A macro-finance view on government debt and economic growth

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Outline

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Introduction

What does government debt do?

- What are the effects on the economy in the short and long run of a bond financed budget defict caused by a tax cut?
- perennial and hotly debated question among economists and policy makers
- distinction between conventional (non-Ricardian) and Ricardian view on the effects of government debt, as in Elmendorf, Mankiw (1990), and Ball, Mankiw (1995)
- Ricardian view on government debt in Barro (1974)
- focus of my project on medium and long run effects in a non-Ricardian world

Outline

Related literature
a preliminary selection

- stylized OLG model in the spirit of Allais (1947), Samuelson (1958) and Diamond (1965)
- government debt in neo-classical OLG model as in Diamond (1965) and many follow-up papers
- empirical finding of **financial crowding out** by Graham, Leary and Roberts (2013)
- importance of macro-financial linkages to understand aggregate outcomes, as in myriad of recent papers

Outline

The model in a nutshell

Stochastic OLG economy populated with:

- two-period lived risk averse households
- one-period lived representative firm in each production sector
- two-period lived risk averse financial intermediaries
- infinitely-lived government

The baseline model without growth

Assumptions:

- **households:** inelastic aggregate labor supply and constant distribution across sectors
- **firms:** two production sectors
- **financial intermediaries:** risk-free government bond and two (productive) risky assets
- **government:** lump sum tax on young, government spending, and government bond

Households

Households of generation $t \geq 1$

- take as given prices (r_{t+1}, w_t^L, w_t^H) and lump sum tax τ_t^t
- unitary time endowment
- inelastic labor supply to each production sector
- choose consumption and savings plan $(c_t^t, c_{t+1}^t, a_t^t)$ to maximize expected life-time utility

$$\max_{\{c_t^t, c_{t+1}^t, a_t^t\}} u(c_t^t) + \beta \mathbb{E}_t[u(c_{t+1}^t)]$$

$$\text{s.t.} \quad c_t^t + a_t^t \leq w_t^L \bar{h}^L + w_t^H \bar{h}^H - \tau_t^t$$

$$c_{t+1}^t \leq (1 + r_{t+1}) a_t^t$$

$$1 = \bar{h}^L + \bar{h}^H$$

Households

Initial old households of generation 0

- take as given wealth $(1 + r_1)a_0^0$
- choose utility maximizing consumption plan c_1^0

$$\max_{\{c_1^0\}} u(\ c_1^0\ )$$
$$\text{s.t.}\ \ c_1^0 \leq (1 + r_1)a_0^0$$

Representative financial intermediary

- takes as given prices $(r^b_{t+1}, (p^i_t, r^i_{t+1})_i)$ and savings a^t_t
- buys capital stocks $(\tilde{k}^{i,d}_t)_i$, chooses investment plan $(b^d_t, (x^i_t)_i)$ to maximize mean-variance utility of portfolio wealth
- in period $t+1$, liquidates the portfolio and transfers wealth Ω^t_{t+1} to old households

$$\max_{\{b^d_t, (\tilde{k}^{i,d}_t, x^i_t)_i\}} \mathbb{E}_t[\Omega^t_{t+1}] - \left(\frac{\gamma}{2}\right) \mathbb{V}_t[\Omega^t_{t+1}]$$

$$\text{s.t. } b^d_t/(1+r^b_t) + \sum p^i_t \tilde{k}^{i,d}_t + \sum x^i_t \leq a^t_t$$

$$b^d_t + \sum r^i_{t+1} k^{i,s}_{t+1} + \sum p^i_{t+1} k^{i,s}_{t+1} = \Omega^t_{t+1}$$

$$k^{i,s}_{t+1} = (1-\delta_i)\tilde{k}^{i,d}_t + x^i_t$$

- portfolio return follows from budget constraint and definition of portfolio wealth $(1 + r_{t+1}) = \Omega^t_{t+1}/a^t_t$

Initial old financial intermediary

- given investment plan from the past generates portfolio wealth

$$\Omega_1^0 = b_0^d + \sum r_1^i k_1^{i,s} + \sum p_1^i k_1^{i,s}$$

- initial old financial intermediary transfers realized portfolio wealth to households of generation 0

Representative firms

- low-risk ($i = L$) and high-risk ($i = H$) production sector, each inhabited by a representative firm
- take as given prices (r_t^i, w_t^i) and sector-specific TFP-levels z_t^i
- choose inputs to production $(k_t^{i,d}, h_t^{i,d})$ to maximize profits

$$\max_{\{k_t^i, h_t^i\}} y_t^i - \sum r_t^i k_t^{i,d} - \sum w_t^i h_t^{i,d}$$

$$\text{s.t. } y_t^i = z_t^i f(k_t^{i,d}, h_t^{i,d})$$

TFP-levels and technology shocks

- exogenous log-level of total factor productivity in each sector

$$\log(z_t^i) = (1 - \rho_z)\log(\bar{z}^i) + \rho_z \log(z_{t-1}^i) + \epsilon_t^i$$

- normally distributed technology shocks

$$\epsilon_t^i \sim \mathrm{N}(0, \sigma_i^2)$$

- low-risk vs high-risk production sector

$$0 < \sigma_L < \sigma_H < \infty$$

- possibility of correlated technology shocks

$$\sigma_{L,H} \neq 0$$

Government

- given initial level of outstanding debt b_0^s
- exogenous sequence of government spending $\{g_t\}_t$
- budget-feasible government policies (τ_t^t, b_t^s) satisfy
  1. period-t budget constraint

$$g_t + b_{t-1}^s \leq \tau_t^t + \frac{b_t^s}{(1 + r_t^b)}$$

  2. no-Ponzi-game condition (a.e.)

$$\lim_{m \to \infty} \left(\prod_{j=0}^{m} R_j^b \right)^{-1} b_m = 0$$

Outline

Sequential Markets Equilibrium 1/2

Definition (Sequential Markets Equilibrium)

Sequential Markets Equilibrium is **allocations** for households, firms, and financial intermediaries, **prices** and **government policies** such that:

1. c_1^0 solves the problem of households of generation 0
2. $\{(c_t^t, c_{t+1}^t, a_t^t)\}_{t=1}^{\infty}$ solves the problem of hh born in $t \geq 1$
3. $\{(k_t^{i,d}, h_t^{i,d})_i\}_{t=1}^{\infty}$ solves the representative firms' problem
4. $\{b_t^d, (\tilde{k}_t^{i,d}, x_t^i)_i\}_{t=1}^{\infty}$ solves the financial intermediaries' problem
5. $\{(\tau_t^t, b_t^s)\}_{t=1}^{\infty}$ is a budget-feasible government policy

Sequential Markets Equilibrium 2/2

Definition (Sequential Markets Equilibrium, cont.)

6. i (Goods market)

$$c_t^{t-1} + c_t^t + \sum k_{t+1}^i + g_t = \sum y_t^i + \sum (1 - \delta_i) k_t^i$$

ii (Government bond market)

$$b_t^d = b_t^s$$

iii (Capital markets)

$$k_t^{i,d} = k_t^{i,s}$$

iv (Labor markets)

$$\begin{aligned} h_t^{L,d} &= (1 - \bar{h}^H) \\ h_t^{H,d} &= \bar{h}^H \end{aligned}$$

Equilibrium
Consumption & saving

- assumption: log-utility
- consumption of households of generation 0

$$c_1^0 = \Omega_1^0$$

- consumption and saving of households of generation $t \geq 1$

$$\begin{aligned} c_t^t &= \left(w_t^L (1 - \bar{h}^H) + w_t^H \bar{h}^H - \tau_t^t \right) / (1 + \beta) \\ a_t^t &= \beta c_t^t \\ c_{t+1}^t &= b_t + \sum r_{t+1}^i k_{t+1}^i \end{aligned}$$

Equilibrium

Financial intermediaries and government

- define period $t+1$ excess returns after depreciation

$$\Delta^i_{t+1} = r^i_{t+1} - \delta_i - r^b_t$$

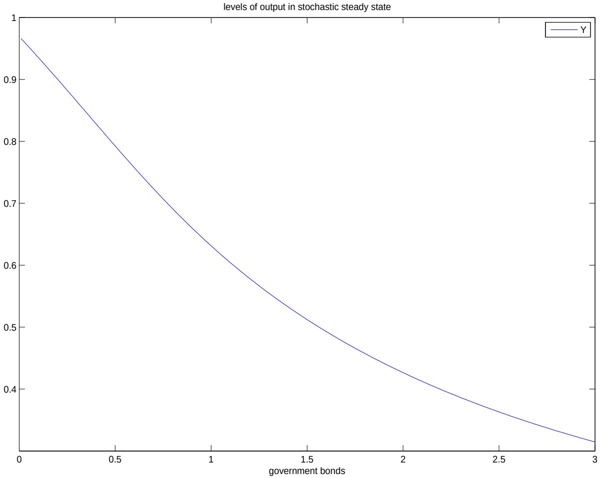
- in equilibrium $((k^i_{t+1})_i, r^b_t, b_t)$ solves the non-linear system of equations

$$\begin{aligned} k^i_{t+1} &= \left[\frac{\mathbb{E}_t[\Delta^i_{t+1}]}{\gamma \mathbb{V}_t[\Delta^i_{t+1}]}\right] - \left[\frac{\mathbb{C}\mathrm{ov}_t[\Delta^i_{t+1}, \Delta^j_{t+1}]}{\gamma \mathbb{V}_t[\Delta^i_{t+1}]}\right] k^j_{t+1} \\ a^t_t &= b_t/(1+r^b_t) + \sum k^i_{t+1} \\ b_t &= (1+r^b_t) b_{t-1} + (1+r^b_t)(g_t - \tau^t_t) \end{aligned}$$

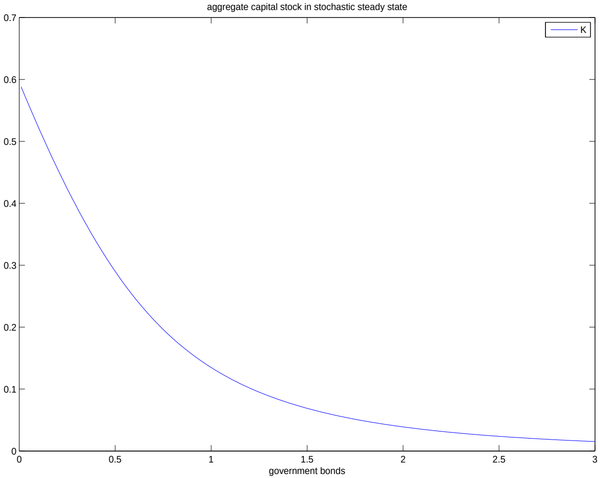
- motives for trading: speculation and diversification

Outline

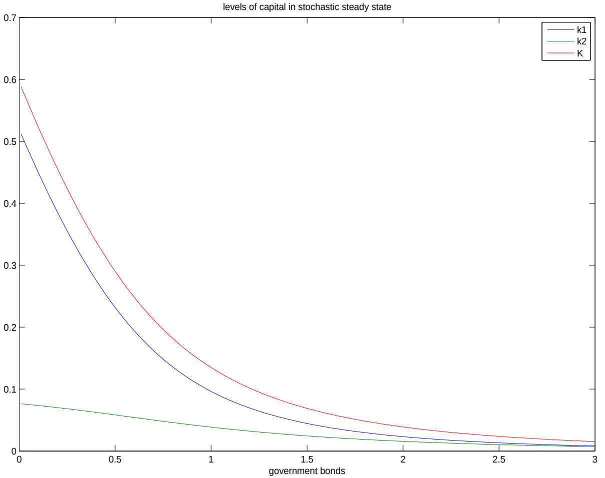
Government debt has negative effect on long-run output . . .



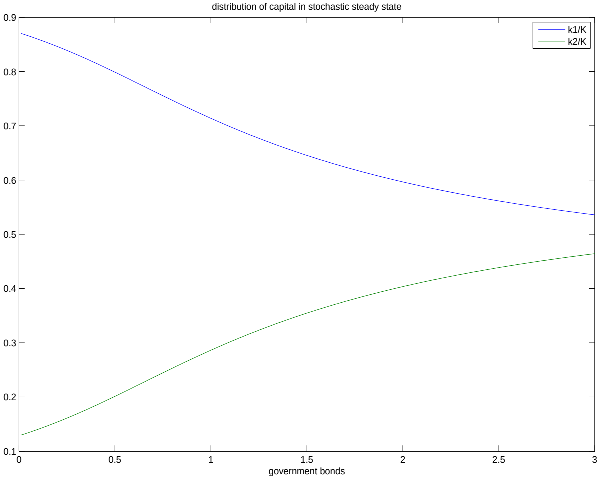
…due to crowding out of private capital



Government debt also changes composition of capital stock



Financial crowding out of government debt



How does financial crowding out operate in the model?
A partial equilibrium view

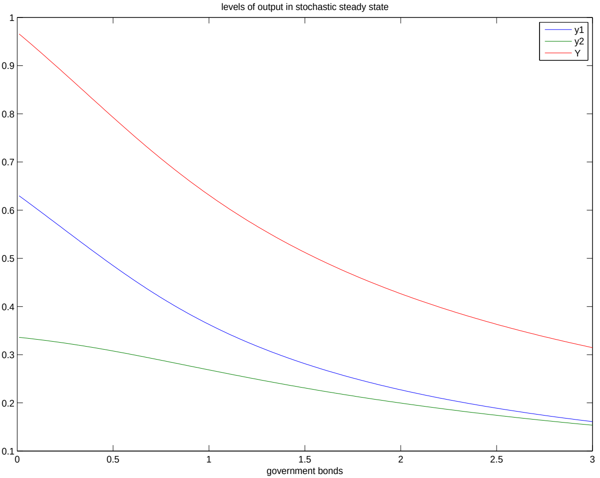
- assumption: independent technology shocks
- then speculation becomes the financial intermediaries' only motive for trading

$$k_{t+1}^{i} = \frac{\mathbb{E}_t[r_{t+1}^{i} - \delta_i] - r_t^{b}}{\gamma \mathbb{V}_t[\Delta_{t+1}^{i}]} - \frac{\mathbb{C}\mathrm{ov}_t[\Delta_{t+1}^{i}, \Delta_{t+1}^{j}]}{\gamma \mathbb{V}_t[\Delta_{t+1}^{i}]} k_{t+1}^{j}$$

- an increase in government debt depresses the price of the government bond, inreases the risk-free rate and leads to lower investment in risky capital
- the financial intermediary cuts her investment in the low-risk asset by more than in the high-risk asset since the former is a closer substitute for the risk-free government bond

Can government debt increase average level of output?

. . . at the cost of larger output fluctuations?



Outline

Where to go from here?

Some ideas for future work:

1. account for endogenous aggregate labor and non-constant distribution of labor across production sectors
2. comparison to C-CAPM model to clarify the role of finanical intermediaries
3. inclusion of exogenous growth to discuss effects of public debt on growth
4. future projects:
   - i extension to quantifiable SOLG model usable for policy analysis
   - ii analysis of self-financing government debt policies