

Lecture 5: The Labor Market

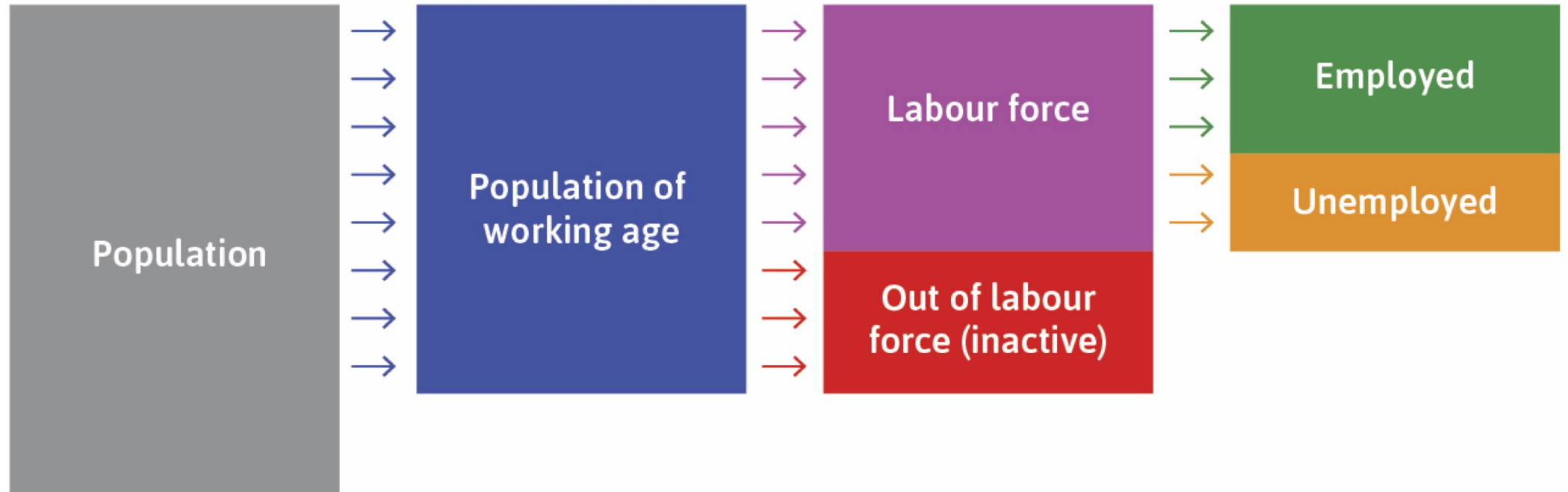
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EC566 | Macroeconomics for Business

This lecture

- We will learn about
 - how the economy-wide labor market determines wages and employment
- We will model
 - wage-setting behavior of the firms in the entire economy
 - price-setting behavior of the firms in the entire economy

Measuring unemployment

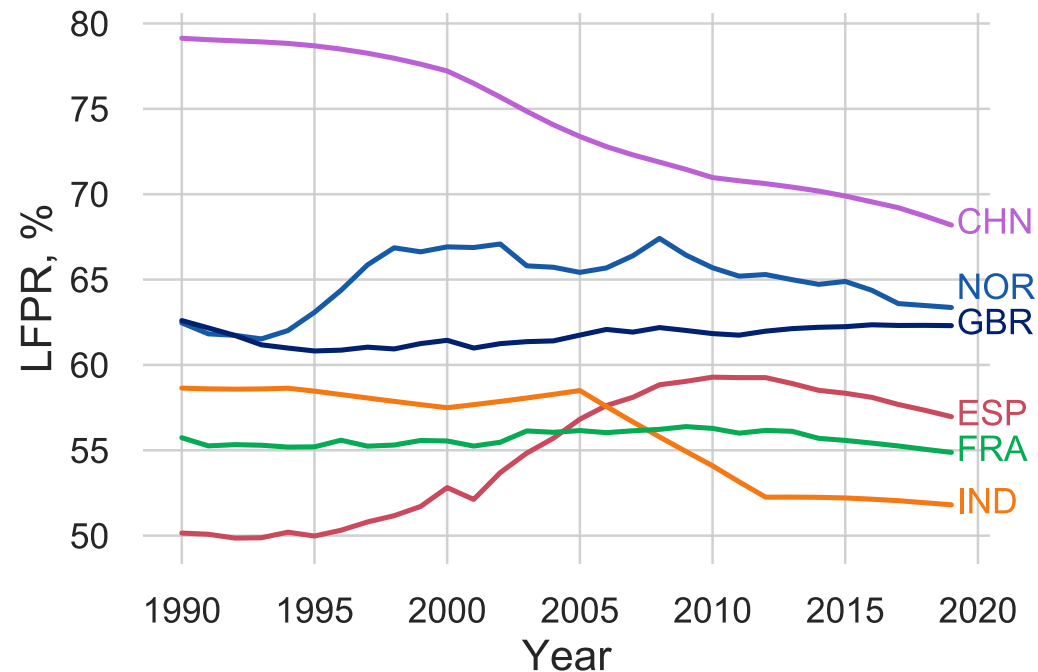


Definitions

- **Population of working age:** number of all the people aged between 15 and 64.
- **Labor force:** number of all the people in the working age who are working or seeking an employment outside of the household.
- **Out of labor force:** number of working age people who are not working and not actively looking for a job
 - e.g. people unable to work due to sickness, stay at home parents to raise children, ...
- **Employed:** number of people that have a job
- **Unemployed:** number of people that does not have a job but actively seeking for one

Labor force participation rate (LFPR)

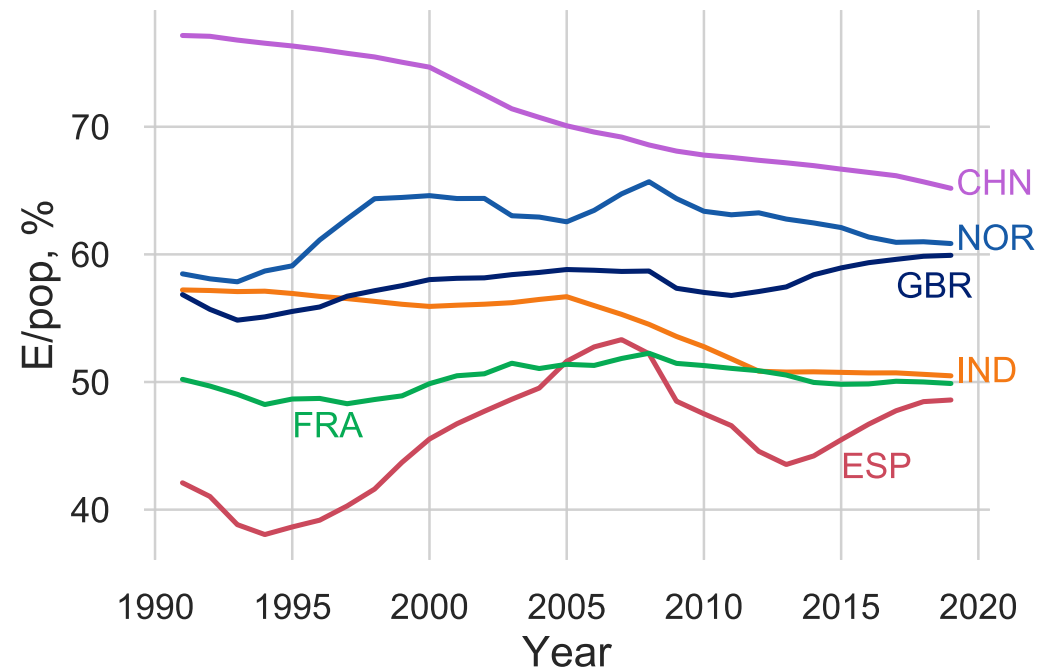
$$\text{Labor force participation rate} = \frac{\text{Labor force}}{\text{Population of working age}}$$



Data source: [The World Bank](#)

Employment to working age population ratio (E/pop)

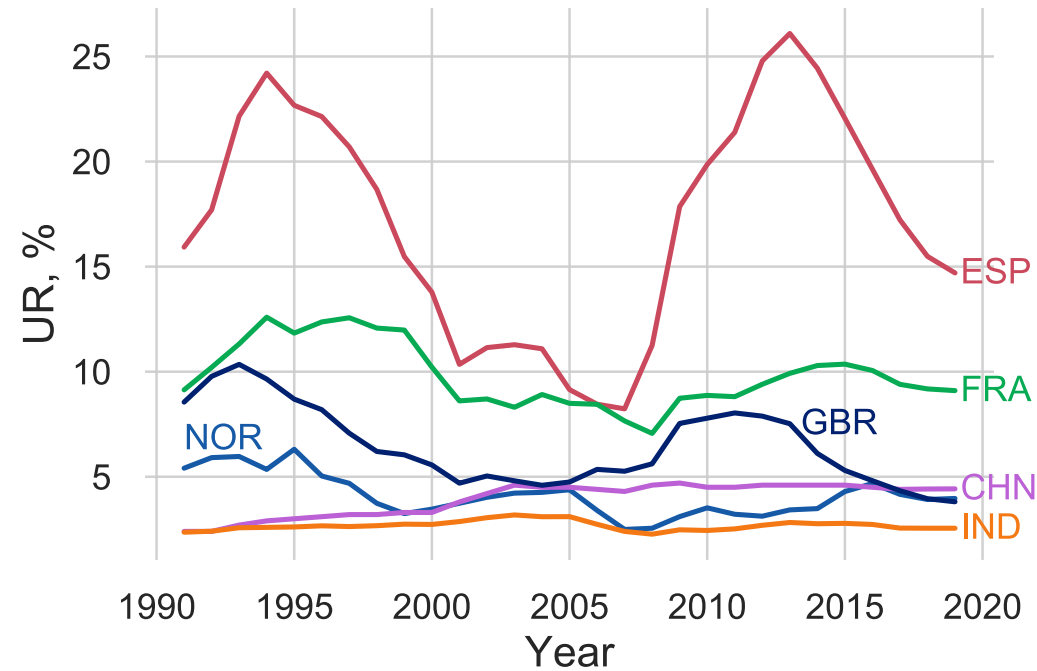
$$\text{Employment rate} = \frac{\text{Employed}}{\text{Population of working age}}$$



Data source: [The World Bank](#)

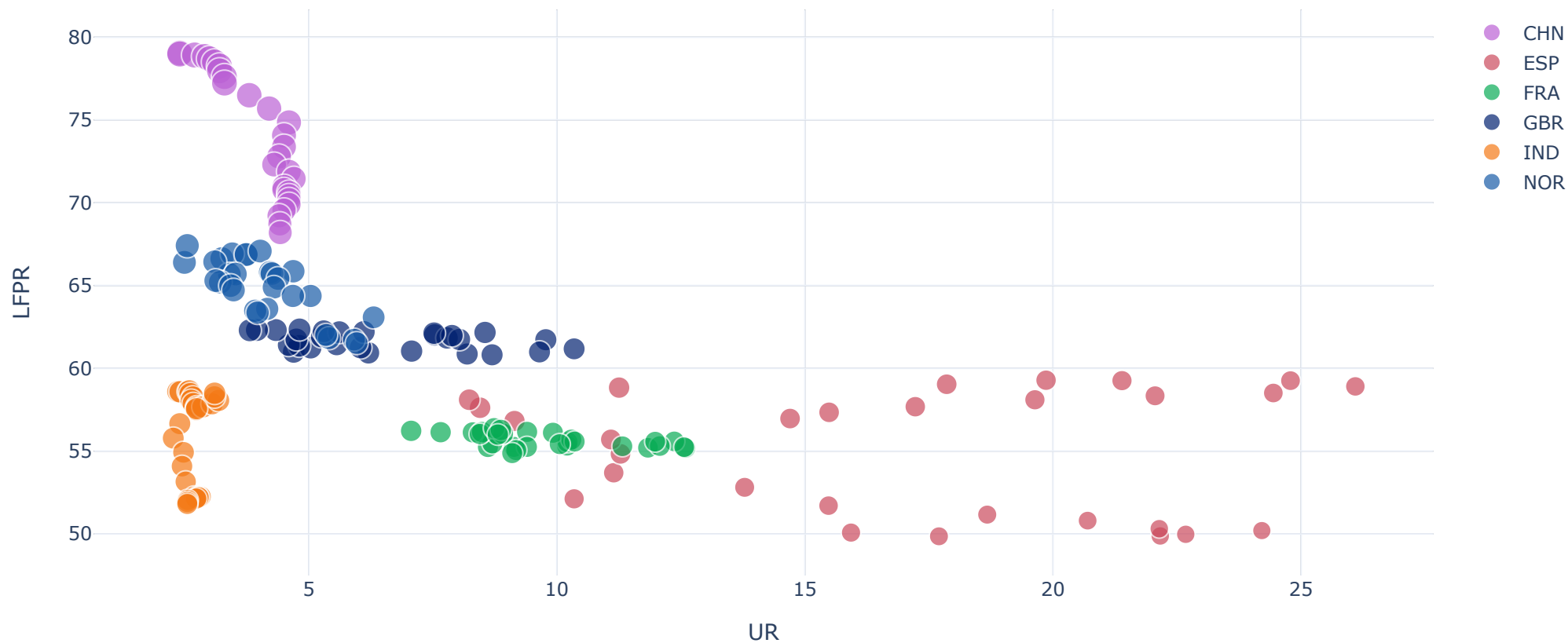
Unemployment rate

$$\text{Unemployment rate} = \frac{\text{Unemployed}}{\text{Labor force}}$$



Data source: [The World Bank](#)

Labor force participation rate and unemployment rate



Recall what we learned in the previous lectures

At the firm level

- Wage setting: firms set wage sufficiently high to motivate employees to exert high effort
- Price setting: firms set a markup above the marginal cost of production to maximize profits

The chain of firm decisions

Nominal wage = $f(\text{other firms' prices and wages, unemployment rate})$



Price = $f(\text{own nominal wage, demand for own product})$



Output = $f(\text{optimal price, demand curve})$



Number of employees = $f(\text{output, production function})$

- Notice that unemployment rate, input to the nominal wage function, depends on the number of employees function.
 - Hence macroeconomics: actions/decisions of all agents in the economy are interrelated.

Goal of this lecture

Characterize

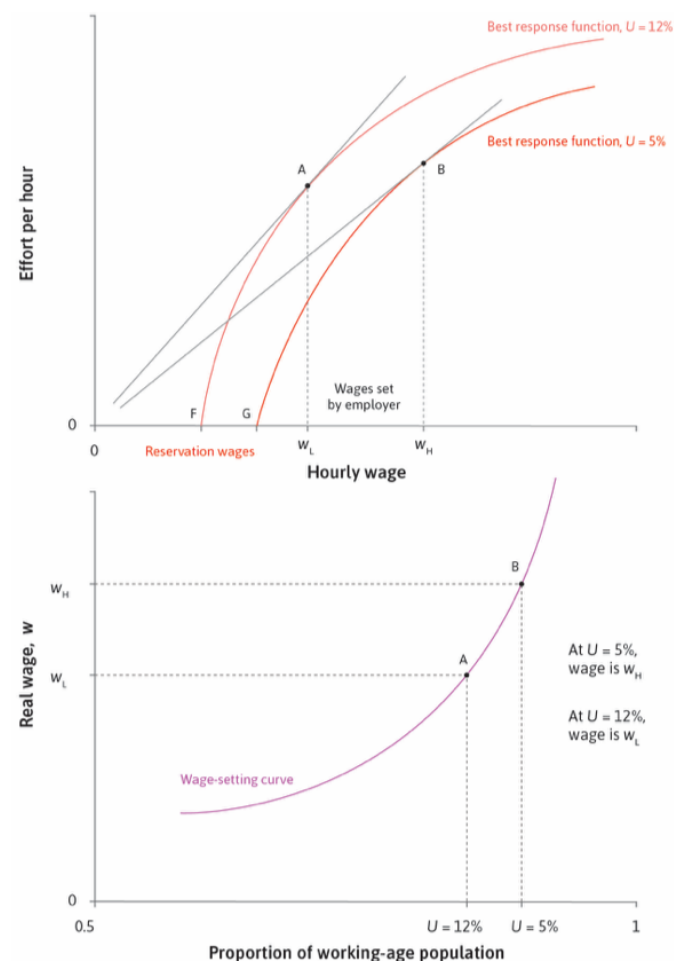
- real wage = W/P in the entire economy
 - W is the nominal wage, P is the price level of a representative bundle of goods in the economy
 - What workers care about is the what they can purchase with their salaries
- level of employment in the entire economy

To achieve this goal

1. derive the wage-setting curve in the entire economy
2. derive the price-setting curve in the entire economy
3. put them together to get the equilibrium

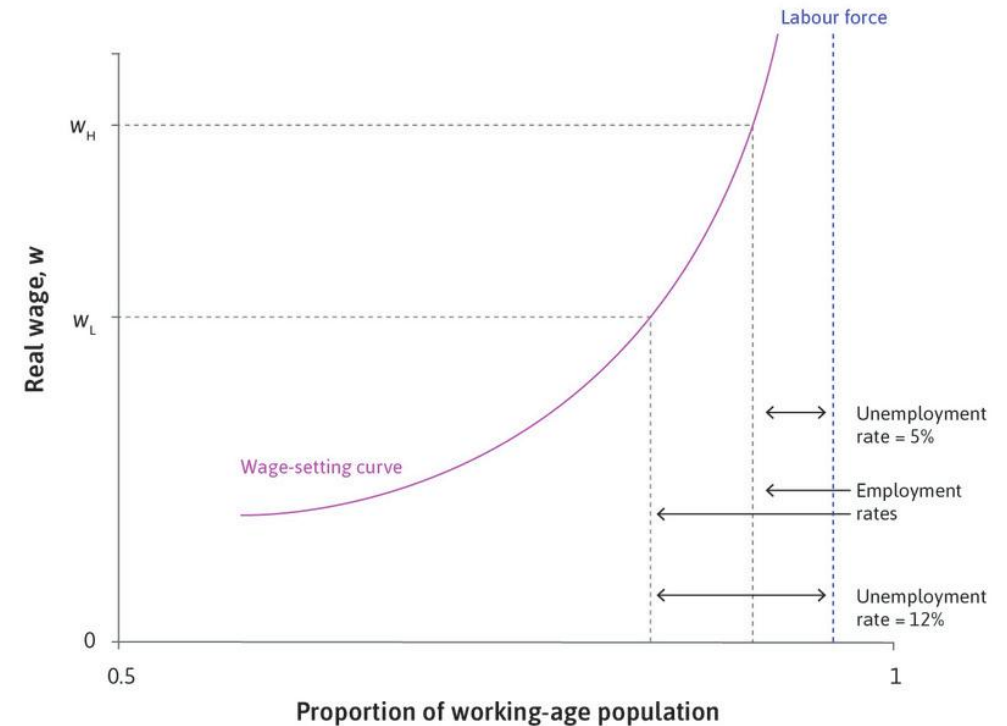
Deriving the wage-setting curve

- As unemployment decreases
 - workers are more likely to find a job elsewhere had they lose their job
 - results in lower employment rents
 - to keep workers motivated, firms raise wages
 - hence there is a positive relationship between employment and real wages
- In the last seminar I overcomplicated this graph.
 - Assume workers' best response curve have characteristics that a rightward shift always leads to an increase in the wage rate.



Wage-setting curve

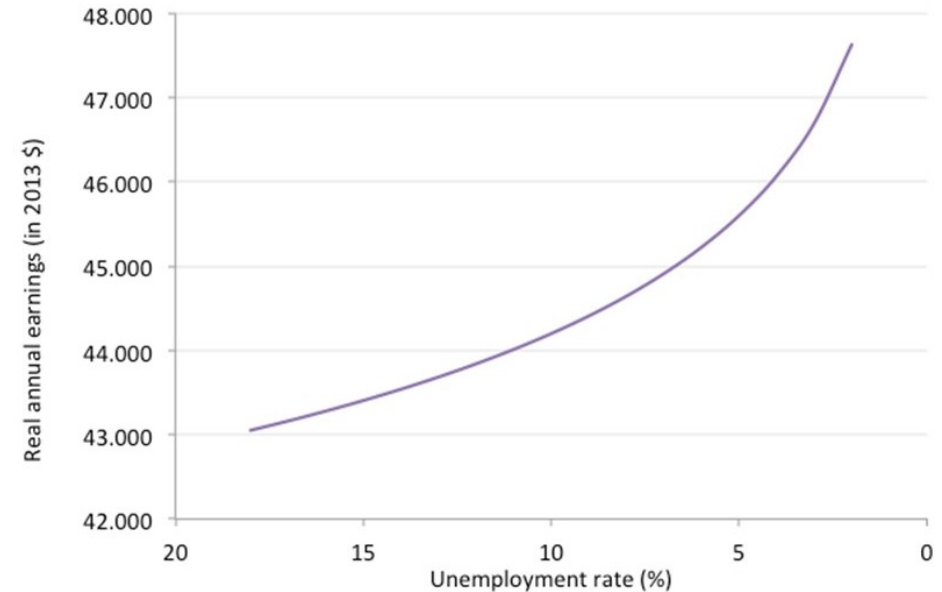
- **Wage-setting curve** shows the real wage necessary to keep workers motivated at each level of economy-wide employment.
- At a given real wage, the distance between the corresponding employment rate and the labor force is the unemployment rate (times the labor force participation rate)
 - Example, at real wage = w_L , the unemployment rate is equal to 12%.
- As unemployment rate decreases, real wage increases.



An estimated wage-setting curve

An example wage-setting curve

- estimated from the Current Population Survey (USA) from 1979 to 2015 by Stephen Machin
- using unemployment rates and wages in the local areas



Deriving the price-setting

- Given a firm's own wage and the demand for own product, the marketing department sets the prices
- Given the price chosen by the marketing department, production department sets the quantity
- Given production, HR hires workers

Using these decisions, we will derive the price-setting curve.

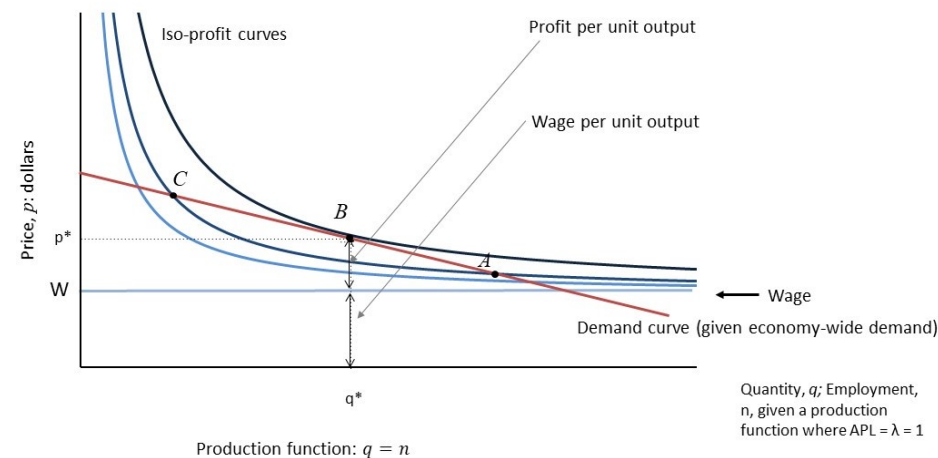
Assumptions

- Labor is the only factor of production
- One unit of labor produces λ units of output
 - Constant marginal cost of production
 - Marginal cost of production is equal to wage rate over labor productivity, W/λ
- All firms face the same demand curve

Price Setting curve

- To maximize profits, the firm produces at point B.
- Markup, $\mu \equiv \frac{p^* - MC}{p^*} = \frac{p^* - W/\lambda}{p^*}$, where p^* is the firm price
 - Markup is a measure of market power
 - Contrast this with a competitive market in which $p^* = MC$, and hence firms don't have any market power
- Since all firms face the same demand curve, they all charge the same price, hence $p^* = P$, where P is the price of a bundle of the goods in the economy.

$$\mu = \frac{P - W/\lambda}{P}$$



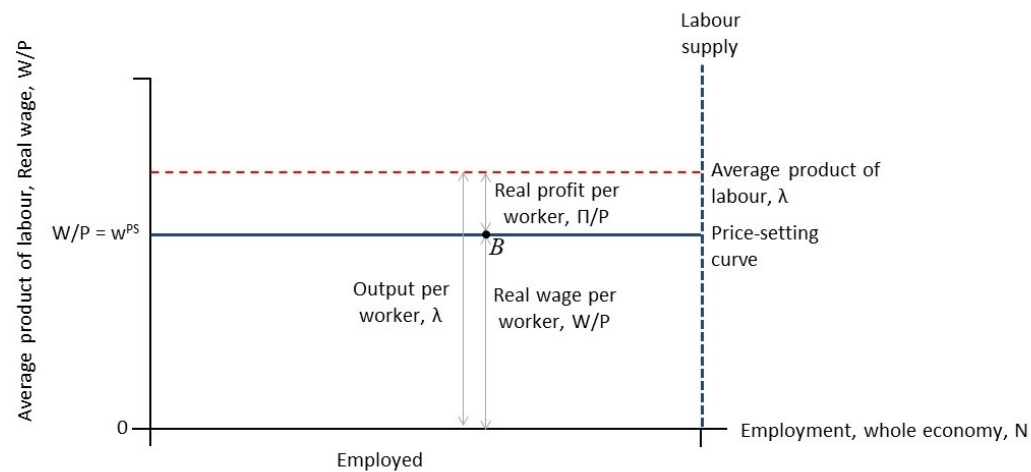
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Price setting

- We assume that the markup, μ , is determined by the market conditions such
 - level of competition in the market
 - elasticity of demand
- Then $\mu = \frac{P-W/\lambda}{P} = 1 - \frac{W}{P} \frac{1}{\lambda} \Rightarrow \frac{W}{P} = \lambda - \lambda\mu$
- Real wage, $\frac{W}{P} = \lambda - \lambda\mu$, is independent of the employment level
- Real wage is positively related to labor productivity, and inversely related to market power.
- To better understand this point, read
 - Einstein: The elasticity of demand and the marginal revenue
 - Einstein: The price-setting curve
 - Or, check out my slides

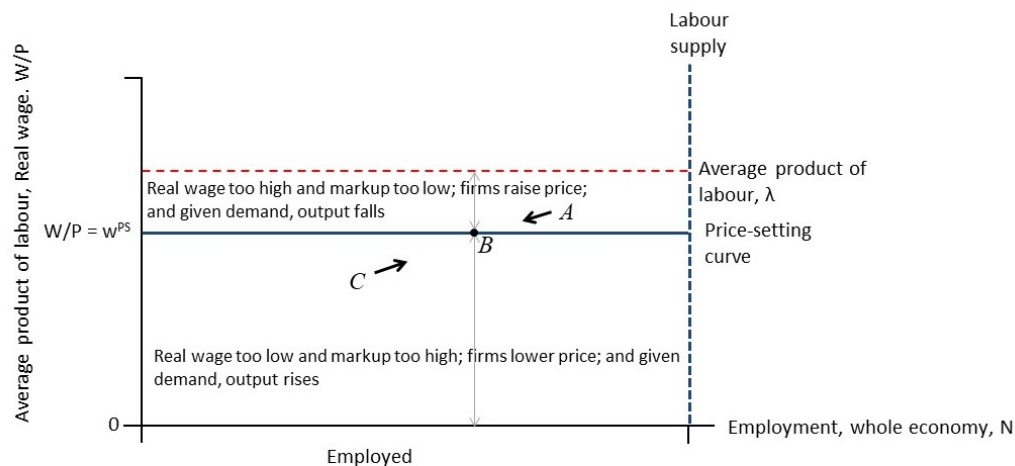
Price-setting curve

- It's actually a point (or flat line independent of employment level)
- Given a wage rate, all firms charge a price P such that W/P is equal to a constant that is determined by factors such as
 - consumer preferences
 - level of competition
 - labor productivity



Price-setting curve, cont'd

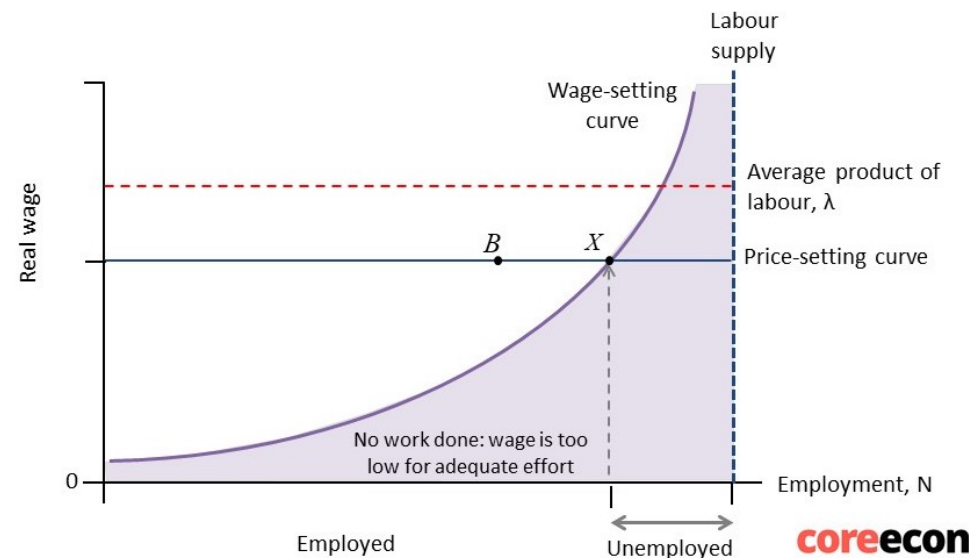
- At point A, real wage is high, and output is high
 - Given demand, firms raise prices, output decreases, but profits increase.
 - Economy moves towards point B
- At point C, real wage is low, and output is low
 - Given demand, firms decrease prices, output increases, but profits increase.
 - Economy moves towards point B



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Labor market equilibrium

- Intersection of the wage-setting curve and price-setting curve gives the Nash equilibrium.
 - Point X in the graph
 - Firms pay the smallest wage to make workers exert sufficient effort
 - Given the wage, employment is at the highest level
 - Workers cannot ask more (firms will not pay more)
 - Workers cannot put less effort (they will lose their jobs)
 - Unemployed people cannot persuade firms to hire them
 - Firms cannot improve their profit by paying less wage or charging more.
- In equilibrium, there is unemployment
- In equilibrium, real wage is lower than labor productivity



Summary

- We have learned the definitions of
 - labor force participation rate
 - unemployment rate
 - employment rate
- We derived the wage-setting curve
- We derived the price-setting curve
- We characterized the labor market equilibrium using the above two

Next lecture

- Distribution of output
- Involuntary unemployment
- Demand-deficit unemployment
- Labor market policies
- Labor unions

Price-setting curve, mathematical

- Recall that at the optimum, slope of the isoprofit curve (MRS) is equal to the slope of the demand curve (MRT)
- Write down the slope of the demand curve as a function of elasticity

$$\epsilon = -\frac{\frac{\Delta Q}{Q}}{\frac{\Delta P}{P}} = -\frac{\Delta Q}{\Delta P} \frac{P}{Q}$$

$$MRT \equiv -\frac{\Delta P}{\Delta Q} = \frac{P}{Q} \frac{1}{\epsilon}$$

- Then write down MRS, say, at the $\pi = k$ isoprofit line

$$P * Q - Q * AC = k$$

- Differentiate alongside this curve

$$dP * Q + P * dQ - dQ * AC = 0$$

$$dP * Q - dQ(P - AC) = 0$$

$$MRS = \frac{dP}{dQ} = \frac{P - AC}{Q} = \frac{P - W/\lambda}{Q}$$

since average cost of production is equal to marginal cost (in this economy with cost unit costs), which is equal to W/λ

- In optimum, $MRS = MRT$

$$\frac{P - W/\lambda}{Q} = \frac{P}{Q} \frac{1}{\epsilon}$$

Then

$$\mu = \frac{P - W/\lambda}{P} = \frac{1}{\epsilon} \Rightarrow \frac{W}{P} = \lambda - \frac{\lambda}{\epsilon}$$

- Real wage is positively related to elasticity of substitution, but independent of employment