Chapter 14

Labor
Chapter Outline

• A Perfectly Competitive Firm’s Demand for Labor
• Market Demand Curve for Labor
• An Imperfect Competitor’s Demand for Labor
• Labor Supply
• Market Supply Curve
• Monopsony
• Minimum Wage Laws
• Wage Premiums and Safety
A Perfectly Competitive Firm’s Demand for Labor

- **Marginal product (MP):** how much more output is produced by an additional unit of input.
- **Value of marginal product (VMP):** the value, at the current market price, of the extra output produced by an additional unit of input.
A Perfectly Competitive Firm’s Demand for Labor

• Consider a perfectly competitive firm that
  – hires labor in a perfectly competitive factor market (takes wage as given), and
  – sells output in a perfectly competitive output market (takes price as given).

• The hiring rule for a perfectly competitive firm is to employ the amount of labor for which the wage is equal to the VMP.
A Perfectly Competitive Firm’s Demand for Labor

• If hired too few workers, the value of the marginal product would exceed the wage, so should hire some more workers.
  – Bring in more money than pay out in wage.

• If hired too many, the value of the marginal product of labor would be less than the wage so should fire some.
  – Bring in less money than pay out in wage.
Figure 14.1 Short-Run Labor Demand

- Suppose marginal product of labor is $MP = 10 - \frac{1}{20}L$.
- If hire $L = 40$ hours of labor, each hour of labor produces $MP = 10 - \frac{1}{20}L = 10 - \frac{40}{20} = 10 - 2 = 8$.
- If hire $L = 80$ hours of labor, each hour of labor produces $MP = 10 - \frac{1}{20}L = 10 - \frac{80}{20} = 10 - 4 = 6$.
- If hire $L = 120$ hours of labor, each hour of labor produces $MP = 10 - \frac{1}{20}L = 10 - \frac{120}{20} = 10 - 6 = 4$.
- Every additional 40 hours of labor hired reduces the marginal product of labor by 2.
**Figure 14.1 Short-Run Labor Demand**

<table>
<thead>
<tr>
<th>Labor (L) in hours</th>
<th>Marginal Product MP</th>
<th>Value of Marginal Product VMP for P = 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>8</td>
<td>16</td>
</tr>
<tr>
<td>60</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>80</td>
<td>4</td>
<td>8</td>
</tr>
</tbody>
</table>

- If product sells for $2 per unit, multiply MP values by 2 to get VMP.
- If wage equals 12, hire 60 hours of labor, where $w = VMP$. 

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Figure 14.1: The Competitive Firm’s Short-Run Demand for Labor

(a) Marginal product of labor (units of output/unit of labor)

Marginal product of labor
(units of output/unit of labor)

(b) Value of marginal product ($/unit of labor)

Value of marginal product
($/unit of labor)

Optimal quantity of labor when \( w = 12 \)

\[ 
VMP_L = P \times MP_L 
\]
Labor Demand in the Long-Run

• The long-run demand for labor is more elastic (flatter) than the short-run demand for labor because the firm can substitute capital for labor when capital is not fixed.

• The firm’s demand for labor will tend to be more elastic:
  – the more elastic the demand is for its product.
  – the more it is able to substitute the services of labor for those of other inputs.
Figure 14.2: Short and Long-Run Demand Curves for Labor
Market Demand for Labor

• The market demand curve is steeper than horizontal sum of each firm’s demand curve.
• A reduction in the wage causes firms to hire more labor and thus produce more output.
• The increase output causes the price to fall in the market.
• The reduction in price then reduces the value of the marginal product of labor.
Figure 14.3 Market Demand for Labor

- Originally price is $P_1$, wage is $w_1$ and firms hire $L_1$ units of labor.
- Suppose the wage falls to $w_2$.
- The expansion in output due to hiring more labor causes price to fall to $P_2$.
- VMP shifts down due to the lower price, leading to $L_2$ labor hired at wage $w_2$.
- The market demand (DD) for labor traces out points $(w_1, L_1)$ and $(w_2, L_2)$. 

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Figure 14.3: The Market Demand Curve for Labor
An Imperfect Competitor’s Demand for Labor

• *Marginal revenue product (MRP):* the amount by which total revenue increases when employ an additional unit of input.

• The firm will hire the quantity for which the wage equals the *MRP.*
The Supply Of Labor

• **Leisure activities**: includes play, sleep, eating, and any other activity besides paid work in the labor market.

• The choice is between two goods called “income” and “leisure.”
  
  – As in the standard consumer choice problem, the individual is assumed to have preferences over the two goods that can be summarized in the form of an indifference map.
Income/Leisure Budget Constraint

- An income/leisure budget constraint splits hours between work and play.
- If enjoy \( h \) hours of leisure in a 24 hour day, then work the remaining \( 24 - h \) hours.
- Earn income \( M \) equal to wage \( w \) times hours worked \( 24 - h \).

\[ M = w(24 - h) \]
Income/Leisure Budget Constraint

• Endpoints of the income/leisure constraint
  \[ M = w(24 - h) \] are:
  – Work all 24 hours with no leisure and earn maximum income of wage for 24 hours work
    \((h = 0, M = 24w)\), or
  – Enjoy leisure all 24 hours and earn no income
    \((h = 24, M = 0)\).

• Each hour of leisure consumed reduces income by the wage \(w\).
Optimal Leisure Choice

• Optimal choice of leisure occurs at tangency of an indifference curve and the income/leisure budget constraint.
• Any lesser amount of leisure or greater amount of leisure lies on a lower indifference curve and thus would be less preferred.
Figure 14.4 Optimal Leisure Choice

• If wage \( w = 10 \), then income/leisure constraint is
  \[ M = 10(24 - h) = 240 - 10h \]

• Endpoints of this constraint are:
  – If consume no leisure \( h = 0 \) then \( M = 240 \), or
  – if consume all leisure \( h = 24 \), then \( M = 0 \).

• Every hour of leisure costs \( w = 10 \) in sacrificed wage income.
Figure 14.4 Optimal Leisure Choice

• If consume leisure $h = 15$, then earn income

$$M = 240 - 10h = 240 - 10(15)$$

$$= 240 - 150 = 90$$

• $h = 15$ is optimal income/leisure choice.
  – Occurs at point of tangency between the highest feasible indifference curve and the budget constraint.
Figure 14.4: Optimal Choice of Leisure and Income
Figure 14.5 Optimal Leisure Choices for Different Wages

- If \( w = 4 \), consume leisure \( h = 18 \) and earn
  \[
  M = 24w - wh = 96 - 4h
  = 96 - 4(18) = 96 - 72 = 24
  \]

- Recall \( w = 10, h = 15, M = 90 \)

- If \( w = 14 \), consume leisure \( h = 17 \) and earn
  \[
  M = 24w - wh = 336 - 14h
  = 336 - 14(17) = 336 - 238 = 98
  \]
Figure 14.5 Optimal Leisure Choices for Different Wages

- $w = 4, h = 18, 24 - h = 6$
- $w = 10, h = 15, 24 - h = 9$
- $w = 14, h = 17, 24 - h = 7$
- Wage rising from 4 to 10 causes leisure to fall from 18 to 15 and work hours to rise from 6 to 9.
- Wage rising further to 14 causes leisure to rise from 15 to 17 and work hours to fall from 9 to 7.
Figure 14.5: Optimal Leisure Choices for Different Wages

Income ($/day)

24(14) = 336
24(10) = 240
24(4) = 96

w = 14
w = 10
w = 4

h_2^* = 15; h_1^* = 18; h_3^* = 17

Leisure (hr/day)
Income effect dominates when an increase in the wage causes the hours worked (labor supplied) to rise:
  – wealthier so consume more leisure
Substitution effect dominates when an increase in the wage causes the hours worked to fall:
  – Leisure becomes more expensive so substitute toward income to spend on other things
Figure 14.6: Labor Supply Curve for a Worker

![Labor Supply Curve for a Worker](image)
Figure 14.7: Labor Supply Curve for a Worker Seeking a Target Income

• Suppose a worker chooses how many hours worked with the goal of maintaining a target level of income, such as $M = 200$.

• In this case, higher wages will lead to fewer hours worked.
  – At $w = 20$, works 10 hours.
  – If wage doubles to $w = 40$, would work half as many hours.
Figure 14.7: Labor Supply Curve for a Worker Seeking a Target Level of Income
Figure 14.8: When Leisure and Income are Perfect Complements

• Find the optimal leisure demand for wage \( w = 20 \) if view income and leisure as perfect complements, demanding one hour of leisure for every $10 of income \((M = 10h)\).

• If \( w = 20 \), budget constraint

\[
M = 24w - wh = 480 - 20h
\]

• Solve for optimal leisure

\[
10h = 480 - 20h, 30h = 480, h = 16
\]
Figure 14.8: When Leisure and Income are Perfect Complements
Market Supply Curve

• The market supply curve in any category of labor is obtained by horizontally adding up the individual worker’s supply curves.
• Almost certain to be upward sloping.
• Wage increases in one category of labor may draw workers into that category from other similar categories.
Monopsony

• **Average factor cost (AFC):** another name for the supply curve for an input.

• **Total factor cost (TFC):** the product of the employment level of an input and its average factor cost.

• **Marginal factor cost (MFC):** the amount by which total factor cost changes with the employment of an additional unit of input.
Monopsony

- The optimal level of employment for a monopsonist is the level for which MFC and the demand for labor are equal.
  - For a monopsony firm, wages will be lower than under competition.
Figure 14.10: Average and Marginal Factor Cost

• Suppose \( MFC = \frac{2}{25} L \) and AFC (labor supply) is \( w = \frac{1}{25} L \).

• Total factor cost is

\[
TFC = wL = \left( \frac{1}{25} L \right) L = \frac{1}{25} L^2
\]

• At \( L = 100, MFC = 8, AFC = 4 \).
Figure 14.10: Average and Marginal Factor Cost

$MFC = \Delta TFC/\Delta L$

$S = AFC$

$\frac{S}{L}$

8.04

4.04

4.00

100

101

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Linear AFC and MFC

• If the AFC curve is a straight line $AFC = a + bL$, then the corresponding MFC curve will be $MFC = a + 2bL$, a straight line with the same intercept and twice the slope.

$$TFC = wL = (a + bL)L = aL + bL^2$$

$$MFC = \frac{dTFC}{dL}$$
Figure 14.11: Profit-Maximizing Monopsonist

- Demand for labor is the same as any other firm: value of marginal product of labor VMP.
- Optimal to hire amount of labor where MFC and demand for labor intersect.
  - Where how much hiring another hour of labor increases total factor cost equals how much additional revenue will bring in.
- Read wage off of labor supply curve.
Figure 14.11: The Profit-Maximizing Wage and Employment Levels for a Monopsonist
Figure 14.12: Comparing Monopsony and Competition in the Labor Market

• Because a monopsonist faces an upward sloping labor supply curve and takes into account the effect that hiring another hour of labor has on the wage must pay all other workers, a monopsonist will always hire less labor and pay less than if it were to hire labor in a perfectly competitive factor market.

— Would hire up to where labor supply intersects labor demand if labor market were competitive.
Figure 14.12: Comparing Monopsony and Competition in the Labor Market

- Monopsonist generates a distortion that some workers are not employed whose value of marginal product exceeds their reservation wage (the lowest wage at which they would be willing to work - the value of their leisure time).

- Thus the total gains in the labor market are not realized, similar to a monopoly as a single seller in a product market.
Figure 14.12: Comparing Monopsony and Competition in the Labor Market
Minimum Wage Laws

• In 1938 Congress passed the Fair Labor Standards Act.
  – One of whose provisions established a minimum wage for all covered employees.

• Whether the net effect of the minimum wage is to increase the amount of income earned by unskilled workers depends on the elasticity of demand for that category of labor.
Figure 14.13: A Minimum Wage Law

• Initial equilibrium at intersection of labor demand and labor supply.
• Artificially high minimum wage generates unemployment (excess supply).
• Workers who hold onto jobs gain from higher wages, but some workers lose their jobs.
• Some people are unemployed under the minimum wage but were not employed originally; they are drawn into the labor market by the higher wage.
• The workers who lose their jobs should be working for efficiency because their VMP (read off labor demand) higher than their reservation wage (read off labor supply) and the equilibrium wage but lower than minimum wage.

• Interfering with market outcome leads to inefficiency; better to have workers earn low wage than none at all.

• Better still to boost workers VMP through education, training or other policies.
  – The minimum wage is particularly damning if low wage jobs are a form of training before obtaining high wage jobs.
Role of Elasticity in Minimum Wages

- The magnitude of how many workers enjoy the wage gain and how many suffer unemployment depends on elasticities of labor demand and supply.
- If labor supply is very inelastic, then the wage increase will not draw many new workers into the labor market.
- If labor demand is also very inelastic, then employers will not reduce jobs much in response to the higher wage.
- Unfortunately, the low wage end of the labor force seems to be the most responsive - data shows a substantial withdrawal of low wage workers from the labor market as their wages fall (demand side data less clear).
Figure 14.13: A Minimum Wage Law
Figure 14.14: Minimum Wage Law in the Case of Monopsony

• An exception to the adverse effect of minimum wage is the case of imposing a minimum wage on a monopsonist.

• When impose the minimum wage, the marginal factor cost for the monopsonist becomes flat at the minimum wage until hits labor supply.

• The new marginal factor cost intersects labor demand at greater employment than in the absence of the minimum wage.
  – Both wage and employment rise.
Figure 14.14: Minimum Wage Law in the Case of Monopsony

• Minimum wage takes away the upward sloping labor supply: the monopsonist no longer has to raise wage paid to all workers when hiring an additional worker.
  – Monopsonist behaves more like hiring in a perfectly competitive labor market - the minimum wage makes it behave as if the wage is fixed.

• Note that the government must be careful not raise minimum wage too high (above MFC*) if it wants to ensure that employment will rise.

• Monopsonists (single firm hiring labor) are rare.
Figure 14.14: Minimum Wage Law in the Case of Monopsony
Figure A14.1: Optimal Wage-Safety Combination

• Risky (or otherwise unpleasant) jobs are often paid a compensating differential to entice workers to take the jobs.

• Less risk adverse workers take the riskier jobs like painting bridges and working on an oil rig or as a police officer.

• Safety requirements can reduce utility for workers who would prefer the greater risk with higher pay.
Figure A14.1: Optimal Wage-Safety Combination
Figure A14.3: A Safety Requirement that Reduces Utility
Problem 1

1. In his current job, Smith can work as many hours per day as he chooses, and he will be paid $1/hr for the first 8 hours he works, $2.50/hr for each hour over 8. Faced with this payment schedule, Smith chooses to work 12hr/day. If Smith is offered a new job that pays $1.50/hr for as many hours as he chooses to work, will he take it? Explain.
1. Under his current job, Smith's maximum income from working all 24 hours is the sum of 8 hours at wage $1 and the remaining 16 hours at wage $2.50: $8(1) + 16(2.5) = 8 + 40 = 48$. An hour of leisure requires sacrifice of $2.50 income up to 16 hours and $1 income beyond 16 hours. Consuming 16 hours of leisure and working $24 - 16 = 8$ hours yields 8 income (at the kink in the budget constraint).
Solution 1

If works 12 hours, then enjoys 12 hours of leisure, and earns income $8(1) + 4(2.5) = 18$. Under the potential new job, maximum income from working all 24 hours is $24(1.5) = 36$. An hour of leisure requires sacrifice of $1.50$ income. The new budget constraint would be $M = 36 - 1.5h$. The original optimal labor supply choice $h = 12, M = 18$ would still be feasible with the new budget constraint: could earn the same income with the same amount of leisure time under the new budget constraint.
Solution 1

Thus, can be no worse off with the new budget constraint. However, will have an opportunity cost of leisure time of 1.5 with the new budget constraint rather than 2.5 with the old budget constraint. Would optimally adjust toward more leisure. Will be happier at new optimal labor supply choice: reaches a higher (further out) indifference curve between income and leisure. Smith will accept the new job.
Problem 2

2. Consider the following two antipoverty programs: (1) A payment of $10/day is to be given to each person who is classified as poor last year; and (2) each person classified as poor will be given a benefit equal to 20 percent of the wage income he earns each day. Assuming that poor persons have the option of working at $4/hr, show how each program would affect the daily budget constraint of a representative poor worker during the current year. Which program would be most likely to reduce the number of hours worked?
Solution 2

2. The original budget constraint is
   \[ M = w(24 - h) = 4(24 - h) = 96 - 4h \]
   The budget constraint for program one is
   \[ M = 10 + 96 - 4h = 106 - 4h \]
   The budget constraint for program two is
   \[ M = (1.2)4(24 - h) = 115.2 - 4.8h \]
Solution 2

The first program is more likely to reduce hours worked because it increases income but leaves the opportunity cost of leisure unchanged: assuming leisure is a normal good, higher income leads to more leisure consumed. In contrast, the second program increases the opportunity cost of leisure. Thus, the poor will likely work less under the first program and more under the second program.
Problem 3

3. A monopsonist’s demand curve for labor is given by \( w = 12 - 2L \), where \( w \) is the hourly wage rate and \( L \) is the number of person-hours hired. If the monopsonist’s supply (AFC) curve is given by \( w = 2L \), which gives rise to a marginal factor cost curve of \( MFC = 4L \), how many units of labor will he employ and what wage will he pay? What would change if the monopsonist were confronted with a minimum wage bill requiring him to pay at least $7/hr?
Solution 3

3. A monopsonist hires labor up to the point where marginal factor cost equals the value of the marginal product of labor

\[ MFC = VMP, 4L = 12 - 2L, 6L = 12, L = 2 \]

The monopsonist pays only as much as necessary for workers to supply that much labor

\[ w = 2L = 4 \]
Solution 3

A minimum wage makes the monopsonist's marginal factor cost constant at the level of the minimum wage out to the intersection of the minimum wage level and the supply curve. Thus, confronted with a minimum wage, the monopsonist hires labor up to the point where the minimum wage equals either the value of the marginal product of labor or the labor supply curve, whichever indicates the smaller employment level.

\[ 7 = 12 - 2L, \quad 2L = 5, \quad L = 2.5 \]
Solution 3

\[ D = 12 - 2L \]

\[ MFC = 4L \]

\[ AFC = 2L \]

\[ w = 7 \]
Problem 4

4. The demand curve facing a monopsonist is given by $w = 35 - 6L$; the supply curve (AFC) for this monopsonist $w = 3 + L$, with corresponding MFC = $3 + 2L$, where $w$ represents the hourly wage rate and $L$ is number of person-hours hired. Find the optimal quantity of labor and the wage for this profit-maximizing monopsonist. Suppose a minimum wage law imposed a $17/hr minimum wage. How would this affect the quantity of labor demanded by the firm?
4. A monopsonist hires labor up to the point where marginal factor cost equals the value of the marginal product of labor

\[ MFC = VMP, \ 3 + 2L = 35 - 6L, \]

\[ 8L = 32, \ L = 4 \]

The monopsonist pays only as much as necessary for workers to supply that much labor

\[ w = 3 + L = 7 \]
Solution 4

A minimum wage makes the monopsonist's marginal factor cost constant at the level of the minimum wage out to the intersection of the minimum wage level and the supply curve. Thus, the monopsonist hires labor up to the point where the minimum wage equals the value of the marginal product of labor

\[ 17 = 35 - 6L, \quad 6L = 18, \quad L = 3 \]

Such a high minimum wage that employment fell.
Labor (L)

Wage (w)

MFC = 3 + 2L

AFC = 3 + L

D = 35 – 6L

w = 17

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