

# Sequential Banking with Credit Lines

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    - Debt  $\approx$  900 billion \$
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    - Charge-offs 5% (pre-crisis)
- **Can it effectively fulfil this dual role (given microstructure)?**

## Microstructure: 3 Features We Focus On

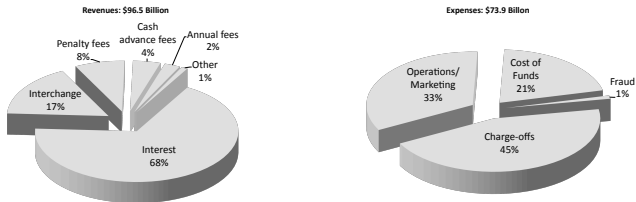
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- **Some degree of commitment by lenders**
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- **Credit lines which give free option to draw funds**
  - Data: CC = finance charge + limit (largely)
  - Anecdotal evidence: fees no. 1 enemy of cc-lenders

Figure: Consolidated Credit Card Revenue and Cost (2002)



## Microstructure: 3 Features We Focus On

- **Some degree of commitment by lenders**
  - *Largely* required by law (interest rate, maturity)
  - Possibly reputation at stake due to pre-authorization

**Right to Opt Out.** To opt out of these changes, you must call or write us by January 31, 2009. When you do, you must tell us that you are opting out. Call us toll-free at **1-866-565-7030**. (Please have your account number available.) Write us at Customer Service Center, P.O. Box 6218, Sioux Falls, South Dakota, 57117-6218. Include your name, address, and account number on your letter.

If you opt out of these changes, you may use your account under the current terms until the end of your current membership year or the expiration date on your card, whichever is later. We will close your account at that time. You must then repay the balance under the current terms.

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We hope you choose to take full advantage of your Citi Card revolving line of credit and all the benefits and services we offer you.  
Please save this notice for future reference.

## Microstructure: 3 Features We Focus On

- **Virtually, no commitment by borrowers**
    - Tying arrangements prohibited (12 U.S.C. sec. 1972)
      - Bank may not condition the availability or price on requirement that a consumer
      - Obtain an additional product from the bank
      - Provide an additional product to the bank
      - Not obtain an additional product from competitor (the exclusive dealing restriction)\*
- \* Other than condition that shall reasonably be imposed to assure soundness of credit

## Visible Footprint in Data

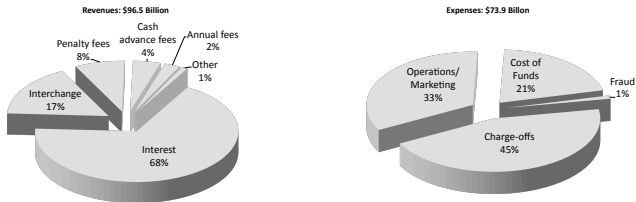
- Multiple cards: 3.5 per person
- Balance transfers: 60% of offers, 17% of funds annually

		<p><b>Citi® Platinum Select® MasterCard®</b></p> <p><b>0% APR* on balance transfers and purchases for up to 15 months</b></p> <p>Extra Cash from Citi: enjoy significant discounts on gift cards, travel, merchandise and more.</p> <p>CB® Identity Theft Solutions</p> <p>\$0 liability on unauthorized purchases</p> <p>Secure, free online account management</p> <p>No annual fee</p> <table><tr><td><b>Intro Purchase APR</b></td><td><b>Intro Balance Trans. APR</b></td><td><b>APR as low as</b></td><td><b>Annual Fee</b></td></tr><tr><td>0%* for up to 15 mo.</td><td>0%* for up to 15 mo.</td><td>11.99% Variable</td><td>None</td></tr></table>	<b>Intro Purchase APR</b>	<b>Intro Balance Trans. APR</b>	<b>APR as low as</b>	<b>Annual Fee</b>	0%* for up to 15 mo.	0%* for up to 15 mo.	11.99% Variable	None
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## Visible Footprint in Data

- **Multiple cards: 3.5 per person**
- **Balance transfers: 60% of offers, 17% of funds annually**

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- Positive theory of such contracting environment
  - discussed features = restriction on allocation
- Efficiency of insurance implied by bankruptcy option?

## Overview of Results

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- Bang bang insurance: overinsurance or underinsurance
- Different comparative statics
- Novel mechanism
  - **Moral hazard not required** (DeMarzo and Bizer (1992))
- Quantitative results (preliminary)
  - 30% mean preserving spread around 2nd best insurance
  - Excess interest rate faced by all (insured) by 2pp

## Motivating Example

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- Inelastic Borrower
  - Normal times: wants to borrow 10,000
    - Will not default unless  $L=20,000$
  - $\kappa$ -shock: Will default always (prob.  $p/(1-p)$ )
    - Values 'implicit insurance' up to 15,000
  - Interest rate  $\Rightarrow$  causes dis-utility, no effect on borrowing

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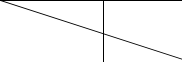
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- Lending and Poaching
  - Initial Lenders: Credit line under commitment (not *fully* needed)
    - Face future lenders = hold option of balance transfer
  - Have informational advantage and can undercut (know  $\kappa$ )

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Second Best (planner)	1.5p	15,000	10,000		



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<b>Initial Lender (deters)</b>	<b>2p</b>	<b>20,000</b>	<b>10,000</b>	<b>0</b>	<b>0</b>
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**Sharp Contrast with DeMarzo and Bizer (1992):**  
Second best is the equilibrium outcome in their case!

## Related Literature

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- Most closely related:
  - DeMarzo and Bizer (1992) [discussed before]
- Quantitative models of consumer bankruptcy
  - Livshits & McGee and Tertilt (2006, 2010), Chatterjee, Corbae, Nakajima and Rios-Rull (2006), Athreya(2003) etc...
  - Drozd and Nosal (2008), Rios-Rull and Mateos-Planas (2008)
- Microstructure of credit markets (various contexts)
  - Kahn and Mookherjee (1998)
  - Parlour and Rajan (2001), Bisin and Guaitoli (2004)
  - Rajan (1992), Petersen and Rajan (1995), Cao and Shi (2001)
  - Attar, Campioni, Chassagnon and Rajan (2008)
- GE equilibrium incomplete and implicit insurance through bankruptcy
  - Dubey, Geanakoplos and Shubik (1988, 2005), Zame (1993)

## Analytic Model

## Model

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- Two periods (intra-period of the later life-cycle model)
- Two types of agents
  - Consumers: Use credit to smooth consumption
    - risk of large shock (medical bills)  $\kappa$
    - pre-existing debt  $B$
    - default strategically when credit limits are 'too generous'
  - Lenders: Extend unsecured credit lines to consumers
    - deep pockets, cover cost of funds in expectation

## Credit Line Contracts

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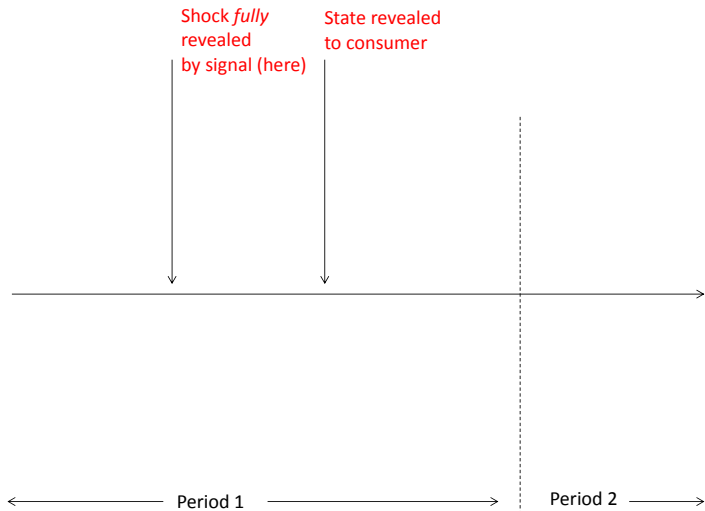
- Unsecured credit lines
  - interest rate  $R$ , credit limit  $L$
  - consumers do not commit to use credit lines
  - lenders commit [really have access to commitment device]
- Non-exclusivity of contracts
- Credit limits defaultable—consumers can max-out prior to default
- One contract per round assumed

## Decentralization of 'One Contract Per Round' \_\_\_\_\_

- Lenders extend credit *under partial commitment*
  - commit not to change unless more contracts are accepted
- Buyers shop for as many contracts as they wish (within any round)
- **Lemma** At most one line is accepted per round.

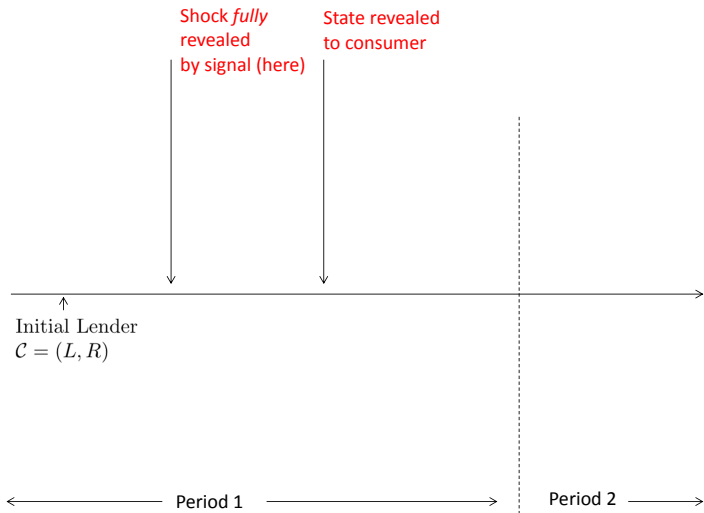
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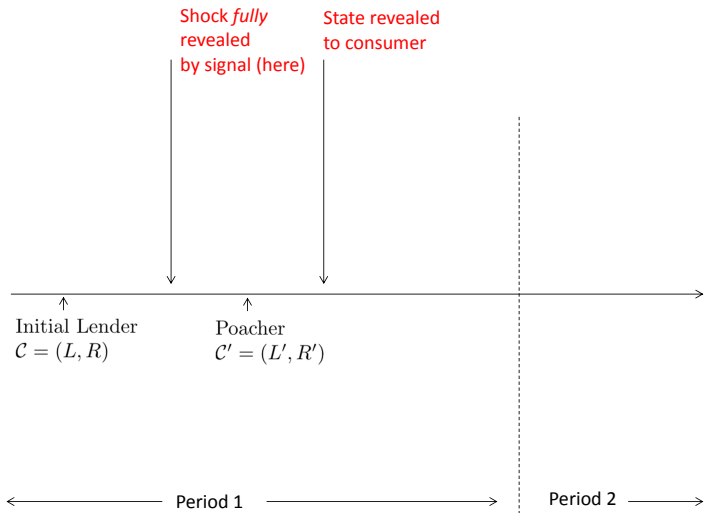
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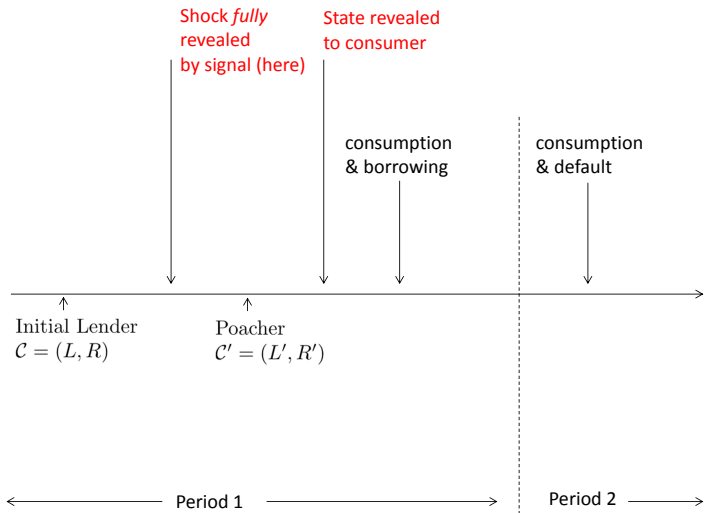


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# Consumers

## Consumers

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- Risk of large shock  $\kappa \in \{x, 0\}$  with small probability  $p/(1-p)$ 
  - income constant and normalized to  $y$
- Utility function is  $u(G(c_1, c_2))$  (u-CES, G-CES hod 1),

$$G(c_1, c_2) = (c_1^{1-\sigma} + c_2^{1-\sigma})^{\frac{1}{1-\sigma}}$$

## Default Decision (Part of the Fixed Point) \_\_\_\_\_

- Given state  $(\kappa; \mathcal{C}, \mathcal{C}')$ , default decision  $D$  satisfies:

$$\mathcal{V}(\kappa, \mathcal{C}, \mathcal{C}') \equiv \max_{\delta \in \{0,1\}} V^\delta(\kappa, \mathcal{C}, \mathcal{C}').$$

*Definition: Credit Limit Carrying Capacity*

$\mathcal{L}_{max}(L, R, R')$  s.t.  $V^0(\kappa = 0, \cdot) < V^1(\kappa = 0, \cdot)$  for all  $L' > \mathcal{L}_{max}(L, R, R') - L$  and  $V^0(\kappa = 0, \cdot) \geq V^1(\kappa = 0, \cdot)$  otherwise.

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*Assumption*

$$G_1(y - B, y) - G_2(y - B, y) < G_1(y, y).$$

*Lemma*

Lemma  $\mathcal{L}_{max}(\cdot)$  is differentiable and decreasing in L for all  $R > 0$ .

## Value Conditional on No-Default $\delta = 0$ \_\_\_\_\_

- Given state  $(\kappa; \mathcal{C}, \mathcal{C}')$ , consumers solve

$$V^{\delta=0}(\kappa, \mathcal{C}, \mathcal{C}') = \max u(G(c_1, c_2))$$

subject to

- borrowing constraint:  $b \leq L + L'$
- budget constraint

$$\begin{aligned}c_1 + B + \rho(b, \mathcal{C}, \mathcal{C}')/2 &= y + b \\c_2 + \rho(b, \mathcal{C}, \mathcal{C}')/2 + \kappa + b &= y.\end{aligned}$$

$$\rho(b, \mathcal{C}, \mathcal{C}') = \begin{cases} \underbrace{R \max(b - L', 0) + R' \min(L', b)}_{\text{borrowing}}, & b > 0, \\ \underbrace{0}_{\text{saving}}, & b \leq 0, \end{cases}$$

## Value Conditional on Default $\delta = 1$ \_\_\_\_\_

- Given state  $(\kappa; \mathcal{C}, \mathcal{C}')$ , consumers solve:

$$V^{\delta=1}(\kappa, \mathcal{C}, \mathcal{C}') = \max u(G(c_1, c_2))$$

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$$c_1 + B = y + b,$$

$$c_2 + b = \theta_\kappa y + L + L'$$

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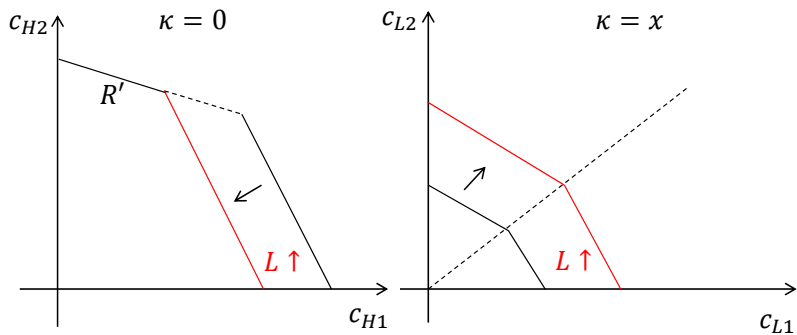
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- budget constraint

$$\begin{aligned}c_1 + B &= y + b, \\c_2 + b &= \theta_\kappa y + L + L'\end{aligned}$$

- Punishment for defaulting:  $(1 - \theta_\kappa)y$

## Budget Constraint



# Lenders

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  - Zero expected profits
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  - Second round: given  $C = (R, L)$ , choose  $C'$  to solve  $\max \mathcal{V}(y, C, C')$  s.t. zero profits
  - High state:  $\kappa = 0 \Rightarrow R' = 0\%$  and  $L' = L_{max} - L$
  - Low state:  $\kappa = x \Rightarrow L' = 0$

- Bertrand competition in 2 rounds separated by flow of information
  - Zero expected profits
- Subgame perfect equilibrium
  - First round: choose  $\mathcal{C}$  to solve

$$\max \zeta EV(y, \mathcal{C}, \mathcal{C}'(\mathcal{C})) + (1 - \zeta)EV(y, \mathcal{C}, \emptyset)$$

$$\text{s.t. } (1 - p)R [\zeta(b_0 - (\mathcal{L}_{max}(\cdot) - L)) + (1 - \zeta)b_1] - pL$$

## Equilibrium Allocation

---

- The equilibrium is *policy functions* and *value functions*

$$\delta(y, \mathcal{C}, \mathcal{C}'), b(y, \mathcal{C}, \mathcal{C}'), \mathcal{C}, \mathcal{C}'(\mathcal{C}, s),$$

and *value functions*

$$\mathcal{V}(y, \mathcal{C}, \mathcal{C}'), V^\delta(y, \mathcal{C}, \mathcal{C}'), \pi(y, \mathcal{C}, \mathcal{C}'), \pi'(y, \mathcal{C}, \mathcal{C}'),$$

that satisfy the consumer and lender problem.

## Second Best Allocation

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- Constrained efficient allocation (CEA)

$$(\mathcal{C}, \mathcal{C}') = \arg \max_{\mathcal{C}, \mathcal{C}'} EV(\kappa, \mathcal{C}, \mathcal{C}'), \text{ subject to } E\pi \geq 0 \text{ and } \pi' \geq 0.$$

## Analytic Results

## Focus Attention on Nontrivial Case \_\_\_\_\_

- Assumption (Non-Empty Set of Contracts)

For  $\zeta = 1$ , there exists  $L > 0$  that is strictly profit feasible.

- Assumption (Partial Utilization Possible)

$$B/2 < L_{max}.$$

## Leading Numerical Example

---

- CRRA utility  $\sigma = 2$ , income normalized to  $y = 1$
- pre-existing debt  $B = 25\%$  of income ( $B = .25$ )
- punishment for defaulting ( $\theta_0 = \theta_x = 0.75$ )
- probability of expense shock  $x$  is  $p = 0.047$
- $x = 0.25$ , implies  $\delta = 1$  after the shock ( $\theta_x y \geq y - x$ )
- ALL ASSUMPTIONS ARE SATISFIED, RESULTS ARE:

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- ALL ASSUMPTIONS ARE SATISFIED, RESULTS ARE:
  - EA :  $L = .237$ ,  $R = .0597$ ,  $b/L = 42\%$ ,  $pL/(1 - p)b = 11.7\%$
  - CEA:  $L = .137$ ,  $R = .306$ ,  $b/L = 81\%$ ,  $pL/(1 - p)b = 6.1\%$

## Constrained Efficient Allocation

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- Consumption = certainty equivalent in each state
- Resource feasibility

$$Rb = pL$$

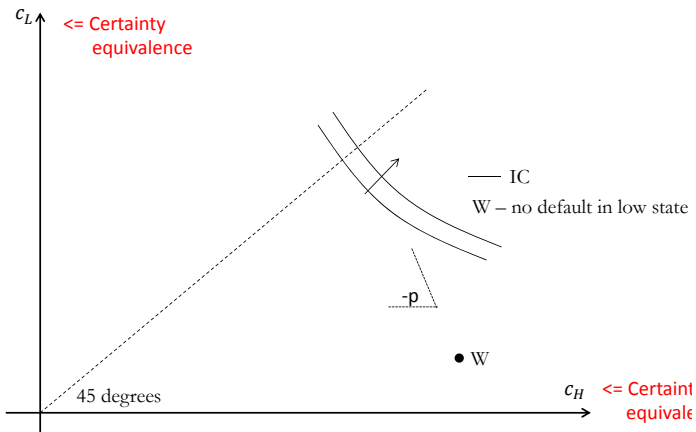
- Key objects

$$\text{IC} = (c_H, c_L) \text{ s.t. } u \text{ constant}$$

$$\text{RFCF} = (c_H, c_L) \text{ feasible and resource efficient}$$

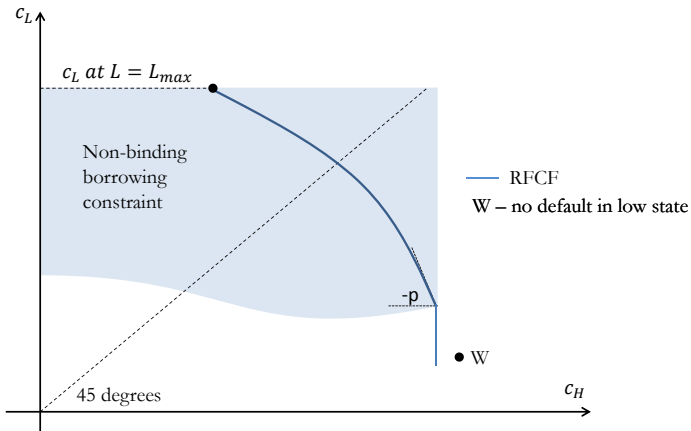
# Constrained Efficient Allocation

Preferences nice and smooth.



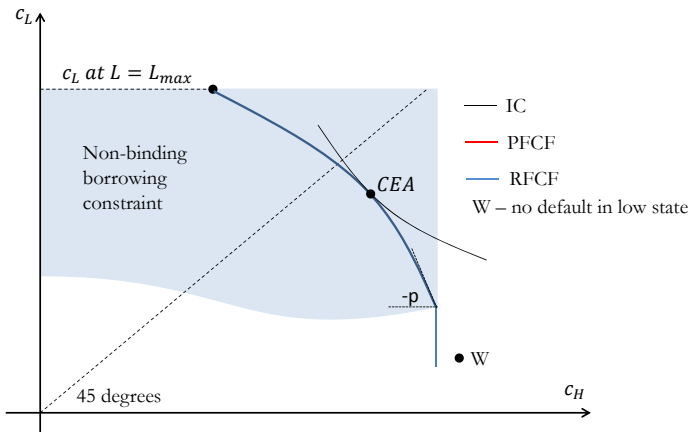
## Constrained Efficient Allocation

RFCF globally flatter than  $p$ , except binding case.



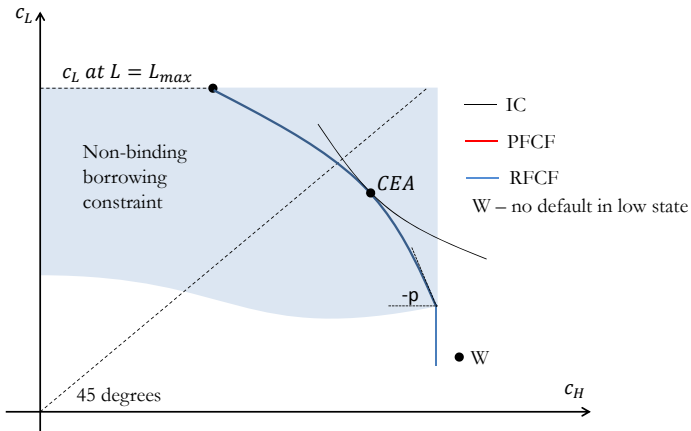
## CEA: Global-Flatness

Proposition: CEA interior, except binding case.



## CEA: Relation to Exclusivity

Proposition: Exclusivity implements CEA (nb).



## Equilibrium

---

- Consumption = certainty equivalent in each state
- RFCF replaced with PFCF, given by:

$$E\pi(\kappa, \mathcal{C}, \mathcal{C}'(\mathcal{C})) = 0$$

$$E\pi'(\kappa, \mathcal{C}, \mathcal{C}') = 0$$

$$(L + L' = L_{max})$$

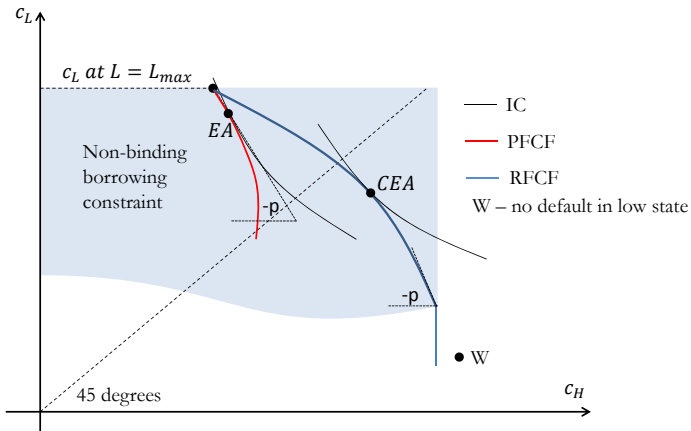
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$$\text{IC} = (c_H, c_L) \text{ s.t. } u \text{ constant}$$

$$\text{PFCF} = (c_H, c_L) \text{ zero profit and } L' \text{ best response}$$

## Equilibrium: Global-Steepness

Proposition:  $\zeta$  close to 1, PFCF globally steeper than AFTL.



## Intuition Behind the Proof ---

$\uparrow L$  **increases profits**

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transfer rate ( $c_H$  to  $c_L$ ) ~~better than fair~~

lowers "profits"

positive

worse than fair

## Intuition Behind the Proof

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transfer rate ( $c_H$  to  $c_L$ ) ~~better than fair~~

lowers "profits"

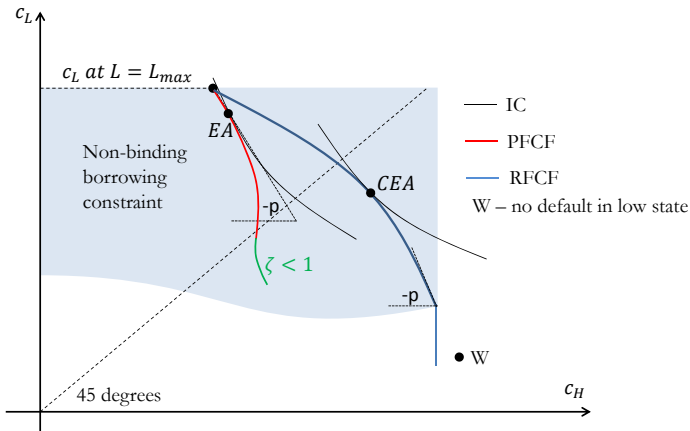
**positive**

**worse than fair**

Unless utilization too high (or full) - bound on  $\zeta$ : then  $RdL < pdL$

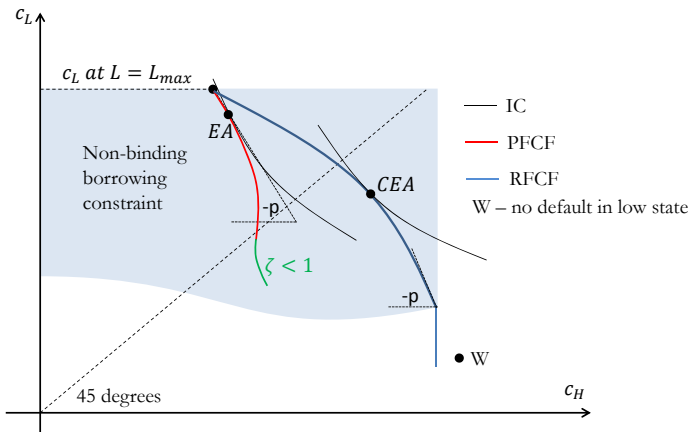
# Equilibrium: Steepness-At-Top

Proposition:  $\zeta \geq \frac{1}{2}B/L_{\max}$ , PFCF steeper than AFTL close to  $\mathcal{L}_{\max}$ .



## Equilibrium: Steepness-At-Top

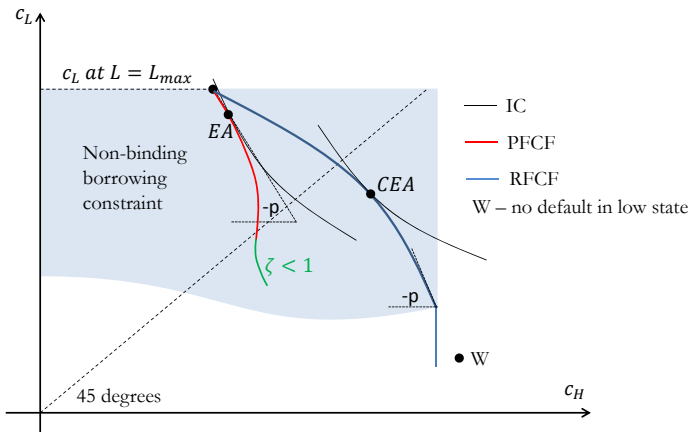
Proposition:  $\zeta \geq \frac{1}{2}B/L_{\max}$ , PFCF steeper than AFTL close to  $\mathcal{L}_{\max}$ .



- Leading example:  $\zeta > .582$

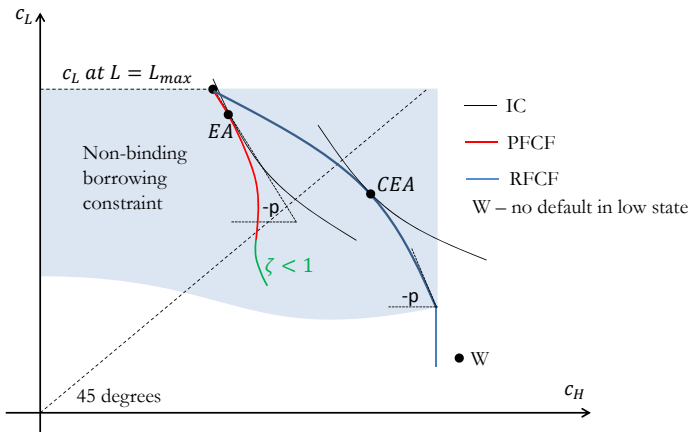
# Equilibrium: Relation to First Best \_\_\_\_\_

Proposition: At  $L_{\max}$ ,  $c_L > c_H$  if and only if  $\theta_0 < \theta_x$ .



## Equilibrium: Relation to First Best

Proposition: At  $L_{\max}$ ,  $c_L > c_H$  if and only if  $\theta_0 < \theta_x$ .



- In CEA:  $c_L/c_H = 68\%$ , in EA:  $c_L/c_H = 100\%$ !

## Equilibrium Allocation

## Model Generalizes to Imperfect Information \_\_\_\_\_

- Signal precision  $0 < \pi < 1$ .
- Key differences:  $C'$  provides some insurance, entry deterrence “easier”

Analogous results go through.

## Quantitative Results (Benchmark)

## Quantitative Results

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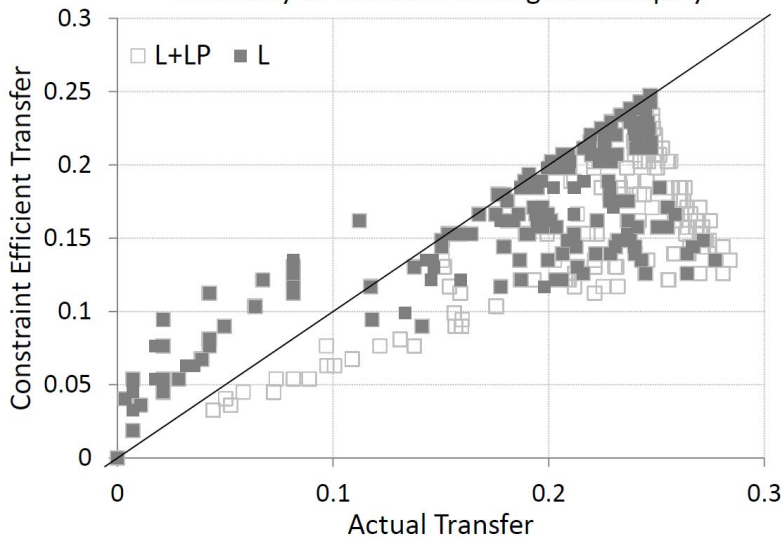
- OLG model of consumer default a la Livshits, MacGee and Tertilt (2008)
  - Credit lines & poaching within period (3 years)
- Calibration fairly standard (choose  $\beta$  and cost of default)
- Aggregates similar in CEA and E
  - unsecured debt 9% to income
  - filing rate 5.5 and charge-off rate about 5%

## OLG Setup

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- 18 periods (last 3 = retirement)
- Markov persistent income  $y = e(t)z$ ,  $z$  Markov
- i.i.d. financial distress shock:  
 $\kappa \in \{ \text{medical bills} \}$
- default = 1 period exclusion from market

## Efficiency of Transfers Through Bankruptcy



## Conclusions

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- Microstructure of CC market matters
- Generically, distorted provision of insurance
- Overinsurance possible (quantitative results suggest it is likely, 20-30%)
- Different effects as credit limit carrying capacity matters
  - e.g. means testing may increase charge-offs by borrowers under distress
- Suggestive about benefits of government facilitated exclusivity