Private Information and Price Regulation in the US Credit Card Market

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2009 CARD Act transforms Credit Card Pricing

- Credit card market: source of credit for over 50M households
  - 70% of active accounts used for borrowing ≥ 3 months per year
- 2009 Credit CARD Act strongly restricted credit card banks from *discretionarily* raising a borrower's interest rate over time
- Cannot adjust rates $\implies$ pricing cannot respond to new *information* learned through lending relationships
- How does the credit card market respond to such informational pricing restrictions?

Repricing Before and After the CARD Act

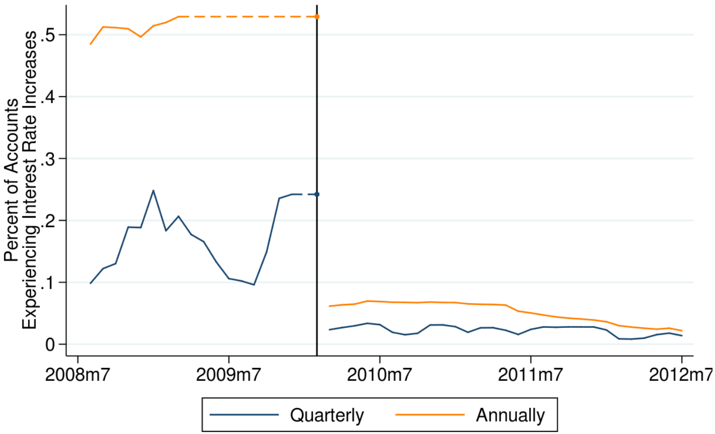

Figure shows the incidence of interest rate increases on current borrowers over 12-month and 3-month horizons, excluding the following interest rate increases permissible under the CARD Act: increases due to the expiration of a promotional rate, to changes in an index rate, or to delinquencies of 60 days or more). Dotted lines extrapolate from the most recent available datapoint when these horizons overlap with the implementation of the CARD Act's interest rate repricing restrictions in February 2010, marked by the vertical black line.

▸ Monthly Frequency

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Repricing restrictions $\Longrightarrow$ difficult to adjust prices for new information

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Tradeoff between two forces: **adverse selection** and **market power**

How do these two forces trade off to determine the overall effect of the CARD Act price restrictions?

- Do some market segments benefit? Do some unravel?
- How does consumer and total surplus change?
- Can CARD-Act-like informational restrictions improve efficiency?

This Paper

- **Reduced form evidence:** both forces play a crucial role
  - Adverse selection: *changes* in credit score become *nearly unpriced* $\implies$ adverse retention on existing accounts + unraveling at origination
  - Market power: *many* privately observed signals of *demand characteristics* $\implies$ price dispersion falls, markups fall

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- **Structural model** of the credit card market: study both forces in equilibrium
  - Estimate model on pre-CARD-Act equilibrium
  - Use data from near-universe of US credit card accounts
  - Exploit quasi-experimental price variation; recover borrowers' private types and their dynamics
  - Implement CARD Act pricing restrictions in the model $\implies$ analyze eqm response

Data Details

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  - Implement CARD Act pricing restrictions in the model $\implies$ analyze eqm response
- **Key result:** Consumer surplus rises and average transacted prices fall throughout the market; *total* surplus rises in the prime market
  - Market power $>$ adverse selection in the credit card market
  - Insurance value key for prime market's surplus gain

Data Details

Relation to Other Work

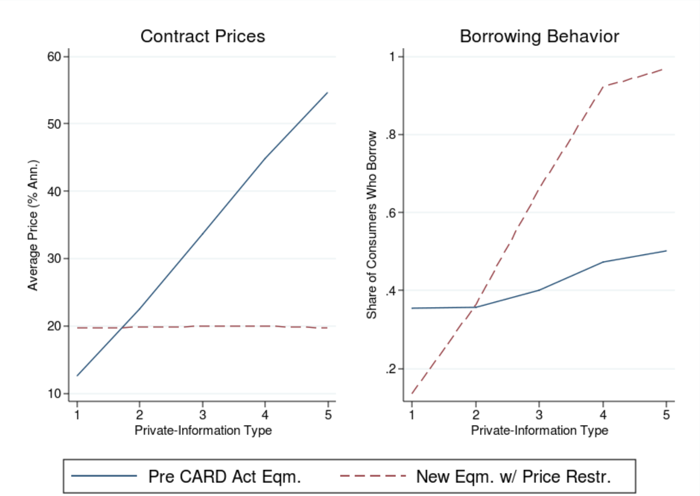
- *CARD Act:* **Agarwal et al.** (2015); Jambulapati and Stavins (2014); Keys and Wang (2019); Han et al. (2018); Hong et al. (2018); Debbaut et al. (2016); Santucci (2015); Pinheiro et al. (2016)
- *Imperfect competition in the credit card market:* **Ausubel** (1991); Berlin and Mester (2004); Brito and Hartley (1995); Stavins (1996); Grodzicki (2014)
- *Credit card demand and usage:* **Gross and Souleles** (2002); Gathergood et al. (2017); Ponce et al. (2017); Meier and Sprenger (2010); Agarwal et al. (2018); Gross et al. (2016); Fulford (2015); Alexandro et al. (2017); Ru and Schoar (2016); Kuchler and Pagel (2018)
- *Adverse selection in a second-best world:* **Handel, Hendel and Whinston** (2016); Handel et al. (2017); Finkelstein et al. (2005); Cochrane (2005);
- *Equilibrium effects of information restrictions*: **Mahoney and Weyl** (2016); Einav, Finkelstein and Cullen (2010); Liberman et al. (2018)
- *Credit market power through private info / switch costs*: **Sharpe** (1990); Petersen and Rajan (1995); Klemperer (1987); Hunt and Serfes (2013)

Preview of Findings: Market Power and Adverse Selection

FICO 680 Consumers, on FICO 680 Contracts

Safest private types face **higher prices** and **borrow less often**. . .

. . . **riskiest** private types face **lower prices** and **borrow more often**



Brief Background on 2009 Credit CARD Act

- Substantially restricted lenders' ability to change pricing in response to new information over time
  - Effectively **no interest rate (APR) increases** allowed on existing debt
  - Behavior-contingent **fees eliminated or capped**
- Included other mandates: new disclosures, nudges, billing methods, interest calculation, etc., and yet restrictions on interest rate increases were the "*core, most important provision of the CARD Act*" (ABA 2013)
- These restrictions can affect the pricing of **two types of information**:
  - Public: credit report data, summarized by FICO score
  - Private: soft information acquired over time

Illustration of Fee Restrictions

Summary of Reduced Form Results

- CARD Act **de-coupled pricing from risk** (e.g., changes in FICO) $\implies$ borrower pool becomes riskier over time; partial unraveling at origination
- Other information became unpriced too: borrower **demand characteristics**
  - Some market segments: *majority* of pre-CARD-Act price increases were in response to behaviors that revealed more about demand than risk
  - Example: repaying late by less than 30 days
  - Pre-CARD-Act excess returns on these accounts reached 300 bps ann.; reduced or reversed after the Act
- Mature-account **price dispersion fell** sharply conditional on risk after implementation of the Act

Demand Signals Price Dispersion

(Mis)pricing of Public Information

- CARD Act $\implies$ cannot raise APR in response to credit score change
- Examine basic relationship between interest rate r_{it} and $\text{FICO}_t(i)$ changes since origination:

$$r_{it} = \alpha_{\text{FICO}_0(i)} + \alpha_{\tau(i)} + \beta[\text{FICO}_t(i) - \text{FICO}_0(i)] + \epsilon_{it}$$

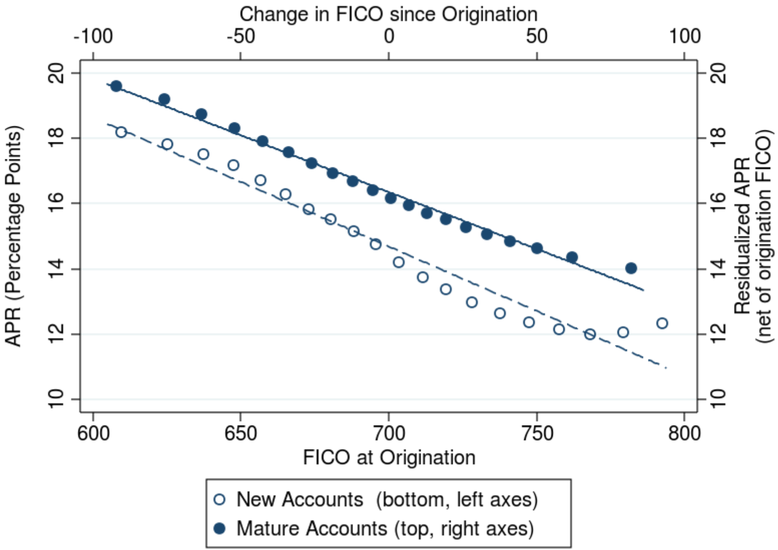
  Notation: FEs α for $\text{FICO}_0(i)$ and account age $\tau(i)$

- Benchmark against the credit score price gradient at origination:

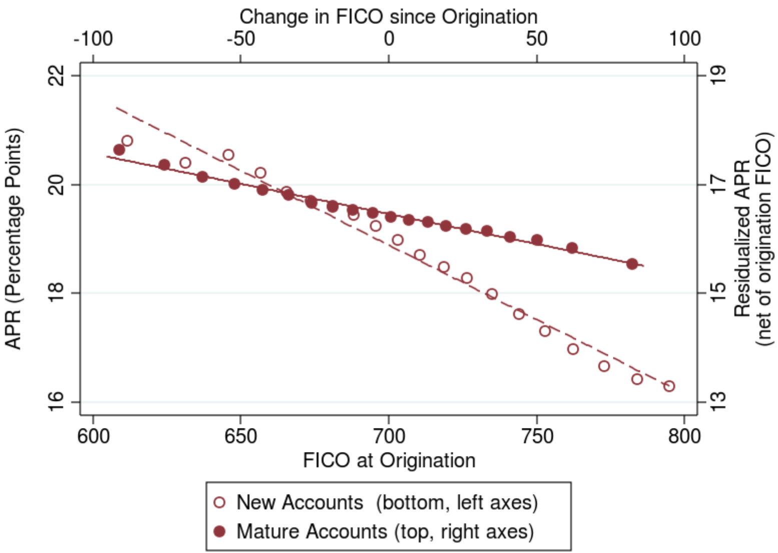
$$r_{i0} = a + b \cdot \text{FICO}_0(i) + e_{it}$$

- Study graphically how these two gradients change with the CARD Act

Pre-CARD Act Price-Risk Gradients



Post-CARD Act Price-Risk Gradients

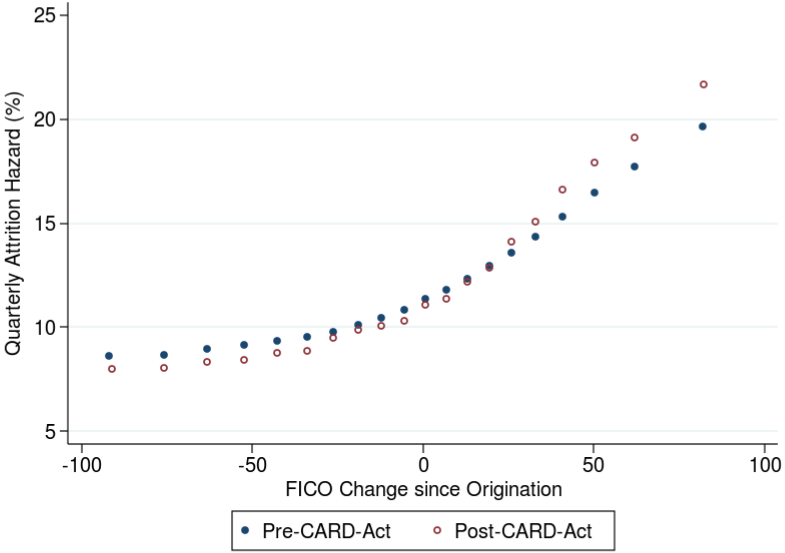


Implications for Adverse Retention

- Unpriced risk $\implies$ newly risky borrowers want to not attrite
- Dynamic adverse selection! Do borrowers exhibit this "adverse retention" post-CARD-Act?
- Examine relationship between attrition and risk changes:

$$1_{\{\mathrm{attrite}(i)\}} = \alpha_{\mathrm{FICO}_0(i)} + \alpha_{\tau(i)} + \beta[\mathrm{FICO}_t(i) - \mathrm{FICO}_0(i)] + \epsilon_{it}$$

Adverse Retention



Motivation for the Model

- Reduced-form evidence:
  - CARD Act restricted pricing both risk and demand-relevant info; selection in/out of borrowing responded to price
  - More risk info restricted at *low* FICO scores, more elasticity info restricted at higher FICO scores
- Structural model quantifies how risk and elasticity info trade off to determine the CARD Act's effects:
  - Which forces – **lower markups on inelastic borrowers, or adverse selection due to unpriced risk** – dominated in equilibrium?
  - How did consumer and total surplus change after the Act? Do some market segments benefit and others unravel?
- My approach: Estimate model on the pre-CARD Act equilibrium, then implement *only* CARD Act information restrictions

▸ Static Version

Model Primitives: Demand

- Consumers i have unit demand: choose one of **differentiated credit card issuers** $j = 1 \dots J$ and one of $k \in \{$**b**orrow,tra**n**sact$\} \equiv \{$b,n$\}$
- Outside good $=$ no credit card
- **Finite mixture of consumer types** θ: each type gets utility $d_{\theta j} \in \mathbb{R}$ from borrowing and incurs disutility $-\gamma_\theta p_{\theta j}$ from borrowing at price $p_{\theta j}$
- Types face adjustment costs (e.g. setup costs for new accounts) and have tastes for transactional (non-borrowing) use of a card
- **Flexible correlation between demand characteristics and risk**: types determine default rate $\delta \in [0, 1]$ each period as $\delta = \delta(\theta)$. Default $\implies$ account is closed (outside good).
- Types evolve under joint Markov transition matrix $T_{\theta\theta'}$

▸ Evidence on Adjustment Costs

Model Primitives: Type Parameterization

- Collapse consumer heterogeneity into two dimensions, $\theta_{it} = (x_{it}, \psi_{it})$:
  - $x_{it} \in X$ public type (think: FICO score)
  - $\psi_{it} \in \Psi$ private type
- (WLOG) let private-information types be ordered such that default increases in type:

$$\psi' > \psi \implies \delta(x, \psi') > \delta(x, \psi) \quad \forall x$$

- Two assumptions make it possible to recover private types ψ_{it}:
  - "Price-invariance of default": default rates are $\delta = \delta(\theta)$
  - "Non-advantageous selection": low-risk types are not sufficiently more inelastic that lenders would want to price them *higher* than high-risk types. (Overly) sufficient condition on borrower retention probabilities:

$$Pr(b, j | x, \psi, b, j) \nearrow \psi \quad \forall x$$

Price-invariance of default

Model Primitives: Demand ctd.

- Choose max of: flow utility + expect. of cont. value V + EV1 shock
- *Example*: continuing to borrow (b) with current bank (j),

$$\underbrace{d_{j\theta} - \gamma_\theta p^1_{\theta j}}_{\text{flow utility}} + \beta \underbrace{\mathbb{E}_\theta \left[V(\theta', j, b) \right]}_{\text{exp. cont. value}} + \epsilon_{ijb}$$

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- So continuation values are,

$$V(\theta, j, k) = \log \left(\sum_{j',k'} \exp \left(v \left(j', k' | j, k, \theta \right) \right) \right)$$

Model Primitives: Grid of Flow Payoffs

Current Period: / *Prior Period:*	Same Bank j: Borrower	Same Bank j: Non-Borrower	New Bank j': Borrower	New Bank j': Non-Borrower	No Credit Card With Any Bank
Borrower, on Credit Card with Bank j	$d_{\theta j} - \gamma_\theta p_{1\theta j}$	$n_{\theta j} - l_{\theta j}$	$d_{\theta j'} - \gamma_\theta p_{0\theta j'} - s_{\theta j'}$	$n_{\theta j'} - s_{\theta j'} - l_{\theta j}$	$-l_{\theta j}$
Non-Borrower, on Credit Card with Bank j	$d_{\theta j} - \gamma_\theta p_{1\theta j}$	$n_{\theta j}$	$d_{\theta j'} - \gamma_\theta p_{0\theta j'} - s_{\theta j'}$	$n_{\theta j'} - s_{\theta j'}$	0
No Credit Card with Any Bank	*n/a*	*n/a*	$d_{\theta j'} - \gamma_\theta p_{0\theta j'} - s_{\theta j'}$	$n_{\theta j'} - s_{\theta j'}$	0

Model Primitives: Supply

- Two informational assumptions:
  - Firms observe their **mature** consumers' full type $\theta = (x, \psi)$, *including* private type ψ...
  - ...but *only* observe public type (FICO score) x on **newly originated** accounts
- At start of period, each issuer j posts prices $p_1^j(\theta)$ for mature cards
- Also posts "teaser rate" prices $p_0^j(x)$ for new consumers: i.e., consumers who held a competitor's card or no card
- Firm flow payoffs are simple: price minus cost

Demand Estimation Step 1: Recovering Private Types ψ

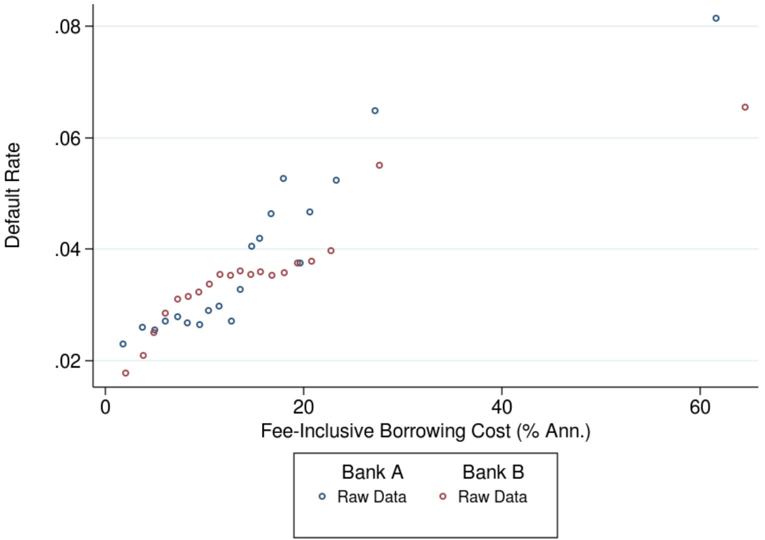
- Non-advantageous selection of borrowers $\implies$ equilibrium price functions are monotone in private types ψ at each FICO score x,

$$p_1^j(x, \psi) \nearrow \psi \quad \forall x$$

- Price-invariance of default $\implies$ ex post default reveals which type ψ was priced at each value of p_1^j
- Invert observed equilibrium price functions by estimating ex-post default rates $\hat{\delta}_{jx}$ at each price (and each FICO x and each lender j), and then taking quantiles p_x^{-1} of estimated default rates,

$$(x, \psi) = p_x^{-1}(\hat{\delta}_{jx}((p_1^j(x, \psi))) \quad \forall x$$

Illustration of Step 1: Recovering Private Types ψ



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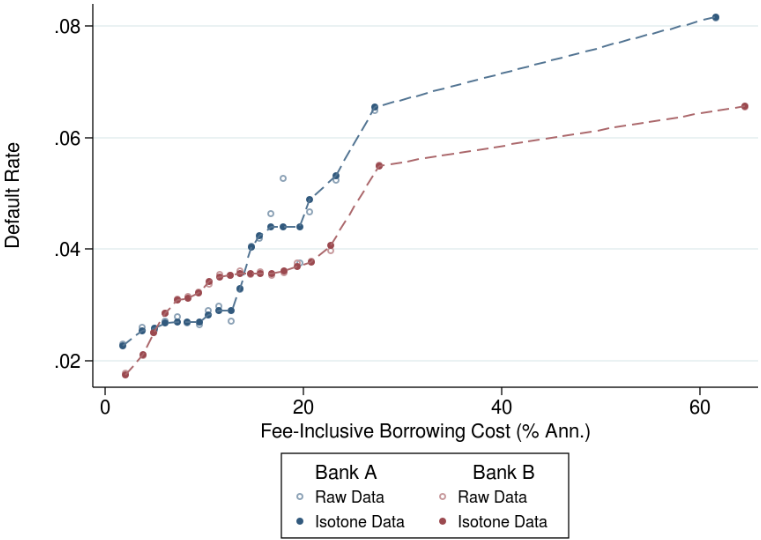

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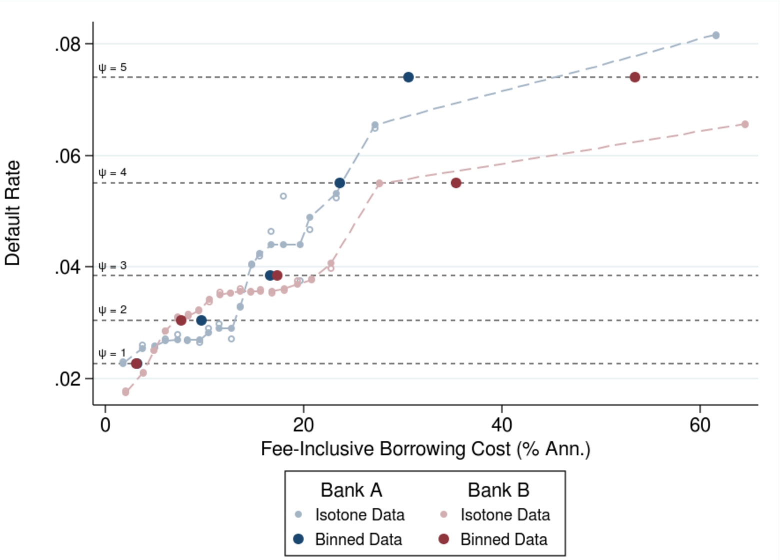


Importance of Private Information

- Steep slope of inverse price functions suggests **private information is important**: strongly predictive of default
- For example, safest quintile of private information among 660 credit scores behaves like riskiest quintile of 720 credit scores:

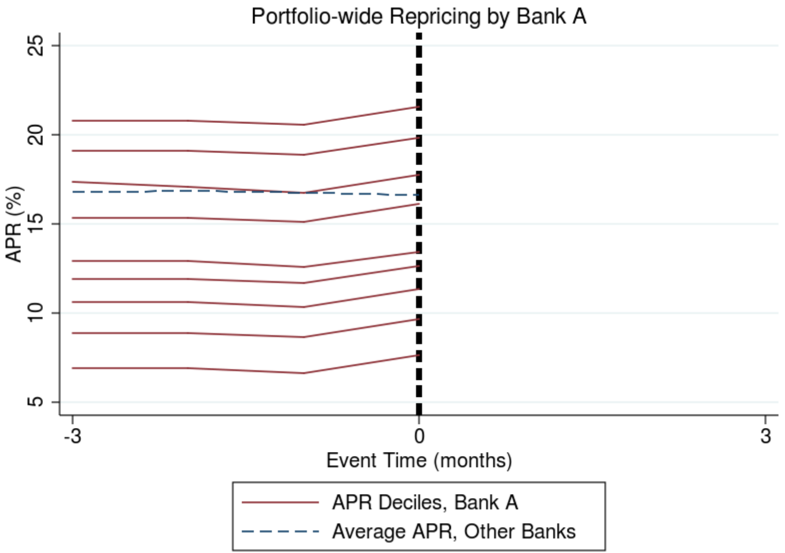
FICO	**One-Year Default Rate by Quintile of Private-Information Type (%)**		
Group	1st	3rd	5th
600	5.93	13.75	20.47
660	3.34	5.13	8.75
720	1.05	1.59	3.27

Regression Version   Type Transition Probabilities

Demand Estimation Step 2: Price Sensitivities

- Use novel source of quasi-experimental price variation in credit card market: **occasional, idiosyncratic portfolio-wide repricing** by certain lenders
  - Gives arguably well-identified price elasticities; then use model to translate these elasticities to model primitives
- Examples of portfolio-wide repricing
  - Increase *all* accounts' interest rates by 100 bps
  - Increase interest rates on an identifiable subset of accounts – e.g. the "airline card portfolio" – by 250 bps
- Why are lenders doing this?
  - Industry insiders say: cost shocks, M&A, change in management style, etc.
- Baseline estimates use repricing event due to upcoming M&A, consummated several quarters later

Example of Repricing Campaign



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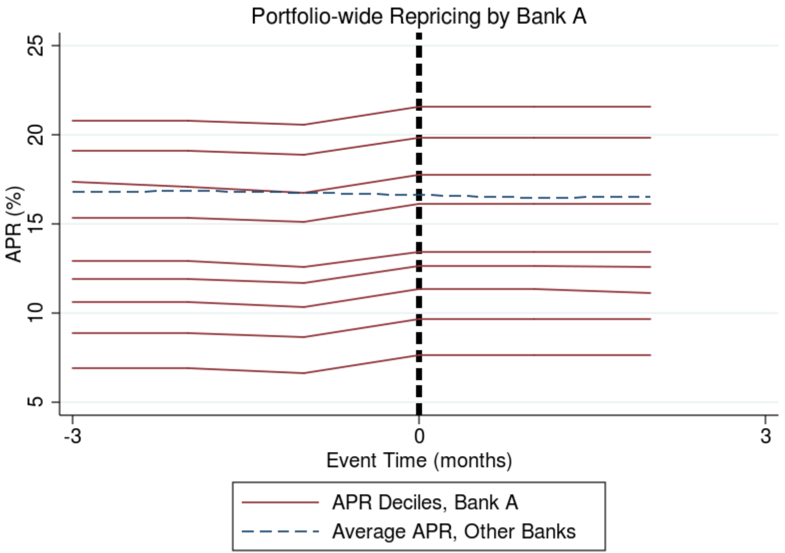

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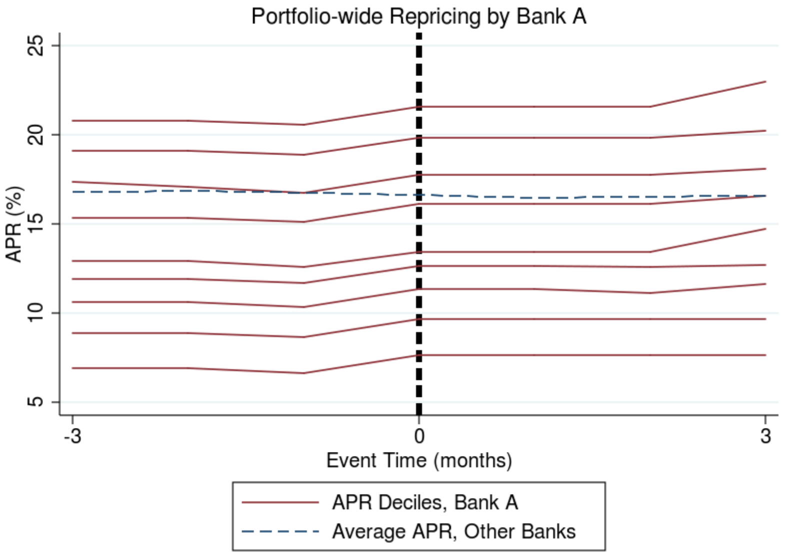

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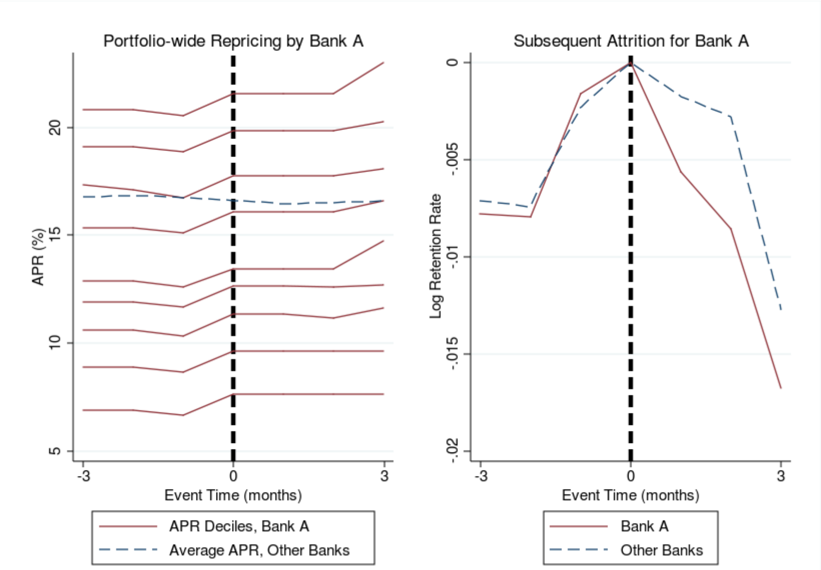


Price Sensitivity Estimates

Estimate γ_θ via two-stage least squares

$$\log P_{\theta jt} = a_{\theta j} + a_t + b_j \times t + \pi_\theta Z_{jt} \times 1_\theta + e_{\theta jt} \quad (1)$$

$$\log Q_{\theta jt} = \alpha_{\theta j} + \alpha_t + \beta_j \times t - \gamma_\theta \log P_{\theta jt} + \epsilon_{\theta jt} \quad (2)$$

Dependent Variable	Log(Retention Rate)	Log(Retention Rate)
Estimator	OLS	2SLS
Gamma	-0.0000339***	-0.106***
	(0.0000118)	(0.0129)
Bank-Specific Trends	YES	YES
1st Stage F-Stat	.	54.26
Observations	60638012	60638012
Clusters	550	550

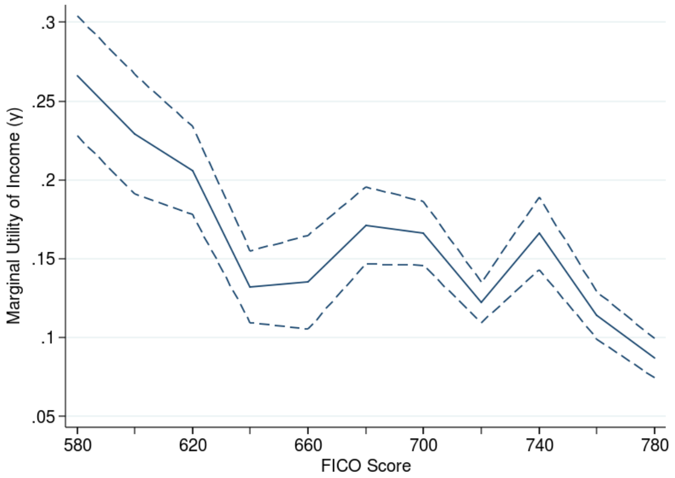
Need to bootstrap SEs to account for estimated terms in $P_{\theta jt}$

Derivation of Estimating Eqn   Back to Price Invariance of Default

Heterogeneous Price Sensitivities by FICO

Lower FICO score borrowers have **higher estimated MU's** of income. . .

. . . consistent with their being poorer



Implementing the CARD Act in the Model

- Remainder of model is estimated by matching moments to recover other demand parameters (e.g. switching costs across accounts), and by using firm FOCs to recover costs
- Using model estimates, next *implement* CARD Act pricing restrictions in the model as a mandate that lenders set *one* go-to price p_1^j for the life of an account

$$\text{Before: } p_1^j = p_1^j(x_t, \psi_t)$$
$$\text{Now: } p_1^j = p_1^j(x_0)$$

- Teaser rates still allowed on new accounts: $p_0^j = p_0^j(x_0)$

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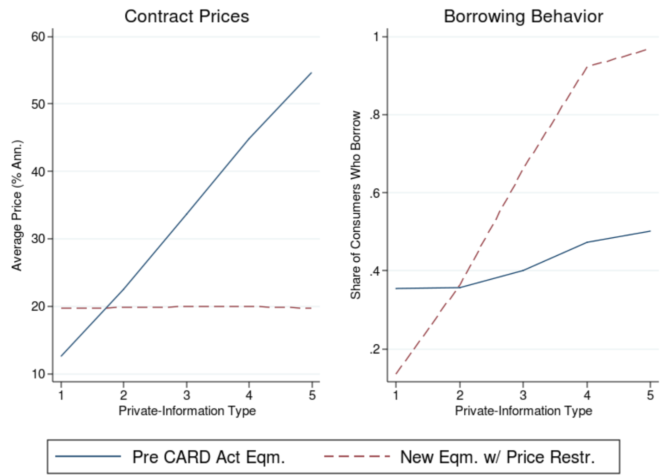
- Teaser rates still allowed on new accounts: $p_0^j = p_0^j(x_0)$
- Two key forces:
  - Adverse selection $\iff$ set p_0^j, p_1^j higher for safe types than before
  - Lower markups $\iff$ cannot raise prices on inelastic consumers

Estimation and Convergence | Demand Parameter Estimates | Supply Estimates

Partial Unraveling

FICO 680 Consumers, on FICO 680 Contracts

Safest private types face **higher prices** and **borrow less often**...
...**riskiest** private types face **lower prices** and **borrow more often**

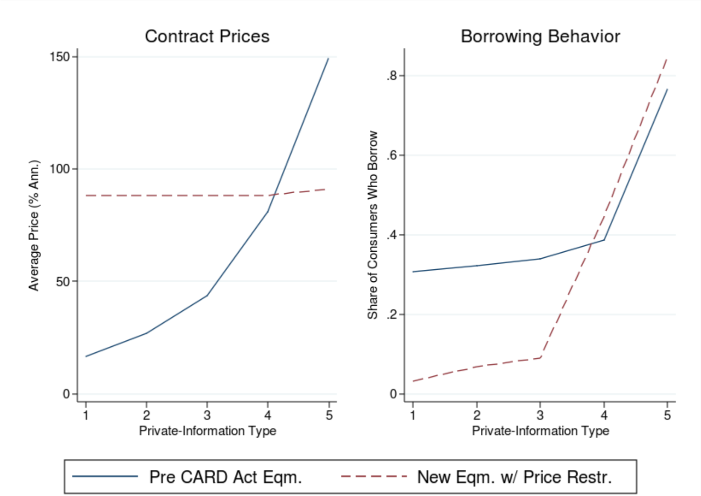


Partial Unraveling, ctd.

FICO 580 Consumers, on FICO 580 Contracts

Price changes are **larger at the subprime end** of the market...

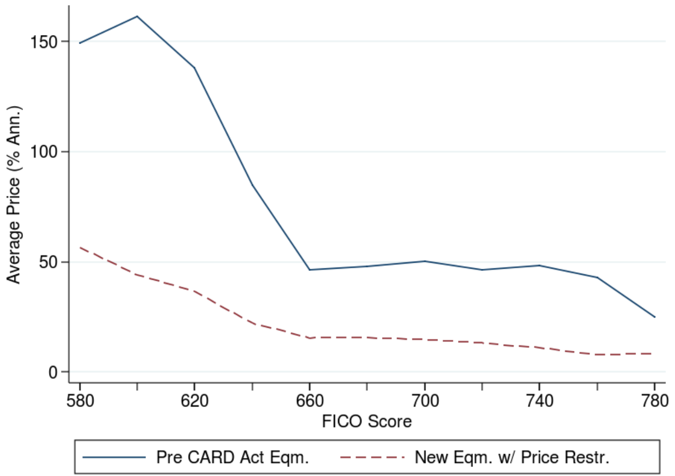
...and **unraveling is more severe**



Overall Prices Fall

Average **transacted prices are lower** when **including all contracts**. . .

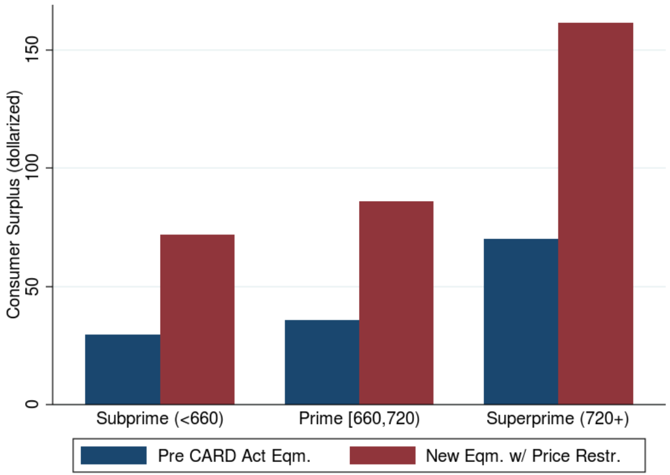
. . . in part b/c **consumers retain favorable contracts** over time



Consumer Surplus Rises

Using marginal utility of income γ_θ to dollarize consumer surplus. . .

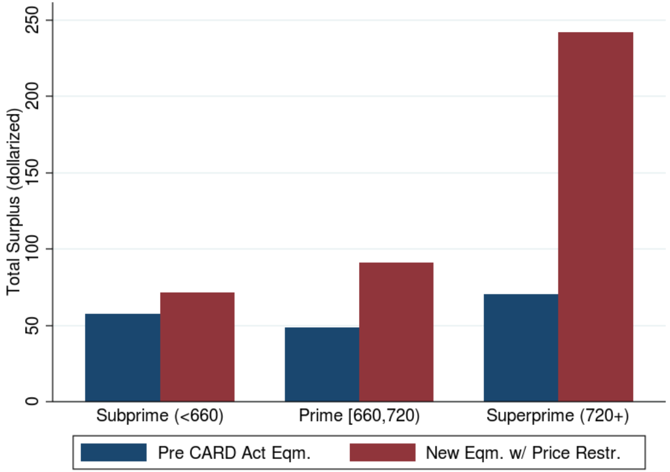
. . . **consumer surplus rises** in all FICO groups



Changes in Total Surplus are Heterogeneous

Total surplus is higher at higher FICO scores . . .

. . . but restrictions are **just a transfer** for lower FICO scores



Mechanisms for Surplus Gains

Examine mechanisms for these surplus gains via two counterfactuals:

- Fixed consumer types: no **insurance value** from the Act
- No switching costs: no gain from **reduced churn**

In each case, compute percent change in consumer surplus from pre-CARD Act to post-CARD Act (partial eq. / one consumer at a time):

	Subprime	Prime	Superprime
Percent Change in Consumer Surplus due to CARD Act:			
Baseline	130.5%	165.3%	143.0%
No Insurance Value	126.8%	48.9%	16.6%
No Account Setup Costs	73.0%	84.0%	111.8%

- Over 80% of superprime CS gain is from insurance value: CARD Act solves coordination problem / provides commitment power
- Nearly 50% of prime and subprime CS gain is from reduced churn

Conclusion

- Price restrictions in the 2009 CARD Act $\implies$ both risk and demand-relevant information become unpriced
- Partial unraveling results from unpriced risk, but markups on inelastic borrowers were by far the dominant force in pre-CARD-Act pricing
- Overall, prices fall for almost all borrowers, but relatively safe subprime borrowers (for their FICO score) are hurt
- Consumer *and* total surplus both rise
- Lessons may be relevant for information regulation in other selection markets as well: ACA, ECOA, etc.

Repricing Before and After the CARD Act

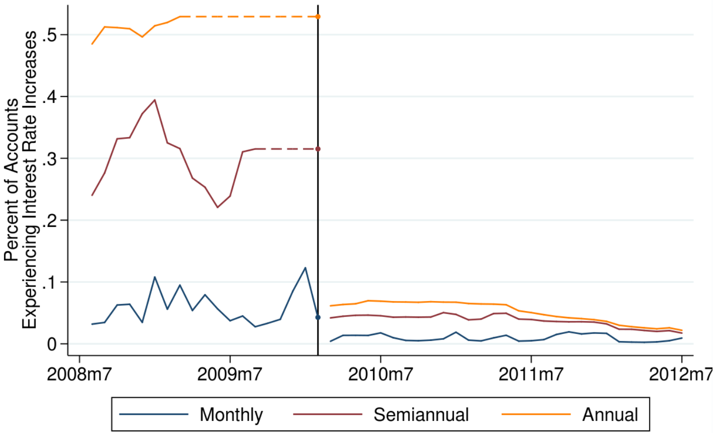


Figure shows the incidence of interest rate increases on current borrowers over 1-month, 6-month and 12-month horizons, excluding the following interest rate increases permissible under the CARD Act: increases due to the expiration of a promotional rate, to changes in an index rate, or to delinquencies of 60 days or more). Dotted lines extrapolate from the most recent available datapoint when these horizons overlap with the implementation of the CARD Act's interest rate repricing restrictions in February 2010, marked by the vertical black line.

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CARD Act Effect on Late Fees

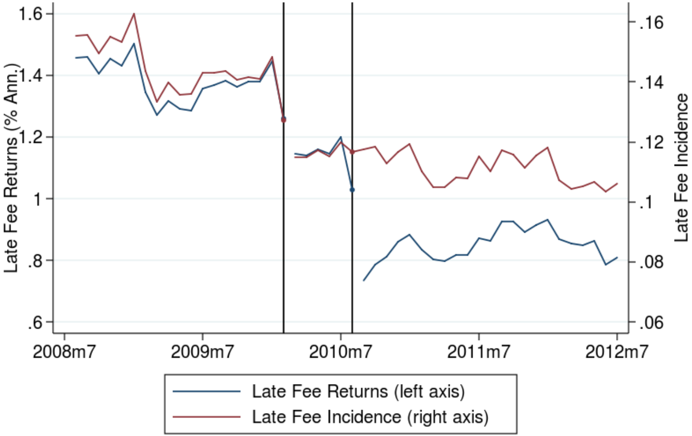

Figure shows annualized lender returns from late fees relative to total outstanding balances for revolvers (left axis) and the average incidence of late fees across accounts. The vertical black lines show CARD Act implementation dates in February and August 2010. Late fee restrictions took effect at the later date, while the earlier date imposed restrictions on over-limit fees and increases in interest rates, inter alia.

CARD Act Effect on Over-Limit Fees

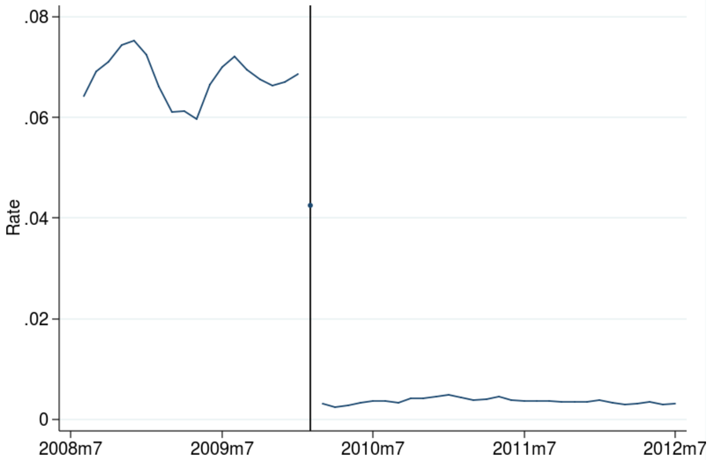

Figure shows the monthly incidence of over-limit fees on current borrowers, excluding any fees subsequently reversed. The implementa
date of the CARD Act's over-limit fee restrictions in February 2010 is marked by the vertical back line.

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Data Overview

- Use two large new administrative datasets maintained by the Consumer Financial Protection Bureau (CFPB)
- CFPB **Credit Card Database** (CCDB)
  - De-identified account-level data from 17-19 of largest issuers
  - Covers roughly 90% of outstanding US credit card balances
  - Rich details on balances, repayment, interest, fees
  - Monthly panel from 2008 to present
  - Multiple accounts for the same borrower are not linked
- CFPB **Consumer Credit Panel** (CCP)
  - 1/48 national random sample of de-identified consumer credit reports from one of the three large nationwide credit reporting agencies
  - Quarterly panel from 2004 to present (monthly since mid-2012)
  - Show nearly all accounts for each consumer over time
  - Limited price data

Summary Statistics Back to Intro

Summary Statistics

FICO Group	Cum. Months of Borrowing	Share within FICO Group	Fee-Inclusive Charges (% Ann.) 25th Pctile	Mean	75th Pctile
620 - 639	0	1.81%	.	.	.
	1-2	2.13%	11.03	25.75	29.03
	3-5	4.10%	8.86	21.35	27.98
	6-11	20.79%	9.98	21.19	27.92
	12	71.16%	12.18	21.15	27.99
740 - 759	0	15.86%	.	.	.
	1-2	8.01%	2.16	11.52	15.65
	3-5	9.27%	1.68	9.84	14.29
	6-11	24.03%	3.17	10.24	14.36
	12	42.83%	6.20	11.59	14.98

Identifying Price Elasticity Signals Signals

- For a given signal s, calculate expected annualized returns over accounts i with behavior $b_t(i) = s$ in month $t = 0$

$$\sum_{t=0}^{T} \frac{\sum_{i:b_0(i)=s} R_{it} - C_{it}}{\sum_{i:b_0(i)=s} B_{it}/12}$$

Notation: revenue R, losses C and revolved balances B

- Compare to the same sum for $s = 0$

$$\sum_{t=0}^{T} \left[\frac{\sum_{i:b_0(i)=s} R_{it} - C_{it}}{\sum_{i:b_0(i)=s} B_{it}/12} - \frac{\sum_{i:b_0(i)=0} R_{it} - C_{it}}{\sum_{i:b_0(i)=0} B_{it}/12} \right]$$

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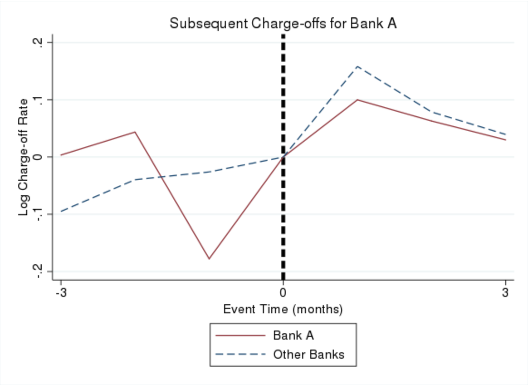
Evidence on Adjustment Costs

Revolvers continue to revolve; transactors unlikely to start revolving:

FICO	Recent Revolvers		All Accounts	
Group	Transactor	Revolver	Transactor	Revolver
580	0.16	0.85	0.05	0.84
600	0.14	0.89	0.05	0.80
620	0.13	0.89	0.05	0.79
640	0.12	0.89	0.04	0.81
660	0.12	0.89	0.03	0.77
680	0.11	0.88	0.03	0.79
700	0.10	0.88	0.02	0.75
720	0.09	0.87	0.02	0.72
740	0.08	0.87	0.02	0.70
760	0.08	0.86	0.01	0.65
780	0.08	0.82	0.01	0.49

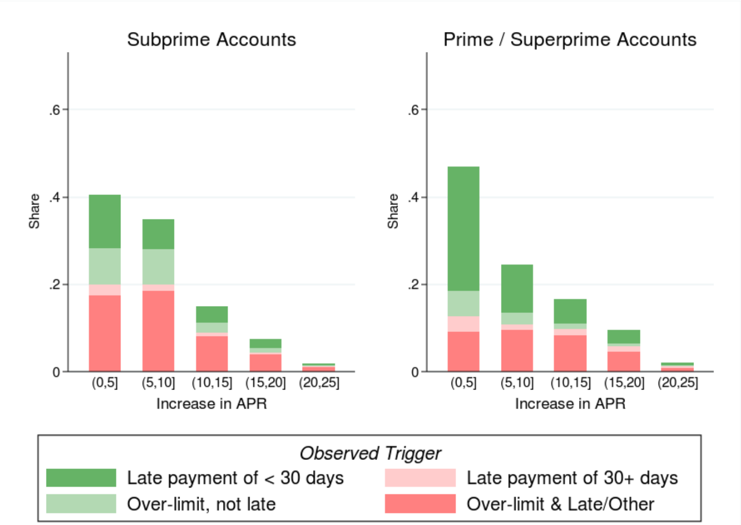
Evidence on Price-Invariance of Default

- RCT evidence: precise zero for APR effect on default (Seira et al., 2018))
- Credit card *payments* are "small" for median borrower: only 17% of total debt payments; +100 bps in interest rate $\implies$ +\$2/mo.),
- Using my later price variation, I also find no effect on default:



Decomposition of Repricing

What share of repriced signals were such price elasticity signals?



Decomposition of Fee Revenue

FICO Group	Late by <30 Days	Over-Limit not Delinquent	Over-Limit and Delinquent	Late by 30+ Days	FICO Drop of 30+ Points
580 - 599	11.49	9.85	72.42	6.15	0.10
600 - 619	27.11	18.20	47.57	6.78	0.35
620 - 639	32.15	20.33	41.04	6.01	0.47
640 - 659	38.71	20.63	34.25	5.76	0.64
660 - 679	47.20	19.00	27.18	5.70	0.92
680 - 699	56.19	16.38	20.38	5.88	1.18
700 - 719	64.78	13.51	13.98	6.25	1.47
720 - 739	71.26	11.02	9.60	6.59	1.53
740 - 759	77.00	8.40	6.34	7.06	1.19
760 - 779	82.71	5.13	3.62	7.80	0.74
780 - 799	85.03	2.63	2.11	9.97	0.26

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Private Information Types Predict Default

	(1)	(2)	(3)
Dependent Variable		One-Year Default Rate	
Sample	All Accounts	Subprime	Prime
Estimator	OLS	OLS	OLS
2nd Quintile	0.0317***	0.0902***	0.00176***
	(0.0000460)	(0.000116)	(0.0000310)
3rd Quintile	0.0585***	0.147***	0.00502***
	(0.0000503)	(0.000118)	(0.0000355)
4th Quintile	0.0780***	0.191***	0.0129***
	(0.0000535)	(0.000131)	(0.0000367)
5th Quintile	0.0904***	0.198***	0.0257***
	(0.0000627)	(0.000150)	(0.0000437)
Quarter FEs	YES	YES	YES
Bank x FICO FEs	YES	YES	YES
Observations	243734158	88264172	155469986

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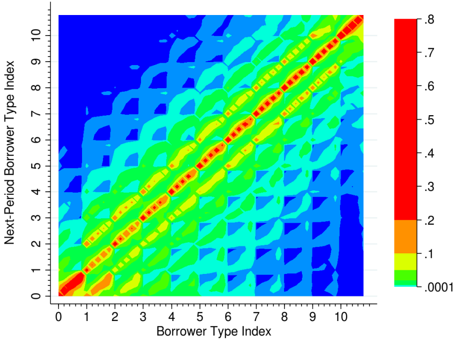
Type Transition Probabilities

- After identifying private types, transition probabilities are "just data" – estimate nonparametrically
- Being a risky private type also predicts transition to a worse FICO score in the future



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Demand Estimation Step 2: Price Sensitivities

- To derive an estimating equation for γ_θ, start with relationship between marginal utilities of income γ and price elasticities η for logit demand,

$$\eta_{\theta j} = -\gamma_\theta p_{\theta j}(1 - Q_{\theta j})$$

- And substitute for $\eta_{\theta j}$ using the definition of an elasticity,

$$\text{dlog}(Q_{\theta j}) = -\gamma_\theta p_{\theta j}(1 - Q_{\theta j})\text{dlog}(p_{\theta j})$$

- Empirical analog of infinitesimal changes in logs: difference-in-difference in logs

$$\log Q_{\theta jt} = \alpha_{\theta j} + \alpha_t + \beta_j \times t - \gamma_\theta \log P_{\theta jt} + \epsilon_{\theta jt}$$

  where the scaled price term $P_{\theta jt}$ is

$$\log P_{\theta jt} = (1 - Q_{\theta j0})p_{\theta j0}\log(p_{\theta jt})$$

- Finally instrument for $P_{\theta jt}$ using indicators Z_{jt} for repricing campaigns as instruments

Net Effects of CARD Act Restrictions: Price Dispersion

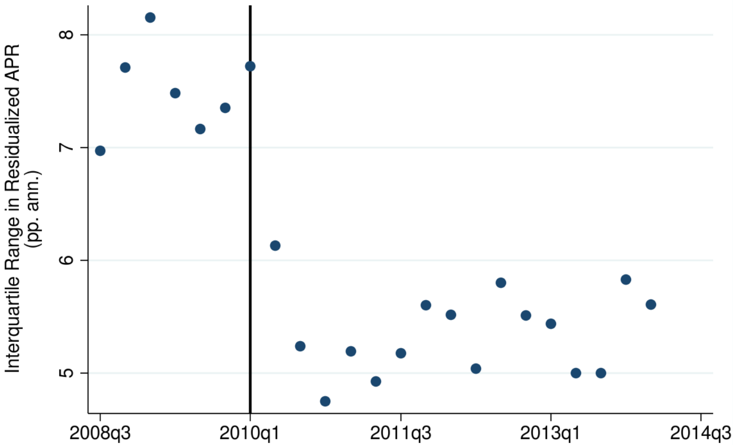

Figure shows the interquartile range (IQR) of annualized percentage rates (APRs) on revolving credit card accounts by origination cohort, after partialling out origination FICO and origination month. The date shown for each cohort is its age of maturity (18 months), by which point introductory promotional rates have typically expired. FICO controls are 20-point bins, and sample is restricted toinclude only accounts in the same FICO bin at the date observed as at origination. The vertical black line shows the date of implementation for the CARD Act's restrictions on interest rate increases.

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Evidence on Markups: Causes for Repricing

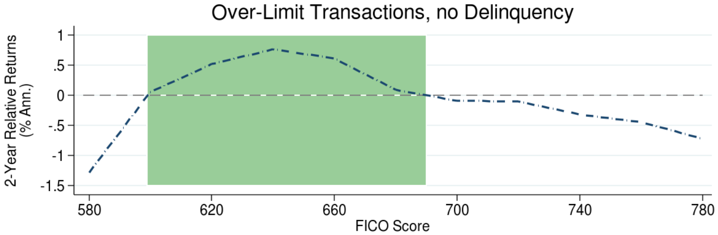
- Drop in price dispersion $\implies$ lenders lost the ability to price other information too, not just ΔFICO
  - "Triggers" disclosed in contract: delinquency, exceeding credit limit
  - Not disclosed: high balances, call center behavior, shopping habits...
- Some of this information was *good* news despite higher risk:

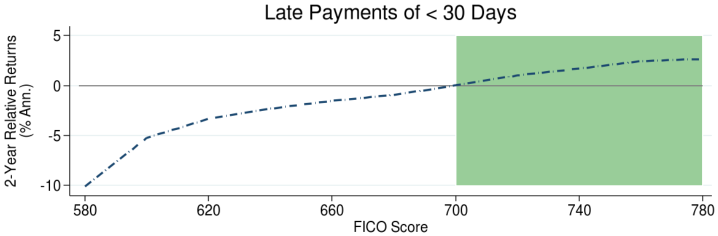
$$\text{price} \uparrow \implies \{\Delta\text{revenue} > \Delta\text{losses}\} \implies \text{expected returns} \uparrow$$

- For profit-maximizing lenders, $\{\Delta\text{revenue} > \Delta\text{losses}\}$ suggests these signals revealed lower *elasticities* + led to higher markups
- Refer to these as "price elasticity signals"

Identifying Price Elasticity Signals

Some Signals of Risk were *Good* News





Other Signals are *Not* “Price Elasticity Signals”

FICO Group	Baseline (% Ann.)	Over-Limit and Delinquent	Late by 90+ Days	Late by 60-89 Days	Late by 30 - 59 Days	FICO Drop of 60+ Points
580 - 599	0.89	-36.65	-40.77	-34.25	-27.34	-12.65
600 - 619	2.99	-25.36	-41.97	-35.77	-25.69	-9.55
620 - 639	3.30	-21.90	-43.67	-37.73	-24.20	-7.96
640 - 659	3.69	-19.95	-45.26	-38.92	-23.20	-6.16
660 - 679	4.35	-19.04	-47.23	-40.17	-23.39	-5.22
680 - 699	5.09	-18.70	-48.28	-42.01	-23.00	-4.21
700 - 719	6.02	-17.94	-49.06	-42.51	-22.06	-3.87
720 - 739	6.99	-16.88	-51.65	-44.83	-19.53	-3.87
740 - 759	7.92	-16.07	-53.05	-45.12	-16.27	-3.18
760 - 779	8.82	-15.78	-52.16	-43.26	-11.98	-2.79
780 - 799	9.24	-17.47	-50.81	-42.11	-8.19	-2.31

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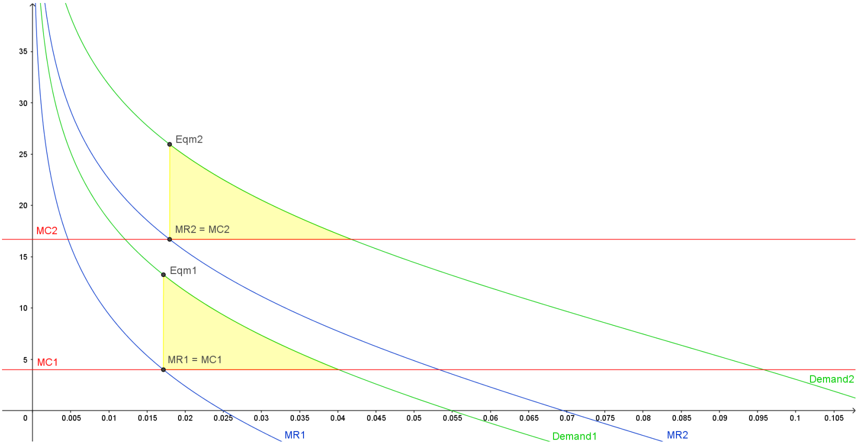
Illustration of Demand-Risk Tradeoff



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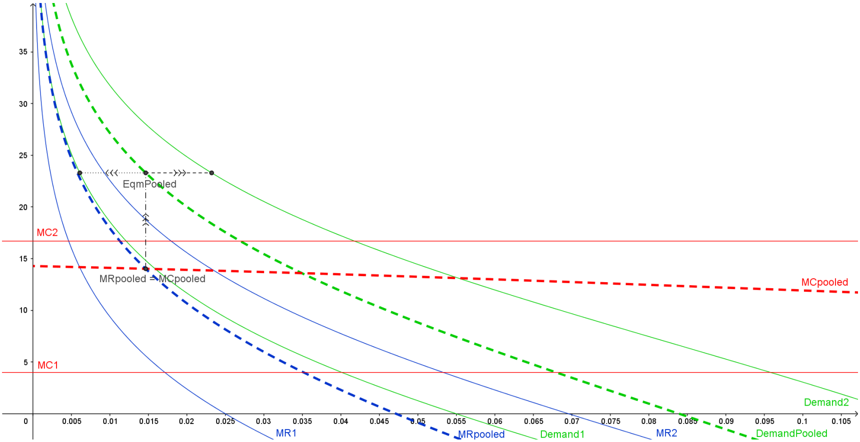

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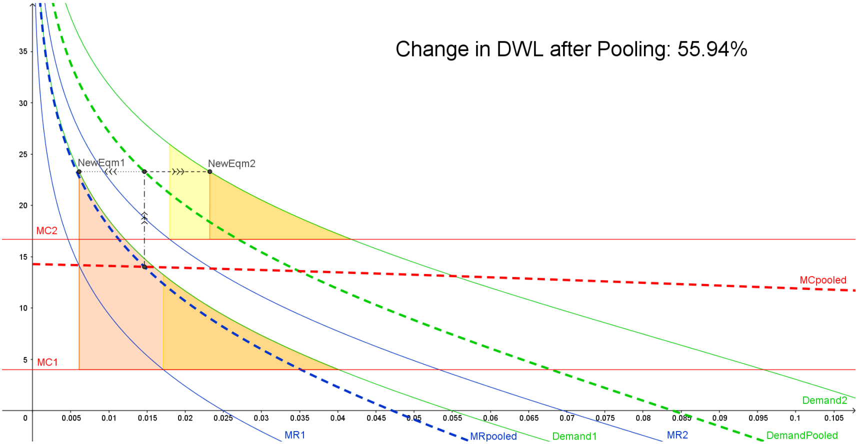

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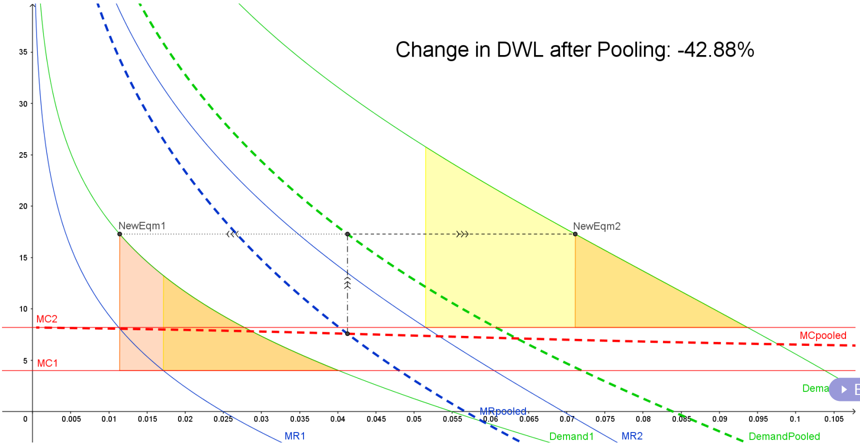

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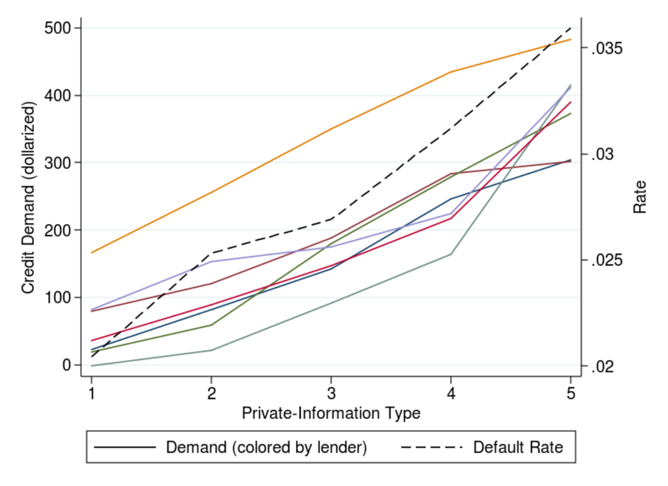
Demand Parameter Estimates

Borrowing Demand *d* for FICO 660-679 Consumers

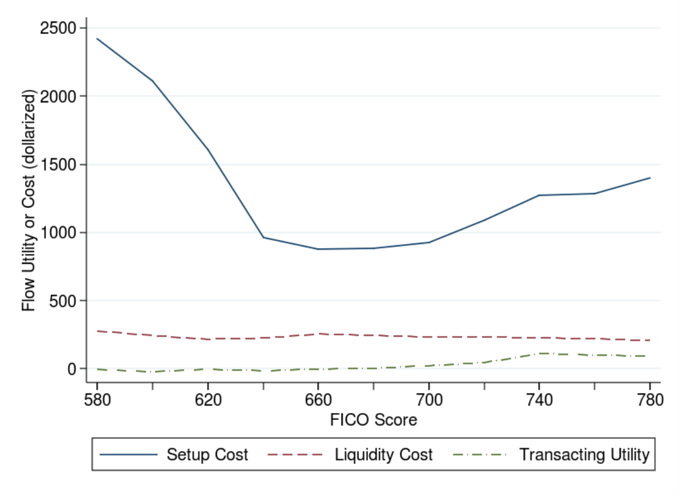
Private types are adversely selected: riskier types also higher demand



Demand Parameter Estimates

Transacting Demand, Setup Costs, Exit Costs

Setup costs are high; transacting demand and liquidity costs are modest



Firm Costs: Details

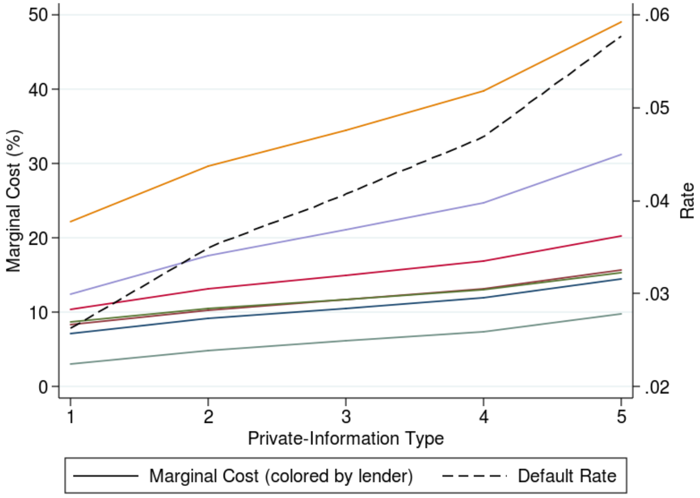
- Recall firm flow payoffs:
  - $1_{\text{borrow}} \cdot (p_1^j(\theta) - c_1^j(\theta))$ on mature accounts
  - $1_{\text{borrow}} \cdot (p_0^j(x)) - c_0^j(x)$ on new accounts
- Parameterize mature account costs as,

$$c_1^j(\theta)) = a_j x + b_j \delta(\theta)$$

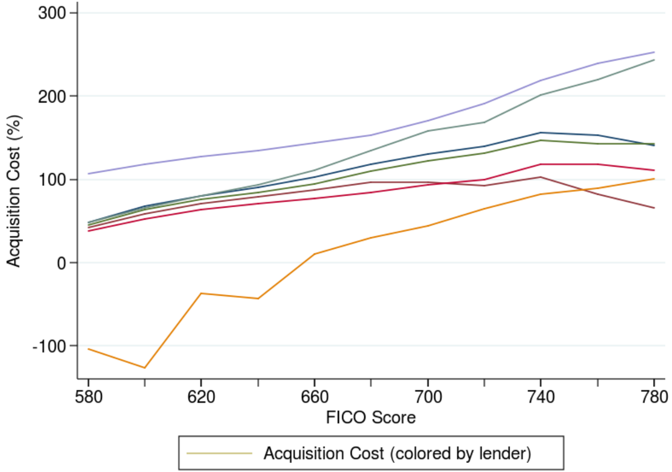
- Interpretation:
  - $(1 - b_j)$: recovery rates on loans in default
  - a_j: marginal costs in market segment x (FICO score group), e.g. account management costs
- I recover $\{a_j, b_j, c_0^j\}$ from firm FOCs

Example of Marginal Cost Estimates

FICO 620-639 Consumers



Acquisition Cost Estimates



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Counterfactual Estimation and Convergence

- I solve for the new equilibrium with repricing restrictions through **successive best-replies** of each lender
- Follow best replies *starting from the pre-CARD-Act price vector*
  - Persistence is important in pricing $\implies$ sensible equilibrium selection for actual CARD Act effects
  - Consistent with equilibrium convergence studied in Doraszelski et al. (2017)
  - Cf. Ryan (2012) on potential multiplicity of equilibria
- Heavily traded contracts mostly converge after 5-10 iterations; full convergence after 24

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