Consumption Response to Credit Expansions:

Evidence from Experimental Assignment of 45,307 Credit Lines

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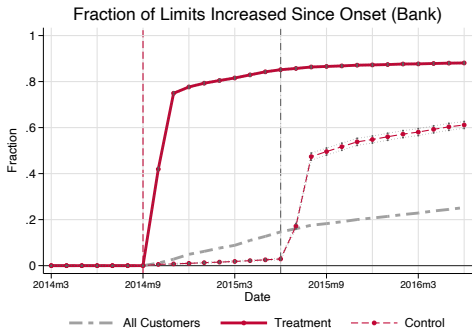
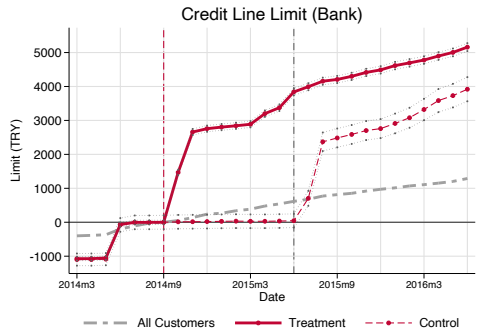
Outline

- Large-scale field experiment to study how consumption expenditures respond to credit shocks.
  - Construct a randomized credit limit increase, on average, 145% of monthly net income.
  - Deliberately and temporarily pause underwriting for randomly selected customers preapproved for a lender-initiated credit limit increase
  - Counterfactual withheld from receiving the limit increases for nine months.
- Estimate average and heterogeneous treatment effects—**marginal propensities to borrow and spend**—by comparing cardholders who receive the credit line extension at different times.

Figure 1: Experimental Timeline





Outline

- $MPC^{\Delta L}$ distinct from but tightly linked to the well-studied *MPC* out of a one-time asset transfer

$$\frac{\Delta C^*}{\Delta L} = \frac{\Delta C^*}{\Delta A} - \frac{R}{1+R}\frac{\Delta C^*}{\Delta Y^P} \tag{1}$$

- Theory—magnitude, heterogeneity, composition, and dynamics *identified moments* to discipline intertemporal consumption models.
  - Heterogeneity—are effects confined to borrowers with a binding constraint who could not finance purchases with resources that will accrue in the future?
  - Dynamics—do short-run effects reverse, potentially holding back spending in the long run?
  - Mechanism—what role is played by commonly invoked classical (e.g., precautionary savings) versus nonstandard ingredients that arbitrate spending through borrowing?
- Policy
  - Credit expansions and household leveraging.
  - Design and targeting of fiscal and macroprudential policies (e.g., *stimulus lines*, limit caps)
  - Precautionary behavior and aggregate demand.

Findings: Short-run and Long-run Magnitude; Balance Sheet Effects

- Pure shock to limits has a precisely measured and economically significant effect.
  - Using the randomized experimental assignment as an instrument, I find borrowing rises by 11 cents in the first quarter, and 16 cents over 3 quarters, factoring in balance shifting.
  - Increase in borrowing comes through increased spending.
  - No discernible effects on delinquencies or labor supply.
  - Slight positive extensive margin adjustment in big-ticket loans.
  - In the long run, the effects are not rapidly reversed but extend to the third year.

Findings: Heterogeneity

- Effects extend to those far from the limit, those who had the new limits as available credit, and those with a meaningful buffer of liquid assets.
  - Participants hold few liquid assets, but only one-in-ten had binding constraints at the onset.
    - For nine-in-ten, new borrowing feasible using baseline unused credit.
  - Robust positive correlation of marginal propensity to borrow and spend with
    - low income
    - high utilization of the existing limit
    - low nominal level of the credit buffer
    - low holdings of liquid assets
    - frequency with which credit constraints bind in the long-run
  - Estimated 3-quarter responses:
    - Highest, at 50 cents, for participants with currently binding constraints.
    - Lowest, at 4 cents, for participants holding liquid assets worth more than 15 months of median post-tax income.

Findings: Composition —Contract Choice and Spending Patterns

- In the short run, participants use flexible revolving contracts, accumulated through dynamic choice, in similar proportions to installment contracts, accumulated in-store and paid down over time according to a preplanned schedule.
    - Flexible debt used to finance cash advances and spending on perishable nondurable goods.
    - Installment debt used to finance durables and services for future consumption in non-lumpy increments.
    - Nontradable or discretionary nondurable spending accounts for an economically and statistically insignificant fraction.
- Participants far from the limit tend to use more preplanned installment contracts.
- In the long run, preplanned installment debt accounts for the predominant share of response.

Findings: Dynamics of Binding Constraints

- Use event studies to analyze the interaction of constraints with precautionary behavior
  - Estimated effect far from the limit is due to the treatment increasing the pace at which they borrow.
  - Strikingly, estimated effect for participants near their limits is due to the control delevering.
    - When in treatment, participants against their limits increase borrowing and spending.
    - Under the counterfactual, they put off spending, avoid borrowing, and save out of binding constraints.
- Key features provide support for a buffer-stock interpretation emphasizing precautionary saving.

Outline

Experimental Design

Participants

- Participants not randomly selected, but identified by processing active cardholders through the bank underwriting decision rule in Table 2.

- Participants, compared with the universe of cardholders, do not differ substantially in terms of age, labor income, spending on bank credit lines, and total debt.
    - However, median credit line across all banks is about 40% lower than typical cardholder.
    - Appear to be cardholders with low limits outside the bank whose incomes justify a limit increase.

Table 1: Summary Statistics

	Panel A: Participants N=45,307						*Panel B: All Customers ex. Participants* N=10,000	
	N	Mean	s.d.	$p10$	$p50$	$p90$	Mean	$p50$
Age	45,307	37	9.6	26	35	50	41	40
Labor income (TRY)	17,690	2,465	2,423	943	1,600	5,111	2,292	1,426
Credit lines (Bank)								
Limit (TRY)	45,307	5,111	5,653	800	3,150	12,000	7,305	3,000
Debt (TRY)	45,307	1,265	2,012	0	641	3,037	1,842	630
Flexible (TRY)	45,307	358	910	0	0	1,045	597	0
Installment (TRY)	45,307	907	1,657	0	373	2,278	1,245	212
Spending (TRY)	45,307	874	1,577	0	387	2,151	954	201
Flexible (TRY)	45,307	628	1,278	0	258	1,522	685	126
Installment (TRY)	45,307	248	757	0	0	687	273	0
Credit lines (All Banks)								
Limit (TRY)	45,307	10,462	17,289	1,600	5,000	24,100	20,284	8,500
Debt (TRY)	45,307	3,446	8,619	94	1,277	6,978	6,220	1,983
Balance sheet								
Debt (Total) (TRY)	45,307	18,463	103,847	334	6,017	49,640	20,742	5,812
Checking (Bank) (TRY)	30,796	1,011	3,269	0	4	2,153	721	0

Table 2: Automatic Limit Underwriting: Stylized Decision Rule

#	Division	Criteria	Threshold	Range
(1)	Sales	Expected value added	> 0	$(-\infty, \infty)$
(2)	Risk	Internal score(s)	$> \bar{s}$	$[\underline{s}, \bar{s}]$
(3)	Risk	Delinquent	$= 0$	$[0, \infty)$
(4)	CRM	Months since limit increase	$> \bar{T}^1$	$[0, \infty)$
(5)	CRM	Months since card opening	$> \bar{T}^2$	$[0, \infty)$
$(*)$	*Experiment*	$\mathbb{Z}_i$	$= 1$	$\{0, 1\}$
(6)	Compliance	Consent	$= 1$	$\{0, 1\}$
(7)	Regulatory	Limit-to-income ratio	< 4	$[0, \infty)$

Figure 2: Selection: Kernel Densities

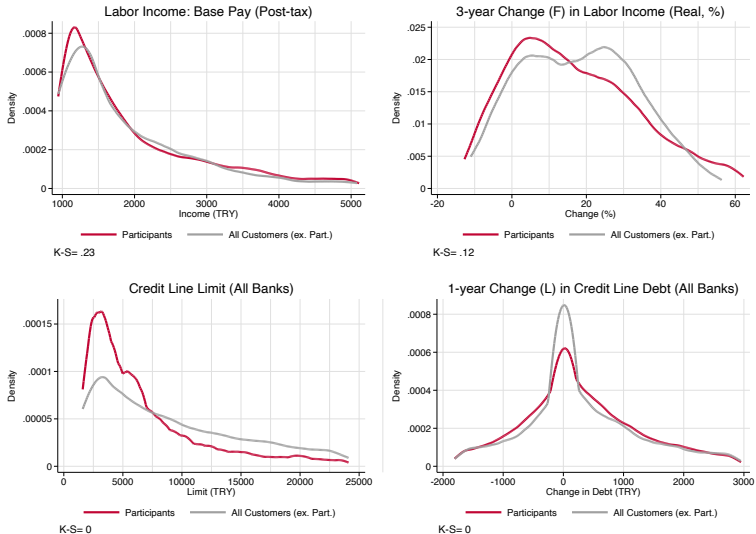


Table 3: Experimental Timeline

Aug. 2014	**Selection** Universe processed by Decision Rule 2. Customers who pass criteria (1) to (5) are designated as participants.
	Randomization
Sep. 2014	**Implementation** Criteria $(*)$ added to Decision Rule 2. $\mathbb{Z}_i = 0$ fail criteria $(*)$, withheld from *lender-initiated* underwriting. $\mathbb{Z}_i = 1$ pass criteria $(*)$, continue downstream to criteria (6) to (7). New limits printed on statements, notified.
Oct. 2015	**Start of *Experiment***
Experimental Timeframe	Criteria $(*)$ withholds $\mathbb{Z}_i = 0$ from *lender-initiated* underwriting. $\mathbb{Z}_i = 0$ may *request*, and receive, manual limit increases. $\mathbb{Z}_i = 1$ who pass criteria (1) to (7) *may* receive *additional* automatic limit increases.
Jun. 2015	**End of *Experiment*** Criteria $(*)$ removed from Decision Rule 2. Participants may receive automatic limit increases. Participants may request, and receive, manual limit increases.
Dec. 2017	**End of Follow-up**

Randomization and Covariate Balance

- Assignment to control after preapproval, but before the limits are pushed.
  - Stratified into nonoverlapping and exhaustive bins by end-of-billing-cycle balances over limits.
  - A random subsample is then drawn from each bin. I denote this assignment $\mathbb{Z}_i = 1$.
- Control group withheld from lender-initiated increases for nine months by altering the decision rule governing automatic underwriting.
  - Only 85% of treatment see limits increase over the first nine months.
  - 3% of control request and are granted a limit increase.
  - Starting month six, treatment may be reevaluated and have their credit lines increased a second time.
- Exogenous variable for econometric evaluation the dummy variable for treatment group, $\mathbb{Z}_i$.
  - Similar to stimulus payments, randomizing the *timing over the short run*.
  - Magnitude not randomized. Analysis restricts variation to only $\mathbb{Z}_i$.

Figure 3: Covariate Balance: Pre-trends

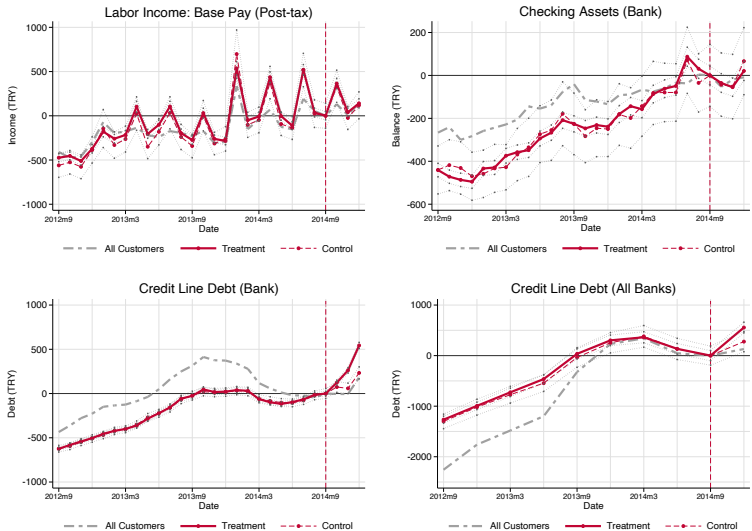
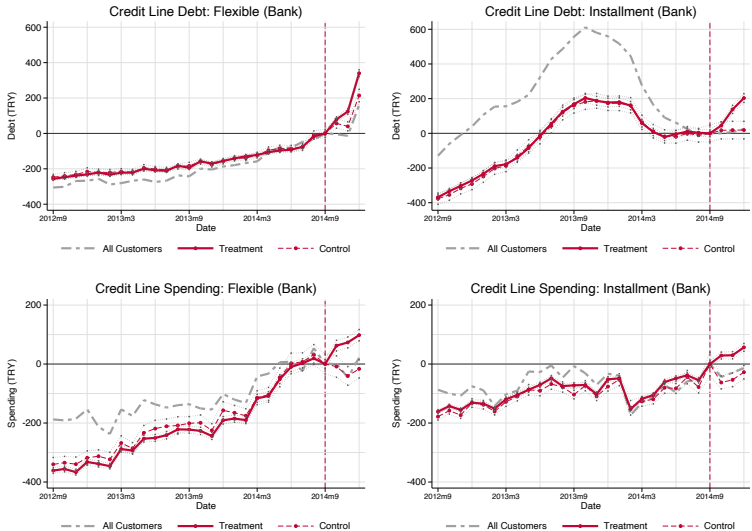


Figure 4: Covariate Balance: Pre-trends



Information, Salience, and Effects on Other Margins

- Limit increases are *automatic*, not requested, initiated and pushed by issuer.
  - No explicit participation choice and no lack of blinding.
- Limit increases are unpredictable based on repeat learning and calibration.
  - Logit model based on the timing rule and account usage has out-of-sample *AUC* is 0.55.
- Randomized assignment operates only via the impact on credit limits.
  - Increase in the limit entails no wealth effects.
  - Holds constant interest rate (24% APR) and non-interest perks.
  - Vis-a-vis expectations-based models, limit increases have no informational value regarding future income prospects.
    - Unlike a once-in-a-lifetime event, repeated experience creates an opportunity for learning and attenuation of the informational effects.

Figure 5: Anticipation of Limit Increases

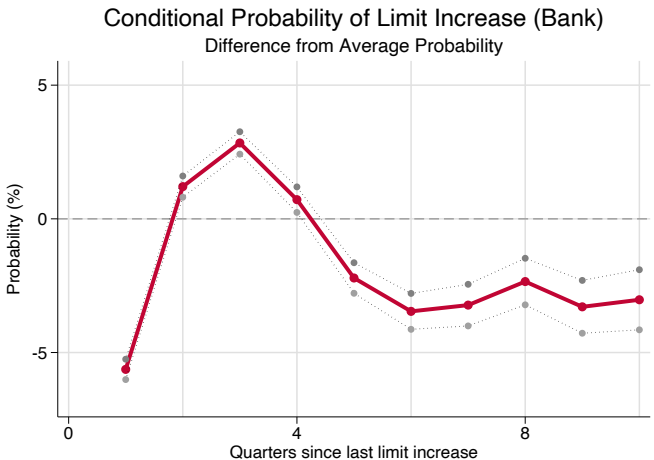
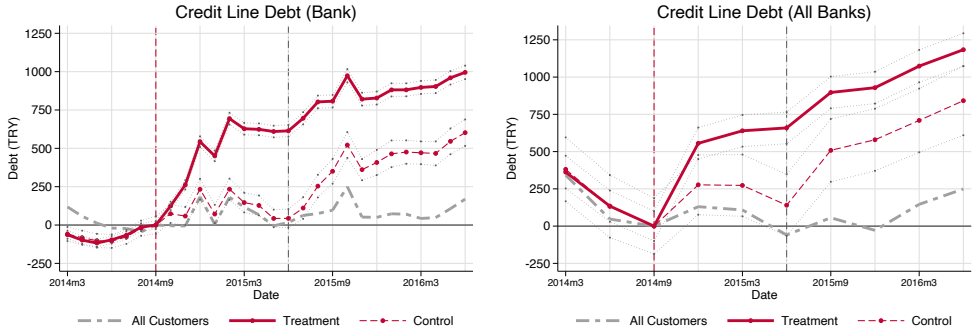


Table 4: Predictability of Limit Increases

		Panel A: Participants N=45,307						*Panel B: All Customers ex. Participants N*=10,000		
		In-sample			*Out-of-sample*			*In-sample*		
Actual	TP+FN	.18	.18	.17	.79	.79	.84	.12	.12	.15
Predicted	TP+FP	.57	.58	.51	.25	.33	.38	.57	.56	.53
Precision	TP / (TP+FP)	.21	.21	.21	.72	.80	.86	.14	.16	.20
Sensitivity	TP / (TP+FN)	.65	.68	.63	.22	.34	.39	.68	.73	.69
AUC		.56	.57	.61	.43	.55	.56	.55	.61	.63
Timing rule		✓	✓	✓	✓	✓	✓	✓	✓	✓
Account characteristics			✓	✓		✓	✓		✓	✓
Income-based				✓			✓			✓

Results

Figure 6: Event Study



- Left-hand-side variable $\Delta^{\tau} D_i$.
- Net cumulative spent is change in balance—total spent minus topped off.

Empirical Framework

- First-stage (FS) and intent-to-treat (ITT) compare average change in limits and debt using OLS focusing on exogenous differences.
- Marginal propensity (MP) estimates treatment effect using 2SLS, using the randomized assignment as an instrument.
  - LATE for the participants who see limit changes induced by $\mathbb{Z}_i$.
  - Additional identifying assumption, no effect of $\mathbb{Z}_i$ that does not operate via the impact credit limits.
- Estimates using simple and dynamic specifications.

$$Y_i = \psi X_i + f_s + \varepsilon_i \tag{2}$$

$$Y_{it} = \sum_{j=1}^{T} \phi_j X_{ij} + f_t + f_s + \varepsilon_{it} \tag{3}$$

Table 5: Empirical Framework

	Panel A: Equation (2)					*Panel B: Equation* (3)					
	$Y_i = \psi X_i + f_s + \varepsilon_i$					$Y_{it} = \sum_{j=1}^{T} \phi_j X_{ij} + f_t + f_s + \varepsilon_{it}$					
	N = 45,307					$N \times T$ = 45,307 $\times$ T					
	Z_i	X_i	Y_i	Est.	See	Z_{it}	X_{ij}	Y_{it}	Est. In-time	Est. Cum.	See
First-stage	$\mathbb{Z}_i$	$\mathbb{Z}_i$	$\Delta^\tau L_i$	ψ_τ^{FS}	Table 6	$\mathbb{Z}_i \times f_t$	$\mathbb{Z}_i \times f_{t=j}$	ΔL_{it}	ϕ_j^{FS}	$\Phi_\tau^{\text{FS}} = \sum_{j=1}^{\tau} \phi_j^{\text{FS}}$	Table 6, 7, 8
Intent-to-treat	$\mathbb{Z}_i$	$\mathbb{Z}_i$	$\Delta^\tau D_i$	ψ_τ^{ITT}	Table 6	$\mathbb{Z}_i \times f_t$	$\mathbb{Z}_i \times f_{t=j}$	ΔD_{it}	ϕ_j^{ITT}	$\Phi_\tau^{\text{ITT}} = \sum_{j=1}^{\tau} \phi_j^{\text{ITT}}$	Table 6, 7, 8 Figure 9
Marginal Propensity	$\mathbb{Z}_i$	$\Delta^\tau L_i$	$\Delta^\tau D_i$	ψ_τ^{MP}	Table 6	$\mathbb{Z}_i \times f_t$	ΔL_{it-j+1}	ΔD_{it}	ϕ_j^{MP}	$\Phi_\tau^{\text{MP}} = \sum_{j=1}^{\tau} \phi_j^{\text{MP}}$	Table 6, 7, 8 Figure 9

Table 6: Borrowing on Credit Lines: First-stage, Intent-to-treat, and Marginal Propensity Estimates

	Baseline level (TRY)		*Panel A: Equation* (2) — ψ			*Panel B: Equation* (3) — ϕ		
			F-stat			Point-in-time		Cumul.
			$3q$	$1q$	$3q$	$1q$	$\sum_{j=2q}^{3q}$	$3q$
Δ Limit (TRY) (Bank)	5,111	First-stage (OLS)	1,397	2,737 (24)	3,795 (34)	2,737 (24)	1,058 (23)	3,795 (34)
Δ Debt (TRY) (Bank)	1,265	Intent-to-treat (OLS)		310 (28)	571 (35)	310 (28)	260 (35)	571 (35)
		Marginal Propensity (2SLS)		0.113 (0.010)	0.150 (0.009)	0.114 (0.010)	0.049 (0.015)	0.162 (0.012)
Δ Limit (TRY) (All banks)	10,462	First-stage (OLS)	1,110	2,589 (50)	3,554 (73)	2,589 (50)	965 (64)	3,554 (73)
Δ Debt (TRY) (All banks)	3,446	Intent-to-treat (OLS)		278 (48)	519 (69)	278 (48)	240 (61)	519 (69)
		Marginal Propensity (2SLS)		0.108 (0.018)	0.146 (0.019)	0.106 (0.019)	0.053 (0.026)	0.159 (0.023)

Figure 7: Event Study: Balance Sheet Effects

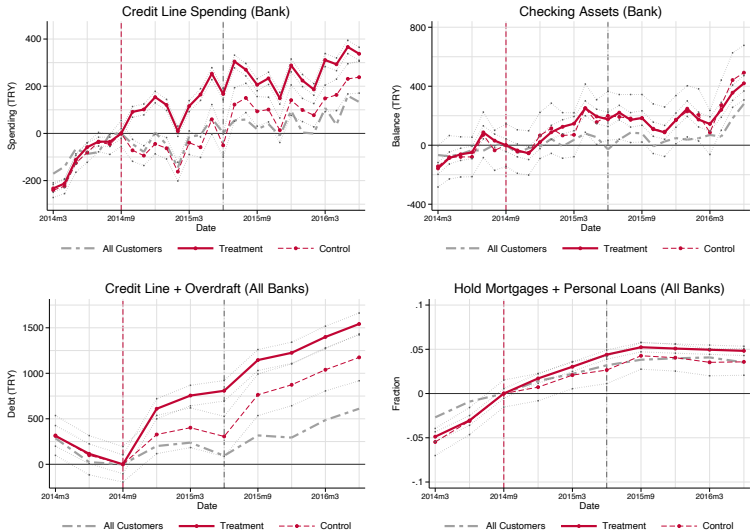
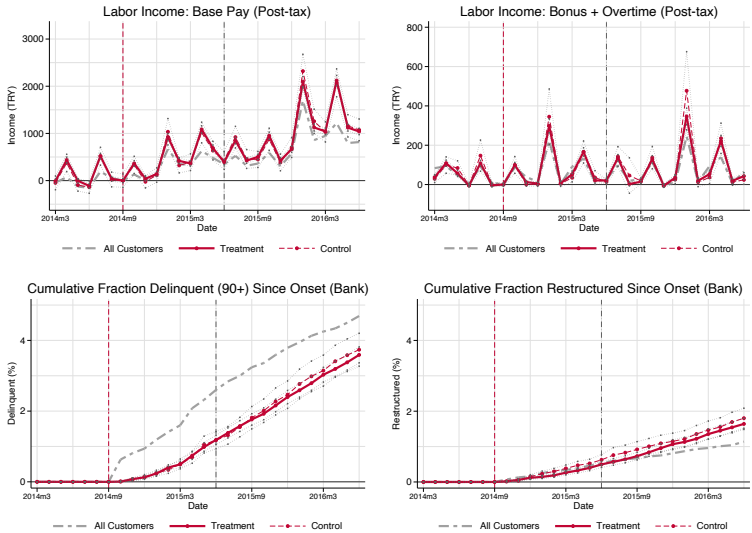


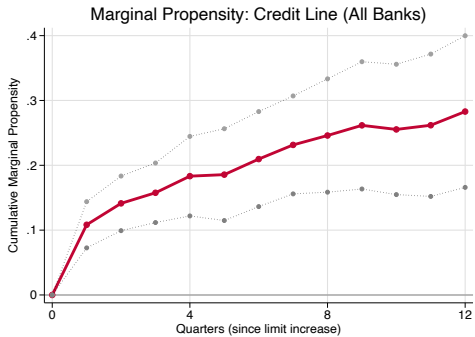
Figure 8: Event Study: Balance Sheet Effects



Long-run Effects

- Not everyone in the control receives a limit increase after the experimental timeframe.
  - Short-run withholding creates long-run differences.
- This feature allows for an investigation of long-run effects beyond the short-term window.
- A priori, the sign or magnitude of the long-run impact of credit is not obvious.
  - *MPC* out of assets should sum to one.
  - *MPB* out of credit limits should sum to zero.
  - However, interest costs and debt service can also hold back borrowing and spending.

Figure 9: Borrowing on Credit Lines: Long-run Intent-to-treat and Marginal Propensity Estimates



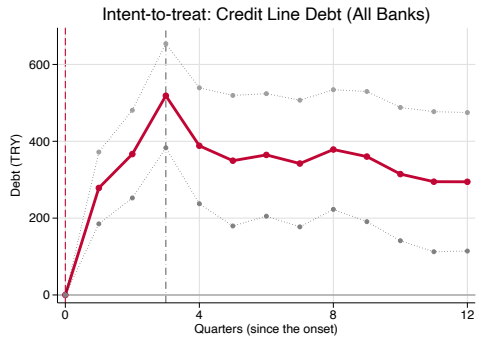


Table 7: Borrowing on Credit Lines: Long-run

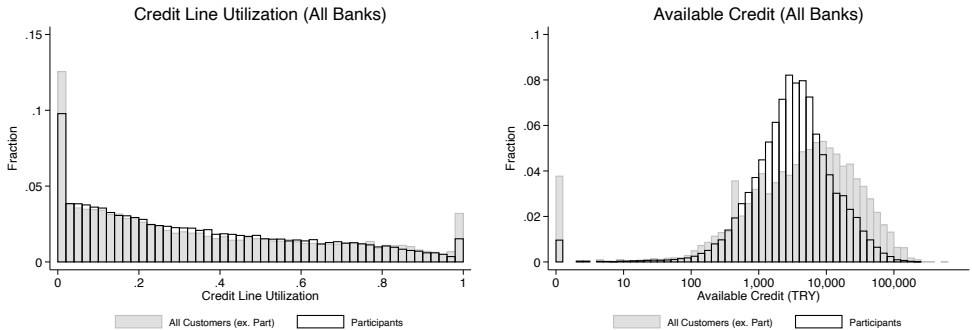
		Cumulative			Point-in-time			
		$4q$	$8q$	$12q$	$1q$	$\sum_{j=2q}^{4q}$	$\sum_{j=5q}^{8q}$	$\sum_{j=9q}^{12q}$
Δ Limit (TRY)	First-stage (OLS)	1,450	844	717	2,589	- 1,139	- 606	- 127
		(102)	(141)	(167)	(50)	(96)	(100)	(100)
Δ Debt (TRY)	Intent-to-treat (OLS)	388	379	295	278	110	- 10	- 84
		(77)	(79)	(92)	(48)	(74)	(74)	(74)
	Marginal Propensity (2SLS)	0.183	0.246	0.283	0.108	0.075	0.063	0.037
		(0.031)	(0.045)	(0.060)	(0.018)	(0.025)	(0.037)	(0.037)

- Borrowing continues beyond the first year.
- Effect builds up over time.
- Short-run borrowing does not reflect a transitory surge that is rapidly reversed.

Baseline Distance-to-limit and Liquid Assets Holdings

- Median and average credit line utilization are 0.27 and 0.34.
- Only one-in-ten utilize more than 75% of their credit lines.
- For 89%, debt levels by the end of experimental timeframe feasible using unused credit at onset.
- 73% had the additional limits they receive as available credit.

Figure 10: Baseline Distance-to-limit



$$Y_{it} = \sum_{k=1}^{K} \sum_{j=1}^{T} \phi_{jk} \cdot X_{ij} \times f_k \; + f_{kt} + f_s + \varepsilon_{it} \tag{4}$$

Table 8: Borrowing on Credit Lines: Heterogeneity by Baseline Distance-to-limit and Liquid Asset Holdings

	Panel A: Credit Line Utilization					*Panel B: Available Credit Quintiles*					*Panel C: Total Liquid Assets at Bank*				
			FS_{3q}	ITT_{3q}	MP_{3q}			FS_{3q}	ITT_{3q}	MP_{3q}			FS_{3q}	ITT_{3q}	MP_{3q}
	D/L	$L-D$ (TRY)	ΔL (TRY)	ΔD (TRY)	ΔD	$QU_{(L-D)}$	$L-D$ (TRY)	ΔL (TRY)	ΔD (TRY)	ΔD	A^{Liq} (Bank)	$L-D$ (TRY)	ΔL (TRY)	ΔD (TRY)	ΔD
Less liquidity	[0.75, 1]	1,278	2,580 (210)	1,227 (182)	.503 (.067)	QU_1	557	2,466 (91)	713 (43)	.298 (.022)	$\emptyset$	6,808	2,485 (112)	459 (120)	.200 (.052)
	[0.50, 0.75)	3,957	2,707 (139)	1,010 (251)	.403 (.096)	QU_2	1,767	2,616 (86)	658 (78)	.266 (.033)	[0, 250)	5,626	2,565 (111)	663 (137)	.269 (.058)
	[0.25, 0.50)	6,690	3,313 (156)	403 (110)	.121 (.040)	QU_3	3,328	2,621 (117)	405 (72)	.166 (.030)	[250, 2, 500)	6,698	4,079 (179)	434 (102)	.119 (.031)
	(0, 0.25)	10,266	4,262 (121)	247 (102)	.073 (.030)	QU_4	6,181	3,452 (133)	437 (103)	.144 (.035)	[2, 500, 25, 000)	9,951	6,488 (290)	505 (175)	.096 (.039)
More liquidity	$= 0$	4,834	3,813 (182)	275 (69)	.073 (.026)	QU_5	23,252	6,615 (286)	385 (309)	.062 (.054)	25, 000+	15,233	10,899 (407)	204 (484)	.041 (.067)

Heterogeneity by Credit Line Utilization

- Unsurprisingly, baseline demand out of the existing supply associated with a high MPB; estimated responses are largest close to constraints.
- Participants utilizing 75% or more borrow 50 (6.7) cents, three times the average response.
  - 95% confidence interval is (0.37, 0.63) rejecting the null of literal hand-to-mouth behavior.
- Participants not carrying any balances (6%) are induced to borrow 7.3 (2.6) cents.
- Those carrying some balances but using less than 25% of limits accumulate 7.3 (3.0) cents.
  - Available credit of 10,000 TRY, increase in limits of 4,000 TRY, and borrow 247 (102) TRY.
  - 95% of this group, could have feasibly financed their debt using unused credit at the onset.
  - 81% of this group had the additional limits they receive as available credit.

Heterogeneity by Credit Line Utilization, continued

- Heterogeneity by utilization directionally compatible with simple utilization-targeting heuristics.
- However, strict form utilization-targeting rejected in the data.
  - 3-quarter response of 0.162 (0.012) significantly smaller than baseline utilization of 0.34.
  - Treatment reduce utilization rate, by 0.041 (0.004) on average, but also at all utilization levels.
  - Heterogeneity by utilization significantly flatter than the 45-degree line. Participants at their constraints reduce their utilization, while those not utilizing at the onset do respond.
- Nevertheless, tight link between the estimated sensitivity to credit and the number of times constraints bind in the long-run.

Heterogeneity by Liquid Asset Holdings

- Total liquid assets at bank: checking, savings, stocks, bonds, and funds.
- Participants with an account but next to no assets borrow 26.9 (5.8) cents. Adjacent group, assets between 250 TRY and 2,500 TRY, response is 11.9 (3.1) cents.
  - Strict hand-to-mouth behavior for these two groups is decisively rejected.
- Effect of credit extends to those with a meaningful buffer of assets.
  - Participants holding 2,500 TRY to 25,000 TRY—about $1,000 to $10,000— borrow 9.6 (3.9) cents.
  - For this group, increase in debt 505 (175) TRY, available credit at onset is 10,000 TRY.
  - Had both available credit and liquid assets to finance the new marginal increase in debt.
  - Only 6% of this group borrow beyond the limit available to them at the onset.
- For the 4% holding more than 25,000 TRY of total assets, the null is not rejected (p=0.54).

Contract Choice

- Flexible debt, or conventional revolving borrowing.
  - Represents unpaid end-of-billing-cycle balances.
  - Accumulated through dynamic choice after seeing the balances.
- Installment debt.
  - Incurred at the time of purchase to finance in-store expenditures.
  - Paid down according to a preplanned schedule with a fixed nominal payment every month.
- Change in the stock of flexible and installment debt relative to the onset tied to net flexible and installment spending over the same period, after factoring in payments made toward balances.

Figure 11: Event Study: Contract Choice and Spending Patterns

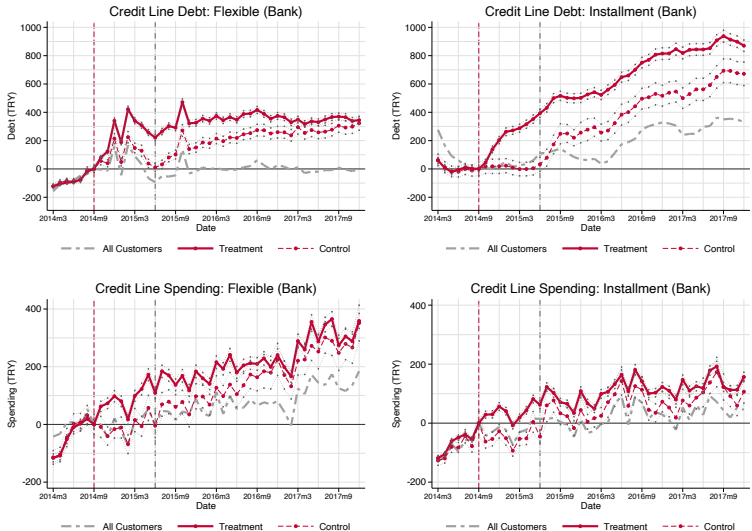


Table 9: Borrowing on Credit Lines: Contract Choice

	Baseline Level	Intent-to-Treat							Marginal Propensity (Monthly)				
									Point-in-time			Cumulative	
		$1m$	$2m$	$1q$	$3q$	$8q$	$12q$	$13q$	$1m$	$\sum_{j=2m}^{3m}$	$\sum_{j=4m}^{9m}$	$3m$	$9m$
ΔD Flex. (TRY)	358	23	84	126	211	143	64	22	.017	.032	.003	.049	.052
(Bank)		(11)	(12)	(18)	(17)	(25)	(27)	(28)	(.008)	(.011)	(.016)	(.012)	(.012)
ΔD Inst. (TRY)	907	28	119	185	360	255	245	198	.019	.052	.034	.072	.105
(Bank)		(14)	(20)	(23)	(31)	(39)	(47)	(47)	(.010)	(.010)	(.017)	(.012)	(.012)
Flex Share		.45	.41	.41	.37	.36	.21	.10	.47	.38	.08	.40	.33
(Bank)													

Contract Choice

- In the short-run flexible and preplanned contracts used in tandem, in similar proportions.
  - Modest 1.7 (0.8) and 1.9 (1) cents in the first month for flexible and installment borrowing.
  - After the third month, flexible borrowing comes to a pause (p=0.87). The second and the third quarters only bring additional installment debt.
  - Over the 3-quarter experimental timeframe flexible debt accounts for 33% of the additional borrowing.
- In the long run, the difference in flexible debt between the treatment and control group attenuates, with preplanned installment debt accounting for the predominant share of the difference in debt levels.
  - Focusing on installments, treatment spend more, stack concurrent loans, create new debts beyond matching installments due.
  - Focusing on flexible revolving, debt levels peak after about 8 quarters.
  - In the last quarter of follow-up, flexible debt accounts for only 10% of the response.

Figure 12: Event Study: Contract Choice by Distance-to-limit

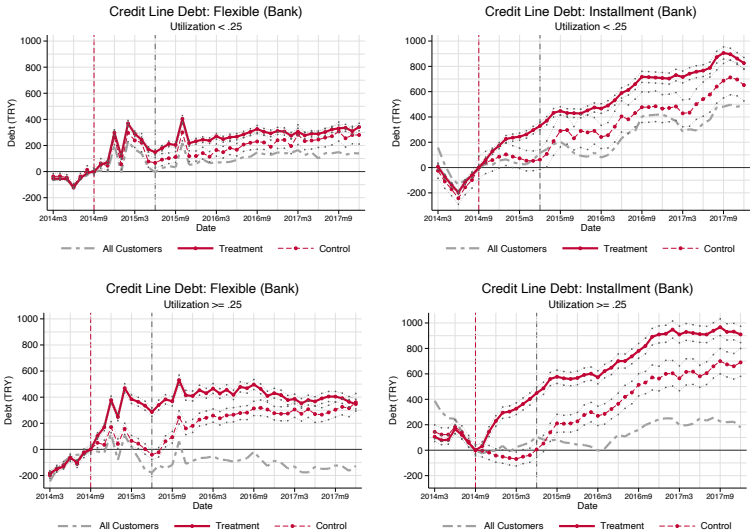
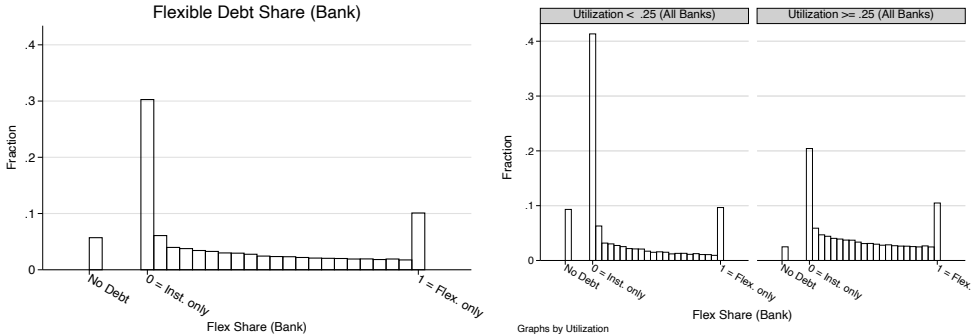


Figure 13: Baseline Contract Share



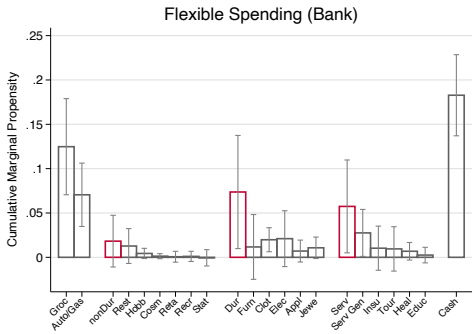
Contract Choice: Heterogeneity

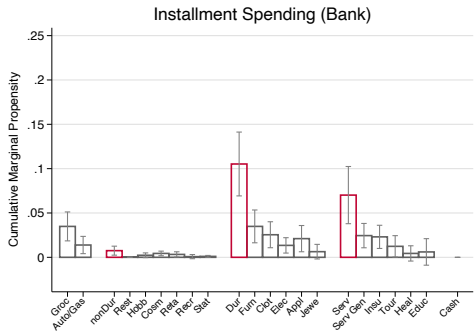
- Unconstrained predominantly use preplanned installment contracts.
  - For participants with no debt flexible debt accounts only for 17% of the response.
  - Ratio levels between 41% to 44% for participants closer to their constraints.
- Much of the heterogeneity in the composition associated with the baseline contract share.
  - For mass (30%) holding only installment debt, flexible debt share is 13%
  - For those who hold only flexible debt, the flexible debt share is about 40%, irrespective of whether they hold installment debt or not.
  - Participants far from the limit are more likely to only hold installment debt.

Contract Choice: Interpretation of Voluntary Choice of Preplanned Contracts

- Pecking-order.
  - Installment debt often cheaper.
  - Use of expensive flexible debt reflect a temporary deviation, converge to target in the long run.
- Flexibility.
  - Installment contracts one-time preplanned arrangements.
  - Although not *pure* or *hard* commitments, preclude the possibility of dynamic revisions.
  - Borrowers with a sophisticated time-inconsistent taste for immediate gratification may use preplanned contracts as a *meaningfully binding* commitment to prevent overborrowing a naif might do.
- Precautionary behavior.
  - Positive relationship between distance-to-limit and the use of preplanned contracts.
- A unified theory of contract choice needs to explain the short-run heterogeneity, long-run dynamics, and the baseline contract share.

Figure 14: Spending Patterns





Spending Patterns

- Flexible debt response of 5.2 (1.2) cents, accumulated by transactions worth 34 cents and cash advances worth 18 cents.
  - 36% directed toward groceries, a category in which expenditures and consumption are tightly linked.
  - Remaining flexible spending evenly accounted by vehicle expenses, durables, and services
  - For nontradables that affect demand within their region, such as restaurants and recreation and discretionary nondurables, the response is small and indistinguishable from zero.
- Installment debt response of 10.5 (1.2) cents, accumulated by transactions worth 23 cents.
  - Composition skewed toward durables and services, associated with future consumption.
  - Durables response accounts for 46% of transactions. Driven by extensive margin adjustments in furniture, clothing, and appliances.
  - Negligible share made in lumpy increments.
  - Ratio of cumulative spent to borrowed compatible with 4-month installment loans.

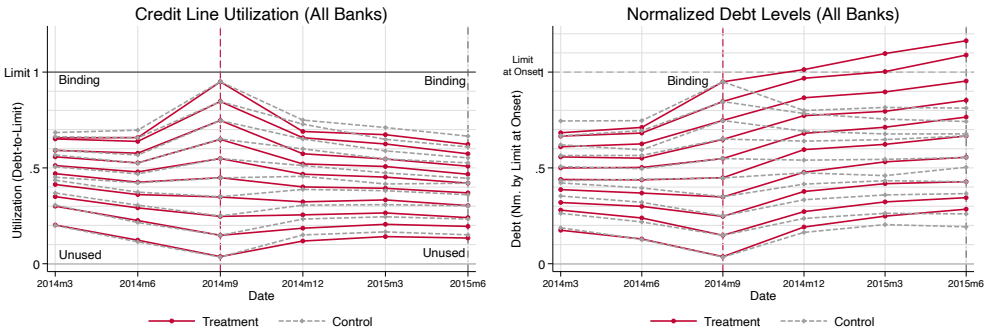
Spending Patterns - Heterogeneity

- Estimated treatment effect on revolving debt highest closer to the limit.
- Figure 17 decomposes spending patterns by distance-to-limit.
  - Gross spending response is higher across all categories for both flexible and installment spending for participants closer to the limit.
  - For installment spending, fraction directed to each category is similar, concentrated in durables and services.
  - For flexible spending, participants closer to their limits are
    - much more likely to take out cash advances
    - direct a larger share to durables and eating out
    - direct a lesser share to services and auto/gas

Dynamics of Binding Constraints and Precautionary Behavior

- Turn to participants facing a binding constraint.
- Use the sharp counterfactual to analyze the dynamic interaction of constraints with precautionary saving—the most frequent explanation as to why consumption is sensitive broadly to credit expansions.
- Smoking gun for precautionary behavior, ultimately difficult to disentangle, is a tendency to put off spending and build a buffer near the limit.

Figure 15: Dynamics of Binding Constraints and Precautionary Behavior



Dynamics of Binding Constraints and Precautionary Behavior

- First discernible feature (naturally occuring) is mean-reverting debt dynamics.
  - Participants with a binding constraint at the onset spend very little time at the limit. Instead, tend to quickly save out of strict constraints and build a buffer after only one quarter.
  - Those who persistently remain at limit constitute a sliver of the population—over a 3-year horizon, no more than 1.4%—see utilization transition matrix Table 14.
- Second, comparing treatment to control, estimated high $MPC^{\Delta L}$ at the constraints partly due to control delevering when limits are tight.
  - Main mechanism around binding constraints a precautionary savings effect by which constrained households depress spending and delever under tight constraints.

What Explains the Buffers?

- First-order model implication that those facing greater income risk desire larger buffers.
  - Average available credit to monthly income ratio of 2.6 to 2.8
  - One standard deviation increase in future (past) income risk is associated with an increase in available credit of 57% (33%) of monthly income.
  - Going from the 10th-to-90th percentile of future (past) income risk is associated with an increase in available credit of 108% (62%) of monthly income.

Table 10: What Explains the Buffers?

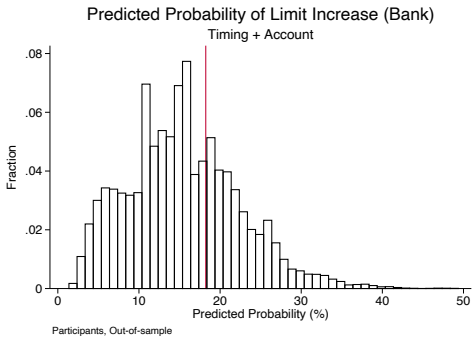
	Panel A: 100 × (1 - Utilization)		*Panel B:* log Limit		*Panel C:* log Available Credit		*Panel D:* Available Credit to Monthly Income	
Buffer$_i$	$100 \times \left(1 - \frac{D}{L}\right)$		$\log L$		$\log(L - D)$		$(L - D)/Y$	
	Past	*Future*	*Past*	*Future*	*Past*	*Future*	*Past*	*Future*
β	9.1	11.4	1.2	.8	1.6	1.1	5.0	7.9
	(6.4)	(5.9)	(.30)	(.28)	(.37)	(.34)	(.86)	(.77)
α	76.6	76.4	9.3	9.4	9.0	9.0	2.8	2.6
	(.53)	(.52)	(.02)	(.02)	(.03)	(.03)	(.07)	(.07)
$\beta \times \sigma$	.60	.81	.08	.06	.10	.08	.33	.57
$\beta \times p_{10}^{90}$	1.12	1.55	.15	.11	.19	.15	.62	1.08

Further Research

1. Relationship between the *MPC* and $MPC^{\Delta L}$.
   - Policy: Efficacy and applicability of *stimulus lines* to weather recessions or stimulate demand.
   - Theory: Equation (1) predicts similar response to one-time transfer if R is low.
2. Modeling and design of the contractual features of credit markets.
   - Small-dollar installment credit accounted for much of expansion in household debt during the 1920s, but largely disappeared with the Great Depression.
   - Do installment contracts lead to repayment that differs from the counterfactual flexible repayment that would prevail in the absence of installment contracts?
3. Limit increase as environmental cue.
   - Could directly raise the marginal utility, lead to a mechanical and spontaneous increase in spending. Repeated pairings and cue-based complementarities.
   - Borrowers could perceive the cue as informational about future income prospects.

Appendix

Figure 16: Predictability of Limit Increases



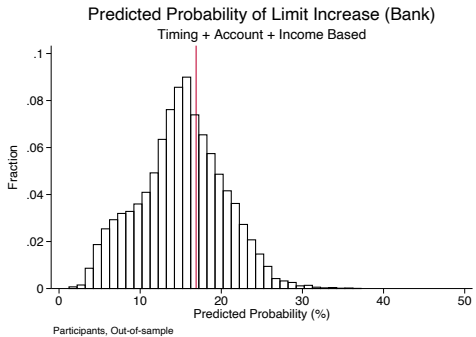


Table 11: Covariate Balance: Pre-trends

	Panel A: Levels					*Panel B: Changes*				
	Limit (Bank)	Inst. (Bank)	Flex. (Bank)	Spent (Bank)	Debt (All banks)	Δ Limit (Bank)	Δ Inst. (Bank)	Δ Flex. (Bank)	Δ Spent (Bank)	Δ Debt (All banks)
ϕ_{-1}	80	33	-7	83	-37	-15	20	-7	72	20
	(106)	(21)	(10)	(52)	(118)	(50)	(15)	(10)	(35)	(65)
ϕ_{-2}	95	13	0	11	-57	-3	-9	-1	18	-66
	(95)	(23)	(9)	(46)	(122)	(99)	(16)	(9)	(33)	(65)
ϕ_{-3}	98	22	1	-7	9	69	-4	12	-34	-24
	(148)	(23)	(9)	(45)	(114)	(63)	(14)	(11)	(32)	(52)
ϕ_{-4}	29	26	-11	27	33	31	0	-4	23	-9
	(168)	(24)	(11)	(46)	(110)	(32)	(16)	(10)	(33)	(64)
p	.60	.42	.78	.17	.76	.65	.78	.82	.14	.73

Table 12: Balance Sheet Effects

			Baseline Level	Short-run				Long-run		*p*-value	
				1*m*	2*m*	1*q*	3*q*	8*q*	12*q*	3*q*	12*q*
Total Balance Sheet (All banks)	ΔD Credit Line + Overdraft	(TRY)	3,721			283 (49)	502 (72)	410 (87)	317 (104)	$<.001$	.007
	ΔD Total	(TRY)	18,463			499 (262)	538 (470)	723 (708)	1,611 (748)	.253	.031
	Δ Has Big Ticket D		.60			.010 (.004)	.017 (.007)	.010 (.009)	.016 (.009)	.009	.076
Credit Line (Other banks)	Limits Increased		0			-.010 (.005)	-.035 (.007)	-.041 (.008)	-.035 (.008)	$<.001$	$<.001$
	Δ Limit	(TRY)	5,350			-148 (46)	-241 (66)	-275 (106)	-151 (122)	$<.001$	.216
	ΔD Credit Line	(TRY)	2,181			-32 (38)	-52 (59)	-19 (62)	-14 (72)	.379	.843

Table 13: Balance Sheet Effects

			Baseline Level	Short-run				Long-run		*p*-value	
				1*m*	2*m*	1*q*	3*q*	8*q*	12*q*	3*q*	12*q*
Real Terms (Bank)	Δ Limit	(TRY)	5,146	1,428 (19)	2,587 (23)	2,692 (23)	3,560 (33)	957 (103)	659 (104)	<.001	<.001
	Δ*D* Flexible	(TRY)	361	22 (11)	82 (12)	124 (18)	198 (17)	123 (22)	50 (22)	<.001	.022
	Δ*D* Installment	(TRY)	913	27 (14)	116 (20)	181 (23)	337 (30)	218 (35)	186 (39)	<.001	<.001
Income	Δ Wage Base	(TRY)	2,465	-2 (55)	55 (34)	26 (52)	-69 (54)	10 (62)	11 (101)	.196	.914
	Δ Wage Overtime + Bonus	(TRY)	2,500	-8 (60)	69 (35)	30 (52)	-58 (54)	4 (63)	3 (101)	.280	.974
Delinquencies (Bank)	Δ NPL 90+ (%)		0	-.006 (.010)	.017 (.029)	-.013 (.039)	.009 (.141)	.057 (.273)	.111 (.321)	.951	.729
	Δ NPL Rest. (%)		0	.006 (.011)	.026 (.019)	-.031 (.037)	-.130 (.087)	-.139 (.182)	.115 (.265)	.134	.664
Assets (Bank)	Δ*A* Checking	(TRY)	1,011	8 (63)	-2 (55)	-46 (57)	-24 (78)	0 (94)	-103 (93)	.762	.266

Table 14: Utilization Transition Matrix

τ = -4q	= 0	(0, 0.25)	[0.25, 0.50)	[0.50, 0.75)	[0.75, 1]
$\emptyset$	319 0.08	1,165 0.29	1,071 0.26	879 0.22	653 0.16
= 0	764 0.23	1,434 0.43	570 0.17	341 0.10	191 0.06
(0, 0.25)	960 0.06	9,370 0.60	3,393 0.22	1,433 0.09	551 0.04
[0.25, 0.50)	345 0.03	4,040 0.38	3,248 0.31	1,957 0.19	954 0.09
[0.50, 0.75)	166 0.02	1,758 0.26	1,959 0.29	1,787 0.26	1,115 0.16
[0.75, 1]	107 0.02	899 0.18	1,186 0.24	1,370 0.28	1,322 0.27
	2,661 0.06	18,666 0.41	11,427 0.25	7,767 0.17	4,786 0.11

τ = -12q	= 0	(0, 0.25)	[0.25, 0.50)	[0.50, 0.75)	[0.75, 1]
$\emptyset$	1,201 0.07	6,118 0.35	4,412 0.26	3,299 0.19	2,263 0.13
= 0	558 0.10	2,445 0.45	1,235 0.23	778 0.14	436 0.08
(0, 0.25)	544 0.05	6,121 0.57	2,450 0.23	1,127 0.11	438 0.04
[0.25, 0.50)	193 0.03	2,333 0.41	1,627 0.28	1,039 0.18	541 0.09
[0.50, 0.75)	94 0.03	1,028 0.31	961 0.29	779 0.23	464 0.14
[0.75, 1]	71 0.03	621 0.22	742 0.26	745 0.26	644 0.23
	2,661 0.06	18,666 0.41	11,427 0.25	7,767 0.17	4,786 0.11

Figure 17: Spending Patterns by Distance-to-limit

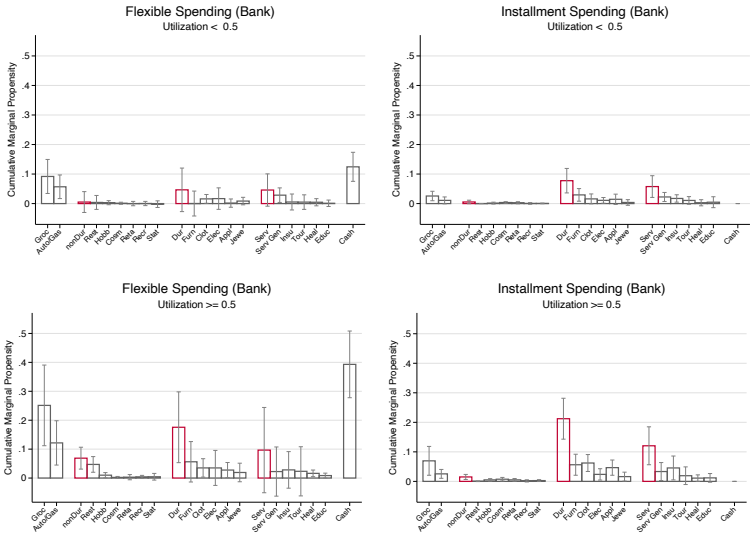
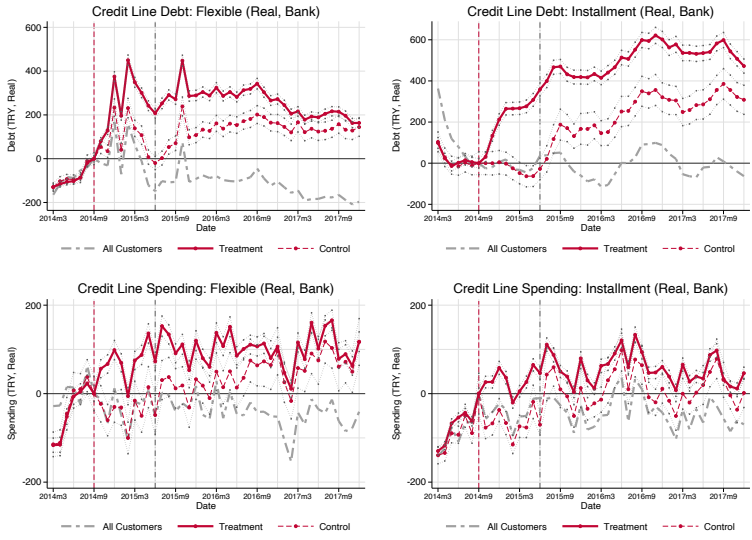


Figure 18: Event Study: Contract Choice and Spending Patterns—Real Terms



[Persons(1930)]: The expansion of credit involved in installment selling has been hotly and voluminously debated. This sales method has been variously hailed as the foundation of our prosperity and as the most dangerous credit development of this decade. . . . Recent studies estimate that 70 to 80 per cent of furniture is now sold on installments. . . . It has been estimated that 140 million dollars worth of clothing is sold on installments annually. . . . Without further elaboration we may accept the current estimates that annual installment sales are now about 6 billions and that the total debt outstanding at a given time is about half that sum, or 3 billions. Of this debt about half results from the sale of automobiles and trucks, both new and in the used car market.

[Olney(1999)]: The collapse of consumption in 1930 came on the heels of a decade of virtual explosion in household use of installment debt. . . . Outstanding nonmortgage consumer debt more than doubled in the 1920s, reaching a 1929 peak of -9.3 percent of income- that was not surpassed until 1939. . . . Installment buying accounted for much of the 1920s expansion in household credit use. . . . Finance charges on installment plans were considered a charge for the convenience of paying later and were therefore not subject to usury laws. Available evidence indicates that the effective rate of interest-which reflects the finance charge, assorted fees, and the difference between cash and time prices- was generally in the neighborhood of 30 to 40 percent 'but sometimes ranged as high as 100 percent for installment contract. . . . Durable goods had contract maturities of twelve to eighteen months and down payments of 10 to 25 percent. . . . Over 41 percent of the 506 families of federal employees whom the BLS surveyed in 1928 bought a good on installments, purchasing furniture, clothing, radios, automobiles, pianos, and appliances.

Table 15: Installment Calculations

				t	-1	0	1	2	3	4	5
Spending	Flexible	C_t^{Flex}			0	50	100	0	0	0	0
	Installment	C_t^{Inst}	$= \sum_{k \geq t} C_{j=t,k}^{\text{Inst}}$		0	0	0	80	0	0	0
End-of-billing-cycle statement	Flexible debt $(t-1)$ + interest	$D_{t-1}^{\text{Flex}}(1+R)$	(1)		0	0	0	51	0	20.4	0
	Flexible spent	C_t^{Flex}	(2)		0	50	100	0	0	0	0
	Installments due	$\sum_{j \leq t} C_{j,k=t}^{\text{Inst}}$	(3)		0	0	0	20	20	20	20
	Balance	Bal_t	(1)+(2)+(3)		0	50	100	71	20	40.4	20
	Payments	Pay_t	(4)		0	50	50	71	0	40.4	20
Debt	Flexible	D_t^{Flex}	(1)+(2)+(3)-(4)		0	0	50	0	20	0	0
	Installment	D_t^{Inst}	$= \sum_{j \leq t} \sum_{k > t} C_{j,k}^{\text{Inst}}$		0	0	0	60	40	20	0

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