

## Econ. 1A. Chapter 8. Potential GDP and Natural Unemployment Rate.

1. In chapters 5, 6 and 7, we learned how economists define and measure indicators of macroeconomic performance: RGDP ( $Y$ ), potential GDP ( $Y_p$ ), unemployment rate (UR or  $U-3$ ), natural unemployment rate (NUR), CPI, inflation rate ( $\pi$ ), nominal interest rate ( $i$ ) and real interest rate ( $r$ ). In this chapter and those that follow is to learn **macroeconomic models (theories)** that explains macroeconomic performance of an economy and provides the basis for **policies** that might improve it.
2. Three main schools of economic thoughts:
  - a. **Classical macroeconomics**: the view that the market economy works well, and that aggregate fluctuations are a natural consequence of an economy and government cannot improve the efficiency of the market economy.
  - b. **Keynesian macroeconomics**: the view that the market economy is inherently unstable and needs active government intervention to achieve full employment and sustained economic growth.
  - c. **Monetarist macroeconomics**: the view that the market economy works well, and that aggregate fluctuations are a natural consequence of an expanding economy, but that fluctuations in the quantity of money also bring the business cycle.
3. **Today's Consensus**
  - a. **Classical macroeconomics** provides the model for the economy at or close full employment. But it doesn't explain how the economy performance in the face of a major slump in spending.
  - b. **Keynesian macroeconomics** provides the model for the economy in a recession or depression. When spending is cut and the demand for most of goods and services and the demand for labor all decrease, prices and wage rates don't fall but the quantity of goods and services sold and the quantity of labor employed do fall and the economy goes into recession. *In a recession, an increase in spending by governments, or a tax cut that leaves people with more of their earnings to spend, can help to restore full employment.*
  - c. **Monetarist macroeconomics** elaborates the Keynesian theory by emphasizing that a contraction in the quantity of money brings higher interest rates and borrowing costs, which are a major sources of cuts in spending that bring recession. *Increasing the quantity of money and lowering the interest rate in a recession can help to restore full employment.* And keeping the quantity of money growing steadily in line with the expansion of the economy's production possibilities can help to keep inflation in check, and can also help to moderate the severity of a recession.

**Note that in today's consensus another component is the view that the long-run problem of economic growth is more important than the short-run problem of recession.**

## Potential GDP

4. **Potential GDP** is the value of RGDP when all the economy's factors of production – L, K, N, E –are fully employed. At potential GDP,  $UR = NUR$ .

### (i) Production Function

5. **The aggregate production function** is a function showing for a given state of technological knowledge the relationship between the maximum RGDP as the quantity of labor employed changes and all other influences (K, N and E) on production remain the same.

$$Y = F(L; K, N, E)$$

where  $Y = \text{RGDP}$ ,  $L = \text{labor}$ ,  $K = \text{capital}$ ,  $N = \text{land}$ ,  $E = \text{entrepreneurship}$ .

	Y	$\Delta Y$	L	$\Delta L$	$\Delta Y/\Delta L$
A	11		100		
		5		100	$5/100 = 0.05$
B	16		200		
		4		100	$4/100 = 0.04$
C	20		300		

$Y = \text{RGDP}$  trillions (in 2005 dollar).  $L = \text{billions of hours per year}$

**Note that the production function must display diminishing returns.**

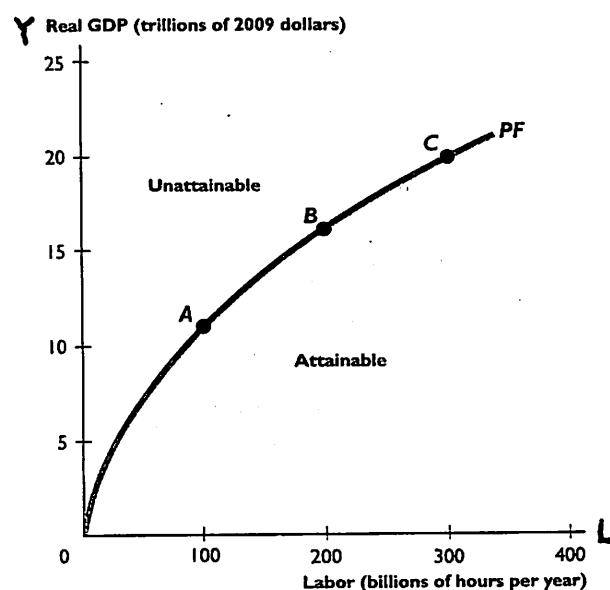
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**Diminishing returns:** The tendency for *each additional labor employed* to produce a successively *smaller* additional amount of RGDP when K, N, and E are fixed.

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The production function shows the maximum quantity of real GDP that can be produced as the quantity of labor employed changes and all other influences on production remain the same. In this example, 100 billion hours of labor can produce \$11 trillion of real GDP at point A, 200 billion hours of labor can produce \$16 trillion of real GDP at point B, and 300 billion hours of labor can produce \$20 trillion of real GDP at point C.

The production function separates attainable combinations of labor hours and real GDP from unattainable combinations and displays diminishing returns: Each additional hour of labor produces a successively smaller additional amount of real GDP.



Labor (billions of hours per year)	100	200	300
Real GDP (trillions of 2009 dollars)	11	16	20
	A	B	C

## (ii) Labor Market

6. **The labor market:** Any arrangement that brings *labors* and *firms* together and enables them to get information, make rational decision. It is the interaction of demand for labor (LD) and supply of labor (LS) in the labor market.

### 7. Economic Model: Labor Market

#### 7.1. Assumptions

- Other influences (things) remain the same.  
**LD:** K, N, E, Technology.  
**LS:** labor force, income taxes, unemployment benefits.
- Given a time period
- The laws of demand (i.e., the lower the real wage rate, the greater is the quantity of labor demanded,) and supply (i.e., the greater the real wage rate, the greater is the quantity of labor supplied,) hold.

7.2. **LD (demand for labor)** is the negative relationship between quantity of labor demanded ( $L_d$ ) and the real wage rate ( $w$ ) when all other influences on firms' hiring plans remain the same during a given time period..

7.3. **LS (Supply of Labor)** is the positive relationship between quantity of labor supplied ( $L_s$ ) and the real wage ( $w$ ) when all other influences on work plans remain the same during a given time period.

7.4. **Labor market Equilibrium** is a situation where  $L_d = L_s$ .

(a) **equilibrium real wage rate:** The real wage rate at which  $L_d = L_s$ .

(b) **equilibrium employment:** The employment at which  $L_d = L_s = L_f$ , where  $L_f$  = full employment.

#### 7.5. LD, LS and labor market

$w$	$L_d$	$L_s$
75	120	300
<b>50</b>	<b>200</b>	<b>200</b>
25	300	100

where  $w$  = real wage  $W/P$ ,

$W$  = nominal wage.

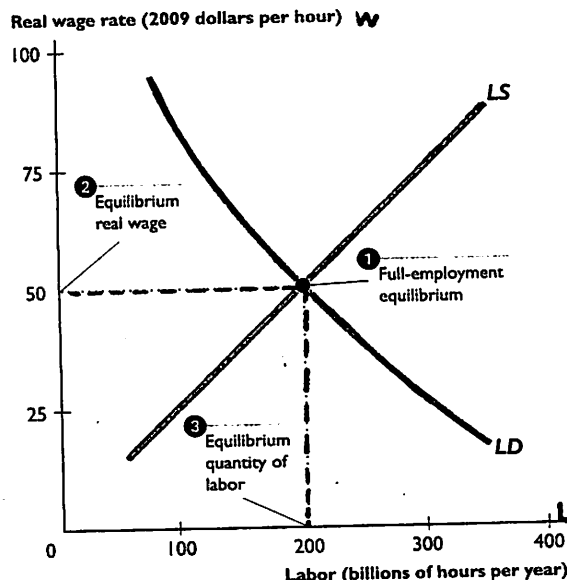
$P$  = CPI and the base year is 2005

$L_d$  and  $L_s$  = billions of hours per year.

**Equilibrium real wage rate**

( $w$ ) = \$50 in 2005 dollar.

**Full employment ( $L_f$ ) = 200.**



(a) The labor market

- 1 Full employment occurs when the quantity of labor demanded equals the quantity of labor supplied. 2 The equilibrium real wage rate is \$50 an hour, and 3 the equilibrium quantity of labor employed is 200 billion hours a year.

## Potential GDP ( $Y_p$ ) Model

Combining (i) production function and (ii) labor market, we obtain the Potential GDP ( $Y_p$ ) model.

### 8. Potential GDP Model

#### 8.1. Assumptions:

a. Given a time period.

(Production Function:  $Y = F(L; K, N, E)$ )

b.  $K, N, E$  and technology remain the same.

c. The law of diminishing returns holds.

(Labor market)

d. Other influences (things) remain the same.

LD:  $K, N, E, \text{ Technology}$ .

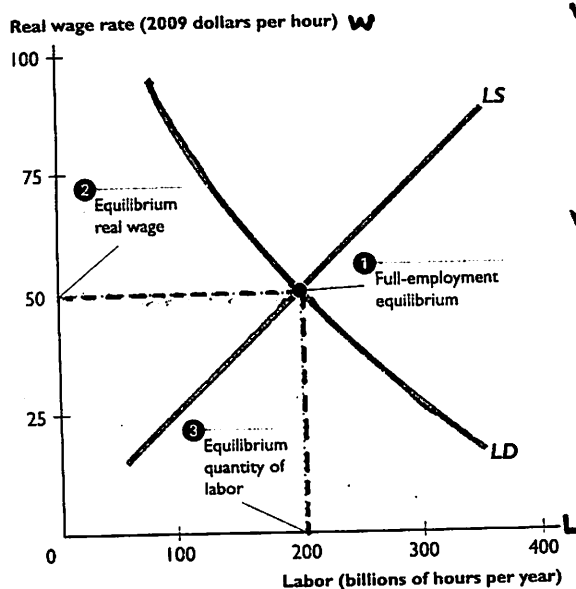
LS: labor force, income taxes and unemployment benefits.

e. The laws of demand and supply of labor hold.

#### 8.2. Determination of potential GDP

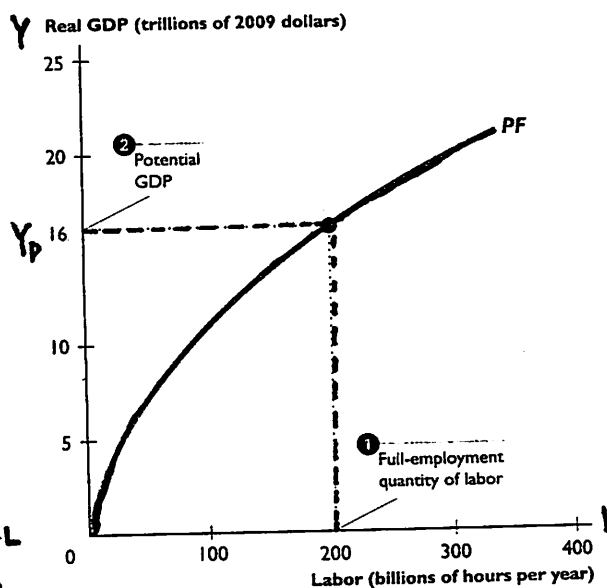
	Y	L	w	$L_d$	$L_s$
A	11	100	75	120	300
B	16	200	50	200	200
C	20	300	25	300	100

In the labor market equilibrium, the equilibrium level of employment ( $L_f$ ) = 200 and  $w = 50$ . Substituting this into the production function,  $Y = F(L; K, N, E)$  where  $K, N,$  and  $E$  are given, we find  $Y = \text{RGDP} = 16$  trillion (in 2005 dollar). This level of RGDP = potential GDP.



(a) The labor market

1 Full employment occurs when the quantity of labor demanded equals the quantity of labor supplied. 2 The equilibrium real wage rate is \$50 an hour, and 3 the equilibrium quantity of labor employed is 200 billion hours a year.



(b) Potential GDP

Potential GDP is the real GDP produced on the production function by the full-employment quantity of labor. 1 The full-employment quantity of labor, 200 billion hours a year, produces a 2 potential GDP of \$16 trillion.

### 8.3. Potential GDP, employment rate and natural unemployment rate

In the above case,  $w = 50$ ,  $L_f = 200$ . If there are 12 labor in **job search**, the labor force =  $200 + 12 = 212$  and the natural unemployment rate (NUR) =  $(12/212) \times 100\% = 5.7\%$ .

In this case,  $UR = NUR = 5.7\%$ .  $Y = Y_p = 16$  trillion (in 2005 dollar).

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**When the economy is at full employment, all unemployment is frictional, structural. The unemployment rate (UR) = natural unemployment rate (NUR).**

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Recall that

9. Potential GDP is the level of RGDP that the economy would produce if it were at full employment or at the natural rate of unemployment rate.
10. **Full employment ( $L_f$ )**: when there is no cyclical unemployment or, equivalently when all unemployment is frictional, structural.
11. Natural unemployment rate (NUR): The unemployment rate at full employment.
12. **Example**: In the labor market equilibrium, the equilibrium level of employment ( $L_f$ ) = 200. Substituting this into the production function,  $Y = F(L; K, N, E)$  where  $K$ ,  $N$ , and  $E$  are given, we find  $Y = \text{RGDP} = 16$  trillions (in 2005 dollar). This level of RGDP = potential GDP, i.e.,  $Y = Y_p$ .

#### Natural Unemployment Rate (NUR)

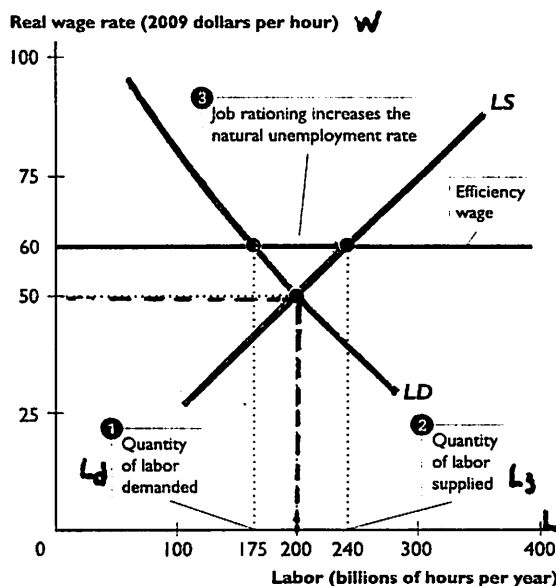
When the economy is at full employment, all unemployment is frictional or structural. The unemployment rate (UR) = natural unemployment rate (NUR).

13. Two fundamental causes of frictional and structural unemployment:
  - a. *Job search*: The activity of looking for an acceptable vacant job. The amount of job search depends on (i) demographic change; (ii) unemployment benefits; (iii) structural change.
  - b. *Job rationing*: A situation that arises when the real wage rate is above the equilibrium. The job rationing arises because (i) efficient wage; (ii) minimum wage, (iii) union wage.

#### Job Rationing Increases the Natural Unemployment Rate

The full-employment equilibrium real wage rate is \$50 an hour. Efficiency wages, the minimum wage, and union wages put the average real wage rate above the full-employment equilibrium level—at \$60 an hour.

- ① The quantity of labor demanded decreases to 175 billion hours.
- ② The quantity of labor supplied increases to 240 billion hours.
- ③ A surplus of labor arises and increases the natural unemployment rate.

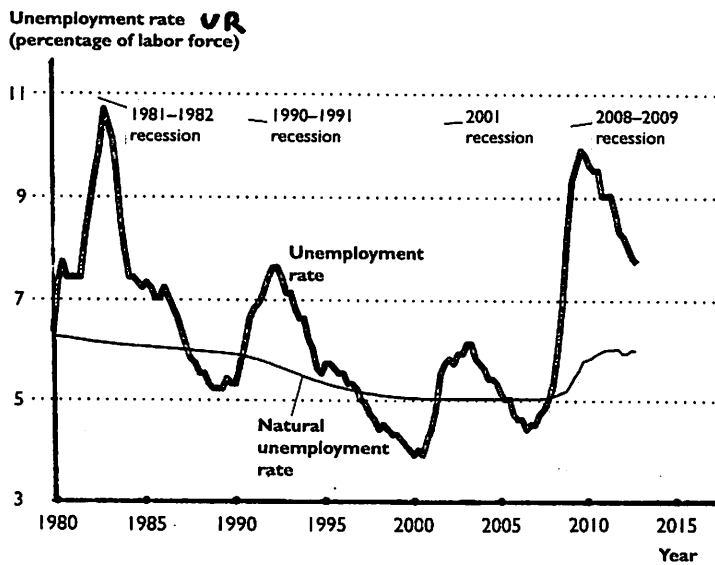


### 14. Example:

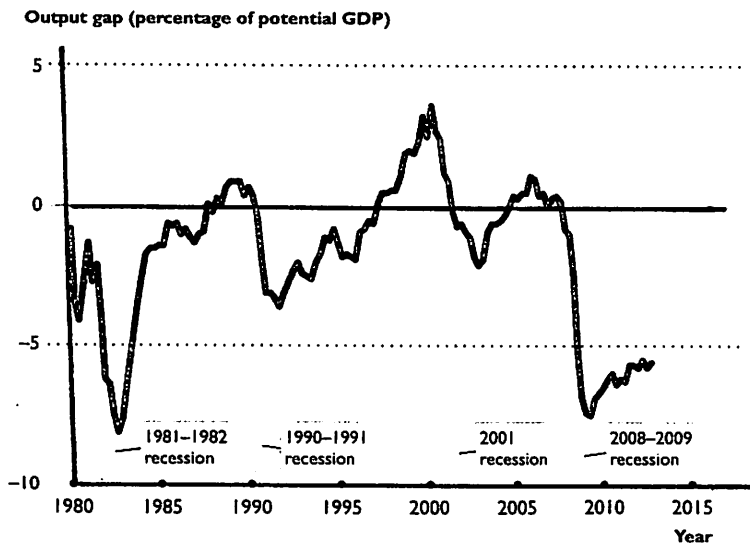
In the above case,  $w = 50$ ,  $L_f = 200$ . If there are 12 labor in job search, the labor force  $= 200 + 12 = 212$  and the natural unemployment rate  $= (12/212) \times 100\% = 5.7\%$ . In this case,  $UR = NUR = 5.7\%$ .  $Y = Y_p = 16$  trillion (in 2005 dollar).

## The Relationship among UR, NUR and Output gap

### The Relationship Between Unemployment and the Output Gap



(a) Cyclical and natural unemployment



(b) The output gap

As the unemployment rate fluctuates around the natural unemployment rate in part (a), the output gap—real GDP minus potential GDP expressed as a percentage of potential GDP—fluctuates around a zero output gap in part (b).

When the unemployment rate exceeds the natural unemployment rate, real GDP is below potential GDP and the output gap is negative (red sections in both parts).

When the unemployment rate is below the natural unemployment rate, real GDP is above potential GDP and the output gap is positive (blue sections in both parts).

The natural unemployment rate shown in the graph is the Congressional Budget Office's estimate. It might turn out to be a substantial underestimate for the years since 2008.

$$\text{Output gap} = \frac{Y - Y_p}{Y_p} \times 100\%$$

$Y = \text{RGDP}$   
 $Y_p = \text{potential GDP}$