What is a sustainable public debt?

Pablo D’Erasmo
Federal Reserve Bank of Philadelphia

Enrique G. Mendoza
Univ. of Pennsylvania, NBER & PIER

Jing Zhang
Federal Reserve Bank of Chicago

The views expressed here do not necessarily reflect those of the Federal Reserve Bank of Chicago, the Federal Reserve Bank of Philadelphia or the Federal Reserve System.
What is sustainable public debt?

• Literally: *A sustainable debt is that which can be maintained at a certain rate or level*
  – A tautology unless that rate/level derives from a framework

• In macro literature:
  1. **With commitment**: debt consistent with solvency (IGBC) and/or a stationary equilibrium
  2. **Without commitment**: debt in equilibria with default risk

• Critical question in fiscal policy analysis
  – 2008-11, debt ratios rose by 31 (20) ppts. in U.S. (Europe)
  – Global market of local-currency gov. bonds was 1/2 of world’s GDP in 2011 ($30 trillion, 6 times investment-grade external sov. debt)
1. Historical perspective from U.S. data

2. Critical review of “classic” approach

3. *Empirical approach*: Bohn’s Fiscal Reaction Function

4. *Structural approach*: Two-country DGE model with fiscal sector that matches actual tax elasticities

5. *Domestic default approach*: Model of optimal default driven by distributional incentives

• New applications to U.S. and cross-country data, and analysis of their implications
1. Historical perspective on U.S. public debt
Debt crises in the United States

• Episodes in 95 percentile of annual increases in federal debt-GDP ratio since 1791 (ranked):
  1. WW 2
  2. WW 1
  3. Great Recession (but debt ratio is already 2\textsuperscript{nd} highest)
  4. Civil War
  5. Great Depression

• GR episode is unique
  – Primary balance remains in deficit and is projected to remain in deficit at least through 2026! (CBO, 03/16)
  – In all other episodes, primary surpluses played a role in reducing debt
Public Debt Crises in U.S. History
(net federal debt-GDP ratio, 1791-2012 from Bohn (2013), 2013-2026 from CBO)
Figure 2. Primary Fiscal Deficits as a Share of GDP After U.S. Debt Crises

- WW2
- WW1
- Great Recession
- Civil War
- Great Depression
- CBO March 2016 forecast
What brought the debt down?

- Budget constraints in terms of GDP ratios:

\[ b_t - b_{t-1} = def_t - \left( \frac{\gamma_t}{1 + \gamma_t} \right) b_{t-1} \]

\[ b_t - b_{t-1} = pr.def_t - \left( \frac{i_t - \gamma_t}{1 + \gamma_t} \right) b_{t-1} \]

<table>
<thead>
<tr>
<th>Initial debt ratio</th>
<th>Final debt ratio</th>
<th>Change in debt ratio</th>
<th>Overall deficit</th>
<th>Growth effect</th>
<th>Primary deficit</th>
<th>Debt service</th>
<th>Net debt Service</th>
<th>Nominal growth</th>
<th>Inflation growth</th>
<th>Real growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
<td>(6)</td>
<td>(7)</td>
<td>(8)</td>
<td>(9)</td>
<td>(10)</td>
<td>(11)</td>
</tr>
<tr>
<td>a) 1792-1812</td>
<td>37.5%</td>
<td>7.2%</td>
<td>-30.3%</td>
<td>-7.2%</td>
<td>-23.1%</td>
<td>-25.2%</td>
<td>18.0%</td>
<td>-5.1%</td>
<td>5.8%</td>
<td>1.4%</td>
</tr>
<tr>
<td>b) 1866-1916</td>
<td>33.5%</td>
<td>3.0%</td>
<td>-30.5%</td>
<td>-16.7%</td>
<td>-13.8%</td>
<td>-45.0%</td>
<td>28.3%</td>
<td>14.5%</td>
<td>3.3%</td>
<td>-0.6%</td>
</tr>
<tr>
<td>c) 1919-1930</td>
<td>34.6%</td>
<td>15.6%</td>
<td>-19.0%</td>
<td>8.8%</td>
<td>-27.8%</td>
<td>-2.7%</td>
<td>11.6%</td>
<td>-16.3%</td>
<td>2.6%</td>
<td>0.1%</td>
</tr>
<tr>
<td>d) 1946-1974</td>
<td>108.7%</td>
<td>23.9%</td>
<td>-84.8%</td>
<td>18.5%</td>
<td>-103.3%</td>
<td>-24.1%</td>
<td>42.6%</td>
<td>-60.7%</td>
<td>6.9%</td>
<td>3.3%</td>
</tr>
<tr>
<td>e) 1994-2001</td>
<td>49.2%</td>
<td>32.5%</td>
<td>-16.7%</td>
<td>1.0%</td>
<td>-17.7%</td>
<td>-21.5%</td>
<td>22.4%</td>
<td>4.8%</td>
<td>5.6%</td>
<td>1.8%</td>
</tr>
</tbody>
</table>

I. Peak to Through

II. Per-year averages

- Budget constraints in terms of GDP ratios:
2. Critical Review of Classic Approach
• Period GBC with Arrow gov. securities:

\[ \sum_{s_{t+1}} Q_1(s_{t+1}|s_t)b_t(s_{t+1}|s^t) - b_{t-1}(s_t|s^{t-1}) = g(s_t) - \tau_t(s^t). \]

– In GDP ratios and under perfect foresight:

\[ b_t - (1 + r_t)b_{t-1} = -pb_t \quad \quad r_t \equiv (1 + \bar{r}_t)/(1 + \gamma_t) - 1 \]

• NPG condition + arbitrage yields IGBC:

\[ b_{t-1} = pb_t + \sum_{j=1}^{\infty} E_t[MRS(c_{t+j}, c_t)pb_{t+j}] \quad \quad pb_t \equiv \tau_t - g_t \]
Classic approach

- Proposed by Buiter (1985), Blanchard (1990), and widely used in policy institutions (IMF, 2015)
- At steady-state & under perfect foresight, GBC yields “Blanchard ratio” (debt-stabilizing $pb$):

$$b^{ss} = \frac{pb^{ss}}{r}$$

- First flaw: Disconnected from initial debt and IGBC
  - FRFs with different coefficients satisfy IGBC for same initial debt but attain different steady states, and can even go to infinity!
Classic approach (contn’d)

• Second flaw: Ignores uncertainty & asset markets

• Mendoza & Oviedo (06, 09): under incomplete markets, adding shocks + smoothing (or tolerable min. outlays) yields “Natural Public Debt Limit:”

\[ b_t \leq NPDL \equiv \frac{\tau_{\text{min}} - g_{\text{min}}}{i' - \gamma} \]

  – Blanchard ratio uses sample means (violates NPDL)
  – NPDL tighter for economies with more volatile revenues or less able to adjust outlays
  – Debt follows random walk with boundaries:

\[ b_t = \max[NPDL, (1 + r_t)b_{t-1} - pb_t] \geq \bar{b} \]
3. Empirical Approach: Bohn’s Fiscal Reaction Function
1. IGBC tests discounting at risk free rate are misspecified:

\[ b_{t-1} = pb_t + \sum_{j=1}^{\infty} \left[ \frac{E_t[pb_{t+j}]}{R_{t+j}} + cov_t(MRS(c_{t+j}, c_t), pb_{t+j}) \right] \]

2. IGBC holds if debt or outlays+interest are integrated of any finite order (no particular integration order needed!)

3. Linear FRF \( pb_t = \mu_t + \rho b_{t-1} + \varepsilon_t \), with \( \rho > 0 \) is sufficient for IGBC (debt is stationary if \( \rho > r \), or diverges to infinity if \( 0 < \rho < r \) but is still sustainable!)

4. Empirical tests based on historical U.S. data 1791-2003 support linear FRF and some nonlinear variations
New FRF Estimates

• U.S. estimates (1791-2014) and cross-country panels (1951-2013) again pass sufficiency test
  – EMs have stronger response, less access to debt

• Structural break post-2008 (lower response, large residuals, large primary deficits)

• U.S. deficits have been much larger than out-of-sample pre-08 forecast

• FRFs with lower response coefficient satisfy IGBC at same initial debt, but with larger deficits & higher long-run debt
New FRF Estimates: U.S. 1792-2014

<table>
<thead>
<tr>
<th>Coefficient</th>
<th>Base model (1)</th>
<th>Asymmetric response (2)</th>
<th>AR(1) term (3)</th>
<th>Debt Squared (4)</th>
<th>Time trend (5)</th>
<th>Bohn’s Sample (1793-2003) (6)</th>
<th>Pre-Recession (1793-2008) (7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>0.00648 (0.004)</td>
<td>0.00540 (0.003)*</td>
<td>0.00974 (0.008)</td>
<td>0.00653 (0.004)</td>
<td>0.00601 (0.006)</td>
<td>0.00485 (0.003)*</td>
<td>0.00470 (0.003)</td>
</tr>
<tr>
<td>Initial debt $d_t^*$</td>
<td>0.07779 (0.040)*</td>
<td>0.08689 (0.030)***</td>
<td>0.10477 (0.032)***</td>
<td>0.07715 (0.038)*</td>
<td>0.07674 (0.035)</td>
<td></td>
<td>0.10498 (0.023)***</td>
</tr>
<tr>
<td>GDP gap</td>
<td>0.07404 (0.078)</td>
<td>0.07300 (0.079)</td>
<td>0.15330 (0.043)***</td>
<td>0.07390 (0.079)</td>
<td>0.07490 (0.077)</td>
<td>0.07987 (0.086)</td>
<td>0.07407 (0.086)</td>
</tr>
<tr>
<td>Military Expenditure</td>
<td>-0.72302 (0.133)**</td>
<td>-0.72001 (0.136)***</td>
<td>-0.98955 (0.110)***</td>
<td>-0.72320 (0.133)**</td>
<td>-0.72462 (0.135)***</td>
<td>-0.77835 (0.135)**</td>
<td>-0.76857 (0.135)**</td>
</tr>
<tr>
<td>max($0, d_t^* - d$)</td>
<td>-0.14487 (0.061)</td>
<td></td>
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<tr>
<td>AR(1)</td>
<td></td>
<td>0.89154 (0.029)***</td>
<td></td>
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<tr>
<td>$(d_t^* - d)^2$</td>
<td></td>
<td>0.00261 (0.044)</td>
<td></td>
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<td></td>
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<tr>
<td>Time trend</td>
<td></td>
<td></td>
<td>6.89E-06 (5.9E-05)</td>
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Note: HAC standard errors shown in parenthesis, 2-lag window prewhitening. "***", "**", "*" denote that the corresponding coefficient is statistically significant at the 90, 95 and 99 percent confidence levels. Output gap is percent deviation from Hodrick-Prescott trend. Military expenditure includes all Department of Defense and Department of Veterans Affairs outlays.
Out-of-sample forecast uses actual values for the independent variables for 2009-2014 and 2016 President’s Budget for 2015-2020
Debt Projections: Alternative FRFs

(a) US debt to GDP

(b) Europe debt to GDP

Note: For the US: Model (3) in table 1 is used in conjunction with estimated AR(2) processes for the output gap and military expenditure, plus the government budget constraint. For Europe: Model (5) in table 2 is used in conjunction with estimated AR(1) processes for the output gap and government consumption gap in each country, and a simple average among advanced European countries is taken.
Why use a structural approach?

- FRFs with different parameters satisfy IGBC for same initial debt, but macro dynamics and welfare differ and FRFs can’t compare them.
- Use calibrated variant of workhorse two-country Neoclassical model to compare fiscal adjustment policies in response to an increase in initial debt.
- Match observed tax elasticities by introducing utilization and limited depreciation tax allowance.
Model highlights

- Deterministic setup with exogenous long-run growth driven by labor-augmenting technological change
- Fiscal sector includes taxes on capital, labor and consumption, gov. purchases, transfers and debt
- Utilization choice & limited tax allowance for depreciation
- Trade in goods and bonds (residence-based taxation)
- Capital immobile across countries, but trade in bonds arbitrages post-tax returns & induces capital reallocation
- Unilateral tax changes have cross-country externalities (relative prices, wealth distribution, tax revenues)
Fiscal sector

- Gov. purchases and transfers are exogenous and kept constant at initial steady-state levels

- GBC:
  \[ d_t - (1 + \gamma)q_t^g d_{t+1} = pb_t \]
  \[ \equiv \tau_C c_t + \tau_L w_t l_t + \tau_K (r_t m_t - \theta \delta) k_t - (g_t + e_t) \]

- IGBC:
  \[ \frac{d_0}{y_{-1}} = \psi_0 \left[ \frac{pb_0}{y_0} + \sum_{t=1}^{\infty} \left( \prod_{i=0}^{t-1} \psi_i \frac{pb_t}{y_t} \right) \right] \]
  \[ \psi_i \equiv (1 + \gamma)\psi_i q_i^g, \]
  \[ \psi_i \equiv y_{i+1}/y_i \]

- Dynamic Laffer curves (DLCs) plot change in PDV of \( pb/y \) (i.e. in sustainable debt) as a tax rate changes.
Tax distortions and externalities

- Asset markets arbitrage (ignoring capital adj. costs):

\[
\frac{(1 + \gamma)u_1(c_t, 1 - l_t)}{\tilde{\beta}u_1(c_{t+1}, 1 - l_{t+1})} = (1 - \tau_K)F_1(m_{t+1}k_{t+1}, l_{t+1})m_{t+1} + 1 - \delta(m_{t+1}) + \tau_K \theta \bar{\delta} \\
= \frac{1}{q_t} = \frac{1}{q_t^g},
\]

\[
= (1 - \tau_K^*)F_1(m_{t+1}^*k_{t+1}^*, l_{t+1}^*)m_{t+1}^* + 1 - \delta(m_{t+1}^*) + \tau_K^* \theta \bar{\delta} = \frac{(1 + \gamma)u_1(c_t^*, 1 - l_t^*)}{\tilde{\beta}u_1(c_{t+1}^*, 1 - l_{t+1}^*)}
\]

- Labor market:

\[
\frac{u_2(c_t, 1 - l_t)}{u_1(c_t, 1 - l_t)} = \frac{1 - \tau_L}{1 + \tau_C} F_2(k_t, l_t) \quad (1 - \tau_W) \equiv (1 - \tau_L)/(1 + \tau_C)
\]

- Capacity utilization:

\[
F_1(m_t k_t, l_t) = \frac{1 + \Phi_t}{1 - \tau_K} \delta'(m_t),
\]
Calibration: Fiscal Heterogeneity

| GDP-weighted | | | |
|--------------|---|---|
| EU15 US      | | | |
| (a) Macro Aggregates | | | |
| $\tau_C$     | 0.17 | 0.04 |
| $\tau_L$     | 0.41 | 0.27 |
| $\tau_K$     | 0.32 | 0.37 |
| $c/y$        | 0.57 | 0.68 |
| $x/y$        | 0.21 | 0.21 |
| $g/y$        | 0.21 | 0.16 |
| $tb/y$       | 0.00 | -0.05 |
| Rev/$y$      | 0.45 | 0.32 |
| Total Exp/$y$| 0.47 | 0.39 |

(b) Debt Shocks

<p>| | | |</p>
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<tr>
<td>$d_{2007}/y_{2007}$</td>
<td>0.38</td>
<td>0.43</td>
</tr>
<tr>
<td>$d_{2011}/y_{2011}$</td>
<td>0.58</td>
<td>0.74</td>
</tr>
<tr>
<td>$\Delta d/y$</td>
<td>0.20</td>
<td>0.31</td>
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</table>
Main findings

• Capital taxes:
  1. Large externalities (strategic incentives)
  2. US: debt *not* sustainable (DLC max below required level)
  3. EU15: inefficient side of DLC (tax cut makes debt sustainable via external effects--closed-economy DLC also peaks below required level)
  4. Without utilization and limited allowance short-run tax elasticity has wrong sign and DLC is linearly increasing

• Labor taxes:
  1. Negligible externalities
  2. US low initial taxes yield DLCs that sustain higher debt
  3. EU15: DLCs (closed or open) peak below required level
Capital Tax Dynamic Laffer Curves

(a) US

(b) EU15
### Effects of Using Maximum US Capital Tax Rate

<table>
<thead>
<tr>
<th>Tax rates</th>
<th>Old</th>
<th>New</th>
<th>Old</th>
<th>New</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\tau_K$</td>
<td>0.37</td>
<td>0.40</td>
<td>0.32</td>
<td>0.32</td>
</tr>
<tr>
<td>$\tau_C$</td>
<td>0.04</td>
<td>0.04</td>
<td>0.17</td>
<td>0.17</td>
</tr>
<tr>
<td>$\tau_L$</td>
<td>0.27</td>
<td>0.27</td>
<td>0.41</td>
<td>0.40</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ΔPV(Primary Bal.)/$y_0$</th>
<th>0.014</th>
<th>0.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Welfare Impact</td>
<td>-2.19</td>
<td>0.74</td>
</tr>
<tr>
<td>Δ$y_{ss}$</td>
<td>-3.87</td>
<td>1.25</td>
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</tbody>
</table>

**Note:** Capital tax increase to maximum point of open-economy Laffer curve. Fore neutrality by lowering labor tax.
### Capital Tax Base Elasticities: Models v. Data

<table>
<thead>
<tr>
<th></th>
<th>Elasticity</th>
<th>$y_1$</th>
<th>$l_1$</th>
<th>$m_1$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Empirical estimates</strong></td>
<td>[0.1, 0.5]</td>
<td></td>
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</tr>
<tr>
<td><strong>Model Implications for the U.S.</strong></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>exog. utilization &amp; $\theta = 1$</td>
<td>$-0.09$</td>
<td>$0.04%$</td>
<td>$0.011$</td>
<td></td>
</tr>
<tr>
<td>exog. utilization &amp; $\theta = 0.2$</td>
<td>$-0.09$</td>
<td>$0.08%$</td>
<td>$0.028$</td>
<td></td>
</tr>
<tr>
<td>endog. utilization &amp; $\theta = 0.2$</td>
<td>$0.29$</td>
<td>$-0.15%$</td>
<td>$0.010$</td>
<td>$-0.471$</td>
</tr>
</tbody>
</table>
U.S. Capital Tax DLCs: Alternative Models

\( \Delta PV(\text{Primary Balance})/y_0 \)

- **Endog Util**
- **Exog Util**
- **Exog Util \( \theta=1 \)**

Capital Tax Rate

(a) US
5. Domestic Default Approach: Default as Optimal Redistributive Policy
Why a domestic default approach?

- Previous two approaches cast doubt on chances of restoring fiscal solvency via conventional tools

- European crisis + historical evidence (Reinhart & Rogoff (11), Hall & Sargent (14)) raise possibility of domestic defaults
  - A “forgotten history” (R&R) until recently (D’Erasmo & Mendoza (2013,14), Dovis et al. (2014), ...)

- Remove commitment: Distributional incentives lead to default unless costs are sufficiently high or gov. favors bond holders
  - Solvency is not enough to make debt sustainable!
A model of optimal domestic default
(D’Erasmo & Mendoza, JEEA 2016)

• Two-period model with two types of risk-averse agents $(L, H)$, with fraction $\gamma$ of L-types $(b_0^L < b_0^H)$

• Gov. collects lump-sum taxes $\tau$, faces stochastic $g$, issues bonds $B$ ($g$ and default are non-insurable aggregate risks)

• Default is costly as a fraction $\phi(g)$ of income that varies with realization of $g$ (a’la Arellano (2008))

\[
\phi(g) \geq 0, \text{ with } \phi'(g_1) \leq 0 \text{ for } g_1 \leq \bar{g}_1, \phi'(g_1) = 0 \text{ otherwise}
\]

• Gov. attains 2nd-best deviation from equal mg. utilities by redistributing via debt & default
Payoff function for $i=L, H$:

$$v^i(B_1, \gamma) = \max_{b_1^i} \left\{ u(y + b_1^i - q_0b_1^i - \tau_0) + \right. $$

$$\left. \beta E_g \left[ (1 - d_1(B_1, g_1, \gamma))u(y + b_1^i - \tau_1^{d_1=0}) + d_1(B_1, g_1, \gamma)u(y(1 - \phi(g_1)) - \tau_1^{d_1=1}) \right] \right\}$$

subject to $b_1^i \geq 0$

with initial bond holdings given by initial wealth distribution and bond market clearing:

$$b_0^H = \frac{B_0 - \gamma b_0^L}{1 - \gamma} \geq b_0^L \geq 0$$
Budget constraints

\[ \tau_0 = g_0 + B_0 - q_0 B_1 \]

\[ \tau_1^{d=0} = g_1 + B_1 \quad \tau_1^{d=1} = g_1 \]

Default optimization problem in 2\textsuperscript{nd} period (utilitarian SWF):

\[
\max_{d \in \{0, 1\}} \left\{ W_1^{d=0}(B_1, g_1, \gamma), W_1^{d=1}(g_1, \gamma) \right\}
\]

\[
W_1^{d=0}(B_1, g_1, \gamma) = \gamma u(y - g_1 + b_1^L - B_1) + (1 - \gamma) u(y - g_1 + b_1^H - B_1)
\]

\[
W_1^{d=1}(g_1, \gamma) = u(y(1 - \phi(g_1)) - g_1)
\]

Debt issuance optimization problem in 1\textsuperscript{st} period:

\[
W_0(\gamma) = \max_{B_1} \left\{ \gamma v^L(B_1, \gamma) + (1 - \gamma) v^H(B_1, \gamma) \right\}
\]
Default Decision in 2\textsuperscript{nd} Period

- Assume bond demand choices given by:
  \[ b_1^L = B_1 - \epsilon \quad \text{and} \quad b_1^H(\gamma) = B_1 + \frac{\gamma}{1-\gamma} \epsilon. \]
- Socially optimal allocations (under repayment):
  \[
  u'(y - g_1 + \frac{\gamma}{1-\gamma} \epsilon^{SP}) = u'(y - g_1 - \epsilon^{SP}) \iff \epsilon^{SP} = 0.
  \]
  - Zero consumption dispersion is first best
- If default is costless, it is always optimal (attains 1\textsuperscript{st} best) and debt cannot be sustained.
  - Cost makes default suboptimal (for some bond demand choices dispersion is smaller with repayment)
  - Cost can be endogenized (liquidity, self-insurance) or replaced with gov. bias favoring bond holders
Default choice with & without default costs
Default choice with government bias
Debt Issuance Decision in 1\textsuperscript{st} Period

- Selling debt reduces dispersion at $t=0$, but increases it at $t=1$ under repayment:

\[
\begin{align*}
    c^{H}_0 - c^{L}_0 &= \frac{1}{1 - \gamma} \left[ B_0 - q(B_1, \gamma)B_1 \right] \\
    c^{H,d=0}_1 - c^{L,d=0}_1 &= \frac{1}{1 - \gamma} B_1 \\
    c^{H,d=1}_1 - c^{L,d=1}_1 &= 0.
\end{align*}
\]

- Gov. internalizes how the gain of issuing debt is hampered by default risk, which lowers bond prices (debt Laffer curve).
Debt Issuance Optimality Condition

- Without default, some dispersion is optimal (debt helps relax L-types borrowing constraint)

\[ u'(c_0^H) = u'(c_0^L) + \frac{\eta}{q(B_1, \gamma)\gamma} \{ \gamma \mu^L \} \]

\[ \mu^L \equiv q(B_1, \gamma)u'(c_0^L) - \beta E_{g_1} [(1-d^1)u'(c_1^L)] > 0. \]

- With default risk, more dispersion at t=0 is traded off for possibly zero at t=1 in default states

\[ u'(c_0^H) = u'(c_0^L) + \frac{\eta}{q(B_1, \gamma)\gamma} \{ \beta E_{g_1} [\Delta d \Delta W_1] + \gamma \mu^L \} \]

\[ \Delta d \equiv d(B_1 + \delta, g_1, \gamma) - d(B_1, g_1, \gamma) \geq 0, \text{ for } \delta > 0 \text{ small,} \]

\[ \Delta W_1 \equiv W_1^{d=1}(g_1, \gamma) - W_1^{d=0}(B_1, g_1, \gamma) \geq 0, \]
## Calibration to European Data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discount Factor</td>
<td>$\beta$ 0.96</td>
</tr>
<tr>
<td>Risk Aversion</td>
<td>$\sigma$ 1.00</td>
</tr>
<tr>
<td>Avg. Income</td>
<td>$y$ 0.79</td>
</tr>
<tr>
<td>Low household wealth</td>
<td>$b_0^L$ 0.00</td>
</tr>
<tr>
<td>Avg. Gov. Consumption</td>
<td>$\mu_g$ 0.18</td>
</tr>
<tr>
<td>Autocorr. G</td>
<td>$\rho_g$ 0.88</td>
</tr>
<tr>
<td>Std Dev Error</td>
<td>$\sigma_g$ 0.017</td>
</tr>
<tr>
<td>Initial Gov. Debt</td>
<td>$B_0$ 0.79</td>
</tr>
<tr>
<td>Output Cost Default</td>
<td>$\phi_0$ 0.02</td>
</tr>
</tbody>
</table>

Note: Government expenditures, income and debt values are derived using data from France, Germany, Greece, Ireland, Italy, Spain and Portugal.
Equilibria as Fraction of Non-debt-holders Rises

Utilitarian government

Biased government
Non-bond-holders may prefer bias!
(if ownership is sufficiently concentrated)
Conclusions

• Three approaches to examine sustainable debt paint a bleak picture of fiscal prospects:

1. FRFs structural break post-2008, primary deficits much larger than predicted, larger than in previous crises

2. Capital tax DLCs peak well below required increase to offset higher debt (except if EU exploits externalities)

3. Domestic default is a real possibility (default costs or gov. bias make debt exposed to default risk due to distributional incentives sustainable)

4. Economies with concentrated debt ownership may elect biased governments that sustain high debt at low spreads and default probs. (but default happens!).