Monthly Payment Targeting and the Demand for Maturity

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Monthly Payments

- Ample evidence households sensitive to cash flows
  - SNAP benefits, tax rebates, extra paychecks, windfalls...
  - See also mortgage modification literature

- Traditional explanation: liquidity constraints
- Emerging explanation: mental accounting

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- Traditional explanation: liquidity constraints
- Emerging explanation: mental accounting

- Our explanation: monthly budgeting

$$\text{Monthly Expenditure}_k \leq \text{Budget}_k \; \forall \, \text{categories } k$$

- In debt decisions, leads to
  1. excess sensitivity to maturity
  2. monthly payment smoothing (mental accounting)
  3. payment-size targeting
  4. even for the unconstrained

Paper $\in$ Nutshell

- Use rich data on auto-loan contract features and borrower decisions from hundreds of lenders, millions of borrowers
- Exogenous variation in offered contracts $\rightarrow$ demand elasticities
- Evidence for mental accounting and categorical budgeting
  - with credible identification
  - in high-stakes setting
  - among financially sophisticated
  - with cross-sectional variation in constraints
- Estimate connection between aggregate auto debt and Δmaturity

How do households make installment debt decisions?

Three main empirical results, each holds for all types of borrowers

1. Maturity elasticities $\gg$ Rate elasticities
   - @ both intensive and extensive margins
2. Consumers smooth monthly payments when offered better loan terms
   - keep payment constant instead of reallocating across budget categories
3. Monthly payments bunch at salient monthly payment amounts

$\rightarrow$ consistent with adhering to round-number categorical monthly budget

Outline

1. **Related literature**
2. Model
3. Data and setting
4. Detecting lending policy discontinuities
5. Estimating demand elasticities
6. Monthly payment smoothing evidence
7. Monthly payment bunching evidence
8. Aggregate importance of maturity
9. Conclusion

1. Large maturity elasticities

- Large maturity elasticities relative to interest-rate elasticities
  - Karlan & Zinman (2008) microfinance field experiment in S. Africa
  - Attanasio et al. (2008) loan size correlations in CEX
  - Both interpret as evidence of binding liquidity constraints

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  - Juster & Shay (1964), Eberly & Krishnamurthy (2014), Fuster & Willen (2017), Greenwald (2018), Ganong & Noel (2018)

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- *Contribution*: binding liquidity constraints not the only explanation for large maturity elasticities
  - Borrowers of all stripes bunch at salient payment amounts
  - Maturity is the mechanism of choice to monthly payment target
  - \+ identification in high-stakes setting among financially sophisticated

Aside: Maturity as a credit-supply shock

- Typical form of credit supply shocks: $r \downarrow$ or lending standards $\downarrow$
- Other features of credit surface matter besides price and constraints
- Maturity key example – free parameter in installment debt contract
  - Significant increases in installment-loan maturity over time
  - Triggered regulatory concern ▸ OCC
  - Perhaps overlooked in literature because less relevant to mortgages
  - Demand-side drivers, too: collateral durability, endogenous to prices, ...

$\rightarrow$ this paper: new reasons why maturity so valued

2. Smoothing of monthly payments

- Mental accounting and non-fungibility of money

- Thaler (1985, 1990): HHs who don't view wealth as fungible; organize cash flows into a set of segmented mental accounts
- Hastings and Shapiro (2013, 2107) HHs do not treat gasoline savings and food-stamps benefits as fungible across expenditure categories
- Extra paycheck sensitivity (Zhang, 2017), PIH departure literature
- Keung (2018) even wealthy HHs with liquidity have high MPC out of Alaska oil dividend

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- *Contribution*: in high-stakes durables setting, most consumers spend car financing savings on bigger loan instead of reallocating across categories

3. Bunching at salient payment amounts

- Behavioral response to pricing precedent in marketing and psychology
  - Wilhelm & Fewings (2008) marketing surveys: consumers focus on first digit of monthly payment amounts
  - Qualitative work in psychology: consumers monthly budgeting via categories (Ranyard, Williamson, Hinkley and McHugh, 2006)
- Bunching behavior difficult to rationalize with liquidity constraints or myopia
- Suggests many consumers attempt to not overspend by forming a sense of affordability based on monthly expenses by category

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- Suggests many consumers attempt to not overspend by forming a sense of affordability based on monthly expenses by category
- *Contribution*: empirical evidence from many actual borrowers using budgeting heuristics in high-stakes setting

Methodological Cousins

- Not the first to use FICO-based discontinuities for identification
  - e.g., Keys et al. (2010) and Agarwal et al. (2017)
- See also literature using bunching as feature not bug
  - Best & Kleven (2017), DeFusco & Paciorek (2017), Di Maggio, Kermani & Palmer (2017)
  - Exploit institutional features to estimate HH optimization in mortgage markets

Also in the family

- Argyle, Nadauld, and Palmer (2017)
  - Search costs in secured credit markets can distort collateral choices
  - With elastic demand for differentiated products, search frictions more consequential
- Argyle, Nadauld, Palmer, and Pratt (2018)
  - Heterogenous incidence of credit supply shocks in durables markets
  - Financing conditions capitalized into prices buyers pay for a car, even when financing obtained independently

Contribution Summary

- Optimization models can generate monthly payment importance via binding liquidity constraints
- Our results document additional factors pervasive in an important, high-stakes market: mental accounting and budgeting heuristics
- Suggestive of consumers recognizing their own commitment problems, cognitive costs, etc. and developing a plan accordingly

Outline

Consumer Optimization Model with Installment Debt

- Goal: illustrate extent to which canonical model can accommodate stylized facts we see in car-loan decisions

Outline

Auto loans are ubiquitous

- 86% of car purchases are financed
- Vehicles 50%+ of total assets for low-wealth HHs (Campbell, 2006)
- 3rd largest category of consumer debt, 100 million outstanding loans
- Over \$1 trillion outstanding auto loans with \$400 bn/year originated

Data Source

- Data from a private software services company
- 2.4 million auto loans from 319 lending institutions in 50 states
- Majority originated by credit unions
- 70% of sample was originated between 2012 and 2015
- 1.3 million loan applications originating from 45 institutions
- Exclude indirect loans and refinances

Variables

- Ex-ante borrower variables: FICO, DTI, gender, age, $\widehat{\text{ethnicity}}$
- Ex-ante loan variables: Interest rate, maturity, LTV, channel
- Collateral variables: make, model, year, trim, purchase price
- Ex-post loan performance: delinquency, charge-off, ΔFICO
- Summary statistics

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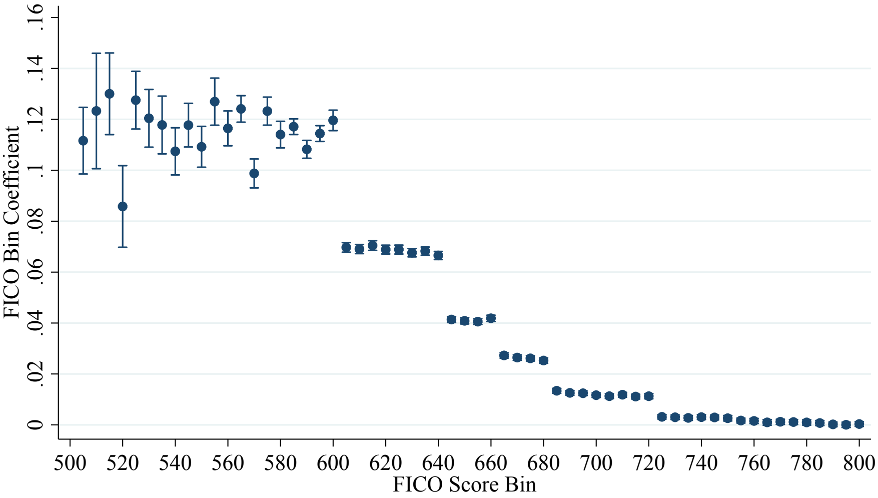
Identifying Demand Elasticities

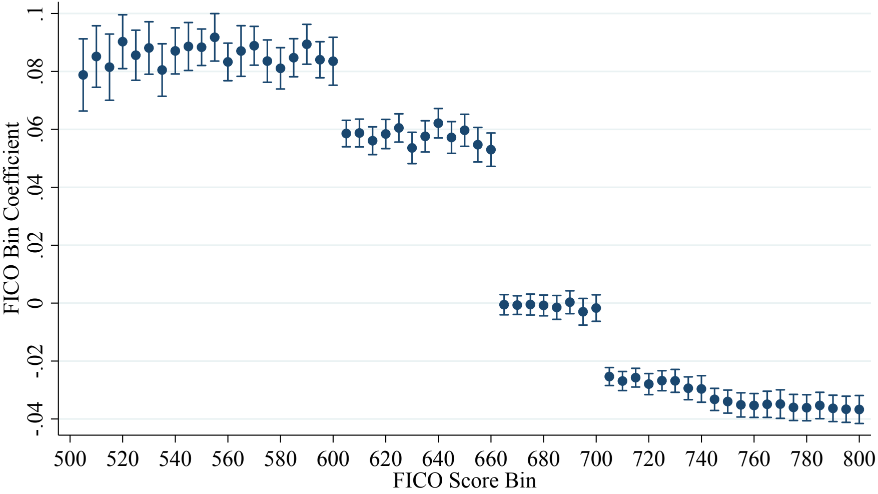
$$\eta^{rate} = \frac{\partial \log Q}{\partial \log r}$$
$$\eta^{term} = \frac{\partial \log Q}{\partial \log T}$$

- Requires variation in loan terms coming from supply not demand
- Need this to be exogenous—driven by supply (lender) not demand
- Need demand to not change differentially at discontinuity
- In data, we have variation in r and T from discontinuous pricing rules
- Will test using observables—standard RD identifying assumptions

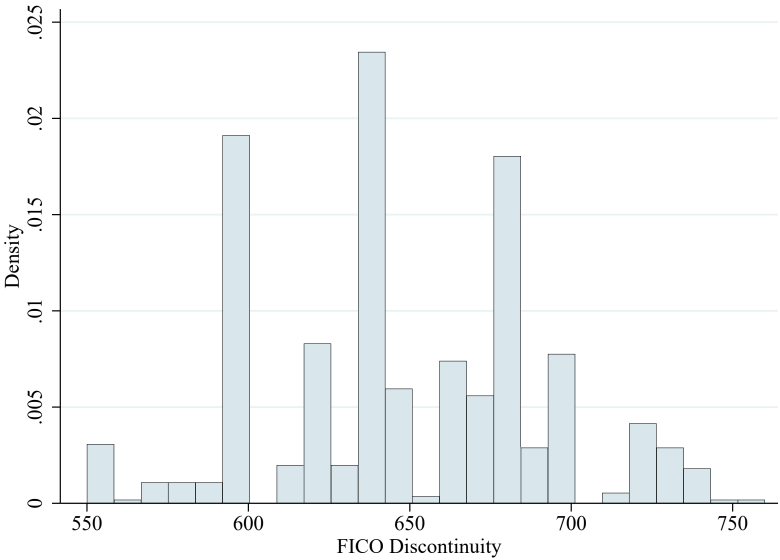
Example Credit Union #1



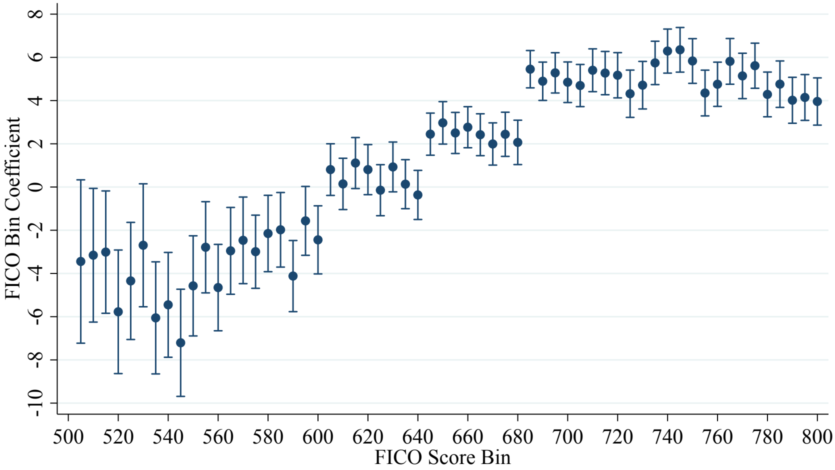
Example Credit Union #2



Wide heterogeneity across institutions in policies



Also see discontinuities in maturity: example



Detecting Discontinuities

- Regress interest rates r on 5-point FICO bin dummies for each lender l

$$r_{il} = \alpha + \sum_b \delta_{bl} 1(FICO_i \in Bin_b) + \varepsilon_{il}$$

- Define a discontinuity as a FICO score cutoff with
  - a 50 bps difference in adjacent coefficients (economically significant)
  - p-value of difference less than .001 (statistically significant)
  - p-values between the leading and following bins $>.1$ (not just noise)

Aside: why would lenders price this way?

- Hard coded from pre-Big Data era (Hutto & Lederman, 2003)
- Persistence of rate-sheet pricing
- Particular processing cost structure (Bubb & Kauffman, 2014; Livshitz et al., 2016)
- Worry about overfitting (Al-Najjar and Pai, 2014; Rajan et al., 2015)

* n.b., costly search makes it hard to gain market share by undercutting

Example rate sheet

UNITUS COMMUNITY CREDIT UNION

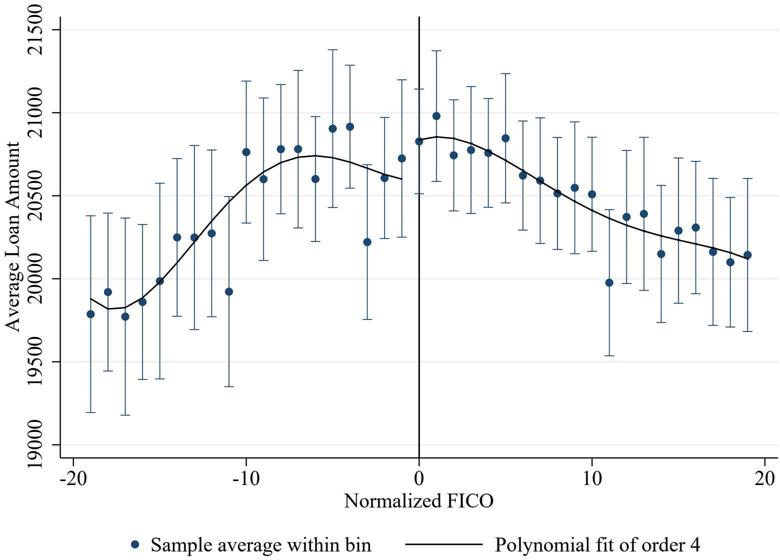
Consumer Loan Rate Sheet
Effective March 1, 2017

New Auto Loans: Model Years 2015 and Newer													
Repayment Period	**Minimum Loan Amount**	**Credit Score 740 +**		**Credit Score 739 to 700**		**Credit Score 699 to 660**		**Credit Score 659 to 610**		**Credit Score 609 to 560**		**Credit Score 559 or below**	
		APR^	**DPR**	**APR^**	**DPR**	**APR^**	**DPR**	**APR^**	**DPR**	**APR^**	**DPR**	**APR^**	**DPR**
Up to 36 Months[1]	$500	**2.24%**	0.0061%	**2.74%**	0.0075%	**3.99%**	0.0075%	**8.24%**	0.0226%	**13.49%**	0.0370%	**14.49%**	0.0397%
37 - 60 Months	$5,000	**2.74%**	0.0075%	**3.24%**	0.0089%	**4.49%**	0.0116%	**8.74%**	0.0239%	**13.99%**	0.0383%	**14.99%**	0.0411%
61 - 66 Months	$6,000	**2.99%**	0.0082%	**3.49%**	0.0096%	**4.74%**	0.0116%	**8.99%**	0.0246%	**14.24%**	0.0390%	**15.24%**	0.0418%
67 - 75 Months	$10,000	**3.24%**	0.0089%	**3.74%**	0.0102%	**4.99%**	0.0130%	**9.24%**	0.0253%	**14.49%**	0.0397%	**15.49%**	0.0424%
76 - 84 Months[2]	$15,000	**3.49%**	0.0096%	**3.99%**	0.0109%	**5.24%**	0.0158%	**9.49%**	0.0260%	**N/A**		**N/A**	
2015 and newer hybrid vehicles qualify for an additional 0.25% rate reduction.													
We may finance up to 100% Retail NADA or KBB unless the vehicle has over 100,000 miles in which case we may lend up to 100% of NADA or KBB for Tier 1 borrowers and up to 80% of NADA or KBB for Tier 2-6 borrowers. Maximum term for vehicles with over 100,000 miles is 66 months.													

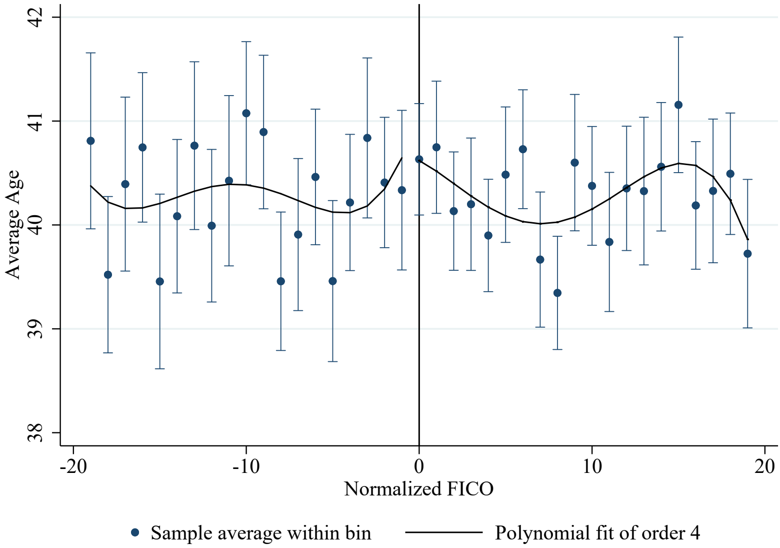
Is there selection around interest-rate discontinuities?

- Are LHS borrowers just different from RHS borrowers?
- Rule out heterogeneity via several checks:
  - McCrary density test
  - Smoothness of observables at discontinuity:
    - ✓ Application loan size
    - ✓ Application Debt-to-Income
    - ✓ Borrower age
    - ✓ Borrower gender
    - ✓ Borrower ethnicity
  - Loan Performance
    - ✓ Delinquencies
    - ✓ charge-off probability
    - ✓ Default rates
    - ✓ change in FICO

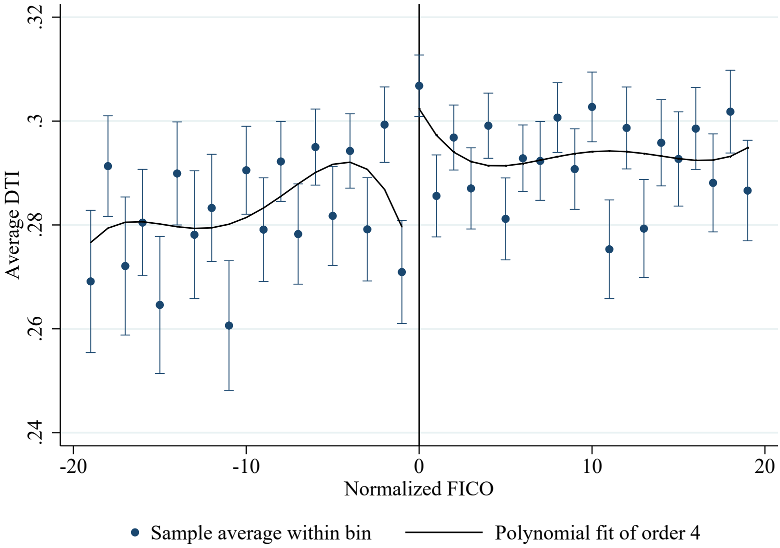
Balance checks: Application Loan Amount



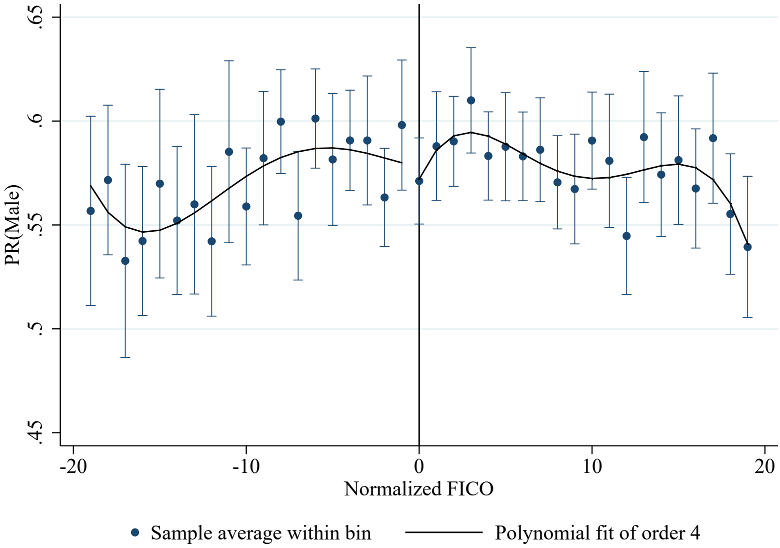
Balance checks: Applicant Age



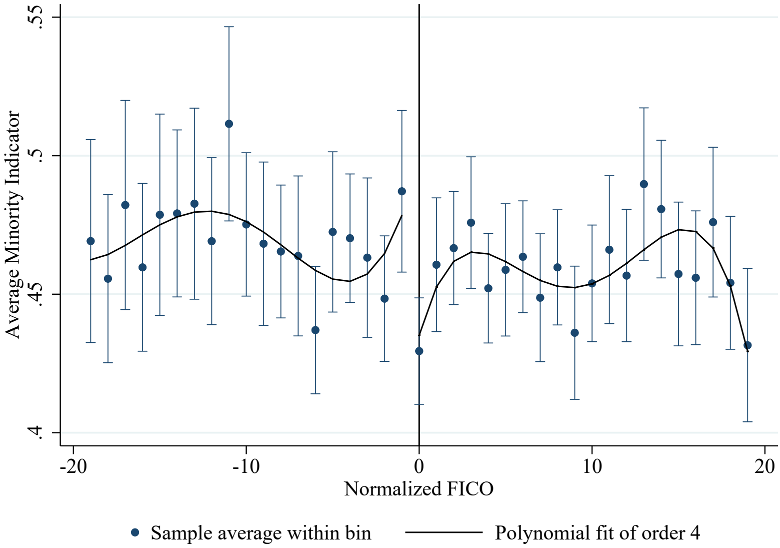
Balance checks: Application DTI



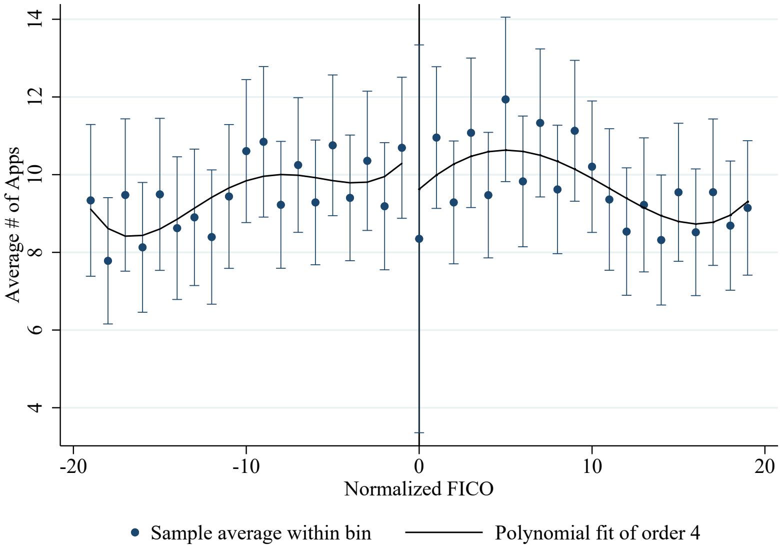
Balance checks: Applicant Gender



Balance checks: Applicant Ethnicity



No bunching in running variable: Application Counts



Ex-ante Smoothness

	(1) Debt-to-Income	(2) Age	(3) Minority Race	(4) Loan Amount	(5) Application Count
Discontinuity	-0.001	0.24	-0.02	339.8	1.30
Coefficient	(0.008)	(0.47)	(0.02)	(353.3)	(1.74)
RD Controls	✓	✓	✓	✓	✓
CZ $\times$ Quarter FEs	✓	✓	✓	✓	✓
Dep. Var. Mean	0.276	40.59	0.43	20,226.7	11.98
R-squared	0.312	0.02	0.138	0.094	0.778
Observations	28,513	24,909	31,618	31,619	2,567

First stage specification

- RD around detected lending thresholds $\mathcal{D}$
- Normalize FICO scores to each discontinuity d, allow overlapping d

$$y_{iglt} = \sum_{d \in \mathcal{D}} 1(FICO_{il} \in \mathcal{D}_d) \left(\delta \cdot 1(\widetilde{FICO}_{id} \geq 0) + f(\widetilde{FICO}_{id}; \pi) + \psi_{dl} \right) + \xi_{gt} + v_{iglt}$$

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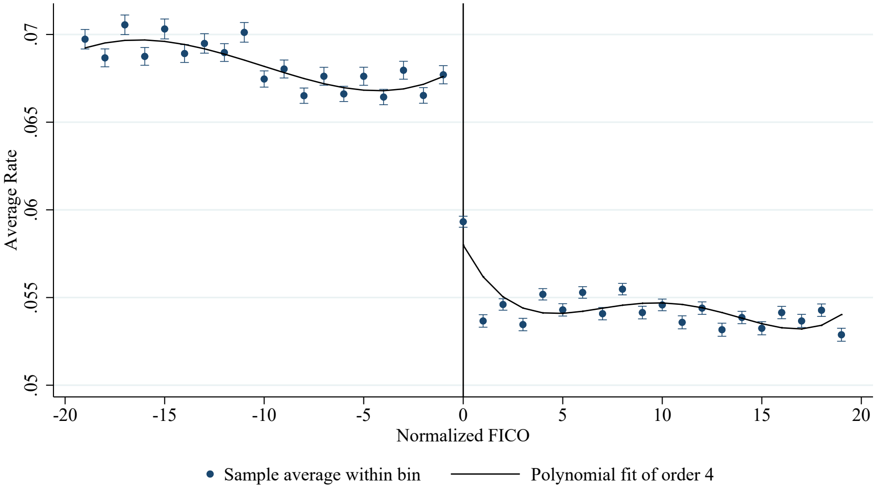
- Quadratic RD function of running variable

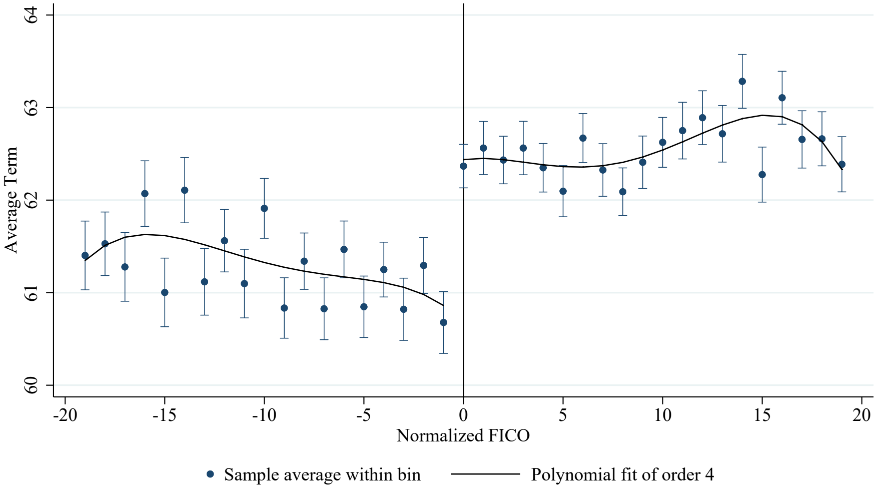
$$f(\widetilde{FICO}; \pi) = \pi_1 \widetilde{FICO} + \pi_2 \widetilde{FICO}^2 + 1(\widetilde{FICO} \geq 0) \left(\pi_3 \widetilde{FICO} + \pi_4 \widetilde{FICO}^2 \right)$$

- Uniform kernel: $1(FICO_{il} \in \mathcal{D}_d)$ indicates loan i within 19 points of discontinuity d at lender l
- Discontinuity $\times$ lender and CZ $\times$ quarter fixed effects

First stage for Interest Rates



First stage for Maturities



First stage: Discontinuities in loan parameters

	(1) Loan Interest Rate	(2) Loan Maturity (months)
Discontinuity Coefficient	-0.013***	0.738***
	(0.004)	(0.171)
RD Controls	✓	✓
CZ × Quarter FEs	✓	✓
Partial *F*-statistic	424.19	49.19
R-squared	0.22	0.13
Observations	533,798	533,798

Standard errors in parentheses clustered by *FICO*

Outline

Estimating Elasticities

$$y_{iglt} = \eta^{r} \log r_i + \eta^{T} \log T_i + \sum_{d \in \mathcal{D}} 1(FICO_{il} \in \mathcal{D}_d) \left(f(\widetilde{FICO}_{id}; \theta_l) + \varphi_{dl} \right) + \alpha_{gt} + \varepsilon_{iglt}$$

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- Term and rate jointly endogenous, priced together in equilibrium
- Instrument set is lender-specific discontinuity indicators

$$\begin{aligned} \log r_{iglt} &= \sum_{d \in \mathcal{D}} 1(FICO_{il} \in \mathcal{D}_d) \left(\delta_l^r 1(\widetilde{FICO}_{id} \geq 0) + f(\widetilde{FICO}_{id}; \pi_l^r) + \psi_{dl}^r \right) + \xi_{gt}^r + v_{iglt}^r \\ \log T_{iglt} &= \sum_{d \in \mathcal{D}} 1(FICO_{il} \in \mathcal{D}_d) \left(\delta_l^T 1(\widetilde{FICO}_{id} \geq 0) + f(\widetilde{FICO}_{id}; \pi_l^T) + \psi_{dl}^T \right) + \xi_{gt}^T + v_{iglt}^T \end{aligned}$$

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- Identifying variation: independent movement of (r, T) at discontinuities across lenders
- Identifying assumption: RHS borrowers don't have higher demand shocks than LHS borrowers at large discontinuity lenders than at small discontinuity lenders

Estimated Elasticities

Margin	(1) Extensive	(2) Intensive
log(interest rate)	-0.10***	-0.18***
	(0.02)	(0.01)
log(maturity)	0.83***	0.66***
	(0.25)	(0.13)
RD Controls	✓	✓
CZ $\times$ Quarter FEs	✓	✓
Equality F-stat	8.26	12.07
R-squared	0.08	0.41
Observations	31,618	533,798

Why would maturity matter so much?

- Rates more important for PV of loan than maturity
- But maturity more important for monthly payments
- Finding: demand elasticities are greater w.r.t. maturity than rates
- So people care more about monthly payments than PV? Yes.
- Usual explanation: credit constraints
- New explanation: heuristic budgeting with targeted monthly payment amounts irrespective of the cost of the loan

Maturity Valued by Credit-*Un*constrained

- Use FICO as proxy for credit constraints
- Explicitly designed as measure of ability to service debt
- Lower FICO $\leftrightarrow$ higher r and DTI, lower loan size, payment, price
- Robust to other measures (DTI, local income, etc.)

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	(1)	(2)	(3)
Sample	FICO$\leq$ 650	651$\leq$ *FICO* $\leq$ 699	FICO$\geq$ 700
		A. Extensive-margin Elasticities	
log(interest rate)	-0.36***	-0.18***	-0.80**
	(0.07)	(0.03)	(0.35)
log(maturity)	0.75***	1.69***	2.12***
	(0.25)	(0.61)	(0.60)
CZ $\times$ Quarter FEs	✓	✓	✓
Equality *F*-stat	2.15	6.14	5.05
R-squared	0.14	0.28	0.40
Observations	6,763	18,784	6,071

Even high FICO loan sizes sensitive to T

	(1)	(2)	(3)
Sample	FICO≤650	651≤FICO≤ 699	FICO≥700
	B. Intensive-margin Elasticities		
log(interest rate)	-0.22***	-0.10***	-0.09
	(0.02)	(0.03)	(0.06)
log(maturity)	0.61***	0.59***	1.27***
	(0.11)	(0.14)	(0.19)
CZ × Quarter FEs	✓	✓	✓
Equality F-stat	9.92	13.12	30.55
R-squared	0.44	0.39	0.48
Observations	191,140	248,404	94,254

Outline

Evidence on Monthly Payment Smoothing

$$payment_{iglt} = \sum_{d \in \mathcal{D}} 1(FICO_{il} \in \mathcal{D}_d) \left(\delta \cdot 1(\widetilde{FICO}_{id} \geq 0) + f(\widetilde{FICO}_{id}; \pi) + \psi_{dl} \right) + \xi_{gt} + v_{iglt}$$

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	(1)	(2)	(3)	(4)
Sample	All	FICO≤650	[651, 699]	FICO≥700
Discontinuity	2.48	0.57	2.01	2.48
Coefficient	(1.89)	(3.67)	(1.82)	(3.46)
CZ × Quarter FEs	✓	✓	✓	✓
R-squared	0.10	0.15	0.12	0.13
Observations	533,798	191,140	248,404	94,254

Monthly Payment Smoothing Evidence

- Based on first stage, RHS borrowers could pay \$13/month *less*
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- Instead: average borrower actually has the *same* payment as before.

Monthly Payment Smoothing Evidence

- Based on first stage, RHS borrowers could pay \$13/month *less*
- Could reallocate across consumption categories...
- Elasticity estimates $\Rightarrow$ $+$\$5.38 Δpayments across discontinuities.
- Instead: average borrower actually has the *same* payment as before.
- Could generate with DTI constraints...
- ...but holds for high FICO and no evidence of DTI bunching more

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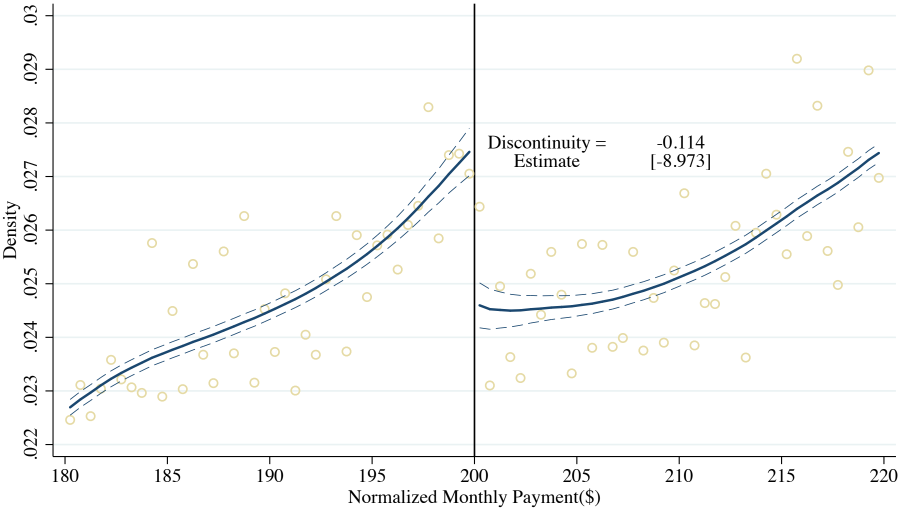
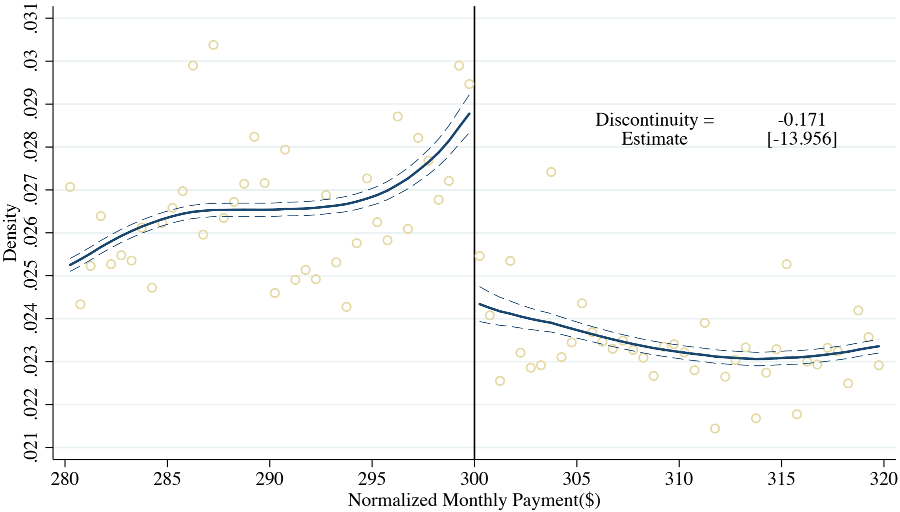
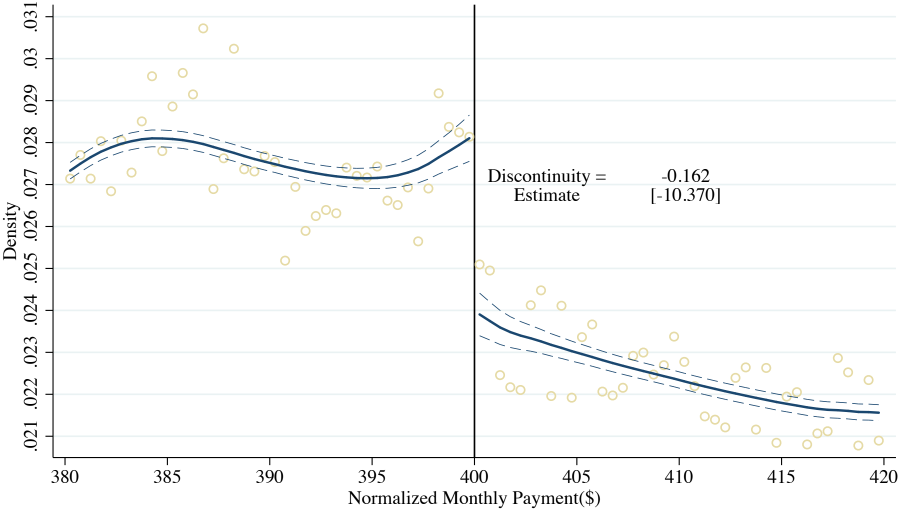
Abnormal bunching at $200



Abnormal bunching at $300

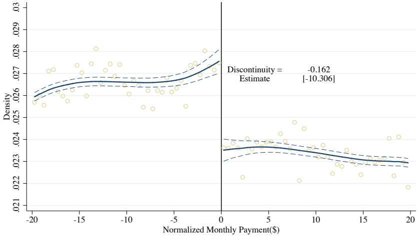


Abnormal bunching at $400

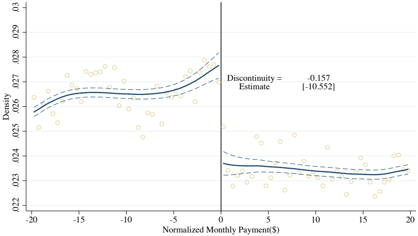


All FICO groups seem to budget this way

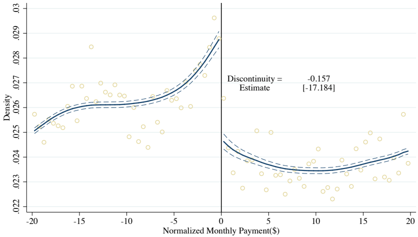
FICO $\leq$ 650



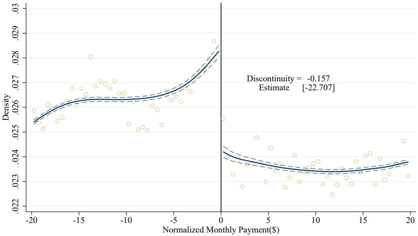
651$\leq$ FICO $\leq$ 699



700$\leq$ FICO



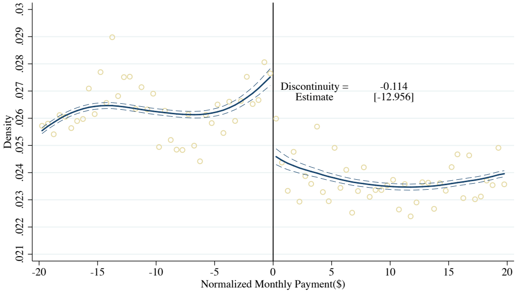
All



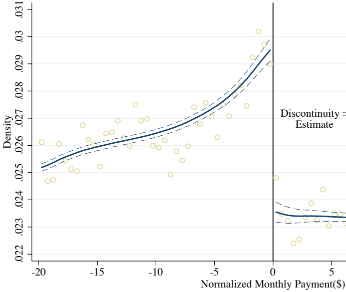
Maturity sensitivity not just about credit constraints

Maturity is instrument of choice for payment targeting

Typical Maturities



Atypical Maturiti



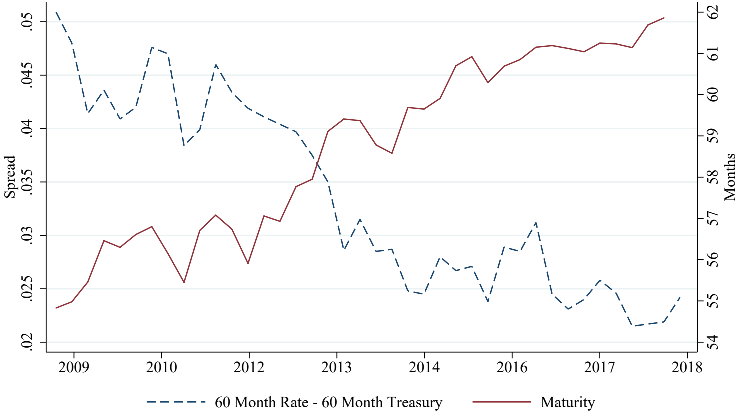
Difference in McCrary stats

Evidence on Monthly Payment Targeting

- Modal consumer adjusts loan size to keep monthly payment constant
- Abnormal bunching at round-number payment sizes
- Even among unconstrained borrowers
- Toy model: can't be explained by liquidity constraints ▸ No DTI Bunching
- Unlikely to bind at $100-multiples anyway
- Maturity popular instrument among those targeting
- Points to mental, categorical budgeting

Outline

Maturity and rate trends imply supply expansion



- 2009-2018: Maturity increased 13%, rate spreads fell 57%.
- Smoke (falling r, increasing T and Q) suggesting credit supply shock

Outstanding debt more sensitive to maturity

- Assume for the sake of argument that credit supply is responsible for the same share of the increase in T and decrease in r
- Even though rate spreads fell 4.4x more than maturities increased, elasticities $\Rightarrow$ maturity affects outstanding debt 1.2x more than rates
- If half $\Delta T, r$ from supply shock then credit supply responsible for $+\$76$B outstanding debt through maturity channel, \$62B from rates

Details

Policy Implications

- Given commitment problems and cognitive costs of optimization, categorical budgeting may be (boundedly) rational
- But makes consumers susceptible to monthly payment marketing resulting in costlier (NPV) loans
- March towards longer maturity loans could raise negative equity prevalence
- Monthly payment focus increases household leverage as maturity eased from credit supply

Conclusion

- Monthly Payment Targeting: making debt decisions by targeting specific monthly payments
- Well-identified elasticities: Consumers are more sensitive to maturity than rate despite rate affecting cost more
    - Targeting payments: Atypical maturities most likely to bunch

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- Well-identified elasticities: Consumers are more sensitive to maturity than rate despite rate affecting cost more
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- Smoothing evidence: strong preferences over payment size levels

Conclusion

- Monthly Payment Targeting: making debt decisions by targeting specific monthly payments
- Well-identified elasticities: Consumers are more sensitive to maturity than rate despite rate affecting cost more
  - Targeting payments: Atypical maturities most likely to bunch
- Smoothing evidence: strong preferences over payment size levels
- Maturities have increased and interest rates have fallen, consistent with credit supply shock
  - Taste for maturity + credit supply shock → bigger increase in debt than from falling rates

Alarm about longer maturities

Too much emphasis on monthly payment management *and volatile collateral values can increase risk, and this often occurs gradually until the loan structures become imprudent. Signs of movement in this direction are evident, as lenders offer loans with larger balances, higher advance rates, and longer repayment terms...* ***Extending loan terms is one way lenders are lowering payments****, and this can increase risk to banks and borrowers. Industry data indicate that 60 percent of auto loans originated in the fourth quarter of 2014 had a term of 72 months or more (see figure 23). Extended terms are becoming the norm rather than the exception and need to be carefully managed.*
–OCC (2015)

Representativeness

- Top 5 states by number of loans:
  - Washington (465,553 loans)
  - California (335,584 loans)
  - Texas (280,108 loans)
  - Oregon(208,358 loans)
  - Virginia (189,857 loans)
- Our data are slightly less diverse (73% estimated to be white vs. 64.5% in census data).
- Median FICO at origination is 714 (vs. 695 for US borrowers)
- ▸ Back

Discontinuity Sample Summary Statistics

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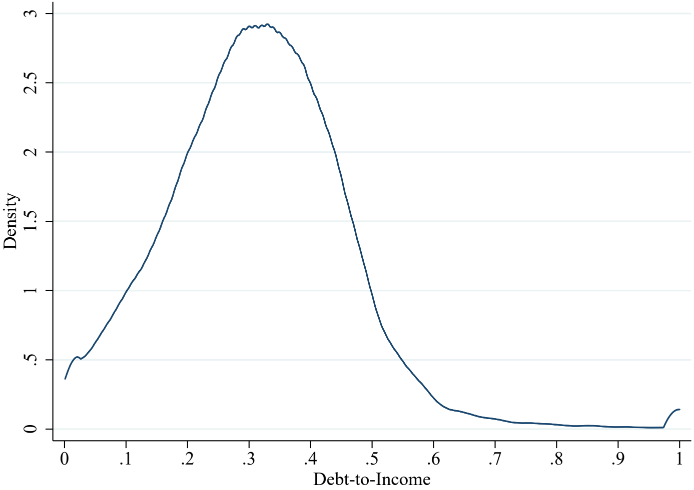
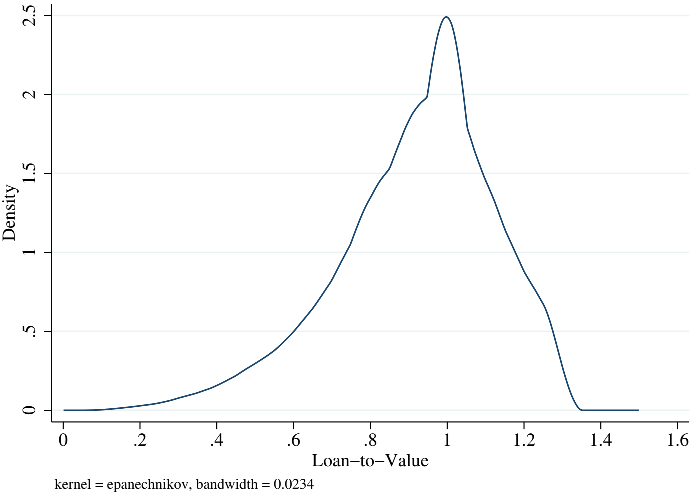
	Count	Mean	Std. Dev.	25th	50th	75th
			A. Approved Loan Applications			
Loan Rate (%)	31,618	0.051	0.017	0.037	0.048	0.061
Loan Term (months)	31,618	63.3	11.9	60	60	72
Loan Amount ($)	31,618	20,226.7	8,458.1	13,736.7	19,467.5	26,025.6
FICO Score	31,618	674.1	27.1	654	676	695
Debt-to-Income (%)	28,513	0.28	0.2	0.2	0.3	0.4
Age (years)	24,909	40.6	13.6	29	39	50
Minority Indicator	31,618	0.43	0.50	0	0	1
Male Indicator	31,618	0.34	0.48	0	0	1
Take-up	31,618	0.55	0.50	0	1	1
			B. Originated Loans			
Loan Rate (%)	533,798	0.06	0.03	0.037	0.053	0.075
Loan Term (months)	533,798	61.4	20.1	48	60	72
Loan Amount ($)	533,798	16,242.2	8,823.7	10,000	14,739	20,679
FICO Score	533,798	663.5	40	638	666	691
Debt-to-Income (%)	248,895	0.24	0.16	0.10	0.27	0.38
Collateral Value ($)	533,798	17,435.8	8,521.3	11,500	15,800	21,566.1
Monthly Payment ($)	533,798	305.9	135.5	210.7	284.4	374.8

No significant DTI bunching

- Monthly payment smoothing, bunching unlikely to be driven binding payment-to-income constraints Back1 Back2



No LTV bunching, either



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How is this Monthly Payment Targeting accomplished?

Sample:	Atypical Maturities	Typical Maturities	
	(1)	(2)	Diff
McCrary θ	-0.35	-0.11	-0.24
	[-8.14]	[-3.66]	[-4.58]
	111,299	162,730	

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Aggregate Effects Calibration

- Let α be fraction of change in equilibrium r and T that can be attributed to credit supply shock
- ΔMaturity would increase outstanding debt by a factor of

$$(1 + \alpha \cdot \%\Delta \bar{T} \cdot \eta^{T}_{extensive})(1{+}\alpha{\cdot}\%\Delta \bar{T} \cdot \eta^{T}_{intensive})$$

- ΔRates would increase outstanding debt by a factor of

$$(1 + \alpha \Delta \bar{r} \eta^{r}_{extensive})(1{+}\alpha \Delta \bar{r} \eta^{r}_{intensive}) - 1$$

- If $\alpha = .5$, then credit supply shock increased outstanding debt \$76B through maturity and \$62B through rates

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