Credit Enforcement Cycles

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The views expressed in this paper are those of the authors and do not necessarily reflect those of the Federal Reserve Bank of Philadelphia or the Federal Reserve System.

NEW YORK (CNNMoney, 2012) – Borrowers facing foreclosure are learning that they can stay in their homes for years (...) Among the tactics: Challenging the bank's actions, waiting to file paperwork right up until the deadline, requesting the lender dig up original paperwork or, in some extreme cases, declaring bankruptcy. Nationwide, the average time it takes to process a foreclosure has climbed to 674 days from 253 days just four years ago (...).

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(borrowing constraints/credit spreads)

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$\updownarrow$

Default decisions

+

Ability to enforce repayment / seize collateral

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Endogenous to economic environment:

1. **Current and future economic conditions**
2. **Efficacy of enforcement institutions**

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(borrowing constraints/credit spreads)

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Literature =>

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(borrowing constraints/credit spreads)

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Endogenous to economic environment:

Literature => **1. Current and future economic conditions**

This paper => **2. Efficacy of enforcement institutions**

Motivation

1. **Enforcement of credit contracts a time consuming process**
   - enforcement of contracts (OECD high-income) 532 days (WB,2017)
   - resolution of insolvency in OECD high-income: 432 days (WB, 2017)

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   - US (06-09): foreclosure timelines 8 $\uparrow$ 15 months (Calem, 2014)
   - Italy (07-11): loan enforcement 4 $\uparrow$ 6+ years (Bank of Italy, 2014)
   - Spain(07-15): commercial loan enforcement 2.5 $\uparrow$ 5 years (est.)

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3. **Numerous micro-level studies now document causal link to credit**
   - court conjestion $\Rightarrow$ efficacy of enforcement (Iverson, 2015)
   - efficacy of enforcement $\Rightarrow$ strategic default (Schianterlli, 2016)
   - court conjestion $\Rightarrow$ cedit supply (Japelli et al., 2005; Safavian and Sharma, 2007; Ponticelli, 2015; Rodano, 2016; Chan et al., 2014):

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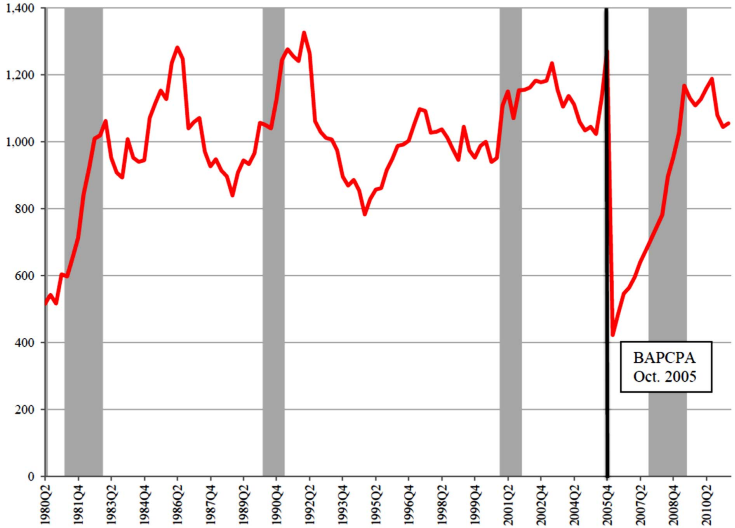
Weighted Caseload per Judge in the U.S. (Iverson, 2015)



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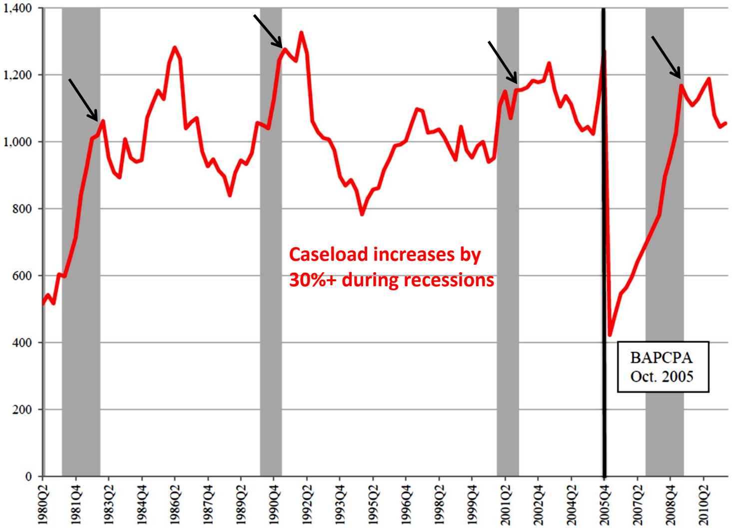

Diff-and-Diff BAPCPA Results (Iverson, 2015)

- Business cycle 300h extra caseload per judge associated with:
  - probability of ch.11 bankruptcy filing dismisal up by 8%, conversions to ch.7 up by 11% for SME
  - increased loan losses on C&I up by $\approx$ 50%
  - re-filing of dismissed cases doubles (recidivism)

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$$\text{shock } \uparrow \Rightarrow \text{enforcement} \downarrow \Rightarrow \text{default} \uparrow \Rightarrow \text{credit } \downarrow \ldots$$

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- Use the model to inspect the mechanism:

  shock $\uparrow \Rightarrow$ enforcement $\downarrow \Rightarrow$ default $\uparrow \Rightarrow$ credit $\downarrow$ ...

- Contribution:
  - analysis of enforcement externality with credit & heterogenious agents in GG-setup

Related Literature

- Enforcement externality:
  - Bond and Rai (2009), Arellano and Kocherlakota (2009), tax evasion and crime literature.
- Global Games
  - Carlsson and Van Damme (1993), Morris and Shin (1998, 2003), Frankel, Morris and Pauzner (2003), Sakovics and Steiner (2012)

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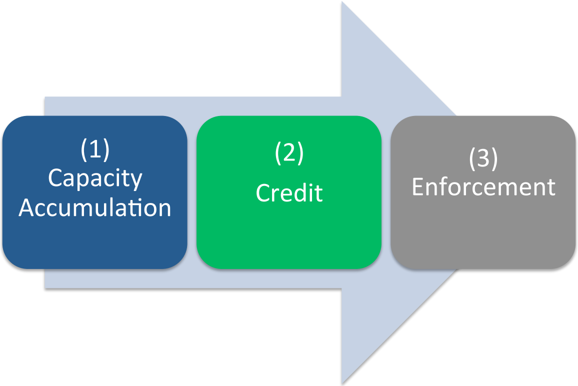
- Debt defaultable; seizing collateral requires enforcement that is capacity constrained
- Enforcement capacity accumulated ex- ante by a planner

Timing



Enforcement

Entrepreneurs

- Measure one of risk-neutral entrepreneurs with loan b from lender(s)
  - invest $y + b$ and receive $(y + b)w$, $w \in [0, \infty)$ is private info, $w \sim F$
    F unrestricted, but in presentation single-peaked (log-normal, Pareto)

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2. Simultaneously decide whether to repay $\bar{b} \equiv \bar{w}(y + b)$ or default
   - if default and
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     - not enforced, get a share γ of liquidation value $\mu(y + b)w$

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Lemma

Entrepreneurs default iff $E(P) \geq \theta_{\bar{w}}$*, where* $\theta_{\bar{w}}(w) := 1 - \frac{1}{\mu\gamma}\left(1 - \frac{\bar{w}}{w}\right)$.

Enforcement Technology

- Enforcement of defaulted loans is limited by capacity fixed capacity X:
  default rate $\psi \leq$ enforcement capacity $(X) \Rightarrow P \leq X/\psi$

Common Knowledge-Equilibrium

- Higher ψ lower $P \Rightarrow$ Strategic complementarities $\Rightarrow$ Multiple equilibria

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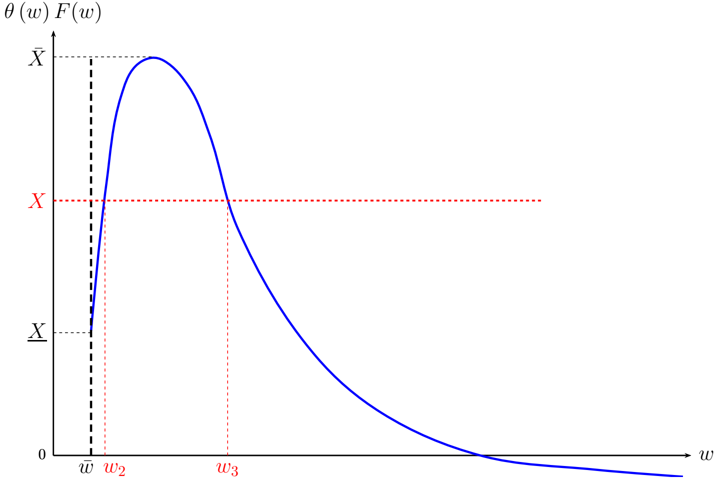
- Higher ψ lower $P \Rightarrow$ Strategic complementarities $\Rightarrow$ Multiple equilibria
  - let $\hat{w}$ be threshold type indifferent between defaulting or not
  - observe default rate is $\psi = F(\hat{w})$
  - for equilibrium must have: $\theta(\hat{w}) = P = X/F(\hat{w}) \to \theta(\hat{w})F(\hat{w}) = X$

Multiplicity under Common-Knowledge



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- Multiplicity relies on common knowledge of ψ (higher order beliefs)
- Small uncertainty regarding X can eliminate multiplicity
  - creates strategic uncertainty (ψ no longer common knowledge)
  - strategic uncertainty tampers coordination $\Rightarrow$ uniqueness
- GG-Eqiulibrium: agents receive a noisy signal: $x = X + \nu\eta$
  $\nu > 0$ scale factor, $\eta \in [-1/2, 1/2]$ i.i.d. with distribution H

GG intuition

GG-Equilibrium

Proposition (*uniqueness*)

The enforcement game has a unique limit equilibrium characterized by a (weakly) decreasing threshold $k(w)$ on signal x such that:

- *if $x \geq k(w)$, agents choose to repay $(a = 1)$*
- *if $x < k(w)$, agents choose to default $(a = 0)$*

solution

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- **Equilibrium fully characterized by indifference conditions**:

$$\lim_{\nu \to 0} \mathbb{E}[P|x = k(w)] = \theta_{\bar{w}}(w) \qquad \forall w \text{ s.t. } \theta_{\bar{w}}(w) \in [0, 1]$$

solution

GG-Equilibrium Strategy

Proposition (*equilibrium strategy*)

In the limit $k(w)$ is given by:

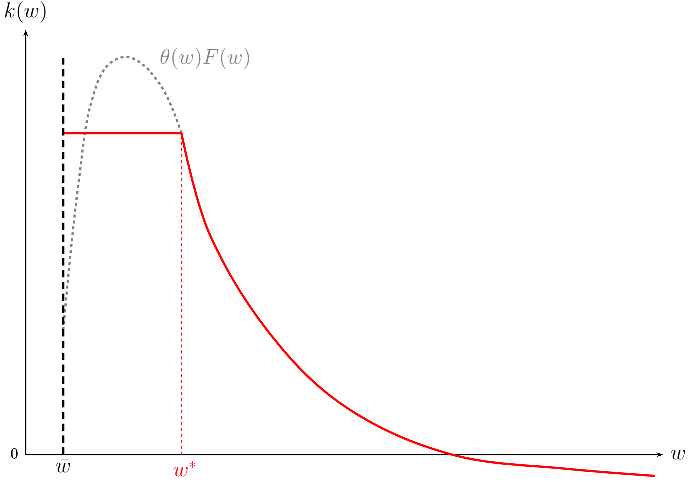
$$k(w) = \begin{cases} \theta(w^*)F(w^*) & \text{for all } w \in (\bar{w}, w^*] \\ \theta(w)F(w) & \text{for all } w > w^* \end{cases}$$

where $w^* \geq \bar{w}$ and w^* has two possible values:

1. *If $\bar{w} \geq w_{\max}$, $w^* = \bar{w}$*
2. *If $\bar{w} < w_{\max}$, w^* is the unique solution to*

$$\theta(w^*)F(w^*)\left(1 - \log\theta(w^*)\right) - F(\bar{w}) = \int_{\bar{w}}^{w^*} \theta(w)dF(w)$$

GG-Equilibrium Strategy



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Intuition Behind Clustering

1. Consider two types:

   - $m_h = 60\%$ have θ_h
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   - When h receives k_h, she thinks $\psi = \frac{1}{2}m_l = 30\%$
   - When l receives $k_l > k_h$, she thinks $\psi = \frac{1}{2}m_l + m_h/2 = 70\%$

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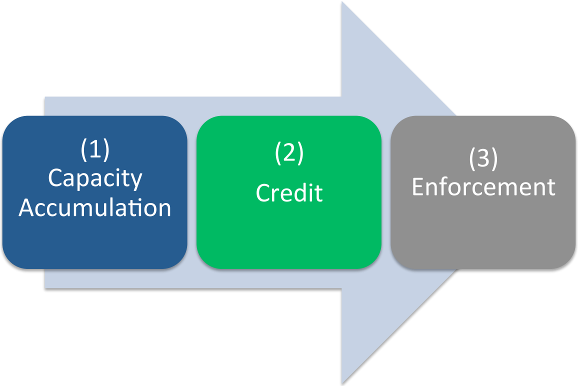
Endogenous Credit

Timing



Endogenous Credit Setup

- Lenders issue credit contracts $(b, \bar{w})$
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Optimization Problems

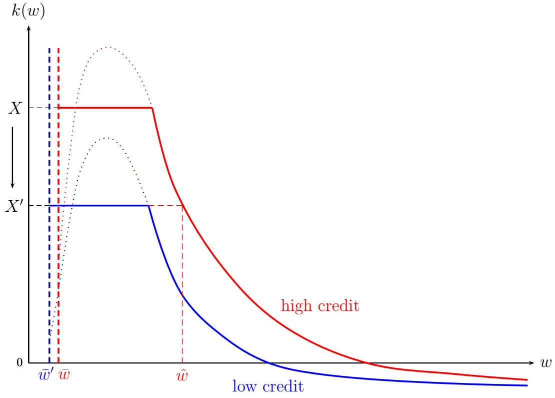
Comparative Statics

- Shock tangles measure s of enforcement capacity: $X' = X - s$
  - equivalent to an exogenous shift in distribution of returns

Comparative Statics

Proposition

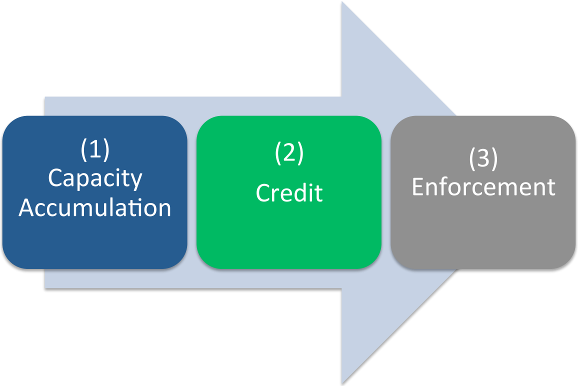
If $X \geq k(w^*)$ at the optimal contract then b and $\bar{w}$ increase (decrease) with X.



Heterogeneity

Calibrated Numerical Example

Timing



Endogenous Enforcement Setup

- Planner chooses enforcement capacity X at a cost $c(X)$
  - maximizes expected agent payoffs net of capacity costs

Calibrated Numerical Example

1. Calibrate to U.S. data (large shock, small shock) Example

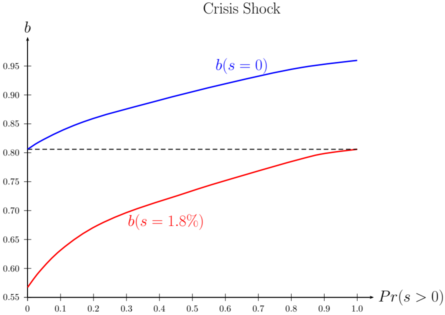
2. Show:

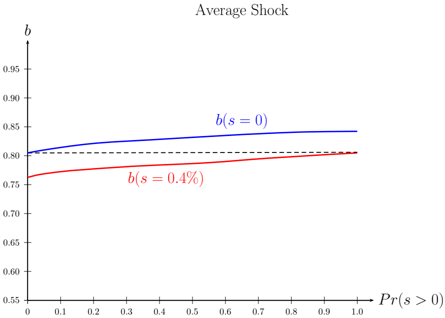
    - shock that lowers X (or affects F) leads to a severe credit crunch

    - propagation even if there is ample capacity to accommodate the shock.

Transmission of Calibrated Shocks

- Binary shock s reduces capacity to $X = X_o - s$ before credit market opens ($\uparrow$ default rate on existing loans $\Rightarrow$ $\downarrow$ residual capacity for new loans)





- *Credit enforcement cycle*: (potential dynamics)

$$\uparrow \psi \quad \Rightarrow \quad \downarrow X \quad \Rightarrow \quad \downarrow b \quad \Rightarrow \quad \downarrow \psi \quad \ldots$$

Conclusions

- Framework to study endogenous enforcement
  - Focus on link between enforcement institutions and credit fluctuations
  - Approach applicable to other default spillovers (e.g., endogenous collateral values)
- Developed method to deal with equilibrium indeterminacy under heterogeneity, suitable for quantitative work
  - Economic fragility despite substantial heterogeneity

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Backup Slides

Related Literature

1. Law and Finance: enforcement and credit
   - La Porta et al (1990), Djankov et al (2007, 2008)
   - Our paper: (endogenous) enforcement and credit volatility

2. Enforcement externalities:
   - Bond and Rai (2009), Arellano and Kotcherlakota (2009), tax evasion and crime literature.

3. Global Games
   - Carlsson and Van Damme (1993), Morris and Shin (1998, 2003), Frankel, Morris and Pauzner (2003), Sakovics and Steiner (2012)

Lender and Planner Problems

- Lenders: ($a = 1$ denotes repay)

$$V(X) := \max_{b,\bar{w},P} \left[\int_{\{w:a=1\}} (y+b)(w-\bar{w})dF + (1-P) \int_{\{w:a=0\}} \gamma\mu(y+b)wdF \right]$$

s.t. $P \leq \min\left\{\frac{X}{\psi}, 1\right\}$ and

$$\begin{aligned} b \leq & \int_{\{w:a=1\}} (y+b)\bar{w}dF + P \int_{\{w:a=0\}} \mu(y+b)wdF \\ & +(1-P) \int_{\{w:a=0\}} (1-\gamma)\mu(y+b)wdF \end{aligned}$$

go back

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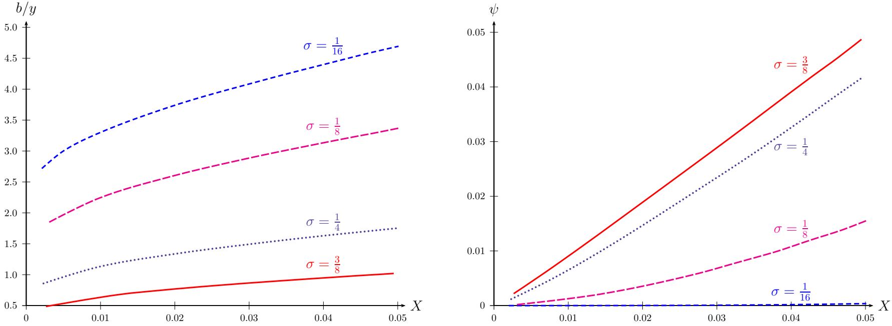
   Snowballing: agent with w' wants to default at higher signals, $k(w') \uparrow$

The Impact of Heterogeneity

$F =$ Lognormal, $Ew = 1.02$, $\mu = 0.88$ (Bernanke et al; 1999), $y = 1$, $\gamma = 0.25$



concentrated returns $\Rightarrow$ negligible insolvency rate, cluster too large (60%)

go back

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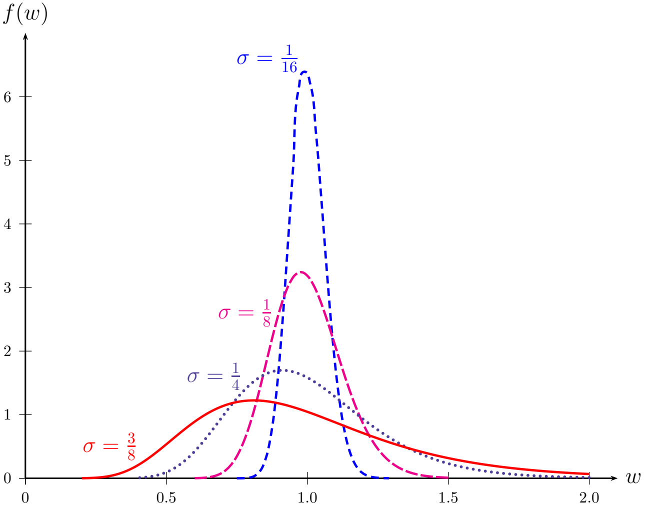

go back

Optimal capacity: Borrowing constraint

$$\sigma = 3/8,\ c(X) = 0.088X$$

Statistic	Value	Target
b/y	0.8	0.5 - 1
ψ	2.3%	2.3%
ROE	3.4%	
$c(X_o)$/ROE	0.06	
Utilization $(\frac{\psi}{X})$	95%	
Cluster	1.7%	
% Strategic	6.9%	

Borrowing constraint: b is 20% lower than without externality $(\gamma = 0)$

go back

Uniqueness

- If agent receives x then $X \in [x - \nu/2, x + \nu/2]$ and other agents' signals are in $[x - \nu, x + \nu]$
- Proof sketch:
  1. There is a lowest and highest equilibria, both in threshold strategies (resp. $\underline{\mathbf{k}}$ and $\overline{\mathbf{k}}$)

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     - X went up by Δ on average
     - strategic beliefs about ψ are the same! (translation invariant)
  4. Either $\underline{\mathbf{k}}$ or $\overline{\mathbf{k}}$ violates indifference conditions
  5. Argument generalizes to unequal $\Delta \Rightarrow$ eq. uniqueness

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Backup Slides

Enforcement Delays

Figure : Default Cases (left axis) and Enforcement Delay (right axis)

How We Solve the Game

- For $\lim_{\nu \to 0} k(w)$ equilibrium satisfies:

$$\mathbb{E}[P|x = k(w)] = \theta(w) \qquad \forall w \text{ s.t. } \theta(w) \in (0,1)$$

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- How about strategic beliefs about ψ?

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- *Laplacian Property*: if $k(w) = k$ for all $w \Rightarrow \psi|x = k$ uniformly distributed
- Under heterogeneous $k(w)$ the Laplacian property holds 'on average' (Sakovics-Steiner, 2012)
  - Cluster of thresholds converging to the same limit $\Rightarrow$ average the indifference conditions and replace the average belief by the uniform distribution
  - Use monotonicity of θ to identify the cluster bounds

back

The Belief Constraint (Sakovics-Steiner, 2012)

- **Equilibrium fully characterized by indifference conditions**:

$$\lim_{\nu \to 0} \mathbb{E}[P|x = k(w)] = \theta_{\bar{w}}(w) \qquad \forall w \text{ s.t. } \theta_{\bar{w}}(w) \in [0,1]$$

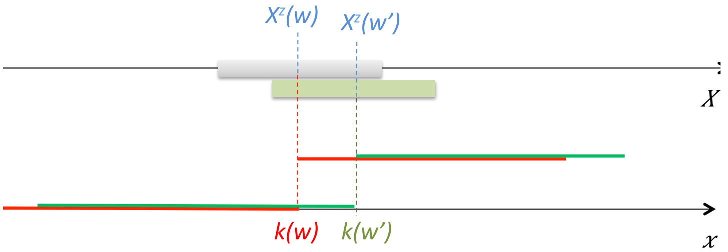
Lemma (*belief-constraint*)

Let $\psi(W')$ be the default rate in some measurable set $W' \subseteq [0,\infty)$. Then, for any $z \in [0,1]$,

$$\frac{1}{\int_{W'} f(w)dw} \int_{W'} \mathbb{P}_w \left(\psi(W') \le z \middle| x = k(w)\right) f(w)dw = z,$$

where $\mathbb{P}_w \left(\cdot \middle| x = k(w)\right)$ is the probability assessment of the default rate in W' by an agent whose signal x is equal to her threshold $k(w)$.

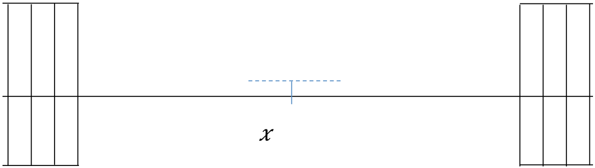
The Belief Constraint



- Belief asymmetry between w and w' regarding each other actions in $[k(w), k(w')]$ averages out

go back

Basic Idea



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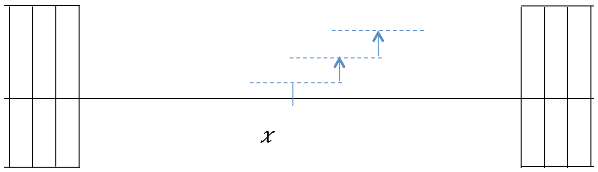
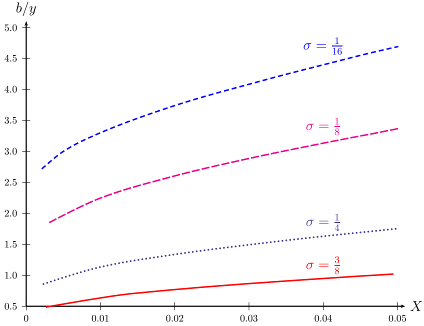


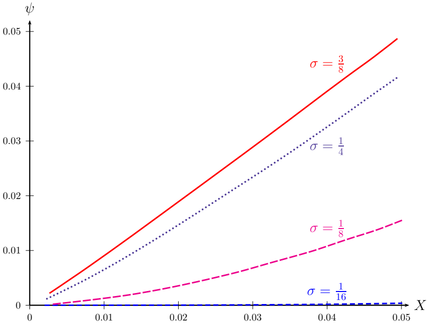
go back

Identification

$F =$ Lognormal, $Ew = 1.02$, $\mu = 0.88$ (Bernanke et al; 1999), $y = 1$, $\gamma = 0.25$

Return Distributions





concentrated returns ⇒ negligible insolvency rate, cluster too large (60%)

Extended Intuition For Clustering

1. Thresholds must be decreasing in w (lower propensity to default $\Rightarrow$ lower k)

2. $k(\cdot)$ strictly decreasing $\Rightarrow$ As $\nu \to 0$ agent believes $\psi = F(w)$ at $x = k(w)$

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   Snowballing: agent with w' wants to default at higher signals, $k(w') \uparrow$

Sketch of Proof of Uniqueness

- If agent receives x then $X \in [x - \nu/2, x + \nu/2]$ and other agents' signals are in $[x - \nu, x + \nu]$
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  4. Either $\underline{\mathbf{k}}$ or $\overline{\mathbf{k}}$ violates indifference conditions
  5. Argument generalizes to unequal $\Delta \Rightarrow$ eq. uniqueness