





## Factor Markets EE311

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### Topics to be Discussed

- Competitive Factor Markets
- Equilibrium in a Competitive Factor Market
- Factor Markets with Monopoly Power
- Factor Markets with Monopsony Power
- Bilateral Monopoly


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### Summary


Factor Seller Market	Factor Buyer Market	Final Good Market	
		Competitive	Monopoly
Competitive	Competitive	1	2
	Monopoly	3	---
Monopoly	Competitive	4	---
	Monopoly	5	

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### Competitive Factor Markets

- Characteristics
  1. Large number of sellers of the factor of production
  2. Large number of buyers of the factor of production
  3. The buyers and sellers of the factor of production are price takers
  4. Examples: construction worker market (In 2006, there were about 89,000 construction firms)



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## Factor Input Demand – One Variable Input (L), short run

- Demand for a Factor Input when only one input is variable (L), assuming K fixed
  - Factor demands are derived demand
    - Demand for an input that depends on, and is derived from, both the firm's level of output and the cost of inputs.
    - Demand for carpenters derived from how much furniture the firm expects to sell

## Factor Input Demand – One Variable Input

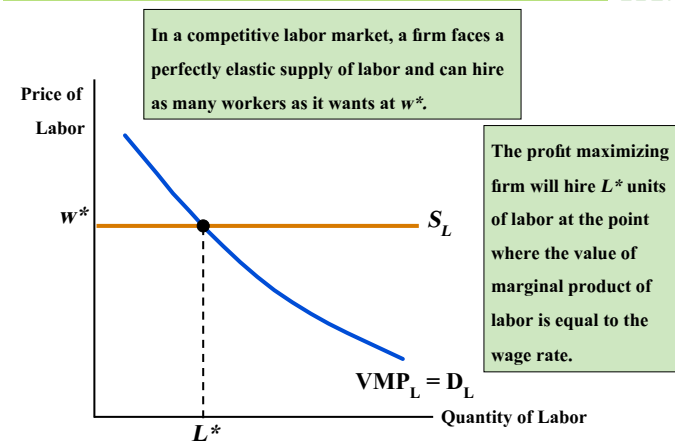
- How does a firm decide if its profitable to hire another worker?
  - If the additional revenue from the output of hiring another worker is greater than its additional cost
- The incremental cost of a unit of labor is the wage rate,  $w$

## Factor Input Demand – One Variable Input

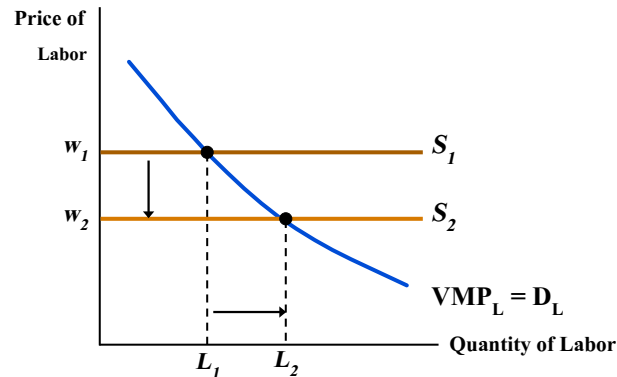
- Value of Marginal Product of Labor  $VMP_L = P \times MP_L$ 
  - Additional revenue resulting from the sale of output created by the use of one additional unit of an input
- Profitable to hire more labor if the  $VMP_L$  is at least as large as the wage rate,  $w$

$$VMP_L \geq W$$

## Hiring by a Firm in the Labor Market



## A Shift in the Supply of Labor



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## Comparing Input and Output Markets

$$\text{Max } \pi = \text{TR} - \text{TC} = \text{PQ}(\text{L}) - \text{wL}$$

$$\frac{\Delta \pi}{\Delta \text{L}} = \text{P}(\text{MP}_\text{L}) - \text{w} = 0$$

$$\text{VMP}_\text{L} = \text{w}$$

$$\text{Example: } \text{Q}(\text{L}) = (\text{L})^{0.5}, \text{MP}_\text{L} = 0.5(\text{L})^{-0.5},$$

$$\text{P}(0.5(\text{L})^{-0.5}) = \text{w}$$

$$\text{L} = (\text{P}/2\text{w})^2 \text{ is the derived demand}$$

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## Comparing Input and Output Markets

- From  $\text{VMP}_\text{L} = \text{P} \times \text{MP}_\text{L} = \text{w}$

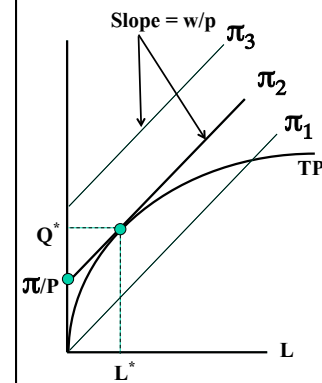
$$\begin{aligned} \text{P} &= \frac{\text{w}}{\text{MP}_\text{L}} = \frac{\text{w}}{\Delta \text{Q} / \Delta \text{L}} = \frac{\text{w} \Delta \text{L}}{\Delta \text{Q}} \\ &= \frac{\Delta \text{wL}}{\Delta \text{Q}} = \frac{\Delta \text{TVC}}{\Delta \text{Q}} = \text{MC} \end{aligned}$$

- If  $\text{VMP}_\text{L} = \text{w}$ ,  $\text{P} = \text{MC}$  also. See 10Competitive Factor.xls

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## Comparing Input and Output Markets



- The profit function  $\pi = \text{PQ} - \text{wL}$ , can be rewritten as  $\text{Q} = \pi/\text{P} + \text{wL}/\text{P}$
- It is called Iso-profit function that gives all combinations of L and Q that keep profits at  $\pi$
- The slope of this function is  $\text{w}/\text{p}$ ; while the slope of Q is  $\text{MP}_\text{L}$

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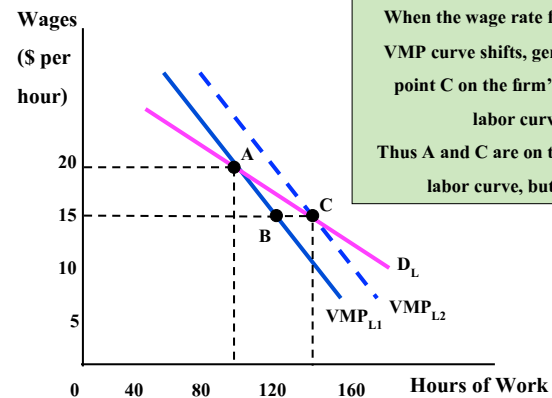
## Comparing Input and Output Markets

- At point B in Panel I, the iso-profit line tangents  $TP_L$ ,  $w/P = MP_L$  or  $P \times MP_L = w$  or  $\max \pi$  at  $L^*$
- In panel II,  $L^*$  causes  $VMP_L = w$  or  $D_L = S_L$
- In Panel I,  $L^*$  generates output  $Q^*$
- Using the  $45^\circ$  degree line in Panel III, we can flip the output  $Q^*$  to the horizontal axis in Panel IV
- This output  $Q^*$  must correspond to the output that causes  $MR = MC$  in Panel IV

## Factor Input Demand – Many Inputs, long run

- If the wage rate falls
  - MC of production falls
  - Profitable for firm to increase output
  - Will invest in additional machinery to expand production causing  $MP_L$  to increase
  - $VMP_L$  will shift right, quantity of labor demanded increases

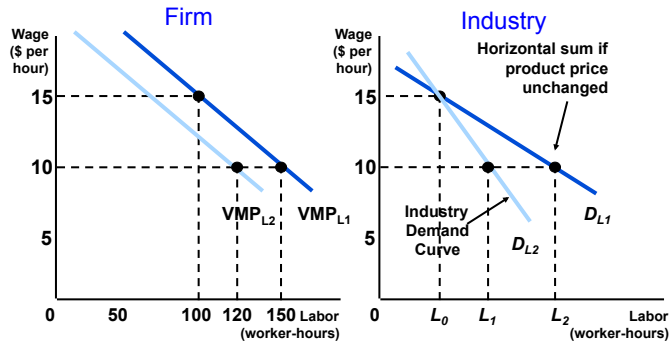
## Factor Input Demand – Many Inputs, long run



## Market or Industry Demand Curve

- Because all firms increase demand for labor a lower wage
  - All firms would hire more workers
  - Market supply of that good would increase
  - The market price will fall
  - The quantity demanded for labor by each firm will be lower, as compared to the case where price is constant --> Market demand is less elastic

## Industry Demand for Labor



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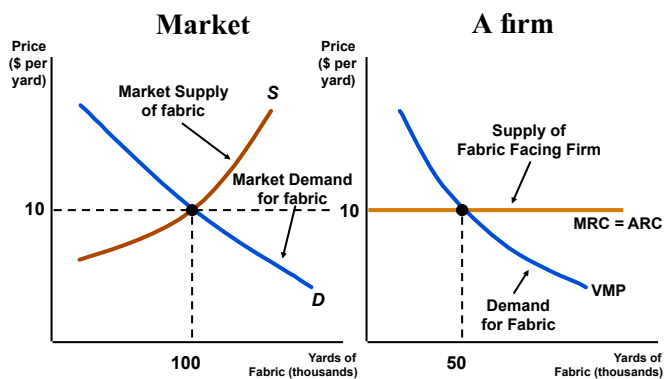
## The Supply of Inputs to a Firm

- In competitive market, firm can purchase as much of an input it wants at the market price
  - Determined by supply/demand of input market
- Input supply to a firm is perfectly elastic
- It is a small part of market so does not affect market price

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## A Firm's Input Supply in a Competitive Factor Market



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## The Supply of Inputs to a Firm

- The firm supply curve is also the average resource cost (ARC) curve to the firm
  - Supply curve representing the price per unit that the firm pays for an input
- Also, marginal resource cost (MRC) curve represents the firm's expenditures on an additional unit of input that it buys
  - Analogous to MC curve in output market

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## The Supply of Inputs to a Firm

- When factor market is competitive, ARC and MRC are identical horizontal lines
- How much of the input should the firm purchase?
  - As long as  $VMP > MRC$ , profit can be increased by buying more input
  - When  $VMP < MRC$ , benefits lower than costs
  - Maximize profit when  $VMP = MRC$

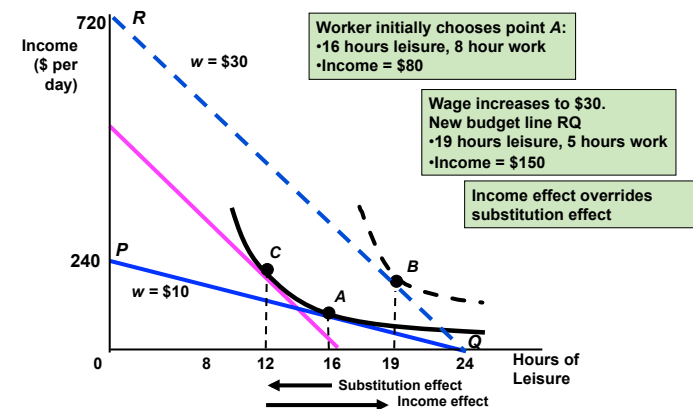
## The Market Supply of Inputs

- The market supply for factor inputs is upward sloping
  - Examples: jet fuel, fabric, steel
- The market supply for labor may be upward sloping and backward bending

## The Supply of Inputs to a Firm

- The Supply of Labor
  - The choice to supply labor is based on utility maximization
  - Leisure competes with labor for utility
  - Wage rate measures the price of leisure
  - Higher wage rate causes the price of leisure to increase

## Substitution and Income Effects of Wage Increase



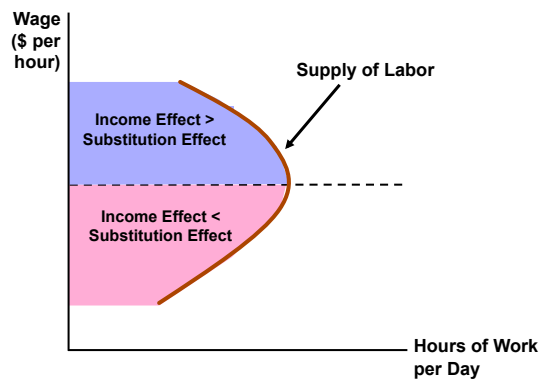
## The Market Supply of Inputs

- The Supply of Labor
  - Higher wages encourage workers to substitute work for leisure
    - The substitution effect
  - Higher wages allow the worker to purchase more goods, including leisure which reduces work hours
    - The income effect

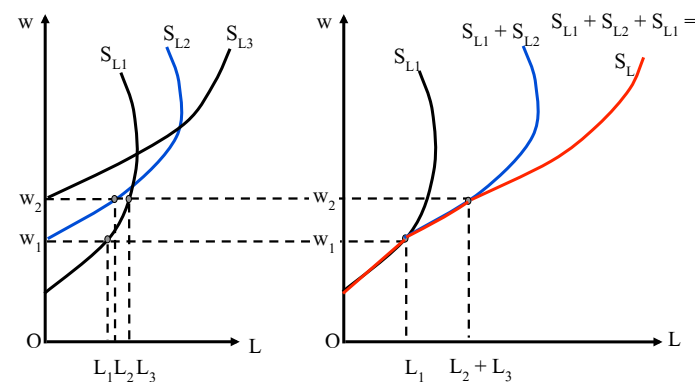
## Competitive Factor Markets

- The Supply of Labor
  - If the income effect exceeds the substitution effect the supply curve is backward bending
  - By using utility and budget line graph, we can show how the supply curve can be backward bending
    - Can show how the income effect can exceed the substitution effect

## Backward-Bending Supply of Labor



## Market Supply of Labor



## Equilibrium in a Competitive Factor Market

- Competitive factor market is in equilibrium when the prevailing price equate quantity supplied and quantity demanded
- Since workers are well informed, all received the same wage and generate identical  $VMP_L$  when employed

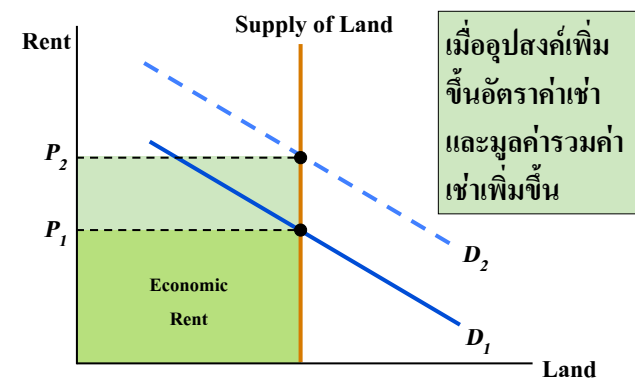
## Equilibrium in a Competitive Factor Market

- Economic Rent
  - For a factor market, economic rent is the difference between the payments made to a factor of production and the minimum amount that must be spent to obtain the use of that factor.
  - The economic rent associated with the employment of labor is the excess of wages paid above the minimum amount needed to hire workers
  - The concept is similar to the producer surplus.

## Ricardian rents: Land

- Land: Perfectly Inelastic Supply
  - The supply of land for housing or agriculture is fixed at least in the short run
  - The land rental rate is therefore determined by the market demand
  - If the demand is higher, the rental rate and the total value of economic rents are higher

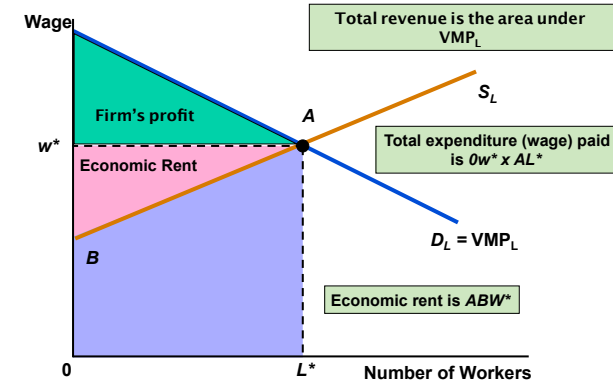
## Ricardian rents: Land



## Economic rents: Labor

- The lowest wage rate that necessary to motivate a worker to work is called the reservation wage. It is measured by the high of the  $S_L$  curve
- The economic rent for labor is the summation of all wage payments that are higher than the reservation wage
- or the area between the wage rate and the  $S_L$  curve

## Economic Rent



## Labor Market Equilibrium Monopolistic Output Market

- Example: Disney company hiring people to act as Mickey Mouse
- If output market is not competitive
  - $P > MR = MC$
  - $VMP_L$  no longer measures additional additional revenue from hiring  $L$
- Marginal Revenue product:  $MRP_L = MR \times MP_L$  is now the additional revenue to the firm when it hires more labor.



## Labor Market Equilibrium Monopolistic Output Market

$$\text{Max } \pi = \text{TR} - \text{TC} = P(Q(L))Q(L) - wL$$

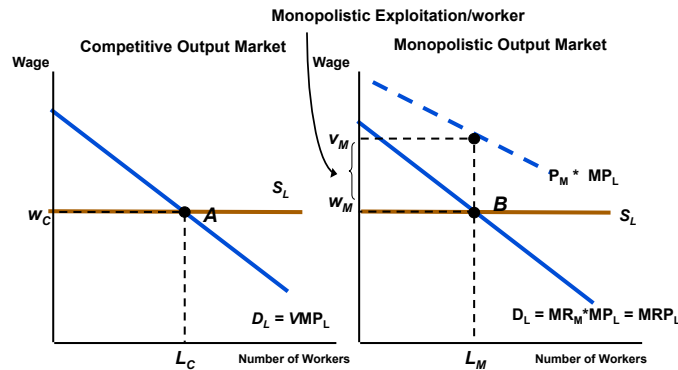
$$\frac{\Delta \pi}{\Delta L} = P \frac{\Delta Q(L)}{\Delta L} + Q \frac{\Delta P}{\Delta Q} \frac{\Delta Q(L)}{\Delta L} - w = 0$$

$$\left[ P + Q \frac{\Delta P}{\Delta Q} \right] \frac{\Delta Q(L)}{\Delta L} = w$$

$$(\text{MR})(\text{MP}_L) = w \quad \text{or} \quad \text{MRP}_L = w$$

$$\begin{aligned} \text{This implies } \text{MR} &= \frac{w}{\text{MP}_L} = \frac{w}{\Delta Q / \Delta L} = \frac{w \Delta L}{\Delta Q} \\ &= \frac{\Delta w L}{\Delta Q} = \frac{\Delta \text{TVC}}{\Delta Q} = \text{MC} \end{aligned}$$

## Labor Market Equilibrium Monopolistic Output Market



Seg Interactive Excel: 10Competive Factor.xls

## Labor Market Equilibrium Monopolistic Output Market

- If output market is not competitive
  - Although firm maximizes profits, output is below efficient level and uses less than efficient level of output
  - Economic efficiency would be increased if more laborers were hired and more output produced
    - At equilibrium number of workers, marginal cost to firm,  $w_M$ , is less than marginal benefit to consumers  $V_M$ .
    - Gains to consumers would outweigh firm's lost profit

## Example

- Let  $P = 100 - Q$ ,  $Q = L^{0.5}$ ,  $w = 4$

$$\begin{aligned}\pi &= (100 - Q)Q - 4L = 100Q - Q^2 - 4L \\ &= 100L^{0.5} - L - 4L = 100L^{0.5} - 5L\end{aligned}$$

$$\frac{d\pi}{dL} = \underbrace{50L^{-0.5}}_{MRP_L} - 1 - 4 = 0, \quad L = 100,$$

- Thus  $Q = 10$ ,  $P = 100 - 10 = 90$ ,

$$VMP_L = P MP_L = 90(0.5L^{-0.5}) = 45/100^{0.5} = 4.5$$

$$MRP_L = 4 = w, \text{ exploitation} = (4.5 - 4)(100) = 50$$

## Monopsony

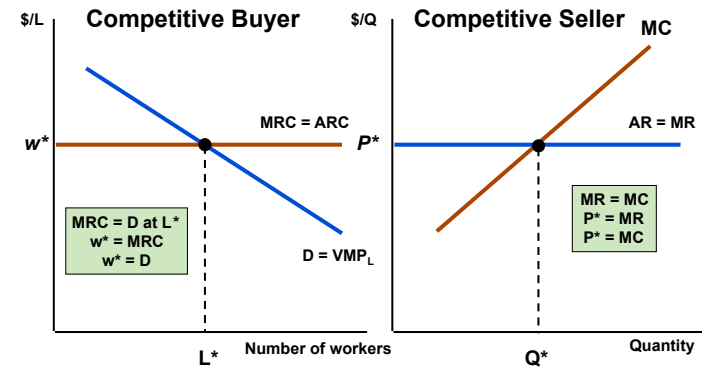
- Single factor buyer
- In reality, there may be a few factor buyers or Oligopsony
- Example:
  - Army is the single employer for soldiers
  - Ministry of Education is the single employer for teachers
  - Large discounted stores



## Monopsony

- If it were a competitive factor buyer
  - Price taker
  - $w = \text{Marginal expenditure} = \text{Average expenditure}$  or  $w = \text{MRC} = \text{ARC}$
  - $D = \text{Value of Marginal Product}$
- Graphically can compare competitive buyer to competitive seller

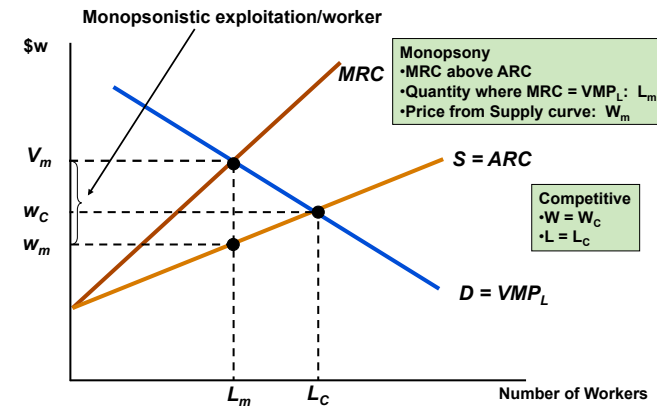
## Competitive Buyer Compared to Competitive Seller



## Monopsony

- Buyer will buy until value from last unit (VMP) equals expenditure on that unit (MRC).
- Market supply show how much must pay per unit as a function of total units purchased
- Supply curve is **average resource cost** (ARC) curve
- The market supply curve is not the marginal expenditure (MRC) curve
  - Upward sloping supply implies the marginal resource cost curve must lie above ARC
  - Decision to buy extra unit raises price paid for *all* units
- Example: at  $w_1=10, L_1=2$ , at  $w_2=12, L_2=3$

## Monopsony



## Monopsony

$$\text{Max } \pi = \text{TR} - \text{TC} = \text{PQ}(L) - \text{TRC}(L)$$

$$\frac{d\pi}{dL} = P \cdot MP_L - \frac{d\text{TRC}(L)}{dL} = 0$$

$$\frac{d\text{TRC}(L)}{dL} = \frac{d[\text{ARC}(L) \cdot L]}{dL}$$

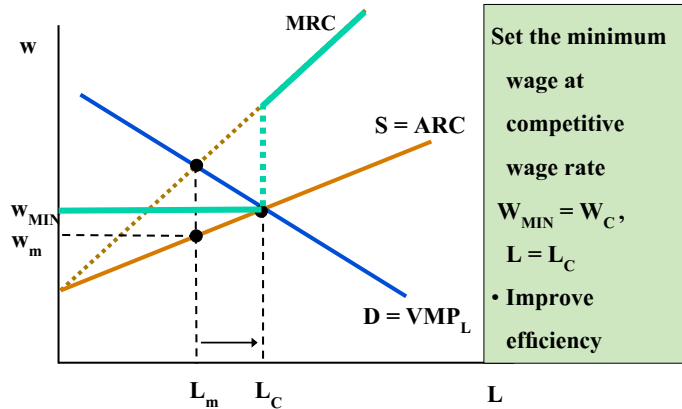
$$\text{MRC}(L) = \text{ARC}(L) \cdot \frac{dL}{dL} + L \cdot \frac{d\text{ARC}(L)}{dL}$$

$$\text{VMP}_L = \text{MRC}(L)$$

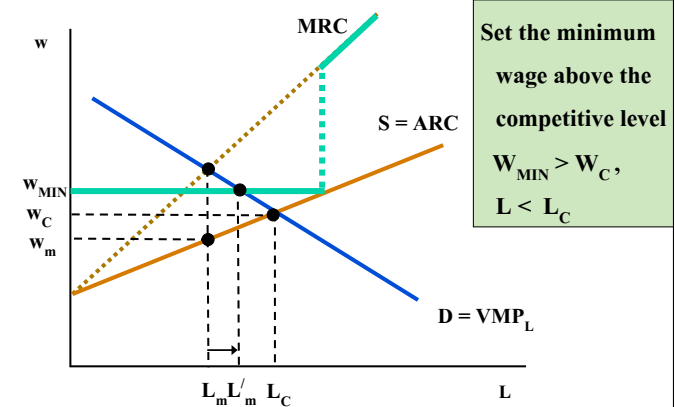
## Example

- $\text{VMP}_L$ :  $L_D = 600 - 20W \rightarrow W(L_D) = 30 - L_D/20$
- $L_S = 20W \rightarrow W(L_S) = L_S/20$
- $\text{TRC} = W(L)L = L^2/20$ ,  $\text{ARC} = L/20$ ,  
 $\text{MRC} = d\text{TRC}/dL = 2L/20 = L/10$
- Maximize profits require  $\text{VMP}_L = \text{MRC}$ :  
 $30 - L/20 = L/10$   
 $600 - L = 2L$   
 $L = 200$ ,  $W(L_S) = 200/20 = 10$   
 $W(L_D) = 30 - 200/20 = 20$ , exploitation = 2000

## Minimum wage and Monopsony



## Minimum wage and Monopsony



## Factor Markets with Monopoly Power

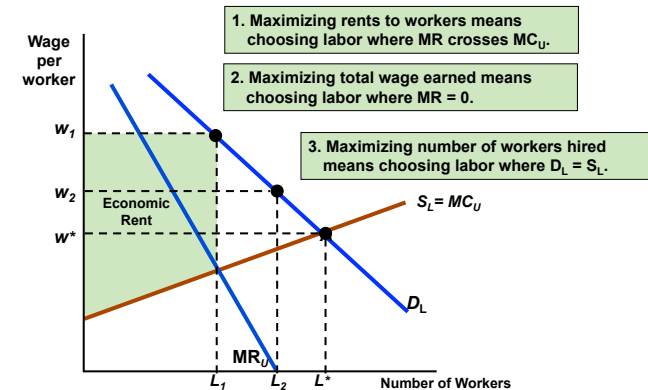
- Sellers of inputs have monopoly power
- Example: Labor unions
- The monopoly power of the labor union allow it to be price maker



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## Monopoly Power of Sellers of Labor



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## Monopoly Power of Sellers of Labor

- The union's monopoly power allows it to choose any wage rate and quantity supplied
  - If wanted to obtain higher wages, would restrict membership to  $L_1$  workers to get hirer wage  $w_1$
  - Those who find jobs are better off. Those without jobs are worse off.

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## Monopoly Power of Sellers of Labor

- **Rent maximization:** combination of wage rate and number of workers is where MR crosses  $MC_U =$  supply.
- Price comes from the demand curve
- This gives a combination of  $L_1$  and  $w_1$
- Shaded area below the demand curve and above the supply curve to the left of  $L_1$  is the economic rent that all workers receive

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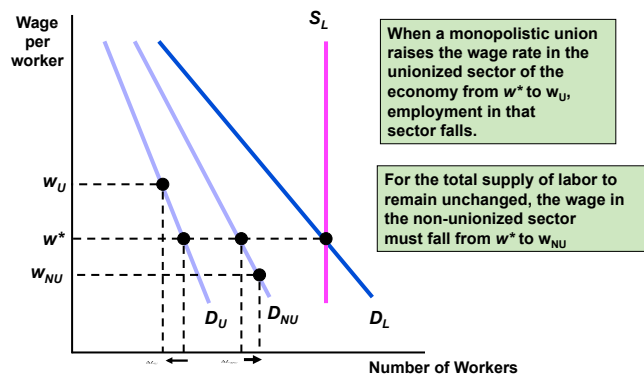
## Factor Markets with Monopoly Power

- An alternative objective is to **maximize aggregate wages** that all union members receive
  - This gives  $L_2$  and  $w_2$  where  $MR_U = 0$
- The last alternative is to **maximize the number of workers hired**
  - This gives  $L^*$  and  $w^*$  where  $D_L = S_L$  or competitive outcome

## Unionized and Non-unionized Workers

- Assume the total supply of workers is fixed
  - supply is  $S_L$
- Demand for unionized labor is  $D_U$  and demand for non-unionized labor is  $D_{NU}$
- Total market demand is  $D_U + D_{NU} = D_L$

## Wage Discrimination in Labor Market



## Unionized and Non-unionized Workers

- What if union chooses to raise wage above competitive wage  $w^*$ , to  $w_U$
- Number of workers hired by the union falls by amount  $\Delta L_U$
- As these workers find employment in nonunion sector, wage rate in that sector adjusts until labor market is in equilibrium
- At new wage rate,  $w_{NU}$ , additional numbers hired in sector is  $\Delta L_{NU}$ 
  - Equals number of workers who left unionized sector

## Bilateral Monopoly

- Bilateral Monopoly

- Market where there is only one buyer and one seller
- Bilateral monopoly is rare, however, markets with a small number of sellers with monopoly power selling to a market with few buyers with monopsony power is more common.

- Example: Association of sugar producers vs. Sugarcane grower union

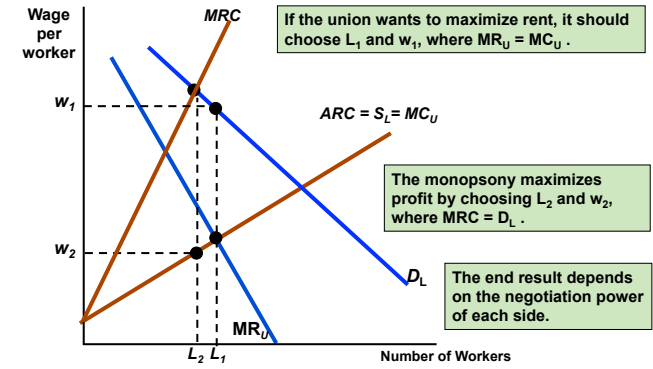


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## Bilateral Monopoly



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