At the Right Time: Eliminating Mismatch between Cash and Credit Flows in Microcredit*

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Abstract

Traditional microcredit creates a timing mismatch between cash and credit flows for farmers. Although farmers earn little income before harvest, they must make frequent repayments, effectively raising borrowing costs. Moreover, agricultural investments occur sequentially, whereas standard microcredit provides a lump-sum disbursement, forcing farmers to save for later-stage investments. We conduct a randomized experiment with tenant farmers in Bangladesh to evaluate contract designs that better align credit with agricultural cash flows. We find that allowing a single repayment after harvest increases loan uptake, while sequential loan disbursement increases later-stage investments among present-biased borrowers. These modifications do not worsen repayment performance. Moreover, sequential disbursements reduce the amount borrowed, plausibly by reducing precautionary borrowing. Using a calibrated model, we show that adding a self-imposed credit limit to sequential contracts further improves welfare for present-biased borrowers, whereas credit-line products may lower welfare despite increasing profits.

Keywords: Microcredit; timing mismatch; commitment; flexibility; precautionary borrowing

JEL Classification: G21, O16, Q14

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1 Introduction

Improving agricultural productivity remains fundamental to poverty reduction in developing countries, where farming is the main source of income for many poor households (Christiaensen et al., 2011). Expanding access to finance has long been viewed as a key instrument for stimulating agricultural investment and smoothing consumption over time. Despite the substantial global expansion of microcredit (MC) programs, credit uptake among smallholder farmers remains low (Hossain et al., 2019).[1] This persistent gap raises a fundamental question: Why does expanded credit availability often fail to translate into actual borrowing and productive investment among farmers?

A growing body of evidence suggests that the challenge lies not only in the availability of credit but also in the management of cash flows over time. Farming households face substantial seasonality in both income and production expenses, with periods of acute cash shortage before harvest and larger inflows only later in the production cycle. In such settings, the timing of financial flows can be as important as their magnitude (Casaburi and Macchiavello, 2019; Gerard and Naritomi, 2021; Kansikas et al., 2023). Misalignment between income and expenses exposes households to binding cash-flow constraints, costly borrowing, and underinvestment in profitable activities (Burke et al., 2019), highlighting the need for financial products that facilitate cash-flow management, rather than merely expanding access to credit.

In this study, we focus on a specific form of cash-flow misalignment: the timing mismatch between cash and credit flows. Standard MC creates two distinct mismatches for farmers. The first mismatch arises between cash inflows and credit outflows. Farm income is realized at harvest, yet standard MC contracts require frequent repayment before harvest. This repayment structure raises the effective cost of borrowing and forces farmers to divert resources away from production.[2] The second mismatch occurs between cash outflows and credit inflows. Agricultural investments are made in stages—land preparation, planting, irrigation, and fertilization—but MC loans are disbursed as a lump sum at the beginning of the crop season. This disbursement structure shifts the burden of within-season cash-flow management onto borrowers, who may face savings constraints, behavioral biases, and limited attention that make such management difficult (Ashraf et al., 2006; Duflo et al., 2011;

[1] An exception is Fink et al. (2020), who report high uptake and positive impacts on labor and output among farmers in Zambia.

[2] This problem is particularly severe for farmers cultivating long-cycle crops. Although they could, in principle, diversify across crops with staggered harvests to smooth income flows, most smallholders specialize in a single crop for efficiency.

Dupas and Robinson, 2013; Callen et al., 2019; Augenblick et al., 2023). These timing mismatches may dampen credit demand, lower investment, and induce over-indebtedness. We therefore ask: do credit products that better align with farmers' cash-flow cycles increase credit uptake and productive investment?

To address this question, we examine alternative MC contract designs that eliminate these timing mismatches. We first present a simple dynamic model showing how such mismatches distort borrowing and investment decisions. Standard MC contracts that require pre-harvest installment repayments raise the effective interest rate, discourage investment, and induce borrowers to take larger loans to meet pre-harvest repayments, leading to over-indebtedness. For present-biased (PB) borrowers, sequential disbursements, in which funds are disbursed in stages, can serve as a commitment device that limits overconsumption and promotes later-stage investment.[3]

We empirically test these predictions using a randomized controlled trial (RCT) with 1,000 tenant rice farmers in rural Bangladesh, most of whom lack collateral and face highly seasonal income flows. We implement four MC contracts that vary in repayment and disbursement schedules: (i) traditional MC (TradMC), with lump-sum disbursement and monthly installments; (ii) crop credit (CropC), with lump-sum disbursement and a single repayment after harvest; (iii) sequential credit (Seq-C), with sequential disbursement and a single repayment; and (iv) sequential in-kind credit (Seq-K), a variant of Seq-C with partial in-kind disbursement (e.g., fertilizer) to strengthen commitment by limiting liquidity. By jointly varying repayment timing (monthly vs. post-harvest) and disbursement timing (lump-sum vs. sequential), we identify how aligning credit inflows and outflows affects borrowing and investment.[4]

Our results show that a single repayment increases loan uptake by 10.5 percentage points relative to monthly installments, particularly benefiting poorer farmers facing pre-harvest cash shortages. Sequential disbursement does not increase uptake, even among PB borrowers, consistent with Laibson (2015)'s argument that demand for commitment is limited. Nonetheless, among PB farmers, sequential disbursement significantly increases investment, especially in later stages of production. Among PB borrowers, in-kind disbursement reduces the amount borrowed, consistent with reduced liquidity limiting overconsumption through

[3]Laibson (2015) define commitment as a pure restriction on one's choice set without any confounding extrinsic benefits.

[4]Similar to our work, Das et al. (2019) and Hossain et al. (2019) evaluate MC programs for sharecroppers in Bangladesh but use standard MC contracts with monthly installments and lump-sum upfront disbursement. Beaman et al. (2023) implement a product similar to our CropC for farmers in Mali but do not consider alternative contract structures.

the choice of M_2 at $t = 2$. Importantly, none of the modified contracts (CropC, Seq-C, Seq-K) worsen repayment performance relative to TradMC, and all improve borrower satisfaction and subsequent-season loan uptake. These results suggest that credit products better aligned with borrowers' cash-flow patterns can enhance investment and financial inclusion without compromising repayment performance.

A notable finding is that sequential disbursement reduces the amount borrowed, particularly among non-PB farmers (by 8.0–8.3%), contrary to the baseline model's prediction of no effect for these borrowers. We interpret this reduction as reflecting lower *precautionary borrowing*. Under standard lump-sum disbursement, borrowers tend to borrow more than they need as a buffer against future shocks, since they cannot access new loans until existing ones are repaid.[5] Sequential disbursement relaxes this constraint by allowing borrowing adjustments after shocks are realized, thereby reducing the need for ex ante buffer borrowing. An opposing precautionary motive may also arise under standard lump-sum disbursement, as borrowers anticipating a poor harvest may borrow less to avoid heavy debt burdens in low-income states. To assess which effect likely dominates, we extend the baseline model to incorporate productivity and expenditure shocks and conduct numerical simulations. The results show that, under plausible parameter values, sequential disbursement reduces the amount borrowed and also generates welfare gains.

Finally, we use the calibrated model to evaluate two counterfactual credit designs: sequential credit with a self-set limit (Seq-SSL) and credit lines (CLs). Seq-SSL allows borrowers to set their own borrowing limits in advance, introducing an additional layer of commitment. CLs offer flexible borrowing up to a credit limit, which prior studies link to higher profitability and improved insurance value (Aragón et al., 2020; Lane, 2024). While both products provide flexibility, they differ in how commitment is embedded in the contract. Our simulations show that Seq-SSL yields higher expected utility than Seq-C for sophisticated PB borrowers and remains beneficial for partially naïve PB borrowers. In contrast, although CLs lead to greater investment and profits as found in Aragón et al. (2020), they may reduce expected utility relative to Seq-C and even CropC because of overborrowing. These results highlight that evaluating credit products based solely on production outcomes can be misleading; welfare-based assessments require structural models that map observed outcomes to policy-relevant welfare measures. While most existing studies provide reduced-form estimates of MC impacts (Augsburg et al., 2015; Banerjee et al., 2015; Karlan and Zinman, 2011), designing improved credit contracts calls for a deeper structural understanding.

[5]This constraint may be context-specific. For instance, Karlan and Zinman (2011) finds that MC access improves borrowers' ability to secure informal financial assistance during emergencies.

Although our study focuses on agriculture, the mechanisms we highlight—timing mismatches, precautionary borrowing, and the balance between commitment and flexibility—are relevant to credit design more broadly. With the expansion of mobile banking and digital finance, tailoring repayment and disbursement schedules to individual cash-flow patterns is increasingly feasible across diverse settings. Our framework therefore provides a general perspective on how financial products can enhance welfare by improving cash-flow management and better aligning credit with household income and expenditure cycles.

This study contributes to the growing literature on flexible MC design, including less frequent installments (Field and Pande, 2008), longer grace periods (Battaglia et al., 2023; Field et al., 2013), flexible repayment schedules (Barboni and Agarwal, 2023; Shonchoy and Kurosaki, 2014), shifting the timing of credit provision to help farmers sell harvests at higher prices (Burke et al., 2019), and offering flexible CLs (Aragón et al., 2020) or emergency loans (Lane, 2024). It also contributes to the literature on commitment devices for PB individuals (Ashraf et al., 2006; Casaburi and Macchiavello, 2019) and to broader work on the trade-off between commitment and flexibility (Amador et al., 2006; John, 2020).

We make three specific contributions. First, we formalize how timing mismatches between cash and credit flows distort borrowing and investment, leading to underinvestment and borrowing for repayment. While Karlan and Mullainathan (2010) argue that standard frequent repayment "greatly limits the size of the loans the poor can borrow," we show that it can increase the amount farmers borrow by inducing borrowing for repayment. The model also rationalizes the positive investment effects of grace periods documented by Field et al. (2013).

Second, we highlight the relatively underexplored role of precautionary borrowing. While precautionary saving has been extensively studied (Caballero, 1990; Carroll and Samwick, 1998; Kimball, 1990), only a few studies have examined precautionary borrowing (Alan et al., 2012; Druedahl and Jorgensen, 2018), typically in the context of financial crises or under dynamic debt limits, where outstanding balances affect future credit ceilings. In contrast, we consider a more common situation in which borrowers cannot access new loans until existing debts are repaid——an institutional feature found in many real-world lending environments. Such constraints can induce borrowers to take out larger loans in anticipation of future credit needs, particularly when top-up borrowing is not feasible during the loan cycle. Recognizing this behavior reveals a previously overlooked benefit of flexible credit and improved financial access: The mere availability of additional or emergency credit can reduce debt burdens by lessening the need for precautionary borrowing. This insight is relevant beyond agriculture,

including contexts such as student loans and housing finance.

Third, we identify disbursement timing as a key design lever that embeds both commitment and flexibility in credit contracts, improving borrowers' cash flow management. While most prior studies focus on modifying repayment structures (Afzal et al., 2024; Battaglia et al., 2023; Field et al., 2013), we show sequential disbursement can simultaneously address present bias and the need for flexibility in responding to shocks, particularly for borrowers who invest in stages.[6] By linking disbursements to production stages, sequential credit provides a built-in commitment device that curbs overconsumption while preserving flexibility to adapt to shocks. Relatedly, Burke et al. (2019) shift disbursement to the post-harvest period to help farmers exploit seasonal price variation but do not consider disbursement timing as a mechanism for enhancing commitment and flexibility. While prior work (Casaburi and Macchiavello, 2019; Gerard and Naritomi, 2021) shows that disbursement timing can serve as a commitment device for PB individuals, we show that it can also provide flexibility by allowing borrowers to adjust later tranches in response to realized shocks.

The following section presents the baseline model that motivates our interventions. Section 3 describes the local context, experimental design, and data. The results are presented in Section 4. Section 5 discusses precautionary borrowing by incorporating uncertainty into the baseline model. Section 6 evaluates counterfactual credit designs. Section 7 concludes.

2 Conceptual Framework

Agricultural production is characterized by sequential investments and infrequent harvest income. Consider rice production as an example. At the beginning of the season, farmers make upfront investments in seeds, land preparation, irrigation, and basal fertilizer. They then transplant the seedlings, which requires additional labor. A month and a half after seeding, farmers apply herbicides, topdressing fertilizer, and pesticides, and perform labor-intensive weeding, often hiring extra workers. Harvesting occurs more than three months after seeding and requires additional labor for cutting, threshing, and transporting the crops. Until the harvest is sold, farmers have little income unless they work elsewhere, in either agricultural or non-agricultural activities. The typical schedule of agricultural investment is summarized in Table 1.

Farmers seeking credit typically apply for loans before production. Under standard MC,

[6] Chowdhury et al. (2014) advocate "sequential lending" under joint liability to deter coordinated default by staggering disbursements across group members. Our design staggers disbursements within a borrower, promoting investment and reducing precautionary borrowing.

Table 1: Typical schedule of agricultural investment and credit flow

	Stage 0	Stage 1	Stage 2	Stage 3
Production		(-) Land preparation (-) Seed (-) Basal fertilizer (-) Transplanting (-) Irrigation	(-) Topdressing fertilizer (-) Weeding (-) Herbicide (-) Pesticide	(+) Sell harvest (-) Crop-cutting (-) Threshing (-) Transporting
Credit	Application	(+) Disbursement (-) Regular installment	(-) Regular installment	(-) Regular installment

The positive sign (+) indicates cash inflows and the negative sign (-), cash outflows.

Table 2: Cash and credit flows and timing of decisions

$t = 0$	$t = 1$	$t = 2$	$t = 3$
Endowment A_0	Receive M_1 Repay $\pi_1 R$	Receive $M - M_1$ Repay $\pi_2 R$	Harvest $Y = F(K_1, K_2)$ Repay $(1 - \pi_1 - \pi_2)R$
* Decide borrowing $M \leq \overline{M}$ (and M_1)	* 1st investment K_1 * Consume c_1	* 2nd investment K_2 * Consume c_2	Consume $c_3 = Y - (1 - \pi_1 - \pi_2)R$

Asterisks (*) indicate the decision variables.

they receive the full loan amount at the start of the season and begin frequent repayments shortly after disbursement. This creates a timing mismatch between cash and credit flows: Farmers must start repaying before earning income, and they receive all credit upfront despite investing sequentially.

To formalize how repayment and disbursement schedules affect behavior, consider a multi-period model of a farmer with endowment A_0. We abstract from labor decisions and time discounting and assume a fixed land input. The sequence of decisions and credit flows is summarized in Table 2. At $t = 0$, the farmer applies to borrow $M \leq \overline{M}$ from a microfinance institution (MFI) at a simple interest rate r, where $\overline{M}$ is the maximum loanable amount (MLA). In periods $t = 1, 2, 3$, the farmer derives utility from consumption c_t, evaluated by a concave utility function $u(c_t)$. They make the first investment K_1 at $t = 1$ and the second investment K_2 at $t = 2$, and the harvest generates revenue $Y = F(K_1, K_2)$ at $t = 3$. The revenue function $F(K_1, K_2)$ is differentiable, with $F'_j \equiv \frac{\partial F}{\partial K_j} > 0$ for $j = 1, 2$, and its second-derivative matrix is negative definite.[7]

The MFI disburses $M_1 \leq M$ at $t = 1$ and the remainder, $M - M_1$, at $t = 2$. While M_1 is typically set by the MFI, it may be borrower-determined in flexible MC contracts. Total repayment is $R = (1 + r)M$, with fractions π_1 and π_2 repaid at $t = 1$ and $t = 2$ (before harvest), respectively, where $\pi_1 + \pi_2 < 1$ and $\pi_1, \pi_2 \geq 0$. The disbursement schedule (M_1) and repayment schedule (π_1, π_2) together determine the budget constraints in each period.

[7]This ensures that the first-order conditions characterize the optimum. For the matrix to be negative definite, $F''_{11} < 0$, $F''_{22} < 0$, and $F''_{11}F''_{22} > (F''_{12})^2$. For a Cobb–Douglas function $F(K_1, K_2) = \theta K_1^{\psi_1} K_2^{\psi_2}$, this condition is equivalent to $\psi_1 + \psi_2 < 1$ (decreasing returns to scale), which is plausible given the fixed land input.

Since most MFIs apply simple interest over the loan term, we assume total repayment is unaffected by the disbursement schedule (M_1) or repayment schedule (π_t). The amount repaid at $t = 3$ is $(1-\pi_1-\pi_2)R$, implying consumption $c_3 = Y-(1-\pi_1-\pi_2)R$.[8] Borrowing M therefore implies repaying $(\pi_1 + \pi_2)(1 + r)M$ before income is realized, leaving only $M - (\pi_1 + \pi_2)(1 + r)M = [1 - (\pi_1 + \pi_2)(1 + r)]M$ by $t = 2$. We denote this fraction by

$$Q \equiv 1 - (\pi_1 + \pi_2)(1 + r). \tag{1}$$

We present only the main results here; full derivations are shown in Appendix A.1. For simplicity, income flows other than the harvest are ignored, though they can be incorporated by redefining A_0 to include other income sources (Appendix A.1.1).

2.1 A time-consistent borrower

A time-consistent farmer's problem is $\max_{c_1,c_2,K_1,K_2,M} \sum_{t=1}^{3} u(c_t)$ subject to budget and borrowing constraints. The optimal borrowing amount M^* satisfies

$$F_j'(K_1^*, K_2^*) \geq 1 + \frac{r}{Q}, \qquad j = 1, 2, \tag{2}$$

with equality if the borrowing constraint is not binding. Suppose equality holds. If $\pi_1 = \pi_2 = 0$, then $Q = 1$ by Equation (1), so $F_j'(K_1^*, K_2^*) = 1 + r$, implying that a farmer borrows until the marginal product of investment equals its marginal cost. However, if $\pi_1, \pi_2 > 0$, as in traditional MC, then $Q < 1$ and $F_j'(K_1^*, K_2^*) = 1 + \frac{r}{Q} > 1 + r$, which reduces investment.

This reduction arises from a higher effective interest rate: Borrowing M leaves only QM available for investment after early repayments. To invest M', the borrower must borrow $\frac{M'}{Q}$, resulting in an interest payment of $\frac{rM'}{Q}$. Thus, the effective interest rate is $\frac{r}{Q}$, and a lower Q (larger pre-harvest repayments) discourages investment. Under traditional MC with $\pi_1 = \pi_2 = 1/3$ and $r = 20\%$, $Q = 0.2$, yielding an effective interest rate of $\frac{r}{Q} = 100\%$. If Q becomes negative, borrowing is suboptimal, as it reduces the resources available before harvest. Allowing external borrowing does not alter this result (Appendix A.1.2), and because such borrowing for production is rare in our setting, we abstract from it here.

A lower Q also reduces pre-harvest consumption and widens the gap in consumption before and after harvest, lowering borrowers' utility and limiting loan uptake by constraining

[8] Without uncertainty, borrowers take only the amount they need and do not save at $t = 2$. Saving at $t = 2$ is introduced later when incorporating uncertainty.

consumption smoothing.

Claim 1 *Frequent installment requirements reduce investment and loan uptake.*

The repayment schedule, represented by π_t, affects borrower behavior solely through Q. This framework applies broadly to settings with delayed investment returns. For example, Field et al. (2013) show that introducing a grace period in their RCT increases investment. Our model interprets this as a consequence of a higher Q induced by the grace period, which lowers the effective interest rate and stimulates investment.

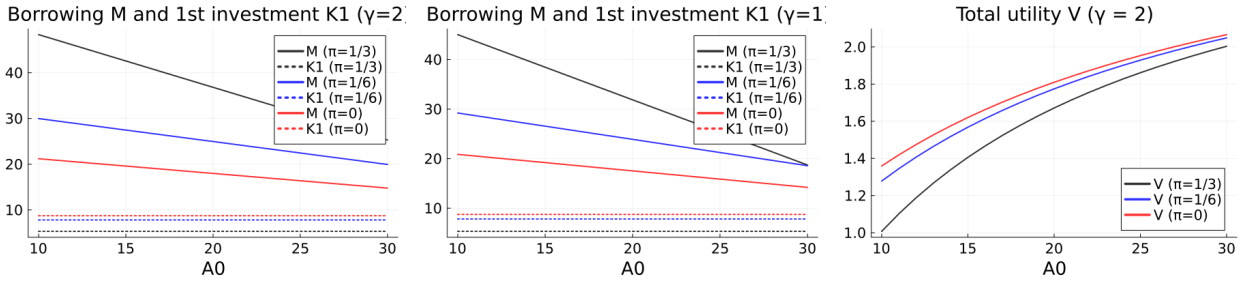
The effect of Q on the optimal borrowing amount M^* is indeterminate without further assumptions on the utility and revenue functions, even though investment and consumption decline as Q falls. This is because pre-harvest installment requirements induce borrowers to borrow in order to finance repayments.

Figure 1 illustrates how repayment schedules affect borrower behavior. We assume a Cobb–Douglass revenue function $F(K_1, K_2) = \theta K_1^{\psi_1} K_2^{\psi_2}$, with parameters calibrated to survey data: $(\psi_1, \psi_2, \theta) = (0.299, 0.152, 13.784)$ (Appendix A.3). Preferences follow a CRRA utility function $u(c) = \frac{c^{1-\gamma}-1}{1-\gamma}$, where larger $\gamma(\geq 0)$ implies stronger consumption-smoothing motives ($u(c) = \ln(c)$ when $\gamma = 1$). Guided by existing estimates of the intertemporal elasticity of substitution (Havranek et al., 2015), we set $\gamma = 2$ in the baseline and also present results for $\gamma = 1$, reflecting lower curvature typically observed in high-frequency data. While the utility specification does not alter production decisions, it influences the optimal borrowing amount and consumption profiles. The left panel of Figure 1 shows model predictions for borrowing M (solid lines) and first investment K_1 (dotted lines) against initial endowment A_0 under different repayment schedules for $\gamma = 2$. Black lines correspond to equal installments ($\pi_1 = \pi_2 = 1/3$), red lines to a single repayment after harvest ($\pi_1 = \pi_2 = 0$), and blue lines to an intermediate case ($\pi_1 = \pi_2 = 1/6$). As indicated in Equation (2), investment K_1 depends on π_t through Q but not on A_0, while borrowing M declines with A_0. Higher pre-harvest repayments (larger π_t) have two opposing effects on loan demand: They reduce resources for consumption and investment but also induce borrowers to borrow more to finance early installments. Within the range of A_0 shown, the latter effect dominates, leading to higher loan demand, especially among those with low A_0, indicating that poorer farmers allocate a substantial share of borrowed funds to repayment rather than production.

The middle panel shows analogous results for $\gamma = 1$, where weaker consumption-smoothing motives lead to smaller borrowing under equal installments ($\pi = 1/3$).

The right panel reports total utility for $\gamma = 2$, which is lowest under equal installments and highest under a single repayment. The welfare gain from relaxing early repayment is

Figure 1: Borrowing, first investment, and total utility under different values of π



Note: π is the fraction of the total repayment amount to be repaid at each period before harvest. $\pi = 1/3$ corresponds to equal installments and $\pi = 0$ to a single repayment.

larger for farmers with lower A_0, reflecting their heavier borrowing to finance pre-harvest installments. The same pattern holds for $\gamma = 1$ (not shown).

2.2 A present-biased borrower

In this baseline model, the disbursement schedule, represented by M_1/M (the share of credit disbursed at $t = 1$), affects time-consistent borrowers' decisions only if M_1 is small enough to make the Period-1 budget constraint binding. Such a low M_1 provides no benefit, as it just tightens available resources. In contrast, PB borrowers may prefer a smaller M_1 to restrict Period-1 consumption.

Consider a quasi-hyperbolic discounter who discounts future utility by β and believes their discount factor is $\hat{\beta}$. For simplicity, set $\pi = 0$ and examine whether a PB borrower has an incentive at $t = 0$ to choose a lower M_1. The full model is presented in Appendix A.1.3; here, we summarize the main insight, which aligns with the standard rationale for commitment demand (Laibson, 1997).

Claim 2 *A PB farmer who recognizes their present bias prefers sequential disbursement, which increases the second investment.*

Numerical examples (Appendix A.3.2, Appendix Figures 1 and 2) confirm this prediction. The utility gains are small, particularly for $\gamma = 2$, consistent with evidence that commitment demand is limited (Laibson, 2015).

Three points merit emphasis. First, the commitment mechanism is ineffective for borrowers with large A_0, as their ample resources prevent the Period-1 budget constraint from binding even if $M_1 = 0$; thus, sequential disbursement does not increase their second investment. Second, PB borrowers may prefer lump-sum disbursement if the MFI sets an excessively low upper bound on M_1. In particular, the presence of uncertainty—omitted in

this baseline model—would increase the optimal M_1, as flexibility becomes more valuable (Amador et al., 2006). Third, for naïve borrowers ($\hat{\beta} = 1$), sequential disbursement may not increase loan uptake but can still raise the second investment if the MFI sets M_1 adequately low.

3 Survey and Experiment

3.1 Local context

Motivated by the aforementioned predictions, we conducted an RCT among tenant rice farmers in the Dinajpur district of northwestern Bangladesh. The region's poverty rate (64.3%) far exceeded the national average (24.3%) (Hill and Genoni, 2019). Most tenant farmers were landless and excluded from formal credit. ROSCAs and other semi-formal institutions were virtually absent, and informal borrowing was limited. This institutional void made the area an ideal setting to study how credit timing affects borrowing and investment behavior.

Rice is Bangladesh's dominant crop, accounting for half of agricultural GDP. It is cultivated in three seasons: *Aush*, *Aman*, and *Boro*. Our study focuses on the *Aman* (rainy-season) crop, which contributes about 40% of annual production. The production cycle begins with land preparation in late June to July, followed by sowing in July–August. Subsequent operations—such as weeding, fertilizer application, and pest control—occur between August and October, and harvesting typically takes place in November–December. Because *Aman* cultivation is largely rain-fed and technologically homogeneous, farmers' credit demand primarily reflects liquidity needs for recurrent inputs rather than technology adoption.

Farmers procure seeds, fertilizers, and agrochemicals from local markets. Although some traders sell hybrid seeds, most *Aman* farmers use traditional varieties.[9] Mechanized plowing has largely replaced animal traction, and farmers typically pay local service providers in cash.

Most tenancy contracts require tenants to give 30% of the harvest to the landlord, while fixed-rent contracts are rare (below 1%). Lacking collateral and informal credit options, sharecroppers face severe credit constraints. Landlords rarely provide loans or inputs owing to moral-hazard concerns and costly monitoring, particularly as most live outside the village. These conditions highlight the acute liquidity constraints faced by tenant farmers and motivate our study focus.

[9] Only a few purchase hybrid seeds in *Aman*, but many use them in the shorter *Boro* season.

Most MFIs in the region continue to employ rigid "Grameen-style" contracts with weekly installments and offer few products tailored to agricultural cash-flow cycles. BRAC has experimented with a sharecropper loan (BCUP), but its monthly repayment schedule remains poorly aligned with farmers' seasonal income patterns.

3.2 Product design

The experiment was conducted in collaboration with *Gana Unnayan Kendra* (GUK), an NGO operating in northern Bangladesh for over 35 years. GUK typically offers individual-liability MC with monthly repayments but requires borrowers to form groups for screening and monitoring.

Before the 2015 *Aman* season, we conducted a pilot with GUK to track agricultural cash flows and production costs through farmer bookkeeping exercises. Based on these data, GUK set the MLA at BDT 400 (about USD 4.88) per decimal of tenanted land, at a five-month interest rate of 12%.

Eligible borrowers were tenant farmers not enrolled in existing MC programs. Borrowing groups were formed in May, and loans were disbursed in July. For the experiment, we offered four distinct credit products to study how loan timing and structure influence borrowing and investment behavior.

TradMC: This is GUK's standard contract: full disbursement at planting with equal monthly installments starting one month later. The loan matures after harvest, with four of five installments due before harvest, implying a very low value of Q in our model. Such low Q values highlight the main limitation of TradMC: Substantial pre-harvest repayments severely reduce funds available for investment. Borrowers may therefore use the loan for purposes other than crop production. Although GUK's enforcement is lenient (Section 3.4), mitigating the effective burden, the contract design reveals a pronounced mismatch between credit and income timing.

CropC: This product eliminates monthly installments, requiring a single repayment after harvest on the same date as the final installment under TradMC. In the model, CropC corresponds to $Q = 1$ and $M_1 = M$.

Seq-C: This product modifies CropC with three phased disbursements aligned with investment timing. Based on the pilot bookkeeping exercise, the first disbursement was capped at 60% of the MLA, with borrowers choosing any amount up to this cap ($M_1 \leq 0.6\overline{M}$). One month later, a second disbursement of up to 20% of the MLA was available, in addition to any unused amount from the first phase, allowing access to up to 80% of the MLA. A

Table 3: Product design

	Repayment		Disbursement		Cash/in-kind	
	Monthly ($Q < 1$)	Single ($Q = 1$)	Lump-sum ($M_1 = M$)	Sequential ($M_1 < M$)	Cash	In-kind
Traditional MC (TradMC)	✓		✓		✓	
Crop credit (CropC)		✓	✓		✓	
Sequential credit (Seq-C)		✓		✓	✓	
Sequential in-kind (Seq-K)		✓		✓		✓

final disbursement, intended for harvesting and post-harvest activities, occurred one month later. Borrowers chose the initial disbursement at planting and could subsequently request additional disbursements at each phase, subject to the remaining cap. While our model assumes $M_2 = M - M_1$, the field design allowed $M_2 < M - M_1$, enabling borrowers to adjust borrowing ex post. We return to this feature later.[10]

Seq-K: This product modifies Seq-C by delivering the first two disbursements in kind—fertilizers, seeds, pesticides, herbicides, and vitamins—through vouchers redeemable at vetted agro-dealers, limiting the scope for overconsumption. The final disbursement was provided in cash, as harvesting and post-harvest expenses are less input-intensive and more difficult to fulfill in kind.

Table 3 summarizes the characteristics of these products. CropC, Seq-C, and Seq-K replace monthly installments with a single post-harvest repayment; Seq-C and Seq-K introduce staged disbursements; and Seq-K delivers early disbursements in kind.

GUK held monthly meetings with all group members to monitor activities, collect monthly installments from TradMC borrowers, and promote voluntary savings. Control-group members also had access to this savings service. Because monthly meetings were maintained for all groups, our design cannot separately identify the effects of eliminating monthly installments from those of eliminating monthly meetings.[11]

3.3 Survey

To select the study site, we enumerated all subdistricts in Dinajpur and conducted a village survey on MFI penetration and the prevalence of tenant rice cultivation, cross-checking MFI activity with the Microcredit Regulatory Authority. Based on these data, we selected three unions (Ghoraghat, Palsha, and Vaduria) across two subdistricts (Ghoraghat and Nawabganj) where MFI presence was minimal, tenant rice farming was widespread, and geographic

[10] Under the baseline model without uncertainty, this flexibility does not change the solution.

[11] Feigenberg et al. (2013) show that regular group meetings play a key role in sustaining high repayment rates by strengthening social ties among borrowers.

Table 4: Summary statistics

	Count	Mean	SD	Min	Max
Tenanted land area (Baseline)	998	79.397	14.760	0	145
Owned land area (Baseline)	998	12.260	15.677	0	50
Productive asset (Baseline)	998	47173.757	42946.179	300	454500
Total other income (Baseline)	998	100839.124	45727.822	0	386124
Any borrowing (baseline)	998	0.348	0.476	0	1
Any saving (baseline)	998	0.805	0.397	0	1
Total borrowing (Baseline)	998	1296.744	5173.912	0	80000
Savings (Baseline)	998	544.807	2833.248	0	50000
Low education (primary or below)	998	0.471	0.499	0	1
Present-biased	998	0.589	0.492	0	1
1st investment (Baseline)	998	8281.677	2495.362	0	15720
2nd investment (Baseline)	998	4357.983	1777.883	0	11795
Profit (Baseline)	998	3976.659	5674.025	-14780	25678
Output (Baseline)	998	32238.176	10179.309	0	84000
Uptake	799	0.701	0.458	0	1
Total borrowing from GUK	560	16095.107	3888.165	3360	27300
Not repaid on due date (Arrear)	560	0.487	0.500	0	1
Default	560	0.118	0.323	0	1
% of amount not collected	560	0.076	0.235	0	.951
Cumulative savings	998	1377.568	1155.965	0	3940

access was limited. In early May 2015, GUK created 50 self-formed groups of 20 potential borrowers in these unions, informing farmers that both credit access and contract design would be randomized.

The baseline survey, conducted in June 2015, collected demographic and socioeconomic information for these 1,000 potential borrowers, including land area under tenancy. The follow-up survey, conducted in February 2016, repeated the baseline modules and additionally measured borrowers' satisfaction with the credit scheme they received.[12] We excluded two farmers who reported implausibly small tenanted areas at endline (implied MLA below BDT 3,000), as they likely omitted some cultivated plots, which would bias investment and output measures downward. Table 4 reports baseline summary statistics.

The average tenanted area at baseline was 79.3 decimals (0.32 ha), and most farmers cultivated less than 100 decimals (0.41 ha).[13] Given that farmers with under 2 ha were classified as smallholders, operational scales in our sample were very small.

Not all tenant farmers were landless, but most owned little or no land: 57% owned none, average landholdings were 12.3 decimals overall and 28.7 decimals among those with positive holdings, and none exceeded 50 decimals (Appendix Figure 3).

Access to credit was limited at baseline. Approximately two-thirds of farmers had not

[12]The consumption module was inadvertently omitted from the follow-up questionnaire, preventing estimation of consumption impacts.

[13]One decimal equals 40.47 m^2. Appendix Figure 3 shows the distribution of tenanted and owned land. While some farmers changed plots between baseline and follow-up, most cultivated the same land.

borrowed in the past 12 months, and only 5% had borrowed at least BDT 10,000 (Panel (C) of Appendix Figure 3). Borrowing from moneylenders was rare (1%). The most common source of credit was shop owners (59.7%), followed by other NGOs, including the Grameen Bank. About 92% of borrowing from shop owners was for food purchases, with small loan amounts. Only 9.0% of all baseline borrowing was for crop production.

It turns out that many tenant farmers also worked as daily wage laborers even during the agricultural season, earning substantial cash income before harvest. Average annual nonfarm income exceeded BDT 100,000, roughly 70% of which came from wage labor. A majority worked 240–360 days per year for wages (Appendix Figure 4), with an average daily wage of BDT 300.[14] Nearly all households had additional nonfarm income sources, including self-employment, and devoted substantial time to these activities (Appendix Figure 5). Consequently, only 10% of farmers earned *Aman*-season profits exceeding one-fourth of their total nonfarm income. In our model, nonfarm income is incorporated into initial endowments A_0 (Appendix A.1.1). These income flows may mitigate the cash-flow pressures created by the mismatch between agricultural production and MC repayment schedules, potentially dampening the impacts of removing monthly installments or introducing sequential disbursements. The effects would likely have been stronger if the intervention targeted farmers more dependent on crop income. We corroborate this mechanism through heterogeneity analyses by total other income.

Next, we describe the measurement of investment and present bias, which play a central role in our analysis. Investment measures are constructed consistent with the production timeline in Table 1. The first investment includes spending on seeds, basal fertilizer, hired labor and machinery for land preparation and transplanting, and irrigation fees. The second investment includes topdressing fertilizer, herbicides, pesticides, and hired labor for weeding. Because our focus is on how credit affects productive investment, we exclude the imputed cost of family labor from investment but include it when computing profits.The first investment is roughly twice as large as the second, as shown in Table 4.

The PB indicator is constructed using hypothetical intertemporal-choice questions, following Ashraf et al. (2006). We avoid real financial incentives because the unreliability of future payments and the transaction costs of collecting delayed rewards can lead even time-consistent individuals to prefer immediate money, making them appear PB (Chabris et al., 2008). Prior studies show that hypothetical and incentivized measures produce similar pref-

[14]Among wage earners, 57% worked in their own village and 38% in another village in the same union. Urban migration was rare owing to limited job networks: Only 1% migrated to another district (including Dhaka) for work.

erence patterns (Johnson and Bickel, 2002), and the hypothetical approach remains widely used for its simplicity (Cohen et al., 2020). We observed a relatively high proportion of PB individuals, consistent with evidence that present bias is more common among the poor (Haushofer and Fehr, 2014). Because this measure cannot distinguish between sophisticated and naïve PB types, PB-related results should be interpreted with this limitation in mind.

3.4 Randomization and product implementation

After the baseline survey, we randomly assigned 200 members (four per group) to each of the four credit products (TradMC, CropC, Seq-C, and Seq-K) for the 2015 *Aman* season. The remaining 200 members served as controls.[15] Because our primary outcomes are investment and production, randomization was stratified by an economic status score intended to proxy latent productivity. The score was constructed using principal component analysis on indicators including ownership of agricultural land, livestock, and productive assets; borrowing in the previous three years; access to electricity and latrine toilets; housing quality (mud walls); area of agricultural land; and years of education. Five households with similar scores were grouped and randomly assigned to the five experimental arms.Appendix Table 1 reports balance tests based on regressions of baseline characteristics on the treatment indicators. Consistent with the stratified design, the baseline characteristics were well balanced across groups.

There may be potential spillover effects among group members, especially through informal transfers or credit sharing. In the pilot phase, unstructured interviews revealed no evidence of such exchanges. Similarly, in the baseline and follow-up surveys, respondents were asked to report any cash or in-kind transfers to other group members, and none were recorded. This absence of informal transfers aligns with the institutional setting: Borrowing groups were newly formed and did not necessarily coincide with pre-existing informal networks or risk-sharing arrangements. Because first-stage investment needs were typically smaller than the disbursed loan, one concern was that lump-sum disbursement borrowers might have shared excess funds with nonborrowers. If so, we would expect lower second-stage investment or repayment delays among lump-sum disbursement borrowers, yet neither

[15]The sample size was constrained by GUK's capacity to expand field operations. We considered dropping Seq-K to increase the per-arm sample size from 200 to 250, which would have reduced standard errors by only 12%. We ultimately retained Seq-K to study the role of reduced liquidity. With a power of 0.8 and a significance level of 0.05, the minimum detectable effect size (MDE) under an i.i.d. data-generating process is 0.28 standard deviations (0.25 with 250 per arm). Thus, significant effects on noisy outcomes, such as income or profits, were unlikely to be detected. We report the MDE to aid the interpretation of results for these outcomes.

pattern appeared in the data. These findings indicate that spillovers through credit redistribution were minimal. Other channels, such as adjusting spending after observing peers in different treatment arms, cannot be fully ruled out, but any such effects would likely attenuate, rather than amplify, treatment differences, rendering our estimates conservative.

The average uptake rate among those offered credit was 70%, as shown in Table 4. This relatively high rate reflects that our sample consisted of farmers who had expressed interest in borrowing, consistent with Attanasio et al. (2015).[16] The average amount borrowed was BDT 16,095 (about USD 196), ranging from BDT 3,360 to BDT 27,300. For most borrowers, the amount borrowed was below the MLA inferred from tenanted area reported in the follow-up survey (GUK did not maintain individual borrower MLA records), as shown in Panel (A) of Appendix Figure 6. This suggests that the constraint $M \leq \overline{M}$ was not binding in most cases.[17] As only six borrowers took a third disbursement, we computed M_2 as the sum of the second and third disbursements.

Adverse weather delayed the harvest and affected repayment. Many borrowers could not complete harvesting by the original due date, prompting GUK to extend the maturity by three weeks (extended due date). Despite this extension, 48.7% of borrowers failed to repay by the extended due date. GUK then undertook intensive collection efforts and set a final due date one week later. Loans not fully repaid by the extended due date were classified as in arrears, and those not fully repaid by the final due date were classified as defaulted. The default rate was 11.8%, relatively high compared with that under standard MC programs elsewhere.

Nearly all TradMC borrowers missed at least one monthly installment, and fewer than 2% made all scheduled repayments. Repayment performance deteriorated two to three months after disbursement: Roughly 90-–95% of borrowers missed installments from September through November (Panel (A) of Appendix Figure 7). By November (the month preceding the final due date), the median share of the loan repaid was 0, and the 75th percentile was only 0.2 (Panel (B) of Appendix Figure 7). Recognizing these difficulties, GUK allowed borrowers to defer installments as long as the full balance was repaid by the final due date. This lenient enforcement likely attenuated differences between TradMC and CropC.

[16]Some farmers may have expressed interest only to retain the option to borrow, contributing to imperfect uptake. Anticipating uncertainty about loan availability may also have induced some to seek alternative credit sources.

[17]Some field staff set the MLA based on both tenanted and owned land. If the MLA was computed using the total area, the actual amount borrowed exceeded the MLA for only one borrower (Panel (B) of Appendix Figure 6), supporting the accuracy of our inferred MLA.

4 Results

To examine the effects of modifying repayment and disbursement schedules, we estimate the following equation:

$$y_{ij}^F = \gamma_0 + \gamma_1 y_{ij}^B + \tau_M MC_{ij} + \mathbf{T}_{ij}\boldsymbol{\tau} + \mathbf{X}_{ij}\boldsymbol{\gamma}_x + \zeta_j + \epsilon_{ij},$$

where y_{ij}^F is the outcome for household i in randomization stratum j at follow-up, y_{ij}^B is the baseline outcome, $\mathbf{X}_{ij}$ is a set of control variables, ζ_j are strata fixed effects (FEs), and ϵ_{ij} is the error term. Control variables are selected using post-double-selection (PDS) lasso (Belloni et al., 2014), applied to baseline asset values, owned and tenanted land areas, borrowing and saving indicators and amounts, first and second investments, total output, farm profit, total nonfarm income, education, the economic status score used for stratification, and their squared and interaction terms.

MC_{ij} is an indicator for access to any of our credit products, and $\mathbf{T}_{ij} = (BR_{ij}, SD_{ij}, IK_{ij})$ is a vector of indicators for the product characteristics described in Table 3 where

$$BR_{ij} = \begin{cases} 1 & \text{if offered a product with a single repayment (CropC, Seq-C or Seq-K)} \\ 0 & \text{otherwise} \end{cases}$$
$$SD_{ij} = \begin{cases} 1 & \text{if offered a product with sequential disbursement (Seq-C or Seq-K)} \\ 0 & \text{otherwise} \end{cases}$$
$$IK_{ij} = \begin{cases} 1 & \text{if offered a product with in-kind disbursement (Seq-K)} \\ 0 & \text{otherwise} \end{cases}.$$

With this specification, τ_M measures the effect of TradMC relative to the control group. The vector $\boldsymbol{\tau} = (\tau_{BR}, \tau_{SD}, \tau_{IK})$ captures the incremental effects of a single repayment, sequential disbursement, and in-kind disbursement. For instance, τ_{SD} represents the difference between CropC and Seq-C, while $\tau_{BR} + \tau_{SD}$ represents the difference between TradMC and Seq-C. Standard errors are clustered at the stratum level to account for within-stratum dependence induced by the treatment assignment.

For outcomes not defined for the control group, such as uptake, we estimate

$$y_{ij}^F = \ddot{\gamma}_0 + \mathbf{T}_{ij}\ddot{\boldsymbol{\tau}} + \mathbf{X}_{ij}\ddot{\boldsymbol{\gamma}}_x + \ddot{\zeta}_j + \ddot{\epsilon}_{ij}. \tag{3}$$

Because no baseline measure exists for these outcomes, the regression does not include the baseline outcome y_{ij}^B.

Table 5: Uptake and amount borrowed

	Uptake				
	(1) All	(2) Low other income	(3) High other income	(4) Non-PB	(5) PB
Single payment	0.105	0.149	0.063	0.086	0.113
	(0.048)	(0.073)	(0.079)	(0.095)	(0.063)
Seq disbursement	-0.027	-0.086	-0.004	-0.010	-0.038
	(0.042)	(0.074)	(0.067)	(0.085)	(0.059)
In-kind	0.066	0.127	0.027	0.059	0.065
	(0.045)	(0.075)	(0.066)	(0.092)	(0.058)
Observations	799	396	398	323	476
Mean_Control	0.595	0.570	0.626	0.605	0.589
SeqC_vs_TradMC	0.123	0.403	0.473	0.431	0.262
SeqK_vs_TradMC	0.002	0.011	0.260	0.146	0.026
Crop_vs_SeqK	0.406	0.571	0.743	0.562	0.667

	Amount borrowed					
	(1) All	(2) All:IPW	(3) non-PB	(4) non-PB:IPW	(5) PB	(6) PB:IPW
Single payment	-13.903	-147.302	-368.385	-306.176	167.615	-58.712
	(503.718)	(530.056)	(728.585)	(675.866)	(735.016)	(757.567)
Seq disbursement	-1243.886	-1209.916	-1358.276	-1407.965	-909.281	-853.692
	(372.704)	(382.967)	(595.567)	(602.387)	(501.098)	(515.098)
In-kind	-529.017	-625.522	18.423	-187.481	-1052.243	-1095.530
	(330.202)	(376.756)	(545.096)	(598.336)	(516.252)	(530.510)
Observations	560	557	231	231	329	326
Mean_Control	16910.420	16910.420	17274.348	17274.348	16681.096	16681.096
SeqC_vs_TradMC	0.006	0.006	0.010	0.009	0.297	0.212
SeqK_vs_TradMC	0.000	0.000	0.014	0.006	0.013	0.008
Crop_vs_SeqK	0.000	0.000	0.036	0.015	0.000	0.000

The table reports the estimated treatment effects, with standard errors clustered at the stratum level in parentheses. We include the group FEs, baseline savings, and variables selected by PDS lasso as the control. PB denotes present-biased individuals. The lower panel indicates the p values for the null hypotheses that the treatment effects are the same between the corresponding products.

4.1 Uptake

The upper panel of Table 5 reports loan uptake results estimated using Equation (3). We also report mean values for the TradMC group and p values for pairwise comparisons across products. For example, the p-value in the row SeqC_vs_TradMC corresponds to a test of the null $H_0 : \ddot{\tau}_{BR} + \ddot{\tau}_{SD} = 0$, that is, no difference in uptake between SeqC ($BR_{ij} = 1, SD_{ij} = 1$) and TradMC ($BR_{ij} = 0, SD_{ij} = 0$).

Uptake under TradMC is nearly 60%, remarkably high given the very low (or negative) Q implied by its repayment schedule, even though our sample consists of farmers who expressed interest in borrowing. This suggests that many may have borrowed for purposes other than crop production.

Consistent with the model, replacing monthly installments with a single repayment increases uptake by 10.5 percentage points, a 17.6% increase relative to TradMC. Sequential disbursement has no significant effect on uptake. In-kind disbursement is associated with

higher uptake, but the estimate is not statistically significant, and the difference in uptake between CropC and Seq-K remains insignificant.

Our theoretical model also predicts stronger effects of removing monthly installments among farmers with lower endowments or limited nonfarm income. To test this, Columns (2) and (3) report estimates for subsamples split by baseline total other income above and below the median.[18,19] The results align with the theoretical prediction: Removing monthly installments significantly increases uptake only among farmers with low other income. Although the difference in coefficients between the subsamples is not statistically significant, the pattern supports the view that frequent installment requirements limit the reach of MC to poorer farmers.

Columns (4) and (5) report results for subsamples split by time consistency. We find no evidence that sequential disbursement increases uptake among PB farmers, for whom its commitment feature would be expected to be most valuable. This suggests that the value of commitment provided by sequential disbursement is limited in practice, consistent with our numerical results showing only small utility differences between the CropC and Seq-C contracts (Appendix Figures 1–2). We also find no statistically significant differences across the two groups in the effects of repayment and disbursement structures on uptake.

4.2 Borrowing

The lower panel of Table 5 reports the effects on borrowing. Because borrowing is observed only for borrowers, these estimates are based on the selected sample of uptakers.[20] The model predicts that frequent installments increase borrowing upon uptake but reduce uptake itself, creating a potential sample selection problem. To address this, we also report results using inverse probability weighting (IPW) (Robins et al., 1995; Wooldridge, 2010).[21] Across both

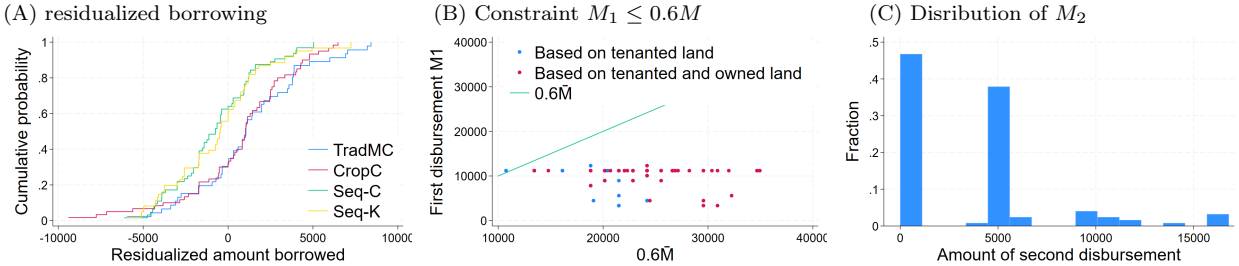
[18]We exclude five observations with baseline other income at the median.

[19]We impose the strata FEs in the subsample regressions to be the same as those in the full-sample regressions, because allowing different strata FEs for each subsample is infeasible. Specifically, we residualize outcomes using the group FEs estimated from the full sample and then apply PDS lasso with degrees of freedom adjusted. Specifications interacting treatment indicators with a subsample indicator (i.e., high vs. low other income or PB) yield similar results, but we report subsample analyses for clarity.

[20]ITT estimates on borrowing (including non-uptakers) are reported in Column (1) of Appendix Table 3. These estimates capture the expected lending volume per credit offer and are largest for CropC, indicating that MFIs can expand lending by offering CropC.

[21]IPW requires covariates $\mathbf{W}_{ij}$ that sufficiently predict selection such that, conditional on $\mathbf{W}_{ij}$, uptake is uncorrelated with unobserved determinants of y_{ij}. We use all covariates $\mathbf{X}_{ij}$ in Equation (3) and the average uptake and borrowing of other group members. (Group FEs are excluded to avoid perfect predictivity.) We first estimate the uptake decision using PDS lasso logistic regression to obtain the predicted probability $p(\mathbf{W}_{ij}) \equiv Pr(uptake_{ij}|\mathbf{W}_{ij})$, and then apply PDS lasso for Equation (3) using $1/p(\mathbf{W}_{ij})$ as the weight. This procedure improves covariate balance across treatment arms among the selected sample.

Figure 2: Distribution of the partial residuals of borrowing, M_1 and M_2 (non-PB)



Panel (A) shows the cumulative distributions of the partial residuals of borrowing, controlling for the variables selected by PDS lasso. Panel (B) plots the first disbursement M_1 against the predicted MLA $\overline{M}$. Panel (C) illustrates the distributions of the second disbursement M_2. All the figures use the sample of time-consistent borrowers.

specifications, introducing a single repayment does not significantly reduce borrowing.[22]

A striking finding is the substantial reduction in borrowing under sequential disbursement, by BDT 1,210–1,244 (7.2–7.4%). Sequential in-kind disbursement further reduces borrowing, though its estimate is less precise. Columns (3)–(6) show that the effect of sequential disbursement is larger for time-consistent (non-PB) borrowers, amounting to BDT 1,358–1,408 (8.0–8.3%), although the difference relative to PB borrowers is not statistically significant. Panel (A) of Figure 2 plots the cumulative distributions of partial residuals of borrowing for non-PB borrowers across treatment groups, controlling for variables selected by PDS lasso. This illustrates that sequential disbursement shifts the entire distribution leftward. Kolmogorov–Smirnov (KS) tests reject equality of the borrowing distributions between Seq-C and CropC, and between Seq-C and TradMC, at the 1% level.[23]

For PB borrowers, the effect of sequential disbursement is smaller (BDT 854–909), but in-kind disbursement is more effective in further reducing borrowing (BDT 1,052–1,096). This likely reflects the fact that PB borrowers still face the overconsumption problem at $t = 2$ under Seq-C: They could increase consumption by choosing a larger M_2. Reducing liquidity through in-kind disbursement mitigates this problem, resulting in lower borrowing.

As noted in the introduction, we attribute the reduction in borrowing under sequential disbursement to a decreased need for precautionary borrowing. We defer a detailed discussion to the next section and focus here on ruling out alternative explanations.

One possible explanation is that the lower borrowing reflects a higher effective interest rate on the second disbursement due to its delay. If so, borrowers with $M_2 > 0$ should exhaust the cheaper first-disbursement limit, that is, $M_1 = 0.6\overline{M}$. Panel (B) of Figure 2 contradicts

[22] In general, the sign of $\frac{\partial M^*}{\partial Q}$ is indeterminate and depends on the functional forms of F and u (see footnote 31 in Appendix A.1.1 for the expression). Hence, the observed pattern is not necessarily inconsistent with the model.

[23] For the full sample, differences narrow but remain statistically significant. KS tests again reject equality at the 1% level.

this: Most such borrowers choose M_1 well below $0.6\overline{M}$. Panel (C) further shows that many still select large M_2, inconsistent with a higher effective cost for the second disbursement.

Another potential explanation is that the cap $M_1 \leq 0.6\overline{M}$ constrains the first investment, lowering the marginal productivity of the second investment and thus reducing total borrowing. This is also inconsistent with the data: Many borrowers choose M_1 well below the cap, and, as shown later, sequential disbursement does not reduce second investments and even increases them for PB borrowers.

Further evidence comes from savings behavior, which aligns with the precautionary borrowing explanation. If sequential disbursement reduces the need for precautionary borrowing, it should also reduce precautionary saving. Appendix Table 2 confirms that sequential disbursement decreases total savings and savings in GUK accounts during the months of sequential disbursement for both PB and non-PB borrowers.[24]

Finally, Appendix Tables 3 and 4 show no differential borrowing from other sources, no changes in wage earnings, and no changes in net cash inflow (wage earnings plus external borrowing minus savings). Thus, changes in borrowing are not driven by broader shifts in income or borrowing patterns.

4.3 Investment, output, profit

Next, we examine the effects on investment, reported in the upper panel of Table 6. Our theory predicts that removing monthly repayments increases both first and second investments, with effects that may differ by borrower type. The estimates in Columns (1)–(6) are broadly consistent with these predictions.

Columns (1) and (4) show that farmers offered a single repayment make larger first investments, although the estimate is not statistically significant in the full sample. Columns (2), (3), (5), and (6) report separate estimates for time-consistent and PB farmers. The positive effect of a single repayment on first investment is larger and statistically significant among time-consistent farmers, whereas the corresponding estimate for PB borrowers is smaller and imprecisely estimated.

Sequential disbursement, in contrast, significantly increases second investments among PB farmers. By aligning the timing of loan disbursements with investment needs, sequential disbursement helps PB borrowers curb overconsumption and finance second investments, increasing them by 246 BDT (5.9%). Consistent with this mechanism, the effect appears only among PB farmers with low other income, who are more likely to exhaust funds needed

[24]GUK encouraged savings, which may explain higher savings amounts in the treatment groups.

Table 6: Investment and output

	First investment			Second investment		
	(1) All	(2) non-PB	(3) PB	(4) All	(5) non-PB	(6) PB
MC	-14.552	-191.857	100.372	14.149	-101.315	100.327
	(87.408)	(154.084)	(114.539)	(94.119)	(161.423)	(120.945)
Single payment	151.142	330.863	50.062	72.662	219.292	-12.904
	(95.865)	(168.047)	(112.935)	(95.417)	(183.775)	(114.293)
Seq disbursement	122.017	0.134	219.554	80.205	-153.644	245.808
	(102.487)	(187.162)	(116.235)	(106.100)	(183.783)	(124.830)
In-kind	-132.150	-95.058	-146.266	-36.183	-3.634	-63.360
	(104.275)	(171.247)	(123.565)	(95.777)	(159.618)	(132.994)
Observations	998	410	588	998	410	588
Mean_Control	8337.849	8217.782	8431.116	4151.714	4266.851	4062.277
Crop_vs_Control	0.151	0.436	0.159	0.403	0.538	0.461
SeqC_vs_Control	0.009	0.421	0.002	0.095	0.827	0.011
SeqK_vs_Control	0.161	0.788	0.054	0.191	0.820	0.032
SeqC_vs_TradMC	0.004	0.040	0.031	0.107	0.657	0.072
SeqK_vs_TradMC	0.125	0.117	0.312	0.221	0.696	0.171
Crop_vs_SeqK	0.911	0.592	0.516	0.672	0.404	0.121

	Output			Profit		
	(1) All	(2) non-PB	(3) PB	(4) All	(5) non-PB	(6) PB
MC	76.796	-262.429	240.055	-27.993	228.293	-250.848
	(433.090)	(709.867)	(534.654)	(384.313)	(620.614)	(475.401)
Single payment	255.374	760.263	-34.532	-42.816	-100.587	9.955
	(408.007)	(675.392)	(504.656)	(334.168)	(628.975)	(410.150)
Seq disbursement	159.759	-116.170	328.979	-107.084	181.727	-268.555
	(399.810)	(620.545)	(572.077)	(387.943)	(646.468)	(487.513)
In-kind	-364.877	-597.914	-158.465	3.644	-162.630	175.659
	(484.270)	(707.070)	(614.085)	(405.724)	(672.432)	(511.385)
Observations	998	410	588	998	410	588
Mean_Control	33733.166	32871.954	34402.143	6115.970	5436.828	6643.518
Crop_vs_Control	0.423	0.449	0.708	0.848	0.834	0.628
SeqC_vs_Control	0.250	0.566	0.372	0.658	0.618	0.354
SeqK_vs_Control	0.784	0.773	0.526	0.663	0.819	0.510
SeqC_vs_TradMC	0.321	0.343	0.599	0.688	0.901	0.584
SeqK_vs_TradMC	0.907	0.951	0.808	0.666	0.904	0.844
Crop_vs_SeqK	0.634	0.309	0.765	0.772	0.977	0.830

The table reports the estimated treatment effects, with standard errors clustered at the stratum level in parentheses. We include the baseline outcome, group FEs, baseline savings, and variables selected by PDS lasso as the control. PB denotes present-biased individuals. The lower panel indicates the p values for the null hypotheses that the treatment effects are the same between the corresponding products.

for the second investment (Appendix Table 5). The estimates also indicate a positive effect on first investments among these PB farmers. This pattern is consistent with the interpretation that the expectation of sufficient second investment raises the perceived returns to first investment. Our numerical example in the next section also support this interpretation: sequential disbursement can increase both first and second investments among PB farmers with low other income (Figure 3). In-kind disbursement has no statistically significant effect on first or second investments, either in the full sample or in subgroup analyses.[25]

[25]For time-consistent farmers, none of the products significantly increase first or second investments compared to the control group. These null effects suggest that control farmers are generally able to finance

The lower panel of Table 6 reports effects on output and profit. These variables are noisy, and the modest sample size implies large MDEs, so we do not detect significant differences across treatment arms. For example, the MDE for the effect of a single repayment on profit is 936, roughly 15% of mean profit.[26] Given the modest impacts on investment documented above and the limited profit effects reported in earlier MC evaluations (Augsburg et al., 2015; Banerjee et al., 2015), the absence of detectable impacts on output and profit is unsurprising.

4.4 Repayment performance

Table 7 reports repayment performance. The upper panel presents results for loans in arrears (Columns (1)–(4)) and for default (Columns (5)–(8)).[27] We find no significant differences across treatment arms, except that Seq-K borrowers are less likely to be in arrears than TradMC borrowers, significant at the 10% level (Column (1)). Applying IPW to address potential sample selection bias yields similar results (Columns (2) and (5)). Overall, more flexible schemes, such as a single repayment after harvest or sequential disbursement, do not worsen repayment performance.

The lower panel examines the ratio of uncollected loan amounts. Since the MFI could confiscate savings in the MFI savings account, we compute this ratio as

$$\text{ratio of uncollected loan amount} = 1 - \frac{\text{Amount repaid} + \text{Net savings at MFI}}{\text{Total amount to be repaid}}.$$

Again, we detect no significant differences across products (Column (1)). A Tobit specification that accounts for left-censoring at zero (Column (2)), as well as IPW estimates and subgroup analyses for PB and non-PB borrowers (Columns (3)-–(7)), produce similar results.

Overall, modifying repayment and disbursement schedules does not worsen repayment performance on any measure. In agricultural settings where income arrives in a lump sum at harvest, shifting repayment to the post-harvest period naturally supports borrowers' repay-

investments without formal credit, which is plausible given their long experience cultivating rice without MC access. In informal follow-up interviews, control farmers typically stated that they "managed somehow," without specifying financing sources. Survey data likewise show little reliance on alternatives to MC: Only 2.3% borrowed from relatives or friends and 1.2% from moneylenders. Appendix Table 3 further shows that neither borrowing from other sources nor net money inflow (borrowing plus wage income minus savings) is affected by the interventions. Taken together, these patterns indicate that many farmers are not severely credit-constrained in agricultural production, likely owing to nonfarm income flows. This also aligns with our earlier argument that many farmers may have used credit for purposes other than crop investment.

[26] If the sample size were increased by removing the Seq-K arm (see footnote 15), the MDE would decline only modestly (to 802).

[27] As discussed in section 3.4, we classify loans not fully repaid by the extended due date as in arrears, and those not fully repaid by the final due date as defaulted.

Table 7: Repayment performance

	Arrear				Default			
	(1) All	(2) All:IPW	(3) non-PB	(4) PB	(5) All	(6) All:IPW	(7) non-PB	(8) PB
Single payment	-0.061	-0.036	-0.022	-0.046	-0.017	-0.029	0.061	-0.064
	(0.053)	(0.057)	(0.118)	(0.081)	(0.041)	(0.043)	(0.092)	(0.052)
Seq disbursement	0.004	-0.020	0.017	-0.017	-0.013	-0.020	-0.073	0.004
	(0.052)	(0.052)	(0.102)	(0.077)	(0.035)	(0.038)	(0.084)	(0.049)
In-kind	-0.047	-0.039	-0.075	-0.015	-0.016	-0.026	0.009	-0.003
	(0.051)	(0.053)	(0.106)	(0.076)	(0.038)	(0.035)	(0.074)	(0.050)
Observations	560	557	231	329	560	557	231	329
Mean_Control	0.588	0.588	0.630	0.562	0.160	0.160	0.174	0.151
SeqC_vs_TradMC	0.310	0.328	0.961	0.437	0.425	0.274	0.893	0.299
SeqK_vs_TradMC	0.060	0.084	0.489	0.312	0.197	0.056	0.964	0.216
Crop_vs_SeqK	0.441	0.266	0.583	0.661	0.378	0.186	0.386	0.968

	Uncollected						
	(1) All	(2) All:Tobit	(3) All:IPW	(4) non-PB	(5) non-PB:IPW	(6) PB	(7) PB:IPW
Single payment	0.003	-0.015	-0.004	0.043	0.044	-0.022	-0.023
	(0.029)	(0.213)	(0.031)	(0.068)	(0.058)	(0.035)	(0.031)
Seq disbursement	-0.010	-0.081	-0.015	-0.027	-0.031	-0.013	-0.011
	(0.024)	(0.211)	(0.028)	(0.063)	(0.055)	(0.032)	(0.029)
In-kind	-0.004	-0.067	-0.013	-0.014	-0.010	0.017	0.016
	(0.028)	(0.215)	(0.026)	(0.057)	(0.049)	(0.032)	(0.029)
Observations	560	560	557	231	231	329	329
Mean_Control	0.094	0.094	0.094	0.115	0.115	0.081	0.081
SeqC_vs_TradMC	0.793	0.660	0.553	0.821	0.820	0.341	0.301
SeqK_vs_TradMC	0.688	0.444	0.248	0.973	0.952	0.566	0.523
Crop_vs_SeqK	0.576	0.479	0.252	0.446	0.380	0.883	0.848

The table reports the estimated treatment effects, with standard errors clustered at the stratum level in parentheses. We include the group FEs, baseline savings, and variables selected by PDS lasso as the control. PB denotes present-biased individuals. The lower panel indicates the p values for the null hypotheses that the treatment effects are the same between the corresponding products.

ment capacity. These findings suggest that easing the timing mismatch between income and repayment can enhance financial inclusion without compromising financial sustainability.

4.5 Uptake in the second round and satisfaction

Finally, we assess borrower satisfaction with these new credit schemes. Columns (1)–(3) of Table 8 report uptake in the second loan cycle, when farmers were reoffered their initial contract. Higher uptake indicates greater borrower satisfaction. Uptake of TradMC is 44%. Introducing a single repayment increases second-round uptake by 12 percentage points, while adding sequential or in-kind disbursement has no additional effect. Uptake patterns are similar for PB and non-PB borrowers. Columns (4)–(9) present self-reported satisfaction on a 1-5 scale ("completely unsatisfied" to "fully satisfied"), estimated using ordinary least squares and IPW to adjust for sample selection. Introducing a single repayment significantly

Table 8: Uptake in the second round

	Uptake (2nd round)			Satisfaction					
	(1) All	(2) Non-PB	(3) PB	(4) All	(5) All:IPW	(6) Non-PB	(7) Non-PB:IPW	(8) PB	(9) PB:IPW
Single payment	0.122	0.126	0.127	1.870	1.872	1.716	1.660	1.930	1.972
	(0.051)	(0.130)	(0.083)	(0.121)	(0.106)	(0.183)	(0.171)	(0.144)	(0.133)
Seq disbursement	-0.030	0.079	-0.068	-0.799	-0.779	-0.789	-0.759	-0.757	-0.763
	(0.048)	(0.131)	(0.084)	(0.086)	(0.077)	(0.116)	(0.121)	(0.119)	(0.111)
In-kind	0.039	-0.053	0.040	-0.295	-0.273	-0.344	-0.319	-0.356	-0.324
	(0.050)	(0.135)	(0.080)	(0.075)	(0.081)	(0.141)	(0.141)	(0.113)	(0.109)
Observations	799	323	476	553	550	229	229	324	321
Mean_Control	0.440	0.421	0.452	2.839	2.839	3.043	3.043	2.708	2.708
SeqC_vs_TradMC	0.071	0.091	0.466	0.000	0.000	0.000	0.000	0.000	0.000
SeqK_vs_TradMC	0.008	0.300	0.216	0.000	0.000	0.002	0.001	0.000	0.000
Crop_vs_SeqK	0.863	0.851	0.752	0.000	0.000	0.000	0.000	0.000	0.000

The table reports the estimated treatment effects, with standard errors clustered at the stratum level in parentheses. We include the baseline outcome, group FEs, baseline savings, and variables selected by PDS lasso as the control. PB denotes present-biased individuals. The lower panel indicates the p values for the null hypotheses that the treatment effects are the same between the corresponding products.

increases satisfaction. Sequential and in-kind disbursements reduce satisfaction relative to CropC, although Seq-C and Seq-K still generate higher satisfaction than TradMC.

The endline survey also asked borrowers to report the reasons underlying their satisfaction. Among Seq-C and Seq-K borrowers, only 18% cited sequential disbursement as a reason for satisfaction, while 5% mentioned it as a reason for dissatisfaction. Although the survey did not capture more detailed qualitative explanations, these patterns suggest that the design or timing of staged disbursements may require further refinement.

5 Option value and precautionary borrowings

5.1 Model

The previous section showed that the amount borrowed is systematically smaller under sequential disbursement. We argue that this reflects precautionary borrowing: When loans are disbursed upfront, borrowers take larger amounts as a buffer against potential future shocks, whereas staged disbursements allow borrowers to adjust after shocks are realized, reducing the need for buffer borrowing. This mechanism, however, is theoretically nuanced. Anticipating adverse productivity shocks that lower revenues in $t = 3$, borrowers may also choose to borrow less to avoid excessive debt. Thus, the net effect of sequential disbursement depends on the interaction between productivity and expenditure risk.

To formalize these ideas, we extend the baseline model to incorporate uncertainty and characterize borrowing behavior under CropC and Seq-C. For expositional clarity, we focus on time-consistent borrowers here, with the full solution (including PB borrowers) presented

Table 9: Timing of decisions under uncertainties

	$t=0$	$t=1$ Observe θ_1, ξ_1	$t=2$ Observe θ_2, ξ_2	$t=3$ Observe ξ_3
Production, consumption		* 1st investment K_1 * Consume c_1	* 2nd investment K_2 * Consume c_2	Harvest $Y = \theta_1\theta_2 F(K_1, K_2)$ Consume c_3
CropC	* Decide M	Receive M		Repay $(1+r)M$
Seq-C	* Decide M_1	Receive M_1	* Receive $M_2 \leq \overline{M} - M_1$	Repay $(1+r)(M_1+M_2)$
Seq-SSL	* Decide $\tilde{M}, M_1$	Receive M_1	* Receive $M_2 \leq \tilde{M} - M_1$	Repay $(1+r)(M_1+M_2)$
CL		* Receive $M_1 \leq \overline{M}$	* Receive $M_2 \leq \overline{M} - M_1$	Repay $(1+r)(M_1+M_2)$

The asterisk (*) indicates the decisions to be made.

in Appendix A.2. This extended framework is also used in the next section for counterfactual simulations.

We introduce two types of uncertainty: productivity shocks and expenditure shocks. First, we modify the revenue function as $Y = \theta_1\theta_2 F(K_1, K_2)$, where $\theta_t > 0$ $(t = 1, 2)$ represents productivity shocks realized at the beginning of period t. Values of $\theta_t > 1$ indicate favorable shocks, and $\theta_t < 1$ indicate unfavorable ones. Second, we introduce expenditure shocks ξ_t $(t = 1, 2, 3)$, which reduce the resources available for consumption and investment in period t by ξ_t, tightening the budget constraint. Negative values of ξ_t can be interpreted as positive income shocks. Productivity shocks directly affect investment choices, whereas expenditure shocks do not. Shocks realized only after Period 2 do not influence investment and are omitted for simplicity.

Table 9 presents the timing of decisions under CropC and Seq-C and, for completeness, also includes the counterfactual contract variants (Seq-SSL and CLs) that we introduce and evaluate in the next section.

Under CropC, borrowers choose the total borrowing M at $t = 0$, before observing any shocks. The optimal choice satisfies

$$E[u'(c_2^*)] = (1+r)E[u'(c_3^*)], \tag{4}$$

which equates expected marginal utility across the pre-harvest and post-harvest periods, adjusted for the interest rate r.

Under Seq-C, borrowers choose the second disbursement M_2 after observing $(\theta_1, \theta_2, \xi_1, \xi_2)$, subject to two constraints: [M2a] $M_2 \leq \overline{M} - M_1$ (total borrowing does not exceed the maximum limit) and [M2b] $M_2 \geq 0$ (negative disbursements are not allowed). This decision determines the total borrowing. If neither constraint binds, the optimal second disbursement M_2^*, and consequently the total borrowing, satisfies

$$u'(c_2^*) = (1+r)E[u'(c_3^*)|\mathcal{I}_2], \tag{5}$$

where $\mathcal{I}_2$ represents the information set at $t = 2$, including $(\theta_1, \theta_2, \xi_1, \xi_2)$.

Comparing (4) and (5) highlights the source of precautionary borrowing under CropC. Because M is chosen before shocks are observed, borrowers face uncertainty over c_2. To insure against low realizations of c_2, they borrow more than they would under full information. Uncertainty about c_3 also matters: CropC borrowers face additional uncertainty about c_3 due to productivity shocks θ_1, θ_2. Anticipating adverse productivity shocks, they may borrow less to limit repayment burdens under negative shocks. Hence, the effect of sequential disbursement on borrowing depends on the severity of potential productivity and expenditure shocks.

Whether constraints [M2a]-[M2b] bind depends on the loan limit $\overline{M}$ and the choice of the first disbursement M_1, set at $t = 0$. A large M_1 increases the likelihood that the borrower would prefer $M_2 < 0$—for example, when expenditure shocks are mild or productivity shocks reduce investment demand—but this is precluded by [M2b]. Conversely, a small M_1 increases the probability that the Period-1 budget constraint [BC1] $c_1 + K_1 \leq A_0 + M_1 - \xi_1$ binds, especially under adverse expenditure shocks or high investment demand. Let ν and λ be the Lagrange multipliers on constraints [M2b] and [BC1], respectively. Under an interior solution, the optimal M_1 at $t = 0$ satisfies

$$E(\lambda) = E(\nu).$$

Thus, borrowers choose M_1 to balance the risk of insufficient resources at $t = 1$ against the risk of overborrowing.

Finally, we characterize the second investment decision K_2 at $t = 2$, which affects conditions (4) and (5). Under CropC, the optimal K_2 satisfies

$$\theta_1\theta_2 F_2'(K_1, K_2^*) = 1 \qquad \text{if the budget constraint does not bind,} \quad (6)$$

$$u'(c_2^*) = \theta_1\theta_2 F_2'(K_1, K_2^*) E[u'(c_3^*)|\mathcal{I}_2] \qquad \text{if it binds.} \quad (7)$$

The Period-2 budget constraint does not bind when borrowers hold sufficient buffers relative to realized shocks. In this case, they save at $t = 2$, and reducing K_2 by one unit increases savings carried over to $t = 3$ by one, while reducing output at $t = 3$ by $\theta_1\theta_2 F_2'$. The optimal K_2^* therefore satisfies $\theta_1\theta_2 F_2' = 1$, as in Equation (6). When the budget constraint binds, reducing K_2 by one unit raises c_2 by one, while reducing output at $t = 3$ by $\theta_1\theta_2 F_2'$, leading to condition (7).

Under Seq-C, the second investment satisfies $\theta_1\theta_2 F_2'(K_1, K_2^*) = 1 + r$ because reducing

K_2 by one unit lowers the repayment due at $t = 3$ by $1 + r$ and reduces output by $\theta_1\theta_2 F_2'$. Hence, the marginal product of K_2 is equated to the effective capital cost $1 + r$, achieving the optimal investment level.

5.2 Numerical exercises for precautionary borrowing

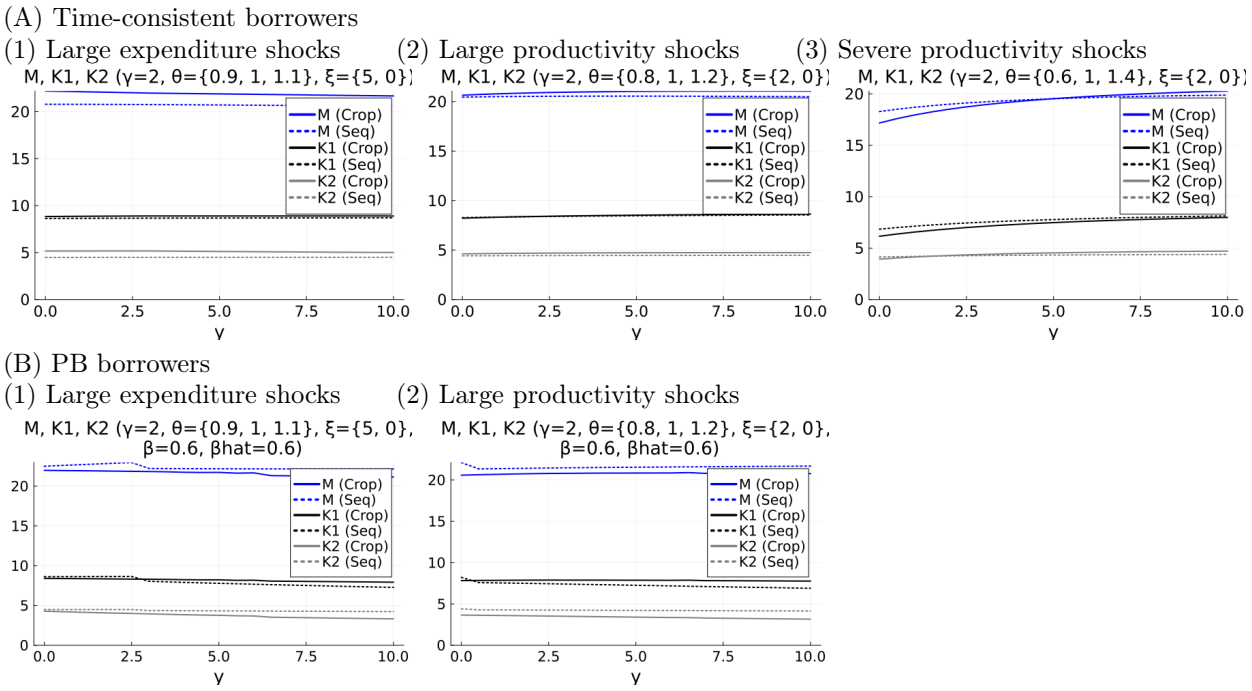
As discussed above, the extent of precautionary borrowing under CropC depends on the importance of potential productivity and expenditure shocks. Because closed-form solutions are not available, we use numerical exercises to examine whether, under plausible parameter values, precautionary borrowing can explain the observed reduction in borrowing under Seq-C. To reduce computational burden, we consider discrete, i.i.d. productivity and expenditure shocks: $\theta_t \in \{\theta_L, \theta_M, \theta_H\}$, $\xi_t \in \{\xi_L, \xi_H\}$, for $t = 1, 2$, where $\theta_L < \theta_M < \theta_H$ and $\xi_L < \xi_H$. We omit expenditure shocks at $t = 3$, which substantially increase computation but have a negligible effect on the results.[28] We consider three cases, each with $\Pr(\theta_t = \theta_L) = \Pr(\theta_t = \theta_H) = 0.1$ and $\Pr(\xi_t = \xi_H) = 0.2$:
Case 1 (Large expenditure shocks): $\theta_t \in \{0.9, 1.0, 1.1\}$, $\xi_t \in \{0, 5.0\}$.
Case 2 (Large productivity shocks): $\theta_t \in \{0.8, 1.0, 1.2\}$, $\xi_t \in \{0, 2.0\}$.
Case 3 (Severe productivity shocks): $\theta_t \in \{0.6, 1.0, 1.4\}$, $\xi_t \in \{0, 2.0\}$.
Expenditure shocks are more important in Case 1, while productivity shocks are more important in Case 2. Case 3 considers even larger productivity shocks, under which average investment may yield losses in the worst states. To reflect the substantial nonfarm income observed in our data, we incorporate a deterministic regular income y in each period, which is used as the horizontal axis. Uncertainty in nonfarm income is subsumed in the expenditure shocks ξ_t. We set the loan limit $\overline{M} = 32,000$, corresponding to the MLA for the average farmer. Computational details are in Appendix A.3.

Figure 3 displays the model's predictions for total borrowing M^* and investment levels K_1^* and K_2^* under CropC (solid lines) and Seq-C (dotted lines) for $\gamma = 2$. To focus on the effect of precautionary borrowing, the figure shows choices in the no-shock state ($\theta_t = 1, \xi_t = 0$). Averaging over all shock realizations produces similar patterns.

Panel (A) shows the results for time-consistent borrowers. Borrowing is smaller under Seq-C than under CropC, particularly when expenditure shocks are important. The gap narrows as productivity shocks become more significant. Appendix Figure 9 shows analogous results for $\gamma = 1$, where Seq-C yields uniformly smaller borrowing across all three cases.

[28] Appendix Figure 8 shows the results for time-consistent borrowers with an expenditure shock at $t = 3$ ($\xi_3 \in \{-2.0, 0, 2.0\}$, where $\Pr(\xi_3 = 0) = 0.8$ and $\Pr(\xi_3 = -2.0) = \Pr(\xi_3 = 2.0) = 0.1$). The patterns are nearly identical to those in Panel (A) of Figure 3.

Figure 3: Choice of (M, K_1, K_2) under CropC and Seq-C ($\gamma = 2$)



Second-period investment (K_2) is lower under Seq-C, reflecting overinvestment under CropC as implied by (6). The differences in first-period investment (K_1) are much smaller. Seq-C achieves slightly higher expected utility than CropC (Appendix Figure 10).

Panel (B) shows the results for PB borrowers ($\beta = \hat{\beta} = 0.6$). We omit Case 3 owing to non-convergence for some values of y. Unlike time-consistent borrowers, PB borrowers choose larger borrowing under Seq-C for the parameter values considered. Under CropC, they anticipate overconsumption by their future selves and therefore deliberately reduce borrowing as a commitment device. Seq-C relaxes this concern by allowing them to keep M_1 low to restrain Period-1 consumption and later finance the second investment through M_2. This combination of commitment and flexibility leads to larger total borrowing under Seq-C.

Seq-C also increases the second investment, which raises the marginal product of K_1 and, for PB borrowers with low other income, makes a larger first investment optimal. This mechanism is consistent with the positive (though imprecisely estimated) coefficient on sequential disbursement in Table 6. It may also explain why the difference in borrowing between CropC and Seq-C is smaller for PB borrowers in Table 5, although PB borrowers still borrow less under Seq-C in the data.

5.3 Suggestive evidence on the role of productivity shocks

The direction and magnitude of precautionary borrowing effects depend on the relative importance of productivity and expenditure shocks, but we lack direct measures of these shocks. However, since the second disbursement is determined by $M_2^* = K_2^* + c_2^* + \tilde{A}_2 - \xi_2$ and K_2^* responds to productivity shocks (θ_1, θ_2), variations in K_2 should be strongly correlated with variations in M_2 if productivity shocks are quantitatively important. Appendix Table 6 tests this implication. Among time-consistent Seq-C borrowers, after controlling for the demographic variables selected by PDS lasso, we find no statistically significant correlation between K_2 and M_2. Including K_1 or using the total borrowing $(M_1 + M_2)$ produces the same result. Adding higher-order polynomials of K_2 and K_1 does not change the results (not reported). Although statistical power is limited, these null results suggest that productivity shocks are not major determinants of the amount borrowed.

One concern is that unobservables correlated with K_1 and K_2 may confound these regressions. To address this, we pool Seq-C and CropC borrowers and regress borrowing on K_1, K_2, and their interactions with a Seq-C indicator. These interaction terms capture the additional correlation between investment and borrowing specific to Seq-C, net of such unobservables. They remain insignificant, reinforcing the view that productivity shocks play a limited role.

Overall, the evidence suggests that productivity shocks are not a primary driver of borrowing, and that expenditure shocks likely play the central role; this is consistent with precautionary borrowing explaining the substantial reduction in borrowing under sequential disbursement.

6 Counterfactual simulations

Our findings highlight the importance of both commitment and flexibility in sequential disbursement. Commitment arises from aligning the timing of credit inflows with cash outflows, while flexibility comes from aligning the timing of the decision on credit size with the realization of credit needs. Commitment increases investment for PB borrowers, whereas flexibility reduces borrowing by limiting precautionary borrowing.

However, flexibility at $t = 2$ may induce overconsumption among PB borrowers by enabling additional borrowing. Column (1) of Table 10 shows that under Seq-C, PB borrowers receive larger second disbursements by BDT 1,622, or 10% of the average total borrowing. In-kind disbursement can mitigate this problem by restricting the use of funds for consumption.

Table 10: Present bias and second disbursement

	(1) M2: Seq-C	(2) M2: Seq-K	(3) M2=0: Seq-C	(4) M2=0: Seq-K	(5) M1: Seq-C	(6) M1: Seq-K
PB	1621.694	-277.938	-0.189	-0.037	-488.273	-16.369
	(613.111)	(741.135)	(0.083)	(0.081)	(443.142)	(441.733)
Observations	140	155	140	155	140	155

The table shows the estimated coefficients with standard errors clustered at the stratum level in parentheses. Baseline savings and variables selected by PDS lasso are included as controls.

Consistent with this, the corresponding regression for Seq-K borrowers shows no significant tendency for PB borrowers to take larger second disbursements (Column (2)). Similarly, PB borrowers are less likely to choose $M_2 = 0$ under Seq-C, but not under Seq-K (Columns (3) and (4)).

Notably, no systematic differences in the first disbursement appear between PB and time-consistent borrowers under either Seq-C or Seq-K (Columns (5) and (6)). Thus, PB borrowers primarily face the overconsumption problem at $t = 2$. While in-kind disbursement could limit this problem, its reduced liquidity makes it harder for borrowers to manage expenditure shocks. This trade-off may explain the lower satisfaction with Seq-K compared with that for CropC and Seq-C, as reported in Table 8.

To address overconsumption at $t = 2$ while preserving liquidity for expenditure shocks, we propose modifying Seq-C by allowing borrowers to set a maximum credit limit $\tilde{M}$ at $t = 0$. We call this product Seq-SSL, which differs from Seq-C only in that borrowers choose $\tilde{M}$ upfront. Time-consistent borrowers will select a sufficiently high $\tilde{M}$ so that the Period-2 constraint $M_2 \leq \tilde{M} - M_1$ never binds. PB borrowers, in contrast, may set a tighter limit to restrict available resources at $t = 2$. A full characterization of the model is provided in Appendices A.2.2 and A.2.3.

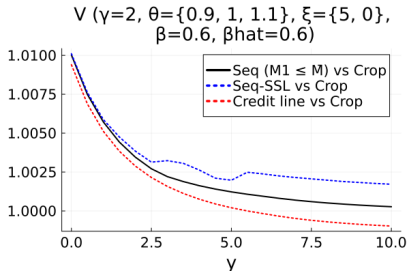
We evaluate Seq-SSL using a calibrated model and compare it to CropC, Seq-C, and another hypothetical product, CLs. Under CLs, borrowers choose M_1 at $t = 1$ and M_2 at $t = 2$ after observing shocks. While Seq-C and Seq-SSL offer both commitment and flexibility, CLs provide only flexibility. Time-consistent borrowers have no demand for commitment, so Seq-C, Seq-SSL, and CLs deliver the same investment and consumption decisions. To make interest costs comparable across products (given the absence of time discounting in our model), we apply a constant simple interest rate r to all borrowing, regardless of timing.

Figure 4 presents the results for PB borrowers with $\beta = \hat{\beta} = 0.6$ under Case 1 (large expenditure shocks), with $\gamma = 2$ in Panel (A) and $\gamma = 1$ in Panel (B). The results for Case 2 (large productivity shocks) are similar and provided in Appendix Figure 11.

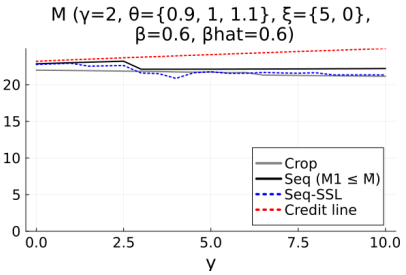
Figure 4: Counterfactual policy simulations ($\beta = \hat{\beta} = 0.6$, large expenditure shocks)

(A) $\gamma = 2$

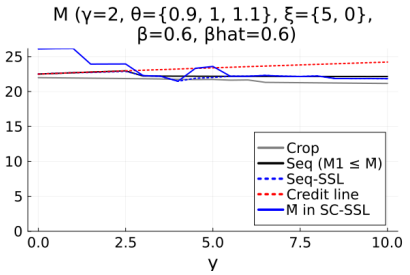
(a) Expected utility



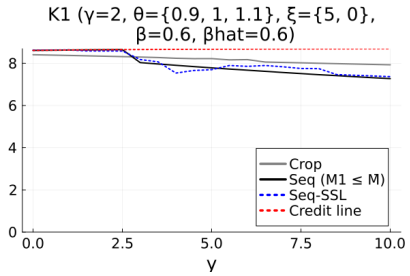
(b) Average borrowing



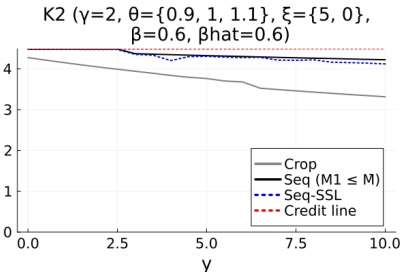
(c) Borrowing (no shocks)



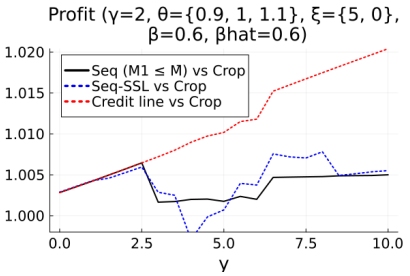
(d) First investment



(e) Second investment

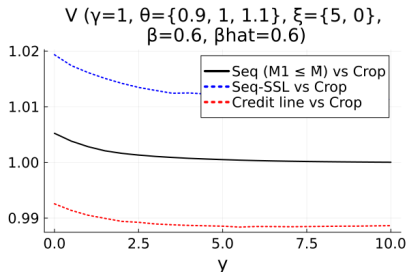


(f) Profit

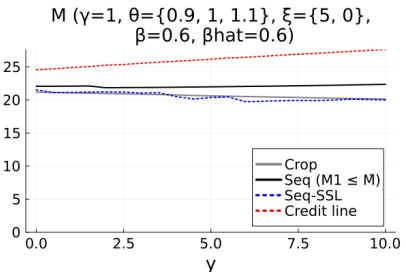


(B) $\gamma = 1$

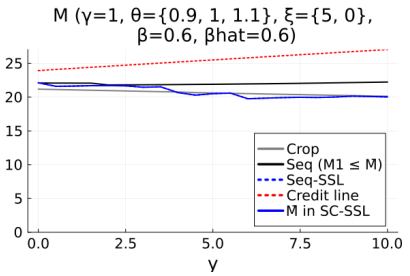
(a) Expected utility



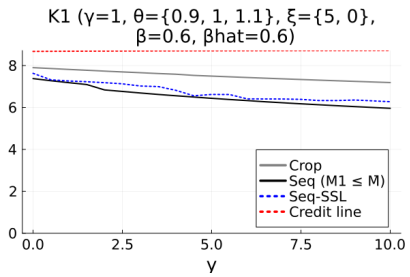
(b) Average borrowing



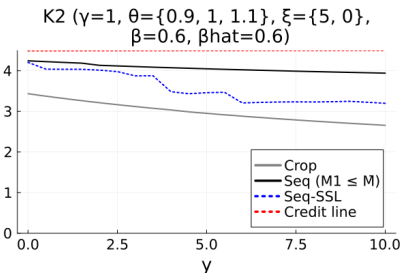
(c) Borrowing (no shocks)



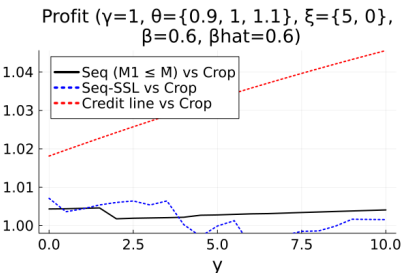
(d) First investment



(e) Second investment



(f) Profit



Subpanel (a) in each panel reports the expected utility gain over CropC for Seq-C (black solid lines), Seq-SSL (blue dotted lines), and CLs (red dotted lines). The jagged profiles reflect the discrete stochastic process, as well as the 0.5-unit grid used for evaluating the x-axis variable.Seq-SSL generates the largest expected utility gains, particularly when $\gamma = 1$. In contrast, CLs can produce lower expected utility than CropC for borrowers with high nonfarm income y or when $\gamma = 1$.

CLs perform poorly because they encourage substantially larger borrowing. Subpanels (b) show that the average borrowing is highest under CLs. While CLs provide valuable flexibility after negative shocks, the benefit is minimal for borrowers with sufficiently high nonfarm income flow y. For these borrowers, CLs offer excessive flexibility, leading to overborrowing and lower utility.

Differences between Seq-C and Seq-SSL are more pronounced when $\gamma = 1$. With $\gamma = 2$, strong consumption-smoothing motives lead borrowers to set the limit $\tilde{M}$ high for precautionary purposes, reducing Seq-SSL's commitment value. With $\gamma = 1$, borrowers tolerate larger consumption fluctuations and set $\tilde{M}$ low to curb overconsumption at $t = 2$. Subpanels (c) illustrate this pattern, showing borrowing in the no-shock state (blue dotted lines) alongside the self-set limit $\tilde{M}$ (blue solid lines) under Seq-SSL. When $\gamma = 2$ and y is low, $\tilde{M}$ exceeds the chosen borrowing and does not bind. When $\gamma = 1$, $\tilde{M}$ binds, indicating effective commitment.

Subpanels (d)–(f) present production-related outcomes in the no-shock state. Subpanels (d) and (e) show first and second investments, while Subpanels (f) report profit, defined as revenue minus input costs.[29] Notably, CLs generate the largest first and second investments (and thus the highest output), and the highest profit. These results are consistent with those of Aragón et al. (2020). However, as discussed, expected utility is lower under CLs, highlighting that evaluating credit interventions based solely on production outcomes can be misleading: Welfare impacts may move in the opposite direction. Identifying welfare-improving contract designs requires structural models linking behavioral and technological features to welfare.

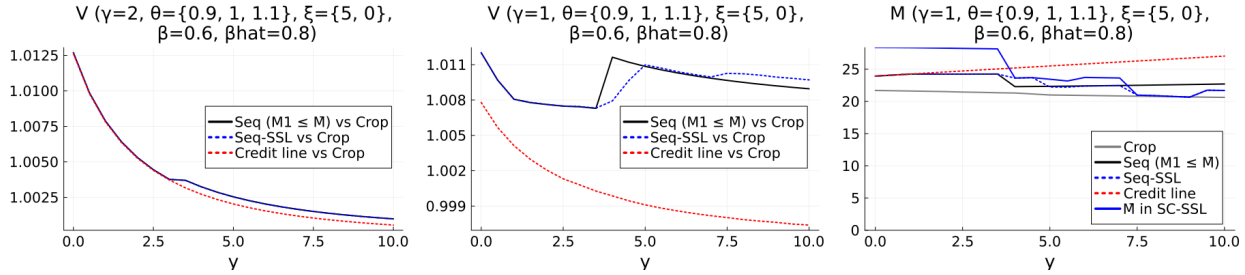
Seq-C and Seq-SSL produce lower first investments but higher second investments than CropC, with sharper differences when $\gamma = 1$ (when commitment is more effective).[30] These patterns highlight substantial heterogeneity in the relative value of commitment and flexi-

[29]Because money is fungible and borrowers can use loans for consumption rather than investment, repayment amounts are typically excluded from profit calculations.

[30]When present bias is milder ($\beta = \hat{\beta} = 0.8$), differences in expected utility across Seq-C, Seq-SSL, and CLs are small; see Appendix Figure 12.

Figure 5: Counterfactual policy simulations ($\beta = 0.6, \hat{\beta} = 0.8$)

(A) Expected utility when $\gamma = 2$ (B) Expected utility when $\gamma = 1$ (C) Borrowing when $\gamma = 1$



bility across borrowers.

A potential concern is that strengthening commitment through Seq-SSL may harm partially naïve PB borrowers (John, 2020). To examine this, Figure 5 reports the results for partially naïve borrowers with $(\beta, \hat{\beta}) = (0.6, 0.8)$ under Case 1 (large expenditure shocks). Appendix Figure 13 shows analogous results for Case 2 (large expenditure shocks), with similar patterns.

Panel (A) shows expected utility gains over CropC when $\gamma = 2$. Strong consumption-smoothing motives already limit overconsumption, leaving little scope for commitment to add value. Partial naïveté further reduces the value of commitment: By underestimating their future bias, borrowers place insufficient weight on commitment, resulting in minimal differences in expected utility across products. Panel (B) shows the results for $\gamma = 1$, where weaker consumption-smoothing motives produce larger differences across products. Even here, Seq-SSL performs well. Seq-C slightly outperforms Seq-SSL for some values of y, but both deliver similar welfare gains relative to CropC.

Seq-SSL performs well for partially naïve borrowers because they do not set the limit $\tilde{M}$ excessively low. Panel (C) shows that $\tilde{M}$ (blue solid line) rarely constrains the borrowing (blue dotted line) and typically exceeds the borrowing under Seq-C in the no-shock state (black line). Comparing Figures 4 and 5 shows that partially naïve borrowers ($\beta = 0.6, \hat{\beta} = 0.8$) set larger credit limits than sophisticated borrowers ($\beta = \hat{\beta} = 0.6$). When choosing $\tilde{M}$, borrowers balance commitment and flexibility, but partially naïve borrowers underestimate their present bias, place less weight on commitment, and choose larger credit limits.

The relative performance of CLs compared to CropC is also better for partially naïve borrowers than for sophisticated borrowers. Under CropC, partially naïve borrowers overconsume relative to their own expectations, sharply reducing second-period investment. The flexibility of CLs mitigates this problem, giving them a utility advantage over CropC.

7 Conclusion

Standard MC creates substantial timing mismatches between cash and credit flows for crop farmers. Frequent installments require sizable repayments before harvest, effectively raising borrowing costs and prompting farmers to borrow just to meet repayments. Lump-sum disbursements can also lead PB borrowers to overconsume, leaving insufficient funds for later investments. Our experimental findings show that eliminating frequent installments increases credit uptake without worsening repayment, and that sequential disbursements increase later investments among PB borrowers. Moreover, sequential disbursements reduce borrowing by removing the need for precautionary borrowing, suggesting that mere access to emergency or additional loans can lower debt burdens by reducing precautionary borrowing. Taken together, these results demonstrate that both repayment timing and disbursement flexibility play key roles in shaping credit demand and welfare impacts.

For borrowers who invest in stages, sequential disbursements provide both commitment and flexibility. Our counterfactual simulations suggest that allowing borrowers to set their credit limit can further benefit PB borrowers by enhancing commitment. In contrast, CLs, which offer flexibility alone, may reduce welfare despite generating larger investments and profits. These results show that evaluating credit interventions based solely on production outcomes can be misleading and that structurally grounded analyses are essential for identifying welfare-improving contract designs.

Credible welfare analysis requires high-frequency data on consumption, income, and shocks to capture within-season liquidity fluctuations and typical cash-flow timing. Sequential disbursements are particularly valuable for households facing highly seasonal income or substantial expenditure shocks. Even among farmers with significant nonfarm income, as in our setting, alleviating timing mismatches materially affects borrowing and investment. More broadly, aligning the timing of cash and credit flows can enhance financial inclusion and welfare for farmers and self-employed individuals with irregular earnings, especially as digital platforms make tailored disbursement and repayment schedules increasingly feasible.

Finally, our analysis abstracts from asymmetric information. While we observe no systematic differences in repayment across products, the MFI's monitoring and debt-collection efforts may have mitigated asymmetric information problems. Understanding how adverse selection and moral hazard interact with flexible contract designs remains an important avenue for future research, particularly for scaling these products in settings with weaker monitoring.

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A Appendix

A.1 Theoretical model details: Benchmark model

A.1.1 A time-consistent borrower

Let π_t be the fractions of the repayment amount $R = (1+r)M$ due at $t = 1, 2$, and let M_1 be the first disbursement. Available resources at $t = 1$ and $t = 2$ are

$$A_1 = A_0 + M_1 - \pi_1(1+r)M, \tag{A.1}$$

$$A_2 = A_1 - c_1 - K_1 + (M - M_1) - \pi_2(1+r)M. \tag{A.2}$$

The time-consistent farmer solves

$$\begin{aligned} \max_{c_1,c_2,K_1,K_2,M,M_1} \; & u(c_1) + u(c_2) + u(c_3) \\ \text{s.t. } & c_1 + K_1 \leq A_1 && \text{(A.3)} \\ & c_2 + K_2 = A_2 \\ & c_3 = F(K_1, K_2) - (1 - \pi_1 - \pi_2)(1+r)M && \text{(A.4)} \\ & M_1 \leq M \leq \overline{M}. && \text{(A.5)} \end{aligned}$$

M_1 matters only if it binds (A.3). If freely chosen, the borrower would set M_1 large enough to avoid the constraint. Here, we consider the case where it is not binding.

Solving backward, the optimality conditions for consumption and investment are

$$c_1^* = c_2^*, \tag{A.6}$$

$$F_1'(K_1^*, K_2^*) = F_2'(K_1^*, K_2^*), \tag{A.7}$$

$$u'(c_2^*) = F_2'(K_1, K_2^*)u'(c_3^*). \tag{A.8}$$

Given this decision rule, the borrower chooses borrowing M at $t = 0$ subject to constraint (A.5). If this constraint does not bind, the FOC implies

$$QF_2'(K_1^*, K_2^*)u'(c_3^*) - (Q + r)\, u'(c_3^*) = 0, \tag{A.9}$$

where $Q \equiv 1 - (\pi_1 + \pi_2)(1+r)$. This can be rewritten as

$$F_1'(K_1^*, K_2^*) = F_2'(K_1^*, K_2^*) = 1 + \frac{r}{Q}. \tag{A.10}$$

Thus investment depends only on $\frac{r}{Q}$, not on the initial wealth A_0. If constraint (A.5) binds, then $M = \overline{M}$ and $F_1'(K_1^*, K_2^*) = F_2'(K_1^*, K_2^*) > 1 + \frac{r}{Q}$. Note that if $Q \leq 0$, the LHS of (A.9) is always negative, so borrowing is never optimal. When $Q \leq 0$, the borrower must repay $(1-Q)M \geq M$ before harvest, so the required pre-harvest repayment is at least as large as the loan, eliminating the incentive to borrow.

The repayment schedule π_t affects choices only through Q. We can derive

$$\frac{\partial K_1^*}{\partial Q} > 0, \qquad \frac{\partial K_2^*}{\partial Q} > 0, \qquad \frac{\partial c_1^*}{\partial Q} = \frac{\partial c_2^*}{\partial Q} > 0, \qquad \text{and}$$
$$\frac{\partial M^*}{\partial Q} = \frac{1}{Q}\left[\frac{\partial K_1^*}{\partial Q} + \frac{\partial K_2^*}{\partial Q} + 2\frac{\partial c_2^*}{\partial Q} - M^*\right].$$

The sign of $\frac{\partial M^*}{\partial Q}$ is ambiguous without additional assumptions on $u(\cdot)$ and $F(\cdot)$. The final term, M^*, reflects borrowing used to finance repayment: a reduction in Q by ΔQ decreases pre-harvest resources by $\Delta Q\, M$, prompting additional borrowing to maintain consumption and investment.[31] The effect of Q on the maximized utility $V \equiv u(c_1^*) + u(c_2^*) + u(c_3^*)$ is $\frac{\partial V}{\partial Q} = \frac{rM^*}{Q}u'(c_3^*) > 0$. Hence a higher pre-harvest repayment (a lower Q) reduces utility and therefore lowers loan uptake.

We can incorporate other income flows at each period, y_t, $t = 1, 2, 3$, by modifying (A.1)–(A.2) and (A.4) as

$$\begin{aligned} A_1 &= A_0 + y_1 + M_1 - \pi_1(1+r)M, \\ A_2 &= A_1 + y_2 - c_1 - K_1 + M - M_1 - \pi_2(1+r)M, \\ c_3 &= F(K_1, K_2) - (1 - \pi_1 - \pi_2)(1+r)M + y_3. \end{aligned}$$

As long as (A.5) is slack, investment depends only on $\frac{r}{Q}$. Consumption is $c_1^* = c_2^* = \frac{1}{2}(\tilde{A}_0 - K_1^* - K_2^* + QM^*)$, where $\tilde{A}_0 = A_0 + y_1 + y_2$. Thus, income flows y_1 and y_2 affect choices only

[31] The exact expressions of the comparative statics when $M^* < \overline{M}$ are

$$\frac{\partial K_j^*}{\partial Q} = \frac{r}{Q^2}\frac{F_{12}'' - F_{jj}''}{F_{11}''F_{22}'' - (F_{12}'')^2} > 0, \qquad \frac{\partial c_1^*}{\partial Q} = \frac{\partial c_2^*}{\partial Q} = -\frac{rD_0}{D_1} > 0,$$

for $j = 1, 2$, where $D_0 \equiv u'(c_3^*) - (Q+r)M^*u''(c_3^*) > 0$ and $D_1 \equiv Q^2u''(c_2^*) + 2(Q+r)^2u''(c_3^*) < 0$. The property of the production function ensures $F_{12}'' - F_{11}'' > 0$, $F_{12}'' - F_{22}'' > 0$ and $F_{11}''F_{22}'' > (F_{12}'')^2$. When $M^* = \overline{M}$, $\frac{\partial K_j^*}{\partial Q} > 0$ for $j = 1, 2$ and $\frac{\partial c_1^*}{\partial Q} = \frac{\partial c_2^*}{\partial Q} > 0$. We can also derive

$$\frac{\partial M^*}{\partial Q} = \frac{1}{Q}\left[\frac{r}{Q^2}\frac{2F_{12}'' - F_{11}'' - F_{22}''}{F_{11}''F_{22}'' - (F_{12}'')^2} - \frac{2rD_0}{D_1} - M^*\right],$$

whose sign is undetermined without further assumptions.

through $\tilde{A}_0$, and we may reinterpret A_0 to include these flows.

A.1.2 Additional funding sources

Consider additional funding sources from which a farmer can borrow b_t at period $t = 1, 2$. Let B_t denote outstanding debt at period t, evolving as $B_{t+1} = \rho_t(B_t + b_t)$, where $\rho_t(\cdot)$ is increasing, weakly convex, and differentiable, with $\rho_t(x) > x$, $\rho_t'(x) > 1$ and $\rho_t''(x) \geq 0$. This function captures borrowing costs. Under a fixed interest rate i, $\rho_t(x) = (1+i)x$. For small loans, informal borrowing (e.g., from relatives and friends) may be cheaper than MC, in which case $\rho_t(x) < (1+r)x$ for small x.

Endowed with A_0 and income flows y_t, the farmer chooses (M, M_1) at $t = 0$. Since returns accrue only at $t = 3$, all debts must be repaid at $t = 3$. They solve

$$\begin{aligned}
&\max_{c_1,c_2,K_1,K_2,M,M_1,b_1,b_2} u(c_1) + u(c_2) + u(c_3) \\
\text{s.t. } & c_1 + K_1 \leq A_1 + b_1 \\
& c_2 + K_2 = A_2 + b_2 \\
& c_3 = F(K_1, K_2) + y_3 - (1 - \pi_1 - \pi_2)(1+r)M - B_3 \\
& M_1 \leq M \leq \overline{M} \\
& B_2 = \rho_1(b_1) \\
& B_3 = \rho_2(B_2 + b_2).
\end{aligned}$$

Optimal investment, MC borrowing, and borrowing from additional sources satisfy

$$F_1'(K_1^*, K_2^*) = F_2'(K_1^*, K_2^*) = \rho_2'(b_2^*) = 1 + \frac{r}{Q},$$

which is the analogue of (A.10). If $\rho_2'(0) > 1 + \frac{r}{Q}$, then $b_1^* = b_2^* = 0$ and the farmer relies exclusively on MC. Conversely, if $\rho_2'(b_2^*) < 1 + \frac{r}{Q}$, they use only the additional borrowing sources and set $M^* = 0$. When $\rho_2'' > 0$, a lower Q (a larger pre-harvest share of repayment) raises b_2^*.

A.1.3 A present-biased borrower

Consider a quasi-hyperbolic discounter who discounts future utility by $\beta < 1$. At $t = 0$, they choose the total borrowing M and the first disbursement M_1, anticipating that their future selves will discount the future by $\hat{\beta} \in [\beta, 1]$. For simplicity, suppose $\pi_t = 0$ and $y_t = 0$.

The resources available at $t = 1, 2$ are $A_1 = A_0 + M_1$ and $A_2 = A_1 - c_1 - K_1 + M - M_1$, respectively.

At $t = 2$, the borrower maximizes the discounted value function

$$W_2(A_2, K_1, M; \beta) = \max_{K_2} \; u(A_2 - K_2) + \beta u\left(F(K_1, K_2) - (1 + r)M\right).$$

The FOC is

$$u'(c_2^*) = \beta F_2'(K_1, K_2^*) u'(c_3^*), \tag{A.11}$$

which yields the decision rules for c_2, K_2, and c_3. We denote these by $c_2^{*(\beta)} \equiv c_2(A_2, K_1, M; \beta)$, $K_2^{*(\beta)} \equiv K_2(A_2, K_1, M; \beta)$, and $c_3^{*(\beta)} \equiv F(K_1, K_2^{*(\beta)}) - (1 + r)M$.[32]

The partial derivatives of the discounted value function are

$$\begin{aligned}
\frac{\partial W_2(A_2, K_1, M; \beta)}{\partial A_2} &= u'(c_2^{*(\beta)}) \\
\frac{\partial W_2(A_2, K_1, M; \beta)}{\partial K_1} &= \beta F_1'(K_1, K_2^{*(\beta)}) u'(c_3^{*(\beta)}) \\
\frac{\partial W_2(A_2, K_1, M; \beta)}{\partial M} &= -(1 + r)\beta u'(c_3^{*(\beta)}).
\end{aligned}$$

At $t = 1$, the borrower anticipates that the period-2 self will follow the decision rules $c_2^{*(\hat{\beta})}$ and $K_2^{*(\hat{\beta})}$. For convenience, we use (A_0, M, M_1) rather than (A_1, M) as the state at $t = 1$. The discounted value function that the period-1 self maximizes is

$$\begin{aligned}
W_1(A_0, M, M_1; \beta, \hat{\beta}) = \max_{c_1, K_1} \; & u(c_1) + \beta \hat{V}_2(A_2, K_1, M; \hat{\beta}) \\
\text{s.t. } & c_1 + K_1 \leq A_0 + M_1
\end{aligned} \tag{A.12}$$

where $A_2 = A_0 + M - c_1 - K_1$ and $\hat{V}_2(\cdot; \hat{\beta})$ is the continuation value under the decision rules

[32] By differentiating (A.11), we obtain

$$\frac{\partial c_2^{*(\hat{\beta})}}{\partial A_2} = \frac{\hat{\beta}[F_{22}'' u'(c_3^{*(\hat{\beta})}) + (F_2')^2 u''(c_3^{*(\hat{\beta})})]}{D_2} \in (0, 1), \qquad \frac{\partial K_2^{*(\hat{\beta})}}{\partial K_1} = -\frac{\hat{\beta}[F_{12}'' u'(c_3^{*(\hat{\beta})}) + F_1' F_2' u''(c_3^{*(\hat{\beta})})]}{D_2}$$

where $D_2 \equiv u''(c_2^{*(\hat{\beta})}) + \hat{\beta}\left[F_{22}'' u'(c_3^{*(\hat{\beta})}) + (F_2')^2 u''(c_3^{*(\hat{\beta})})\right] < 0$. The sign of $\frac{\partial K_2^{*(\hat{\beta})}}{\partial K_1}$ depends on F_{12}'' and the concavity of u. Unless complementarity (F_{12}'') is sufficiently strong or the farmer is nearly risk neutral, $\frac{\partial K_2^{*(\hat{\beta})}}{\partial K_1} < 0$. If we assume a Cobb–Douglass production function and CRRA utility $u(c) = \frac{c^{1-\gamma}}{1-\gamma}$, then $F_{12}'' u'(c_3) + F_1' F_2' u''(c_3) = F_{12}'' c_3^{-(1+\gamma)}\left[(1 - \gamma)Y - (1 + r)M\right]$. Given empirical evidence that $\gamma > 1$ (Havranek et al., 2015), we obtain $\frac{\partial K_2^{*(\hat{\beta})}}{\partial K_1} < 0$. An increase in K_1 has two opposing effects: (1) it reduces resources available at $t = 2$, lowering K_2, and (2) it raises the marginal product of K_2, increasing K_2. The net effect reflects the balance of these forces.

with belief $\hat{\beta}$:

$$\hat{V}_2(A_2, K_1, M; \hat{\beta}) = u(c_2^{*(\beta)}) + u\left(F(K_1, K_2^{*(\hat{\beta})}) - (1+r)M\right).$$

Following Harris and Laibson (2001), we exploit the relationship between $\hat{V}_2$ and W_2. Under the decision rule $c_2^{*(\hat{\beta})}$ and $K_2^{*(\hat{\beta})}$, we can write

$$W_2(A_2, K_1, M; \hat{\beta}) = u(c_2^{*(\hat{\beta})}) + \hat{\beta}u\left(F(K_1, K_2^{*(\hat{\beta})}) - (1+r)M\right).$$

Hence $\hat{V}_2$ and W_2 are linked as $\hat{V}_2(\cdot; \hat{\beta}) = \frac{1}{\hat{\beta}}\left[W_2(\cdot; \hat{\beta}) - (1-\hat{\beta})u(c_2^{*(\hat{\beta})})\right]$. Then,

$$\begin{aligned}\frac{\partial \hat{V}_2(A_2, K_1, M; \hat{\beta})}{\partial A_2} &= \frac{1}{\hat{\beta}}\left[\frac{\partial W_2(A_2, K_1, M; \hat{\beta})}{\partial A_2} - (1-\hat{\beta})u'(c_2^{*(\hat{\beta})})\frac{\partial c_2^{*(\hat{\beta})}}{\partial A_2}\right], \\ &= F_2'(K_1, K_2^{*(\hat{\beta})})u'(c_3^{*(\hat{\beta})})\left[1 - (1-\hat{\beta})\frac{\partial c_2^{*(\hat{\beta})}}{\partial A_2}\right]. \qquad \text{(A.13)}\end{aligned}$$

Analogously, we can obtain

$$\frac{\partial \hat{V}_2(A_2, K_1, M; \hat{\beta})}{\partial K_1} = u'(c_3^{*(\hat{\beta})})\left[F_1'(K_1, K_2^{*(\hat{\beta})}) + (1-\hat{\beta})F_2'(K_1, K_2^{*(\hat{\beta})})\frac{\partial K_2^{*(\hat{\beta})}}{\partial K_1}\right] \qquad \text{(A.14)}$$

$$\frac{\partial \hat{V}_2(A_2, K_1, M; \hat{\beta})}{\partial M} = -u'(c_3^{*(\hat{\beta})})\left[1 + r + (1-\hat{\beta})F_2'(K_1, K_2^{*(\hat{\beta})})\frac{\partial c_2^{*(\hat{\beta})}}{\partial M}\right].$$

Now consider the decision rules of the period-1 self, $c_1^{*(\beta,\hat{\beta})} \equiv c_1(A_0, M, M_1; \beta, \hat{\beta})$ and $K_1^{*(\beta,\hat{\beta})} \equiv K_1(A_0, M, M_1; \beta, \hat{\beta})$. We analyze separately the cases where constraint (A.12) is not binding and where it binds.

Case (a): constraint (A.12) **is not binding.** The FOCs are

$$u'(c_1^{*(\beta,\hat{\beta})}) - \beta\frac{\partial \hat{V}_2(A_2^*, K_1^{*(\beta,\hat{\beta})}, M; \hat{\beta})}{\partial A_2} = 0 \qquad \text{(A.15)}$$

$$-\beta\frac{\partial \hat{V}_2(A_2^*, K_1^{*(\beta,\hat{\beta})}, M; \hat{\beta})}{\partial A_2} + \beta\frac{\partial \hat{V}_2(A_2^*, K_1^{*(\beta,\hat{\beta})}, M; \hat{\beta})}{\partial K_1} = 0, \qquad \text{(A.16)}$$

where $A_2^* = A_0 + M - c_1^{*(\beta,\hat{\beta})} - K_1^{*(\beta,\hat{\beta})}$. Substituting (A.13) into (A.15) yields

$$u'(c_1^{*(\beta,\hat{\beta})}) = \beta F_2'(K_1^{*(\beta,\hat{\beta})}, K_2^{*(\hat{\beta})}) u'(c_3^{*(\hat{\beta})}) \left[1 - (1-\hat{\beta})\frac{\partial c_2^{*(\hat{\beta})}}{\partial A_2}\right],$$

where $\frac{c_2^{*(\hat{\beta})}}{\partial A_2} > 0$ (footnote 32). Comparison with the FOC at $t = 2$, (A.11), implies $c_1^{*(\beta,\hat{\beta})} \geq c_2^{*(\hat{\beta})}$, with strict inequality when $\hat{\beta} < 1$. The term $(1-\hat{\beta})\frac{\partial c_2^{*(\hat{\beta})}}{\partial A_2}$ reflects that a borrower who is aware of their present bias ($\hat{\beta} < 1$) internalizes that higher current consumption reduces A_2 and thus future consumption, partially offsetting the present-bias problem at $t = 2$. This tends to raise consumption at $t = 1$.

We can also rewrite the FOC (A.16) as

$$F_2'(K_1^{*(\beta,\hat{\beta})}, K_2^{*(\hat{\beta})}) - F_1'(K_1^{*(\beta,\hat{\beta})}, K_2^{*(\hat{\beta})}) = (1-\hat{\beta}) F_2'(K_1^{*(\beta,\hat{\beta})}, K_2^{*(\hat{\beta})}) \left[\frac{\partial c_2^{*(\hat{\beta})}}{\partial A_2} + \frac{\partial K_2^{*(\hat{\beta})}}{\partial K_1}\right] \quad \text{(A.17)}$$

If $\hat{\beta} = 1$, the marginal products are equalized. If $\beta < 1$, then $F_2' > F_1'$.[33]

Given A_0 and M, the choice of M_1 does not affect the state (A_2, K_1, M) at $t = 2$ when the constraint (A.12) is slack. Hence, from (A.15)–(A.16),

$$\frac{\partial c_1^{*(\beta,\hat{\beta})}}{\partial M_1} = 0, \qquad \frac{\partial K_1^{*(\beta,\hat{\beta})}}{\partial M_1} = 0, \quad \text{and} \quad \frac{\partial W_1(A_0, M, M_1; \beta, \hat{\beta})}{\partial M_1} = 0.$$

Case (b): constraint (A.12) **is binding.** With (A.12) binds, the borrower maximizes $u(A_1 - K_1) + \beta \hat{V}_2(M - M_1, K_1, M; \hat{\beta})$, which gives the FOC

$$-u'(c_1^{*(\beta,\hat{\beta})}) + \beta \frac{\partial \hat{V}_2(M - M_1, K_1^{*(\beta,\hat{\beta})}, M; \hat{\beta})}{\partial K_1} = 0.$$

Substituting (A.14), this becomes

$$u'(c_1^{*(\beta,\hat{\beta})}) = \beta u'(c_3^{*(\hat{\beta})}) \left[F_1'(K_1^{*(\beta,\hat{\beta})}, K_2^{*(\hat{\beta})}) + (1-\hat{\beta}) F_2'(K_1^{*(\beta,\hat{\beta})}, K_2^{*(\hat{\beta})}) \frac{\partial K_2^{*(\hat{\beta})}}{\partial K_1}\right].$$

[33] Using the expression in footnote 32, equation (A.17) can be rewritten as

$$F_2' - F_1' = (1-\hat{\beta}) F_2' u'(c_3^{*(\hat{\beta})}) \frac{F_{22}'' - F_{12}''}{u''(c_2^{*(\hat{\beta})}) + \hat{\beta}[F_{22}'' u'(c_3^{*(\hat{\beta})}) + \hat{\beta}(F_2')^2 u''(c_3^{*(\hat{\beta})})]}.$$

Both numerator and denominator are negative, so $F_2' - F_1' > 0$ whenever $0 < \hat{\beta} < 1$.

If $\frac{\partial K_2^{*(\hat{\beta})}}{\partial K_1} < 0$ (as suggested in footnote 32), borrowers who are aware of their present bias tend to overconsume at $t = 1$, anticipating that their future selves will partially offset lower K_1 by increasing K_2.

Finally, consider the problem at $t = 0$ and whether the borrower prefers to make (A.12) binding. Given belief $\hat{\beta}$, the period-0 self anticipates period-1 choices $(c_1^{(\hat{\beta},\hat{\beta})}, K_1^{(\hat{\beta},\hat{\beta})})$ when (A.12) is slack. Define $M_1^{+(\hat{\beta},\hat{\beta})}$ as the first disbursement that exactly covers period-1 expenditure net of the endowment: $c_1^{+(\hat{\beta},\hat{\beta})} + K_1^{+(\hat{\beta},\hat{\beta})} = A_0 + M_1^{+(\hat{\beta},\hat{\beta})}$. With $M_1^{+(\hat{\beta},\hat{\beta})}$, we have $A_2 = M - M_1^{+(\hat{\beta},\hat{\beta})}$. Utility when $M_1 = M_1^{+(\hat{\beta},\hat{\beta})}$ is $u(A_0 + M_1^{+(\hat{\beta},\hat{\beta})} - K_1^{+(\hat{\beta},\hat{\beta})}) + \hat{V}_2(M - M_1^{+(\hat{\beta},\hat{\beta})}, K_1^{+(\hat{\beta},\hat{\beta})}, M; \hat{\beta})$.

Now, consider the change in the utility if they reduce M_1 from $M_1^{+(\hat{\beta},\hat{\beta})}$ by ΔM_1, tightening the $t = 1$ budget constraint. The resulting utility change is

$$-\Delta M_1 \left[u'(c_1^{+(\hat{\beta},\hat{\beta})}) \left(1 - \frac{\partial K_1^{*(\hat{\beta},\hat{\beta})}}{\partial M_1} \right) - \frac{\partial \hat{V}_2(\cdot;\hat{\beta})}{\partial A_2} + \frac{\partial \hat{V}_2(\cdot;\hat{\beta})}{\partial K_1} \frac{\partial K_1^{*(\hat{\beta},\hat{\beta})}}{\partial M_1} \right],$$

evaluated at $(c_1, K_1, M_1) = (c_1^{+(\hat{\beta},\hat{\beta})}, K_1^{+(\hat{\beta},\hat{\beta})}, M_1^{+(\hat{\beta},\hat{\beta})})$. Using (A.15)-(A.16) and rearranging, this simplifies to $-\Delta M_1 \left(1 - \frac{1}{\hat{\beta}}\right) u'(c_1^{+(\hat{\beta},\hat{\beta})}) \left(1 - \frac{\partial K_1^{*(\hat{\beta},\hat{\beta})}}{\partial M_1}\right)$, which is positive if $0 < \hat{\beta} < 1$. Hence, borrowers aware of their present bias prefer to set M_1 low enough to bind the $t = 1$ budget constraint.

By setting M_1 small enough to bind the period-1 budget constraint, they can increase A_2. Since $\frac{\partial K_2^{*(\hat{\beta})}}{\partial A_2} > 0$ (footnote 32), sequential disbursement that lets borrowers choose the first disbursement amount will increase the second investment.

A.2 Theoretical model details: Introducing uncertainty

We now introduce productivity and expenditure shocks. [34] For brevity, we consider the case where $\pi_t = 0$. The production function is $Y = \theta_1\theta_2 F(K_1, K_2)$, where $\theta_t > 0$ are productivity shocks realized at the beginning of $t = 1, 2$. Expenditure shocks ξ_t are realized at the beginning of $t = 1, 2, 3$, with negative ξ_t indicating positive income shocks. The budget constraints at $t = 1, 2$ are $c_1 + K_1 \leq A_1 - \xi_1$ and $c_2 + K_2 \leq A_2 - \xi_2$, respectively. Introducing uncertainty creates a potential need for saving at $t = 2$.

[34] We assume expectations and derivatives are exchangeable

A.2.1 Crop credit

First, consider a time-consistent borrower under crop credit, who chooses $M \leq \bar{M}$ at $t = 0$. Resources at $t = 1, 2$ are $A_1 = A_0 + M$ and $A_2 = A_1 - \xi_1 - c_1 - K_1$, respectively. Period-3 consumption is $c_3 = \theta_1\theta_2 F(K_1, K_2) - (1 + r)M + A_2 - \xi_2 - c_2 - K_2 - \xi_3$.

At $t = 2$, the borrower observes $(\theta_1, \theta_2, \xi_1, \xi_2)$. The value function is

$$V_2^C(A_2, K_1, M, \theta_1, \theta_2, \xi_2) = \max_{c_2, K_2} u(c_2) + E[u(c_3)|\mathcal{I}_2] \quad \text{s.t. } c_2 + K_2 \leq A_2 - \xi_2 \tag{A.18}$$

where $\mathcal{I}_2$ is the information set at $t = 2$ including $(A_2, K_1, M, \theta_1, \theta_2, \xi_1, \xi_2)$.[35] Denoting the Lagrange multiplier associated with the constraint (A.18) by η, the FOCs are:

$$u'(c_2^*) - E[u'(c_3^*)|\mathcal{I}_2] - \eta = 0,$$
$$[\theta_1\theta_2 F_2'(K_1, K_2^*) - 1]\, E[u'(c_3^*)|\mathcal{I}_2] - \eta = 0.$$

If the constraint (A.18) is not binding, then $\theta_1\theta_2 F_2'(K_1, K_2^*) = 1$.

At $t = 1$, the borrower only knows the value of θ_1 and ξ_1. The value function is

$$V_1^C(A_1, M, \theta_1, \xi_1) = \max_{c_1, K_1} u(c_1) + E\left[V_2^C(A_2, K_1, M, \theta_1, \theta_2, \xi_2)|\mathcal{I}_1\right] \quad \text{s.t. } c_1 + K_1 \leq A_1 - \xi_1,$$

where $\mathcal{I}_1$ is the information set at $t = 1$ including $(A_1, M, \theta_1, \xi_1)$. The FOCs are:

$$u'(c_1^*) = E[u'(c_2^*)|\mathcal{I}_1].$$
$$E[u'(c_2^*)|\mathcal{I}_1] = \theta_1 E[\theta_2 F_1'(K_1^*, K_2^*)u'(c_3^*)|\mathcal{I}_1].$$

At $t = 0$, the borrower chooses $M \leq \bar{M}$ to maximize $E[V_1^C(A_0 + M, M, \theta_1, \xi_1)]$. When the upper bound is not binding, the FOC implies $E[u'(c_2^*)] = (1 + r)E[u'(c_3^*)]$.

A.2.2 Sequential credit

Under sequential credit, the borrower chooses $M_1 \leq M$ at $t = 0$ (with $M \leq \overline{M}$ under Seq-SSL), and then at $t = 2$, after observing $(\theta_1, \theta_2, \xi_1, \xi_2)$, chooses $M_2 \leq M - M_1$. Total

[35] The expenditure shock at $t = 1$, ξ_1, affects the period-2 problem only through its effect on A_2, and hence is not included as a state variable at $t = 2$.

repayment at $t = 3$ is $(1 + r)(M_1 + M_2)$. Define resources at $t = 2$ excluding M_2 as $\tilde{A}_2 = A_1 - \xi_1 - c_1 - K_1$.

At $t = 2$, the value function is

$$V_2^S(\tilde{A}_2, K_1, M, M_1, \theta_1, \theta_2, \xi_2) = \max_{c_2, K_2, M_2} \; u(c_2) + E[u(c_3)|\mathcal{I}_2]$$

$$\text{s.t. } c_2 + K_2 \leq \tilde{A}_2 - \xi_2 + M_2 \tag{A.19}$$

$$M_2 \leq M - M_1 \tag{A.20}$$

$$M_2 \geq 0 \tag{A.21}$$

where $c_3 = \theta_1\theta_2 F(K_1, K_2) - (1+r)(M_1 + M_2) + \tilde{A}_2 - \xi_2 + M_2 - c_2 - K_2 - \xi_3$. The state now includes M_1, as it affects the upper limit of M_2. The FOCs are:

$$u'(c_2^*) - E[u'(c_3^*)|\mathcal{I}_2] - \eta = 0, \tag{A.22}$$

$$[\theta_1\theta_2 F_2'(K_1, K_2^*) - 1]E[u'(c_3^*)|\mathcal{I}_2] - \eta = 0, \tag{A.23}$$

$$-rE[u'(c_3^*)|\mathcal{I}_2] + \eta - \mu + \nu = 0, \tag{A.24}$$

where η, μ, and ν are Lagrange multipliers on constraints (A.19), (A.20), and (A.21), respectively. At least one of μ or ν must be zero, and (A.24) implies $\eta = rE[u'(c_3^*)|\mathcal{I}_2] + \mu - \nu$, so $\eta > 0$ whenever $\nu = 0$. Thus four cases arise: (i) $\mu = \nu = 0, \eta > 0$; (ii) $\mu > 0, \nu = 0, \eta > 0$; (iii) $\mu = 0, \nu > 0, \eta = 0$; and (iv) $\mu = 0, \nu > 0, \eta > 0$. Substituting (A.24) into (A.22)–(A.23) gives

$$\begin{aligned} u'(c_2^*) &= (1+r)E[u'(c_3^*)|\mathcal{I}_2] + \mu - \nu, \\ [\theta_1\theta_2 F_2'(K_1, K_2^*) - (1+r)]E[u'(c_3^*)|\mathcal{I}_2] &= \mu - \nu. \end{aligned} \tag{A.25}$$

The partial derivatives of the value function are

$$\frac{\partial V_2^S}{\partial \tilde{A}_2} = u'(c_2^*) \tag{A.26}$$

$$\frac{\partial V_2^S}{\partial K_1} = \theta_1\theta_2 F_1'(K_1, K_2^*)E[u'(c_3^*)|\mathcal{I}_2] \tag{A.27}$$

$$\frac{\partial V_2^S}{\partial M} = \begin{cases} 0 & \text{if } \mu = 0 \\ u'(c_2^*) - (1+r)E[u'(c_3^*)|\mathcal{I}_2] & \text{if } \mu > 0 \end{cases} \tag{A.28}$$

$$\frac{\partial V_2^S}{\partial M_1} = \begin{cases} -(1+r)E[u'(c_3^*)|\mathcal{I}_2] & \text{if } \mu = 0 \\ -u'(c_2^*) & \text{if } \mu > 0 \end{cases} \tag{A.29}$$

In deriving $\frac{\partial V_2^S}{\partial M}$ and $\frac{\partial V_2^S}{\partial M_1}$, we used the fact that if $\mu > 0$, then $\nu = 0$ and hence $\eta > 0$.

Now consider the period-1 problem. The value function is

$$\begin{aligned} V_1^S(A_1, M, M_1, \theta_1, \xi_1) = \max_{c_1, K_1} \; & u(c_1) + E\left[V_2^S(A_2, K_1, M, M_1, \theta_1, \theta_2, \xi_2)\middle|\mathcal{I}_1\right] \\ & \text{s.t. } c_1 + K_1 \leq A_1 - \xi_1 \end{aligned} \tag{A.30}$$

The FOCs combined with equations (A.26) and (A.27) give

$$\begin{aligned} & u'(c_1^*) = E\left[u'(c_2^*)|\mathcal{I}_1\right] + \lambda, \\ & \theta_1 E\left[\theta_2 F_1'(K_1^*, K_2^*)u'(c_3^*)|\mathcal{I}_1\right] = E\left[u'(c_2^*)|\mathcal{I}_1\right] + \lambda, \end{aligned}$$

where λ is the Lagrange multiplier associated with the constraint (A.30).

The partial derivatives of the value function are:[36]

$$\begin{aligned} \frac{\partial V_1^S}{\partial A_1} &= \begin{cases} E\left[u'(c_2^*)|\mathcal{I}_1\right] & \text{if } \lambda = 0 \\ u'(c_1^*) & \text{if } \lambda > 0, \end{cases} \\ \frac{\partial V_1^S}{\partial M} &= E[\mu|\mathcal{I}_1] \\ \frac{\partial V_1^S}{\partial M_1} &= -E\left[u'(c_2^*)|\mathcal{I}_1\right] - E[\nu|\mathcal{I}_1]. \end{aligned}$$

At $t = 0$, the borrower maximizes $E[V_1^S(A_0 + M_1, M, M_1, \theta_1, \xi_1)]$. The FOC for M_1 is $E[\lambda] - E[\nu] = 0$, capturing the trade-off between (i) relaxing the period-1 budget (a higher M_1) and (ii) preserving flexibility at $t = 2$ to reduce repayment by choosing a smaller M_2 (a lower M_1 makes it less likely that the constraint $M_2 \geq 0$ binds).

Under SC-SSL, M is also chosen. If $M^* < \overline{M}$, the FOC yields $E[\mu] = 0$, implying they

[36] To illustrate, we derive $\frac{\partial V_1^S}{\partial M}$. From the definition of $V_1^S(A_1, M, M_1, \theta_1, \xi_1)$ and (A.28),

$$\begin{aligned} \frac{\partial V_1^S}{\partial M} =& E\left[\frac{\partial V_2^S}{\partial M}\middle|\mathcal{I}_1\right] = \Pr(\mu = 0|\mathcal{I}_1)\cdot 0 + \Pr(\mu > 0|\mathcal{I}_1)E\left[u'(c_2^*) - (1+r)u'(c_3^*)|\mathcal{I}_1, \mu > 0\right] \\ =& \Pr(\mu > 0|\mathcal{I}_1)E\left[\mu - \nu|\mathcal{I}_1, \mu > 0\right] \end{aligned}$$

where the last equation follows from (A.22) and (A.24). Since $\nu = 0$ when $\mu > 0$ and $E\left[\mu|\mathcal{I}_1\right] = \Pr(\mu > 0|\mathcal{I}_1)E\left[\mu|\mathcal{I}_1, \mu > 0\right]$ for $\mu \geq 0$, we obtain $\frac{\partial V_1^S}{\partial M} = E\left[\mu|\mathcal{I}_1\right]$.

choose M large enough that the period-2 constraint $M_2 \leq M - M_1$ never binds.

A.2.3 Present-biased borrowers under sequential credit

Under sequential credit, a PB borrower's discounted value function at $t = 2$ is:

$$W_2^S(\tilde{A}_2, K_1, M, M_1, \theta_1, \theta_2, \xi_2; \beta) = \max_{c_2, K_2, M_2} u(c_2) + \beta E[u(c_3)|\mathcal{I}_2]$$
$$\text{s.t. (A.19)} - \text{(A.21)}.$$

Analogous to the case of the time-consistent borrowers, the FOCs are

$$\begin{aligned} &u'(c_2^*) - \beta E[u'(c_3^*)|\mathcal{I}_2] - \eta = 0, \\ &[\theta_1\theta_2 F_2'(K_1, K_2^*) - 1]\,\beta E[u'(c_3^*)|\mathcal{I}_2] - \eta = 0, \\ &-\beta r E[u'(c_3^*)|\mathcal{I}_2] + \eta - \mu + \nu = 0. \end{aligned}$$

We denote the resulting decision rules by $c_2^{*(\beta)} \equiv c_2(\tilde{A}_2, K_1, M, M_1, \theta_1, \theta_2, \xi_2; \beta)$, $K_2^{*(\beta)} \equiv K_2(\tilde{A}_2, K_1, M, M_1, \theta_1, \theta_2, \xi_2; \beta)$, and $M_2^{*(\beta)} \equiv M_2(\tilde{A}_2, K_1, M, M_1, \theta_1, \theta_2, \xi_2; \beta)$.

At $t = 1$, the PB borrowers' discounted value function is

$$W_1^S(A_1, M, M_1, \theta_1, \xi_1; \beta, \hat{\beta}) = \max_{c_1, K_1} u(c_1) + \beta E\left[\hat{V}_2^S(\tilde{A}_2, K_1, M, M_1, \theta_1, \theta_2, \xi_2; \hat{\beta})\middle|\mathcal{I}_1\right]$$
$$\text{s.t. } c_1 + K_1 \leq A_1 - \xi_1$$

where $\hat{V}_2^S(\cdot; \hat{\beta})$ is the continuation value under the decision rules with belief $\hat{\beta}$:

$$\hat{V}_2^S(\cdot; \hat{\beta}) = u\left(c_2^{*(\hat{\beta})}\right) + E\left[u\left(c_3^{*(\hat{\beta})}\right)|\mathcal{I}_2\right],$$

in which $c_3^{*(\hat{\beta})} = \theta_1\theta_2 F(K_1, K_2^{*(\hat{\beta})}) - (1+r)(M_1 + M_2^{*(\hat{\beta})}) + \tilde{A}_2 - \xi_2 + M_2^{*(\hat{\beta})} - c_2^{*(\hat{\beta})} - K_2^{*(\hat{\beta})} - \xi_3$. The FOCs imply the decision rules $c_1^{*(\beta,\hat{\beta})} \equiv c_1(A_1, M, M_1, \theta_1, \xi_1; \beta, \hat{\beta})$ and $K_1^{*(\beta,\hat{\beta})} \equiv K_1(A_1, M, M_1, \theta_1, \xi_1; \beta, \hat{\beta})$, which satisfy

$$u'(c_1^{*(\beta,\hat{\beta})}) = \frac{\beta}{\hat{\beta}} E\left[\left\{1 - (1-\hat{\beta})\frac{\partial c_2^{*(\hat{\beta})}}{\partial \tilde{A}_2}\right\} u'(c_2^{*(\hat{\beta})})\middle|\mathcal{I}_1\right] + \lambda,$$
$$\beta E\left[\theta_1\theta_2 F_1'(K_1^*, K_2^{*(\hat{\beta})}) u'(c_3^{*(\hat{\beta})})\middle|\mathcal{I}_1\right] = \frac{\beta}{\hat{\beta}} E\left[\left\{1 - (1-\hat{\beta})\left(\frac{\partial c_2^{*(\hat{\beta})}}{\partial \tilde{A}_2} - \frac{\partial c_2^{*(\hat{\beta})}}{\partial K_1}\right)\right\} u'(c_2^{*(\hat{\beta})})\middle|\mathcal{I}_1\right] + \lambda.$$

Finally consider the period-0 problem. For generality, we consider SC-SSL limit in which

the borrower can also choose M. The problem to solve is

$$\max_{M\leq\overline{M},M_1\leq M} E[u(c_1^{*(\beta,\hat{\beta})}) + \hat{V}_2^S(\tilde{A}_2, K_1^{*(\beta,\hat{\beta})}, M, M_1, \theta_1, \theta_2, \xi_2; \hat{\beta})]$$

This can be written by using $W_1(\cdot; \hat{\beta}, \hat{\beta})$ as follows:

$$\max_{M\leq\overline{M},M_1\leq M} \frac{1}{\hat{\beta}} E\left[W_1^S(A_0 + M_1, M, M_1, \theta_1, \xi_1; \hat{\beta}, \hat{\beta}) - (1-\hat{\beta})u(c_1^{*(\beta,\hat{\beta})})\right].$$

Solving the FOCs when $M^* < \overline{M}$, we can obtain

$$E[\mu] = (1-\hat{\beta})E\left[u'(c_1^{*(\hat{\beta},\hat{\beta})})\frac{\partial c_1^{*(\hat{\beta},\hat{\beta})}}{\partial M} + u'(c_2^{*(\hat{\beta})})\frac{\partial c_2^{*(\hat{\beta})}}{\partial M}\right]$$

$$E[\lambda] - E[\nu] = (1-\hat{\beta})E\left[u'(c_1^{*(\hat{\beta},\hat{\beta})})\left(\frac{\partial c_1^{*(\hat{\beta},\hat{\beta})}}{\partial A_1} + \frac{\partial c_1^{*(\hat{\beta},\hat{\beta})}}{\partial M_1}\right) + u'(c_2^{*(\hat{\beta})})\left(\frac{\partial c_2^{*(\hat{\beta})}}{\partial \tilde{A}_2} + \frac{\partial c_2^{*(\hat{\beta})}}{\partial M_1}\right)\right].$$

The RHSs are strictly positive (whereas they are zero for time-consistent borrowers). Hence a PB borrower chooses M and M_1 so that the probability of binding resource constraints at $t = 1, 2$ is higher, resulting in lower optimal M and M_1.

A.2.4 Present-biased borrowers under credit lines (CL)

Under CL, the borrower chooses M_1 at $t = 1$ and M_2 at $t = 2$, subject to $M_1 + M_2 \leq \bar{M}$. We focus on the case where this constraint does not bind, i.e., the loan limit $\bar{M}$ is sufficiently large relative to demand, as in our data.

The period-2 problem of the PB borrower is identical to the sequential credit case, yielding the value function $\hat{V}_2^S(\tilde{A}_2, K_1, \overline{M}, M_1, \theta_1, \theta_2, \xi_2; \hat{\beta})$. At $t = 1$, they solve

$$\begin{aligned}\max_{c_1,K_1,M_1}\ & u(c_1) + \beta E\left[\hat{V}_2^S(\tilde{A}_2, K_1, \overline{M}, M_1, \theta_1, \theta_2, \xi_2; \hat{\beta})\middle|\mathcal{I}_1\right] \\ \text{s.t. }\ & c_1 + K_1 \leq A_0 + M_1 - \xi_1. \end{aligned} \tag{A.31}$$

The FOCs are:

$$u'(c_1^*) - \beta E\left[\frac{\partial \hat{V}_2^S(\cdot;\hat{\beta})}{\partial \tilde{A}_2}\middle|\mathcal{I}_1\right] - \lambda^{cl} = 0,$$

$$\beta E\left[-\frac{\partial \hat{V}_2^S(\cdot;\hat{\beta})}{\partial \tilde{A}_2} + \frac{\partial \hat{V}_2^S(\cdot;\hat{\beta})}{\partial K_1}\middle|\mathcal{I}_1\right] - \lambda^{cl} = 0,$$

$$\beta E\left[\frac{\partial \hat{V}_2^S(\cdot;\hat{\beta})}{\partial \tilde{A}_2}+\frac{\partial \hat{V}_2^S(\cdot;\hat{\beta})}{\partial M_1}\middle|\mathcal{I}_1\right]+\lambda^{cl}=0.$$

where λ^{cl} is the Lagrange multiplier associated with the constraint (A.31). Note that $\frac{\partial V_2^S}{\partial \tilde{A}_2}+\frac{\partial V_2^S}{\partial M_1}=0$ by (A.25), (A.26), and (A.29) if $\nu=0$. Hence, the borrower chooses M_1 such that $\lambda^{cl}=0$ or at a level where the budget constraint no longer binds at the optimal (c_1^*,K_1^*), i.e., $M_1^*=c_1^*+K_1^*+\xi-A_0$. Using the analogous argument to the case of sequential credit, the other two FOCs can be rewritten as

$$u'(c_1^{*(\beta,\hat{\beta})})=\frac{\beta}{\hat{\beta}}E\left[\left\{1-(1-\hat{\beta})\frac{\partial c_2^{*(\hat{\beta})}}{\partial \tilde{A}_2}\right\}u'(c_2^{*(\hat{\beta})})\middle|\mathcal{I}_1\right],$$

$$E\left[\theta_1\theta_2F_1'(K_1^*,K_2^{*(\hat{\beta})})u'(c_3^{*(\hat{\beta})})\middle|\mathcal{I}_1\right]=\frac{1}{\hat{\beta}}E\left[\left\{1-(1-\hat{\beta})\left(\frac{\partial c_2^{*(\hat{\beta})}}{\partial \tilde{A}_2}-\frac{\partial c_2^{*(\hat{\beta})}}{\partial K_1}\right)\right\}u'(c_2^{*(\hat{\beta})})\middle|\mathcal{I}_1\right].$$

A.3 Numerical examples

A.3.1 Benchmark model and calibration

Consider the benchmark model without uncertainty, whose solution is characterized by the FOCs (A.6), (A.7), (A.8) and (A.10). With Cobb–Douglas production

$$F(K_1,K_2)=\theta K_1^{\psi_1}K_2^{\psi_2}, \tag{A.32}$$

the FOCs (A.7) and (A.10) imply

$$\frac{K_2^*}{K_1^*}=\frac{\psi_2}{\psi_1}, \tag{A.33}$$

$$\theta\psi_1^{1-\psi_2}\psi_2^{\psi_2}K_1^{\psi_1+\psi_2-1}=1+\frac{r}{Q}. \tag{A.34}$$

Assuming CRRA utility $u(c)=\frac{c^{1-\gamma}-1}{1-\gamma}$, the optimal consumption and borrowing are

$$c_1^*(K_1,M)=c_2^*(K_1,M)=\frac{1}{2}\left[A_0+QM-K_1-K_2^*(K_1)\right],$$

$$c_3^*(K_1,M)=F(K_1,K_2^*(K_1))-(Q+r)M,$$

$$M^*=\frac{P^{1/\gamma}}{P^{1/\gamma}Q+2(Q+r)}\left[\left(\frac{\alpha_1^{\alpha_2}\alpha_2^{\alpha_2}\theta}{P}\right)^{\frac{1}{1-\alpha_1-\alpha_2}}\left(2\alpha_1^{\alpha_1-\alpha_2}P^{1-\frac{1}{\gamma}}+\alpha_1+\alpha_2\right)-A_0\right]$$

where $P\equiv 1+\frac{r}{Q}$.

To calibrate the production parameters, we use equations (A.32), (A.33), and (A.34) to match the sample moment for non-PB borrowers under CropC ($Q = 1$). The sample averages of (K_1, K_2, Y) were $(8745, 4503, 33240)$. We set $r = 0.12$ to mimic our intervention, yielding the calibrated parameters $(\psi_1, \psi_2, \theta) = (0.295, 0.152, 13.964)$. These values are used throughout the numerical analysis.[37]

A.3.2 Numerical example for a PB borrowers

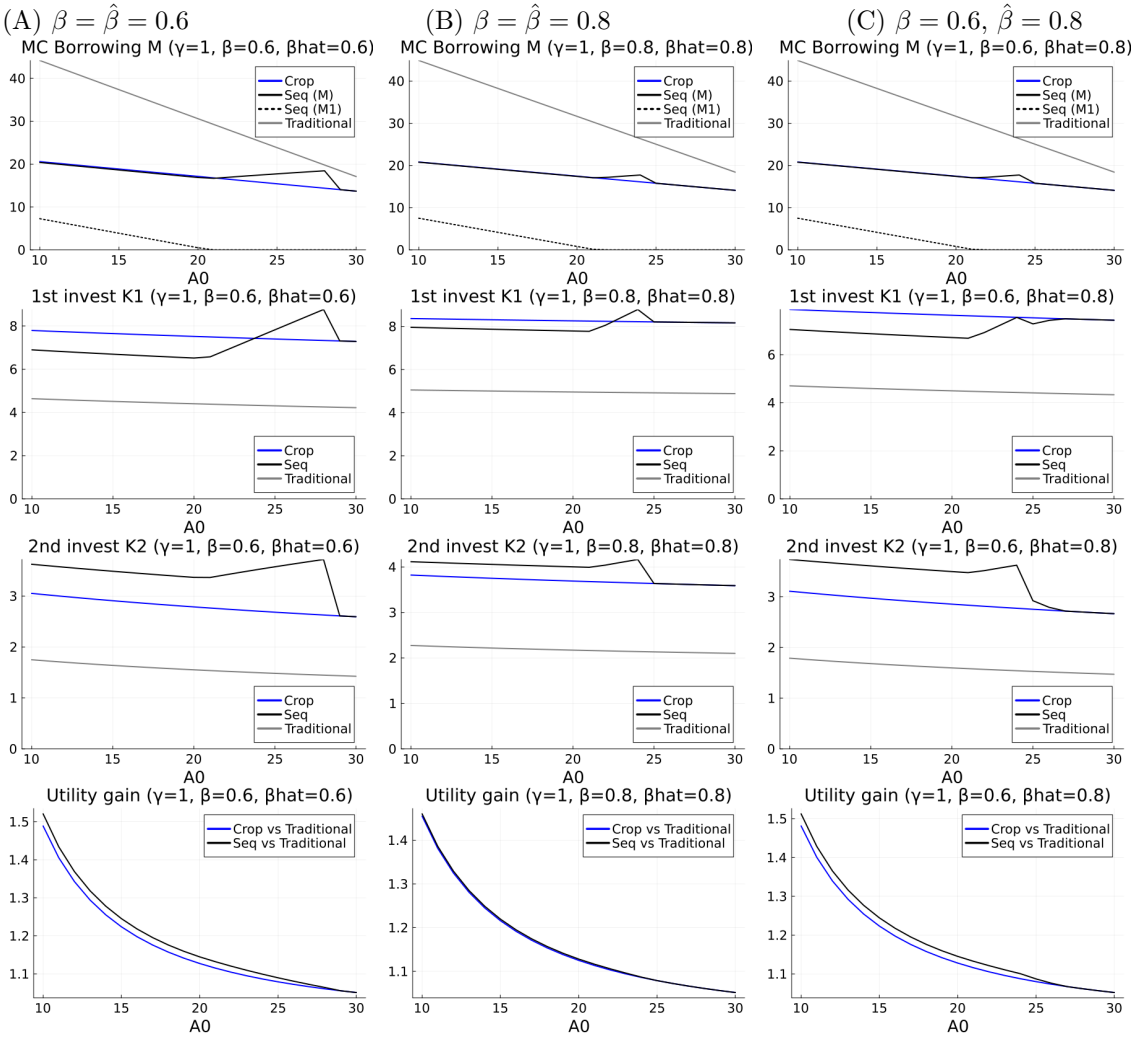
Appendix Figure 1 shows PB borrowers' decisions on borrowing and investment, and utility gain over traditional MC under crop credit (CropC) and sequential credit (Seq) when $\gamma = 1$. The left and middle panels show sophisticated PB borrowers ($\beta = \hat{\beta} = 0.6$ and $\beta = \hat{\beta} = 0.8$, respectively), while the right panel shows partially naive PB borrowers ($\beta = 0.6, \hat{\beta} = 0.8$). For Seq, we report both total borrowing M and the first disbursement M_1.

Total borrowing is similar under CropC and Seq when A_0 is either low or very high. Consider first low A_0. Under Seq, M_1 is chosen so that the period-1 budget constraint $c_1 + K_1 \leq A_0 + M_1$ binds, limiting overconsumption at $t = 1$. This lowers the first investment but increases the second investment by ensuring sufficient resources for the period-2 self.

As A_0 increases, the desired M_1 becomes negative, which is infeasible, so the borrower sets $M_1^* = 0$. For moderately large A_0, the budget constraint still binds, but the period-1 self has more resources for consumption and investment, leading to larger K_1. This raises the marginal product of K_2, encouraging a larger second investment and hence a larger M. When A_0 is very large, the borrower cannot make the period-1 constraint bind even with $M_1 = 0$. In this case, they cannot constrain the period-1 self, and outcomes under CropC and Seq coincide.

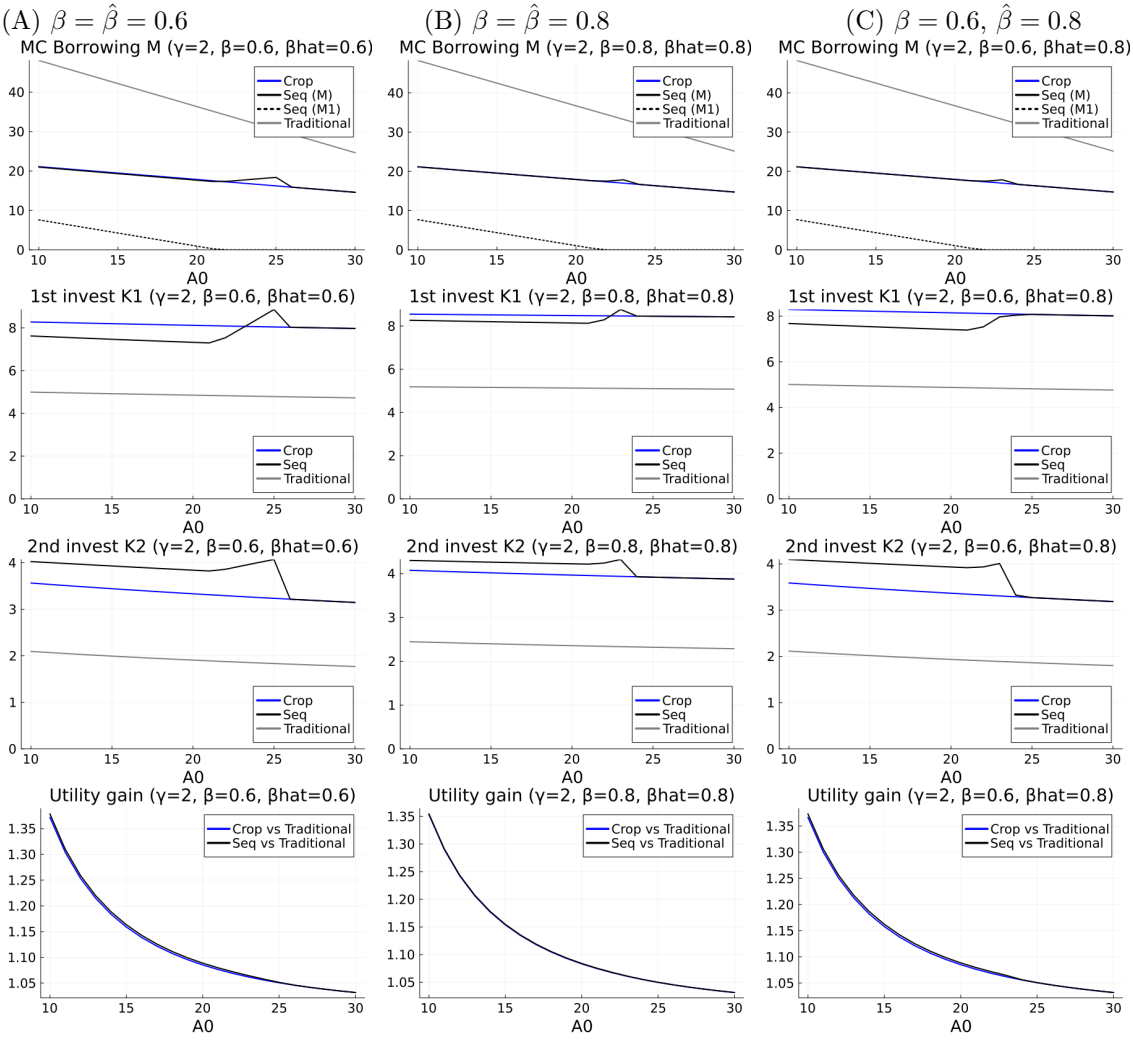
[37] An alternative approach is to estimate the production function. However, input choices (K_1, K_2) are likely correlated with unobserved productivity θ_t, and without valid instruments, which are unavailable in our setting, consistent estimation is not feasible.

Appendix Figure 1: Choice of (M, K_1, K_2) and the total utility of PB borrowers under traditional MC, crop credit, and sequential credit: $\gamma = 1$



Traditional MC: lump-sum disbursement with frequent installments ($M_1 = M, \pi_1 = \pi_2 = 1/3$). CropC: lump-sum disbursement with bullet repayment after harvest ($M_1 = M, \pi_1 = \pi_2 = 0$). Seq: sequential disbursement with bullet repayment after harvest ($M_1 < M, \pi_1 = \pi_2 = 0$). The parameter β denotes present bias, and $\hat{\beta}$ is the farmer's perceived value of β.

Appendix Figure 2: Choice of (M, K_1, K_2) and the total utility of PB borrowers under crop credit, sequential credit, and traditional MC: $\gamma = 2$

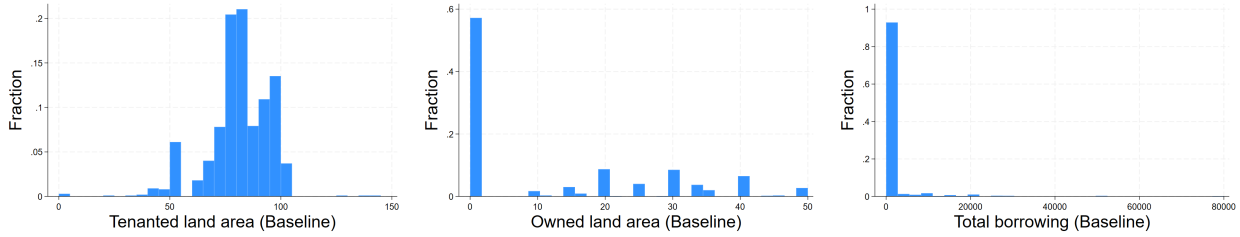


See notes to Appendix Figure 1.

A.4 Additional Figures and Tables

Appendix Figure 3: Tenanted land, owned Land, and borrowing in the last 12 months (Baseline)

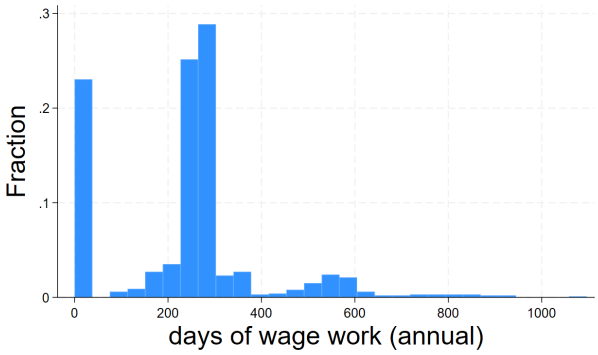
(A) Tenanted land area (B) Owned land area (C) Borrowing (past 12 months)



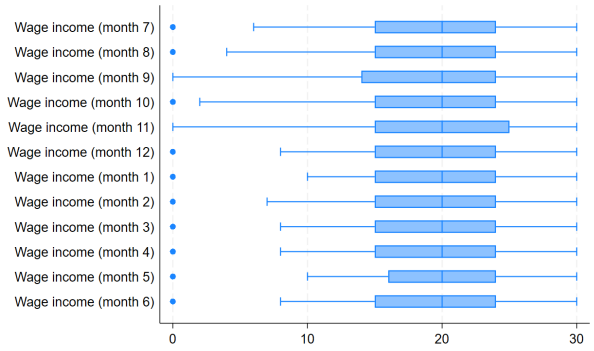
Areas are measured in decimals. Borrowing refers to the total borrowing amount received over the past 12 months.

Appendix Figure 4: Days worked as a daily wage laborer in the last 12 months (Baseline)

(A) Total days of working for wage income (household, annual)



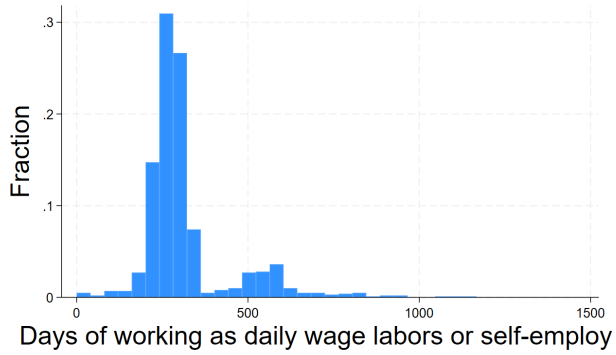
(B) Days of working for wage income (individual, monthly)



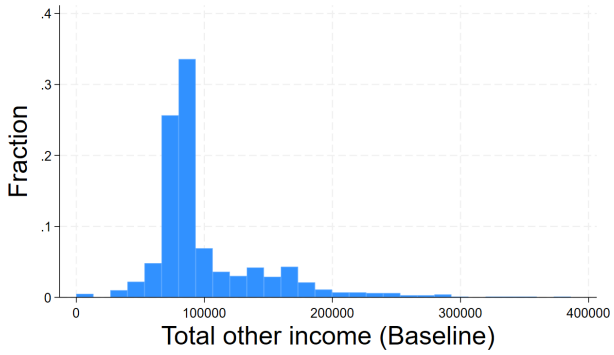
Panel (A) shows the histogram of the days worked for wage income in the last 12 months at the household level in the baseline data. Panel (B) is a box plot of the days worked as a daily wage laborer disaggregated at the monthly level, based on individual-level data.

Appendix Figure 5: Total income sources other than farming at the baseline

(A) Days of working for non-farm activity



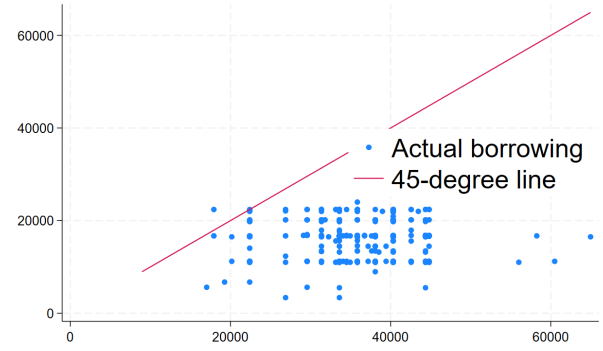
(B) Distribution of the total other income



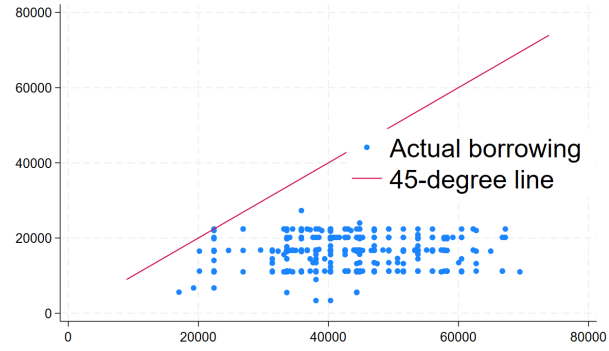
The left panel shows the histogram of the days worked for wage income and self-employment activity in the last 12 months at the household level. The right panel shows the distribution of the total income from wage labor, self-employment, fishery, and poultry. We exclude the revenue from livestock transactions as we do not have information on livestock purchase.

Appendix Figure 6: Inferred maximum loanable amount and actual borrowing

(A) MLA = area of tenanted land × 400BDT



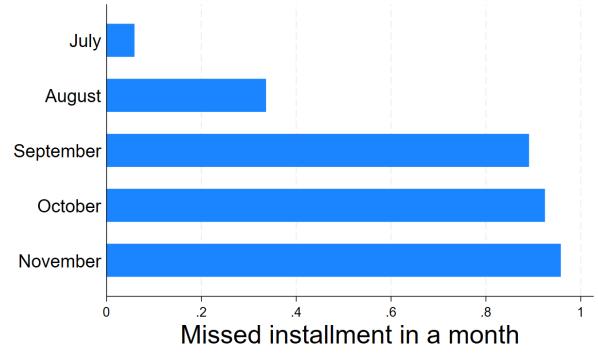
(B) MLA = area of tenanted and owned land × 400BDT



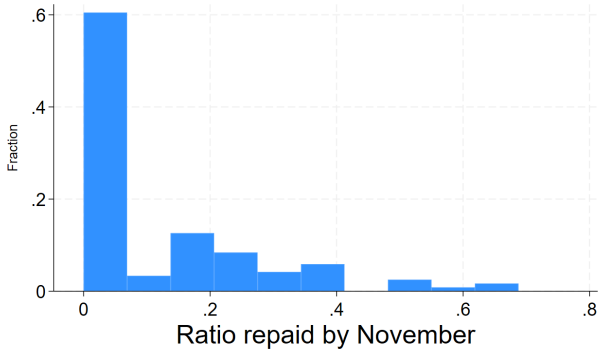
The vertical axis is the actual borrowing, and the horizontal axis is the maximum loanable amount (MLA) inferred from the survey data. The MLA is calculated based on the reported area of tenanted land in Panel (A) and the reported area of tenanted and owned land in Panel (B). The red solid lines show 45-degree lines.

Appendix Figure 7: Missed installments under traditional microcredit

(A) Whether missed installments in a month



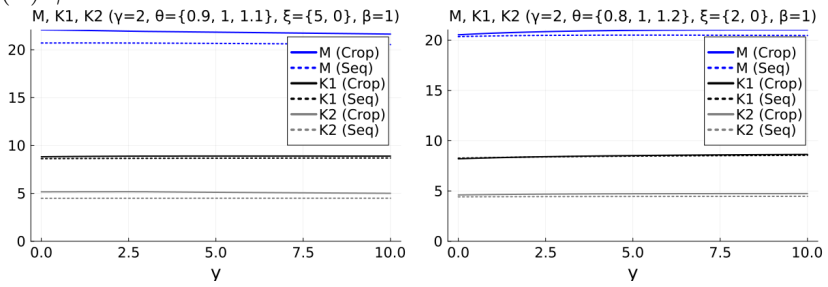
(B) Ratio of the amount repaid by November



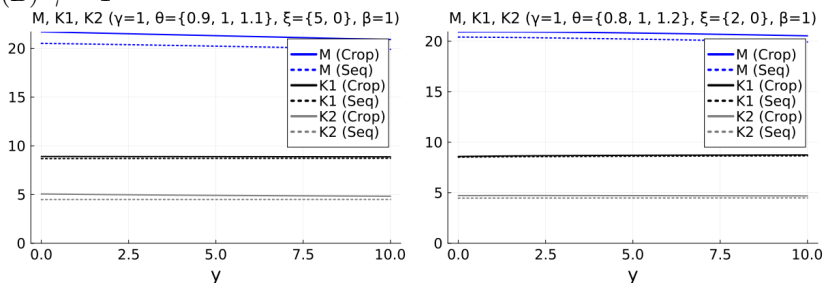
Panel (A) shows the ratio of borrowers who missed any installments in a month under traditional microcredit (TradMC). Panel (B) and Panel (C) show the histogram of the ratio of the repaid amount by November (December) under TradMC.

Appendix Figure 8: Choice of (M, K_1, K_2) under crop credit (CropC) and sequential credit (Seq-C) for time-consistent borrowers with income shocks at $t = 3$

(A) $\gamma = 2$

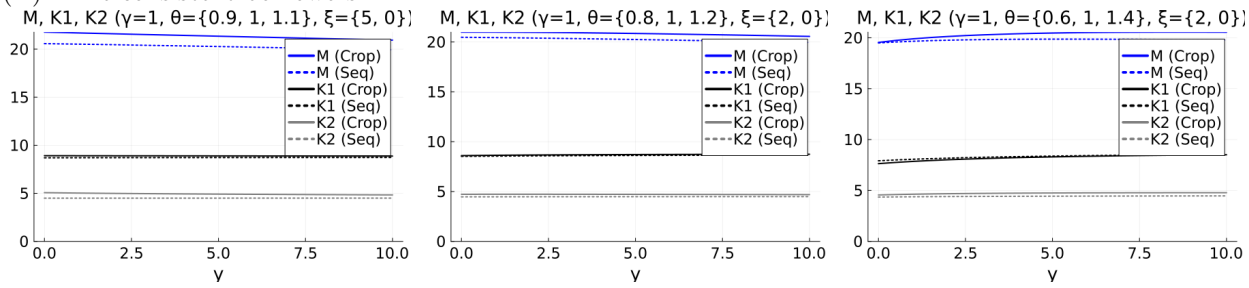


(B) $\gamma = 1$

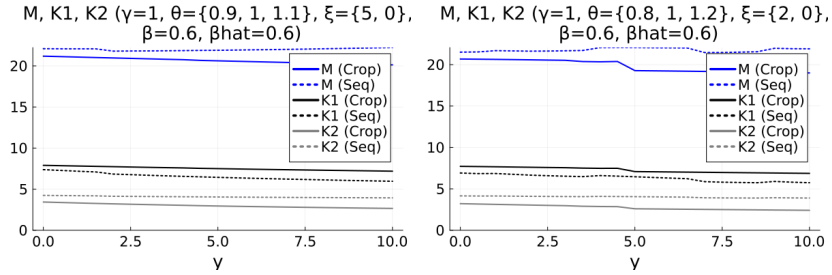


Appendix Figure 9: Choice of (M, K_1, K_2) under CropC and Seq-C when $\gamma = 1$

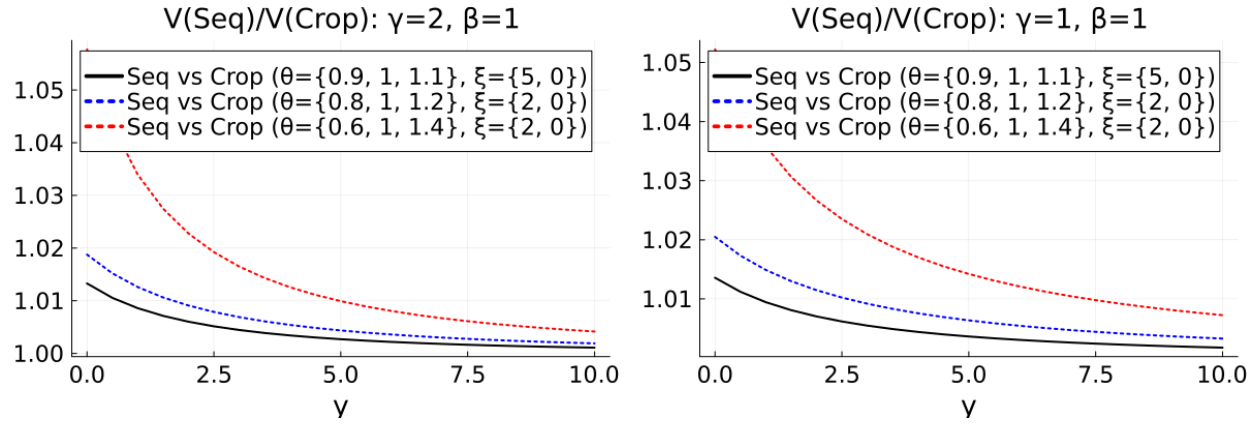
(A) Time-consistent borrowers



(B) PB borrowers



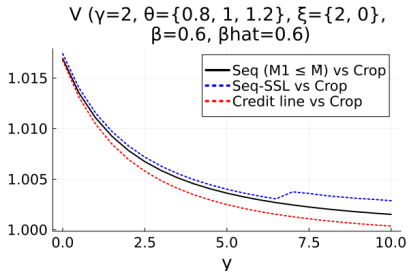
Appendix Figure 10: Ex ante expected utility under Seq-C compared to that under CropC for time-consistent borrowers



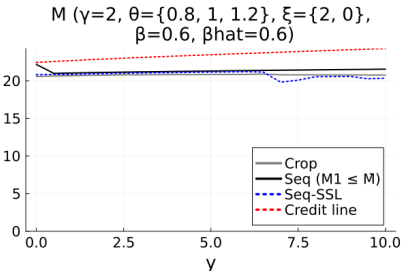
Appendix Figure 11: Counterfactual policy simulations ($\beta = \hat{\beta} = 0.6$, large productivity shocks)

(A) $\gamma = 2$

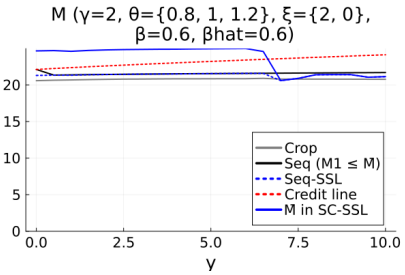
(a) Expected utility



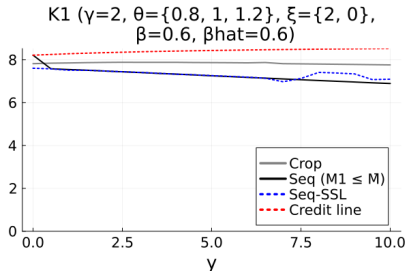
(b) Average borrowing



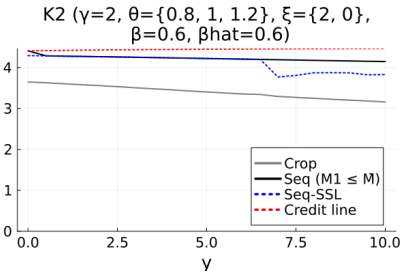
(c) Borrowing (no shocks)



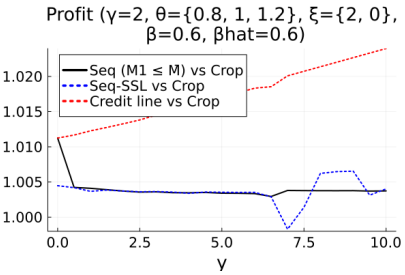
(d) First investment



(e) Second investment

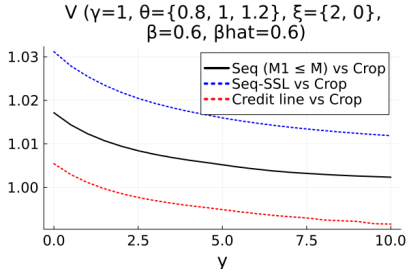


(f) Profit

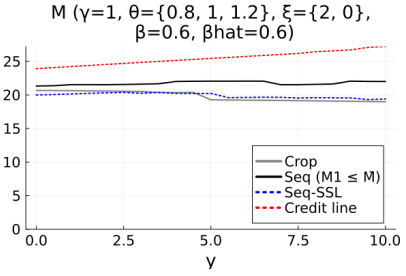


(B) $\gamma = 1$

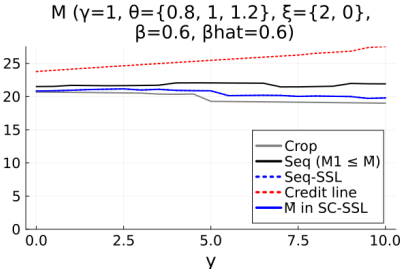
(a) Expected utility



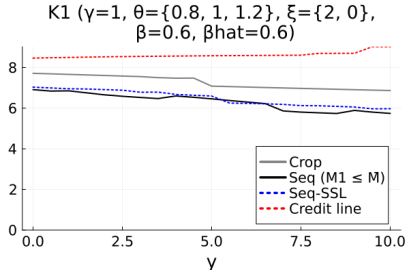
(b) Average borrowing



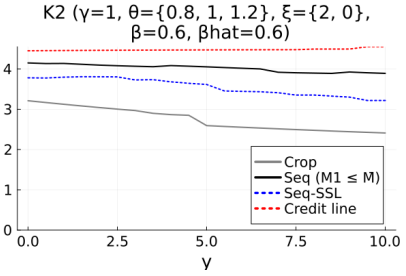
(c) Borrowing (no shocks)



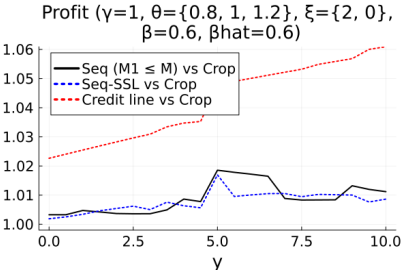
(d) First investment



(e) Second investment



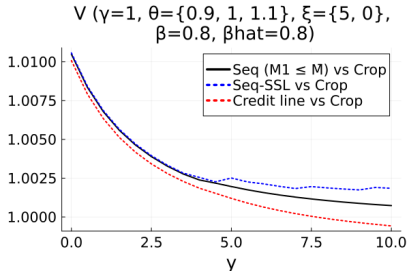
(f) Profit



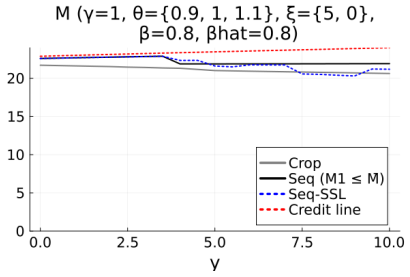
Appendix Figure 12: Counterfactual policy simulations ($\beta = \hat{\beta} = 0.8$)

(1) Large expenditure shocks ($\gamma = 1$)

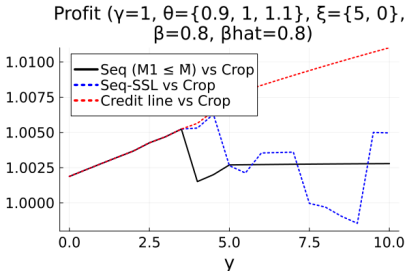
(a) Expected utility



(b) Average borrowing

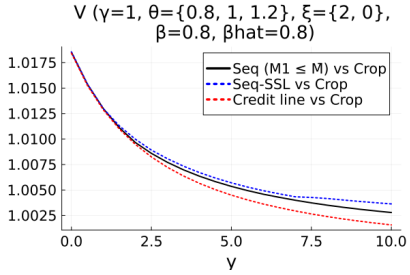


(c) Profit

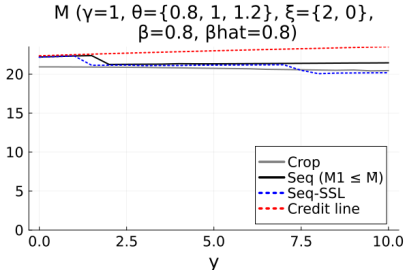


(2) Large productivity shocks ($\gamma = 1$)

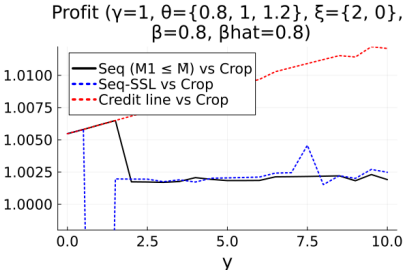
(a) Expected utility



(b) Average borrowing

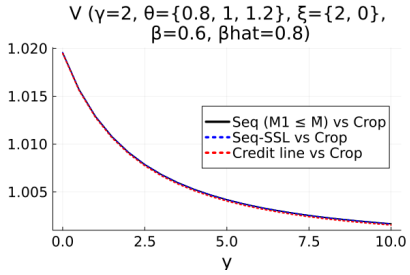


(c) Profit

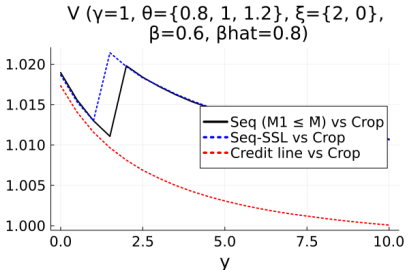


Appendix Figure 13: Counterfactual policy simulations ($\beta = 0.6, \hat{\beta} = 0.8$, large productivity shocks):

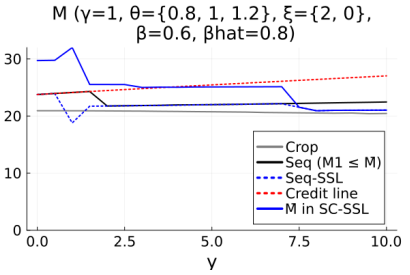
(A) Expected utility when $\gamma = 2$



(B) Expected utility when $\gamma = 1$



(C) Borrowing when $\gamma = 1$



A.5 Appendix Tables

Appendix Table 1: Balance tests

	(1) Asset	(2) Tenancy area	(3) Borrowing	(4) 1st invest	(5) 2nd invest	(6) Output	(7) Other income	(8) Saving
TradMC	-0.029	-1.624	378.831	229.808	186.665	-274.187	-5120.481	192.947
	(0.058)	(1.479)	(546.940)	(185.069)	(176.079)	(765.125)	(5412.860)	(311.204)
CropC	-0.034	-0.357	-100.194	349.185	85.517	-98.337	-1719.999	-50.743
	(0.058)	(1.470)	(440.689)	(208.924)	(185.252)	(856.919)	(5955.845)	(196.932)
Seq-C	0.017	0.146	166.279	336.082	115.981	707.459	-6445.644	68.780
	(0.056)	(1.633)	(420.412)	(198.530)	(158.098)	(814.328)	(5086.986)	(263.513)
Seq-K	0.018	0.413	-48.504	325.268	192.107	1055.513	-6600.386	66.697
	(0.056)	(1.571)	(593.730)	(199.108)	(171.203)	(941.422)	(5127.849)	(337.010)
Observations	998	998	998	998	998	998	998	998
Mean_Control	12.516	79.734	1219.668	8029.598	4247.568	31984.472	1.05e+05	490.477
SD_Control	0.881	16.211	3957.328	2494.998	1685.506	10390.971	48632.276	1959.240
CropC_vs_TradMC	0.933	0.354	0.372	0.575	0.546	0.836	0.516	0.397
SeqC_vs_TradMC	0.417	0.191	0.681	0.573	0.683	0.198	0.769	0.724
SeqK_vs_TradMC	0.412	0.136	0.532	0.621	0.975	0.129	0.773	0.751
SeqC_vs_Crop	0.375	0.731	0.589	0.950	0.859	0.332	0.350	0.609
SeqK_vs_Crop	0.371	0.591	0.905	0.909	0.566	0.186	0.332	0.716
SeqK_vs_SeqC	0.985	0.859	0.719	0.959	0.653	0.695	0.973	0.995

The table reports the estimated coefficients of the regression, with standard errors clustered at the stratum level in parentheses. The lower panel indicates the p value for the null hypothesis that the coefficients of the corresponding treatment indicators are the same.

Appendix Table 2: Savings

	Saving			Savings at GUK in Jul-Aug		
	(1) All	(2) non-PB	(3) PB	(4) All	(5) non-PB	(6) PB
MC	1475.782	1424.589	1419.267	905.881	990.521	834.757
	(209.659)	(242.124)	(269.047)	(77.366)	(128.527)	(98.392)
Single payment	110.830	280.545	54.960	193.515	190.750	195.800
	(204.743)	(226.646)	(311.345)	(87.904)	(144.187)	(111.115)
Seq disbursement	-279.333	-234.063	-355.774	-211.587	-196.776	-213.217
	(109.095)	(182.011)	(242.361)	(71.272)	(123.727)	(96.463)
In-kind	31.391	16.938	162.007	26.632	9.697	44.989
	(115.309)	(176.742)	(231.889)	(68.795)	(119.819)	(89.818)
Observations	998	410	588	998	410	588
Mean_Control	266.884	232.931	293.259	122.563	129.770	116.964
Crop_vs_Control	0.000	0.000	0.000	0.000	0.000	0.000
SeqC_vs_Control	0.000	0.000	0.000	0.000	0.000	0.000
SeqK_vs_Control	0.000	0.000	0.000	0.000	0.000	0.000
SeqC_vs_TradMC	0.427	0.836	0.451	0.833	0.965	0.864
SeqK_vs_TradMC	0.518	0.776	0.594	0.918	0.979	0.798
Crop_vs_SeqK	0.037	0.224	0.362	0.025	0.138	0.100

The table shows the estimated coefficients of the regression, with standard errors clustered at the stratum level in parentheses. We include the baseline outcome, group dummies, baseline savings, and variables selected by post-double-selection (PDS) lasso as the control. PB denotes present-biased individuals.

Appendix Table 3: ITT on microcredit borrowing and borrowings from other sources

	(1) GUK borrowing	(2) Other borrowings	(3) Other borrowings, non-PB	(4) Other borrowings, PB	(5) Non-MFI Borrowing	(6) Borrowing from other MFIs
MC	9652.464	-28.051	-17.877	-5.866	-21.697	-7.533
	(691.621)	(28.393)	(51.534)	(60.903)	(26.931)	(10.345)
Single payment	1861.187	22.628	27.331	4.549	18.235	5.891
	(851.687)	(31.179)	(77.510)	(60.793)	(30.868)	(7.516)
Seq disbursement	-1264.283	94.605	-18.407	173.930	-10.892	105.384
	(691.881)	(123.833)	(81.738)	(187.915)	(33.549)	(118.167)
In-kind	510.331	-53.442	83.075	-151.154	13.741	-67.645
	(685.414)	(124.727)	(121.133)	(177.971)	(26.125)	(117.782)
Observations	998	998	410	588	998	998
Mean_Control	0.000	40.452	53.609	30.232	40.452	0.000
Crop_vs_Control	0.000	0.878	0.914	0.984	0.918	0.845
SeqC_vs_Control	0.000	0.439	0.875	0.390	0.534	0.358
SeqK_vs_Control	0.000	0.529	0.552	0.757	0.982	0.346
SeqC_vs_TradMC	0.478	0.333	0.835	0.377	0.639	0.360
SeqK_vs_TradMC	0.138	0.266	0.442	0.671	0.472	0.260
Crop_vs_SeqK	0.337	0.506	0.639	0.726	0.943	0.301

The table shows the estimated coefficients of the regression, with standard errors clustered at the stratum level in parentheses. We include the baseline outcome, group dummies, baseline savings, and variables selected by PDS lasso as the control. PB denotes present-biased individuals.

Appendix Table 4: Wage and cash inflow

	Wage income			Borrow+wage-saving		
	(1) All	(2) non-PB	(3) PB	(4) All	(5) non-PB	(6) PB
MC	3720.624	4707.515	3337.004	2323.542	3405.823	1795.204
	(3414.319)	(4866.815)	(4511.579)	(3407.982)	(4901.525)	(4484.166)
Single payment	-3326.332	-4030.193	-3150.333	-3525.356	-4376.443	-3132.569
	(2974.789)	(5309.937)	(3766.579)	(2954.037)	(5320.800)	(3756.514)
Seq disbursement	-1505.609	-2430.695	-792.204	-1402.691	-2912.673	-258.032
	(3105.280)	(5488.096)	(3622.529)	(3167.304)	(5531.882)	(3659.608)
In-kind	-827.837	1099.390	-2375.028	-404.169	2312.056	-2426.464
	(3091.132)	(5204.930)	(3828.702)	(3116.004)	(5281.259)	(3849.794)
Observations	998	410	588	998	410	588
Mean_Control	74892.211	82793.678	68754.464	74665.779	82614.356	68491.438
Crop_vs_Control	0.903	0.891	0.967	0.709	0.845	0.765
SeqC_vs_Control	0.727	0.737	0.898	0.414	0.463	0.735
SeqK_vs_Control	0.570	0.884	0.534	0.380	0.730	0.400
SeqC_vs_TradMC	0.130	0.250	0.325	0.122	0.198	0.396
SeqK_vs_TradMC	0.060	0.277	0.131	0.078	0.319	0.161
Crop_vs_SeqK	0.393	0.789	0.401	0.510	0.904	0.479

The table shows the estimated coefficients of the regression, with standard errors clustered at the stratum level in parentheses. We include the baseline outcome, group dummies, baseline savings, and variables selected by PDS lasso as the control. PB denotes present-biased individuals.

Appendix Table 5: Investment

	1st investment				2nd investment			
	(1) non-PB,low	(2) non-PB,high	(3) PB,low	(4) PB,high	(5) non-PB,low	(6) non-PB,high	(7) PB,low	(8) PB,high
MC	-180.991	-168.484	297.961	-131.394	-123.618	-148.004	305.776	-95.441
	(277.911)	(282.560)	(196.279)	(210.216)	(301.401)	(294.705)	(193.497)	(220.051)
Single payment	283.998	371.435	-71.453	136.081	-6.671	387.387	-90.971	44.621
	(334.575)	(308.188)	(181.982)	(213.971)	(247.781)	(368.795)	(170.864)	(229.849)
Seq disbursement	76.741	-140.166	330.468	127.324	98.512	-294.769	348.829	137.864
	(357.238)	(348.213)	(204.983)	(197.766)	(269.633)	(343.483)	(185.630)	(242.878)
In-kind	27.794	-173.856	-190.530	-161.944	14.932	-13.081	-106.387	-103.423
	(328.268)	(315.223)	(225.021)	(208.360)	(306.740)	(280.346)	(237.542)	(244.102)
Observations	189	219	299	286	189	219	299	286
Mean_Control	8221.780	8214.217	8153.922	8662.869	4298.244	4238.870	3651.784	4405.475
Crop_vs_Control	0.764	0.532	0.234	0.979	0.671	0.468	0.220	0.825
SeqC_vs_Control	0.562	0.847	0.011	0.506	0.919	0.842	0.010	0.715
SeqK_vs_Control	0.504	0.707	0.087	0.869	0.962	0.812	0.030	0.938
SeqC_vs_TradMC	0.216	0.441	0.222	0.237	0.712	0.749	0.221	0.447
SeqK_vs_TradMC	0.198	0.832	0.738	0.640	0.710	0.792	0.489	0.723
Crop_vs_SeqK	0.771	0.325	0.490	0.853	0.707	0.362	0.222	0.883

The table shows the estimated coefficients of the regression, with standard errors clustered at the stratum level in parentheses. We include the baseline outcome, group dummies, baseline savings, and variables selected by PDS lasso as the control. PB denotes present-biased individuals, and "low" ("high") indicates individuals whose baseline total other income is below (above) the median.

Appendix Table 6: Productivity shocks and disbursement amount (time-consistent)

	(1) M2	(2) M2	(3) M: Seq	(4) M: Crop & Seq
K_2	-0.488	-0.585	-0.574	-1.272
	(0.351)	(0.465)	(0.394)	(0.449)
K_1		0.086	-0.625	0.368
		(0.249)	(0.375)	(0.313)
Seq $\times K_2$				0.700
				(0.607)
Seq $\times K_1$				-0.348
				(0.321)
Observations	64	64	64	125

The table shows the estimated coefficients with standard errors clustered at the stratum level in parentheses. Baseline savings and variables selected by PDS lasso are included as controls. The group fixed effects are omitted because productivity shocks might occur at the group (i.e., village) level.