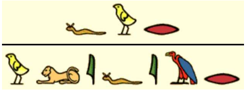
On the Optimal Speed of Sovereign Deleveraging with Precautionary Savings



Thomas Philippon and Francisco Roldán

Jacques Polak ARC, November 2016

How fast should governments repay their debt?

- Aggregate demand effect –> straightforward
- Cost of sovereign risk –> unclear
- Literature
    - External debt (Eaton-Gersovitz '82, Arellano '08): exclusion & exogenous output loss.
    - Financial intermediaries: Gennaioli et al. (2014), Boccola (2016)
        - Clearly important in the short term. But rely on levered exposure and no recapitalization
- We emphasize precautionary savings by those *ultimately* exposed to the risk
    - Either directly, or because they hold bank equity

Model: Government

- Budget constraint, long term debt price q_t, duration ρ

$$q_t \left(B_t^g - (1-\rho)\frac{B_{t-1}^g}{\Pi_t} \right) = \kappa \frac{B_{t-1}^g}{\Pi_t} + G_t - T_t,$$

- Default risk

$$\pi\left(\frac{B_t^g}{\bar{Y}}; \varepsilon_t\right)$$

- Normalize $\kappa = r + \rho$ so $q^* = 1$

Households

- Closed economy

$$\sum_{t=0}^{\infty} \beta_i^t \left(u\left(C_t^i\right) - \kappa_n \frac{N_{i,t}^{1+\varphi}}{1+\varphi} \right)$$

- Two types
  - χ borrowers $B_t^h \leq \bar{B}_t^h$ and

$$C_t^b = \frac{W_t^b}{P_t} N_t^b + \frac{B_t^h}{R_t^h} - \frac{B_{t-1}^h}{\Pi_t} - T_t.$$

  - $1-\chi$ savers $\beta_s > \beta_b$, Euler equation and

$$(1-\chi)\, S_t = q_t B_t^g + \chi \frac{B_t^h}{R_t^h}$$

Production

- Linear in labor

$$Y_t = \mathbf{N}_t - \delta_t \Delta,$$

where

$$\mathbf{N}_t \equiv N_{b,t}^{\chi} N_{s,t}^{1-\chi}.$$

and set $\Delta = 0$ for the talk.

- Normalize steady state to $\mathbf{N} = 1 + G$, $\mathbf{C} = 1$, $\mathbf{W} = 1$

2-period Model with CARA Preferences

- CARA/Cobb-Douglas separation result

$$\bar{\mathsf{N}} = 1 + G$$

- Long Run: Flexible prices

$$C_2^s = 1 + \frac{\chi}{1-\chi} \frac{B_1^h + (1 - \delta\hbar) B_1^g}{\Pi_2}$$

No Sovereign Risk

- Wealth effect, funding constraint

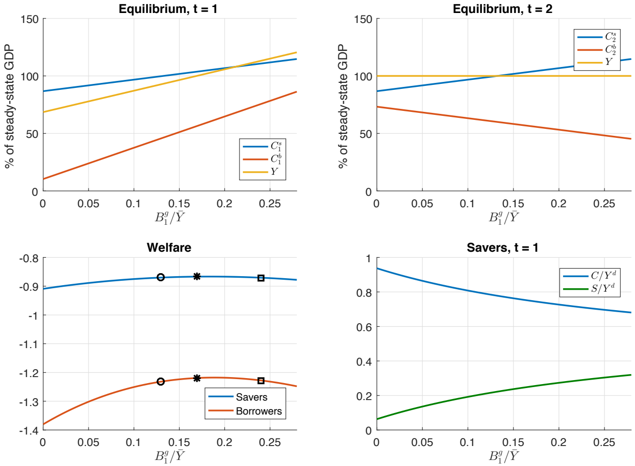
$$C_2^s = 1 + \frac{\chi}{1-\chi}\frac{\bar{B}_1^h + B_1^g}{\Pi_2}$$

$$u'(C_1^s) = \mathbb{E}\left[\frac{\beta R_1}{\Pi_2} u'(C_2^s)\right]$$

$$\mathbf{N}_1 = C_1^s + \frac{\chi}{1-\chi}\left(\frac{B_1^g + \bar{B}_1^h}{R_1} - \left(B_0^g + B_0^h\right)\right) + G$$

- 3 equations, 5 effects:
  - Non Ricardian, ZLB, commitment to inflate, multiplier $(1+\beta)\frac{\chi}{1-\chi}$, priv. and sov. debts perfect substitutes for AD mgt
  - Focus on the case $\frac{\beta R_1}{\Pi_2} = 1$

Fiscal Policy with Private Deleveraging



Circles = neutral. Stars = full employment. Squares = constant debt.

Sovereign Risk: 3 Equations, 7 Effects!

- Present Value Equation

$$C_1^s = 1 + \frac{\chi}{1-\chi}\left(B_1^h + B_1^g\right) - \frac{1}{\gamma}\log\left(1 - \pi + \pi e^{\gamma \frac{\chi}{1-\chi}\hbar B_1^g}\right)$$

- Funding Equation

$$\mathbf{N}_1 = C_1^s + G_1 + \frac{\chi}{1-\chi}\left(q_1 \frac{B_1^g}{R_1} + \frac{\bar{B}_1^h}{R_1} - B_0^g - B_0^h\right)$$

- Debt Pricing Equation

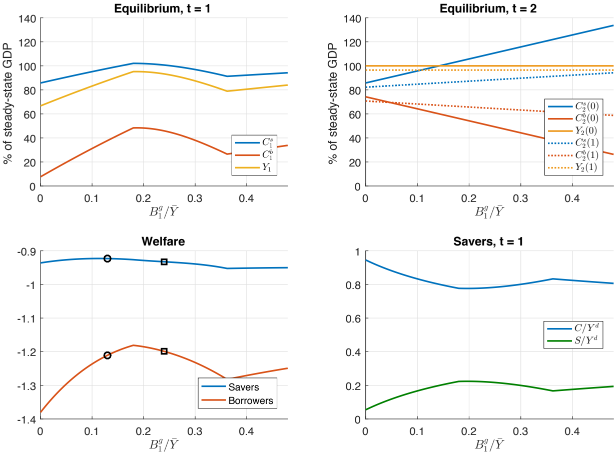
$$\frac{q_1}{\beta} = 1 - \hbar\pi\left(B_1^g\right) e^{\gamma\left(C_1^s - C_2^s(\delta)\right)}$$

Calibration of Sovereign Risk

- Martin & Philippon (2014)

$$Spread_t^{crisis} = 1\% \cdot \mathbf{I}_{B^g_{t-2} \leq 0.9} B^g_{t-2} + 10\% \cdot \mathbf{I}_{B^g_{t-2} > 0.9} \left(B^g_{t-2} - 0.9\right)$$

Simulations with Sovereign Risk



Circles = neutral. Squares = constant debt.

Dynamic Risk-Sensitive Economy

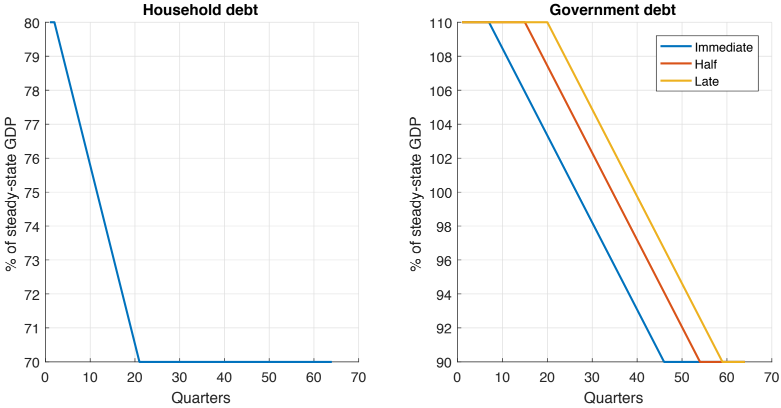
- Infinite horizon, flexible price and no risk beyond some large T
- The government can default *once* at any time $t < T$.
- Epstein-Zin preferences: EIS ψ, CRA γ

$$V_t^{\frac{\psi-1}{\psi}} = (1-\beta)\, C_t^{\frac{\psi-1}{\psi}} + \beta \left(\mathbb{E}_t \left[V_{t+1}^{1-\gamma} \right] \right)^{\frac{\psi-1}{\psi(1-\gamma)}}$$

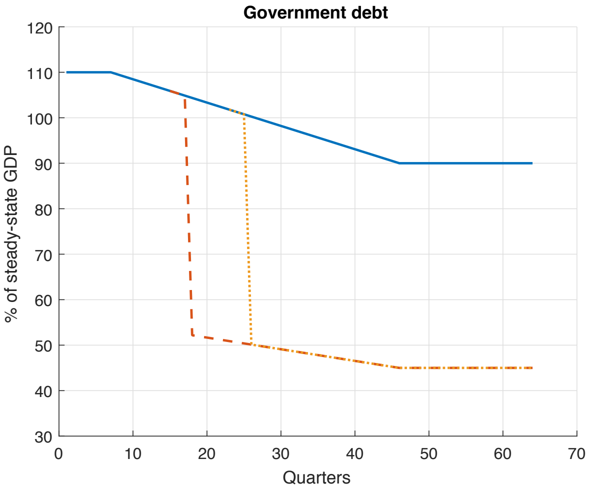
- Pricing kernel

$$M_{t+1} = \beta \left(\frac{C_{t+1}^s}{C_t^s} \right)^{\frac{-1}{\psi}} \left(\frac{V_{s,t+1}}{\left(\mathbb{E}_t \left[V_{s,t+1}^{1-\gamma} \right] \right)^{\frac{1}{1-\gamma}}} \right)^{\frac{1}{\psi}-\gamma} .$$

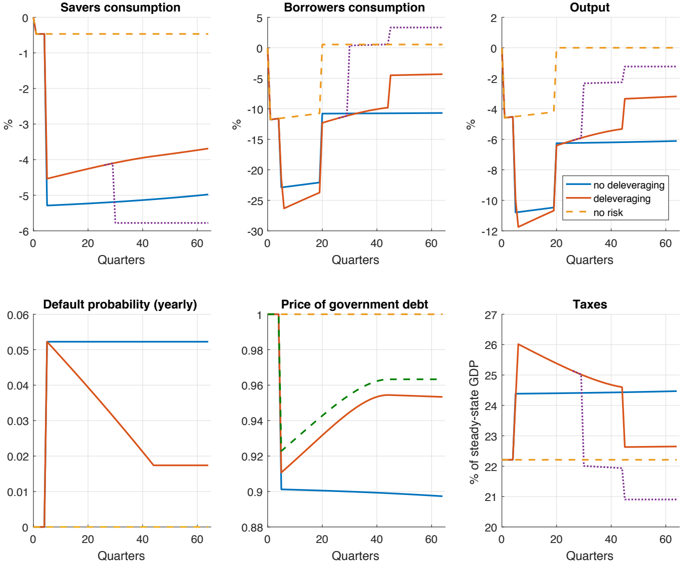
Private and Sovereign Deleveraging Dynamics



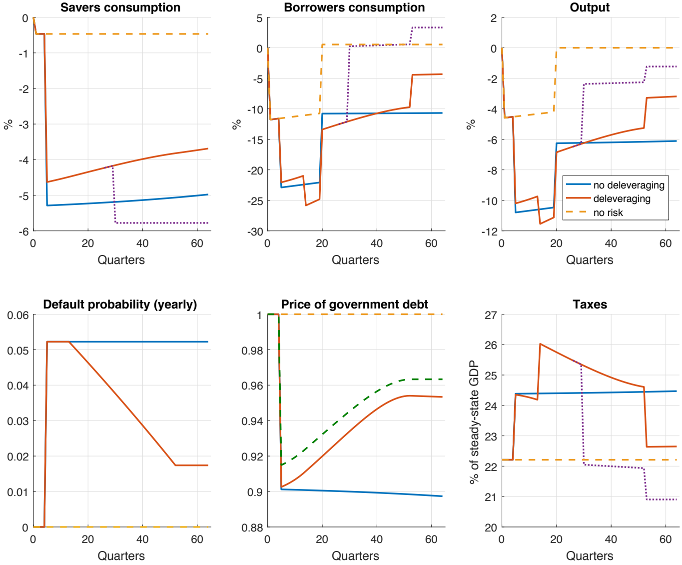
Government Deleveraging and Default Paths



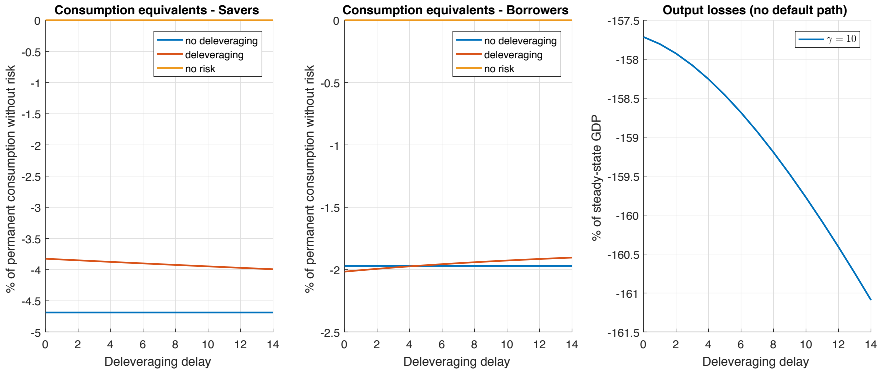
Early Deleveraging



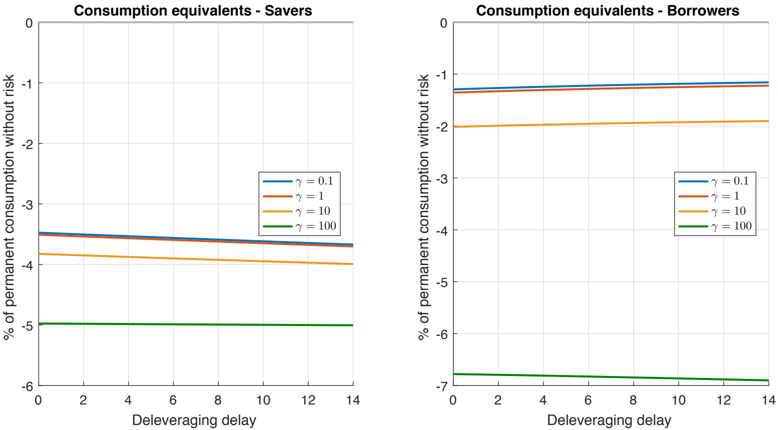
Late Deleveraging



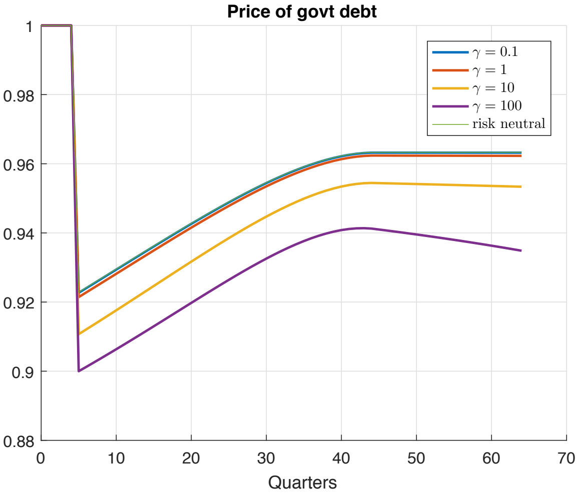
Welfare and Deleveraging Delay



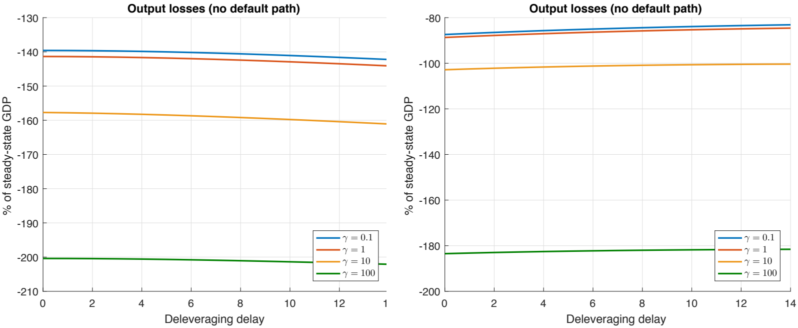
Welfare and Delay for Different Risk Aversions



Risk Aversion and the Price of Government Debt



Output Loss and Delay



(a) Crisis Times (b) Normal Times

Notes: Output losses are capitalized over 60 quarters with the borrower's discount factor.

Concluding Remarks

- Disagreement: savers prefer early deleveraging, borrowers prefer late.
- Minimize output loss: early deleveraging in crisis times, delay in normal times
  - but capitalized value not very different
- Risk aversion: large impact on output loss and welfare
  - no macro/finance separation as in Tallarini (2000)

2-period Model with CARA Preferences

- CARA/Cobb-Douglas

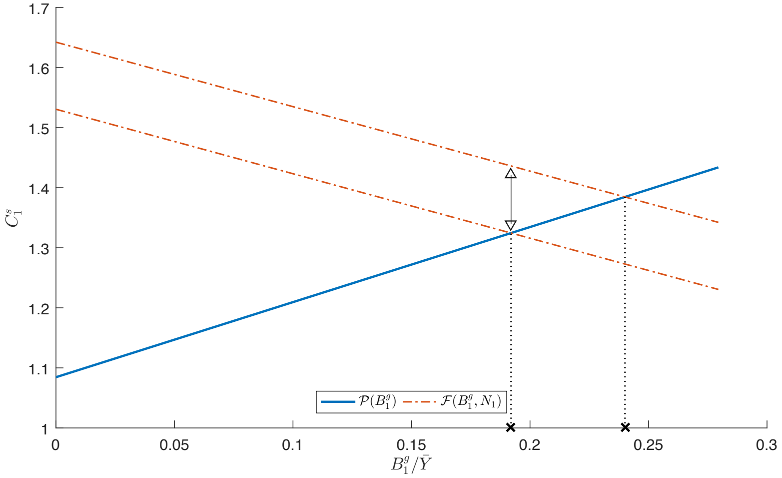
$$\bar{\mathbf{N}}(\delta): \ \log \kappa_n + \varphi \log \mathbf{N} = -\gamma(\mathbf{N} - G - \delta\Delta)$$

  - Nice separation gross debt & production. $\bar{\mathbf{N}}(0) - G = 1$.

- Long Run: Flexible prices

$$C_2^s = \bar{\mathbf{N}}(\delta) - G - \delta\Delta + \frac{\chi}{1-\chi} \frac{B_1^h + (1-\delta\hbar) B_1^g}{\Pi_{H,2}} \tag{1}$$

Equilibrium in the 2-Period Model



Different choices of B_1^g give different equilibrium outcomes for N_1.