The Lifecycle Model: Adding a Government

Prof. Lutz Hendricks

Econ520

February 13, 2012

The Government

- The government is the only agent whose behavior is not derived from an optimization problem (why not?).
- The government chooses:
  1. expenditures: G, G'.
  2. tax rates: t, t'.
  3. borrowing in period 1: B.

Government budget constraint

- Tax revenues are $T = tN$ and $T' = t'N'$.
- Budget constraint in period 1:

$$B = tN - G \tag{1}$$

- In period 2:

$$G' + (1+r)B = T' \tag{2}$$

- With 2 budget constraints, 2 government policies cannot be chosen independently.
- Important: when describing policy (experiments), all policy variables must satisfy the budget constraints.

Government budget constraint

We assume:

- Expenditures (G, G') and period 1 taxes (t) are **fixed**.
- B and t' adjust to balance the budget constraints.

This is purely for convenience: we want to talk about the effects of spending and current taxes.

Present value budget constraint

Substitute B out of the budget constraints:

$$\begin{aligned} G' &= T' - (1+r)B \\ &= T' - (1+r)(T-G) \end{aligned}$$

Collect terms:

$$\underbrace{G + \frac{G'}{1+r}}_{\text{Pr value of spending}} = \underbrace{T + \frac{T'}{1+r}}_{\text{Pr value of revenue}} \tag{3}$$

This also holds for many periods and has important implications.

- Example: The government cannot alter the household's tax burden by borrowing more or less.

The Supply Side

- To keep the model simple, we abstract from production (for now).
- We think of (y, y') as fixed endowments.
- Call these (e, e').

Competitive Equilibrium

A **Competitive Equilibrium** is:

- an allocation (C, C'),
- a set of prices (r),
- a system of government policies (B, t')

such that:

- households choose (C, C'), given prices:
  - $MRS = -(1 + r)$.
  - the lifetime budget constraint is satisfied.
- the government budget constraint is satisfied;
- markets clear.

Market clearing

Which **markets** do we have?

- Goods in periods 1 and 2.
- Bonds.

Bond market clearing

- Supply of bonds: B.
- Demand for bonds:
  - household saving, $S^P = Ns$
  - $s = y - t - c$ is saving per household.
- Market clearing:

$$B = S^P \tag{4}$$

Goods market in period 1:

- Supply of goods: $Y = Ne$.
- Demand for goods: $C + G$.
- Market clearing:

$$Y = C + G \tag{5}$$

Goods market in period 2:

- Supply: $Y' = Ne'$.
- Demand: $C' + G'$.
- Market clearing:

$$Y' = C' + G' \tag{6}$$

Policy Effects

Analyzing the model

- Too much is exogenous - the model has few interesting implications.
- **Consumption** is quasi-exogenous:

$$C = Ne - G \tag{7}$$

- Total **saving** is zero:

$$S = S^P - B = Ne - C - G = 0 \tag{8}$$

- B is given by the government budget constraint:

$$B = G - tN \tag{9}$$

- The only interesting variable: the **interest rate** must adjust to that the household wants to consume $Ne - G$.

Ricardian Equivalence

What happens if the government tries to stimulate the economy with a temporary tax cut?

Ricardian Equivalence

What happens if the government tries to stimulate the economy with a temporary tax cut?

Ricardian Equivalence

A change in the timing of *lump-sum* taxes, holding *expenditures* constant, has no effect on the equilibrium allocation or on prices.

Ricardian Equivalence

Why is this important:

- The assumptions under which R.E. holds are restrictive. Nobody believes that R.E. holds in the data.
- R.E. is an extreme version of a more general idea: **the private sector tends to undo the effects of government budget deficits.**
- In particular: current **tax cuts** may be far less effective for manipulating aggregate demand than simple (Keynesian) thinking suggests.

Why does R.E. hold?

- An easy answer:
  - The Pareto optimal allocation is independent of taxes.
  - The Competitive Equilibrium is Pareto optimal.
- A more interesting answer:
  - Changing the timing of taxes does not affect the household's lifetime budget constraint.
  - The household does not change consumption (C, C').
  - The only tricky part: Does the capital market clear with unchanged C?

Why does R.E. hold?

No change in lifetime budget constraint.

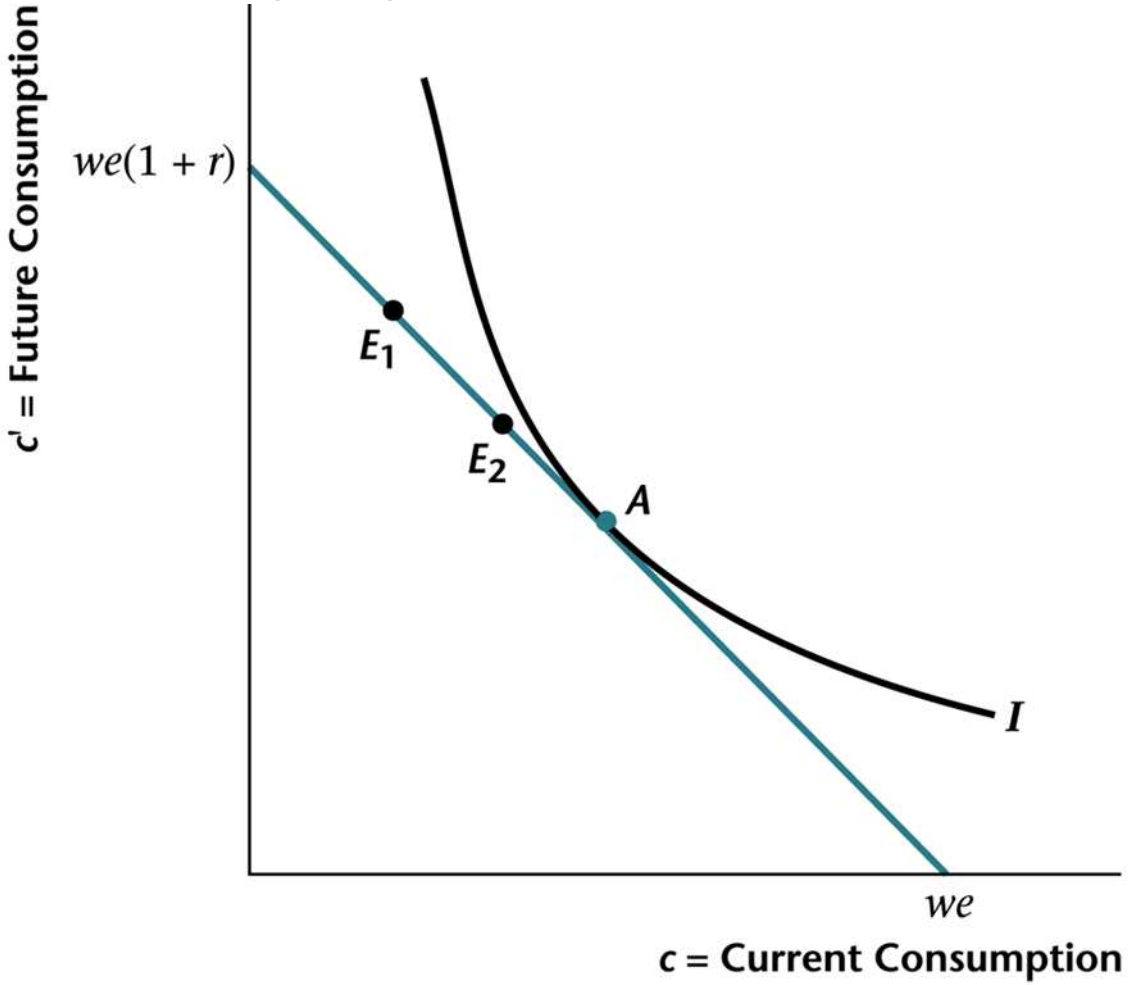
- Only the present value of taxes matters for the household.
- The government budget constraint fixes the present value:

$$G + \frac{G'}{1+r} = T + \frac{T'}{1+r} \tag{10}$$

- What if households are heterogeneous?

Why does R.E. hold?

If prices do not change, the household can and will choose the same allocation (c, c').



The endowment point moves along the budget constraint.

R.E.: Does the capital market clear?

- Government needs to issue additonal bonds, if taxes are cut:

$$\Delta B = \Delta G - \Delta T = -\Delta T \tag{11}$$

- Change in household saving is determined by the budget constraint:

$$\begin{aligned} c + s &= y - t \Rightarrow \\ \Delta s &= -\Delta t \end{aligned} \tag{12}$$

- Change in aggregate saving:

$$\Delta S^P = N\ \Delta s = -N\ \Delta t = -\Delta T$$

- **The household saves the entire tax cut**! (Cf. the IS/LM model!)
- Bond market clears at unchanged prices.

Is Government Debt Irrelevant?

If Ricardian Equivalence holds, government debt is irrelevant (neutral).
In practice, debt is not neutral. The reasons:

1. Future taxes may not be paid by the same households as current taxes.
   - Debt postpones taxes (even though it does not change their total present value).
   - Debt therefore redistributes tax burden from current to future generations.
   - Households are heterogeneous.
2. Taxes are **not lump sum**. Real world taxes change prices.
   - Example: Lowering wage taxes today and raising them tomorrow leads households to work more today.
3. **Credit markets** are not perfect.
   - Households do not borrow and lend at the same rate as the government.
   - Households may not be able to borrow to pay higher current taxes.
4. High government debt indicates **solvency risk**.

Social Security

How Social Security Works

- Social security taxes earnings and pays transfers to the retired.
- For many U.S. households, social security is the main source of retirement earnings.

Two flavors of Social Security

- **Fully funded**:
  - For each worker, the government invests the tax payments.
  - This is equivalent to a forced saving plan.
- **Pay-as-you-go**:
  - Current transfers are paid from current tax revenues.
- U.S. social security is "pay-as-you-go."

Pay-as-you-go Social Security

- Assume that $N_t = (1+n)^t$ persons are born in year t.
- Tax collection from the current young: $N_t \ \tau^y$.
- Transfer payments to the current old: $-N_{t-1} \ \tau^o$.
- The budget balances in each period:

$$N_{t-1}\tau^o = -\tau^y N_t \tag{13}$$

$$\tau^o = -(1+n)\tau^y \tag{14}$$

Pay-as-you-go Social Security

From the household's perspective:

- Forced saving with return n.
- Saving drops by an amount different from τ_t^y.

Fully funded Social Security

- Tax collection from the current young: $N_t \ \tau^y$.
- Transfer payments to old next period: $-N_t \tau^o$.
- Social security budget constraint:

$$\tau^o = -(1+r)\tau^y \tag{15}$$

- From the household's perspective: forced saving with rate of return r.

Effects of Social Security

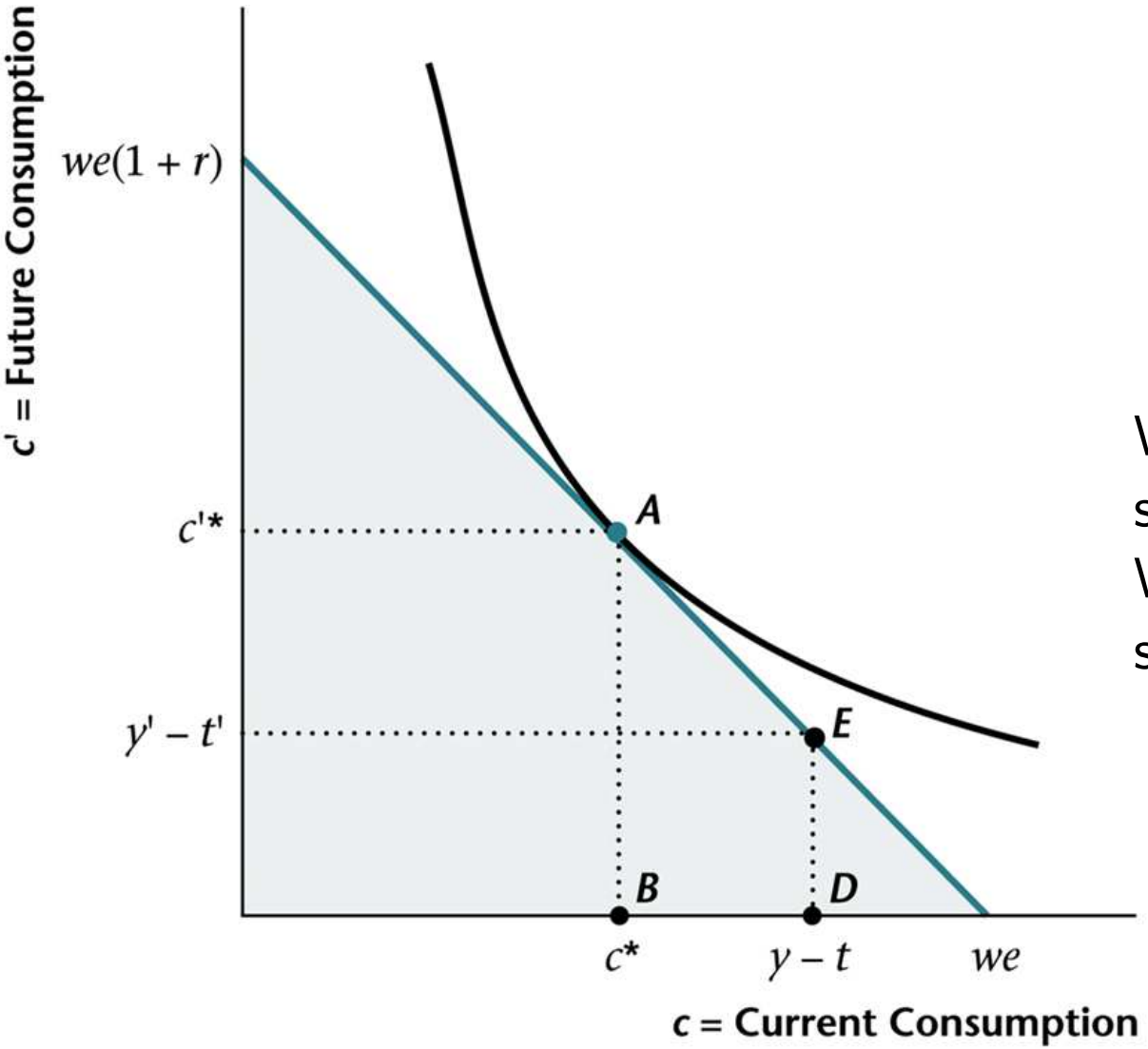
Household solves

$$\max_{c,c'} u(c) + \beta\, u(c') \tag{16}$$

subject to lifetime budget constraint

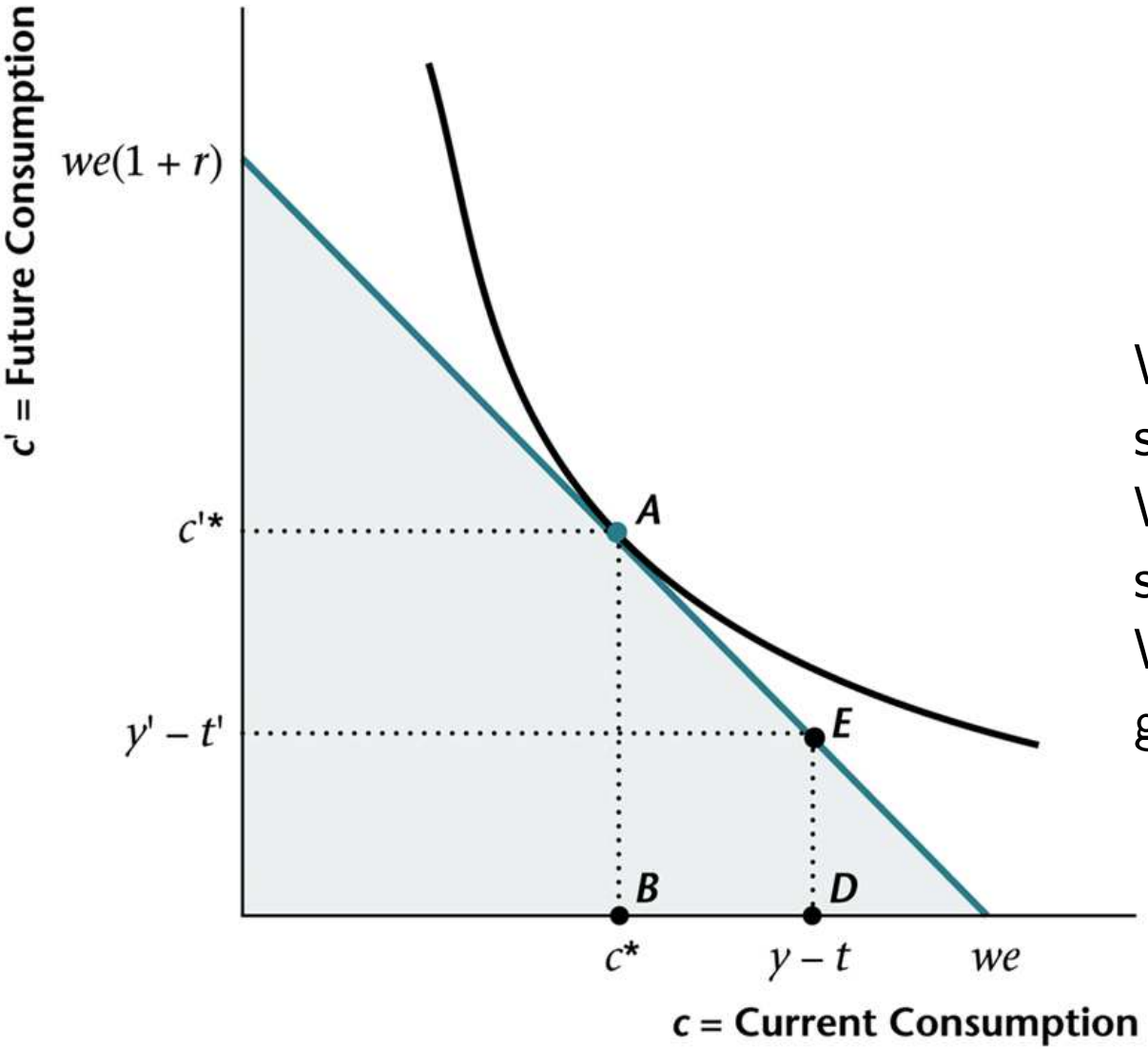
$$\underbrace{c + \frac{c'}{1+r}}_{\text{Present value of c}} = \underbrace{y + \frac{y'}{1+r}}_{\text{Present value of y}} - \underbrace{\tau^y + \frac{\tau^o}{1+r}}_{\text{Present value of t}}$$

Fully Funded Social Security



What happens to private saving?
What happens to aggregate saving?

Pay-as-you-go Social Security



What happens to private saving?
What happens to aggregate saving?
What happens when population growth falls?

Effects of Social Security

1. Fully funded Social Security has little effect.
    1. it raises saving for those saving less than τ^y.
    2. it does nothing to those saving more than τ^y.
2. Pay-as-you-go Social Security reduces saving.
    1. The age composition of the population is key for its solvency.

Reading

- Williamson, Macroeconomics, ch. 8
- Jones, Charles I. (2008). Macroeconomics (1st ed.). W. W. Norton, ch. 13
- Romer, D. (2012). Advanced macroeconomics (4 ed.). McGraw-Hill/Irwin, ch. 12