ECB Mini-Course: Monetary-Fiscal Policy Interactions

Lecture 9. Sovereign Default Risk Premia & Fiscal Policy

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The Questions


- How do sovereign default risk premia interact with fiscal policy?

- How do institutional changes to fiscal behavior affect sovereign debt risk premia?
The Findings

- Fiscal limits are country specific:
  - depend on government size, degree of countercyclical fiscal policy, political risk, and shock processes
- Risk premia are nonlinear in level of government debt
- Long-term bonds can provide early warning
- Fiscal reforms can significantly shift distribution of fiscal limits
RECENT SOVEREIGN RISK PREMIA

Long–term Interest Rate Spread over Germany

- Ireland
- Greece
- Spain
- Italy
- Portugal


**Historical Sovereign Ratings**

- OECD sovereign bonds are not always risk-free

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**Australia**

1980 1990 2000 2010

AAA
AAA+
AA
AA+

**Canada**

1980 1990 2000 2010

AAA
AAA+
AA
AA+

**Denmark**

1980 1990 2000 2010

AAA
AA+
AA
AA+

**Finland**

1980 1990 2000 2010

AAA
AA+
AA
AA+

**Greece**

1980 1990 2000 2010

A+
A
A−
BBB+
BBB
BBB−
BB+

**Ireland**

1980 1990 2000 2010

AAA
AA+
AA
AA+

**Italy**

1980 1990 2000 2010

A+
A
A−
AA−
AA
AA+
AAA

**Japan**

1980 1990 2000 2010

AAA
AA+
AA
AA+

**New Zealand**

1980 1990 2000 2010

AAA
AA+
AA
AA+

**Portugal**

1980 1990 2000 2010

AAA
AA+
AA
AA+

**Spain**

1980 1990 2000 2010

AAA
AA+
AA
AA+

**Sweden**

1980 1990 2000 2010

AAA
AA+
AA
AA+
Evidence 1: Sovereign Downgrades

- **New Zealand**
  - Ratings: AA+, AA
  - Debt-GDP: 0, 30, 60, 90, 120

- **Canada**
  - Ratings: AA+, AAA
  - Debt-GDP: 0, 30, 60, 90, 120

- **Italy**
  - Ratings: AA+, AA
  - Debt-GDP: 0, 35, 70, 105, 140

- **Belgium**
  - Ratings: AAA
  - Debt-GDP: 0, 35, 70, 105, 140

- **Sweden**
  - Ratings: AA−, AA, AA+
  - Debt-GDP: 0, 50, 100, 150, 200

- **Japan**
  - Ratings: AA−, AA
  - Debt-GDP: 0, 30, 60, 90, 120
EVIDENCE 2: EMPIRICAL RELATIONS

Risk premium responds to government indebtedness nonlinearly:

- Alesina, De Broeck, Prati and Tabellini (1992); Ardagna, Caselli and Lane (2007): OECD data
A Model

Exogenous technology and government spending:

\[
\ln \frac{A_t}{A} = \rho^u \ln \frac{A_{t-1}}{A} + \varepsilon^A_t \quad \varepsilon^A_t \sim \mathcal{N}(0, \sigma^2_A)
\]
\[
\ln \frac{g_t}{g} = \rho^e \ln \frac{g_{t-1}}{g} + \varepsilon^g_t \quad \varepsilon^g_t \sim \mathcal{N}(0, \sigma^2_g)
\]

Household problem:

\[
\max E_0 \sum_{t=0}^{\infty} \beta^t u(c_t, L_t)
\]
\[
\text{s.t.} \quad A_t(1 - \tau_t)(1 - L_t) + z_t - c_t = b_t q_t - (1 - \Delta_t) b_{t-1}^d
\]

FOC:

\[
\frac{u_L(t)}{u_c(t)} = A_t (1 - \tau_t)
\]
\[
q_t = \beta E_t \left[ (1 - \Delta_{t+1}) \frac{u_c(t+1)}{u_c(t)} \right]
\]
A Model

Government budget:

\[ \tau_t A_t (1 - L_t) + b_t q_t = g_t + z_t + \underbrace{(1 - \Delta_t) b_{t-1}}_{b^d_t} \]

- Unenforceable bond contract:

\[ \Delta_t = \begin{cases} 
0 & \text{if } b_{t-1} < b^*_t \text{ with } b^*_t \sim \mathcal{N}(b^*, \sigma_b^2) \\
\delta & \text{if } b_{t-1} \geq b^*_t 
\end{cases} \]

- Debt-stabilizing tax rule:

\[ \tau_t - \tau = \gamma (b^d_t - b) \]

- Countercyclical lump-sum transfers:

\[ \ln \frac{z_t}{z} = -\zeta z \ln \frac{A_t}{A} \]
Two Key Elements in the Analysis

- Distribution of fiscal limits
- Nonlinear simulation under sequences of bad shocks
Joint Labor Tax Laffer Curve: USA  EU–14

Steady State Labor Tax

Steady State Tax Revenues (Average=100)

U.S. avg.

EU–14 avg.

U.S. Peak

EU–14 Peak

Source: Trabandt & Uhlig
Steady State Capital Laffer Curves

Capital Tax Laffer Curve: USA & EU−14

Steady State Tax Revenues (Average=100)

U.S. avg.
EU−14 avg.
U.S. Peak
EU−14 Peak

Source: Trabandt & Uhlig
**Dynamic Laffer Curve**

\[ T_t = \tau_t A_t (1 - L_t) \]

\[ \Rightarrow T^{max}(A, g) = \mathcal{T}(T^{max}(A, g); A, g) \]
**Fiscal Limit**

Fiscal limit: maximum sustainable level of government debt

\[ B^* = E_0 \sum_{t=0}^{\infty} \frac{u_c^\text{max}(t)}{u_c^\text{max}(0)} \theta_t \left( T_t^\text{max} - g_t - z_t \right) \]

The distribution depends on:

- Government size: \( g/y \) and \( z/y \)
- Countercyclical lump-sum transfers: \( \zeta \)
- Political risk: \( 0 < \theta_t \leq 1 \) (ICRG index)
  
  Standard & Poor’s (2008): “stability, predictability, and transparency of a country’s political institutions are important considerations...”

- Shock processes

**MCMC simulation:**

- Simulate \( N \) paths to approximate \( \mathcal{N}(b^*, \sigma_b^2) \).
Fiscal limit: General comparison

• Benchmark case: average across developed countries (1971-2007)

<table>
<thead>
<tr>
<th>$\tau^L$</th>
<th>$g/y$</th>
<th>$z/y$</th>
<th>$\zeta^z$</th>
<th>$\theta$</th>
<th>$\rho^A$</th>
<th>$\sigma^A$</th>
<th>$\rho^g$</th>
<th>$\sigma^g$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.362</td>
<td>0.213</td>
<td>0.157</td>
<td>-0.947</td>
<td>0.83</td>
<td>0.553</td>
<td>0.02</td>
<td>0.553</td>
<td>0.02</td>
</tr>
</tbody>
</table>

• Comparison: change one parameter each time
  • In the following figure:
    • red is Sweden ($g/y = .29$, etc)
    • black is Switzerland ($g/y = .137$, etc)
    • blue is averaged across developed countries ($g/y = .213$, etc)
**Fiscal Limit: Simulation**

**Government Purchases–GDP**
- $g/y = 0.29$
- $g/y = 0.213$
- $g/y = 0.137$

**Lump–sum Transfers–GDP**
- $z/y = 0.224$
- $z/y = 0.157$
- $z/y = 0.084$

**Countercyclicality**
- $\zeta^z = -2.22$
- $\zeta^z = -0.947$
- $\zeta^z = -0.093$

**Political Risk**
- $\theta = 0.96$
- $\theta = 0.83$
- $\theta = 0.59$

**Shock Persistence of A**
- $\rho^A = 0.747$
- $\rho^A = 0.553$
- $\rho^A = 0.342$

**Shock Standard Deviation of A**
- $\sigma^A = 0.034$
- $\sigma^A = 0.02$
- $\sigma^A = 0.014$

**Shock Persistence of g**
- $\rho^g = 0.726$
- $\rho^g = 0.553$
- $\rho^g = 0.2$

**Shock Standard Deviation of g**
- $\sigma^g = 0.0288$
- $\sigma^g = 0.02$
- $\sigma^g = 0.0147$
FISCAL LIMIT: DATA

New Zealand

Canada

Italy

Belgium

Sweden

Japan
FISCAL LIMIT: COUNTRY COMPARISON

Canada vs. New Zealand: shock process

<table>
<thead>
<tr>
<th>$\tau^L$</th>
<th>$g/y$</th>
<th>$z/y$</th>
<th>$\zeta^z$</th>
<th>$\theta$</th>
<th>$\rho^A$</th>
<th>$\sigma^A$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.32</td>
<td>0.21</td>
<td>0.13</td>
<td>-1.25</td>
<td>0.85</td>
<td>0.6</td>
<td>0.02/0.04</td>
</tr>
</tbody>
</table>

Belgium vs. Italy: political risk

<table>
<thead>
<tr>
<th>$\tau^L$</th>
<th>$g/y$</th>
<th>$z/y$</th>
<th>$\zeta^z$</th>
<th>$\theta$</th>
<th>$\rho^A$</th>
<th>$\sigma^A$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.4</td>
<td>0.225</td>
<td>0.18</td>
<td>-0.63</td>
<td>0.8/0.7</td>
<td>0.68</td>
<td>0.025</td>
</tr>
</tbody>
</table>

Japan vs. Sweden: government size and countercyclical transfers

<table>
<thead>
<tr>
<th>$\tau^L$</th>
<th>$g/y$</th>
<th>$z/y$</th>
<th>$\zeta^z$</th>
<th>$\theta$</th>
<th>$\rho^A$</th>
<th>$\sigma^A$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.32</td>
<td>0.162/0.29</td>
<td>0.1/0.195</td>
<td>-1.15/-2.22</td>
<td>0.86</td>
<td>0.6</td>
<td>0.018</td>
</tr>
</tbody>
</table>
Fiscal limit: Country comparison (simulation)
NONLINEAR SOLUTION

Monotone mapping method (Coleman (1991), Davig (2004)):

\[ q_t = \beta E_t \left( (1 - \Delta_{t+1}) \frac{u_c(t+1)}{u_c(t)} \right) \]  

\( b^d_t + g_t + z(\psi_t) - \tau(\psi_t) A_t \left( 1 - L(\psi_t) \right) \)
\[ f^b(\psi_t) \]
\[ = \beta E_t \left\{ \left( 1 - \Delta(f^b(\psi_t), b^*_{t+1}) \right) \frac{u_c(f^b(\psi_t), A_{t+1}, g_{t+1}, b^*_{t+1})}{u_c(\psi_t)} \right\} \]

• Grid points of 3-dimension state space, \( \psi_t = (b^d_t, g_t, A_t) \), using Tauchen (1991)
• Initial guess of the decision rule \( f^b_0(.) \) \( b_t = f^b_0(\psi_t) \)
• Update the decision rule \( f^b_i(.) \) by iterating over equation (2) until it converges \( (\epsilon = 1e^{-8}) \)

Numerical integration: Newton-Cotes formulas.
**Calibration**

- Default scheme: A higher uncertainty of fiscal limits implies higher $\delta$

\[
\Delta_t = \begin{cases} 
0 & \text{if } b_{t-1} < b^*_t \\
\delta \equiv \frac{2\sigma_b}{b^*} & \text{if } b_{t-1} \geq b^*_t 
\end{cases} 
(b^*_t \sim \mathcal{N}(b^*, \sigma^2_b))
\]

- Calibrate to Greece (1971 - 2007):

<table>
<thead>
<tr>
<th>$\tau^L$</th>
<th>$\gamma$</th>
<th>$z/y$</th>
<th>$\zeta^z$</th>
<th>$g/y$</th>
<th>$\rho^g$</th>
<th>$\sigma^g$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.32</td>
<td>0.42</td>
<td>0.134</td>
<td>-0.45</td>
<td>0.167</td>
<td>0.426</td>
<td>0.0294</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>$\theta_H$</th>
<th>$\theta_L$</th>
<th>$p$</th>
<th>$\beta$</th>
<th>$L$</th>
<th>$\rho^A$</th>
<th>$\sigma^A$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.78</td>
<td>0.61</td>
<td>1/13</td>
<td>0.95</td>
<td>0.75</td>
<td>0.45</td>
<td>0.0328</td>
</tr>
</tbody>
</table>

- Markov switching $\theta_t$: $\theta_t \in \{\theta_H, \theta_L\}$ with $p_{LL} = p_{HH} = p$
**Fiscal Limit: Greece**

The diagram illustrates the debt-to-GDP ratio for different scenarios of fiscal limits in Greece. The x-axis represents the debt-to-GDP ratio, while the y-axis indicates the probability density. The graph shows distributions for high and low fiscal limits under different assumptions, with the blue line representing a Markov process and the red and black dashed lines representing different fiscal limit scenarios.
**Decision Rule:** $R(b^d, A, g)$

- **r(b) with g at Steady State under Different A**
  - $A$ at ss
  - Low $A$
  - High $A$

- **r(b) with A at Steady State under Different g**
  - $g$ at ss
  - Low $g$
  - High $g$
SIMULATION: A SEVERE RECESSION

- Given the paths of \( A_t \) and \( g_t \).

- At each period, the effective fiscal limit \( (b_t^*, \text{ green line}) \) is drawn from the approximated distribution.

- The paths of \( c_t, L_t, \tau_t, b_t, r_t \) are determined by equilibrium conditions.

<table>
<thead>
<tr>
<th></th>
<th>t=1</th>
<th>t=2</th>
<th>t=3</th>
<th>t=4</th>
<th>t=5</th>
<th>t=6</th>
</tr>
</thead>
<tbody>
<tr>
<td>( A_t )</td>
<td>-4.88%</td>
<td>-8.61%</td>
<td>-9.97%</td>
<td>-6.67%</td>
<td>-4.21%</td>
<td>-1.92%</td>
</tr>
<tr>
<td>( g_t/y_t )</td>
<td>20.35%</td>
<td>21.68%</td>
<td>21.81%</td>
<td>21.08%</td>
<td>20.29%</td>
<td>19.52%</td>
</tr>
</tbody>
</table>
**Long-term Bonds**

- Price of long-term bond with maturity $n$:

$$Q^n_t = \beta^n E_t \left( (1 - \Delta_{t+n}) \frac{u_c(t+n)}{u_c(t)} \right)$$

$$r_{t}^{n\Delta} = \frac{1}{Q^n_t} - \frac{1}{Q^{nf}_t}$$

- Solution: finite-element method
SIMULATION: LONG-TERM BONDS
A Little Swedish History

- In 1990s, had a banking & a fiscal crisis
- In fits and starts, fiscal reforms were implemented
- Today Standard & Poor’s comments:
  - “The established fiscal rules have served Sweden well...”
  - “…the Kingdom [has] substantial fiscal buffers to support its creditworthiness in the current adverse economic environment.”
Swedish Interest Rate Premia

Chart 20: Swedish bond spreads rose ahead of the correction

Giavazzi and Pagano (1990) emphasise the importance of the expectations channel in Ireland’s expansionary fiscal adjustment (an “income effect”), arguing that other factors (reduced real interest rates, lower ULCs, etc.) cannot fully account for the acceleration in growth.

Sweden (1994-98)

Background

Sweden’s experience in the 1990s has provided interesting parallels at every stage of the global financial crisis. Its problems started with the bursting of a real estate bubble in 1989/1990. This led to a banking crisis, which drove the economy into a deep recession and ultimately resulted in a government debt crisis. But, for all the problems that it faced, Sweden’s story is ultimately one of daunting challenges that were successfully overcome: the final cost to the government of the bank rescue was close to zero, the government balance moved from a deficit of 11.2% of GDP in 1993 to a surplus of 1.2% in 1998, and GDP growth averaged 3.5% per year during this adjustment. Indeed, post-crisis growth was faster than the pre-crisis trend and, while it took close to 10 years, the negative effect of the crisis on the level of GDP was also eliminated (Chart 19).

In previous research we have discussed Sweden’s experience in the context of (i) the design of Sweden’s successful bank bail-out and (ii) the role that Sweden’s exchange rate devaluation (and easier financial conditions more generally) played in its recovery. While it is impossible to fully disentangle the role that each played in the subsequent recovery, we focus here on the part played by fiscal policy.

In common with Ireland, the implementation of Sweden’s fiscal correction also required a change of government. In contrast to Ireland, however, the change in government involved a leftward shift, with the right-of-centre Moderate/Centre Party coalition replaced by the left-of-centre Social Democrats (who formed a minority government).

Also in common with Ireland, bond spreads (vs. Germany) had risen sharply in the months ahead of the election (Chart 20). However, it is difficult to conclude that this factor alone forced the incoming government to implement the correction, as spreads had been higher during the 1970s and early 1980s (when inflation was much higher than German y and Sweden had experienced a series of devaluations—Chart 21).

4. Reinhart and Rogoff (2008) have identified Sweden’s banking crisis of the early-1990s as one of five financial crises that were most akin, in severity and type, to the current crisis.

Source: OECD, GS Global ECS Research
Swedish Fiscal Reforms

- “Consolidation Programme” of 1994
- Sought to stabilize debt
- Resulted in
  - reducing transfers and revenues as share of GDP
  - shifted government spending from counter- to pro-cyclical
  - reduced the counter-cyclicality of transfers
  - adopted an operational expenditure ceiling
  - aim to hit a medium-term surplus target
- Designed to achieve two goals:
  1. make the Fiscal Limit occur at higher levels of debt
  2. reduce current debt: move it farther from the Fiscal Limit
SWEDISH FISCAL LIMIT PRE-CRISIS
SWEDISH FISCAL LIMIT POST-CRISIS

Pre–Crisis Fiscal Limit (Debt–GDP)

Pre and Post–Crisis Fiscal Limits (Debt–GDP)
Fiscal Limits and Fiscal Stimulus

• Wide range of fiscal responses to current recession
  1. Massive stimulus: China, United States
  2. Moderate additional stimulus: France, Sweden
  3. Contraction/consolidation: Iceland, Ireland
  4. Planned contraction: Greece, Portugal, Spain

• Differences explained by tension between stimulus and solvency

• Fear of the Fiscal Limit: now many countries planning substantial consolidation despite the weak recovery
Dynamic Laffer Curve (macroeconomic fundamentals):

- Fiscal limits are country specific
  - Depend on the government size, degree of countercyclical fiscal policy, political uncertainty and shock processes
- Sovereign risk premia arise nonlinearly with respect to the level of government debt
- Long-term bonds provide early warnings