Crises in Repo Markets with Adverse Selection

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Outline

1. The model.

2. Analysis.
   - Sunny regime
   - Rainy regime
   - Rainy steady state

3. Discussion and Conclusion.

Question

How can the worsening of a small part of the loan market lead to a crash as well as a prolonged crisis in secondary loan prices, bank equity prices, and lending activity?

Answers

- **Method:** A model with banks, short-term repurchase financing and adverse selection.
- **Results:** initial crash (very bad), followed by adverse selection (somewhat bad).
- **Policy (tentative!):**
  - Emergency purchases in $t = 0$ very good.
  - After $t > 0$, it may be better to leave the market as is.

Outline

Overview of the model:

- Banks and only banks can issue loans.
- Loans are long-term contracts.
- Banks use short-term repurchase agreements (“repos”) to leverage equity.
- Heterogeneous leveraging ability.
- Primary loan market (“loan-generation”).
- Secondary market, where loans can be traded among banks and sold by short-term lenders.
- Loans may differ in quality. Private info to bank. Adverse selection on secondary market.
- Transition from “sunny” to “rainy” regime.

Time, Regimes and Households

- Time: $t = \ldots, -2, -1, 0, 1, 2, \ldots$.
- Regimes: “Sunny”, “Rainy”.
  - Start “sunny”.
  - Surprise transition to “rainy” forever.
  - Date $t = 0$: first date of “rainy”.
- Households: $R \geq 1$,

$$U = E\left[\sum_{t=-\infty}^{\infty} R^{-t} c_t\right]$$

- Zero endowment. c_t can be negative.

Two linear technologies ("loans")

- "good" (g), "bad" (b)
- Require one unit of input at date t.
- Terminate with probability $1 - \kappa$.
- Otherwise: pay dividend forever:
  - "Good": d_s, while "sunny. d_g while "rainy".
  - "Bad": d_s, while "sunny. $d_b < d_g$ while "rainy".

Banks

- Only banks can issue and collect on loans.
- Primary market: creation of new loans.

$$P(\text{“}good''\text{)} = \alpha$$

- Lots of tiny loans. Probability = fraction. LLN.
- Secondary market: trade loans. Endogenous market price p_t.

$$P(\text{“}good''\text{)} = \tilde{\alpha}_t \ (endogenous)$$

- Only holding bank observes dividends.
  - “Sunny”: no distinction.
  - “Rainy”: holding bank knows “good” from “bad”.

Leverage and short-term lending

- Households create new banks of type $\tau \in [0, 1]$ each period, with unlevered equity density $f(\tau)$: exogenous.
- Banks: "born" with type $\tau \in [0; 1]$.
- "Haircut" or "Leverage".
- Loans L. Market value p_t.
- Repurchase agreements or repos:
  - borrow short term, post collateral in excess of loan.
  - borrow up to $(1 - \tau)p_t L$, repay with return R next period.
- Banks exit with probability $1 - \gamma$. They then sell their portfolio and pay their shareholders.

Outline

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Leverage (given: $e = 1$.

- Equity: e.
- For L loans, can borrow ("repo") $(1 - \tau)pL$.
- Primary market:

$$L = e + (1 - \tau)pL$$

or

$$L = \frac{1}{1 - (1 - \tau)p} e$$

- Secondary market:

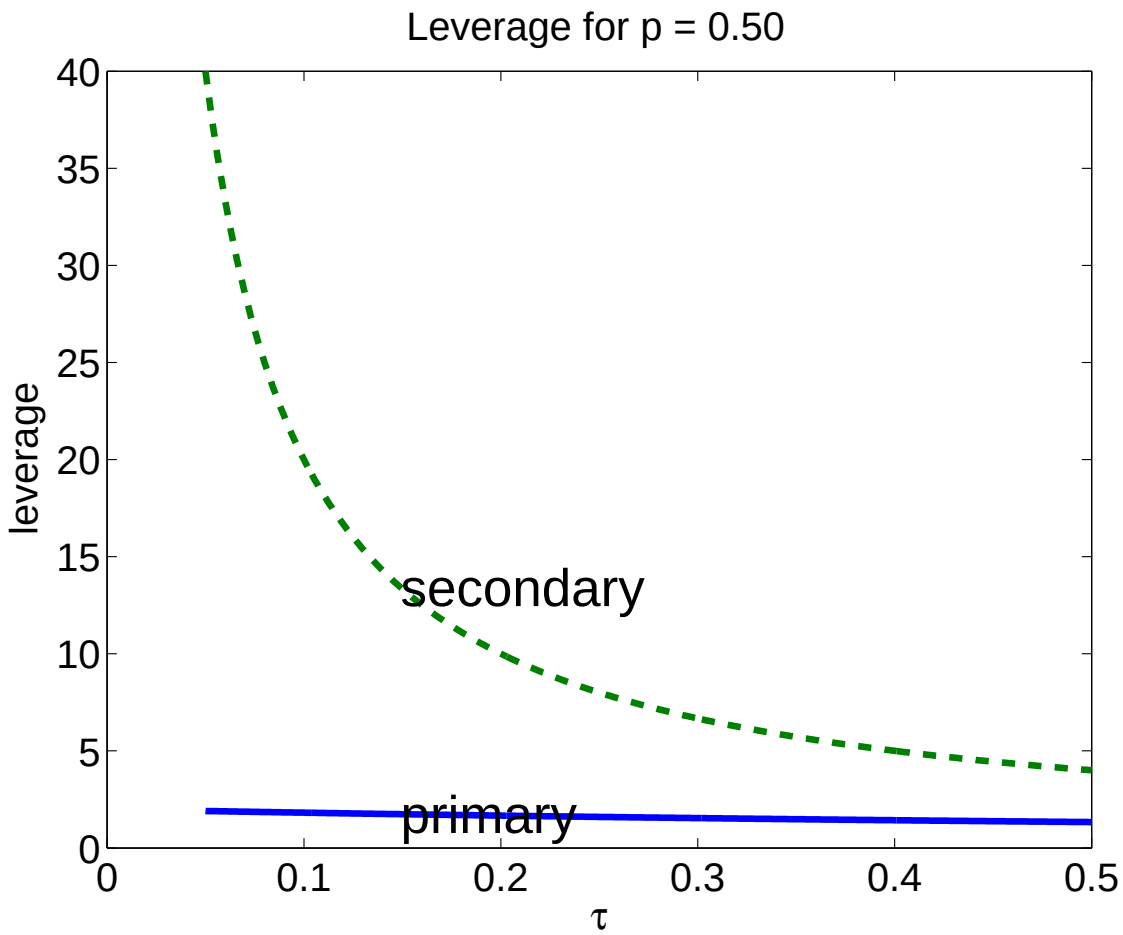
$$pL = e + (1 - \tau)pL$$

or

$$L = \frac{1}{\tau p} e$$

- Same for $p = 1$.

Leverage


Leverage for p = 0.50
leverage
τ
secondary
primary
0
5
10
15
20
25
30
35
40
0
0.1
0.2
0.3
0.4
0.5

Investment strategy

- Parameters such that it is good to be a bank, but not infinitely so.
- Always reinvest dividends.
- Get maximal leverage. Use new repos to pay off old repos.
- When exiting:
  - Sell all assets.
  - Pay off shareholders.

Loans and stock price

- $p = 1$.
- Loans:

$$L(\tau) = \frac{f(\tau)}{\tau(1 - \gamma R) - \gamma(d_s - r)} \tag{1}$$

- Assumption:

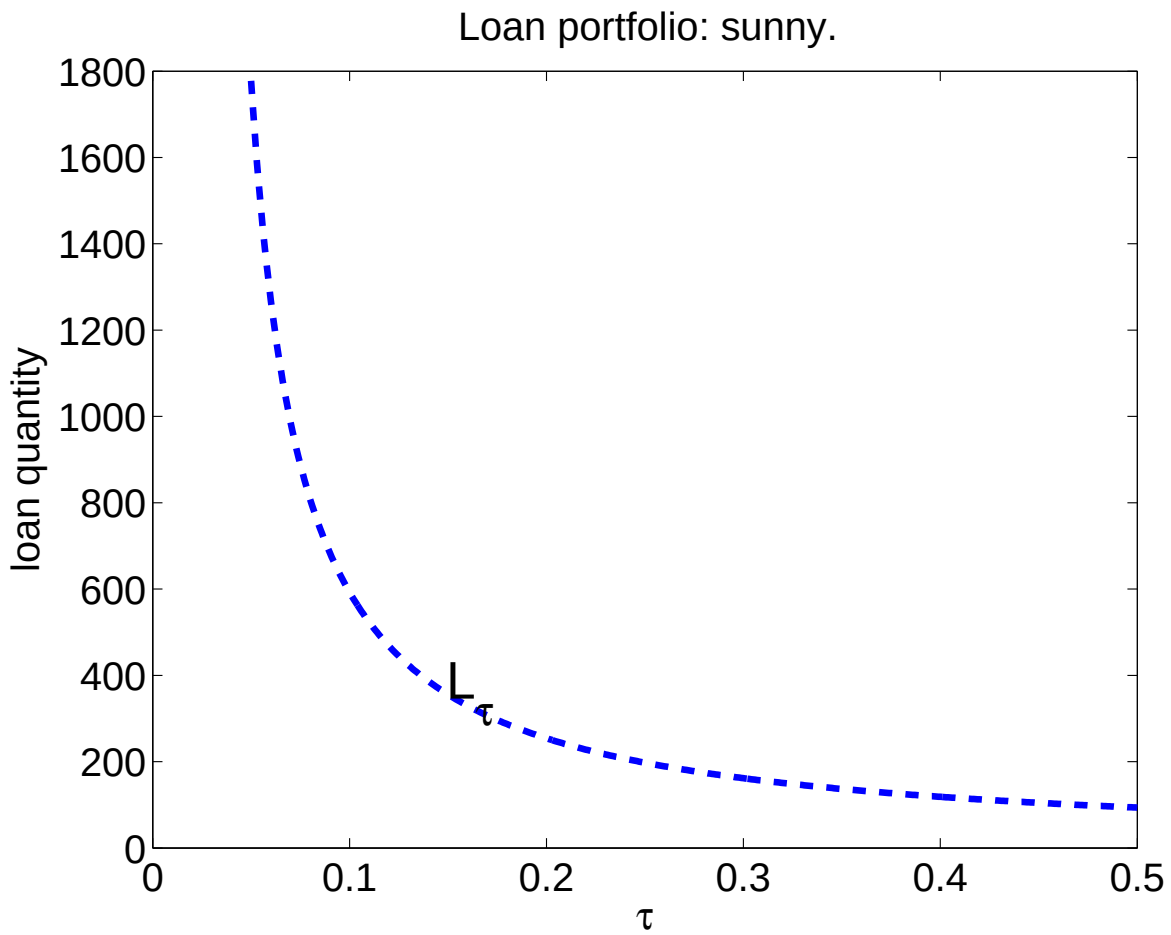
$$\tau(1 - \gamma R) - \gamma(d_s - r) > \epsilon > 0 \tag{2}$$

Parameters for Illustration

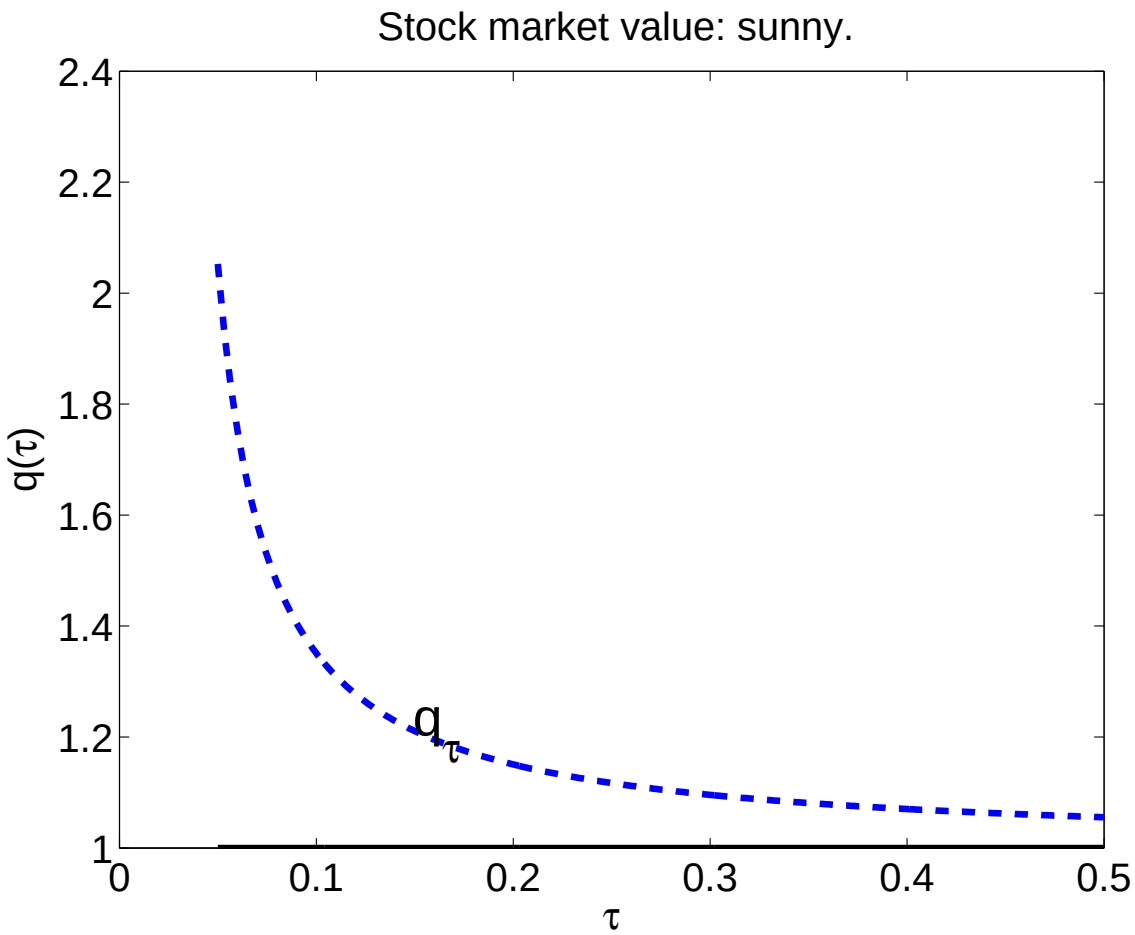
α	P("good")	0.9
γ	continuation prob. for banks	0.95
R	refinancing return	1
κ	continuation prob. for loans	0.9
$\underline{\tau}$	inverse of max. leverage	0.05
ϵ	(technical)	0.0013
d_g	dividends, "good"	0.113
d_b	dividends, "bad"	0
d_s	dividends, "sunny"	$= \bar{d}$
$r = R - \kappa$	required rate of return	0.1
$\bar{d}$	av. "rainy" dividends	0.1013

Bank creation: uniform density $f(\tau)$ on $\tau \in [0.05, 0.5]$, with $\int f(\tau) = 1$.
I.e.: leverage between 2 and 20.

Loans


Loan portfolio: sunny.
loan quantity
1800
1600
1400
1200
1000
800
600
400
200
0
0
0.1
0.2
0.3
0.4
0.5
τ
L_τ

Stock price


Stock market value: sunny.
2.4
2.2
2
1.8
1.6
1.4
1.2
1
q(τ)
0
0.1
0.2
0.3
0.4
0.5
τ
q_τ

Outline

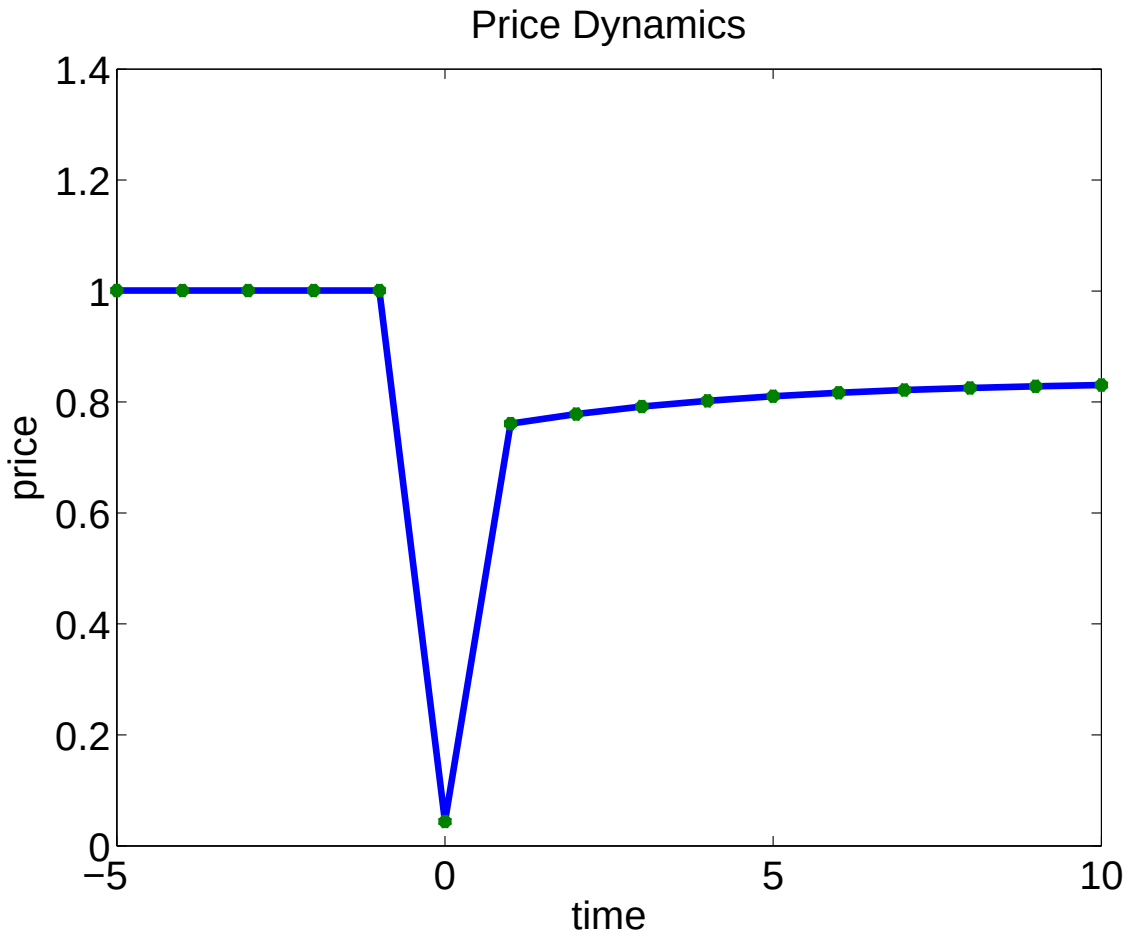
Rainy period

- Banks will sell bad loans before selling good loans.
- Banks will sell all bad loans, if price exceeds their value.

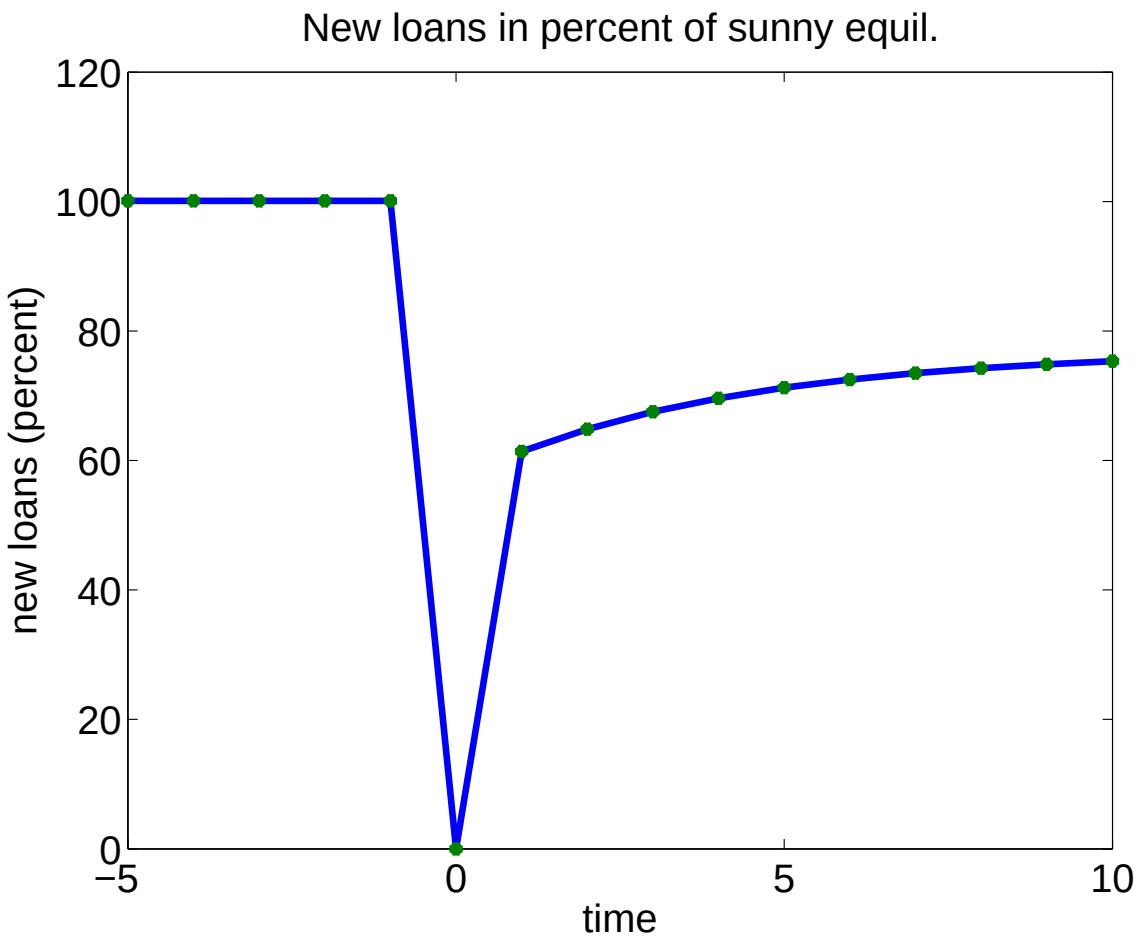
Two phases

- $t = 0$: **Cash-in-the-Market**. Price below value of bad loan. Emergency selling only.
- $t > 0$: **Adverse Selection**. Price above value of bad loan. All continuing banks sell all their bad loans.

Price dynamics (speed: conjectured)



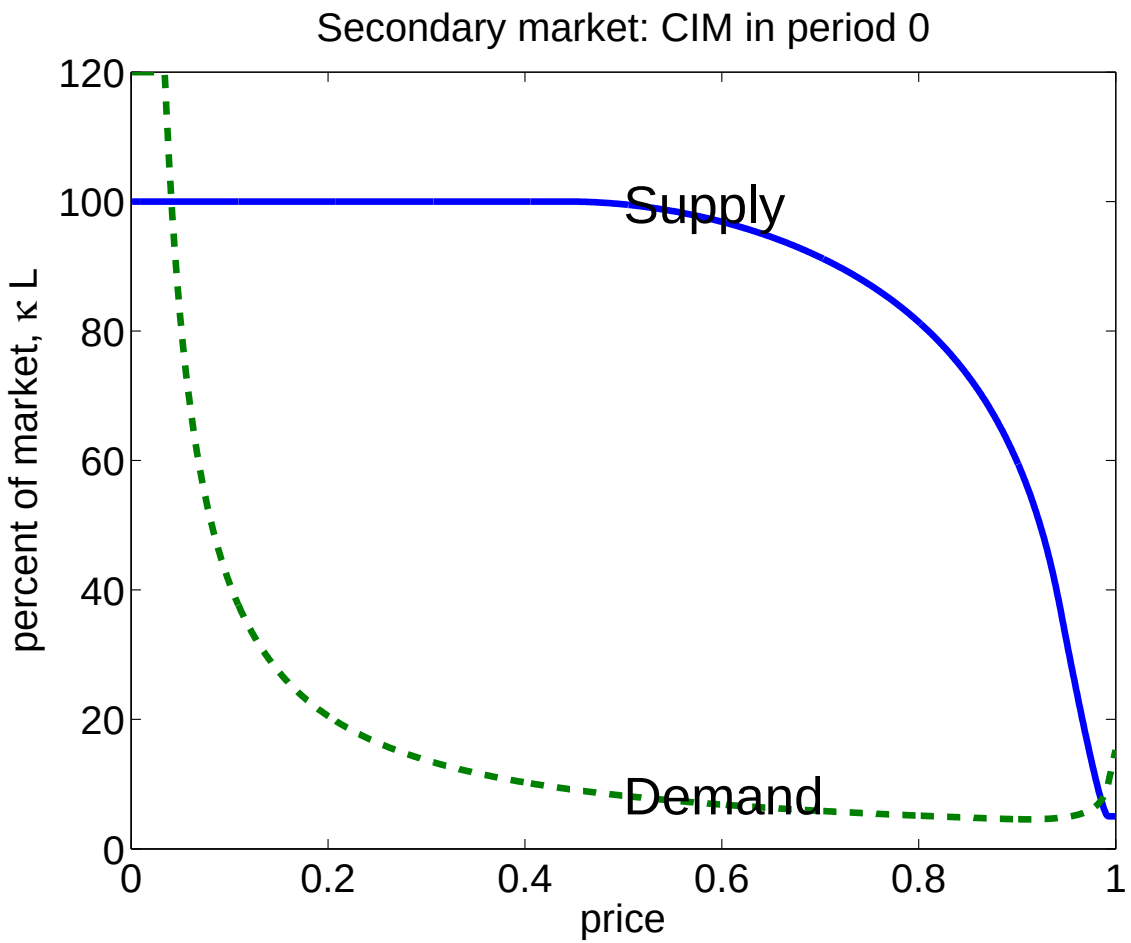
New loan dynamics (speed: conjectured)



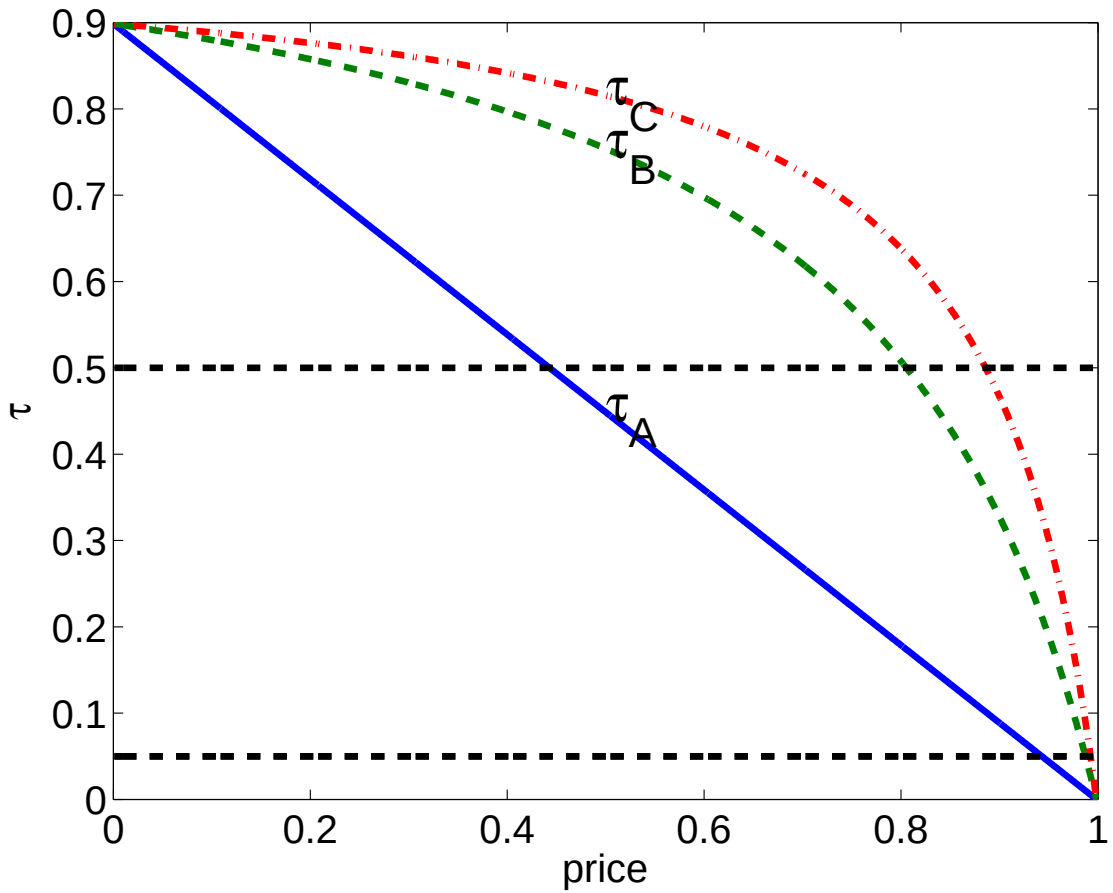
Cash in the Market Pricing, $t = 0$

- Must have: $p_0 < 1$.
- Banks have been highly leveraged. Use new loans at $p = 1$ to pay off old loans. But now, $p_0 < 1$.
- Equilibrium: price p_0, supply = demand, τ_A, τ_B, τ_C.
- $\tau \leq \tau_A$: bankruptcy.
- $\tau_A < \tau \leq \tau_B$: sell all bad loans, some good loans.
- $\tau_B < \tau \leq \tau_C$: sell some bad loans.
- $\tau_C \leq \tau$: buy loans.
- Numerics: $p_0 = 0.044$.
- Price is below value of bad loan, all sell all loans: $\tau_A > 0.5$. Demand: only the new banks.

Cash in the Market Pricing, $t = 0$



Cash in the Market Pricing, $t = 0$



Outline

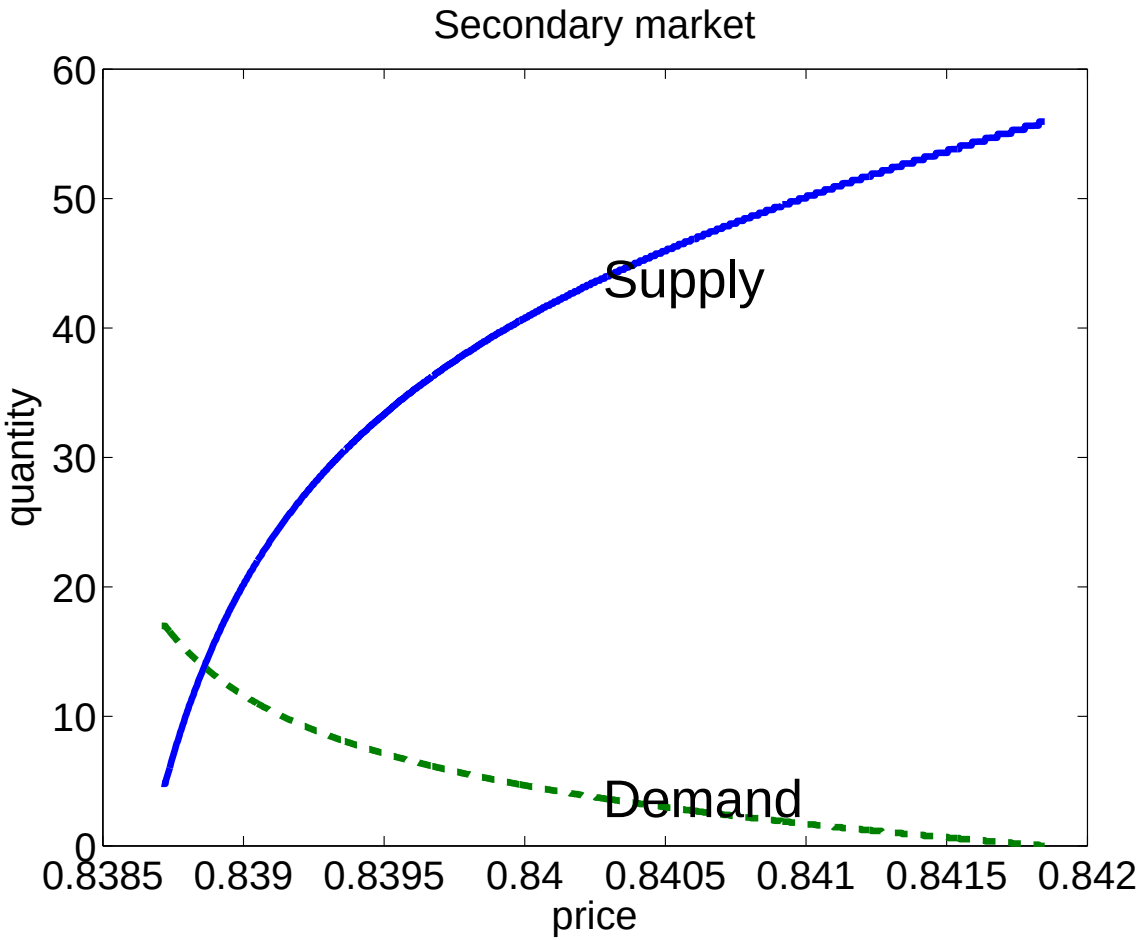
Adverse selection, $t > 0$. Steady state.

- Price above value of bad loan.
- All continuing banks sell all their bad loans.
- Mix on secondary market:

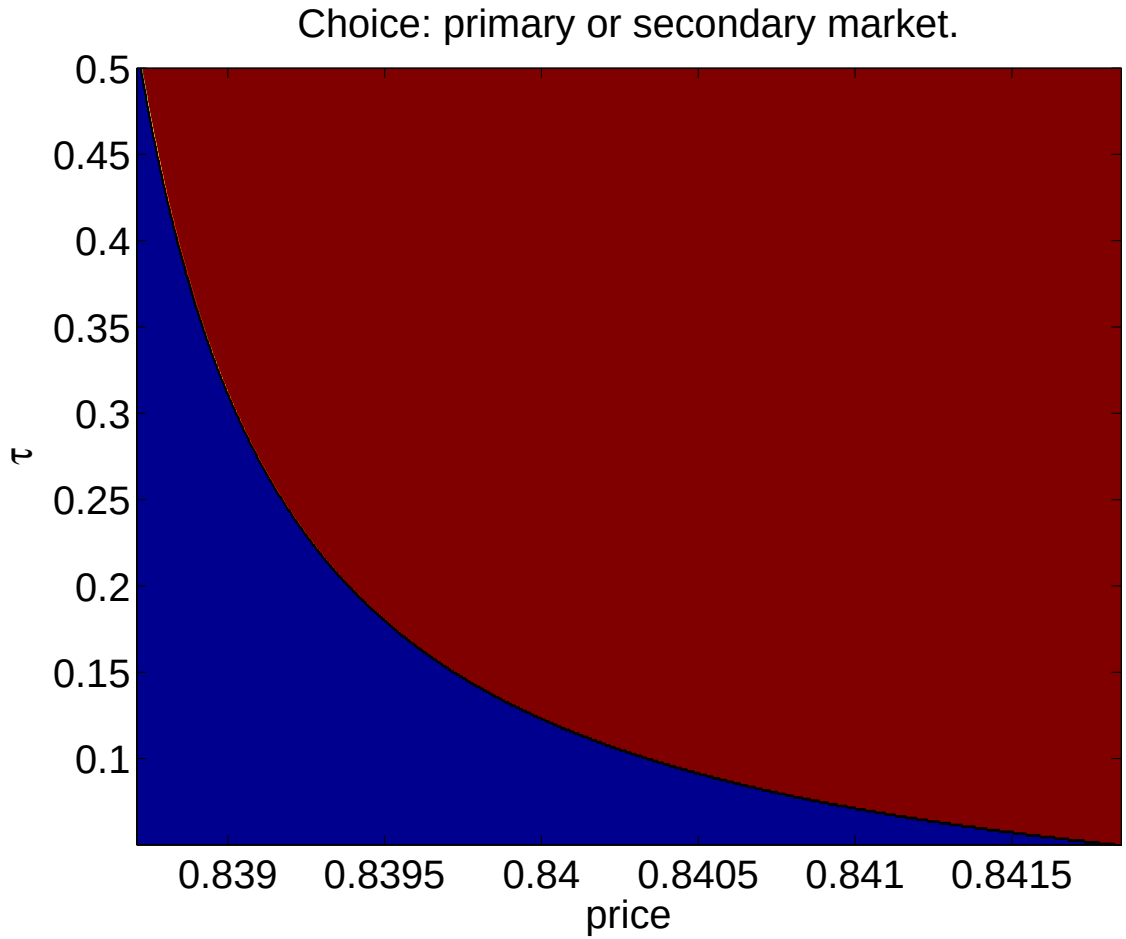
$$\tilde{\alpha} = \frac{(1-\gamma)\alpha}{1-\gamma\alpha} < \alpha$$

  Numerics: $\alpha = 0.9$, but $\tilde{\alpha} = 0.31$.
- High τ (low leverage): only primary market.
- Low τ (high leverage): only secondary market.

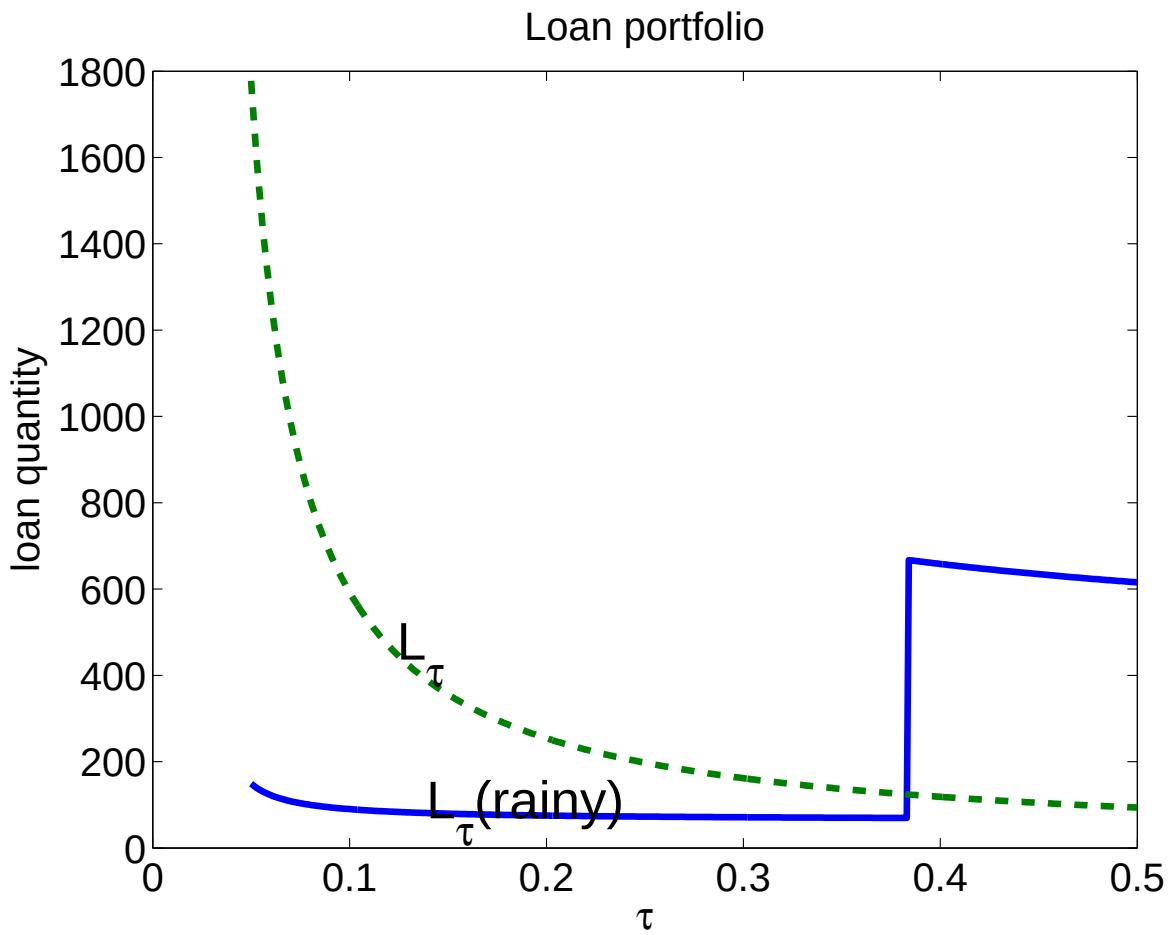
Adverse selection steady state



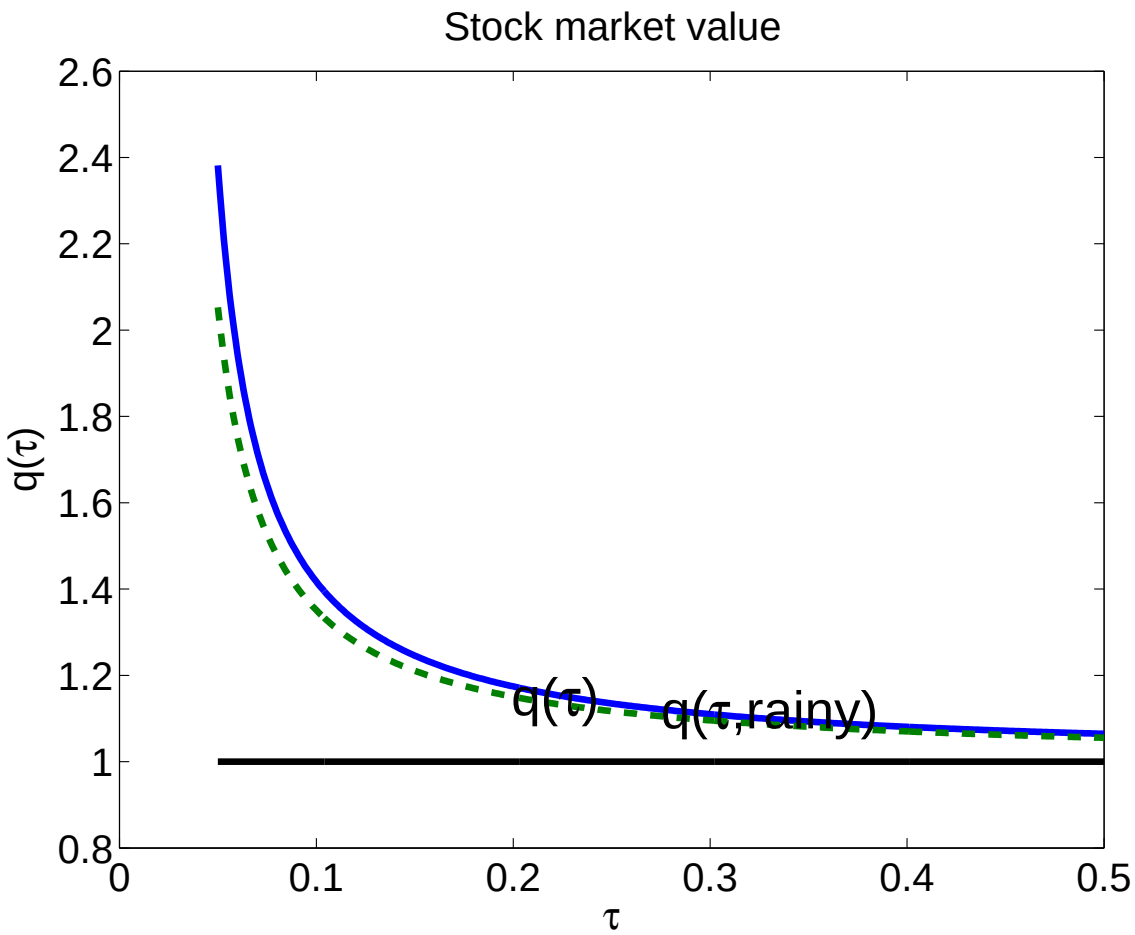
Adverse selection steady state



Adverse selection steady state



Adverse selection steady state



Numerical results

$\tilde{\alpha}$	0.31
$\tilde{\alpha}_{\text{prim}}$	0.984
$\tilde{\alpha}_{\text{sec}}$	0.756
p_0	0.044
$p_{(\textit{rainy})}$	0.839
τ^*_{rainy}	0.384
$L_{\text{rainy}}/L_{\text{sunny}}$	77.0 %

Outline

What can policy do?

- Less leverage?
  - Reduces L in "sunny" times.
  - Crash at $t = 0$, unless leverage restriction is then relaxed.
- Buy assets.
  - Excellent in $t = 0$!
  - In $t > 0$?
- Lower haircut, i.e. reduce τ.
  - Won't help much.
  - Not the issue in $t = 0$.
- Lower interest rates R.
- Reschedule loans. Very powerful in $t = 0$.
- Adverse selection steady state somewhat worse, but not much than "sunny" with d, but not much. Easy to over-correct! It may be better to live with some inefficiencies.

Conclusions

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