

# Chapter 6 : A Real Intertemporal Model with Investment (Part 3)

EE312

Macroeconomics, Stephen Williamson, Chapter 11

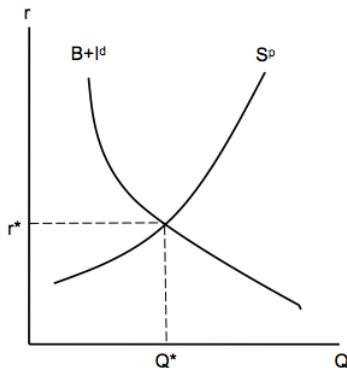
2015

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- Real Intertemporal Model (Introducton) (Part 1)
- Competitive Equilibrium (Part 2)
- The credit market (Part 3)
  - Credit Market
  - Shocks Experiments
    - Current government purchases increase temporarily ( $G$ );
    - Current capital stock decreases due to a natural disaster or war ( $K$ );
    - A temporary increase in current total factor productivity ( $z$ );
    - An increase in future total factor productivity ( $z'$ ).

# The credit market

- The supply of credit is the consumer's private saving.
- The demand for credit is government's borrowing and the firm's investment demand ( $I^d$ ).



## Exogenous shocks in the model

- A shock in the model occurs when one of exogenous variable changes, causing endogenous variables to change accordingly.
- The macro effect depends on whether it is temporary or permanent.
- An expected shock in the future has effects in the current period.

## Shock experiments

- Current government purchases increase temporarily ( $G$ );
- Current capital stock decreases due to a natural disaster or war ( $K$ );
- A temporary increase in current total factor productivity ( $z$ );
- An increase in future total factor productivity ( $z'$ ).

## A temporary increase in $G$

- Assume an increase in  $G$  with  $G'$  unchanged.
- **Keynesian (EE212) analysis:**
  - A higher  $G$  causes the demand for goods to increase.
  - Output and income increases.
  - Part of the increase in income is spent on consumption goods — more demand for output.
  - Direct and indirect increases in the demand for output — **the multiplier effect.**

## The Keynesian $Y^d$ multiplier

$$\Delta Y^d = \Delta G$$

$$\Delta C = MPC \times \Delta Y^d \quad , \text{where } 0 < MPC < 1$$

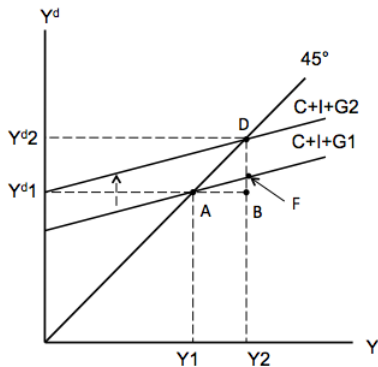
$$\Delta Y^d = \Delta G + (MPC \times \Delta Y^d)$$

$$\Delta Y^d = \frac{1}{1 - MPC} \Delta G$$

- The larger is MPC, the larger the  $Y^d$  multiplier, and the more powerful  $\Delta G$ !

# The Keynesian $Y^d$ multiplier $> 1$

- Assume constant MPC.
- $\Delta G = DF$
- $\Delta Y = \Delta Y^d = AB = DB$ .
- But  $DB > DF$
- $\frac{\Delta Y}{\Delta G} > 1$



- The increase in  $G$  has no negative effect on lifetime wealth and consumption spending.
  - But PV of taxes must rise and lifetime wealth falls.
- Total income or output ( $Y$ ) increases by the same amount as the demand for goods ( $Y^d$ ).
- The effect on the real interest rate?
- Increases in  $C$  and  $Y$  come as a free lunch!

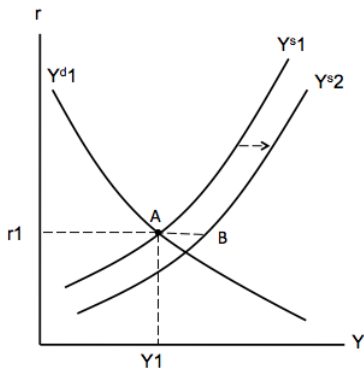
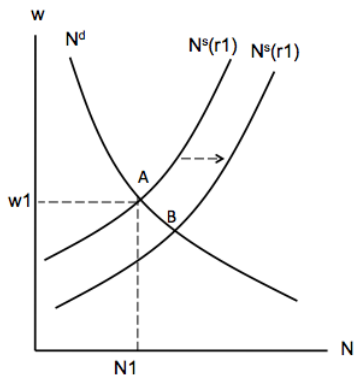
- The increase in total current demand for goods ( $Y^d$ ).
  - The increase in government spending ( $\Delta G$ ).
  - The multiplier effect =  $MPC\Delta G$ .
  - Lifetime wealth drops = PV of taxes =  $\Delta G$ . ; so current consumption **falls** by  $MPC\Delta G$ .

$$\Delta Y^d = \Delta G + MPC\Delta G - MPC\Delta G$$

$$\Delta Y^d = \Delta G$$

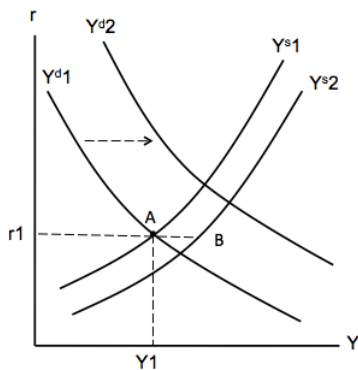
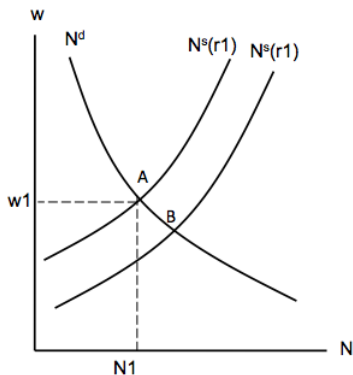
- Step 1: direct effect of  $\Delta G$ :
- Effects on  $Y^S$ :
  - The PV of taxes rises; the consumer's lifetime wealth falls.
  - Leisure decreases and labor supply increases, given the real wage.
  - The output supply curve shifts rightwards.

## Step 1 An increase in G: $Y_s$ shift



- Government's demand for output ( $G$ ) increases.
- Falling lifetime wealth reduces the consumer's demand for current consumption goods ( $C^d$ ).
- Current demand for goods increases by the amount of  $\Delta Y^d = \Delta G$  ; the  $Y^d$  multiplier = 1 .
- $Y^d$  shifts rightwards by the amount of  $\Delta G$ .
- Both  $Y^s$  and  $Y^d$  shift to the right; what happens to the real interest rate?

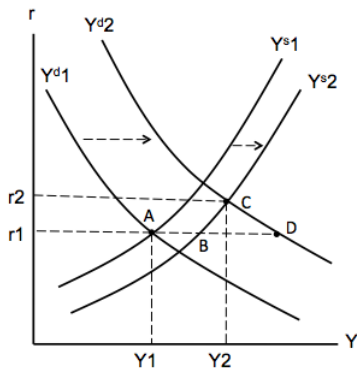
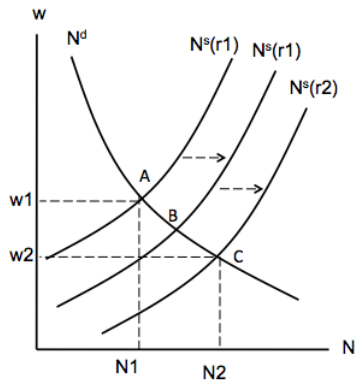
## Step 1 An increase in G: $Y^d$ shift



- The real interest rate increases as  $Y^d$  **shifts more than**  $Y^s$ .
  - $\Delta G$  is temporary and has a small negative effect on lifetime wealth.
  - A small decrease in leisure, and small increases in labor supply and output supply (small  $Y^s$  shift).
  - A small decrease in current consumption while the increase in  $G$  remains large (larger  $Y^d$  shift).
- Step 2: effect of the rising  $r$ .
  - A higher  $r$  reduces leisure, current consumption and investment.

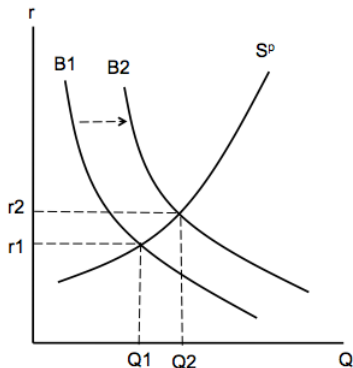
- Leisure falls and labor supply increases again.
  - The real wage falls further; employment and output increase — a movement along the  $Y_s$ .
- Investment decreases due to the higher real interest rate.
- Current consumption falls:
  - Falling lifetime wealth reduces current consumption while higher income raises it — small net effect.
  - The higher  $r$  also reduces it — dominant effect.

## Step 2 An increase in G: rising $r$



## Rising $r$ and the credit market

- The government increases current borrowing (bond sale).
- The real interest rate increases.



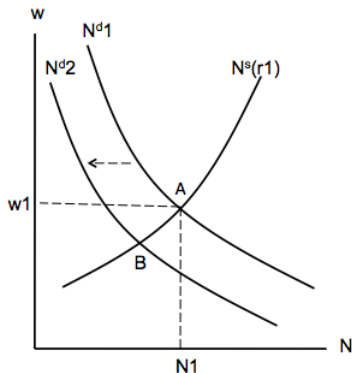
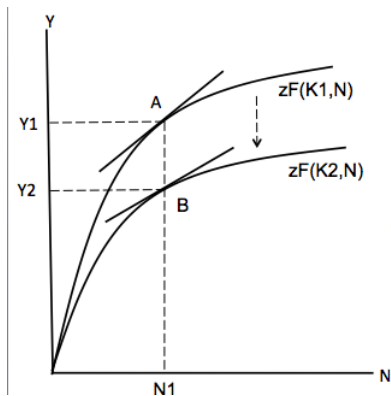
- The government increases borrowing in the current period.
  - The increased bond sale raises the real interest rate.
- A temporary increase in  $G$  **crowds out** both current consumption and investment by raising the real interest rate.
  - The consumer works more for a lower real wage and consumes less.
  - Lower investment means lower future capital stock and future productive capacity.

- The total expenditure multiplier is less than 1.
  - $\Delta Y^d = \Delta G = AD > Y_1 Y_2$ .
  - So  $\frac{\Delta Y}{\Delta G} < 1$ .
  - The higher real interest rate results in the crowding-out effect on private spending ( $C^d$  and  $I^d$ ).
- Higher government spending and larger output come at a cost — no free lunch!

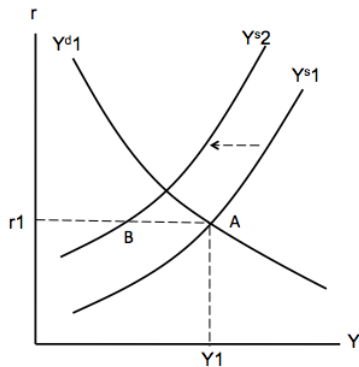
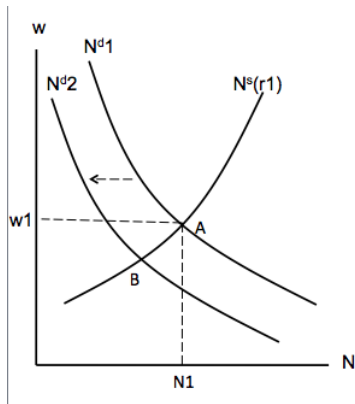
## A decrease in current capital stock

- Reduction in current capital stock ( $K$ ) due to a natural disaster, war, etc.
- **Step 1: Effect on  $Y^S$ :**
  - A smaller  $K$  with the same  $N$ , current  $MP_N$  drops.
  - The firm reduces its demand for labor.
  - The labor demand curve shifts left (given  $w$ ).
  - the output supply curve ( $Y^S$ ) shifts left.

## Step 1 A lower K reduces MPN

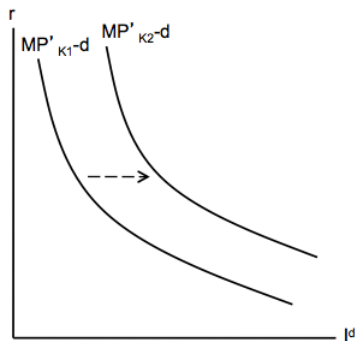
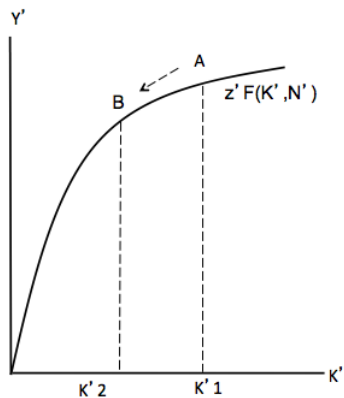


## Step 1 Lower Nd: Ys shifts left.

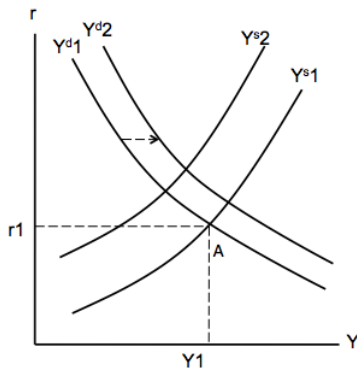
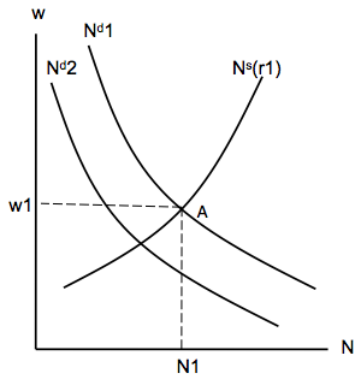


- **Effect on  $Y^d$ :**
  - A smaller current  $K$  means a smaller future  $K'$ .
  - Future  $MP'_K$  rises; investment increases, given  $r$ .
  - The optimal investment curve ( $I^d$ ) shifts right.
  - The output demand curve ( $Y^d$ ) shifts right.
- The real interest rate must rise.
- **Step 2:** the higher real interest rate reduces leisure (increases labor supply), current consumption and investment.

## Step 1 Higher MP'K and rising $I^d$

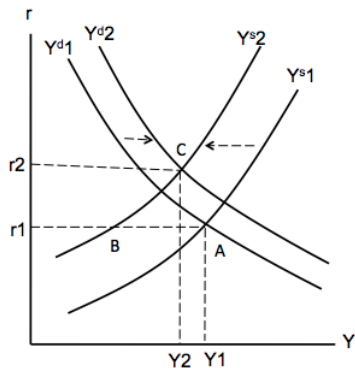
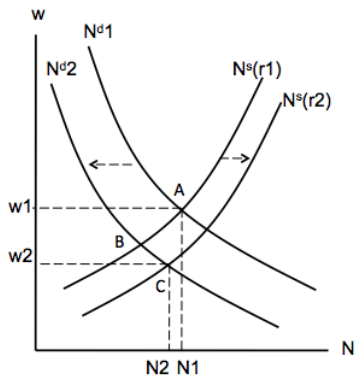


## Step 1 A rising $Id$ shifts $Yd$ right.



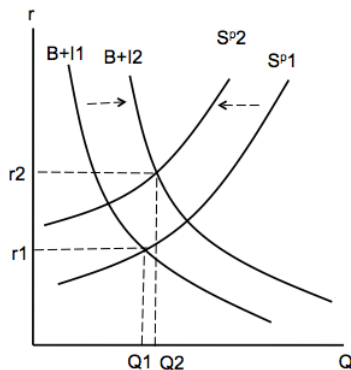
- Leisure decreases and labor supply increases.
  - The labor supply curve shifts to the right.
  - The real wage drops further.
  - A movement on the  $Y_s$  curve.
- Investment increases to make up for the decline in the capital stock:
  - The higher real interest rate depresses investment, but higher  $MP'_K$  raise it.
  - If investment finally decreases, current  $K$  will be falling indefinitely — impossible.

## Step 2 A decrease in current K: rising r



# The credit market

- Lower current income reduces consumption and private saving.
- Investment increases (net effect).
- The real interest rate increases, given  $B$ .



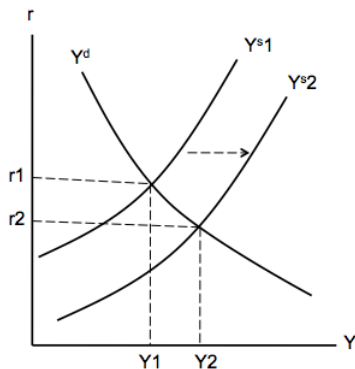
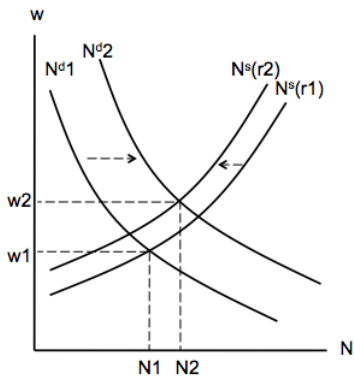
## Overall effect of a drop in K

- A decrease in current K raises the real interest rate but may increase or reduce output.
  - Current consumption and leisure decrease.
  - Investment increases.
  - The real wage decreases.
  - Employment and output may increase or decrease.
- Destruction of K tends to reduce output; but higher investment increases output.

## A temporary increase in $z$

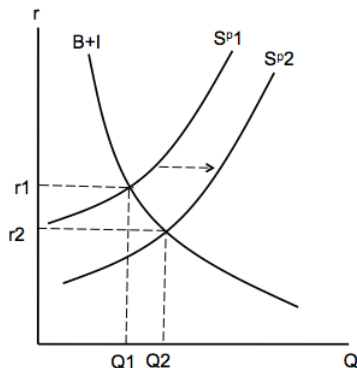
- Step 1: An increase in current total factor productivity ( $z$ ) raises MPN.
  - Labor demand and output supply shift right.
  - The real interest rate decreases.
- Step 2: the lower  $r$  raises current consumption, investment and leisure.
  - Labor supply decreases; the labor supply curve shifts left.
  - Employment, output and the real wage increase.

# An increase in $z$



# The credit market

- Higher current income raises both consumption and private saving.
- The real interest rate decreases, given  $B$ .



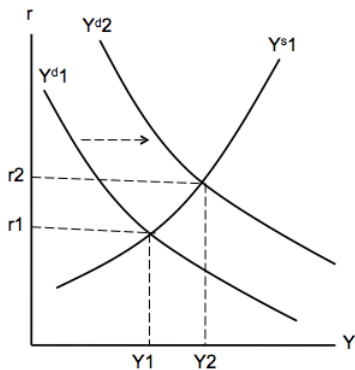
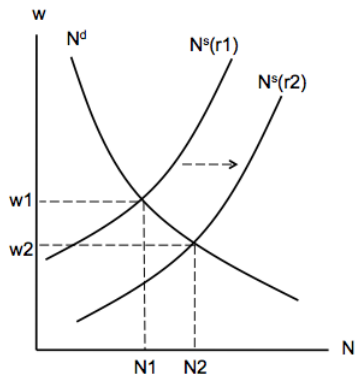
- An increase in the current  $z$  reduces the real interest rate but increases output.
  - Employment and output increase.
  - The real wage increases.
  - This is partly offset by the increase in leisure (with lower  $r$  and higher current income).
  - Investment increases (with lower  $r$ ).
  - Current consumption increases with lower  $r$  and larger  $Y$ .

## An increase in future $z'$

- Step 1: Future  $z'$  is expected to rise; future  $MP'_K$  increases.
- Investment ( $I^d$ ) increases; output demand shifts right.
  - The real interest rate increases.
- Step 2: the higher  $r$  reduces consumption, investment and leisure.

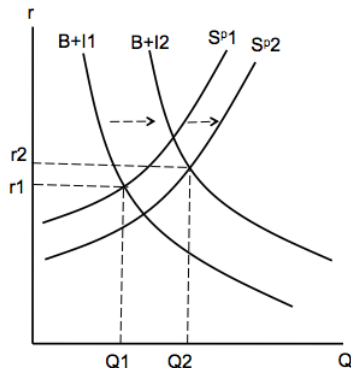
- The labor supply curve shifts right; the real wage drops.
- Employment and output increase.
- Higher current income raises consumption, but the higher real interest rate depresses it.
- The higher investment from higher  $MP'_K$  is partially offset by the higher real interest rate.
  - Investment increases as the effect of  $MP'_K$  is stronger .

# An expected increase in $z'$



# The credit market

- Higher current income raises both consumption and private saving.
- Investment also increases.
- The real interest rate increases.



## Overall effect of $\Delta z'$

- Investment increases with higher expected  $MP'_K$ , partly offset by the higher  $r$ .
  - A larger future capital stock due to higher expected  $z'$ .
- Both real interest rate and output increase.
- Current consumption may rise or fall due to higher income but higher real interest rate.
- Employment increases with falling real wage.