

*Who bears the welfare costs of monopoly?
The case of the credit card industry*

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The views expressed herein are those of the authors and not necessarily those of the Federal Reserve System.

Introduction

Key features of U.S. credit card (CC) industry

1. Large degree of market concentration
 - Regional monopoly in 60s/70s, Oligopoly in 2016
2. Excess spreads and profits
3. Lawsuits for **anti-competitive practices**

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- **Measure distribution of welfare losses from non-competitive behavior**

Competitive reforms

1. Monopoly in 1970 to duopoly

- Measure welfare on transition path
- Poor gain from improved consumption smoothing
 - Higher limits, lower spreads
 - Reform worth 0.10-0.76% of lifetime consumption for zero-asset HH

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2. Duopoly to Oligopoly in 2016

- Equivalent one-time transfer worth 1.32% of GDP to current cohort

Related Literature

Workhorse consumer credit models

- Chatterjee et al. (2007), Livshits et al. (2007, 2010)

Non-competitive Empirics

- Ausubel (1991), Hunt (2003), Grodzicki (2017), Agarwal et al. (2015, 2018)

Search and matching in credit market

- Wasmer and Weil (2004), Drozd and Nosal (2008), Petrosky-Nadeau and Wasmer (2013), Galenianos and Nosal (2016), Herkenhoff (2017)

Credit lines, non-exclusive contracts, and market power

- Mateos-Planas and Seccia (2006, 2013), Drozd and Serrano-Padial (2013, 2017), Braxton et al. (2019), Bizer and DeMarzo (1992), Hatchondo and Martinez (2019), Kovrijnykh et al. (2019), Raveendranathan (2018), Nelson (2019), Wang et al. (2018), Benetton (2018)

This paper

1. Finite number of non-atomistic lenders
2. Non-exclusive credit lines

Key features of U.S. credit card industry

1. Concentration: Regional monopoly in 60s/70s

- i. Visa/Mastercard owned by founding banks
 - Visa-West, Mastercard-Midwest, Amex-East

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 - Abandon exclusionary contracts in 1976

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 - Sears attempts to issue low rate card
 - Visa bans Sears and all cards “deemed competitive”

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 - Visa bans Sears and all cards “deemed competitive”
- iv. Interest rate **collusion**
 - Wells Fargo & others sued for interest rate fixing in 80s (settled)
 - **Knittel & Stango (2003)**: widespread collusion at interest rate ceilings
 - 1978 Marquette Act facilitates national competition

1. Concentration: CC Issuing Banks (2016)

Table: Revolving credit share by issuer

Company	Cumulative share
1. Citigroup	18
2. JP Morgan	34
3. Capital One	46
4. Bank of America	58
5. Discover	66
6. Synchrony	73
7. American Express	78
8. Wells Fargo	83
9. Barclays	86
10. Other	100

- 9 issuers account for **86** percent of market share
- Oligopoly in 2016

By network

2. Excess Spreads

- Actual Spread:

$$\tau_{actual} = \underbrace{r_b}_{\text{credit card interest rate}} - \underbrace{r}_{\text{risk-free rate}}$$

- Zero profit spread: what lenders should charge above risk-free rate to break-even

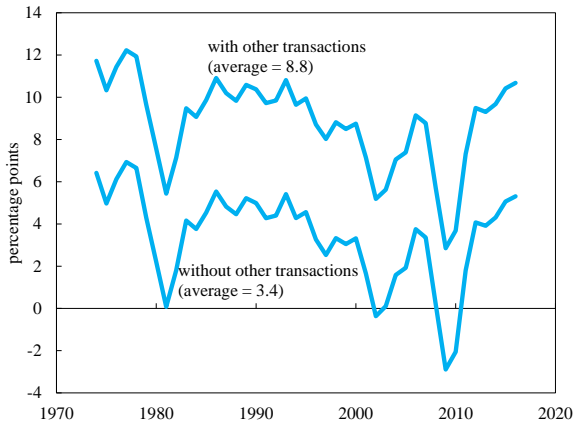
$$\underbrace{(1 - D)B(1 + r + \tau_{zero})}_{\text{interest income - charge-offs}} = \underbrace{B(1 + r + \tau_o)}_{\text{cost - non-interest income}}$$

- $\tau_o = \text{rewards/fraud} + \text{operational cost} - \text{fee/interchange income} < 0$
- Significant non-interest income: $\tau_o = -.052$

More

2. Excess Spreads = $\tau_{actual} - \tau_{zero}$

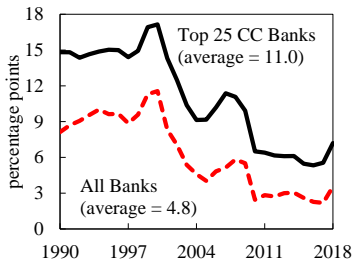
Average CC charges 3.4-8.8 p.p. above break-even, $r = Aaa$



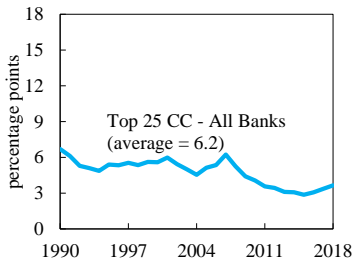
2. Excess Profits: Return on Assets (ROA)

$$\frac{[\text{Interest and non-interest income} - \text{Charge-offs}]}{\text{Assets}} = r + \tau_{\text{actual}} - D$$

(a) Average ROA



(b) Excess ROA



Summary of Key features of U.S. CC industry

- i. Large degree of market concentration
- ii. Average CC charges 3.4-8.8 p.p. above break-even
- iii. Excess profits 5 p.p. more than industry average
- iv. Lawsuits for anti-competitive practices

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Next

- Model with finite number of non-atomistic CC firms
 - Implications for excess spreads and excess profits
 - Measure distribution of welfare losses from non-competitive behavior

Model

Model Overview

Consumers

- Choose consumption, savings, and default/repayment
- (i, θ, ϵ, a) : credit flag (good/bad), permanent earnings, persistent earnings shock, assets
- Extreme value shocks over default and repayment ζ_R and ζ_D

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N lenders issue non-exclusive credit lines

- One credit line per lender - contracts are long-term
- Choose limit \bar{l} and spread τ to maximize profits
- **No price discrimination in 1970** (Livshits et al 2016), allow in 2016

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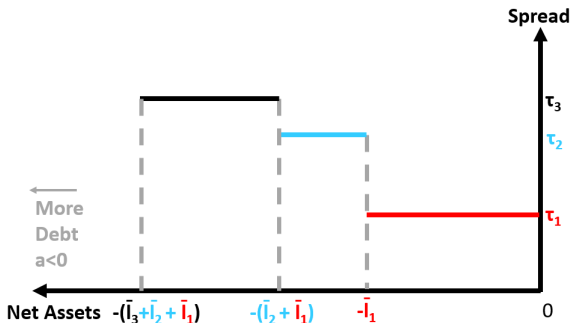
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Representative firm

- Hires workers, rents capital competitively

Credit Lines Example: $N=3$

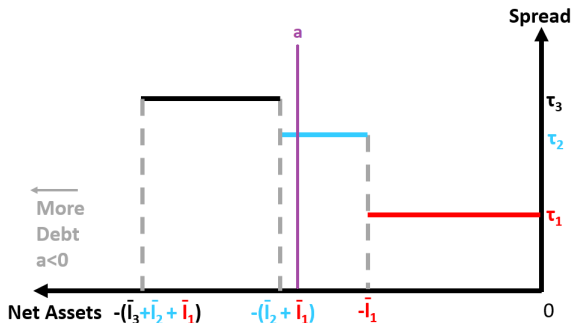
- Borrow from lowest spread first, τ_1 , then next lowest, τ_2, \dots



Equations

Credit Lines Example: $N=3$

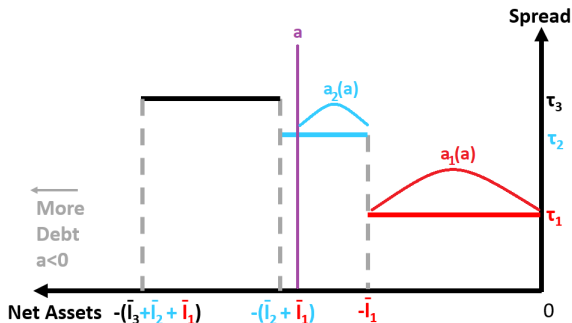
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Equations

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Equations

Consumer's Problem: Repayment or Default

- Let credit line state $S = \{(\tau_1, \bar{l}_1), \dots, (\tau_N, \bar{l}_N)\} \in (\mathbb{R}_+, \mathbb{R}_+)^N$
- Repay or universal default
- Value of consumer

$$V(i, \theta, \epsilon, a) = E_{\zeta_D, \zeta_R} \max \left\{ \underbrace{V^D(\theta, \epsilon)}_{\text{default}} + \zeta_D, \underbrace{V^R(i, \theta, \epsilon, a)}_{\text{repay}} + \zeta_R \right\}$$

- Probability of default ($\kappa =$ scaling parameter)

$$p(i, \theta, \epsilon, a) = \frac{\exp(\kappa V^D(\theta, \epsilon))}{\exp(\kappa V^D(\theta, \epsilon)) + \exp(\kappa V^R(i, \theta, \epsilon, a))}$$

Consumer: Value of Repayment in Good Standing

- May freely save or borrow on credit lines

$$V^R(g, \theta, \epsilon, a) = \max_{c, a'} U(c) + \beta E_{\epsilon' | \epsilon} V(g, \theta, \epsilon', a')$$

s.t.

$$c + a' = w\theta\epsilon + (1 + r)a + \sum_{j=1}^N \tau_j a_j(a) + \Pi$$

$$a' \geq - \sum_{j=1}^N \bar{l}_j$$

▶ Value of repayment in bad standing

Consumer: Value of Default

- Period of default: autarky 1 period, incur stigma χ
- Period after default: can save, with probability ϕ can re-enter

Equation

Lenders: Profits

- Lender $k \in \{1, \dots, N\}$ chooses (τ^k, \bar{l}^k) to maximize profits
- Skip mapping from credit line rank to CC firm
- Flow profit from the j^{th} ranked credit line

$$\Pi_j = \int \left[\underbrace{-(1 - p(g, \theta, \epsilon, a))\tau_j a_j(a)}_{\text{spread if repaid}} + \underbrace{p(g, \theta, \epsilon, a)(1 + r)a_j(a)}_{\text{loss upon default}} \right] \underbrace{d\Omega(g, \theta, \epsilon, a)}_{\text{ergodic dist}}$$

- Discount at rate r_t (relevant for transition)

Lenders: Competition

- $N = 1$: Monopoly lender
 - Monopolist maximizes profits by choosing τ^1 and \bar{l}^1
- $N = 2$: Stackelberg Duopoly
 - Second mover chooses τ^2 and \bar{l}^2 given τ^1 and \bar{l}^1
 - First mover chooses τ^1 and \bar{l}^1 given $\tau^2(\tau^1, \bar{l}^1)$ and $\bar{l}^2(\tau^1, \bar{l}^1)$
- $N > 1$: 2-stage game
 - Stage 2: All lenders compete symmetric Nash on limits
 - Stage 1: Collusion on spreads/leader picks spread

Final Good Firm's Problem and Equilibrium Definition

Calibration

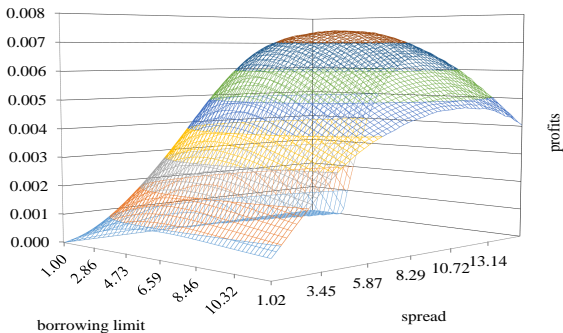
- Take standard parameters from literature
- Estimate remaining parameters to match moments
- Calibrate **monopoly (N=1)** in 1971-75

parameters

Parameters Calibrated to Match Moments

Parameter	Value	Target	Data	Model
Monopoly		Year = 1971-75		
χ Stigma	8.188	Charge-off rate	2.57	2.56
κ Scaling parameter	0.712	Defaults: health care, divorce, lawsuit	44.81	44.90
β Discount rate	0.960	Risk free rate	1.27	1.27

Equilibrium properties: monopolist profit function



- Borrowing limits (percent of GDP per capita), spreads (percentage points), profits (percent of GDP)
- Interior solution

Non-targeted moments (1971-75)

Variable (unit=percent/p.p.)	Monopoly model	Data
Borrowing limit to GDP pc	6.39	-
Credit to GDP	0.11	0.74
Spread	5.15	8.48
Excess spread: actual - zero-profit	2.55	5.70
Excess profits: return on assets	2.50	-

- Generate 40% of excess spreads

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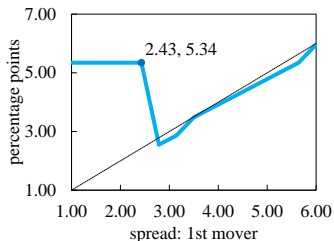
- Generate 40% of excess spreads

Next: 1970 Competitive Reform from monopoly to Stackelberg duopoly

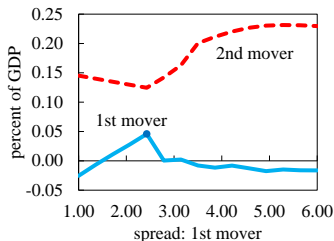
Equilibrium Properties: Duopoly

Fix 1st mover optimal limit and vary 1st mover spread:

(a) Spread: 2nd mover



(b) Profits

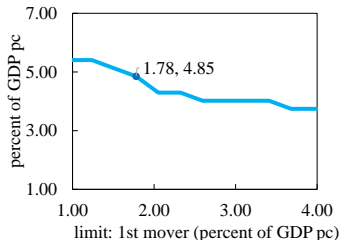


- 2nd mover **undercuts** high spreads
- **Strategic complements** of spreads \implies 2nd mover advantage

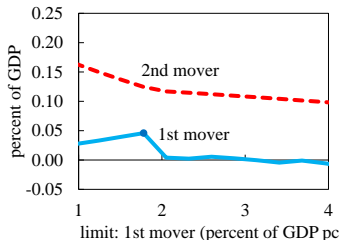
Equilibrium Properties: Duopoly

Fix 1st mover optimal spread and vary 1st mover limit:

(a) Limit: 2nd mover



(b) Profits



- 2nd mover sets **low limit** when 1st mover sets **high limit**
- **Strategic substitutability** of limits \implies 1st mover advantage

1970 Reform: Monopoly to Stackelberg Duopoly

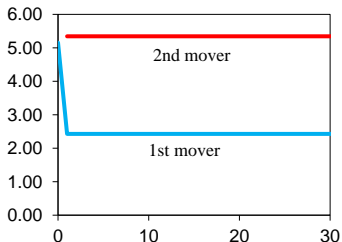
Variable	Monopoly	Duopoly
Firm 1: first mover		
Borrowing limit to initial GDP pc	6.39	1.78
Spread	5.15	2.43
Market share of outstanding credit	100.00	46.26
Market share of total profits	100.00	24.75
Firm 2: second mover		
Borrowing limit to initial GDP pc	-	4.85
Spread	-	5.34
Market share of outstanding credit	-	53.74
Market share of total profits	-	75.25
Excess spread: actual - zero-profit	2.55	1.67
Excess profits: return on assets	2.50	1.62

- Lower spread on first line and higher total limit
- Lower excess spread and excess profits

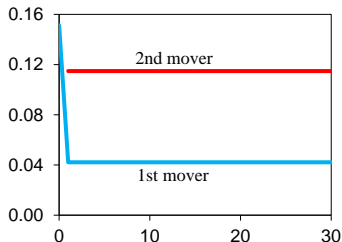
Transition Path 1970 Monopoly to Stackelberg Duopoly

- Unexpected transition from monopoly to duopoly at $t = 1$
- Perfect foresight thereafter
- Both lenders re-optimize and commit

(a) Spread

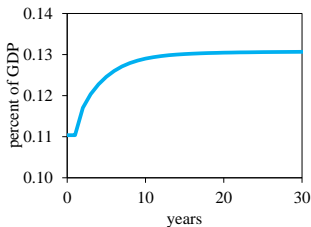


(b) Limit

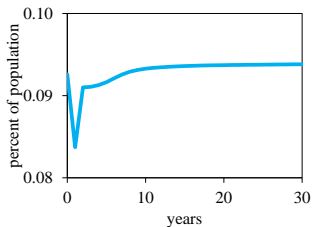


Transition Path 1970 Monopoly to Stackelberg Duopoly

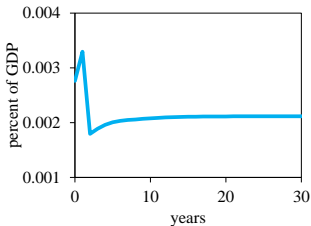
(a) Credit



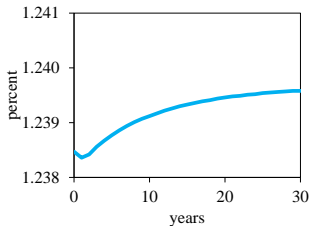
(b) Default Rate



(c) Profits



(d) Risk-free Rate



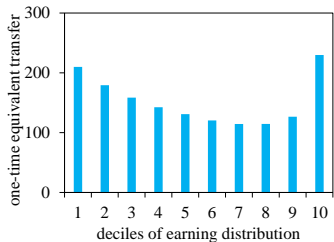
Welfare Measure: Wealth Equivalent Variation (WEV)

- One time equivalent transfer such that consumer is indifferent between monopoly and transition
- Advantages
 1. agents re-optimize
 2. aggregate across agents

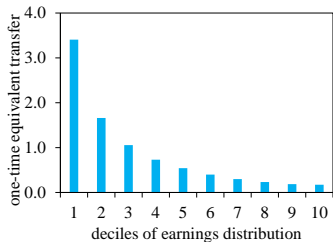
$$\begin{aligned} \min \quad & WEV \\ \text{s.t.} \quad & \\ & V_0(i, \theta, \epsilon, a + WEV) \geq V_t(i, \theta, \epsilon, a) \\ & a + WEV \geq -\bar{l}^1 \quad \text{if } i = g \\ & a + WEV \geq 0 \quad \text{if } i = b \end{aligned}$$

Distribution of Gains 1970 Reform (Stackelberg)

(a) By earnings decile (2016 dollars)

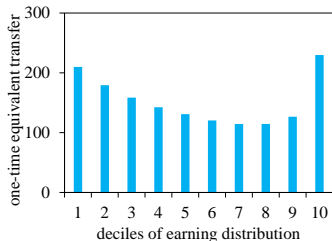


(b) By earnings decile (percent of earnings)

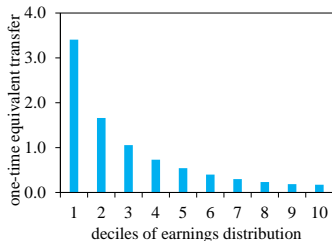


Distribution of Gains 1970 Reform (Stackelberg)

(a) By earnings decile (2016 dollars)



(b) By earnings decile (percent of earnings)



- **Poor**: better ability to smooth consumption
- **Rich**: consume precautionary savings & higher r
- Equivalent one time transfer worth 0.26% of GDP to current cohort
- Consumption equivalence for consumer with no assets = 0.10 percent

GE vs SOE

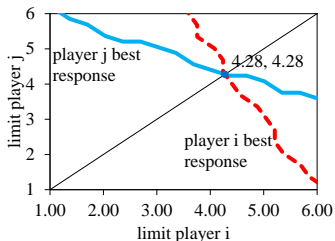
c

Monopoly to 2-stage duopoly

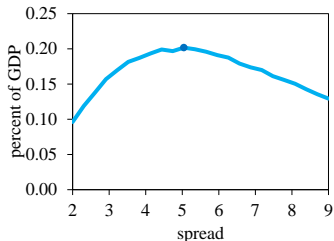
2-stage game

- Stage 2: Given spread, equilibrium limit determined from symmetric Nash game (left)
- Stage 1: Collusion on spread/leader picks spread (right)

(a) Stage 2 Example

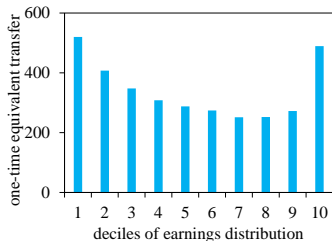


(b) Stage 1 Profits

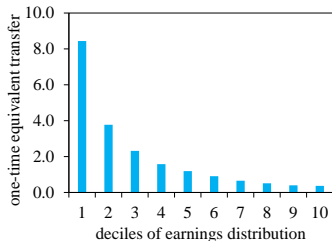


Distribution of Gains/Losses 1970 Reform (2-stage)

(a) By earnings decile (2016 dollars)



(b) By earnings decile (percent of earnings)



- Equivalent one time transfer worth 0.59% of GDP to current cohort
 - Gains mainly from higher limit
- Consumption equivalence for consumer with no assets = 0.22 percent

Monopoly to Perfect Competition

Monopoly to Perfect Competition

- **Selection criteria:** borrowing limits and spreads that **maximize welfare** of an unborn agent with zero net assets
 - Subject to weakly positive profits

Monopoly to Perfect Competition

- **Selection criteria:** borrowing limits and spreads that **maximize welfare** of an unborn agent with zero net assets
 - Subject to weakly positive profits
- Equivalent one time transfer worth **2.17%** of GDP to current cohort
 - Only spread = 0.41% of GDP to current cohort
 - Only limit = 1.41% of GDP to current cohort
- Consumption equiv. for consumer with no assets = **0.76** percent
 - Upper bound for gains from 1970 reforms

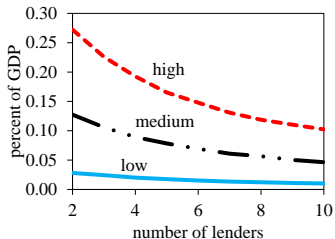
Decomposing Gains

Duopoly to 2016 Oligopoly with Discrimination

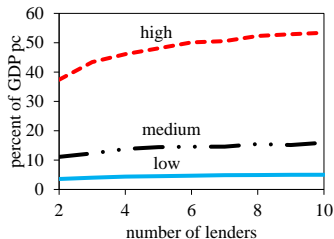
Duopoly to 2016 Oligopoly with Discrimination

Lenders price discriminate WRT permanent earnings ($\theta \in \{\theta_L, \theta_M, \theta_H\}$)

(a) Total Profits by Type



(b) Total Limit by Type



- Total profit decreases with more lenders (left)
- Total limit increases with more lenders (right)
- Equivalent one time transfer worth 1.32% of GDP to current cohort

Conclusion

- Integrate oligopolistic lenders into consumer credit model
 - Generates 25-40% of observed spreads & excess profits
- Estimate distribution of welfare gains from competitive reforms
 - 1970: reform from monopoly to duopoly, 0.26-2.17% WEV
 - 2016: reform from duopoly to oligopoly, 1.32% WEV

Next: policy on rate caps and minimum limits

Appendix

Transaction cost - non-interest income (Agarwal et al. 2015)

Variable	(unit = percent of average daily balance)
Total costs	
Rewards and fraud	2.2
Operational costs	3.4
Total non-interest income	
Total fees	7.6
Interchange income	3.2
Other transactions	-5.2

- ▶ Negative transaction cost net of non-interest income!
- ▶ Firms make profits ignoring interest charges, charge-offs, and cost of funds

[back](#)

Details: τ_{zero}

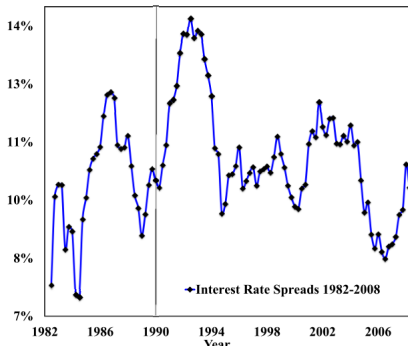
τ_{zero} : denote zero-profit spread

- D charge-off rate (Credit Cards, Flow of Funds)
- B outstanding revolving credit (Cancels)
- r Moody's Aaa rate for Commercial Paper (4.0% Jan, 2016)
- τ_o transition cost net of non-interest income

$$= \frac{\text{operational cost} + \text{rewards and fraud} - \text{fees income} - \text{interchange income}}{\text{outstanding revolving credit}}$$

2. Excess Spreads: Alternate risk-free rate

Grodzicki (2017), spreads using 1-year const. maturity treasury



Notes: The figure shows the trend in the mean difference between banks' most commonly offered credit card interest rate and the cost of funds, or mean spread. Data through August 1994 are from the Federal Reserve Board's Quarterly Report of Interest Rates on Selected Consumer Loans (form 2825). Data through 2008 are from the Board's Quarterly Report of Credit Card Interest Rates (Form 2835a) and are available from the Board's website. The cost of funds is the market rate on U.S. treasury securities at 1- year constant maturity (FRB series H. 15 - 4) plus 75 basis points.

2. Excess Spreads: Alternate risk-free rate

Grodzicki (2017), relative ROA

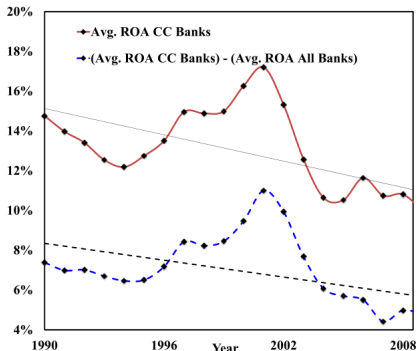


Figure 2: Profitability of Credit Card Lending 1990-2008

Notes: The figure shows trends in the (asset weighted) mean return on assets (ROA) for large credit card banks. Relative profitability is defined as the difference between the asset weighted mean ROA of the largest 25 credit card banks (by credit card assets) and the asset weighted mean profitability of all banks in the sample. Data are from each year's 1st and 3rd quarter Call Report filings. For detailed ROA definitions see appendix.

Lack of price discrimination

Credit score	Interest rate (percent)	90+ DPD in last 24 months (percent)	Credit limit (dollars)
≤ 660	19.63	51	2,561
661 – 700	14.50	21	4,324
701 – 740	15.35	14	4,830
> 740	14.70	5	6,941

- ▶ Source: Agarwal, Chomsisengphet, Mahoney, and Stroebel (2017)
- ▶ Interest rate hardly changes above credit score of 660

3. Lawsuits for anti-competitive practices

- Repeated lawsuits for anti-competitive practices (US/EU)
 - Multi-billion dollar damages and settlements
 - No reforms to industry
- **Example:** Black Card LLC vs. Visa, JP Morgan Chase, Capital One (2018, pending)
 - Black Card: new luxury card offering higher quality benefits
 - Visa, JP Morgan and Capital One colluded to launch competitive products and block the entry of Black Card
 - Very hard to enter

▶ Back

There is a representative, perfectly competitive firm that produces the final good by hiring labor, L , and renting capital, K , in order to maximize profits:

$$\max_{K,L} K^\alpha L^{1-\alpha} - wL - rK$$

Factor prices are given by $r = \alpha(K/L)^{\alpha-1}$ and $w = (1 - \alpha)(K/L)^\alpha$. The firm earns zero profits.

Consumer: Value of Repayment in Bad Standing

- Can save, but not borrow
- May **redefault** on expense shock, even if already in bad standing (end of period)

$$V^R(b, \theta, \epsilon, a) = \max_{c, a'} U(c) + \beta E_{\epsilon'|\epsilon} [\phi V(g, \theta, \epsilon', a') + (1 - \phi) V(b, \theta, \epsilon', a')]$$

s.t.

$$c + a' = w\theta\epsilon + (1 + r)a + \Pi$$

$$a' \geq 0$$

▶ Back

2016 Competitive Reform

Bertrand competition equilibrium:

- ▶ Keep number of lenders fixed, $N = 2$
- ▶ Banks can offer a maximum of 2 credit lines
- ▶ Assume consumer must pick a bank exclusively
 - ▶ **Selection criteria:** borrowing limits and spreads that **maximize welfare** of an unborn agent with zero net assets, subject to weakly positive profits
- ▶ Any deviation by the other bank will not be adopted by the consumer

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Final Good Firm

- Competitive final output market
- Hire labor, L , and rent capital, K , in order to maximize profits:

$$\max_{K,L} K^\alpha L^{1-\alpha} - wL - rK$$

- Factor prices are given by $r = \alpha(K/L)^{\alpha-1}$ and $w = (1 - \alpha)(K/L)^\alpha$.

back

Def. Equilibrium

Set of credit lines S , distribution $\Omega(i, \theta, \epsilon, a)$, wage rate w , interest rate r , profits Π , default probability $p(i, \theta, \epsilon, a)$, savings/borrowing policy $a'(i, \theta, \epsilon, a)$, best responses $\tau^k(\cdot), \bar{l}^k(\cdot)\}_{k=1}^N$, and final good firm's $\{K, L\}$ s.t.

- i. given S, w, r , and Π , policies $p(i, \theta, \epsilon, a)$, and $a'(i, \theta, \epsilon, a)$ solve the consumer's problem.
- ii. for $k \in \{1, 2, \dots, N\}$, $\{\tau^k(\cdot), \bar{l}^k(\cdot)\}_{k=1}^N$ maximizes credit card firm's profits.
- iii. final good firm's choices give factor prices $r = \alpha(K/L)^{\alpha-1}$ and $w = (1 - \alpha)(K/L)^\alpha$.
- iv. distribution $\Omega(i, \theta, \epsilon, a)$ consistent with policy functions.
- v. labor market clears:

$$L = \int \epsilon d\Omega(i, \theta, \epsilon, a)$$

- vi. capital market clears:

$$K = \int a d\Omega(i, \theta, \epsilon, a)$$

1. Concentration: CC Networks (2016)

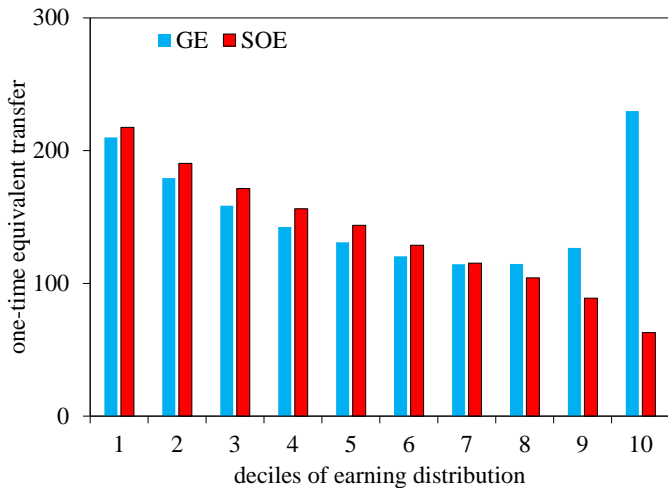
Table: Credit card purchase volume by payment network

Company	Cumulative share
1. Visa	51
2. American Express	74
3. Master Card	96
4. Discover	100

- 3 networks account for 96% of market share
- Visa/MasterCard founded and jointly owned by largest banks
- Set *large* interchange fees (scale with rewards) paid to banks
 - Rewards programs generate net revenues for banks
 - *Not in model*

back

Distribution of Gains 1970 Reform: GE vs SOE



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Credit Lines

- Consumer first borrows from cheapest credit line
 - Ignore firm identity for now
 - Let j denote the spread ranking of a credit line
- Sort credit lines in ascending order by spreads
 - $(\tau_1 \leq \tau_2 \leq \dots \tau_j \leq \dots \leq \tau_N)$ w/ corresponding limits $(\bar{l}_1, \bar{l}_2, \dots, \bar{l}_N)$
- Balance on credit line $j \in 1, 2, \dots, N$

$$a_j(a) = \begin{cases} -\bar{l}_j & \text{if } a \leq -\sum_{k=1}^j \bar{l}_k \\ \min [a + \sum_{k=1}^j \bar{l}_k - \bar{l}_j, 0] & \text{if } a > -\sum_{k=1}^j \bar{l}_k \end{cases}$$

back

Parameters Determined Outside of Model Equilibrium

- We assume that each period corresponds to one year.
- Capital share $\alpha = 0.33$, Depreciation rate $\delta = 0.045$, Risk aversion $\sigma = 2$
- Re-entry prob. good credit standing $\phi = 0.1$ (10-year exclusion)
- AR(1) process from Guvenen, Ozkan, Song (2014)
 $\rho_\epsilon = 0.953$ and $\sigma_\epsilon^2 = 0.06$
- 3 permanent types $\theta \in \{\theta_L, \theta_M, \theta_H\}$
Quartiles of fixed effects in earnings estimation

back

Consumer: Value of Default

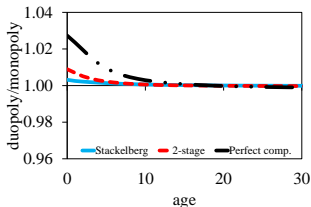
- **Period of default:** autarky 1 period, incur stigma χ
- **Period after default:** can save, with probability ϕ can re-enter

$$V^D(\theta, \epsilon) = U(w\theta\epsilon + \Pi) - \chi \\ + \beta E_{\epsilon'|\epsilon} [\underbrace{\phi V(g, \theta, \epsilon', 0)}_{\text{good standing}} + (1 - \phi) V(b, \theta, \epsilon', 0)]$$

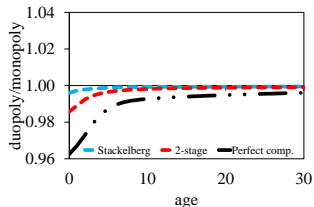
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Decomp. Gains: Consumers Lowest Earnings Decile

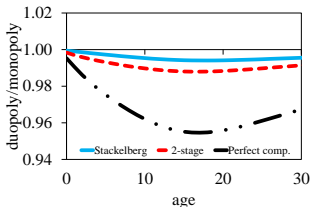
(a) Average consumption



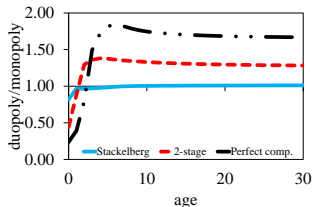
(b) Variance consumption



(c) Average net assets



(d) Default Rate



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