My Research

- I study how **conflict** of interest **between generations influence public spending**
- Both positive and normative approach with OLG setting
  - **Positive**: Games played between voters and policymakers, who cannot commit on future policies and have electoral incentives
  - **Normative**: Benevolent social planner who maximizes the utility of all generations, but subject to enforceability constraints

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  - **Normative**: Benevolent social planner who maximizes the utility of all generations, but subject to enforceability constraints
- What am I after?

My Research

- Goal of my current research is to incorporate relevant frictions in the design of optimal fiscal policy: Normative vs Positive??
- My current aspirations
  - theory: dig into how heterogeneous beliefs and subjective expectations influence the design of optimal policy
  - empirical: Italian public debt observatory www.publicdebtvaluation.com/

Outline of the Course

Fiscal Sustainability

Optimal Fiscal Policy

Outline of the Course

Which **questions** are we trying to tackle in this mini-course?

Outline of the Course

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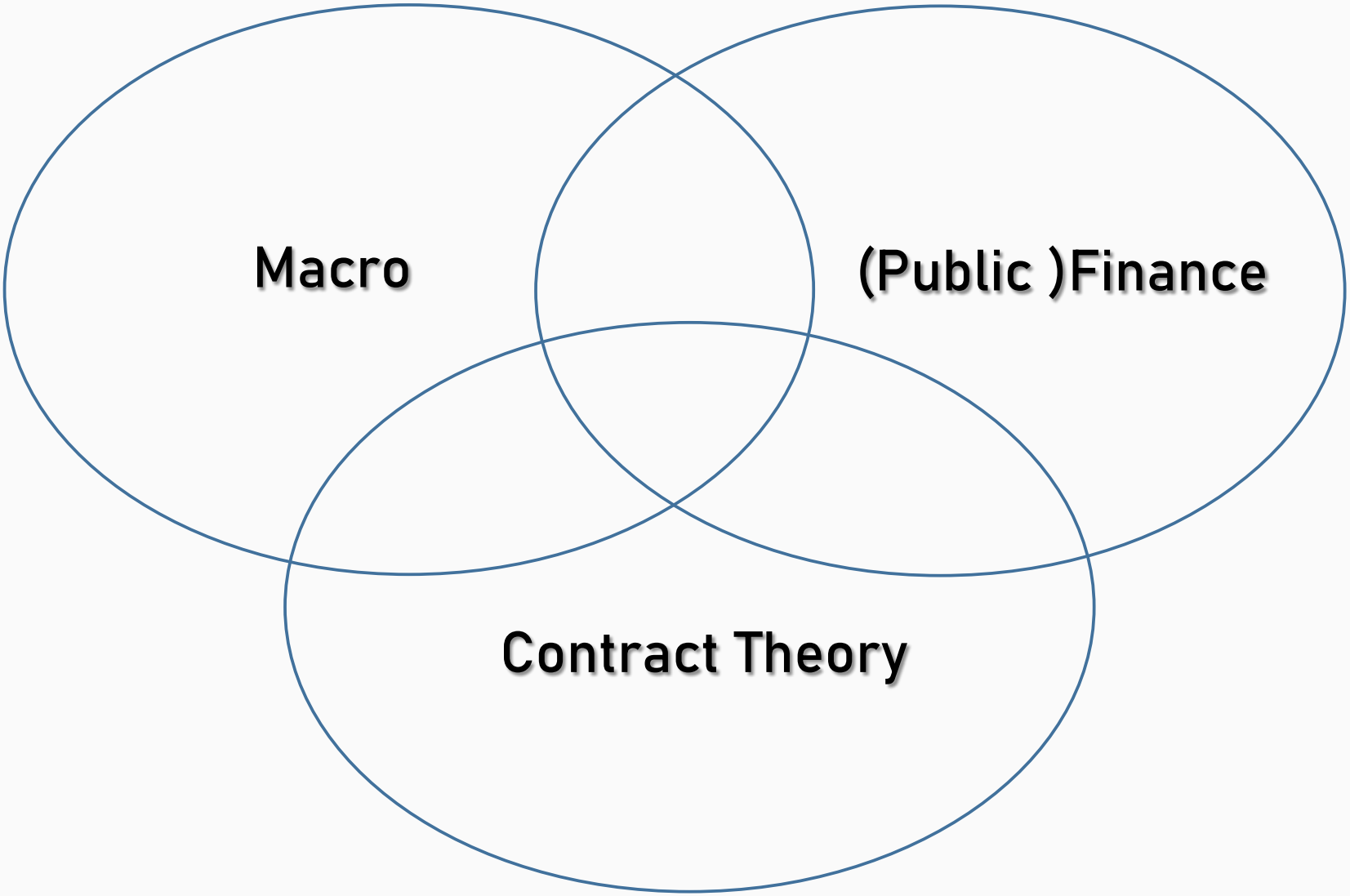
- What is a sustainable fiscal policy
- How taxes should be optimally designed to finance public expenditure?
- What are the implications in terms of redistribution and incentives?

Fiscal Sustainability

"Fiscal sustainability is the most important macroeconomic issue of our time" (Cochrane, 2021)

Outline of the Course



(Tentative) Plan of Lectures

1. Public Budget, Ricardian Equivalence, and Connections to FTPL
2. Debt Sustainability and Asset Pricing
3. Intergenerational Insurance under Limited Enforcement and Implications for Debt Sustainability
4. Optimal Dynamic Ramsey Taxation
5. Optimal Dynamic Mirrlees Taxation

Main Books' References

1. Ljungquist and Sargent "Recursive Macroeconomic Theory" and quantecon.org :

   Ch.10 Ricardian Equivalence

   Ch.13 Asset Pricing

   Ch.15 Optimal Taxation with Commitment

   Ch.19 Insurance vs Incentives

2. Kocherlakota "The New Dynamic Public Finance"

   Ch. 2 The Ramsey Approach and Its Problems

   Ch. 3 Basics of Dynamic Social Contracting

   Ch. 4 Dynamic Optimal Taxation: Lessons for Macroeconomists

Exam

On **XXX Phd individual presentation** (via Zoom if not possible in presence) of **15 min** on a paper (or more than one if related) with:

- Discussion
- Replication
- Potential ideas (extensions, critiques, new tests)

Highly recommended to use methods and theory studied in the first and second part of this course as well as the advanced macro course with Efrem and Gianni!

Integration of this course

- 16 – 17/05 **Padova Macro Talks**
- 22/05 at 14.40 – 16.30: **Lecture by Marco Bassetto** on the Fiscal Theory of Price Level
- 23/05: Workshop on **Modelling Fiscal Policy**
- 27/05 at 5pm or 28/05 after 10am: Presentation with Luciano Greco and Valentina Catapano on **MTS data on secondary market** quotations and transactions and liquidity measures of Italian treasury market

Public Finance

- Public finance studies the role of the government in the economy
- Government in charge of huge regulatory structure
- Taxes: governments in advanced economies collect $30 - 50\%$ of National Income in taxes
- Expenditures: tax revenue funds traditional public goods (infrastructure, public order and safety, defense), and welfare state (education, retirement benefits, health care, income support)
- Macro-economic stabilization through central bank (interest rate, inflation control), fiscal stimulus, bailout policies

Government Intervention

- **Failure of 1st Welfare Theorem**: Government intervention can help if there are market or individual failures. Markets first, government second

- **Fallacy of the 2nd Welfare Theorem**: Government intervention is required to reduce economic inequality and implement a particular competitive equilibrium

Government Intervention: 1st Welfare Theorem Failure

- **1st Welfare Theorem** holds: If (1) no externalities, (2) perfect competition, (3) perfect information, (4) agents are rational, then private market equilibrium is Pareto efficient

Government Intervention: 1st Welfare Theorem Failure

- **1st Welfare Theorem** holds: If (1) no externalities, (2) perfect competition, (3) perfect information, (4) agents are rational, then private market equilibrium is Pareto efficient
- Government intervention may be desirable if:
  1. Externalities require government interventions (Pigouvian taxes/subsidies, public good provision)
  2. Imperfect competition requires regulation (typically studied in IO)
  3. Imperfect or asymmetric information (e.g., adverse selection may call for mandatory insurance)
  4. Agents are not rational (analyzed in behavioral economics)

Government Intervention: 2nd Welfare Theorem Fallacy

- Even with no market failures, free market might generate substantial inequality
- **2nd Welfare Theorem**: Any Pareto Efficient outcome can be reached by (1) Suitable redistribution of initial endowments (lump-sum taxes based on indiv. characteristics and not behavior), (2) Then letting markets work freely

  $\Rightarrow$ No trade-off between efficiency and equity: **1st-Best Taxation**

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  $\Rightarrow$ No trade-off between efficiency and equity: **1st-Best Taxation**
- Redistribution of initial endowments is not feasible

  $\Rightarrow$ Govt needs to use distortionary taxes and transfers

  $\Rightarrow$ Trade-off between efficiency and equity: **2nd-Best Taxation**

Public Budget

Debt Accumulation Equation

- $B_{t+1} = p_{t+1}\tilde{b}_{t+1}$: dollar denominated one-period discount bonds issued at time t, which promises to pay 1\$ in $t+1$
- q_t: date t dollar price one-period discount bonds
- $T_t = p_t\tilde{\tau}_t$: dollar denominated tax revenue at time t
- $G_t = p_t\tilde{g}_t$: dollar denominated public spending at time t
- p_t: date t dollar price of one unit of consumption
- Law of motion for government debt is given by

$$\underbrace{q_t B_{t+1} + T_t}_{\textit{Revenue}} = \underbrace{B_t + G_t}_{\text{Spending}}$$

Debt Accumulation Equation

- $1 + \pi_{t+1} := \frac{p_{t+1}}{p_t}$: gross inflation rate
- $1 + i_t := \frac{1}{q_t}$: gross nominal interest rate
- $1 + \gamma_{t+1} := \frac{y_{t+1}}{y_t}$: gross real GDP growth rate
- $1 + r_{t+1} = \frac{1+i_t}{1+\pi_{t+1}}$: gross real interest rate (Fisher parity condition)

$$q_t \frac{p_{t+1}}{p_t} \frac{y_{t+1}}{y_t} \frac{\tilde{b}_{t+1}}{y_{t+1}} + \frac{\tilde{\tau}_t}{y_t} = \frac{\tilde{b}_t}{y_t} + \frac{\tilde{g}_t}{y_t}$$

$$\Rightarrow$$

$$\frac{(1 + \pi_{t+1})(1 + \gamma_{t+1})}{1 + i_t} b_{t+1} + \tau_t = b_t + g_t$$

Debt Accumulation Equation

- $x_t = \tau_t - g_t$: primary surplus (if positive) or deficit (if negative)

$$b_{t+1} = \frac{1 + r_{t+1}}{1 + \gamma_{t+1}}(b_t - x_t)$$

- $\mathcal{Q}_t^k = \prod_{j=t+1}^{k} \frac{1+\gamma_j}{1+r_j}$ with $\mathcal{Q}_t^t \equiv 1$ is the real price of a $k-$ period compounded bond

Debt Accumulation Equation

- Iterating forward we obtain:

$$\frac{\tilde{b}_0}{p_0} = b_0 = \sum_{t=0}^{T} \mathcal{Q}_0^t x_t + \lim_{T\to\infty} \mathcal{Q}_0^T b_T$$

- If $\lim_{T\to\infty} \mathcal{Q}_0^T b_T < \infty$ (trasversality condition holds)

$$\frac{\tilde{b}_0}{p_0} = b_0 = \underbrace{\sum_{t=0}^{\infty} \mathcal{Q}_0^t x_t}_{\text{NPV of Expected Future Surplus}}$$

- The above equation is a **gvt debt valuation equation** (as in asset pricing), but under several caveats...

Connection to the FTPL

- **Unpleasant monetarist arithmetics** (Sargent and Wallace, 1981): Only if monetary policy is active and fiscal policy adjusts surplus to meet the budget ("Ricardian" Regime in Woodford (1995)'s words), then prices can be determined $\Rightarrow$ as in a Chicken Game, first mover constrains second mover's action

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- **FTPL**: If fiscal policy is active and sets an exogenous sequence of surplus ("Non Ricardian" Regime), and $b_0 > 0$ is predetermined [note it must be positive!], then p_0 is (uniquely) determined from the debt valuation equation (which is an equilibrium Eq. not a constraint)
- Implication for inflation formation and coordination monetary and fiscal policy

Ricardian Equivalence

Historical Origin

How should the government finance a war? The extra spending can be financed either by raising taxes now, or by raising public debt.

- What are the macroeconomic consequences of using these different instruments?
- Which instrument is to be preferred from a normative point of view?

Historical Origin

- **Ricardian equivalence**:

  in the point of the economy, there is no real difference in either of the modes; for twenty millions in one payment [or] one million per annum for ever ... are precisely of the same value (in "Funding System", David Ricardo, 1772-1823)

$\Rightarrow$ The timing of taxes and the debt sequence are irrelevant

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- **Intuition** and **implication**
  - Debt implies future taxes with a present value equal to the value of the debt
  - Rational agents, recognizing this equivalence, will proceed as if the debt did not exist
  - Expansionary/recessionary fiscal policy (with constant $\{g_t\}$) has no effect on aggregate demand

Historical Origin

- Ricardo formulates and explains the equivalence hypothesis, but is sceptical about its empirical validity

> ...*but the people who pay the taxes never so estimate them, and therefore do not manage their affairs accordingly. [] It would be difficult to convince a man possessed of $20,000, or any other sum, that a perpetual payment of $50 per annum was equally burdensome with a single tax of $1,000.*

A Simple Derivation (Barro, 1974)

- Consider the debt accumulation equation of before but assume no growth and constant $1 + r$:

$$b_0 = \sum_{t=0}^{\infty} \left(\frac{1}{1+r}\right)^t x_t$$

- If $b_0 = 0$, then

$$\sum_{t=0}^{\infty} \left(\frac{1}{1+r}\right)^t \tau_t = \sum_{t=0}^{\infty} \left(\frac{1}{1+r}\right)^t g_t$$

- Gvt commits to a sequence of policy $\{g_t, \tau_t\}_{t=0}^{\infty}$ given b_0 (or time consistent policy)

A Simple Derivation

- Consider a representative infinitely living (IL) agent who maximizes

$$\sum_{t=0}^{\infty} \beta^t \left[u(c_t) - \phi \left(\frac{h_t}{1+\theta} \right)^{1+\theta} \right]$$

subject to

$$c_t + a_{t+1} \leq w h_t - \tau_t + (1+r) a_t$$

- The FOCs are (without borrowing constraints)

$$u'(c_t) = \beta(1+r) u'(c_{t+1})$$

$$u'(c_t) = \frac{\phi h_t^{\theta}}{w}$$

A Simple Derivation

- Consider now the budget constraint for individual households. By assumption, HH face the same interest rates as the Gvt

$$\begin{aligned} c_0 + a_1 &= wh_0 - \tau_0 + (1+r)\, a_0 \\ c_1 + a_2 &= wh_1 - \tau_1 + (1+r)\, a_1 \\ c_2 + a_3 &= wh_2 - \tau_2 + (1+r)\, a_2 \\ &\dots \end{aligned}$$

- Iterating forward, we get

$$(1+r)a_0 = \sum_{t=0}^{\infty} \left(\frac{1}{1+r}\right)^t c_t - \sum_{t=0}^{\infty} \left(\frac{1}{1+r}\right)^t wh_t - \sum_{t=0}^{\infty} \left(\frac{1}{1+r}\right)^t \tau_t \tag{1}$$

A Simple Derivation

- Plugging the Gvt budget into the individual intertemporal budget yields

$$(1+r)a_0 = \sum_{t=0}^{\infty}\left(\frac{1}{1+r}\right)^t c_t - \sum_{t=0}^{\infty}\left(\frac{1}{1+r}\right)^t wh_t - \sum_{t=0}^{\infty}\left(\frac{1}{1+r}\right)^t g_t$$

- **Theorem** *A fiscal reform that does not change government spending* $\{g_t\}$*, and only changes the timing of taxes, but leaves the NPV of taxes paid by each household unaffected has no effect on aggregate consumption in any time period*.

- **Intuition:** Gvt debt is not net wealth because Gvt debt implies a future tax burden. When debt increases, households save so as to be able to pay the future debt

Discussion

- RE does not imply that shocks in g_t do not have impact on consumption, but only that the timing of taxation/debt for a given sequence $\{g_t\}$ is irrelevant
- A shock of transfers, for example a deficit-financed tax cut, will not affect marginal propensity of consumption since permanent disposable income remains unchanged
- RE holds also with finitely lived agents if dynastic altruism
- RE does not hold in several cases, in which positive or negative wealth effects may then occur

Failure of Ricardian Equivalence

- The RE theorem relies on the fact that the household can undo what the government does by using financial markets

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- There are many ways to break Ricardian equivalence and makes debt as net wealth:

  - **borrowing constraints (incomplete market)**: if the constraint binds the household cannot freely change saving to absorb the shock of transfers (see graph)

Failure of Ricardian Equivalence

- The RE theorem relies on the fact that the household can undo what the government does by using financial markets

- There are many ways to break Ricardian equivalence and makes debt as net wealth:

  - **borrowing constraints (incomplete market)**: if the constraint binds the household cannot freely change saving to absorb the shock of transfers (see graph)

  - **distortionary taxes**: taxes distorts the consumption-leisure tradeoff and therefore has an impact on aggregate consumption

Distortionary Taxation (Judd, 1978)

- With distortionary taxation $TR_t = wh_t\tau_t$:

$$\sum_{t=0}^{\infty} \beta^t \left[u(c_t) - \phi\left(\frac{h_t}{1+\theta}\right)^{1+\theta} \right]$$

subject to

$$c_t + a_{t+1} \leq wh_t(1-\tau_t) + (1+r)a_t$$

- The FOCs are (without borrowing constraints)

$$u'(c_t) = \beta(1+r)u'(c_{t+1})$$

$$u'(c_t) = \frac{\phi h_t^{\theta}}{w(1-\tau_t)}$$

$$c_t^*(\{\tau_t\}), h_t^*(\{\tau_t\})$$

Failure Ricardian Equivalence

... more on failure of RE

- **Uncertain future income** (Mankiw, Barsky, Zeldes, 1986): A tax cut leads to increased current consumption, because expectation of higher future contingent taxes reduces future income uncertainty and the need for precautionary savings

Failure Ricardian Equivalence

... more on failure of RE

- **Uncertain future income** (Mankiw, Barsky, Zeldes, 1986): A tax cut leads to increased current consumption, because expectation of higher future contingent taxes reduces future income uncertainty and the need for precautionary savings
- **Endogenous public spending** (Bohn, 1990): Here $\{g_t\}$ enters HH's utility and Gvt *optimally* tradeoffs marginal cost of taxes and marginal benefits of public spending. A rise of taxes should be optimally followed by a reduction of future public spending. Consumption increases.

OLG

- If finitely lived agents without bequest (or imperfect altruism), then RE fails
- If the time horizon of the HH is shorter than that of Gvt, HH will be dead before the Gvt will start raising taxes to pay back public debt, i.e., debt is net wealth

OLG

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- If the time horizon of the HH is shorter than that of Gvt, HH will be dead before the Gvt will start raising taxes to pay back public debt, i.e., debt is net wealth
- OLG have some special features, which make them different from IL HH... but historically OLG models have sometimes been overlooked

(*Aiyagari, S. R. (1985): Observational Equivalence of the Overlapping Generations and the Discounted Dynamic Programming Frameworks for One-sector Growth," Journal of Economic Theory, 35, 202-221*)

OLG Structure

Structure of a simple two-generations model:

	t	$t+1$	$t+2$	$t+3$
Old at time t:	c_t^o			
Young at time t:	c_t^y	c_{t+1}^o		
Young at time $t+1$:		c_{t+1}^y	c_{t+2}^o	
Young at time $t+2$:			c_{t+2}^y	c_{t+3}^o
... and so on ...				

OLG and Failure of RE

- Consider two period OLG with intertemporal utility

$$u(c_t^y) + \beta u(c_{t+1}^o)$$

subject to

$$c_t^y \leq w^y - \tau_t^y - a_t$$
$$c_{t+1}^o \leq w^o - \tau_{t+1}^o + (1 + r_{t+1})a_t$$

- The FOCs are

$$u'(c_t^y) = \beta(1 + r_{t+1})u'(c_{t+1}^o)$$

- Bonds in zero net supply: $a_t = b_{t+1}$

OLG versus IL

- Recall that in an IL with complete market and non distortionary taxes, RE implies that saving (or asset demand, let's denote it S) fully absorbes any changes of debt
- $S = b$ is an identity, it is not an interest-rate elastic demand function!
- Goods market clearing condition implies $c_t = y_t$ with y_t equal to real income (suppose $y_t = y$)
- From Euler condition, we have:

$$u'(y) = \beta(1 + r_{t+1})u'(y) \Rightarrow \frac{1}{1 + r_{t+1}} = \beta$$

OLG versus IL

- In an OLG, the asset demand is interest-rate elastic $S(r_{t+1})$, which is an implication of failure of RE
- The individual intertemporal budget is

$$c_t^y + \frac{c_{t+1}^o}{1 + r_{t+1}} \leq w^y + \frac{w^o}{1 + r_{t+1}} - \tau_t^y - \frac{\tau_{t+1}^o}{1 + r_{t+1}}$$

- The intertemporal Gvt budget (under the trasversality condition) is still

$$b_t = \sum_{j=t}^{\infty} \mathcal{Q}_t^j (\tau_j^y + \tau_j^o)$$

- Consumption reacts to changes in τ_t^y depending on expectation on τ_{t+1}^o and $S(r_{t+1})$ responds to r_{t+1}

Example

- Suppose $r_t = r$, which implies that outstanding debt is kept constant, for example $b = 0$
- Consider an expansionary deficit-finance fiscal policy: $\tau_0^y = \tau_0^o = -d/2$ (gift), financed by setting $\tau_t^y = \tau_t^o = rd/2$ for all $t = 1, 2, ...$ (intergenerational redistribution)

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- Intertemporal Gvt budget is still satisfied:

$$
\begin{aligned}
b_0 &= \sum_{t=0}^{\infty} \left(\frac{1}{1+r}\right)^t (\tau_t^y + \tau_t^o) \\
&= -d/2 - d/2 + \frac{1}{1+r} \sum_{t=1}^{\infty} \left(\frac{1}{1+r}\right)^{t-1} (rd/2 + rd/2) \\
&= -d + \frac{1}{1+r} \frac{1+r}{r} rd = 0
\end{aligned}
$$

Example

- The Old at $t = 0$ will consume all they get
- The Young at $t = 0$ will save some of they get (consumption smoothing)
- Aggregate consumption at $t = 0$ rises with the expansionary policy

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- The Old at $t = 0$ will consume all they get
- The Young at $t = 0$ will save some of they get (consumption smoothing)
- Aggregate consumption at $t = 0$ rises with the expansionary policy
- The Old at $t = 1$ may consume still more than at $t = 0$ since some transfer was saved
- The Young at $t = 1$ will consume less because of higher taxes
- Sign of changes of aggregate consumption at $t = 1$ is ambiguous
- From $t \geq 2$ aggregate consumption falls since generations pay higher taxes

OLG versus IL

- The asset market clearing condition is no longer an identity

$$S(r_{t+1}) = b_{t+1}$$

- The goods market condition implies:

$$c_t^y + c_t^o = w^y + w^o$$

- From the Euler condition, we have:

$$\frac{1}{1+r_{t+1}} = \beta \frac{u'(w^o - \tau_{t+1}^o + (1+r_{t+1})S(r_{t+1})))}{u'(w^y - \tau_t^y - S(r_{t+1}))} \equiv m_{t,t+1}(r_{t+1})$$

- There can be multiple equilibria!

Empirical Evidence

- Many different models and predictions
- At the end, whether RE is a good approximation of reality remains an empirical question
- Way to test for RE:
  - Assess whether increase in Gvt bonds lead to increase HH wealth and thus consumer spending
  - Estimates of MPC

Empirical Evidence

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- Way to test for RE:
  - Assess whether increase in Gvt bonds lead to increase HH wealth and thus consumer spending
  - Estimates of MPC

Ricardian equivalence is "resoundingly rejected. Moreover, the estimated deviation from Ricardian equivalence is roughly what one would expect if households faced perfect insurance markets and did not have altruistic bequest motives."

(Evans, 1993)

Back to FTPL...

- We showed that under RE, asset market clearing condition is an identity $S = b$
- The Gvt debt valuation equation simplies to:

$$\frac{\tilde{b}_0}{p_0} = \sum_{t=0}^{\infty} \beta^t x_t$$

$$\text{with} \quad \beta = \frac{1}{1 + r_{t+1}} = \frac{(1 + \frac{p_{t+1}}{p_t})(1 + \gamma_{t+1})}{1 + i_t}$$

- Hence, from the first Eq. we can uniquely determine p_0 and from the second Eq. the entire sequence of prices if passive monetary policy pegging i_t

Back to FTPL...

- If RE fails because of incomplete market, for example in OLG, asset market clearing condition is a constraint $S(r) = b$ which relates b to r

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- If RE fails because of incomplete market, for example in OLG, asset market clearing condition is a constraint $S(r) = b$ which relates b to r
- The Gvt debt valuation equation is:

$$\frac{\tilde{b}_0}{p_0} = \sum_{t=0}^{\infty} m_{0,t}(\{r_t\})x_t$$

$$\text{with} \quad m_{0,0} \equiv 1, m_{0,k} \equiv m_{0,1} \cdot m_{1,2} \cdot \ldots \cdot m_{k-1,k}$$

- The first Eq. can no longer be used to pinned down p_0 since p_0 is also on the RHS of the Eq. $\Rightarrow$ Source of indeterminancy

Relevant Papers

Ricardian Equivalence

- Mankiw NG, Barsky R, Zeldes S. "Ricardian Consumers with Keynesian Propensities." 1986. AER. 676-691.
- Bohn, H. "Endogenous Government Spending and Ricardian Equivalence." 1992. The EJ. 588-97.
- Seater, J., "Ricardian Equivalence." 1993. JEL, 142-90.

Fiscal Theory of Price Level

- Farmer, R., and Zabczyk, P. "A Requiem for the Fiscal Theory of the Price Level." 2019. IMF Working Paper No. 19/219.
- Hagedorn, M., "The Failed Theory of the Price Level.", CEPR Discussion Paper No. 18786. 2024.
- Bassetto, M., "A game-theoretic view of the fiscal theory of the price level." 2002. ECMA 70(6), 2167–2195.

Relevant Papers

Fiscal Theory of Price Level

- Niepelt, D., "The Fiscal Myth of the Price Leve". 2004. QJE 119(1), 277-300.
- Leeper, E., "Equilibria under Active and Passive Monetary and Fiscal Policies". 1991. JME XXVII, 129-147
- Sargent, T., and N., Wallace, "Some Unpleasant Monetarist Arithmetic". 1981. FED Bank MQR, 1-17
- Cochrane, J., "The Fiscal Theory of the Price Level", 2023, Princeton University Press.

More on the FTPL

- More discussion with Bassetto's seminar on 21/05 and his lecture on 22/05
- Hagedorn's presentation on 23/05