MACROECONOMICS
73-240

Lecture 19

Shu Lin Wee

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Plan for This Lecture

1) Understanding Equilibrium in the Extended 2 Period Model
   - Aggregate Output Supply
   - Aggregate Output Demand

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Extending the Two Period Model

Key Observations from the Consumer and the Firm

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Key Observations

- We will focus on two markets in equilibrium
  - Current Labor Market: $N^d = N^s$
  - Current Goods Market: $Y = C + I + G$

- From the Consumer, we learn about N^s and C
- From the Firm, we learn about N^d and I

Key Observations

Key Observations from the Consumer's Problem

- Labor Supply, $N^s(w, r, NLI)$
  - Increasing in the wage, w
  - Shifts to the right when r increases
  - Shifts to the left when NLI increases

- Consumption Demand, $C^d(we, r)$
  - we is a function of current income
  - $\Rightarrow C^d$ is Increasing in current income, Y
  - MPC: Increase in C^d caused by unit increase in current income
  - Shifts down when r increases

Key Observations

Key Observations from the Firm's Problem

- Labor Demand, $N^d(w, z, K)$
  - Decreasing in the wage w
  - Shifts to the right when z or K increases

- Investment Demand, $I(z', r, K)$
  - Decreasing in the interest rate, r
  - Shifts to the right if z' increases or K decreases

Extending the Two Period Model
The Government

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Government

- Recall there is a government that balances budget over two period

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

Equilibrium in the Extended Two Period Model

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Equilibrium in the Extended 2 Period Model

-Definition-

Given a set of exogenous parameters/variables $\{h, K, z, z', d, G, G'\}$ a *competitive equilibrium* is a set of endogenous variables $\{C, C', l, l', \pi, \pi', N, N', I, T, T', w, r\}$ such that

1) Given w, r, T, T', π, π', the consumer's choices $(C, C', l, l')$are optimal
2) Given w, r, the firm's choices (N, N', I) are optimal
3) The Government's lifetime budget constraint is satisfied
4) Labor Markets Clear $(N = h - l$ and $N' = h - l')$
5) Goods Markets Clear $(C + I + G = zF(K, N)$ and $C' + G' - (1 - d)K' = z'F(K', N'))$
6) Credit Market Clears

Whew!

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Analysis of Equilibrium in the Extended 2 Period Model

- Definition of equilibrium is standard
  1) Consumer and Firms optimize
  2) Government satisfies lifetime budget constraint
  3) All feasibility (or market clearing) conditions hold
- We focus on equilibrium in two markets:
  1) Labor market (relating wages and employment *today*)
  2) Goods market (relating interest rate and output *today*)
- Which markets are we NOT focusing on?

Analysis of Equilibrium in the Extended 2 Period Model

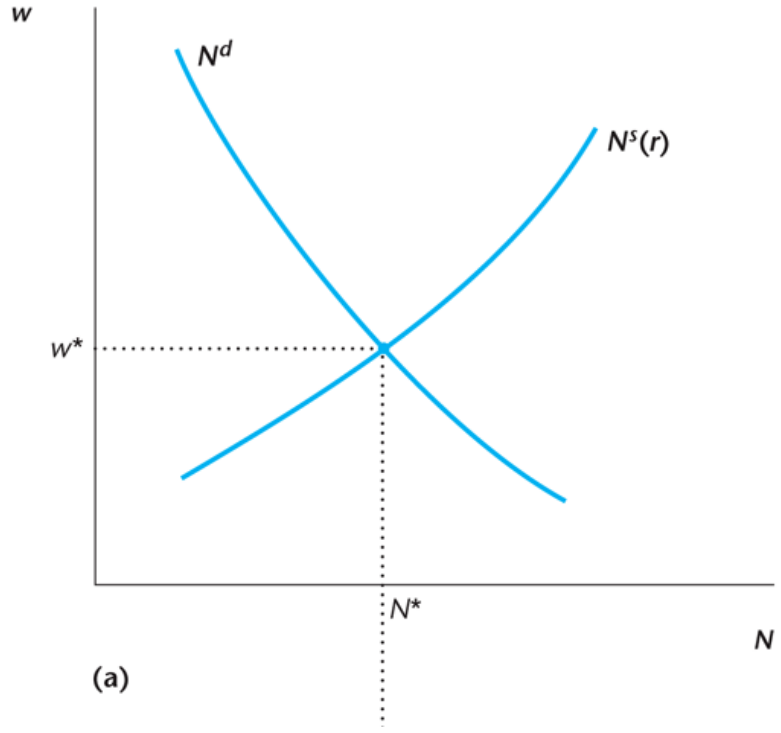
Our Approach:

- Ultimately, we need to determine two prices, w, r
- Fixing r, how much current output is consistent with labor market clearing?
  - Need to find the wage that clears labor markets given r
  - And, given w, we know employment by firms, and therefore output
  - We call this Output Supply
- Fixing r, how much *current output* is consistent with *current goods market* clearing?
  - We know investment demand and G
  - Given current income, we know current consumption demand
  - For what level of current income does $Y = C^d(Y, r) + I(r) + G$?
  - We call this Output Demand
- Ask, at what r does Output Demand equals Output Supply

Equilibrium in the Labor Market

Step 1: For fixed r, how much output is consistent with labor markets clearing?

- Equate demand for labor (firm) and supply of labor (consumer):



- We obtain the employment (N^*) and wage (w^*)
- Recall supply of labor depends on r

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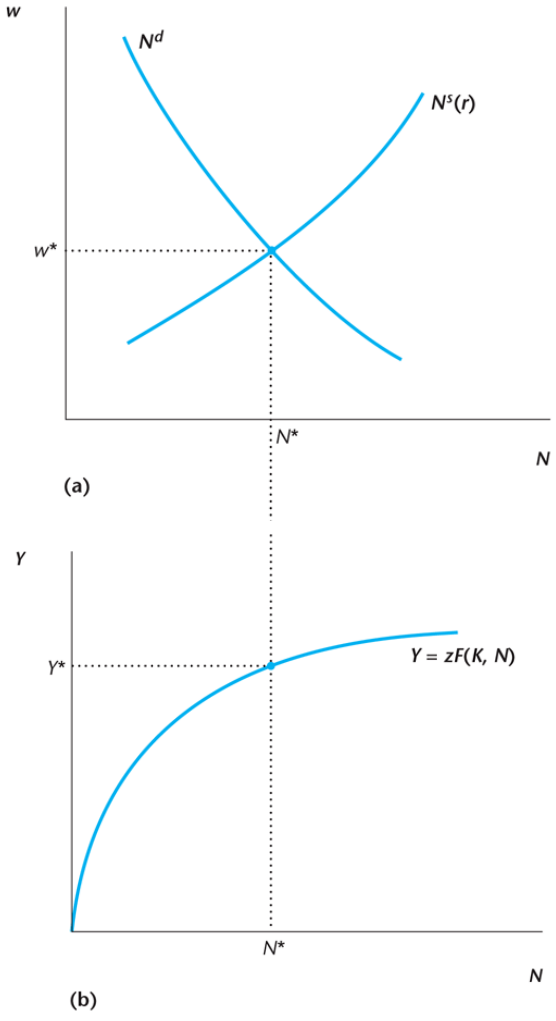
Relating Employment and Output

- Given N^*, we can relate employment to output



⟵ For a given interest rate quantity of labor and wages are determined by current labor market clearing

⟵ The quantity of output is then determined by production function.

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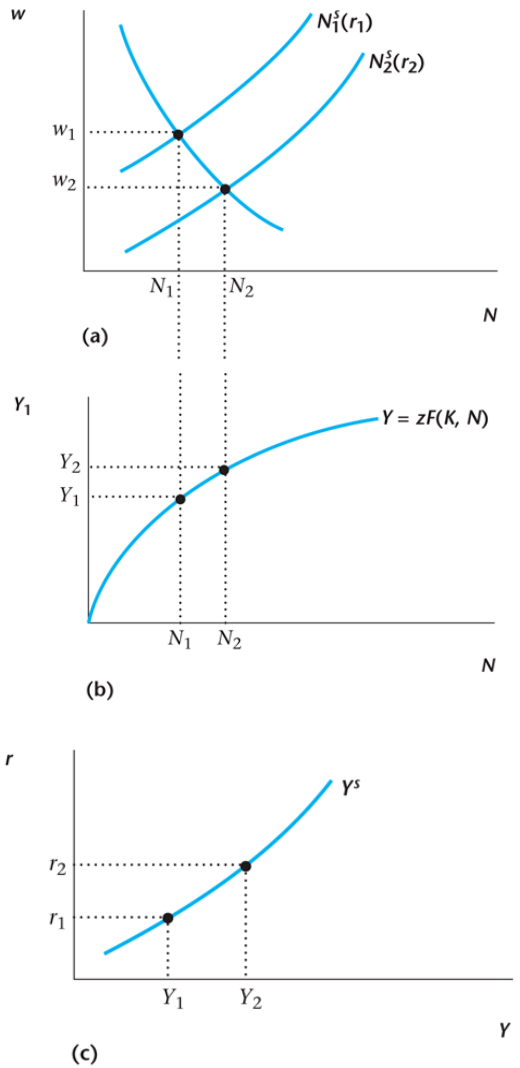
Construction of The Output Supply Curve

We can now link r and Y recalling the consumer behavior
$\Rightarrow$ suppose r increases:



$\longleftarrow$ At higher interest rate, at every wage, labor supply is higher, therefore the quantity of labor hired in equilibrium is higher (with lower equilibrium wages).

$\longleftarrow$ Hence, at higher interest rate more quantity of output is supplied (supply curve is upward sloping).

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The Output Supply Curve

- Another way to see this:

$$\frac{dY^s}{dr} = \frac{d}{dr} zF(K, N^s) = z\frac{dF(K, N^s)}{dN^s} \underbrace{\frac{dN^s}{dr}}_{>0} > 0$$

-Definition-

- We call the increasing relation between r and Y the output supply curve

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Equilibrium in the Current Goods Market

Step 2: We ask, given r, what level of current output clears the goods market so that

$$Y = C + I + G$$

- Given r, we know G and I (recall, G exogenous, I depends only on r and other exogenous variables)
- Problem: current consumption, C depends on r and lifetime wealth
  - Current income, Y, is a component of lifetime wealth (recall: Income Approach to measuring GDP!)
- So we look for a value of current income Y^d

$$Y^d = C(we, r) + I(z', r, K) + G$$

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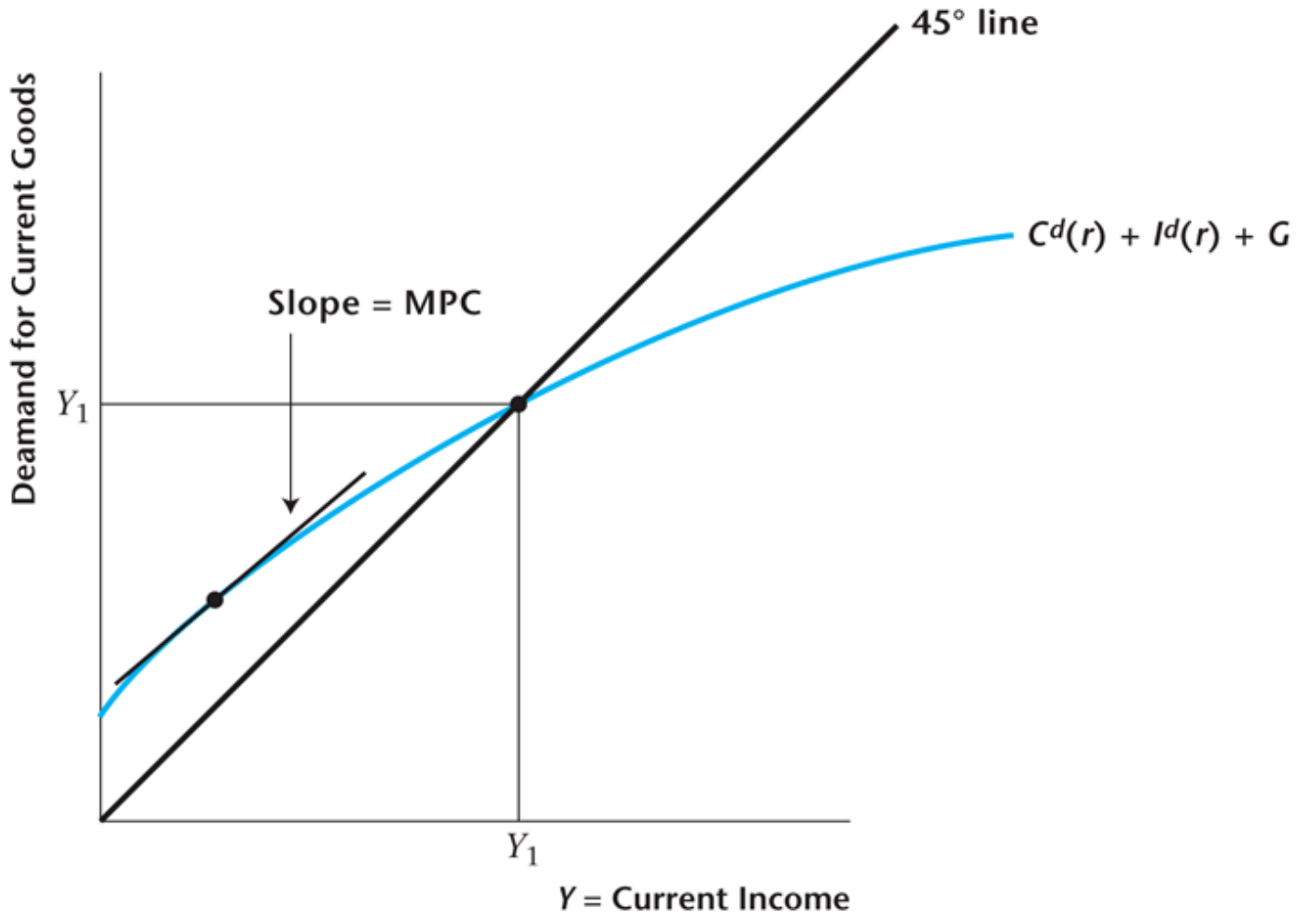
The Demand for Current Goods



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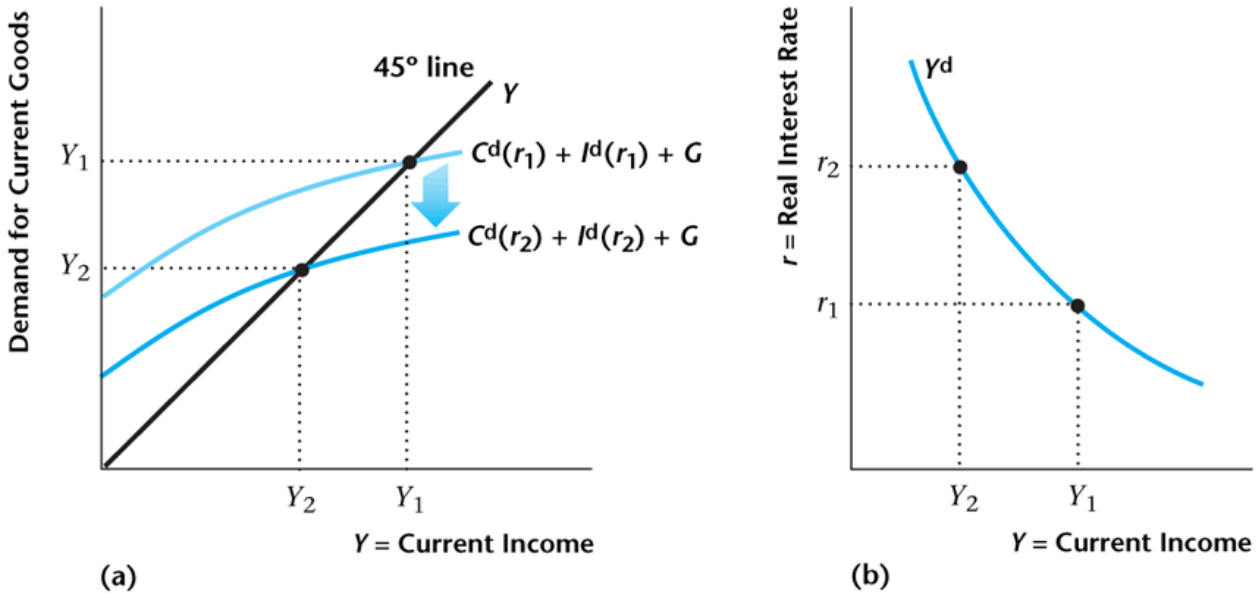
Construction of The Output Demand Curve

Recall when interest rate increases

- Demand for current consumption falls
- Demand for Investment falls



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The Output Demand Curve

- Another way to see this:

$$Y^d(r) = C(we, r) + I(r) + G$$

- Note: we is comprised of current and future income $\Rightarrow$ C is also a function of current income Y^d
- Differentiate both sides with respect to r:

$$\frac{dY^d(r)}{dr} = \underbrace{\frac{dC^d(we,r)}{dY^d(r)}}_{MPC}\frac{dY^d(r)}{dr} + \frac{dC^d(we,r)}{dr} + \frac{dI(r)}{dr}$$

- Re-arrange terms and find

$$\frac{dY^d}{dr} = \frac{1}{1-MPC}\left[\underbrace{\frac{dC^d(Y^d,r)}{dr}}_{<0} + \underbrace{\frac{dI(r)}{dr}}_{<0}\right] < 0$$

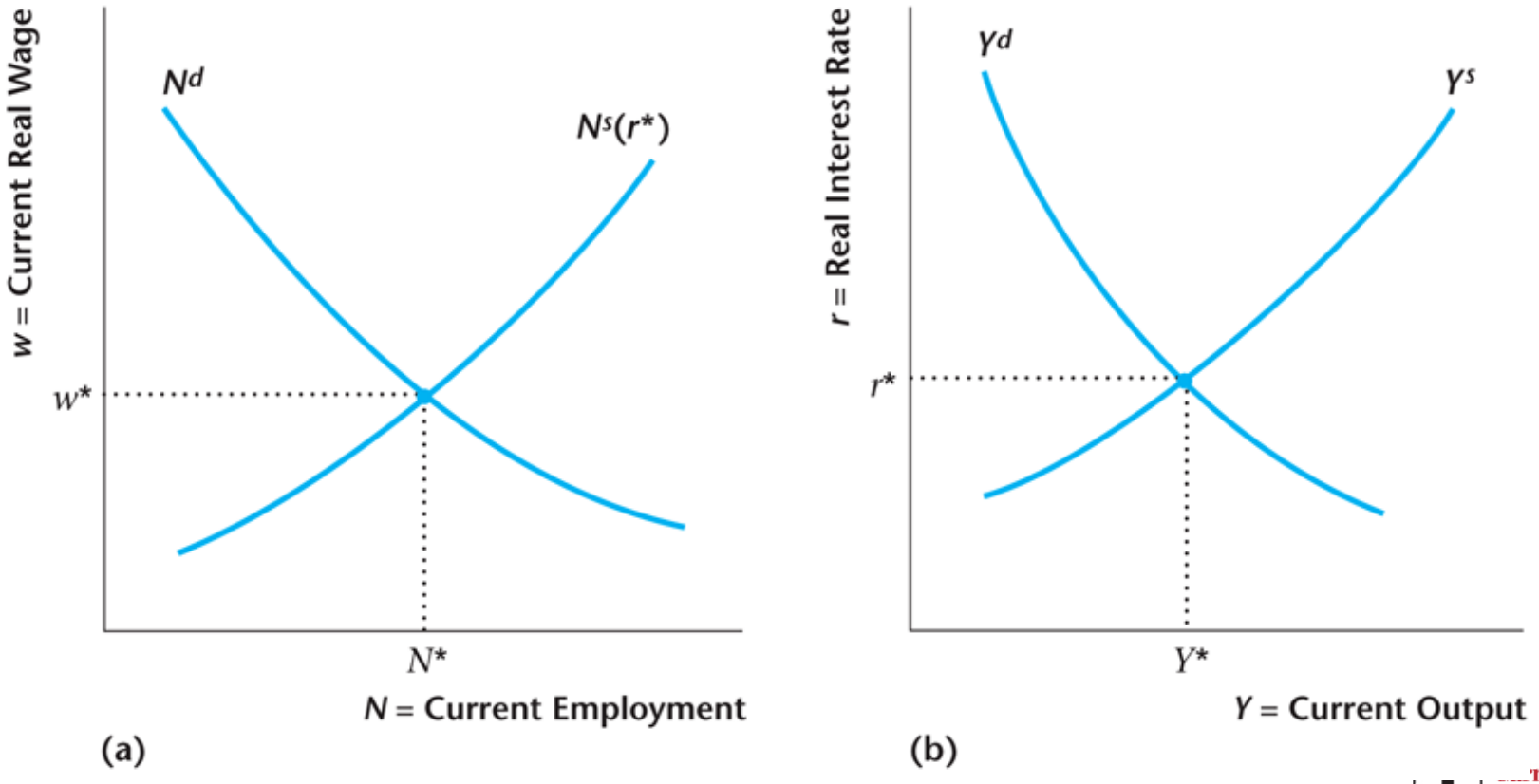
The Output Demand Curve

-Definition-

- We call the decreasing relationship between r and Y the Output Demand Curve

Graphical Equilibrium

Step 3: Combine Output Supply and Output Demand to solve for equilibrium interest rate r^* and output Y^*:



Summing Up

- For fixed r, what value of output is consistent with labor market clearing?

  Answer: $Y^s(r)$

- For fixed r, what value of output is consistent with goods market clearing?

  Answer: $Y^d(r)$

- In equilibrium, both labor and goods markets must clear, so $Y^s(r^*) = Y^d(r^*)$

- Given equilibrium r^*, Y^*
  - Employment: N^* s.t. $Y^* = zF(K, N^*)$
  - Consumption $C^* = C(Y^*, r^*)$
  - Investment I^* s.t. $MPK' - d = r^*$

Working with the Model

We now use the model to understand short-run fluctuations by performing experiments

- Temporary increase in current tfp (z increases)
- Expected increase in future tfp (z' increases)
- Temporary Increase in current gov't spending (G increases)
- Decrease in current capital stock (K decreases)

Working with the Model

Approach

- **Step A:** Determine whether Output Supply and/or Output Demand Shifts on impact

- **Step B:** Use Step A to determine if variables that changed on impact had any effect on equilibrium interest rate, r^*

- Combine outcomes from Step A and Step B to obtain "Equilibrium" Effects

Experiments: Increase in Current Productivity

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Experiment: Temporary Increase in Productivity

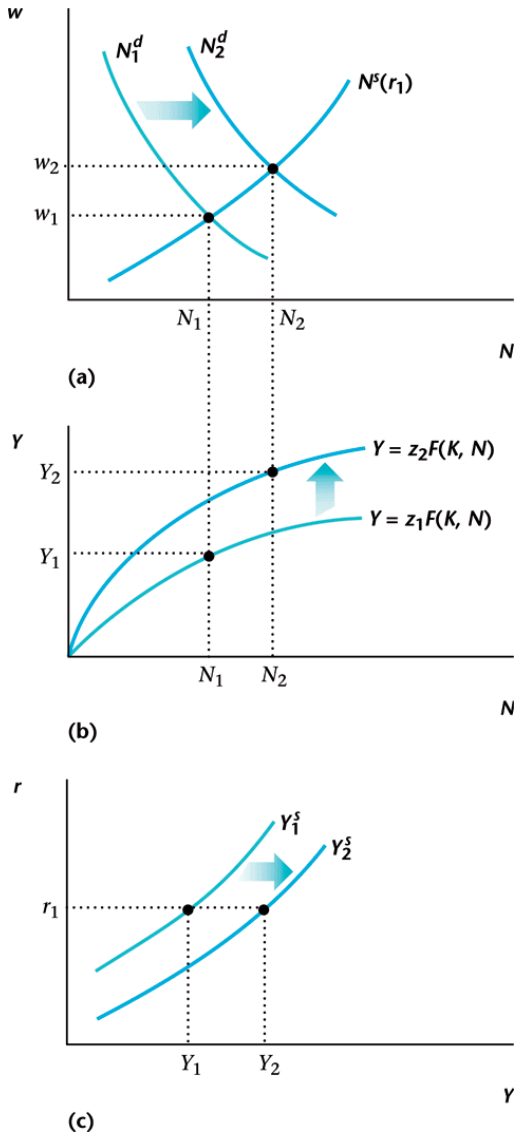
Note: all things happen simultaneously in equilibrium, but we will walk through the logic sequentially.

Consider an increase in z

- Each unit of labor more productive $\implies N^d \uparrow \implies Y^s \uparrow$
- No direct impact on Y^d (although there can be indirect effects through changing prices)
  - Conclude output must increase and interest rate must decrease
- Lower interest rate decreases labor supply
- Equilibrium Effects:
  - Higher wages
  - Higher Consumption
  - Higher Investment
  - Labor ambiguous

Shifting the Output Supply Curve

Suppose TFP increases $z_1 \uparrow z_2$



⟵ Higher productivity increases demand for labor. Which leads to higher equilibrium wage and higher quantity of labor hired.

⟵ Second, each unit of labor is now more productive.

⟵ Hence output is higher at each interest rate.

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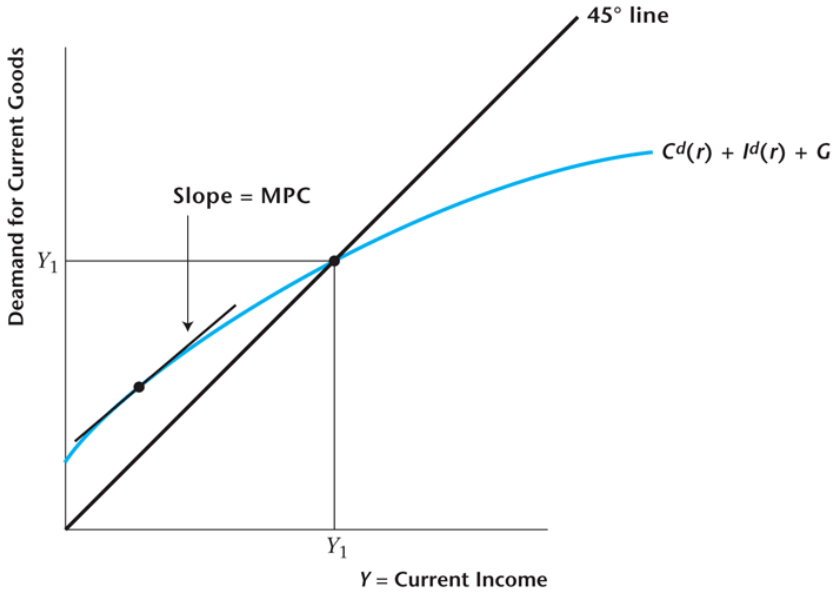
No Change in Output Demand Curve

Suppose TFP increases $z_1 \uparrow z_2$



- For each r and level of current income, no change in $C(Y, r), I(r)$, or G
- Since this does not change, $Y^d(r)$ does not change

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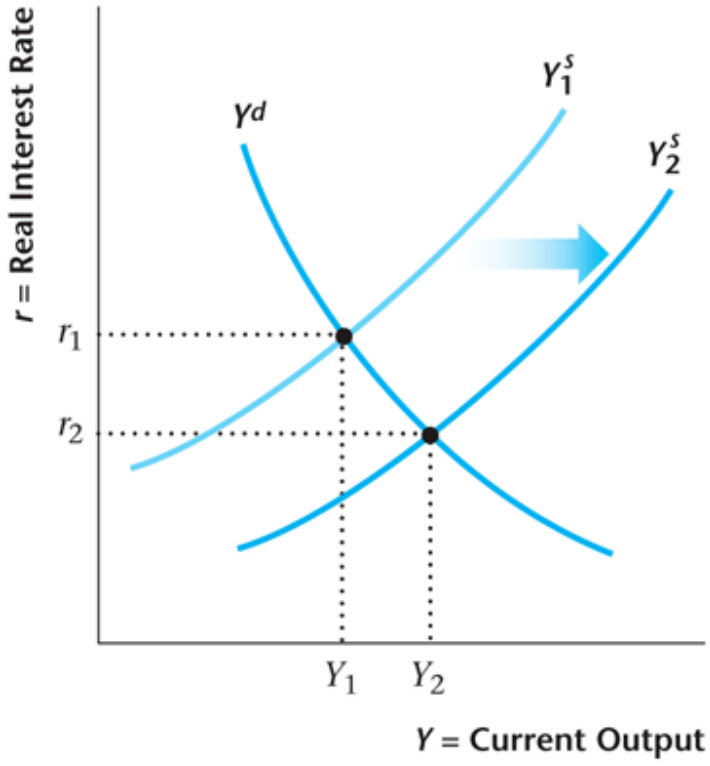
Impact Effect of Temporary Increase in z



- Output Supply Shifts to the Right

$\Rightarrow$ Equilibrium Y must increase

$\Rightarrow$ Equilibrium r must fall

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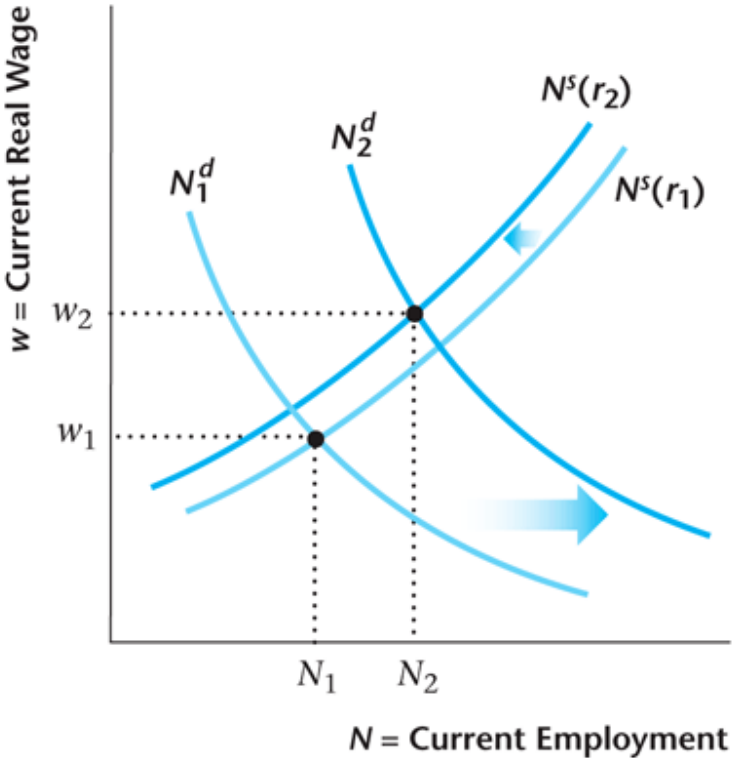
Equilibrium Effects in Labor Markets

- Effect of lower interest rate on N and w:



- Lower r implies labor supply shifts to the left (to $N^s(r_2)$)
- Recall, increased z caused N^d to shift to the right
- Wage must rise, Employment is ambiguous

- Impact effect: w rises, N rises
- Effect of lower equilibrium r: w rises, N falls

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Equilibrium Effects in Goods Markets

- Higher Income, Y and lower interest rate, r implies
  - Current consumption increases
    (remember, $C(Y, r)$ increasing in Y, decreasing in r)
  - Investment increases
    (remember, $I(r)$ decreasing in r)

Temporary Increase in z

Punchline: A temporary increase in productivity causes

- r to decreases
- Y increase
- C to increase
- I to increase
- w to increase
- N increases if $\Delta N^s < \Delta N^d$

- Question: Are temporary fluctuations in productivity a good explanation of business cycles?

Some recent news

CNBC

December could be a good month for the stock market, but there's one big risk: trade

The health of the economy is also a factor for markets, and there is some key data, with the ISM manufacturing report on Monday followed by ...

5 days ago

Reuters.com

U.S. stocks retreat on economy and trade jitters

NEW YORK (Reuters) - Wall Street stepped back from last week's record highs on Monday, with weak U.S. manufacturing data and fresh trade ...

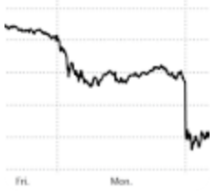
2 days ago

The New York Times

Trump Volatility in Markets Is Back

After weeks of relative calm and record highs, stocks in the United States fell ... on his China trade war rattled investors and revived some of the market .... Falling bond yields typically are seen to reflect declining

1 day ago



CNBC

Investors fear another December sell-off if Trump lets tariffs take effect Dec. 15

15 as a pivot point for the stock market, with expectations the U.S. and China would agree to a first phase trade deal and stocks would then ...

1 day ago

Why do we care about the stock market?

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Some recent news

- Movements in the stock market reflect investor sentiment
- Movements in the stock market reflect how firms and investors view future business conditions
- Stock market viewed as a signal (not a perfect signal) of movements in economic activity
- In other words, stock market activity can be a (noisy) indicator of future economic activity (we would model this as information about z')

Final Exam Info

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Final Exam Info

- Where: HOA (Hall of the Arts) 160
- When: Thursday Dec 12
- Time: 830am - 1130am (but you should be able to finish early)
- Coverage: Everything after midterm 2 (Lecture 15- Lecture 19)
- Format: same as your midterm exam!

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Office hours

I will be holding office hours on

- Tues: 330-530pm
- Wed: 330-530pm

Try the practice final that's been posted online. Your TAs will go over the solution this Friday during recitation

Final words

That's it!

Its been a pleasure teaching you
You've been a great class!

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