Democratization of Credit and the Rise in Consumer Bankruptcies

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October 2012

Motivation

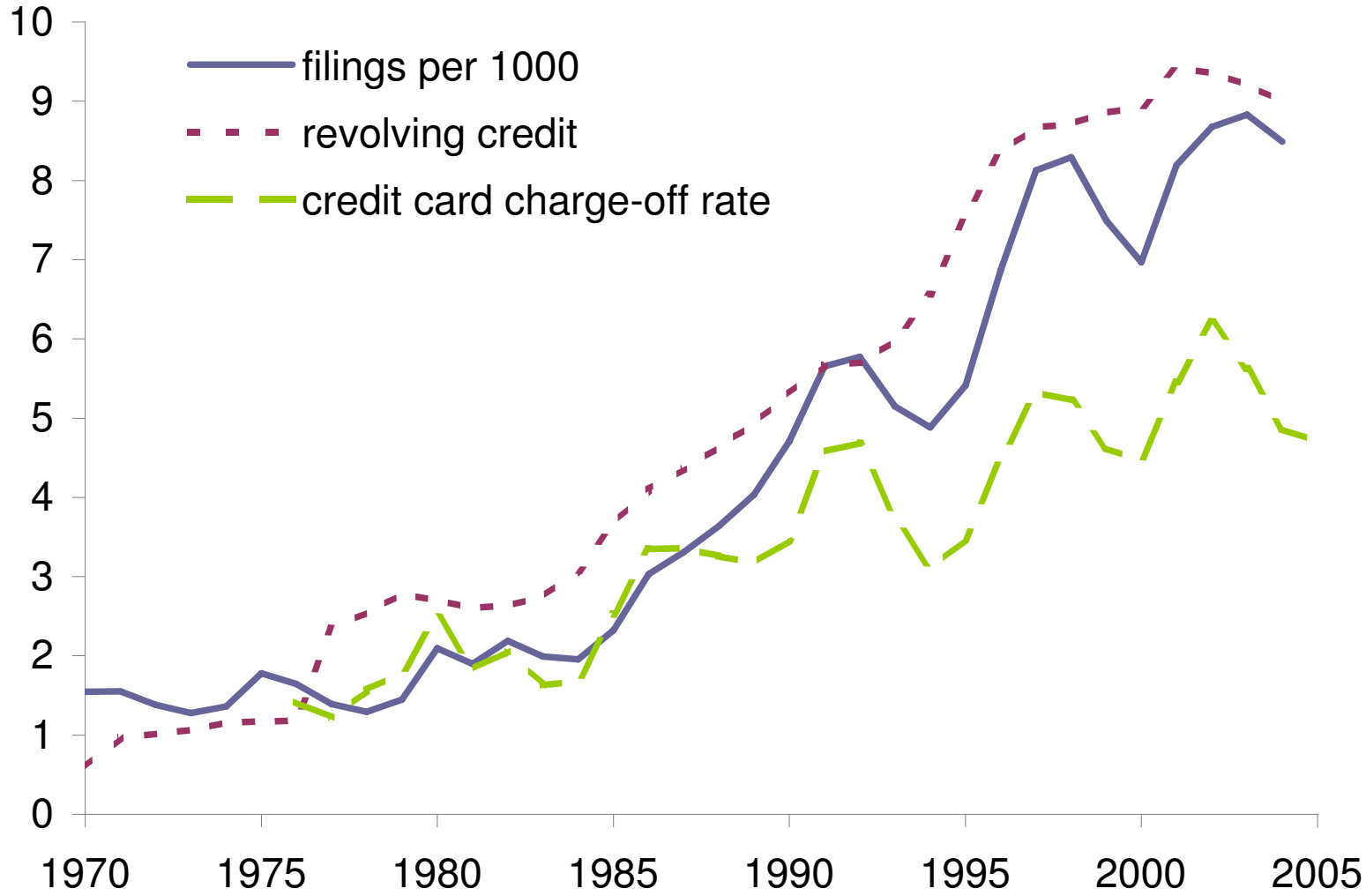
- Large changes in consumer credit markets over last 30 yrs.
  - Increase in bankruptcies
  - Increase in borrowing

- In Livshits, MacGee and Tertilt (AEJM 2007) we ruled out
  - changes on consumer side (e.g. more income risk)
  - legal changes

- This paper: technological progress in consumer credit sector.

  $\rightarrow$ increased access to credit (Democratization of Credit)

Debt and Defaults over Time



Changes in Access to Credit Cards

	1983	1989	1995	1998	2001	2004
% Pop. has card	43%	56%	66%	68%	73%	72%
% Pop. has balance	22%	29%	37%	37%	39%	40%

$\Rightarrow$ Large changes on extensive margin.

Due to changes in lending technology?

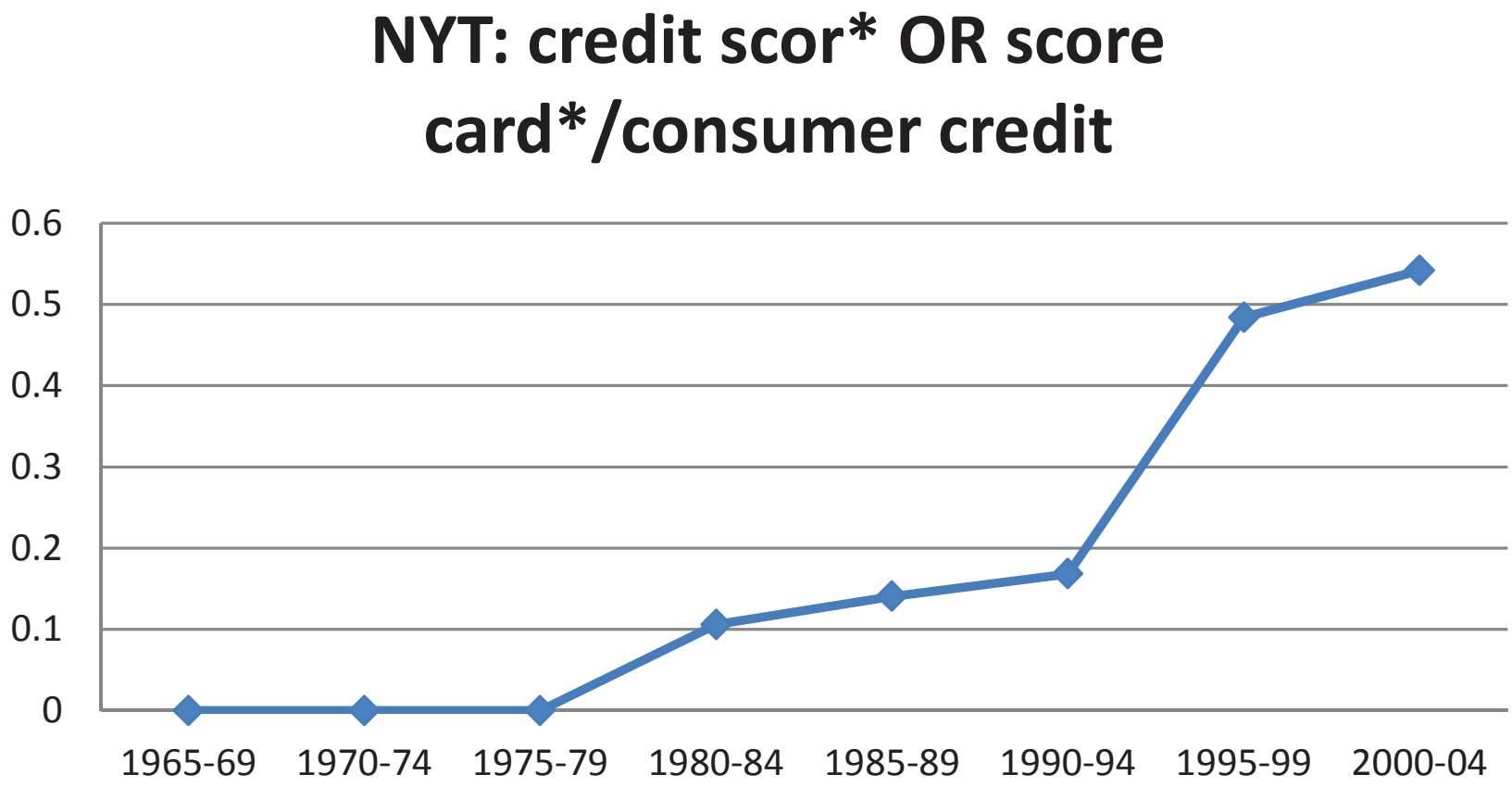
Computational Advances

- Nordhaus (JEH 2007) documents increase in computational speed, and decrease in computational cost for a long time period.
- Finds most rapid pace of improvement: 1985-1995.

$\rightarrow$ Our hypothesis: Enabled widespread use of credit scoring technology.

Diffusion of Credit Scoring Technology

Evidence from newspaper keywords



Innovations in Credit Card Sector

1981	MBNA (first monoline) was founded, national credit cards
1984	First Deposit Corporation was founded (Andrew Kahr), ultimately became Providian. SEGMENTATION: focus on particular segment of people
1980s	non-bank entrants (such as Sears, GM, and ATT), have informational advantage because they have some data on their own customers.
1988	Richard Fairbank and Nigel Morris: Information-based strategy (IBS), they start at Signet which becomes Capital One. EXPERIMENTATION with credit card terms and market segments, then analyze data and use only profitable segments.
1988	About half of all banks use credit scoring as a loan approval tool
1991	Amex/Citi: target low risk customers
early 1990s	credit cards have become hotly competitive, CUSTOMIZED PRODUCTS with thousa of combinations of rates, fees, credit lines, rewards, and services.
Early 1990s	Credit card companies rapidly expanded their use of risk-based pricing
1990s	Use of SCORECARDS as a loan approval tool soared.
2000	About seven-eighths of all banks use credit scoring as a loan approval tool

Our Interpretation

*"Credit-scoring systems generally involve significant **fixed costs** to develop, but their "operating" cost is extremely low–that is, it costs a lender little more to apply the system to a few million cases than it does to a few hundred."*

Federal Reserve Board Report, 2007

- There exists a fixed cost of designing credit contract: selecting target market, analyzing data sets, development of scoring models, experimentation, customer service tailored to product.
- Costs needs to be paid on recurring basis (scoring models are constantly re-estimated, as economic conditions change).
- Fixed cost may have fallen over time due to better computing technologies.
- Accuracy of scoring technology may have increased over time.

What We Do

1. Model *endogenous* consumer credit contracts with default
   - Fixed cost of offering a contract
   - Imperfect information about consumer's riskiness
     - adverse selection
2. Study implications of technology improvement:
   (a) Increase in precision of signal
   (b) Decrease in fixed cost
3. Compare predictions of model to data:
   (a) Greater interest rate heterogeneity
   (b) More risk based pricing
   (c) Increased lending to lower income (riskier) households

Preview of Results

- Fixed cost of offering lending contract generates
  1. Finite number of contracts in equilibrium
  2. Each contract serves subset of population

- Increase in precision of signal and/or decline in cost of contract lead to
  1. Each contract serves a smaller subset
     - "Pools" become smaller
     - More accurate risk-based pricing
  2. More contracts offered in equilibrium
     - More borrowing
     - Expansion of credit to riskier borrowers
     - More defaults

- Consistent with observations
- Insight into Ausubel (1991) puzzle?

Related Literature

- Rise in consumer bankruptcy:
  Athreya (2004), Livshits, MacGee and Tertilt (2010)
- Technological Progress: focus on intensive margin
  Narajabad (2012), Nosal and Drozd (2007),
  Sanchez (2012), Athreya et al (2012)
- Credit history and lending:
  Chatterjee, Corbae and Rios-Rull (2007, 2008)
- More risk-based pricing of consumer loans in US:
  Edelberg (2006)
- Lending and adverse selection:
  Jaffee and Russell (1976), Rotshild and Stiglitz (1976),
  Wilson (1977), Hellwig (1987)

Simple Model: Key Features

- Two period endowment economy
- Endowment stochastic in second period
- Household types differ in risk of endowment
- Risk-free interest rate (cost of funds) exogenous
- Incomplete markets: Non-contingent debt only
- Exogenous bankruptcy rule
- Financial intermediaries (lenders) pay fixed cost χ to offer debt contract (interest rate, loan size, eligibility set)
- Lenders observe noisy signal of HH risk type

Model: Consumers

- Risk-neutral borrowers:

$$u(c_1, c_2) = c_1 + \beta E_i c_2$$

- Endowment:
  - No uncertainty in period 1
  - In period 2, $y_i \in \{y_l, y_h\}$
- Heterogeneity:
  - Consumers differ in probability ρ_i of good state y_h
    - ρ_i distributed uniformly on $[0, 1]$
  - Lenders see signal σ of household type:
    - with probability α signal is accurate: $\sigma_i = \rho_i$
    - otherwise signal is pure noise: $\sigma \sim U[0, 1]$

Bankruptcy

- Borrowers can declare bankruptcy in period 2.
  - Bankruptcy option introduces partial contingency.
- Cost of bankruptcy:
  - Lose a fraction γ of endowment.
- Endogenous borrowing limits:
  - $L \leqslant \gamma y_l$
    Risk-free contract: Always repaid.
  - $\gamma y_l < L \leqslant \gamma y_h$
    Risky contract: Repaid with probability ρ_i.
  - $L > \gamma y_h$ is never repaid.

Model: Contracts

A contract is a triplet $(q, L, \bar{\sigma})$ offered by one intermediary.

- L is the loan size (face value)
- q is the bond price
  - Interest rate $r = \frac{1}{q} - 1$
- $\bar{\sigma}$ specifies the eligibility set:
  - All consumers with $\sigma \geq \bar{\sigma}$ are eligible for the contract

Model: Financial Intermediaries

- Competitive intermediaries.
- Intermediaries pay fixed cost χ to offer contract $(q, L, \bar{\sigma})$.
- Can borrow at rate $\bar{r}$. Define $\bar{q} = \frac{1}{1+\bar{r}}$.
- Assume $\bar{q} > \beta$ (otherwise no borrowing).
- Lenders see public signal σ, not ρ.
- Special case: complete info ($\alpha = 1$).
- All contracts observable by competition and households.

Timing (Wilson 1977, Hellwig 1987)

1.a. Lenders pay fixed costs χ and announce contracts.

1.b. HHs observe all contracts and choose which to apply for realizing some intermediaries may choose to exit.

1.c. Intermediaries decide whether to exit the market.

1.d. Remaining lenders notify approved applicants.

1.e. Borrowers choose best contract offered to them.

2.a. Households realize endowments and make default decisions.

2.b. Non-defaulting households repay their loans.

Assures existence.

Characterizing Equilibria

Proposition 1: All contracts offered feature either

- $L = \gamma y_l$ (risk-free contract)
- or $L = \gamma y_h$ (risky contracts)

Proposition 2: If $\alpha = 1$, all risky contracts $(q_k, L = \gamma y_h, \bar{\rho}_k)$ feature the following interest rate/eligibility cut-off relationship:

$$q_k = \bar{q}\bar{\rho}_k$$

Proof: $\bar{\rho}_k$ is the "break-even" type for a loan with price q_k.

$\Rightarrow$ The "riskiest" borrower accepted by a contract makes no contribution to the overhead cost χ.

Corollary: Can order risky contracts: $1 = \bar{\rho}_0 > \bar{\rho}_1 > \bar{\rho}_2 > \ldots$

Equilibria: Characterization ($\alpha = 1$)

- Free entry into intermediations determines "supply" of equilibrium contracts.
- Zero profit condition (of contract that serves interval (ρ_n, ρ_{n-1})).

$$\int_{\rho_n}^{\rho_{n-1}} (\rho_i \overline{q} - q_n) L di \quad = \quad \chi$$

- Household participation decision determines contract "demand" – If top (lowest risk) household in interval participates, then all HH in interval participate.
- 2 Participation constraints:
  a) risky contract preferred over risk-free contract.
  b) risky contract preferred over autarky.

Equilibria: Characterization ($\alpha = 1$)

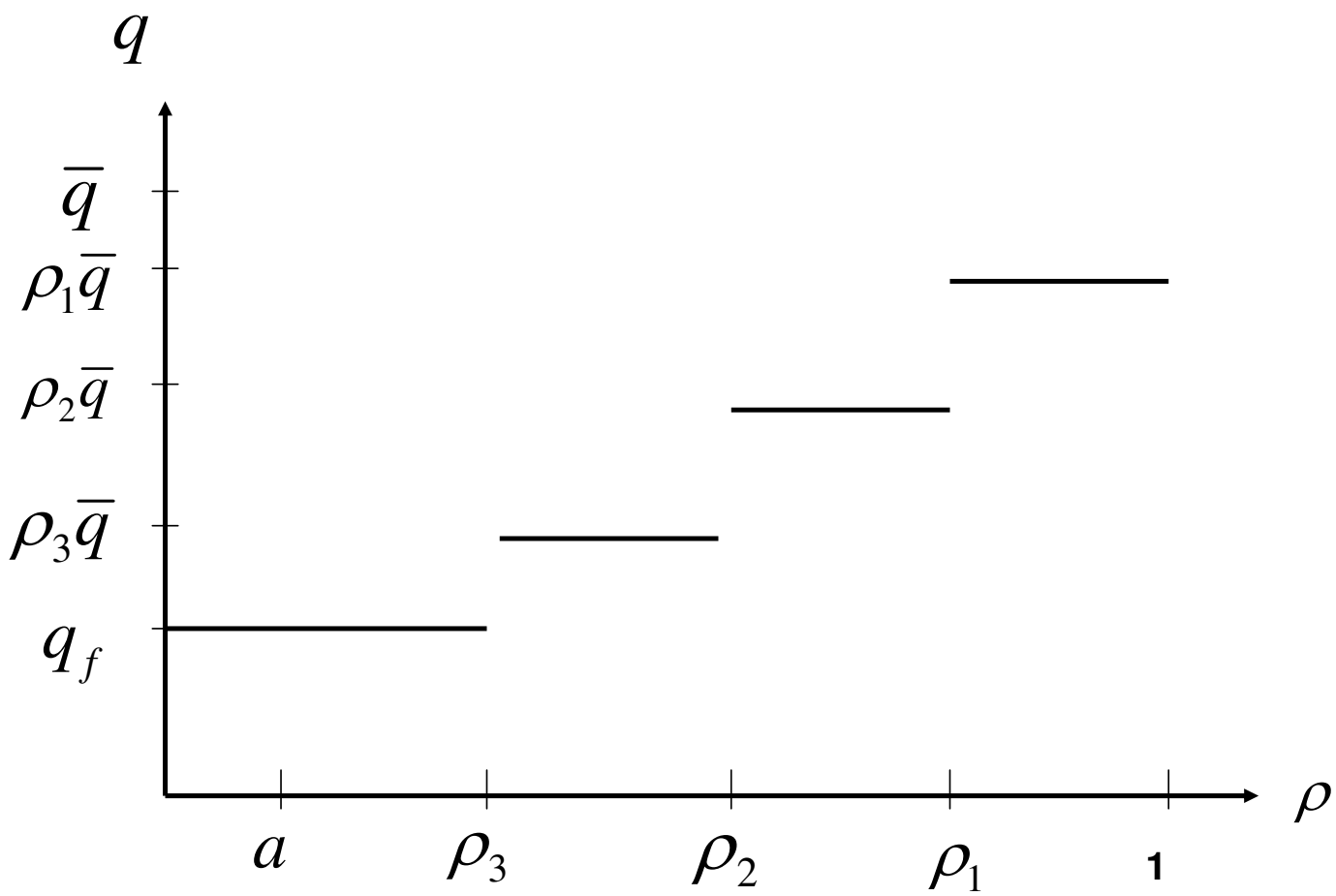
Proposition 3: Finitely many (N) risky contracts offered. Each contract $(q_n, \gamma y_h, \rho_n)$ serves borrowers in interval $\rho \in (\rho_n, \rho_{n-1}]$, where

$$\begin{aligned} \rho_n &= 1 - n\sqrt{\frac{2\chi}{y_h \gamma \overline{q}}} \\ q_n &= \overline{q}\rho_n \end{aligned}$$

Implications:

- Effective "pooling" even w/o asymmetric info
- some types are denied credit.

Equilibrium Set of Contracts



Complications of Asymmetric Information

- Good borrowers with bad signals will opt out.
- While bad borrowers with good signals stay in.
- Affects the pool of applicants for risky contracts.
- Makes contract pricing more difficult.

Characterizing Equilibria

Proposition 4: All risky contracts $(q_k, L = \gamma y_h, \bar{\sigma}_k)$ generate exactly zero profit in equilibrium.

Proof: Follows from free entry.

Proposition 5: Finitely many (N) risky contracts offered. Each contract $(q_n, \gamma y_h, \bar{\sigma}_n)$ serves borrowers in interval $\sigma \in [\bar{\sigma}_n, \bar{\sigma}_{n-1})$, where

$$\bar{\sigma}_n = 1 - n\Theta$$

and

$$\Theta = \sqrt{\frac{2\ \chi}{y_h \gamma\ \ \overline{q}\quad \alpha}}$$

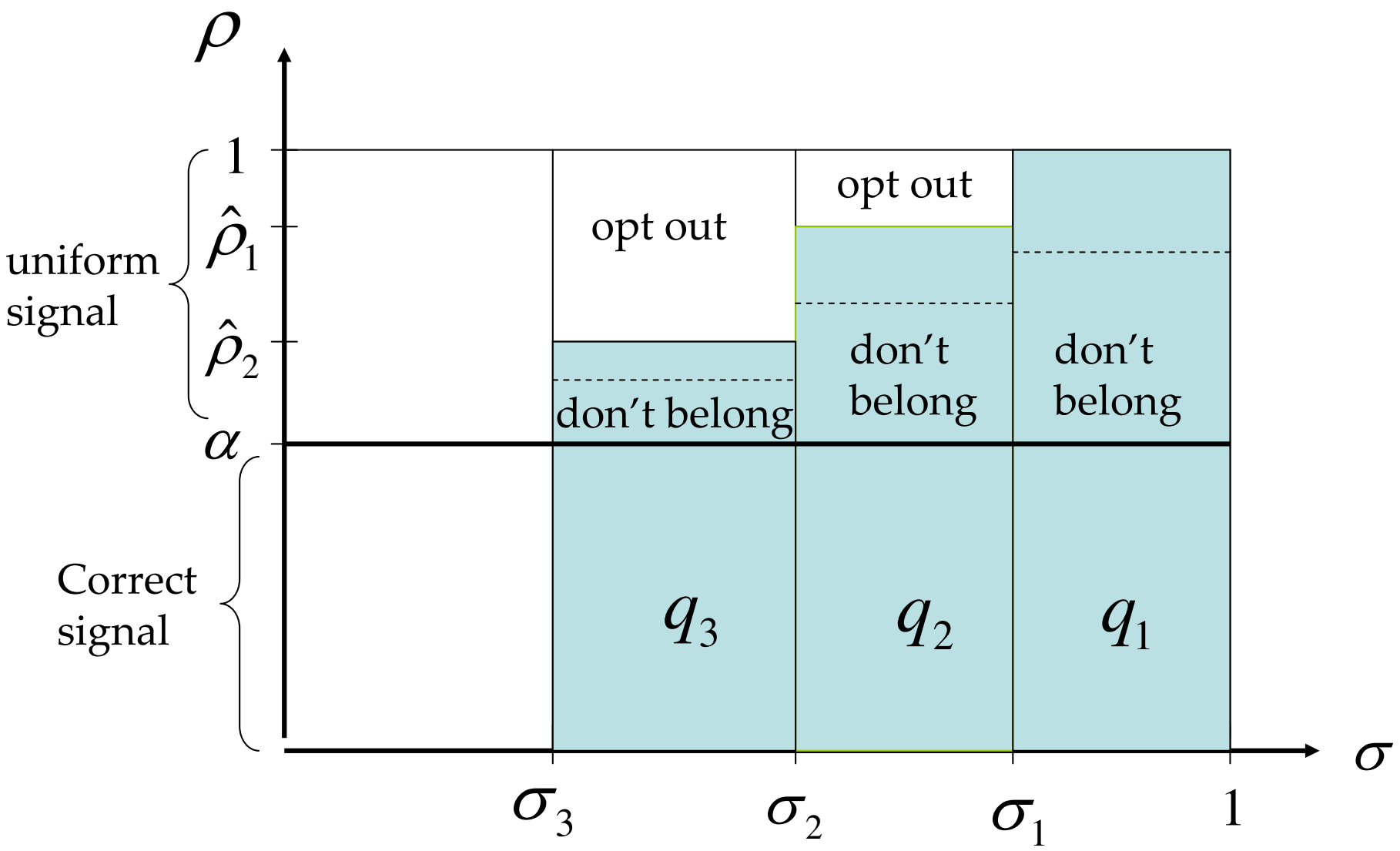
Note: Higher α implies lower Θ.

Equilibrium Set of Contracts

is determined by the **participation constraints**:

- Risky contracts must be preferred to alternatives
  - Either risk-free contract or autarky need to be checked
  - Find cut-off type $\widehat{\rho_n} \in [\bar{\sigma}_n, 1]$ for each contract
  - This pins down the number of risky contracts, N
- Risk-free contract
  - Serves borrowers with $\sigma < \bar{\sigma}_N$ and $\rho > \widehat{\rho_n}$
  - Offered only if it is preferred to autarky

With Asymmetric Information



Outline of Rest of Talk

- Use model to analyze two channels of improved credit technology:
  1. Decrease in fixed cost
  2. Increase in precision of risk assessment
- Both channels can generate an increase in product variety.
- Compare model predictions to data:
  - Number of different contracts
  - Borrower characteristics and pricing
  - Household access to unsecured credit
- Implications of shift in risk-free interest rate in model: Ausubel (1991) puzzle.

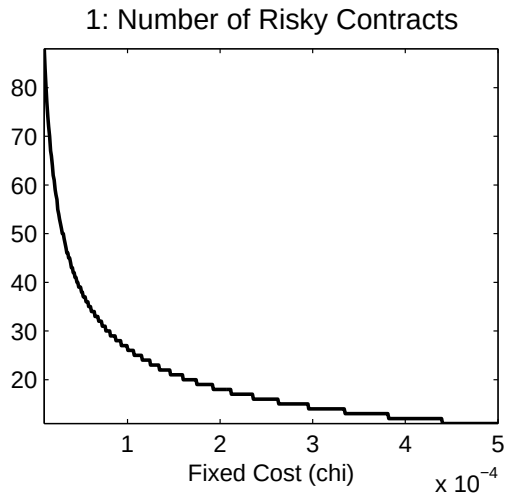
Summary of Model Implications

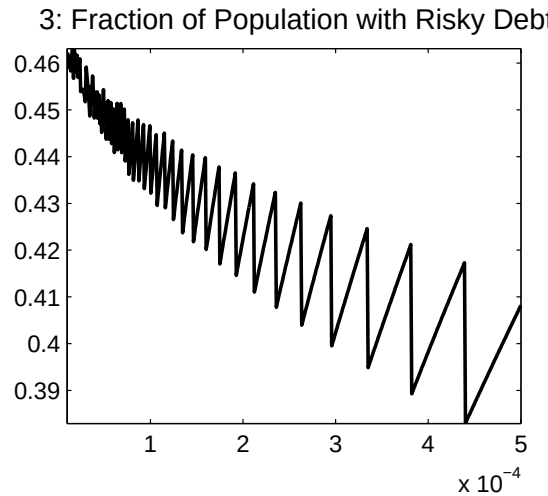
Both technological changes imply

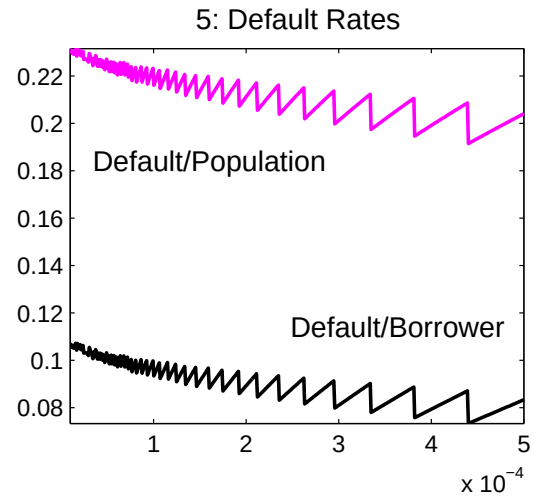
- more access of credit to riskier people.
- more total borrowing.
- more bankruptcies.
- increase in dispersion of interest rates.
- increase in ex-ante welfare.

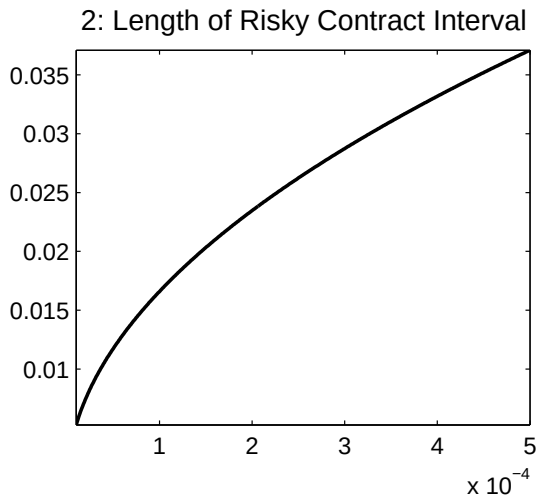
Key Mechanism: extensive margin.

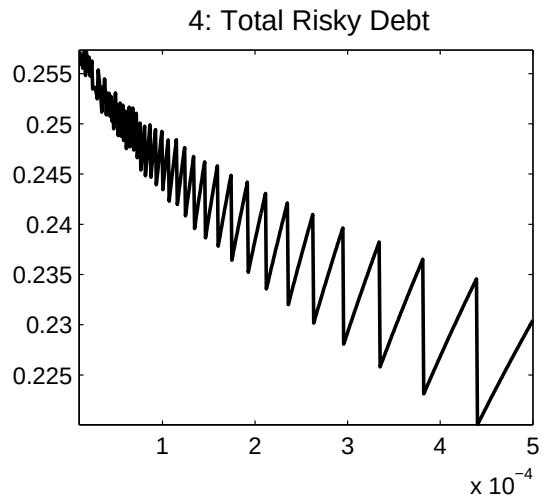
Comp statics in fixed cost χ

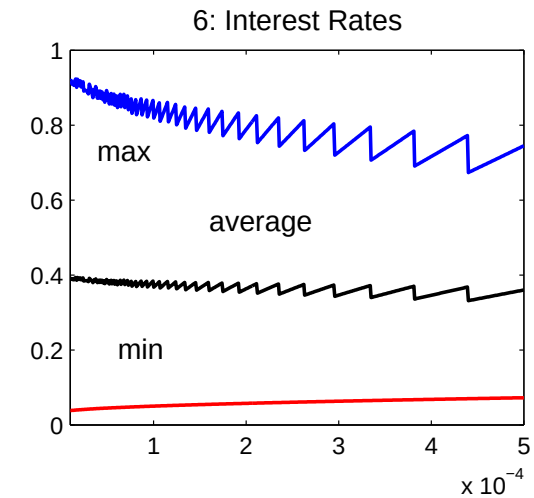




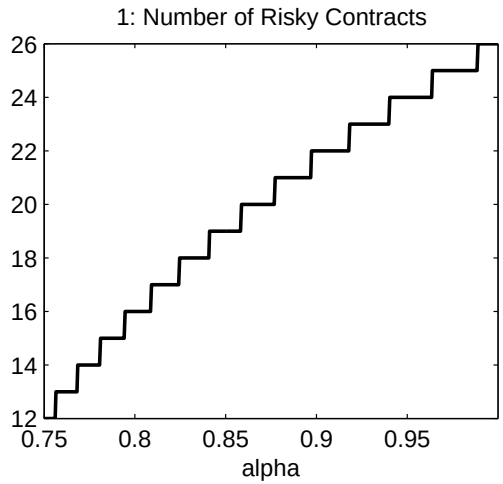


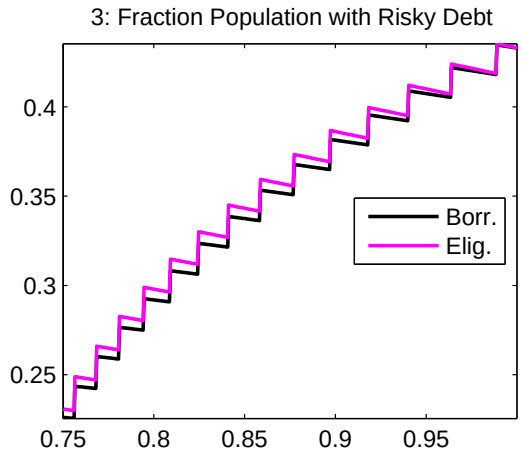


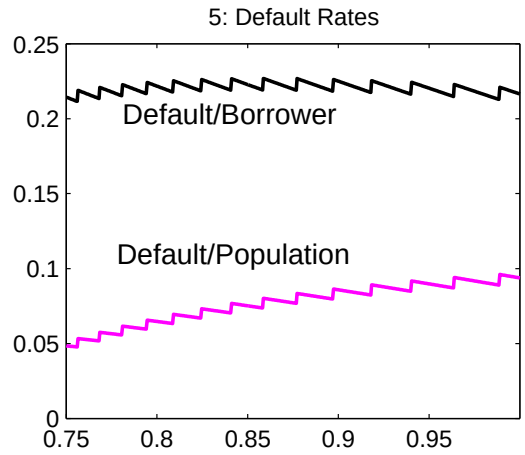


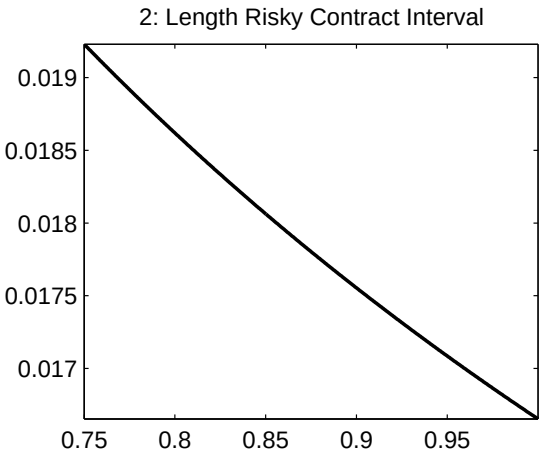


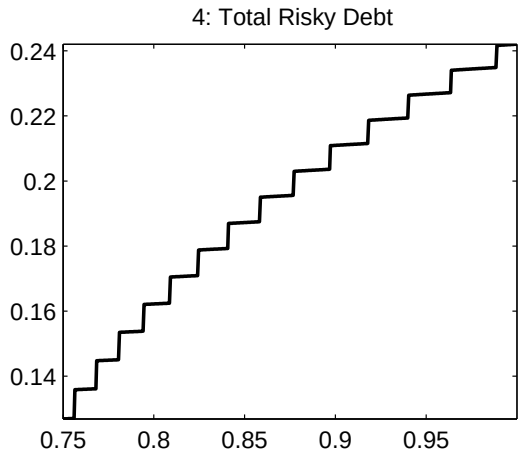
Comp statics in signal accuracy α

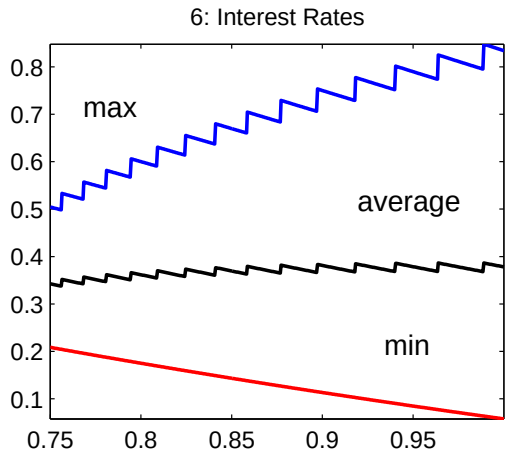












Data

- Use data from
  - Borrowers: Survey of Consumer Finance (SCF)
  - Lenders: interest rate data collected by the Fed
- Key changes in unsecured consumer lending market:

1. Greater heterogeneity of lending contracts
2. More risk based pricing
3. Increased lending to lower income (riskier) households

Fact 1a: Increase in "Contract Variety"

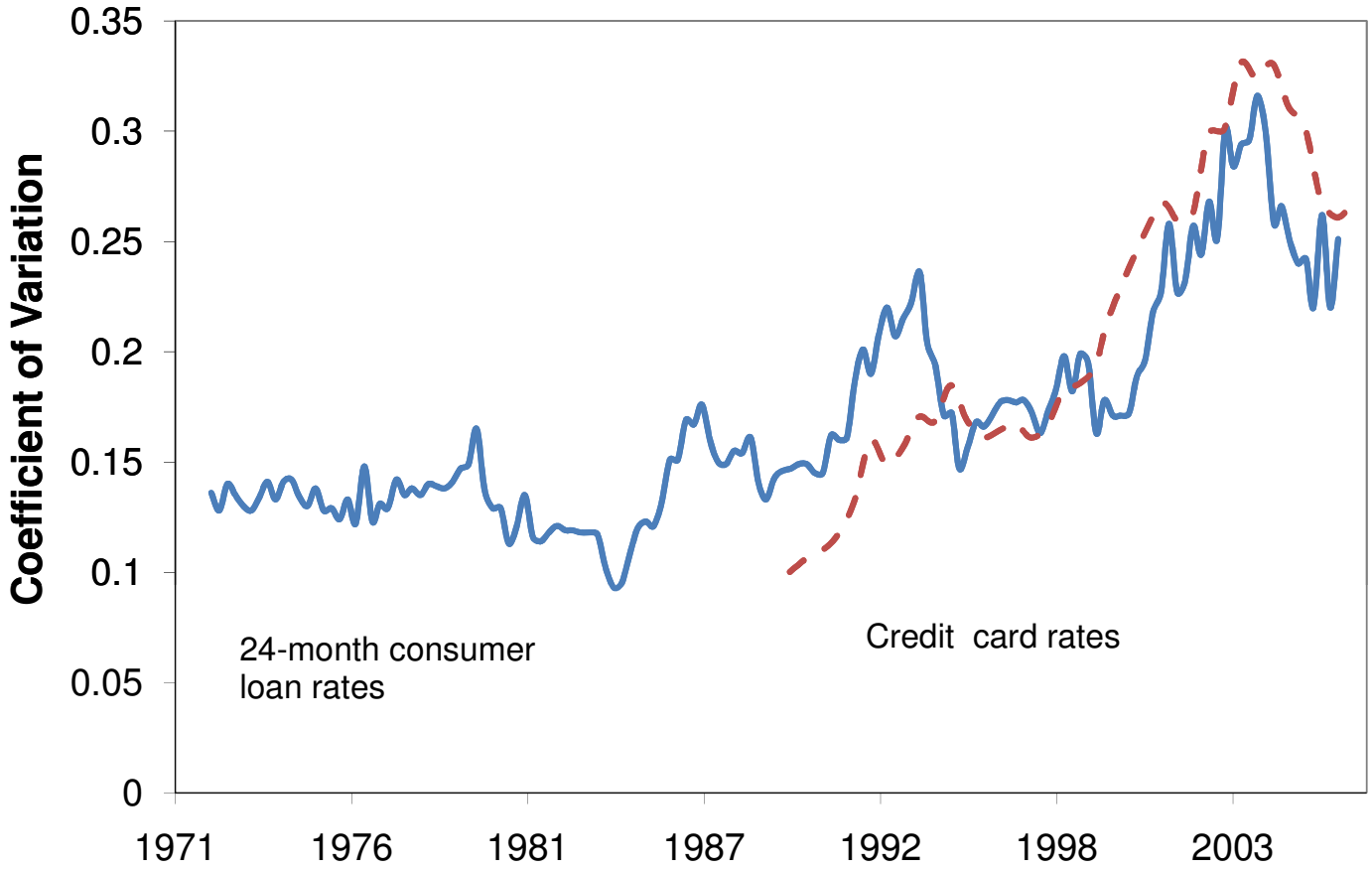
- Focus on interest rates as measure of number of contracts
- Increase in number of different credit card interest rates reported by households:

Year	All HH	HH with Debt
1983	78	47
1995	142	118
1998	136	115
2001	222	155
2004	211	145

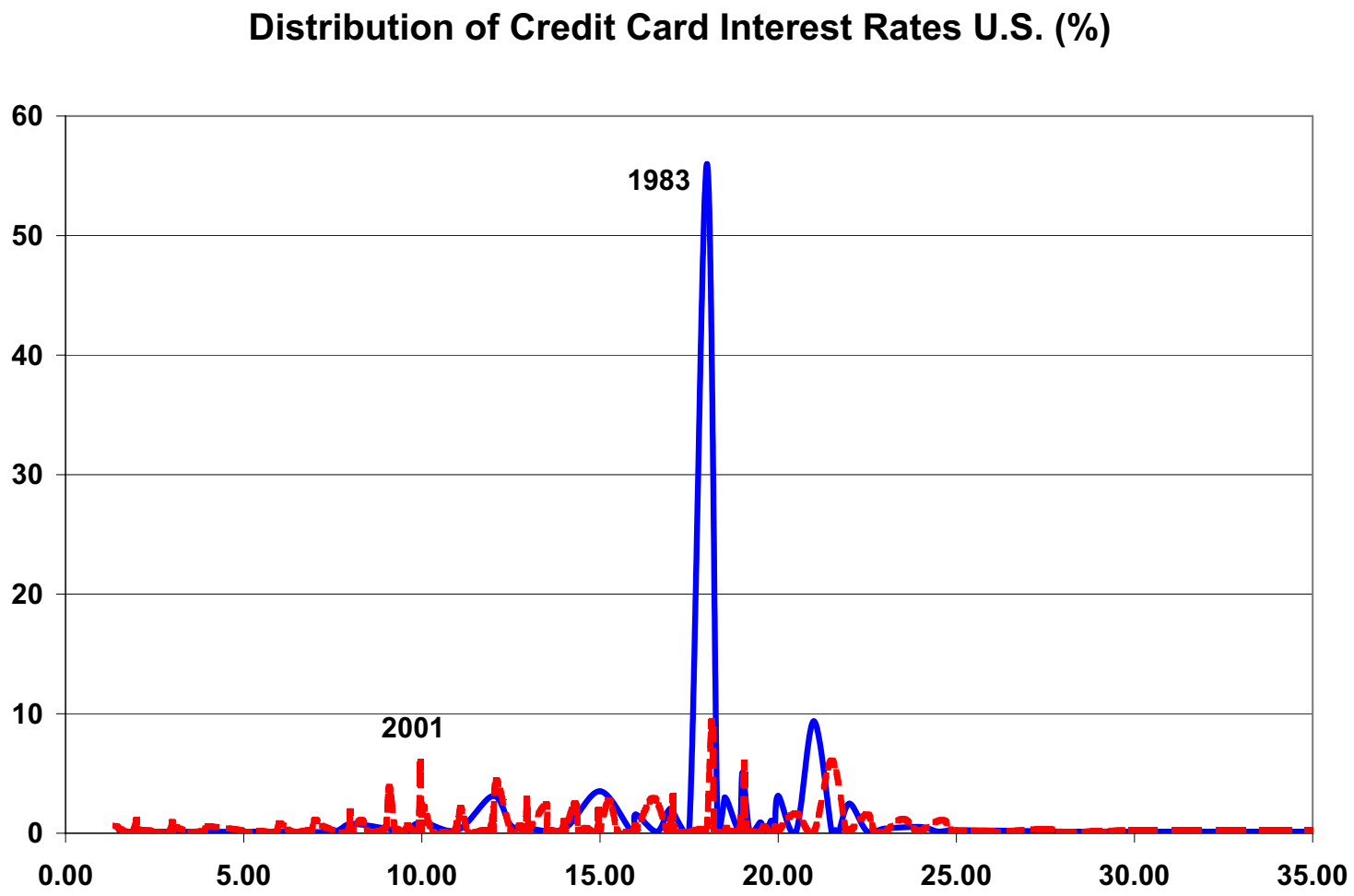
Source: Survey of Consumer Finance.

- More disperse distribution of reported interest rates.

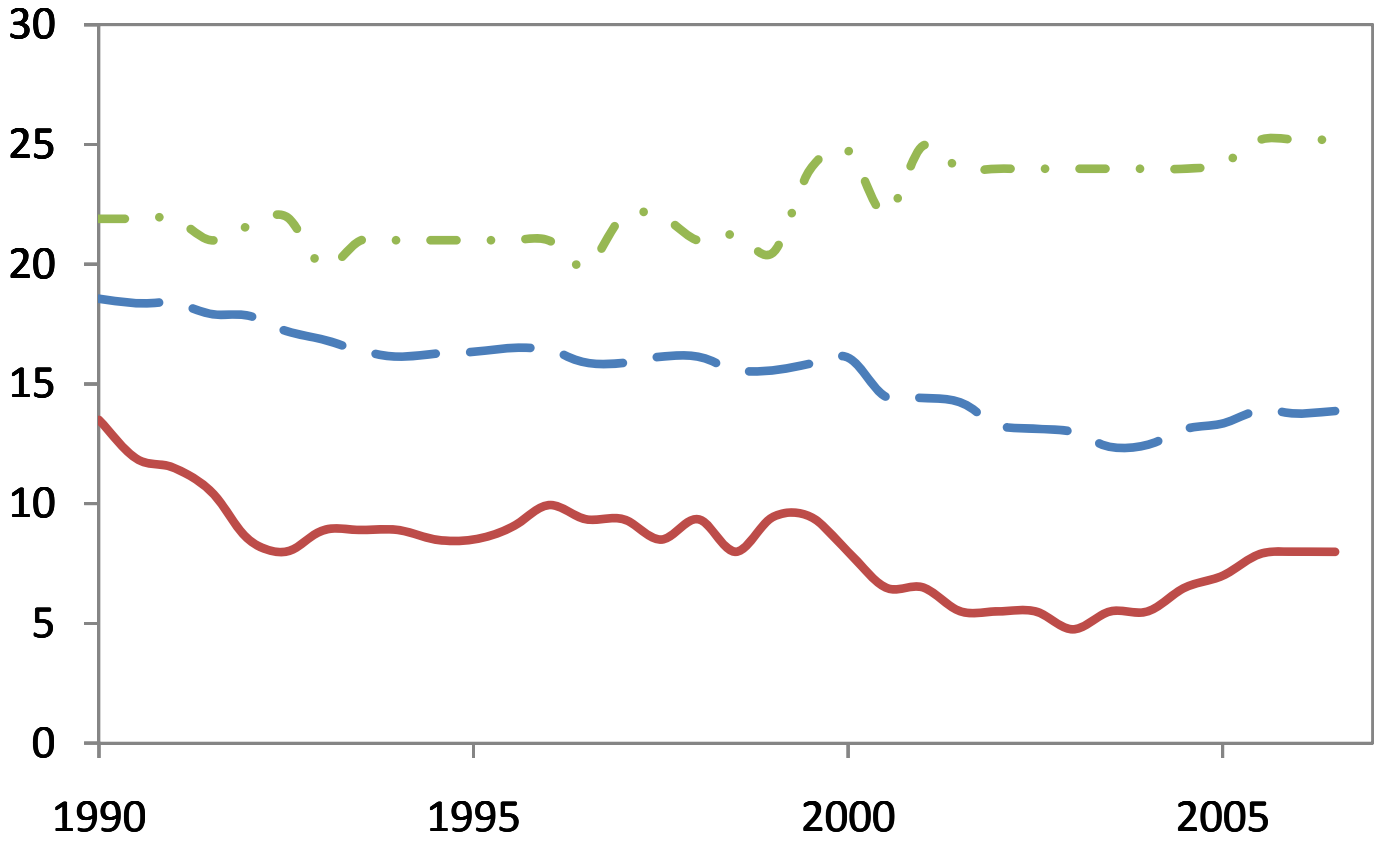
Fact 1b: More Dispersed Interest Rates



Fact 1c: "Flatter" Interest Rate Distribution

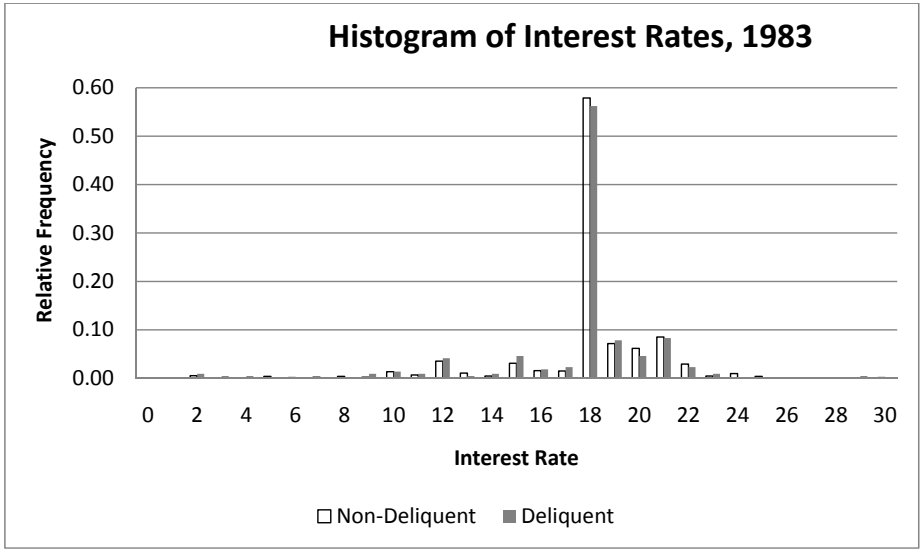


Fact 1d: Greater Spread

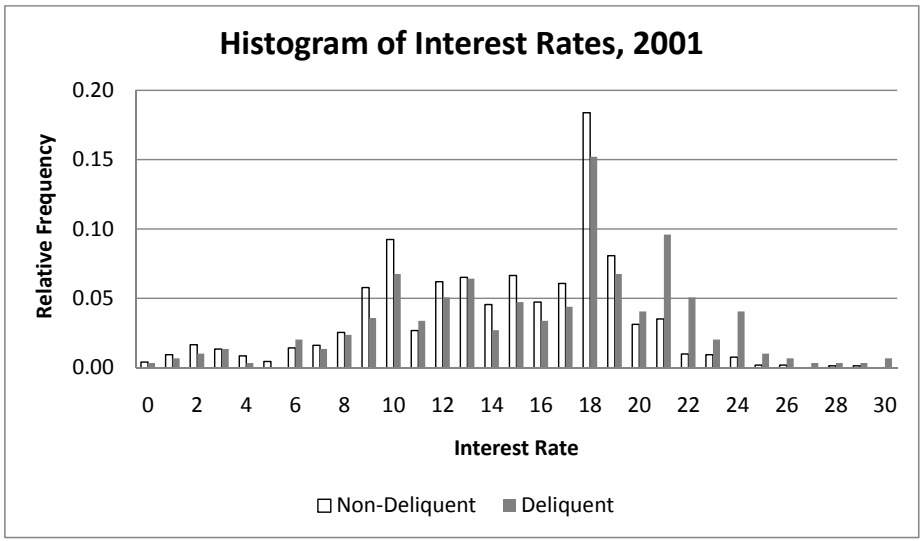


Fact 2: More Risk Based Pricing, 1983 vs 2001

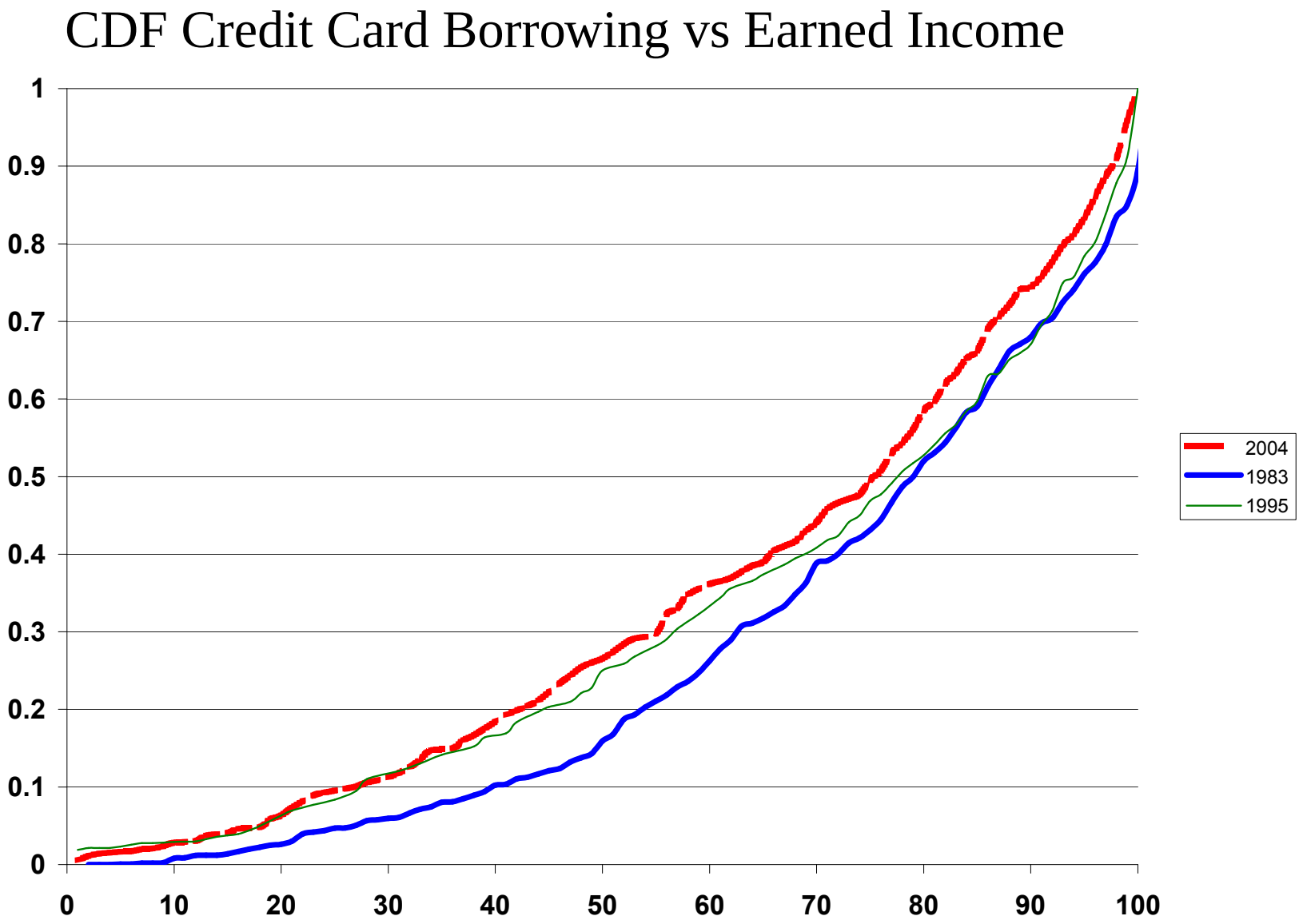
PANEL A



PANEL B



Fact 3: Increased Lending to Lower Income



Fact 3. Increased Lending to Lower Income

Percent HH with Bank Credit Card, U.S.

Income Quint	1983	1989	1995	1998	2001	2004
Lowest	11%	17%	28%	29%	38%	38%
Balance > 0	40%	43%	57%	59%	60%	61%
2^{nd} Lowest	27%	36%	54%	58%	65%	61%
Balance > 0	49%	46%	57%	58%	59%	60%
Highest	79%	82%	95%	95%	95%	96%
Balance > 0	47%	46%	50%	45%	38%	44%

Source: Survey of Consumer Finance.

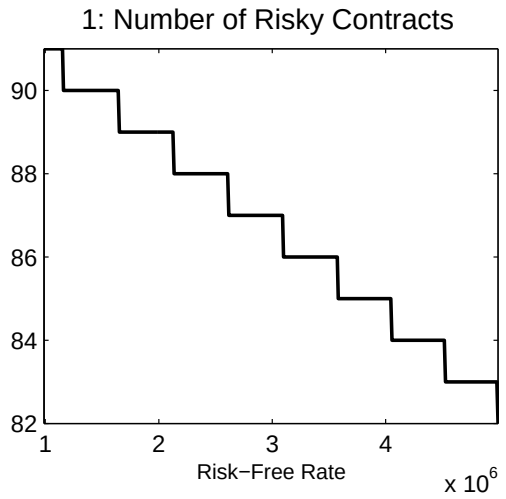
Other Comparative Statics: Ausubel (1991)

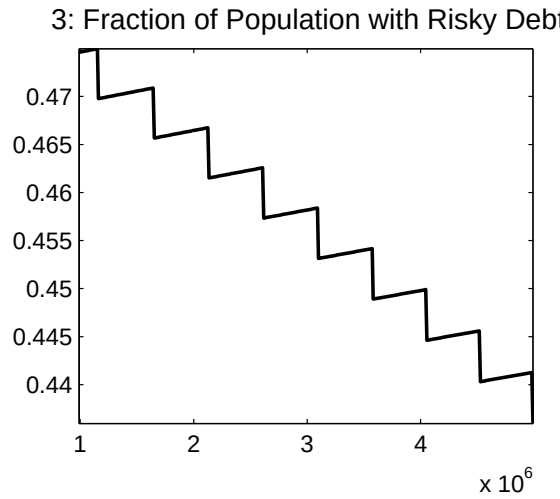
- Ausubel (1991) Puzzle: Why did credit card interest rate not $\Downarrow$ with T-bill rate $\Downarrow$ in 80s?
- Debate: credit card industry not competitive?
- What are predictions of our model for $\Downarrow$ risk-free rate? Lower risk-free rate can lead to greater number of contracts

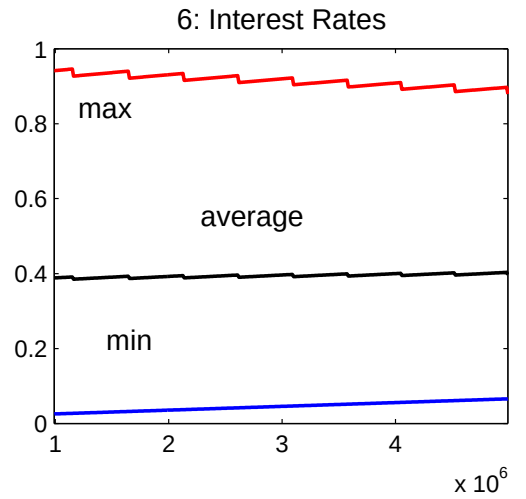
$$\begin{aligned} \rho_n &= 1 - n\sqrt{\frac{2\chi}{y_h \gamma \overline{q}}} \\ q_n &= \overline{q}\rho_n \end{aligned}$$

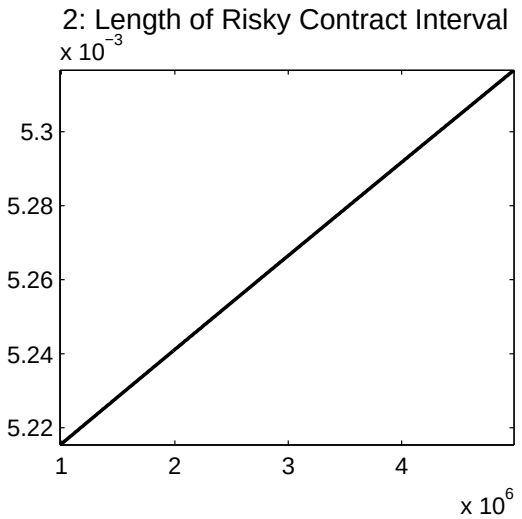
- Avg. interest rate of existing borrowers declines.
- Avg. interest rate of *all* borrowers changes little due to expansion of credit to riskier households.

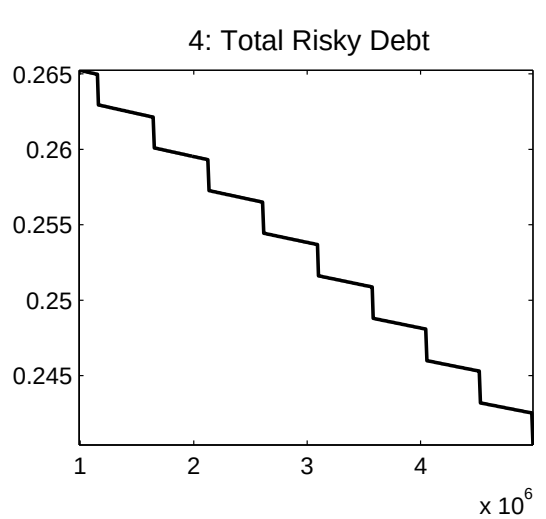
Comp statics in safe interest rate $\bar{r}$

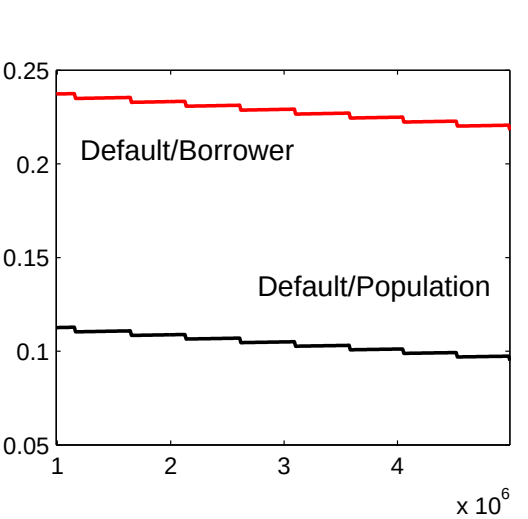








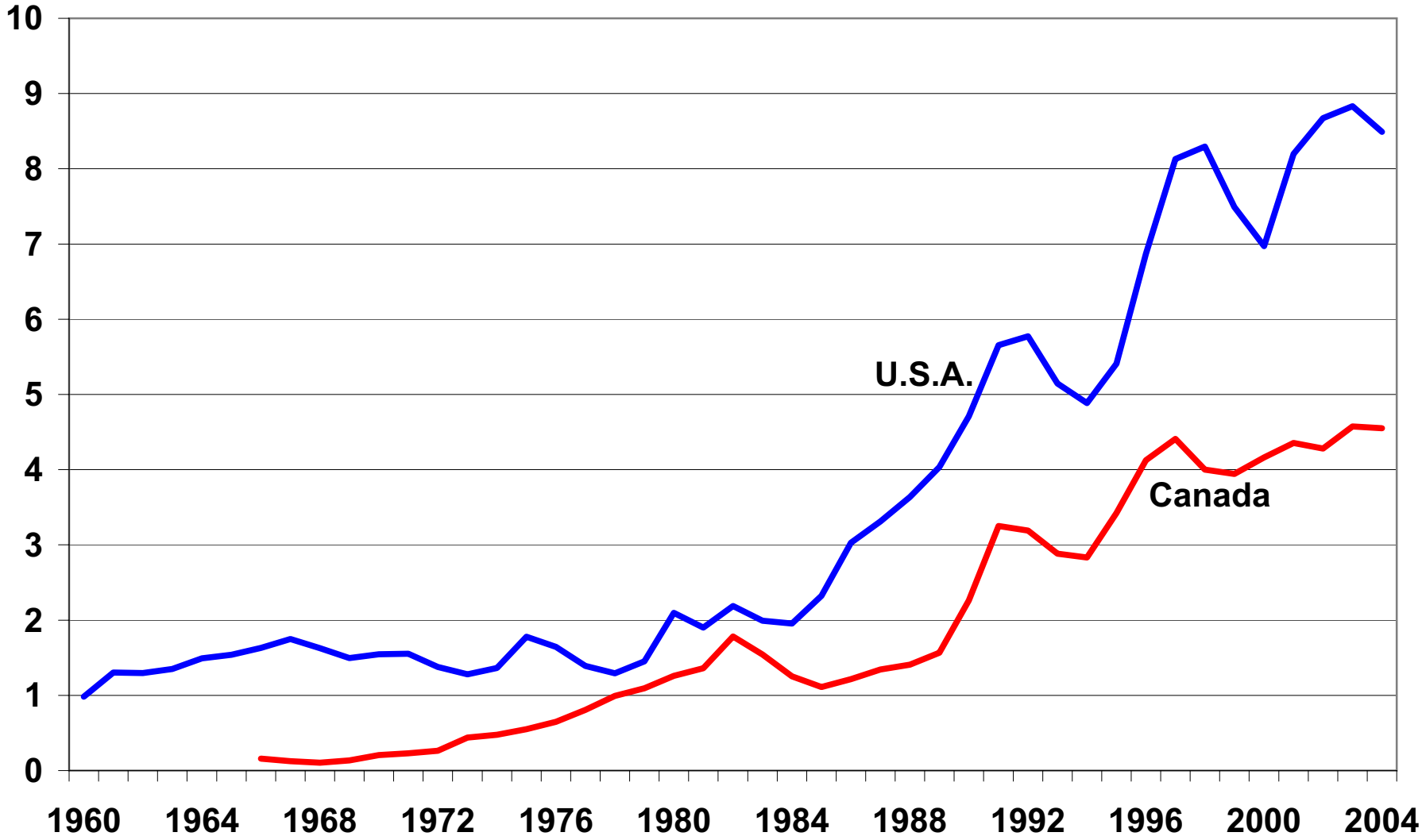


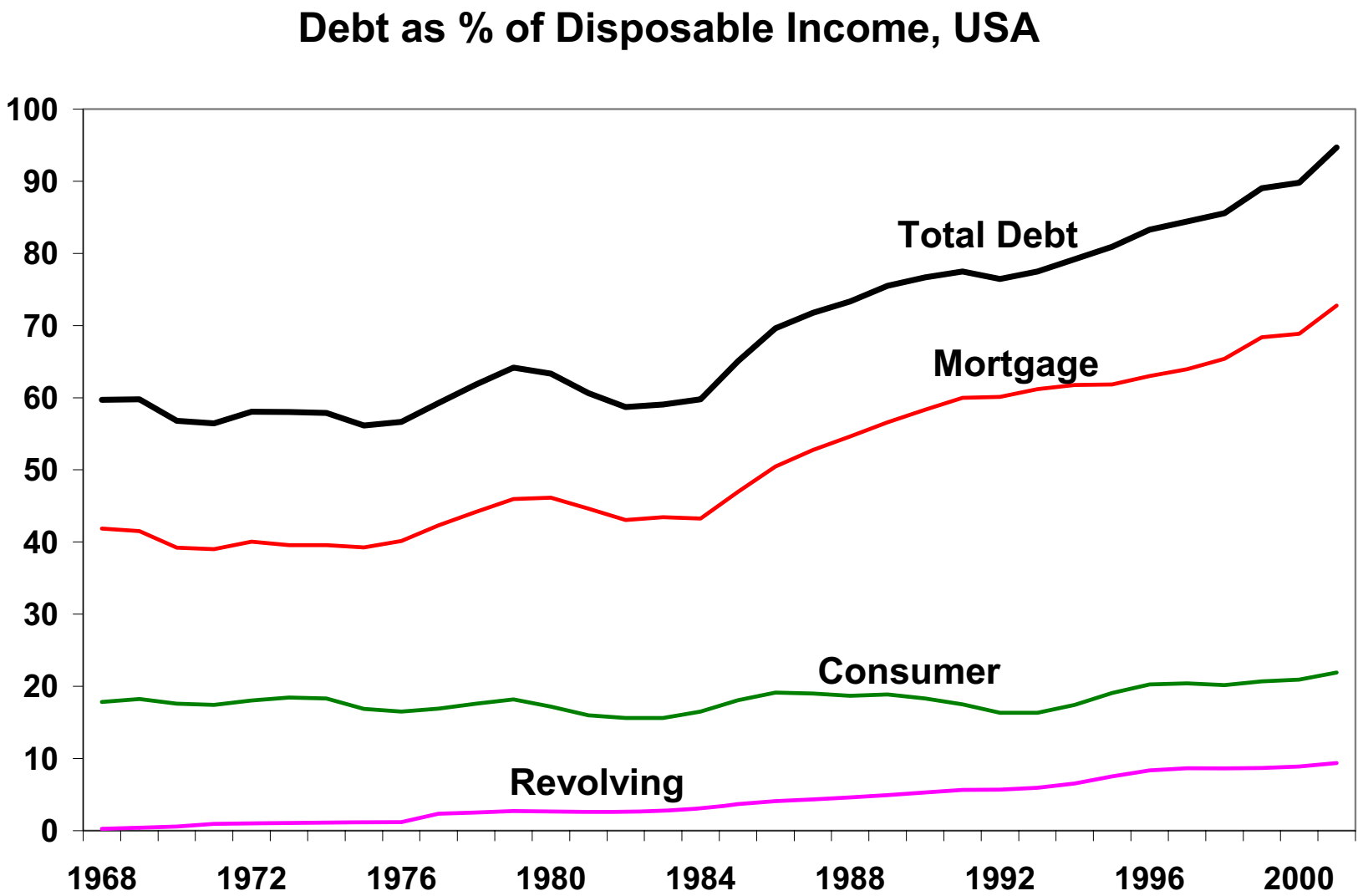


Summary

- Simple model of unsecured lending with default with
  - Fixed costs of creating contracts
  - Adverse selection (noisy signals)
- Can qualitatively generate key changes (more debt, more defaults, more interest rate variety, more access to credit for higher risk types) in consumer credit markets through
  - improved signal quality (credit scoring)
  - decline in cost of offering contracts (data mining)
- Key Mechanism: extensive margin
- Next:
  - Quantitative relevance?
  - Which channel is more important?
  - Decomposition: extensive vs. intensive margin

Figure 1: Consumer Bankruptcies per 1000 of 18-64 yr-old




Debt as % of Disposable Income, USA
100
90
80
70
60
50
40
30
20
10
0
1968
1972
1976
1980
1984
1988
1992
1996
2000
Total Debt
Mortgage
Consumer
Revolving

Overview Bankruptcy Law

United States Ch. 7, 13	Canada Straight, Proposal
Chapter 7	**Straight Bankruptcy**
Discharge unsecured debt in exchange for assets.	
Non-dischargeable: child support, taxes, etc.	
6 years between filings	No limit on frequency
$\approx$ 4 months	9 months
$\approx$ 70% of filings	$\approx$ 85% of filings

Fact 1.b: More Dispersed Interest Rates

Coefficient of Variation of Limits and Interest Rates, SCF:

Variable	1983	1989	1998	2001	2004
Int Rate (all)	0.22	NA	0.32	0.37	0.56
Int Rate (bal > 0)	0.21	NA	0.35	0.40	0.56
Credit Limit	NA	1.60	1.45	1.64	1.49
Credit Limit/Income	NA	1.27	1.85	1.53	1.82
Balance (all)	1.80	2.22	2.35	2.87	2.29
Balance (bal > 0)	1.08	1.45	1.60	1.99	1.59

- Credit limit/balance more disperse than interest rates but $\Uparrow$ trend in dispersion larger in interest rates.

Consumer Credit Card Facts

- Mean Values of Limits and Interest Rates Credit Cards, SCF

Variable	1983	1989	1998	2001	2004
Int Rate (all)	18.05%	NA	14.46%	14.36%	11.49%
Int Rate (bal >0)	18.08%	NA	14.48%	14.20%	11.81%
Credit Limit	NA	7077	12846	13552	15424
Credit Limit/Income	NA	0.19	0.41	0.37	0.41
Balance (all)	497	952	1695	1452	1860
Balance (bal >0)	971	1828	3096	2706	3312

Indirect Evidence: Interest Rates

- Survey of Consumer Finance: interest rates paid by consumers on credit card debt.
- Bank Survey conducted by Board of Governors: most common interest rate charged.

$\Rightarrow$ both data sets show an increase in "interest rate variety."

Equilibria: Characterization

Proposition 3: Finitely many (N) risky contracts offered. Each contract $(q_n, \gamma y_h, \rho_n)$ serves borrowers in interval $\rho \in (\rho_n, \rho_{n-1}]$, where

$$\begin{aligned} \rho_n &= 1 - n\sqrt{\frac{2\chi}{y_h \gamma \overline{q}}} \\ q_n &= \overline{q}\rho_n \end{aligned}$$

Implications:

- Effective "pooling" even w/o asymmetric info
- Some types are denied credit.

If risk-free contract $(q_f, \gamma y_l)$ offered, serves borrowers with $\rho \in [0, \rho_N]$.

$$q_f = \overline{q} - \frac{\chi}{y_l \gamma \rho_N}$$