Forbearance vs. Interest Rates:
Experimental Tests of Liquidity and Strategic Default Triggers*

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May 2023

Abstract

I use the random assignment of debt relief policies in a large-scale field experiment to test default models emphasizing liquidity and strategic behavior. In contrast to liquidity being the sole trigger, borrowers respond differently to a dollar reduction in current payments when delivered through forbearance or interest rate reduction: forbearance reduces payments twice as much, whereas delinquencies are more responsive to a rate reduction. Compatible with strategic behavior, borrowers default in response to changes in future payments orthogonal to solvency and liquidity. Compatible with the endogeneity of triggers, whether forbearance or interest rates are more effective, and defaults are strategic is tightly linked to borrower balance sheets. I characterize a single strategic default trigger whose location is influenced by distress, precaution, and assets. The findings have implications for targeting loan modifications and modeling the pass-through of interest rates.

(*JEL* G51, D15, E63)

What triggers default on debt obligations, and what policy best prevents it? The answers to these questions have implications for policymaking, finance, and macroeconomics. In policymaking, the answer guides the design and targeting of debt relief. In finance, the answer distinguishes between the 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, sizes, and timing of effects through which policies affect behavior are disciplined through credibly identified moments.

In this paper, I report the results of a large-scale randomized field experiment to provide new evidence on the triggers of default and the efficacy of policies to prevent default. I design a debt relief program at a European bank in Turkey that refinances 20,944 delinquent unsecured borrowers. The design isolates classical solvency constraints by holding constant the face value of liabilities owed. It then randomly provides the most commonly used debt relief—forbearance, interest rate reductions, and term extensions—in a novel

*I am grateful to Cevdet Akcay and Adrien Auclert for early-stage discussions; to Douglas Bernheim, Marieke Bos, Nuno Clara, Joao Cocco, John Cochrane, Muge Demir, William Fuchs, Ian Glover, Radha Gopalan, Brett Green, Sean Higgins, Felicia Ionescu, Yigitcan Karabulut, Atilla Koc, Rodolfo Manuelli, Pascal Noel, Eren Ocakverdi, Luigi Pistaferri, Therese Scharlemann, Janis Skrastins, Aiga Stokenberga, Anjan Thakor, Niccolo Ubertalli, Emil Verner, Emircan Yurdagul, and numerous seminar and conference participants at Society for Financial Studies Cavalcade, Northwestern University (Kellogg), Universidad Carlos III Madrid (Economics), Koç University, NBER Innovative Data in Household Finance, Central Bank of Chile, MoFiR Workshop on Banking, Advances in Field Experiments, CEPR Household Finance Workshop, Econometric Society World Congress, Midwest Finance Association Meetings, American Finance Association, CFPB Research Conference, FDIC Consumer Research Symposium, Theory and Experiments in Monetary Economics, Red Rock Finance Conference, Federal Reserve Bank of St. Louis, and the Society of Economic Dynamics for valuable suggestions. Oguz Caylan provided excellent research assistance. The field experiment was submitted to the American Economic Association Randomized Controlled Trial Registry under the title Liquidity vs. Present Value Effects (#1781) and was deemed exempt from institutional review by Washington University IRB (HRPO #201704038).

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2-by-2-by-2 design. I first present an analysis of the experiment using the language and framework of a randomized controlled trial.[1] I then provide novel tests of widely used models for why borrowers default: solvency (face value too high), liquidity (current payments too high), and strategic (future payments too high).

I begin by providing a conceptual framework in Section 1. This framework clarifies how forbearance and interest rates affect borrower behavior through liquidity and strategic channels. Interest rates are the primary tool used for macroeconomic stabilization. For a borrower who refinances to a lower rate, it entails a small reduction in current payments, accompanied by news of a large reduction in the present value of future payments. Hence, interest rate reductions move current and future payments in the same direction, reducing defaults due to liquidity and strategic effects. Forbearance is the other most commonly used debt relief policy. It entails a large, immediate, targeted, and easy-to-implement but temporary payment reduction, here for three months. However, it merely postpones the payment of principal, backloading this reduction to future payments one for one. Hence, forbearance moves current and future payments in different directions, reducing defaults due to a liquidity effect but increasing defaults due to a strategic effect. I use the experimental assignment as instrumental variables—that shift current and future payments in different directions—to identify the relative contributions of liquidity and strategic behavior to borrower decisions.[2]

First, I focus on solvency (i.e., default because the face value of liabilities is too high). Using transparent event studies, I show that modifications orthogonal to the face value and other default determinants (e.g., income, wealth, health, risk, default costs) affect whether and when a borrower defaults. Forbearance take-up prevents 1 in 3 defaults in the first month. However, these short-term reductions in payments are repaid with higher payments in the long run, and the short-term effects do not extend beyond the expiration. As delinquencies increase when payments increase, forbearance only shifts the timing of the default decision. This qualitative pattern is broadly in contrast to the effect of interest rate reductions that occur immediately and persists in the long run.

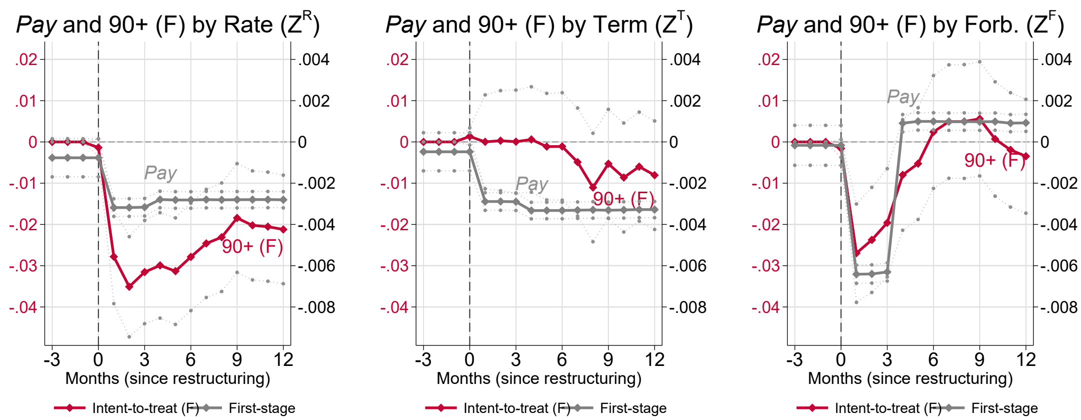
Second, I focus on liquidity. Suppose borrowers default because current payments are too high. In that case, they should respond similarly to a dollar reduction in current payments, regardless of whether it is delivered through forbearance or interest rate reduction. To test this implication, the design here varies payments for similar participants through the three relief types. This is a distinguishing feature of the design and contrasts with previous studies, which analyze policies that act on payments in isolation or compare a policy that acts on payments with another that does not.

To test the association between current payments and delinquencies, I use the first stage (effect on payments) and intent-to-treat (effect on defaults) estimates in superimposition. In contrast to liquidity being the sole trigger, a dollar change in payments has drastically different effects depending on whether it is delivered through forbearance, term extension, or interest 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: forbearance would have to reduce current payments by more than three times to obtain an impact on delinquencies similar to that of interest rate reductions.

[1] The experiment abstracts away from intermediation frictions and the endogenous matching of borrowers with particular lenders and contracts. This allows for the identification of causal effects using a purely experimental variation. The experiment's first stage is very strong (*F* of 7,551 and 2,216 on rates and forbearance; 401 and 2,128 on current and future payments). The bank offered interest rate reductions and forbearance for the first time; these aspects were not preannounced and likely unanticipated.

[2] The experimental design automatically passes through interest rate reductions for all participants, as the benefit for the borrower is unambiguous. However, the benefits of postponing payments depend on borrower preferences. In these respects, the experimental design combines random encouragement with borrower choice. I study forbearance and interest rate reductions alongside a partial forbearance term extension policy that only slightly reduces the payment of principal and spreads the payments over time.

Figure: Preview of Results—Tests of Liquidity



Third, I focus on strategic behavior. A default is strategic if an able borrower won't pay. The current design does not affect the face value of liabilities, separating strategic behavior from solvency. This feature allows for the investigation of true strategic behavior—that is, the unwillingness despite being solvent *and* liquid. Hence, in the current context, strategic unsecured borrowers default because future payments are too high. Using unexpected variation mitigates the identification difficulty whereby borrowers anticipating default could strategically put themselves in a liquidity problem.

If borrowers are *not* strategic, they should behave identically whether the reduction in current payments is accompanied by a dollar increase or decrease in payments tomorrow. In contrast, if borrowers see through the intertemporal veil and default due to strategic considerations, announced but not yet realized future payments trigger a default. I provide evidence for such strategic default using nonparametric and instrumental variables methods. Using the randomized variation, I identify the liquidity equivalent of the strategic trigger: a dollar change in future payments orthogonal to solvency and liquidity causes a change in defaults by as much as a 30-cent change in payments in the current quarter.

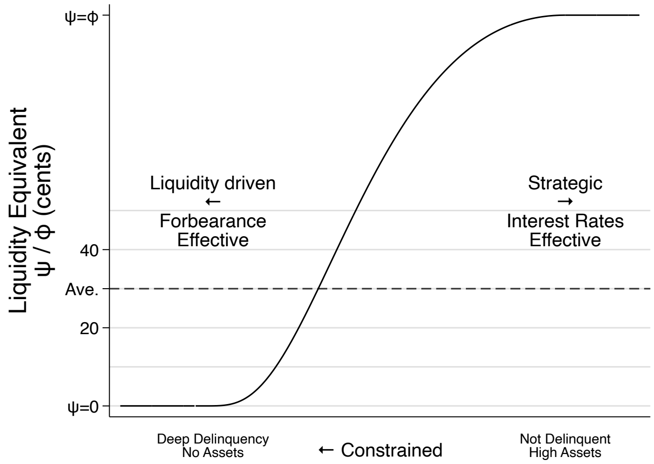
Fourth, I scrutinize the empirical implications of endogenous default models by analyzing heterogeneity in the default triggers.[3] Although particular frictions differ, all models emphasize imperfections in intertemporal substitution that hamper strategic motives and how borrowers respond to future payments due to a lack of liquid assets, precautionary savings, or financial distress.

Consistent with endogenous default models, the efficacy of forbearance and interest rates—and whether a default is strategic—are not constant but tightly linked to liquidity, precaution, and distress. For an unconstrained borrower (e.g., less than 30 days late), forbearance—replacing current payments with future payments of similar present value—does not have a material effect on behavior. This is because unconstrained behavior is sensitive to future payments; hence defaults are strategic, making interest rate reductions a much more powerful tool. In contrast, for constrained borrowers (e.g., deeper delinquency, more frequently binding constraints, fewer assets), behavior is less sensitive to future payments, making forbearance a more powerful tool.

Regarding the theory of debt default, these findings allow for informative inferences regarding the trigger's shape. For an unconstrained borrower, a dollar change in future

[3]Previous work examining default triggers and alternative policies' efficacy ignores the heterogeneity. Instead, they focus on average treatment effects. This is due to either data limitations (e.g., no data on balance sheets) or research designs (e.g., no variation in balance sheets around the discontinuity that identifies the treatment effects). The current environment and design compensate for these shortcomings and allow for an investigation of mechanisms not yet tested.

Figure: Preview of Results—Shape of the Default Trigger



payments affects the default decision just as much as a dollar change in current payments. Hence, unconstrained borrowers who can intertemporally substitute are strategic. However, a much smaller change in current payments can trigger a default as constraints become more binding. That is, borrowing constraints accelerate default by decreasing the liquidity equivalent of the strategic trigger level. The heterogeneity analysis allows for characterizing this single strategic default trigger whose location is influenced by distress, precaution, and assets. Among existing models, this interpretation is most compatible with a model in the spirit of Campbell and Cocco (2015).

In addition to providing new evidence on the validity of alternative default models, the findings have implications for modeling and policy. Most notably, interest rate reductions are not pure liquidity shocks that affect behavior only through current payments. By contrast, most behavioral response to interest rates is attributable to future payments and strategic channels. The less constrained a borrower, the more interest rates get into the cracks that rescheduling policies that act on payments cannot. In the current context, the effects of interest rates through strategic channels provide the same reduction in delinquencies as a deferral program that reduces monthly payments by 5% of average monthly household disposable income. Interest rate reductions also incentivize lenders who bear the loss since this is an effective way to increase recovery today by reducing strategic default.

Related Literature. The study design complements a large literature that studies household default (e.g., Karlan and Zinman (2009), Verner and Gyöngyösi (2020)). Fuster and Willen (2017) and Cherry et al. (2021) study interest rate and forbearance policies that act on payments in isolation. Dobbie and Song (2020) and Ganong and Noel (2020) use *either-or* designs to compare a policy that acts on payments with another that does not. Castellanos et al. (2018) and Dobbie and Song (2020) studies are similar to the current study in design. However, they both focus on credit cards. Hence, current payments and the present value of future payments are not well defined. In the current study, relief policies make marginal changes to current and future payments in an environment where debt and repayment already exist and payments are well defined. This feature allows for an analysis of the relationship between liquidity and defaults in Section 4.2 and decomposing the effect of current and future payments in Section 4.3. Finally, these studies do not analyze heterogeneity as in Section 4.4.

My findings here also suggest a unifying reconciliation of what appears to be conflicting results from previous studies. For example, deeply delinquent mortgagors given large writedowns of underwater home equity are less likely to monetize these long-run obligations (e.g., Ganong and Noel (2020)). Hence, liquidity drives borrower decisions. Their findings are similar to Indarte (2022), who studies the bankruptcy decision of deeply delinquent households and similarly finds liquidity drives borrower decisions. This is the opposite of the early-cycle debt counseling restructurings of credit card holders who can more likely intertemporally substitute the small face value they owe, as in Dobbie and Song (2020); or pre-delinquency borrowers who strategically fall into delinquency to obtain a modification, as in Mayer et al. (2014).[4]

Layout. Section 1 provides a conceptual framework to clarify how forbearance and interest rates affect borrower behavior through current payments and the present value of future payments, acting on liquidity and strategic default triggers. Section 2 describes the macroeconomic conditions and relevant institutional features. Section 3 details the experimental design and implementation. Section 4 presents the results. Subsections 4.1, 4.2, 4.3, and 4.4 focus on solvency, liquidity, strategic, and endogenous triggers. Section 5 discusses implications and external validity. Concluding remarks are in Section 6.

1 Conceptual Framework

I begin by presenting a simple conceptual framework. First, I provide an intuitive approximation of the annuity formula to clarify how forbearance and interest rates affect current and future payments. I then describe statistical tests to distinguish solvency, liquidity, and strategic default.

Consider an intertemporal model in the spirit of Imrohoroğlu (1989), Deaton (1991), and Carroll (1997) that incorporates solvency, liquidity, and strategic default constraints (that could be motivated by selection or enforcement problems) 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 focuses on unsecured loans with a fixed rate and fixed nominal payments. Hence triggers related to collateral values are ignored. The intervention holds the outstanding face value at origination, FV_0, constant, and creates independent variation in the interest rate ($R \downarrow$), the term ($T \uparrow$), and forbearance (F). One way to think about how these modifications affect current payments is to consider the Taylor approximation of the annuity formula for constant amortizing payments,

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

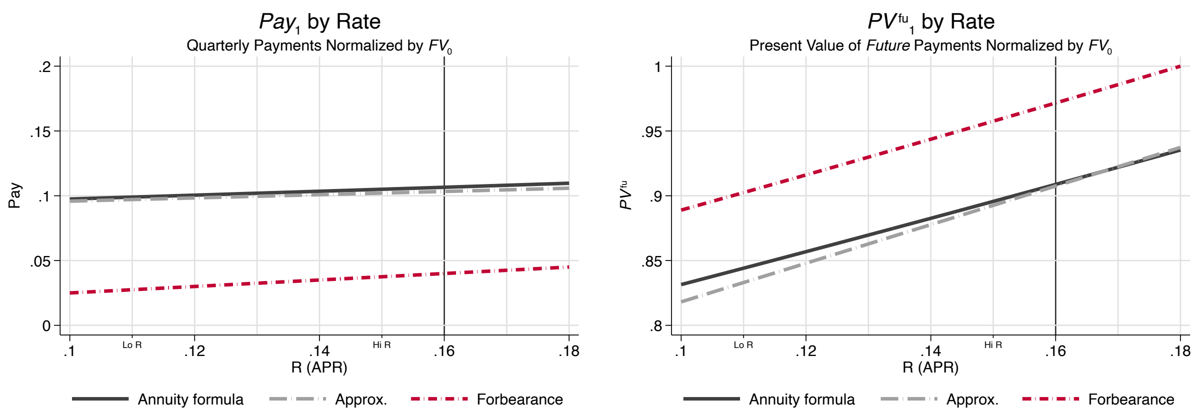
Pay denotes current payments normalized by FV_0. This formula gives the relative contributions of interest and amortizing principal to payments. R has a linear effect on Pay, while T has a $\frac{1}{T}$ effect. In the current setting, the typical R is about 16% APR or 4% per quarter. The typical T is about 3 years or 12 quarters. This gives a 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

[4] Similarly, Ganong and Noel (2022) provide evidence that liquidity (i.e., cash flow, affordability, and short-run) and Guiso et al. (2013) and Mayer et al. (2014) that strategic considerations drive borrower default decisions. Also see Eberly and Krishnamurthy (2014), Scharlemann and Shore (2016), Campbell et al. (2018), Agarwal et al. (2017), Fiorin et al. (2022), and Dinerstein et al. (2022).

very skewed in favor of forbearance and much less on the interest rate. Forbearance suspends the payment of principal, keeps the term constant, and reduces *Pay* by 60%—from 10% to the quarterly interest rate of 4%. By contrast, a 4 percentage point APR reduction in the interest rate reduces *Pay* by only 5%—a 25% reduction off a base of 16% APR. Similarly, a 10% increase in T' (off a base of 3 years) reduces payments by about 7%. Figure 1 shows these effects.

Figure 1: Effect of Rate and Forbearance on Current and Future Payments



The relative merits of these policies are determined by their effects on future payments. Suppose the borrower is discounting future payments at a rate R^* (higher than the risk-free rate) to calculate a present value to undertake meaningful comparisons of current versus future payments. The Taylor approximation of the present value at t=0, the time of origination, is given by:

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

where the second line follows from substituting approximation (1) as Payment. Figure 1 shows these effects on PV_t^{fu}, henceforth denoting the present value of *future* payments coming after t, normalized by FV_0 and assuming an R^* of 18% APR.[5]

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

The reduction in the payment stream due to the interest rate reduction could be repli-

[5] To calculate the capitalized value of the implied stream of future liabilities, one approach is to use the inflation rate and compare real dollar terms. Another approach is to use as R^* the borrower's marginal funding cost. If the borrower can transfer resources across time at a rate of R^*, a dollar increase in current payments or the present value of future payments would lead to the same lifetime budget constraint, the same feasible set, hence the same set of optimal decisions. A third approach is to interpret R^* as a subjective discount rate directly tied to time preference, the marginal utility of consumption, and today's and tomorrow's aggregate state. In models with borrowing constraints, R^* also incorporates the shadow cost of the constraint. By arbitrage, the cost of marginal funding bounds R^* above. 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 is indifferent to a $1 increase in *Pay*).

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

By contrast, forbearance only alters the timing of payments, merely backloading the reduction in current payments one-for-one to future payments, leading to higher future payments with a similar present value as the initial reduction. Hence, forbearance is effective only if households cannot recognize this equivalence through the intertemporal veil (e.g., Barro (1989)) or cannot intertemporally substitute—if the behavior is more sensitive to current payments than future payments.

Unlike interest rate reductions, forbearance and term extensions are not attractive to everyone. Rescheduling through term extensions spreads out payments further over time. 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 the 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?			Most effective policy
	FV	Pay	PV^{fu}	$R\downarrow$	$T\uparrow$	F	
Solvency	✓						Write-down
Liquidity		✓		✓	✓	✓	Forbearance
Strategic			✓	✓			Rate reduction
Endogenous	✓	✓	✓	Heterogeneous			Heterogeneous

Note. FV, Pay, and PV^{fu} denote face value, current payments, and the present value of future payments, respectively. $R\downarrow$, $T\uparrow$, and F denote rate reductions, term extensions, and forbearance, respectively.

This leads to the four models in Table 1, which are differentiated by the default trigger.

- *Solvency.* At one extreme is a classical frictionless model, which emphasizes what is on the balance sheet: the borrower defaults because liabilities exceed assets (i.e., the face value is too high). This model is obtained under no borrowing constraints and R^*=R (i.e., the borrower's discount rate equals the interest rate on debt). In this model, payments decrease when the interest rate decreases, although their present value does not. The testable prediction is that changing the interest rate or the schedule of payments should not affect borrower behavior. The policy implication is that only face-value write-downs provide relief.
- *Liquidity.* At the other extreme are models 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. I define liquidity as current payments—the borrower defaults because the 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 could be extremely impatient or myopic (e.g., neglect all future liabilities) or may not be able to substitute (i.e., $R^* = \infty$) intertemporally. The testable predictions are that the reduction in current payments determines efficacy and future payments are irrelevant beyond current payments. Every modification reduces payments, with forbearance reducing the most and interest rates

reducing the least. Hence, forbearance will be the most effective, and interest rate reductions the least.

- *Strategic.* The third type of model is one in which factors beyond solvency or liquidity drive the borrower's default decision. In this model, the borrower weighs the costs and benefits of default (e.g., drop in credit score and access, stigma, moral factors, recourse, postponing or preventing repayment) and trades these costs off the present value of future payments. These defaults are forward-looking and strategic, independent of the amount owed and affordability, but due to future payments. This captures the able but won't pay—borrowers will stop making payments when it is an advantageous financial decision, even though they are solvent and liquid (i.e., possess assets to cover the face value of liabilities and can afford the payments). The testable prediction is that news about non-callable higher future payments leads to immediate behavior changes. The policy implication is that interest rate reductions will be the most effective due to the large effects on future payments that cannot be replicated using forbearance policies.

- *Endogenous.* The final class of model is one in which whether the default is triggered by solvency, liquidity, or strategic considerations is endogenous. Although particulars differ, such models emphasize imperfections in the ability to intertemporally substitute and borrow against future income, which often leads to an inability to respond to news about future payments. In this case, the entire intertemporal path of future payments will matter for the default decision, even when liquidity is scarce, but current payments matter most. The testable prediction is that the endogenous trigger will be heterogenous by assets, precaution, or distress, as in Kaplan and Violante (2014), McKay et al. (2016), and Campbell and Cocco (2015), respectively.

The experiment creates random variation in current payments versus future payments using forbearance and interest rate reductions to estimate average and heterogeneous treatment effects. This methodology allows me to quantify the channels and sizes of effects through which debt relief policies affect behavior, characterize the shape of the default triggers, and provide new evidence on the validity of these alternative models.

2 Environment and Institutional Details

In this section, I first provide an overview of the macroeconomic environment. I then discuss the relevant institutional details on the unsecured loan market, consumer bankruptcy, and distressed debt refinancing.

Macroeconomic Environment. The experiment was conducted, and debt contracts were refinanced between June 2017 and July 2018. Refinanced contracts are followed up for 15 months. 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:Q2, 2018:Q3, and 2018:Q4. At the onset, the annual inflation rate (CPI) was about 11%, and 4% of the aggregate face value of household debt was in nonperforming status. See Figure A.1 for aggregate credit and nonperforming credit growth, and Table A.2 for the macroeconomic variables.

The effectiveness of various debt relief options may depend on the type of shock experienced by the economy. The macroeconomic conditions that led to these delinquencies are neither the depression type (e.g., as in the Great Recession in the U.S.—a prolonged and severe slump caused by the bursting of a housing bubble, with a lengthy recovery in both the housing and labor markets) nor the transitory type (e.g., a short-lived recession due to temporary banking liquidity or an emerging market shock, associated with short-term layoffs and disruptions in receivables). Unlike what is common in financial crises (e.g., aggressive lending, bad regulation of intermediaries, and bad central bank policy), nothing during this period suggests that banks or the government are immediately culpable. Hence, the delinquencies considered here are best characterized as idiosyncratic.[6]

Unsecured Loans. The unsecured loans I examine 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, potential borrowers first declare their education level, employment title, and monthly disposable income. They then state the amount they want to borrow and choose a contract term. Home improvements, emergency expenses, or large purchases are common reasons. Underwriting features little discretion, and evaluation is based on credit and in-house risk scores. Credit is rationed. For borrowers who can access personal loans, equilibrium credit terms vary slightly with borrower risk, with only a 260 bps APR difference in interest rates between the 10th and 90th percentiles.

Delinquencies. If a borrower is late on a debt payment, the bank will follow up via text messages and phone calls. Thirty days overdue will appear on the credit report. A preliminary notice is sent after two subsequent payments are overdue. Ninety days past due gives the bank the right to take legal action and report nonperforming status to the credit bureau. The contract is kept in collections for at least 90 additional days, during which the bank attempts recovery through customer contact. Suppose the borrower does not provide a repayment plan. In that case, the lender can take legal action and sue the borrower for the loan balance plus penalties, interest due up to 30% of face value, collection costs, and legal fees. The default flag remains on the borrowers' credit history for five years, and obstructs the borrower's access to credit markets until removed.

Collections. Turkey lacks a personal bankruptcy option. Moreover, the recourse loans considered here allow the lender to pursue claims on the defaulting borrower's assets. Thus, debtors are responsible for the loan balance regardless of whether they stop making payments. Lenders collect on the debt. Repossession risk is real and meaningful. Unpaid debts are collected through an onerous and arduous process that can entail garnishment, guarantors, and sequestration. At enforcement proceedings, recovery is made through confiscating cash and other liquid assets, wage garnishing up to 25% of net income, and then confiscation of durables and real estate. If there is a guarantor, this person shares all the responsibility if the debtor cannot repay: her labor income could be garnished and durables or real estate sequestrated. This process usually takes 2 to 3 years. Hence, default postpones repayment for the typical borrower. For an unemployed borrower with no leviable bank account or confiscatable illiquid assets, recovery may not be possible. Hence, default may prevent recovery from some borrowers. 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 request of the creditor.

Refinancing. The market features frequent refinancing of distressed unsecured debt by the lender of the delinquent loan. Banks contact delinquent borrowers through an in-house call center to work out a repayment plan. Banks predominantly refinance borrowers for whom it is the sole creditor. These are one-time modifications. Lenders have the capability 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.

[6] Anecdotal evidence and refinancing phone calls suggests that some borrowers became unemployed or had temporary problems with businesses or receivables; others acknowledge that they borrowed too much.

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 collaborated with a large European retail bank in Turkey. The bank has a customer base representative of the local banked population. The experiment provides randomized debt relief in a 2-by-2-by-2 design for borrowers who are representative of the delinquent pool. The controlled trial is conducted to understand borrower behavior in response to unanticipated loan forbearance and interest rate reductions. Holding constant the face value of the amount owed by the borrower, the experiment refinances the old delinquent loan with a new loan. The experimental design automatically reduces the interest rate for every participant, which every participant strictly prefers, but varies the magnitude of the reduction by experimental assignment. The design also reschedules payments through forbearance and term extensions in a manner that combines random encouragement, as these decisions depend on borrower preferences. Here, I describe the core features of the experiment.

3.1 Selection

Study participants are preexisting borrowers who hold an unsecured loan. Most (but not all) of them in arrears: one month before the refinancing, 89% are more than 30 days late and 30% are more than 90 days late. These borrowers have been nudged by the bank

Original Contract in Arrears	$\rightarrow$	Randomization	$\rightarrow$	Refinancing Call	$\rightarrow$	New Contract
(R, T)		$\mathbb{Z}^R \times \mathbb{Z}^T \times \mathbb{Z}^F$ (2×2×2=8 groups)		$R'\vert\mathbb{Z}^R$ displayed $T^{\text{Offer}}\vert T, \mathbb{Z}^T$ offered T' decided $F\vert\mathbb{Z}^F$ offered F decided		(R', T', F)

via text messages and phone calls. However, their loans have not previously been refinanced. The sample is representative of the bank's delinquent refinancing pool, with the only exception being the exclusion of loans with less than six months remaining.

Table 2 displays summary statistics. The unit of measurement for nominal variables is the local currency, TRY. The average borrower's age is 38; the average interest rate is 16.3% APR; the average face value refinanced is about 10,000 TRY. 20% of the participants consolidate multiple loans. 5% consolidate three loans. 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, hence holding negative net liquid assets. 86% of the participants 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.

3.2 Randomization

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

3.3 Balance

The randomization gives three variables for econometric evaluation, $\mathbb{Z}_i^R$, $\mathbb{Z}_i^T$, and $\mathbb{Z}_i^F$. I conduct statistical tests for covariate balance across treatment legs using simple regressions of the following form:

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

Table 3 reports the results of regressions of original 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. These regressions allows me to test 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 2 displays visual evidence of dynamic pre-trends. Focusing on the top panels, participants, on average, appear to exhaust checking assets before refinancing. However, no statistically significant differences exist across treatment legs before and around refinancing in checking assets or credit line limits.

Appendix Figure A.2 displays the kernel densities for face value at origination and normalized monthly payments. These tables and figures show that the final assignment to high/low treatments is orthogonal to pre-experiment characteristics and the typical determinants of the default decision. Different treatment legs have statistically indistinguishable covariates before the experiment.

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	- 0.0002	- 22	34	0.003	0.08	- 1.2	- 0.08	-0.82	-0.31
		(0.13)	(0.007)	(155)	(124)	(0.02)	(0.11)	(5.2)	(0.05)	(0.43)	(0.64)
	$\mathbb{Z}^T$	- 0.07	- 0.01	-3	105	0.01	-0.11	0.4	- 0.05	-0.10	0.67
		(0.13)	(0.007)	(154)	(124)	(0.02)	(0.11)	(5.2)	(0.05)	(0.43)	(0.64)
	$\mathbb{Z}^F$	- 0.02	- 0.009	172	170	- 0.02	0.06	5.5	- 0.02	0.45	-0.03
		(0.14)	(0.008)	(162)	(130)	(0.02)	(0.11)	(5.4)	(0.05)	(0.45)	(0.67)
Cons.		38.1	1.26	15,234	10,274	16.3	36.8	530	6.5	89.6	30.3
		(0.13)	(0.007)	(147)	(118)	(0.02)	(0.10)	(4.9)	(0.05)	(0.41)	(0.60)
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 the month before refinancing. N=20,944. F-test p-value for the null that coefficient estimates θ^k are jointly equal to zero. Kolmogorov-Smirnov p-values are 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

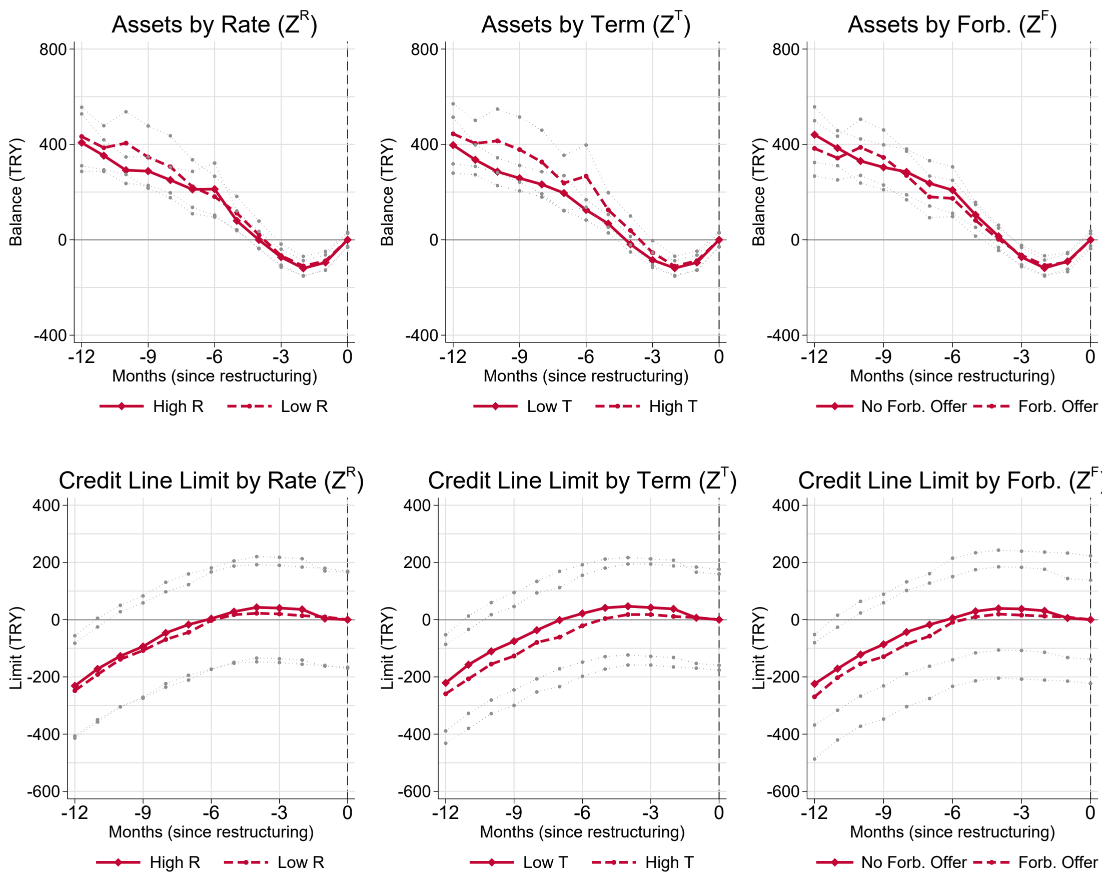
The three randomized dummy variables $\mathbb{Z}_i^R$, $\mathbb{Z}_i^T$, and $\mathbb{Z}_i^F$ determine the borrower's refinanced interest rate R', term offer T^{offer}, and forbearance offer.

Interest rates. The refinanced contract features an interest rate reduction to $R' < R$. This rate is *not* negotiable and cannot be changed. 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 original contract rate. Based on this market rate, participants with $\mathbb{Z}_i^R = 0$ are assigned to 60 bps, and borrowers with $\mathbb{Z}_i^R = 1$ to 540 bps APR interest 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 interest 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. Naturally, borrowers with high preexisting interest rates receive higher rate reductions. In the analysis, I will restrict the amount of variation used to only what is random: the assignment $\mathbb{Z}_i^R$.

Term. The experiment's focus is unexpected forbearance and rate reductions in a natural environment where borrowers are not constrained in the choice of term. Hence, the experiment does not constrain the new contract term, T'. The experiment features an individualized term extension *offer*, $T^{\text{offer}} > T$, a recommendation made by the bank representative. Customers are grouped into grids of width 12 with respect to the remaining term T in 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. I denote 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.

Forbearance. Borrowers with $\mathbb{Z}_i^F$=1 are offered forbearance. Forbearance suspends and

Figure 2: 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 95% confidence intervals for the estimate of the mean.

postpones the payment of the principal for 3 months, keeping the term constant and back-loading the program's costs. This feature allows for an analysis of temporary policies before and after expiration. In contrast to deferment, forbearance is not free: the borrower is responsible for the interest that accrues, and forbearance increases total payments. For participants who take up forbearance, payments in the first quarter equal the interest on the principal, and amortizing payments start 4 months after refinancing.

Refinancing call. In a typical refinancing call, the bank 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, bank employees 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 employee sees customer demographic information and information on the delinquent loan, the market rate and a term choice screen. The one-size-fits-all interest rate schedule is *not* negotiable and cannot be changed. The borrower is asked how much she can afford to pay each month and is flexible in the choice of term up to $\bar{T}$. The employee then reviews the new contract and conditions and states the monthly and total payments. The contract is forwarded for processing if the customer accepts the new terms.

The experimental refinancing call is identical to the typical one, except for 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 term. 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. The loan officer similarly *encourages* the borrower toward forbearance. The customer then has the option to either accept or reject the forbearance offer. 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 3 months equal the interest on the principal only, and payments starting in month t=4 are determined by the annuity formula, given FV, $T' - 3$, and R'.

Information, anticipation, and effects on other margins. Before the controlled trial, the bank did offer loan modifications to delinquent borrowers. Therefore, customers may anticipate the refinancing. However, these modifications did not include interest rate reductions (borrowers were always given the market rate) or forbearance. Hence, 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. Hence, the experiment allows analysis of the timing of decisions regarding the current and future components of unexpected policy changes. Using unexpected variation also mitigates the identification difficulty that borrowers anticipating default could strategically put themselves in a liquidity problem. Importantly, there is no explicit participation choice and lack of blinding, which ensures that participants are unaware that they are participating in a controlled trial.

The experiment is also designed to control for 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 the total stream of payments, assuming no discounting, are communicated to participants in a salient manner, both verbally and in writing, to overcome any difficulty whereby borrowers find it challenging to discount future cash flows and calculate a present value. Moreover, contract features are not conditional on borrower behavior (e.g., success in making some payments or commitment to not using overdrafts), abstracting away from strategic behavior.

Why a design that unambiguously benefits the borrower? Due to ethical and regulatory considerations, fielding an experiment that does not benefit participants compared with the status quo is not possible. Interest rate reductions entail a reduction in both current and future payments, unambiguously benefiting the borrower. Hence, the experiment pushes interest rate reductions for everyone, randomly varying the magnitude of interest rate reduction by experimental assignment. In contrast, the benefits of term extensions and forbearance depend on borrower preferences. Therefore, the experiment does not force participants into forbearance or a particular term. Instead, the design combines random encouragement with borrower choice. This approach of not forcing forbearance or term upon the borrower has two additional benefits. First, better targeting: forbearance or a high term is taken up by those who need it the most. Second, better external validity: borrowers are not dictated a term in the wild and are free to take up forbearance. So the experiment does not create an artificial margin.

3.5 Data

In the following analysis, I use data on 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 became 30+ or 90+ days overdue. The former captures arrears, and the latter captures defaults. The data also contain information on borrower balance sheets, such as credit card balances and limits, checking assets-overdraft debt, and indicators for whether the borrower is delinquent on any other accounts at the bank. There is no information on borrower incomes. Delinquency and balances are measured on the last day of the calendar month.

My analysis is based on the 15-month timeframe after refinancing. Hence, participants are followed for 12 months after the expiration of the forbearance. The data are monthly, and the unit of analysis is at the individual level. For participants who had consolidated multiple loans, I match the accounts and aggregate the variables using a unique customer identification number, ensuring perfect match quality.

Table 4: First Stage Effects on 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)	
Cons.	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. F-test p-value is for the null hypothesis that the coefficient estimates θ^k are jointly equal to zero.

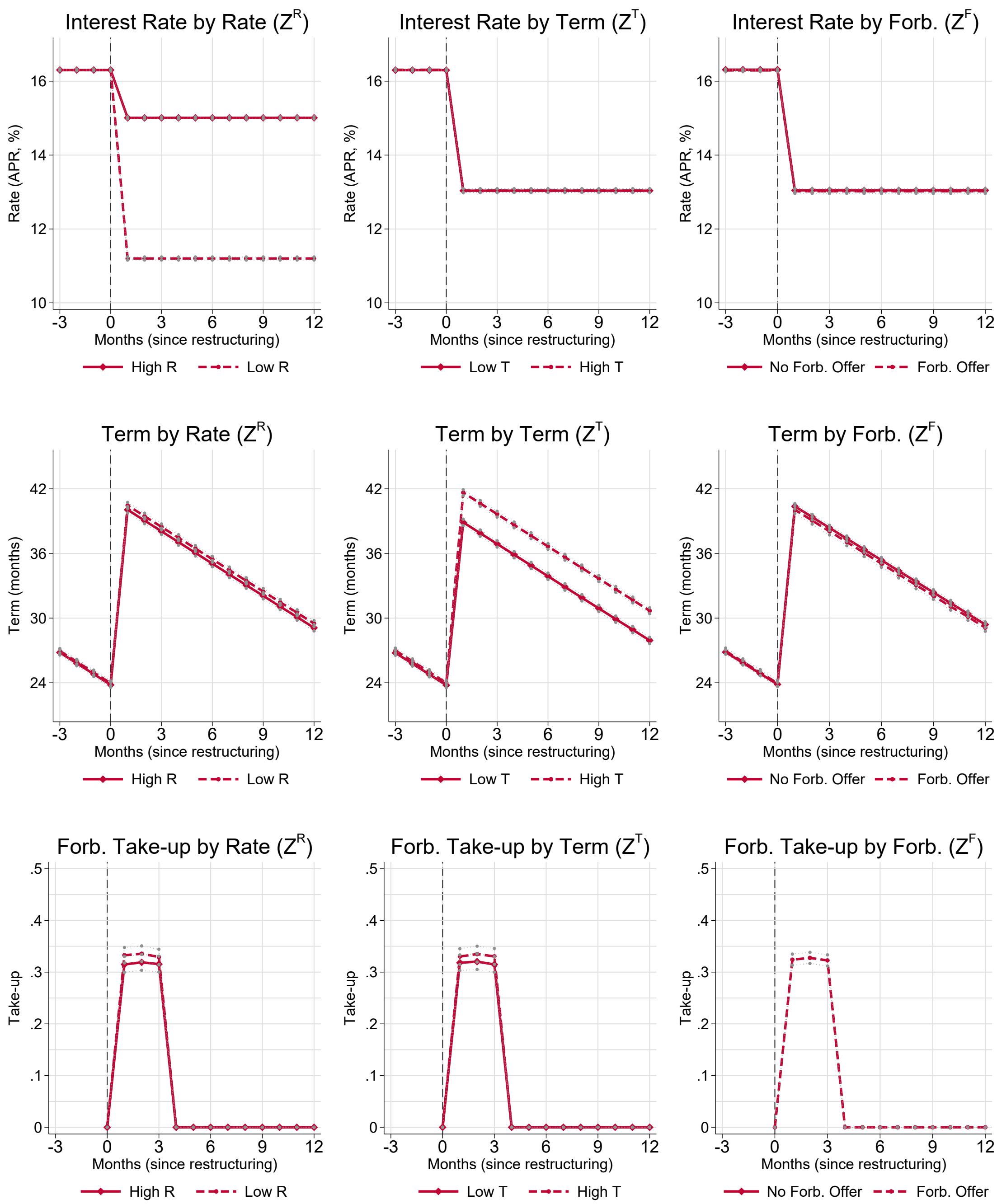
3.6 First Stage

Table 4 reports the first stage effect of the three instruments $\mathbb{Z}_i^k$ on the new contract interest rate R', term T', and take-up of the forbearance offer, using Equation 3. Figure 3 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 $\mathbb{Z}_i^k$ are jointly equal to zero.

The average interest rate for the original contract is 16.3% APR, which 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 interest rate reduction between the low and high rate treatment is 381 bps APR. Since the interest rate is bounded below a minimum $\underline{R}$ set by the bank, the difference between the treatment and control groups 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 choose the offered term. The remaining are about equally likely to choose a term below or above the recommendation (19.1% versus 18.4%). For participants in the high-term group, $\mathbb{Z}_i^T = 1$, versus the low-term group, $\mathbb{Z}_i^T = 0$, where averages are 40 and 43 months, respectively. The median term T' for the high- and low-term groups is 36 versus 48 months. The F-statistic for this first stage is 63.

Figure 3: 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 95% confidence intervals for the estimate of the mean.

There is some evidence that participants in the high-interest rate group opt to shorten the debt term (by about half a month or 1%).

Forbearance take-up. 35% of the participants (7,308) are randomized to receive a forbearance offer. The first stage effect of forbearance offers is reported in columns three and four in Table 4. The results in column 4 are for subjects offered forbearance ($\mathbb{Z}^F$=1). I discuss the take up decision in detail in Table A.1.

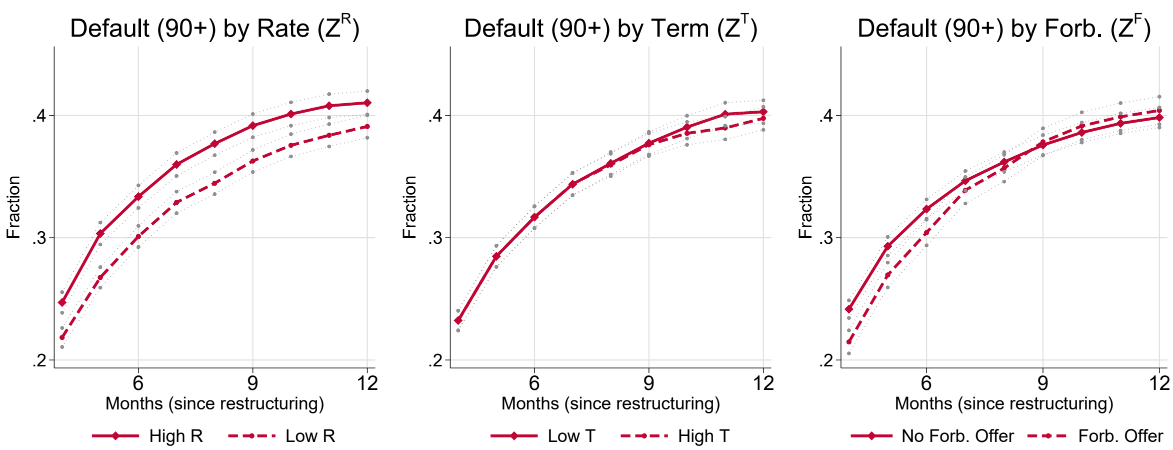
One-third of those offered forbearance take up this offer. The F-statistic for this first stage is 2,216. Similar to term extension offers, I find no evidence to suggest that differences in interest rates or term encouragements compound forbearance take-up.[7] Take-up of the forbearance offer is tightly linked to the remaining term of the original contract. For example, borrowers with an additional 12 months remaining on their original 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 in 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 the take-up by about 2 percentage points.

4 Results

4.1 Solvency Triggers

I begin by studying the effect of experimental assignments on the qualitative dynamics of defaults using event studies. I use the event studies to document that modifications orthogonal to the face value of liabilities—solvency—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 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 4: Event Study



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 95% confidence intervals for the estimate of the mean.

Figure 4 plots average cumulative delinquency frequencies separately by rate, term, and forbearance. In the event studies, t=0 is each participant's refinancing month. The x-axis indicates the months elapsed since refinancing. The y-axis displays the cumulative fraction in each treatment leg that reaches 90+ day delinquent status. Dashed lines indicate 95% confidence intervals for estimates of the mean. The panel on the left displays delinquency status by $\mathbb{Z}_i^R$—the high-rate-reduction group versus the low-rate-reduction group. The panel on the right displays delinquency status by $\mathbb{Z}_i^F$—the group that received the forbearance offer versus the group that did not.

Participants who refinance the contract are expected to make the first monthly payment

[7] 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 percentage point 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.

at t=1. If the first payment due in month t=1 is missed, Figure 4 will show 90+ day delinquent status in month t=4. 47% of 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 6 months is 32%. After t=6, a gradual increase in delinquencies occurs, and 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 in Figure 4, 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 an interest rate reduction only. These figures corroborate the previously documented findings whereby changes in the interest rate alone can reduce the default hazard without changing the face value (e.g., Fuster and Willen (2017) and Di Maggio et al. (2017)). Importantly, the effect of interest rate reductions occurs immediately and persists throughout the experimental timeframe, decreasing the long-run default probabilities.

Temporary forbearance policies are merely backloading and finance payment reductions with future debt. A salient policy question is whether these policies reduce delinquencies compared with the counterfactual in which they are not offered and whether the effects extend beyond expiration. The event study on the right in Figure 4 shows the fraction delinquent by those who receive a forbearance offer versus those who do not. The temporary forbearance modification provides an immediate payment reduction that is, by construction, large and targeted. It reduces payments to interest on the principal 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+ day delinquent status visible in period t=6, 90 days after expiration of forbearance. However, forbearance only shifts the timing of the default decision, with no long-run effects. After forbearance expires, defaults increase and catch up with the group not receiving a forbearance offer.

To quantify and perform statistical tests on the difference in conditional means for the different groups displayed in the event studies in Figure 4, I report simple reduced form or 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 denotes an individual, f_t denotes 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, health, liabilities, 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 quantify differences in 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^R, θ^T, and θ^F—the intent-to-treat effects of the assignment to a high-relief leg concerning a particular contract feature on delinquencies at a given time.

The results are reported in Table 5. 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. Accordingly, use 90+ day delinquent 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+ day delinquent status after 9, 12, and 15 months as the left-hand-side variable.

Table 5: Intent-to-treat Effects

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

	Short-run			Long-run		
	4*m*	5*m*	6*m*	9*m*	12*m*	15*m*
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. The left-hand-side variable is a 90+ indicator at t, multiplied by 100. N=20,944.

The first row in Table 5 reports the difference in defaults for the treatment leg that receives a higher interest rate reduction. The group receiving higher interest rate reductions see their probability of defaulting by month t=6 reduced by 3.15 (s.e. 0.6) percentage points off a base of 32%, or by 10% relative to the mean delinquency rate. The effect is immediate, and 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 interest rate reductions is detected after 15 months, and the response is highly statistically significant (p=0.002).

The third row in Table 5 reports the difference in defaults for the treatment leg that receives a forbearance offer. Offering forbearance 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, respectively). Estimating the effect of forbearance take-up on compliers as the ratio of the estimated intent-to-treat effect of a forbearance offer and the estimated proportion of compliers yields $\frac{2.69}{0.328} = 8.2$ and $\frac{1.96}{0.328} = 6.0$ percentage points. Therefore, accepting 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, I find no statistically significant long-run differences in defaults for participants offered forbearance (p=0.73, 0.43, and 0.62 after 9, 12, and 15 months, respectively).

The second row in Table 5 reports the difference in defaults for the treatment leg that receives a higher term offer. These borrowers are encouraged to address their persistent liquidity constraints by spreading payments further over time and providing more drawn-out relief. Point estimates of the effects of term extensions are negligible in magnitude compared with rate and forbearance. 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 but remains statistically insignificant (p=0.22 after 15 months). These patterns are broadly incompatible with solvency being the sole driver of borrower decisions.

4.2 Liquidity Triggers

If liquidity drives decisions, borrowers default because current payments are too high. Previous research discussed in the literature review test liquidity triggers by analyzing policies that act on payments in isolation or comparing a policy that acts on payments with another that does not. Here, the experimental design varies payments for similar participants in three ways. This feature allows for direct tests of the association between current payments and delinquencies, as predicted by theories that emphasize liquidity.

To better understand the relationship between liquidity and the default decision, Table 6 reports the first stage effect of experimental assignment on current payments separately by rate, term, and forbearance legs. These first stage estimates quantify the exogenous differences in payment flow between the treatment and control groups using OLS. The first column focuses on payments in the quarter before the expiration of the forbearance. The second column focuses on payments in the quarter after the expiration of forbearance.

Table 6: First Stage Effects on Current and Future Payments

	Pay_1 Current	Pay_2 Current	PV_1^{fu} Future	PV_2^{fu} Future
$\mathbb{Z}^R$	- 0.96	- 0.85	- 6.28	- 5.74
	(0.07)	(0.06)	(0.08)	(0.12)
$\mathbb{Z}^T$	- 0.88	- 1.01	0.49	1.59
	(0.07)	(0.06)	(0.08)	(0.12)
$\mathbb{Z}^F$	- 1.92	0.29	1.66	1.63
	(0.07)	(0.06)	(0.09)	(0.13)
Cons.	11.6	11.8	92.9	85.2
	(0.06)	(0.06)	(0.08)	(0.12)
F	401	160	2,128	816

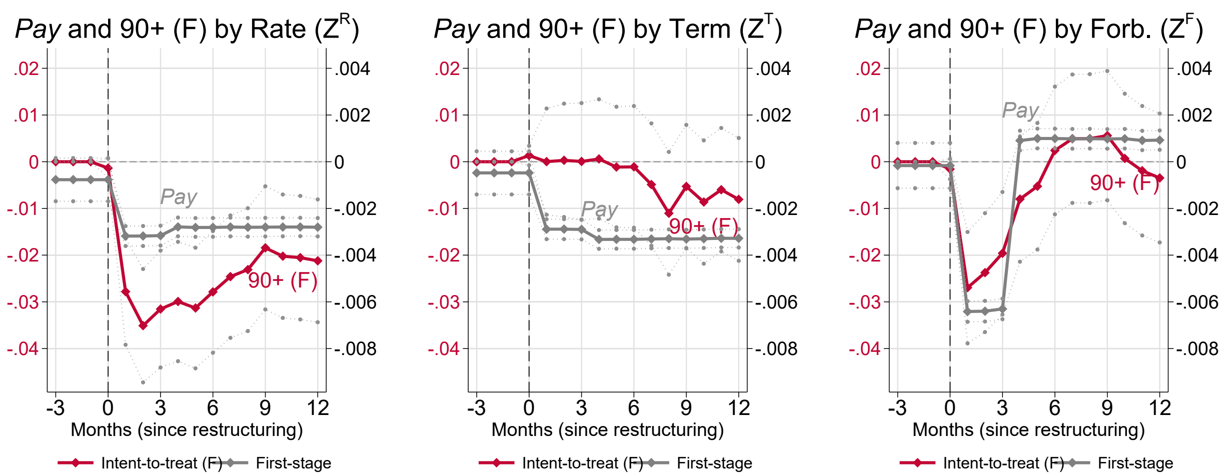
Note. Table reports the first stage effects on current payments in quarter t, Pay_t, and the present value of future payments coming after quarter t, PV_t^{fu}. N=20,944. Both are normalized by and expressed as a percentage of face value at the time of refinancing FV_0. F-test p-value is for the null hypothesis that coefficient estimates are jointly equal to zero.

All modifications reduce current payments. Interest rate reductions, reported in the first row of Table 6, entail a similar effect on payments compared to the effect of term extension encouragements, reported in the middle row, and a much smaller effect on payments compared to forbearance offers, reported at the bottom row—equivalent to 96 cents, 88 cents, and $1.92 for each $100 of face value, respectively. As payments are relatively more sensitive to term than the interest rate, the small difference in terms between the treatment and control groups creates a reduction in payments similar to the interest rate reductions. The reduction in payments entailed by forbearance offers (1.92% of face value) is due to a reduction in the quarterly payments from about 10% of face value to interest on the principal of 4% of face value for the one in three who take up.

To visualize the contemporaneous relationship between payments and the borrower's decision to default, in Figure 5 I superimpose the first stage differences reported in Table 4 (in gray) on the intent-to-treat estimates reported in Table 5 (in red). As previously, I juxtapose interest rate reductions, term extensions, and forbearance for contrasting effect. To capture the concurrence, the left-hand-side variable of the intent-to-treat specification is the 3-month forward of 90+ day delinquent status. Regarding timing, the borrower observes the current quarter *Pay* and then decides whether to stop making payments. Once she stops making payments in any given quarter, 90+ day delinquent status is reached 3 months later. The left axis displays the reduction in delinquencies. The right axis displays the reduction in payments as a percentage of the face value at origination.

Qualitatively, Figure 5 visually corroborates key dynamics from the event studies in Figure 4. The left panel in Figure 5 shows that interest rate reductions lead to an immediate decrease in defaults that persists in the long run. The right panel in Figure 5 shows

Figure 5: First Stage and Intent-to-treat Effects



Note. Red line plots the reduction in fraction delinquent—coefficients from the linear probability intent-to-treat specification, where the left-hand-side variable is the three-month forward of 90+ status. Gray line plots the reduction in payments per dollar of principal—coefficients from the first stage specification, where the left-hand-side variable is *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.

that offering forbearance also leads to a decrease in defaults, with the 90+ day delinquent status picking up in the last month before forbearance expiration. The delinquency rate rises sharply after the expiration of the forbearance period when payments resume and rise. Eventually, forbearance only shifts the timing of the default decision. This is compatible with the view that forbearance leaves the borrower with more debt, becoming a drag in the long run. The middle panel in Figure 5 shows that the effect of term extensions becomes more pronounced in the final months.[8] Still, the effect of term extensions remain economically and statistically insignificant.

Quantitatively, Figure 5 shows that the marginal reduction in payments entailed by a modification has a weak association with the borrower's default decision. The Wald estimator of this association—the sensitivity of defaults to payments—can be calculated as the ratio of these intent-to-treat and first stage effects. Forbearance targets those who need the most and reduces payments, on average, twice as much interest rate reductions. Term extension encouragements are also targeted and reduce payments in a similar magnitude and persistence as rate reductions. However, encouraging borrowers to shorten their term marginally (by about 3 months off a base of 40 months) to entail an average reduction in payments that equals that of the interest rate does not lead to a comparable increase in delinquencies. Strikingly, delinquencies are noticeably more responsive to interest rate reductions.

Let ϕ denote the sensitivity of defaults to current payments. To quantify this sensitivity, I study a specification of the following form:

$$Y_i = \phi Pay_i + f_t + \varepsilon_i \tag{5}$$

where *Pay* is the quarterly payment (flow) normalized by the face value. f_t denotes calendar month fixed effects. The error term ε_i accounts for delinquencies due to other factors,

[8]Consider a borrower with uncertain income who defaults if payments are above income. Then the differences in defaults should increase over time as affordability shocks hit. Compatible with this interpretation, the effects of term extension become more pronounced over time. In contrast to this interpretation and compatible with strategic behavior, the effects of rate reductions are immediate.

such as income and wealth shocks. As in Figure 5, the left-hand-side variable is the three-month forward of 90+ day delinquent status. In this specification, I use data on a single cross-section in the first quarter for the 20,944 participants.

Estimating Equation (5) using OLS would identify ϕ from the variation that includes that in the magnitude of changes in Pay. However, the variation in the magnitude of the change in $Pay_i|\mathbb{Z}_i^k$—although possibly uncorrelated with the error term ε_i— is not randomized. Therefore, the coefficient for ϕ is estimated using 2SLS, where either $\mathbb{Z}_i^R$, $\mathbb{Z}_i^T$, or $\mathbb{Z}_i^F$ are used as instruments, in a similar spirit to Parker et al. (2013) and Aydin (2022). Randomization ensures that the experimental assignment is orthogonal to all other variables by construction, in particular, potential omitted variables and the residual ε_i; and generates variation in current payments, as shown in Table 6.

Panel A in Table 7 reports the results. In the first column I restrict variation to $\mathbb{Z}_i^R$, akin to studies that use naturally occurring interest rate shocks (e.g., adjustable mortgage rate resets) to estimate the sensitivity of defaults to periodic payments. In the second and third columns, I restrict variation to $\mathbb{Z}_i^T$ and $\mathbb{Z}_i^F$, respectively. These estimates give the instrumental variables 2SLS estimate of the local average treatment effect (LATE). This effect is of a marginal increase in current payments equivalent to 1% of face value on the probability of default in percentage points.[9]

A dollar change in payments has drastically different effects if delivered through forbearance, term extension, or interest rate reduction. When payments are reduced by 1% of face value through an interest rate reduction, the incidence of defaults decreases by 3.31 percentage points (p <0.001). By contrast, when payments are reduced by 1% of face value through forbearance, defaults only decrease by 1.03 percentage points (p=0.004). Hence, forbearance would have to reduce current payments by more than three times to obtain an impact on delinquencies similar to that of rate reductions. Payment reductions that entail a reduction in payments similar interest rate reductions through term extensions do not affect defaults (p=0.99). As the specification is exactly identified, these estimates overlap with the 2SLS estimator. These patterns are broadly incompatible with liquidity being the sole driver of borrower decisions.

4.3 Strategic Triggers

Strategic defaults are due to future payments, holding constant solvency (ability to meet total liabilities in face value), and liquidity (ability to meet current payments). The novel design here separates strategic behavior from the face value of debt. This approach allows for an investigation of strategic default triggered by (non-callable) future payments before they act through the budget constraint and affordability.

The smoking gun of the strategic effects is the immediate and large reduction in delinquencies for borrowers in the high rate reduction group. This effect is due to changes in the intertemporal path of payments beyond current payments since interest rate reductions reduce payments, on average, just as much as term extensions (which have a relatively negligible effect on defaults) and only by half as much as with forbearance (which have a lesser effect on defaults).

[9]This LATE is for compliers induced by the instruments to see a change in the value of the endogenous regressors. Compliers and treatment effects change when a different subset of instruments is used for identification. 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 $\mathbb{Z}_i^F$ and $\mathbb{Z}_i^T$ as the instrument yields a treatment effect that is the local average for participants who take up the forbearance and extend the term, the most relevant subpopulations. 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. For the instrument $\mathbb{Z}_i^T$, monotonicity requires that borrowers with $\mathbb{Z}_i^T = 1$ do not choose a term shorter than that would prevail under $\mathbb{Z}_i^T = 0$.

Table 7: Treatment Effects of Current and Future Payments

Panel A: Sensitivity
$Y_i = \phi Pay_i + f_t + \varepsilon_i$

Pay	3.31	-0.007	1.03
Current	(0.72)	(0.74)	(0.35)
Instrument			
$\mathbb{Z}^R$	✓		
$\mathbb{Z}^T$		✓	
$\mathbb{Z}^F$			✓
$\mathbb{P}(\phi = 0)$	<0.001	0.99	0.004

Panel B: Decomposition
$Y_i = \phi Pay_i + \psi PV_i^{fu} + f_t + \varepsilon_i$

Pay	1.11	1.29	1.21	3.11
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)
Instrument				
$\mathbb{Z}^R$	✓	✓	✓	✓
$\mathbb{Z}^T$	✓		✓	✓
$\mathbb{Z}^F$	✓	✓	✓	✓
			Controls	IV Probit
$\mathbb{P}(\phi = \psi = 0)$	<0.001	<0.001	<0.001	<0.001
$\mathbb{P}(\phi = 0)$	<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
ψ / ϕ	0.30	0.24	0.30	0.29

Note. N =20,944. The left-hand-side variable is the 3-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.

Recall that what distinguishes these debt relief policies is their effects on future payments. Columns 3 and 4 in Table 6 report this first stage effect of experimental assignment on PV_t^{fu}—the present value of payments that come after a quarter t. This present value is calculated using the annuity formula assuming a discount rate R^* of 18% APR.

Forbearance moves current and future payments in different directions: it reschedules payments by backloading. The short-term reduction in payments is repaid with an approximately one-for-one increase in the present value of future payments; thus, reducing defaults due to a liquidity effect and increasing defaults due to a strategic effect. Let ψ denote the sensitivity of defaults to PV_t^{fu}. A reduction in delinquencies due to forbearance then reflects the extent of liquidity constraints, roughly equal to the difference in the sensitivity to current versus future payments, ϕ - ψ.

By contrast, interest rate reductions move current and future payments in the same direction, thereby reducing defaults due to both a liquidity effect and a strategic effect. The effect on current payments is small, and the effect on the present value of future payments is much larger—equivalent to $6.28 for each $100 of face value.

In the specifications that use naturally occurring data and variation to study the effects of interest rate reductions, as in Equation (5) (e.g., downward rate reset designs), the present value of future payments is an omitted variable. These research designs cannot observe, distinguish, or decompose liquidity versus the strategic effects of changes in interest rates. The experimental variation here shifts current and future payments in a different direction, which allows for the identification of their relative contributions to borrower decisions.

I first obtain a naive and nonparametric decomposition of the strategic effects using a *bivariate Wald* estimator. I do this by comparing the intent-to-treat and first-stage effects of $\mathbb{Z}^R$ and $\mathbb{Z}^F$. The intent-to-treat effects of $\mathbb{Z}^R$ and $\mathbb{Z}^F$ on defaults in the first quarter are reported in Table 5 (-3.15 and -1.96 percentage points). The first stage effects of $\mathbb{Z}^R$ and $\mathbb{Z}^F$ on current payments and the present value of future payments in the same period reported in Table 4. I then solve the exactly identified system of two equations and two unknowns:

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

The relative contributions of current payments and the present value of future payments to defaults, ϕ and ψ, yield 1.28 and 0.31. Hence, defaults are triggered by current and future payments but are more sensitive to current payments. Moreover, a dollar increase in the present value of future payments increases defaults by as much as a ψ/ϕ =24-cent increase in current payments—a strategic effect.

Using this identification strategy, I then decompose the effect of current payments, Pay, from the present value of future payments, PV^{fu}, using a linear probability model of the following form:

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

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), calculated using the annuity formula from the perspective of a quarter. These variables are normalized by the face value at origination, FV_0. The error term 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. The borrower then decides whether or not to stop making payments or not. Once she stops making payments, 90+ day delinquent status is reached 3 months later. In this specification, I use data on a single cross-section in the first quarter for the 20,944 participants.

The objects of interest are the coefficients ϕ and ψ, which 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% of face value on the probability of default in percentage points.

As described earlier, estimating Equation (6) by OLS would identify ϕ and ψ from 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, 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.

The additional identifying assumption for the LATE interpretation is that the experimental assignment has no effect 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 Panel A of Table 7 due to the omitted PV^{fu} term, which the decomposition design here overcomes.

These estimates are reported in Panel B of Table 7. The first column provides the estimates that uses variation in all three instruments.[10] The point estimates for ϕ indicate that an increase in Pay corresponding to 1% of the face value of debt increases defaults by 1.11 percentage points. In comparison, an increase in PV^{fu} corresponding to 1% of the face value of debt increases defaults by only 0.33 percentage points. The second column in Panel B uses variation in only $\mathbb{Z}_i^F$ and $\mathbb{Z}_i^R$. In this case, the specification is exactly identified, and these estimates numerically overlap with the naive estimator discussed earlier.

[10]Using many instruments simultaneously produces a weighted average of the causal effects of instrument-specific compliant populations, in which the weights depend on the relative strength of each instrument in the first stage; see Imbens and Angrist (1994). Hence the PV effect ψ is identified mainly from the variation in $\mathbb{Z}_i^R$.

Liquidity Equivalent. At the bottom of Table 7, I calculate an identified moment ψ/ϕ. This liquidity equivalent summarizes the sensitivity to future payments relative to current payments. As a wedge, it distinguishes between alternative models in ways that differ from the commonly estimated sensitivity of behavior to current payments. If future payments have no effect, ψ/ϕ would yield 0. In a model with fungibility—indifference between \$1 today and \$1+R^*tomorrow—ψ/ϕ would yield 1. If current payments had no effect, ψ/ϕ would yield ∞. I estimate that 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 key moment also captures the strategic motive's relative strength. I examine this liquidity equivalent in more detail in the following sections.

Tests of Competing Models. The models discussed in Section 1 and Table 1 (i.e., solvency, liquidity, strategic) make different predictions about the determinants of default. The bottom rows of Table 7 report the results of statistical tests of these models.

In the classical solvency model borrowers default because the face value of liabilities is too high. Hence, neither reducing payments nor changing the interest rate affects borrower behavior: $H_0 : \phi = \psi = 0$. Unsurprisingly, this hypothesis is decisively rejected, with $\mathbb{P}(\phi = \psi = 0) < 0.001$.

In models emphasizing liquidity borrowers default because current payments are too high. Naturally, 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.

However, liquidity is not the sole driver of borrower decisions. If liquidity is the sole driver of borrower decisions, borrowers should behave identically whether or not the reduction in current payments is accompanied by a dollar increase or decrease in payments tomorrow. Hence, reducing 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. The treatment effect estimates imply that the borrowers default less in response to announced but not yet realized reductions in future payments. This effect occurs when the change enters borrower information sets before the payments take effect through cash flow or affordability constraints. This is evidence toward the strategic default model in which the default decision is driven by news about future payments after current payments are accounted for. Note that as forbearance and interest rate reductions are unanticipated, the analysis here mitigates the difficulty that borrowers anticipating default could strategically put themselves in a liquidity problem.

A special and knife-edge case of the strategic model that is particularly interesting is that with fungibility. In this case, a dollar increase in current payments should have the same effect on borrower behavior as a dollar change in the present value of future payments—$H_0 : \phi = \psi$. The hypothesis of fungibility is also rejected, with p=0.017. In contrast, the effects of future payments are much less pronounced than the dollar-for-dollar benchmark the perfect intertemporal substitution model predicts—with a liquidity equivalent of 30-cents. Note that rejection of fungibility acknowledges behavior is sensitive to current and future payments. Fungibility tests for a different interpretation of liquidity constraints—that behavior is relatively *more* sensitive to current payments.

Further Analysis

Balance sheet effects. Panel A in Table 8 reports the effects on late payments. These metrics reflect different types of borrower decisions. Regarding timing, a borrower who decides to stop making payments in any given quarter shows up as 0+ day delinquent status in that quarter, 30+ day delinquent status one month later, and 60+ day delinquent status two months later. Accordingly, the left-hand variable is either a 0+ indicator, one month forward of 30+ status, two months forward of 60+ status, and so on. This specification uses

Table 8: Balance Sheet Effects

	Panel A: Late Payments				Panel B: Other	
	0+	30+	120+	150+	30+	90+
Base	58%	38%	30%	30%	4%	1%
$\mathbb{Z}^R$	-3.58 (0.68)	-3.53 (0.67)	-3.00 (0.63)	-3.17 (0.63)	-0.11 (0.25)	-0.01 (0.14)
$\mathbb{Z}^F$	-3.80 (0.71)	-3.08 (0.70)	-1.87 (0.66)	-1.62 (0.66)	0.84 (0.27)	0.28 (0.14)
Pay Current	1.81 (0.31)	1.69 (0.31)	1.07 (0.29)	1.00 (0.29)	-0.26 (0.12)	-0.09 (0.06)
PV^{fu} Future	0.29 (0.11)	0.30 (0.11)	0.31 (0.10)	0.35 (0.10)	0.06 (0.04)	0.02 (0.02)
$\mathbb{P}(\psi = 0)$	0.008	0.004	0.002	<0.001	0.13	0.43
$\mathbb{P}(\phi = \psi)$	<0.001	<0.001	0.02	0.04	0.014	0.11
ψ/ϕ	0.16	0.18	0.29	0.35	<0	<0

data on only the cross-section in the first quarter for the 20,944 participants. For brevity, I omit $\mathbb{Z}_i^T$, which is economically and statistically insignificant in every case.

The estimates in Panel A in Table 8 indicate that early-cycle delinquencies (e.g., 0+ and 30+ day delinquent status) are noticeably more sensitive to forbearance and current payments (i.e., liquidity-driven). By contrast, late-cycle delinquencies are relatively more sensitive interest rate reductions and future payments (i.e., driven by strategic considerations). The liquidity equivalent of future payments, ϕ/ψ, is reported at the bottom row in Table 8. The relative effect of future payments and strategic effects become pronounced when 120+ and 150+ day delinquent status is used as the left-hand-side variable (0.29 and 0.35, compared to 0.16 and 0.18). However, strategic effects remain pronounced at all lateness metrics including 0+ and 30+ day delinquent status (p <0.01).

Panel B in Table 8 reports the effects on other accounts at the bank. These accounts represent credit line and overdraft accounts. The literature often interprets being current on a secondary account (e.g., credit card, overdraft) but not on the primary account as an indication of strategic behavior. The increase in borrower defaults come predominantly through an increase in the refinanced loan contract. Interest rate reductions do not have statistically significant effects on delinquencies on other accounts. However, borrowers who are offered forbearance tend to default more on other accounts, compatible with the interpretation that borrowers now need the liquidity provided by these other accounts less.

Table 9: Robustness: Discounting

	Constant			Hyperbolic		Hetero.	Expected
R^*	0%	24%	48%	β=0.9	β=0.8	Old R_i	$\mathbb{E}[PV]$
Pay Current	1.15 (0.29)	1.10 (0.30)	1.07 (0.30)	1.11 (0.29)	1.11 (0.29)	1.12 (0.29)	1.79 (0.33)
PV^{fu} Future	0.25 (0.07)	0.35 (0.11)	0.38 (0.15)	0.37 (0.11)	0.41 (0.13)	0.32 (0.10)	0.71 (0.22)
$\mathbb{P}(\psi = 0)$	<0.001	0.002	0.017	0.001	0.001	<0.001	0.001
$\mathbb{P}(\phi = \psi)$	0.003	0.026	0.078	0.025	0.040	0.015	<0.001
ψ/ϕ	0.22	0.32	0.36	0.33	0.37	0.29	0.40

Discounting. As discussed in Section 1, the change in the present value of future payments, to a first-order approximation, is independent of the rate at which the borrower discounts the future. In the previous analysis, I calculate present value equivalents assuming a discount rate of R^* of 18% APR.[11] Table 9 reports the results from alternative specifications in which the discount rate R^* varies.

In the first column, I calculate the present value of future payments as the nominal sum assuming no discounting (R^*=0). This is the number read aloud and communicated in writing to the borrower. In the second and third columns, I use a discount rate of 24% and 48% APR, respectively.[12] The 24% APR corresponds to the (capped hence constant) interest rate on credit card and overdraft accounts, the relevant cost of funds at which borrowers can intertemporally substitute and discount future payments. In the fourth and fifth columns, I assume quasi-hyperbolic discounting where initial payments are heavily weighted. In the sixth column, I use the original contract interest rate, allowing individuals to discount the future differently. The original contract interest rate likely reflects the borrower's pre-experiment risk and discount rate. In each of these assumptions about the discount rate, I decisively reject the null hypothesis that strategic effects are absent and liquidity is the sole driver of borrower decisions.

Finally, forward-looking borrowers may anticipate default and base their decision on the payments they expect to make before defaulting. In the seventh column, I use the *expected* present value of future payments. I calculate this expected present value using the predicted values obtained from the instrumental variables probit model reported in Table 7. I weigh two scenarios: loan defaults or loan cures. If the borrower defaults, payments are no longer made. In the case in which the loan cures, the present value is calculated in the usual way. Under this specification, the strategic effects due to future payments become even more pronounced.

4.4 Endogenous Triggers

In the debt default models that macroeconomists routinely use (i.e., that feature uninsured income shocks), triggers will be endogenous and heterogeneous. Previous debt relief studies ignore the heterogeneity and focus on the average effects due to a lack of data on balance sheets or limitations in research designs (e.g., no variation in balance sheets around the discontinuity that identifies the treatment effects). The current study features data on balance sheets; and variation in balance sheets that, by construction, is orthogonal to the experimental variation. This aspect allows for an investigation of mechanisms yet to be tested.

Although the frictions invoked—distress, precaution, lack of assets—differ, all models emphasize the inability to perform intertemporal substitution, with similar implications for the shape of the default trigger. Naturally, default is more attractive to a distressed borrower because it has the benefit of reducing current payments. Moreover, precautionary saving shortens the effective planning horizon and renders irrelevant strategic considerations due to news about payments after hitting the constraint. Finally, a lack of assets may hamper the borrower's ability to respond to news about future payments before they act through the budget constraint.[13]

I examine the heterogeneity of the borrower's response using baseline balance sheet metrics that proxy for the state variables that capture these mechanisms: the degree of distress, the number of times credit constraints bind, and checking account balances. I

[11] This roughly corresponds to an annualized discount factor of 0.94, as in Kaplan and Violante (2014).

[12] Although possible, a discount rate of 48% or above is not entirely compatible with a borrowers' term and forbearance choices. A borrower who discounts future payments at a high discount rate naturally takes up forbearance and extends the term. However, only one in three borrowers offered forbearance takeup, and only a small fraction of borrowers chose the maximum term of 72 months. Moreover, the marginal distribution of term choice is very similar among the forbearance compliers and never-takers. Previously, Harrison et al. (2002) elicited individual discount rates in Denmark using experimental survey data with monetary rewards to be 28% per year on average. Busse et al. (2013) estimate discount rates in the U.S. from car purchases ranging from negative values to 17% per year (10th to 90th percentiles).

[13] See Kaplan and Violante (2014), Campbell and Cocco (2015), and McKay et al. (2016).

perform sample splits based on pre-experiment values for each variable and divide participants into three bins.

Table 10 and Table 11 report the heterogeneous intent-to-treat and treatment effect estimates, as in Equation (4) and (6).

In these tables, the columns are ranked by borrowers' intertemporal substitution capacity. Panel A reports results by the degree of delinquency one month before refinancing. Participants 90+ days late (30%) are in the first bin. This group represents deeply delinquent debt restructuring. Participants less than 30 days late (11%) are in the last bin. This group can be thought of as mimicking regular non-delinquent refinancing. Panel B reports results based on the frequency with which credit limits bind (i.e., credit card debt-to-limit ratio above 75%). Participants without a credit line (14%) are in the first bin. Participants with a credit line are split using a cutoff equal to the median number of times constraints bind in the year before the intervention, 5. Panel C reports results based on checking balances. 90% (18,715) of participants have access to a checking account. Participants without a checking account at the bank are in the first bin. Similarly, participants with a checking account are split using a cutoff equal to the median balances.

Table 10: Forbearance vs. Interest Rates: Heterogeneity

	Panel A: by Distress Days Late			Panel B: by Precaution Times Binding			Panel C: by Assets Checking Balances		
	(A1)	(A2)	(A3)	(B1)	(B2)	(B3)	(C1)	(C2)	(C3)
	90+	31 - 90	< 30	$\emptyset$	High	Low	$\emptyset$	Low	High
Fraction	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

Note. Table reports the results from the intent-to-treat specification (4). The left-hand-side variable is the three-month forward of 90+ status at $t = 3$, multiplied by 100.

Forbearance vs. Interest Rates: Heterogeneity. First, I focus on the intent-to-treat effects in Table 10. The first row reports the baseline 90+ rate at $t = 6$, 90 days after the expiration of forbearance. The next two rows report the intent-to-treat effects of interest rate reductions and forbearance during the first quarter, estimated using OLS. Participants are not equally affected, and the absolute and relative effects of forbearance and interest rates depend on borrower balance sheets.

Forbearance reschedules payments by backloading to future payments. Therefore theory suggests forbearance should only have an effect if intertemporal substitution is imperfect. Moreover, the effect should be larger if the difference in the sensitivity to current versus future payments is large.

The first column in Panel A focuses on early-cycle delinquencies (<30 days late). For this group, offering forbearance is not effective and leads to a 5% *increase* in defaults. Naturally, borrowers who are not in default do *not* find forbearance attractive because it only alters the timing of repayment. In contrast, for participants who were already in default, offering forbearance leads to a 14% decrease in defaults (a 4.55 percentage point reduction off of a base 32%), with take-up leading to $\frac{-4.55}{0.34} = 13.6$—a 43% decrease in defaults.

Focusing on Panel B, borrowing constraints are also highly relevant for the default decision. In particular, the efficacy of forbearance is strictly increasing in the number of times credit constraints bind. The first column in Panel B focuses on participants without a credit line. For this group, take-up of forbearance prevents 1 in 3 defaults ($\frac{3.52}{0.37}$ off a base of 28%). In contrast, for participants whose credit limits bind infrequently, take-up of forbearance prevents only 1 in 6 defaults ($\frac{1.63}{0.33}$ off a base of 29%).

Similarly, focusing on Panel C, take-up of forbearance prevents 1 in 3 defaults ($\frac{3.58}{0.36}$ off a base of 28%) for participants without a checking account, but only 1 in 6 ($\frac{1.67}{0.33}$ off a base of 29%) for participants who have high checking balances.

In contrast to forbearance, interest rate reductions unambiguously benefit the borrower and should decrease defaults for all subgroups. Rate reductions are indeed associated with a statistically significant reduction in delinquencies for all subgroups. The only groups for which the effect is not statistically significant are participants with no checking account (p=0.09) and participants who were not late (p=0.25)—the two subgroups that contain about 10% of participants each. Hence the inability to reject the null likely reflects the low number of observations in these bins.

Forbearance is relatively less effective than interest rate reductions for all subgroups. The only exception is participants with no checking account (10%), for whom interest rate reductions and forbearance have economically and statistically similarly significant effects. Interest rate reductions are substantially more effective (twice as much or more) for participants who can intertemporally substitute. These are participants who are non-delinquent, whose borrowing constraints bind less frequently, and who hold higher liquid checking assets.

Table 11: Treatment Effects of Current and Future Payments: Heterogeneity

	Panel A: by Distress Days Late			Panel B: by Precaution Times Binding			Panel C: by Assets Checking Balances		
	(A1)	(A2)	(A3)	(B1)	(B2)	(B3)	(C1)	(C2)	(C3)
	90+	31 - 90	< 30	∅	High	Low	∅	Low	High
Fraction	0.30	0.59	0.11	0.14	0.43	0.43	0.10	0.45	0.45
Pay Current	2.40 (0.55)	0.66 (0.38)	0.08 (0.70)	2.19 (0.87)	0.79 (0.46)	1.09 (0.42)	2.08 (0.91)	1.04 (0.45)	0.97 (0.43)
PV^{fu} Future	0.39 (0.18)	0.28 (0.14)	0.23 (0.22)	0.43 (0.25)	0.20 (0.17)	0.39 (0.15)	0.19 (0.30)	0.23 (0.16)	0.44 (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
ψ/ϕ	0.16	0.43	2.88	0.20	0.26	0.35	0.09	0.22	0.45

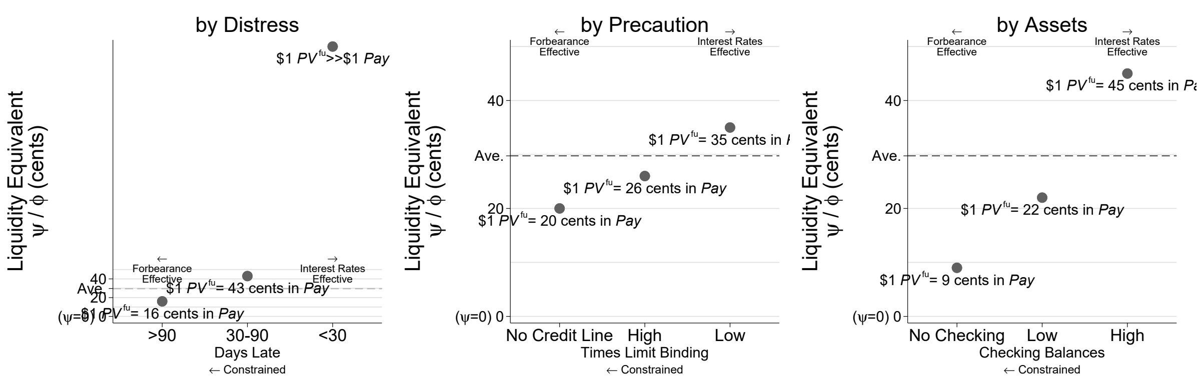
Note. Table reports the results from the treatment effect specification (6) by bin. The left-hand-side variable is the three-month forward of 90+ status at $t = 3$, multiplied by 100.

Sensitivity to Current vs. Future Payments: Heterogeneity. Next, I focus on treatment effect estimates in Table 11. These estimates decompose the effect of current and future payments. Like the reduced form estimates, average treatment effect estimates mask substantial heterogeneity. Compatible with the intent-to-treat effect estimates of forbearance, delinquencies are most sensitive to current payments for the lowest liquidity groups (2.40

for 90+, 2.19 for no credit line, 2.10 for no checking account). For non-delinquent refinancers in Panel A3, the sensitivity of defaults to current payments is very close to zero (p=0.91).

Figure 6 displays the heterogeneity in the liquidity equivalent ψ/ϕ. Similar to the intent-to-treat effects reported in Table 10, the relative sensitivity of behavior to current versus future payments also depends on distress, precaution, and assets. For all balance sheet metrics, the relative effect of future payments is monotonically increasing. The relative sensitivity ϕ/ψ is smallest, at 9 cents, for borrowers without a checking account (10%) and highest, at \$2.88, for the non-delinquent (11%). Focusing on Panel B, the relative sensitivity ϕ/ψ is smallest, at 20 cents, for borrowers without a credit line (14%) and highest at 35 cents for participants whose credit lines bind less frequently. Hence, the precautionary savings effect that countervails forces of intertemporal substitution grows stronger as the number of times constraints bind increases. Focusing on Panel C, the higher the checking balances, the higher the default sensitivity to news about future payments: the relative sensitivity ϕ/ψ is smallest, at 9 cents, for borrowers without a checking account (10%) and highest at 45 cents for participants with high checking account balances.

Figure 6: Relative Sensitivity to Future Payments: Heterogeneity



Note. Figure plots the ratio ψ/ϕ—liquidity equivalent of the strategic trigger level—from the treatment effect specification (6) by bin, as in Table 11.

These heterogeneous effect estimates in Table 11 and Figure 6 allow for informative inferences regarding the shape of the default trigger. For an unconstrained borrower, a dollar change in future payments affects their default decision just as much as a dollar change in current payments. However, as constraints become more binding, a much smaller change in current payments becomes sufficient to trigger a default. This intuition is best captured by the model of Campbell and Cocco (2015). In this model, binding constraints increase the marginal utility of consumption today relative to the future and increase the effective discount rate, making the immediate benefits of default more attractive. In other words, borrowing constraints accelerate default by decreasing the liquidity equivalent of the strategic trigger level. Distress, precaution, and assets are all key state variables that determine the location of the liquidity trigger.

This approach contrasts the commonly invoked dual-trigger model; strategic (e.g., the face value of debt is lower than the home value) and liquidity (e.g., income) triggers are required for a default. Here, neither liquidity nor strategic considerations are necessary, but both are sufficient to trigger a default.

5 Discussion

5.1 Liquidity versus Strategic Effects of Interest Rates

Since Fisher (1933)'s debt deflation analysis of the Great Depression, macroeconomists have appreciated the importance of revaluation shocks on borrower behavior.[14] Such revaluation shocks, despite entailing a small effect through Keynesian channels that operate via the cash flow effect through current payments, are shocks to the stock of debt and affect borrower behavior through strategic channels and future payments.[15] As discussed in Section 1, a 2% reduction in the interest rate will entail a revaluation effect that approximately equals a $\frac{1}{2}\ T\ \Delta R\ =$10% writedown for a borrower who holds a 10-year mortgage, with more or less the entire impact happening through future payments. Nevertheless, interest rate reductions (e.g., refinancing a mortgage) are often interpreted as a cash flow shock that acts only through current payments and the liquidity channel. This interpretation is due to the limits of research designs that can overcome the violation of exclusion restriction and identify elasticities credibly.

The experiment allows for a decomposition of the share of the behavioral response to interest rates that is attributable to a strategic effect (as opposed to a liquidity effect):

$$\frac{\Delta Y}{\Delta R} = \underbrace{\underbrace{\frac{\Delta Y}{\Delta Pay}}_{\hat{\phi}=1.11} \underbrace{\frac{\Delta Pay}{\Delta R}}_{0.96\%\ FV_0}}_{\text{Liquidity}\approx\frac{1}{3}} + \underbrace{\underbrace{\frac{\Delta Y}{\Delta PV^{fu}}}_{\hat{\psi}=0.33} \underbrace{\frac{\Delta PV^{fu}}{\Delta R}}_{6.28\%\ FV_0}}_{\text{Strategic}\approx\frac{2}{3}}$$

where 1.11 and 0.33 are estimates of the sensitivity of behavior to current and future payments, ϕ and ψ, respectively and 96 cents and \$6.28 per \$100 of principal are the corresponding first stage effect of interest rate reductions.

These estimates imply that only one-third of the effect of interest rate reductions on delinquencies is due to liquidity effects (current payments), with the remaining two-thirds due to strategic effects (future payments). The benefits of interest rate changes through future payments are equivalent, in the sense of providing the same reduction in delinquencies, to a deferral program that reduces monthly payments by 5% of average monthly household disposable income.[16] These effects of interest rate changes on future payments are not replicable by term extensions and forbearance. In this regard, interest rates get into the cracks that rescheduling policies that act on payments cannot. To compensate, a forbearance program should reduce current payments by about three times what interest rate reductions do to obtain a similar impact on delinquencies; see Table 7. Evaluating the performance of models that simulate monetary policy based on their ability to capture the effect of payment reductions quantitatively leads to an incomplete picture regarding the channels and sizes of effects through which interest rates affect behavior.

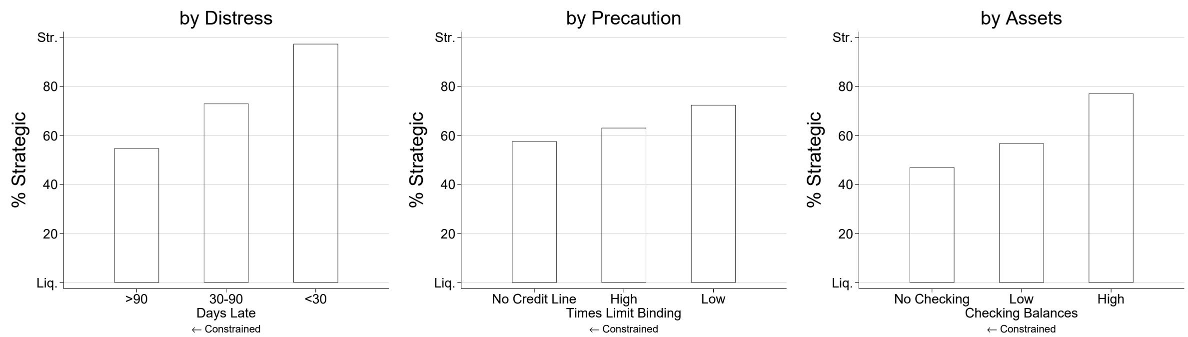
Figure 7 decomposes liquidity versus strategic effects of interest rate changes for different balance sheet groups. There is a direct connection between the substitution implied by a model (i.e., the relative sensitivity of behavior to future payments) and the strength of the strategic motive. The liquidity effects of interest rates are more pronounced if borrowers are distressed, face asset constraints, or have constraints that bind frequently. For early-cycle delinquencies, 98% of the behavioral response to interest rates is attributable to a strategic effect. Hence, for a typical refinancing in which a non-delinquent borrower reduces the interest rate on the debt contract, the effects on future payments account for

[14] See Campbell and Cocco (2003) and Verner and Gyöngyösi (2020) for inflation and currency devaluation.

[15] For example, a Hungarian household that borrowed in Swiss francs will see the face value of debt in local currency go up by 10% if the Hungarian forint depreciates by 10% relative to the franc. Similarly, a U.S. household holding nominal debt with a fixed rate will see the real value of debt decline by 10% if U.S. dollar inflation is 10%.

[16] This number is obtained as $0.30 \times 6.28\% \times \frac{10{,}403}{3{,}844}$—the revaluation effect on the present value of future payments equals 6.28% of 10,403 TRY; ϕ/ψ=0.30 is the relative sensitivity, and Y=3,844 TRY the mean monthly household disposable income (see Appendix A).

Figure 7: Liquidity versus Strategic Effects of Interest Rates: Heterogeneity



more or less the entire impact of interest rate changes. Even for participants who are the least able to substitute intertemporally, strategic effects account for no less than 50% of the total effect. Hence, the findings are incompatible with a simple two-agent calibration with stylized heterogeneity.

5.2 Generalizability

How would the results differ if the experiment were replicated in different settings? The analysis of heterogeneous triggers in Section 4.4 suggests that the key state variable determining the efficacy of alternative forms of debt relief is baseline balance sheets—distress, precaution, and assets. These variables determine whether forbearance or interest rate reductions are more effective. They also govern the heterogeneity in the sensitivity of behavior to current payments versus news about future payments, ϕ, and ψ; thus they determine how much of the defaults are due to liquidity versus strategic considerations.

An important issue is that the sample here primarily consist of distressed borrowers. Naturally, these borrowers are in poor financial shape since they hold little to no assets and frequently face binding borrowing constraints. Focusing on early-cycle refinancings (reported in Table 11, A3), merely postponing payments is ineffective, and the effects of future payments is more pronounced, which renders standard monetary policy an even more powerful relief tool. Similarly, background policies that ease constraints on borrowers and allow for better intertemporal substitution (e.g., fiscal stimulus payments) would also render interest rates more powerful.

Borrowers default due to strategic considerations—that is, they stop making payments even when they can afford to when it is a more advantageous financial decision than continuing to pay—if the present value of future payments is higher than the costs associated with default. Hence, an increase in the costs associated with default (e.g., an irreversible decision such as moving, deadweight loss, recourse, stigma, etc.) will hamper the attractiveness of default due to the strategic motive.

Finally, the results offer a reconciliation to what appears to be conflicting results from previous debt relief studies and provide a unifying explanation regarding under what conditions liquidity versus strategic behavior triggers default. Dobbie and Song (2020) and Ganong and Noel (2020) use either-or designs in which one group receives a write-down, and another receives a payment reduction. Focusing on average effects, the former study finds that payment reductions do not affect defaults, whereas the latter finds that only current payments determine defaults. Hence, the implied relative sensitivity of future payments to current payments, ψ/ϕ, is ∞ and 0, respectively. In the former study, participants are early-cycle delinquent borrowers in debt counseling who are given relatively small write-downs on credit cards that they can intertemporally substitute. This is precisely what I find for early-cycle delinquencies. In the latter study, participants are deeply delinquent mortgagors facing very high default costs (e.g., moving, family, stigma, deadweight loss) who are given large writedowns of underwater home equity; hence, they are much less likely to be able to monetize these long-run obligations. The latter finding is similar to Indarte (2022), who studies the bankruptcy decision of deeply delinquent households and similarly finds liquidity drives borrower decisions.

6 Conclusions

In this paper, I analyzed an unexpected debt relief experiment using the language and framework of a randomized control trial. I use the experiment to revisit a question of a longstanding interest in policymaking, finance, and macroeconomics: what triggers default on debt obligations, and what relief policy best prevents it?

There are four main findings regarding default triggers. First, in contrast to defaulting because face value is too high (solvency), modifications orthogonal to face value affect whether and when to default. Second, in contrast to defaulting because current payments are too high (liquidity), borrowers respond differently to a dollar reduction in current payments when delivered through forbearance or interest rate reduction: forbearance reduces payments twice as much, whereas delinquencies are more responsive to an interest rate reduction. Third, compatible with strategic behavior, borrowers default in response to changes in future payments orthogonal to solvency *and* liquidity: a dollar increase in future payments increases defaults by as much as a 30-cent increase in current payments. Fourth, compatible with the endogeneity of triggers, whether forbearance or interest rates is more effective and whether defaults are strategic is tightly linked to borrower balance sheets.

From a theoretical perspective, these findings allow for informative inferences regarding the default trigger's shape. As borrowing constraints become more binding, a much smaller change in current payments becomes sufficient to trigger a default. That is, borrowing constraints decrease the liquidity equivalent of the strategic trigger level. This interpretation is most compatible with a model in the spirit of Campbell and Cocco (2015). In this model, there exists a single strategic default trigger whose location is influenced by distress, precaution, and assets.

From a policy perspective, these findings inform about the targeting of policies. The efficacy of forbearance and interest rates are heterogenous and tightly linked to the balance sheets. For the typical borrower, most of the behavioral response to interest rates is attributable to future payments and strategic channels. The less constrained a borrower, the more interest rates get into the cracks that rescheduling policies that act on payments cannot. The more constrained a borrower, the more powerful forbearance is as a debt relief tool.

In future work, it would be valuable to ask whether commonly used calibrations of intertemporal models are qualitatively compatible with the shape of the default region and quantitatively compatible with the heterogeneous treatment effects reported here. Finally, assessing the generality of the conclusions by examining the behavior of a representative nondelinquent refinancing is crucial for understanding monetary policy pass-through and requires further measurement and understanding.

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Online Appendix
Forbearance versus Interest Rates

Figure A.1: Macroeconomic Environment

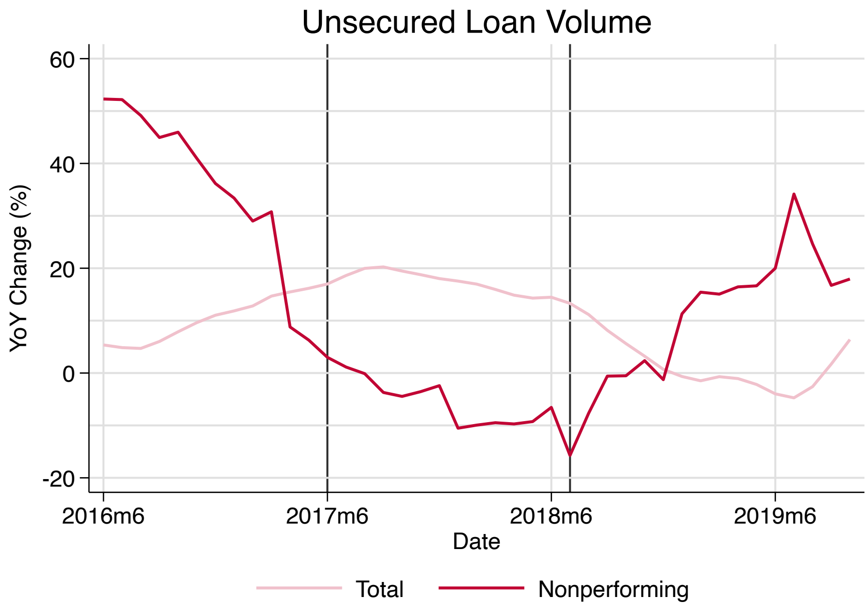
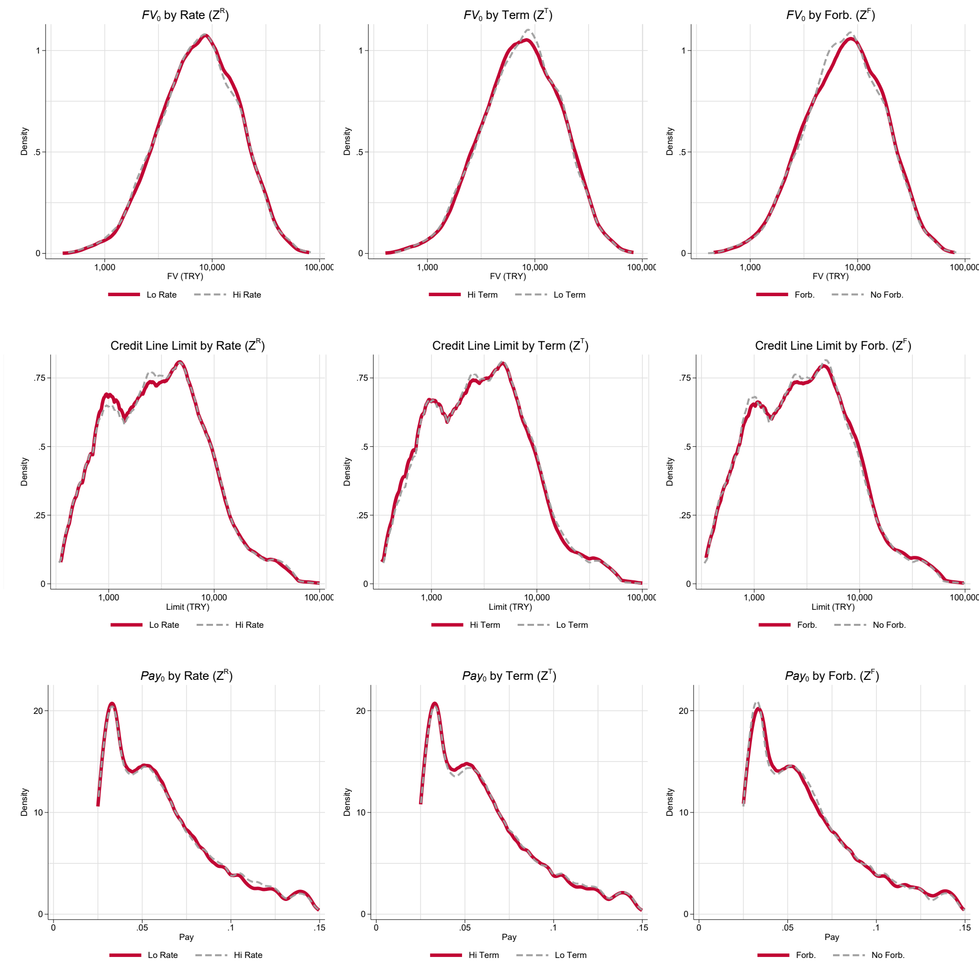


Figure A.2: Covariate Balance: Kernel Densities



Note. Figures plot the kernel densities for FV_0 (top panel, log base 10), credit card limit (log base 10) and *Pay* (bottom panel), separately by $\mathbb{Z}_i^R$, $\mathbb{Z}_i^T$ and $\mathbb{Z}_i^F$.

Table A.1: Forbearance Take-up

$\mathbb{Z}^R$		1.39		1.24		1.25		0.039	
		(1.06)		(1.05)		(1.05)		(0.031)	
$\mathbb{Z}^T$		1.08		0.92		0.93		0.030	
		(1.06)		(1.05)		(1.05)		(0.031)	
R' (APR, %)			-0.32		-0.30		-0.30		-0.003
			(0.28)		(0.28)		(0.28)		(0.008)
T'			0.34		0.33		0.33		0.011
			(0.34)		(0.38)		(0.38)		(0.011)
T				0.63	0.46	0.64	0.46	0.019	0.013
				(0.06)	(0.21)	(0.06)	(0.21)	(0.002)	(0.007)
$\log(FV)$				-2.27	-3.44	-2.47	-3.61	-0.074	-0.12
				(0.78)	(1.65)	(0.78)	(1.61)	(0.024)	(0.05)
Cons.	32.8							-0.59	-0.28
	(0.55)							(0.30)	(0.34)
	OLS	OLS	2SLS	OLS	2SLS	OLS	2SLS	Probit	Probit
f_t		✓	✓	✓	✓	✓	✓	✓	✓
$X_i\beta$						✓	✓	✓	✓
N	7,308	7,308	7,308	7,308	7,308	7,308	7,308	7,308	7,308
p^R		0.19	0.26	0.24	0.29	0.23	0.28	0.21	0.73
p^T		0.31	0.31	0.38	0.39	0.38	0.38	0.33	0.30

Note. This table uses data from 7,308 participants (35% of the full sample) with $\mathbb{Z}_i^F = 1$. The left-hand-side variable is an indicator for accepting the forbearance offer. Columns (A) to (G) report the results of simple linear probability models, and the left-hand-side variable is multiplied by 100. Columns (H) and (I) report the results of probit models. In Columns (C), (E), (G) and (I) the new interest rate R' and contract term T' are instrumented using $\mathbb{Z}_i^R$ and $\mathbb{Z}_i^T$. Columns (F) to (I) also add demographic controls.

A Data Appendix

- Banking Regulation and Supervision Agency (BDDK) reports aggregate outstanding balances of different types of household debt, see bddk.org.tr. The data is available by month and year. The total balance of household debt at the onset of the experiment (June 2017) is 452 billion TRY, with 180 million TRY of this accounted by short term unsecured loans, 180 billion TRY accounted by mortgages, 84 billion TRY accounted by credit cards, with auto loans accounting for a negligible 7 billion TRY. Non-performing loans accounted for 18 billion TRY, which is roughly 4% of total household debt.
- Turkish Statistical Instiitite (TUIK) reports the Income and Living Conditions Survey, see data.tuik.gov.tr. Mean annual household disposable income for 2017 was 46,131 TRY.

Table A.2: Macroeconomic Variables

Nominal GDP (TL, billions)	3,111
Nominal GDP (USD, billions)	859
Nominal GDP Per Capita (USD)	10,629
GDP Per Capita Based on PPP (2021 USD)	28,242
GDP Per Capita Based on PPP (EU28=1)	0.66
Population (millions)	81
Unemployment rate (%)	10.2
Inflation (CPI, %)	10.9
Exchange Rate (TL/$)	3.52
2-Year Benchmark Rate (%)	11.10
10-Year Benchmark Rate (%)	10.5
5-Year CDS Rate (bps)	194

Note. GDP and population variables based on 2017 values. The remaining variables based on June 2017 values. Source: Turkey Data Monitor, IMF, Bloomberg, Turkstat, and Worldbank.