The Capitalization of Consumer Financing into Durable Goods Prices

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Credit $\Longleftrightarrow$ Asset prices

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- Affecting affordability through credit common policy objective

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- Payment size itself important dimension of credit, esp. for households
  - Fuster & Willen 2017, Eberly & Krishnamurthy 2014, Ganong & Noel 2017, Bachas 2018, Argyle, Nadauld & Palmer 2019

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- This paper: use disaggregated data on car loans and sales to identify mechanics of credit-supply shock **capitalization** and **incidence**

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2. Marry individual maturity shocks to individual prices paid for equivalent cars
3. Suggestive evidence that credit shocks affect bargaining intensity

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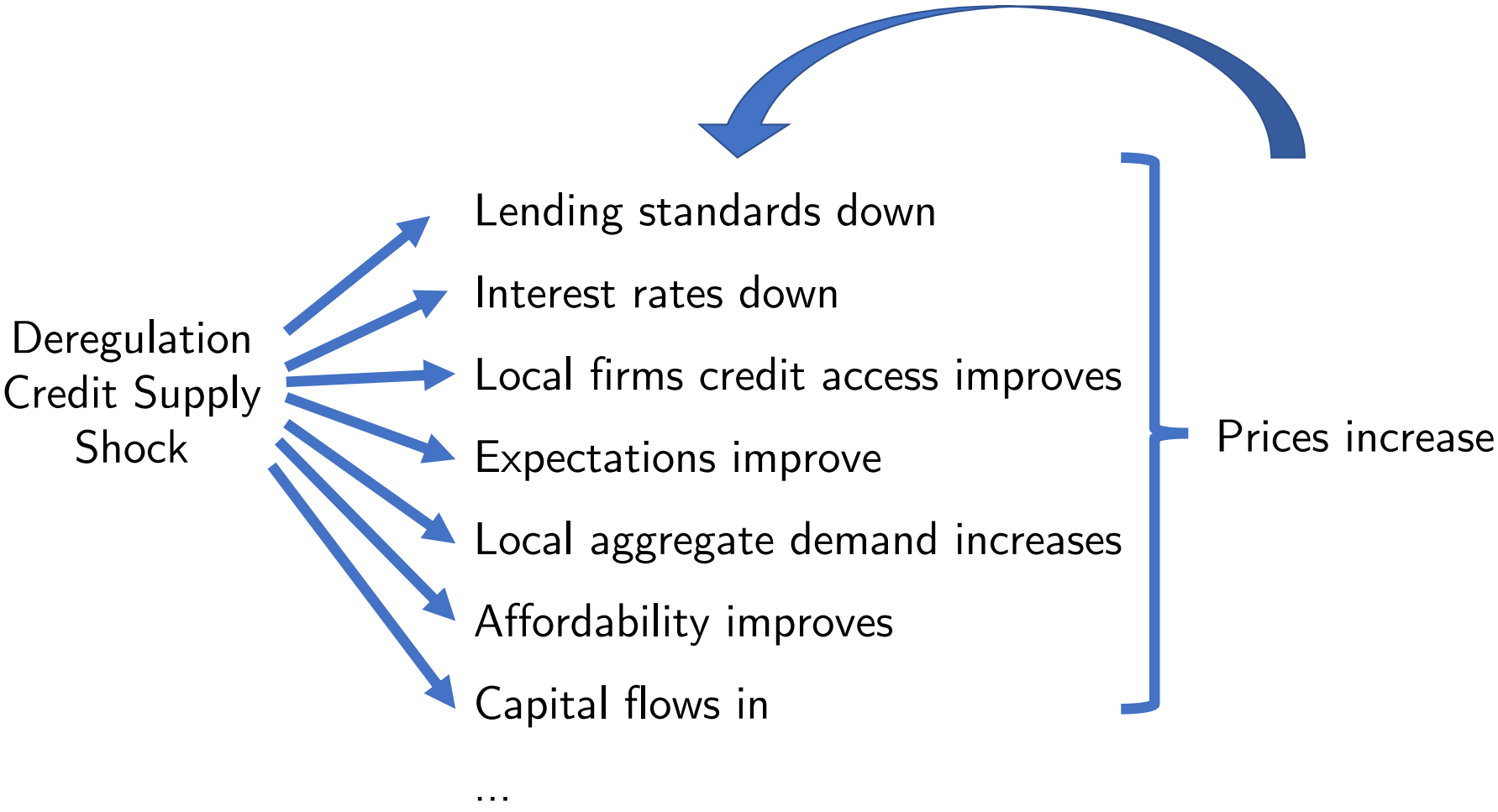
- Spoiler: Significant capitalization effects of individualized credit supply shocks. Price adjustment offsets ~20% of monthly payment increase.

Isolating credit channel



Focus on different dimension of credit supply

- Typical dimensions of credit supply:
  - interest rates (e.g. Bernanke and Gertler 1995)
  - credit limits (e.g. Gross and Souleles 2002)
  - lending standards (e.g. Keys et al. 2010)
- Maturity important for many credit contracts
  - corporate loans, car loans, equipment, personal loans, furniture, student loans, mortgages
- Maturity has large effects on installment-payment size

→ This paper: maturity policies important dimension of credit supply

Tie-in to debt + bargaining literature

- Highlights the usefulness of debt in the bargaining process
- Related corporate finance lit on debt and bargaining in
  - market for corporate control (Israel 1991, Muller and Panunzi 2004)
  - between firms and their suppliers (Hennessey and Livdan 2009)
  - firms and organized labor (Matsa 2010)
  - between hospitals and insurers (Towner 2018)

→ We show similar dynamic: limited financial flexibility influences the bargaining process

- Relevance: most secured debt involves bargained-over collateral

Outline

Auto loans are ubiquitous, important

- $1.2 trillion outstanding (NY Fed, 2016)
- Fastest growing consumer debt category, 3rd largest
- 100m outstanding loans $\approx$ 0.8 per U.S. household
- Vehicles 50%+ of low-wealth HHs total assets (Campbell, 2006)

Data source

- Data from a private software services company
- Originated by 372 lending institutions in all 50 states
- ~1 million used auto loans from 2005-2017
- Most are used-car loans originated by credit unions
  - CU market share of used car loans ~30%
- Observe price, make, model, model year, trim, origination date
- Drop loans intermediated by seller (indirect loans)

Loan summary statistics

Variable	Mean	Std Dev
Interest Rate	0.041	0.024
Maturity (months)	61.3	12.8
Purchase Price ($)	20,341	9,432
Car Age (years)	3.88	2.95
FICO Score	714.1	69.0
Loan-to-Value Ratio	0.91	0.22
Observations	972,621	

Outline

Identification challenge

- Goal: Test for capitalization effects of financing terms in cross-section
- Can't regress price on maturity
  - Better cars have higher prices and can support longer maturity
- Estimate lender-specific maximum allowable maturity policies

→ Isolate natural experiment in *offered* maturity affecting ~5% of sample

Average maturities decline with car age

- Collateral depreciates $\Rightarrow$ max offered maturity = f(car age)
- Overall, smooth relationship between maturity and car age
- Fairly similar patterns for all car types

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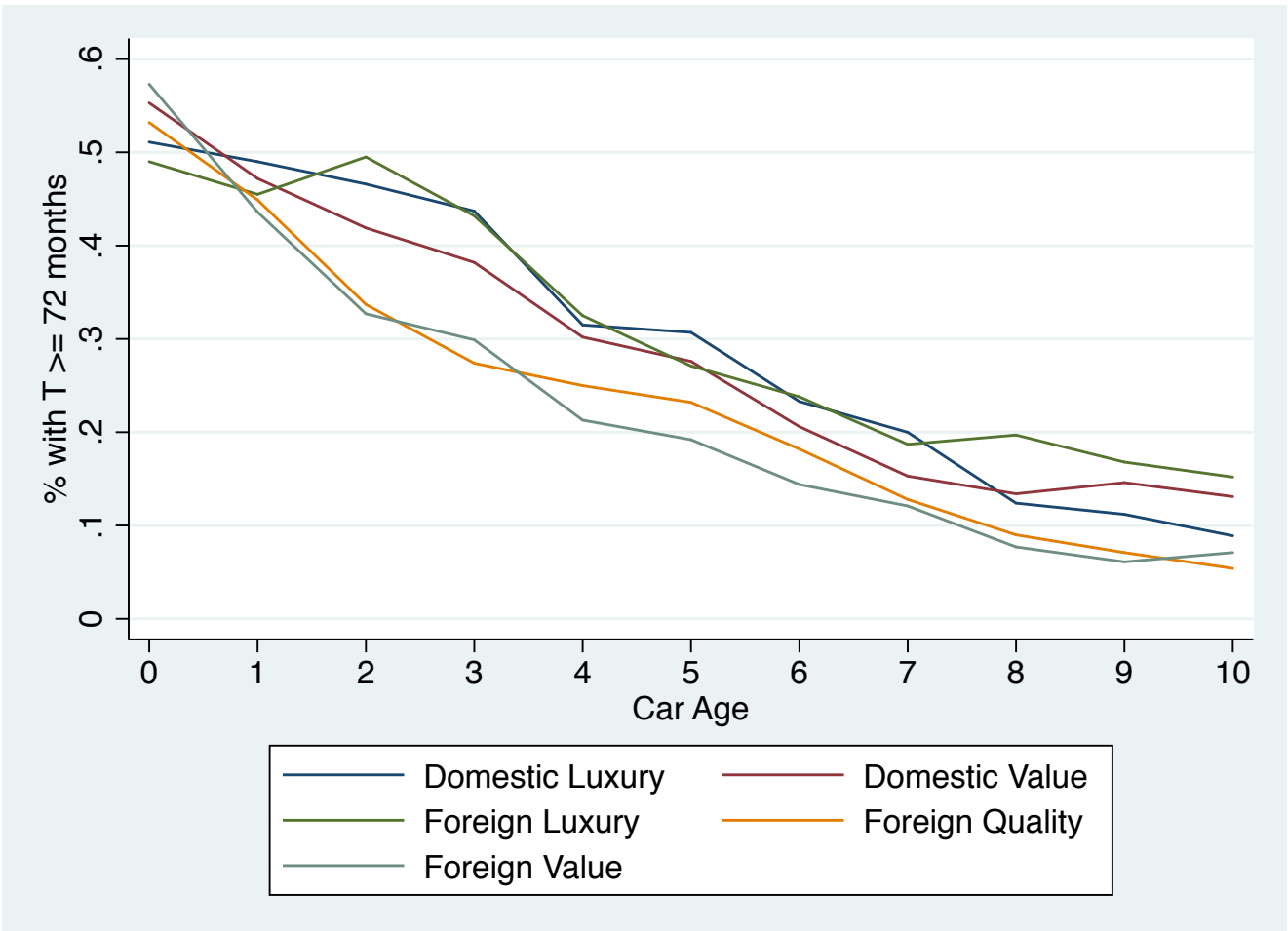

Lender-specific maturity policies

- Key insight: cars all age on Jan 1 (car age $\equiv$ calendar year - model year)
- Policies that limit max offered maturity based on car age cutoff will lead to January 1 discontinuities
- Important: Policies vary across lenders, search costly

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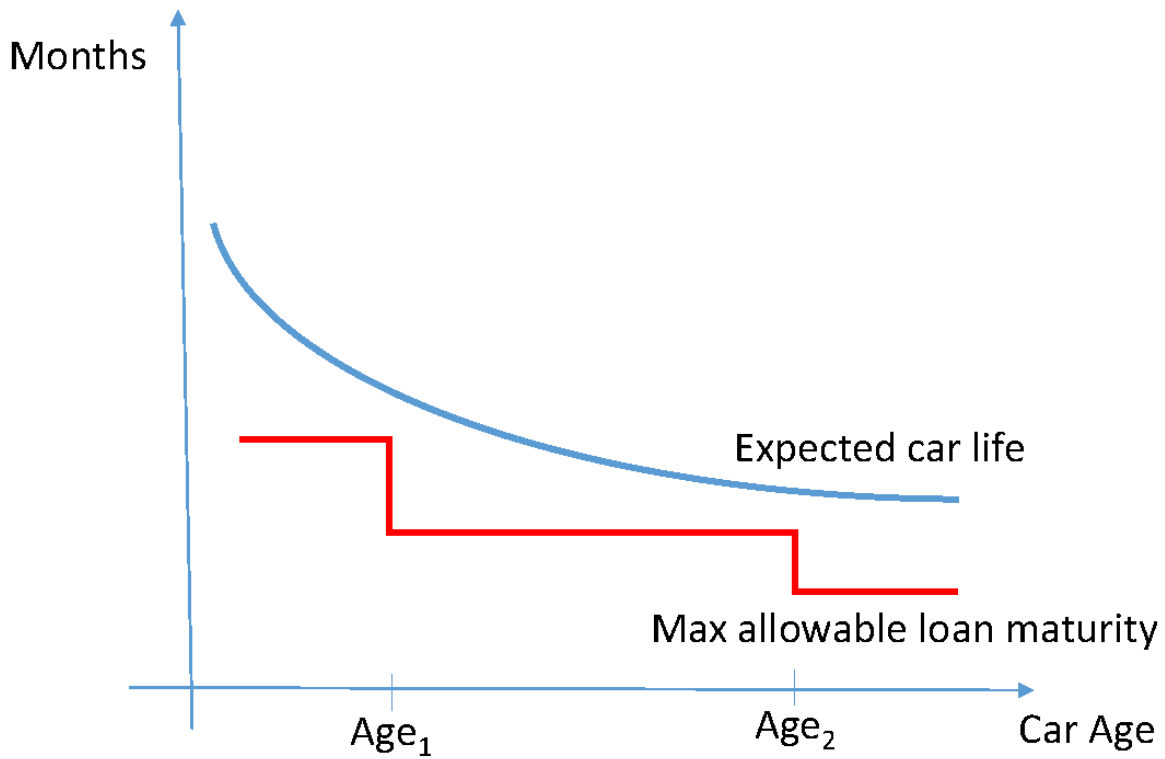
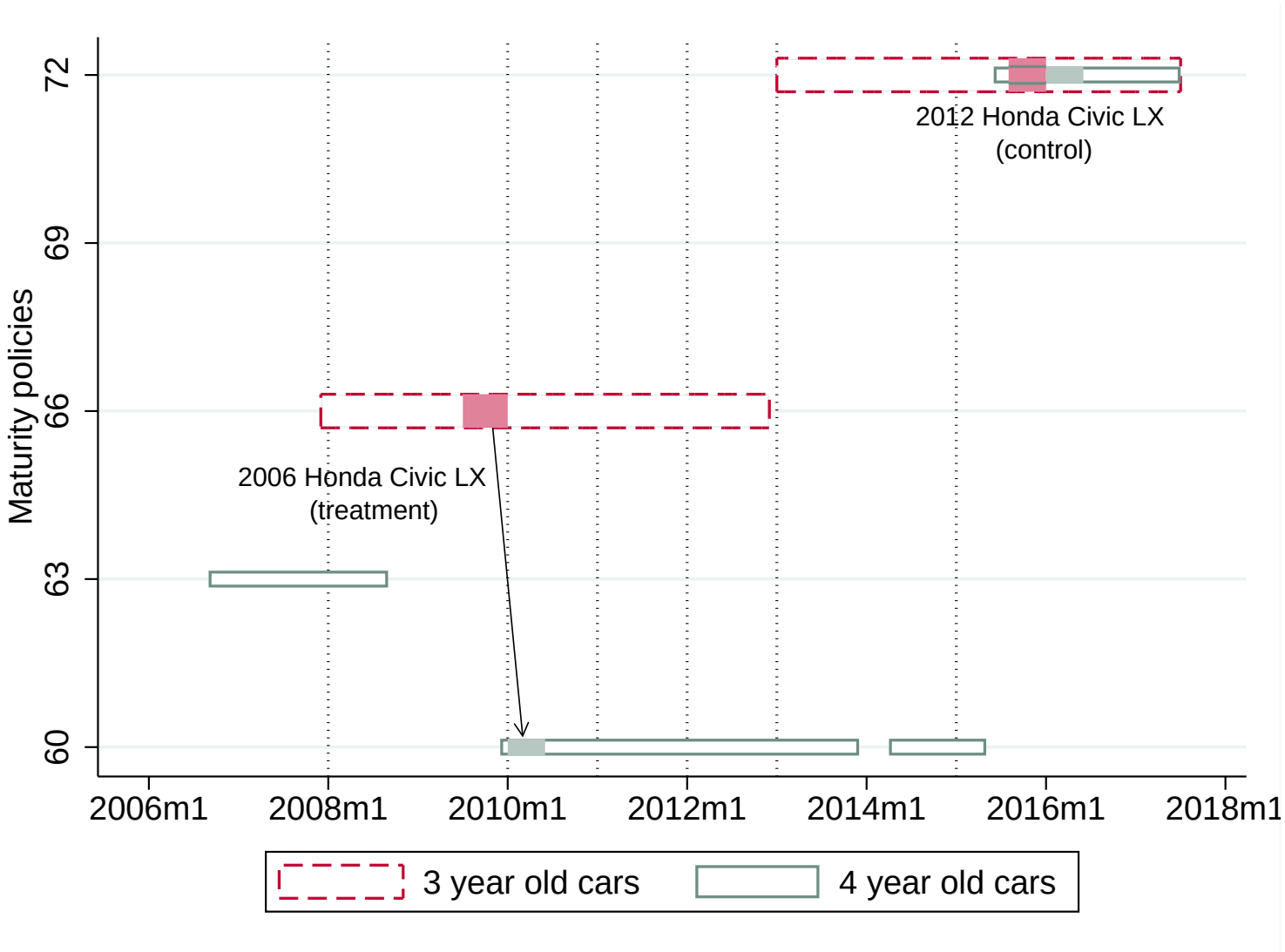


Detecting exogenous maturity shocks

1. For each lender $\times$ car age, identify lender max maturity policy
   - E.g., lender offers max maturity of 72 months for cars 0-3 years old
   - Same lender offers max maturity of 60 months for cars 4-7 years old
   - Max offered maturity $\equiv$ p80 within lender $\times$ car age $\times$ month
   - Maturity policy $\equiv$ stable max offered maturity for more than one year
2. Follow cars as they age
   - Maturity shock $\iff$ max maturity policy for a *given* vehicle changes from one month to the next

Sample lender maturity policy for 3-year-old cars

Example maturity shocks



Natural experiment

- Summary: isolated plausibly exogenous ~5% of transactions that should be affected by maturity shock

- **Treatment**: max offered maturity changes on Jan 1 (for given lender × model year)
- **Control**: lender's max offered maturity does not change Jan 1
- **Post**: January through June
- **Pre**: July through December

- Rich controls: Same lender, same car in both treatment/control

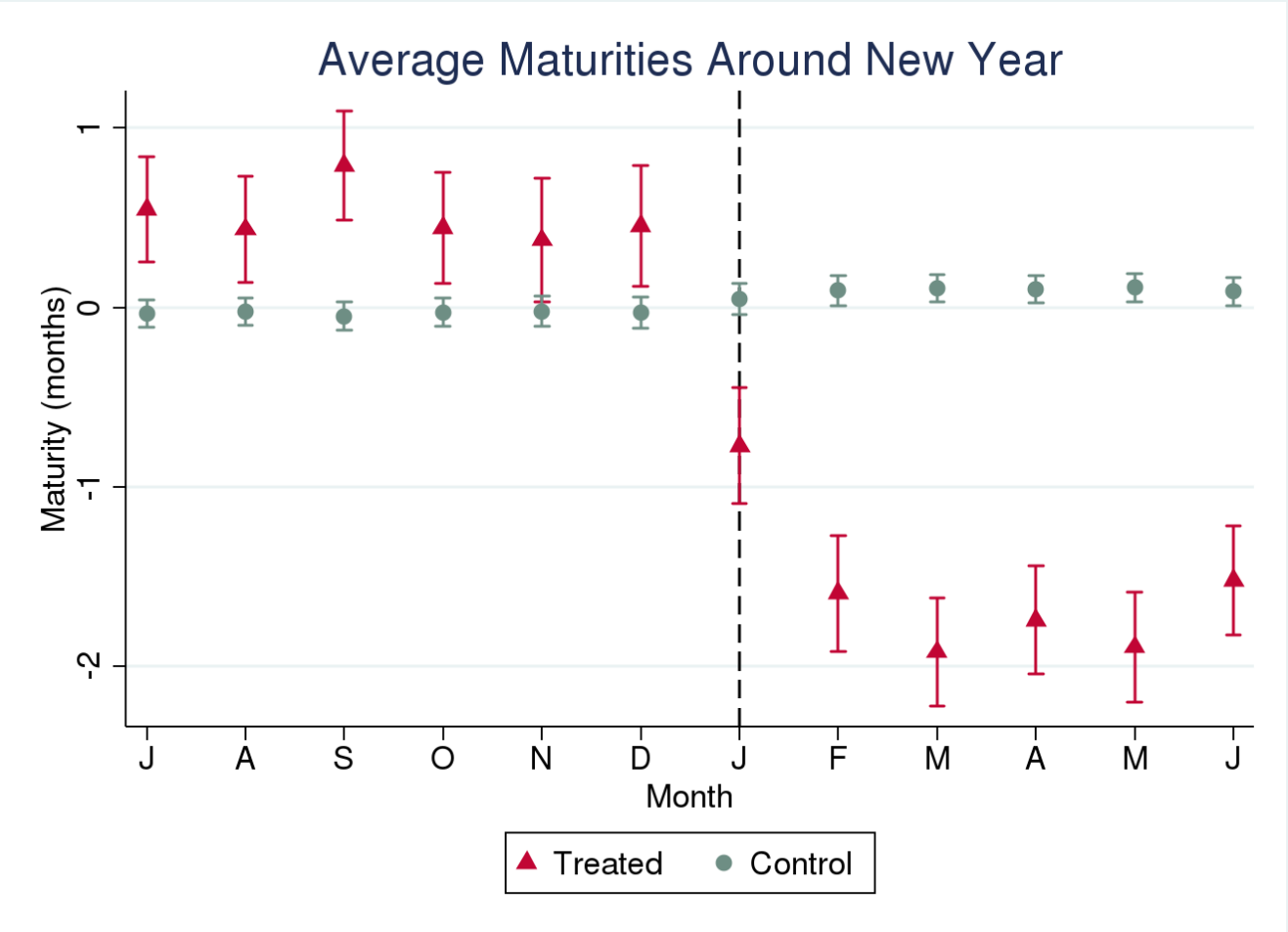
First-stage specification

- Measure relevance for loan i, commuting zone g, lender l, month t

$$Maturity_{iglt} = \beta_1 Post_t + \beta_2 Treat_i + \beta_3 Treat_i \cdot Post_t + X'_{it}\gamma + \varphi_g + \psi_l + \varepsilon_{iglt}$$

- β_3 reports how maturity changed for treated cars post-Jan
- Identifying assumption: treatment and control loans would have had similar maturity trends but for age-based policies
- Crucial controls: Year-Make-Model-Trim $\times$ Month FEs $\delta_{YMMT(i),t}$
- Double cluster by commuting zone and month

Maturity parallel trends



First stage maturity regressions

Maturity	(1)	(2)	(3)
Treatment × Post	-2.157***	-2.284***	-2.290***
	(0.304)	(0.271)	(0.265)
Treatment	-0.371	0.561**	0.368
	(0.365)	(0.282)	(0.263)
Borrower Controls	Yes	Yes	Yes
YMMT × Month FE	Yes	Yes	Yes
CZ FE		Yes	Yes
Lender FE			Yes
Observations	972,621	972,621	972,621
R-squared	0.350	0.407	0.447

→ Chosen maturity decreases by ~2 months for treated borrowers
(e.g., 1 in 4 borrowers receives the max, which decreases by 9 months)

Outline

Use variation in loan terms to test for capitalization

- Reduced-form specification to look for discrete price changes
- For loan *i*, commuting zone *g*, lender *l*, month *t estimate*

$$\log Price_{iglt} = \beta_1 Post_t + \beta_2 Treat_i + \beta_3 Treat_i \cdot Post_t + X'_{it}\gamma + \varphi_g + \psi_l + \varepsilon_{iglt}$$

- Identifying assumption: parallel price trends for treatment/control
- Requires no differential unobserved changes in composition
  - Support with balance tests
- Double cluster by CZ and month

Unobserved heterogeneity

- Worry: Composition changed with $T \Leftrightarrow$ lower P anyway
- Year-Make-Model-Trim (YMMT) fixed effects go very far
- Timing supportive: not a one-month shock but move to new stable $\bar{T}$
- Still important unobservables: mileage, accident history, sophistication, etc.

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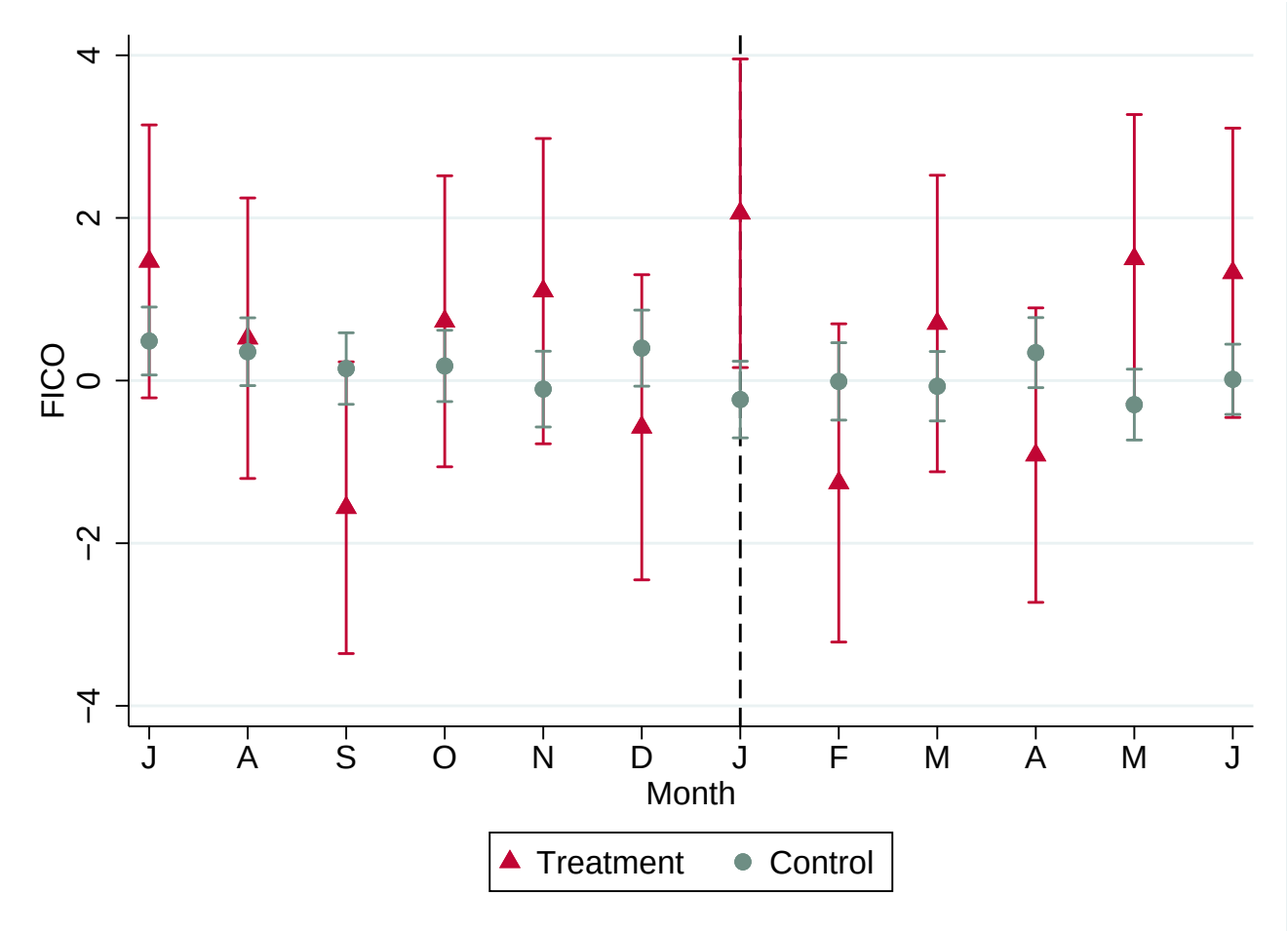
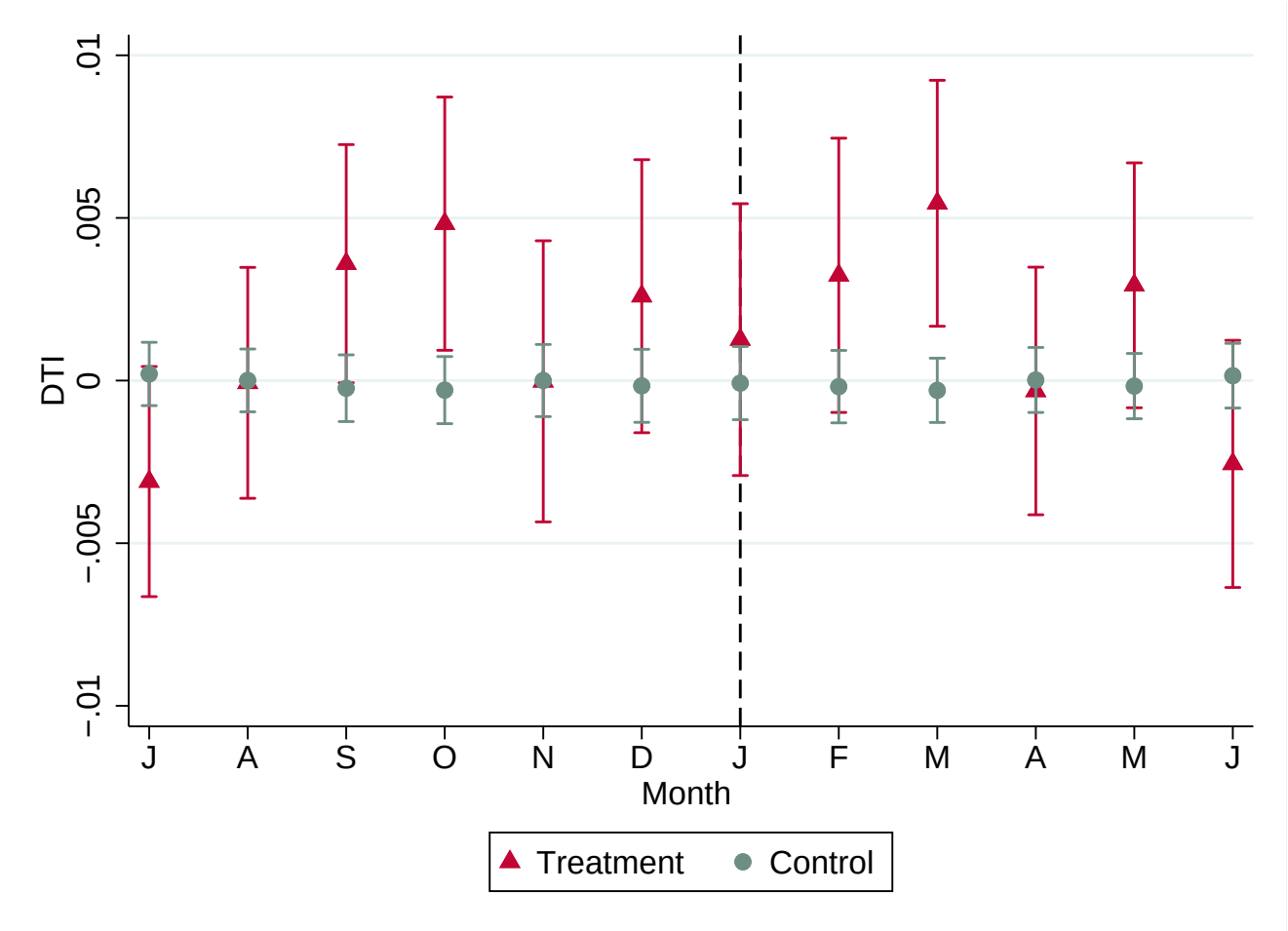
1. Borrower characteristics balance checks
2. No detectable effect on vehicle mileage
3. Repeat-sales test
4. Maturity effects constant with car age
5. Oster (2017) unobserved selection test

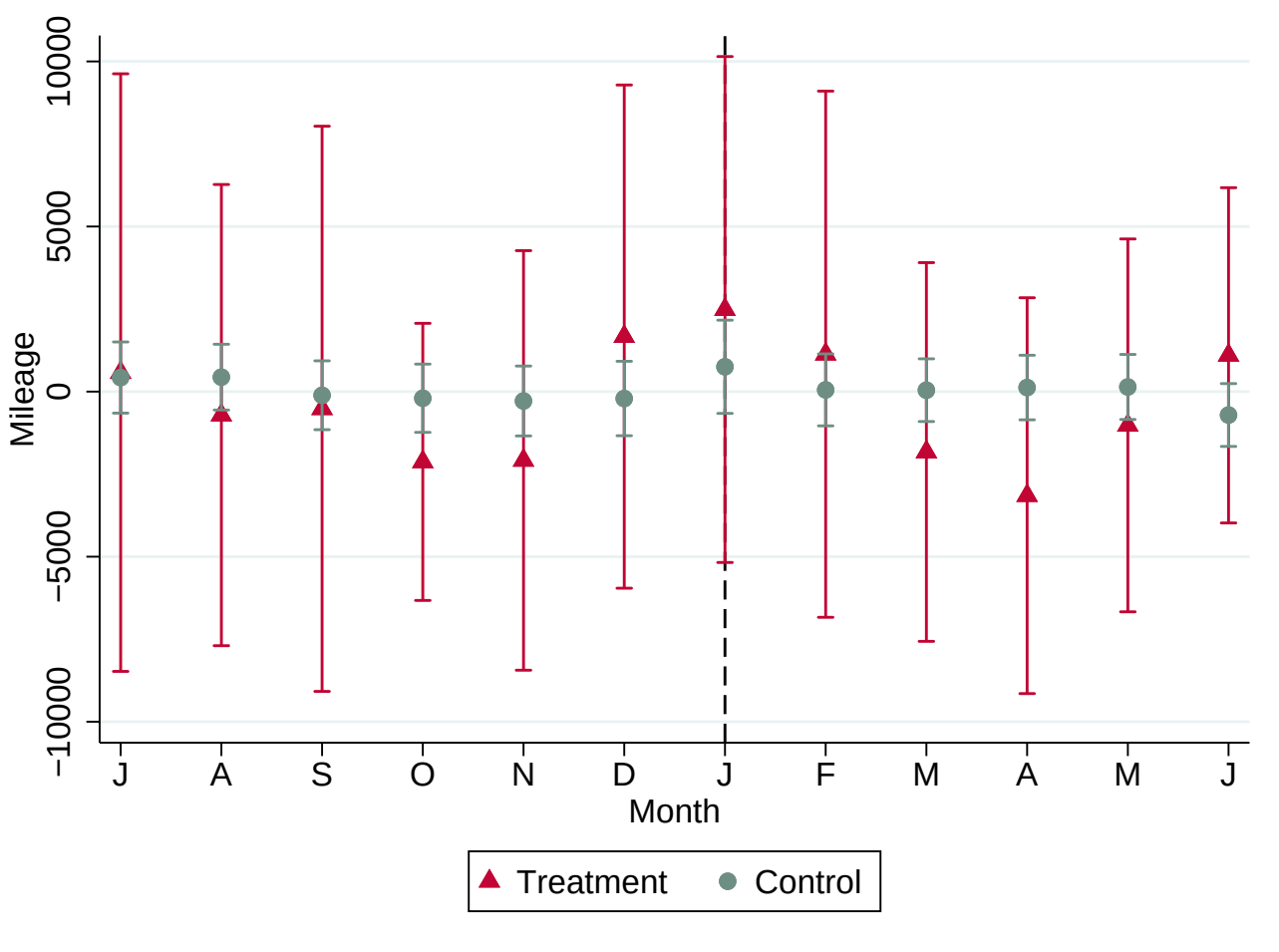
Borrower composition balance: FICO



Borrower composition balance: DTI



Mileage differential stable around Jan 1



Reduced form parallel trends

Capitalization effects

$$\log Price_{iglt} = \beta_1 Post_t + \beta_2 Treat_i + \beta_3 Treat_i \cdot Post_t + X'_{it}\gamma + \varphi_g + \psi_l + \varepsilon_{iglt}$$

log(Price)	(1)	(2)	(3)
Treatment × Post	-0.006**	-0.007***	-0.007***
	(0.003)	(0.003)	(0.002)
Treatment	-0.007	0.006	0.006
	(0.006)	(0.005)	(0.005)
Borrower Controls	Yes	Yes	Yes
YMMT × Month FE	Yes	Yes	Yes
CZ FE		Yes	Yes
Lender FE			Yes
Observations	972,621	972,621	972,621
R-squared	0.909	0.911	0.914

→ Average prices drop ~70 bp from average ΔT ▸ Repeat Sales

Isolating maturity effects from interest-rate effects

- Treatment $\times$ Post affects both T and r ▸ Interest Rates
- Estimate 2SLS system to estimate partial value of maturity
- Instrument set is Lender $\times$ Year $\times$ Age cell k indicators $\times$ Post

$$\log Price_{iglt} = \sum_k \alpha_k \mathbb{I}_{k(ilt)} + \eta^{mat} Maturity_i + \eta^{rate} Rate_i + X'_{iglt}\mu + \varepsilon_{iglt}$$

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$$\begin{aligned} Maturity_{iglt} &= \sum_k \pi_k^{mat} \mathbb{I}_{k(ilt)} \cdot Post_t + \sum_k \varphi_k^{mat} \mathbb{I}_{k(ilt)} + X'_{iglt}\gamma^{mat} + v_{iglt}^{mat} \\ Rate_{iglt} &= \sum_k \pi_k^{rate} \mathbb{I}_{k(ilt)} \cdot Post_t + \sum_k \varphi_k^{rate} \mathbb{I}_{k(ilt)} + X'_{iglt}\gamma^{rate} + v_{iglt}^{rate} \end{aligned}$$

Isolating maturity effects from interest-rate effects

	(1)	(2)
Maturity	0.0024***	0.0023***
	(0.0004)	(0.0004)
Rate	-0.863***	-0.905***
	(0.328)	(0.333)
Borrower Controls	Yes	Yes
YMMT × Month FE	Yes	Yes
CZ FE	Yes	Yes
Lender FE		Yes
Observations	972,621	972,621

→ Implied elasticity of price w.r.t. payment size of -0.23

Interpreting magnitudes

- 2SLS LATE: value of one year of maturity is $12 \times .23\% = 2.8\%$
  - estimated used-car margins ~5–20%
    (Gavazza et al. 2014, Huang et al. 2015, Larsen 2018)
- $2.8\% \times \$20\text{k} = \$560$ ΔP for $\Delta \bar{T} = 12$ months
- One year *lower* $\Delta \bar{T}$ has IRR of ~8.9%
- Lower price offsets about 20% of the higher monthly payment

Outline

Typical transaction timing

1. Loan application/Preliminary shopping for car
2. Loan approval
3. Finalize car transaction with financing terms

$\rightarrow$ scope for prices to adjust because of search or bargaining

What is the transmission mechanism?

- Welfare interpretation affected by mechanism
- Search frictions most likely explanation for price dispersion, market clearing through bargaining (ANP, 2017)
- If lower prices result of treated borrowers searching more intensively, price effects may be washed out by incurred search costs
- On the other hand, bargaining intensity could have costs, too...

Suggestive evidence on mechanisms

1. Search intensity: length of time between application and sale does not change treatment $\times$ post

2. Bargaining success: prices fall from app $\rightarrow$ sale for treatment $\times$ post

Search intensity

	Days Between Application and Origination				
Treatment × Post	-1.184	-1.326	-2.112	-2.114	0.416
	(1.025)	(1.379)	(1.606)	(1.808)	(1.7)
Post	0.117	1.312	0.301	0.951	
	(0.678)	(1.065)	(0.644)	(1.121)	
Treatment	-3.6917**	-1.468	-4.1160**	-1.941	-1.054
	(1.728)	(1.85)	(1.661)	(1.501)	(1.346)
Borrower Controls	Yes	Yes	Yes	Yes	Yes
Lender FEs		Yes		Yes	Yes
Car Age FEs			Yes	Yes	Yes
CZ FEs					Yes
Loan Month FEs					Yes
Observations	54,929	54,929	54,929	54,929	54,929
R-squared	0.005	0.045	0.007	0.046	0.059

Conclusion: New lessons on credit markets

1. New evidence on the **locality** of credit shocks
   - Previous work: aggregate credit shock affects aggregate prices
   - This paper: Credit varies in the cross-section $\Rightarrow$ prices vary in the cross-section
   - Prices adjust at a more granular level than we might have expected
   - Scope in most durables markets with secured credits

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2. Illustrates new **mechanism of transmission** of credit to asset prices
   - Δ demand operating through overlooked dimension of credit surface
   - Likely importance of bargaining in transmission

No significant change in price residuals

log(Price)	Initial-sale (1)	Second-sale (2)	Difference (1) - (2)
Treatment × Post	-0.012	0.006	0.018*
	(0.010)	(0.007)	(0.011)
Treatment	0.009	-0.005	
	(0.010)	(0.004)	
YMMT × Month FE	Yes	Yes	
CZ FE	Yes	Yes	
Observations	8,697	8,697	
R-squared	0.001	0.001	

Back

Interest rates change little with max maturity

Interest Rate	(1)	(2)	(3)	(4)	(5)
Treatment × Post	0.0006	0.0004	0.0009	0.0012*	0.0016***
	(0.0010)	(0.0011)	(0.0007)	(0.0007)	(0.0005)
Treatment	0.0001	-0.0002	-0.0030***	-0.0009	-0.0005
	(0.0014)	(0.0017)	(0.0008)	(0.0005)	(0.0004)
Post	0.0002	-0.0006			
	(0.0007)	(0.0006)			
Borrower Controls	Yes	Yes	Yes	Yes	Yes
Car Age FE		Yes			
YMMT × Month FE			Yes	Yes	Yes
CZ FE				Yes	Yes
Lender FE					Yes
Observations	972,621	972,621	972,621	972,621	972,621
R-squared	0.426	0.443	0.604	0.640	0.664

→ Interest rates don't respond much to $\Delta \bar{T}$ policies, but perhaps some

Back

Robust to 50% hold-out training sample

log(Price)	(1)	(2)	(3)	(4)	(5)
Treatment × Post	-0.0003	-0.031**	-0.009*	-0.009**	-0.009***
	(0.025)	(0.012)	(0.005)	(0.004)	(0.003)
Treatment	-0.101***	-0.026**	-0.008	0.006**	0.008***
	(0.037)	(0.012)	(0.009)	(0.003)	(0.002)
Post	-0.062***	0.055***			
	(0.008)	(0.005)			
Borrower Controls	Yes	Yes	Yes	Yes	Yes
Car Age FE		Yes			
YMMT × Month FE			Yes	Yes	Yes
Commuting Zone FE				Yes	Yes
Lender FE					Yes
Observations	232,984	232,984	232,984	232,984	232,984
R-squared	0.070	0.325	0.923	0.925	0.926

Oster Unobserved Selection Bias

log(Price)	(1)	(2)	(3)	(4)	(5)
Estimated Coefficient	-0.026	-0.027	-0.009	-0.006	-0.007
Omitted Variables Bias-Adjusted	-0.068	-0.071	-0.029	-0.010	-0.009
Includes Zero?	No	No	No	No	No
Adjusted Coefficient within Original Confidence Interval?	No	No	Yes	Yes	Yes
Car Age FE		Yes			
Age × MMT FE			Yes		
YMMT × Month FE				Yes	Yes
Commuting Zone FE					Yes
Lender FE					