Chapter 5

The Demand for Labor
1. Derived Demand for Labor
Derived Demand

- The demand for labor is a *derived demand*.
  - That is, it is derived from the demand for the product or service that the labor is helping produce.
    - The demand for hamburgers leads to the demand for hamburger workers.
  - Demand for workers depends on:
    - How the productive the workers are.
    - The price of the product the workers are helping produce.
2. A Firm’s Short-Run Production Function
Production Function

- A *production function* shows the relationship between inputs and outputs.
- Assume that only two inputs are used to make a product-- labor (L) and capital (K).
- In the short run, *at least one input is fixed*.
- The total product for a firm in the short run is:
  - \( TP_{SR} = f(K, L) \), where \( K \) is fixed.
Definitions

- **Total product (TP)** is the total product produced by each combination of labor and the fixed amount of capital.

- **Marginal product (MP)** is the change in total product associated with the addition of one more unit of labor.

- **Average product (AP)** is the total product divided by the number of units of labor.
• As units of variable input (labor) are added to a fixed input, total product will increase . . .
• First at an increasing rate . . .
• Then at a declining rate . . .
• Note that the Total Product curve is smooth, indicating that labor can be increased by amounts of less than a single unit (it is a continuous function).

<table>
<thead>
<tr>
<th>Units of Variable Resource</th>
<th>Total Product (Output)</th>
<th>Marginal Product</th>
<th>Average Product</th>
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**Law of Diminishing Returns**

Total Product

[Graph showing the relationship between Total Product and Quantity of Labor]
The *Marginal Product* curve will initially increase (when *TPC* is increasing at an increasing rate), reach a maximum, and then decrease (as *TPC* increases at a decreasing rate).

- The *Average Product* curve will have the same general form except that its maximum point will be at a higher output level.

### Units of Variable Resource

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<th>Average Product</th>
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### Important Note

*MP* always crosses *AP* at its maximum point.
Graphed together, one can see the relationship between the TP, MP, and AP curves more clearly.
3. Short-Run Demand for Labor: The Perfectly Competitive Seller
Hiring Decision

- Profit-maximizing firms will hire additional workers as long as each worker adds more to revenue than she costs.
  - *Marginal revenue product* (MRP) is the change in total revenue that results from hiring of an additional worker.
    - \( \text{MRP} = \text{Marginal Revenue (MR)} \times \text{MP} \)
Hiring Decision

- *Marginal wage cost* (MWC) is the change in total wage cost of hiring an additional worker.

- The Hiring Rule:
  - Hire additional workers until MRP = MWC.
Short-Run Demand for Perfectly Competitive Firm

- In the numerical example below, a computer company uses both technology and data-entry operators to provide services in a perfectly competitive market. For each unit processed the firm receives $200 (4).
- Column (2) shows how total output changes as additional data-entry operators are hired (given a fixed capital level).
- The *Marginal Revenue Product* schedule (6) indicates how hiring an additional operator affects the total revenue of the firm.

<table>
<thead>
<tr>
<th>Units of Labor (L) (1)</th>
<th>Total Product (TP) (units per week) (2)</th>
<th>MP ( \frac{\Delta TP}{\Delta L} ) (3)</th>
<th>Sales Price (Per Unit) (4)</th>
<th>Total Revenue (5)</th>
<th>MRP ( \frac{\Delta TR}{\Delta L} ) (6)</th>
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<td>$3,400</td>
<td>100</td>
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Since a profit-maximizing firm will only hire an additional worker only if the worker adds more to revenues than she adds to wage costs, the $\text{MRP}$ curve is the firm’s short run demand curve for labor.

In the short-run, it will slope downward because the marginal product of labor falls as more of it is used with a fixed amount of capital.
Value of Marginal Product

- The *value of marginal product* (VMP) is the extra output in dollar terms that society gains when an extra worker is employed.
  - VMP = Price * MP

- For a perfectly competitive seller, MR = Price.
  - As a result, VMP = MRP for such firms.
Question for Thought

1. “Only that portion of the MP curve that lies below AP constitutes the basis for a firm’s short-run demand curve for labor.” Explain.
4. Short-Run Demand for Labor: The Imperfectly Competitive Seller
Short-Run Demand for Imperfectly Competitive Firm

- In the numerical example below, the company uses both technology and data-entry operators to provide services in an imperfectly competitive market.

- Since it is in an imperfectly competitive market, the firm faces a downward sloping product demand curve \((4)\). That is, the product price falls as the firm sells more units.

<table>
<thead>
<tr>
<th>Units of Labor ((L)) (1)</th>
<th>Total Product ((TP)) (units per week) (2)</th>
<th>(MP) (\frac{\Delta TP}{\Delta L}) (3)</th>
<th>Sales Price (Per Unit) (4)</th>
<th>Total Revenue (5)</th>
<th>MRP (\frac{\Delta TR}{\Delta L}) (6)</th>
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</table>
For imperfectly competitive firms, the labor demand curve will slope because of a falling marginal product of labor and because the firm must decrease the price on all units of output as more output is produced.

The MRP (=MR * MP) for imperfect competitors is less than the VMP (=P*MP) at all levels of output past the first unit.

The labor demand curve for an imperfectly competitive firm (MRP) is less elastic than that for a perfectly competitive firm (VMP). As a result, they will hire fewer workers other things equal.
5. Long-Run Demand for Labor
Long-Run Labor Demand

- In the long run, *both* labor and capital are variable.
- The total product for a firm in the long run is:
  - $TP_{LR} = f(K, L)$
- The long-run labor demand curve is downward sloping because a wage decline has both an output and substitution effect.
• A decline in the wage rate will reduce the marginal cost (MC₁ to MC₂) to and increase the profit maximizing level of output (40 to 70).

• To produce the higher output level, the firm will have to hire more workers.

• This output effect is present in the short run.
Substitution Effect

- The *substitution effect* is the change in employment resulting from a change in the *relative* price of labor, output being held constant.
  - If a decline in the wage rate occurs, firms will substitute labor for the now relatively more expensive capital.
  - Since capital is fixed in the short run, this effect can’t occur in the short run.
• A wage decrease from $800 per week to $600 increases the short-run quantity of labor from 3 to 4 (A to B). This is the *output effect*.

• In the long-run, the firm also substitutes labor for capital, resulting in a *substitution effect* of 2 units (B to C).

• The long-run demand curve results from both effects and is found by connecting points A and C.
Other Factors

- Product demand
  - *Product demand* is more elastic in the long run than in the short run, making labor demand more elastic the longer the period.

- Labor-Capital interaction
  - If the wage rate falls, the short-run quantity demanded of labor rises.
    - This will increase the MP of capital and thus the MRP of capital.
Other Factors

- The higher MRP of capital, will increase the quantity of capital and thus the MP and MRP of labor.
- As a result, the long-run response will be greater than the short-run response.

Technology

- If the wage rate falls, technology innovators will try to reduce the use of relatively more expensive and increase the use of labor.
- The long run response will be greater than the short-run response.
Question for Thought

1. Referring to the output and substitution effects, explain why an increase in the wage rate for autoworkers will generate more of a negative employment response in the long run than in the short run. Assume there is no productivity increase and no change in the price of nonlabor resources.
6. Market Demand for Labor
• The market demand curve for labor is less elastic than a horizontal summation of the demand curves of individual firms ($\Sigma D$).

• A lower wage induces all firms to hire more labor and produce more output, causing the supply of the product to increase.

• The resulting decline in the product price shifts the firms’ labor demand to left.

• As a result, total employment rises to A to B rather than from A to C.
7. Elasticity of Labor Demand
Wage Elasticity Coefficient

- The wage elasticity coefficient measures the responsiveness of the quantity demanded of labor to the wage rate.

\[ \text{Wage Elasticity Coefficient} = \frac{\% \text{ Change in quantity demanded}}{\% \text{ Change in Wage}} = \frac{\% \Delta Q}{\% \Delta W} \]

- or put simply -

\[ \frac{(Q_0 - Q_1)/(Q_0 + Q_1)}{(W_0 - W_1)/(W_0 + W_1)} \]
Determinants of Elasticity

- Elasticity of product demand
  - The greater the price elasticity of product demand, the greater the elasticity of labor demand.
    - Firms with market power tend to more inelastic product demand, and thus a more inelastic labor demand
    - Product demand tends to be more elastic in the long run and thus labor demand is more elastic in the long run.
Determinants of Elasticity

- Ratio of labor costs to total costs
  - The larger the share of labor costs in total costs, the greater will be the elasticity of labor demand.
    - A 10% wage rise if labor accounts for 10% of total costs, will raise total costs by 1%.
    - A 10% rise in wages when labor costs for 50% of total costs will raise total costs by 5%.
      - If costs rise more, the price rise must be greater and thus decrease quantity more.
Determinants of Elasticity

- Substitutability of other inputs
  - The greater the substitutability of other inputs for labor, the greater will be the elasticity of labor demand.

- Supply elasticity of other inputs
  - The greater the elasticity of supply of other inputs for labor, the greater will be the elasticity of labor demand.
Estimates of Elasticity

- Most estimates of elasticity indicate the overall long-run elasticity of demand is about -1.0.
  - A 1% rise in the wage rate will lower the quantity demanded of labor by 1%.
Significance of Elasticity

- Labor unions.
  - Unions can achieve greater wage gains when the labor demand curve is more inelastic.

- Minimum wage
  - The employment decline of a hike in the minimum wage will be larger when the labor demand curve for affected worker is more elastic.
8. Determinants of Demand for Labor
Determinants of Labor Demand

- Product demand
  - A change in product demand, will shift labor demand in the same direction.

- Productivity
  - Assuming that it does not cause an offsetting decrease in the product price, a change in marginal product will shift labor demand in the same direction.
Determinants of Labor Demand

- Number of employers
  - Other things equal, a change in the number of firms employing a particular type of labor will change labor demand in the same direction.

- Prices of other resources
  - Normally labor and capital are substitutes in production.
    - One can substitute labor for capital and vice versa in the production process.
Determinants of Labor Demand

- Gross substitutes

  - *Gross substitutes* are inputs such that when the price of one changes, the demand for the other changes in the same direction.

  - Implies substitution effect outweighs the output effect.

  - Example: the decline in the price of security equipment used by businesses has decreased the demand for night guards.
Determinants of Labor Demand

- Gross complements
  - *Gross complements* are inputs such that when the price of one changes, the demand for the other changes in the opposite direction.
  - Implies output effect outweighs the substitution effect.
  - Example: the decline in the price of telephone switching equipment has increased the demand for communications workers.
Determinants of Labor Demand

- Pure complements
  - *Pure complements in production* are inputs that are used in direct proportion to each other.
  - Since no substitution effect occurs, the inputs must be gross complements.
Question for Thought

1. Use the concepts of (a) substitutes in production versus pure complements in production and (b) gross substitutes versus gross complements to assess the likely impact of the rapid decline in the price of computers and related office equipment on the labor demand for secretaries.
9. Real World Applications
• Employment in the textile and apparel industries has fallen in one-half since 1973.

• Demand for American textile and apparel workers has fallen because the share of sales due to imports has risen from 5% in 1970 to 40% now.

• Robots and assembly-line labor are gross substitutes. The price of robots has fallen and so labor demand has fallen.
End

Chapter 5