Unsecured Borrowing and the Credit Card Market

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This Paper

- Build new theory of unsecured borrowing via credit cards
- Motivation
  - emergence of the credit card as a major form of unsecured credit
  - shortcomings of existing theories

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- Build new theory of unsecured borrowing via credit cards
- Motivation
  - emergence of the credit card as a major form of unsecured credit
  - shortcomings of existing theories
- Explore qualitative and quantitative predictions of the new theory
  - versus universally used 1-period loans
    e.g. Livshits et al. (2008), Corbae et al. (2006)
- Show
  - credit cards more complete insurance against bad financial shocks
  - quantify its effect: more bankruptcy and chargeoffs
  - long-run nature of relationships crucial

Motivation: Snapshot of Data (2000-2005)

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- Credit Cards main form of *unsecured borrowing*
  - Revolving credit $> 90\%$ of unsecured debt
  - Penetration rate 72%, 39% revolvers [Table]
  - Outstanding balances > 600 billion (2004)
  - Number of cards > 600 million (2004)
  - Credit card debt relative to disposable income: 9.2% [Figure]

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  - Credit card debt relative to disposable income: 9.2% [Figure]
- Delinquency and bankruptcy
  - Unsecured debt discharged: 5.2% [Figure]
  - Bankruptcy rate: 5.75
  - Over 1 million households in 2004 [Figure]
- Bigger picture: concurrent trends
  - Rise of bankruptcy & delinquency together with rise of CC [Figure]

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- Competition: solicitation of customers by banks (major form in data)
- Contrast with contracts in literature
  - 1-period loan contracts
  - Creditworthiness reevaluated each time rolling over debt
  - Qualitatively very different. What about quantitatively
    We show our model improves quantitatively in important dimensions

Standard Model of Default

- Based on Livshits, MacGee and Tertilt (2008), Corbae et al. (2008), Athreya (2002,04,09)
- Main Features
  - Consumers face idiosyncratic income and expense shocks
  - Incomplete financial contracts and the option of default
  - Default:
    - discharge of debt, seizure of assets (Chapter 7)
    - autarky of stochastic length and utility cost
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- Bertrand competition among banks

$$Q(b|s^t) = \frac{P(repay\, at\, t+1|s^t)}{1+r^f}$$

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- No commitment: constant reevaluation

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  - Default mostly on 'defaultable expense shocks'
  - When such big shock hits, extremely expensive to roll over $\rightarrow$ default which removes the expense shock
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  - When such big shock hits, extremely expensive to roll over $\rightarrow$ default which removes the expense shock
  - As a 'side issue', default on prior debt
- Quantitatively
  - Most driven by medical shock
  - Low fraction of debt discharged (chargeoff rate)
  - Affects significantly the bankruptcy statistics

[ResultsLMT]

Literature

- Benchmark model extension of Butters (1977) and Burdett & Judd (1983)
  - static consumer & firm
- This model
  - Introduce dynamics
  - Endogenous duration of contracts: dynamic poaching driven by variation of consumer attractiveness

Literature

- Benchmark model extension of Butters (1977) and Burdett & Judd (1983)

- Other work on unsecured credit

  - Models with period-by-period, competitive zero profit pricing:
    Chatterjee, Corbae, Nakajima, Rios-Rull (2006)
    Livshits, MacGee, Tertilt (2008, 2010)
    Athreya (2001,2004,2009)

  - Pooling of default risks with a single intermediary: Athreya (2002)

  - Long-lasting contract for the entire life: Narajabad (2007)

  - Long-lasting contracts with credit lines and switching costs:
    Mateos-Planas and Rios-Rull (2007)

Model of Credit Card Market

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1. Loans $\rightarrow$ Lines
   - consistent with data (option)
2. Continual renegotiation $\rightarrow$ LR contracts with commitment
   - in practice, rarely changed in response to shocks (Souleles (2002))
3. Bertrand competition $\rightarrow$ direct solicitation of consumers by banks
   - major form in data (appx. 75%)
   - consistent with switching behavior (Lee and Hogarth (2000))

Theory

- Continuous time, infinite horizon economy
- Incomplete markets + default option
- Uncertainty: income + expense shocks
- Credit card: (L,R), exclusivity

Theory: Consumers

- Consumers
  - Income shocks y (discrete Markov)
  - Expense shocks dJ
  - Save at r^f, borrow at R up to L
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$$da = (y - c + ra)dt + dJ, \;\; a \geq -L$$

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- Default: discharge of debt and exclusion from borrowing and utility cost φ

Theory: Consumers

- Consumers state $\theta = (a, y, L, R)$, value $V(\theta)$
  - Income shocks y (discrete Markov)
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Consumer: Value Function

- Consumers choose consumption plans & default decision to maximize

$$V(a, y, L, R) = \max E\{\int_0^T e^{-\rho t} U(c(t))dt + e^{-\rho T} V'\}$$

  subject to

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  - arrival of income regime change (Poisson intensity η)

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  - arrival of a credit card offer (Poisson intensity κ)

$$V' = \int v\mathcal{F}(dv|\theta)$$

  - where $\mathcal{F}(v|\theta)$ is the distribution of best offer

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  - death (Poisson intensity δ)

$$V' = 0$$

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  - default: exclusion to autarky and utility cost

$$V' = V^D(y) - \varphi$$

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  - Death
- Default: loss equal to a
- Choice: make CC offers at cost χ
  - (lotteries on) (L,R)
  - Simultaneous with other banks

Profit From a Given Contract

- Given consumer consumption decisions and other banks' strategies
- The profit from having customer with L, R and state (a, y) is

$$\pi(a, y, L, R) = E\{\int_0^T e^{-\rho t}(R - r^f)\max\{-a, 0\}dt + e^{-\rho T}\pi'\}$$

  where a follows

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  - arrival of a new credit card offer (Poisson intensity k)

$$\pi' = \omega E\Pi$$

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  - death (Poisson intensity δ)

$$\pi' = a/2$$

Most Efficient Way of Delivering v

- Profit maximizing mix (L', R') to deliver v to type (a, y, L, R)

$$\Pi(v, a, y) \equiv \max \sum pr(L', R')\, \pi(a, y, L', R')$$

subject to

$$v = \sum pr(L', R') V(a, y, L', R')$$

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- Allows us to focus on pairs (Π, v), not (L', R', v)

Solicitations and offers

- Consumers review offers with intensity κ (monthly)
  Review means they are targets for solicitations
  - Offer (L,R) is summarized by a future delivered value v and profit Π

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- State (a, y) evolves until next offer (poaching)

[Butters]

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State: $\theta = (a, y, L, R)$

y – exogenous

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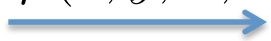
$\kappa\mu(a, y, L, R)$ 

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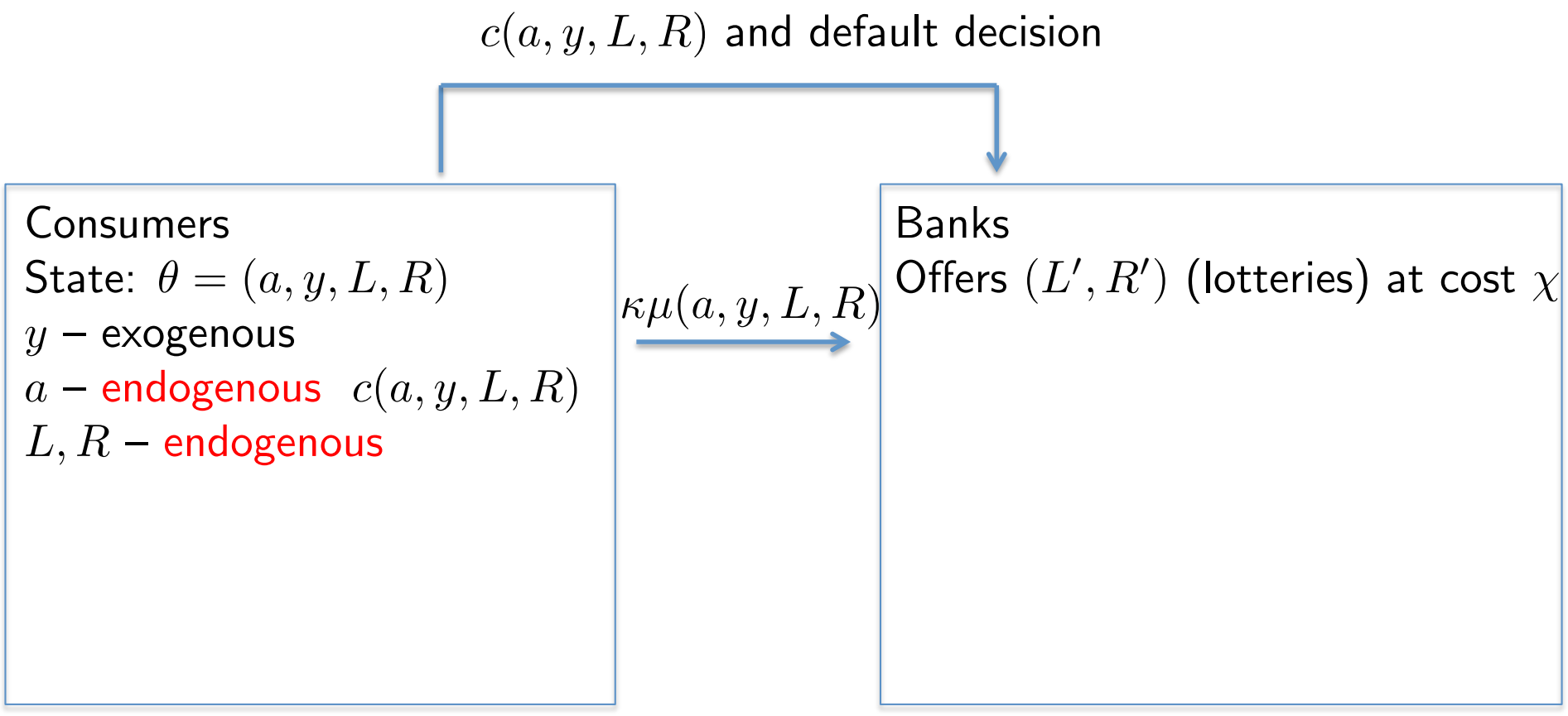

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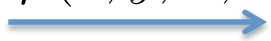

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gives profit $\pi(a, y, L', R'|c)$

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average # of offers $\mu(a, y, L, R)$

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Zero profit on each offer pins down these objects

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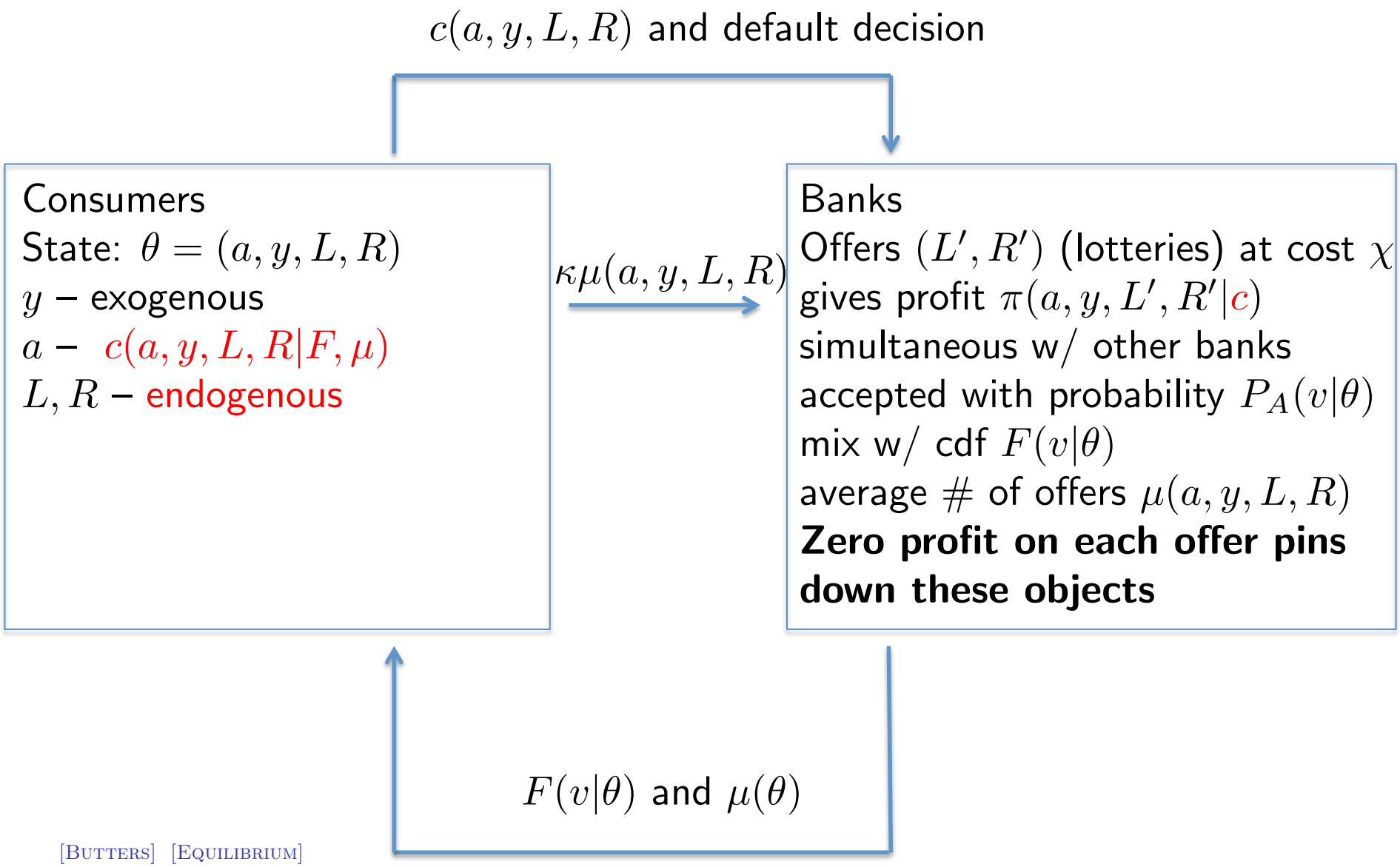

Model Results

Benchmark Parameterization

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- Income: 4-state discretized Markov process (Rouwenhorst (1995))
- Includes
  - Income from Guvenen (2005)

$$\ln y = \ln z + \ln \varepsilon$$
$$\ln z = \rho \ln z_{-1} + \eta$$

$\rho = 0.988$, var$(\eta) = 0.015$, var$(\varepsilon) = 0.061$

  - Divorce and unexpected pregnancy shocks as in Livshits et al. (2008)
26% of mean income, frequency 1.744%

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- Expense shocks: Medical expense shocks as in Livshits et al. (2008)
  37% of mean income, $P_J = 0.78\%$

Benchmark Parameterization

- Standard parameters
  - risk aversion 2
  - risk free rate 2.5%
  - discount factor 0.06
  - death probability 2%

Benchmark Parameterization

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- Remaining parameter
  - stigma φ to match 9.2% credit card debt/income

Quantitative Results

- Benchmark model vs data

Quantitative Results

Results	Data (2000-2005)	Benchmark Model
Filings	5.75	6.33
due to expense shocks	16%-30%	17%
Debt/Income	9.2%	9.2%
Chargeoff rate	5.2%	5.54%
Interest rates	12%	15% (14%)
Revolvers	39%	22%

- D/Y calibrated
- Matches other statistics well
  - filings and Chargeoffs
  - reasons for bankruptcy
  - average interest rates
- Underpredicts fraction of revolvers: concentration (penetration 68%)

Quantitative Results

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$$da = (RL + y - c + (L + a)r^f)dt + dJ$$

- Parameterize in the same way when possible;
- Two main features:

1 Repricing

  - every year, and in particular after each occurrence of shocks
  - when repricing, Bertrand competition

2 Anonymity: customer always leaves (or defaults)

Quantitative Results

Results	Data (2000-2005)	Benchmark Model	Repricing same stigma
Filings	5.75	6.41	1.03
due to expense shocks	16%-30%	16.8%	90%
Debt/Income	9.2%	9.2%	.04%
Chargeoff rate	5.2%	5.4%	1.9%
Interest rates	12%	13.9% (15%)	2.52% (7.5%)
Revolvers	39%	22%	0.17%

- Small bakruptcy statistics
- Most bankruptcies are medical bankruptcies
- Increasing D/Y (i.e. increasing stigma) has adverse effects

[ResultsLMT]

Quantitative Results

Results	Data (2000-2005)	Benchmark Model	Repricing same stigma
Filings	5.75	6.41	1.03
due to expense shocks	16%-30%	16.8%	90%
Debt/Income	9.2%	9.2%	.04%
Chargeoff rate	5.2%	5.4%	1.9%
Interest rates	12%	13.9% (15%)	2.52% (7.5%)
Revolvers	39%	22%	0.17%

- Credit cards offer more 'insurance' through the possibility of discharge of debt due to persistent low income
- No repricing after bad shocks means that credit doesn't become 'tighter' the more debt you have
- In particular, sometimes expense shocks can be buffered and extended in time

[ResultsLMT]

Quantitative Results

Results	Data (2000-2005)	Benchmark Model	Repricing parameterized
Filings	5.75	6.41	0.3
due to expense shocks	16%-30%	16.8%	93%
Debt/Income	9.2%	9.2%	10%
Chargeoff rate	5.2%	5.4%	0.03%
Interest rates	12%	13.9% (15%)	2.62% (3%)
Revolvers	39%	22%	23%

- Small bakruptcy statistics
- Most bankruptcies are medical bankruptcies
- Increasing D/Y (i.e. increasing stigma) has adverse effects

[ResultsLMT]

Quantitative Results

- Driving forces behind the difference
- Debt Overhang and Anonymity
  - in some cases, ex-post the bank would like to renegotiate
  - faces big loss or bigger loss
  - would prefer to act as monopoly and extend the relationship
  - by assumption this is not possible

Quantitative Results: Debt Overhang

- Allow the bank to choose bankruptcy or the monopoly contract
- Both give negative expected profit: the household stays
  - Chose sure loss on current loan ($-L$) or contract extension
  - Under extension monopoly: no bank wants to take on customer
- Getting rid of the anonymity assumption
- Makes the relationship long-lasting

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- Makes the relationship long-lasting
- Re-parameterize stigma to match 9.2% debt/income

Quantitative Results: Debt Overhang

Results	Data (2000-2005)	Repricing **renegotiation**
Filings	5.75	3.22
due to expense shocks	16%-30%	14%
Debt/Income	9.2%	9.2%
Chargeoff rate	5.2%	2.61%
Interest rates	12%	2.75% (3.67%)
Revolvers	39%	21%

- Model moves towards the data (reduces the 'steep Q curves problem')
- Striking: medical bankruptcy
- Bank often chooses to bankroll expense shocks than to face smaller loss
- Only threat of sure loss makes it optimal

Quantitative Results: Recap

- Pre-approved nature and long horizon of CC important in matching data
  - commitment to average terms
  - no unilateral termination
  - no anonymity
- Credit cards more 'compatible' with high levels of debt and bankruptcy
- Trends in both use of CCs and bankruptcy statistics may be connected

Quantitative Results: Numerical Experiment

- Progress in solicitation technology
- Affects the acquisition cost through changes in χ
- Two cases for acquisition cost: $\$100$ (Benchmark, 2000s), $\$200$ (1980s)

Quantitative Results

Results	Benchmark Model	High χ ($200)
Filings	6.33	5.7
due to expense shocks	17%	22.5%
Debt/Income	9.2%	5.33%
Chargeoff rate	5.54%	5.5%
Interest rates	15% (14%)	13% (12.42%)
Revolvers	22%	18%
Duration (months btw offers)	3.36	5.1

Quantitative Results

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- Lower cost increases competition at time of switch
- But also lowers duration: less scope for insurance provision
- Result: lower change in chargeoffs

Quantitative Results: Role of Duration

- Chargeoffs are mostly affected by duration
- In particular more duration, with fixed competition, means higher chargeoffs typically
- Caveat: effect nonlinear.
- Higher duration reduces d/y, which tends to lower filings: through efficiency of a contract
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- Here commitment and no renegotiation plays a big role
- Limiting case as $\chi \to 0, \kappa \to \infty$
- Very low debt and no bankruptcy, for any stigma
- Duration goes to zero

Quantitative Results: Role of Duration

- Chargeoffs are mostly affected by duration
- In particular more duration, with fixed competition, means higher chargeoffs typically
- Caveat: effect nonlinear.
- Higher duration reduces d/y, which tends to lower filings: through efficiency of a contract
- Here commitment and no renegotiation plays a big role
- Limiting case as $\omega \to 1$
- Low number of revolvers and debt
- Low bankruptcy and chargeoffs

Quantitative Results: Role of Duration

- Any change we introduce will affect both competition and duration
- Important to consider full effects in evaluating policy
- Example: limiting poaching may have beneficial effects, but not in the extreme no poaching case

Conclusion

- Theory of credit card market with explicit micro-structure of competition

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- Why new product emerged? Theory of χ?

Backup Slides

Stop Flipping, This Is It

Equilibrium

- Consumer policy $c(\theta)$ and value $V(\theta)$
- Bank's values $\pi(\cdot)$, $\Pi(v|\theta)$
- Bank's mixing strategy over v (and hence (L, R)), $F(v|\theta)$ with support $[\underline{v}(\theta), \bar{v}(\theta)]$, and implied $\mu(\theta)$
- Number of offers per household $\mu(\theta)$ and the resulting acceptance probability of an offer

$$P_A(v|\theta) = e^{-\mu(1-F(\bar{v}|\theta))} (\times (1-\omega) \text{if has card})$$

[Back]

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such that given $\mu(\theta)$ and $F(v|\theta)$:

- $V(\theta)$ and $c(\theta)$ solve the consumer problem
- The zero profit condition for marginal offer holds

$$P_A(v|\theta)\Pi(v|\theta) \leq \chi \text{ for all } v$$

$$\text{with equality if } v \in [\underline{v}(\theta), \bar{v}(\theta)]$$

[Back]

Theory: Offers

- Banks make credit card offers to customers of specified characteristics
  - Offer is (L,R) (or lottery on (L,R)s)
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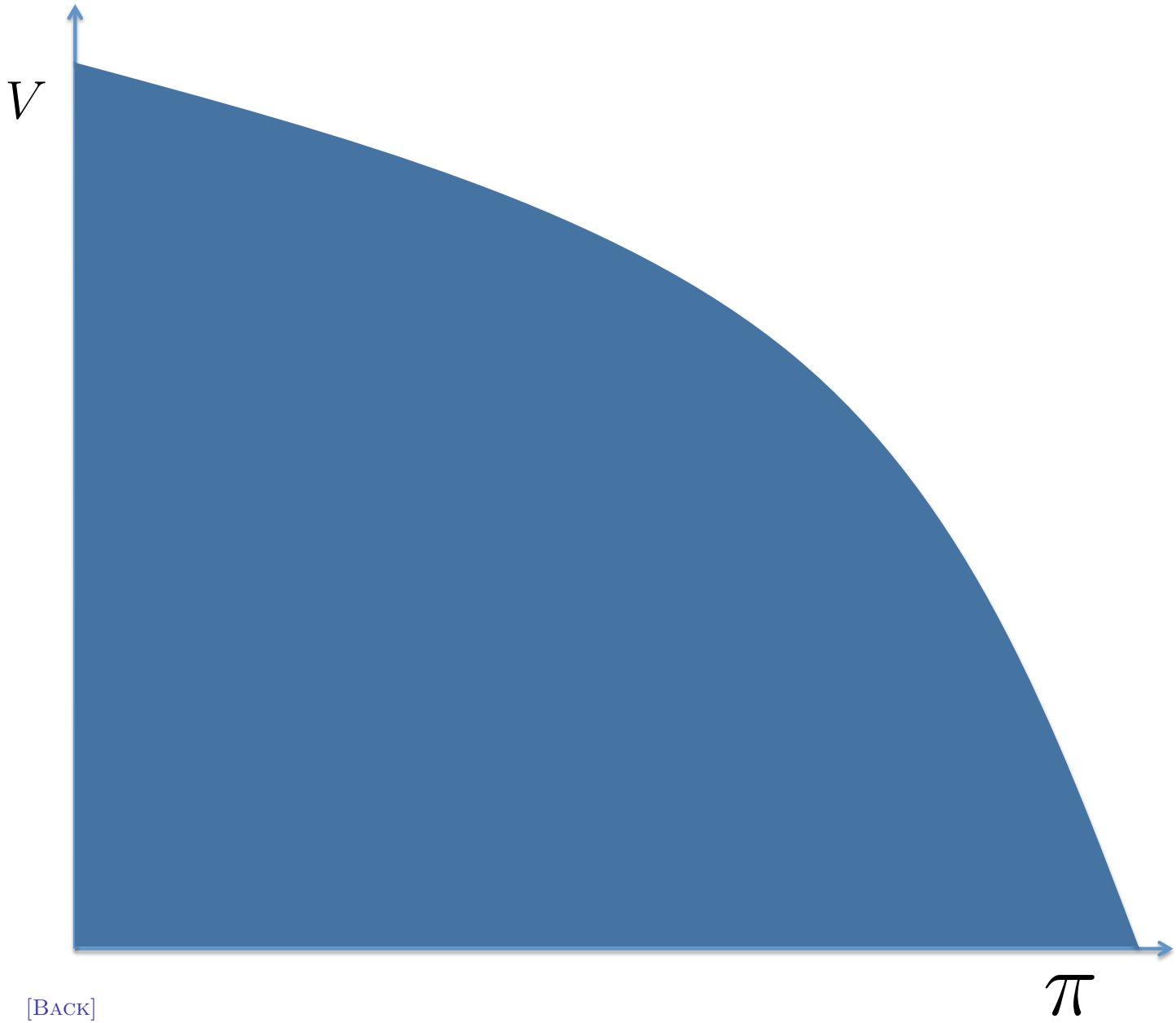
- Profit depends on
  - Terms and duration: summarized in π

[Back]

Most Efficient Way of Delivering v



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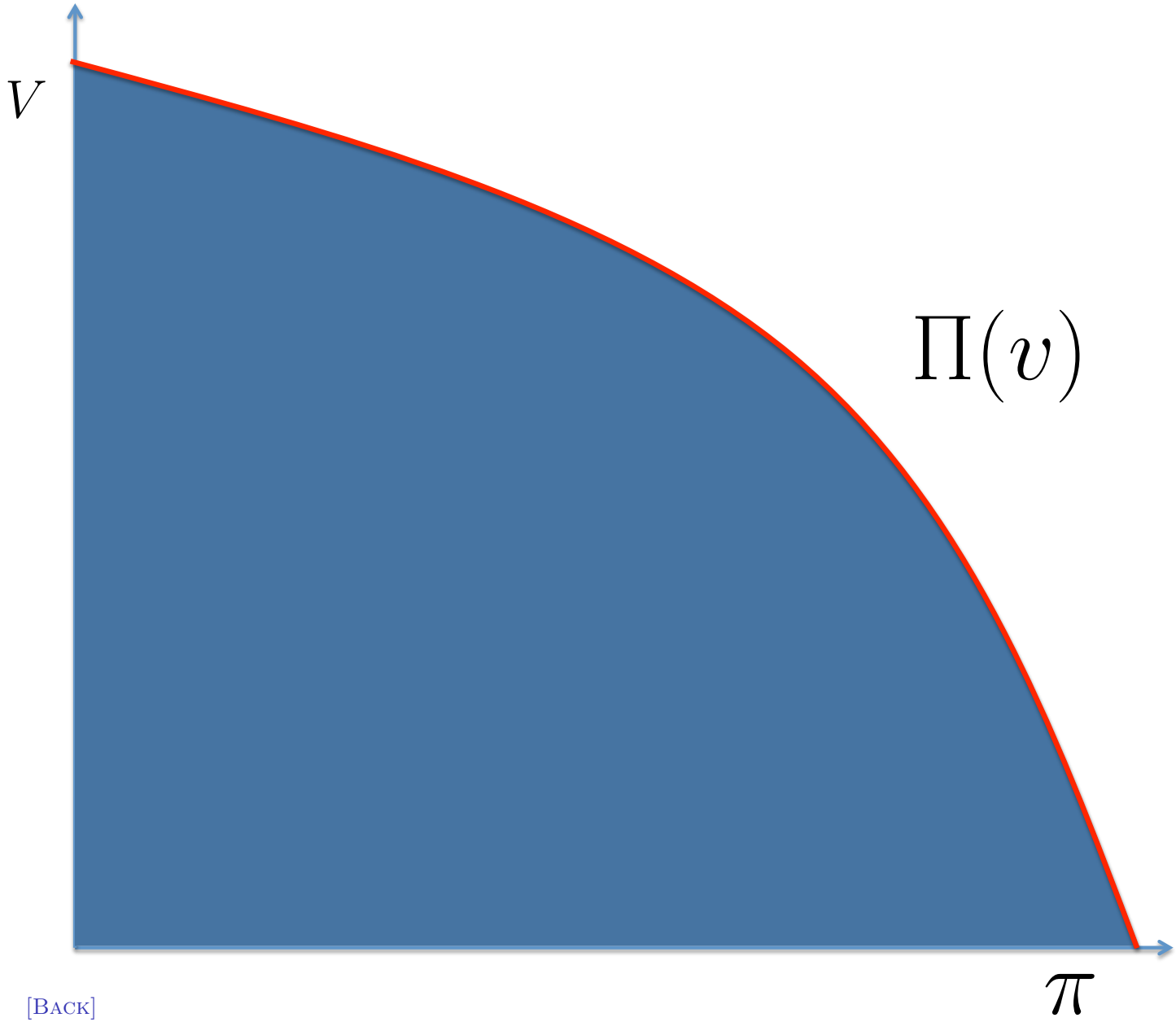

[Back]

Theory: Competition

- Extension of matching a la Butters (1977) and Burdett & Judd (1983)
  - Competition for customer that has a random number of price quotes
  - Show unique equilibrium with price dispersion
- Extension: 2-dim contract offers (L,R), long-run interaction
- Different contracts offered simultaneously
- Banks offer all: indifferent and randomize according to $F(v|\theta)$

[Back]

Theory: Number of Equilibrium Offers

- As in Butters (1977) 'balls and bins' model
- Banks randomly allocate offers across all consumers in state θ
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[Back]

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- What is the acceptance probability?

[Back]

Theory: Number of Equilibrium Offers

- Intensity of offers is μ
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- Intensity of sending offers better than $\bar{v}$ is $\mu(1 - F(\bar{v}|\theta))$
- Offer accepted if no other offers better
- Acceptance probability of sending an offer delivering $\bar{v}$ to consumer θ

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- μ and $F(\bar{v}|\theta)$ determine realized offer distributions

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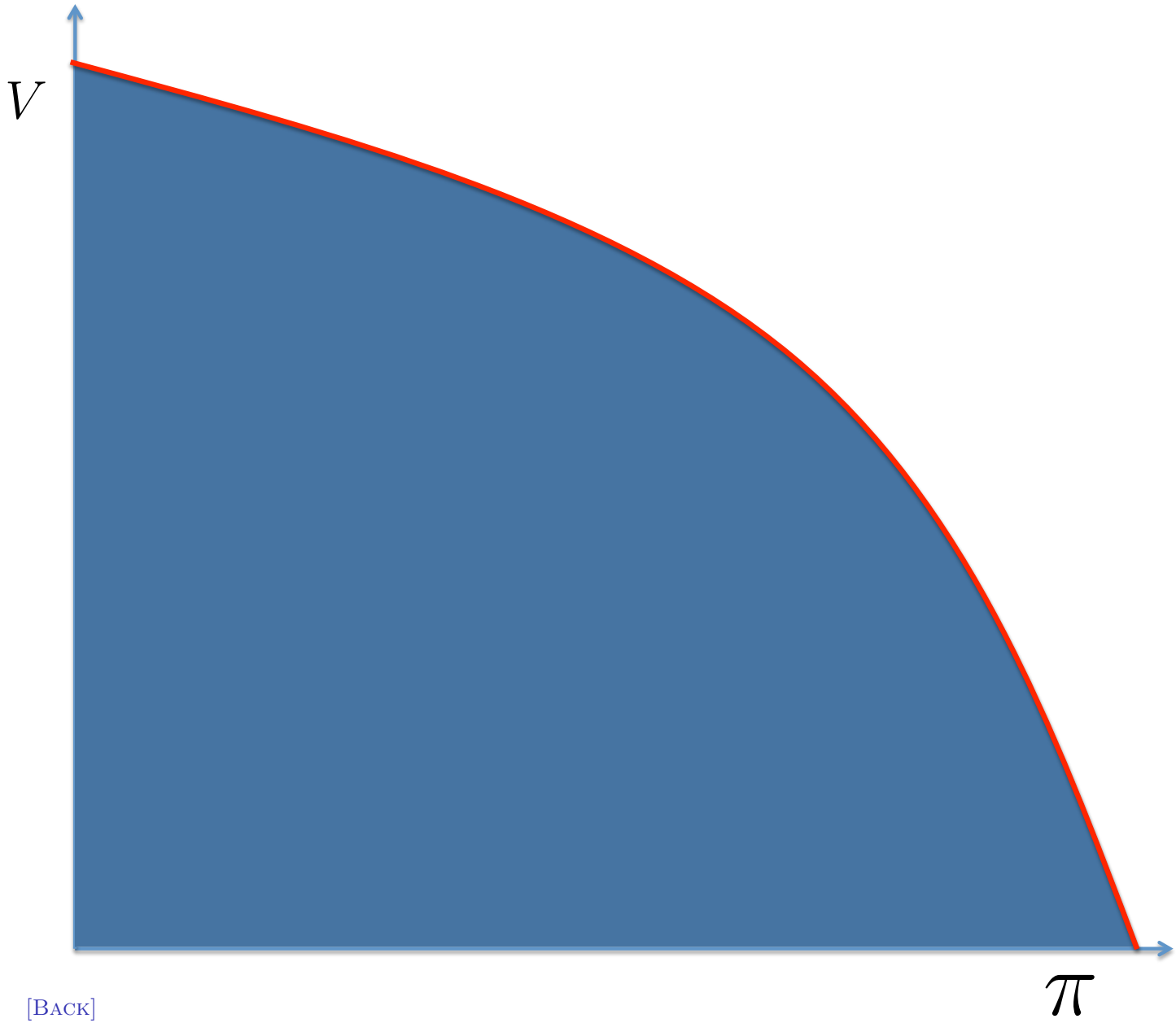
Equilibrium



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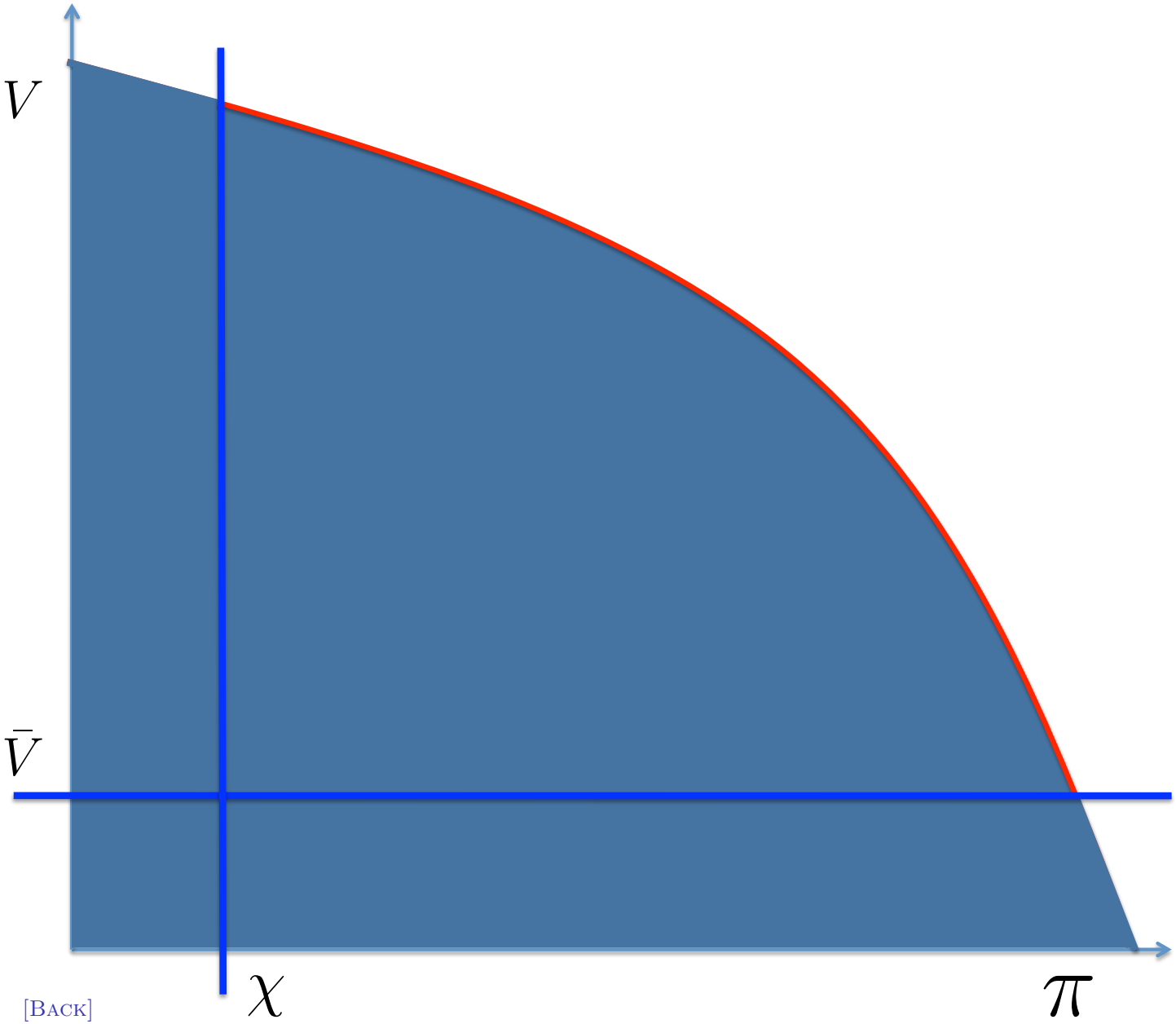
Equilibrium



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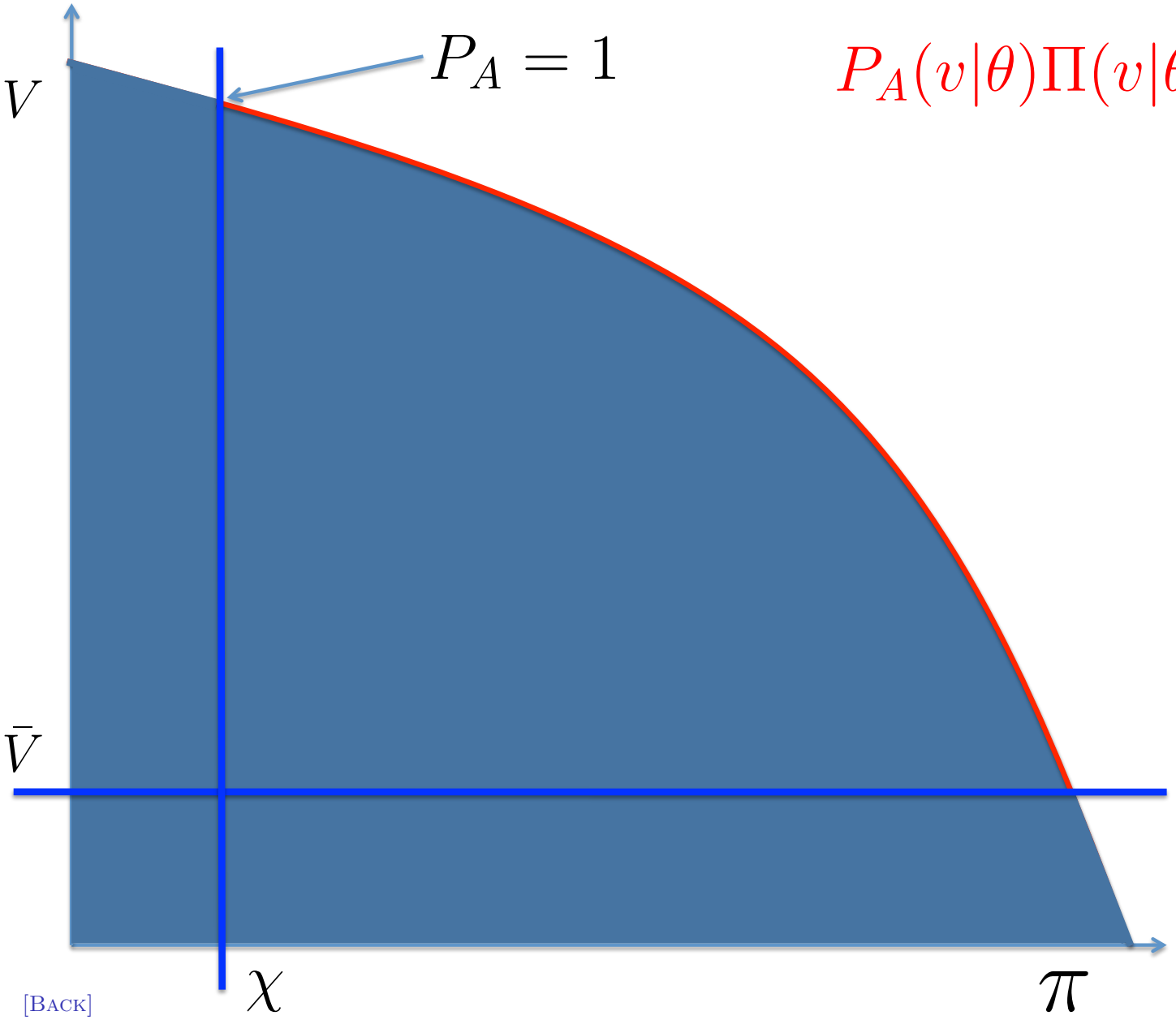
Equilibrium



$$P_A(v|\theta)\Pi(v|\theta) = \chi$$

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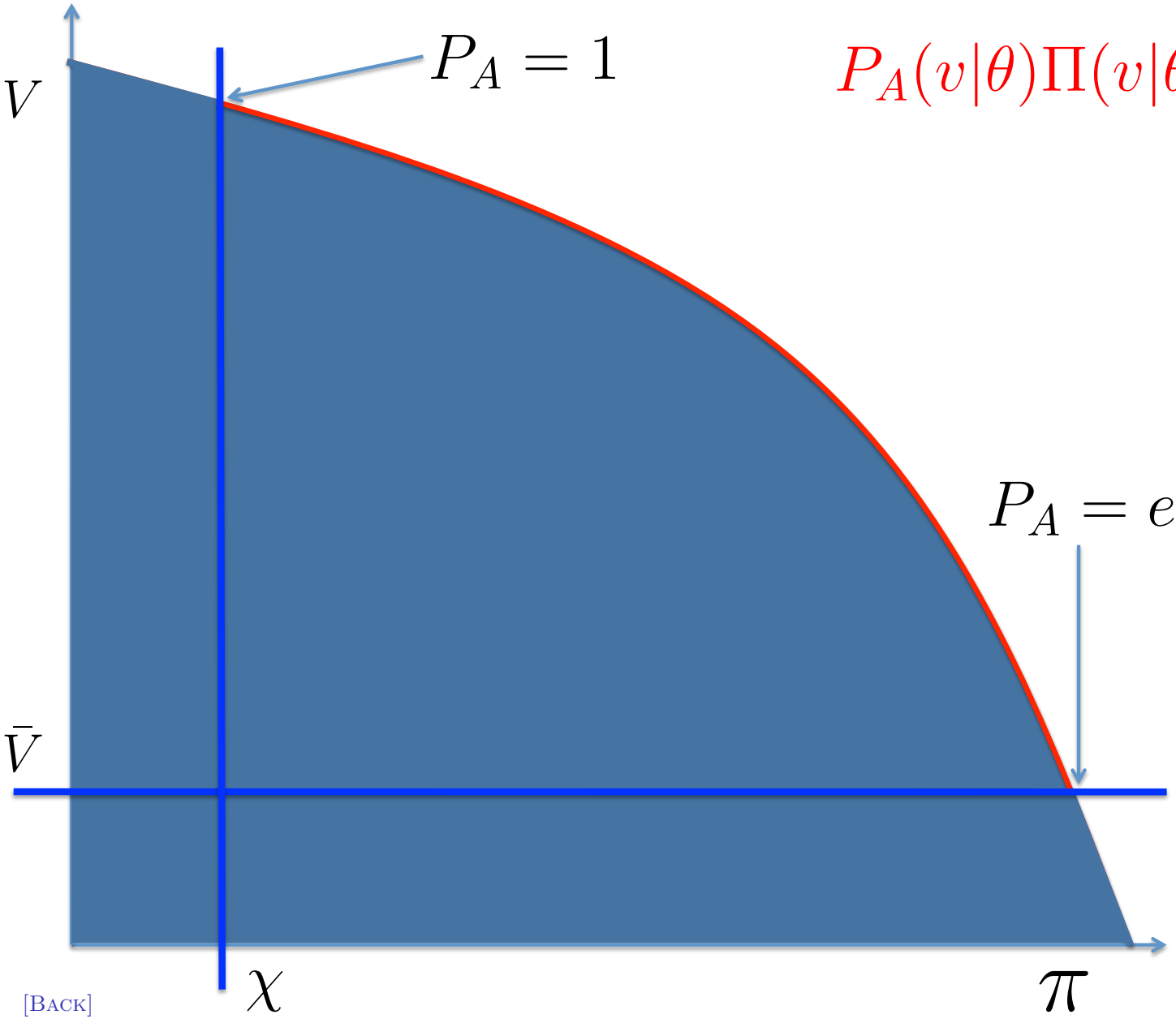
Equilibrium



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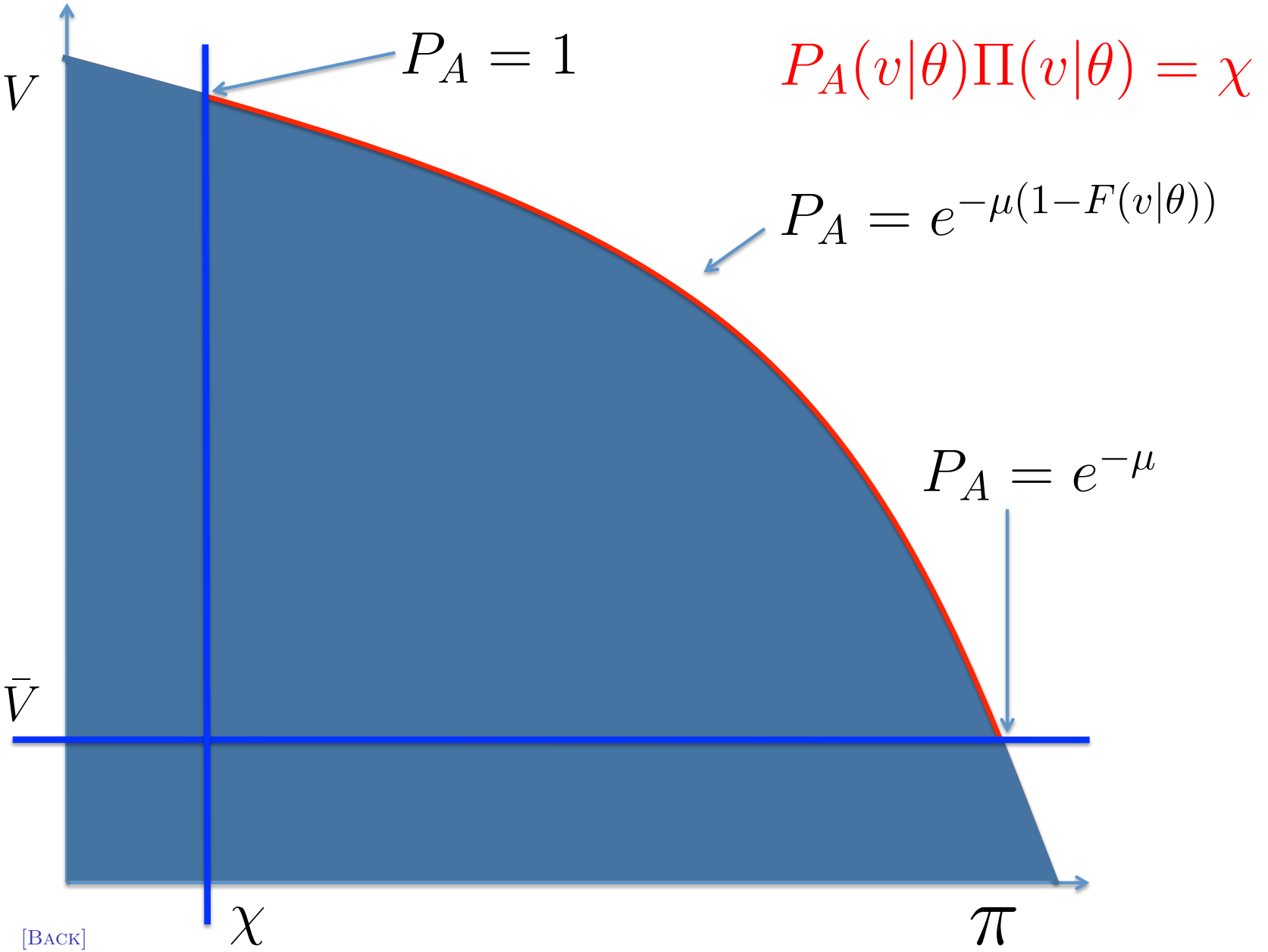
Equilibrium



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Survey of Consumer Finances

Family	1983	1995	2004
Has Bank-type card	43	66	71
Of Those Carries Balance	51	56	56

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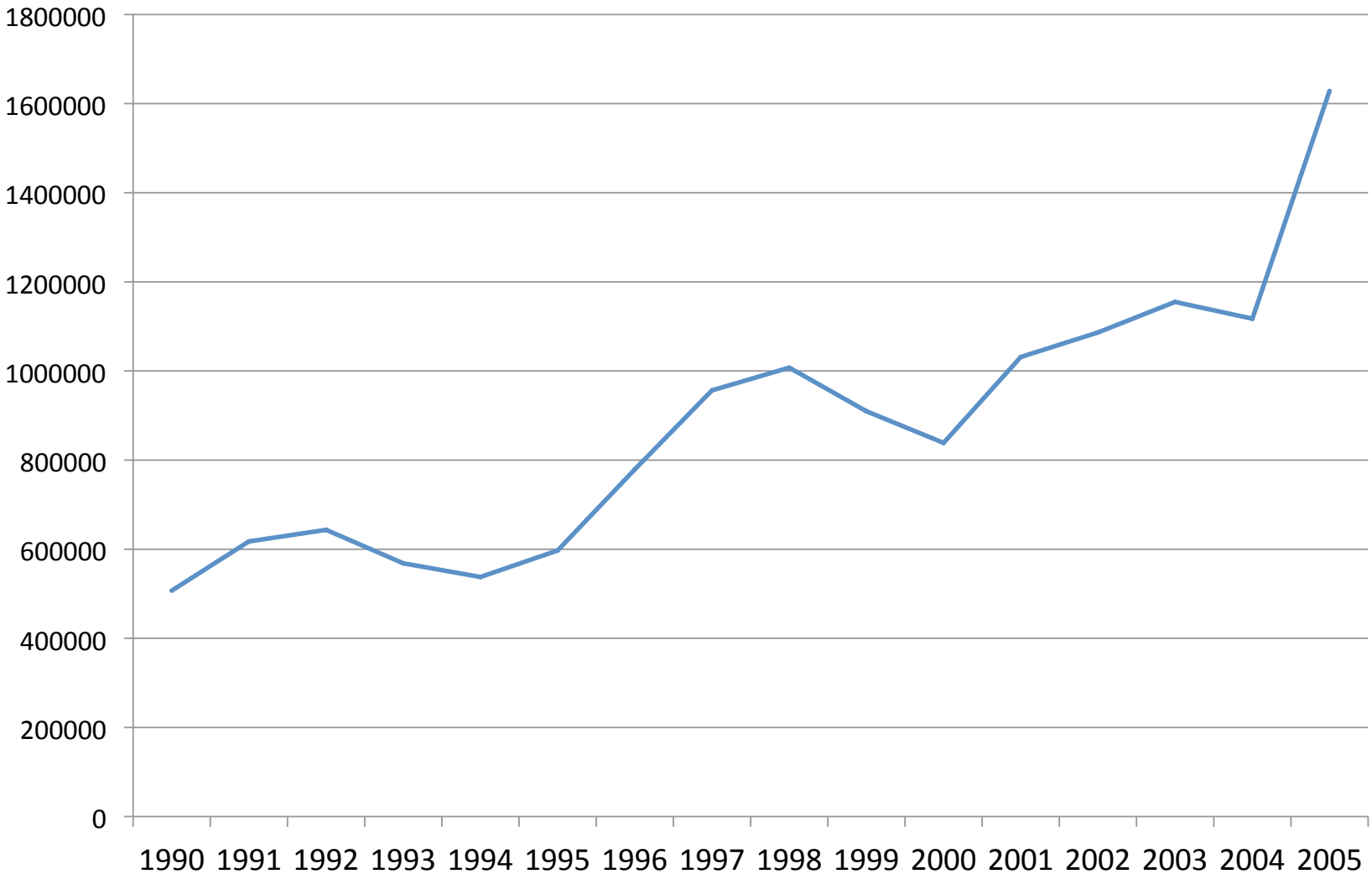
Chapter 7 bankruptcy filings



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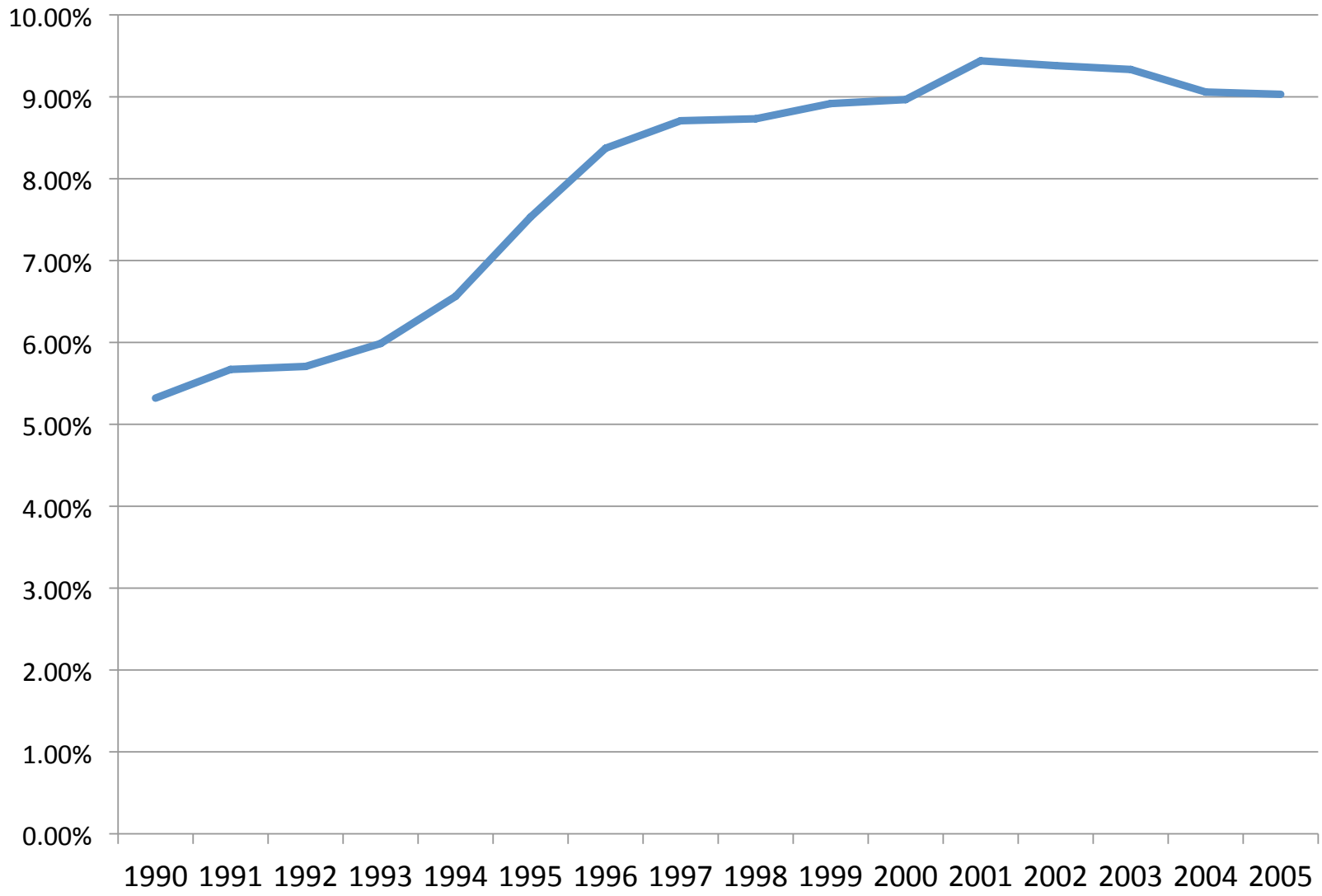
Credit Card Debt/Disposable Income



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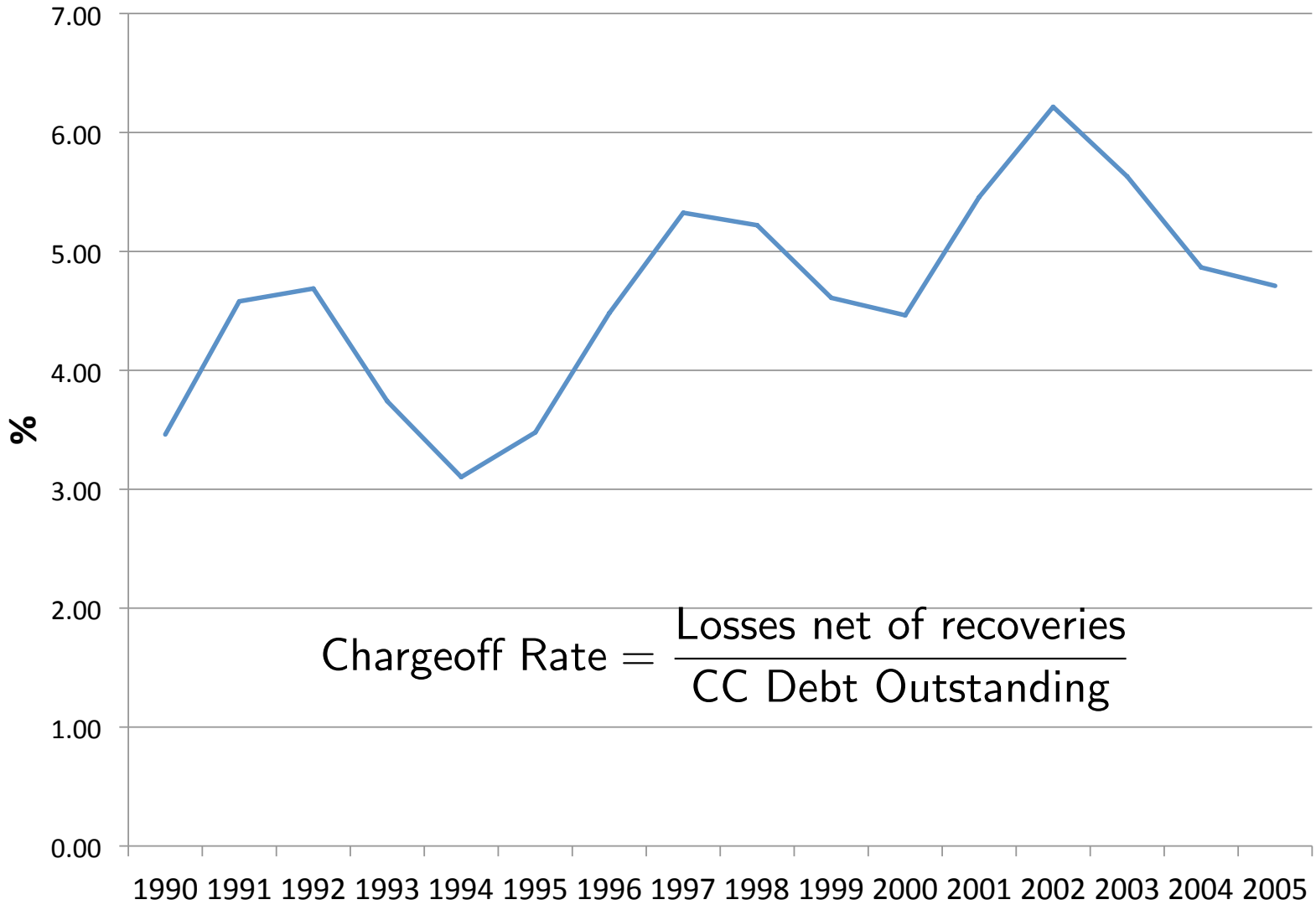
Chargeoff Rate



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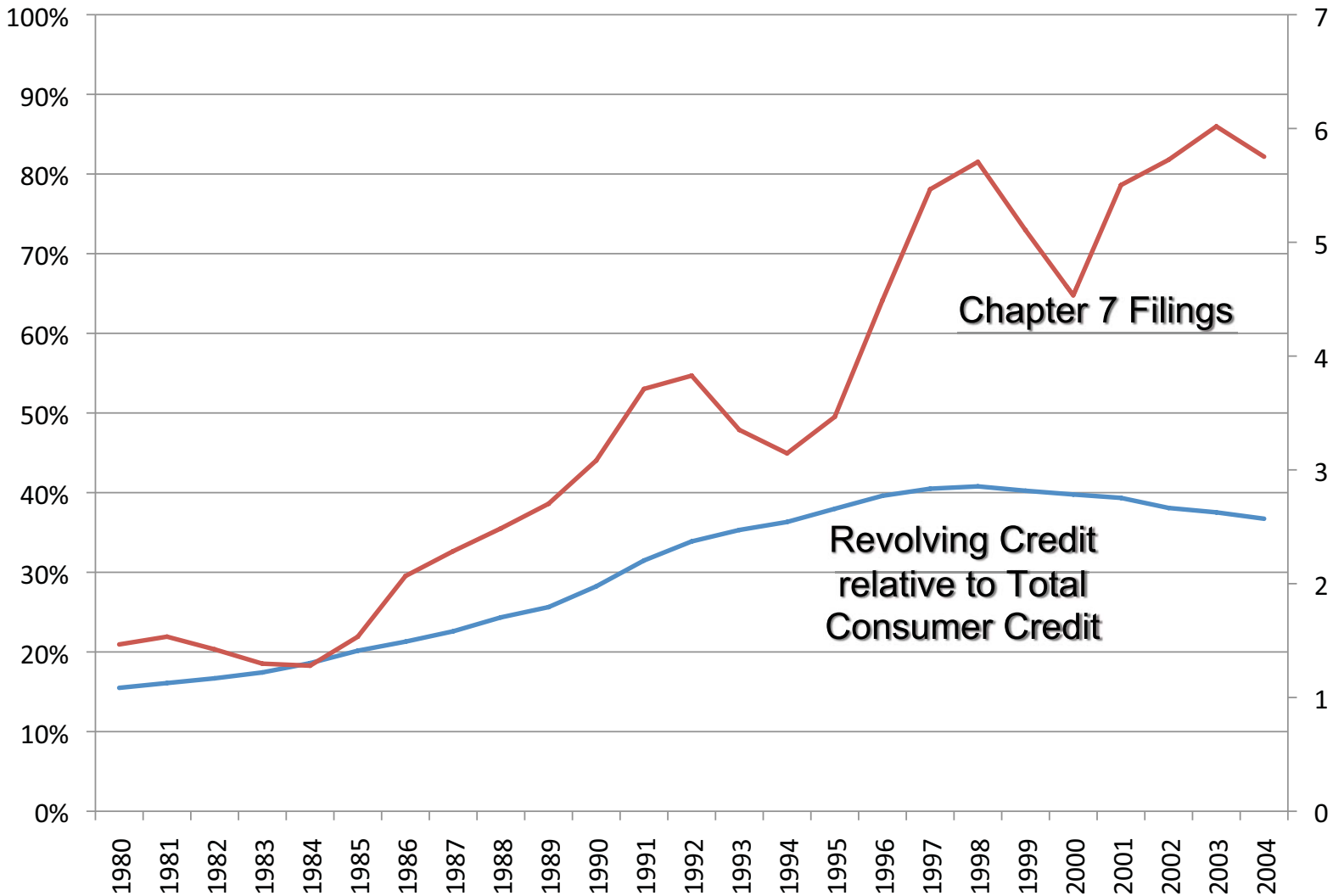
Trends


100%
90%
80%
70%
60%
50%
40%
30%
20%
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7
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3
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1
0
Chapter 7 Filings
Revolving Credit relative to Total Consumer Credit
1980
1981
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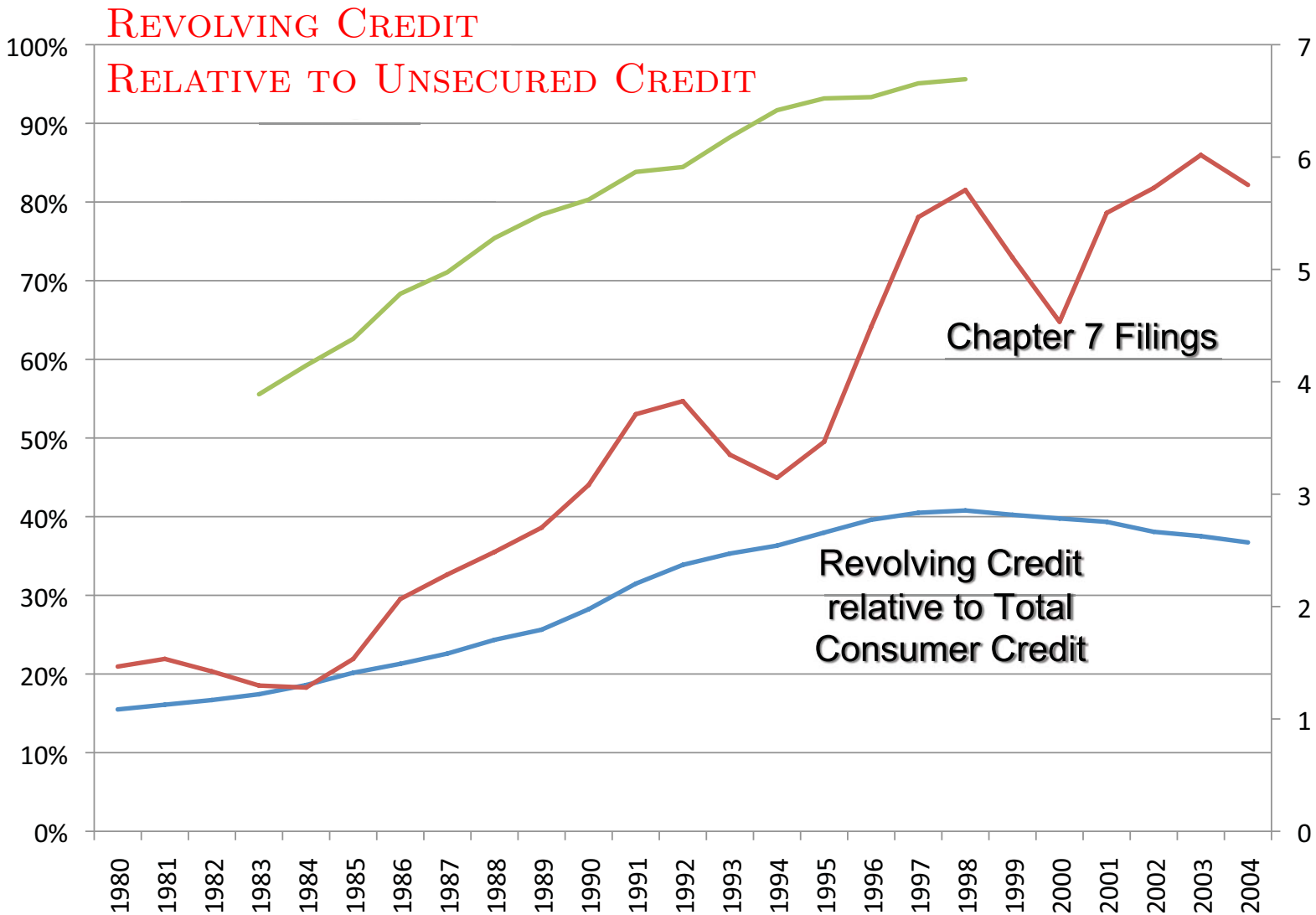
Trends


Revolving Credit
Relative to Unsecured Credit
Chapter 7 Filings
Revolving Credit relative to Total Consumer Credit
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
7
6
5
4
3
2
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1992
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1996
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Quantitative Results

- Livshits, MacGee, Tertilt (AER 2008)
- Table 3: Defaults by reason

	Expense Shock			
	Low	High	None	Total
No decrease in income	63.7%	9.9%	1.6%	75.2%
Fall in persistent income only*	8.1%	1.5%	5.3%	14.9%
Negative transitory shock only**	7.0%	1.1%	0.1%	8.3%
Fall in persistent income and negative transitory shock	0.9%	0.2%	0.6%	1.7%
Sum	79.7%	12.7%	7.6%	100.0%

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Evolution of Agent

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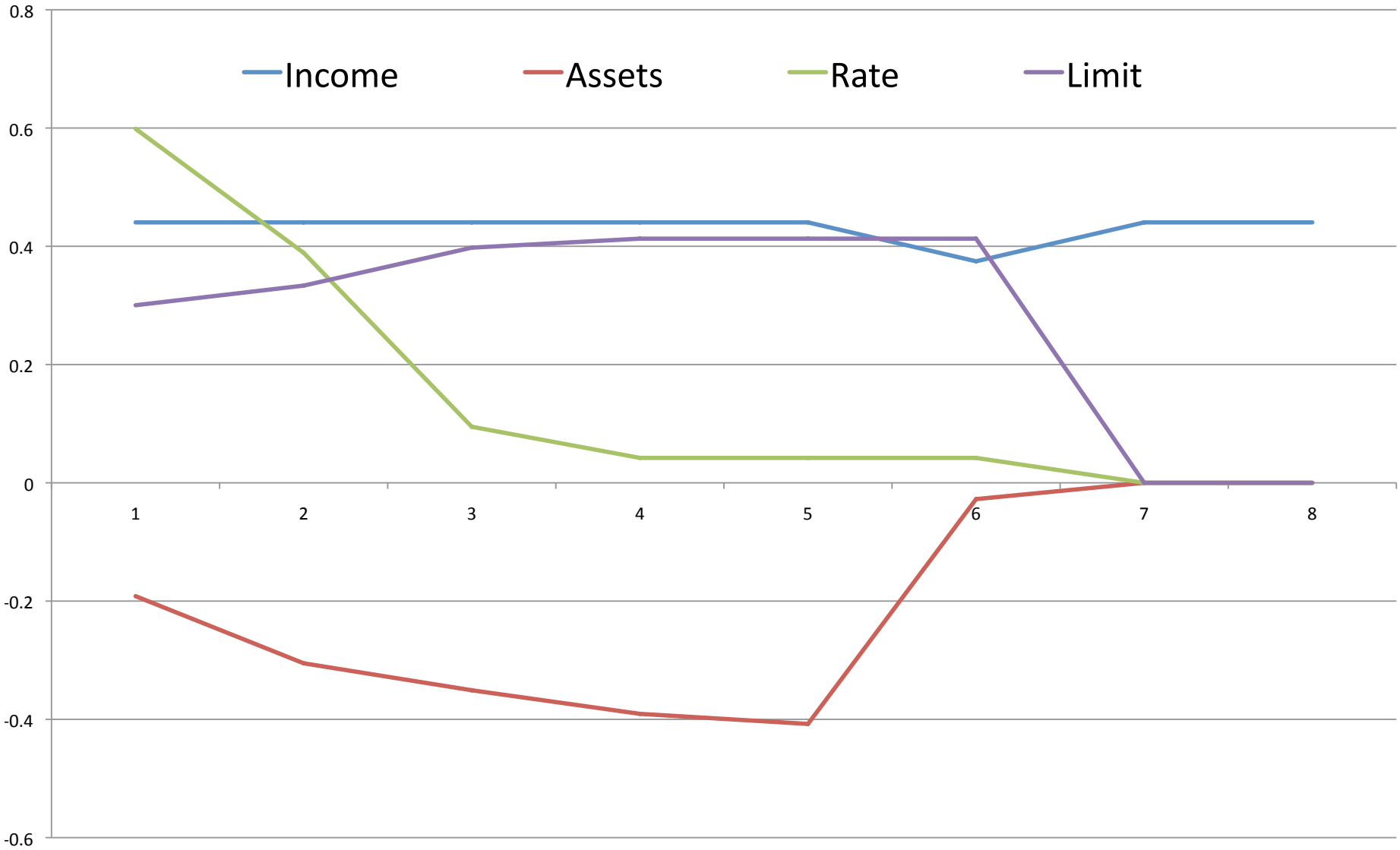

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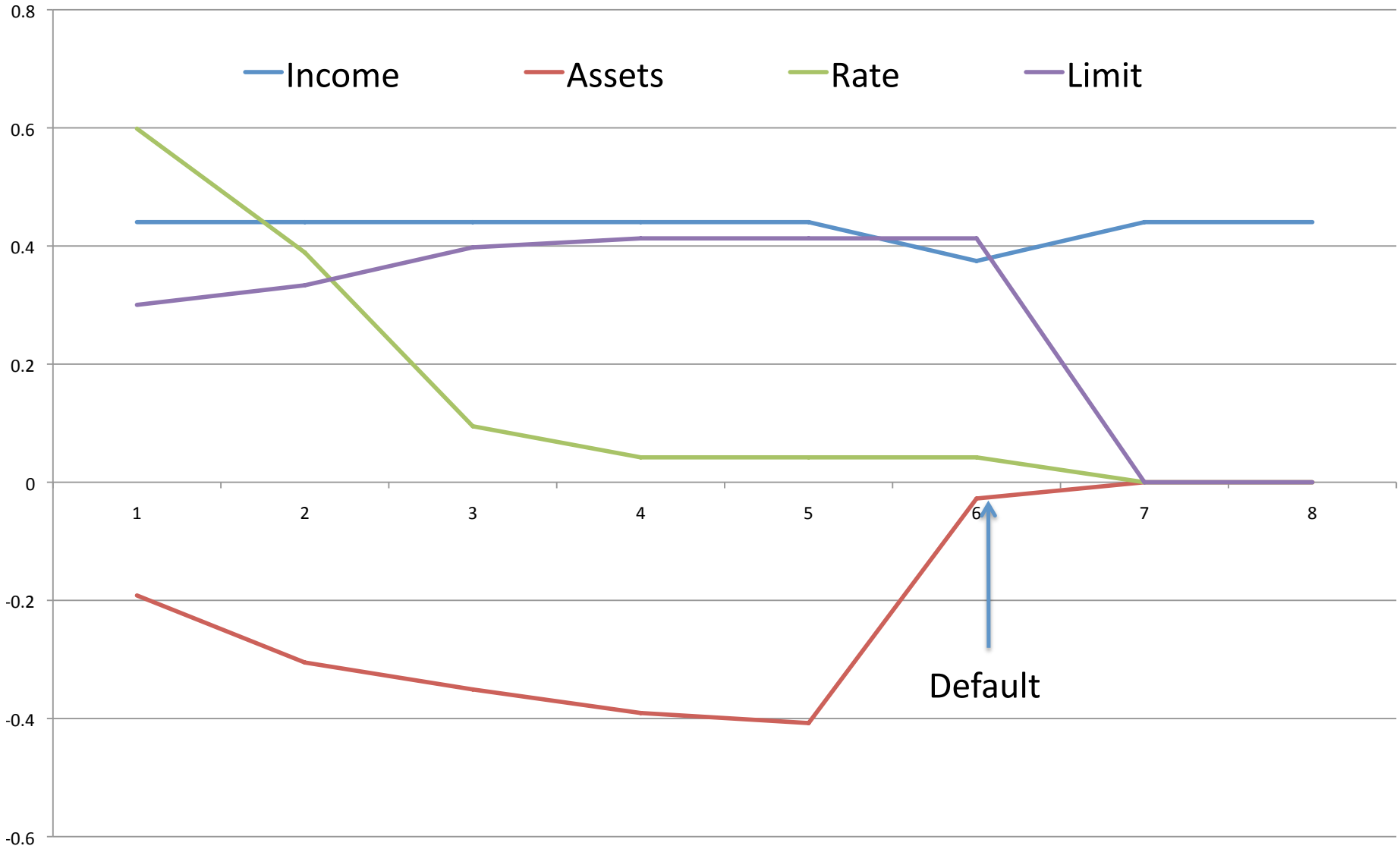

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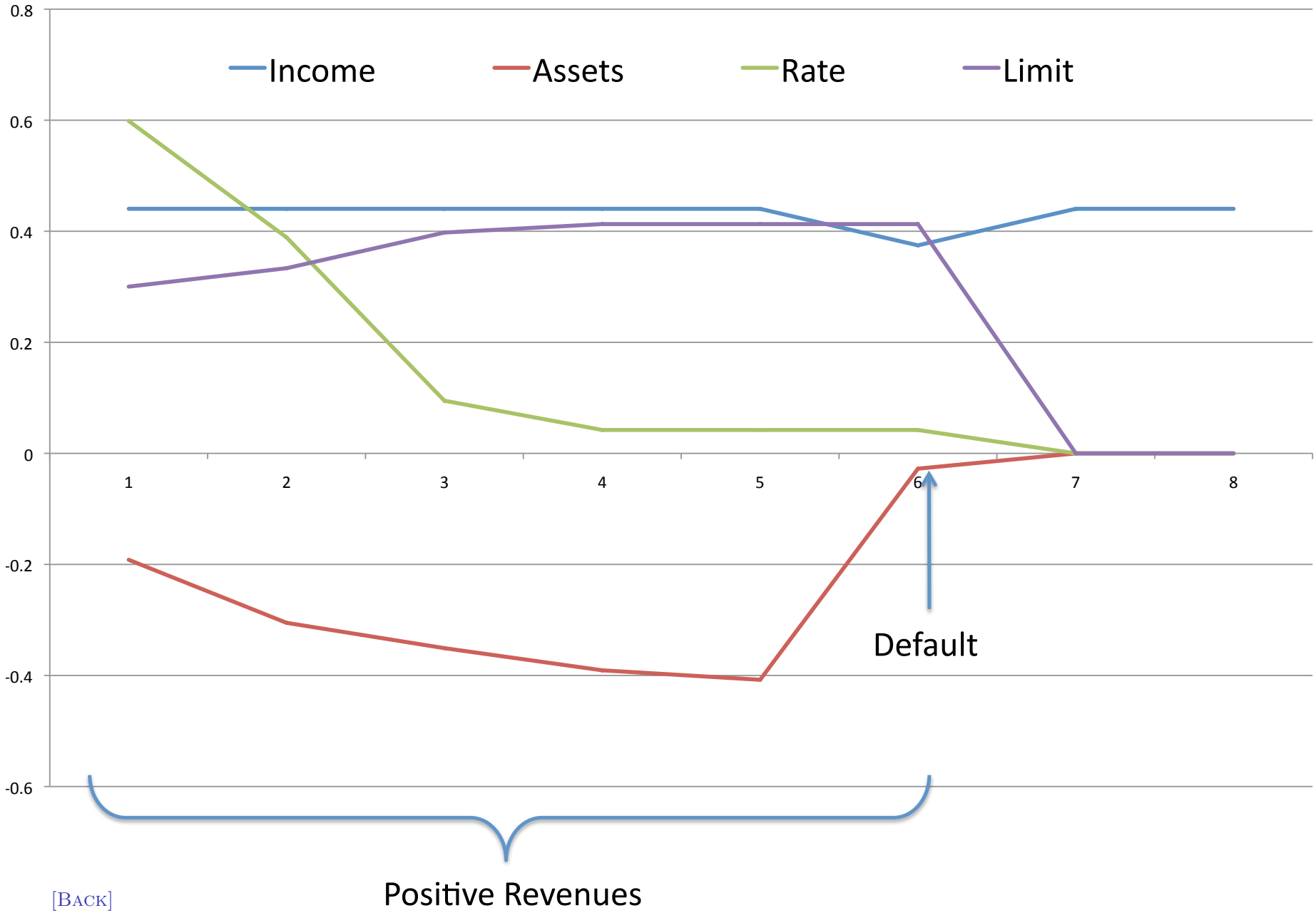

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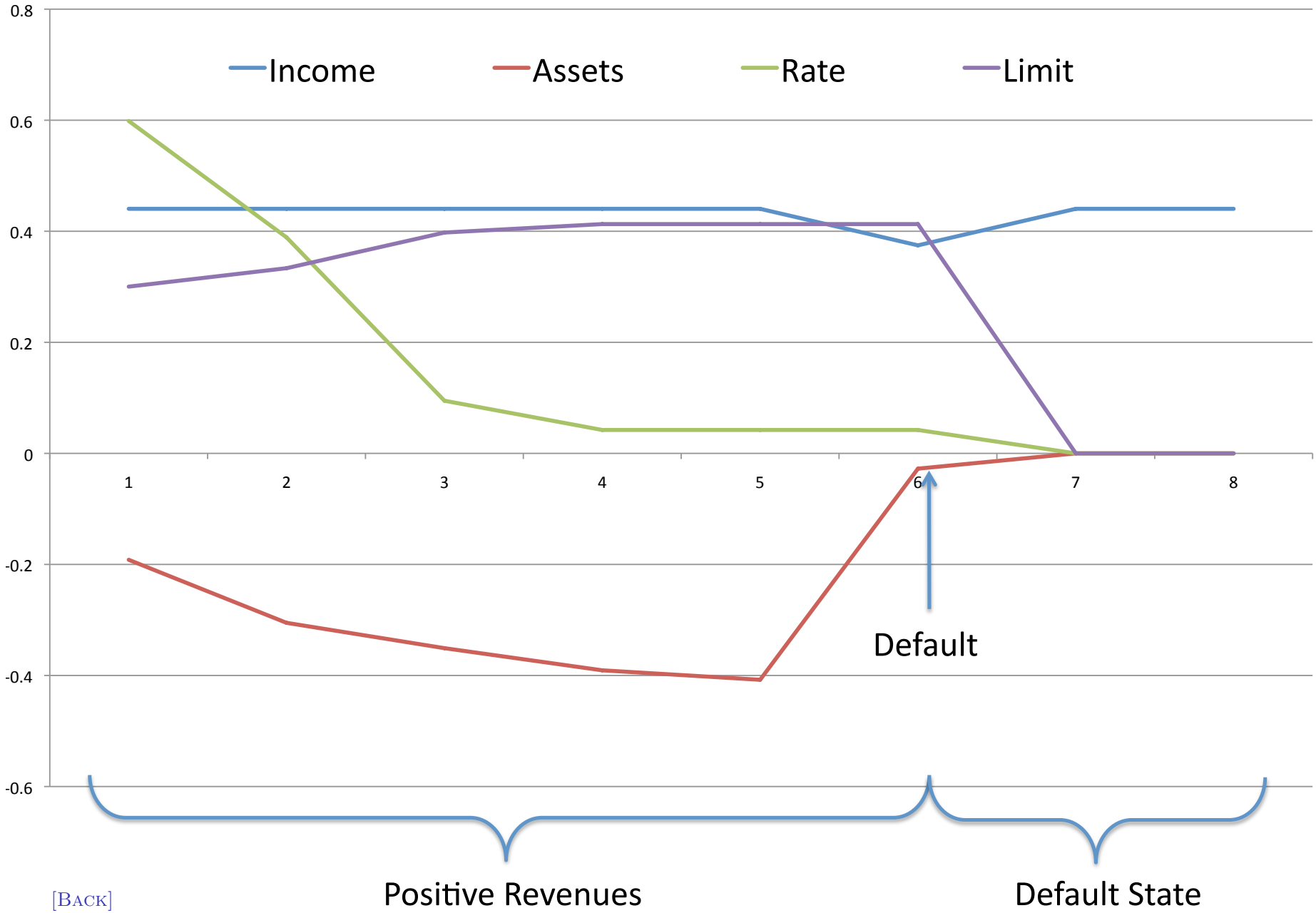

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