Forbearance vs. Interest Rates:
Tests of Liquidity vs. Strategic Default Triggers in a Randomized Debt Relief Experiment*

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October 2022

Abstract

I study the efficacy of debt relief policies in a large-scale field experiment that randomizes forbearance, term, and interest rates independently in a novel 2-by-2-by-2 design. I then provide tests of models of default that emphasize solvency, liquidity, and strategic behavior. In contrast to models emphasizing solvency, modifications orthogonal to face value have distinct effects on whether and when to default. Forbearance has no effects beyond expiration, whereas the effect of interest rate reductions persists. In contrast to models emphasizing liquidity, the reduction in current payments has a weak association with default. Although forbearance reduces payments twice as much as rate reductions, delinquencies are discernibly more responsive to the rate reduction. Compatible with strategic default, news about a dollar increase in future payments increases defaults by as much as a 30-cent increase in current payments. Compatible with the endogeneity of triggers, the efficacy of forbearance and rate reductions, the sensitivity of behavior to current versus future payments, and hence whether the default is strategic is tightly linked to balance sheets. The findings are most compatible with the interpretation that *every default is strategic* with the endogenous trigger being influenced by liquidity and financial distress. Findings have important implications for modeling the pass-through of interest and the design of loan modifications.

(*JEL* G51, D15, E63)
(Keywords: forbearance, interest rates, debt relief, distress, liquidity, present value, randomized field experiment)

What triggers default on debt obligations, and what relief policy best prevents it? The answer to this question has important implications for macroeconomics, finance, and policymaking. In policymaking, the answer determines how to target and prioritize commonly used debt relief policies such as forbearance and rate reductions. In finance, the answer distinguishes between widely used models that emphasize solvency, liquidity, and strategic behavior. In macroeconomics, models that simulate monetary and fiscal policy will only provide accurate predictions if the channels and sizes of effects through which relief

*Washington University in St. Louis, Olin Business School. Email: daydin@wustl.edu I am grateful to Cevdet Akcay and Adrien Auclert for early-stage discussions; to Marieke Bos, Nuno Clara, Joao Cocco, John Cochrane, Ian Glover, Radha Gopalan, Brett Green, Sean Higgins, Felicia Ionescu, Rodolfo Manuelli, Pascal Noel, Eren Ocakverdi, Aiga Stokenberga, Anjan Thakor, Niccolo Ubertalli, Emil Verner, Emircan Yurdagul, and numerous seminar and conference participants for valuable suggestions. Oguz Caylan provided excellent research assistance. The field experiment was submitted to the American Economic Association Randomized Controlled Trial Registry (#1781) and was deemed exempt from institutional review by Washington University IRB (HRPO #201704038).

policies affect behavior are disciplined through credibly identified moments, which have proven difficult to estimate due to the limits of research designs.

A large literature studies household defaults (e.g., Karlan and Zinman (2009), Mian and Sufi (2009), Verner and Gyöngyösi (2020)) and the efficacy of debt relief policies in isolation (e.g., Dobbie and Song (2015),Fuster and Willen (2017), Cherry et al. (2021)). More recently, influential work by Dobbie and Song (2020) and Ganong and Noel (2020) uses either-or designs to study the relative merits of write-downs compared with policies that act on payments. Although not all results align, one salient takeaway is that liquidity—defined on different occasions as payments, affordability, short-run, and cash flow—is a more important trigger of default compared to solvency than previously emphasized by theory.[1] However, there is still neither a firm consensus nor a unifying explanation as to under what conditions solvency, liquidity, or strategic behavior triggers default. Moreover, the efficacy of alternative forms of debt relief under various circumstances remains a topic in need of further measurement and understanding.

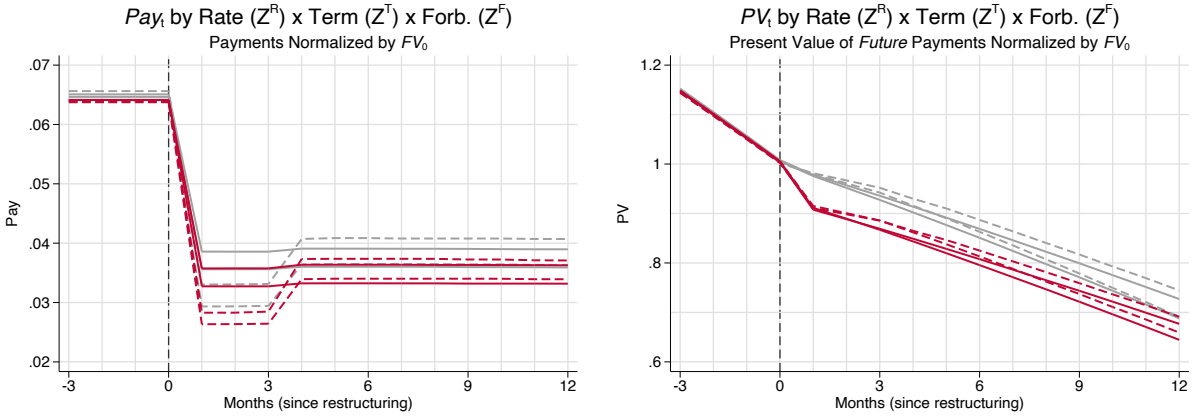
In this paper, I report the results of a large-scale field experiment to provide new evidence for this debate. I design a debt relief program at a European financial institution that refinances unsecured borrowers. The design isolates classical solvency constraints by holding constant the face value owed. It then deliberately and randomly provides the most widely used debt relief in a novel 2-by-2-by-2 design. Rate reductions are the primary tool for macroeconomic stabilization, entailing a small reduction in current payments, accompanied by a large reduction in the present value of future payments. As rate reductions unambiguously benefit the borrower, the design automatically passes through rate reductions for all participants, randomly varying the magnitude of the reduction. Forbearance is the other commonly used debt relief policy. Full forbearance temporarily postpones the payment of principal for three months, entailing an immediate, easy-to-implement, large, and targeted reduction in payments, backloading this reduction to future payments one for one. I study this alongside a partial forbearance term extension policy that partially reduces the payment of principal and spreads the payments over time. As the benefits of postponing payments depend on borrower preferences, in these aspects, the design combines random encouragement with borrower choice. I then use the sharp counterfactuals and the randomized shocks to current versus future payments to analyze the qualitative dynamics and quantitative determinants of defaults and provide novel tests of widely used models for why borrowers default.

The current paper provides a unique opportunity to study a truly unexpected and randomized experiment, analyzed using the language and framework of a randomized control trial. The design complements previous research conducted in the U.S. in notable ways, allowing for a direct investigation of important theoretical and policy-relevant questions not possible to answer using naturally occurring variations or previous research designs.[2] The experiment's internal validity is quite strong and yields surprising and informative results.

[1] Similarly, Indarte (2022) and Ganong and Noel (2022) provide further evidence that liquidity is the main driver of borrower default decisions.

[2] The experiment abstracts away from intermediation frictions and the endogenous matching of borrowers with particular lenders and contracts. In contrast to previous work, this allows for the identification of causal effects using a purely experimental variation. The experiment is associated with a strong first stage on rates and forbearance (F of 7,551 and 2,216) and a strong first stage on current and future payments (F of 401 and 2,128). The financial institution did not offer rate reductions or forbearance before; these aspects are not preannounced and are likely unanticipated. The current design, due to tightly related regulatory, ethical, targeting, and external validity reasons, does not force a borrower into forbearance or a particular term. By only encouraging policies that postpone payments, relief targets borrowers most in need while respecting intertemporal preferences.

Figure 1: First Stage



Note. Figure displays, separately by 2-by-2-by-2 treatment legs, current payments and the present value of future payments, calculated as in Section 1 and normalized by face value at refinancing. Forbearance (dashed) entails a large reduction in payments in the first quarter by postponing amortizing principal and backloading to future payments. Rate reductions (red) entail a small reduction in payments accompanied by a much larger reduction in the present value of future payments.

I organize the empirical analysis into four subsections. Each section scrutinizes a testable implication of a commonly used default model. I then provide a unifying explanation of what may appear to be mixed and conflicting findings documented in different settings as to what triggers default and discuss critical policy implications.

First, I use transparent event studies to analyze the qualitative dynamics of defaults under alternative debt relief policies. In contrast to models in which solvency is the sole driver of borrower decisions (i.e., default if the face value is too high), modifications orthogonal to the face value and other observable and unobservable determinants of the default decision (e.g., income, wealth, risk, costs of default) have discernible and distinct effects on the borrower's decision on whether and when to default. Forbearance take-up prevents one in three defaults in the first month and one in five defaults in the last month before expiration. However, the effects of forbearance do not extend beyond the expiration as delinquencies increase when payments increase, as forbearance only shifts the timing of the default decision. This qualitative pattern is broadly in contrast to the effect of interest rate reductions which occurs immediately and persist in the long run.

Second, I use the first-stage and intent-to-treat estimates in superimposition to analyze the association of defaults with the payments borrowers make. Previous *either-or* research designs that test the liquidity hypothesis either reduce payments or don't. The current research design is novel and unique in that it varies current payments for similar participants in three ways. This feature allows for a direct test of the association between current payments and delinquencies as predicted by theories emphasizing liquidity. In contrast to models in which liquidity is the sole driver of borrower decisions (i.e., default because payments are too high), the reduction in current payments has an imperfect and weak association with the decision to default. Notably, a dollar change in payments has drastically different effects depending on whether it is entailed through forbearance, term extension, or rate reduction. One striking pattern that motivates further tests is that although offering total forbearance reduces payments twice as much as reducing the interest rate, delinquencies are noticeably more responsive to the interest rate reduction.

Third, I use the experimental assignment as instrumental variables to estimate strategic default triggers in ways the literature has not yet addressed. The experimental variation shifts current and future payments in different directions, allowing for the identification of their relative contributions to borrower decisions. In contrast to work that focuses on write-downs (reductions in the face value of the amount owed in case of prepayment), the current design allows for a direct investigation of strategic default triggered by news about (non-callable) future payments, holding constant solvency (face value) and accounting for liquidity (current payments)—the unwilling despite ability.

If liquidity is the sole driver of borrower decisions, the second testable implication is that borrowers should behave identically whether the reduction in current payments is accompanied by a dollar increase or decrease in payments tomorrow. In contrast, if the default is triggered by strategic considerations (i.e., default if future payments are too high), news about announced but not yet realized cash flows in the future trigger default. Using both nonparametric and instrumental variables methods, I provide evidence for strategic default. Using the randomized variation in the 2-by-2-by-2 design, I estimate a treatment effect—an identified moment—that a dollar increase in future payments causes an increases defaults as much as a 30-cent change in payments in the current quarter.

Fourth, I scrutinize the empirical implications of endogenous default models by analyzing the heterogeneity in the strategic default triggers. Previous work focuses on average treatment effects, either due to limitations in data (i.e., no data on balance sheets) or research designs (i.e., no variation in balance sheets around the discontinuity that identifies the treatment effects). The current environment and design compensate for these shortcomings, allowing for an investigation of mechanisms emphasized but not yet tested. Although particulars of the frictions differ, all emphasize an inability to substitute intertemporally—kinks or lack of liquid assets, precautionary saving, or financial distress, as in Campbell and Cocco (2015), McKay et al. (2016), or Kaplan et al. (2018).

Consistent with these models, whether forbearance or interest rate reductions are relatively more effective, the relative sensitivity of behavior to current versus future payments—and hence whether the default is strategic or due to liquidity—are tightly linked to baseline liquidity and financial distress. Rate reductions are more effective, defaults more strategic, and behavior is more sensitive to future payments for early cycle delinquencies, borrowers who do not face a binding borrowing constraint and borrowers with higher checking balances. Conversely, forbearance is more effective, and defaults are more tightly linked to liquidity and current payments for late-cycle delinquencies and borrowers who hold little liquidity to perform the intertemporal substitution.

The findings are most compatible with the interpretation that *every default is strategic* but the trigger is influenced by liquidity and financial distress, as emphasized by Campbell and Cocco (2015). Liquidity is an important trigger for the average participant. For a borrower who can intertemporally substitute, all defaults are strategic. In contrast to models featuring simple heterogeneity—where a small subset of defaults is strategic, and a large fraction defaults based on liquidity—future payments and strategic channels remain pronounced to some extent for many borrowers (cash on hand levels).

I conclude by discussing several implications for theory and policy. One such implication regards the pass-through of interest rates. Macroeconomists have long appreciated that shocks like inflation and currency depreciation affect household behavior through Fisherian mechanisms through the revaluation of debt *stock*. Nevertheless, researchers

and policymakers often invite the interpretation that rate reductions (e.g., refinancing a mortgage) affect behavior through a liquidity channel only, invoking Keynesian frictions. Forbearance and interest rates are only partially substitutable because the effects of rate reductions are predominantly due to the effects on future payments through strategic channels. The benefits of rate reductions through future payments are equivalent to providing the same reduction in delinquencies to a deferral program that reduces monthly payments by 5% of average monthly household disposable income. It is not possible to replicate this benefit using policies such as forbearance and term extensions. For borrowers who can intertemporally substitute, such as households who are current on their mortgages and refinancing to a lower rate, interest rates are a substantially more powerful tool in providing relief than forbearance, which does not have an effect. Hence, influencing interest rates gets into cracks that are difficult to replicate using rescheduling policies that act on payments only.

The results here also provide a unifying reconciliation to what appears as disagreeing results from previous research. For example, Dobbie and Song (2020) and Ganong and Noel (2020) use an either-or design in which one group receives a write-down and another receives a payment reduction. The former study finds write-downs are effective and face value matters, whereas the latter, studying underwater homeowners, argues that liquidity is driving borrower decisions. This is precisely what I find for early cycle delinquencies. Hence, the estimated relative sensitivity of default future payments to current payments is ∞ and 0, respectively. In the former study, participants are early cycle delinquent credit card holders who can more likely intertemporally substitute the small face value they owe. In the latter study, participants are deeply delinquent underwater mortgage borrowers less so—particularly concerning large sums of long-run obligations, i.e., those more than five years away.

Layout. The paper proceeds as follows. In Section 1 I provide a simple conceptual framework to clarify how forbearance and interest rates affect borrower behavior through current payments as well as the present value of future payments, acting on liquidity and strategic default triggers. Section 2 describes the macroeconomic conditions and relevant institutional details (e.g., unsecured loan market, distressed debt refinancing, and the institutional features. Section 3 details the experimental design and implementation. Section 4 presents the results. Subsection 4.1 provides tests of solvency by analyzing the effects on the qualitative dynamics of defaults using event studies. Subsection 4.2 uses the experimental assignment as instruments to decompose the relative contributions of future payments from the effect of current payments. Subsection 4.4 discusses explanations for the wedge between the sensitivity of behavior to current versus future payments. Section 5 concludes.

1 Conceptual Framework

Here, I provide a simple conceptual framework to clarify how forbearance and interest rates affect borrower behavior via liquidity and strategic channels through current and future payments. First, I provide an intuitive approximation to the annuity formula to quantify these effects. I then describe statistical tests to distinguish solvency, liquidity, and strategic default. The reader familiar with these issues could skip to Section 3 on experimental design.

Consider an intertemporal model in the spirit of Deaton (1991) and Carroll (1997) that

incorporates solvency, liquidity, and strategic default constraints, as in Chatterjee et al. (2007), Livshits et al. (2007), or Campbell and Cocco (2015). In such a model, the face value of the principal owed, current payments, and future payments will all affect the borrower's decision to default differently since they capture different aspects of the intertemporal path of payments borrowers face.

The experiment considers unsecured loans. Hence strategic defaults related to collateral values are ignored. It holds the face value at origination FV_0 constant, and creates independent variation in rate ($R \downarrow$), term ($T \uparrow$), and forbearance (F).

One way to think about how these modifications affect current payments is to consider the Taylor approximation to the annuity formula for constant amortizing payments,

$$\begin{aligned} \text{Payment} &= FV_0 \left(\frac{1}{T} + \frac{R}{2} + \frac{R}{2T} + \frac{R^2 T}{12} - \frac{R^2}{12T} + O(R^3) \right) \\ \text{Pay} &\simeq \left(\frac{1}{T} + \frac{R}{2} \right) \end{aligned} \tag{1}$$

Henceforth Pay denotes current payments normalized by FV_0. This formula gives the relative contributions of interest and amortizing principal to payments. R has a linear effect on Pay, while T has a $\frac{1}{T}$ effect. In the current setting, the typical R is about 16% APR or 4% per quarter. The typical T is about three years or 12 quarters. This gives quarterly Pay of $\frac{1}{12} + \frac{4\%}{2} \simeq 10\%$ of FV_0.

Any modification affects payments. However, the relative sensitivity of payments is very skewed in favor of forbearance and much less on the interest rate. Forbearance suspends the payment of principal, keeping the term constant, reducing Pay by 60%, from 10% to the quarterly interest rate of 4%. In contrast, a 4pp APR reduction in the interest rate (a 25% reduction off a base of 16% APR) reduces Pay by about 5%; and a 10% increase in T' (off a base of 3 years) reduces payments by about 7%. Figure 2 shows these effects.

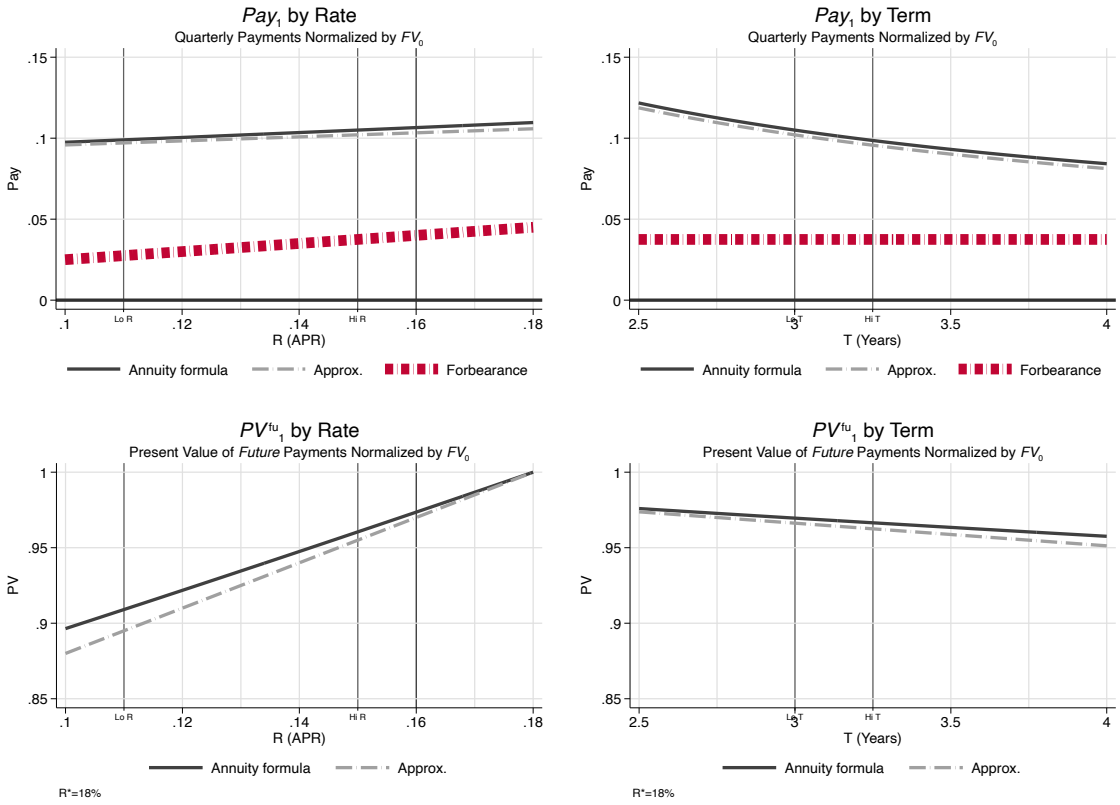
What determines the cost of debt to the borrower and hence the relative merits of these policies is the effects on future payments. Suppose the borrower is discounting future payments at a discount rate R^* to calculate a present value to undertake meaningful comparisons of current versus future payments. Similarly, consider the Taylor approximation to the present value formula,

$$\begin{aligned} \text{Present Value}_0 &= \text{Payment} \left(T - \frac{R^*\, T}{2} - \frac{R^*\, T^2}{2} + O(R^{*2}) \right) \\ PV_0 &\simeq \left(1 + (R - R^*) \frac{T+1}{2} \right) \end{aligned} \tag{2}$$

where the second line follows from substituting the approximation (1) as Payment. Figure 2 shows these effects on PV_t^{fu} for $t = 1$, henceforth denoting the present value of *future* payments coming *after* t, normalized by FV_0 and assuming an R^* of 18% APR.[3]

[3]From the lender's perspective, present value is the market value of the loan, and R^* is a risk-adjusted discount rate. One approach is to use the inflation rate and compare real dollar terms, which allows measurement of an increase in future payments that is equivalent to a $1 today in real terms. See real capital value in the terminology of Campbell and Cocco (2003). From the borrower's perspective, R^* is a subjective discount rate, which, in general, will be directly tied to the marginal utility of consumption. In models with borrowing constraints, R^* also incorporates the shadow cost of the constraint. Interpreting R^* as a subjective discount rate allows for a measurement of present value equivalents across time; e.g., an increase in future payments in which the borrower

Figure 2: Effect of Rate, Term, and Forbearance on Current and Future Payments



Note. Figures show the sensitivity of payments and present value of future payments to changes in R and T. The panels on the top plot payments, using the annuity formula and the approximation in Equation 1. The panels on the bottom plot the present value of future payments, using the annuity formula and the approximation in Equation 2. The panels on the left hold term constant at $T = 3$ years and vary the interest rate. The panels on the right hold the interest rate constant at the high rate of $R = 15\%$ and vary the contract term.

Rate reductions alter the present value of payments despite keeping face value constant, unambiguously benefiting the borrower. Notably, the effects on future payments account for more or less the entire impact of interest rate changes. Hence, rate reductions are effective either if households are sensitive to either current payments or future payments. Assuming a contract term of $T = 3$ years, a rate reduction ΔR of 4pp APR reduces total future payments as much as a debt-write down of $\frac{1}{2} \cdot T \cdot \Delta R$= 6% of FV_0.

The reduction in the payment stream due to the rate reduction could be replicated via a face value write down. Borrowers would see an identical effect in both scenarios but with different compositions of principal and interest. However, unlike a write-down, borrowers cannot capitalize on the present value effects by prepaying or calling the loan at face value. To a first-order approximation, the change through R in the present value of future payments is independent of R^*. The revaluation effect is proportional for current and future

is indifferent to a \$1 increase in Pay. Another approach is to use R^* as the cost of marginal funding—the interest rate at which borrowers can transfer resources across time. A borrower who can borrow and save freely at a rate of R^* can compensate for the increase in current payments by borrowing to pull forward the reduction in future payments. If borrowers can transfer resources across time at a discount rate of R^*, a dollar increase in current payments and a dollar's worth of change in the present value of future payments would lead to the *same budget constraint*, the same feasible set, hence the same set of optimal decisions. By arbitrage, the cost of marginal funding bounds R^* above.

payments, hence larger if the debt has a high duration, i.e., T is large.

In contrast, forbearance only alters the timing of payments, backloading the reduction in current payments one-for-one to future payments. Hence, forbearance is effective if households are more sensitive to current payments than future payments. Rescheduling through term extensions spreads out payments further over time.

Unlike rate reductions, forbearance and term extensions are not attractive to everyone. A reduction in payments through the term T has an ambiguous effect on the present value of future payments that depends on the path of $R - R^*$. In the knife-edge scenario $R^* \simeq R$ term extensions will not affect present value of future payments; otherwise, the effect will be proportional to $\frac{1}{2} \cdot T \cdot (R - R^*)$.

Table 1: Competing Models

Model	What triggers default?			What reduces default?			Policy
	FV	Pay	PV^{fu}	$R\downarrow$	$T\uparrow$	F	
Solvency	✓						Write-down
Liquidity		✓		✓	✓	✓	Forbearance
Strategic			✓	✓		?	Rate reduction
Endogenous	✓	✓	✓	✓	✓	✓	Heterogenous

Note. FV, Pay, and PV^{fu} stand for face value, current payments, and present value of future payments. $R\downarrow$, $T\uparrow$, and F stand for rate

This leads to four models in Table 1 that are distinguished by the default trigger.

- *Solvency.* At one extreme is a classical frictionless model emphasizing what is on the balance sheet in which solvency triggers default. In this model, the borrower defaults because the face value is too high. This model is obtained with no borrowing constraints and R^*=R, i.e., the borrower's discount rate equals the interest rate on debt. In this model, when the interest rate decreases payments also decrease, although their present value does not. The testable prediction is that changing current payments or the present value of future payments should not affect borrower behavior. The policy implication is that only face-value write-downs would affect borrower behavior.
- *Liquidity.* At the other extreme are alternatives in which the default decision is driven only by liquidity. There is no commonly adopted definition of liquidity, which is often used interchangeably with cash flow, periodic debt service, affordability, and short-run obligations. Here, liquidity is defined as current payments. In this model, the borrower defaults because current payments are too high. For example, the borrower could have an affordability constraint and default if and only if current payments are higher than her income. Alternatively, the borrower may not be able to intertemporally substitute (i.e., $R^* = \infty$). The testable predictions are that the reduction in payments determines the efficacy; and beyond current payments, future payments are irrelevant. Every modification reduces payments, with forbearance reducing the most and interest rates reducing the least. Hence, the policy implication

is that forbearance will be most effective, and rate reductions least so.

- *Strategic.* The third class of model is one in which the default decision is driven by factors beyond solvency (face value) or liquidity (current payments). In this model, borrowers weigh the costs and benefits of default (e.g., drop in credit score and access, loss of option value, stigma, moral factors, recourse, postponing or preventing repayment) and trade these costs off the present value of future payments. This captures the able but won't pay. These defaults are forward-looking and strategic as they are independent of affordability but due to news about future payments. The testable prediction is that beyond current payments, expecting higher future payments lead to immediate changes. The policy implication is that rate reductions will be the most effective due to the large effects on future payments through strategic channels that can not be replicated using forbearance policies.

- *Endogenous.* The final class of model is one in which triggers are endogenouswhether default will be triggered by solvency, liquidity, or strategic considerations is endogenous. In this case, the entire intertemporal path of future payments may matter for the default decision, even when liquidity is scarce. For example, as in Campbell and Cocco (2015), default is more attractive for a constrained borrower, as it has the immediate benefit of reducing payments. Hence, borrowers will stop making payments although they can afford to when it is a more advantageous financial decision than continuing to pay. This is triggered by an endogenous default constraint, when the present value of the debt obligations exceeds a threshold. Although every default is strategic, the trigger threshold is influenced by liquidity and financial distress. The literature emphasizes two other ingredients that lead to potentially rational, patient, and forward-looking borrowers being unable to honor current payments using resources that will accrue in the future; either because they have no liquid assets to perform intertemporal substitution, as in Kaplan et al. (2018); or if they engage in precautionary saving in response to a constraint that may bind in the future effectively shortening the planning horizon, as in McKay et al. (2016).

Using the experiment to create random variation in current payments versus future payments through forbearance and rate reductions to estimate average and heterogeneous treatment effects allows me to distinguish these alternatives and disentangle the factors driving borrower behavior.

2 Environment and Institutional Details

I first provide an overview of the macroeconomic conditions and relevant institutional details (e.g., unsecured loan market, consumer bankruptcy, distressed debt refinancing).

Macroeconomic Environment. The experiment was conducted and delinquent participants were refinanced between June 2017 and July 2018. Refinanced contracts are followed up for a period of 15 months. See Figure A.1 and Table A.3 for macroeconomic variables.

The effectiveness of various debt relief options may depend in part on the type of shock experienced by the economy. The household balance sheet dynamics that led to these delinquencies are neither the depression type (e.g., as in the Great Recession in the U.S.—a large and long slump caused by a persistent shock, such as bursting of a housing bubble that takes a long time to recover both in the housing and labor markets) nor the transitory type (e.g., a short-lived recession due to a temporary emerging market shock, such as a brief cur-

rency attack, associated with short-term layoffs and disruptions in receivables). In terms of broad economic conditions, the economy expanded from 2017 through 2019, except for declines in seasonally adjusted quarter-on-quarter GDP in 2018:II, 2018:III, and 2018:IV. At the onset, the annual inflation rate (CPI) was about 11%; 4% of the aggregate face value of households is in non-performing status.

Unsecured Loans. The unsecured loans studied here feature fixed interest rates, terms of up to 72 months, and fixed nominal payments in local currency. These loans account for two-thirds of the total non-mortgage FV outstanding to the household sector. At initial underwriting, borrowers first declare education level, employment title, and monthly disposable income; then, indicate the amount they would like to borrow and choose a contract term. Borrowers do not state a purpose, but anecdotal evidence suggests that home improvements, emergency expenses, or large purchases are common reasons. Underwriting features little discretion, and evaluation is based on credit history and in-house risk scores built using spending, income, and repayment behavior. For the borrowers who can access personal loans, equilibrium credit terms vary only to a small extent with borrower risk, with only a 260 bps APR difference in interest rates between the 10th and 90th percentiles. Customers always have the free option to prepay the loan at face value.

Delinquencies. If a borrower is late on a debt payment, the bank will follow up via text messages and phone calls. A preliminary notice is sent after two subsequent payments are overdue. 90 days past due gives the bank right to take legal action and report nonperforming status to the credit bureau. The contract is kept in collections for about 90 additional days, during which the bank attempts recovery through customer contact. Suppose the borrower does not come forward with a definite plan to repay. In that case, the lender can opt for legal proceedings and sue the borrower for the loan balance plus penalties, due interest up to 30% of face value, collection costs, and legal fees. Post-default, credit score deteriorates. The default flag remains on the borrowers' credit history for five years, obstructing access to credit.

Collections. Turkey lacks a personal bankruptcy option. Moreover, the recourse loans considered here allow the lender to pursue claims on assets of a borrower who defaults. Thus, debtors are on the hook for the loan balance regardless of whether they stop making payments, and the benefits of defaulting are significantly lower. Unpaid debts are collected through an onerous and arduous process, through garnishment, guarantors, and sequestration. At enforcement proceedings, recovery is made through confiscating cash and other liquid assets, wage garnishment of up to 25% of net income, and then confiscation of durables and real estate. If there is a guarantor, she shares all the responsibility if the debtor cannot repay—her labor income could be garnished, and durables or real estate confiscated or sequestrated. This process usually takes two to three years. Hence, default postpones repayment for the typical borrower. However, recovery is not possible for an unemployed borrower with no leviable bank account or confiscatable illiquid assets. Hence, default prevents recovery from some borrowers. The financial institution could sell the bad debt to a collection agency. There is no immediate imprisonment for a debtor who cannot pay. However, a debtor in legal proceedings who has not declared the full extent of garnishable income or confiscatable property or made a commitment to pay the debts and failed to do so without a justifiable reason could face imprisonment for up to three months upon the request of the creditors.

Refinancing. The market features widespread refinancing of distressed unsecured debt directly by the lender of the delinquent loan. The financial institutions contact delinquent

borrowers through an in-house call center to work out a plan for the customer to continue making debt repayments. Financial institutions predominantly refinance borrowers for whom it is the sole or predominant creditor. These modifications are one-time and consist of term extensions only. Lenders have capabilities to facilitate loan modifications, such as in-house call centers to reach out to delinquent borrowers and analytics teams that optimize the refinancing process. I describe the restructuring process in detail in Section 3.

Table 2: Summary Statistics

	Unit	N	mean	s.d.	$p10$	$p50$	$p90$
Demographics							
Age	Years	20,944	38.0	9.8	26	37	52
Metro area (1m+)		20,944	0.23	0.42	0	0	1
Delinquent loan							
Loans (Consolidated)	Count	20,944	1.25	0.53	1	1	2
FV (Original)	TRY	20,944	15,281	11,172	4,546	12,298	29,081
FV (Remaining)	TRY	20,944	10,403	8,980	2,480	7,728	21,639
R	APR, %	20,944	16.3	1.1	14.8	16.4	17.4
T (Original)	Months	20,944	36.8	7.7	24	36	48
T (Remaining)	Months	20,944	23.9	11.9	10	21	43
Payment	TRY	20,944	531	375	176	434	959
Pay	% of FV	20,944	6.4	3.4	3.0	5.6	11.2
New loan							
FV_0	TRY	20,944	10,403	8,980	2,480	7,728	21,640
R'	APR, %	20,944	13.0	2.6	9.6	13.2	16.5
T'	Months	20,944	41.3	14.9	18	48	61
Forbearance (Take-up)	%	7,308	32.8	46.9	0	0	100
Payment	TRY	20,944	306	255	77	238	617
Pay	% of FV	20,944	3.3	1.6	1.5	3.0	5.6
Balance sheet							
30+		20,944	0.89	0.31	0	1	1
90+		20,944	0.30	0.46	0	0	1
Assets (Checking)	TRY	18,715	-1,022	1,778	-2,400	-792	0
Limit (Credit Line)	TRY	18,112	5,163	8,169	650	2,750	10,800
Debt (Credit Line)	TRY	18,112	4,173	8,252	0	1,653	9,890

3 Experimental Design

For the field experiment, I collaborate with a large European retail bank in Turkey.[4] The experiment provides randomized debt relief in a 2-by-2-by-2 design for borrowers representative of the delinquent pool. The controlled trial is conducted to understand borrower behavior in response to relief not previously offered, namely, forbearance and rate reductions. Holding constant the face value of the amount owed, the experiment refinances the old delinquent loan with a new loan. The design automatically reduces the interest rate for every participant, which every participant strictly prefers, but deliberately varies the magnitude of the reduction by experimental assignment. The design also reduces payments through term extensions and forbearance to combine random encouragement with borrower choice, as these decisions depend on borrower preferences. Here, I briefly describe

[4]The financial institution has a customer base that is representative of the local banked population. In addition to unsecured loans, it offers many financial products, including credit lines, checking, savings, overdraft accounts, and mortgages.

the core features of the experiment.

3.1 Selection Participants are preexisting borrowers who hold an unsecured loan in arrears. These borrowers have recently been overdue on payments and have been nudged by the bank via text messages and phone calls. However, the bank does not require borrowers to be 90+ to qualify. In the month of refinancing, 90% are in 30+, and 30% are in 90+ status. These participants have not been previously modified. The sample is representative of the financial institution's delinquent pool refinanced between June 2017 and July 2018. The only exception is that borrowers holding loans with less than six months remaining are excluded. Hence, the participants represent a population of interest in understanding the efficacy of various forms of debt relief.

Table 2 displays summary statistics. The unit of measurement for the nominal variables is the local currency TRY. The average borrower age is 38; the average interest rate is 16.3% APR; the average FV refinanced is about 10,000 TRY. 20% of the participants consolidate multiple loans, with 5% consolidating three. The average monthly payment is about 500 TRY. 89% of the participants have access to a checking account. Almost all participants borrow into overdraft on these checking accounts and hold negative net liquid assets—with a median checking balance of -792 TRY. 86% have access to a credit line facility. The regulatory authority caps the interest rate on credit lines or checking-linked overdraft accounts at 24% APR. This state-mandated maximum is binding for virtually all customers. In the month before the refinancing, 89% of the participants are in 30+ status, and 30% are in 90+ status.

3.2 Randomization Participants are assigned to 8 treatment legs in a 2-by-2-by-2 design. First, participants are stratified into nonoverlapping and exhaustive bins by outstanding face value and the number of days the contract is late. Second, three random numbers—to determine the interest rate (R), the term (T), and forbearance (F)—are drawn for each participant. Third, if the random number is above a specific threshold, a participant is assigned a *high* relief designation for a particular contract feature. I denote this assignment $\mathbb{Z}_i^k = 1$. The threshold equals 0.5 for rate and term and 0.65 for relief. Hence, half of the participants are allocated to high vs. low legs for interest rate and term, and about one-third are offered forbearance.

3.3 Covariate Balance This procedure gives three randomized variables for econometric evaluation, $\mathbb{Z}_i^R$, $\mathbb{Z}_i^T$, and $\mathbb{Z}_i^F$. I provide formal statistical tests for covariate balance across treatment legs using simple regressions of the form:

$$Y_i = \alpha + \theta^R \mathbb{Z}_i^R + \theta^T \mathbb{Z}_i^T + \theta^F \mathbb{Z}_i^F + \epsilon_i \tag{3}$$

Table 3 reports the results of regressions of old contract terms and customer demographic variables on the three instruments $\mathbb{Z}_i^R$, $\mathbb{Z}_i^T$, and $\mathbb{Z}_i^F$, as well as a constant term, and asks whether economically meaningful or statistically significant pre-experiment differences exist across customers in different treatment legs. The F-tests check whether covariates display statistically significant differences across the legs and do not find a statistically significant difference.

Similarly, Figure 3 displays visual evidence on dynamic pre-trends. Participants, on average, appear to exhaust checking assets before refinancing, with no statistically signif-

icant differences across different treatment legs. Appendix Figure A.3 displays the kernel densities for FV and Pay. These tables and figures show that the final assignment to high/low treatments is orthogonal to pre-experiment characteristics and the likely determinants of the default decision. Different treatment legs have statistically indistinguishable pre-experiment covariates.

Table 3: Covariate Balance

		Age Years	Loans Consol. Count	FV Org. TRY	FV_0 Rem. TRY	R Org. APR, %	T Org. Months	Payment Org. TRY	Pay Org. Nm	30+ %	90+ %
	$\mathbb{Z}^R$	- 0.22 (0.13)	- 0.0002 (0.007)	- 22 (155)	34 (124)	0.003 (0.02)	0.08 (0.11)	- 1.2 (5.2)	- 0.08 (0.05)	-0.82 (0.43)	-0.31 (0.64)
	$\mathbb{Z}^T$	- 0.07 (0.13)	- 0.01 (0.007)	-3 (154)	105 (124)	0.01 (0.02)	-0.11 (0.11)	0.4 (5.2)	- 0.05 (0.05)	-0.10 (0.43)	0.67 (0.64)
	$\mathbb{Z}^F$	- 0.02 (0.14)	- 0.009 (0.008)	172 (162)	170 (130)	- 0.02 (0.02)	0.06 (0.11)	5.5 (5.4)	- 0.02 (0.05)	0.45 (0.45)	-0.03 (0.67)
Constant		38.1 (0.13)	1.26 (0.007)	15,234 (147)	10,274 (118)	16.3 (0.02)	36.8 (0.10)	530 (4.9)	6.5 (0.05)	89.6 (0.41)	30.3 (0.60)
	N	20,944	20,944	20,944	20,944	20,944	20,944	20,944	20,944	20,944	20,944
F	p	0.40	0.33	0.77	0.48	0.60	0.58	0.78	0.28	0.19	0.72
K-S	$\mathbb{Z}^R$	0.41	1	0.59	0.46	0.92	0.91	0.74	0.18	0.88	1
	$\mathbb{Z}^T$	1	0.98	0.27	0.56	0.65	0.33	0.67	0.22	1	0.97
	$\mathbb{Z}^F$	0.77	1	0.20	0.11	0.94	1	0.12	0.41	1	1

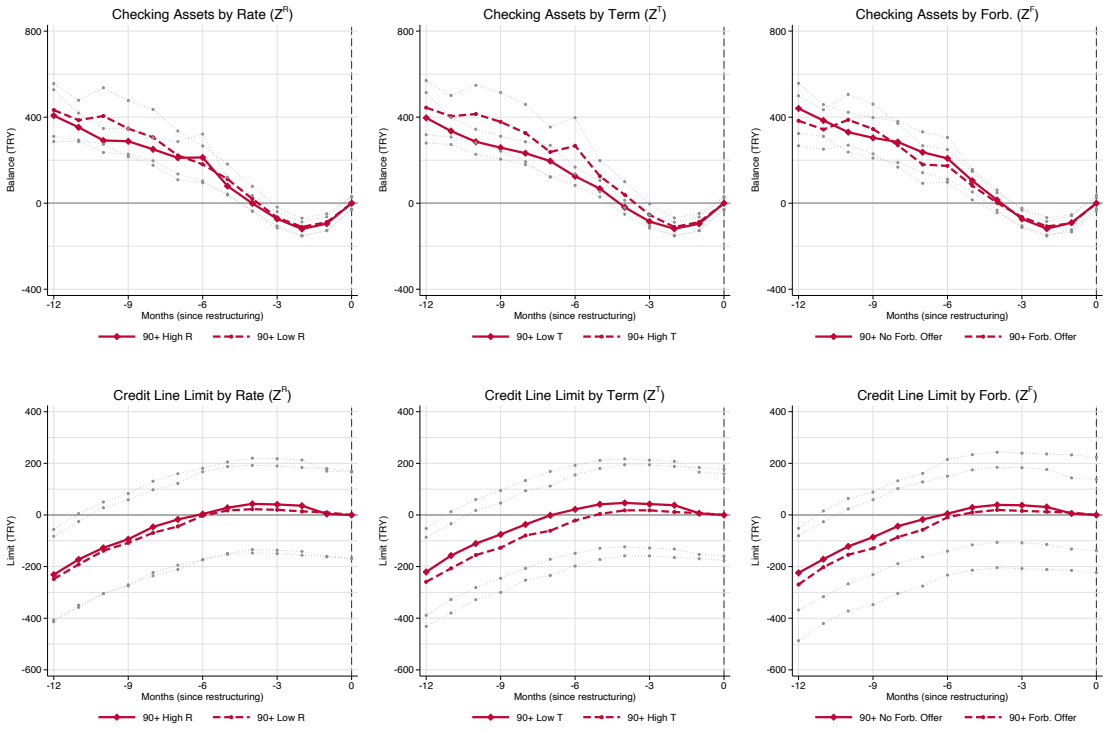
Note. Estimated coefficients from Equation 3, based on pre-experiment values. F-test p-value for the null that coefficient estimates θ^k are jointly equal to zero. Kolmogorov-Smirnov p-values for the equality of distributions by $\mathbb{Z}^R$, $\mathbb{Z}^T$ and $\mathbb{Z}^F$.

3.4 Assignment of Interest Rates, Term, and Forbearance The three randomized dummy variables $\mathbb{Z}_i^R$, $\mathbb{Z}_i^T$, and $\mathbb{Z}_i^F$ determine the borrower's refinanced interest rate R', term offer T^{offer}, and forbearance offer.

Interest rates. The new contract features an interest rate reduction to $R' < R$. This reduction is off a market rate that reflects conditions at the time of refinancing. In the study's timeframe, the market rate is, for the most part, lower than the old contract rate. Based on this market rate, participants with $\mathbb{Z}_i^R = 0$ are assigned to 60bps and borrowers with $\mathbb{Z}_i^R = 1$ to 540bps APR rate reduction. If the assigned interest rate is below a minimum $\underline{R}$, roughly equal to the inflation rate, I set $R' = \underline{R}$. Hence, the rate reduction, up to 480 bps APR, is quantitatively large and a discernible change. The magnitude of the interest rate reduction conditional on the experimental assignment is not randomized, as, naturally, borrowers with high preexisting interest rates receive higher rate reductions. The analysis restricts the amount of variation used to only what is random: the assignment $\mathbb{Z}_i^R$.

Term. The new contract features a term extension *offer*, $T^{\text{offer}} > T$. As explained later, this offer need not be the final term of the new contract, T', but is a recommendation—an *encouragement*—made by the bank representative as the final term is bilaterally negotiated during the refinancing call. Hence, compliance with the recommended term is imperfect. Customers are grouped into grids of width 12 with respect to the remaining term T in

Figure 3: Covariate Balance: Dynamic Pre-trends



Note. Figures plot group averages separately by $\mathbb{Z}^R$, $\mathbb{Z}^T$, and $\mathbb{Z}^F$. The x-axis indicates event time—months relative to refinancing—and t=0 corresponds to the month of refinancing. Dashed lines indicate the 95% confidence intervals for the estimate of the mean.

months. Borrowers with less than 12 months remaining would be placed in the 12-month bin, borrowers with 13 to 24 months remaining would be placed in the 24-month bin, and so on. Name these bins with the largest element in each bin $\bar{T}_k$. The term extension offer T^{offer} is $\bar{T}_k$ times 150% to participants with $\mathbb{Z}_i^T$=0, and $\bar{T}_k$ times 200% to participants with $\mathbb{Z}_i^T$=1. Participants, on average, are encouraged to take up a term shorter than what pre-experiment cohorts choose.

Forbearance. Borrowers with $\mathbb{Z}_i^F$=1 qualify for and are *offered* forbearance. The current design features a purely transitory forbearance, suspending and postponing the payment of the principal for three months, keeping the term constant, and backloading the costs of the program. In contrast to *deferment*, forbearance is not free, and the borrower is responsible for the interest accrues. For participants who take up forbearance, payments in the first quarter equal the interest on the principal $FV \cdot R'$, and amortizing payments start four months after refinancing.

Refinancing call. In a *typical* refinancing call, the financial institution contacts delinquent borrowers through an in-house call center to work out a plan for the customer to continue making debt repayments. During the call, representatives follow a standard script. The borrower is asked about the nature of the financial distress but does not have to provide proof of hardship. The call center employee sees customer demographic information (e.g., age, location) and information on the delinquent loan (e.g., outstanding balance, remaining term, current monthly payments). The loan officer sees the interest rate of R' and a term

choice screen. The one-size-fits-all interest rate schedule is *not* negotiable and cannot be changed. The term choice screen features a drop-down box that lists all potential terms, ranging from 1 to $\bar{T}$. The borrower is asked how much she can afford to pay each month. T' is the lever of adjustment, and the borrower can choose any term up to $\bar{T}$. The loan officer then reviews the new contract and conditions. Notably, both the monthly payments and the total sum of payments are read aloud to the borrower. The contract is forwarded for processing if the customer accepts the new terms.

The experimental refinancing process is identical to the typical one, except for previously unavailable individually tailored interest rates, term recommendations, and the novel forbearance schedule. The individualized interest rate R' is not negotiable and cannot be changed. Under the new screen designed for the experiment, the default entry in the dropdown box is T^{offer}, with a text tag *recommended* next to it. The loan officer *encourages* the borrower toward this number while the new contract term T' is bilaterally negotiated. Borrowers can pick any term, including those shorter or longer than the offer T^{offer} or the remaining term on the delinquent contract.

The forbearance offer pops up for customers with $\mathbb{Z}^F = 1$ after the interest rate R' is observed and contract term T' is chosen, but before the new contract is finalized. If the customer is not offered forbearance—i.e., $\mathbb{Z}_i^F = 0$—then FV, R', and the negotiated contract term T' determine periodic payments by the annuity formula. If the customer is offered forbearance—i.e., $\mathbb{Z}_i^F = 1$—the loan officer sees a pop-up screen after the borrower and the bank representative agree on the contract term, but immediately before they finalize the refinancing. The customer then has the option to either accept or reject the forbearance. If the customer rejects the forbearance offer, the payment schedule is determined by the annuity formula for $\mathbb{Z}_i^F = 0$. If the customer accepts the forbearance offer, payments in the first three months equal the interest on the principal FV R only, and payments starting month t=4 are determined by the annuity formula, given FV, $T' - 3$ and R'.

Information, anticipation, effects on other margins. Before the controlled trial, the financial institution regularly offered loan modifications to delinquent borrowers. However, these modifications consisted of term extensions only and did not include interest rate reductions or forbearance. Therefore, customers may anticipate the refinancing and the term extension and arrive at the refinancing call with a particular term in mind. Nevertheless, the interest rate and forbearance variation—the main levers that create variation in current and future payments—can be considered unanticipated. For the aspects of the experiment that could be anticipated, randomization ensures that treatment and control groups have similar expectations, at least until the refinancing. Importantly, there is no explicit participation choice and no lack of blinding, ensuring the participants are unaware that they are participating in a controlled trial.

The experiment is also designed to control confounding factors and potential effects on other margins. Refinancing a loan does not trigger a flag on the credit bureau. Penalties for defaulting are not heterogeneous across different treatments. Features of other credit contracts, such as the limits and borrowing rates on credit cards and overdrafts, remain unchanged. The intervention also ensures that face value, monthly payments, and total stream of payments assuming no discounting, are communicated to the participants in a salient manner, both verbally and in writing, to overcome the difficulty whereby borrowers may find it challenging to discount future cash flows and calculate a present value. Moreover, contract features are not conditional on borrower behavior, such as the borrower's success in making some payments, abstracting away from strategic behavior in this regard.

Why a design that unambiguously benefits the borrower? Due to ethical and regulatory considerations, the current experiment is designed to benefit participants compared to the status quo. Rate reductions entail a reduction in both current and future payments, unambiguously benefiting the borrower. Hence, the experiment pushes rate reductions for everyone, randomly varying the magnitude of rate reduction by experimental assignment. In contrast, the benefits of term extensions and forbearance depend on borrower preferences. An important design feature is that participants are not forced into forbearance or a particular term. Instead, the design combines random encouragement with borrower choice. There were also practical reasons for this—the financial institution put this forward as a design constraint, as both the operational and the legal reviews commented that dictating a particular term would draw ire from the regulators. This approach of not forcing forbearance or term upon the borrower has two additional benefits. First, better targeting—forbearance or term is taken up by those who need it the most. Second, better external validity—borrowers are free to choose the term in the wild, so the experiment does not create an artificial margin. I leave experimental designs that force borrowers into contracts they may not prefer against their will as future work.

3.5 Data The following analysis uses data on the loan contracts before and after the refinancing, including contract terms (e.g., rate, term, face value, payments) and borrower behavior, such as the date the new loan reached 30+ or 90+ days late status. The former captures arrears, and the latter captures defaults. The data also contain information on borrower balance sheets at the bank—credit card limits, checking assets-overdraft debt, and indicators for whether the borrower is delinquent on any other accounts at the financial institution. Unfortunately, there is no information on borrower incomes. Delinquency and balances are measured on the last day of the calendar month.

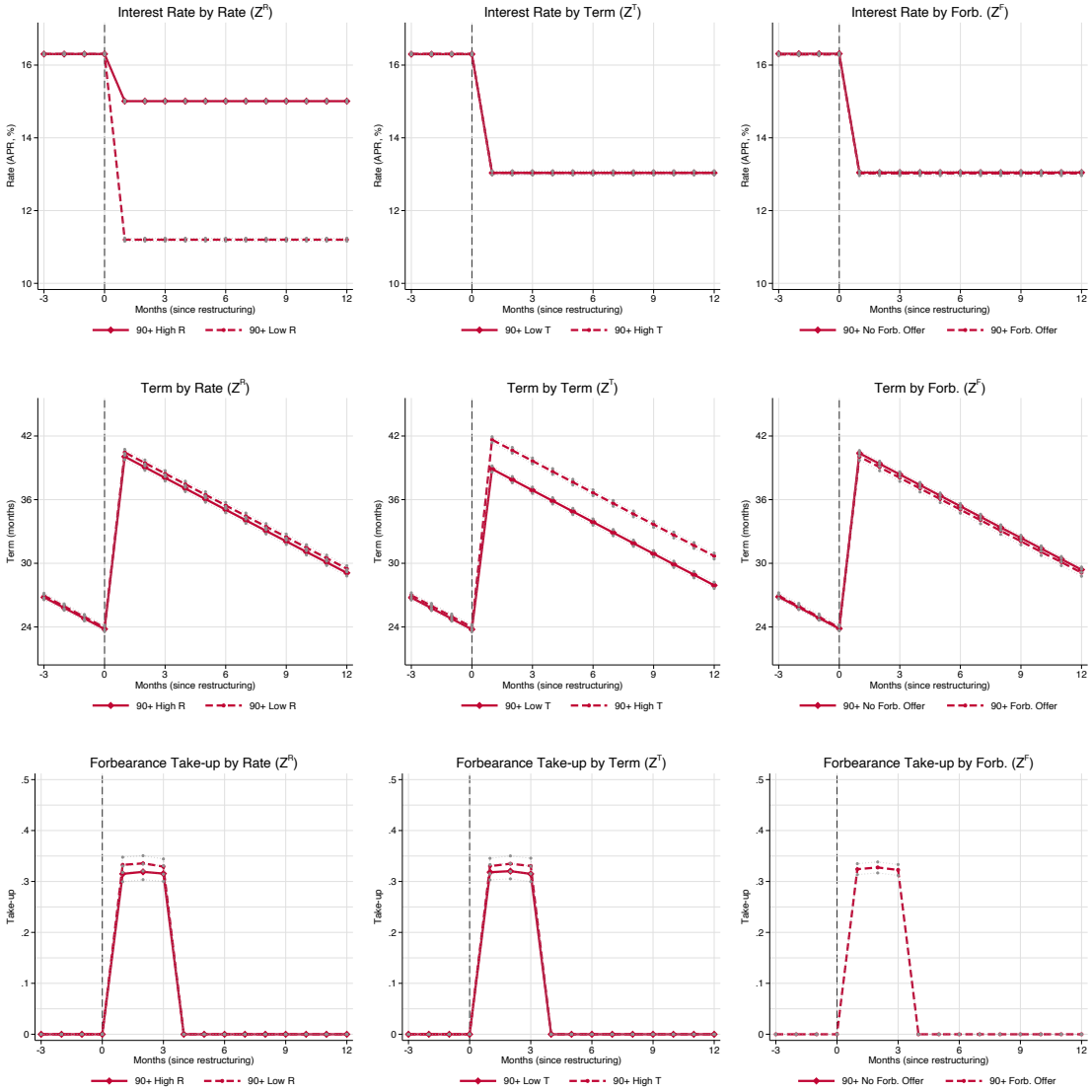
The analysis is based on the 15-month timeframe consequent to refinancing. Hence, the participants are followed up for 12 months after the expiration of the forbearance. The data are monthly, and the unit of analysis is an individual. For participants who had consolidated multiple loans, accounts are matched, variables aggregated using a unique citizenship number, then verified using a customer identification number to ensure perfect match quality.

3.6 First Stage Figure 4 and Panel A in Table 4 reports the first-stage effect of the three instruments $\mathbb{Z}_i^k$ for econometric evaluation on the new contract interest rate R', term T', and the take-up of the forbearance offer, using Equation 3. Figure 4 displays the event study for these first stages. Also reported in the Table is the F-test p-value, which tests the null hypothesis that all coefficients on instruments are jointly equal to zero.

The average interest rate for the old contract is 16.3% APR. This rate is reduced to an average of 15.0% APR for the low-rate-reduction group $\mathbb{Z}_i^R = 0$ and 11.2% APR for the high-rate-reduction group $\mathbb{Z}_i^R = 1$. The average difference in rate reduction between the low and high rate treatment is 381 bps APR. As the interest rate is bounded below a minimum $\underline{R}$ set by the financial institution, the difference between treatment and control is lower than the intended 480 bps APR. The F-statistic for this first stage is 7,551.

The average remaining term at the time of refinancing is 24 months. Almost all participants (99.4%) extend the term. 62.5% of participants chose the offered term, with the remaining choosing a term below or above the recommendation (19.1% vs. 18.4%). For the participants in the high-term group, $\mathbb{Z}_i^T = 1$ vs. low-term group $\mathbb{Z}_i^T = 0$ group averages

Figure 4: First Stage: Contract Terms



Note. Figures plot group averages separately by $\mathbb{Z}^R$, $\mathbb{Z}^T$, and $\mathbb{Z}^F$. The x-axis indicates event time—months relative to refinancing—and t=0 corresponds to the month of refinancing. Dashed lines indicate the 95% confidence intervals for the estimate of the mean.

are 40 and 43 months, respectively. The median term T' for the high- and low-term groups is 36 vs. 48 months. The F-statistic for this first stage is 63. There is little evidence that participants in the high-interest rate group opt to shorten the debt term.

Forbearance take-up. 35% of participants (7,308) are randomized to receive a forbearance offer. Note that forbearance is not free as interest payments continue and total payments increase. Moreover, take-up benefits depend tightly on preference parameters (i.e., impatience) and situational factors (i.e., nature of income shocks faced), both of which are unobservable. Hence, naturally, not everyone takes it. Table A.1 discusses the decision to take up in detail.

One-third of those offered forbearance take up this offer. The F-statistic for this first

stage is 2,216. Similar to term extension offers, there is little evidence that differences in interest rates compound forbearance take-up, with participants in the high-rate-reduction group $\mathbb{Z}_i^R = 1$ only 1.39% more likely to accept (p=0.19). Similarly, participants in the high-term offer group $\mathbb{Z}_i^T = 1$ are 1.08% more likely to accept forbearance (p=0.31).[5] Take-up of the forbearance offer is tightly linked to the remaining term of the old contract. For example, borrowers with an additional 12 months remaining on their existing contract are about 7% more likely to take up the forbearance offer. Intuitively, the old term is an immediate determinant of the elasticity of payments at the new term due to the $\frac{1}{T}$ effect T has on Pay. Take-up of the forbearance offer is also negatively associated with FV, with a 1% increase in FV decreasing take-up by about two percentage points.

Table 4: First Stage: Contract Terms

	R' APR, %	T' Months	F' Take-up, %	F' ($\mathbb{Z}^F$=1) Take-up, %
$\mathbb{Z}^R$	- 3.81	0.43	0.59	1.66
	(0.03)	(0.21)	(0.38)	(1.10)
$\mathbb{Z}^T$	- 0.03	2.77	0.51	1.45
	(0.03)	(0.20)	(0.38)	(1.10)
$\mathbb{Z}^F$	- 0.02	- 0.32	32.8	
	(0.03)	(0.22)	(0.40)	
Constant	15.0	39.8	-0.56	31.2
	(0.02)	(0.19)	(0.36)	(0.96)
N	20,944	20,944	20,944	7,308
F	7,551	63	2,216	2

Note. Table reports the first-stage effect on new contract rate (APR, %), term, and forbearance take-up. Also reported is the F-test p-value, which tests the null hypothesis that the coefficient estimates θ^k are jointly equal to zero.

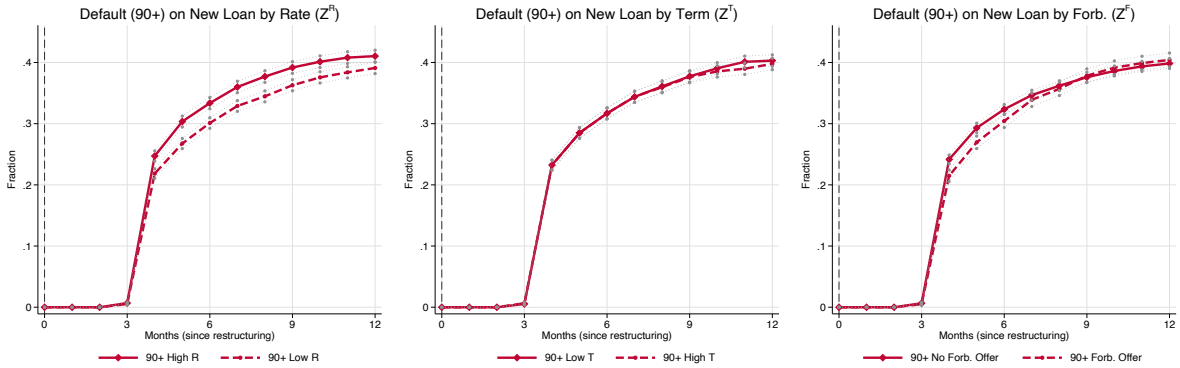
4 Results

4.1 Tests of Solvency I begin the empirical analysis by studying the effect of experimental assignments on the qualitative dynamics of defaults using event studies. I use the event studies to document that in contrast to models in which solvency is the sole driver of borrower decisions (i.e., default if the face value is too high), modifications orthogonal to the face value and other observable and unobservable determinants of the default decision (e.g., income, wealth, risk, costs of default) have discernible and distinct effects on the borrower's decision on whether and when to default. I first focus on defaults (i.e., 90 days past due) at the account level. Later, I focus on other outcome variables, such as late payments (i.e., 30 days past due) and the balance sheet.

Figure 5 plots the average cumulative delinquency frequencies separately by rate, term, and forbearance. In these event studies, t=0 is the month of refinancing for each participant, and the x-axis indicates the months elapsed since refinancing. The y-axis displays the cu-

[5] In a linear probability model in which the new contract interest rate R' and term T' are used as the explanatory variables, and $\mathbb{Z}_i^R$ and $\mathbb{Z}_i^T$ are used as instruments, a one pp APR change in the interest rate leads to a 0.32 percentage point drop. A 1-month change in the new contract term T' leads to a 0.34 percentage point increase in the likelihood of accepting the forbearance offer. However, neither of these effects is statistically significant.

Figure 5: Tests of Solvency—Event Study: Defaults



Note. Figures plot group averages of 90+ status separately by $\mathbb{Z}^R$, $\mathbb{Z}^T$, and $\mathbb{Z}^F$. The x-axis indicates event time—months relative to refinancing—and t=0 corresponds to the month of refinancing. Dashed lines indicate the 95% confidence intervals for the estimate of the mean.

mulative fraction in each treatment leg that reaches 90+ status. Dashed lines indicate 95% confidence intervals for the estimate of the mean. Panels on the left display delinquency status by $\mathbb{Z}_i^R$, the high-rate-reduction group vs. the low-rate-reduction group. Panels on the right display delinquency status by $\mathbb{Z}_i^F$, the group that received the forbearance offer vs. the group that did not.

Participants who refinance the contract at t=0 are expected to make the first payment in month t=1. If the first payment due month t=1 is missed, Figure 5 will show 90+ status by month t=4. 47% of the participants miss (0+), and 30% are late (30+) on the first payment. 23% stop making payments right after refinancing and default (90+) at the first possible instance (t=4). The average default frequency after six months is 32%. After t=6, a gradual increase in delinquencies occurs, and the long-run default frequency converges to 40% after 12 months, with no statistically significant changes in the last month.

Focusing on the left event study, the probability of falling into delinquent status shifts discernibly lower for participants in the high-rate-reduction leg than in the counterfactual low-rate-reduction leg. This difference is the causal effect of a rate reduction only. These figures corroborate the previously documented findings that changes in the interest rate alone can reduce the default hazard without changing the face value.[6] Importantly, the effect of interest rate reductions occur immediately and persists throughout the experimental timeframe and leads to a decrease in long-run default probabilities.

An important policy question is whether temporary forbearance policies are effective compared with the counterfactual in which they are not offered and whether the effects extend beyond expiration. The event study on the right plots the fraction delinquent by those who receive a forbearance offer vs. those who do not. The temporary forbearance modification provides an immediate payment reduction by construction large and targeted, reducing payments to interest on principal only for the 3-month forbearance period for borrowers who accept. The figures show that forbearance also leads to a discernible reduction in short-run delinquencies, with an effect on 90+ status visible in period t=6, 90 days after expiration. However, forbearance appears to only shift the timing of the default decision, with no long-run effects. After forbearance expires, defaults increase and catch

[6] See Fuster and Willen (2017) and Di Maggio et al. (2017).

up with the group that did not receive a relief offer.

To quantify and perform statistical tests on the difference in conditional means for the different groups displayed in the event studies, I run simple intent-to-treat (ITT) linear probability regressions of the form:

$$Y_i = \theta^R \mathbb{Z}_i^R + \theta^T \mathbb{Z}_i^T + \theta^F \mathbb{Z}_i^F + f_t + \varepsilon_i \tag{4}$$

where i stands for an individual, f_t stands for calendar month fixed effects, and Y_i is the delinquency indicator. The error ε_i accounts for delinquencies due to other factors, such as shocks to income, wealth, risk, and other default costs. The explanatory variables are three binary instruments $\mathbb{Z}_i^k$ that indicate assignment to different treatment legs.

These intent-to-treat estimates compare the delinquency rates between the treatment group and the control group at various points in time using ordinary least squares (OLS) and focusing on purely exogenous differences. Sampling and randomization ensure orthogonality between $\mathbb{Z}_i^k$ and all other variables, particularly potential omitted variables and the residual ε_i. The objects of interest are then θ^k, the intent-to-treat effect of the assignment to a high-relief leg concerning a particular contract feature on delinquencies at a given time.

Table 5: Effect on Delinquencies: Intent-to-treat

$Y_i = \sum^{k \in R,T,F} \theta^k \mathbb{Z}_i^k + f_t + \varepsilon_i$						
	Short-run			Long-run		
	$4m$	$5m$	$6m$	$9m$	$12m$	$15m$
Base	23%	28%	32%	38%	40%	40%
$\mathbb{Z}^R$	- 2.78	- 3.51	-3.15	-2.79	-1.85	-2.13
	(0.58)	(0.62)	(0.64)	(0.66)	(0.67)	(0.67)
$\mathbb{Z}^T$	- 0.02	0.01	-0.02	-0.13	-0.54	-0.82
	(0.58)	(0.62)	(0.64)	(0.66)	(0.67)	(0.67)
$\mathbb{Z}^F$	-2.69	-2.37	-1.96	0.24	0.56	-0.35
	(0.61)	(0.65)	(0.67)	(0.70)	(0.71)	(0.70)
$\mathbb{P}(\theta^R = 0)$	<0.001	<0.001	<0.001	<0.001	0.006	0.002
$\mathbb{P}(\theta^T = 0)$	0.98	0.99	0.98	0.85	0.42	0.22
$\mathbb{P}(\theta^F = 0)$	<0.001	<0.001	0.004	0.73	0.43	0.62

Note. Short-run stands for the first six months, that is, within the 90-day period of forbearance expiration. Panel B is estimated using $\mathbb{Z}_i^R$ and $\mathbb{Z}_i^T$ as instruments. The left-hand-side variable is a 90+ indicator at t, multiplied by 100.

The results are displayed in Table 5, Panel A. As before, $\mathbb{Z}_i^R$, $\mathbb{Z}_i^T$, and $\mathbb{Z}_i^F$ stand for a high-rate-reduction dummy, a high-term-encouragement dummy, and a forbearance offer dummy. The first three columns focus on the short-run, within the 90 days of forbearance expiration, and accordingly use 90+ status after 4, 5, and 6 months as the left-hand-side variable. The last three columns focus on the long run and use 90+ status after 9, 12, and 15 months as the left-hand-side variable.

The group receiving higher rate reductions see their probability of defaulting by month t=6 reduced by 3.15 (0.6) percentage points off a base of 32%, or by 10% relative to the

mean delinquency rate. For the duration of the experiment, the cumulative response of the high-rate-reduction group does not exhibit a catch-up with the low-rate-reduction group—longer-run results indicate that the effect of rate reductions is detected after 15 months, and the response is highly statistically significant (p=0.002).

Offering forbearance for the first quarter reduces the likelihood of default by month t=4 by 2.69 (0.6) percentage points and the likelihood of default by month t=6 by 1.96 (0.7) percentage points (p <0.001 and p=0.004). Estimating the effect of forbearance take-up on the compliers as the ratio of the estimated intent-to-treat effect of forbearance offer and the estimated proportion of compliers yields $\frac{2.69}{.328} = 8.2$ and $\frac{1.96}{.328} = 6.0$. Therefore, taking the forbearance offer decreases delinquencies relative to the mean delinquency rate by 35% by month t=4 (90 days after the first month of forbearance) and by 19% by month t=6 (90 days after the last month of forbearance). However, 90+ status starts picking up in the last month of the forbearance. The delinquency rate rises sharply after the expiration of the forbearance period when payments resume (and rise). There are no statistically significant differences in defaults in the consequent months for participants who were offered forbearance (p=0.73, 0.43, and 0.62 after 9, 12, and 15 months).

The second row displays the difference in defaults for the treatment leg that receives a high-term offer that encourages borrowers to address their persistent liquidity constraints by spreading payments further over time and providing more drawn-out relief. The point estimates of the effects of term extensions are minimal in magnitude compared with those of rate and forbearance. In the short run, participants who receive a longer-term recommendation do not exhibit discernible or statistically significant differences in delinquencies. In the long run, the effect of term extensions becomes somewhat more pronounced, nevertheless remaining statistically insignificant (p=.22 after 15 months).

Table 6: First Stage: Current and Future Payments

	First Quarter		Second Quarter		All Quarters	
	Pay_1 Current	PV_1^{fu} Future	Pay_2 Current	PV_2^{fu} Future	Pay_t Current	PV_t^{fu} Future
$\mathbb{Z}^R$	- 0.96	- 6.28	- 0.85	- 5.74		
	(0.07)	(0.08)	(0.06)	(0.12)		
$\mathbb{Z}^T$	- 0.88	0.49	- 1.01	1.59		
	(0.07)	(0.08)	(0.06)	(0.12)		
$\mathbb{Z}^F$	- 1.92	1.66	0.29	1.63		
	(0.07)	(0.09)	(0.06)	(0.13)		
α	11.6	92.9	11.8	85.2		
	(0.06)	(0.08)	(0.06)	(0.12)		
N	20,944	20,944	20,944	20,944	83,412	83,412
F	401	2,128	160	816		

Note. Table reports the first-stage effects on current payments, the present value of future payments, and total future payments, all normalized by face value at the time of refinancing. Also reported is the F-test p-value, which tests the null hypothesis that the coefficient estimates θ^k are jointly equal to zero.

4.2 Tests of Liquidity If liquidity drives borrower decisions, borrowers default only because current payments are too high. In contrast to previous *either-or* research designs, the novel current research design varies current payments for similar participants in three

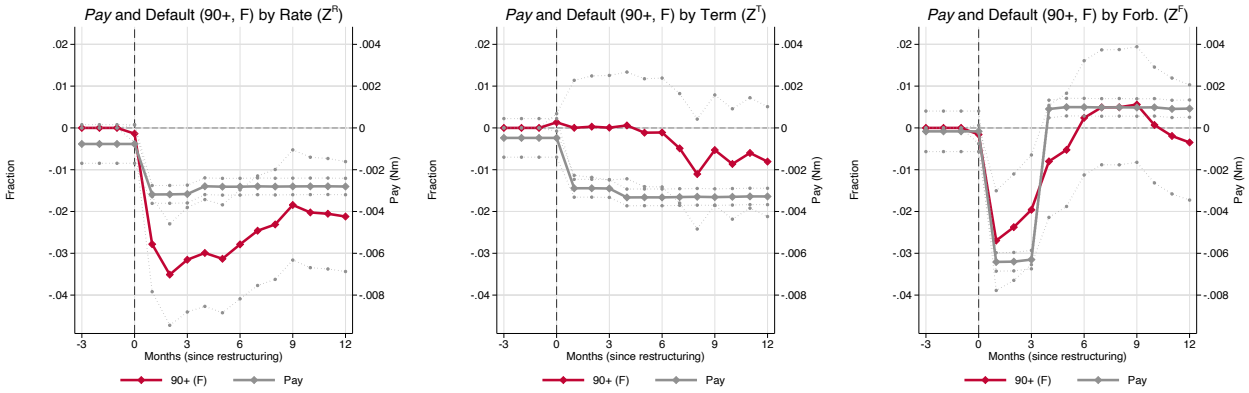
different ways. This feature allows for a direct test of the association between current payments and delinquencies as predicted by theories emphasizing liquidity.

To better understand the relationship between liquidity and the default decision, I first report, in Table 6, the first-stage effect of experimental assignment on current payments separately by rate, term, and forbearance legs.

All modifications reduce current payments. The first column focuses on the short run, the first quarter before the expiration of the forbearance. Rate reductions, reported in the first row, entail a similar effect on payments compared with the effect of term extension encouragements, displayed in the middle, and a much smaller effect on payments compared with forbearance offers, displayed at the bottom—equivalent to 0.96%, 0.88%, and 1.92% of FV_0 per quarter, respectively. The reduction in payments entailed by forbearance equivalent to 1.92% of FV is due to a reduction in the quarterly payments from about 10% of FV to interest on the principal of 4% of FV for the one in three who take up.

To visually capture the contemporaneous relationship between payments and the decision to default, Figure 6 superimposes the first-stage differences reported in Table 4 on the intent-to-treat estimates from Equation 4 of Pay and the 3-month-forward value of 90+ status, reported in Table 5. The first-stage estimates quantify the exogenous differences in payment flow between the treatment and control groups using OLS. Similarly, the intent-to-treat estimates quantify the dynamic evolution of the differences in the decision to default between the treatment and control group using OLS.

Figure 6: Tests of Liquidity—Payments (First-stage) vs. Defaults (Intent-to-treat)



Note. Figures plot the coefficients θ^k from the linear probability intent-to-treat specification Equation 4 using data on N=20,944 participants, where the left-hand-side variables are the three-month forward of 90+ status, and Pay. The x-axis represents months relative to refinancing, and t=0 corresponds to the month of refinancing for each participant. Dashed lines indicate the 95% confidence intervals for the estimate of the mean.

Qualitatively, Figure 6 visually corroborates the key dynamics from the event studies displayed in Figure 5. Focusing on the right, the effects of forbearance do not extend beyond the expiration as delinquencies increase when payments increase, as forbearance only shifts the timing of the default decision. In contrast, the effect of interest rate reductions persists in the long run.

More importantly, quantitatively, Figure 6 shows that the average reduction in payments entailed by a modification has a weak association with the decision to default, in contrast to liquidity being the sole driver of borrower decisions. Strikingly, although for-

bearance targets those who need liquidity the most and reduces payments, on average, by twice as much, delinquencies are noticeably more responsive to interest rate reductions.

To quantify the association between payments and defaults, I study a specification of the form:

$$Y_i = \phi \text{Pay}_i + f_t + \varepsilon_i \tag{5}$$

where Pay is the payment (flow) in the *current* quarter, normalized by face value. f_t stands for calendar month fixed effects. The error ε_i accounts for delinquencies due to other factors, such as income shocks. Regarding timing, the borrower observes the current quarter Pay and then decides whether to stop making payments or not. Once she stops making payments in any given quarter, 90+ status is reached three months later. This specification uses data on only the cross-section in the first quarter for the $N = 20{,}944$ participants.

The coefficient ϕ gives the instrumental variables 2SLS estimate of the local average treatment effect (LATE) of an increase in current payments (equivalent to 1% of face value) on the probability of default in percentage points, for participants who see changes in payments induced by $\mathbb{Z}_i^k$.

The 2SLS estimator identifies the LATE for compliers induced by the instrument through experimental assignment to see a change in the value of the endogenous regressors. When a different subset of instruments is used for identification, the compliers, exclusion restrictions, and treatment effects change.

The design automatically lowers the interest rate, and compliance is perfect. Hence, the instrument $\mathbb{Z}_i^R$ yields an average treatment effect (ATE). In contrast, compliance with respect to the instruments $\mathbb{Z}_i^T$ and $\mathbb{Z}_i^F$ is imperfect because the design only *offers* forbearance and only *encourages* borrowers to postpone payments. Using $\mathbb{Z}_i^F$ as the instrument yields a treatment effect that is the local average for participants who take up the forbearance. Since participants with $\mathbb{Z}_i^F = 0$ do not receive forbearance offers, with respect to this instrument, there are only never-takers and compliers; hence monotonicity is automatically satisfied. Similarly, with respect to $\mathbb{Z}_i^T$, the compliers are borrowers who are convinced to reduce their term.

The first column in Table 7 uses all three instruments. The second column restricts variation to $\mathbb{Z}_i^R$ akin to studies that use naturally occurring revaluation shocks (e.g., adjustable mortgage rate resets, currency devaluation) to estimate the sensitivity of defaults to periodic payments. The final column restricts variation to $\mathbb{Z}_i^T$ and $\mathbb{Z}_i^F$, respectively.

The point estimates indicate that a dollar change in payments has drastically different effects if entailed through forbearance, term extension, or rate reduction. When payments are reduced by 1% FV_0 through a rate reduction, the incidence of defaults by decrease 3.31 percentage points. In contrast, when payments are reduced by 1% FV_0 through forbearance, defaults only decrease by 1.03 percentage points. Hence, a forbearance program should reduce current payments by more than three times to obtain a similar impact on delinquencies as rate reductions.

4.3 Tests of Strategic Behavior Strategic defaults are due to announced but not yet realized future payments, holding constant solvency (face value) and liquidity (current payments). The current design allows a direct investigation of strategic default triggered by news about (non-callable) future payments before they act through liquidity and affordability.

Table 7: Treatment Effect on Delinquencies

Panel A: Sensitivity $Y_i = \phi \text{Pay}_i + f_t + \varepsilon_i$				*Panel B: Decomposition* $Y_i = \phi \text{Pay}_i + \psi PV_i^{fu} + f_t + \varepsilon_i$				
Pay	3.31	-0.007	1.03	Pay	1.11	1.29	1.21	3.11
Current	(0.72)	(0.74)	(0.35)	Current	(0.29)	(0.32)	(0.29)	(0.80)
				PV^{fu}	0.33	0.31	0.36	0.92
				Future	(0.10)	(0.10)	(0.10)	(0.29)
$\mathbb{Z}^R$	✓			$\mathbb{Z}^R$	✓	✓	✓	✓
$\mathbb{Z}^T$		✓		$\mathbb{Z}^T$	✓		✓	✓
$\mathbb{Z}^F$			✓	$\mathbb{Z}^F$	✓	✓	✓	✓
							Controls	Probit
				$\mathbb{P}(\phi = \psi = 0)$	<0.001	<0.001	<0.001	<0.001
$\mathbb{P}(\phi = 0)$	<0.001	0.99	0.004	$\mathbb{P}(\phi = 0)$	<0.001	<0.001	<0.001	<0.001
				$\mathbb{P}(\psi = 0)$	0.001	0.003	<0.001	0.001
				$\mathbb{P}(\phi = \psi)$	0.017	0.007	0.008	0.015
				ϕ/ψ	0.30	0.24	0.30	0.29

Note. The left-hand-side variable is the three-month forward of the 90+ indicator at $t = 3$. In the probit model, Pay and PV^{fu} are projected onto the instruments in the first stage.

The smoking gun of the strategic effects acting through news about future payments is that although rate reductions reduce payments, on average, by half as much, compared with forbearance, rate reductions lead to a more noticable reduction in delinquencies. As discussed in Section 1, the critical dimension distinguishing rate reductions and forbearance are the effects on future payments.

Interest rate reductions move current payments and the present value of future payments in the same direction, with a small effect on Pay and a much more significant effect on PV^{fu}—equivalent to 6.28% of FV. In contrast, forbearance moves Pay and PV^{fu} in different directions: It reschedules payments by backloading the decrease in Pay with an approximately one-for-one increase in PV^{fu}. Term extensions affect PV^{fu} proportional to the difference between the interest and discount rates.

In studies using naturally occurring data and variation to study the effects of rate reductions, the present value of future payments is an omitted variable. Hence, these research designs cannot distinguish and decompose the effect of future payments from current payments. Experimental variation in instruments $\mathbb{Z}_i^k$ shifts current and future payments in different directions, allowing for the identification of their relative contributions to borrower decisions.

A *naive* and nonparametric decomposition of the strategic effects can be obtained by comparing the reduction in delinquencies across the interest rate and forbearance legs in the first quarter reported in Table 5—the intent-to-treat effects of $\mathbb{Z}^F$ and $\mathbb{Z}^R$—to the changes they entail on current payments and the present value of future payments in the same period reported in Table 4—the first-stage effects of $\mathbb{Z}^F$ and $\mathbb{Z}^R$. Solving the exactly identified system of two equations and two unknowns given by,

$$-3.15 = -0.96\phi - 6.28\psi$$
$$-1.96 = -1.92\phi + 1.66\psi$$

the relative contributions of current payments and the present value of future payments to defaults yield 1.28 and 0.31. Hence, news about a dollar increase in the present value of future payments increases defaults by as much as a 24-cent increase in current payments. As the specification is exactly identified, this *bivariate* Wald estimator overlaps with the 2SLS estimator when $\mathbb{Z}^F$ and $\mathbb{Z}^R$ are used as instruments.

Using an identification strategy similar to the naive decomposition above, I decompose the effect of current payments, Pay, from the present value of future payments, PV^{fu}, using a linear probability model of the form:

$$Y_i = \phi \text{Pay}_i + \psi PV_i^{fu} + f_t + \varepsilon_i \tag{6}$$

In this specification, Pay is the payment (flow) in the *current* quarter and PV^{fu} is the present value of *future* payments coming after a quarter (stock), evaluated from the perspective of quarter and calculated using the annuity formula for a given R^*. Both of these variables are normalized by FV. The error ε_i accounts for delinquencies due to other factors, such as income shocks.

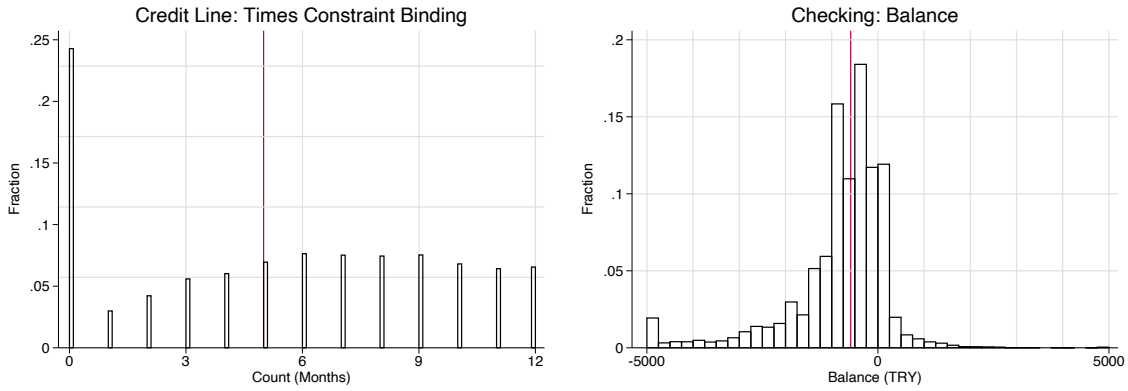
Regarding timing, the borrower observes the current quarter Pay and the PV^{fu} of the payments coming after. She then decides whether to stop making payments or not. Once she stops making payments in any given quarter, 90+ status is reached three months later. This specification uses data on only the cross-section in the first quarter for the $N = 20{,}944$ participants.

The objects of interest are the coefficients ϕ and ψ. These coefficients give the instrumental variables estimate of the local average treatment effects (LATE) for participants who see changes in current payments induced by $\mathbb{Z}_i^k$. These coefficients measure the effect of an increase in periodic Pay and PV^{fu} equivalent to 1% FV on the probability of default in percentage points.

Estimating Equation (6) by OLS would identify ϕ and ψ from the variation in the assignment to a particular treatment leg $\mathbb{Z}_i^k$, as well as the magnitude of changes in Pay and PV^{fu}. However, the variation in the magnitude of the changes, $\text{Pay}_i|\mathbb{Z}_i^k$ and $\text{PV}_i|\mathbb{Z}_i^k$—although possibly uncorrelated with the error ε_i— is not random. Therefore, ϕ and ψ are estimated using 2SLS, and the three $\mathbb{Z}_i^k$ are used as instruments. As discussed in Table 3, randomization ensures that $\mathbb{Z}_i^R$, $\mathbb{Z}_i^T$, and $\mathbb{Z}_i^F$ are orthogonal to all other variables by construction, in particular, potential omitted variables and the residual ε_i. They also generate substantial variation in current and future payments, as discussed in Table 4. The additional identifying assumption for the LATE interpretation is that there is no effect of experimental assignment on defaults, on average, that does not operate via the experimental assignment's impact on payments. This assumption is violated for the sensitivity estimates in Section 4.2 and Panel A of Table 7, which the decomposition design here can overcome.

Table 7 reports results from the simple specifications that study decisions in the first quarter of the experiment before forbearance expiration, which affects defaults in month t=6. The point estimates for ϕ indicate that an increase in Pay corresponding to 1% of the face value of debt in the first quarter increases the frequency of defaults by 1.11 percentage points. In comparison, a similar increase in the normalized PV^{fu} of the payments coming after the first quarter corresponding to 1% of the face value of debt increases the default frequency by only 0.33 percentage points. At the bottom of Table 7 I calculate an identified moment $\zeta = \frac{\psi}{\phi}$—a wedge that summarizes the relative contributions of future payments

Figure 7: Checking Assets and Available Credit



Note. The left Panel displays the histogram of the frequency with which constraints bind in the year before the experiment. The right displays the average checking balances in the year before the experiment. Vertical lines indicate the median.

in terms current payments. A dollar change in the present value of future payments has a similar effect on delinquencies as a 30-cent increase in quarterly payments. This is the relative sensitivity of borrower behavior to current payments vs. the present value of future payments I use throughout the paper.

As discussed in Section 1, the bottom rows display the results of statistical tests for the four classes of reduced-form hypotheses that make different predictions about the determinants of default.

In the classical solvency model, neither reducing payments nor changing the interest rate affects borrower behavior: $H_0 : \phi = \psi = 0$. Unsurprisingly, this hypothesis is decisively rejected, with $\mathbb{P}(\phi = \psi = 0) < 0.001$. Similarly, in models emphasizing liquidity, the default decision is driven by current payments. The hypothesis that liquidity is *not* a driver of borrower decisions, $H_0 : \phi = 0$, is also decisively rejected, with $\mathbb{P}(\phi = 0)$ <0.001.

In models emphasizing strategic behavior, the default decision is driven by news about future payments, accounting for current payments. Hence, a reduction in future payments should have no effects, corresponding to the null hypothesis $H_0 : \psi = 0$. This hypothesis is also decisively rejected, with $\mathbb{P}(\psi = 0)$=0.001. Treatment effect estimates imply that the borrowers, on average, default strategically in response to announced but not yet realized changes in future payments before they take effect through cash flow or affordability constraints.

A special and knife-edge case of the strategic model that is particularly interesting is the textbook finance model with intertemporal *fungibility*. This yields when $R \neq R^*$. In this case, the time path of payments will be irrelevant, and a dollar increase in current payments Pay_t today should have the same effect on borrower behavior as a dollar change in the PV_t^{fu}, the present value of the future stream of Pay. The bottom panel in Table 7 displays the p-value for the null hypothesis that $H_0 : \phi = \psi$. This hypothesis is also rejected, with p=0.017. Fungibility tests for a different interpretation of liquidity constraints: borrower behavior is sensitive to current and future payments, but *more* sensitive to current payments.

4.4 Tests of Endogenous Triggers The average intent-to-treat estimates in the previous section document that the reduction in current payments has an imperfect association with the decision to default. Although forbearance offers reduce immediate payments twice as much as rate reductions, delinquencies are noticeably more responsive to the interest rate reduction. Similarly, average treatment effect estimates suggest that borrowers take into account the present value effects on future payments entailed by the rate reduction before they take effect through periodic constraints and liquidity-affordability-debt service. However, the effects of future payments are less pronounced compared with the dollar-for-dollar benchmark the perfect intertemporal substitution model predicts.

A natural explanation for this finding is liquidity constraints. Potentially rational, patient, and forward-looking borrowers may not be able to honor current payments using resources that will accrue in the future, if they engage in precautionary saving in response to a constraint that may bind in the future effectively shortening the planning horizon, as in McKay et al. (2016); or if they have no liquid assets to perform intertemporal substitution, as in Kaplan et al. (2018). Delinquent borrowers are likely in this situation. In this regard, the benefits of forbearance and rate reductions, as well as the sensitivity of behavior to current and future payments, will potentially vary, and factors like the degree of delinquency and the frequency with which constraints bind are all likely to play an important role. The experimental variation is orthogonal to these characteristics and allows for a study of how different subgroups respond differently.

I investigate in detail the association between heterogeneity in intent-to-treat and treatment effects using balance sheet measures. I focus on the degree of delinquency, the number of times credit constraints strictly bind, and checking balances. For each of these variables, I perform sample splits based on pre-experiment values and place participants into three bins. I then estimate a nested variant of the intent-to-treat Equation (4) and the treatment effect Equation (6).

The results are displayed in Table 8. In each panel, the first row displays the fraction in each bin. The second row displays the base 90+ rate at $t = 6$, 90 days after the expiration of forbearance. The next two rows report the intent-to-treat effects of rate reductions and forbearance during the first quarter estimated using OLS. The next two rows display the treatment effect estimates that decompose the effect of current payments from the present value effect of future payments, estimating using 2SLS as earlier. Finally, the very bottom row reports $\zeta = \frac{\psi}{\phi}$ that summarizes the wedge—i.e., the relative contributions of Pay and PV.

Panel A reports the results based on the degree of delinquency in the month before the refinancing. Participants who were more than 90 days late (30%) are in the first bin. Participants who were less than 30 days late (11%) are in the last bin. Panel B reports the results based on the frequency with which credit limits bind (i.e., utilization rate above 75%) in the year prior to the intervention. 86% (18,112) of participants have a credit line facility. Participants without a credit line are in the first bin. Participants with a credit line are split using a cutoff equal to the median. The median number of times constraints bind in the year before the intervention is 5. Finally, Panel C reports the results based on checking balances. 90% (18,715) of participants have access to a checking account. Participants that do not have a checking account at the bank, indicated $\emptyset$, are in the first bin. Similarly, participants with a checking account are split using a cutoff equal to the median balances.

Participants are not equally affected, and the heterogeneity in the absolute and relative

Table 8: Effect on Delinquencies: Heterogeneity

	Panel A: Delinquency: Days Late			*Panel B:* Credit Line: Times Binding			*Panel C:* Checking Balances		
	(A1)	(A2)	(A3)	(B1)	(B2)	(B3)	(C1)	(C2)	(C3)
	90+	31 - 90	< 30	$\emptyset$	High	Low	$\emptyset$	Low	High
Frac. in Bin	0.30	0.59	0.11	0.14	0.43	0.43	0.10	0.45	0.45
Base	32%	36%	11%	28%	35%	29%	30%	32%	32%
$\mathbb{Z}^R$	- 4.72	- 2.41	- 1.50	- 5.43	- 2.04	- 3.38	- 3.27	- 2.47	- 3.72
	(1.16)	(0.86)	(1.29)	(1.68)	(1.00)	(0.95)	(1.93)	(0.96)	(0.95)
$\mathbb{Z}^F$	- 4.55	- 1.29	0.53	- 3.52	- 1.74	- 1.63	- 3.58	- 1.89	- 1.67
	(1.21)	(0.90)	(1.36)	(1.75)	(1.05)	(1.00)	(2.04)	(1.00)	(1.00)
$\mathbb{P}(\theta^R = 0)$	<0.001	0.005	0.25	0.001	0.04	<0.001	0.09	0.01	<0.001
$\mathbb{P}(\theta^F = 0)$	<0.001	0.15	0.70	0.045	0.10	0.10	0.08	0.06	0.10
Pay	2.40	0.66	0.08	2.19	0.79	1.09	2.08	1.04	0.97
	(0.55)	(0.38)	(0.70)	(0.87)	(0.46)	(0.42)	(0.91)	(0.45)	(0.43)
PV	0.39	0.28	0.23	0.43	0.20	0.39	0.19	0.23	0.44
	(0.18)	(0.14)	(0.22)	(0.25)	(0.17)	(0.15)	(0.30)	(0.16)	(0.15)
$\mathbb{P}(\phi = 0)$	<0.001	0.08	0.91	0.012	0.08	0.009	0.02	0.02	0.02
$\mathbb{P}(\psi = 0)$	0.03	0.04	0.29	0.078	0.22	0.01	0.53	0.15	0.003
$\mathbb{P}(\phi = \psi)$	<0.001	0.38	0.85	0.071	0.26	0.13	0.06	0.12	0.26
ζ	0.16	0.43	2.88	0.20	0.26	0.35	0.09	0.22	0.45

Note. Table reports the results from the nested variant of the intent-to-treat specification (4) and the treatment effect specification (6). The left-hand-side variable is the three-month forward of 90+ status, at $t = 3$.

efficacy of forbearance versus interest rate reductions, and the relative sensitivity of behavior to current vs future payments, crucially depends on borrower balance sheets.

First, I focus on the intent-to-treat effects. Forbearance reschedules payments by backloading to future payments; hence, should be associated with a large reduction in delinquencies for the less liquid, and a small reduction for the more liquid. Compatibly, the intent-to-treat effect of forbearance, in terms of percent reduction in delinquencies, is monotonically related to liquidity.

Focusing on Panel A, Column (A3), the point estimate of the effect of forbearance offers is a 5% *increase* (0.53 percentage point reduction off a base of 11%) in defaults for participants who were current in the month prior to refinancing (p=0.70). For the participants who were 90+, the intent-to-treat effect of forbearance is a 14% reduction in delinquencies (4.55 percentage point reduction off of a base 32%), and a treatment effect on forbearance takers of $\frac{-4.55}{0.34} = 13.6$, or a %43 reduction in 90+ status. Similarly, focusing on Panel B, the efficacy of forbearance is strictly increasing in the number of times credit lines bind. For example, take-up of forbearance take-up prevents one in three defaults ($\frac{3.52}{0.37}$ off a base of 28%) for participants without a credit line, but only one in six ($\frac{1.63}{0.33}$ off a base of 29%) for participants whose credit limits bind infrequently.

Focusing on the intent-to-treat effects of rate reductions, for all subgroups except participants with no checking account, the economic impact of rate reductions is larger, and the estimates are more highly statistically significant, compared with forbearance offers. The null of rate reductions having no effect is not rejected only for two small subgroups: participants with no checking account (p=0.09) and participants who were not late (p=0.25). Note, however, that these subgroups contain about 10% of the participants each, and perhaps the inability to reject the null reflects the low number of observations in these bins.

Second, I focus on the treatment effects, i.e., the absolute sensitivity to current payments and future payments. Within each panel, the sensitivity to current payments, ϕ, is highest for the lowest liquidity groups (2.40 for 90+, 2.19 for no credit line, 2.10 for no checking account). Compatible with forbearance not having an effect on participants who were current, Column (A3), the sensitivity to current payments is very close to zero for this group (p=0.91).

In general, borrowers with higher liquidity are less responsive to current payments and more responsive to the present value of future payments. The relative sensitivity coefficient ζ—wedge between the sensitivity of behavior to current vs. future payments—is smallest, at 9 cents, for the borrowers without a checking account (10%); and highest at \$2.88 for participants who were not even late (30+) on payment at $t = -1$ (11%). $\zeta > 1$ indicates low sensitivity to current payments, and much larger sensitivity to future payments. The relative effect of future payments is monotonically increasing in liquidity across all measures. Finally, the fungibility test $\phi = \psi$ is more likely to be rejected at low liquidity.

5 Concluding Remarks

This paper examined the impact of forbearance and rate reduction policies using a randomized controlled design. Qualitatively, forbearance take-up prevents one in three defaults in the first month and one in five defaults in the last month before expiration. However, the effects of the particular 3-month forbearance studied here do not extend beyond the expiration. In contrast, rate reductions have persistent effects. For the duration of forbearance, rate reductions have considerably higher efficacy in reducing delinquencies per unit reduction in payment, compared with targeted policies that reduce payments by more but reschedule them over time. Using the experimental assignment as an instrument to decompose the effect of future payments entailed by a rate reduction from current liquidity, a dollar change in the present value of future payments has a similar effect on defaults as a 30 cent change in current quarterly payments. Whether forbearance or rate reductions are relatively more effective, the relative sensitivity of behavior to future payments, and whether interest rates affect behavior to the extent that they affect current payments are all tightly linked to balance sheets. Influencing interest rates—less targeted, but requires less tweaking regarding the timing, duration, size, and slope—has debt relief benefits through a present value channel that is difficult to replicate using unconventional policies that only act on current payments.

The findings raise several questions for further research. One avenue is to directly test forbearance designs that feature variable timing, duration, size, and slope; in a manner that is front-loading-ballooning, uniformly amortizing, or backloading.[7] Second, the analysis

[7]Unfortunately, the experiment is underpowered to analyze such interactions, with none of the interaction effects with statistically significant. However, the point estimates indicate that the effects of forbearance is independent of the interest rate; and whether forbearance is paid in an amortizing manner or paired with a maturity

here is base on delinquent borrowers who hold little to no assets and frequently face binding credit constraints; however, present value effects could be even more pronounced for non-delinquent and highly liquid borrowers, making standard monetary policy an even more powerful relief tool. Finally, it would be valuable to ask whether commonly used calibrations of intertemporal models are quantitatively compatible with the relative elasticity ζ of 30 cents estimated in this paper. These are tasks I leave for future research.

extension.

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