Maintaining Central-Bank Solvency under New-Style Central Banking

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The Past and Future of Monetary Policy

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New-style central banking

CB borrows from banks by issuing reserves and invests in long-term bonds
NEW-STYLE CENTRAL BANKING

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Highly profitable carry trade—central banks are successful hedge funds

But when interest rates rise, capital losses on bonds plus higher rate paid on reserves could cause trouble.
Our approach

Study the issue in a model founded on modern financial economics
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Assume inflation stabilization and reserve rate equal to short nominal rate on other safe debt
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Assume a central government able to satisfy its intertemporal BC without resort to inflationary finance
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Assume a central government able to satisfy its intertemporal BC without resort to inflationary finance

Previous work focused mainly on projections, not on CB in RE equilibrium
Evolution of reserves

\[ V' = (1 + r_s)V + q_s'[B_{s'} - (1 - \delta)B_s] - c_sB_s - n_{s,s'} + d_s' \]
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\[ \nabla(y_{s'}) = \text{present value of random future payoff} \]
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EVOLUTION OF RESERVES

\[ V' = (1 + r_s)V + q_s'[B_{s'} - (1 - \delta)B_s] - c_sB_s - n_{s,s'} + d_{s'} \]

\[ \nabla(y_{s'}) = \text{present value of random future payoff} \]

\[ q_s = \nabla(c_s + (1 - \delta)q_{s'}) \]

\[ n_{s,s'} = \frac{p'N_{s'} - pN_s}{p'} \]
Dividends based on net worth

\[ W = q_s B_s - V - N_s \]
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\[ d_{s'} = \left( c_s + q_s' - \frac{q_s}{1 + \pi_s} - \delta q_s' \right) B_s - \frac{i_s V}{1 + \pi_s} \]
DIVIDENDS BASED ON NET WORTH

\[ W = q_s B_s - V - N_s \]

\[ p'W' = pW \]

\[ d_{s'} = \left( c_s + q_{s'} - \frac{q_s}{1 + \pi_s} - \delta q_{s'} \right) B_s - \frac{i_s V}{1 + \pi_s} \]

\[ V_s = q_s B_s - N_s \]
No re-capitalization, dividends keep nominal net worth constant

\[ W' = \frac{W}{1 + \pi_s} - z' \]
Deferral and catchup

\[ d' = \max(y' - D, 0) \]
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\[ D' = \min \left( \bar{D}, \frac{1}{1 + \pi_s} (D - \max(y' - d', 0) + \max(-y', 0)) \right) \]
Deferral and catchup

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\[ D' = \min \left( \bar{D}, \frac{1}{1 + \pi_s} (D - \max(y' - d', 0) + \max(-y', 0)) \right) \]

\[ Z' = \frac{1}{1 + \pi_s} Z + d' - y' \]
## Inputs from Data

<table>
<thead>
<tr>
<th>State number</th>
<th>Safe rate, ( r )</th>
<th>Bond holdings, ( B )</th>
<th>Currency, ( N )</th>
<th>Inflation, ( p'/p-1 )</th>
<th>Reported income, ( y )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.039</td>
<td>0.0079</td>
<td>0.0504</td>
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# Real Interest Rate, Marginal Utility, and Delta-Bond Price

<table>
<thead>
<tr>
<th>State</th>
<th>Safe rate, ( r )</th>
<th>Marginal utility, ( \mu )</th>
<th>Coupon, ( c )</th>
<th>Bond price, ( q )</th>
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</table>
Interest Rate and Bond Price

Year | Bond price, dollars | Nominal interest rate, percent
----|---------------------|-----------------------------
State 1: Normal | 
State 5: Crisis | 
State 3: Normal | 

Bond price, dollars

Nominal interest rate, percent
The Values of the Fed’s Bond Holdings and Reserves Outstanding, Billions of Dollars

- **State 1:** Normal
- **State 5:** Crisis
- **State 3:** Normal

Value of bonds and value of reserves over the years (0 to 3,000 for bonds, 0 to 1,500 for reserves)
Components of the Fed’s Dividend to the Treasury
Flows Into and Out of Reserves

<table>
<thead>
<tr>
<th>Year</th>
<th>Interest on reserves</th>
<th>Bond cost</th>
<th>Coupon receipts</th>
<th>Seignorage</th>
<th>Dividend payments</th>
</tr>
</thead>
<tbody>
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State 1: Normal
State 5: Crisis
State 3: Normal
How the $D$ Account Generates a Speedy Elimination of Extra Reserves from a Capital Loss

<table>
<thead>
<tr>
<th>Year</th>
<th>Net income, $y$</th>
<th>Balance in D account and extra reserves $Z$</th>
<th>Dividends</th>
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</thead>
<tbody>
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<td>17</td>
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</tbody>
</table>

State 1: Normal
State 5: Crisis
State 3: Normal
COMPONENTS OF DIVIDENDS WITH BOND DEFAULT

- Coupon less depreciation
- Capital gain
- Interest on reserves
- Dividend
## Inputs for ECB version

<table>
<thead>
<tr>
<th>State number</th>
<th>Safe rate, $r$</th>
<th>Repos, $Br$</th>
<th>Direct bond holdings, $Bd$</th>
<th>Currency, $N$</th>
<th>Coupon, $c$</th>
<th>Bond price, $q$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.978</td>
<td>0.049</td>
<td>0.018</td>
<td>0.058</td>
<td>1.000</td>
<td>6.364</td>
</tr>
<tr>
<td>2</td>
<td>-1.067</td>
<td>0.077</td>
<td>0.064</td>
<td>0.088</td>
<td>1.000</td>
<td>6.767</td>
</tr>
</tbody>
</table>
**Net Income Under Alternative Scenarios**

The graph illustrates the net income under different scenarios for two states: State 1: Normal and State 2: Crisis. It compares net income with full holdings, only direct holdings, and with an option on repos.

- **State 1: Normal**
  - With full holdings
  - Only direct holdings
  - With option on repos

- **State 2: Crisis**

The graph shows the net income over a period of years, with a significant drop in Year 7 and a recovery towards the end.
Balance in D account and extra reserves Z

![Graph showing balance changes over years for different states and holdings options](image)
Conclusions

1. If the central bank has a draw on the treasury when its income is negative, reserves are stationary and the central bank is always solvent.

2. Under old-style central banking, with no interest on reserves and short-term assets, net income is always positive and solvency issues never arise.

3. Focus on $d < 0$. If the treasury does not pay in, the prospect of insolvency cannot be eliminated, even if a deferred account lowers its probability.

4. Absent complete meltdown with defaults on bonds, the problem is not entering or staying in crisis, it is the recovery period, when losses on bond portfolio occur.

5. Fed and ECB seem in good shape right now. ECB is not nearly as exposed to interest-rate increases.