Intertemporal choice bracketing and the measurement of time preferences*

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Abstract

Development economists routinely use money earlier or later (MEL) responses to infer time preferences, motivated by the potential for time-inconsistency to resolve prominent empirical anomalies. However, the interpretation of MEL responses depends critically on subjects' choice bracketing. If subjects bracket narrowly, MEL responses reflect time preferences; if subjects bracket broadly, responses reflect returns to investment. Despite its importance for interpreting MEL choices, there is limited evidence on individuals' choice bracketing behavior. We conduct a lab-in-the-field experiment in Kenya combining repeated MEL games, randomized large cash transfers, and an illiquid savings product with randomized interest rates. Subjects do not narrowly bracket—randomized cash transfers significantly increase patience in MEL choices. Nor do they broadly bracket—subjects fail to arbitrage across financially equivalent MEL and savings opportunities. We provide evidence that narrowly bracketing subjects drive the predictive power of MEL, rationalizing routine practice.

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1 Introduction

A number of outstanding "puzzles" or anomalies are difficult to rationalize within standard models of intertemporal choice. For instance, individuals in developing countries often fail to invest in long-run high return technologies with relatively small up-front costs or exhibit modest consumption growth while simultaneously foregoing attractive savings and investment opportunities.[1] While alternative explanations (such as credit constraints, risk aversion, non-concave production, or return heterogeneity) have been proposed, these appear insufficient to fully resolve the observed anomalies (Kremer et al., 2019).

Development economists have increasingly turned to the structure of time preferences as a potential explanation for these puzzles. For instance, time-inconsistent preferences offer a promising framework for understanding why individuals might systematically underinvest despite apparently attractive opportunities. Money earlier or later (MEL) games, in which subjects choose between money payments at distinct points in time, have emerged as the primary empirical tool to measure subjects' time preferences, and enable straightforward tests of whether time preferences can account for development anomalies.[2]

However, the interpretation of MEL responses depends crucially upon the underlying model of subject behavior. If subjects bracket narrowly, MEL responses reflect preferences independent of their financial environment and should be invariant to shocks to subjects'

[1] For instance on high returns to capital see Banerjee & Duflo (2014); de Mel et al. (2008); Kremer et al. (2013); McKenzie & Woodruff (2008); Udry & Anagol (2006). On limited adoption of high return technologies (e.g. fertilizer or preventive health technologies) see e.g. Banerjee et al. (2010); Berry et al. (2020); Cohen & Dupas (2010); Duflo et al. (2011); Kremer & Miguel (2007).

[2] Works using time-inconsistency frameworks to understand high-stakes choice behavior in development include Ashraf et al. (2006, 2010); Brune et al. (2021); Duflo et al. (2011); Dupas & Robinson (2013a,b); Giné et al. (2018); Kast et al. (2018); Mahajan et al. (2025); Schaner (2015); see Sunde et al. (2022) for cross-country work. The bulk of these papers use a multiple price list MEL methodology to infer time preferences. The convex time budget approach (Andreoni & Sprenger, 2012) and real-effort tasks (Augenblick et al., 2015) appear to be less frequently used.

financial circumstances. In contrast, if subjects bracket broadly and incorporate outside credit and investment opportunities, MEL responses will reflect marginal returns to investment rather than underlying time preferences, potentially undermining their usefulness for understanding the behavioral foundations of development puzzles.[3]

In this paper, we test the validity of both models by examining their implications in a unified manner using an incentivized lab-in-the field experiment with a common study sample and a set of randomized interventions in Nairobi, Kenya. First, we shock subjects' broader financial environment: we provide subjects with randomized cash transfers and show they have a substantial effect on MEL responses, contradicting the narrow bracketing model. Second, we offer subjects intertemporal choices designed to be financially equivalent to MEL: we offer illiquid savings accounts, similar to a commitment savings product, with randomized interest rates and show that subjects' deposit choices are inconsistent with their MEL responses, contradicting the broad bracketing model. Lastly, we show that these results differ strikingly by household income, in a manner consistent with narrow bracketing by poorer households and broad bracketing by richer households. We combine this heterogeneity with additional analysis suggested by a conceptual model of intertemporal choice, and find that the well documented predictive power of MEL choices for broader financial behavior likely reflects variation in preferences, rather than returns to investment.

We produce these results leveraging six rounds of MEL elicitations with subjects over a ten week experiment. We ensured low attrition by conducting the last five rounds of

[3]Our use of narrow and broad bracketing, in this paragraph and throughout this paper, requires some clarification. Our use of broad bracketing is related to its use in a literature on static choice (Ellis & Freeman, 2024; Lian, 2020; Read et al., 1999), in that it implies a model of decision making of which arbitrage is a testable prediction; it is idiosyncratic in that we will not suggest that MEL choices are made jointly with savings decisions, but rather assume a more general notion that outside returns on investment are a sufficient statistic for MEL choices (Dean & Sautmann, 2021). Our use of narrow bracketing is more restrictive than that used in the literature on static choice in that we assume a model of decision making that implies subjects may fail to arbitrage (Rabin & Weizsäcker, 2009; Read et al., 1999), but it is similar to that used in the literature on MEL (Andreoni et al., 2018; Balakrishnan et al., 2020) and most precisely corresponds to a version of "Consume-on-Receipt without Background Consumption" (Cohen et al., 2020).

MEL elicitations over the phone after an initial in-person lab session, with all payments made by mobile money. While such high frequency MEL elicitation appears to be novel, consistent with previous work we document considerable stability in responses over time (e.g., Meier & Sprenger, 2015), with a within-subject correlation in MEL responses of 0.52, and similar correlations between lab and phone responses.[4]

If subjects narrowly bracket, shocks to subjects' broader financial environment should not affect their MEL choices; we reject this hypothesis, finding that subjects randomly assigned to receive cash transfers equal to roughly 12 weeks of income are 29 percent more likely to choose money later in MEL choices during the 6 weeks following transfer disbursement. This result complements existing work that finds subjects make more patient MEL choices following quasi-experimental income shocks (Carvalho et al., 2016; Dean & Sautmann, 2021); we innovate by using randomized cash transfers as an income shock. While a large literature estimates the impacts of randomized cash transfers (Kondylis & Loeser, 2024), we are to our knowledge the first to collect MEL choices immediately and in the weeks following disbursement of a large transfer in order to implement a more powered test of narrow bracketing.[5]

If subjects broadly bracket, their MEL choices should align with intertemporal choices that are financially equivalent to MEL. We generated a test of broad bracketing by offering subjects an illiquid savings product with randomized interest rates. Subjects could deposit into savings accounts at any time during the study, but could not withdraw until the end of the experiment, at which point subjects' full deposits plus interest were paid. Importantly, both deposits and the withdrawal were made using the same mo-

[4] Meier & Sprenger find a correlation of 0.5 across MEL choices measured at two points in time (one year apart) for a sample of 1400 tax-filers in the United States.

[5] Haushofer & Shapiro (2016) and Jaroszewicz et al. (2024) measure, but do not report impacts on, unincentized MEL choices after a large temporary cash transfer. Hussam et al. (2022) estimate impacts on incentivized MEL choices after a smaller weekly cash transfer was completed, and do not find effects. Handa et al. (2020), Hidrobo et al. (2023), and Viberti et al. (2025) estimate impacts on unincentivized MEL choices during smaller monthly cash transfer programs, and find a mix of null effects and marginally significant increased patience.

bile money platform and by the same lab as the MEL payments. Thus, depositing into the savings account should be financially and logistically equivalent to choosing money later, over money now, at an equal rate of return. Introducing illiquidity complements tests of broad bracketing which compare *liquid* savings decisions, which offer an additional option value of withdrawal, to MEL (e.g., Balakrishnan et al., 2020). Despite this difference, we similarly strongly reject broad bracketing: over 48% of subjects who deposit also choose money earlier at higher rates of return, while over 74% of subjects who choose money later at lower rates of return also fail to make a deposit.[6]

How then should we jointly interpret subjects' MEL and savings decisions, in light of our rejection of both narrow and broad bracketing? We present a stylized conceptual framework, in which subjects make MEL choices which may depend on their preferences (assumed to be stable), their budget constraint, and idiosyncratic errors or bias. Under narrow bracketing, subjects' budget constraints are excluded from their MEL choices. Under broad bracketing, budget constraints (and preferences) enter MEL choices but *only* through subjects' marginal returns on investment. Under both frameworks, we allow for empirically relevant errors or bias: preference reversals and responses implying extreme impatience or patience are well documented in MEL across contexts, suggesting choices are unlikely to reflect preferences and arbitrage alone (Jack et al., 2022).

We derive three implications for subjects' MEL and savings decisions under our conceptual framework. First, as discussed above, shocks to subjects' budget constraints, such as the randomized cash transfer, affect MEL choices under broad bracketing, but not narrow bracketing. Second, under broad bracketing, within-subject variation in marginal returns on investment generates a within-subject correlation between MEL choices and

[6] A related interpretation of this result is that the framing of intertemporal choices (MEL or savings) affects decisions. Andreoni et al. (2018) reject broad bracketing by showing that framing earlier MEL choices as losses causes subjects to make more patient choices. Relative to Andreoni et al. (2018), we observe subjects making choices under both frames, similar to tests of broad bracketing in the portfolio allocation problems in Ellis & Freeman (2024).

savings decisions; in contrast, under narrow bracketing, such variation should not affect MEL choices as preferences are assumed stable. Finally, across-subject correlations between MEL and savings decisions are possible under both broad and narrow bracketing, but carry different interpretations. Under broad bracketing, such correlations reflect heterogeneity in average marginal returns to investment across subjects, while under narrow bracketing they reflect heterogeneity in preferences across subjects.

We then use this framework to better understand heterogeneity in subject responses. Specifically, we present two pieces of evidence that the choices of higher income participants are most consistent with broad bracketing while those of lower income subjects are most consistent with narrow bracketing (as in, e.g., Stango & Zinman, 2023). First, within subject-variation in MEL choices is significantly more strongly correlated with savings decisions for higher income than for lower income subjects. Second, MEL responses for higher income subjects are significantly more responsive to cash transfers relative to those of lower income subjects.

We then leverage the heterogeneity in intertemporal choice bracketing across subjects and implement a test of the interpretation of across-subject variation in MEL choices suggested by our conceptual framework. In particular, we find that across-subject variation in MEL choices is significantly correlated with savings decisions for lower income subjects, but not for higher income subjects. If, consistent with the evidence above, lower income subjects narrowly bracket, this correlation reflects preference heterogeneity. If, as we document above, higher income subjects broadly bracket, the absence of correlation for them suggests limited heterogeneity in average marginal returns. In this view, the full-sample correlation between MEL choices and savings decisions largely reflects heterogeneity in the time preferences of narrow bracketing subjects.

This finding rationalizes the common practice in empirical work of interpreting associations between MEL choices and financial decision making as reflecting the role of

preferences, rather than financial environment, in decision making. This is despite the fact that our results highlight the challenges inherent in the identification of time preferences: the assumption that MEL choices are a proxy for time preferences (Cohen et al., 2020), which we empirically justify, is much weaker than the assumption that time preferences can be recovered from MEL choices, which requires the identification of errors and bias (Jack et al., 2022; Mahajan et al., 2025). We note one key caveat: through the lens of our conceptual framework, our results may be sensitive to the specific subject population, as they depend on the fraction of subjects who narrowly and broadly bracket and their respective heterogeneity in time preferences and average returns on investment. However, our results do provide prima facie evidence for the conventional wisdom that regressions of observed choices on MEL are informative about the role of time preferences.

Our results also contribute to a growing literature that attempts to distinguish between narrow bracketing and arbitrage (or broad bracketing) as models for interpreting individuals MEL responses (see, e.g., Andreoni et al., 2018, for an overview). We simultaneously test implications of both models on a common sample by combining randomized variation in both financial resources as well an illiquid savings product. To our knowledge, this is the first study with such a design. We use a popular digital platform for all transactions so as to ensure as much as feasible the equivalence between MEL responses and savings decisions. The offered illiquid savings product provides a relatively clean and high frequency measure of outside financial decision making, something absent in the current literature on time preferences and MEL. Our ability to experimentally compare responses to economically equivalent savings and MEL decisions then connects the literature on interpreting MEL responses to a distinct literature testing narrow and broad bracketing in static choices (e.g., Ellis & Freeman, 2024; Rabin & Weizsäcker, 2009).

The paper is organized as follows. Section 2 provides an overview of the experimental interventions and the data. Sections 3 and 4 show that narrow and broad bracketing,

respectively, do not explain subjects' MEL choices. Section 5 presents a conceptual framework allowing narrow and broad bracketing with errors. Section 6 tests for heterogeneous bracketing behavior, and discusses implications for the analysis of MEL choices. Section 7 concludes.

2 Data and experimental design

This section presents the data and experimental design. Section 2.1 describes the baseline survey and experimental timeline, and Sections 2.2 to 2.4 provide addition details on the incentivized MEL decisions, illiquid savings accounts, and randomized cash transfers, respectively.

2.1 Data and timeline

We carried out the experiment at the Busara Center for Behavioral Economics (Busara Lab), a well established lab in Kenya with high reported trust among participants. Our sample of participants are predominantly informal workers from Nairobi. This setting is a useful one to investigate the links between choices in MEL experiments and economic decisions such as savings for at least two reasons. Most importantly, we are able to place all financial decisions on a common footing as all payments and savings were made via M-Pesa technology, a commonly used mobile money service.[7] In addition, the cash transfer amounts are sufficiently economically meaningful to affect intertemporal choice behavior.

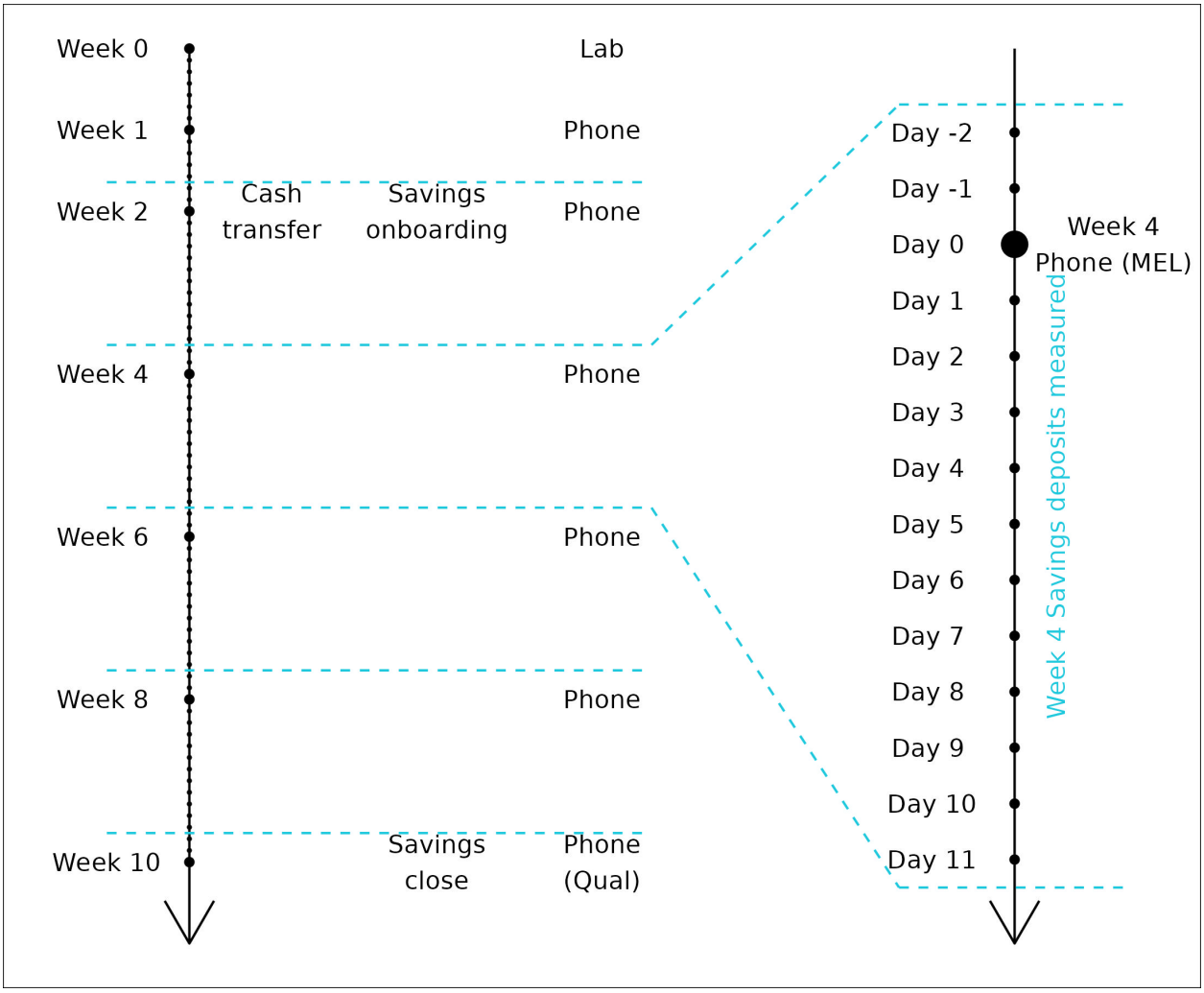
Subjects were recruited over the phone from Kawangware, a neighborhood of Nairobi, with three key sample restrictions. First, implicitly, subjects came from Busara's sample of

[7] Suri & Jack (2016) note that M-Pesa is used by at least one individual in 96% of Kenyan households.

potential participants in lab experiments from Kawangware, who in general are daily informal sector workers. Second, we sampled subjects who reported being either the head or joint head of household to isolate the role of choice bracketing, rather than intrahousehold decision making, in deviations from broad bracketing. Third, we sampled subjects who had not previously participated in MEL games at Busara Lab to maximize external validity.

A timeline of activities associated with the experiment is presented in Figure 1. In the timeline, and for the rest of the paper, we will refer to all activities by weeks since the subject entered the experiment. Subjects were onboarded at Busara in March 2017, and the experiment took place over 10 weeks. The experiment had 3 key components: a baseline lab session, follow up phone surveys with incentized MEL, and our two experimental interventions (a randomized cash transfer, an illiquid savings account with randomized interest rates).

Figure 1: Timeline



First, all subjects started the experiment with a Week 0 baseline survey in the lab. Each lab session had up to 15 subjects, and subjects completed the lab session on touchscreen computers with oral instructions given by experienced lab staff. The instruments used for the lab session were well tested at Busara, and are similar to those used in Balakrishnan et al. (2020). The survey contained basic demographic information. Following the survey, subjects made a series of incentivized MEL decisions discussed further in Section 2.2.

Second, subjects participated in 5 phone surveys featuring incentivized MEL decisions, in Weeks 1, 2, 4, 6, and 8. During each of these phone surveys, they answered basic

questions on their current financial situation, and made a series of incentivized MEL decisions. To minimize attrition, up to 4 follow up calls were attempted, and attrition in these phone surveys ranged from 4.4% in Week 1 to 17.8% in Week 8.[8] Finally, subjects participated in an additional qualitative endline over the phone in Week 10. This asked for additional details of their perceptions of the interventions. Fewer follow up attempts were made for this survey, so attrition was higher at 27.8%.[9]

Third, two randomized interventions were implemented: interest rates on an illiquid savings account similar to a commitment savings product (discussed in Section 2.3), and a cash transfer (discussed in Section 2.4). Subjects were onboarded onto the illiquid savings account and its associated randomly assigned interest rate in Week 2, and the savings account was closed (and deposits plus interest were repaid) in Week 10. The cash transfer was explained and paid to randomly assigned recipients in Week 2.[10]

The random assignment to treatment arms for the two interventions is presented in Figure 2. 150 of the 349 subjects were randomly assigned to receive a cash transfer of 8,000 KSH (80 USD), while one third of subjects were randomly assigned to receive each of a -3%, 0% and 20% interest rate on their savings account.[11] Random assignment to treatment was stratified on waves of subjects; this was in anticipation that later subjects may be systematically different from earlier subjects, in addition to any other differences across lab sessions.

Figure 2: Experimental design

		Interest rate		
		-3%	0%	20%
Cash transfer	0 KSH	66	66	67
	8,000 KSH	50	50	50

[8] There is consequentially some variation in the day of follow up calls, and we present the distribution of days since the lab session for completed MEL phone surveys in Figure OA-1(a).

[9] We test for, and fail to find significance evidence of, differential attrition with respect to experimental treatment assignments in Table OA-1.

[10] Communications to subjects on the cash transfer and the onboarding instructions for the illiquid savings account are described in detail in Appendix E.

[11] At exchange rates at the time of the experiment, 1 USD was approximately equal to 100 KSH.

Multiple activities occurred during two specific weeks – Weeks 2 and 10. In Week 2, the order of activities was 1) onboarding for the cash transfer, 2) phone survey, and then 3) onboarding for the savings account. In Week 10, the order of activities was 1) qualitative endline, and then 2) savings closing. The savings account was closed for subjects, and deposits plus interest repaid, even if they were not reached for the endline or any other phone surveys.

2.2 Incentivized MEL

During the experiment, subjects participated in a series of incentivized MEL choices. These experiments were conducted during the Week 0 baseline in the lab, and during Week 1, 2, 4, 6, and 8 phone calls. At the end of each survey, one decision made by the subject was randomly selected and implemented.

In our Week 0 baseline, we carried out MEL experiments using a multiple price list ("MPL"), a convex time budget ("CTB"), and a BDM mechanism similar to that of Benhabib et al. (2010) to elicit willingness-to-pay for money later.[12] In total subjects made 36 MPL decisions, 36 CTB decisions, and 4 BDM decisions. The MPL and CTB closely followed protocols and instruments used by Balakrishnan et al. (2020) (who in turn closely followed Andreoni & Sprenger, 2012) with a similar subject pool.

For the Week 0 baseline, in addition to the payments tied to the intertemporal choice decisions, all subjects received two additional sets of payments, similar to Andreoni & Sprenger (2012) and Balakrishnan et al. (2020). First, subjects received an additional 250 KSH in cash to cover transportation to and from the lab (2.5 USD at exchange rates at the time of the experiment). Second, subjects received 50 KSH via M-PESA on both the

[12]Subjects appeared to find the BDM approach confusing, and as a consequence BDM responses were uncorrelated with MPL and CTB responses, in contrast to a strong correlation between MPL and CTB responses. With sufficient piloting it is possible that it would be feasible to implement this approach successfully in our context, but we did not pursue this further in the study.

earlier date (which was always that day) and the later date (2, 4, 6, or 8 weeks later) of the randomly selected decision to be implemented. This design choice mitigates any potential effects of fixed costs or behavioral biases associated with receiving non-zero payments on either the earlier or later date.

In follow up phone calls, we only carried out the MPL, as it does not appear feasible to conduct a CTB over the phone; for comparability, all our analysis therefore focuses on MPL choices.[13] The MPL frames in these calls were identical to those in the lab. The earlier date was always today (i.e. the day of the call), and the later date was always 2, 4, 6, or 8 weeks later.[14] The earlier payment was always 200 KSH, while the later payments were chosen from the set $\{180, 200, 220, 240, 260, 300, 350, 400, 600\}$ KSH.[15] Unless otherwise stated, we restrict our analysis to choices for which the later date was Week 10 in order to ensure equivalence with savings decisions; we discuss this equivalence below in Section 2.3.

2.3 Illiquid savings account

The primary contribution of the experimental design is the creation of a savings account that was designed to match the choices subjects face when they make money earlier or later decisions. Specifically, the account was designed such that subjects could make deposits at any time, but withdrawals were not permitted. This makes it akin to a "commitment" saving product (e.g., as in Ashraf et al., 2006). All savings were returned with

[13] To validate the phone measurements we compare the within-subject correlation of MPL decisions between Week 0 and Week 1 (the first of which was in the lab and the second of which was over the phone) and between Week 1 and Week 2 (both of which were over the phone). We find similar within subject correlations although subjects appear to be slightly more impatient over the phone than they are in the lab.

[14] Towards the end of the experiment, and for later waves of subjects, some later payments would have fallen during the pre-election period, during which cash payments could potentially be controversial. Frames where the later week would have fallen during this period were therefore excluded from subjects' choice sets. However, Week 10 was always one of the later dates in Weeks 2, 4, 6, and 8.

[15] The choice of 200 KSH as the base amount was based on a small pilot. In the pilot, pilot subjects' switch points using either 100 KSH or 500 KSH as the earlier amount were at identical gross interest rates. This suggests that any amount in this range, including 200 KSH, can be characterized as small.

interest at the end of the experiment in Week 10.

To see how the design of the savings account ensures that savings decisions are equivalent to choosing the later payment in an MEL decision, consider a subject facing a (randomly assigned) 20% monthly interest rate deciding whether to make a deposit in Week 6 of the experiment. If the subject deposits 200 KSH, then they forgo 200 KSH in Week 6 to receive 240 KSH in Week 10. This subject will face the exact same choice problem in their Week 6 MEL – they will be offered 200 KSH in Week 6 (the earlier payment), and offered to forgo that 200 KSH to receive 240 KSH in Week 10 (the later payment). Ceterus paribus, it would be inconsistent for them to deposit in Week 6 and to turn down later payments larger than 240 KSH. It would also be inconsistent for this subject to not deposit in Week 6 and then choose to receive later payments smaller than 240 KSH in Week 10 (as they could always accept the 200 KSH in Week 6 and immediately deposit it).

The details of the implementation of the savings intervention are as follows. In Week 2, subjects were onboarded for the savings account – information on the account, including their experimentally assigned interest rates as well as instructions for depositing into it were provided.[16] Following the onboarding, subjects could make deposits at any time. Deposits were made using PayBill, a mobile payments technology built on M-Pesa which is commonly used to make payments at shops and was familiar to subjects. The savings account was implemented by Busara Lab, and subjects were informed of this. As a result, the technology for transfers (M-Pesa) and the institution making or receiving transfers (Busara Lab) was held constant across the savings account and the money earlier or later decisions and payments. Consequently, cognitive costs and trust should be very similar across these two framings of intertemporal choice.[17]

[16]The information in Week 2 included an explanation of how interest was calculated (using their monthly interest rate). In order to assess comprehension subjects were repeatedly asked "If you send 1000 KSHs to the savings account t, how much will you receive in eight weeks?", where t was either "today" or "in four weeks". In Week 10, 70% of subjects correctly answered a similar question, and we explore heterogeneity with respect to correct recall in Section 4.

[17]97% of subjects reported both trusting that they would receive their deposits and interest from the

The monthly interest rates on the savings accounts were also experimentally varied across subjects; as in Figure 2, one third each of subjects were assigned to receive a -3%, a 0%, and a 20% monthly interest rate. These amounts were chosen in anticipation that few subjects would save at -3%, and most subjects would save at 20%, and to ensure we had meaningful variation in subjects' decisions to save for at least one interest rate. As reference, M-Shwari, a popular savings and credit product built on M-Pesa, typically offers monthly interest of 0.5% on savings and charges a monthly interest of 7.5% for credit (with restrictions on credit availability based on borrowing and repayment history). Additionally, subjects did not receive interest on deposits greater than 10,000 KSH, which ensured that the maximum possible negative interest on savings in the -3% arm was less than half of the sum of other experimental payments subjects received for participation. In practice, we found little evidence of differences in savings decisions between subjects assigned to receive a -3% and 0% monthly interest rate, and we therefore pool across subjects assigned to receive a -3% and 0% monthly interest for parsimony.

2.3.1 Stylized facts on illiquid savings account usage

To facilitate interpretation of our results in Sections 3, 4 and 6, we discuss five stylized facts on usage of the savings accounts and its responsiveness to interest rates.

First, extensive margin deposits decline over the course of the experiment, while total deposits conditional on depositing are somewhat stable: 30% of subjects deposit in Weeks 2 and 3, with average deposits conditional on depositing of 670 KSH, while 10% of subjects deposit in Weeks 8 and 9, with average deposits conditional on depositing of 510 KSH (Table OA-2). Deposit amounts conditional on depositing correspond to a few days of average income, and roughly three times larger than typical MEL payments, and

savings account and being comfortable with the PayBill technology in the Week 10 qualitative endline. This is comparable to the 95% of subjects who reported trusting that the Busara Lab would make their MEL payments on time in the Week 0 baseline survey.

usage is not universal but also not uncommon.

Second, roughly 1%–7% of subjects deposit into the savings account each day, with steadily declining participation over the course of the experiment (Figure OA-1(b)).

Third, subjects are not meaningfully more likely to deposit on days with MEL phone calls or experimental payments (Figure OA-1(b)). And fourth, deposits bunch at round numbers, including amounts that differ from common experimental payments (50 KSH, 100 KSH, 500 KSH) (Figure OA-1(c)). Combined with the first stylized fact, these suggest that most deposits are made out of extra-experimental income.

Fifth, extensive margin deposits do not respond to changes in interest rates while intensive margin deposits do respond (Tables 2 and OA-2). This is consistent with substantial heterogeneity in required rates of return, and either modest income effects on required rates of return or a high elasticity of substitution across investments.

2.4 Cash transfers

Lastly, 8,000 KSH cash transfers were randomly assigned to 150 of the 349 subjects in Week 2.[18] As reference, subjects reported average monthly income of 2,700 KSH, so this cash transfer is approximately three months of income for the subjects. We anticipate that this amount is sufficiently large to affect both savings behavior and, if subjects face credit constraints, their ability to smooth income. In both cases, these effects could last for the two month duration of the experiment following the cash transfer. We interpret the cash transfer as an exogenous income shock, which will be particularly important for our tests of narrow bracketing and optimization.

[18] We deliberately allocated fewer subjects to this arm to maximize power under our fixed budget constraint (List et al., 2011).

3 Narrow bracketing does not explain MEL choices

Under narrow bracketing, subjects' MEL choices are assumed to be independent of their broader economic environment. This yields a testable prediction – shocks to subjects' broader financial environment should not affect their MEL choices. In Section 3.1, we provide an empirical strategy to test this prediction. In doing so, we leverage our experimental variation in assignment to unconditional cash transfers. We implement the test in Section 3.2, and test for heterogeneity in Section 3.3.

3.1 Empirical strategy

We exploit variation in shocks to subjects' broader financial environment from randomized cash transfers across subjects, which they receive at the start of Week 2. If subjects narrowly bracket, these cash transfers should not affect their MEL choices in subsequent weeks. We test this assumption by comparing the behavior of subjects assigned to receive and assigned to not receive cash transfers in Equation (1).

$$Y_{it} = \beta \text{UCT}_i + \gamma \text{High IR}_i + \theta_{s(i)} + \epsilon_{it} \tag{1}$$

Y_{it} denotes outcome Y for subject i in week $t \in \{2, 4, 6, 8\}$, while UCT_i indicates that subject i was assigned to receive a cash transfer. Equation (1) includes controls for whether subject i was assigned to a monthly savings interest rate of 20% (High IR_i) and strata fixed effects, $\theta_{s(i)}$. The parameter of interest is β, the average impact of assignment to receive a cash transfer on outcome Y.[19]

[19]Note that the fractions of subjects assigned to each experimental intervention were constant across strata so that β can be interpreted as the stratum weighted average treatment effect.

3.1.1 Descriptive statistics and balance

We present basic descriptive statistics on our sample at baseline (Week 0) in Table 1. Subjects are 38 years old on average and 66% are female. 80% of subjects self identify as the head of household, broadly consistent with our sampling strategy. Subjects are poor on average, with roughly 1,400 KSH of income over the past two weeks or about $2.30 USD PPP of daily income. 95% of subjects report trusting Busara to make payments, suggesting that trust is not a first order concern in our context.

Table 1: Balance

	Cash transfer			Savings interest rate		
	Control mean (sd) # of obs.	Treatment mean (sd)	Coefficient (SE) [p-value]	Low interest mean (sd)	High interest mean (sd)	Coefficient (SE) [p-value]
	(1)	(2)	(3)	(4)	(5)	(6)
Female	0.649	0.676	0.026	0.671	0.640	-0.033
	(0.479)	(0.470)	(0.052)	(0.471)	(0.482)	(0.055)
	330		[0.618]			[0.549]
Age	38.1	38.1	-0.0	38.3	37.7	-0.6
	(10.9)	(11.0)	(1.2)	(10.9)	(11.0)	(1.3)
	330		[0.996]			[0.645]
HHH	0.819	0.775	-0.044	0.804	0.793	-0.011
	(0.386)	(0.419)	(0.045)	(0.398)	(0.407)	(0.047)
	330		[0.328]			[0.812]
Married	0.447	0.423	-0.024	0.438	0.432	-0.006
	(0.498)	(0.496)	(0.056)	(0.497)	(0.498)	(0.058)
	330		[0.665]			[0.917]
Some secondary education	0.553	0.527	-0.026	0.526	0.573	0.047
	(0.498)	(0.501)	(0.053)	(0.500)	(0.497)	(0.055)
	349		[0.631]			[0.389]
Income, past two weeks (KSH)	1367	1363	2	1297	1500	211
	(1742)	(1529)	(175)	(1645)	(1665)	(190)
	349		[0.991]			[0.266]
Trusts Busara to pay on time	0.957	0.951	-0.006	0.945	0.973	0.028
	(0.202)	(0.217)	(0.024)	(0.228)	(0.163)	(0.022)
	330		[0.788]			[0.217]
$\overline{\text{Later}}_{0,2}$	0.579	0.574	-0.006	0.568	0.595	0.027
	(0.308)	(0.314)	(0.034)	(0.315)	(0.301)	(0.035)
	344		[0.856]			[0.433]
$\overline{\text{Later}}_{0,8}$	0.529	0.565	0.037	0.529	0.577	0.049
	(0.337)	(0.347)	(0.037)	(0.345)	(0.332)	(0.039)
	347		[0.320]			[0.206]
$\text{Consistent}_{0,8}$	0.779	0.813	0.034	0.815	0.752	-0.063
	(0.416)	(0.391)	(0.043)	(0.389)	(0.434)	(0.047)
	349		[0.435]			[0.180]

Notes: Coefficient in Column (3) reports estimates of β from regression $X_i = \beta \text{Cash transfer}_i + \theta_{s(i)} + \epsilon_i$, where $s(i)$ is the randomization stratum of subject i. Coefficient in Column (6) reports estimates of β from regression $X_i = \beta \text{High interest}_i + \theta_{s(i)} + \epsilon_i$. Robust standard errors are clustered at the subject level.

Subjects' MEL behavior at baseline is consistent with existing work, including findings from Balakrishnan et al. (2020) with a similar sample. Subjects' MEL choices often imply implausible discount rates if taken at face value – subjects choose money two weeks later over money that day in 58% of decisions, and money eight weeks later over money that

day in 52% of decisions.[20] These fractions approximately correspond to switch points of 200 KSH that day compared to 240 KSH two weeks later, and 200 KSH that day compared to 260 KSH eight weeks later, or 10% and 3% weekly discount rates.[21] Additionally, 21% of subjects made inconsistent choices within frame when choosing between money that day and money in eight weeks; that is, subjects chose money earlier at a higher gross interest rate than one at which they chose money later.

We present two tests of the validity of estimates of the impacts of assignment to receive a cash transfer from Equation (1). First, in Table 1, we find no significant differences between characteristics of subjects assigned to not receive and to receive cash transfers, and no significant differences between characteristics of subjects assigned to low and high savings interest rates. Second, in Table OA-1, we test for differential attrition with respect to treatment assignment. Across 12 tests, we find significance difference in attrition only for subjects assigned to receive higher savings interest rates in Week 6 (at the 10% level). This is consistent with what one would expect due to chance, and this differential attrition is the opposite direction of what one would expect, as subjects assigned higher savings interest rates are more likely to attrit; we therefore interpret this difference as likely spurious.

3.2 Results

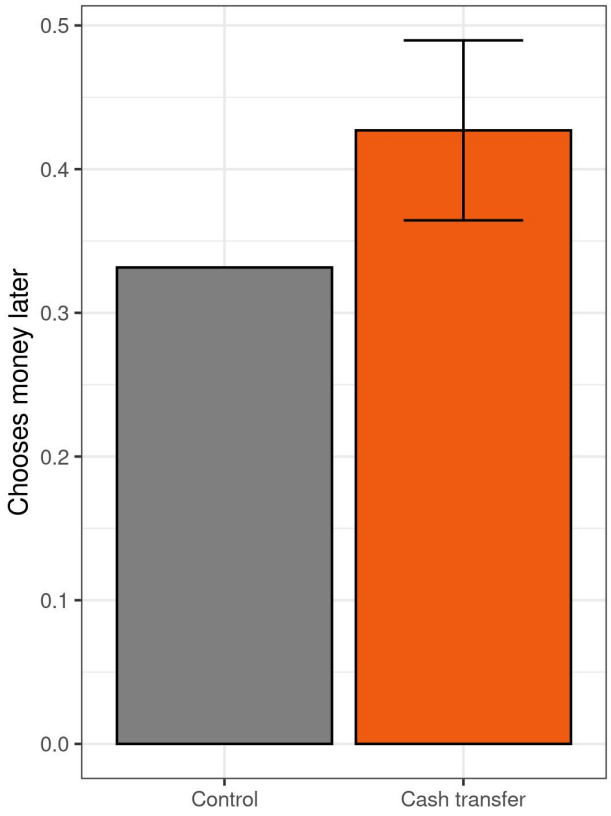
We present results from estimating Equation (1) in Table 2 and Figure 3, where the dependent variable is an indicator equal to 1 if the decision-maker chooses the money later option. Subjects who receive the experimental cash transfer are substantially more likely to

[20] Similar to Kirby (2009) we find that agents' required rates of return increase in later MEL elicitations; in Table 2, we find that subjects choose money in Week 10 over money that day in 37% of decisions in Weeks 2 through 8.

[21] This calculation is based on the following observations: subjects who choose money later whenever the later amount is greater than or equal to 260 KSH (240 KSH), and therefore have a switch point between 240 KSH and 260 KSH (between 220 KSH and 240 KSH), choose later in 55% (44%) of decisions.

choose the later money option in the MEL choice problems – the point estimate suggests an increase of 9.5 percentage points on a base of 33.2 percent (or a 29 percent increase).

Figure 3: Test of narrow bracketing



Notes: Average MEL choices for subjects that were and were not assigned to receive cash transfers are presented in this figure. The 95% confidence interval on the difference is constructed with robust standard errors clustered at the subject level.

Table 2: Test of narrow bracketing

	Chooses money later			$\log(1+\text{RRR}_{t,10})$			Any deposit			Total deposits		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Cash transfer	0.095	0.095	0.078	-0.148	-0.131	-0.133	0.106	0.108	0.093	88	108	97
	(0.031)	(0.038)	(0.033)	(0.047)	(0.057)	(0.051)	(0.030)	(0.039)	(0.033)	(35)	(50)	(42)
	[0.002]	[0.013]	[0.016]	[0.002]	[0.023]	[0.009]	[0.000]	[0.006]	[0.005]	[0.012]	[0.029]	[0.019]
High interest rate	-0.006	0.002	0.005	0.000	-0.023	-0.012	0.018	0.052	0.026	83	124	104
	(0.032)	(0.040)	(0.034)	(0.049)	(0.060)	(0.053)	(0.031)	(0.043)	(0.034)	(42)	(67)	(51)
	[0.842]	[0.958]	[0.874]	[0.997]	[0.706]	[0.819]	[0.566]	[0.221]	[0.439]	[0.045]	[0.066]	[0.040]
Dep. var. mean	0.373	0.372	0.356	0.607	0.610	0.618	0.190	0.206	0.188	105	131	116
Strata FE	X	X	X	X	X	X	X	X	X	X	X	X
Consistent		X			X			X			X	
Drop all extreme			X			X			X			X
# of observations	11,178	7,164	8,982	1,242	796	998	1,396	896	1,120	1,396	896	1,120
# of clusters	345	222	276	345	222	276	349	224	280	349	224	280

Notes: Columns 1 through 3 report outcomes at the subject-by-biweek-by-choice level, while Columns 4 through 12 report outcomes at the subject-by-biweek level. Columns 2, 5, 8, and 11 restrict to subject that were always consistent within multiple price lists at baseline, while Columns 3, 6, 9, and 12 restrict to subjects that did not always choose later or always choose earlier within each decision frame at baseline. Robust standard errors clustered at the subject level are in parentheses, and p-values are in brackets.

We estimate dynamic effects of the cash transfer on MEL choices in Table OA-2; effects are qualitatively similar across biweeks, ranging from 7.2pp to 12.6pp. Effects likely persist because subjects do not immediately spend all of the cash transfer, given it corresponds to approximately three months of their income.[22]

Responses to multiple price lists ("MPL") that are either not internally consistent (i.e., selecting the earlier option in choices with larger offered later amounts than choices in which the later option was selecting), or are always corner solutions (i.e., always choosing either the earlier or the later option within each frame), are potentially indicative of noisy responses which may generate non-classical measurement error (Jack et al., 2022). We therefore examine the robustness of the increase in choosing money later in response to cash transfers to limiting attention to subjects with internally consistent responses in the

[22] An alternative yet closely related possible mechanism is that as households receiving cash transfers are more likely to choose money later, households receiving cash transfers are more likely to receive later payments; while we do not control for experimental payments or other endogenous financial responses to cash transfers, we note that experimental payments are small relative to the cash transfer and therefore unlikely to be a first order mechanism. Consistent with this, exogenous variation in experimental payouts induced by the random choice of which subject decision is implemented does not affect subsequent MEL choices.

intial laboratory based MPL elicitations (Column 2), or by dropping subjects that always chose corner solutions (i.e., always choosing the earlier or the later option) in the initial laboratory based MPL elicitations (Column 3).

To interpret the magnitude of the effect of cash transfers on MEL choices, we calculate an implied required rate of return from subjects' switch points in MPLs.[23] In Column 4, We estimate that required rates of return plus one decreased by approximately 15 percent.

Under broad bracketing, these decreases in required rates of return should translate into increased savings, potentially on both the intensive and extensive margins (Dean & Sautmann, 2021). In Columns 7 and 10, we show that cash transfers caused increased extensive margin (11 percentage points, or 56 percent) and intensive margin (88 KSH, or 84 percent) illiquid savings deposits.[24] We present additional tests of broad bracketing in Sections 4 and 6.

Our finding that cash transfers increase measured patience in MEL is consistent with results reported in Carvalho et al. (2016), who document a stronger preference for immediate rewards among respondents before payday relative to those surveyed after payday (respondents, who were all working adults in the United States, were randomly assigned to be surveyed either before or after their paydays). Our results also align with Ambrus et al. (2015), who document that MEL choices are sensitive to income expectations amongst a sample of Icelandic respondents. We complement these papers by experimentally varying income streams via cash transfers and documenting changes in MEL choices, and similarly rejecting narrow bracketing as an explanation of MEL choices.

[23]For inconsistent subjects, we assign a switch point based on the fraction of choices that were money later; 86% of subjects were consistent in Weeks 2 through 8. We assign required rates of return of -15%, -5%, 5%, 15%, 25%, 40%, 62.5%, 87.5%, 150%, and 250% to subjects who always chose later, switched to earlier at 180 KSH, 200 KSH, 220 KSH, 240 KSH, 260 KSH, 300 KSH, 350 KSH, 400 KSH, and always chose later, respectively.

[24]We estimate dynamic effects in Table OA-2. Intensive margin effects are concentrated immediately after cash transfers, consistent with a large initial intensive margin effect of higher interest rates which quickly fades. Extensive margin effects are larger immediately after cash transfers, but persist throughout the experiment.

3.3 Heterogeneity

Might narrow bracketing vary across subjects? Stango & Zinman (2023) present evidence that cognitive skills, education, and income are all strongly correlated with indices of behavioral biases in which they include narrow bracketing. We extend our test of narrow bracketing in Equation (1), and test for narrow bracketing conditional on key subject characteristics from Table 1: both common demographic variables (gender, age, marital status) and characteristics suggested by Stango & Zinman (2023) (education, income). Specifically, we estimate

$$\text{Chooses money later}_{itm} = \beta_1 \text{UCT}_i + \gamma \text{High IR}_i + \delta X_i + \beta_2 \text{UCT}_i * X_i + \theta_{s(i)} + \epsilon_{itm} \quad (2)$$

where $\text{Chooses money later}_{itm}$ is an indicator that subject i chose money later in week $t \in \{2, 4, 6, 8\}$ for later amount $m \in \{180, 200, 220, 240, 260, 300, 350, 400, 600\}$, and X_i is an indicator that subject i has characteristic X. The parameter of interest is β_2, the average difference in impacts of assignment to receive a cash transfer on choosing money later between subjects with and without characteristic X.

We present results from estimating Equation (2) in Table 3. We find no significant evidence that common demographic variables (gender, age, marital status) predict heterogeneous responses of MEL choices to cash transfers. In contrast, we find evidence that above median income subjects (although not more educated subjects) are significantly differentially more likely to choose money later in response to the cash transfer; as a consequence, while we reject narrow bracketing for higher income subjects, we fail to reject narrow bracketing for lower income subjects. This is consistent with evidence from Stango & Zinman (2023), who find that higher income subjects are less likely to exhibit a broad range of behavioral biases in which they include narrow bracketing.

Table 3: Heterogeneity in evidence against narrow bracketing across subjects

	Chooses money later				
	(1)	(2)	(3)	(4)	(5)
Cash transfer	0.048	0.112	0.064	0.108	0.038
	(0.053)	(0.044)	(0.040)	(0.046)	(0.045)
	[0.371]	[0.011]	[0.105]	[0.017]	[0.395]
High interest rate	0.010	0.007	0.009	-0.006	-0.004
	(0.033)	(0.033)	(0.033)	(0.032)	(0.032)
	[0.760]	[0.823]	[0.787]	[0.860]	[0.905]
X_i	0.033	0.003	-0.043	0.002	-0.102
	(0.044)	(0.043)	(0.043)	(0.042)	(0.040)
	[0.455]	[0.952]	[0.315]	[0.966]	[0.012]
Cash transfer * X_i	0.054	-0.057	0.044	-0.024	0.121
	(0.067)	(0.065)	(0.067)	(0.063)	(0.063)
	[0.418]	[0.379]	[0.513]	[0.699]	[0.057]
Cash transfer + Cash transfer * X_i	0.102	0.055	0.108	0.084	0.159
	(0.039)	(0.046)	(0.052)	(0.043)	(0.043)
	[0.010]	[0.233]	[0.039]	[0.049]	[0.000]
X	Female	High age	Married	Some secondary education	High income
Strata FE	X	X	X	X	X
# of observations	10,584	10,584	10,584	11,178	11,178
# of clusters	326	326	326	345	345

Notes: Robust standard errors clustered at the subject level are in parentheses, and p-values are in brackets.

One alternative interpretation of these results is that all subjects broadly bracket, but cash transfers only shift MEL choices for credit constrained subjects (Dean & Sautmann, 2021), and our results are therefore consistent with lower income subjects not facing credit constraints. We rule out this interpretation for two reasons. First, absent credit constraints, cash transfers should not shift extensive margin savings decisions; in Table 5 we find cash transfers cause similar increases in savings probability for higher and lower income subjects, suggesting both lower and higher income subjects face credit constraints. Second, more simply, it seems unlikely that lower income subjects are less credit constrained.

Complementary to Table 3, in Appendix C, we implement our test of heterogeneity in narrow bracketing using data from Carvalho et al. (2016). We find an identical result: higher income subjects choose significantly larger amounts of money later over money today, just after payday relative to just before payday, when compared to lower income subjects.

We further validate this test of heterogeneity by comparing the probability of selecting interior choices in convex time budget decisions in Week 0, a proxy for narrow bracketing, across subject characteristics in Appendix D. Under this approach, we similarly find that higher income, but not any other subject characteristic, is associated with reduced narrow bracketing.

We revisit the heterogeneity in responses of higher and lower income subjects in Section 6; a complementary test leveraging within-subject, rather than across-subject, variation provides additional evidence that the MEL responses of higher income subjects in our context are inconsistent with narrow bracketing.

4 Broad bracketing does not explain MEL and savings choices

Under broad bracketing, subjects' MEL choices are assumed to be made jointly with their broader financial decisions. This yields a sharp testable prediction – subjects should make identical choices across economically equivalent MEL and savings deposit decisions. This prediction should be particularly likely to hold in a context where protocols, trust levels, and transaction costs for MEL and savings deposit decisions are, by construction, very similar.

In Section 4.1, we theoretically compare savings deposit decisions with contemporaneous equivalent MEL choices, and we present our results in Section 4.2.

4.1 Empirical strategy

To compare MEL and savings deposit decisions, it is helpful to apply the notion of the Required Rate of Return (RRR) to these choices as in Cohen et al. (2020). If an agent in period t_1 is indifferent between receiving x_1 "today" in period t_1 and x_2 "later" in period t_2, we define $RRR_{t_1,t_2} \equiv \frac{x_2 - x_1}{x_1}$ to be their RRR between period t_1 and period t_2. Our MEL elicitations provide an upper and lower bound for RRR. For instance, if a subject in Week 6 prefers 200 KSH today to 220 in four weeks but prefers 240 in four weeks to 200 today, their RRR lies between 0.1 and 0.2, that is $0.1 \leq \text{RRR}_{6,10} \leq 0.2$. It follows then that if such a subject in Week 6 deposits into their illiquid savings account at any rate of return (as determined by their experimentally assigned monthly interest rate) below 0.1, their choice is inconsistent with broad bracketing. Alternatively, if such a subject in Week 6 fails to deposit into their illiquid savings account at any rate of return above 0.2, their choice is also inconsistent with broad bracketing.

Such inconsistencies are common in the data. For instance, 17% of subjects who chose 200 KSH today over 600 KSH in Week 10 nevertheless make a deposit in their saving account, which has a rate of return that is much lower than their implied RRR lower bound of 200%. Similarly, 74% of subjects who chose 180 KSH in Week 10 over 200 KSH today chose not to make any deposits in their saving account, which has a rate of return that is much higher than their implied RRR upper bound of -10%.

We systematically test for such inconsistencies by estimating subjects' average MEL choices for each offered later payment, conditional on their deposit choices; we then compare these choices to bounds we calculate on consistent MEL behavior. Let IR_i denote the monthly interest rate assigned to subject i, such that $R_{it} \equiv (1 + IR_i)^{(10-t)/4} - 1$ is subject i's rate of return on savings deposits made in week t. Let Any deposit_{it} denote that subject i

made a deposit in week t. Then,

$$\text{Any deposit}_{it} = 0 \Rightarrow \text{RRR}_{t,10} \geq R_{it} \tag{3}$$

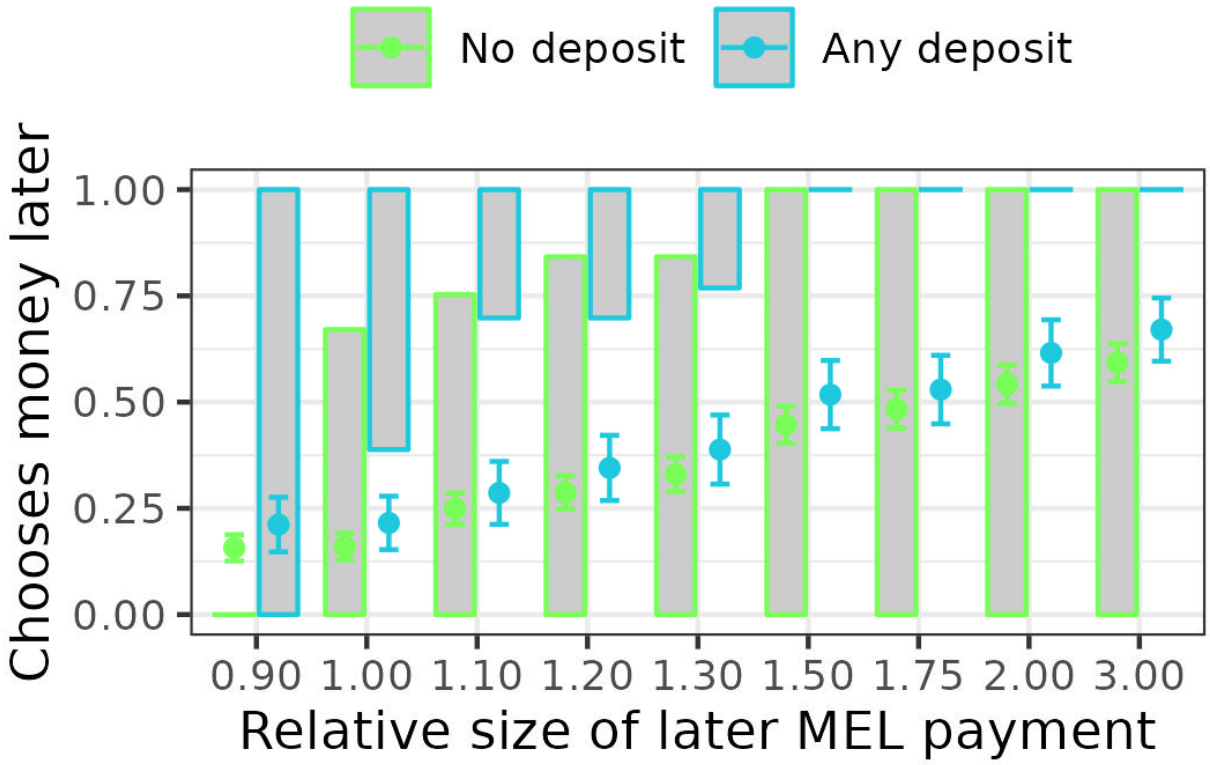
$$\text{Any deposit}_{it} = 1 \Rightarrow \text{RRR}_{t,10} \leq R_{it} \tag{4}$$

Equations (3) and (4) place bounds on $\text{RRR}_{t,10}$ as a function of savings choices – when subjects do not (do) deposit, their required rate of return must be weakly lower (weakly higher) than their rate of return on savings deposits. These bounds in turn imply bounds on the fraction of subjects that may choose money earlier or money later as a function of the offered amount of money later.

4.2 Results

We present bounds on the feasible, under broad bracketing, range of fractions of subjects choosing money later at each offered rate of return as a function of their deposit choices, calculated using Equations (3) and (4), against observed fractions of subjects choosing money later, in Figure 4. We consistently reject broad bracketing – subjects who do not deposit often choose money later at MEL rates of return lower than their rate of return on illiquid savings, while subjects who do deposit often choose money earlier at MEL rates of return higher than their rate of return on illiquid savings.

Figure 4: Test of broad bracketing



Notes: Fraction of subjects choosing money later, conditional on whether the subject deposited into their illiquid savings account that biweek and the size of the later payment, are plotted in this figure with 95% confidence intervals on means are constructed with robust standard errors clustered at the subject level. Gray-shaded bars correspond to ranges of the fraction of subject choosing money later that are potentially consistent with broad bracketing conditional on whether the subject deposited into their illiquid savings account, and its associated rate of return, that biweek, and the size of the later payment.

We present additional analysis in Table 4 of the robustness of two of these results that are inconsistent with broad bracketing – that many subjects who do not deposit choose 180 KSH later over 200 KSH earlier (the farthest left observations in Figure 4), and that many subjects who do deposit choose 200 KSH earlier over 600 KSH later (the farthest right observations in Figure 4). Columns 1 and 6 of Table 4 reproduce estimates in Figure 4: 15.7% of subjects who do not deposit choose 180 KSH later over 200 KSH earlier, and 32.9% of subjects who do deposit choose 200 KSH earlier over 600 KSH later. These results are stable, ranging from 11.8% to 16.6% and from 27.7% to 32.9%, respectively,

across each of the following alternative estimations:

- In Columns 2 and 7, we restrict to subjects with internally consistent responses to baseline MPLs to test whether noisy MEL responses generated a rejection of broad bracketing.
- In Columns 3 and 8, we exclude subjects that always chose corner solutions in baseline MPLs to test whether bunching at corner MEL responses generated a rejection of broad bracketing.
- In Columns 4 and 9, we instead define "Any deposit" as an indicator that the subject deposited into their illiquid savings account on the day their phone survey was scheduled, rather than the biweek, to test whether within-biweek shocks generated a rejection of broad bracketing.
- In Columns 5 and 10, we restrict to subjects who, when asked their experimentally assigned interest rate in Week 10, correctly recalled it, to test whether incorrect recollection of the illiquid savings interest rate generated a rejection of broad bracketing.[25]

[25] 70% of subjects reached in Week 10 correctly recalled their experimentally assigned interest rate.

Table 4: Test of broad bracketing

	Chooses 180 KSH later					Chooses 600 KSH later				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
No deposit	0.157	0.150	0.118	0.166	0.130	0.593	0.589	0.606	0.604	0.587
	(0.016)	(0.020)	(0.015)	(0.015)	(0.020)	(0.022)	(0.028)	(0.025)	(0.021)	(0.031)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Any deposit	0.212	0.225	0.172	0.234	0.205	0.671	0.691	0.672	0.723	0.673
	(0.033)	(0.042)	(0.032)	(0.062)	(0.043)	(0.038)	(0.047)	(0.043)	(0.075)	(0.047)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Consistent		X					X			
Drop all extreme			X					X		
Any deposit on MEL day				X					X	
Recalls interest rate at Week 10					X					X
# of observations	1,242	796	998	1,242	655	1,242	796	998	1,242	655
# of clusters	345	222	276	345	175	345	222	276	345	175

Notes: Robust standard errors clustered at the subject level are in parentheses, and p-values are in brackets. Columns 2 and 7 restrict to subject that were always consistent within multiple price lists at baseline, Columns 3 and 8 restrict to subjects that did not always choose later or always choose earlier within each decision frame at baseline, Columns 4 and 9 construct indicators for whether the subject deposited on the scheduled day, rather than biweek, of MEL, while Columns 5 and 10 restrict to subjects that were reached for the Week 10 survey and correctly recalled their savings interest rate.

These results are consistent with results from a contemporaneous experiment by Andreoni et al. (2018), who find that experimentally changing the framing of MEL decisions from choosing between receiving money earlier or later to choosing between paying money earlier or later significantly impacted subjects' choices. In a similar manner, we show that subjects make different choices across economically equivalent decisions, rejecting broad bracketing.

5 Narrow and broad bracketing with mistakes

The test of broad bracketing implemented in Section 4 is based on a much sharper prediction than our test of narrow bracketing in Section 3: while the latter is derived from the prediction that cash transfers should not affect MEL choices (i.e., a null effect), the former is based on the prediction that savings decisions should be *fully* explained by MEL choices (i.e., $R^2 = 1$).

In this section, we synthesize existing choice models to consider testable implications of each framework, while allowing for idiosyncratic shocks to, or mistakes during, MEL choices. In particular, we consider a generalization of the standard assumptions associated with broad bracketing, which we differentiate by calling "weak broad bracketing", that allows for mistakes. We note that our test in Section 4 may reject under either narrow bracketing or weak broad bracketing, and consider alternative testable predictions of narrow bracketing and of weak broad bracketing.

To begin, we consider a general model of subjects' joint MEL and illiquid savings deposit decisions. We allow for four distinct forces that shape decisions.

1. Subject i holds fixed preferences PREF_i. Preferences may include utility indices, discount factors, present bias, and other primitives that govern intertemporal choice. Preferences are, by assumption, stable within subject.

2. Subject i in period t faces the budget constraint BUDGET_{it}. This may include their assets, labor and investment opportunities (including the rate of return on their illiquid savings account), and other shocks or fundamentals that shape the intertemporal budget constraint or subjects' perception thereof (including cash transfers).

3. Subject i in period t experiences "bias" in their MEL choices, BIAS_{it}. In contrast to preferences and the budget constraint, we exclude bias from affecting subjects' illiquid savings deposit decisions. We interpret this assumption as subjects' illiquid savings deposit decisions reflecting the solution to an intertemporal optimization problem, while additional "bias" shapes MEL choices. Bias may derive from framing effects and limited (perhaps rationally limited) attention, and more generally any across- or within-subject factors that affect MEL choices but not broader intertemporal choice. We assume that bias is idiosyncratic, and is independent of across- and within-subject variation in preferences and budget constraints.

4. Subject i faces distinct rates of return on their MEL and savings decisions; R^{MEL} for MEL choices in a given decision frame, and R_{it}^{SAVE} for savings decisions.

We summarize MEL (MEL_{it}) and illiquid savings deposit (SAVE_{it}) decisions in this framework as follows.

$$\text{MEL}_{it} = \mathbf{1}\{\text{RRR}^{\text{MEL}}(\text{PREF}_i, \text{BUDGET}_{it}, \text{BIAS}_{it}) \leq R^{\text{MEL}}\} \tag{5}$$

$$\text{SAVE}_{it} = \mathbf{1}\{\text{RRR}^{\text{SAVE}}(\text{PREF}_i, \text{BUDGET}_{it}) \leq R_{it}^{\text{SAVE}}\} \tag{6}$$

Subjects choose money later if their required rate of return on MEL, which may depend on their preferences, their budget constraint, and any bias, is less than their offered rate of return. Subjects choose to deposit into their illiquid savings account if their required rate of return on savings, which may depend on their preferences and their budget constraint, is less than their rate of return on savings.

We consider three possible restrictions on MEL choices in this framework: narrow bracketing, broad bracketing, and weak broad bracketing.

Narrow bracketing We derive tests of narrow bracketing, including our test in Section 3, based on the exclusion of the budget constraint from MEL choices in Equation (7).

$$\text{MEL}_{it} = \mathbf{1}\{\text{RRR}^{\text{MEL}}(\text{PREF}_i, \text{BIAS}_{it}) \leq R^{\text{MEL}}\} \tag{7}$$

Additional restrictions on the functional form of RRR^{MEL} in Equation (7), for instance that RRR^{MEL} reflects the solution to an intertemporal optimization problem that does not depend on the subject's budget constraint, are often used to recover preferences from MEL choices (Cohen et al., 2020).

Broad bracketing Our test of broad bracketing in Section 4 is based on the assumption that MEL and illiquid savings deposit decisions are made jointly. As both choices reflect identical tradeoffs over money earlier and later, arbitrage implied by joint optimization yields the prediction that required rates of return are identical for MEL and savings, represented in Equation (8).

$$\text{MEL}_{it} = \mathbf{1}\{\text{RRR}^{\text{SAVE}}(\text{PREF}_i, \text{BUDGET}_{it}) \leq R^{\text{MEL}}\} \tag{8}$$

Under Equation (8), MEL choices can be used to recover the subject's (well-defined) marginal rate of intertemporal substitution (Dean & Sautmann, 2021).

Weak broad bracketing The arbitrage inherent in Equation (8) sharply restricts subjects' choices, and rules out even small probabilities of preference reversals within MEL decision frame, or any framing effects. A much weaker assumption, in the spirit of broad bracketing, allows preferences and budget constraints to only enter subjects' MEL choices through their required rate of return on savings, and is represented in Equation (9).

$$\text{MEL}_{it} = \mathbf{1}\{\text{RRR}^{\text{MEL}}(\text{RRR}^{\text{SAVE}}(\text{PREF}_i, \text{BUDGET}_{it}), \text{BIAS}_{it}) \leq R^{\text{MEL}}\} \tag{9}$$

Under Equation (9), variation in preferences and budget constraints is reflected in MEL choices only through subjects' (still well-defined) marginal rate of intertemporal substitution. However, subjects may fail to arbitrage across MEL and other intertemporal tradeoffs, as idiosyncratic "biases" affect MEL choices.

Predictions of narrow bracketing We use the conceptual framework above to make the following three predictions under narrow bracketing:

1. $\text{UCT}_i \not\to \text{MEL}_{it}$ Cash transfers only affect subjects' budget constraints, and therefore

do not affect MEL choices under narrow bracketing.

2. $\text{MEL}_{it} - \text{MEL}_{i,-t} \not\to \text{SAVE}_{it} - \text{SAVE}_{i,-t}$ Changes in MEL choices are only driven by changes in MEL bias under our modeling of narrow bracketing, which are assumed to be independent of savings decisions.

3. $\text{MEL}_{i,-t} \overset{?}{\to} \text{SAVE}_{it}$ MEL choices predict savings decisions in other periods if there is variation in preferences across subjects; otherwise, across subject variation in MEL choices is driven entirely by idiosyncratic bias independent of determinants of savings decisions.

Predictions of weak broad bracketing We use the conceptual framework above to make the following three predictions under weak broad bracketing:

1. $\text{UCT}_i \to \text{MEL}_{it}$ Cash transfers affect MEL choices through required rates of return on savings.

2. $\text{MEL}_{it} - \text{MEL}_{i,-t} \to \text{SAVE}_{it} - \text{SAVE}_{i,-t}$ Changes in MEL choices are driven by changes in MEL bias and also changes in required rates of return on savings, and changes in required rates of return on savings are correlated with changes in savings decisions.

3. $\text{MEL}_{i,-t} \overset{?}{\to} \text{SAVE}_{it}$ MEL choices predict savings decisions in other periods if there is variation in average required rates of return on savings across subjects.

Summary of predictions of narrow and weak broad bracketing Narrow bracketing and weak broad bracketing have distinct predictions for the impacts of cash transfers on MEL choices and on the association between changes in MEL choices and changes in savings decisions: while both should be zeros under narrow bracketing, both should be positive under weak broad bracketing. The association between MEL choices and

savings decisions in other periods provides an additional test under each framework: under narrow bracketing, a positive association suggests there is variation in preferences across subjects, while under weak broad bracketing, a positive association suggests there is variation in average required rates of return on savings across subjects.

These tests are closely related to existing tests in the literature on the interpretation of MEL choices.

- Prediction 1 of narrow bracketing ($\text{UCT}_i \not\to \text{MEL}_{it}$) corresponds to our test of narrow bracketing in Section 3, with similar tests implemented in Ambrus et al. (2015) and Carvalho et al. (2016).

- Prediction 2 of weak broad bracketing ($\text{MEL}_{it} - \text{MEL}_{i,-t} \to \text{SAVE}_{it} - \text{SAVE}_{i,-t}$) is derived as a testable hypothesis of broad bracketing and tested in Dean & Sautmann (2021).

- Prediction 3 of narrow bracketing is commonly applied to justify using MEL choices as a proxy to test the null hypothesis that there is no effect of preferences on investment choices (e.g., Ashraf et al., 2006), and is much weaker than the assumptions needed for preferences to be recovered from MEL choices (Cohen et al., 2020). However, Prediction 3 of broad bracketing highlights the challenge in interpreting an association between MEL choices and investment decisions as evidence of preferences affecting investment decisions: when subjects are a mix of narrow and weak broad bracketers, a positive association between savings decisions and MEL choices in other periods could reflect either an association between preferences and savings decisions or an association between average required rates of return on savings (which are determined by both preferences and budget constraints) and savings decisions.

6 Evidence of heterogeneous bracketing, and implications

In Section 5, we established that weaker notions of narrow and broad bracketing can enable tests of the presence of variation in preferences and average required rates of return on savings, respectively, even without identification of individual subject preferences or required rates of return on savings. In Section 6.1, we describe these tests in the context of our data and experiment, and implement them in Section 6.2. We discuss broader implications of our results in Section 6.3.

6.1 Empirical strategy

We implement four regressions based on our predictions of narrow bracketing and weak broad bracketing in Section 5. For each regression, we estimate versions that do and do not allow heterogeneity with respect to baseline income; this is motivated by our analysis in Section 3.3, in which we found evidence that higher income subjects had MEL choices that were more responsive to the cash transfer.

Our first regression corresponds to Prediction 1 of narrow bracketing and weak broad bracketing: under narrow bracketing, cash transfers should not affect MEL choices, while under weak broad bracketing, the cash transfer should increase patience in MEL choices. We test this directly by estimating the effect of cash transfers on MEL choices, as in Column 1 of Table 2, and heterogeneity in these effects with respect to subject income.

Our second regression corresponds to Prediction 2 of narrow bracketing and weak broad bracketing: under narrow bracketing, changes in MEL choices should not be associated with changes in savings decisions, while under weak broad bracketing, changes in MEL choices should be associated with changes in savings decisions. To implement this,

we estimate

$$\text{Any deposit}_{i,t} = \beta_1 \overline{\text{Later}}_{i,t,10} + \beta_2 \overline{\text{Later}}_{i,t,10} * X_i + \mu_i + \epsilon_{i,t} \tag{10}$$

where $\overline{\text{Later}}_{i,t,10}$ is the fraction of their 9 choices for which subject i chose money later in week t, and μ_i are subject fixed effects. β_1 captures the association between changes in MEL choices and changes in savings deposit decisions for subjects for whom $X_i = 0$ (below median income), while β_2 captures the differences in this association between subjects for whom $X_i = 1$ and $X_i = 0$ (above median income relative to below median income).

Our third and fourth regressions correspond to Prediction 3 of narrow bracketing and weak broad bracketing: a positive association between savings decisions and MEL choices in other periods is evidence of across-subject heterogeneity in preferences and average required rates of return on savings under narrow bracketing and weak broad bracketing, respectively. We consider two measures of MEL choices in other periods: average MEL responses across Weeks 2, 4, 6, and 8, $\overline{\text{Later}}_{i,*,10}$, and baseline average MEL responses, $\overline{\text{Later}}_{i,0,8}$. We add each of these, and their interaction with above median income, to Equation (2).

$$\begin{aligned}\text{Any deposit}_{i,t} = {} & \gamma_1 \text{UCT}_i + \gamma_2 \text{High IR}_i + \beta_1 \overline{\text{Later}}_{i,*,10} + \delta X_i \\ & + \gamma_3 \text{UCT}_i * X_i + \gamma_4 \text{High IR}_i * X_i + \beta_2 \overline{\text{Later}}_{i,*,10} * X_i + \theta_{s(i)} + \epsilon_{i,t}\end{aligned} \tag{11}$$

$$\begin{aligned}\text{Any deposit}_{i,t} = {} & \gamma_1 \text{UCT}_i + \gamma_2 \text{High IR}_i + \beta_1 \overline{\text{Later}}_{i,0,8} + \delta X_i \\ & + \gamma_3 \text{UCT}_i * X_i + \gamma_4 \text{High IR}_i * X_i + \beta_2 \overline{\text{Later}}_{i,0,8} * X_i + \theta_{s(i)} + \epsilon_{i,t}\end{aligned} \tag{12}$$

The estimates of β_1 and $\beta_1 + \beta_2$ allow us to implement tests of Prediction 3 of narrow

and weak broad bracketing. If below median income (above median income) subjects narrowly bracket, then we expect $\beta_1 > 0$ ($\beta_1 + \beta_2 > 0$) if preferences vary across subjects. If instead below median income (above median income) subjects weakly broadly bracket, then we expect $\beta_1 > 0$ ($\beta_1 + \beta_2 > 0$) if average required rates of return on savings vary across subjects.

For completeness, we also estimate Equations (10) to (12) without interactions with above median income.

6.2 Results

We present our regression analysis building on our predictions of narrow and weak broad bracketing in Table 5.

Table 5: Within and between variation

	$\overline{\text{Later}}_{t,10}$		Any deposit					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cash transfer	0.095	0.038			0.091	0.094	0.104	0.100
	(0.031)	(0.045)			(0.031)	(0.044)	(0.029)	(0.042)
	[0.002]	[0.398]			[0.003]	[0.032]	[0.000]	[0.017]
High interest rate	-0.006	0.001			0.009	0.007	0.016	0.006
	(0.032)	(0.048)			(0.033)	(0.045)	(0.032)	(0.044)
	[0.843]	[0.979]			[0.779]	[0.871]	[0.624]	[0.889]
$\overline{\text{Later}}_{t,10}$			0.008	-0.050				
			(0.043)	(0.060)				
			[0.855]	[0.402]				
$\overline{\text{Later}}_{*,10}$					0.094	0.173		
					(0.056)	(0.067)		
					[0.093]	[0.011]		
$\overline{\text{Later}}_{0,8}$							0.057	0.120
							(0.045)	(0.063)
							[0.204]	[0.057]
High income		-0.098				0.087		0.080
		(0.045)				(0.059)		(0.061)
		[0.030]				[0.138]		[0.189]
Cash transfer * High income		0.120				0.000		0.007
		(0.064)				(0.062)		(0.060)
		[0.059]				[0.996]		[0.904]
High interest rate * High income		-0.010				0.000		0.012
		(0.067)				(0.066)		(0.064)
		[0.883]				[0.995]		[0.852]
$\overline{\text{Later}}_{t,10}$ * High income				0.142				
				(0.083)				
				[0.089]				
$\overline{\text{Later}}_{*,10}$ * High income						-0.154		
						(0.111)		
						[0.164]		
$\overline{\text{Later}}_{0,8}$ * High income								-0.112
								(0.085)
								[0.187]
Dep. var. mean	0.373	0.373	0.205	0.205	0.205	0.205	0.190	0.190
Strata FE	X	X	X	X	X	X	X	X
Subject FE			X	X				
# of observations	1,242	1,242	1,242	1,242	1,242	1,242	1,388	1,388
# of clusters	345	345	345	345	345	345	347	347

Notes: Robust standard errors clustered at the subject level are in parentheses, and p-values are in brackets.

First, Columns 1 and 2 are almost identical to Column 1 of Equation (1) and Column 5 of Equation (2), respectively; cash transfers significantly increase the probability that subjects choose money later, but this result is driven entirely by above median income sub-

jects, and the difference in responsiveness of below and above median income subjects is statistically significant. Through the lens of Prediction 1 of our conceptual framework, the responses of above median income subjects are consistent with weak broad bracketing, while the responses of below median income subjects are consistent with narrow bracketing.

Second, Columns 3 and 4 present estimates of Equation (10), without and with interactions with above median income. We find that below median income subjects, and subjects on average, have no significant association between changes in savings decisions and changes in MEL choices. However, above median income subjects have a significantly more positive association between changes in savings decisions and changes in MEL choices than below median income subjects. Through the lens of Prediction 2 of our conceptual framework, this result is once again consistent with weakly broad bracketing above median income subjects, and narrow bracketing below median income subjects.

Building on our results in Columns 1 through 4 of Equation (10), we maintain the assumption that above median income subjects weakly broadly bracket and below median income subjects narrowly bracket when taking Prediction 3 of our conceptual framework to the data. As a result, Equations (11) and (12) implement tests of heterogeneity in average required rates of return on savings for above median income subjects (i.e., weak broad bracketers) and of heterogeneity in preferences for below median income subjects (i.e., narrow bracketers).

We find consistent results, whether using average MEL choices in Weeks 2 through 8 (Equation (11) in Columns 5 and 6) or baseline MEL choices (Equation (12) in Columns 7 and 8) as our measure of other period MEL choices, across Columns 5 through 8: heterogeneity in preferences generates an association between savings decisions and MEL choices in other periods. We note three results to this end. First, in Columns 6 and 8, we find that MEL choices in other periods are positively associated with savings decisions for

below median income subjects; this association for narrow bracketers provides evidence of heterogeneity in preferences. Second, in Columns 6 and 8, we find these associations all but vanish for above median income subjects; this lack of association for weak broad bracketers implies we fail to find evidence of heterogeneity in average required rates of return on savings. Third, in Columns 5 and 7, we find MEL choices in other periods are positively associated with savings decisions (although not robustly so) on average. As subjects are a mix of narrow bracketers and weak broad bracketers, this association could reflect either heterogeneity in underlying preferences or average required rates of return on savings; our results in Columns 6 and 8 suggest that heterogeneity in underlying preferences, rather than average required rates of return on savings, is responsible for the association between MEL choices in other periods and savings decisions.

6.3 Discussion

Our results speak to the interpretation of MEL choices in empirical work, and in particular to a debate over whether MEL choices are directly informative of either underlying preference parameters (e.g., Andreoni & Sprenger, 2012) or required rates of return on savings (e.g., Augenblick et al., 2015). We presented evidence that the strength of the association between MEL choices and either preferences or required rates of return on savings varies across subjects. In our context, MEL choices of below median income subjects are consistent with narrow bracketing, while MEL choices of above median income subjects are consistent with weak broad bracketing. Through the lens of our conceptual framework, this implies that MEL choices of below median income subjects are correlated across subjects with preferences, while MEL choices of above median income subjects are correlated across subjects with required rates of return on savings. In neither case is this sufficient for the recoverability of preferences or required rates of return on savings from MEL choices, as both idiosyncratic and systematic sources of bias including framing effects (Andreoni

et al., 2018) may render this endeavor impossible. Despite this, these correlations can be informative: in our context, they provide evidence that preference heterogeneity generates persistent differences in savings behavior across subjects. In summary, MEL choices may not be sufficient to recover either preferences or required rates of return on savings, but may be informative about both, and the effects on choices of preferences and average required rates of return on savings can be isolated leveraging heterogeneity across subjects.

7 Conclusion

A number of empirical anomalies in development economics are difficult to square with standard models of inter-temporal choice. Researchers have increasingly turned to the structure of time-preferences as a potential explanation for these puzzles and routinely use MEL experiments to infer time preferences. The interpretation of MEL responses, however, depends critically on subject's choice bracketing behavior. If subjects bracket narrowly then MEL responses may reflect underlying time preferences independent of economic circumstances. Alternatively, if subjects bracket broadly then MEL responses will reflect returns to investment opportunities rather than time preferences. There is, however, limited evidence on subjects bracketing behavior, particularly in developing country contexts.

Using a carefully designed lab-in-the-field experiment in Kenya, we test both narrow and broad bracketing models using two key experimental variations. First, we examine whether randomized cash transfers affect MEL choices—a test of narrow bracketing. Second, we test whether subjects arbitrage across financially equivalent MEL and savings opportunities—an implication of broad bracketing. Our experimental design attempts to ensure that MEL and savings decisions face identical transaction costs, timing, and

institutional features, providing an unusually clean test of arbitrage behavior.

We reject both pure narrow and pure broad bracketing models. Subjects randomly assigned to receive cash transfers worth approximately three months of income are 29 percent more likely to choose money later in subsequent MEL decisions, contradicting narrow bracketing. Simultaneously, we observe widespread failures to arbitrage: 48% of subjects who make deposits also choose money earlier at higher rates of return, while 74% of subjects who choose money later at lower rates of return fail to make deposits.

We then develop a conceptual framework allowing for heterogeneous bracketing behavior and find that income systematically predicts bracketing patterns. Higher-income subjects exhibit behavior consistent with broad bracketing—their MEL choices respond more strongly to cash transfers and correlate with within-subject changes in savings behavior. Lower-income subjects display patterns more consistent with narrow bracketing—their MEL choices are less responsive to financial shocks and show less correlation with contemporaneous savings decisions.

This heterogeneity has important implications for the interpretation of MEL choices. Our analysis suggests that the well-documented correlations between MEL choices and financial behaviors in the literature primarily reflect time preference heterogeneity among narrow-bracketing subjects, rather than variation in marginal returns to investment among broad-bracketing subjects. This finding provides empirical support for the common practice of interpreting MEL-choice correlations as evidence for the role of time preferences in financial decision-making. At the same time, our framework suggests that while MEL choices may serve as useful *proxies* for time preferences, they should not be interpreted as direct measures of time preference parameters.

Several caveats merit emphasis. In particular, our results are obtained from a specific population of informal workers in Nairobi, and the prevalence of narrow versus broad bracketing may vary systematically across contexts. The interpretation of our findings

depends on the relative fraction of narrow and broad bracketers in the population and their respective distributions of time preferences and investment opportunities.

Future research might explore bracketing behavior across different populations, investigate the mechanisms underlying the income-bracketing relationship, and develop alternative elicitation methods that are more robust to bracketing assumptions. Understanding when and why individuals narrow bracket has implications not only for preference measurement but also for the design of financial products and policies aimed at improving intertemporal decision-making in developing economies.

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A Attrition

Table OA-1: Attrition

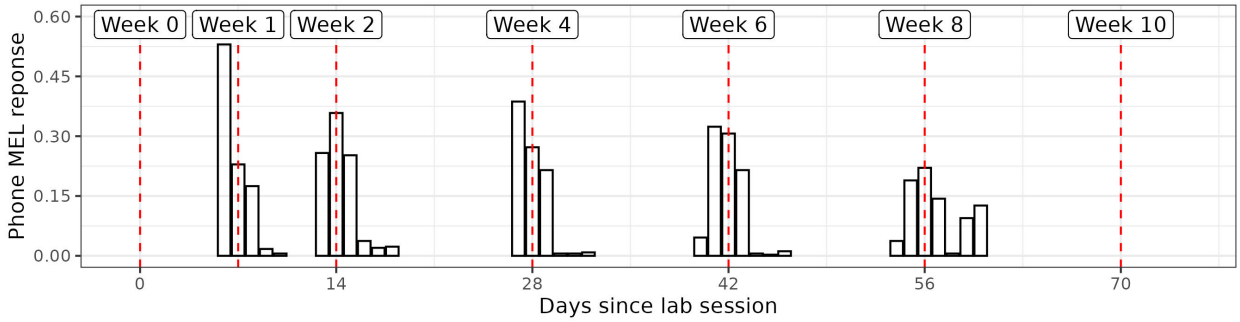
	Cash transfer			Savings interest rate		
	Control mean (sd) # of obs.	Treatment mean (sd)	Coefficient (SE) [p-value]	Low interest mean (sd)	High interest mean (sd)	Coefficient (SE) [p-value]
	(1)	(2)	(3)	(4)	(5)	(6)
Consistent$_{t,10}$	0.863	0.861	-0.003	0.864	0.859	-0.005
	(0.344)	(0.346)	(0.024)	(0.343)	(0.349)	(0.026)
	1,242		[0.908]			[0.858]
Attrited, Week 1	0.050	0.040	-0.010	0.039	0.060	0.021
	(0.219)	(0.197)	(0.023)	(0.194)	(0.238)	(0.026)
	349		[0.661]			[0.404]
Attrited, Week 2	0.065	0.040	-0.026	0.060	0.043	-0.019
	(0.248)	(0.197)	(0.024)	(0.239)	(0.203)	(0.025)
	349		[0.274]			[0.455]
Attrited, Week 4	0.121	0.093	-0.028	0.103	0.120	0.015
	(0.326)	(0.292)	(0.033)	(0.305)	(0.326)	(0.036)
	349		[0.395]			[0.679]
Attrited, Week 6	0.090	0.100	0.010	0.095	0.094	-0.001
	(0.288)	(0.301)	(0.032)	(0.294)	(0.293)	(0.034)
	349		[0.765]			[0.985]
Attrited, Week 8	0.201	0.160	-0.045	0.159	0.231	0.064
	(0.402)	(0.368)	(0.034)	(0.367)	(0.423)	(0.038)
	349		[0.189]			[0.090]
Attrited, Week 10	0.302	0.260	-0.042	0.297	0.256	-0.041
	(0.460)	(0.440)	(0.037)	(0.458)	(0.439)	(0.039)
	349		[0.258]			[0.290]

Notes: Coefficient in Column (3) reports estimates of β from regression $X_i = \beta$Cash transfer$_i + \theta_{s(i)} + \epsilon_i$, where $s(i)$ is the randomization stratum of subject i. Coefficient in Column (6) reports estimates of β from regression $X_i = \beta$High interest$_i + \theta_{s(i)} + \epsilon_i$. Robust standard errors clustered at the subject level are in parentheses, and p-values are in brackets.

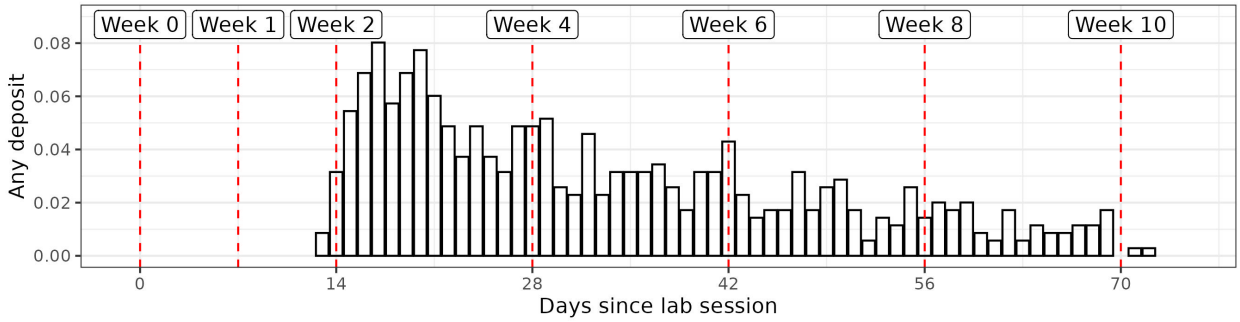
B Dynamics

Figure OA-1: Dynamics of response and deposits

(a) Daily Phone MEL response



(b) Daily any deposit



(c) Distribution of deposit amounts (upper winsorized at 1000 KSH)

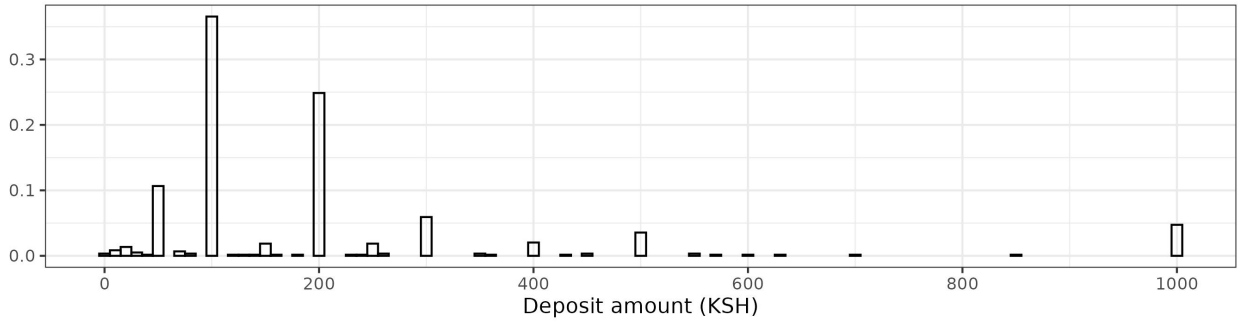


Table OA-2: Dynamics in test of narrow bracketing

	Chooses money later				Any deposit				Total deposits			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Cash transfer	0.126	0.072	0.083	0.100	0.215	0.088	0.042	0.080	275	22	20	34
	(0.039)	(0.041)	(0.040)	(0.038)	(0.048)	(0.044)	(0.038)	(0.033)	(92)	(30)	(41)	(29)
	[0.001]	[0.080]	[0.041]	[0.009]	[0.000]	[0.047]	[0.277]	[0.015]	[0.003]	[0.453]	[0.636]	[0.245]
High interest rate	0.022	-0.058	-0.004	0.013	0.043	-0.026	0.042	0.013	299	-19	60	-6
	(0.040)	(0.043)	(0.042)	(0.042)	(0.050)	(0.045)	(0.041)	(0.033)	(116)	(31)	(57)	(25)
	[0.592]	[0.178]	[0.932]	[0.764]	[0.390]	[0.567]	[0.300]	[0.708]	[0.010]	[0.527]	[0.286]	[0.811]
Dep. var. mean	0.372	0.345	0.390	0.387	0.298	0.223	0.143	0.095	201	91	79	48
Strata FE	X	X	X	X	X	X	X	X	X	X	X	X
Week	2	4	6	8	2	4	6	8	2	4	6	8
# of observations	2,970	2,799	2,844	2,565	349	349	349	349	349	349	349	349
# of clusters	330	311	316	285	349	349	349	349	349	349	349	349

Notes: Columns 1 through 4 report outcomes at the subject-by-biweek-by-choice level, while Columns 5 through 12 report outcomes at the subject-by-biweek level. Robust standard errors clustered at the subject level are in parentheses, and p-values are in brackets.

C Heterogeneity in test of narrow bracketing in Carvalho et al. (2016)

As an additional test of the external validity of our result in Section 3.3, the rejection of narrow bracketing for above median income, but not below median income, subjects, we implement our test of narrow bracketing using replication data from Carvalho et al. (2016). Specifically, we estimate

$$\begin{aligned}\text{Fraction chosen for money later}_{im} = \alpha + \beta_1 \text{Positive income shock}_i \\ + \gamma \text{High income}_i + \beta_2 \text{Positive income shock}_i * \text{High income}_i + \epsilon_{im} \quad \text{(OA-1)}\end{aligned}$$

Fraction chosen for money later$_{im}$ is the fraction of money chosen for later by subject i for choice m. This choice of outcome is facilitates comparison to our primary outcome in our test of narrow bracketing, an indicator for choosing money later. It is also a linear transformation of the primary outcome in Carvalho et al. (2016), the amount of money chosen earlier in each CTB choice. Positive income shock$_i$ is an indicator that Subject i

was randomly selected to be surveyed just after payday (rather than just before payday). This is the primary treatment variable in Carvalho et al. (2016), and we interpret it similarly to the randomized cash transfer in our experiment. High income$_i$ is an indicator that subject i has annual income above \$20,000; while Carvalho et al. (2016) do not report a continuous measure of annual income, this variable is approximately equal to above median income as 55.6% of their analysis sample report annual income above \$20,000.

To facilitate comparison to our analysis, we restrict to the 4 out of 12 CTB choices in Carvalho et al. (2016) that involved an immediate early payment; these involved choices of amounts of money to receive by checks mailed that day and in four weeks, with either a 0%, 0.5%, 1%, or 3% rate of return for money later. This is complementary to the main analysis in Carvalho et al. (2016), which focuses on differences in responses to CTB choices that do and do not involve an immediate early payment.

We report estimates of our tests of narrow bracketing and narrow bracketing across below and above median income subjects, Equations (1) and (2), in Table OA-3, alongside estimates of these same tests using replication data from Carvalho et al. (2016), Equation (OA-1) without and with heterogeneity.

Table OA-3: Consistently heterogeneous impacts of income shocks on MEL choices to income shocks across contexts

	Chooses money later		Fraction chosen for money later	
	(1)	(2)	(3)	(4)
Positive income shock	0.095	0.038	0.004	-0.027
	(0.031)	(0.045)	(0.015)	(0.022)
	[0.002]	[0.394]	[0.807]	[0.222]
High interest rate	-0.006	0.001		
	(0.032)	(0.048)		
	[0.842]	[0.979]		
High income		-0.098		-0.020
		(0.045)		(0.021)
		[0.029]		[0.340]
Positive income shock * High income		0.120		0.054
		(0.063)		(0.029)
		[0.057]		[0.064]
High interest rate * High income		-0.010		
		(0.067)		
		[0.883]		
Dep. var. mean	0.373	0.373	0.512	0.512
Carvalho et al. (2016)			X	X
Strata FE	X	X		
# of observations	11,178	11,178	4,240	4,240
# of clusters	345	345	1,060	1,060

Notes: Robust standard errors clustered at the subject level are in parentheses, and p-values are in brackets.

First, in Column 3, we find no significant differences in the average fraction of money chosen for later between subjects randomly assigned to be surveyed before and after payday in Carvalho et al. (2016). This differs from the result in our experiment in Column 1, that subjects who received the cash transfer were more likely to choose money later.

Second, in Column 4, we find this result masks statistically significant heterogeneity: while below median income subjects do not choose more money later when surveyed after payday, above median income subjects choose significantly more money later when surveyed after payday relative to poor subjects. The sign and significance of this interaction are the same as the result in our experiment in Column 2; in both experiments, above median income subjects are significantly more likely to choose money later in response to

a positive income shock than below median income subjects.

D High income associated with choosing corner solutions in convex time budget

An additional test of whether higher income is associated with behavior consistent with narrow, rather than broad, bracketing, is whether higher income subjects are less likely to choose interior solutions in the convex time budget in Week 0; the choice of interior solutions suggests that convex time budget choices are made with a concave utility function, inconsistent with broad bracketing given the small stakes of these choices (Andreoni & Sprenger, 2012). To test this, in Appendix Table OA-4 we estimate

$$\text{Fraction interior solutions (CTB)}_i = X_i'\beta + \theta_{s(i)} + \epsilon_i \tag{OA-2}$$

where X_i includes each, or all, of the subject characteristics for which we test for heterogeneity in responses of MEL choices to cash transfers in Section 3.3. We find patterns consistent with those in Table 3: high income, but not any other subject characteristic, is associated with a significantly lower probability of choosing interior solutions in convex time budget.

Table OA-4: High income associated with choosing fewer interior solutions in convex time budget

	Fraction interior choices (CTB)					
	(1)	(2)	(3)	(4)	(5)	(6)
Female	0.018					-0.016
	(0.044)					(0.048)
	[0.674]					[0.748]
High age		0.044				0.039
		(0.041)				(0.042)
		[0.282]				[0.349]
Married			-0.052			-0.048
			(0.042)			(0.044)
			[0.224]			[0.270]
Some secondary education				-0.034		-0.025
				(0.042)		(0.045)
				[0.417]		[0.584]
High income					-0.083	-0.070
					(0.041)	(0.042)
					[0.047]	[0.098]
Strata FE	X	X	X	X	X	X
# of observations	330	330	330	349	349	330
# of clusters	330	330	330	349	349	330

Notes: Robust standard errors clustered at the subject level are in parentheses, and p-values are in brackets.

E Interventions

Cash transfer instructions Prior to the Week 2 Savings onboarding, for each Subject randomly assigned to receive a cash transfer, a Field Officer from Busara Lab:

- Field Officer calls Subject, and reads "Hello, my name is .... I am calling from Busara Center for Behavioral Economics. You have been randomly selected to receive 8,000 KSH."
- If Subject confirms: Field Officer hangs up, and sends 8,000 KSH to Subject by M-

Pesa.

- Field Officer calls Subject back, and reads "Have you received the cash?"
- If Subject confirms: Field Officer reads "Thanks", and hangs up.

Subjects were told in Week 0 that the selection of who would receive the 8,000 KSH was random, and field officers were instructed to tell subjects that the selection was random if asked.

Savings onboarding instructions After the Week 2 cash transfer (for subjects randomly assigned to receive a cash transfer), but prior to the Week 2 phone survey, for each Subject, a Field Officer from Busara Lab:

- Field Officer calls Subject, and reads "Hello, my name is .... I am calling from Busara Center for Behavioral Economics. Busara is working with a researcher to test out a new saving platform. You have been selected to participate in this study. You have an opportunity to save for **eight weeks**. We have set up a saving account at Busara for you to be able to save. The saving account is **Pay bill number** XXXXXX account name is **JL (followed by your mobile number)**, you will not be charged anytime you send money to this saving account. Your saving should not surpass 10,000 KSH for the eight weeks. You won't be able to withdraw your money from the savings until the eight weeks are up. In addition, you have been randomly selected to receive a **monthly** interest rate of **{-3%, 0%, 20%} at the end of the entire eight weeks**. For example, if you send 100 KSH to the saving account today, you will receive {94, 100, 140} in 8 weeks. If you send 100 KSH to the saving account in 4 weeks, you will receive {97, 100, 120} in 8 weeks.
- Field Officer asks Subject: "If you send 1,000 KSH to the saving account today, how much will you receive in 8 weeks?"

- If Subject answers correctly, asks Subject: "If you send 1,000 KSH to the saving account in 4 weeks, how much will you receive in 8 weeks?"
- If Subject answers either question incorrectly, Field Officer repeats instructions. If Subject answers both correctly, Field Officer asks "Do you know how to use Pay bill on M-Pesa?" If no, Field Officer instructs "Go to M-Pesa on your phone. Select lipa na mpesa. Select Pay bill. Enter business number XXXXXX. Enter account number **JL (followed by your mobile number)**. Enter amount. Enter your M-Pesa pin. Press Ok."
- Field Officer asks Subject: "Have you understood this or do I repeat again?" If no, Field Officer repeats instructions. If yes, Asks Subject: "Do you have any questions?"
- If Subject has no questions: Field Officer reads "Thanks", and hangs up.

Field Officers were instructed to answer to subjects that the decision of the subjects to save is voluntary. If subjects asked about whether they were supposed to save the 8,000 KSH, Field Officers were instructed to answer that subjects can use the money any way they please including putting it into savings.