# Consumption and Savings Model

ECO 305: Intermediate Macroeconomics

# Goals



1. Describe how consumers make consumption and savings decisions, considering their well being *in the future*
2. Describe how consumer decisions for savings, current consumption, future consumption are affected by,
   - changes in the interest rate
   - temporary changes in current income
   - changes in future income
   - changes in permanent income
3. Predict how borrowers versus savers are affected by changes in interest rates
4. Predict how government expenditure and tax policies affect consumer decisions

# Reading and Exercises



- Williamson, Chapter 9, pp. 306-321: Consumption and savings decisions
- Williamson, Chapter 9, pp. 321-324: Effects on decisions from changes in income
- Williamson, Chapter 9, pp. 327-332: Effects on decisions from changes in interest rates for savers and borrowers
- Williamson, Chapter 9, pp. 337-343: Ricardian Equivalence
- **Canvas Quiz due Wed 11:59 PM**. Multiple-choice, 10 questions, unlimited attempts allowed, only best score counts
- **Homework/In-class Exercise due Fri 11:59 PM**. We will work together in class on Thursday

# Reading and Exercises



- Williamson, Chapter 9, pp. 306-321: Consumption and savings decisions
- Williamson, Chapter 9, pp. 321-324: Effects on decisions from changes in income
- Williamson, Chapter 9, pp. 327-332: Effects on decisions from changes in interest rates for savers and borrowers
- Williamson, Chapter 9, pp. 337-343: Ricardian Equivalence
- **Canvas Quiz due Wed 11:59 PM**. Multiple-choice, 10 questions, unlimited attempts allowed, only best score counts
- **Homework/In-class Exercise due Fri 11:59 PM**. We will work together in class on Thursday

# Reading and Exercises



- Williamson, Chapter 9, pp. 306-321: Consumption and savings decisions
- Williamson, Chapter 9, pp. 321-324: Effects on decisions from changes in income
- Williamson, Chapter 9, pp. 327-332: Effects on decisions from changes in interest rates for savers and borrowers
- Williamson, Chapter 9, pp. 337-343: Ricardian Equivalence
- **Canvas Quiz due Wed 11:59 PM**. Multiple-choice, 10 questions, unlimited attempts allowed, only best score counts
- **Homework/In-class Exercise due Fri 11:59 PM**. We will work together in class on Thursday

# Reading and Exercises



- Williamson, Chapter 9, pp. 306-321: Consumption and savings decisions
- Williamson, Chapter 9, pp. 321-324: Effects on decisions from changes in income
- Williamson, Chapter 9, pp. 327-332: Effects on decisions from changes in interest rates for savers and borrowers
- Williamson, Chapter 9, pp. 337-343: Ricardian Equivalence
- **Canvas Quiz due Wed 11:59 PM**. Multiple-choice, 10 questions, unlimited attempts allowed, only best score counts
- **Homework/In-class Exercise due Fri 11:59 PM**. We will work together in class on Thursday

# Reading and Exercises



- Williamson, Chapter 9, pp. 306-321: Consumption and savings decisions
- Williamson, Chapter 9, pp. 321-324: Effects on decisions from changes in income
- Williamson, Chapter 9, pp. 327-332: Effects on decisions from changes in interest rates for savers and borrowers
- Williamson, Chapter 9, pp. 337-343: Ricardian Equivalence
- **Canvas Quiz due Wed 11:59 PM**.
  Multiple-choice, 10 questions, unlimited attempts allowed, only best score counts
- **Homework/In-class Exercise due Fri 11:59 PM**. We will work together in class on Thursday

# Reading and Exercises



- Williamson, Chapter 9, pp. 306-321: Consumption and savings decisions
- Williamson, Chapter 9, pp. 321-324: Effects on decisions from changes in income
- Williamson, Chapter 9, pp. 327-332: Effects on decisions from changes in interest rates for savers and borrowers
- Williamson, Chapter 9, pp. 337-343: Ricardian Equivalence
- **Canvas Quiz due Wed 11:59 PM**.
  Multiple-choice, 10 questions, unlimited attempts allowed, only best score counts
- **Homework/In-class Exercise due Fri 11:59 PM**. We will work together in class on Thursday

# Two-Period Consumption/Savings Model Setup



- Two variables over two periods: current consumption and future consumption
- Consumers maximize utility, derived from current and future consumption, subject to budget constraints
- Endowment economy: Consumers have everything given to them $y - t$ today, $y' - t'$ in the future
- Consumers can save or borrow in the current period (negative outcome for saving)
- Consumers either consume saved money in future period, or pay back borrowed money in future period

# Two-Period Consumption/Savings Model Setup



- Two variables over two periods: current consumption and future consumption
- Consumers maximize utility, derived from current and future consumption, subject to budget constraints
- Endowment economy: Consumers have everything given to them $y - t$ today, $y' - t'$ in the future
- Consumers can save or borrow in the current period (negative outcome for saving)
- Consumers either consume saved money in future period, or pay back borrowed money in future period

# Two-Period Consumption/Savings Model Setup



- Two variables over two periods: current consumption and future consumption
- Consumers maximize utility, derived from current and future consumption, subject to budget constraints
- Endowment economy: Consumers have everything given to them $y - t$ today, $y' - t'$ in the future
- Consumers can save or borrow in the current period (negative outcome for saving)
- Consumers either consume saved money in future period, or pay back borrowed money in future period

# Two-Period Consumption/Savings Model Setup



- Two variables over two periods: current consumption and future consumption
- Consumers maximize utility, derived from current and future consumption, subject to budget constraints
- Endowment economy: Consumers have everything given to them $y - t$ today, $y' - t'$ in the future
- Consumers can save or borrow in the current period (negative outcome for saving)
- Consumers either consume saved money in future period, or pay back borrowed money in future period

# Two-Period Consumption/Savings Model Setup



- Two variables over two periods: current consumption and future consumption
- Consumers maximize utility, derived from current and future consumption, subject to budget constraints
- Endowment economy: Consumers have everything given to them $y - t$ today, $y' - t'$ in the future
- Consumers can save or borrow in the current period (negative outcome for saving)
- Consumers either consume saved money in future period, or pay back borrowed money in future period

# Intertemporal Budget Constraint



## Budget Constraints

- Current period:

$$c + s = y - t$$

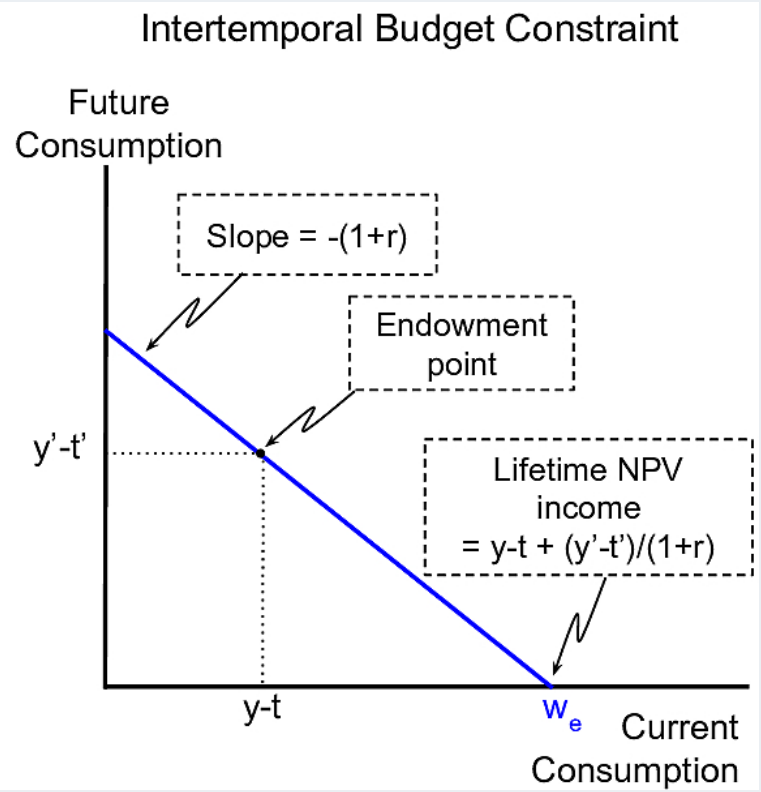
- Future period:

$$c' = y' - t' + (1 + r)s$$

- $r$: real interest rate
- Combining:

$$c + \frac{c'}{1+r} = y - t + \frac{y' - t'}{1+r}$$

## Graphical Budget Constraint



# Intertemporal Budget Constraint



## Budget Constraints

- Current period:

$$c + s = y - t$$

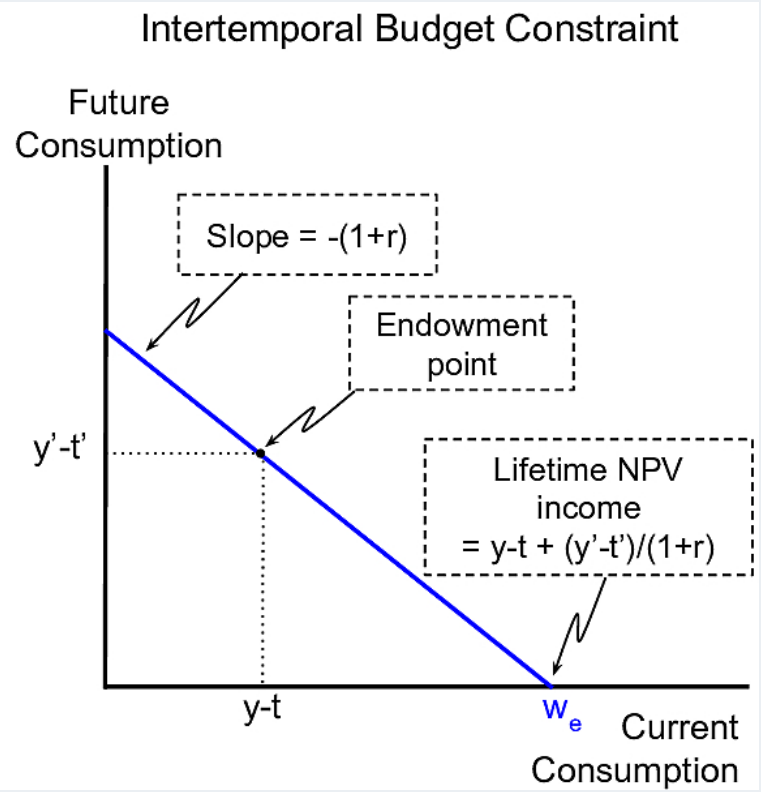
- Future period:

$$c' = y' - t' + (1 + r)s$$

- $r$: real interest rate
- Combining:

$$c + \frac{c'}{1+r} = y - t + \frac{y' - t'}{1+r}$$

## Graphical Budget Constraint



# Intertemporal Budget Constraint



## Budget Constraints

- Current period:

$$c + s = y - t$$

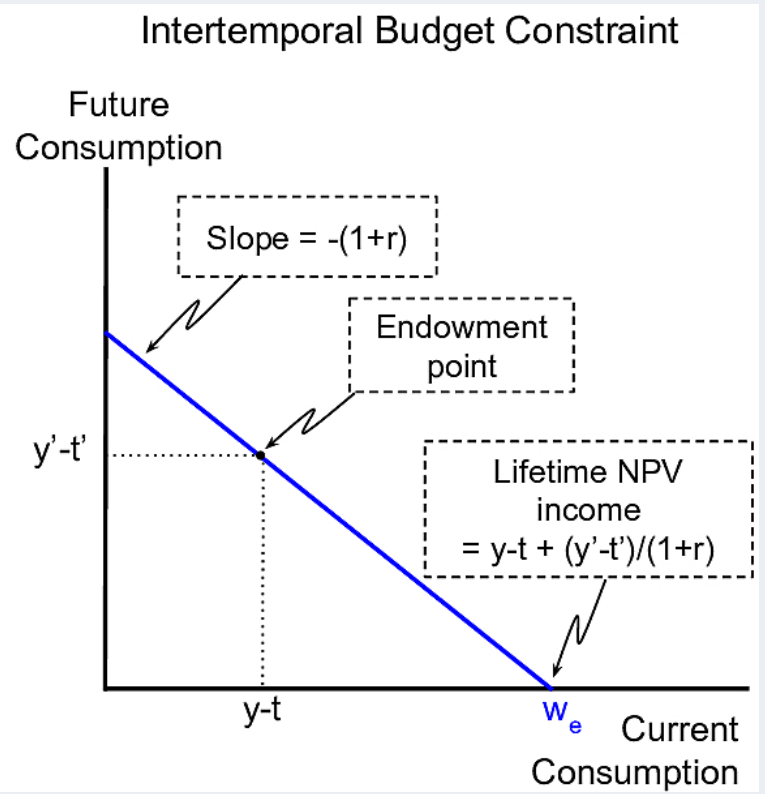
- Future period:

$$c' = y' - t' + (1 + r)s$$

- $r$: real interest rate
- Combining:

$$c + \frac{c'}{1+r} = y - t + \frac{y' - t'}{1+r}$$

## Graphical Budget Constraint



# Intertemporal Budget Constraint



## Budget Constraints

- Current period:

$$c + s = y - t$$

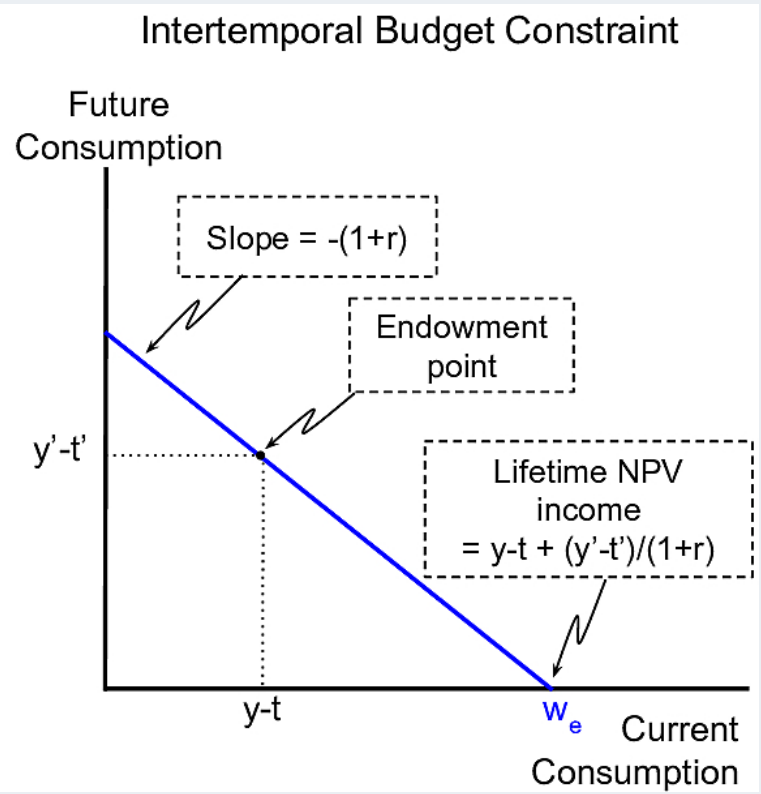
- Future period:

$$c' = y' - t' + (1 + r)s$$

- $r$: real interest rate
- Combining:

$$c + \frac{c'}{1+r} = y - t + \frac{y' - t'}{1+r}$$

## Graphical Budget Constraint



# Intertemporal Budget Constraint



## Budget Constraints

- Current period:

$$c + s = y - t$$

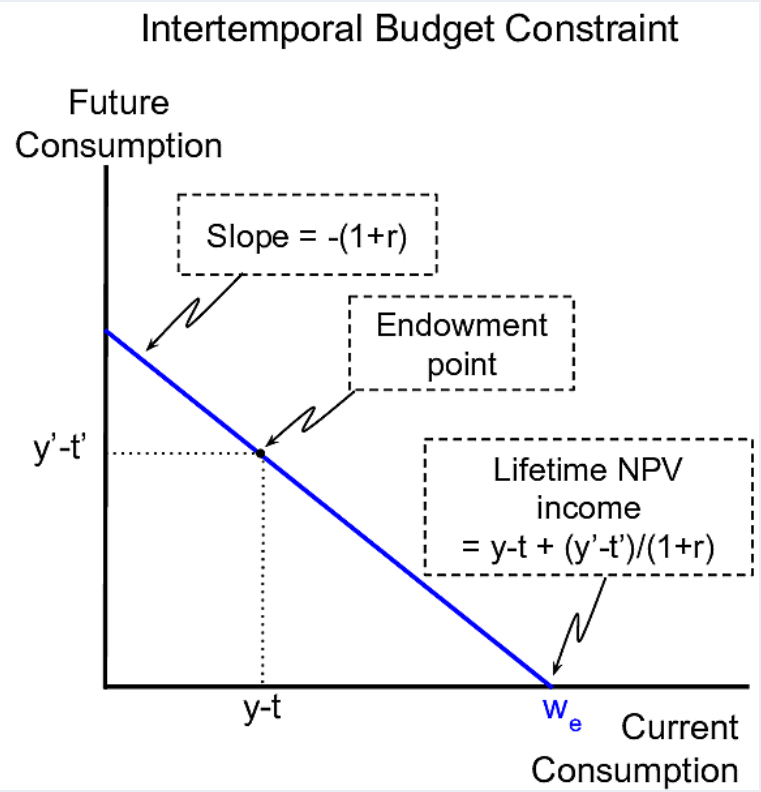
- Future period:

$$c' = y' - t' + (1 + r)s$$

- $r$: real interest rate
- Combining:

$$c + \frac{c'}{1+r} = y - t + \frac{y' - t'}{1+r}$$

## Graphical Budget Constraint



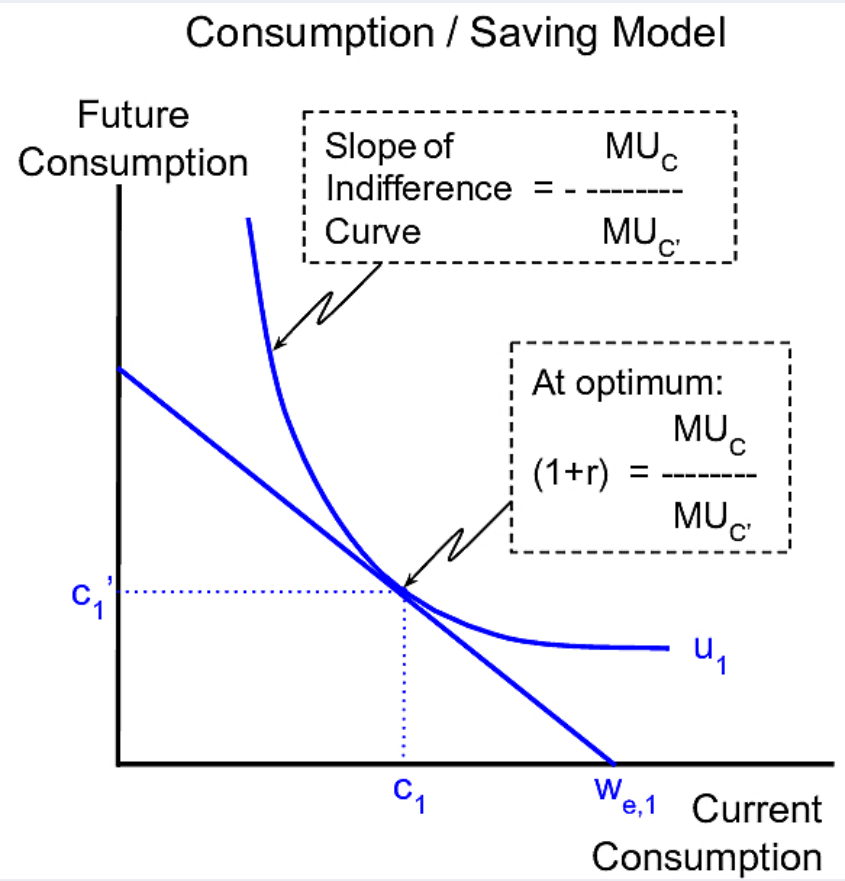
# Utility Maximization



## Consumer Decision

- Choice variables: current and future consumption
- Given variables: endowments $y$ and $y'$, taxes $t$ and $t'$, interest rate, $r$
- Maximize utility: reach highest utility curve possible
- Maximize utility where indifference curve is just tangent to budget constraint

## Graphical Utility Maximization



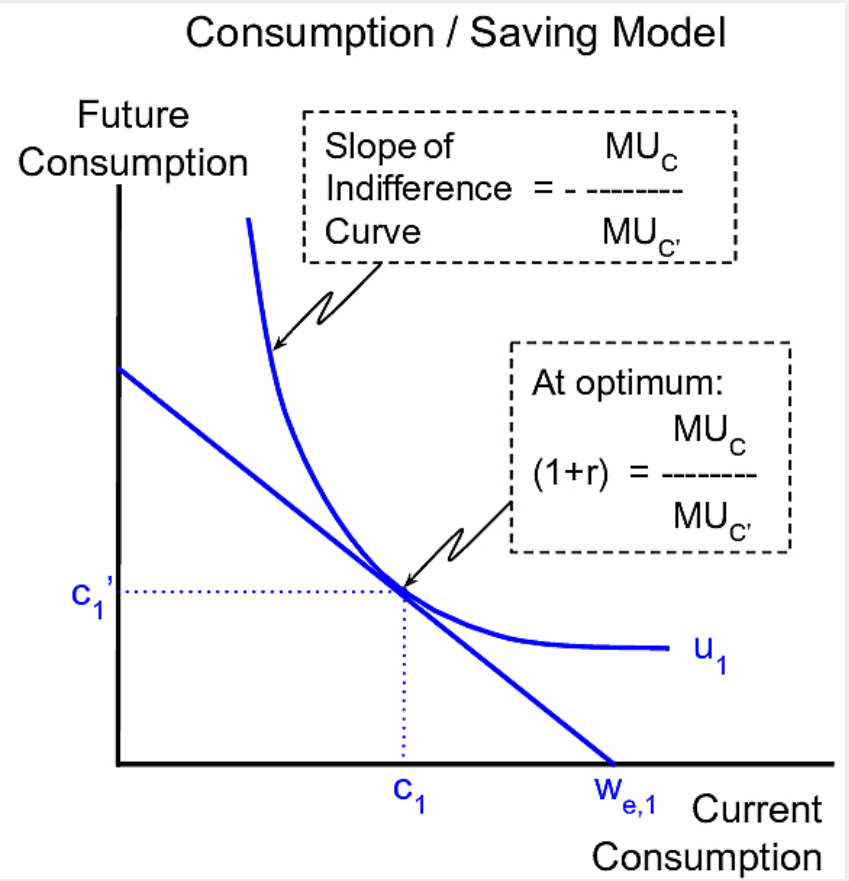
# Utility Maximization



## Consumer Decision

- Choice variables: current and future consumption
- Given variables: endowments $y$ and $y'$, taxes $t$ and $t'$, interest rate, $r$
- Maximize utility: reach highest utility curve possible
- Maximize utility where indifference curve is just tangent to budget constraint

## Graphical Utility Maximization



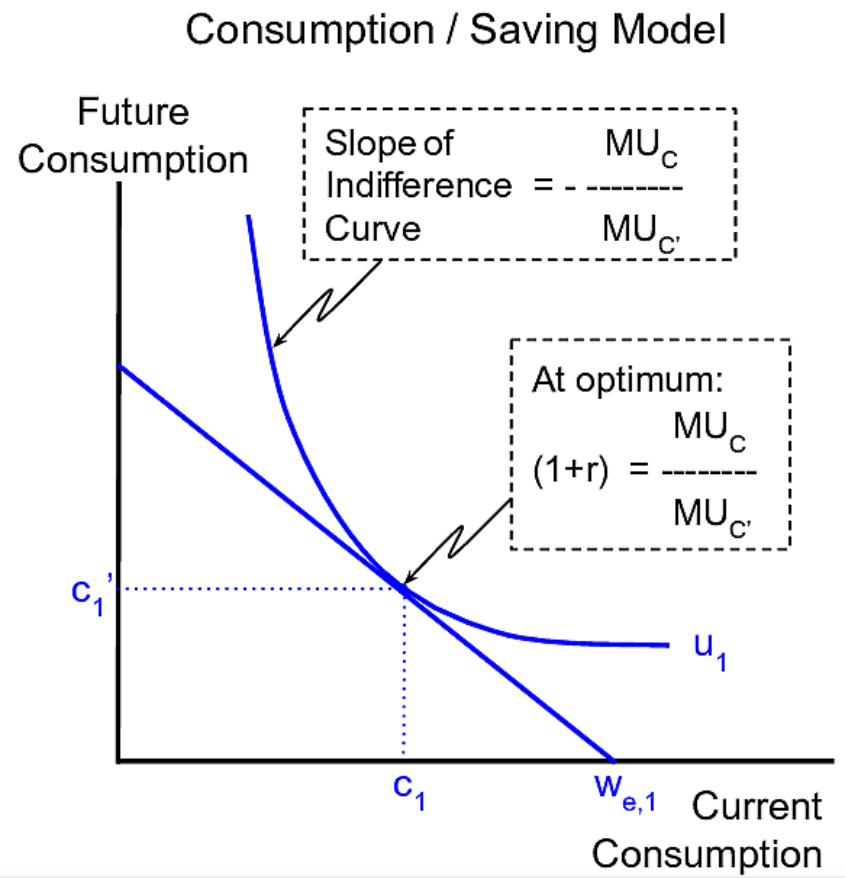
# Utility Maximization



## Consumer Decision

- Choice variables: current and future consumption
- Given variables: endowments $y$ and $y'$, taxes $t$ and $t'$, interest rate, $r$
- Maximize utility: reach highest utility curve possible
- Maximize utility where indifference curve is just tangent to budget constraint

## Graphical Utility Maximization



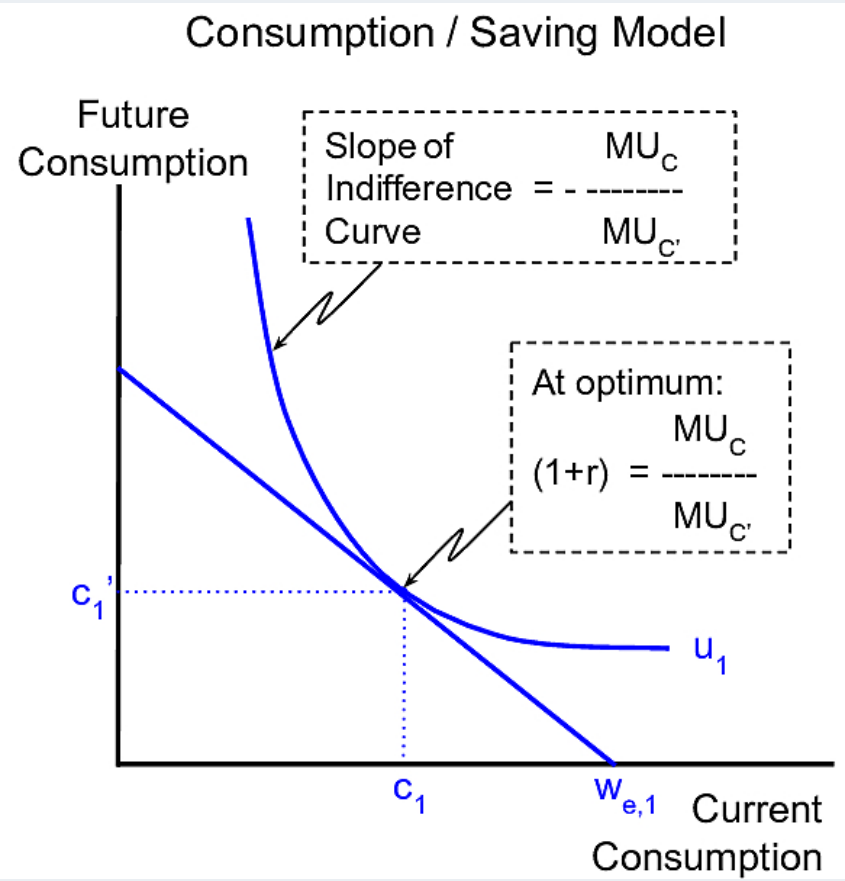
# Utility Maximization



## Consumer Decision

- Choice variables: current and future consumption
- Given variables: endowments $y$ and $y'$, taxes $t$ and $t'$, interest rate, $r$
- Maximize utility: reach highest utility curve possible
- Maximize utility where indifference curve is just tangent to budget constraint

## Graphical Utility Maximization



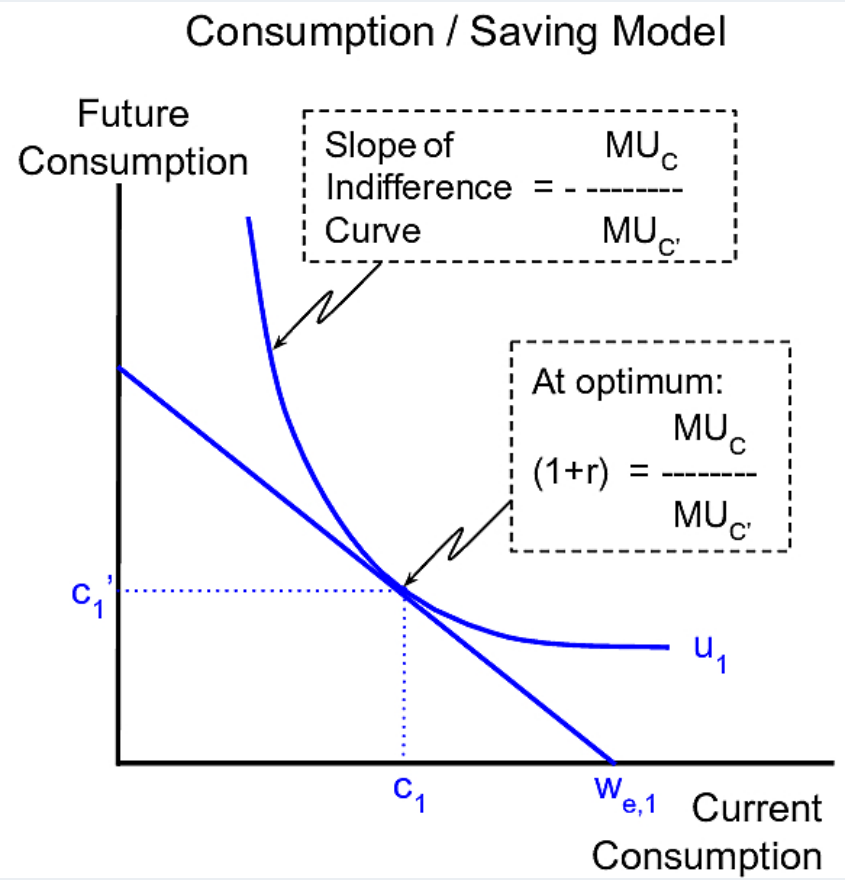
# Utility Maximization



## Consumer Decision

- Choice variables: current and future consumption
- Given variables: endowments $y$ and $y'$, taxes $t$ and $t'$, interest rate, $r$
- Maximize utility: reach highest utility curve possible
- Maximize utility where indifference curve is just tangent to budget constraint

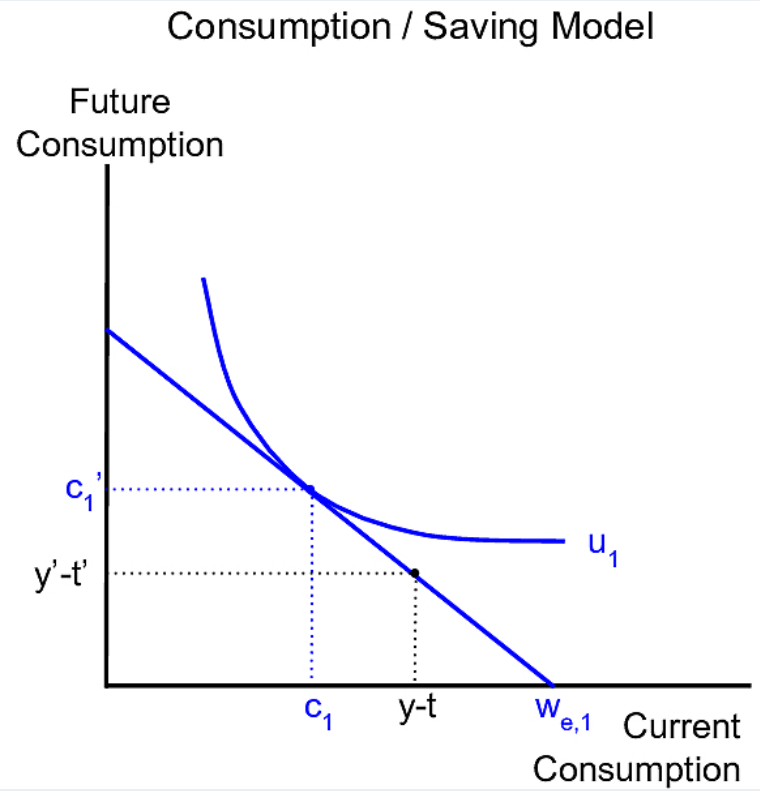
## Graphical Utility Maximization



# Savers Versus Borrwers

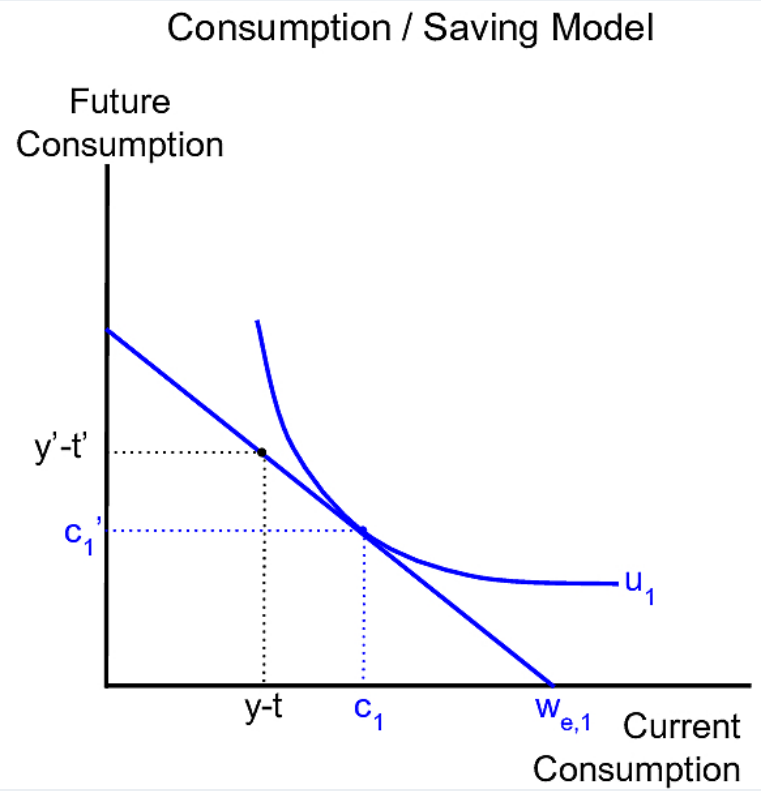


## Consumer is a Saver




$c < y - t$, saving is positive

## Consumer is a Borrower




$c > y - t$, saving is negative

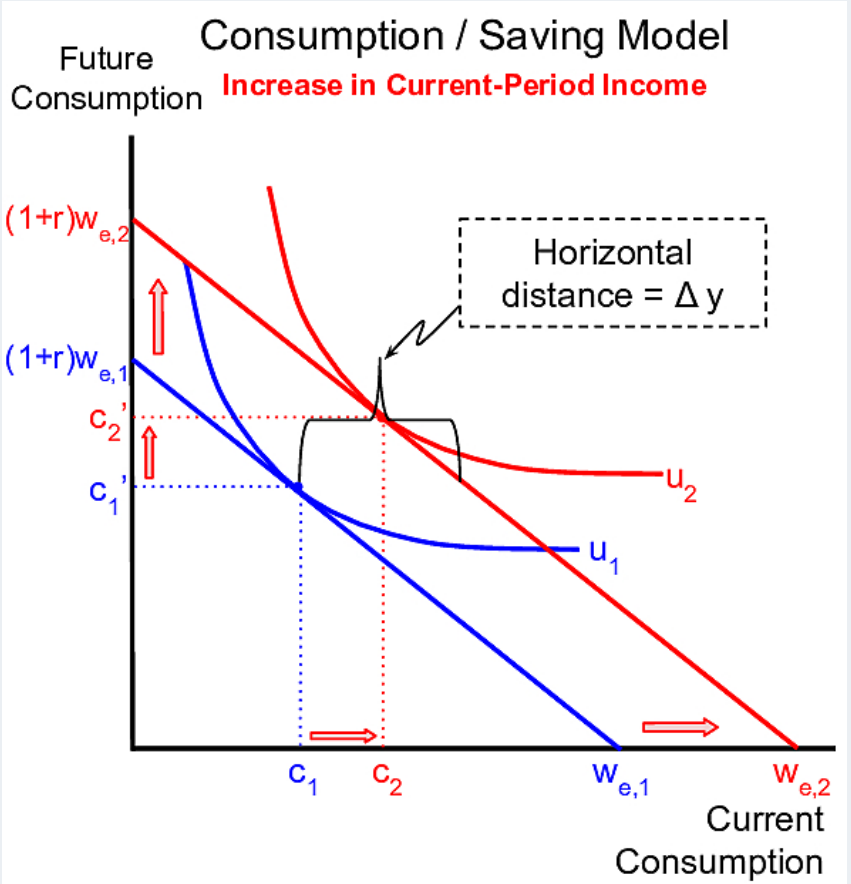
# Temporary Increase in Income



## Temporary Increase in Income

- Suppose income increases in the current period ($\uparrow y$), but expected to be temporary (i.e. no change in $y'$)
- Budget shifts outward, horizontal distance equal to the change in $y$
- Consumption smoothing: Both $c$ and $c'$ increase
- Savings increases: $\Delta c < \Delta y$

## Graphical Utility Maximization



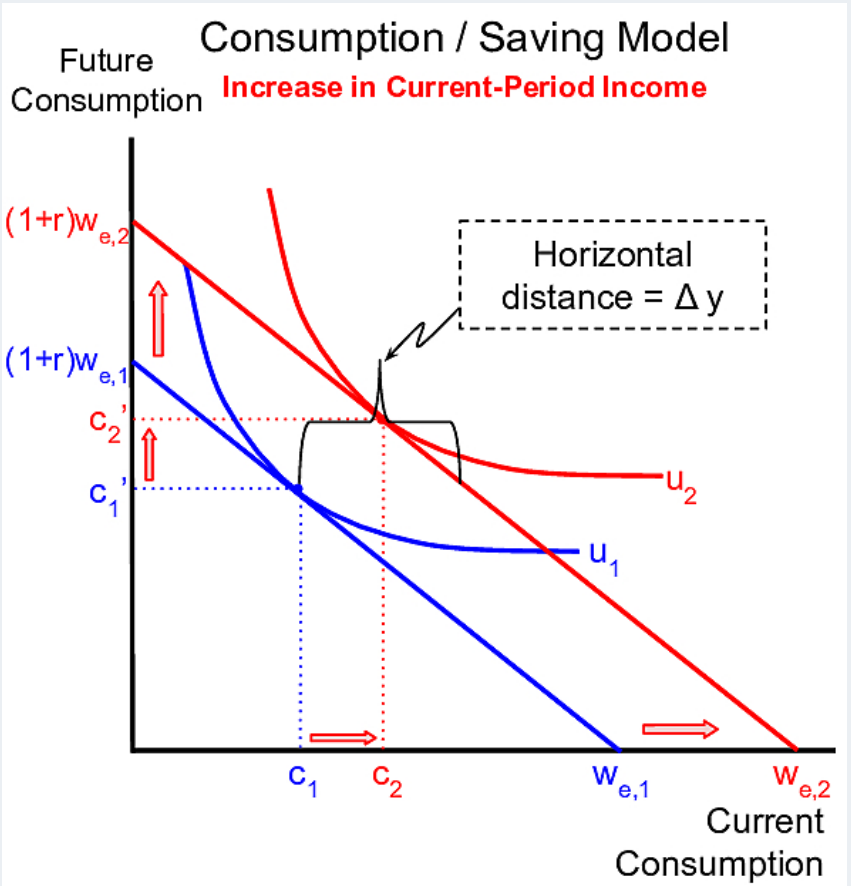
# Temporary Increase in Income



## Temporary Increase in Income

- Suppose income increases in the current period ($\uparrow y$), but expected to be temporary (i.e. no change in $y'$)
- Budget shifts outward, horizontal distance equal to the change in $y$
- Consumption smoothing: Both $c$ and $c'$ increase
- Savings increases: $\Delta c < \Delta y$

## Graphical Utility Maximization



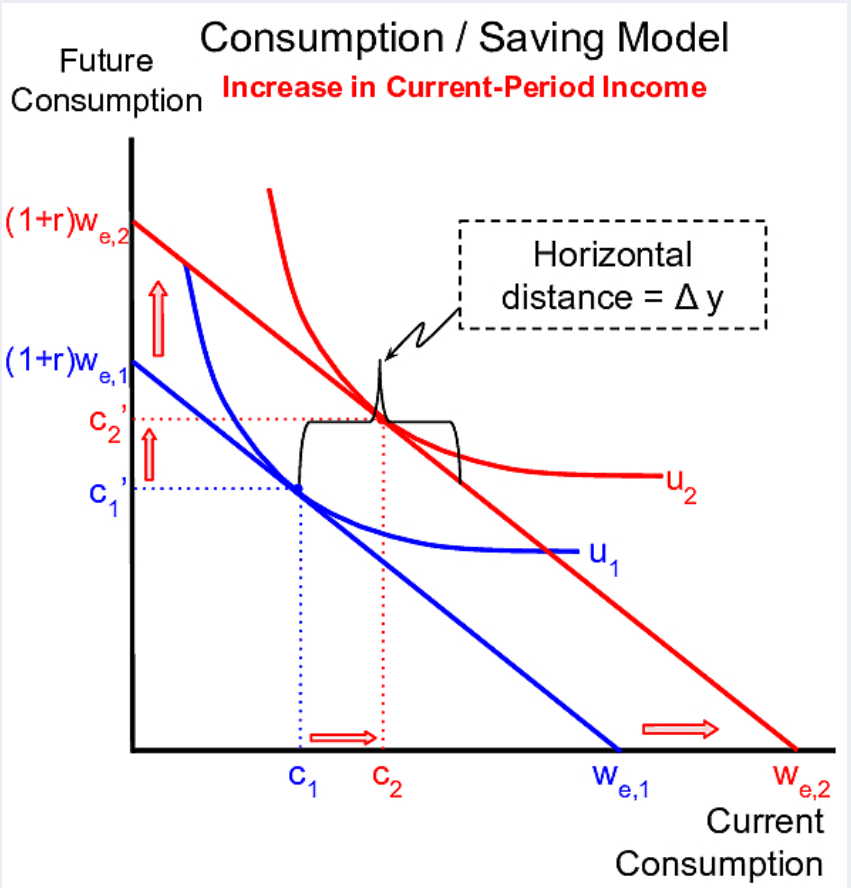
# Temporary Increase in Income



## Temporary Increase in Income

- Suppose income increases in the current period ($\uparrow y$), but expected to be temporary (i.e. no change in $y'$)
- Budget shifts outward, horizontal distance equal to the change in $y$
- Consumption smoothing: Both $c$ and $c'$ increase
- Savings increases: $\Delta c < \Delta y$

## Graphical Utility Maximization



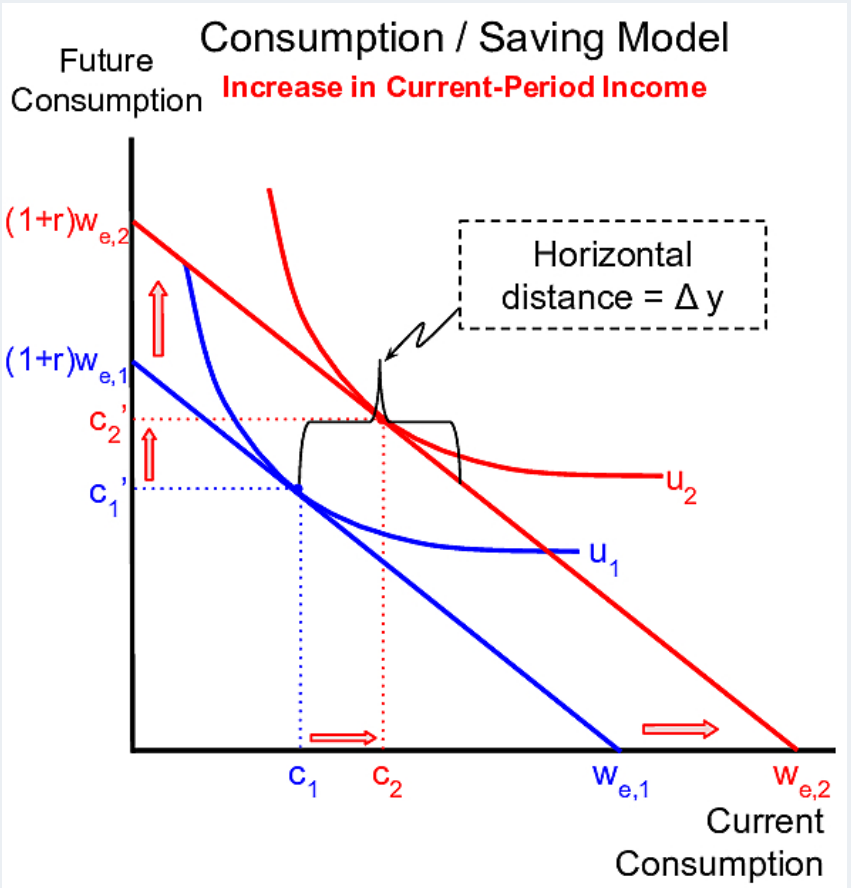
# Temporary Increase in Income



## Temporary Increase in Income

- Suppose income increases in the current period ($\uparrow y$), but expected to be temporary (i.e. no change in $y'$)
- Budget shifts outward, horizontal distance equal to the change in $y$
- Consumption smoothing: Both $c$ and $c'$ increase
- Savings increases: $\Delta c < \Delta y$

## Graphical Utility Maximization



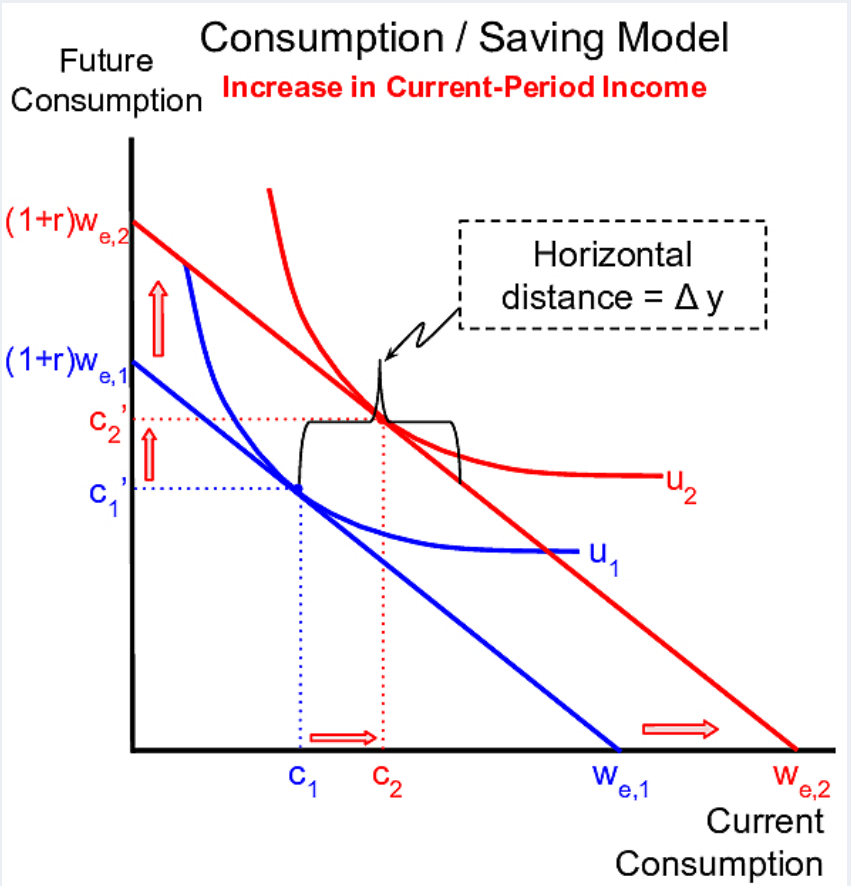
# Temporary Increase in Income



## Temporary Increase in Income

- Suppose income increases in the current period ($\uparrow y$), but expected to be temporary (i.e. no change in $y'$)
- Budget shifts outward, horizontal distance equal to the change in $y$
- Consumption smoothing: Both $c$ and $c'$ increase
- Savings increases: $\Delta c < \Delta y$

## Graphical Utility Maximization



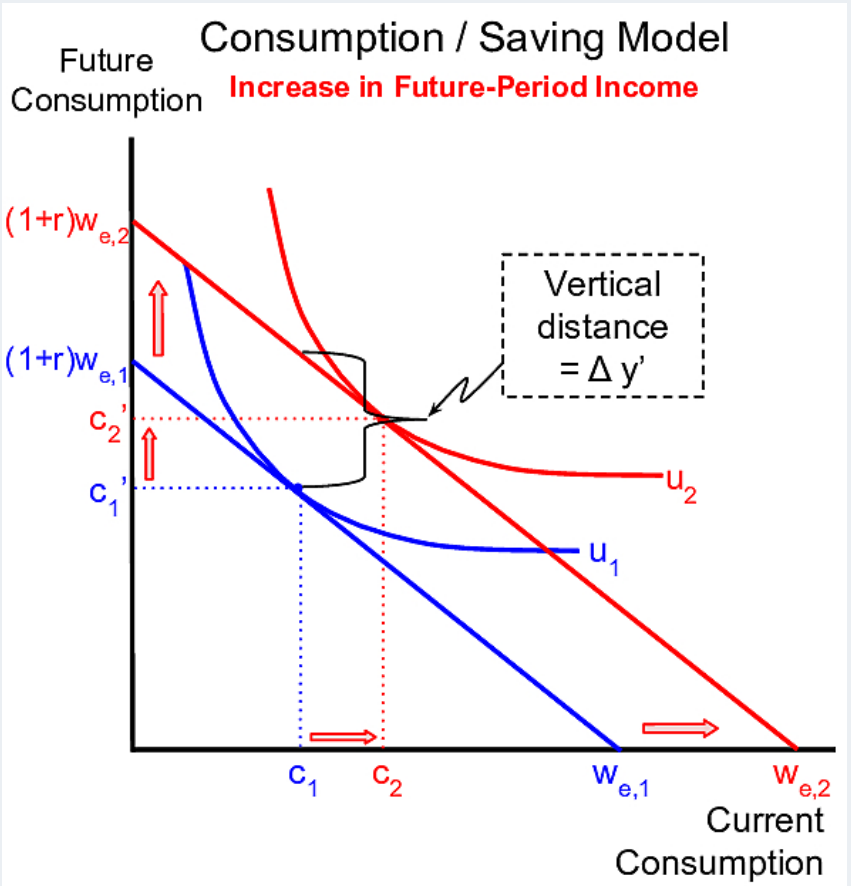
# Increase in Expected Future Income



## Increase Expected Future Income

- Suppose income increases in the future period ($\uparrow y'$), but no change in the current period (i.e. no change in $y$)
- Budget shifts outward, vertical distance equal to the change in $y'$
- Consumption smoothing: Both $c$ and $c'$ increase
- Savings decreases: $s = y - t - c$, $c \uparrow$, but no change in $y$

## Graphical Utility Maximization



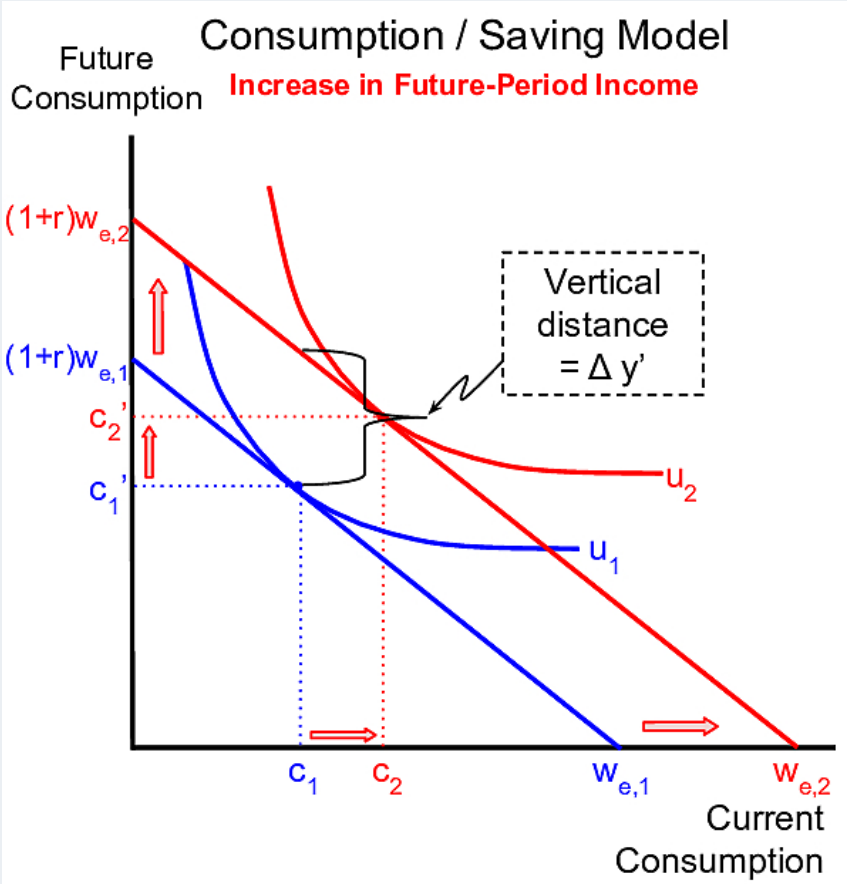
# Increase in Expected Future Income



## Increase Expected Future Income

- Suppose income increases in the future period ($\uparrow y'$), but no change in the current period (i.e. no change in $y$)
- Budget shifts outward, vertical distance equal to the change in $y'$
- Consumption smoothing: Both $c$ and $c'$ increase
- Savings decreases: $s = y - t - c$, $c \uparrow$, but no change in $y$

## Graphical Utility Maximization



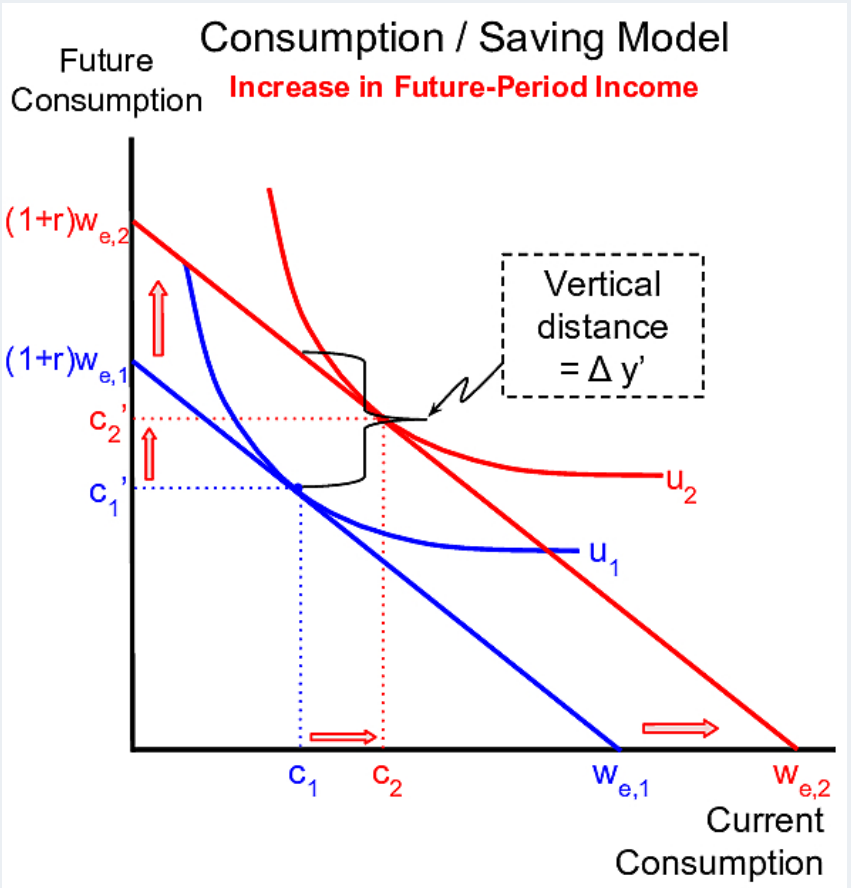
# Increase in Expected Future Income



## Increase Expected Future Income

- Suppose income increases in the future period ($\uparrow y'$), but no change in the current period (i.e. no change in $y$)
- Budget shifts outward, vertical distance equal to the change in $y'$
- Consumption smoothing: Both $c$ and $c'$ increase
- Savings decreases: $s = y - t - c$, $c \uparrow$, but no change in $y$

## Graphical Utility Maximization



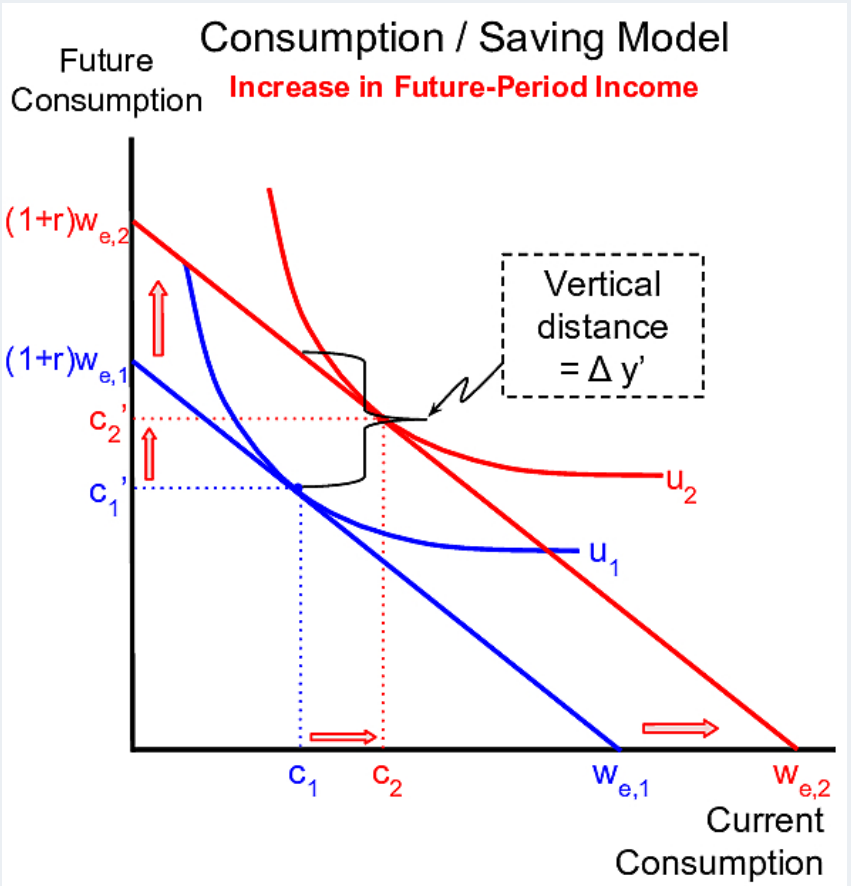
# Increase in Expected Future Income



## Increase Expected Future Income

- Suppose income increases in the future period ($\uparrow y'$), but no change in the current period (i.e. no change in $y$)
- Budget shifts outward, vertical distance equal to the change in $y'$
- Consumption smoothing: Both $c$ and $c'$ increase
- Savings decreases: $s = y - t - c$, $c \uparrow$, but no change in $y$

## Graphical Utility Maximization



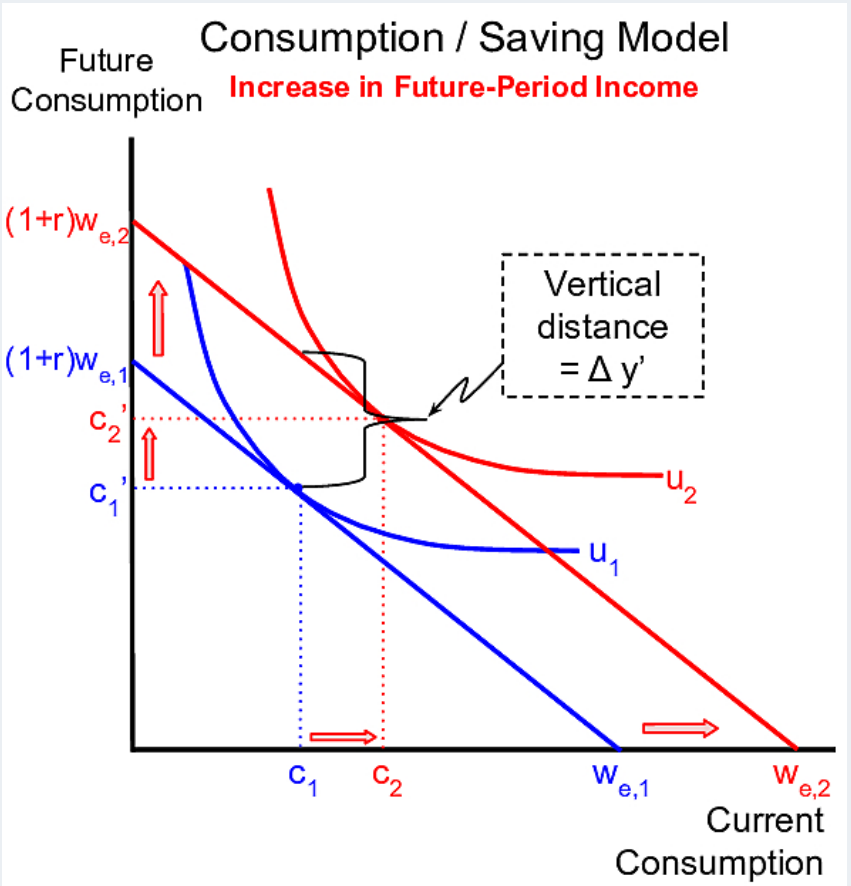
# Increase in Expected Future Income



## Increase Expected Future Income

- Suppose income increases in the future period ($\uparrow y'$), but no change in the current period (i.e. no change in $y$)
- Budget shifts outward, vertical distance equal to the change in $y'$
- Consumption smoothing: Both $c$ and $c'$ increase
- Savings decreases: $s = y - t - c$, $c \uparrow$, but no change in $y$

## Graphical Utility Maximization



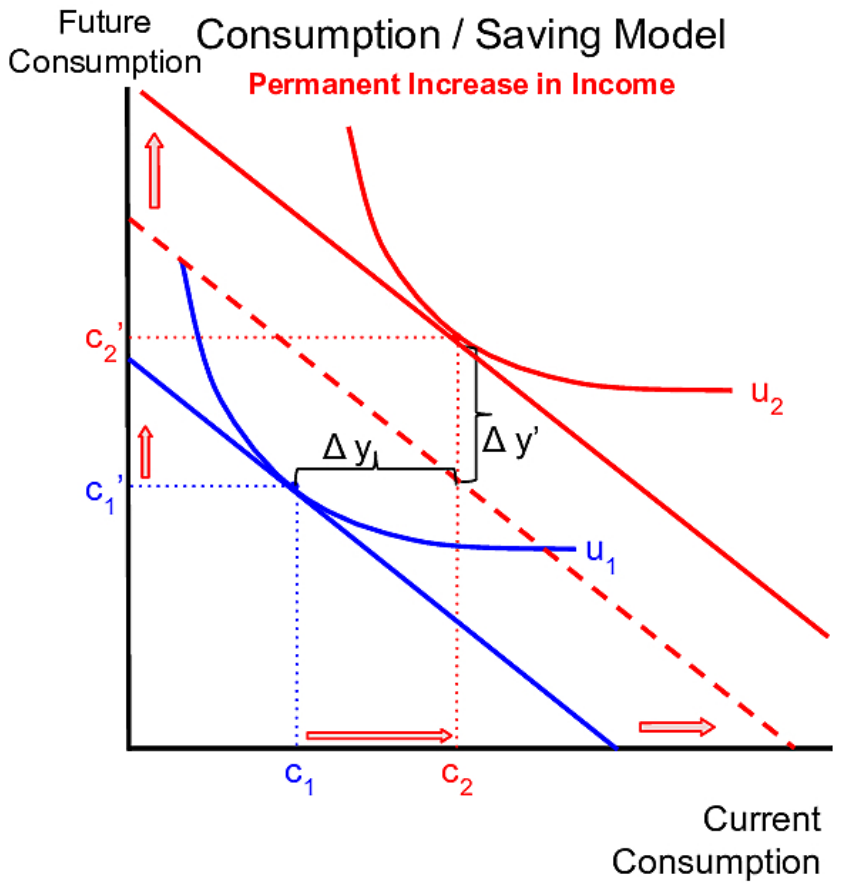
# Permanent Increase in Income



## Permanent Increase in Income

- Suppose income increases in the current and future period by the same amount ($\Delta y = \Delta y'$)
- Budget shifts outward, twice.
- Horizontal distance $= \Delta y$, vertical distance $= \Delta y'$
- No consumption smoothing: Both $c$ and $c'$ increase by full $\Delta y = \Delta y'$
- No change in savings: All increase in income goes to consumption

## Graphical Utility Maximization



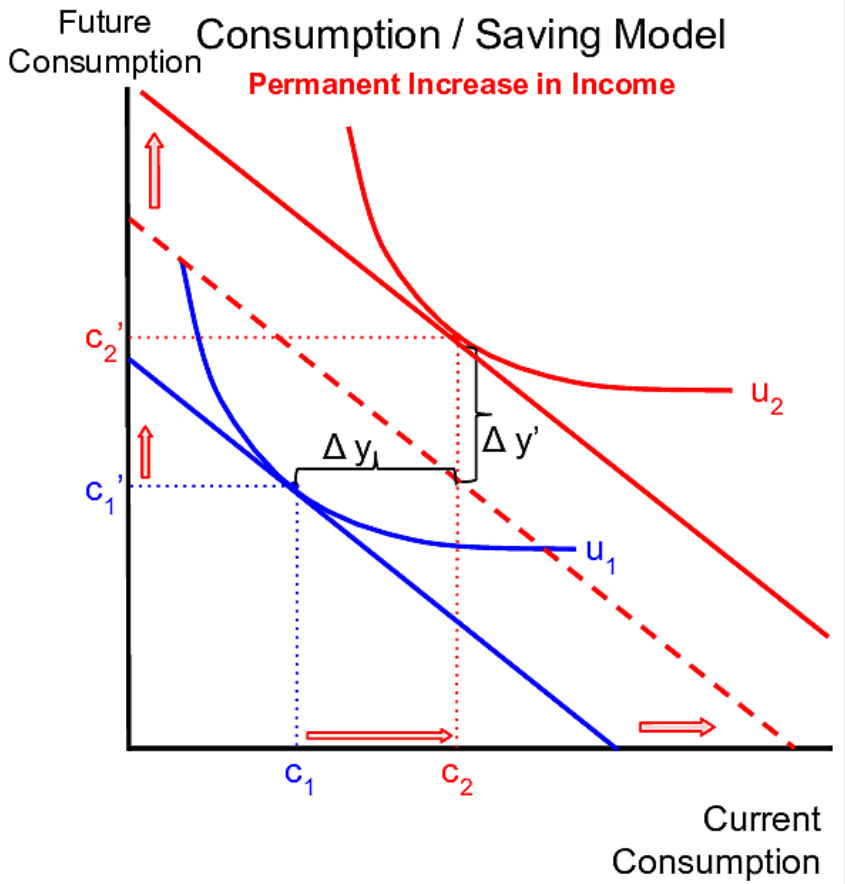
# Permanent Increase in Income



## Permanent Increase in Income

- Suppose income increases in the current and future period by the same amount ($\Delta y = \Delta y'$)
- Budget shifts outward, twice.
- Horizontal distance $= \Delta y$, vertical distance $= \Delta y'$
- No consumption smoothing: Both $c$ and $c'$ increase by full $\Delta y = \Delta y'$
- No change in savings: All increase in income goes to consumption

## Graphical Utility Maximization



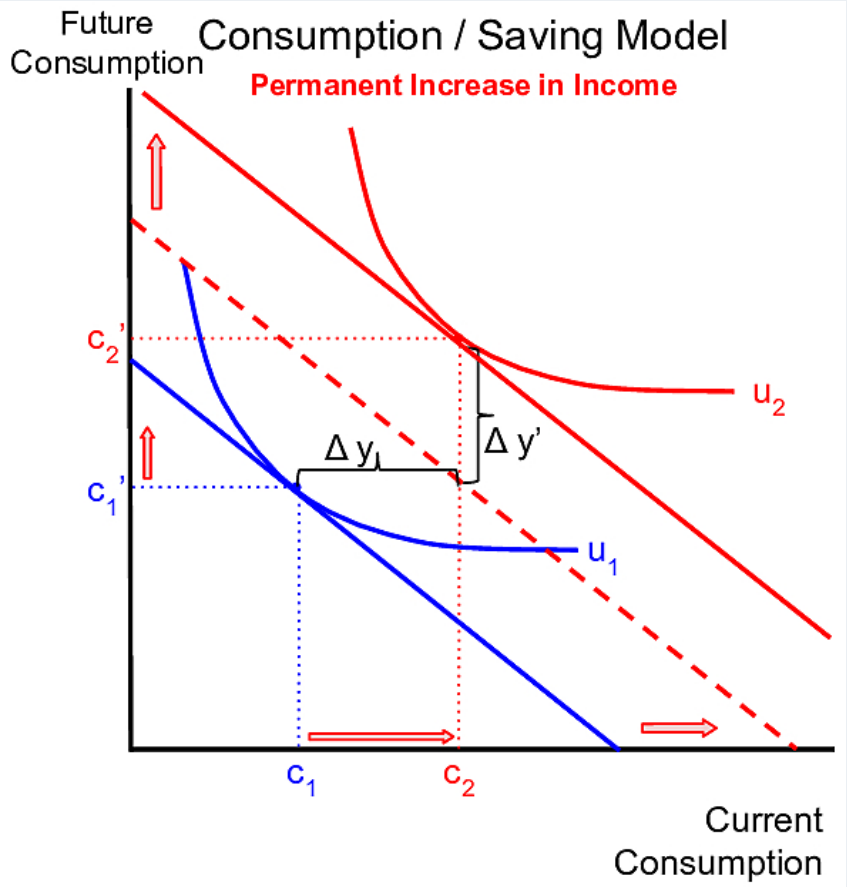
# Permanent Increase in Income



## Permanent Increase in Income

- Suppose income increases in the current and future period by the same amount ($\Delta y = \Delta y'$)
- Budget shifts outward, twice.
- Horizontal distance $= \Delta y$, vertical distance $= \Delta y'$
- No consumption smoothing: Both $c$ and $c'$ increase by full $\Delta y = \Delta y'$
- No change in savings: All increase in income goes to consumption

## Graphical Utility Maximization



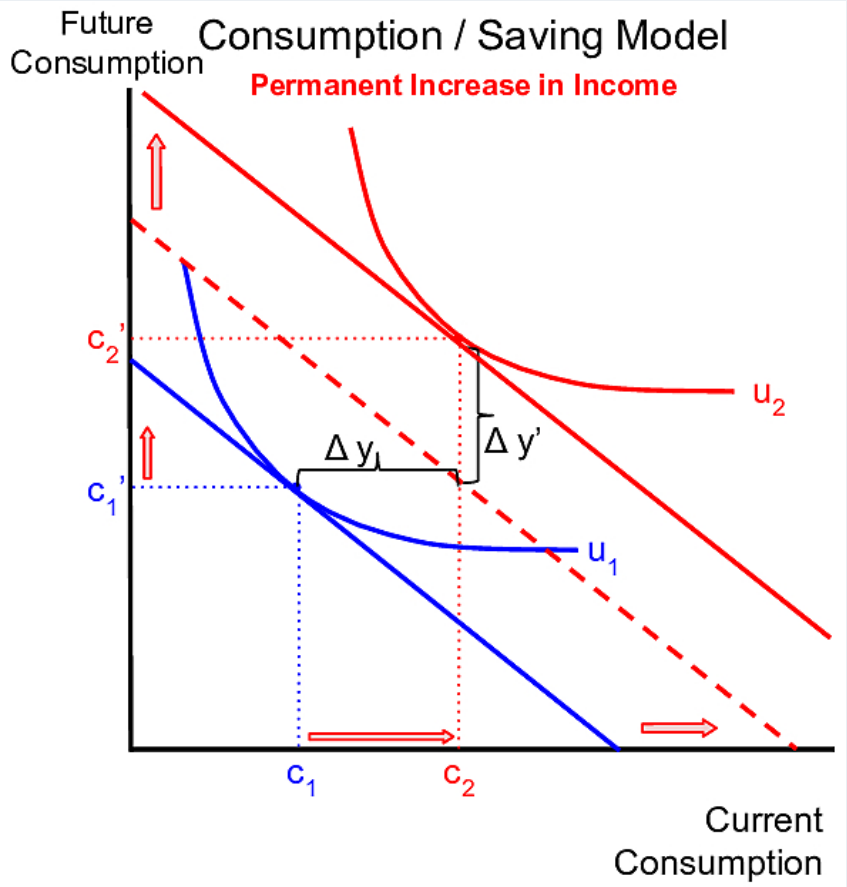
# Permanent Increase in Income



## Permanent Increase in Income

- Suppose income increases in the current and future period by the same amount ($\Delta y = \Delta y'$)
- Budget shifts outward, twice.
- Horizontal distance $= \Delta y$, vertical distance $= \Delta y'$
- No consumption smoothing: Both $c$ and $c'$ increase by full $\Delta y = \Delta y'$
- No change in savings: All increase in income goes to consumption

## Graphical Utility Maximization



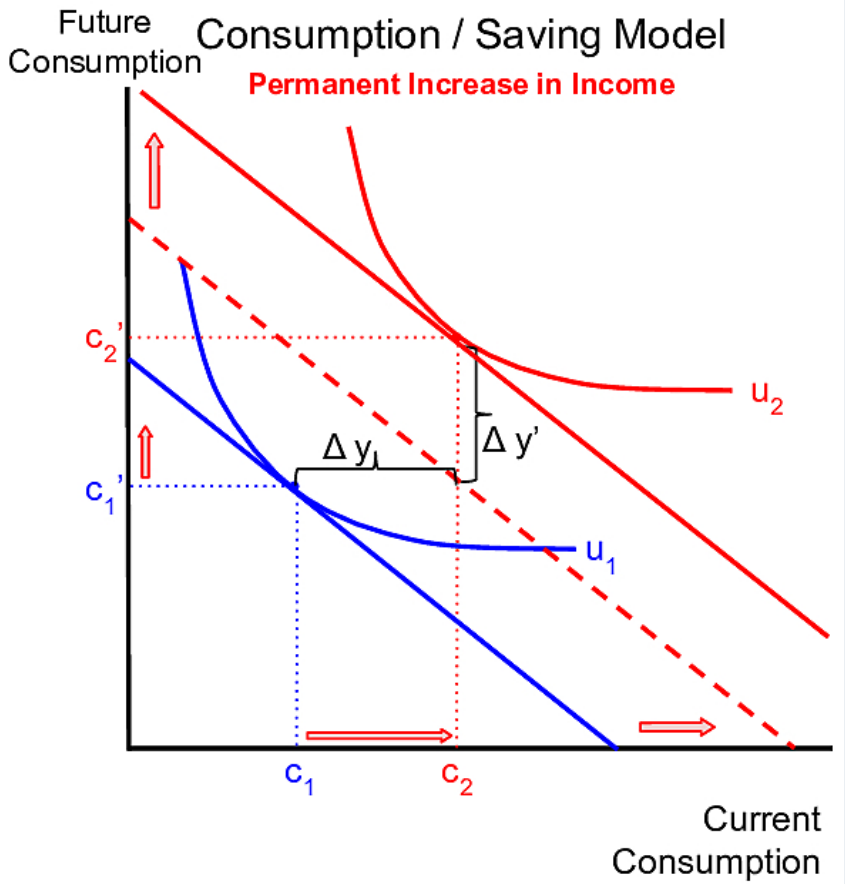
# Permanent Increase in Income



## Permanent Increase in Income

- Suppose income increases in the current and future period by the same amount ($\Delta y = \Delta y'$)
- Budget shifts outward, twice.
- Horizontal distance $= \Delta y$, vertical distance $= \Delta y'$
- No consumption smoothing: Both $c$ and $c'$ increase by full $\Delta y = \Delta y'$
- No change in savings: All increase in income goes to consumption

## Graphical Utility Maximization



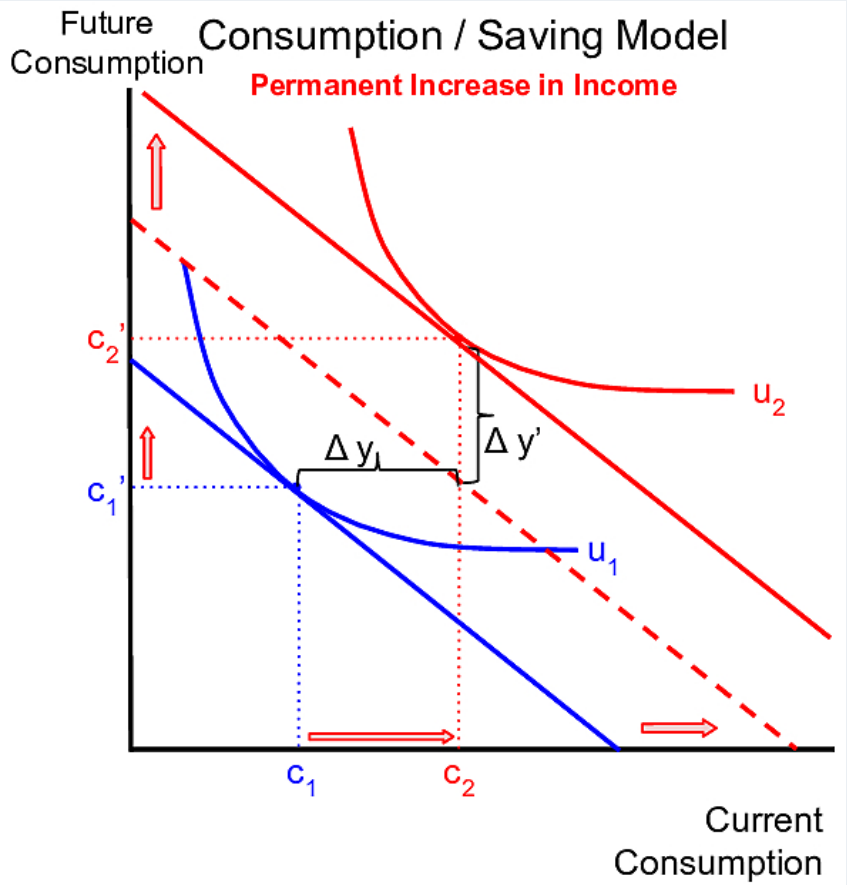
# Permanent Increase in Income



## Permanent Increase in Income

- Suppose income increases in the current and future period by the same amount ($\Delta y = \Delta y'$)
- Budget shifts outward, twice.
- Horizontal distance $= \Delta y$, vertical distance $= \Delta y'$
- No consumption smoothing: Both $c$ and $c'$ increase by full $\Delta y = \Delta y'$
- No change in savings: All increase in income goes to consumption

## Graphical Utility Maximization



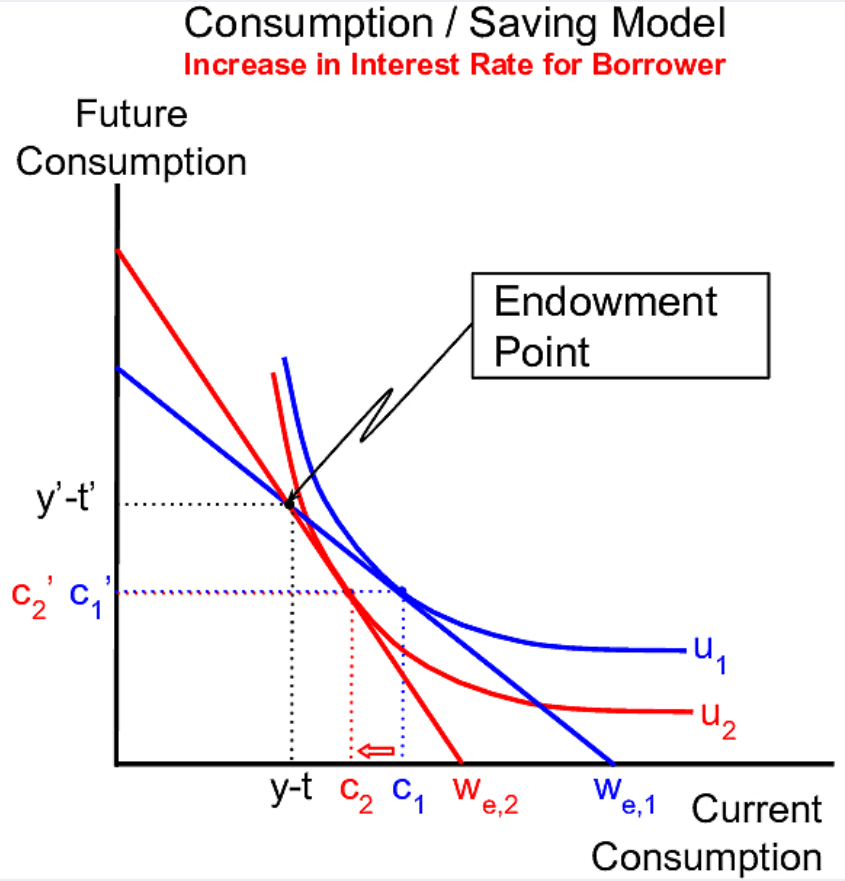
# Increase in Interest Rate on Borrowers



## Increase in Interest Rate

- Causes a pivot in the budget constraint at the endowment point
- Substitution effect: Current consumption more expensive, $\downarrow c, \uparrow c'$
- *Negative* income effect for borrowers: $\downarrow c, \downarrow c'$
- Current consumption decreases
- Indeterminate impact on future consumption
- Saving increases (i.e. borrowing decreases)

## Graphical Utility Maximization



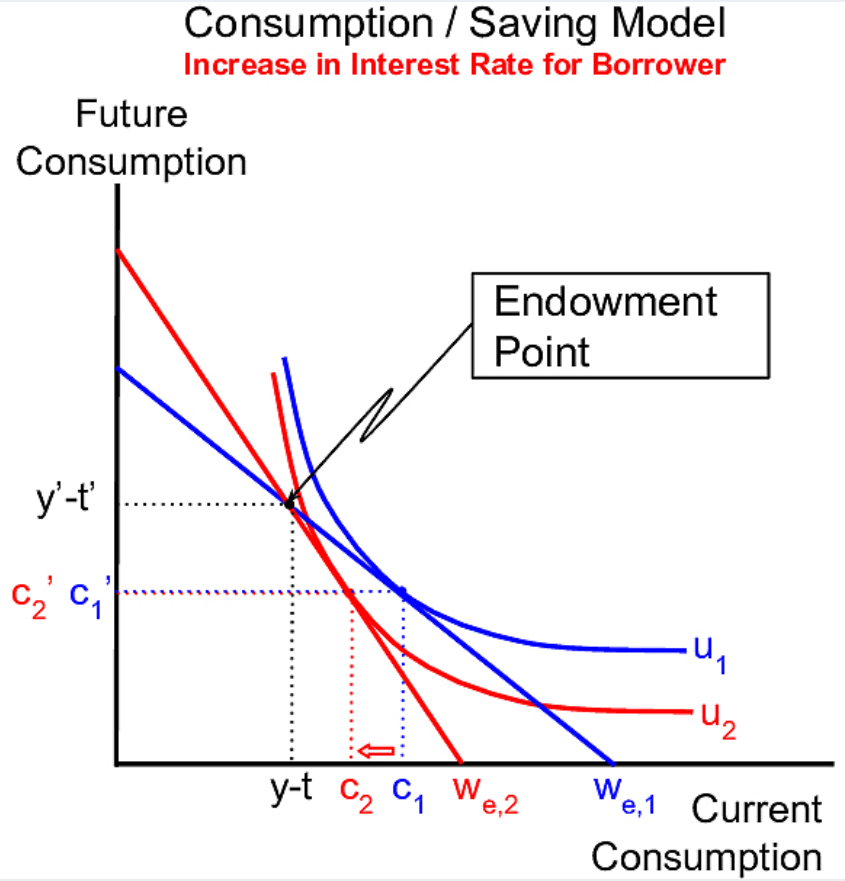
# Increase in Interest Rate on Borrowers



## Increase in Interest Rate

- Causes a pivot in the budget constraint at the endowment point
- Substitution effect: Current consumption more expensive, $\downarrow c, \uparrow c'$
- *Negative* income effect for borrowers: $\downarrow c, \downarrow c'$
- Current consumption decreases
- Indeterminate impact on future consumption
- Saving increases (i.e. borrowing decreases)

## Graphical Utility Maximization



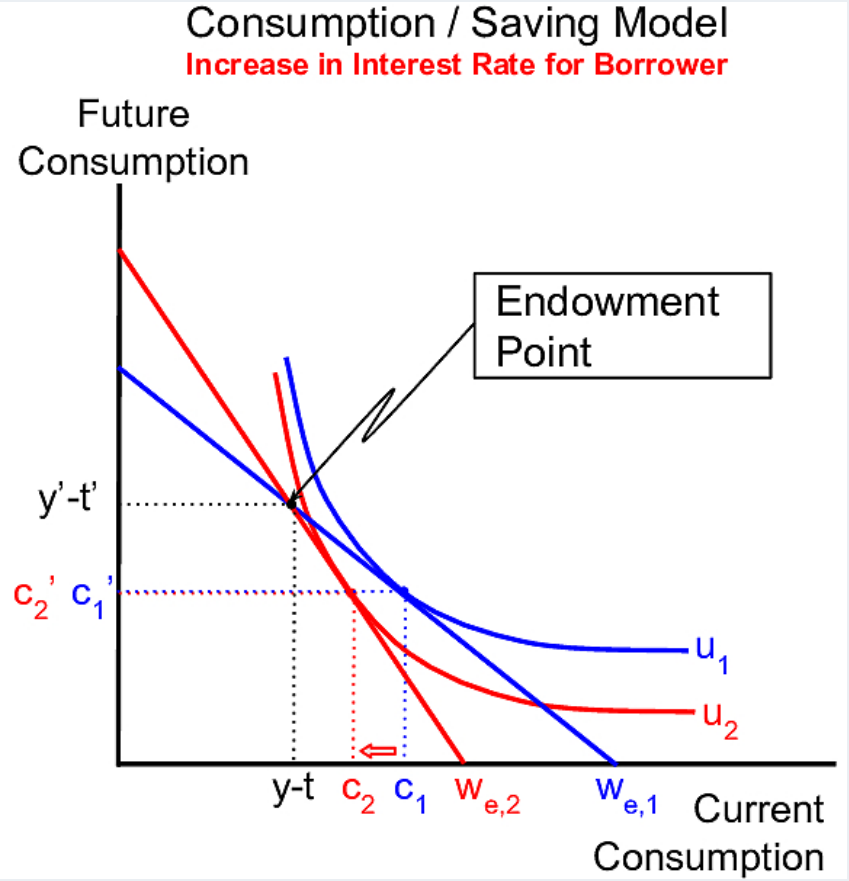
# Increase in Interest Rate on Borrowers



## Increase in Interest Rate

- Causes a pivot in the budget constraint at the endowment point
- Substitution effect: Current consumption more expensive, $\downarrow c, \uparrow c'$
- *Negative* income effect for borrowers: $\downarrow c, \downarrow c'$
- Current consumption decreases
- Indeterminate impact on future consumption
- Saving increases (i.e. borrowing decreases)

## Graphical Utility Maximization



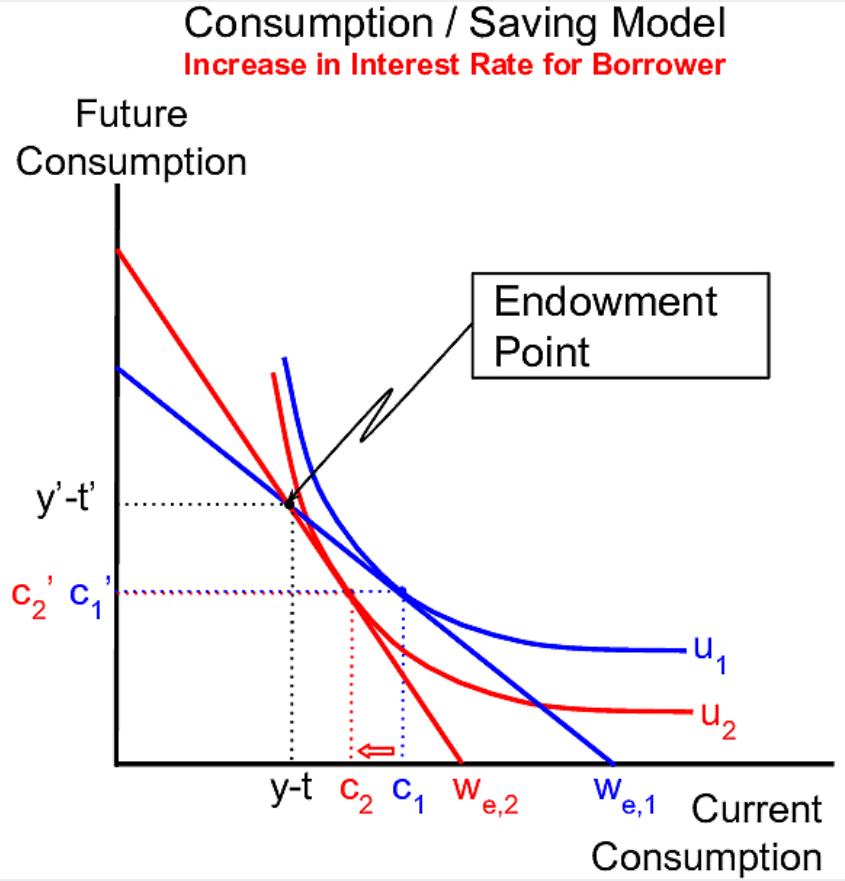
# Increase in Interest Rate on Borrowers



## Increase in Interest Rate

- Causes a pivot in the budget constraint at the endowment point
- Substitution effect: Current consumption more expensive, $\downarrow c, \uparrow c'$
- *Negative* income effect for borrowers: $\downarrow c, \downarrow c'$
- Current consumption decreases
- Indeterminate impact on future consumption
- Saving increases (i.e. borrowing decreases)

## Graphical Utility Maximization



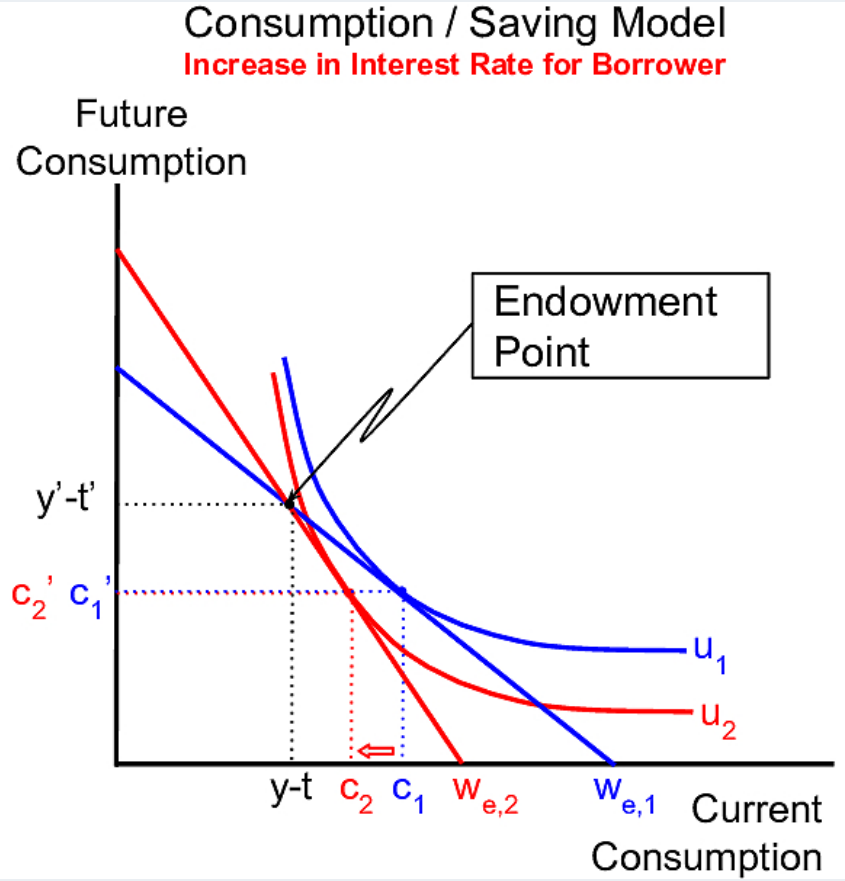
# Increase in Interest Rate on Borrowers



## Increase in Interest Rate

- Causes a pivot in the budget constraint at the endowment point
- Substitution effect: Current consumption more expensive, $\downarrow c, \uparrow c'$
- *Negative* income effect for borrowers: $\downarrow c, \downarrow c'$
- Current consumption decreases
- Indeterminate impact on future consumption
- Saving increases (i.e. borrowing decreases)

## Graphical Utility Maximization



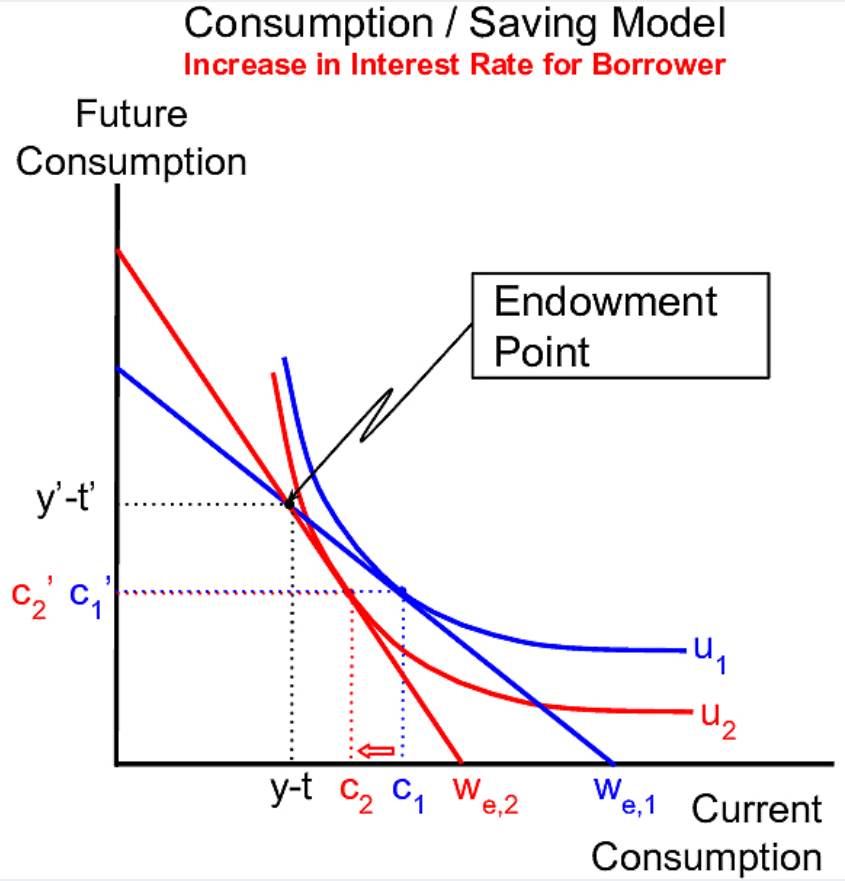
# Increase in Interest Rate on Borrowers



## Increase in Interest Rate

- Causes a pivot in the budget constraint at the endowment point
- Substitution effect: Current consumption more expensive, $\downarrow c, \uparrow c'$
- *Negative* income effect for borrowers: $\downarrow c, \downarrow c'$
- Current consumption decreases
- Indeterminate impact on future consumption
- Saving increases (i.e. borrowing decreases)

## Graphical Utility Maximization



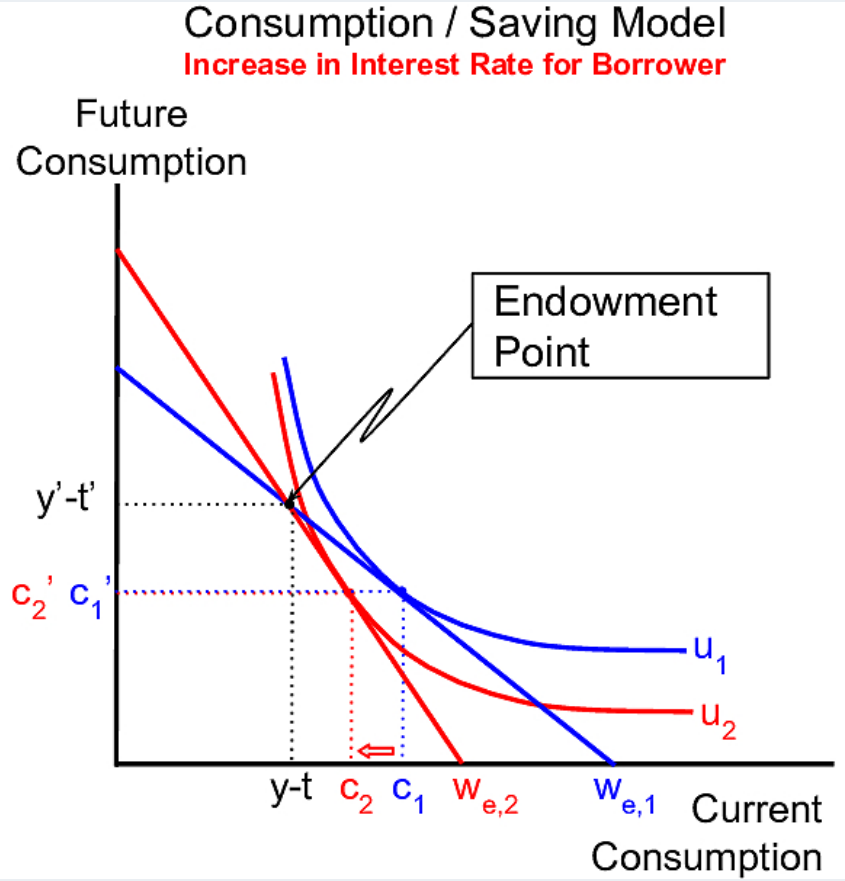
# Increase in Interest Rate on Borrowers



## Increase in Interest Rate

- Causes a pivot in the budget constraint at the endowment point
- Substitution effect: Current consumption more expensive, $\downarrow c, \uparrow c'$
- *Negative* income effect for borrowers: $\downarrow c, \downarrow c'$
- Current consumption decreases
- Indeterminate impact on future consumption
- Saving increases (i.e. borrowing decreases)

## Graphical Utility Maximization



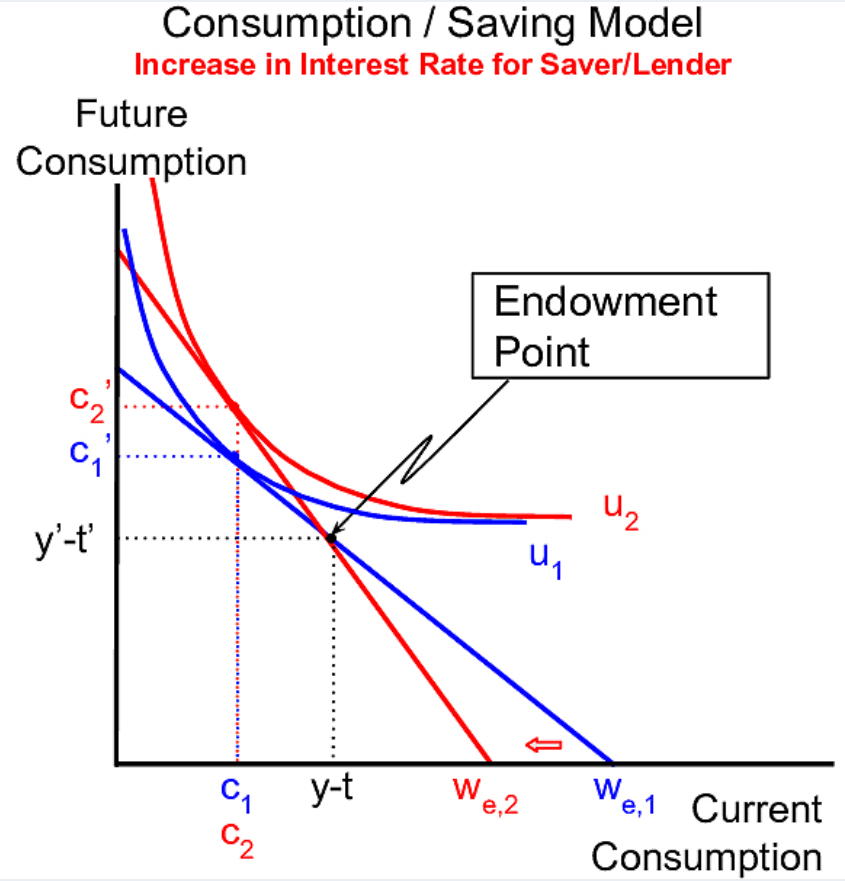
# Increase in Interest Rate on Savers



## Increase in Interest Rate

- Causes a pivot in the budget constraint at the endowment point
- Substitution effect same: Current consumption more expensive, $\downarrow c, \uparrow c'$
- *Positive* income effect for borrowers: $\uparrow c, \uparrow c'$
- Indeterminate impact on current consumption
- Future consumption increases
- Saving is indeterminate

## Graphical Utility Maximization



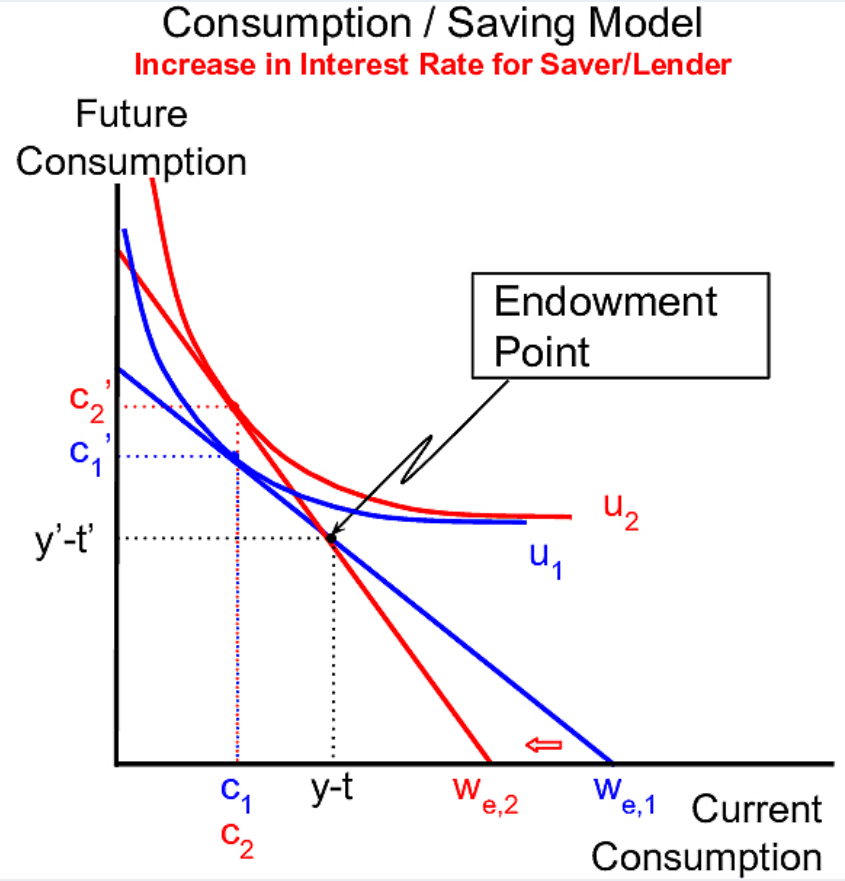
# Increase in Interest Rate on Savers



## Increase in Interest Rate

- Causes a pivot in the budget constraint at the endowment point
- Substitution effect same: Current consumption more expensive, $\downarrow c, \uparrow c'$
- *Positive* income effect for borrowers: $\uparrow c, \uparrow c'$
- Indeterminate impact on current consumption
- Future consumption increases
- Saving is indeterminate

## Graphical Utility Maximization



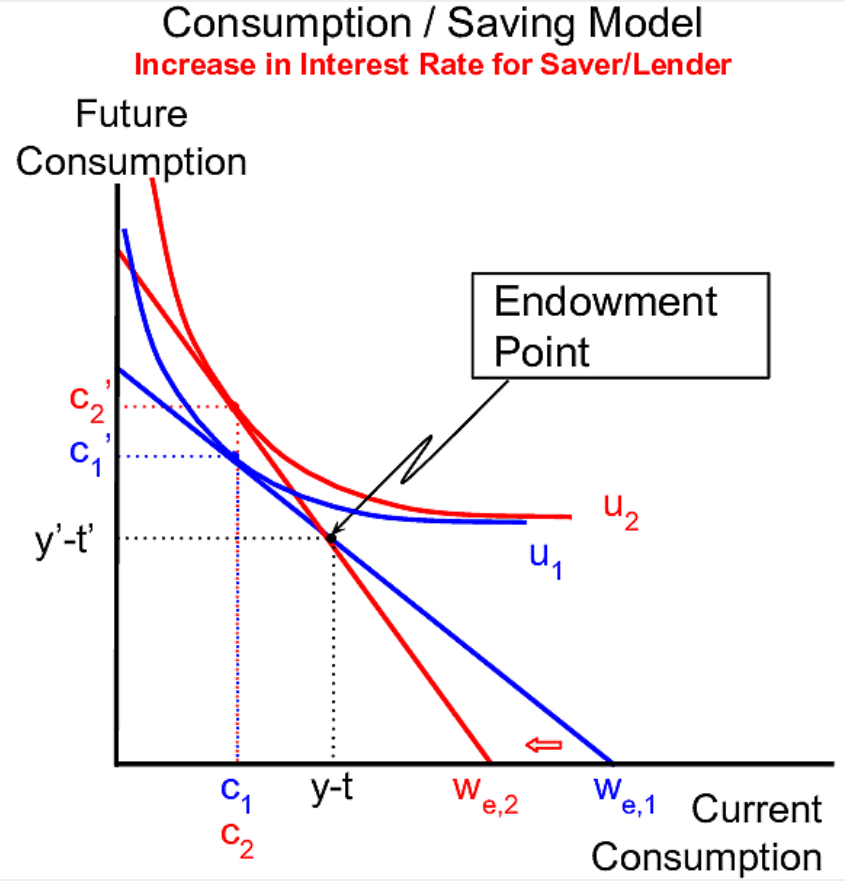
# Increase in Interest Rate on Savers



## Increase in Interest Rate

- Causes a pivot in the budget constraint at the endowment point
- Substitution effect same: Current consumption more expensive, $\downarrow c$, $\uparrow c'$
- *Positive* income effect for borrowers: $\uparrow c$, $\uparrow c'$
- Indeterminate impact on current consumption
- Future consumption increases
- Saving is indeterminate

## Graphical Utility Maximization



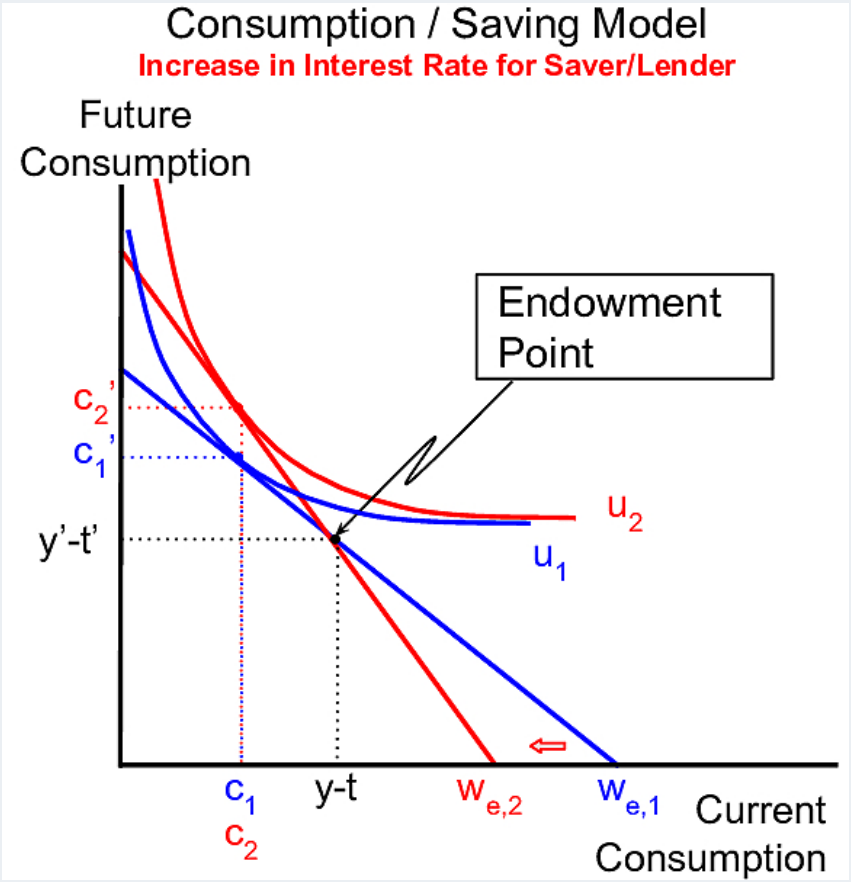
# Increase in Interest Rate on Savers



## Increase in Interest Rate

- Causes a pivot in the budget constraint at the endowment point
- Substitution effect same: Current consumption more expensive, $\downarrow c$, $\uparrow c'$
- *Positive* income effect for borrowers: $\uparrow c$, $\uparrow c'$
- Indeterminate impact on current consumption
- Future consumption increases
- Saving is indeterminate

## Graphical Utility Maximization



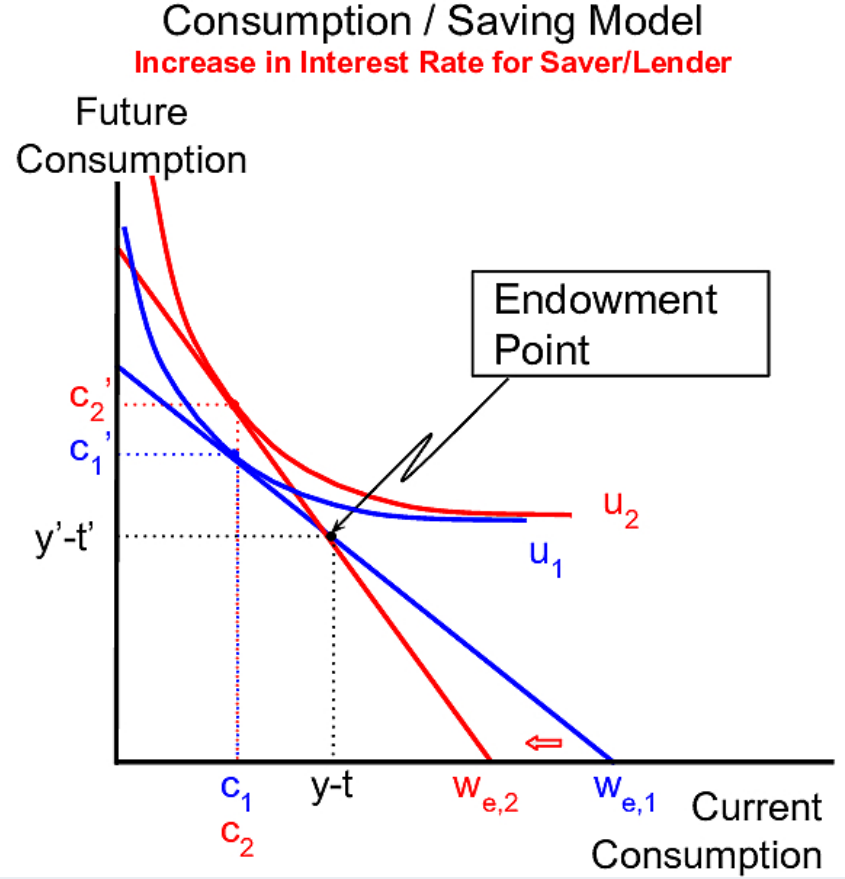
# Increase in Interest Rate on Savers



## Increase in Interest Rate

- Causes a pivot in the budget constraint at the endowment point
- Substitution effect same: Current consumption more expensive, $\downarrow c$, $\uparrow c'$
- *Positive* income effect for borrowers: $\uparrow c$, $\uparrow c'$
- Indeterminate impact on current consumption
- Future consumption increases
- Saving is indeterminate

## Graphical Utility Maximization



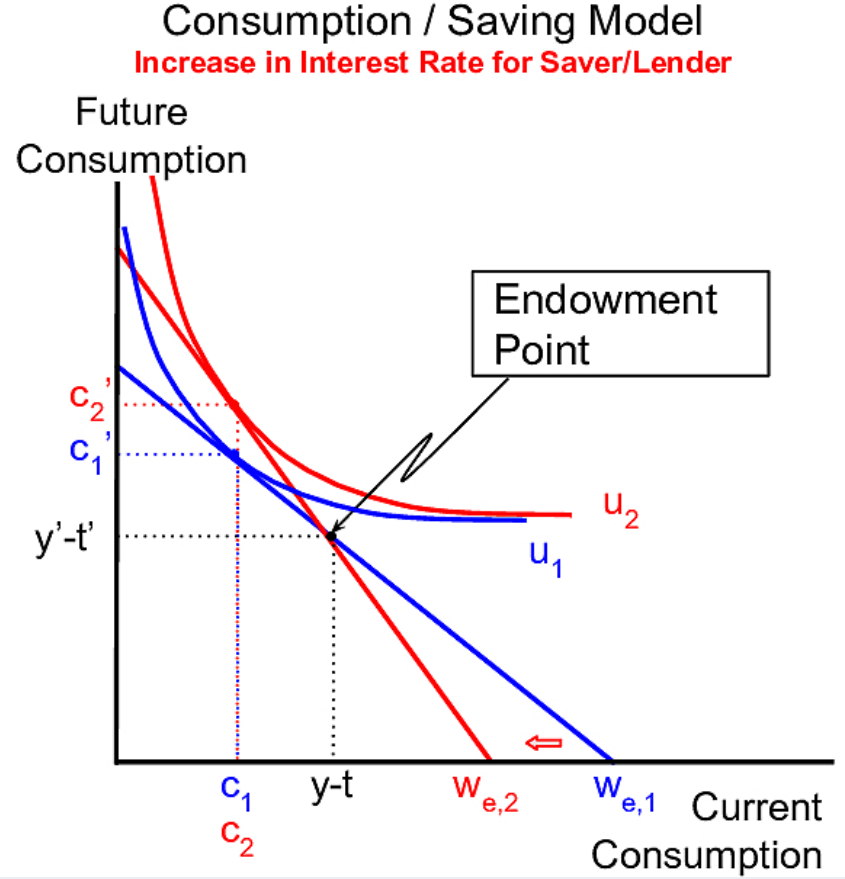
# Increase in Interest Rate on Savers



## Increase in Interest Rate

- Causes a pivot in the budget constraint at the endowment point
- Substitution effect same: Current consumption more expensive, $\downarrow c$, $\uparrow c'$
- *Positive* income effect for borrowers: $\uparrow c$, $\uparrow c'$
- Indeterminate impact on current consumption
- Future consumption increases
- Saving is indeterminate

## Graphical Utility Maximization



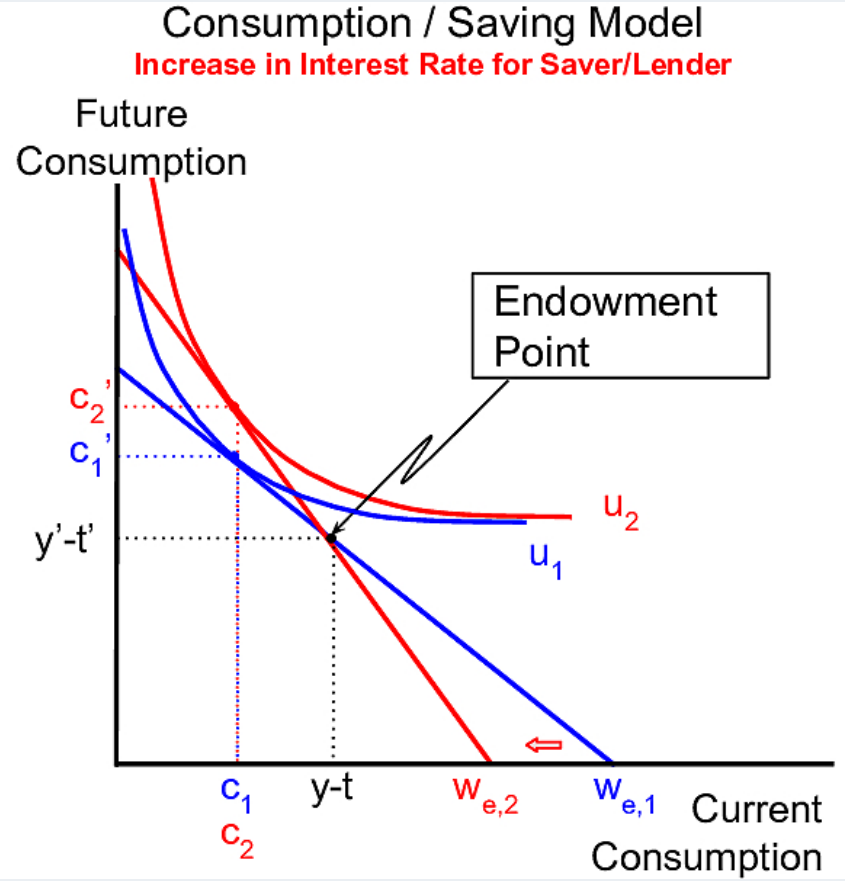
# Increase in Interest Rate on Savers



## Increase in Interest Rate

- Causes a pivot in the budget constraint at the endowment point
- Substitution effect same: Current consumption more expensive, $\downarrow c$, $\uparrow c'$
- *Positive* income effect for borrowers: $\uparrow c$, $\uparrow c'$
- Indeterminate impact on current consumption
- Future consumption increases
- Saving is indeterminate

## Graphical Utility Maximization



# Government Budget Constraint



## Budget Constraints

- Current period:

$$g = t + b$$

- Future period:

$$g' + (1 + r)b = t'$$

- $b$: government borrowing
- Combining:

$$g + \frac{g'}{1+r} = t + \frac{t'}{1+r}$$

## Implications

- Cannot change *only one fiscal variable*, $g$, $g'$, $t$, $t'$
- Recall consumer budget:

$$c + \frac{c'}{1+r} = y - t + \frac{y' - t'}{1+r}$$

$$c + \frac{c'}{1+r} = y + \frac{y'}{1+r} - \left( t + \frac{t'}{1+r} \right)$$

# Government Budget Constraint



## Budget Constraints

- Current period:

$$g = t + b$$

- Future period:

$$g' + (1 + r)b = t'$$

- $b$: government borrowing
- Combining:

$$g + \frac{g'}{1+r} = t + \frac{t'}{1+r}$$

## Implications

- Cannot change *only one fiscal variable*, $g$, $g'$, $t$, $t'$
- Recall consumer budget:

$$c + \frac{c'}{1+r} = y - t + \frac{y' - t'}{1+r}$$

$$c + \frac{c'}{1+r} = y + \frac{y'}{1+r} - \left( t + \frac{t'}{1+r} \right)$$

# Government Budget Constraint



## Budget Constraints

- Current period:

$$g = t + b$$

- Future period:

$$g' + (1 + r)b = t'$$

- $b$: government borrowing
- Combining:

$$g + \frac{g'}{1+r} = t + \frac{t'}{1+r}$$

## Implications

- Cannot change *only one fiscal variable*, $g$, $g'$, $t$, $t'$
- Recall consumer budget:

$$c + \frac{c'}{1+r} = y - t + \frac{y' - t'}{1+r}$$

$$c + \frac{c'}{1+r} = y + \frac{y'}{1+r} - \left( t + \frac{t'}{1+r} \right)$$

# Government Budget Constraint



## Budget Constraints

- Current period:

$$g = t + b$$

- Future period:

$$g' + (1 + r)b = t'$$

- $b$: government borrowing
- Combining:

$$g + \frac{g'}{1+r} = t + \frac{t'}{1+r}$$

## Implications

- Cannot change *only one fiscal variable*, $g$, $g'$, $t$, $t'$
- Recall consumer budget:

$$c + \frac{c'}{1+r} = y - t + \frac{y' - t'}{1+r}$$

$$c + \frac{c'}{1+r} = y + \frac{y'}{1+r} - \left( t + \frac{t'}{1+r} \right)$$

# Government Budget Constraint



## Budget Constraints

- Current period:

$$g = t + b$$

- Future period:

$$g' + (1 + r)b = t'$$

- $b$: government borrowing
- Combining:

$$g + \frac{g'}{1+r} = t + \frac{t'}{1+r}$$

## Implications

- Cannot change *only one fiscal variable*, $g$, $g'$, $t$, $t'$
- Recall consumer budget:

$$c + \frac{c'}{1+r} = y - t + \frac{y' - t'}{1+r}$$

$$c + \frac{c'}{1+r} = y + \frac{y'}{1+r} - \left( t + \frac{t'}{1+r} \right)$$

# Government Budget Constraint



## Budget Constraints

- Current period:

$$g = t + b$$

- Future period:

$$g' + (1 + r)b = t'$$

- $b$: government borrowing
- Combining:

$$g + \frac{g'}{1+r} = t + \frac{t'}{1+r}$$

## Implications

- Cannot change *only one fiscal variable*, $g$, $g'$, $t$, $t'$
- Recall consumer budget:

$$c + \frac{c'}{1+r} = y - t + \frac{y' - t'}{1+r}$$

$$c + \frac{c'}{1+r} = y + \frac{y'}{1+r} - \left( t + \frac{t'}{1+r} \right)$$

# Government Budget Constraint



## Budget Constraints

- Current period:

$$g = t + b$$

- Future period:

$$g' + (1 + r)b = t'$$

- $b$: government borrowing
- Combining:

$$g + \frac{g'}{1+r} = t + \frac{t'}{1+r}$$

## Implications

- Cannot change *only one fiscal variable*, $g$, $g'$, $t$, $t'$
- Recall consumer budget:

$$c + \frac{c'}{1+r} = y - t + \frac{y' - t'}{1+r}$$

$$c + \frac{c'}{1+r} = y + \frac{y'}{1+r} - \left( t + \frac{t'}{1+r} \right)$$

# Government Budget Constraint



## Budget Constraints

- Current period:

$$g = t + b$$

- Future period:

$$g' + (1 + r)b = t'$$

- $b$: government borrowing
- Combining:

$$g + \frac{g'}{1+r} = t + \frac{t'}{1+r}$$

## Implications

- Cannot change *only one fiscal variable*, $g$, $g'$, $t$, $t'$
- Recall consumer budget:

$$c + \frac{c'}{1+r} = y - t + \frac{y' - t'}{1+r}$$

$$c + \frac{c'}{1+r} = y + \frac{y'}{1+r} - \left( t + \frac{t'}{1+r} \right)$$

# Government Budget Constraint



## Budget Constraints

- Current period:

$$g = t + b$$

- Future period:

$$g' + (1 + r)b = t'$$

- $b$: government borrowing
- Combining:

$$g + \frac{g'}{1+r} = t + \frac{t'}{1+r}$$

## Implications

- Cannot change *only one fiscal variable*, $g$, $g'$, $t$, $t'$
- Recall consumer budget:

$$c + \frac{c'}{1+r} = y - t + \frac{y' - t'}{1+r}$$

$$\begin{aligned} c + \frac{c'}{1+r} &= y + \frac{y'}{1+r} \\ &\quad - \left( t + \frac{t'}{1+r} \right) \end{aligned}$$

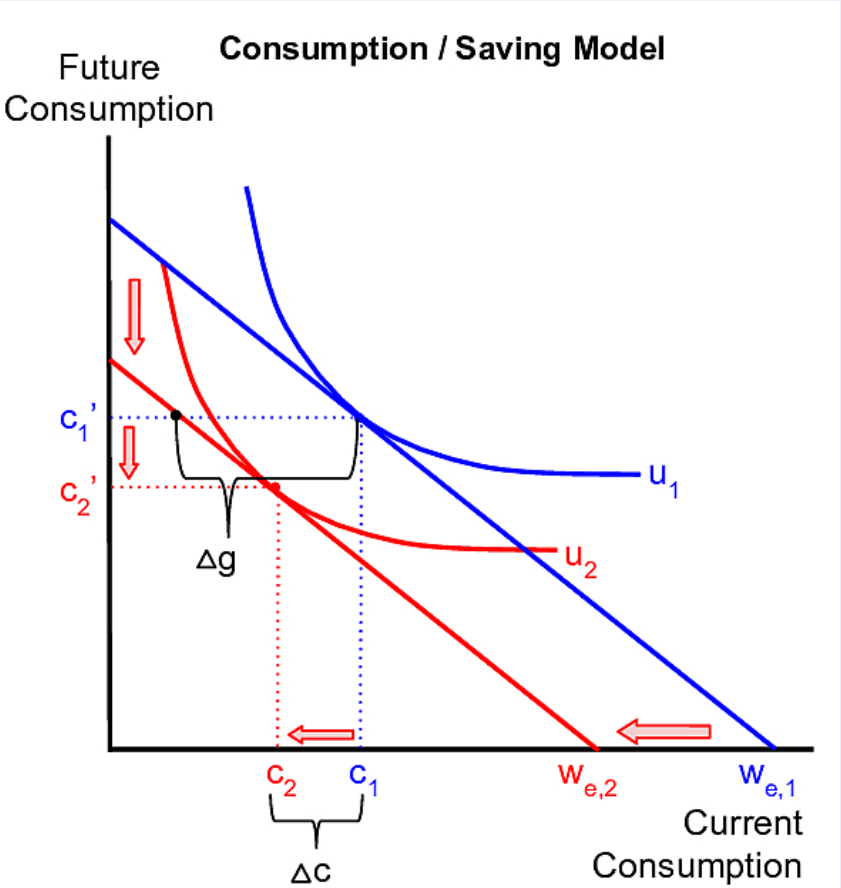
# Increase in Current Government Expenditures



## Scenario

- Suppose government increases spending, with no change in taxes
- Without a credible announcement on change in future spending, people may assume financed with increase in future taxes
- Budget shifts inward, horizontal distance $= \Delta g$
- Consumption smoothing: Both $c$ and $c'$ decrease
- Increase in real GDP, since $\Delta g > -\Delta c$

## Graphical Utility Maximization



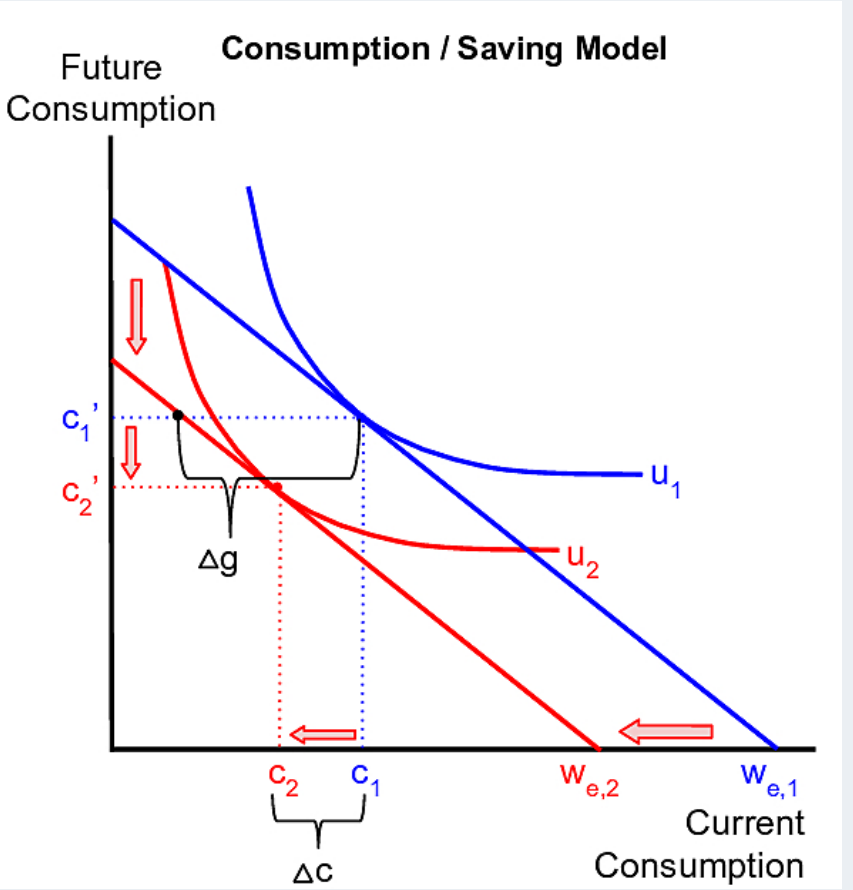
# Increase in Current Government Expenditures



## Scenario

- Suppose government increases spending, with no change in taxes
- Without a credible announcement on change in future spending, people may assume financed with increase in future taxes
- Budget shifts inward, horizontal distance $= \Delta g$
- Consumption smoothing: Both $c$ and $c'$ decrease
- Increase in real GDP, since $\Delta g > -\Delta c$

## Graphical Utility Maximization



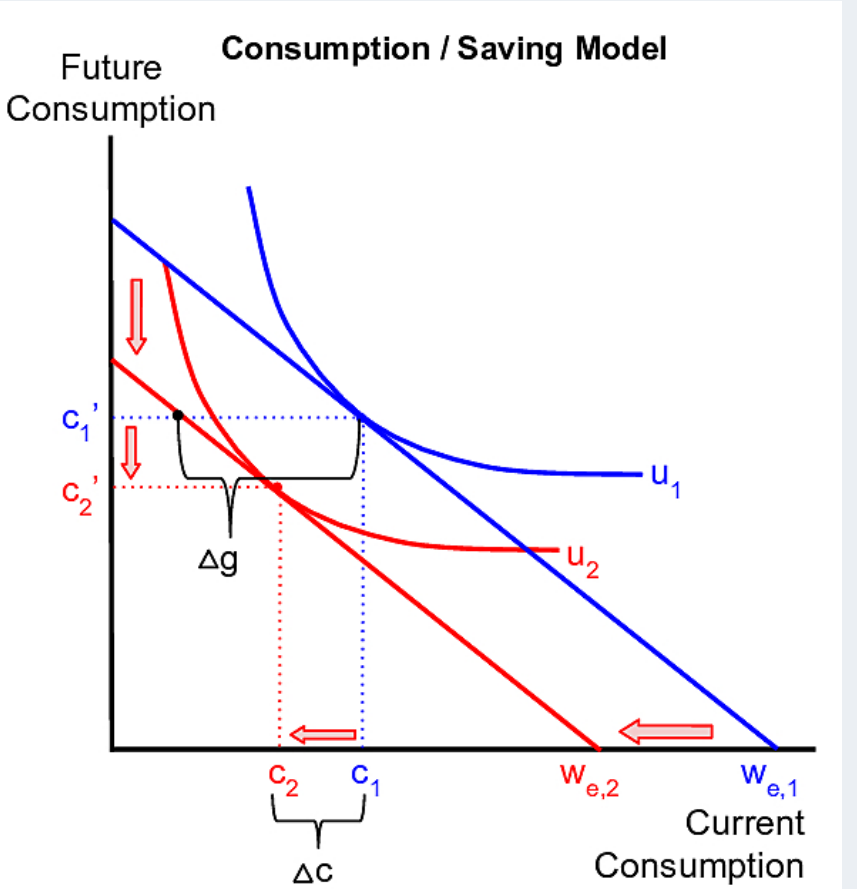
# Increase in Current Government Expenditures



## Scenario

- Suppose government increases spending, with no change in taxes
- Without a credible announcement on change in future spending, people may assume financed with increase in future taxes
- Budget shifts inward, horizontal distance $= \Delta g$
- Consumption smoothing: Both $c$ and $c'$ decrease
- Increase in real GDP, since $\Delta g > -\Delta c$

## Graphical Utility Maximization



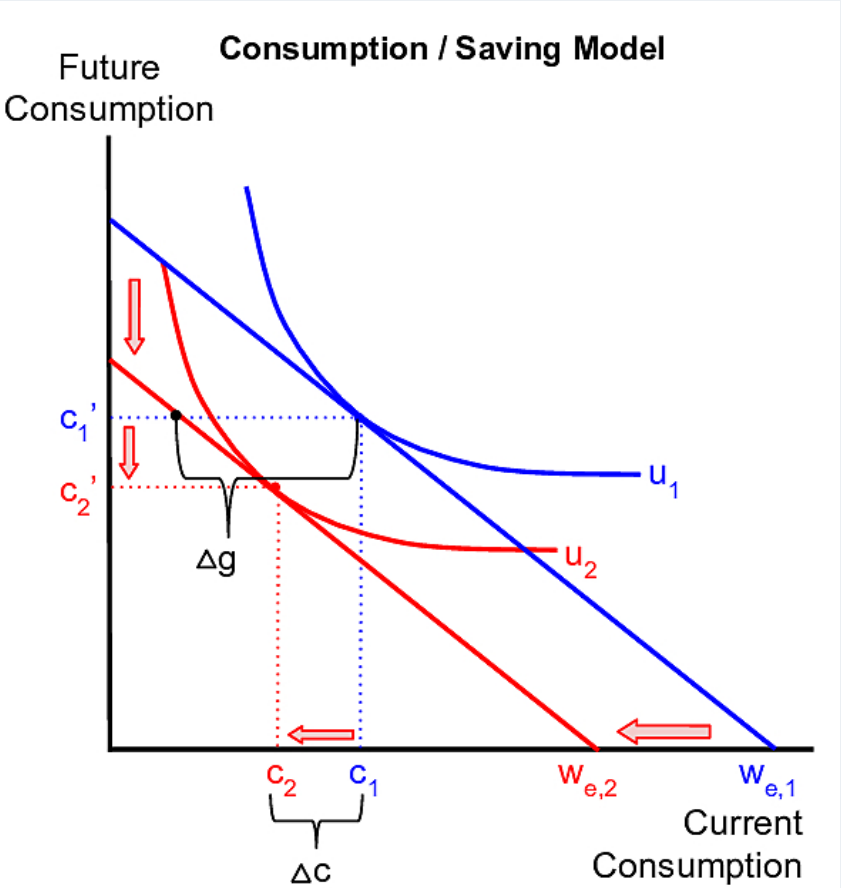
# Increase in Current Government Expenditures



## Scenario

- Suppose government increases spending, with no change in taxes
- Without a credible announcement on change in future spending, people may assume financed with increase in future taxes
- Budget shifts inward, horizontal distance $= \Delta g$
- Consumption smoothing: Both $c$ and $c'$ decrease
- Increase in real GDP, since $\Delta g > -\Delta c$

## Graphical Utility Maximization



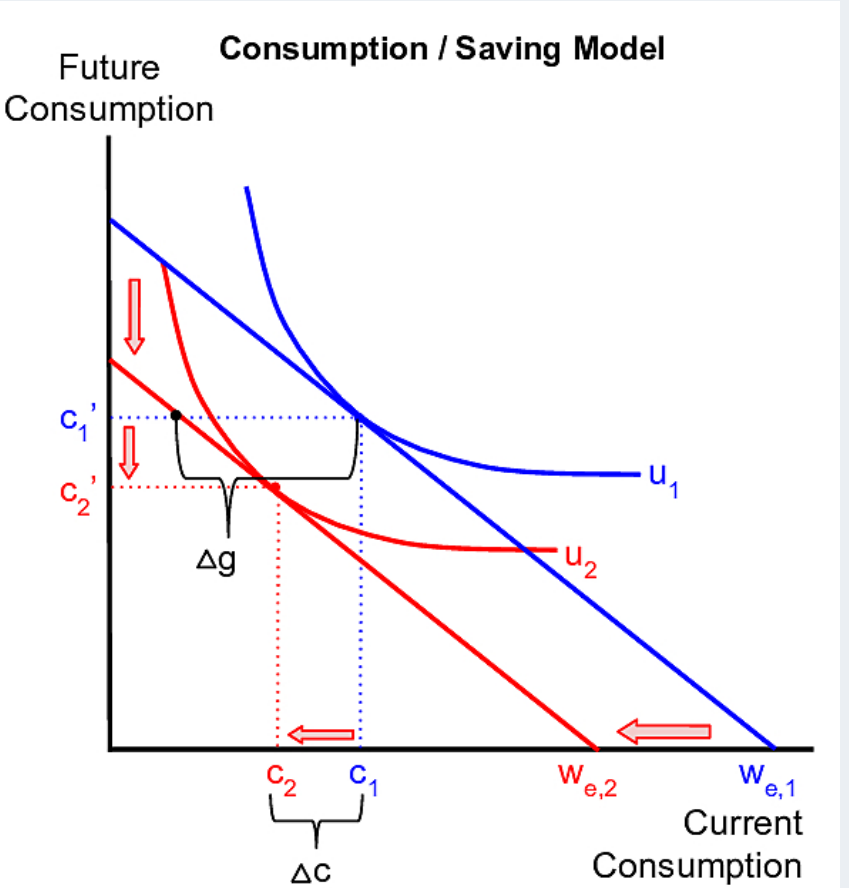
# Increase in Current Government Expenditures



## Scenario

- Suppose government increases spending, with no change in taxes
- Without a credible announcement on change in future spending, people may assume financed with increase in future taxes
- Budget shifts inward, horizontal distance $= \Delta g$
- Consumption smoothing: Both $c$ and $c'$ decrease
- Increase in real GDP, since $\Delta g > -\Delta c$

## Graphical Utility Maximization



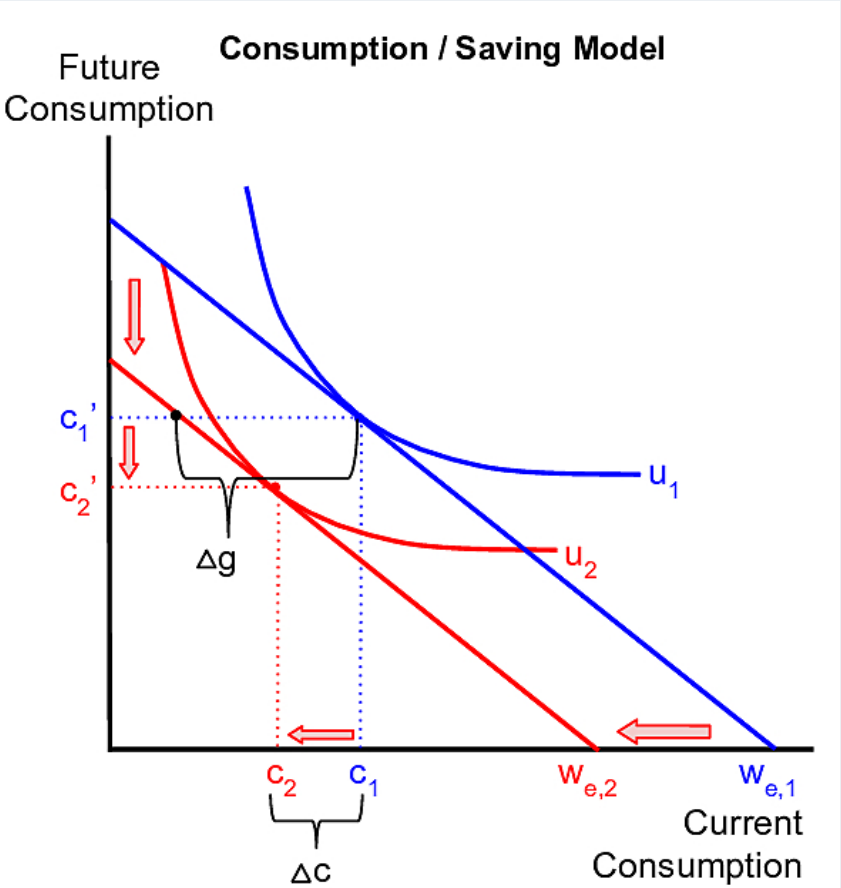
# Increase in Current Government Expenditures



## Scenario

- Suppose government increases spending, with no change in taxes
- Without a credible announcement on change in future spending, people may assume financed with increase in future taxes
- Budget shifts inward, horizontal distance $= \Delta g$
- Consumption smoothing: Both $c$ and $c'$ decrease
- Increase in real GDP, since $\Delta g > -\Delta c$

## Graphical Utility Maximization



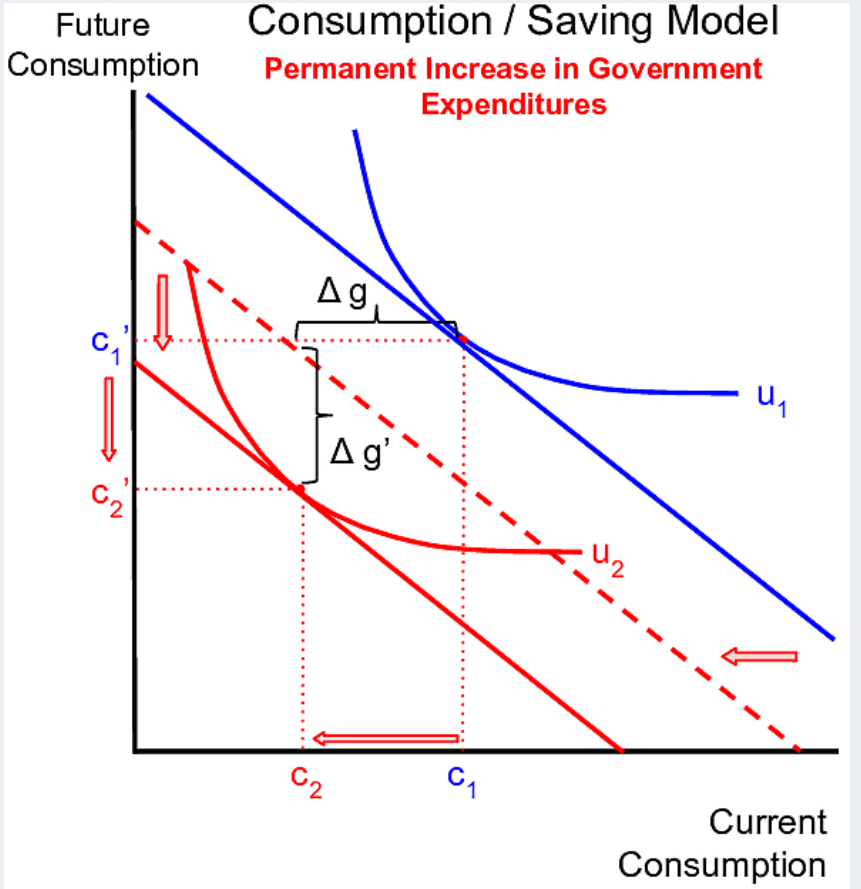
# Permanent Increase in Government Expenditures



## Scenario

- Suppose government increases spending now and in the future
- Net present value of taxes increases by same amount
- Budget shifts inward, horizontal distance $= \Delta g$, vertical distance $= \Delta g'$
- No consumption smoothing: Both $c$ and $c'$ decrease by amounts $= \Delta g$
- No change in real GDP, since $\Delta g = -\Delta c$

## Graphical Utility Maximization



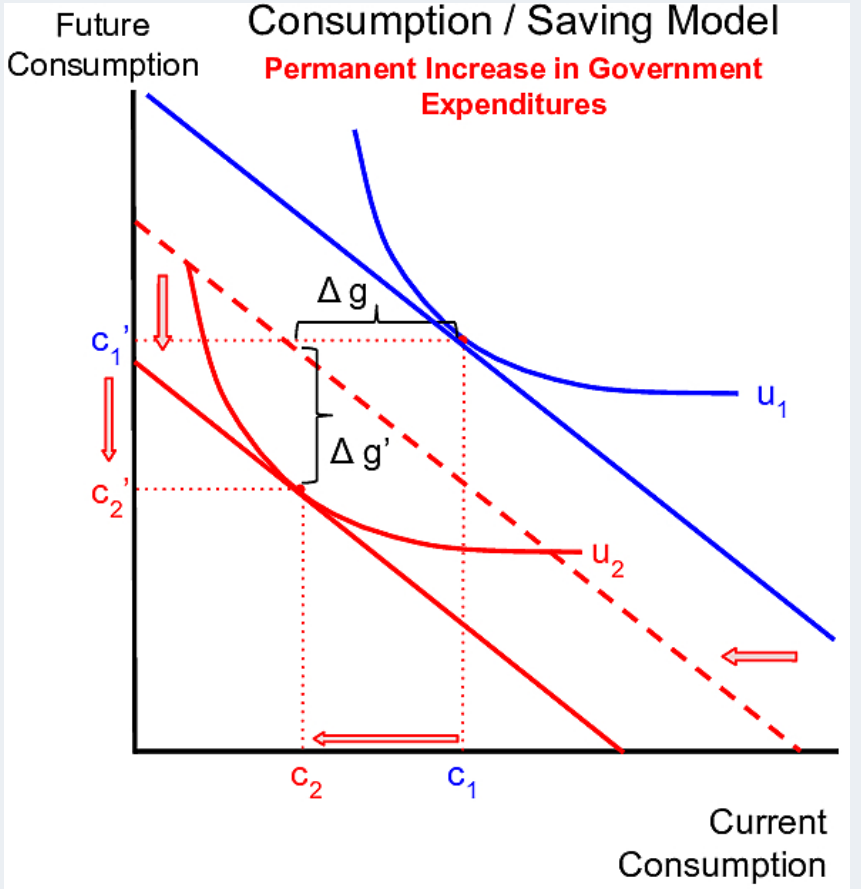
# Permanent Increase in Government Expenditures



## Scenario

- Suppose government increases spending now and in the future
- Net present value of taxes increases by same amount
- Budget shifts inward, horizontal distance $= \Delta g$, vertical distance $= \Delta g'$
- No consumption smoothing: Both $c$ and $c'$ decrease by amounts $= \Delta g$
- No change in real GDP, since $\Delta g = -\Delta c$

## Graphical Utility Maximization



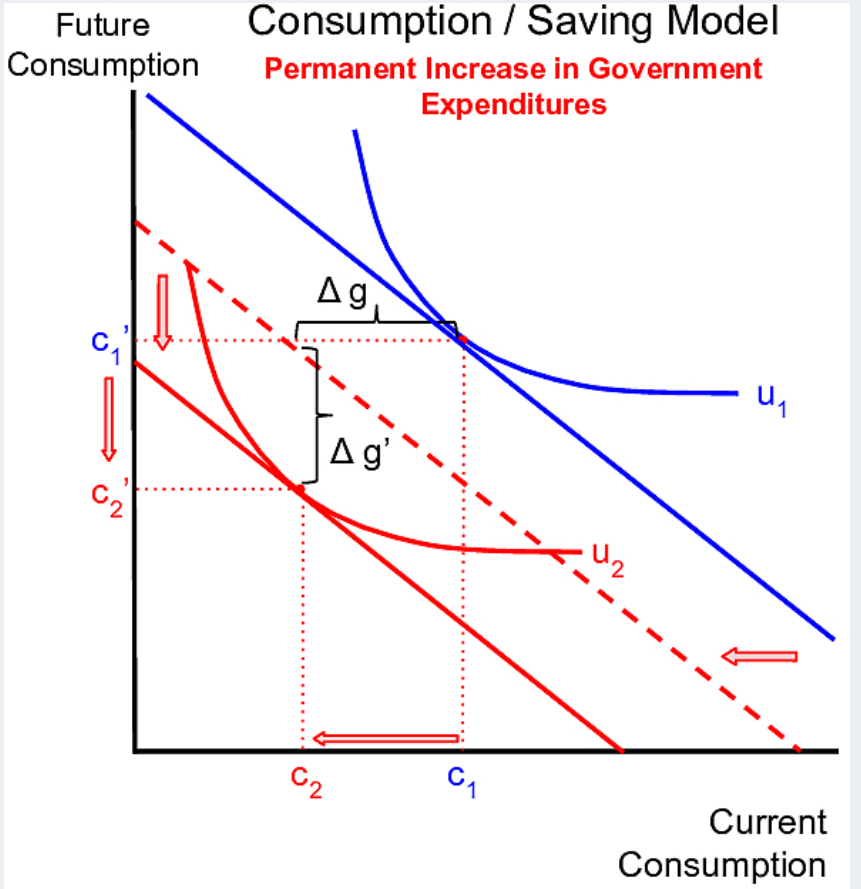
# Permanent Increase in Government Expenditures



## Scenario

- Suppose government increases spending now and in the future
- Net present value of taxes increases by same amount
- Budget shifts inward, horizontal distance $= \Delta g$, vertical distance $= \Delta g'$
- No consumption smoothing: Both $c$ and $c'$ decrease by amounts $= \Delta g$
- No change in real GDP, since $\Delta g = -\Delta c$

## Graphical Utility Maximization



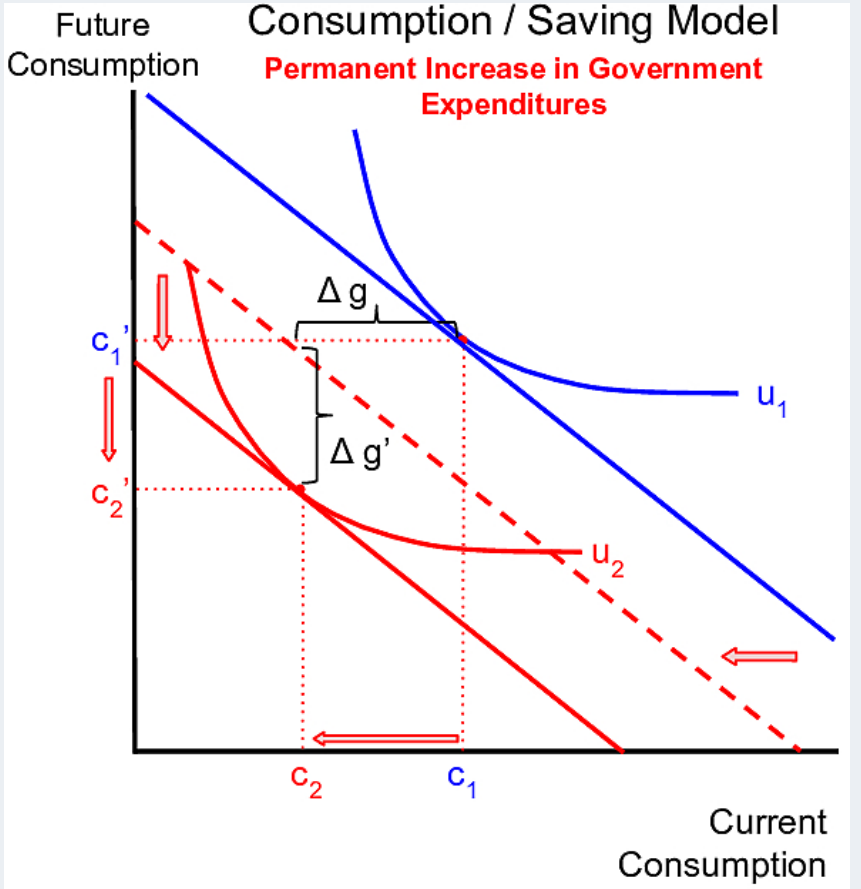
# Permanent Increase in Government Expenditures



## Scenario

- Suppose government increases spending now and in the future
- Net present value of taxes increases by same amount
- Budget shifts inward, horizontal distance $= \Delta g$, vertical distance $= \Delta g'$
- No consumption smoothing: Both $c$ and $c'$ decrease by amounts $= \Delta g$
- No change in real GDP, since $\Delta g = -\Delta c$

## Graphical Utility Maximization



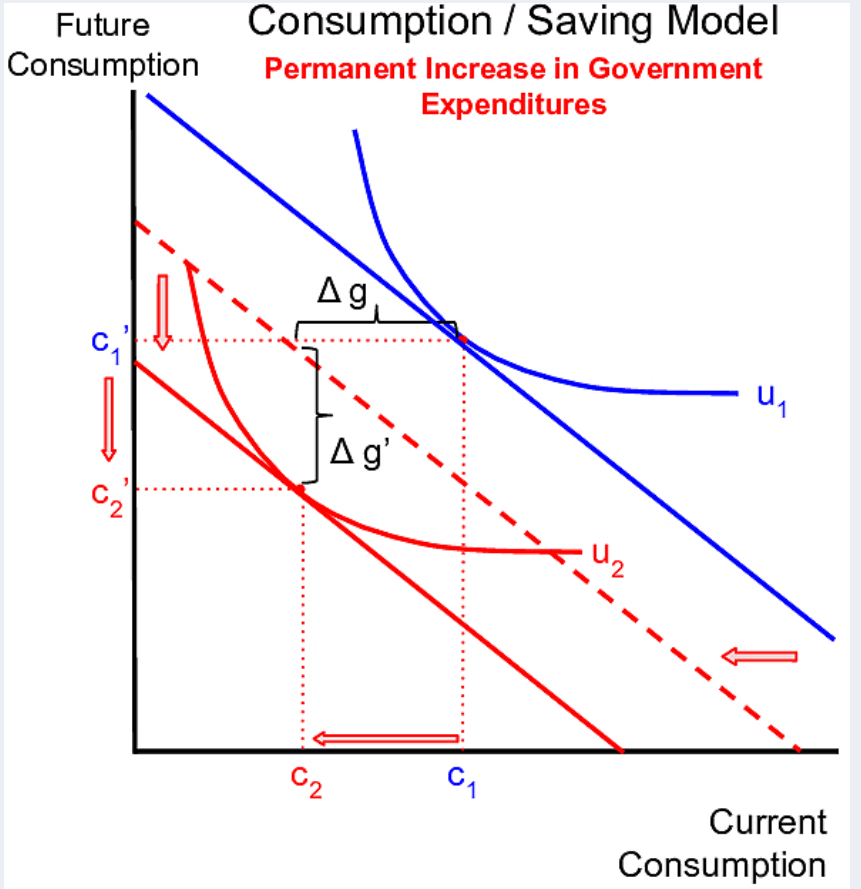
# Permanent Increase in Government Expenditures



## Scenario

- Suppose government increases spending now and in the future
- Net present value of taxes increases by same amount
- Budget shifts inward, horizontal distance $= \Delta g$, vertical distance $= \Delta g'$
- No consumption smoothing: Both $c$ and $c'$ decrease by amounts $= \Delta g$
- No change in real GDP, since $\Delta g = -\Delta c$

## Graphical Utility Maximization



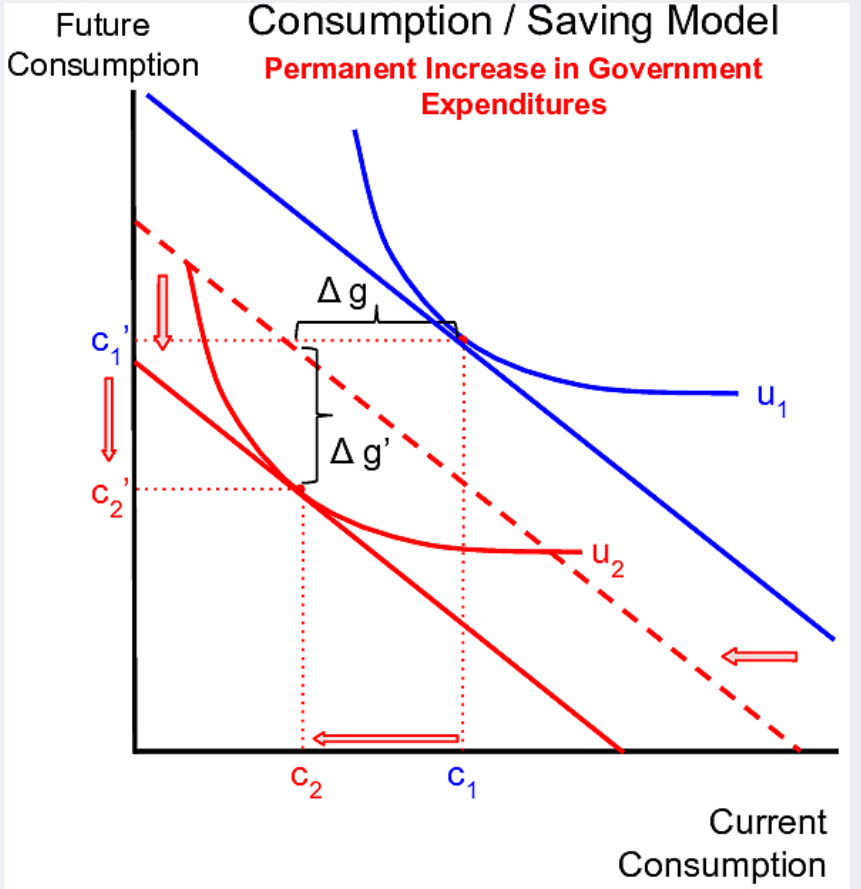
# Permanent Increase in Government Expenditures



## Scenario

- Suppose government increases spending now and in the future
- Net present value of taxes increases by same amount
- Budget shifts inward, horizontal distance $= \Delta g$, vertical distance $= \Delta g'$
- No consumption smoothing: Both $c$ and $c'$ decrease by amounts $= \Delta g$
- No change in real GDP, since $\Delta g = -\Delta c$

## Graphical Utility Maximization



# Tax Cut: Ricardian Equivalence



- Suppose the government gives a tax rebate
- But with no change in current or planned government spending
- Gov't budget: $g + \frac{g'}{1+r} = t + \frac{t'}{1+r}$
- If there is no change in right-side of equation, no change in left-side
- No change in net present-value of taxes, $t + \frac{t'}{1+r}$, implies no change in consumer budget constraint, no change in $c$ or $c'$
- Current period: $c + s = y - t$. With tax cut, no change in $c$, consumer saves all of the tax cut
- Future period: $c' = y' - t' + s$, holds $s$ to pay taxes in future

# Tax Cut: Ricardian Equivalence



- Suppose the government gives a tax rebate
- But with no change in current or planned government spending
- Gov't budget: $g + \frac{g'}{1+r} = t + \frac{t'}{1+r}$
- If there is no change in right-side of equation, no change in left-side
- No change in net present-value of taxes, $t + \frac{t'}{1+r}$, implies no change in consumer budget constraint, no change in $c$ or $c'$
- Current period: $c + s = y - t$. With tax cut, no change in $c$, consumer saves all of the tax cut
- Future period: $c' = y' - t' + s$, holds $s$ to pay taxes in future

# Tax Cut: Ricardian Equivalence



- Suppose the government gives a tax rebate
- But with no change in current or planned government spending
- Gov't budget: $g + \frac{g'}{1+r} = t + \frac{t'}{1+r}$
- If there is no change in right-side of equation, no change in left-side
- No change in net present-value of taxes, $t + \frac{t'}{1+r}$, implies no change in consumer budget constraint, no change in $c$ or $c'$
- Current period: $c + s = y - t$. With tax cut, no change in $c$, consumer saves all of the tax cut
- Future period: $c' = y' - t' + s$, holds $s$ to pay taxes in future

# Tax Cut: Ricardian Equivalence



- Suppose the government gives a tax rebate
- But with no change in current or planned government spending
- Gov't budget: $g + \frac{g'}{1+r} = t + \frac{t'}{1+r}$
- If there is no change in right-side of equation, no change in left-side
- No change in net present-value of taxes, $t + \frac{t'}{1+r}$, implies no change in consumer budget constraint, no change in $c$ or $c'$
- Current period: $c + s = y - t$. With tax cut, no change in $c$, consumer saves all of the tax cut
- Future period: $c' = y' - t' + s$, holds $s$ to pay taxes in future

# Tax Cut: Ricardian Equivalence



- Suppose the government gives a tax rebate
- But with no change in current or planned government spending
- Gov't budget: $g + \frac{g'}{1+r} = t + \frac{t'}{1+r}$
- If there is no change in right-side of equation, no change in left-side
- No change in net present-value of taxes, $t + \frac{t'}{1+r}$, implies no change in consumer budget constraint, no change in $c$ or $c'$
- Current period: $c + s = y - t$. With tax cut, no change in $c$, consumer saves all of the tax cut
- Future period: $c' = y' - t' + s$, holds $s$ to pay taxes in future

# Tax Cut: Ricardian Equivalence



- Suppose the government gives a tax rebate
- But with no change in current or planned government spending
- Gov't budget: $g + \frac{g'}{1+r} = t + \frac{t'}{1+r}$
- If there is no change in right-side of equation, no change in left-side
- No change in net present-value of taxes, $t + \frac{t'}{1+r}$, implies no change in consumer budget constraint, no change in $c$ or $c'$
- Current period: $c + s = y - t$. With tax cut, no change in $c$, consumer saves all of the tax cut
- Future period: $c' = y' - t' + s$, holds $s$ to pay taxes in future

# Tax Cut: Ricardian Equivalence



- Suppose the government gives a tax rebate
- But with no change in current or planned government spending
- Gov't budget: $g + \frac{g'}{1+r} = t + \frac{t'}{1+r}$
- If there is no change in right-side of equation, no change in left-side
- No change in net present-value of taxes, $t + \frac{t'}{1+r}$, implies no change in consumer budget constraint, no change in $c$ or $c'$
- Current period: $c + s = y - t$. With tax cut, no change in $c$, consumer saves all of the tax cut
- Future period: $c' = y' - t' + s$, holds $s$ to pay taxes in future

# Ricardian Equivalence Assumptions



- Assumes government and consumer had same $r$
  - In reality, governments often enjoy lower interest rate on debt
- Assumes the *same* consumer pays higher taxes in the future.
  - In reality, complicated tax policies may direct future taxes to different sub-populations
- Assumes the consumer lives long enough under the same tax bracket to pay future taxes
  - Future increase in taxes may be decades away
- Not explicitly modeled: Assumes conditions for socially optimal equilibrium
  - Slowly adjusting wages and prices, distorting tax policies, can create different predictions
- Why is this useful? Still explains realistic limitations of government policy, and how to address it. Define fiscal policies in terms of *current taxes / government expenditures* and *future tax plans*.

# Ricardian Equivalence Assumptions



- Assumes government and consumer had same $r$
  - In reality, governments often enjoy lower interest rate on debt
- Assumes the *same* consumer pays higher taxes in the future.
  - In reality, complicated tax policies may direct future taxes to different sub-populations
- Assumes the consumer lives long enough under the same tax bracket to pay future taxes
  - Future increase in taxes may be decades away
- Not explicitly modeled: Assumes conditions for socially optimal equilibrium
  - Slowly adjusting wages and prices, distorting tax policies, can create different predictions
- Why is this useful? Still explains realistic limitations of government policy, and how to address it. Define fiscal policies in terms of *current taxes / government expenditures* and *future tax plans*.

# Ricardian Equivalence Assumptions



- Assumes government and consumer had same $r$
  - In reality, governments often enjoy lower interest rate on debt
- Assumes the *same* consumer pays higher taxes in the future.
  - In reality, complicated tax policies may direct future taxes to different sub-populations
- Assumes the consumer lives long enough under the same tax bracket to pay future taxes
  - Future increase in taxes may be decades away
- Not explicitly modeled: Assumes conditions for socially optimal equilibrium
  - Slowly adjusting wages and prices, distorting tax policies, can create different predictions
- Why is this useful? Still explains realistic limitations of government policy, and how to address it. Define fiscal policies in terms of *current taxes / government expenditures* and *future tax plans*.

# Ricardian Equivalence Assumptions



- Assumes government and consumer had same $r$
  - In reality, governments often enjoy lower interest rate on debt
- Assumes the *same* consumer pays higher taxes in the future.
  - In reality, complicated tax policies may direct future taxes to different sub-populations
- Assumes the consumer lives long enough under the same tax bracket to pay future taxes
  - Future increase in taxes may be decades away
- Not explicitly modeled: Assumes conditions for socially optimal equilibrium
  - Slowly adjusting wages and prices, distorting tax policies, can create different predictions
- Why is this useful? Still explains realistic limitations of government policy, and how to address it. Define fiscal policies in terms of *current taxes / government expenditures* and *future tax plans*.

# Ricardian Equivalence Assumptions



- Assumes government and consumer had same $r$
  - In reality, governments often enjoy lower interest rate on debt
- Assumes the *same* consumer pays higher taxes in the future.
  - In reality, complicated tax policies may direct future taxes to different sub-populations
- Assumes the consumer lives long enough under the same tax bracket to pay future taxes
  - Future increase in taxes may be decades away
- Not explicitly modeled: Assumes conditions for socially optimal equilibrium
  - Slowly adjusting wages and prices, distorting tax policies, can create different predictions
- Why is this useful? Still explains realistic limitations of government policy, and how to address it. Define fiscal policies in terms of *current taxes / government expenditures* and *future tax plans*.

# Ricardian Equivalence Assumptions



- Assumes government and consumer had same $r$
  - In reality, governments often enjoy lower interest rate on debt
- Assumes the *same* consumer pays higher taxes in the future.
  - In reality, complicated tax policies may direct future taxes to different sub-populations
- Assumes the consumer lives long enough under the same tax bracket to pay future taxes
  - Future increase in taxes may be decades away
- Not explicitly modeled: Assumes conditions for socially optimal equilibrium
  - Slowly adjusting wages and prices, distorting tax policies, can create different predictions
- Why is this useful? Still explains realistic limitations of government policy, and how to address it. Define fiscal policies in terms of *current taxes / government expenditures* and *future tax plans*.

# Ricardian Equivalence Assumptions



- Assumes government and consumer had same $r$
  - In reality, governments often enjoy lower interest rate on debt
- Assumes the *same* consumer pays higher taxes in the future.
  - In reality, complicated tax policies may direct future taxes to different sub-populations
- Assumes the consumer lives long enough under the same tax bracket to pay future taxes
  - Future increase in taxes may be decades away
- Not explicitly modeled: Assumes conditions for socially optimal equilibrium
  - Slowly adjusting wages and prices, distorting tax policies, can create different predictions
- Why is this useful? Still explains realistic limitations of government policy, and how to address it. Define fiscal policies in terms of *current taxes / government expenditures* and *future tax plans*.

# Ricardian Equivalence Assumptions



- Assumes government and consumer had same $r$
  - In reality, governments often enjoy lower interest rate on debt
- Assumes the *same* consumer pays higher taxes in the future.
  - In reality, complicated tax policies may direct future taxes to different sub-populations
- Assumes the consumer lives long enough under the same tax bracket to pay future taxes
  - Future increase in taxes may be decades away
- Not explicitly modeled: Assumes conditions for socially optimal equilibrium
  - Slowly adjusting wages and prices, distorting tax policies, can create different predictions
- Why is this useful? Still explains realistic limitations of government policy, and how to address it. Define fiscal policies in terms of *current taxes / government expenditures* and *future tax plans*.

# Ricardian Equivalence Assumptions



- Assumes government and consumer had same $r$
  - In reality, governments often enjoy lower interest rate on debt
- Assumes the *same* consumer pays higher taxes in the future.
  - In reality, complicated tax policies may direct future taxes to different sub-populations
- Assumes the consumer lives long enough under the same tax bracket to pay future taxes
  - Future increase in taxes may be decades away
- Not explicitly modeled: Assumes conditions for socially optimal equilibrium
  - Slowly adjusting wages and prices, distorting tax policies, can create different predictions
- Why is this useful? Still explains realistic limitations of government policy, and how to address it. Define fiscal policies in terms of *current taxes / government expenditures* and *future tax plans*.

# Reading and Exercises



- Williamson, Chapter 9, pp. 306-321: Consumption and savings decisions
- Williamson, Chapter 9, pp. 321-324: Effects on decisions from changes in income
- Williamson, Chapter 9, pp. 327-332: Effects on decisions from changes in interest rates for savers and borrowers
- Williamson, Chapter 9, pp. 337-343: Ricardian Equivalence
- **Canvas Quiz due Wed 11:59 PM**. Multiple-choice, 10 questions, unlimited attempts allowed, only best score counts
- **Homework/In-class Exercise due Fri 11:59 PM**. We will work together in class on Thursday

# Reading and Exercises



- Williamson, Chapter 9, pp. 306-321: Consumption and savings decisions
- Williamson, Chapter 9, pp. 321-324: Effects on decisions from changes in income
- Williamson, Chapter 9, pp. 327-332: Effects on decisions from changes in interest rates for savers and borrowers
- Williamson, Chapter 9, pp. 337-343: Ricardian Equivalence
- **Canvas Quiz due Wed 11:59 PM**. Multiple-choice, 10 questions, unlimited attempts allowed, only best score counts
- **Homework/In-class Exercise due Fri 11:59 PM**. We will work together in class on Thursday

# Reading and Exercises



- Williamson, Chapter 9, pp. 306-321: Consumption and savings decisions
- Williamson, Chapter 9, pp. 321-324: Effects on decisions from changes in income
- Williamson, Chapter 9, pp. 327-332: Effects on decisions from changes in interest rates for savers and borrowers
- Williamson, Chapter 9, pp. 337-343: Ricardian Equivalence
- **Canvas Quiz due Wed 11:59 PM**. Multiple-choice, 10 questions, unlimited attempts allowed, only best score counts
- **Homework/In-class Exercise due Fri 11:59 PM**. We will work together in class on Thursday

# Reading and Exercises



- Williamson, Chapter 9, pp. 306-321: Consumption and savings decisions
- Williamson, Chapter 9, pp. 321-324: Effects on decisions from changes in income
- Williamson, Chapter 9, pp. 327-332: Effects on decisions from changes in interest rates for savers and borrowers
- Williamson, Chapter 9, pp. 337-343: Ricardian Equivalence
- **Canvas Quiz due Wed 11:59 PM**. Multiple-choice, 10 questions, unlimited attempts allowed, only best score counts
- **Homework/In-class Exercise due Fri 11:59 PM**. We will work together in class on Thursday

# Reading and Exercises



- Williamson, Chapter 9, pp. 306-321: Consumption and savings decisions
- Williamson, Chapter 9, pp. 321-324: Effects on decisions from changes in income
- Williamson, Chapter 9, pp. 327-332: Effects on decisions from changes in interest rates for savers and borrowers
- Williamson, Chapter 9, pp. 337-343: Ricardian Equivalence
- **Canvas Quiz due Wed 11:59 PM**.
  Multiple-choice, 10 questions, unlimited attempts allowed, only best score counts
- **Homework/In-class Exercise due Fri 11:59 PM**. We will work together in class on Thursday

# Reading and Exercises



- Williamson, Chapter 9, pp. 306-321: Consumption and savings decisions
- Williamson, Chapter 9, pp. 321-324: Effects on decisions from changes in income
- Williamson, Chapter 9, pp. 327-332: Effects on decisions from changes in interest rates for savers and borrowers
- Williamson, Chapter 9, pp. 337-343: Ricardian Equivalence
- **Canvas Quiz due Wed 11:59 PM**.
  Multiple-choice, 10 questions, unlimited attempts allowed, only best score counts
- **Homework/In-class Exercise due Fri 11:59 PM**. We will work together in class on Thursday