Why Prices Don’t Respond Sooner to a Prospective Sovereign Debt Crisis

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Preliminary. Comments Welcome. These are our own personal views.
Introduction

Fiscal problems

- Govt. Debt/GDP
- Long-term Bond Yields
- Short-Term Interest Rate
- Core Inflation

Braun and Nakajima

Why Prices Don’t Respond Sooner to a Prospective Sovereign Debt Crisis
Resolutions

- It seems fairly obvious that the current level of deficit spending in Japan and U.S. cannot be sustained for ever.

- Possible resolutions:
  1. Increase taxes (or reduce spending);
  2. fail to increase taxes (sovereign debt crisis):
     - inflation?
     - payment suspension?

- Is the second scenario a realistic possibility?
  - If so, how can we explain the current state of Japan or the U.S. with
    - stable or declining prices;
    - high government-bond prices;
    - high yen rate, etc?
Our message

- The fact that inflation and bond yields are low today does not mean that the risk of a debt crisis is low.
- The current situations in Japan and the U.S. are perfectly consistent with the view that there is a non-negligible probability of a sovereign debt crisis.
How we make our point

Consider two types of default (separately):

1. Implicit default via inflation (fiscal theory of the price level);
2. Explicit default on long-term government debt.

Compare two specifications:

1. Frictionless asset markets (complete markets);
2. Financial frictions.

Agents have heterogenous beliefs about the probability of default.

Financial frictions are modeled as in Geanakoplos (2003,2010):

- no contingent claims are traded;
- agents can borrow to purchase govt debt;
- govt debt cannot be short sold.
Properties of the model

- **Complete markets:**
  - Prices respond instantly to news about the possibility of a debt crisis.
  - Inflation smoothing.

- **Financial frictions:**
  - No response of price to news about the possibility of a debt crisis.
  - Price responses are concentrated in states immediately prior to default state.

- **Key in our model with financial frictions:**
  - Some individuals want to use leverage to purchase govt debt;
  - Others do not want to purchase govt debt by themselves, but are willing to lend to those who buy it.

- In reality, a large proportion of sovereign debt is held by leveraged financial institutions.
Our model builds on the following two strands of literature:

1. Fiscal theory of the price level (FTPL):
   - Leeper (1991); Sims (1994); Woodford (1994); Cochrane (2001); Bassetto (2002); etc.

2. Collateral, beliefs, and leverage:
   - Geanakoplos (1997, 2003, 2010); Fostel and Geanakoplos (2008); Geanakoplos and Zame (2009), Simsek (2010), etc.
Fiscal theory of the price level

- “Naive” assumptions made in the standard FTPL:
  - The government commits to a fixed sequence of real tax revenues, \( \{ T_t \} \).
  - Such a commitment is made both in and out of the equilibrium path.
  - The price level “adjusts” so that the govt budget constraint holds.

- Criticism against the FTPL by Bassetto (2002):
  - It is impossible to consider “out of the equilibrium path” in the Walrasian framework assumed in the FTPL.
  - Bassetto (2002) considers a market game and finds that a version of the FTPL holds.

- For simplicity, here we follow the naive version of the FTPL, but it is straightforward to build a market game similar to Bassetto’s for our model.
Theory of leverage by Geanakoplos

- Conditions of loans:
  - interest rate;
  - collateral;
  - collateral rate.

- How can the interest rate and the collateral rate be determined in markets simultaneously?
  - That is, how can one demand-equals-supply equation for a loan determine two variables — the interest rate and the collateral rate?

- Geanakoplos has developed a competitive-equilibrium framework determining the interest rate and the collateral rate for loans simultaneously.
  - The key is to consider loans with different collateral rates as different assets.

- In our model only one type of loans are traded in equilibrium, whose collateral rate is given by the ‘no-default constraint.’
Some evidence

- Rheinhart and Rogoff (2010) find that the probability of sovereign debt crises goes up following:
  - banking crises;
  - sharp increases in government and external debt.

- Nieto Parra (2008):
  - Investment banks demand higher underwriting fees 1 to 3 years before debt crisis.
  - Bond spreads do not respond to the news and remain stable up to the crisis.

- Lau (2003): Argentine CDS only increase about 2 months prior to IMF package and 15 months prior to default.

- Greek sovereign debt spread first increased to 2 percent in December 2008 about 16 months before their request for funds from EU/IMF.
Plan of the talk

1. Introduction
2. Implicit default: 2 period model
3. Implicit default: $T$-period model
4. Explicit default
5. Discussion
6. Concluding remarks
1 Introduction

2 Implicit default: 2 period model

3 Implicit default: $T$-period model

4 Explicit default

5 Discussion

6 Concluding remarks
Model

- Two periods: \( t = 0, 1 \).
- Two states at date 1: \( s_1 \in \{U, D\} \).
  - Notation: \( s^0 \in S^0 = \{0\} \) and \( s^1 = s_1 \in S^1 = \{U, D\} \).
- More generally, \( s_t \) denotes the shock realized in period \( t \) and \( s^t \) denotes the history of shocks.
- States are distinguished by the amount of taxes:
  \[
  T_1 = \begin{cases} 
  T_H, & \text{if } s_1 = U, \\
  T_L, & \text{if } s_1 = D \quad \text{(debt crisis)}.
  \end{cases}
  \]
  where \( T_L \ll T_H \).
- A continuum of agents \( h \in [0, 1] \).
  - At date 0, agent \( h \) believes that \( s_1 = U \) with probability \( h \).
  - Agents are identical except for their beliefs.
Implicit default: 2 period model

Event tree

\[ T_0 = 0 \]
\[ T_1 = T_H \]
\[ 1 - h \]
\[ T_1 = T_L \]
Implicit default: 2 period model

Individuals

- Preferences:

\[ c_0 + \sum_{s^1 \in S^1} \gamma^h(s^1)c(s^1) \]

where \( \gamma^h(s^1) = \) subjective probabilities given by

\[ \gamma^h(s^1) = \begin{cases} 
  h, & \text{for } s_1 = U, \\
  1 - h, & \text{for } s_1 = D.
\end{cases} \]

- Endowments:

  - \( y_0 \) at date 0, and \( y_1 \) at date 1 (for all \( s^1 \in S^1 \)).

- Storage technology:

  - Gross real rate of return = \( R \) (riskfree).
Government

- Flow budget constraint:

\[ \bar{B} = P_0 T_0 + q_0 B_0, \]

\[ B_0 = P(s^1) T(s^1), \quad \text{for } s^1 \in S^1. \]

where \( \bar{B} \) = initial amount of govt debt (nominal); \( B_0 \) = amount of govt bonds issued at date 0; \( P(s^t) \) = price level at date-event \( s^t \); \( q_0 \) = nominal price of govt bonds at date 0.

- Monetary policy: the nominal interest rate, \( \frac{1}{q_0} \).

- Fiscal policy: real amount of taxes collected in each period:

\[ T_0 = 0, \]

\[ T(s^1) = \begin{cases} T_H, & \text{if } s^1 = U, \\ T_L, & \text{if } s^1 = D. \end{cases} \]
Implicit default: 2 period model

Three market structures

1. **“complete markets”**
   - asset markets without frictions.
     - complete set of contingent claims with a “natural debt limit.”

2. **“no borrowing”**
   - two assets:
     - govt bonds, and storage.
   - frictions:
     - no borrowing;
     - no short sales of govt bonds.

3. **“leverage”**
   - three assets:
     - govt bonds, storage, and loans.
   - frictions:
     - agents can borrow to purchase govt debt;
     - borrowing is limited by the “no-default constraint.”
     - no short sales of govt debt.
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Implicit default: 2 period model
- Complete markets
- Financial frictions: no borrowing
- Financial frictions: leverage
- Numerical example

Implicit default: $T$-period model

Explicit default

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Complete Markets

- frictionless asset markets:
  - complete set of contingent claims (Arrow securities) are traded under the mildest possible debt limit (natural debt limit).
- Arrow security \((s^1|s^0)\):
  - traded at \(s^0\) and pays off one unit of account in period 1 iff \(s^1\) occurs.
  - \(b^h(s^1|s^0)\) = quantity of Arrow security \((s^1|s^0)\) purchased by individual \(h\).
  - \(q(s^1|s^0)\) = price of Arrow security \((s^1|s^0)\).
- Govt bonds pay one unit of account at every state in period 1.
  - No arbitrage condition:

\[
q_0 = \sum_{s^1 \in S^1} q(s^1|s^0).
\]
Individual $h$

- Utility maximization problem of agent $h$:

$$\max \ c_0 + \sum_{s^1 \in S^1} \gamma^h(s^1) c(s^1)$$

subject to

$$c_0 + k_0 + \sum_{s^1 \in S^1} q(s^1|s^0) \frac{b(s^1|s^0)}{P_0} + q_0 \frac{b_0}{P_0} \leq \frac{\bar{B}}{P_0} + y_0,$$

$$c(s^1) \leq y_1 - T(s^1) + \frac{b(s^1|s^0)}{P(s^1)} + \frac{b_0}{P(s^1)} + Rk_0, \quad s^1 \in S^1,$$

$$c_0, k_0, b_0, c(s^1) \geq 0.$$
Equilibrium with complete markets

- $c_0^h = 0$ for all $h \in [0, 1]$.
- “Marginal agent”: $h_0 = \frac{1}{2}$.
  - Pessimistic agents, $h \leq h_0$,
    $$c^h(s^1) = \begin{cases} 
      0, & \text{for } s^1 = U, \\
      \frac{1}{h_0}(Ry_0 + y_1), & \text{for } s^1 = D.
    \end{cases}$$
  - Optimistic agents, $h > h_0$,
    $$c^h(s^1) = \begin{cases} 
      \frac{1}{1-h_0}(Ry_0 + y_1), & \text{for } s^1 = U, \\
      0, & \text{for } s^1 = D.
    \end{cases}$$
- Equilibrium prices:
  $$\frac{\bar{B}}{P_0} = \frac{1}{R} \left\{ h_0 T_H + (1 - h_0) T_L \right\},$$
  $$\frac{B_0}{P(s^1)} = T(s^1), \quad \text{for } s^1 \in S^1.$$
Equilibrium Trading Strategies

- Optimistic and pessimistic agents hold ‘symmetric’ portfolios:
  - Optimistic agents purchase Arrow security $U$, and sell Arrow security $D$.
  - Pessimistic agents do the opposite.
- The equilibrium price level will equally reflect the views of optimists and pessimists.
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   - Financial frictions: leverage
   - Numerical example

3 Implicit default: T-period model

4 Explicit default

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Market structure

- Two assets:
  - govt bonds and storage.

- Frictions:
  - no short sales of govt bonds;
  - no borrowing.

- Budget set for each individual:
  \[
  c_0 + k_0 + q_0 \frac{b_0}{P_0} \leq \frac{\bar{B}}{P_0} + y_0,
  \]
  \[
  c(s^1) \leq Rk_0 + \frac{b_0}{P(s^1)} - T(s^1) + y_1, \quad \text{for } s^1 \in S^1,
  \]
  \[
  c_0, k_0, b_0, c(s^1) \geq 0.
  \]
Utility maximization

- $h_0 = \text{marginal buyer of govt bonds}.$
- Pessimistic agents only invest in storage: For $h \leq h_0,$
  \[
  c^h_0 = b^h_0 = 0, \\
  k^h_0 = \frac{\bar{B}}{P_0} + y_0, \\
  c^h(s^1) = Rk^h_0 + y_1 - T(s^1)
  \]
- Optimistic agents only invest in govt bonds: For $h > h_0,$
  \[
  c^h_0 = k^h_0 = 0, \\
  b^h_0 = \frac{P_0}{q_0} \left( \frac{\bar{B}}{P_0} + y_0 \right), \\
  c^h(s^1) = \frac{1}{P(s^1)} b^h_0 + y_1 - T(s^1)
  \]
Equilibrium without borrowing

- $h_0 =$ marginal buyer of govt bonds:

\[
\frac{q_0}{P_0} = \frac{1}{R} \left\{ \frac{1}{P(U)} h_0 + \frac{1}{P(D)} (1 - h_0) \right\},
\]

- Market clearing condition for govt bonds:

\[
\frac{q_0}{P_0} B_0 = (1 - h_0) \left( \frac{\bar{B}}{P_0} + y_0 \right),
\]

- Equilibrium prices at date 1:

\[
P(s^1) = \frac{B_0}{T(s^1)}, \quad \text{for } s^1 \in S^1,
\]

- Evolution of the govt debt:

\[
\bar{B} = q_0 B_0.
\]
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Market structure

- Three kinds of assets:
  - govt bonds, storage and loans.

- Frictions:
  - govt bonds cannot be short sold;
  - agents can borrow to purchase govt bonds using those bonds as collateral;
  - loans are limited by collateral requirements.

  - Loans with different collateral rates are traded.

- In this model, only one type of loans are traded in equilibrium.
  - It is the loan contract with the lowest collateral rate sufficient to avoid default.
  - Thus, we need to consider only one type of loans, which is characterized by the risk-free interest rate $R$, and the ‘no-default constraint.’
Budget constraint with loans

- The budget set for each agent can be defined by

\[ c_0 + k_0 + q_0 \frac{b_0}{P_0} \leq \frac{\bar{B}}{P_0} + y_0 + \phi_0, \]

\[ c(s^1) \leq y_1 - T(s^1) + \frac{b_0}{P(s^1)} + Rk_0 - R\phi_0, \quad \text{for } s^1 \in S^1, \]

\[ R\phi_0 \leq \frac{b_0}{P(D)}, \quad \text{(no-default condition)}, \]

\[ c_0, k_0, b_0, c(s^1) \geq 0. \]

- Loan contract with one unit of govt bond \( b_0 \) as collateral:
  - \( \frac{1}{RP(D)} = \) (real) amount of borrowing;
  - \( \frac{q_0}{P_0} = \) (real) value of the bond (collateral) at date 0;
  - collateral rate = value of the bond/ amount of borrowing = \( q_0 \frac{P(D)}{P_0} R. \)
Utility maximization

- Equilibrium leverage:
  - Optimistic agents borrow as much as they can and use the proceeds to purchase government debt.
  - Pessimistic agents lend to optimistic agents.

- Asymmetry between optimists and pessimists:
  - Optimistic agents can bet on their beliefs.
    - Indeed, borrowing to purchase govt debt is effectively equivalent to purchasing Arrow security $U$.
  - Pessimistic agent cannot bet on their beliefs.
    - Short selling of government debt is ruled out so that there is no trading strategy mimicking Arrow security $D$.

- The price level will reflect the optimists’ view more than the pessimists’.
  - This generates deflationary pressure.
Equilibrium with leverage

Utility maximization:

\[ c^h_0 = 0, \quad h \in [0, 1], \]
\[ b^h_0 = \begin{cases} \left( \frac{q_0}{P_0} - \frac{1}{RP(D)} \right)^{-1} \left( \frac{\bar{B}}{P_0} + y_0 \right), & h > h_0, \\ 0, & h \leq h_0 \end{cases} \]
\[ k^h_0 - \phi^h_0 = \begin{cases} -\frac{1}{R P(D)} b^h_0, & h > h_0, \\ \frac{\bar{B}}{P_0} + y_0, & h \leq h_0 \end{cases} \]
\[ c^h(s^1) = y_1 - T(s^1) + \frac{b^h_0}{P(s^1)} + R(k^h_0 - \phi^h_0), \quad h \in [0, 1] \]
Equilibrium with leverage

- $h_0 =$ marginal buyer of govt bonds:
  \[
  h_0 \frac{\frac{1}{P(U)} - \frac{1}{P(D)}}{\frac{q_0}{P_0} - \frac{1}{RP(D)}} = R,
  \]

- Market clearing condition for govt bonds:
  \[
  \left( \frac{q_0}{P_0} - \frac{1}{RP(D)} \right) B_0 = (1 - h_0) \left( \frac{\bar{B}}{P_0} + y_0 \right),
  \]

- Equilibrium prices at date 1:
  \[
  P(s^1) = \frac{B_0}{T(s^1)}, \quad \text{for } s^1 \in S^1,
  \]

- Evolution of the govt debt:
  \[
  \bar{B} = q_0 B_0.
  \]
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Two Period model: numerical example

Inflation rates (%) at $t = 0$ and $s^1 = D$, and marginal buyers

<table>
<thead>
<tr>
<th></th>
<th>$\pi_{-1}$</th>
<th>$\pi_0$</th>
<th>$\pi(D)$</th>
<th>$h_0$</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) complete markets</td>
<td>-1.96</td>
<td>30.72</td>
<td>47.06</td>
<td>0.5</td>
</tr>
<tr>
<td>(2) no borrowing</td>
<td>-1.96</td>
<td>25.57</td>
<td>53.09</td>
<td>0.56</td>
</tr>
<tr>
<td>(3) leverage</td>
<td>-1.96</td>
<td>9.46</td>
<td>75.62</td>
<td>0.79</td>
</tr>
</tbody>
</table>

- At $t = -1$, everyone believes $\Pr(s_1 = U) = 1$.
- At $t = 0$, news arrives so that agents start to hold different views.
- Parameters: $\bar{B} = 1$, $y_0 = 1$, $q_0 = 1$, $R = 1.02$, $T_H = 1$, $T_L = 0.5$.
- Because $q_0 = 1$ and $R > 1$, there is deflation in period -1 ($\pi_{-1} < 0$).
Introduction

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Environment

- Shocks: \( s_t \in \{U, D\}, \ t = 1, \ldots, T. \)

- Endowments:

  \[
  y(s^t) = \begin{cases} 
  y_0, & \text{for } t = 0, \\
  0, & \text{for all } s^t \text{ with } t = 1, \ldots, T - 1, \\
  y_T, & \text{for all } s^T.
  \end{cases}
  \]

- Taxes:

  \[
  T(s^t) = \begin{cases} 
  0, & \text{for all } s^t \text{ with } t = 0, \ldots, T - 1, \\
  T_L, & \text{for } s^T = D^T, \\
  T_H, & \text{for all } s^T \neq D^T.
  \end{cases}
  \]
Example: Event tree in three period model

\[
T_0 = 0
\]

\[
T_1 = 0
\]

\[
T_2 = T_L
\]

\[
T_2 = T_H
\]
At $t = -1$, everyone believes $\Pr(s_t = U) = 1$.

At $t = 0$, news arrives so that agents start to hold different views.

$\bar{B} = 1$, $y_0 = 1$, $q_0 = q(D) = q(U) = 1$, $R = 1.02$, $T_H = 1$, $T_L = 0.5$. 

<table>
<thead>
<tr>
<th></th>
<th>$\pi_{-1}$</th>
<th>$\pi_0$</th>
<th>$\pi(D)$</th>
<th>$\pi(D^2)$</th>
<th>$h_0$</th>
<th>$h(D)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) complete markets</td>
<td>-1.96</td>
<td>17.65</td>
<td>22.55</td>
<td>30.72</td>
<td>0.50</td>
<td>0.33</td>
</tr>
<tr>
<td>(2) with leverage</td>
<td>-1.96</td>
<td>-1.09</td>
<td>10.86</td>
<td>71.89</td>
<td>0.94</td>
<td>0.75</td>
</tr>
</tbody>
</table>
Implicit default: $T$-period model

**Inflation rates at** $s^t = D^t$ **when** $T = 5$

![Graph showing inflation rates at $s^t = D^t$ when $T = 5$](image-url)
Properties of the equilibrium

- **Complete Markets**
  - Inflation rate jumps on the news in period 0
  - Smoothing. Inflation is smooth along the path to a debt crisis.
  - Along path to crisis, marginal buyer is falling at the rate $1/(t+2)$

- **Financial frictions**
  - No response of inflation rate to news.
  - Concentration: Inflation rate is low except in states near and during the debt crisis.
  - Marginal buyer is much higher (above 0.74 in all periods)
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Setup with long-term bonds and explicit default

- Shock $U, D$ is realized in each period.
- Price levels, $\{P(s^t)\}$, are exogenously given.
- Govt debt:
  - $\bar{B} =$ amount of government debt in period 0.
  - No new debt issued in any other period.
  - All debt is long-term and matures in period $T$.
- Sovereign debt crisis:
  - Govt defaults in period $T$ only if $S^T = D^T$.
    - When the govt defaults, it repays only a fraction $\alpha \in (0, 1)$ of $\bar{B}$.
  - Govt only collects taxes in final period.

$$T(s^T) = \begin{cases} \frac{\bar{B}}{P(s^T)}, & \text{if } s^T \neq D^T, \\ \alpha \frac{\bar{B}}{P(s^T)}, & \text{if } s^T = D^T. \text{ (debt crisis)} \end{cases}$$
Numerical example

Look at the evolution of the log yield of the govt debt in $s^t$:

$$\rho(s^t) \equiv \frac{1}{T-t} \ln \left[ \frac{1}{q(s^t)} \right],$$

where $q(s^t) = \text{price of govt debt in } s^t$, which matures in period $T$.

Parameter values:

- Constant price levels: $P(s^t) = P$ for all $s^t$ and $t$.
- Real interest rate: $R = 1.02$.
- Default rate: $\alpha = 0.2$.

Prior to period 0, everyone believes that there is not govt default, i.e., $\alpha(s^T) = 1$ with probability one.

Under this assumption, the log yield of govt debt in period -1 is

$$\rho_{-1} = \ln(1.02) = 1.98\%.$$
Yields on long-term bond at $s^t = D^t$ when $T = 5$

Log yields in the five-period model (\%)

<table>
<thead>
<tr>
<th></th>
<th>$\rho_{-1}$</th>
<th>$\rho_0$</th>
<th>$\rho(D)$</th>
<th>$\rho(D^2)$</th>
<th>$\rho(D^3)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) complete markets</td>
<td>1.98</td>
<td>6.34</td>
<td>14.84</td>
<td>34.68</td>
<td>104.15</td>
</tr>
<tr>
<td>(2) financial frictions</td>
<td>1.98</td>
<td>1.98</td>
<td>2.05</td>
<td>5.04</td>
<td>38.70</td>
</tr>
</tbody>
</table>

- **Complete markets**
  - bond yield responds to news
  - yield rises along the path towards default

- **Financial frictions**
  - bond yield does not respond to news
  - Bond yield response is delayed.
  - Magnitude of the increase in bond yield is smaller along path to default.
Discussion

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Who holds Japanese govt debt?

Holdings of Japanese Government Debt
End of fiscal year 2008

<table>
<thead>
<tr>
<th></th>
<th>Amount (trillion $)</th>
<th>Fraction (%), net of govt</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total</strong></td>
<td>14.03</td>
<td></td>
</tr>
<tr>
<td>Government</td>
<td>6.17</td>
<td>43.9</td>
</tr>
<tr>
<td>Individuals and non-financial companies</td>
<td>1.41</td>
<td>13.0</td>
</tr>
<tr>
<td>Domestic Financial Institutions</td>
<td>5.38</td>
<td>40.3</td>
</tr>
<tr>
<td>Private</td>
<td>1.82</td>
<td>14.8</td>
</tr>
<tr>
<td>Public</td>
<td>2.44</td>
<td>19.7</td>
</tr>
<tr>
<td>Central Bank</td>
<td>0.9</td>
<td>4.4</td>
</tr>
<tr>
<td>Foreign sector</td>
<td>4.44</td>
<td>34.8</td>
</tr>
</tbody>
</table>

- financial sector: accepts deposits and holds government debt
- individual holdings of government debt are small.
Who holds US debt?

Holdings of U.S. Government Debt
End of Calendar year 2010

<table>
<thead>
<tr>
<th></th>
<th>Amount (trillion $)</th>
<th>Fraction (%, net of govt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>14.03</td>
<td></td>
</tr>
<tr>
<td>Government</td>
<td>6.17</td>
<td></td>
</tr>
<tr>
<td>Individuals and non-financial companies</td>
<td>1.41</td>
<td>12.4</td>
</tr>
<tr>
<td>Domestic Financial Institutions</td>
<td>5.38</td>
<td>47.2</td>
</tr>
<tr>
<td>Private</td>
<td>1.82</td>
<td>16.0</td>
</tr>
<tr>
<td>Public</td>
<td>2.44</td>
<td>21.4</td>
</tr>
<tr>
<td>Central Bank</td>
<td>1.11</td>
<td>9.8</td>
</tr>
<tr>
<td>Foreign sector</td>
<td>4.44</td>
<td>38.9</td>
</tr>
</tbody>
</table>

- Financial sector also holds a lot of government debt.
- Foreign sector is also important.
- Our result is robust to the introduction of a foreign sector.
Discussion: Restrictions on short selling govt debt.

- A cheap way to finance a mortgage: short government debt.
  1. Borrow government debt today.
  2. Sell it. Use proceeds to purchase a home.
  3. Repay at the interest rate on government debt.

- Mortgage rates are higher than the yield on government debt.

### Spreads on Mortgage Rates over Government Debt in U.S. and Japan

Data collected on October 24, 2011*

<table>
<thead>
<tr>
<th></th>
<th>U.S.</th>
<th>Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(Percentage)</td>
<td>(Percentage)</td>
</tr>
<tr>
<td>1- Year ARM</td>
<td>2.84</td>
<td>0.86</td>
</tr>
<tr>
<td>5/1-year ARM</td>
<td>1.92</td>
<td>1.22</td>
</tr>
<tr>
<td>15-Year Fixed</td>
<td>0.5125</td>
<td>n.a.</td>
</tr>
<tr>
<td>20-Year Fixed</td>
<td>n.a.</td>
<td>0.47</td>
</tr>
<tr>
<td>30-Year Fixed</td>
<td>1.06</td>
<td>0.46</td>
</tr>
</tbody>
</table>

*Government debt yields and U.S. Mortgage rates are from Bloomberg. Japan Mortgage rates are from Shinsei Bank.
Government restrictions

- Basel I and II induce banks to take long leveraged positions in government debt.
- Governments take actions to restrict short selling in states where the risk of default is high.
- Our model suggests that banning short sales of government debt is effective in reducing price pressure!
Concluding remarks

Introduction

Implicit default: 2 period model

Implicit default: $T$-period model

Explicit default

Discussion

Concluding remarks
Summary

- We have presented a model in which deflation/low yields can persist even when people recognize that a debt fiscal crisis is not a negligible possibility.

- Crucial features of our model:
  - asset markets are imperfect:
    - borrowing is limited by the no-default constraint;
  - individuals hold heterogeneous portfolios:
    - some agents want to purchase govt debt;
    - others do not want to purchase it by themselves, but are willing to lend to those who buy it.

- Compared to the case with frictionless asset markets, our model implies:
  - the inflation rate is much lower before the crisis, but it gets much higher once the crisis occurs.
  - In the model with long-term govt debt, the yield on govt debt behaves similarly.
Robustness

- Here we have assumed that individuals have different beliefs on how likely the debt crisis occurs.
  - Any other assumption that leads to the same type of heterogeneity in portfolios would work too.
    - Example: different degrees of risk aversion.

- We have also assumed that loans are risk-free.
  - If we interpret “loans” in our model as “demand deposits” in banks, this may sound odd, because they are also subject to the risk of inflation.
  - In reality, govt bonds offer higher interest rates than demand deposits.
  - Any other assumption that generates this type of rate-of-return differentials would work too.
    - Example: difference in maturity.
Some directions for future research

- other forms of heterogeneity (e.g., degrees of risk aversion).
- allowing some agents to short-sell government debt (arbitrageurs) as in e.g. Vayanos and Gromb (2010), Chen et al. (2001), but impose limits on arbitrage.
- Endogenous default
- normative analysis.
- more traditional DSGE framework.
- open economy.