The Tipping Point: Low Rates and Financial Stability[a] [b]

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[a]Link to the paper's latest version on *www.dporcellacchia.com*.
[b]This paper represents my own views, not necessarily those of the European Central Bank.

How low can the interest rate go without a banking crisis?

Model ingredients:

1. Liquidity creation $\implies$ crisis-prone banks.
2. Outside option for depositors $\implies$ ZLB on deposit rate.
3. Eq'm net interest spread $\implies$ franchise value of deposits (FVD).

$\left.\right\}$ Diamond and Dybvig (1983)

\+ Infinite horizon $\implies$ easier to work with interest rates.

Methodological contribution: Recursive setting facilitates novel interpretation of Diamond and Dybvig (1983) in terms of net interest spread and FVD.

Results:

1. *Two steady states*: (1) Good SS with healthy banks, (2) Bad SS with failed banks.
2. *Transition mechanism*: low enough interest rate erodes FVD and tips the economy into bad SS.
3. *Tipping-point formula*: increasing in bank's net interest spread and decreasing in duration gap.

Technology, preferences and efficiency

Technology:

- *Investment technology* with per-period net return $\rho > 0$ and duration τ.
- One-period *storage technology* with net return 0.

Preferences:

- Idiosyncratic *liquidity shock*: with probability ϕ consumer becomes impatient and consumes.
- Coefficient of relative *risk aversion* $1/\alpha > 1$.

Social planner's problem:

$$\max_{\{C_t^i\}_{t=0}^{+\infty}} \sum_{t=0}^{+\infty} \phi \cdot (1-\phi)^t \cdot u(C_t^i) \tag{1}$$

subject to:

$$\sum_{t=0}^{+\infty} \left(\frac{1-\phi}{1+\rho}\right)^t \cdot \phi \cdot C_t^i = \sum_{\tau=0}^{+\infty} \frac{\tilde{K}_0(\tau)}{(1+\rho)^\tau} \equiv K_0. \tag{2}$$

$\rightarrow$ *First-order condition*: $\frac{C_{t+1}^i}{C_t^i} = (1+\rho)^\alpha$.

Decentralised economy

Agents and key decisions:

- *Consumer*: deposit-withdrawal decision.
- *Bank*: deposit-rate decision.

Financial friction: Deposits.

- *Non-contingent* unless bank fails.
- *Convertible* on demand.
  - If bank fails, *pro-rata* distribution of bank's resources.

Fundamental runs: as long as model-consistent, consumers are *optimistic*.

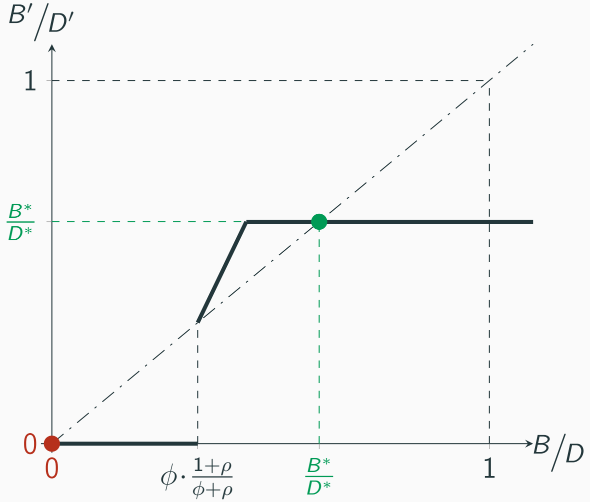
- No self-fulfilling expectations of banking crises.

Multiple steady states

- $B \equiv$ bank's financial assets. $D \equiv$ bank's outstanding deposits. $d \equiv$ deposit rate.

$$\frac{B'}{D'} = \begin{cases} \frac{1+\rho}{1+d} \cdot \frac{\frac{B}{D}-\phi}{1-\phi} & \text{if } \frac{B}{D} \geq \phi \cdot \frac{1+\rho}{\phi+\rho}, \\ 0 & \text{otherwise,} \end{cases} \tag{3}$$

$$d = d(B, D). \tag{4}$$



- Good SS (*) features efficient allocation, i.e. $1+d^* = (1+\rho)^\alpha$.

Bank balance sheet in good SS

- ○ $s \equiv \frac{1+\rho}{1+d}$, bank's net interest spread (NIS).

In good SS, deposits are partly backed by FVD ($\equiv f \cdot D$).

- Necessary for liquidity creation, i.e. $D^* > B^*$.

Assets	Liabilities
B^*	D^*
$f^* \cdot D^*$	

$$f^* = \underbrace{\frac{1-\phi}{\phi+s^*}}_{\text{Average time to withdrawal}} \times \underbrace{s^*}_{\text{Net interest spread}} \qquad (5)$$

→ Erosion in FVD leads to negative equity and convergence to bad SS.

Tipping point $\underline{\rho}$

- Economy on good SS hit by *unexpected permanent interest-rate shock*: $\rho \to \rho'$.

Mechanism. $\rho \downarrow$ has two opposing effects:

1. *FVD erosion*: $f \downarrow$ because $d \geq 0$.
2. *Asset revaluation*: $B \uparrow$ because duration gap $\Delta > 0$.

Proposition
An economy starting on the good SS converges to the bad SS if and only if $\rho' < \underline{\rho}$, where

$$\underline{\rho} = s^* - \frac{1}{a} \cdot \Delta^* \tag{6}$$

with

$$a = \underbrace{\frac{f^*}{1-f^*}}_{\substack{\text{Incidence} \\ \text{of FVD}}} \times \underbrace{\frac{\mathrm{d}f^*/\mathrm{d}s^*}{f^*}}_{\substack{\text{Sensitivity of} \\ \text{FVD to NIS}}} \times \underbrace{\left[\ln\left(1+d^*\right)\right]^{-1}}_{(\text{deposit rate})^{-1}} > 0. \tag{7}$$

Bank's recursive problem

- For simplicity, case with no initial storage.

Value function:

$$V(B,D)=\begin{cases} u(B) & \text{if } \frac{B}{D}<\phi\cdot\frac{1+\rho}{\phi+\rho},\\ \phi\cdot u(D)+(1-\phi)\cdot V\left(B',D'\right) & \text{otherwise,}\end{cases} \tag{8}$$

subject to:

$$\frac{1-\phi}{1+\rho}\cdot B'=B-\phi\cdot D, \tag{9}$$

$$D'=\left[1+d\left(B,D\right)\right]\cdot D. \tag{10}$$

- If bank's financial assets B too low, banking crisis takes place regardless of the deposit rate.

Policy function:

$$1+d(B,D)=\max\left\{(1+\rho)^{\alpha}\cdot\left(\frac{B}{D}-\phi\right)\cdot\frac{(1+\rho)^{1-\alpha}-(1-\phi)}{\phi\cdot(1-\phi)},1\right\}. \tag{11}$$

- Notice the ZLB on deposit rate. Bank wants to avoid triggering withdrawals.

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