Interest-Rate Policy and Stability of Banking Systems

Jan Wenzelburger and Hans Gersbach

Keele University and ETH Zürich

Contents

Dewatripont & Tirole (1994)
Blum & Hellwig (1995)
Gersbach & Wenzelburger (2003)
Gersbach & Wenzelburger (MD 2008)

1 Motivation

A. Macroeconomy

- Significant increase in severe banking crises
- Costs of banking crises may become very high
- Banks are exposed to large macroeconomic risks
- When do banking crises cause long-lasting recessions?
- How can recessions be avoided?

B. Regulation

- Prevention of banking crises and recessions
- Workout of banking crises: optimal policy mix?
  - Capital adequacy
  - Interest-rate policies
  - Bail-outs
  - Quantitative easing

2 Integrated View of Banking Regulation

- Three pillars of regulation
  1. competitive framework
  2. deposit insurance with bail-outs
  3. prudential supervision

- Dynamic approach
  - overlapping generations of depositors and entrepreneurs (new funds can be paid to “old” depositors)
  - tractable explicit stochastic difference equation (random dynamical system, Arnold 1998)
  - extension to myopically optimising agents straightforward

3 The Model

- OLG, continuum of agents indexed by $i \in [0,1]$
- fraction η are potential entrepreneurs, $1-\eta$ are consumers
- endowments (short-term production)
- long-term, risky production with returns

$$\tilde{y}_i = \tilde{q}\,(1+i)\,f(e+I)$$

  - i quality of investment (private information)
  - e equity, I loan
  - $\tilde{q}$ macroeconomic shock $\tilde{q} \in [\underline{q}, \overline{q}]$

- **Intermediation Game:** n banks $(j = 1, \ldots, n)$ offer
  - deposit contracts $D(r_j^d)$
  - loan contracts $C(r_j^c, I)$
  - entrepreneurs with limited liability are **contract takers**

Entrepreneur i invests, if a loan contract is more favorable than a deposit contract

Entrepreneur i invests, if

$$\max_{1\leq j\leq n}\{\Pi(i,r_j^c)\}\geq e\max_{1\leq j\leq n}\{(1+r_j^d)\},$$

where

$$\Pi(i,r_j^c)=\int_{\mathbb{R}_+}\max\{q\,(1+i)\,f(e+I)-I(1+r_j^c),0\}\,\mu(dq)$$

- **Main assumptions:**
  - delegated monitors
  - double-sided Betrand competition (tough competition)
  - no intermediation costs
  - contracts cannot be conditioned on macroeconomic risks
  - banks cannot ration deposits
- **Regulatory instruments:**
  - deposit insurance (implicit, perceived by agents)
  - capital adequacy rules:
    intervention if equity-loan ratio too small
  - crisis intervention and recapitalisation
    * interest-rate policies
    * temporary financial relief: credit easing

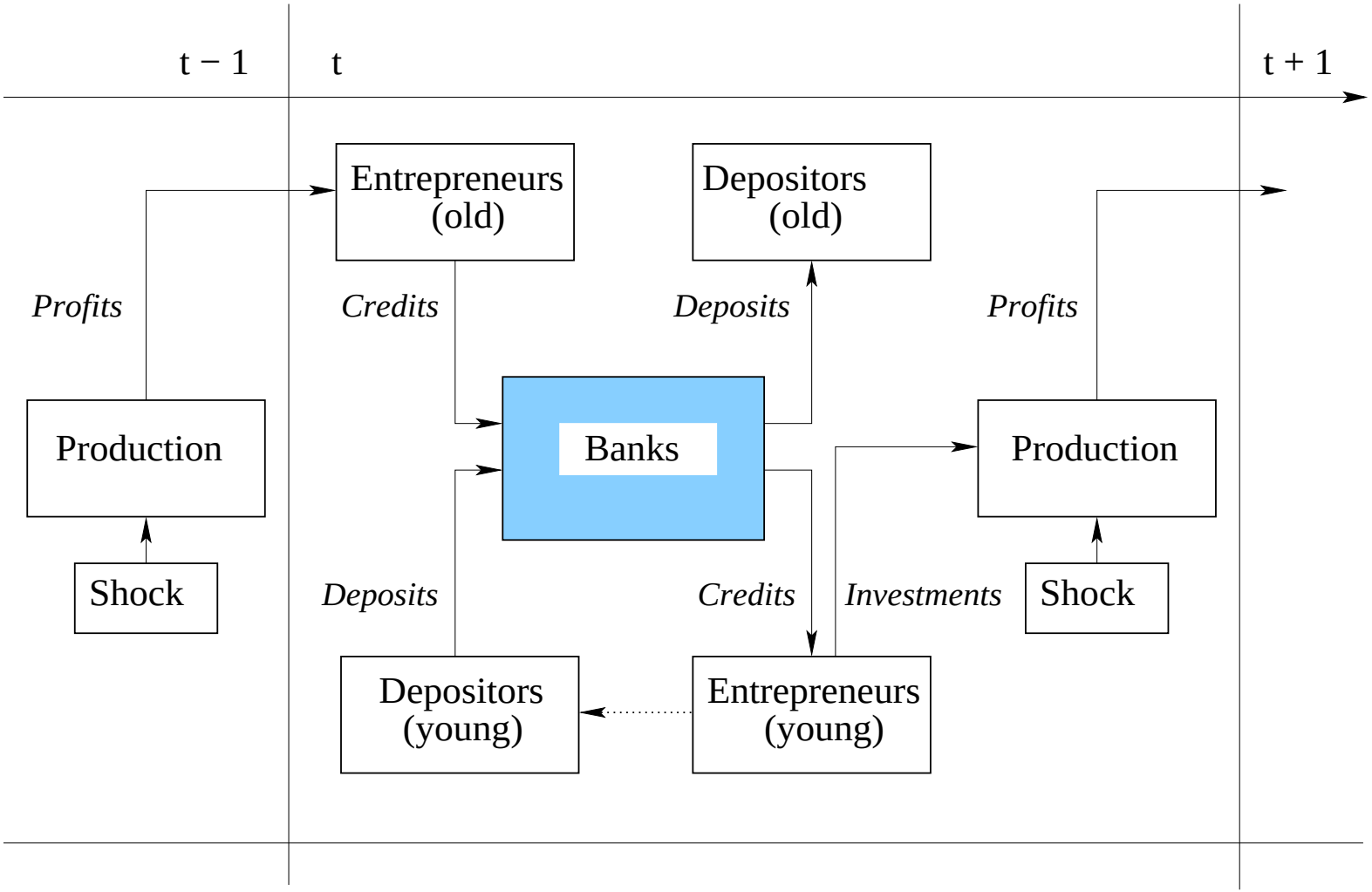


Abbildung 1: Sequential Structure

- **Time-line of actions** within a typical period t

  1. Entrepreneurs pay back with limited liability.
     Current bank capital is realized.

  2. Intermediation and regulation:

     (a) **Scenario A.**
     Banks set interest rates on deposits **and** loans.
     Strict enforcement of capital adequacy rules.
     Scenario B.
     Regulator intervenes.

     (b) Consumers and entrepreneurs decide on which contracts to accept. Resources are exchanged and banks pay back depositors.

  3. Young entrepreneurs produce subject to a macroeconomic shock.

4 Results

4.1 Intermediation game

Proposition

A. Banks set deposit and loan interest rates. Then there exists a unique **subgame-perfect equilibrium** of the intermediation game:

(i) $r^* = r_j^{c*} = r_j^{d*} \qquad j = 1, \ldots, n;$

(iii) Entrepreneurs $i \leq i^*$ save, $i > i^*$ invest;

(iii) Interest rate $r^* = r^*(d)$ determined by

$$\Pi(i^*, r^*) = e(1 + r^*),$$

where $i^* = i_E(d, r^*)$ given by

$$\left[\eta - i^*\right] I = S(r^*) + e\, i^* + d.$$

4.2 Evolution of bank capital of the banking system

Stochastic difference equation for the evolution of bank capital:

$$
\begin{aligned}
d_{t+1} &= G_*(d_t, q_t) \\
&= d_t + \underbrace{d_t r_*^d(d_t) + \underbrace{C_*(d_t)}_{\text{credit volume}} \cdot \underbrace{\left[r_*^c(d_t) - r_*^d(d_t)\right]}_{\text{risk premium}} - \underbrace{L_*(d_t, q_t)}_{\text{credit loss}}}_{\text{bank profit}}
\end{aligned}
$$

$r_*^c(d_t), r_*^d(d_t)$ ... credit- and deposit rates

Here, Betrand competition: $r_*(d) = r_*^c(d) = r_*^d(d)$

$q_t \in [\underline{q}, \overline{q}]$ ... actual shock

- Credit volume: $C_*(d_t) = \left[\eta - i_E\left(d_t, r_*(d_t)\right)\right] I$

- Repayments of entrepreneurs:

$$P_*(d_t, q_t) = \int_{i_E(d_t, r_*(d_t))}^{\eta} \min\left\{ q_t\ (1+i)\, f(e+I)\,,\, I\left[1 + r_*(d_t)\right] \right\} di,$$

- Credit losses: $L_*(d_t, q_t) = C_*(d_t)\left[1 + r_*(d_t)\right] - P_*(d_t, q_t)$

- **Aggregate income** in period t
  - given by

$$Y_t = e + \int_{i_E(d_t, r_*(d_t))}^{\eta} q_t (1+i) f(e+I)\, di$$

  - increasing in d_t for low deposit-rate elasticities

Theorem

Assumptions:

1. Positive probability for firm bankruptcies.
2. Return on assets of the banking system is too small with positive probability, that is,

$$\frac{P_*(d,q) - C_*(d)}{C_*(d)} < \left(\frac{\mathrm{Liab}_*(d)}{C_*(d)}\right) r_*(d) \quad \text{for all } d.$$

Then a **default of the banking system** occurs with **probability 1**, independently of the initial capital base of the system.

Default scenario: Downward spiral

1. Negative macroeconomic shock leads to firm bankruptcies

$$\Downarrow$$

2. Credit losses, banks' capital buffer shrinks

$$\Downarrow$$

3. Credit volume and bank profits shrink

$$\Downarrow$$

4. Capital buffer shrinks more

$$\Downarrow$$

Result: A series of negative shocks might cause a banking system to default

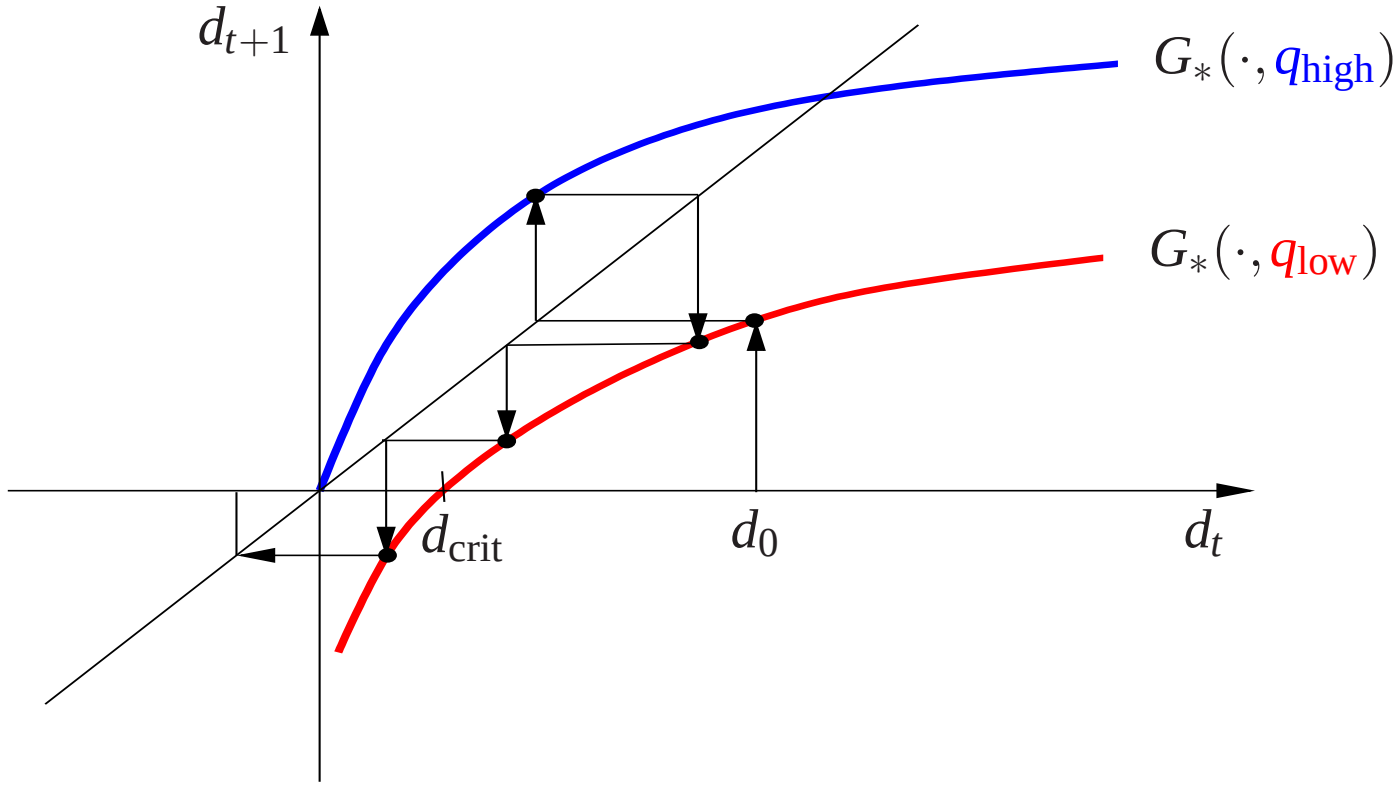


Abbildung 2: Default after shocks $\ldots, q_{\text{low}}, q_{\text{high}}, q_{\text{low}}, q_{\text{low}}, q_{\text{low}}$

Problem:

Credit volume too high despite strict enforcement of capital adequacy

- Probability for firm bankruptcy is too high
- Banking system may accumulate deficits

$\Longrightarrow$

- Crisis intervention may be necessary to recapitalize banks

Central issues:

1. Avoidance of collapse (insolvency)
2. Prevention of recessions, i.e., states with low aggregate income
3. Reversing recessions and preserving states with high aggregate income

4. Optimal policy mix of crisis intervention rules:
   (a) Strict enforcement of capital adequacy
   (b) Interest-rate intervention (cartelization)
   (c) Temporary financial relief (with radom bail-outs)

4.3 Workout of banking crises

Idea:

- Crisis intervention when capital adequacy rules are violated
- Interest-rate intervention:

  Central bank lends at a rate r^d_{CB}

- Temporary financial relief
  1. Taxing consumers and entrepreneurs
  2. Use tax revenues to recapitalise banks

B. Central bank reduces interest rate $r^d_{\text{CB}} < r^*$. Banks set loan interest rates. **Subgame-perfect equilibrium** of the intermediation game:

(i) $r^{c*}_j = r^{c*}, \quad r^{d*}_j = r^d_{\text{CB}}, \qquad j = 1, \ldots, n;$

(ii) Entrepreneurs $i \leq i^*$ save, $i > i^*$ invest.

(iii) Interest rate $r^{c*} = r^{c*}(d, r^d_{\text{CB}})$ determined by

$$\Pi(i^*, r^{c*}) = e(1 + r^d_{\text{CB}}),$$

where $i^* = i_E(d, r^d_{\text{CB}})$ is given by $\left[\eta - i^*\right] I = S + e\, i^* + d$

- **Result:**

(1) $r^{c*} > r^d_{\text{CB}}$

(2) r^{c*} is decreasing in d.

(3) r^{c*} is decreasing in r^d_{CB}.

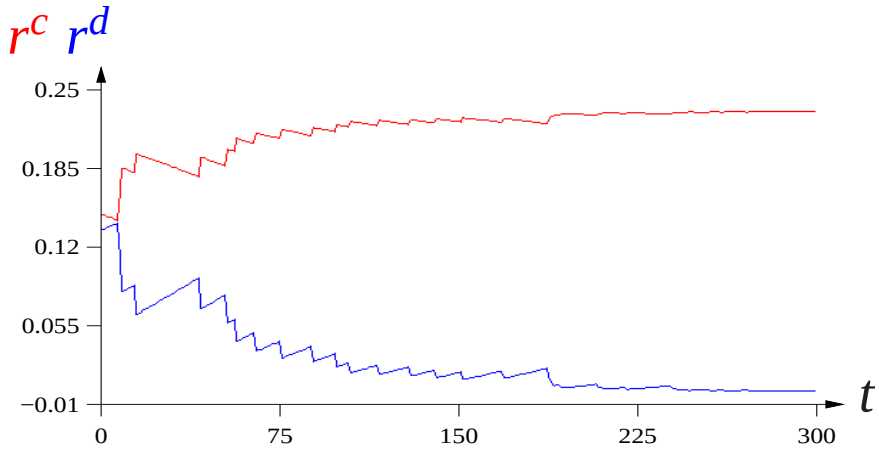
Theorem.

Suppose that there exists a critical chock q_{crit} such that the return on assets satisfies

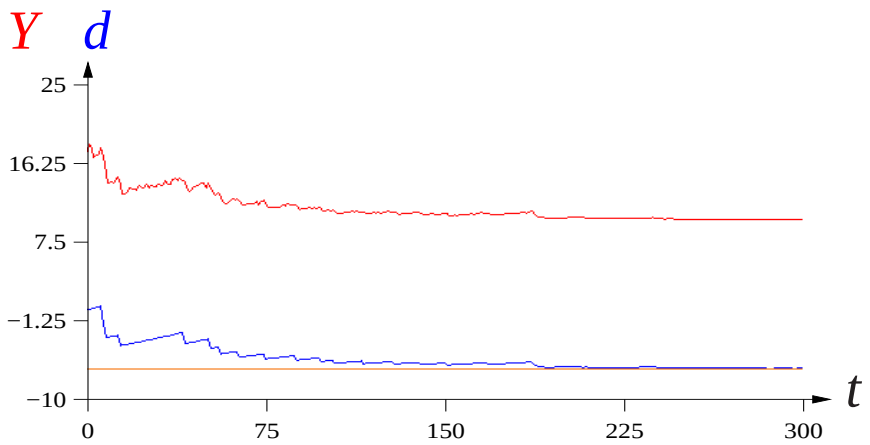
$$\frac{P\left(d, q, r^{c*}(d, r^{d}_{\text{CB}})\right)}{[\eta - i_*(d)]I} - 1 > \left(\frac{S + i_*(d)\, e}{[\eta - i_*(d)]I}\right) r^{d}_{\text{CB}}$$

for all $d \leq d_{\text{reg}}$ and all $q \geq q_{\text{crit}}$.

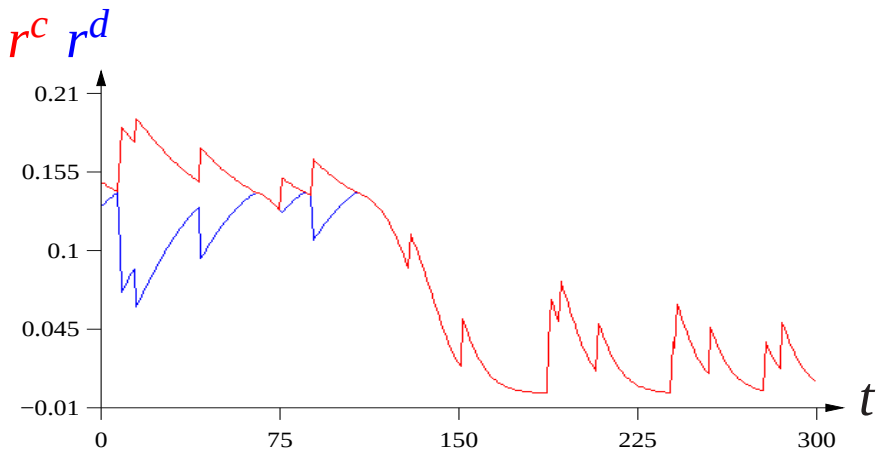
If $\text{Prob}(q \geq q_{\text{crit}}) > 0$, then for any initial capital level $d_0 \in (\underline{d}, \overline{d}]$, a banking crisis will be resolved with probability one.



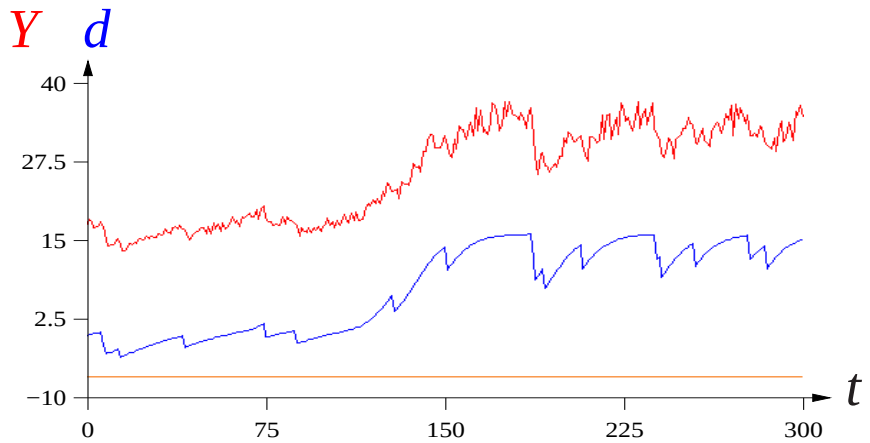
(a) Interest rates



(b) Bank equity and GDP

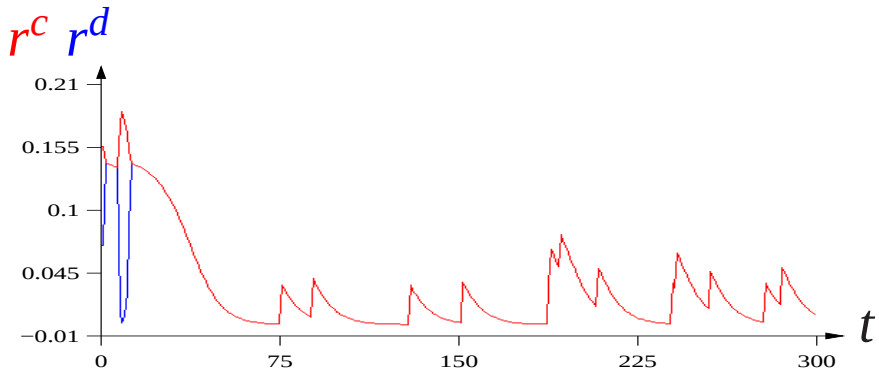


(c) Interest rates

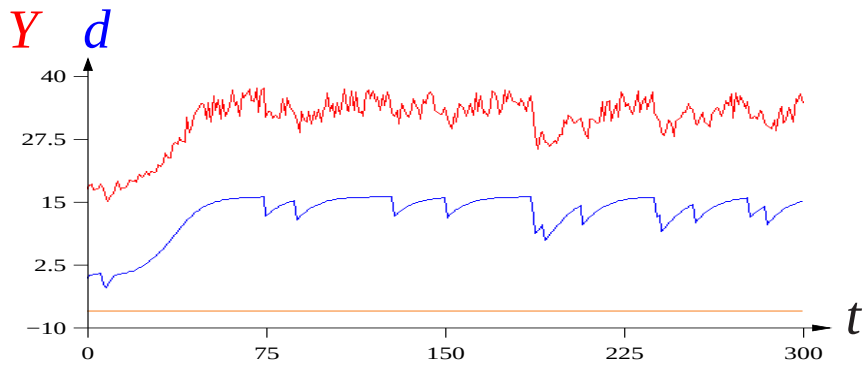


(d) Bank equity and GDP

Abbildung 3: Workout of recessions



(a) Interest rates



(b) Bank equity and GDP

Abbildung 4: Workout of recessions

Summary of results:

1. Tractable stochastic dynamic model whose long-run behavior is described by a **stationary stochastic process** (asymptotically stable random fixed point)
2. **Capital adequacy** alone is insufficient:the economy collapses with probability 1, if default probability of entrepreneurs is too high
3. **Interest rate intervention** $r^d_{\mathrm{CB}} = 0$ avoids a collapse with probability 1
4. If **average productivity** of entrepreneurs is sufficiently high, then:
   (a) recessions can be reversed
   (b) long-lasting recessions can be avoided

5 Conclusions

1. Banking crises may incur long recessions
2. Capital adequacy alone is insufficient
3. Crisis intervention needed to recapitalize banks:
   (a) Interest-rate intervention is effective
   (b) *temporary financial relief is effective*

4. **Key mechanism:**
   Increase interest-rate margin between loan and deposit rate.
   Functions like deposit rate ceiling

- Open issues
  - competitive framework
  - optimal policy mix of crisis intervention
  - risk-sensitive capital adequacy (Basel II)
  - monetary framework
  - conditional contracts