When is Public Debt Sustainable?-Issues for Policy Design

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When is public debt sustainable?

- Key question for macro stability going forward
  - High debt ratios and unfunded liabilities in AEs
  - Rising rapidly in EMs with falling comm. prices
  - Essential "risk-free" asset in financial systems (collateral, capital buffers, liquidity, etc)

1. With commitment:

   a) *Classic methods*: Debt implied by steady-state GBC

   b) *Fiscal solvency methods* (empirical or structural): Debt consistent with IGBC

2. Without commitment: Debt that can be sold in a market where default risk affects issuance & price

Layout of the presentation

1. Government budget constraints
2. Historical U.S. perspective ("The U.S. Debt Crisis")
3. What's wrong with classic methods?
4. Empirical approach to solvency: Bohn's FRFs
5. Structural approach to solvency: Two-country DGE model with fiscal sector calibrated to actual tax elasticities
6. Sustainability without commitment: Domestic default risk driven by distributional incentives v. social value of debt
7. Conclusions

1. Government budget constraints

Government budget constraints

1. Primary fiscal balance: $pb_t = \tau_t - g_t$
   - Determined by fiscal policies, shocks & eq. responses
2. Period government budget constraint (GBC): assuming debt is non-state-contingent, one-period, real bond:

$$R_t b_{t-1} - b_t = pb_t, \qquad R_t \equiv (1 + r_t)$$

   - Using data in ratios of GDP: $(1 + r_t) \equiv (1 + i_t^r)/(1 + \gamma_t)$
3. No-Ponzi game cond.: $\lim_{j\to\infty} E_t \left[b_{t+j} / \prod_{i=1}^{j} R_{t+i-1} \right]$=0
4. Intertemporal gov. budget constraint (IGBC):

$$b_{t-1} = pb_t + \sum_{j=1}^{\infty} E_t \left\{ \left[\prod_{i=1}^{j} (1 + r_{t+i-1})^{-1} \right] pb_{t+j} \right\}$$

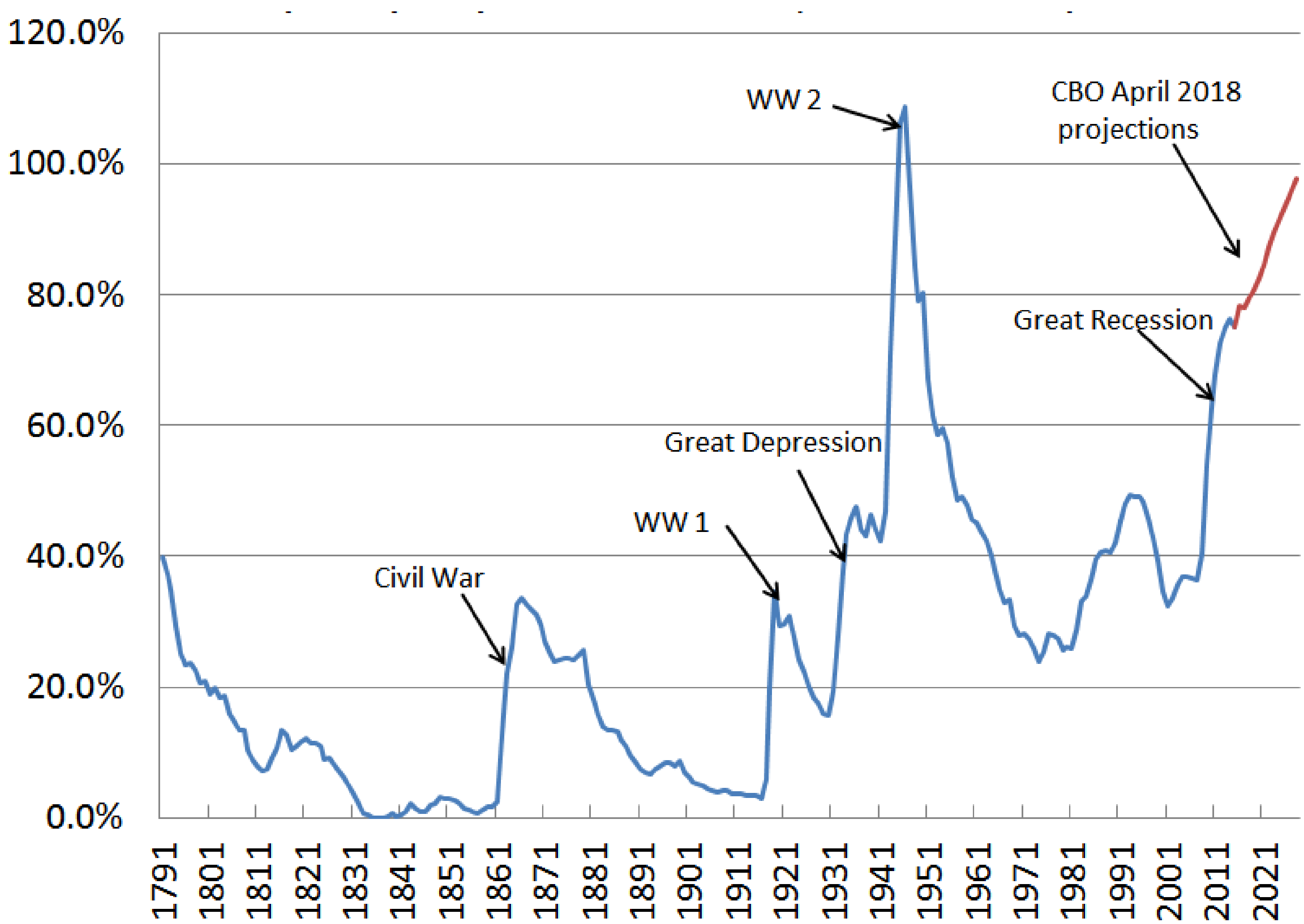
2. The Public Debt Crisis of the United States

Debt crises in U.S. history

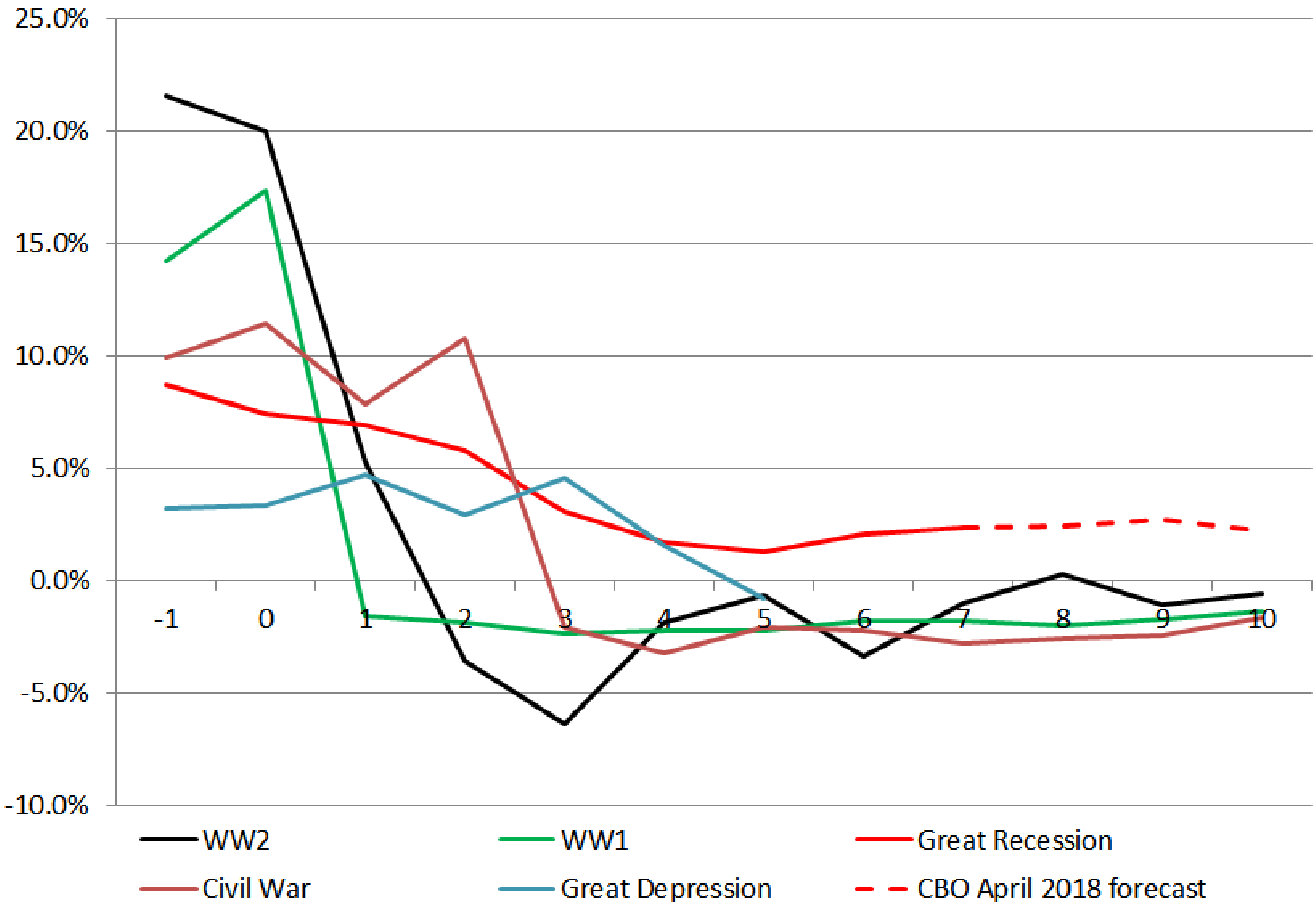
- Episodes in 95 percentile of annual increases in net federal debt-GDP ratio since 1791 (ranked):
  1. WW 2
  2. WW 1
  3. Great Recession (debt ratio is already 2nd highest)
  4. Civil War
  5. Great Depression
- GR episode is unique:
  - pb still in deficit and deficits projected through 2028! (CBO, 04/18)
  - Surpluses have been key to all large debt reductions in U.S.
- Much worse adding large unfunded liabilities:
  - 20% of GDP from state+local govs. (Lutz & Sheiner (14)),
  - 93% of GDP from social sec.+medicare (Moody's (16))

U.S. public debt in history

(net federal debt-GDP ratio, 1791-2012 from Bohn (2013), 2013-2028 from CBO)



U.S. Primary Deficits after Debt Crises



What brought the debt down?

- Use GBC to decompose changes in debt-GDP ratio:

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

$$b_t - b_{t-1} = pb_t - \left(\frac{\gamma_t - i_t^r}{1+\gamma_t}\right) b_{t-1}$$

	Initial debt ratio (1)	Final debt ratio (2)	Change in debt ratio (3)	Cumulated contribution of: Overall deficit (4)	Growth effect (5)	Primary deficit (6)	Debt service (7)	Net debt Service (8)	annnualized rates: nominal growth (9)	inflation (10)	real growth (11)
				I. Peak to Through							
a) 1792-1812	37.5%	7.2%	-30.3%	-7.2%	-23.1%	-25.2%	18.0%	-5.1%	5.8%	1.4%	4.3%
b) 1866-1916	33.5%	3.0%	-30.5%	-16.7%	-13.8%	-45.0%	28.3%	14.5%	3.3%	-0.6%	3.9%
c) 1919-1930	34.6%	15.6%	-19.0%	8.8%	-27.8%	-2.7%	11.6%	-16.3%	2.6%	0.1%	2.5%
d) 1946-1974	108.7%	23.9%	-84.8%	18.5%	-103.3%	-24.1%	42.6%	-60.7%	6.9%	3.3%	3.5%
e) 1994-2001	49.2%	32.5%	-16.7%	1.0%	-17.7%	-21.5%	22.4%	4.8%	5.6%	1.8%	3.7%
				II. Per-year averages							
a) 1792-1812			-1.5%	-0.4%	-1.2%	-1.3%	0.9%	-0.3%			
b) 1866-1916			-0.6%	-0.3%	-0.3%	-0.9%	0.6%	0.3%			
c) 1919-1930			-1.7%	0.8%	-2.5%	-0.2%	1.1%	-1.5%			
d) 1946-1974			-3.0%	0.7%	-3.7%	-0.9%	1.5%	-2.2%			
e) 1994-2001			-2.4%	0.1%	-2.5%	-3.1%	3.2%	0.7%			

3. What's wrong with the classic methods?

Classic methods and their flaws

- Proposed by Buiter (1985), Blanchard (1990), and widely used in policy institutions (IMF, 2015)
- Steady-state GBC yields "Blanchard ratio" or debt-stabilizing *pb*:

$$b^{ss} = pb^{ss}/r$$

- First flaw: Ignores asset market incompleteness
  - NSC debt + commitment impose a "Natural Public Debt Limit" (Mendoza & Oviedo (06,09))
  - r and b^{ss} are joint equilibrium outcomes
- Second flaw: Disconnected from current debt and IGBC
  - Infinitely many future pb sequences satisfy IGBC for same current debt but converge to different b^{ss}, and some even lead to infinitely large debt!

Mendoza-Oviedo Natural Public Debt Limit

- NPDL: largest debt repayable after long spell of low revenues and outlays adjust to feasible minimum:

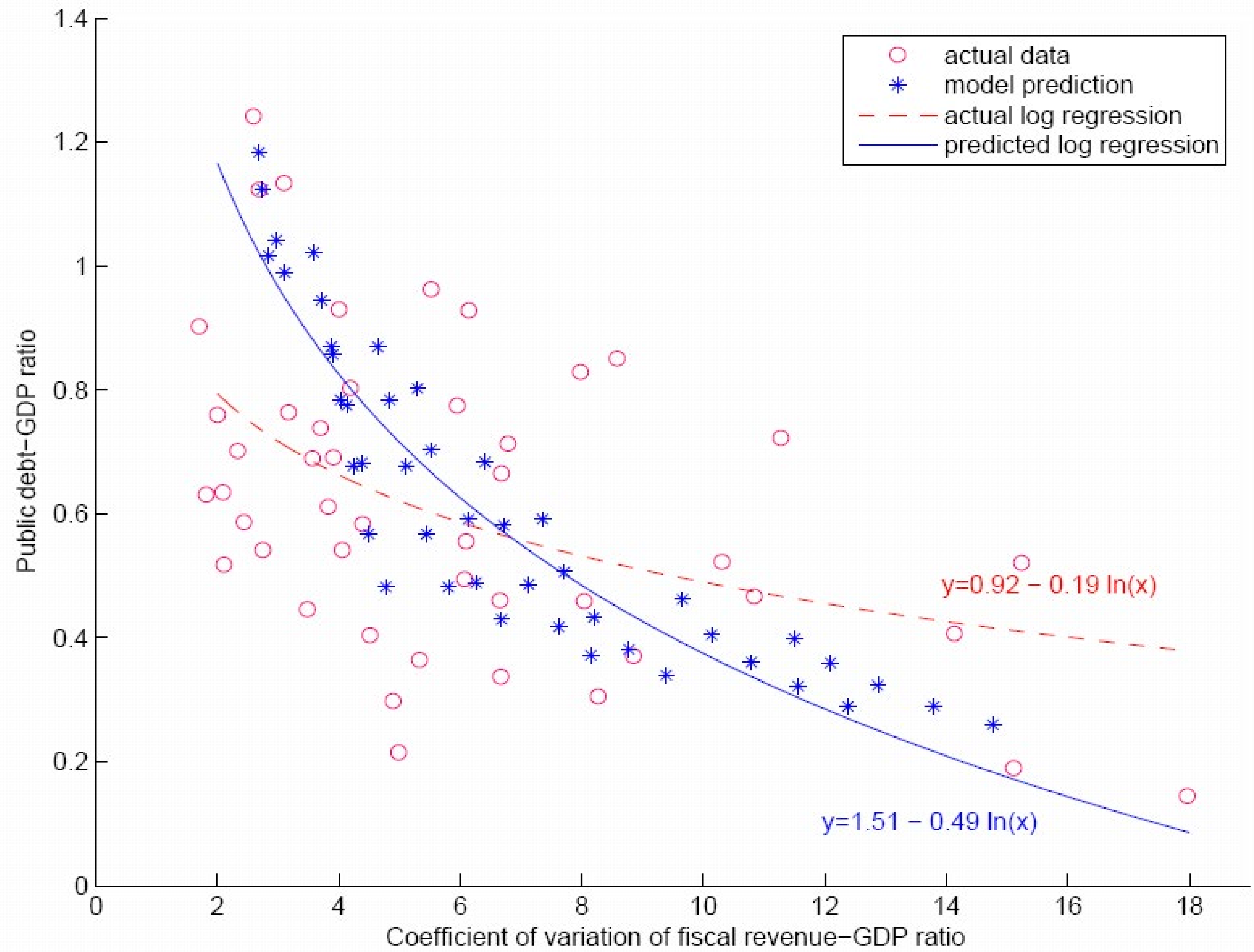
$$b_t \leq NPDL \equiv \frac{\tau^{min} - g^{min}}{r}$$

- Countries with more volatile revenues or less able to cut outlays can borrow less (lower NPDLs)

- Debt follows random walk with boundaries:

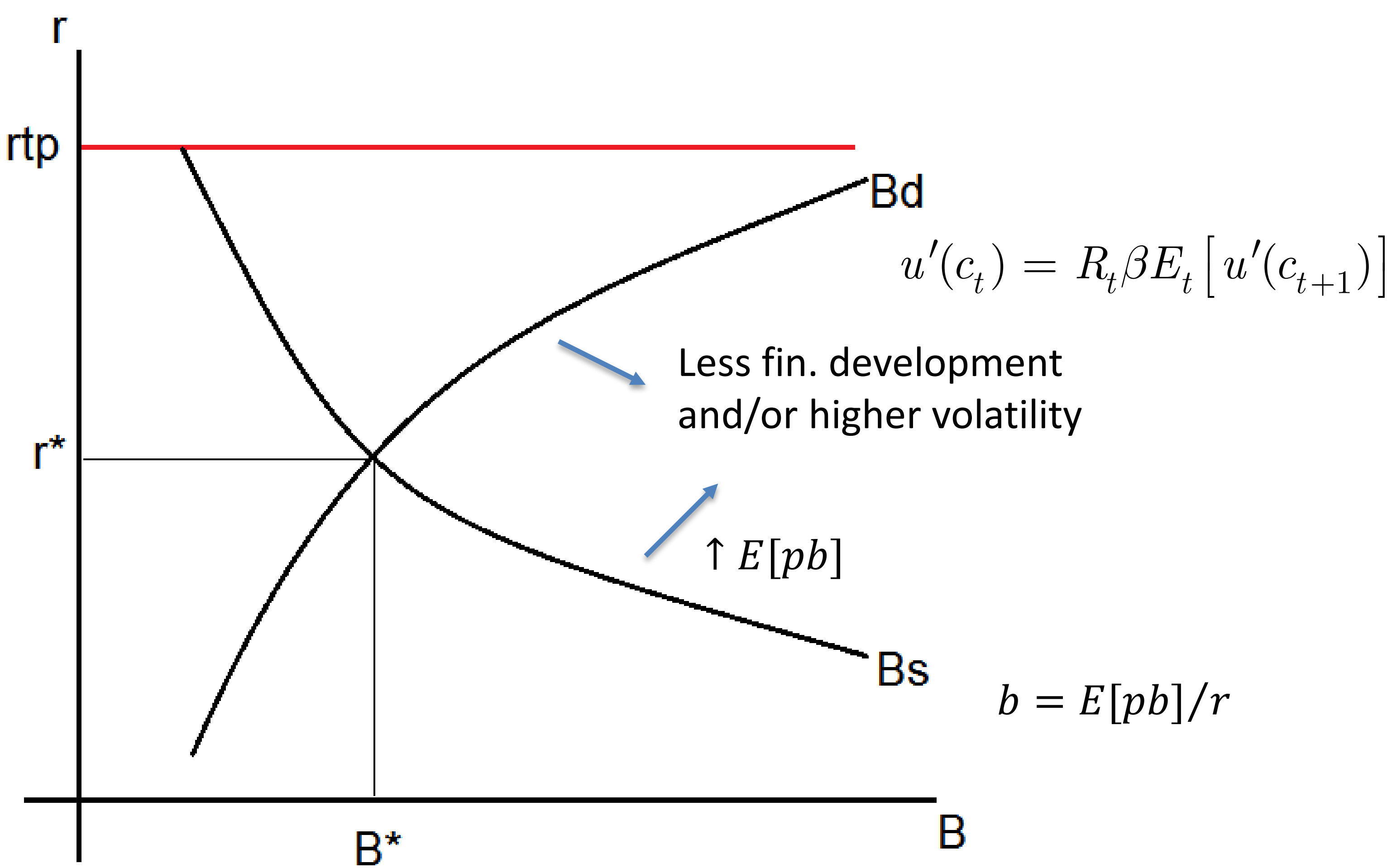
$$b_t = max[NPDL, (1 + r_t)b_{t-1} - pb_t] \geq \bar{b}$$

Revenue variability and average debt (Mendoza & Oviedo (09))



The debt market in the long run

- Demand driven by self-insurance & liquidity
- Blanchard ratio evaluated at mean pb is only a supply condition



4. Empirical Approach to Solvency (Bohn’s Fiscal Reaction Function)

Bohn's Contributions

1. Typical IGBC tests are misspecified: Sustainable debt *does not* equal PDV of expected *pb's*:

$$b_{t-1} = pb_t + \sum_{j=1}^{\infty}\left\{\left(R_{t+j}\right)^{-1} E_t\left[pb_{t+j}\right] + \mathrm{cov}_t\left(\frac{\beta^j u'(c_{t+j})}{u'(c_t)}, pb_{t+j}\right)\right\}$$

   – Given average *pb's*, higher debt is sustainable with *cov(c,pb)* < 0

2. For weak assumptions on R_t process, IGBC holds if debt or outlays + interest are integrated of <u>any</u> finite order

3. FRF $pb_t = \mu_t + \rho b_{t-1} + \varepsilon_t$ with $\rho > 0$ is <u>sufficient</u> for IGBC to hold, and using GBC yields $b_t = -\mu_t + (1 + r - \rho)b_{t-1} + \varepsilon_t$

   – Stationary if $\rho > r$

   – Diverges to infinity if $0 < \rho < r$ but still satisfies IGBC!

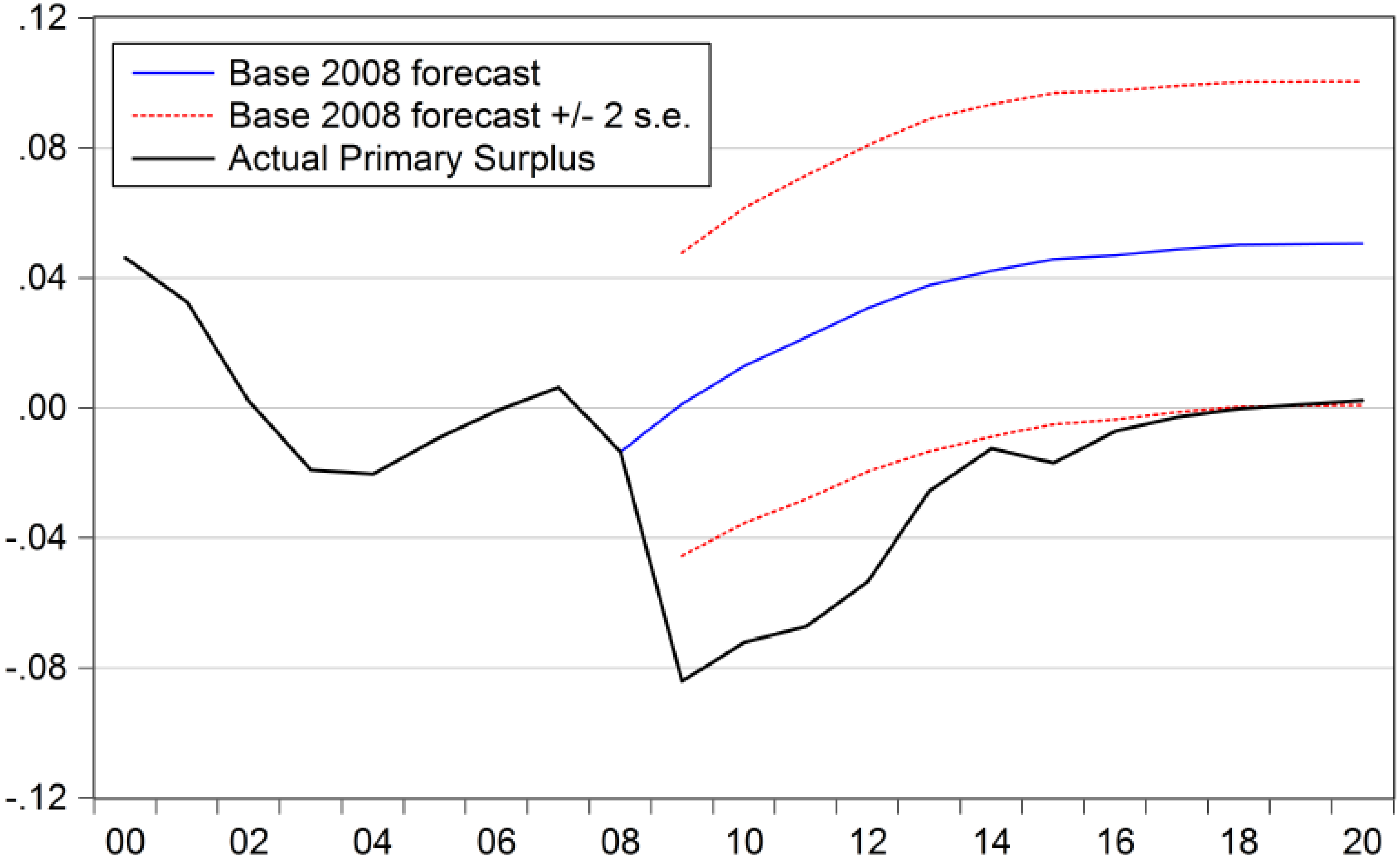
4. Tests on U.S. data 1791-2003 support linear & nonlinear FRFs

Updated FRF Estimates

- U.S. estimates (1791-2014) and cross-country panels (1951-2013) pass FRF tests
  - EMs have stronger response, less access to debt
  - Ghosh et al. (2013) used non-linear FRFs with “fiscal fatigue” to measure “fiscal space”
- Structural break in U.S. FRF post-2008: ρ fell from 0.102 to 0.078 (using 1793-2014 data)
- U.S. deficits have been much larger than out-of-sample pre-08 forecast (in line w. events window)
- FRFs with lower ρ satisfy IGBC at same initial debt, but with larger deficits & higher long-run debt

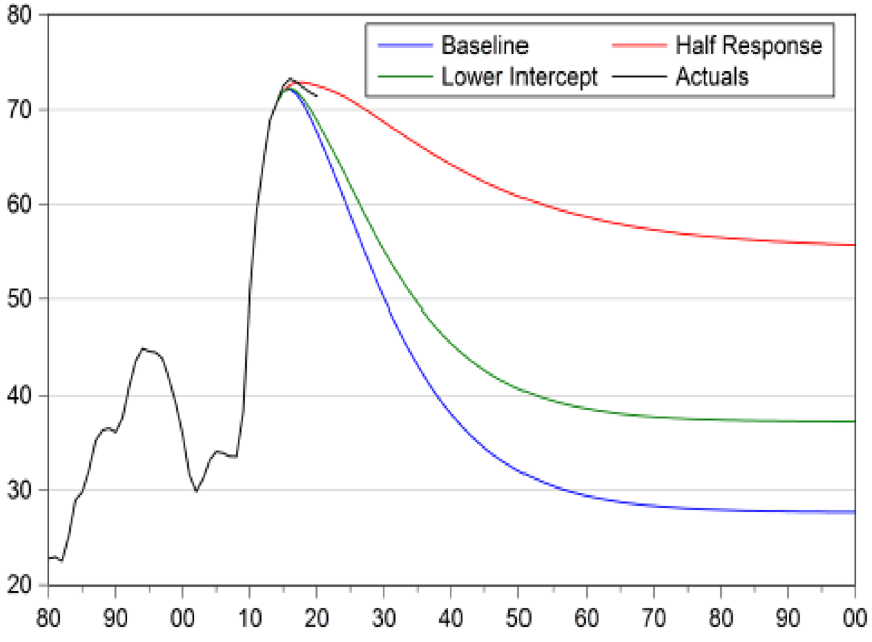
U.S. Primary Balance Post-2008 Forecast

(2009-2020 forecast from 1791-2008 FRF regression)

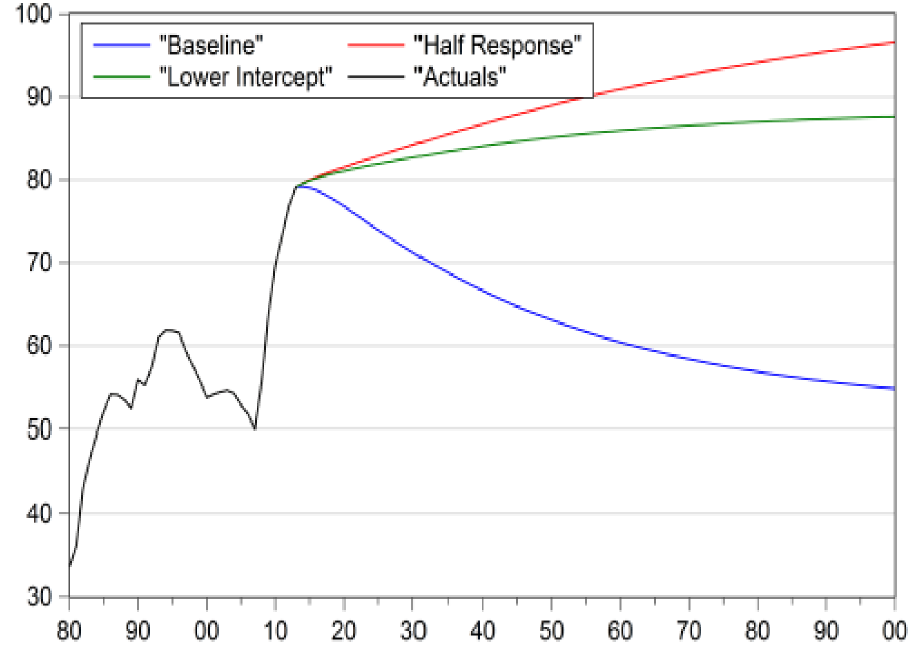


Out-of-sample forecast uses actual values for the independent variables for 2009-2014 and 2016 President's Budget for 2015-2020

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.

5. Structural Approach to Solvency (Two-Country Dynamic GE Model)

Structural approach

- FRFs are not useful for comparing macro and welfare effects
- Calibrated two-country Neoclassical model used to compare US-EU adjustment in response to rise in post-crisis debt
  1. Exogenous long-run growth (labor-augmenting tech. change)
  2. Fiscal sector: capital, labor and consumption taxes, gov. purchases, transfers and debt (calibrated to data)
  3. Match tax elasticity estimates using endogenous utilization & limited tax allowance for depreciation
  4. Trade in goods and bonds with residence-based taxation
  5. Capital immobile across countries, but trade in bonds arbitrages post-tax returns & induces capital reallocation
  6. Taxes have cross-country externalities (relative prices, wealth distribution, tax revenues)

Fiscal sector

- GBC (with discount bonds):

$$d_t - (1+\gamma)q_t^g d_{t+1} = pb_t$$

$$\equiv \tau_C c_t + \tau_L w_t l_t + \tau_K(r_t m_t - \theta\bar{\delta})k_t - (g_t + e_t)$$

- Exogenous gov. purchases & transfers, fixed at 2007 levels

- IGBC:

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

- Dynamic Laffer curves (DLCs): 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:

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

- 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		
τ_C	0.17	0.04
τ_L	0.41	0.27
τ_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		
d_{2007}/y_{2007}	0.38	0.43
d_{2011}/y_{2011}	0.58	0.74
$\Delta d/y$	0.20	0.31

Findings for capital taxes

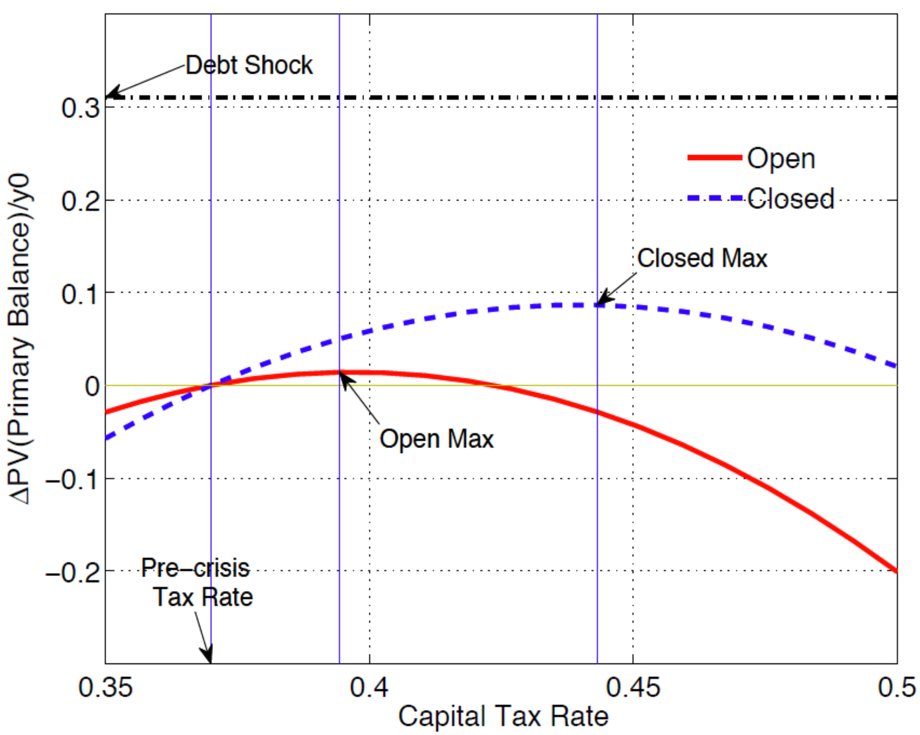
1. Large externalities via K. reallocation, factor prices & tax revenues (strong incentives for tax competition)

2. US debt *not* sustainable (DLC max. is below required increase in PV of *pb*). Capital tax hikes cause large efficiency and welfare losses

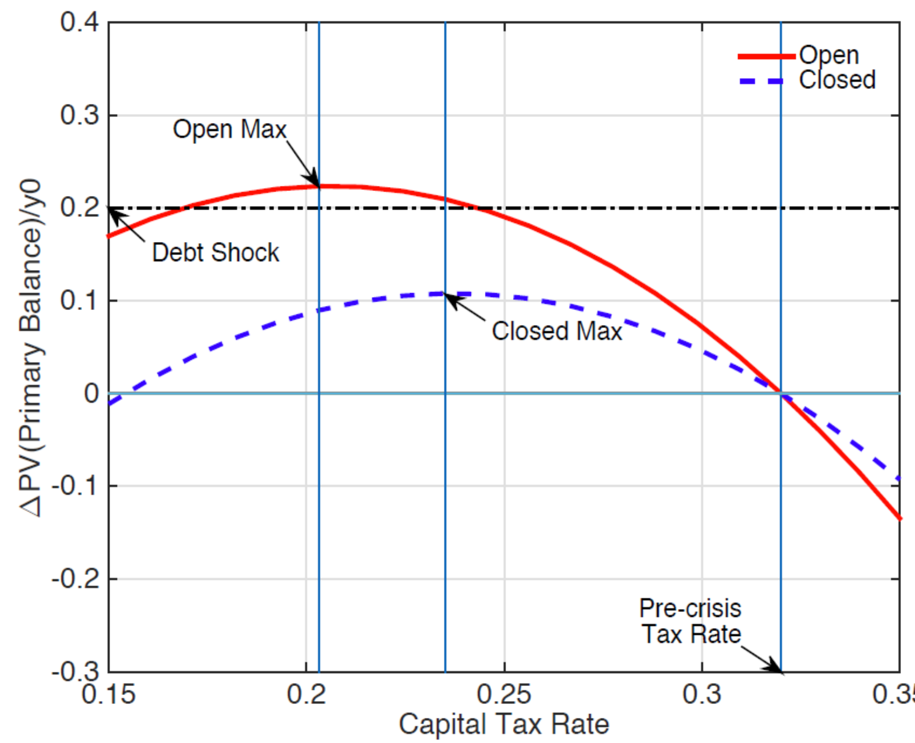
3. EU15 in inefficient side of DLC: tax cut makes debt sustainable via favorable external effects (but closed-economy DLC also peaks below required level)

4. Without utilization and limited allowance, short-run income tax elasticity has wrong sign, DLC is linearly increasing (taxing capital too easy!)

Capital Tax Dynamic Laffer Curves



(a) US



(b) EU15

6. Domestic Default Approach: Sustainable Debt without Commitment

Why consider domestic default?

- Restoring fiscal solvency via conventional tools seems unlikely
- Debt viewed as “risk-free” despite history of domestic defaults:
  1. Reinhart & Rogoff (08): 1.1% frequency since 1750, 1/3 ratio v. external defaults, forgotten history in Macroeconomics
  2. Hall & Sargent (14): U.S. default after revolutionary war
  3. European Debt Crisis akin to domestic default: 85% of EU debt stays in Europe, common currency
  4. Narratives emphasize concern of creditors and their governments for financial/redistributive effects (diff. from external defaults)
- D’Erasmo & Mendoza (13,14) study domestic default and its effects on sustainable debt:
  – Large default costs and/or gov. bias for bond holders make debt sustainable, otherwise distributional default incentives dominate
  – Solvency alone does not make debt sustainable!

Explaining domestic defaults

- Agents differ in debt holdings and income (b, y), gov. issues debt, has stochastic outlays (B, g) and can choose to default
- Utilitarian gov. cares for all domestic agents (including bond holders) & values distributional role of debt:
  1. **Issuing** (*repaying*) debt causes **progressive** (*regressive*) redistribution, making default desirable ex-post
  2. Ex-ante prog. redistribution is hampered by lower debt prices if default risk rises (**debt Laffer curve**)
  3. Default ex-post has large **endogenous costs**!
- Costs driven by financial roles of debt that give it social value:
  1. **Liquidity provision** for credit-constrained agents
  2. **Self-insurance** vehicle for prec. savings & capital buffers
  3. **Risk-sharing** across agents with different income

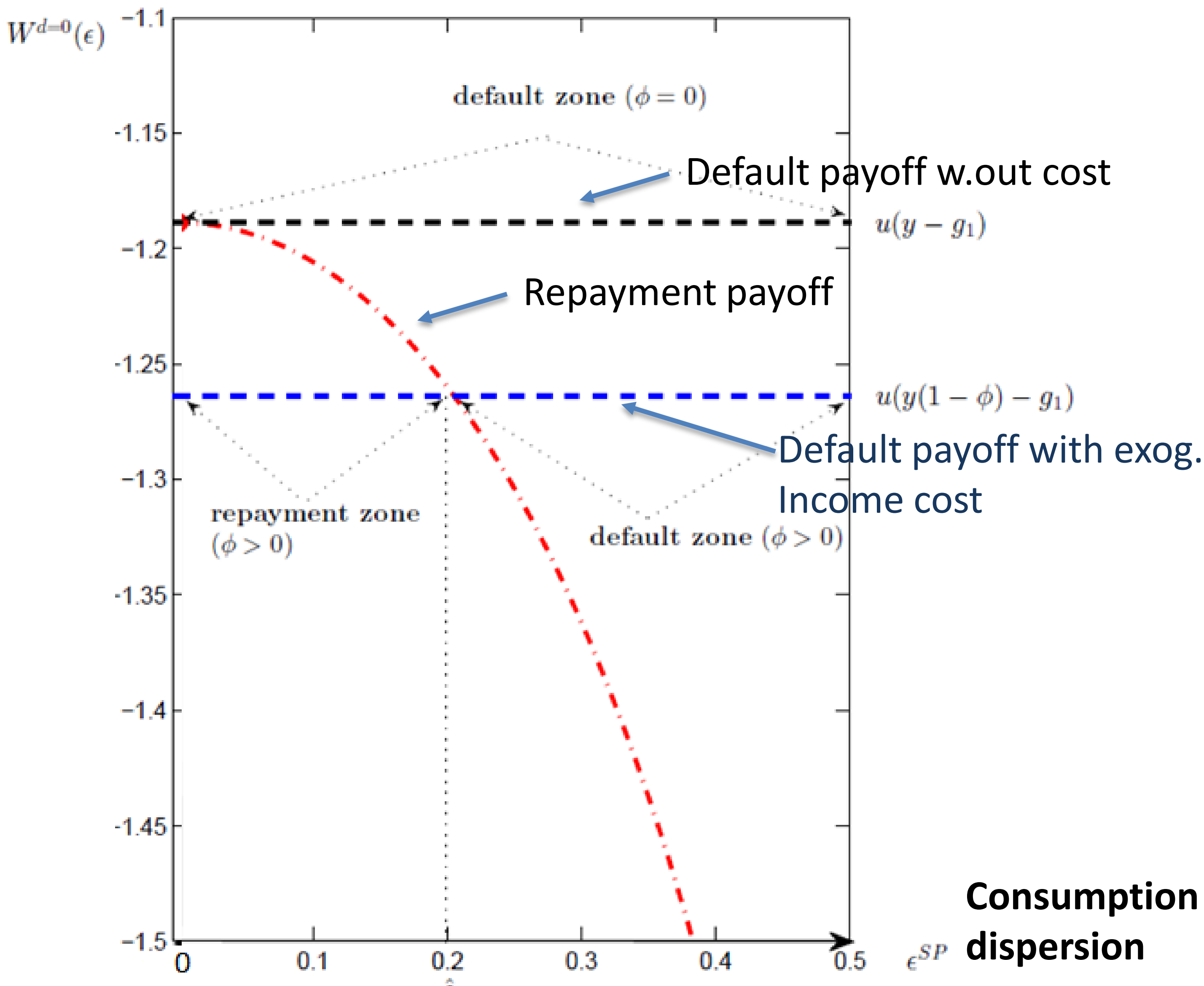
Feedback mechanism

1. Gov. decides to default or repay at *t*
2. If it repays, it sells new debt to foreign (risk neutral) & domestic (risk averse) agents
3. Foreigners are marginal buyers. Debt priced by arbitrage condition (def. risk premium ≈ prob. of def)
4. Agents diff. in (b, y) respond differently to def. risk
5. Individual valuations of gains from default vary widely across agents and move over time
6. Social gains from default change with dispersion of individual valuations (fixed welfare weights, can display "creditor bias")

Redistribution alone cannot sustain debt

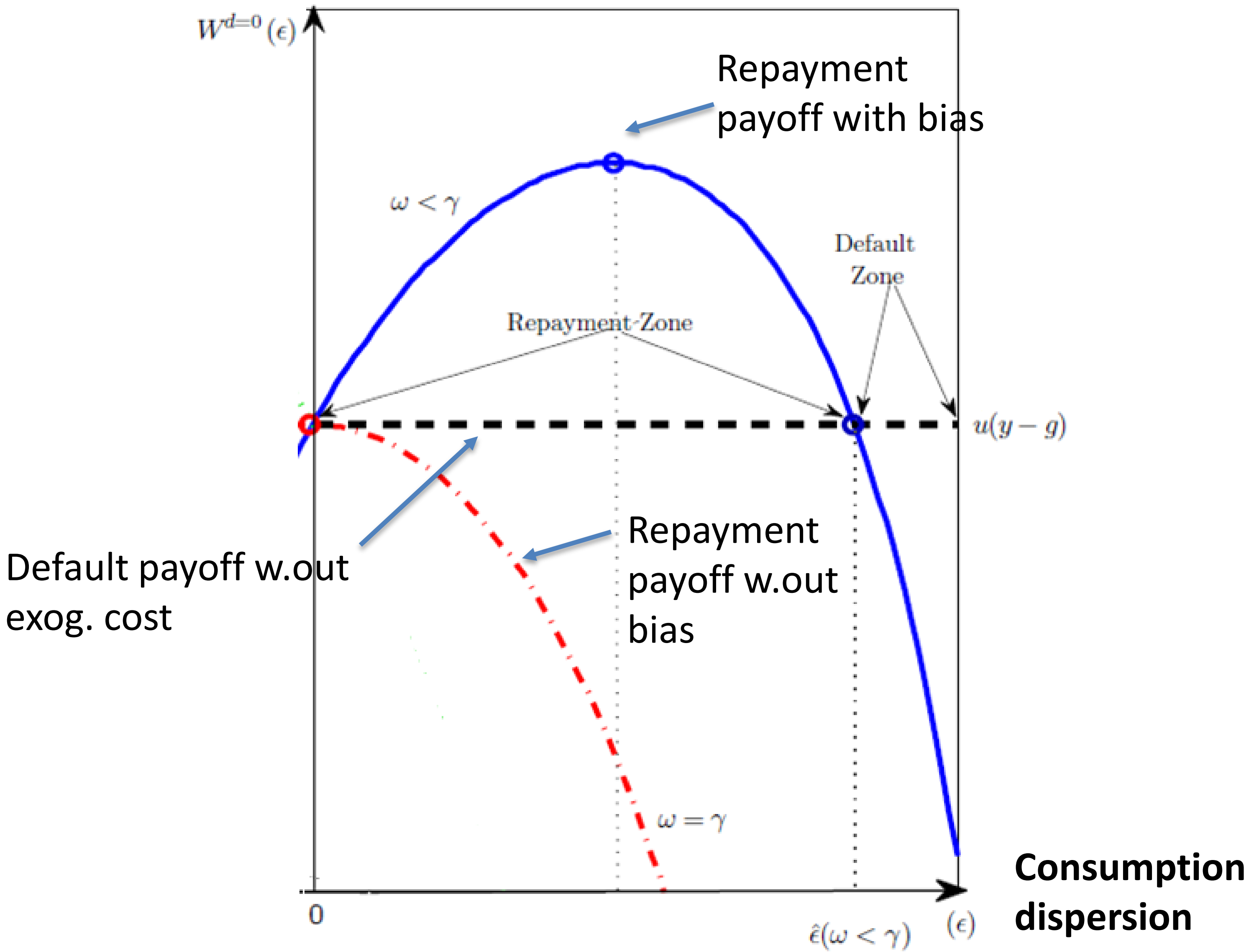
No creditor bias

$\omega = \gamma$



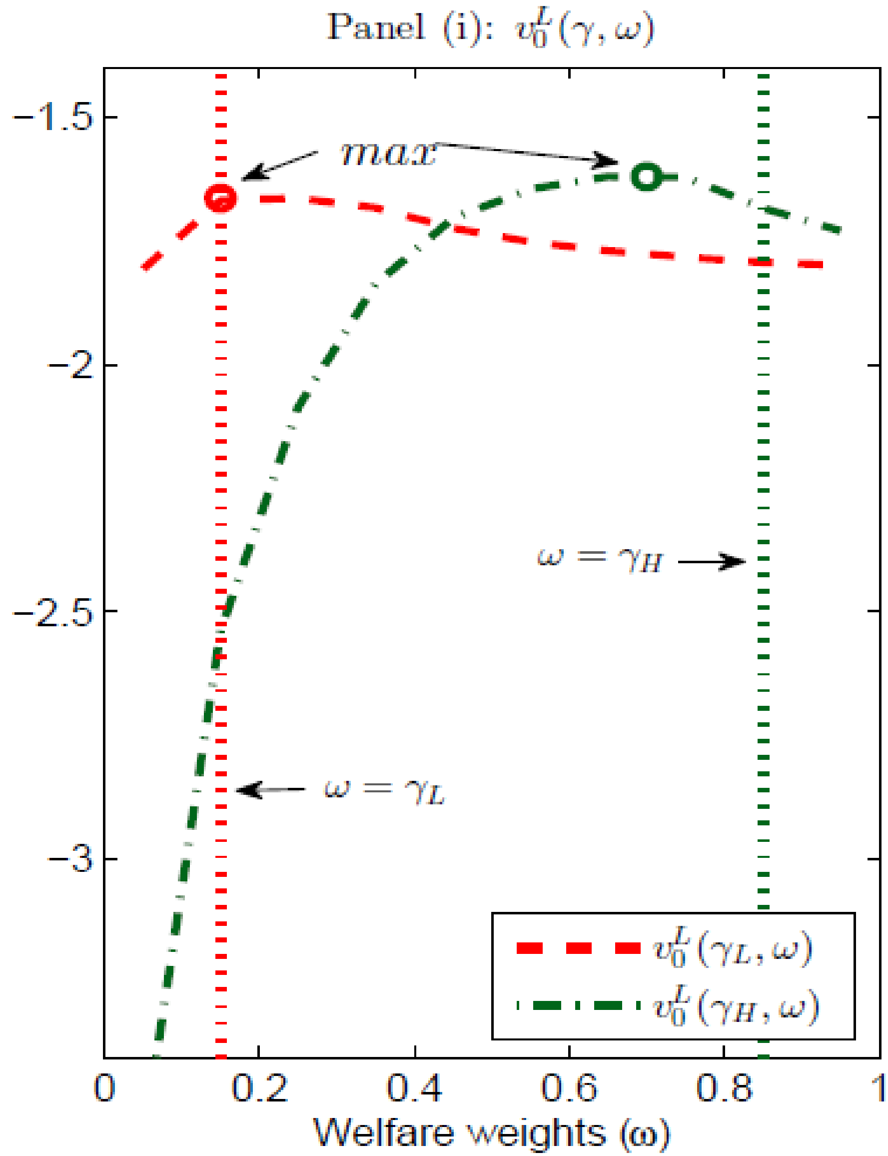
Consumption dispersion

Sustaining debt with creditor bias



Non-bond-holders may prefer bias!

(if ownership is sufficiently concentrated)



Model calibration

- Calibration to Eurozone (also a case with only Spain)
- Most parameters set to data estimates
- Three parameters set by SMM:
  a) Default cost targets mean debt ratio $\phi(g) = \phi_1 \max\{0, (\mu_g - g)^{1/2}\}$
  b) Discount factor targets mean domestic debt ratio
  c) Creditor bias targets mean spread (v. Germany)

Discount Factor	β	0.871
Welfare Weights	$\bar{\omega}$	0.065
Default Cost	ϕ_1	0.793

Moments (%)	Data	Model
Avg. Ratio Domestic Debt	55.53	55.47
Avg. Spread Eurozone	0.92	1.22
Avg. Debt to GDP (maturity adjusted)	7.45	7.87

Quantitative findings

1. Model matches two key R&R historical facts:
   a) Infrequent defaults: 1.2% in model v. 1.1% in data
   b) Defaults w. low external debt (44% of total debt on average)
2. Debt sold at risk-free price 75% of the time, but amount of debt sharply reduced by inability to commit
3. Pre-default dynamics typical of debt crises: Debt & spreads rise sharply, suddenly before defaults (debt 38% above average, spreads at 953 basis points)
4. Model matches negative corrs. of spreads with disp. income and gov. expenditures
5. Large, time-varying dispersion in private default gains

Quantitative findings contn'd

6. When default incentives are weak, debt is used for tax-smoothing, but when they are strong, gov. generates few resources by borrowing, so debt falls when g rises

7. Optimal debt moves across three zones:

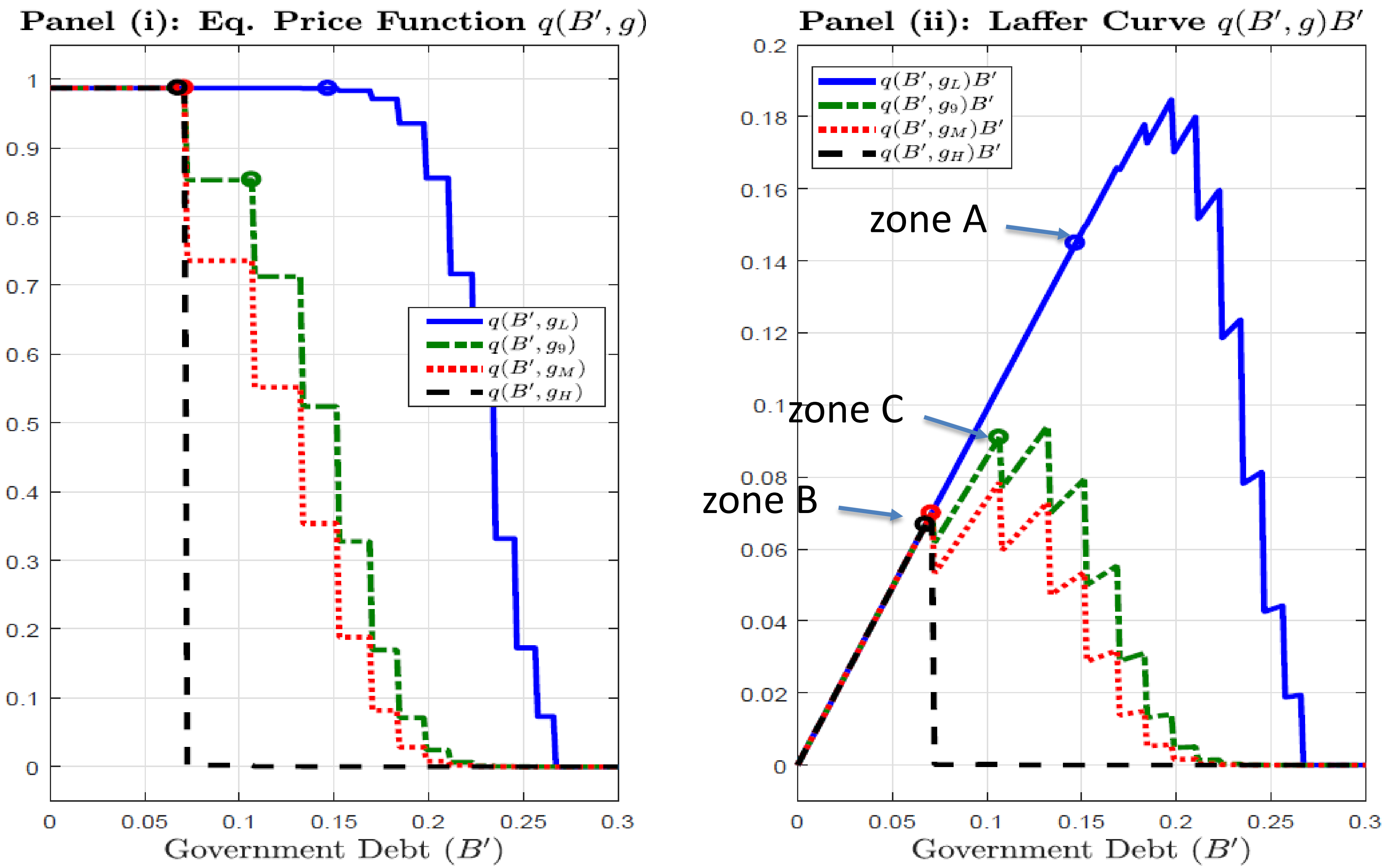
   A. *Unconstrained risk-free debt*: Low enough *(B,g)* so that debt is sold at risk-free price in upward-sloping region of Laffer curve

   B. *Constrained risk-free debt*: High enough *(B,g)* such that debt sells at risk-free price but at the max. of the Laffer curve.

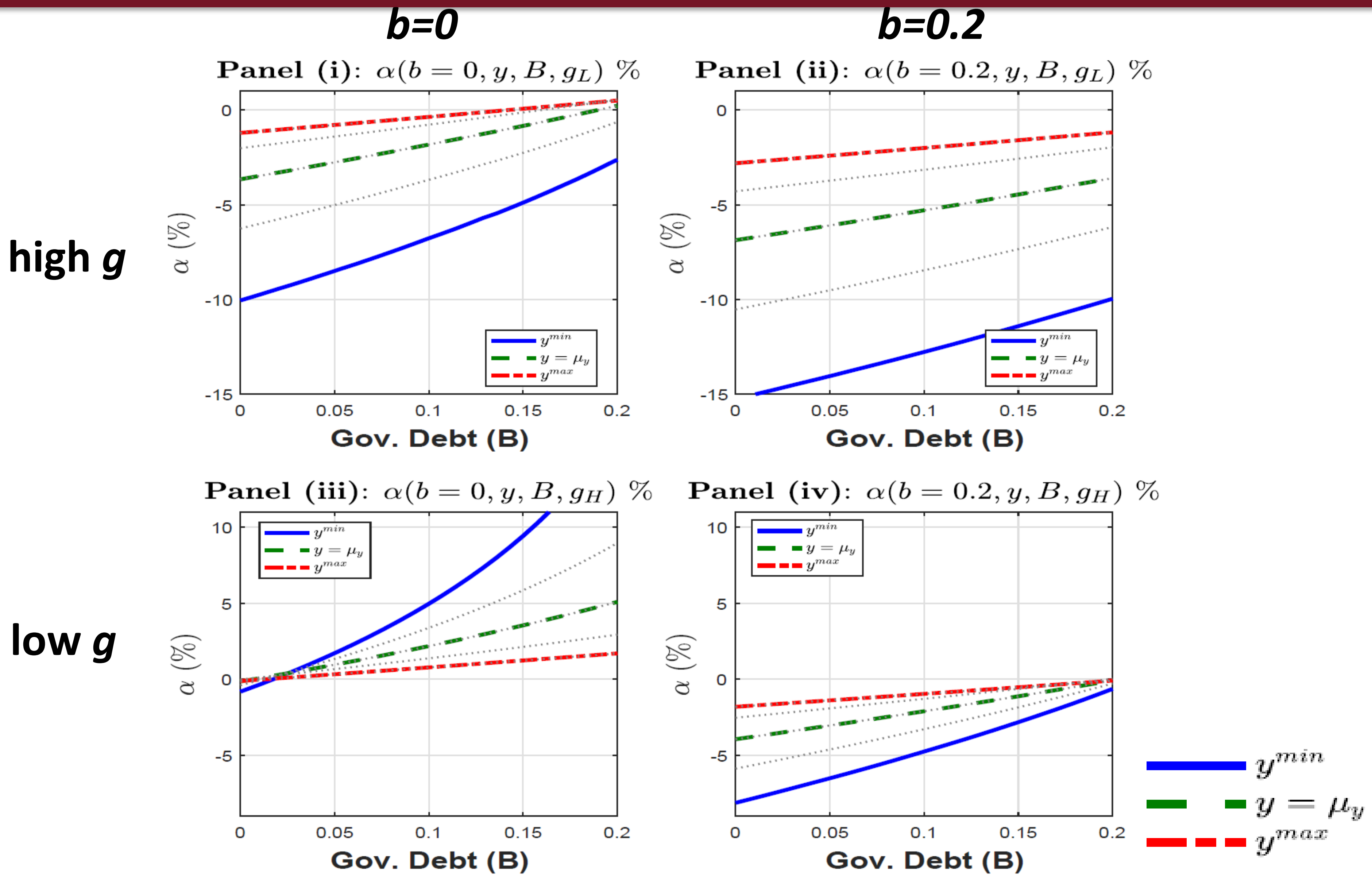
   C. *Debt w. risk premium*: *(B,g)* for which debt carries risk premium and can be at max. of Laffer curve or less (gov. desires more resources than what debt at risk-free price yields, but not always the most it can generate at a positive spread)

   – Debt is in region *C* less frequently, so it sells at the risk-free price more often, but option to default lowers sustainable debt.

Pricing function & Laffer curve

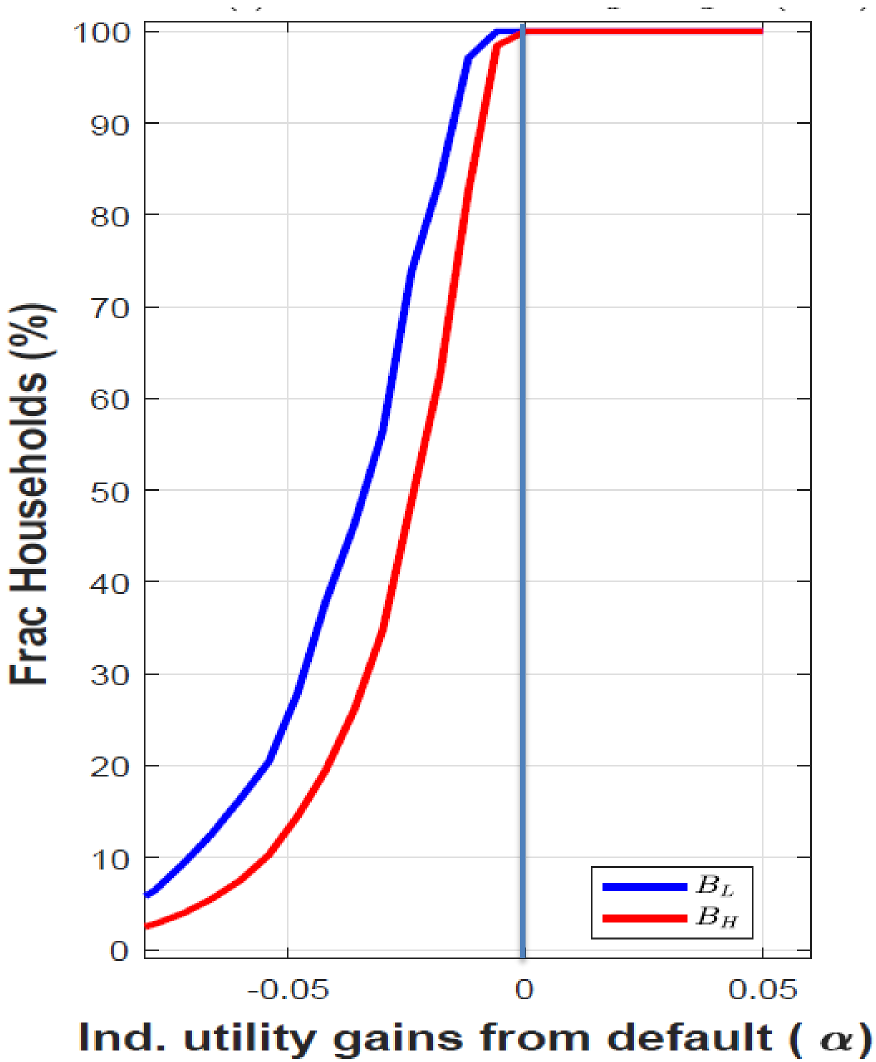


Dispersion in gains from default

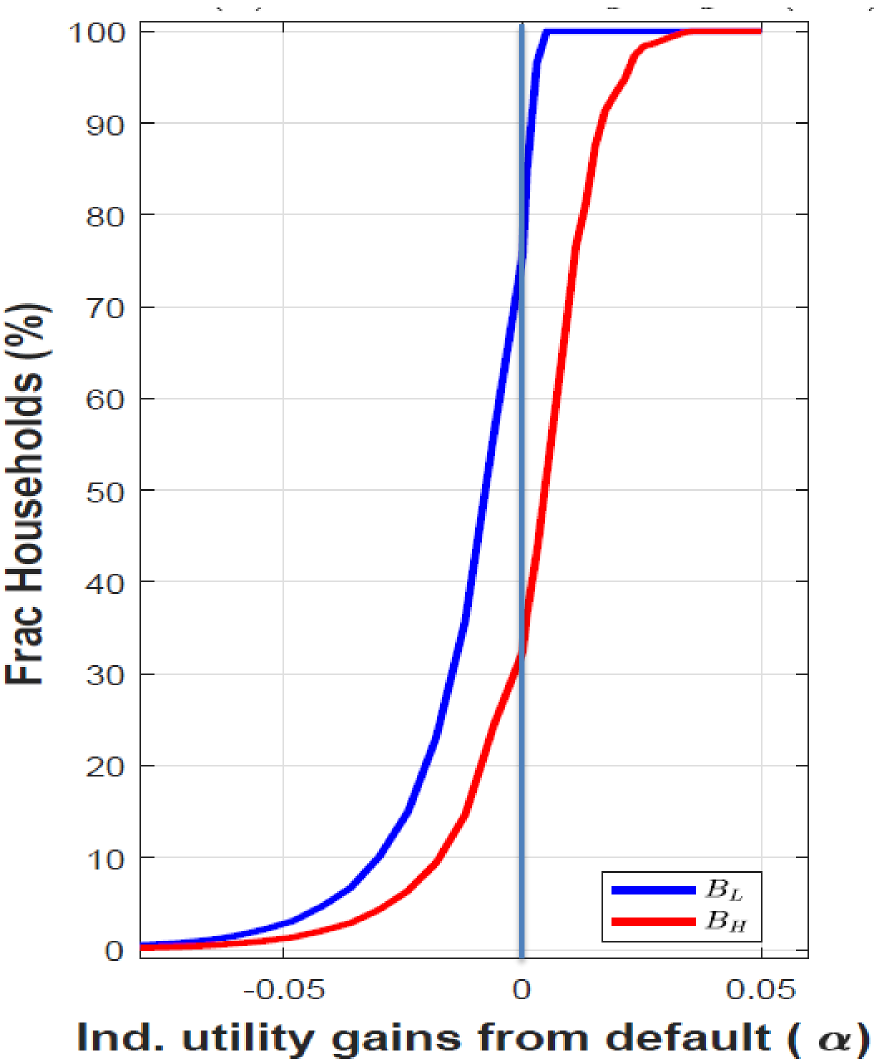


Evolution of social default gains

Low g



High g



Conclusions

- Three ways to approach debt sustainability raise concerns about 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. Allowing for domestic default risk, default costs and/or creditor bias make debt sustainable but at significantly reduced levels
  4. Economies with concentrated debt ownership may elect biased governments so as to sustain more debt