The Tipping Point: Low Rates and Financial Stability\textsuperscript{a} \textsuperscript{b}

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\textsuperscript{a}Link to the paper’s latest version on www.dporcellacchia.com.
\textsuperscript{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).

+ 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 $\tau$.
- One-period storage technology with net return 0.

Preferences:
- Idiosyncratic liquidity shock: with probability $\phi$ consumer becomes impatient and consumes.
- Coefficient of relative risk aversion $\frac{1}{\alpha} > 1$.

Social planner’s problem:

$$\max \left\{ \sum_{t=0}^{+\infty} \phi \cdot (1-\phi)^t \cdot u(C_t^i) \right\}$$

subject to:

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

$\rightarrow$ 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.

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

$$d = d(B, D). \quad (4)$$

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

- $s \equiv \frac{1+\rho}{1+\delta}$, 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. $D^* > B^*$.

\[
\begin{array}{c|c}
\text{Assets} & \text{Liabilities} \\
\hline
B^* & D^* \\
\hline
f^* \cdot D^* & f^* = \frac{1-\phi}{\phi+s^*} \times s^* \quad (5)
\end{array}
\]

$\phi$ Average time to withdrawal

$\phi+s^*$ Net interest spread

→ Erosion in FVD leads to negative equity and convergence to bad SS.
Tipping point $\rho$

- Economy on good SS hit by unexpected permanent interest-rate shock: $\rho \rightarrow \rho^\prime$.

**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 $\rho' < \rho$, where

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

(6)

with

$$a = \frac{f^*}{1 - f^*} \times \frac{df^*/ds^*}{f^*} \times \left[\ln \left(1 + d^*\right)\right]^{-1} > 0.$$  

(7)

Incidence of FVD
Sensitivity of FVD to NIS
(deposit rate)$^{-1}$
Bank’s recursive problem

- For simplicity, case with no initial storage.

Value function:

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

subject to:

\[
\frac{1 - \phi}{1 + \rho} \cdot B' = B - \phi \cdot D, 
\] (9)

\[
D' = [1 + d(B, D)] \cdot D. 
\] (10)

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

Policy function:

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

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