Public Debt and Changing Inflation Targets

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[1] Disclaimer: opinions not necessarily those of the Deutsche Bundesbank

Introduction

- Financial crisis resulted in large increases in public debt due to stimulus and rescue packages.
- Large projected (net) debt increases since 2008
    - U.S.: from 40% to 67% of GDP
    - Germany: from 60% to 85% of GDP
- How to reduce debt burden?

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- How to reduce debt burden?
  - Fiscal consolidation, default, or inflation
- Suggestions to raise inflation target to improve private and public sector balance sheets (e.g., Rogoff, Blanchard, Krugman,...)

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- How effective is inflation in reducing real public debt?
- Two factors
  - **Inflation expectations**: affect current inflation *and* nominal interest rates on newly-issued debt
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  - different degrees of credibility of monetary policy
  - differences in the evolution of inflation expectations

Literature

Aizenman and Marion (2009):

- find large incentives to inflate away public debt in a partial equilibrium model with a fixed interest rate

Hall and Sargent (2009):

- find that historically the fraction of U.S. public debt inflated was comparatively low. Instead, high real GDP growth made the largest contribution, not inflation

Outline

- Main results
- Introducing a ‘stochastic bond’
- Imperfect information about inflation target
- Remaining model features
- Calibration and simulation
- Conclusions

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- Effect on real debt depends on average maturity

Debt structure in advanced economies

Advanced Economies (2009)	Central Government Debt (% of GDP)	Local Currency share of Cent. Gov. Debt	Average Maturity of Debt in Local Currency
Japan	158.2	100	6.1
Greece	116.6	100	7.9
United States	48.5	100	4.4
Ireland	47.3	100	6.0
Spain	42.6	99	6.4
United Kingdom	55.5	100	14.1
France	57.0	100	6.7
Portugal	65.9	98	6.0
Netherlands	44.8	98	6.6
Italy	90.3	100	7.0
Average	72.7	99	7.1

Source: IMF (2010)

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- In steady state:

$$\alpha = \frac{B^{new}}{B^L}$$

Long-term bonds and the maturity structure

- Interest rate of a newly issued long-term bond: i_t^{new}
- Average interest rate i_t^L is weighted average of i_t^{new}

$$i_t^L = \frac{B_t^{new}}{B_t^L} i_t^{new} + (1-\alpha) \frac{B_{t-1}^{new}}{B_t^L} i_{t-1}^{new} + (1-\alpha)^2 \frac{B_{t-2}^{new}}{B_t^L} i_{t-2}^{new} + \ldots$$

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- Linearized

$$i_t^L \approx (1-\alpha)\, i_{t-1}^L + \alpha\, i_t^{new} \quad = \quad \alpha \sum_{s=0}^{\infty} (1-\alpha)^s\, i_{t-s}^{new}$$

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- Recursive representation possible because same fraction of old issuance matures each period, irrespective of date of issuance.

The evolution of real debt

- Long-term debt (divide by price level)

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$$b_t^L = \frac{1}{1+\overline{\phi_\tau} Y_t}\left[g - \overline{\tau} Y_t + (1+i_{t-1}^L)\frac{b_{t-1}^L}{\pi_t}\right]$$

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- Need to determine dynamics of i_t^L and π_t

Household optimization

- Households maximize $E_0 \sum_{t=0}^{\infty} \beta^t U(C_t, M_t, N_t)$ subject to their budget constraint and the equations that describe the evolution of debt and of the average interest rate on long-term debt

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- First-order conditions for bonds (including a short-term bond)

$$1 = E_t \beta \left(\frac{C_{t+1}}{C_t} \right)^{-\sigma} \frac{P_t}{P_{t+1}} \left[1 + i_t \right],$$

$$1 = E_t \beta \left(\frac{C_{t+1}}{C_t} \right)^{-\sigma} \frac{P_t}{P_{t+1}} \left[1 + i_t^{new} - \mu_{t+1} (1 - \alpha) \Delta i_{t+1}^{new} \right],$$

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- μ_t is Lagrange multiplier on long-term interest rate equation

The evolution of interest rates

- The two first-order (Euler) conditions for short- and long-term bonds lead to arbitrage conditions that link i_t and i_t^{new}

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$$i_t = \bar{\imath} + \widehat{\pi}_t^* + \phi_\pi (\widehat{\pi}_t - \widehat{\pi}_t^*) + \phi_y (\widehat{Y}_t - \widehat{Y}_t^n) + \eta_t$$

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- Time-varying inflation target $\widehat{\pi}_t^* = \rho_\pi \widehat{\pi}_{t-1}^* + \eta_t^\pi$, variance $\sigma_{\eta^\pi}^2$
- Monetary policy shock η_t i.i.d. with σ_η^2

Imperfect information about the inflation target

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and κ is the Kalman gain, depends on $\sigma_{\eta^\pi}^2$, ρ_π, and σ_η^2

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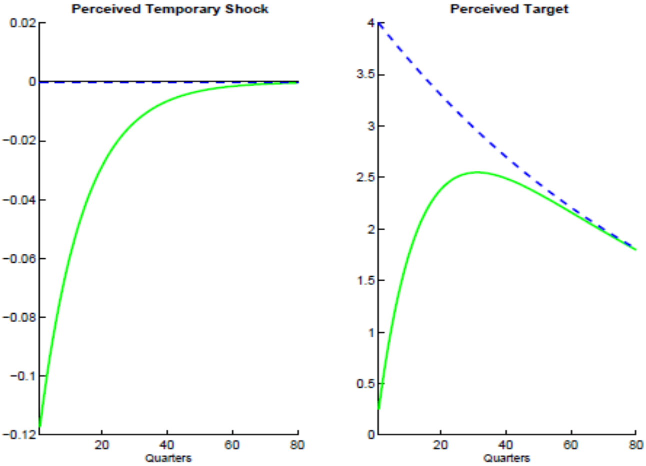
  and κ is the Kalman gain, depends on $\sigma_{\eta^\pi}^2$, ρ_π, and σ_η^2
- The agents' optimal forecast of the inflation target is

$$E_t\widehat{\pi}_{t+s}^* = \rho_\pi^s E_t\widehat{\pi}_t^*$$

Imperfect information about the inflation target



Firms' price setting

- Monopolistic firms face Calvo-style price rigidities
- Prices on average adjusted with steady-state inflation rate $E_t \widehat{\pi}_t^*$
- New Keynesian Phillips curve

$$\widehat{\pi}_t = E_t \widehat{\pi}_t^* + \beta E_t (\widehat{\pi}_{t+1} - \widehat{\pi}_{t+1}^*) + \varphi \widehat{mc}_t$$

  with marginal costs $mc_t = w_t / A_t$

- Note that $E_t \widehat{\pi}_t^*$ need not be identical to true target when there is imperfect information about the inflation target

Interest rate and inflation: mechanism

- Assume flexible prices, then $s \geq 1$

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- The evolution of long-term interest rates becomes

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- With signal extraction: repeated expectational errors

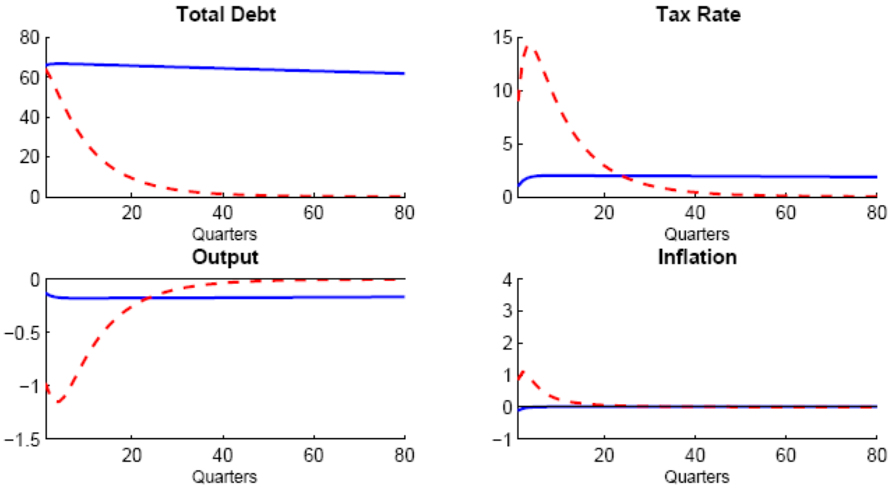
Calibration

Parameter	Value	Description
Preferences		
β	0.99	Time discount factor
σ	1.5	Intertemporal elasticity of substitution
σ_m	2.56	Inverse of the interest elasticity of money demand
χ	5.2×10^{-6}	Scale factor to utility of money balances, targets $m/Y = 0.07$
ϕ	2.00	Inverse of the Frish of labor supply
φ	35.94	Scale factor to disutility of work, targets $h = 1/3$
Bonds market		
α	0.055	Quarterly probability of maturing debt
Firms		
ϵ	6	Price markup of 20%
θ	0.75	One year price contracts
Monetary policy		
ρ_i	0.75	Interest rate smoothing parameter
ϕ_π	1.5	Response of interest rate to inflation
ϕ_y	0.5	Response of interest rate to output gap
Fiscal policy		
ρ_τ	0.5	Tax rate smoothing parameter
ϕ_τ	0.02	Tax feedback to deviations of debt from steady-state

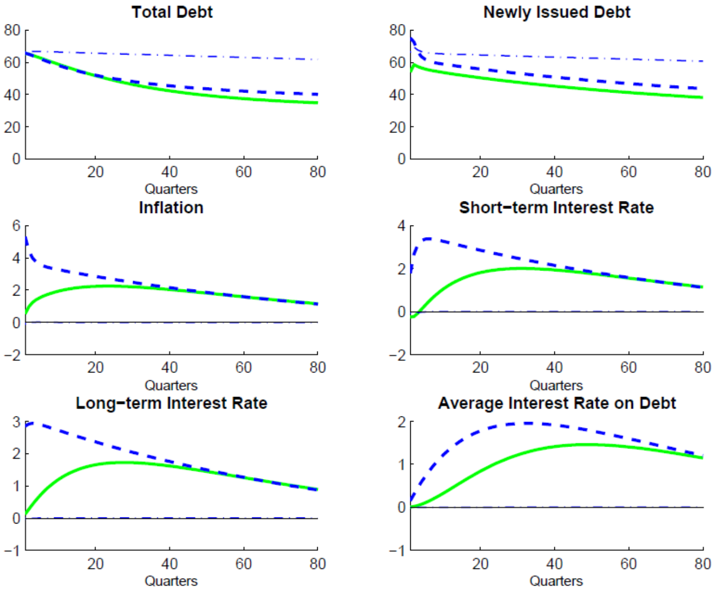
Simulations

- 'Debt shock' that raises U.S. government debt
- First: possible fiscal policy reaction (response of tax rate)
- Second: monetary policy action
    - permanent change of inflation target
    - comparing full and imperfect information
- Fourth: role of debt maturity, credibility, size of target shock

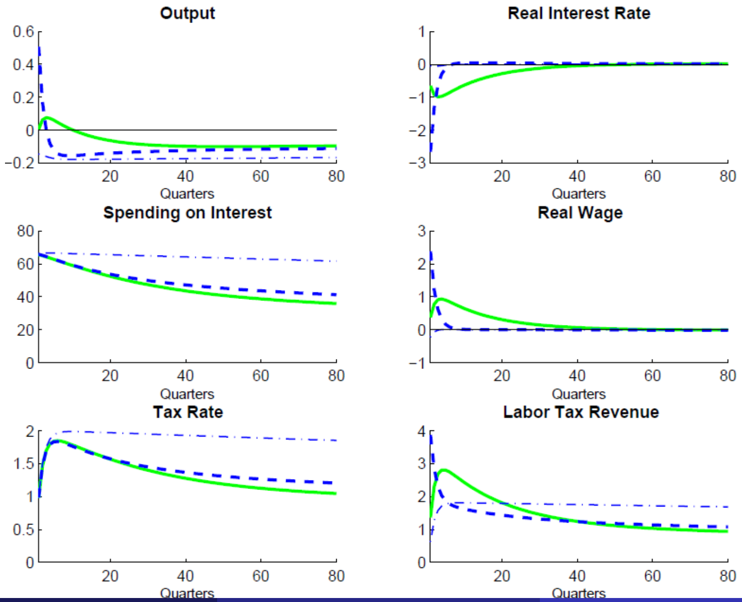
Simulation: debt shock



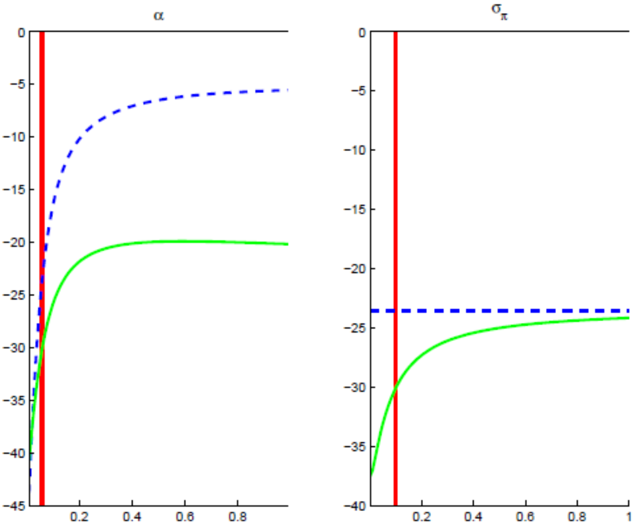
Simulation: permanent inflation target shock I



Simulation: permanent inflation target shock II



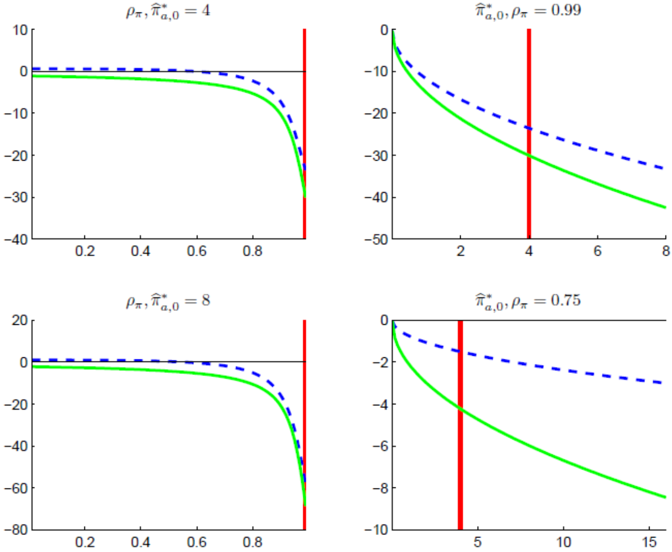
Average maturity and credibility



Average maturity

Advanced Economies (2009)	Central Government Debt (% of GDP)	Local Currency share of Cent. Gov. Debt	Average Maturity of Debt in Local Currency
Japan	158.2	100	6.1
Greece	116.6	100	7.9
United States	48.5	100	4.4
Ireland	47.3	100	6.0
Spain	42.6	99	6.4
United Kingdom	55.5	100	14.1
France	57.0	100	6.7
Portugal	65.9	98	6.0
Netherlands	44.8	98	6.6
Italy	90.3	100	7.0
Average	72.7	99	7.1

Inflation target shock properties



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