Government Debt Management: What We Know and What We Need to Know

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Government Debt Management in Representative-Agent (RA) Models

- With non-distortionary taxes (DT), Ricardian equivalence holds: level and composition of government debt are irrelevant.

  Barro 1974.

- With distortionary taxes, government can use debt for tax smoothing.

  Barro 1979, Aiyagari-Marcet-Sargent-Seppälä 2002; Lucas-Stokey 1983, Angeletos 2002, Buera-Nicolini 2004, Nosbusch 2008, Faraglia-Marcet-Scott 2010, Faraglia-Marcet-Oikonomou-Scott 2017.

Advantages and Limits of RA Models

- DT models can capture governments' concern with rollover risk.
  - Governments issue long-term debt to hedge against risk that interest rates will rise.
  - With short-term debt, if interest rates rise, governments must raise more DT.
  - Correlation between interest rates and government expenditure is important.

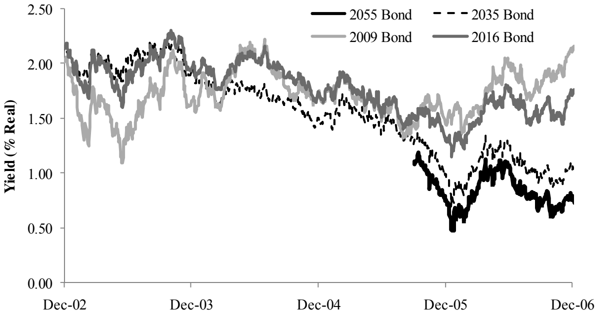
- DT models (and RA models more generally) cannot capture clientele effects, as well as supply effects.

Clientele Effects at Work: U.K. Pension Reform

- Pension funds had to meet a minimum ratio of assets to liabilities.
- Pensions Act of 2004:
  - Discount rate for liabilities: Yield on long-term inflation-indexed government bonds.
  - $\Rightarrow$ Large hedging demand for these bonds.

U.K. Pension Reform and the Term Structure

- U.K. real term structure around reform episode. (Greenwood-Vayanos 2010)



- Long rates dropped significantly relative to:
  - Their historical average (2.3% over 20th century for real rates).
  - Short rates.

- Government issued 50-year bond.

U.K. Pension Reform Through Lens of RA Models

- Why did long rates drop?
  - Increase in marginal utility of consumption in 30/50 years?
- Why did government issue 50-year bond?
  - Cannot provide more aggregate consumption in 50 years.
  - DT would go up in low interest-rate states, against which 50-year bond is supposed to protect.

Modelling Clienteles and Heterogeneity

- Overlapping-generations models.
  - Ricardian equivalence fails.

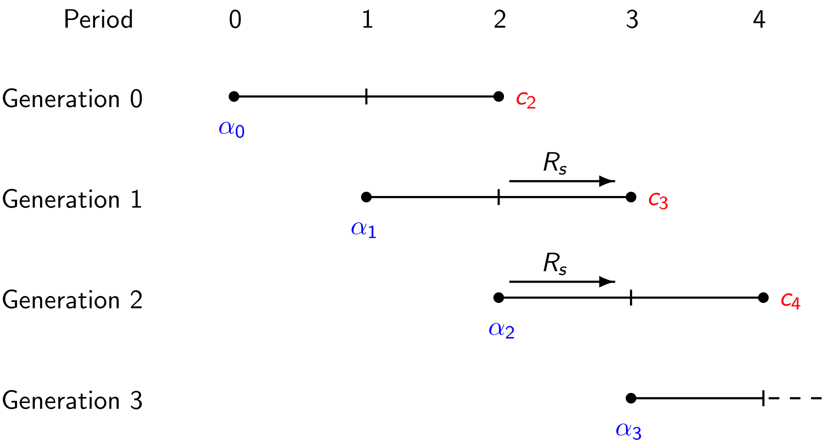
    Diamond 1965, Blanchard 1985, Buiter 1988.
  - Government debt can improve intergenerational risksharing.

    Fischer 1983, Gale 1990.
  - Generations with different horizons co-exist and constitute different clienteles.

    Guibaud-Nosbusch-Vayanos 2013.

- Other frictions (e.g., institutions/agency, segmentation).

Guibaud-Nosbusch-Vayanos RFS 2013 – A Summary



Preferences and Technology

- CRRA preferences:
$$u(c) = \frac{c^{1-\gamma}}{1-\gamma}.$$

- One-period linear production technology with riskless return.

- Gross rate of return between periods t and $t+1$ is R, for $t \neq 2$.

- Return shock: gross rate of return between periods 2 and 3, denoted by R_s, is stochastic and becomes known only in period 2.

- R_s can take either high value R_h or low value R_ℓ with probability p and $1-p$, respectively.

Bond Market

- In period 1, one-period and two-period noncontingent zero-coupon bonds are traded.
  - Market is complete from the perspective of agents trading in period 1.
- In all other periods, we assume without loss of generality that only one-period non-contingent bonds are traded.
- In the absence of government, bonds are in zero net supply.
- Government can affect net supply of bonds through its issuance policy (without changing asset span).

Government

- Government issues bonds and collects income taxes.
  - For simplicity, we set government spending to zero, and assume zero government debt when entering period 1.

- Government debt position:
  - B: face value of two-period debt in period 1.
  - b_t: face value of one-period debt in period $t \geq 1$.

- Taxes raised on young agents endowments.
  - Tax rate denoted by τ_t for $t \geq 2$.

Government Budget Constraints

- Government's budget constraint in period 1 is

$$\frac{b_1}{R} + \frac{B}{L^2} = 0,$$

where L denotes two-period interest rate in period 1.

- Government's budget constraint in period 2 is

$$\alpha_2 \tau_2 + \frac{b_2 - B}{R_s} = b_1.$$

(face value of one-period debt issued in period 2 is $b_2 - B$).

- Budget constraint in period $t > 2$:

$$\alpha_t \tau_t + \frac{b_t}{R} = b_{t-1}.$$

Equilibrium

- Characterize bond market equilibrium in period 1, for given net supply (b_1, B).
- Let B^0 and B^1 denote the face values of two-period bond holdings by generations 0 and 1.
- Market clearing: $B^0(L) + B^1(L) = B$.

Proposition: *There exists a unique equilibrium in the government bond market in period 1.*

Supply Effect

- Effect of maturity structure, i.e., mix of (b_1, B).
  - Consider increasing B, holding $b_1/R + B/L^2$ constant.

Proposition: *A lengthening of the maturity structure in period 1 raises the two-period interest rate L.*

- Intuition: generations 0 and 1 must absorb more two-period bonds, which gives them larger exposure to their risk.
  - Offsetting tax changes affect future generations.

- Hence, lengthening the maturity structure raises
  - the slope of yield curve
  - expected excess returns of two-period bonds.

Clientele Effect

- Consider an increase in the size of the long-horizon clientele, i.e., increasing α_1 holding $R\alpha_0 + \alpha_1$ constant.

Proposition: *If $\gamma > 1$, then an increase in the size of the long-horizon clientele in period 1 lowers the two-period interest rate L. The result is reversed if $\gamma < 1$.*

- Intuition: intertemporal hedging demand.
  - Generation 0 is myopic (one-period horizon), whereas generation $j - 1$ has a two-period investment horizon.
  - When $\gamma > 1$, generation 1 invests a larger share of its wealth in two-period bonds (intertemporal hedging).

- No clientele effect with log utility.

Optimal Maturity Structure

- Intergenerational risksharing is inefficient without government intervention.
- Return shock directly affects generations 0 and 1.
- In the absence of the government, risk can only be shared with generations that participate in the market in period 1.
  - Only risksharing possibility: generation 0 can provide insurance to generation 1 (by selling two-period bonds).
- The government can improve on risksharing by issuing suitable quantities of one- and two-period bonds and by choosing suitable taxes in periods $t \geq 2$.
- To determine optimal maturity structure proceed as follows:
  - Consider the benchmark case of complete participation, where all generations $t \geq 0$ are available to trade in period 1.
  - Then, show that the government can use maturity structure and taxes to effectively induce complete participation.

Complete Participation

Proposition: *Under complete participation, generations $t \geq 1$ consume more in state h than in state ℓ. Generation 0 consumes more in state h than in state ℓ if γ is high, but the comparison is reversed if $\gamma \leq 1$.*

- Properties of excess bond returns:
  - The expected return of two- relative to one-period bonds over a two-period horizon is negative.
  - The expected excess return of two-period bonds over a one-period horizon is negative if γ is high, but positive if $\gamma \leq 1$.

- Equilibrium positions in two-period bonds:
  - Generations $t > 2$ short-sell two-period bonds.
  - Generations 1 and 2 buy two-period bonds if $\gamma \geq 1$.
  - Generation 0 short-sells two-period bonds if γ is high, and buys them if $\gamma \leq 1$.

Inducing Complete Participation

- Let B^* denote the quantity of two-period bonds that generations 0 and 1 buy under complete participation.

Proposition: *Suppose that only generations 0 and 1 can trade in period 1. Then, the government can achieve the same outcome as under complete participation by issuing the quantity B^* of two-period bonds, and levying appropriate state-contingent taxes on generations $t \geq 2$.*

Properties of Optimal Maturity Structure

- Properties of expected excess bond returns are same as in complete participation equilibrium.
  - Two-period bonds have negative excess return over two-period horizon, and negative one-period excess return if γ is high.

- Hence positive expected excess returns of long-term bonds can be viewed as a symptom of excessive supply of these bonds and inefficient risk-sharing.
  - Current generations are worse off when interest rates are high, and future generations are worse off when interest rates are low.

Funding-Cost Minimization

- A possible objective of debt management offices is to minimize government funding cost by exploiting differences in expected returns across maturities.
- When long-term bonds have negative expected excess return over short-term bonds, this would imply tilting issuance towards long-term bonds, up to the point where expected excess returns reach zero.
  - $\Rightarrow$ departure from welfare-maximizing maturity structure.
- Funding-cost minimization fails to account properly for the welfare of future generations.

Clientele Effects

Proposition: *If $\gamma > 1$, then an increase in the size of the long-horizon clientele in period $j - 1$ (i.e., an increase in α_1 holding $R\alpha_0 + \alpha_1$ constant)*

- *raises the optimal supply B^* of two-period bonds.*
- *lowers the equilibrium two-period interest rate L that prevails when two-period bonds are in supply B^*.*

Results are reversed if $\gamma < 1$.

- A welfare-maximizing government responds to clientele demand shocks in a way that appears consistent with minimizing expected funding costs.

Catering

- A welfare-maximizing government effectively caters to clientele demands.
  - e.g., following an increase in the size of the long-horizon clientele, the government increases supply of long-term bonds, offering that clientele more insurance against return shock.
- Yet a welfare-maximizing government does not accommodate fully changes in clientele demands.
  - The government internalizes the cost on future generations of providing extra-insurance to the long-horizon clientele.
  - Hence the government stops short of providing full insurance, thus allowing the long-term interest rate to drop.

Take-aways

- Overlapping generations model gives rise naturally to
  - supply effects.
  - clientele effects.
- Clientele mix affects both prices and the optimal maturity structure.
  - If agents are more risk averse than log, an increase in the relative importance of the long-horizon clientele raises optimal supply and price of long-term bonds.
- Optimal debt-issuance policy has common features with but is distinct from minimizing expected funding costs.
- Could develop overlapping generations model further for analysis of bond prices and optimal maturity structure

Empirical Evidence

- Run the following regressions in a panel of OECD countries

$$Slope_{it} = a + bDem_{it} + u_i + e_{it},$$
$$Maturity_{it} = c + dDem_{it} + v_i + f_{it},$$

where

  - $Slope_{it}$ is 30-year yield minus 10-year yield.
  - $Maturity_{it}$ is weighted average maturity of marketable government debt.
  - Dem_{it} is median age.
  - (u_i, v_i) are country fixed effects.

- Drop country-years when S& P rating is below AA-. Data availability restricts us to
  - 10 countries for slope sample.
  - 20 countries for average maturity sample.

- Consistent with model, $b > 0$ and $d < 0$.

Institutional Frictions

- Incorporating institutional frictions could yield additional insights on optimal maturity structure.
- Anecdotal evidence that development of a country's pension fund sector causes long-term bond yields to drop (e.g., Denmark, Netherlands).
- Should countries with larger pension fund sectors issue more towards the long end of the term structure?
    - Is intergenerational risk-sharing mechanism shown earlier still at work?

Segmentation Frictions

- Supply effects in the data: QE in the US (D'Amico-King 2011).

Table 7. Flow Effects on Day of Purchase, by Subsamples (eligible securities with remaining maturity < 15 years)

	Mar 25 – Jul 6	Jul 7 – Oct. 29	Notes	Bonds	Near on-the-run	Far off-the-run
Own Purchases	0.3442*** (0.094)	0.2975*** (0.089)	0.2669*** (0.068)	0.2498*** (0.090)	0.2318** (0.107)	0.2488*** (0.065)
Purchases of:						
Near substitutes (maturity w/in 2 yrs of own)	0.2863*** (0.086)	0.3038*** (0.083)	0.2503*** (0.062)	0.1694** (0.083)	0.2435** (0.105)	0.1584*** (0.057)
Mid-substitutes (maturity 2 to 6 years away)	0.1989*** (0.082)	0.2037** (0.073)	0.2088** (0.055)	0.0929 (0.080)	0.2501*** (0.092)	0.0744 (0.055)
# Obs.	563	360	769	154	249	674
# CUSIPS	131	121	123	23	53	114
Adj. R^2	0.974	0.975	0.976	0.986	0.986	0.977

Notes: The dependent variable is the daily percentage price change in each outstanding CUSIP. Only days when LSAP purchases occurred are included. Fixed effects and daily time dummies not shown. Standard errors in parentheses. Asterisks indicate statistical significance at the 10 percent (*), 5 percent (**), and 1 percent (***) levels.

- Local and global effects.
- Can overlapping generations model generate such patterns?
- Other institutional or segmentation frictions (preferred habitats)?

Future Research

- Overlapping generations model described so far does not capture rollover risk.
- Bring together overlapping generations (clienteles) with distortionary taxes.