

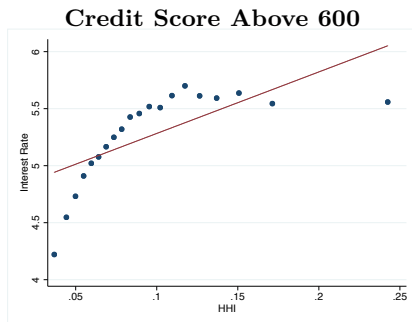
Competition and Selection in Credit Markets

Constantine Yannelis & Anthony Lee Zhang

Fourth Biennial Conference on Auto Lending

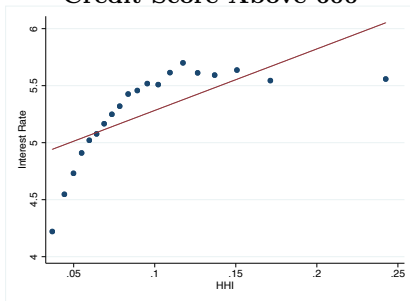
July 15, 2021

Concentration and Interest Rates

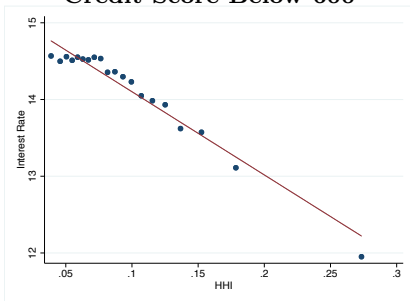


Concentration and Interest Rates

Credit Score Above 600



Credit Score Below 600





Trended Credit and Alternative Data Attributes Improve Dealer and Consumer Experience in Auto Finance Market

TransUnion Client Arivo Acceptance optimizes performance with CreditVision Suite

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Alternative credit data gain acceptance

DAVID MULLER

CISION

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Now Required in Auto Finance: Subprime Data & Analytics Expertise

This Paper

Model

- Lenders make fixed-cost investments to screen borrowers, and then set loan rates
- For high-risk consumers, concentration leads to **lower** interest rates

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Empirics

- Test model predictions using auto loans data
- Rates and concentration pos. correlated for low-risk groups, neg. for high-risk
- Result holds using variation from bank failures, bank mergers
- In more concentrated markets, lenders invest more in observable screening technologies
- Model predictions on default rates, loan quantities also verified

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Implications

- New effect of competition in screening markets
- Implications for competition policy/antitrust

Related Literature

- **Competition, data acquisition, screening:** Broecker (1990), Hauswald & Marquez (2003, 2006), He, Huang, & Zhou (2020)
- **Competition in lending markets:** Petersen & Rajan (1995), Parlour & Rajan (2001), Sapienza (2002), Agarwal & Hauswald (2010), Giroud & Mueller (2010, 2011), Scharfstein & Sunderam (2016), Drechsler, Savov, & Schnabl (2017, 2018), Egan, Hortacsu, & Matvos (2017), Buchak, Matvos, Piskorski, & Seru (2018, 2020), Robles-Garcia (2020), Buchak & Jorring (2021)
- **Competition and selection:** Agarwal, Chomsisengphet, Mahoney & Stroebl (2015), Mahoney & Weyl (2017), Crawford, Pavanini & Schivardi (2018), Lester, Shourideh, Venkateswaran, & Zetlin-Jones (2019), DeFusco, Tang, & Yannelis (2021)
- **Auto lending:** Einav, Jenkins, & Levin (2012, 2013), Benmelech, Meisenzahl, & Ramcharan (2017), Argyle, Nadauld, & Palmer (2020a, 2020b), Grunewald, Lanning, Low, & Salz (2020)

Model Overview

Lenders compete to make loans to consumers

- **Market power:** Lenders set prices above marginal costs
- **Screening:** Lenders make fixed-cost investments to identify and screen out high-risk borrowers

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In high-risk populations, second effect can dominate, so more competition leads to higher interest rates

Model

- N identical lenders, indexed by j
- Unit mass of consumers, located on a Salop circle
- Unit mass of type-G borrowers never default
- Measure q of type-B borrowers always default
- Lenders compete in two stages:
 1. Pay fixed cost $c_q(\delta_j)$ to screen out type B's, decrease default rate to δ_j
 2. Set interest rate r_j

Price-setting

- Suppose default rate is δ_j . Lenders' profits:

$$\Pi_j = s_j \left(r_j - \frac{\delta_j}{1 - \delta_j} \right)$$

- Optimal markups:

$$s_j - \frac{\partial s_j}{\partial r_j} \left(r_j - \frac{\delta_j}{1 - \delta_j} \right) = 0$$

$$\implies r_j - \frac{\delta_j}{1 - \delta_j} = \frac{\theta}{N}$$

- Higher $N \implies$ lower markups

Optimal Screening

- By paying fixed cost $c_q(\delta_j)$, lender removes some type-B consumers from population, decreasing default rate to δ_j
 - Higher cost when population fraction of type-B's, q , is higher
- In baseline model, assume screening outcomes perfectly correlated among firms
 - Hence, no “winner’s curse”
- With screening cost $c_q(\delta_j)$, lender solves:

$$\max_{\delta_j} \max_{r_j} (s_j(r_j)) \left(r_j - \frac{\delta_j}{1 - \delta_j} \right) - c_q(\delta_j)$$

$$\implies \frac{s_j}{(1 - \delta_j)^2} = -c'_q(\delta_j)$$

- Higher $N \implies$ lower $s_j \implies$ lower screening incentives

Equilibrium

In symmetric equilibrium, lenders' market shares are:

$$s_j = \frac{1}{N}$$

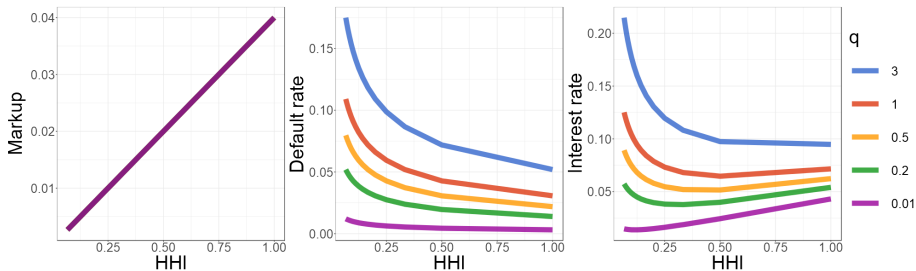
Market shares determine markups:

$$\underbrace{r_j}_{\text{Loan rate}} - \underbrace{\frac{\delta_j}{1 - \delta_j}}_{\text{Break-even rate}} = \frac{\theta}{N}$$

Market shares also determine screening incentives:

$$\frac{s_j}{(1 - \delta_j)} = \underbrace{-c'_q(\delta_j)}_{\text{Marginal screening cost}}$$

Equilibrium Outcomes



Model Predictions

1. Effect of concentration on interest rates depends on population riskiness:
 - **Low risk:** Concentration $\uparrow \implies$ interest rates \uparrow
 - **High risk:** Concentration $\uparrow \implies$ interest rates \downarrow

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2. Concentration $\uparrow \implies$ default rates \downarrow for all groups

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 - **High risk:** Concentration $\uparrow \implies$ interest rates \downarrow
2. Concentration $\uparrow \implies$ default rates \downarrow for all groups
3. Concentration \uparrow can cause loan quantity \downarrow , even if prices \downarrow
 - Demand curves slope down, so this can't happen without some kind of screening/credit rationing

Empirical setting

- Auto loans market
 - Third largest source of household debt in US
 - \$1.4 trillion outstanding in 2020
 - Segmented by borrower risk
 - Lenders bear most losses
 - Loan generally not guaranteed
 - Securitization rate low ($\approx 20\%$) (SPG Global 2020)
 - Screening investments
 - Predictive analytics, ML/AI, GPS

Data

Transunion Consumer Credit Panel

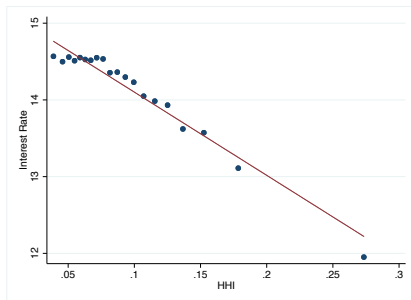
- 10% sample of TransUnion credit records, 2009-2020
- Observe loan balance, payments, maturity: back out interest rates
- Loan volumes comparable to other datasets
- Observe lender ID, allowing us to compute HHIs

Call Reports

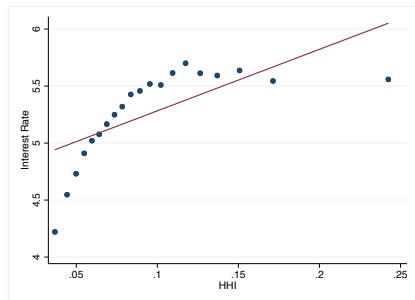
- Bank merger + market share data

Concentration and Interest Rates

Credit Score Below 600



Credit Score Above 600



Regression Specification

- Begin with correlation between rates and HHI
- Estimate variants of

$$\ln(r_{ct}) = \alpha_c + \alpha_t + \beta \ln(\text{HHI}_{ct}) + \varepsilon_{ct}$$

- HHI_{ct} is $\sum_i^N s_i^2$ (within credit score group)
- α_c, α_t are county and year fixed effects

Correlation between Concentration and Interest Rates

Interest Rates and Market Competition

	(1)	(2)	(3)	(4)	(5)	(6)
	Ln(Interest Rate)			Ln(Interest Rate)		
	Credit Score 300-600			Credit Score 600-850		
Ln(HHI)	-0.0632*** (0.0189)	-0.0723*** (0.0200)	-0.0641*** (0.0127)	0.269** (0.109)	0.207* (0.111)	0.134** (0.0628)
Year FE	No	Yes	Yes	No	Yes	Yes
County FE	No	No	Yes	No	No	Yes
Obs	27,887	27,887	27,826	31,773	31,773	31,733
R ²	0.013	0.045	0.571	0.013	0.043	0.845

Finer Credit Score Buckets

Interest Rates and and Market Competition

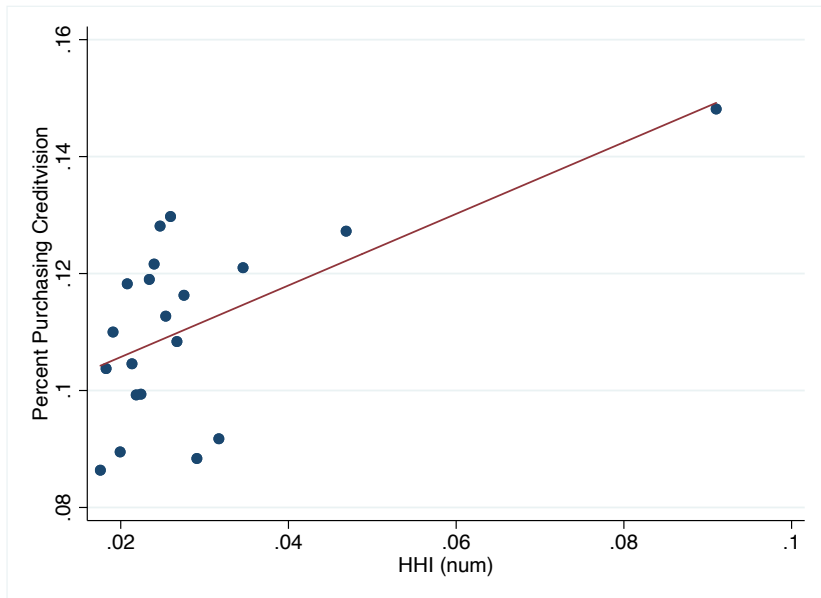
	(1)	(2)	(3)	(4)	(5)	(6)
	Ln(Interest Rate)					
	Credit Score 300-550	Credit Score 550-600	Credit Score 600-650	Credit Score 650-700	Credit Score 700-750	Credit Score 750+
Ln(HHI)	-0.0715*** (0.0129)	-0.0267*** (0.00956)	0.0467* (0.0242)	0.106* (0.0541)	0.0471 (0.0315)	0.103 (0.0731)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs	25,985	27,019	29,162	30,093	29,794	29,989
R ²	0.392	0.565	0.619	0.665	0.760	0.844

Do Lenders Screen More in Concentrated Markets?

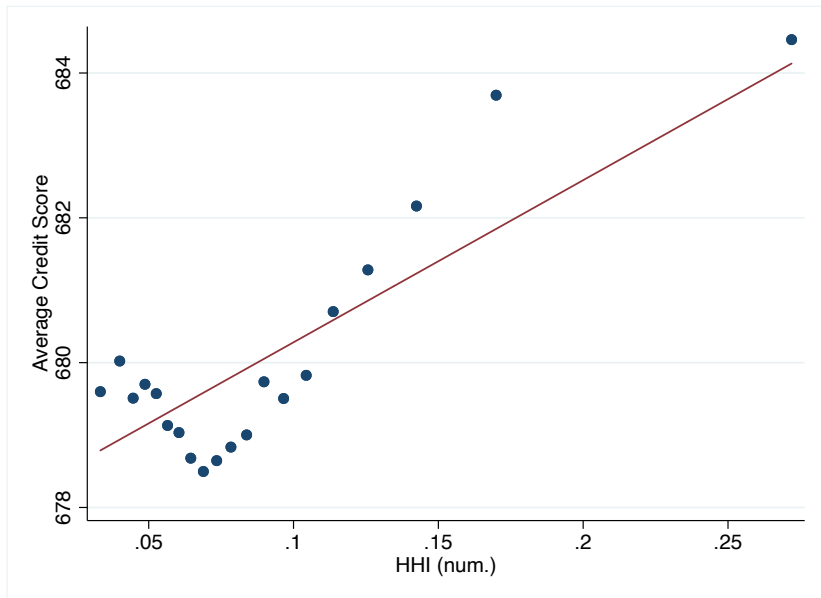


- Lenders can purchase proprietary product from TU
- Additional information on consumer behavior and histories
- Includes predictive modeling
- Purpose-built scores, propensity models, attributes, algorithms, estimators, etc.

Market Concentration and Increased Screening



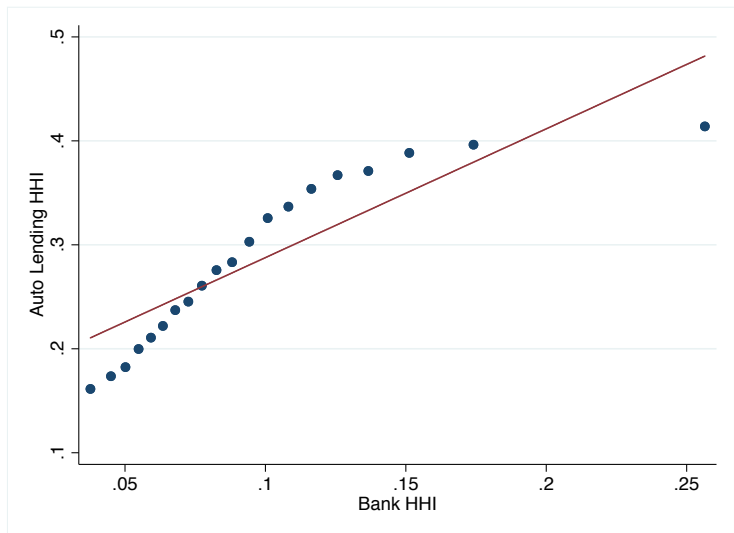
Market Concentration and Credit Scores



Bank Market Structure Variation

- Market HHI may be correlated with many factors associated with price, even within county
- Want source of variation in market structure uncorrelated with other determinants of prices
- Exploit variation from bank market structure shocks:
 - 2008 large bank failures (Buchak & Jorring, 2021)
 - Bank mergers

Auto Loan HHI and Bank Deposit Market HHI



Bank Failures

- Three large banks failed during 2008 crisis: Wachovia, Washington Mutual, Countrywide (Buchak & Jorring, 2021)
- Counties where these banks had high pre-crisis market share have lower post-crisis concentration

- First stage:

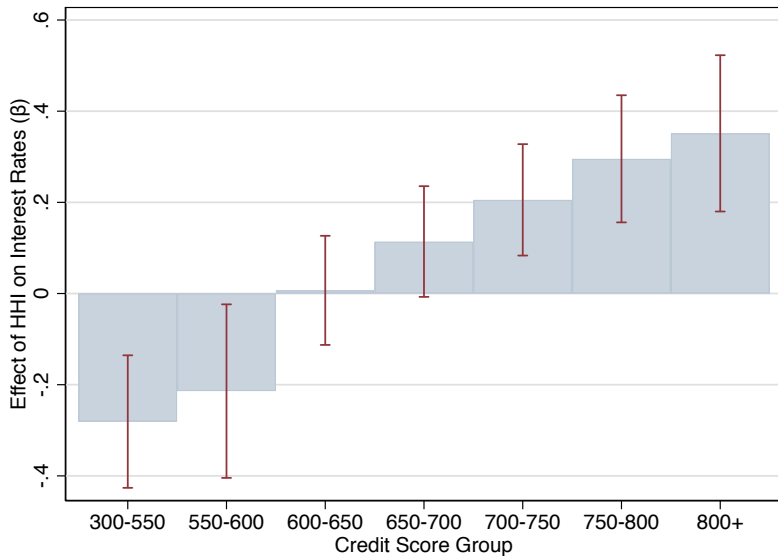
$$\ln(\text{HHI}_{ct}) = \psi \text{Share}_c + X_{ct} + e_{ct}$$

- Second stage:

$$\ln(r_{ct}) = \zeta \ln(\hat{\text{HHI}}_{ct}) + X_{ct} + v_{ct}$$

- Identifying assumption: pre-crisis market share of failed banks not correlated with auto loan rates, except through concentration effects

Bank Failures: IV Estimates



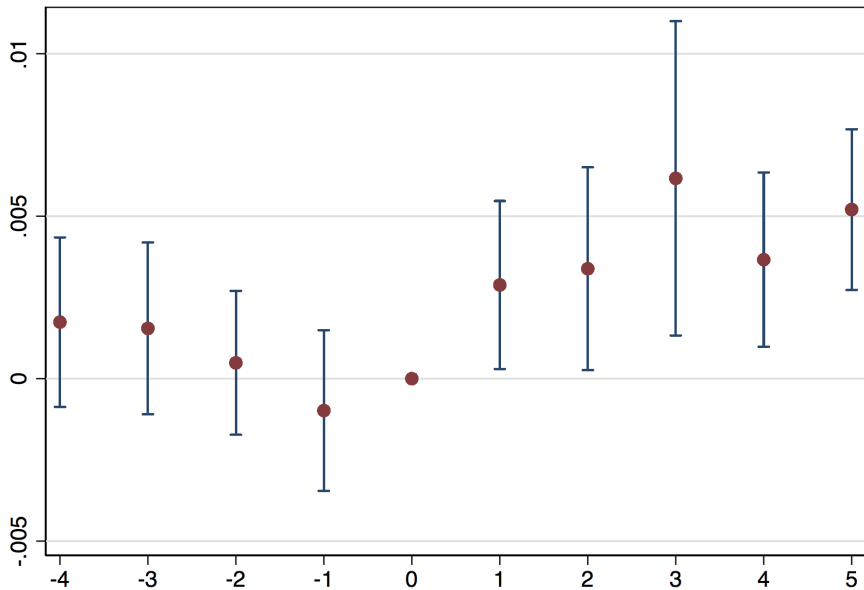
Bank Mergers

- Use bank mergers as a shock to market concentration
- Estimate:

$$\ln(\text{HHI}_{cst}) = \alpha_{cs} + \alpha_t + \alpha_y + \sum_{i=-5}^5 \zeta_i \mathbb{1}[i = t] + \xi_{cst}$$

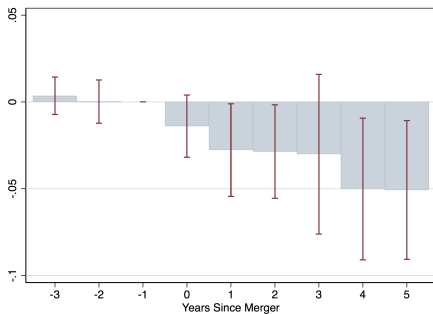
$$\ln(r_{cst}) = \alpha_{cs} + \alpha_t + \alpha_y + \sum_{i=-5}^5 \zeta_i \mathbb{1}[i = t] + \xi_{cst}$$

Bank Mergers: Effect on Concentration

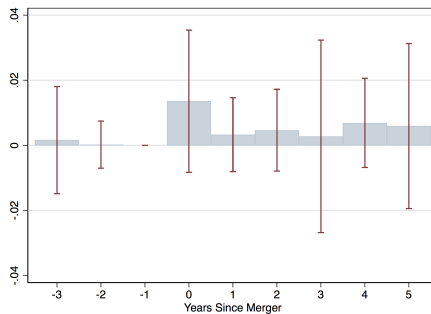


Bank Mergers: Effect on Rates

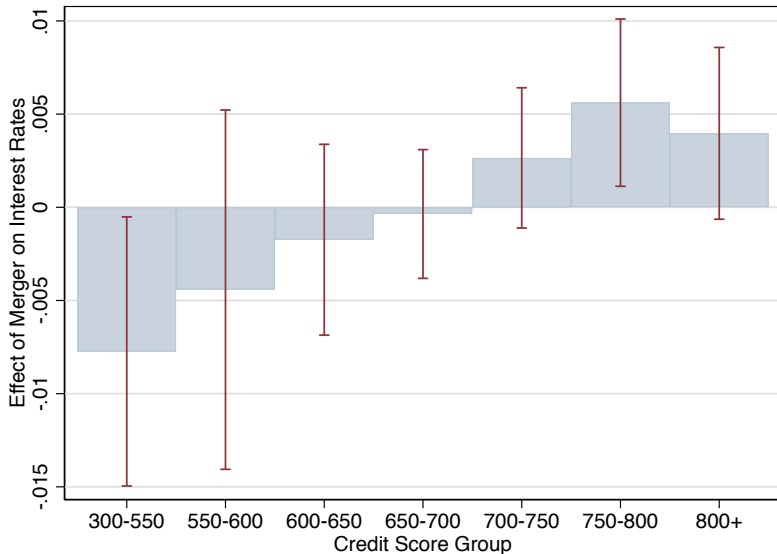
Credit Score 300-600



Credit Score 600-850



Bank Mergers: Reduced Form Estimates



Delinquency Rates

Delinquency Rates and and Market Competition

Panel A: Delinquency and HHI

	(1)	(2)	(3)	(4)	(5)	(6)
	Ln(Delinquency)			Ln(Delinquency)		
	Credit Score 300-600			Credit Score 600-850		
Ln(HHI)	-0.0974** (0.0381)	-0.0534 (0.0421)	-0.0290** (0.0143)	-0.00550 (0.0202)	-0.0225 (0.0183)	-0.0272** (0.0125)
Year FE	No	Yes	Yes	No	Yes	Yes
County FE	No	No	Yes	No	No	Yes
Obs	27,887	27,887	27,826	31,773	31,773	31,733
R ²	0.027	0.710	0.827	0.089	0.617	0.825

Panel B: Delinquency and HHI by Credit Score

	(1)	(2)	(3)	(4)	(5)	(6)
	Ln(Delinquency)					
	Credit Score 300-550	Credit Score 550-600	Credit Score 600-650	Credit Score 650-700	Credit Score 700-750	Credit Score 750+
Ln(HHI)	0.00641 (0.0131)	-0.0651*** (0.0145)	-0.0528*** (0.0151)	-0.0543*** (0.0139)	-0.0301*** (0.0114)	-0.0147** (0.00746)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs	25,985	27,019	29,162	30,093	29,794	29,989
R ²	0.762	0.724	0.694	0.621	0.514	0.503

Loan Quantities

Loans and Market Competition

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Ln(Loans)							
	Credit Score 300-600	Credit Score 600-850	Credit Score 300-550	Credit Score 550-600	Credit Score 600-650	Credit Score 650-700	Credit Score 700-750	Credit Score 750+
Ln(HHI)	-0.105*** (0.0112)	-0.0480*** (0.0129)	-0.0663*** (0.00873)	-0.0669*** (0.00794)	-0.0412*** (0.00731)	-0.0350*** (0.00740)	-0.0336*** (0.00689)	-0.0286*** (0.00942)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs	27,826	31,733	25,985	27,019	29,162	30,093	29,794	29,989
R ²	0.974	0.983	0.977	0.979	0.982	0.985	0.986	0.983

- Results from panel regression of loan quantities:

$$Q_{ct} = \alpha_c + \alpha_t + \beta \ln(\text{HHI}_{ct}) + \varepsilon_{ct}$$

- In high-score buckets, concentration $\uparrow \implies$ interest rate \uparrow , so quantity decrease is intuitive
- In low-score buckets, concentration $\uparrow \implies$ interest rate \downarrow , so quantity decrease shouldn't happen, with downward-sloping demand
 - Suggests some sort of screening/credit rationing

Specialized and Non-specialized Lenders

Concentration and Interest Rates by Lender

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Full Sample				Auto Lenders		All Lenders	
	Credit Score 300-600		Credit Score 600-850		Credit Score 300-600	Credit Score 600-850	Credit Score 300-600	Credit Score 600-850
Ln(HHI)	-0.0737*** (0.0103)	-0.0727*** (0.00996)	0.110** (0.0517)	0.105** (0.0502)	-0.0689*** (0.0114)	0.173** (0.0764)	-0.0785*** (0.00921)	0.0282 (0.0245)
County X Score FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lender FE	No	Yes	No	Yes	Yes	Yes	Yes	Yes
Observations	1,866,741	1,865,935	5,213,296	5,212,710	1,107,222	2,401,999	758,663	2,810,678
R ²	0.678	0.689	0.802	0.805	0.728	0.813	0.622	0.760

Lender size

Lender size

	(1) (p 50) interest_rate	(2) (p 50) interest_rate	(3) (p 50) interest_rate	(4) (p 50) interest_rate
HHI	-0.0806*** (0.0106)	0.0998** (0.0485)	-0.0909*** (0.0108)	0.0881* (0.0456)
Volume	0.000244*** (0.0000254)	0.000367** (0.000146)		
HHI X Volume	0.0000800*** (0.00000833)	0.000113** (0.0000453)		
# Counties			0.0000327*** (0.00000368)	0.0000369*** (0.0000117)
HHI X # Counties			0.0000105*** (0.00000121)	0.0000132*** (0.00000415)
Observations	1866741	5213296	1866741	5213296
R ²	0.678	0.802	0.678	0.802

- For large lenders, screening decisions may be made at aggregated level: local HHIs should matter less
- However, large and small lenders' markups should be similarly sensitive to HHI
- \implies Rates should be more positively correlated with HHI for larger lenders
- However, subprime coef is negative even for large lenders, suggesting there's some local component to screening costs

Alternative Explanations

Concentration \uparrow leads to:

1. Interest rates \uparrow in low-risk groups, \downarrow in high-risk groups
2. Default rate \downarrow in both groups
3. Loan quantity \downarrow in both groups

Other explanations:

- **Adverse selection:** concentration should always increase interest rates (Mahoney & Weyl 2017 ReStat)
- **Competition and loan standards:** concentration should increase interest rates (Mian + Sufi 2009, Favara & Imbs 2015)
- **Moral hazard:** Doesn't explain asymmetry between groups. Doesn't explain rates \uparrow in high group, but default rate \downarrow
- **Dealer markups, het. funding costs:** Doesn't explain asymmetry between groups. Also, our results hold for pure auto lenders
- **Improved collections technology:** similar effect to our channel

Robustness to Alternative Specifications

Results Robust to Varying Main Specification:

- Diff-in-Diff Specification
- Alternative Weighting
- Restricting to Large Counties
- Including All Counties
- Winsorizing
- Loan Based HHI
- Using Number of Lenders

Concluding Remarks

- Simple model of screening and price-setting
 - When population risk is high, higher concentration can decrease interest rates
 - In auto loans data, interest rates + correlated with concentration for low-risk groups, - for high-risk, as model predicts
 - Suggestive evidence that lenders screen more in more concentrated markets
 - Result holds using variation from failures and bank mergers
 - Other model predictions (default rates, quantities) also hold in data
- ⇒ May need to rethink effects of competition in credit markets, and incorporate more heterogeneity between different types of borrowers