52	(233.228)
Planning2	-0.0304	(0.048)	58.44	(199.067)
Planning3	0.0353	(0.055)	-54.65	(221.824)
Planning4	0.00206	(0.012)	-3.966	(43.904)
Liab (hh, r1)	-0.00139	(0.001)	2.715	(3.629)
Networth (hh, r1)	0.000402	(0.000)	-0.184	(1.136)
Diff Networth (hh,r2)	0.00542	(0.248)	595.5	(1137.235)
Death (hh,r2)	-0.0437	(0.085)	163.1	(492.669)
Wedding (hh,r2)	0.220**	(0.098)	-729.0**	(357.926)
Nr Sick Days (hh,r2)	-0.000552	(0.009)	-0.917	(43.173)
Assets Damaged (cat,hh,r2)	-0.399***	(0.130)	767.8	(481.811)
Soc Assist (cat,hh,r2)	-0.0318	(0.030)	-142.3	(110.299)
Fin Instrum (cat,hh,r2)	-0.00723	(0.026)	-259.3***	(89.771)
Got Work (hh)	0.255*	(0.138)	-468.6	(551.111)
Lost Work (hh)	0.637***	(0.141)	-2605.4***	(660.258)
Polygamous (hh)	-0.0268	(0.105)	-356.7	(413.452)
Nr Persons Games (hh)	0.0103	(0.038)	70.18	(155.198)
Married	-0.0304	(0.102)	-539.9	(514.131)
Village Size	0.0000140*	(0.000)	-0.0655**	(0.029)
Fin Dmaker	0.199**	(0.100)	-97.14	(429.027)
Ethnic Nupe	-0.260**	(0.116)	-422.9	(551.676)
Interviewer Chris	0.0851	(0.086)	839.9**	(349.376)
Interviewer Philip	0.133	(0.096)	707.9**	(343.960)
Safe Choices	0.0279	(0.017)	-102.8	(63.385)
Constant	-0.282	(0.327)	4524.6***	(1310.796)
N	239		239	
adj. R^2	0.2148		0.2106	

The dependent variable in Column (2) is $((2+r)(c_2^{REV} - c_2^{R1}))/(1+r)$.
Standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$