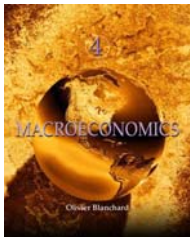
# Intermediate Macroeconomics

ECON 302

Professor Yamin Ahmad

Lecture 12:

- Consumption Theory
- The Microfoundations of Consumption
- Ricardian Equivalence







## Key Concepts In This Lecture

- Indifference Curves and Budget sets
- Utility Maximization and the Consumption Euler Equation
- Life Cycle Hypothesis
- Permanent Income Hypothesis
- Ricardian Equivalence

Note: These lecture notes are incomplete without having attended lectures





## Consumption

### Puzzle in Data

- In cross-section data i.e. across households at a given movement, the relationship between consumption and disposable income is rather flat:
  - $(c_1 < C/(Y-T); C_0 > 0)$;
- In time series data on aggregate consumption and disposable income, we find that the relationship is much steeper:
  - $(c_1 \approx C/(Y-T); C_0 \approx 0)$;

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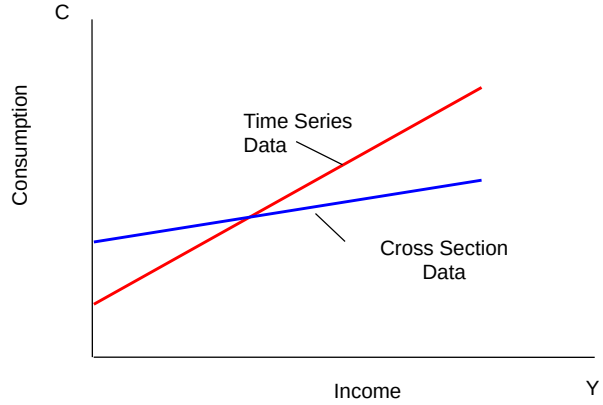
## The Consumption Puzzle




How can we explain this?

Note: These lecture notes are incomplete without having attended lectures

# Basic Consumption/Savings Theory

## Economic Environment

- Representative consumer lives for two periods
- Beginning of each period, they get income, Y
- Representative consumer chooses:
  - How much to consume
  - How much to save
- If they save, they get a real rate of interest, r.





# Basic Consumption/Savings Theory

## Assumptions

Consumers:

- are rational!
- have perfect foresight
- maximize lifetime utility
- For now, we will also assume that
  - Taxes, T = 0;
  - There is no uncertainty
- Question: What is "utility" and how do they maximize it?





# Digression: Indifference Curves

## Tool of Analysis: Indifference Curves

- Represents demand side of the economy (consumers)
- **Indifference Curve** — shows combinations of two goods that yield the same level of satisfaction ("utility") to a consumer.





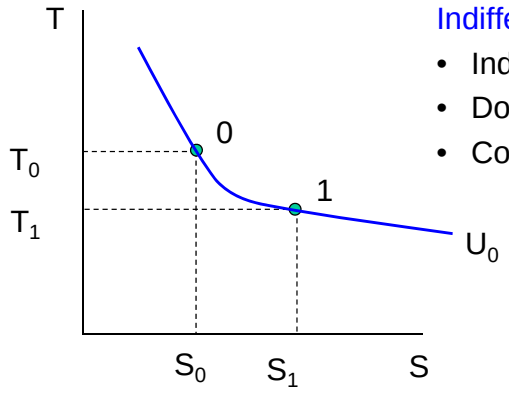
# A Quick Question For You

Think of two goods/items that you like. Let's call them good S and good T. Suppose that you have 10 of each type of good. Now consider the following:

In a table, write down numbers for:

- Additional S: How many units of good T would you be willing to give up for an additional unit of good S? … or for the $12^{th}$,$13^{th}$ or $14^{th}$ unit of good S?
- Additional T: How many units of good S would you be willing to give up for an additional unit of good T? … or for the $12^{th}$, $13^{th}$ or $14^{th}$ unit of good T?
- Plot these on a graph! What shape have you drawn?

# An Indifference Curve



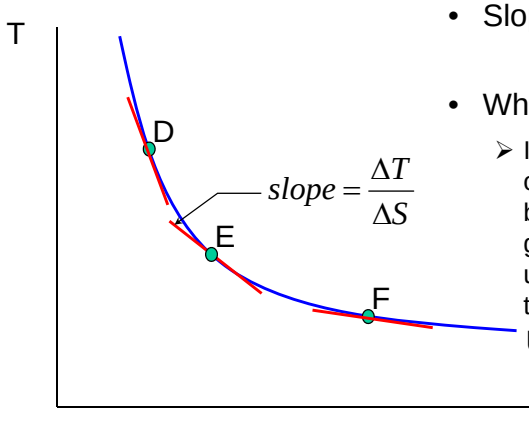

Indifference Curves are:

- Individual Specific
- Downward Sloping
- Convex to the origin





# Marginal Rate of Substitution (MRS)

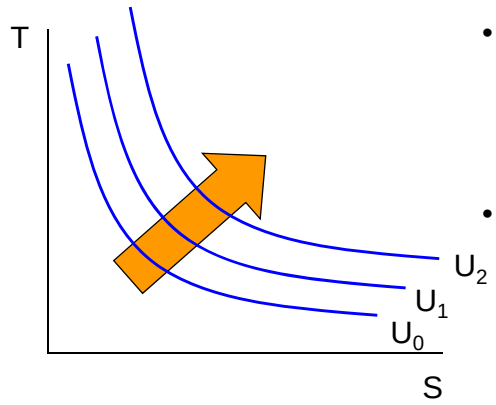



- Slope of IC = MRS
  $= \Delta T / \Delta S$
- What is the MRS?
  - It reflects the opportunity cost faced by consumers of gaining an additional unit of good S, but at the same level of utility.





# Indifference Curves (cont.)




- Higher Indifference Curves represent higher levels of utility.
- Why? $U_1$ and $U_2$ represent combinations of T and S that are at least the same (if not more) of either good (compared to $U_0$).





# Some Things to Think About…

- Question: Can indifference curves cross?
- Answer: ____ … why?

- Question: Are the indifference curves "parallel"?
- Answer:

# Properties of Indifference Curves

To summarize, indifference curves are:

- Individual-specific
- Downward-sloping
- Convex to the origin
- Higher curves indicate higher levels of satisfaction
- Non-intersecting
- Slope of indifference curve is the marginal rate of substitution (MRS)





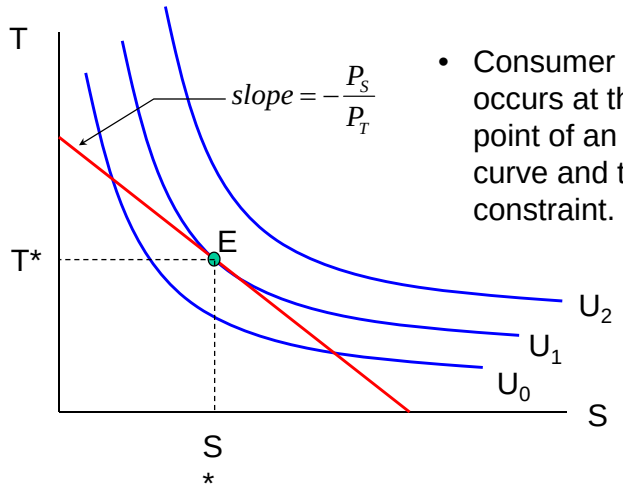
# Consumer Utility Maximization

- Consumer maximizes utility subject to an income or budget constraint
- What does this mean?...
  - Given your budget (income), you try and pick combinations of S and T that lie within your budget whilst giving you the greatest utility!
- Question: Suppose that you have an income, Y, which you want to spend on two goods, S and T, which cost $P_S$ and $P_T$.
  - Write out the budget constraint!





# Consumer Utility Maximization



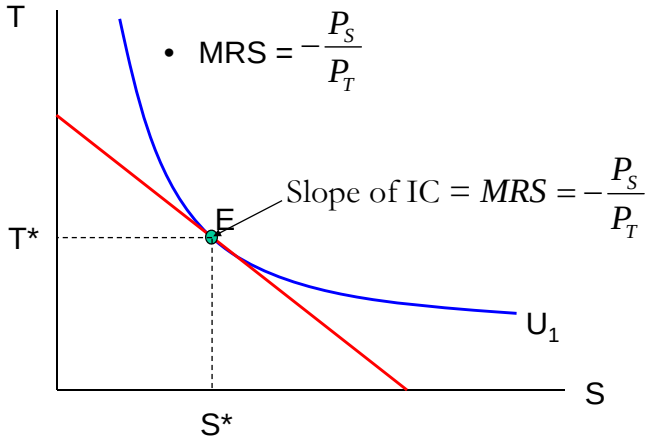

- Consumer solution occurs at the tangency point of an indifference curve and the budget constraint.





# Consumer Utility Maximization

Hence, at the consumer's solution:




- MRS = $-\frac{P_S}{P_T}$

# End Digression… Back to Consumption/Savings

- What are our two goods, S and T here?
  - Choice of consumption today ($C_1$) and consumption tomorrow ($C_2$)!
- What is our budget in each period?
  - Income today, $Y_1$
  - Income tomorrow, $Y_2 + S(1+r)$
- Recall that we set taxes, T= 0;





# Consumption-Savings Decision

- Hence, given an ***endowment, e,*** of income, i.e. e = {$Y_1$, $Y_2$}, and facing our budget constraint in each period, we decide:
  - Consumption today, $C_1$
  - Consumption tomorrow, $C_2$
  - (and hence…. Savings between today and tomorrow)





# Budget Constraints

- Flow budget constraints:
  - Period 1: $C_1 + S = Y_1$ (1)
  - Period 2: $C_2 = Y_2 + (1+r)S$ (2)
- Present Value budget constraint:
  - Eliminate S in equations above to yield

$$C_2 = Y_2 + (1+r)(Y_1 - C_1)$$

$$\Rightarrow C_1 + \frac{C_2}{1+r} = Y_1 + \frac{Y_2}{1+r} \qquad (3)$$





# Formal Definition of Consumer Problem

Consumers maximize utility:

$$\max_{C_1, C_2} U(C_1, C_2) \quad \text{e.g. } U(C_1, C_2) = \log C_1 + \log C_2$$

- subject to:

$$C_1 + S = Y_1 \qquad (1)$$

$$C_2 = Y_2 + (1+r)S \qquad (2)$$

- or alternatively:

$$C_1 + \frac{C_2}{1+r} = Y_1 + \frac{Y_2}{1+r} \qquad (3)$$

# Solution to Consumer's Problem

- Recall from earlier that at solution, slope of IC equals slope of budget constraint

- What is the slope of the budget constraint?
  - Re-write equation (3) as:

$$C_2 = Y_2 + (1+r)(Y_1 - C_1)$$

$$\Rightarrow C_2 = \left[Y_2 + (1+r)Y_1\right] - (1+r)C_1$$

- Hence, the slope of the budget constraint equals *-(1+r)*





# Solution to Consumer's Problem (cont.)

- Hence at the solution, MRS = (1+r), i.e.:

$$\Rightarrow \text{MRS} = \frac{\partial U/\partial C_1}{\partial U/\partial C_2} = 1+r = \text{Intertemporal Price}$$

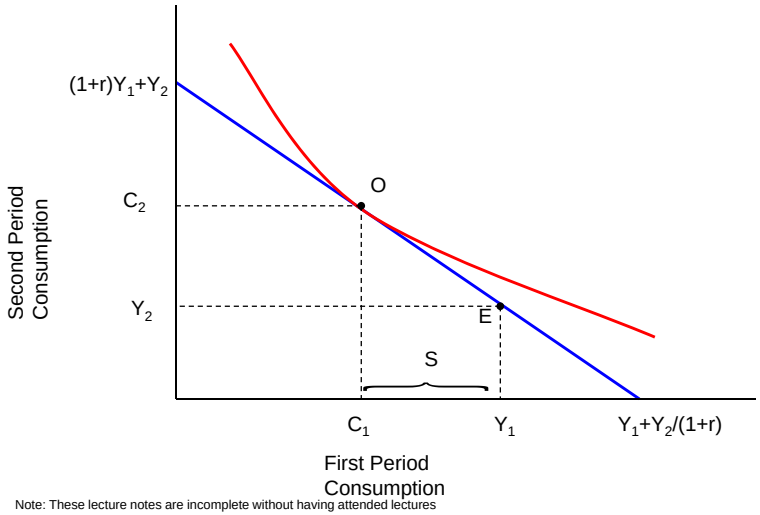
- This condition is known as the **Euler equation**
  - Slope of Indifference curve, i.e. MRS equals slope of the budget constraint at the tangent point.

- Thus, we can write the consumption function as:
  - Consumption function: $C_1 = C[r, Y_1 + Y_2/(1+r)]$





# The Consumption-Savings Decision








# Walkthrough Example

- Suppose that consumers maximize utility

$$\max_{C_1, C_2} U(C_1, C_2) = \log C_1 + \log C_2$$

subject to equation (3) from before.

- Questions:
  1. Write down the consumption Euler equation.
  2. Write down the consumption function.

# What Happens If…?

What is the Impact of…

1. A change in Income
   - Temporary change
   - Permanent Change

2. An increase in interest rates
   1. Borrower perspective
   2. Lender perspective

3. Borrowing Constraints faced by consumers

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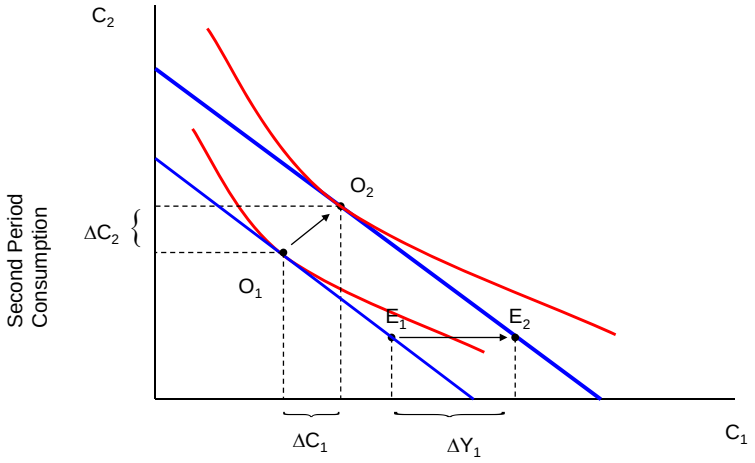
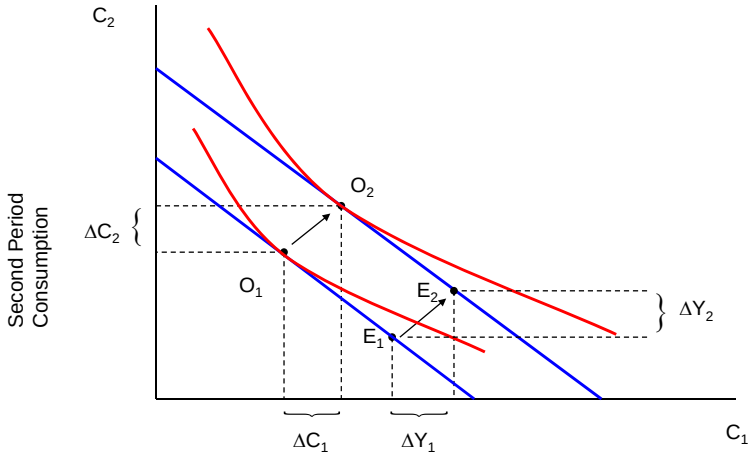
# A Temporary Increase in Income







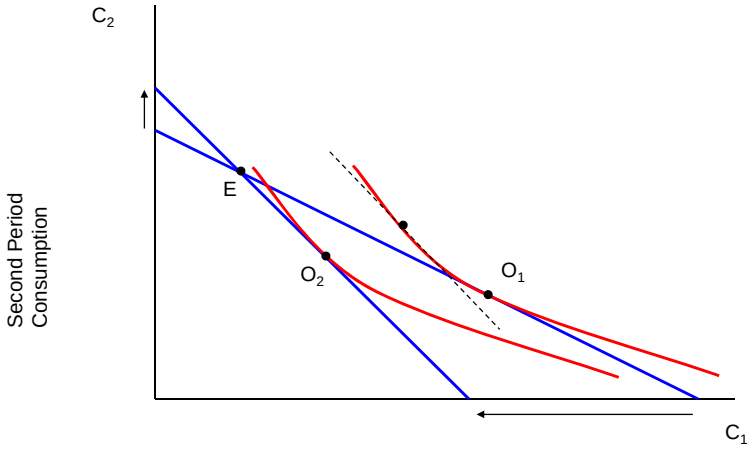

# A Permanent Increase in Income



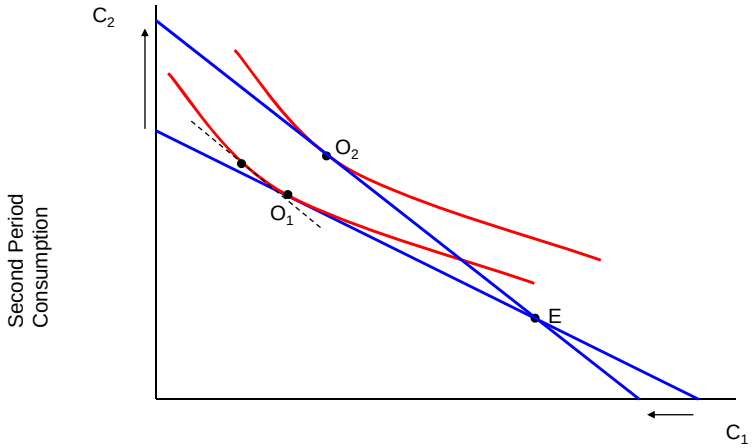





# An Increase in Interest Rates: Borrower



# An Increase in Interest Rates: Lender



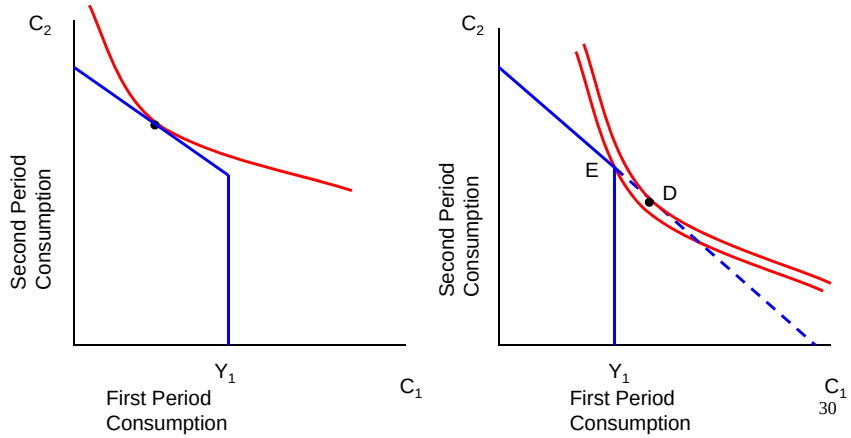





# Borrowing Constraints

A. The Borrowing Constraint is Not Binding

B. The Borrowing Constraint is Binding








# Beyond Two Periods

## Economic Environment

- Representative consumer lives for T periods
- Beginning of each period, they get income, Y
- Each period, representative consumer chooses:
  - How much to consume
  - How much to save
- If they save, they get a real rate of interest, r (assume constant)







# The Life Cycle Hypothesis (Ando-Modigliani)

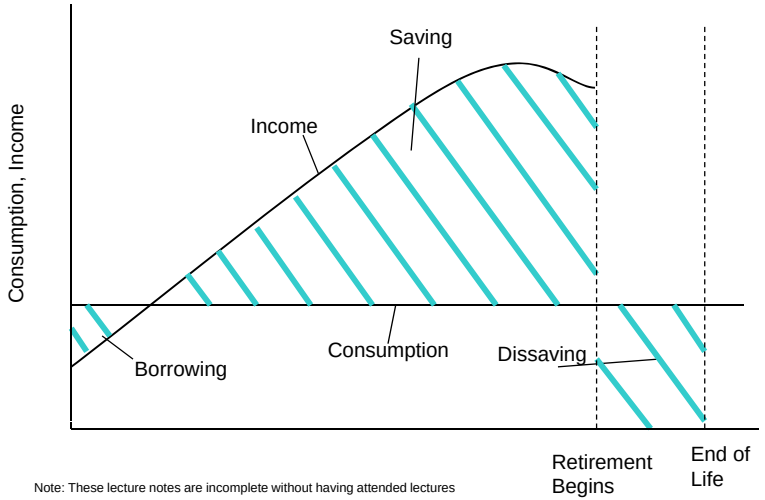
Maximise $U(C_1,C_2,\ldots,C_T)$ subject to:

$$C_1+\frac{C_2}{1+r}+\ldots+\frac{C_T}{(1+r)^{T-1}}=A+Y_1+\frac{Y_2}{1+r}+\ldots+\frac{Y_T}{(1+r)^{T-1}}\equiv A+HW$$

Where A = net assets and HW = "Human Wealth"

- Consumption Euler equation $\Rightarrow$ smooth consumption over lifetime
- Consumption function: $C_1 = C(r,A+HW)$
- Homothetic preferences $\Rightarrow$ $C_1 = \alpha(A+HW)$ where $\alpha$ depends on r,T.

## Consumption and Income over the Life Cycle








## Explaining the Puzzle

- In cross section:
  - high C/Y people are at the beginning and end of the life cycle
  - low C/Y individuals are those in the middle.
- Over time old people die and are replaced by younger ones.
- Economic growth means that the lifetime wealth of young is higher than those they replace.
  - Hence "average" consumer is getting richer over time.





## Permanent Income Hypothesis (Friedman)

- Income (Y) composed of a "Permanent" component ($Y^P$) and a "Transitory" one ($Y^T$)
- $C = \alpha Y^P$
  - $\Rightarrow C/Y = \alpha Y^P/Y = \alpha(1-Y^T/Y)$
- In *cross sectional data,* high C/Y individuals have negative transitory income and vice versa. In aggregate, mean $Y^P \approx$ mean Y, so $C/Y = \alpha$
- If $Y^P = r(A+HW)$ (annuity value of wealth), then **Permanent Income Hypothesis** (PIH) is the same as the **Life Cycle Hypothesis** (LCH).





## Income Expectations and Consumption (Hall)

- Suppose $C_t = \alpha Y^P_t$.
- What is $E_t(C_{t+1})$?
- Then $(Y^P_{t+1})^e = Y^P_t$ by definition. Hence:

$$E_t C_{t+1} = \alpha(Y^P_{t+1})^e + \alpha[Y^P_{t+1} - (Y^P_{t+1})^e]$$
$$= \alpha Y^P_t + \alpha[Y^P_{t+1} - (Y^P_{t+1})^e]$$
$$= C_t + \alpha[Y^P_{t+1} - (Y^P_{t+1})^e]$$

- the best guess of tomorrow's consumption is today's consumption, i.e. consumption follows a "random walk"

# Policy Implications of the LCH-PIH Model

- Best guess of tomorrow's consumption is today's consumption!
  - Roughly 75% of consumers satisfy this.
- Households smooth consumption over their lifetime
- Key Question: Are changes in income permanent ($c_1 \approx 1$) or temporary ($c_1 \approx 0$)?
- In essence the answer to the question above will determine whether people respond to a policy action or not





# Do Taxes Matter?

- How does consumption respond to a change in a policy variable, like taxes?
- Depends on the kind of taxes are being cut?
  - Temporary income tax cut will have little effect on demand.
  - Temporary cut in *expenditure* taxes e.g. sales tax will encourage consumers to bring forward spending (intertemporal substitution of consumption).





# Including The Government

- Economic Environment: 2 periods
- Suppose further that each period, the government collects taxes, T, and spends G.
- Question: Write out the flow budget constraints for the consumer and the government!
- Question: Write out the present value budget constraint for both the consumers and the government





# Ricardian Equivalence

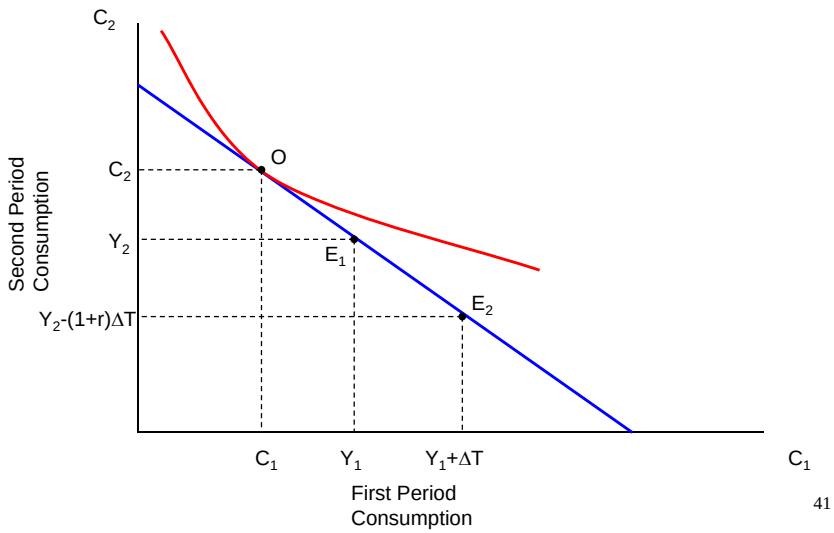
Add taxes: $C_1=C[r,(Y_1-T_1)+(Y_2-T_2)/(1+r)]$

Government Budget Identity:

$$\left.\begin{aligned} D &= G_1 - T_1 \\ T_2 &= (1+r)D + G_2 \end{aligned}\right\} \Rightarrow T_1 + \frac{T_2}{1+r} = G_1 + \frac{G_2}{1+r}$$

- Hence: $C_1=C[r,(Y_1-G_1) + (Y_2-G_2)/(1+r)]$
- Thus the time profile of taxes do not matter. (Also known as "ultra-rationality" or "**debt neutrality**".)

# A Debt-Financed Tax Cut








# Breaking Ricardian Equivalence

- **Myopia**: People are short sighted and do not internalize government budget identity.
- **Borrowing Constraints**. Debt financed tax cut today may relax borrowing constraint.
- **Future Generations**. If future generations pay the taxes, then present generation are better off. However, if they care about future generations, then present generation may increase their bequests and Ricardian Equivalence is re-established (Barro).

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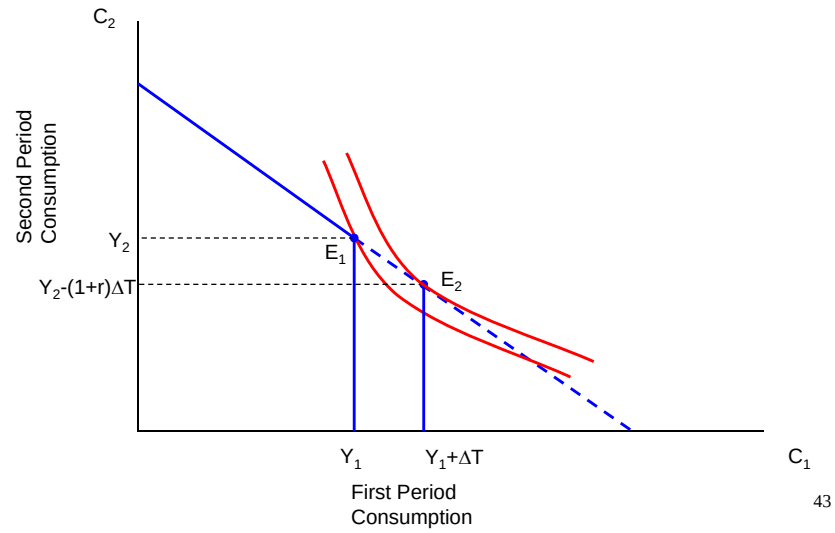
# Debt-Financed Tax Cut: Borrowing Constraints








# Summary

- Utility Maximization:
  - Consumers maximize utility subject to a budget constraint
  - Optimal consumption choice is represented by the Consumption Euler equation, where the MRS = Intertemporal Price
- Life Cycle Hypothesis suggests that households smooth consumption over their lifetime.
  - Goes towards explaining the consumption puzzle of a low C/Y ratio for cross-sectional data and a higher C/Y ratio for time series data
- Permanent Income Hypothesis suggests households consume out of permanent income

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# Summary

- If Permanent Income equals the annuity value of your lifetime wealth, then PIH and LCH are the same
- Incorporating uncertainty about future income with PIH yields the implication that consumption follows a random walk process.
- Ricardian Equivalence would suggest that the time profile of taxes do not matter
  - Breaks down with myopic households, borrowing constraints, and without intergenerational equity