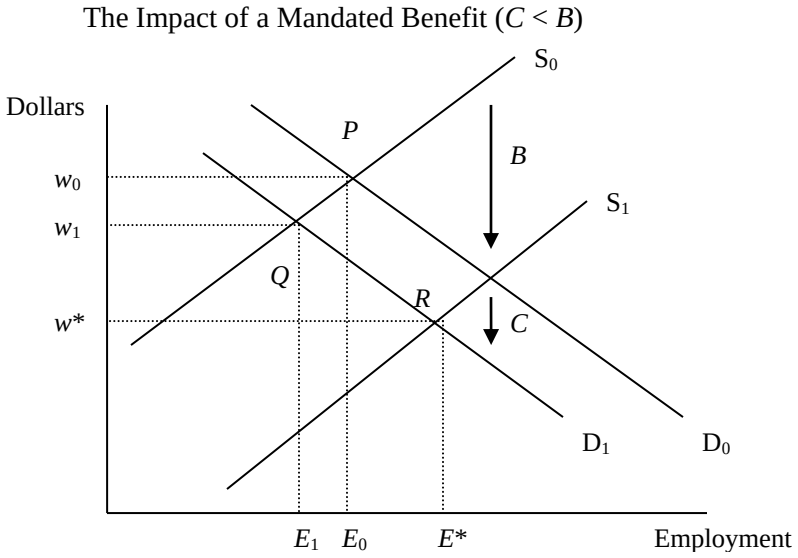
CHAPTER 4

4-1. Figure 4-9 discusses the changes to a labor market equilibrium when the government mandates an employee benefit for which the cost exceeds the worker's valuation (panel a) and for which the cost equals the worker's valuation (panel b).

(a) Provide a similar graph to those in Figure 4-9 when the cost of the benefit is less than the worker's valuation, and discuss how the equilibrium level of employment and wages change. Is there deadweight loss associated with the mandated benefit?



Without the mandate, the original equilibrium is at point *P* with an employment level of E_0 and a wage level of w_0. When the government mandates the benefit, labor demand shifts down by *C* as *C* is the per employee cost of the mandate. At the same time, however, supply shifts down by *B* as each worker values the benefit at *B*. As drawn, the cost is less than the benefit as stipulated in the problem. In this case, the new equilibrium is at *R* with an employment level of *E** and a wage level of *w**. Notice that the mandate has increased employment. It has also lowered the wage, by more than *C* but not by more than *B*. Consequently, firms and workers both benefit from this form of government intervention. Thus, there is no deadweight loss but rather new found surplus to be shared by firms and workers. Note: all of this analysis is predicated on firms and workers being unable to recognize the surplus gain without the government's assistance (see part b below).

(b) Why is the situation in part (a) in which a mandated benefit would cost less than the worker's valuation less important for public policy purposes than when the cost of the mandated benefit exceeds the worker's valuation?

The reason why this situation is less important for public policy purposes is that this is a situation of a "free lunch" that is not taken advantage of by firms and workers but it is observed by the government. Economists don't tend to devote much attention to such problems as it is believed that the firms and workers would come to realize the potential for mutual gain (in which case the above figure would have originally been at point *R* with the benefit supplied for the worker by the firm, making the mandate unnecessary).

4-2. In the United States, labor supply tends to be inelastic relative to labor demand, and according to law, payroll taxes are essentially assessed evenly between workers and firms. Given the above situation, are workers or firms more likely to bear the additional burden of an increased payroll tax in the United States? Could this burden be shifted to the firms by assessing the increase in payroll taxes on just firms rather than having firms and workers continue to be assessed payroll taxes equally?

As labor supply is relatively more inelastic than labor demand, workers will bear a greater percentage of payroll taxes than employers regardless of how the law stipulates the amount be split. Most estimates suggest that workers in the United States bear about 80 to 85 percent of payroll taxes. Again, tax incidence does not depend on who legally is required to pay the tax, so levying a greater percentage of payroll taxes on firms will not have any real economic effect.

4-3. Suppose the supply curve of physicists is given by $w = 10 + 5E$, while the demand curve is given by $w = 50 – 3E$. Calculate the equilibrium wage and employment level. Suppose now that the demand for physicists increases to $w = 70 – 3E$. Assume the market is subject to cobwebs. Calculate the wage and employment level in each round as the wage and employment levels adjust to the demand shock. What is the new equilibrium wage and employment level?

The initial equilibrium requires $10 + 5E = 50 – 3E$. Solving yields $w = \$35$ and $E_S = E_D = 5$. When demand increases to $w = 70 – 3E$, the new equilibrium wage is \$47.5 and the equilibrium level of employment is 7.5, which is found by solving $10 + 5E = 70 – 3E$.

The table below gives the values for the wage and employment levels in each round. The values in the table are calculated by noting that in any given period the number of physicists is inelastically supplied, so that the wage is determined by the demand curve. Given this wage, the number of physicists available in the next period is calculated. By round 7, the market wage rate is within 30 cents of the new equilibrium.

Round	Wage	Employment
1	\$55.0	5
2	\$43.0	9
3	\$50.2	6.6
4	\$45.9	8.0
5	\$48.4	7.2
6	\$46.9	7.7
7	\$47.8	7.4
8	\$47.2	7.6

Scratch work for some of the math:

- Original employment of 5 implies that when labor demand increases, the new posted wage will be $70 – 3E = 70 – 3(5) = \$55$. (The round 1 wage.)
- At this wage, $55 = 10 + 5E$ implies $E = 9$ workers will supply their labor. Given these 9 workers, the firm, using its new demand function, will post a wage of $70 – 3(9) = \$43$. (The round 2 wage.)
- At this wage, $43 = 10 + 5E$ implies $E = 6.6$ workers will supply their labor. Given these 6.6 workers, the firm, using its new demand function, will post a wage of $70 – 3(6.6) = \$50.20$. (The round 3 wage.)

- And so on.

4-4. Suppose labor demand for low-skilled workers in the United States is $w = 24 – 0.1E$ where E is the number of workers (in millions) and w is the hourly wage. There are 120 million domestic U.S. low-skilled workers who supply labor inelastically. If the U.S. opened its borders to immigration, 20 million low-skill immigrants would enter the U.S. and supply labor inelastically. What is the market-clearing wage if immigration is not allowed? What is the market-clearing wage with open borders? How much is the immigration surplus when the U.S. opens its borders? How much surplus is transferred from domestic workers to domestic firms?

Without immigration, the market-clearing wage is \$12 as 24 – 0.1(120) = \$12, at which all 120 million low-skill U.S. workers are employed. With immigration, the market-clearing wage is \$10 as 24 – 0.1(140) = \$10, at which all 120 million low-skill U.S. workers and all 20 million immigrants are employed. Both surplus values are easy to see in Figure 4–15. The additional surplus received by the U.S. economy is the area of triangle *BCF* in the figure. Thus, the additional surplus received by the U.S. because of the immigration equals

$$(\$12 – \$10) \times (140\text{m} – 120\text{m}) / 2 = \$20 \text{ million}.$$

Likewise, the total transfer from U.S. workers to U.S. firms is represented in the figure by the rectangle captered by w_0w_1BF. Thus, the total transfer from U.S. workers to U.S. firms because of the immigration equals

$$(\$12 – \$10) \times (120\text{m}) = \$240 \text{ million}.$$

4-5. There are two reasons why the immigration surplus is greater when immigration is accompanied by human capital externalities compared to when there are no human capital externalities associated with immigration. Both reasons are evident in Figure 4-16. The first is represented by triangle *BCD*. The second is represented by trapezoid *ABEF*. Explain the underlying source of each area. Explain why human capital externalities are important to each region.

Triangle *BCD* represents the additional benefit domestic firms receive from employing immigrants. This is compared to the much smaller triangle equal to the change in the number of immigrants times the change in the wage (times one-half) that would have resulted had the demand for high-skilled workers (in this case, high-skilled immigrant labor) had not increased due to the human capital externalities.

Trapezoid *ABEF* represents the additional benefit domestic firms receive from employing high-skilled domestic workers which comes about because of human capital externalities. This trapezoid exists only because demand for high skilled workers increased because of immigration.

4-6. Let total market demand for labor be represented by $E_D = 1{,}000 - 50w$ where E_D is total employment and w is the hourly wage.

(a) What is the market clearing wage when total labor supply is represented by $E_S = 100w - 800$? How many workers are employed? How much producer surplus is received at the equilibrium wage?

Set $E_D = E_S$ and solve for w yields $w^* = \$12$. At this wage, $E_D = 400$ and $E_S = 400$, which is the equilibrium level of employment.

Lastly, producer surplus is the area below the demand curve but above the wage. Mathematically, producer surplus = $(0.5) \times (\$20 - \$12) \times 400 = \$1{,}600$ where the \$20 comes from solving for w when $E_D = 0$.

(b) Suppose the government imposes a minimum wage of $16. What is the new level of employment? How much producer surplus is received under the minimum wage?

At a minimum wage of $16, labor demand will equal 200 (while labor supply will equal 800). As firms are not required to hire workers if they don't want to, the new level of employment will be 200 workers. In this case, producer surplus = (0.5) × ($20 – $16) × 200 = $400.

4-7. Let total market demand for labor be represented by $E_D = 1{,}200 - 30w$ where E_D is total employment and w is the hourly wage. Suppose 750 workers supply their labor to the market perfectly inelastically. How many workers will be employed? What will be the market clearing wage? How much producer surplus is received?

As the 750 workers supply their labor perfectly inelastically, all 750 will be employed. The wage that the firms must pay satisfies $750 = 1{,}200 - 30w$ which solves as $w^* = \$15$. In this case, producer surplus = (0.5) × ($40 – $15) × 750 = $9,375 where the $40 comes from solving for w when $E_D = 0$.

4-8. A firm faces perfectly elastic demand for its output at a price of $6 per unit of output. The firm, however, faces an upward-sloped labor supply curve of

$$E = 20w - 120$$

where E is the number of workers hired each hour and w is the hourly wage rate. Thus, the firm faces an upward-sloped marginal cost of labor curve of

$$MC_E = 6 + 0.1E$$

Each hour of labor produces five units of output. How many workers should the firm hire each hour to maximize profits? What wage will the firm pay? What are the firm's hourly profits?

First, solve for the labor demand curve: $VMP_E = P \cdot MP_E = \$6 \times 5 = \$30$. Thus, every worker is valued at $30 per hour by the firm. Now, setting $VMP_E = MC_E$ yields $30 = 6 + .1E$ which yields $E^* = 240$. Thus, the firm will hire 240 workers every hour. Further, according to the labor supply curve, 240 workers can be hired at an hourly wage of $18 as

$$240 = 20w - 120 \quad \rightarrow \quad 240 = 20(18) - 120 \quad \rightarrow \quad w = \$18.$$

Finally, as $Q = 5L = 5 \times 240 = 1{,}200$, the firm's hourly profits are:

$$\pi = pQ - wL = \$5 \times 1{,}200 - \$18 \times 240 = \$2,880.$$

4-9. Ann owns a lawn mowing company. She has 400 lawns she needs to cut each week. Her weekly revenue from these 400 lawns is $20,000. If given an 18-inch deck push mower, a laborer can cut each lawn in two hours. If given a 60-inch deck riding mower, a laborer can cut each lawn in 30 minutes. Labor is supplied inelastically at $10 per hour. Each laborer works 8 hours a day and 5 days each week.

(a) If Ann decides to have her workers use push mowers, how many push mowers will Ann rent and how many workers will she hire?

As each worker can cut a lawn in 2 hours, it follows that each worker can cut 4 lawns in a day or 20 lawns in a week. Therefore, Ann would need to hire 20 workers (400 ÷ 20) and rent 20 push mowers (one for each worker) in order to cut all 400 lawns each week.

(b) If she decides to have her workers use riding mowers, how many riding mowers will Ann rent and how many workers will she hire?

As each worker can cut a lawn in 30 minutes, it follows that each worker can cut 16 lawns in a day or 80 lawns in a week. Therefore, Ann would need to hire 5 workers (400 ÷ 80) and rent 5 riding mowers (one for each worker) to cut all 400 lawns each week.

(c) Suppose the weekly rental cost (including gas and maintenance) for each push mower is $250 and for each riding mower is $2,400. What equipment will Ann rent? How many workers will she employ? How much profit will she earn?

If Ann uses push mowers, her weekly cost of mowers is $250(20) = $5,000 while her weekly labor cost is $10(20)(40) = $8,000. Under this scenario, her weekly profit is $7,000. If Ann uses riding mowers, her weekly cost of mowers is $2,400(5) = $12,000 while her weekly labor cost is $10(5)(40) = $2,000. Thus, under this scenario, her weekly profit is $6,000. Therefore, under these conditions, Ann will rent 20 push mowers and employ 20 workers.

(d) Suppose the government imposes a 20 percent payroll tax (paid by employers) on all labor and offers a 20 percent subsidy on the rental cost of capital. What equipment will Ann rent? How many workers will she employ? How much profit will she earn?

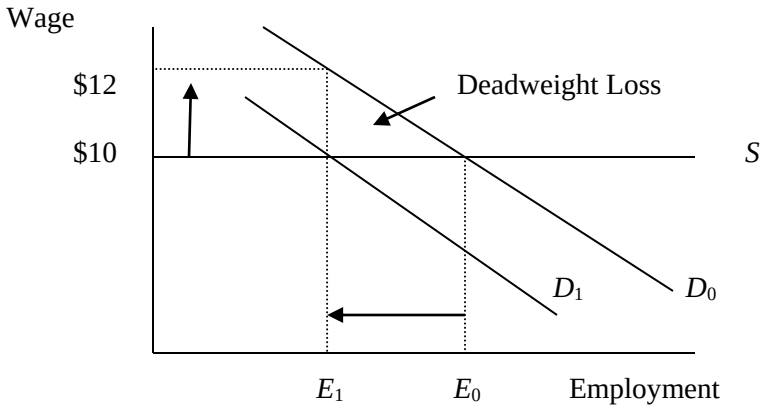
Under these conditions, the cost of labor has increased to $12 per hour, while the rental costs for a push mower and a riding mower have decreased to 0.8 × $250 = $200 and 0.8 × $2,400 = $1,920 respectively. Ann's profits under the two options, therefore, are

Push-Profit = $20,000 – $200(20) – $12(20)(40) = $6,400.
Rider-Profit = $20,000 – $1,920(5) – $12(5)(40) = $8,480.

Thus, under these conditions, Ann rents riding mowers, hires 5 workers, and earns a weekly profit of $11,600.

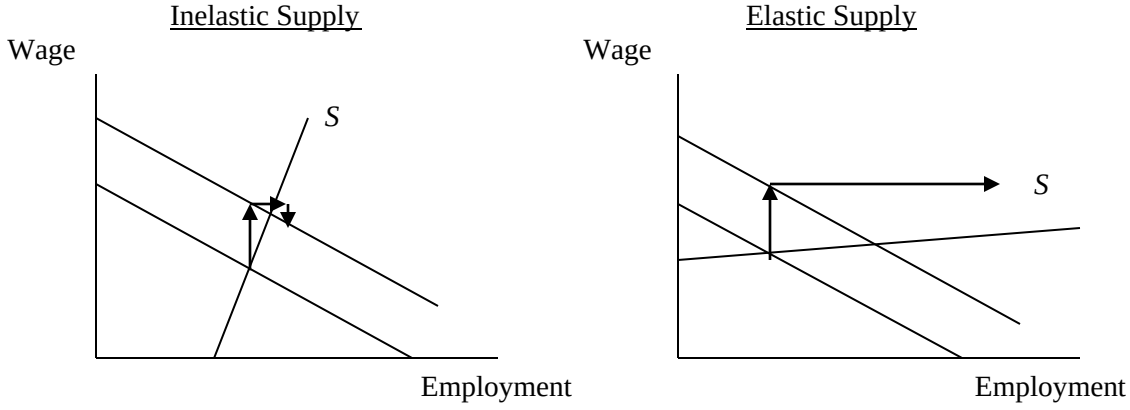
4-10. Figure 4-6 shows that a payroll tax will be completely shifted to workers when the labor supply curve is perfectly inelastic. In this case, for example, a new $2 payroll tax will lower the wage by $2, will not affect employment, and will not result in any deadweight loss. Suppose instead that labor supply is perfectly elastic at a wage of $10. In this case, what would be the effect on wages, employment, and deadweight loss from a $2 payroll tax?

If the labor supply curve is perfectly elastic, the firm will pay the entire tax, so the effective wage earned by workers will remain at $10 but the effective wage paid by firms will increase to $12. However, because the firm pays the entire tax increase, it will respond by reducing employment (from E_0 to E_1 in the figure below). This reduction in employment results in a substantial deadweight loss.



4-11. In the Cobweb model of labor market equilibrium (Figure 4-19), the adjustments in employment can be small with adjustment being fast, or the adjustments in employment can be large with adjustment being slow. The result that comes about depends on the elasticity of labor supply. Which result (small and fast vs. large and slow) is associated with very inelastic labor supply? Which result is associated with elastic labor supply? What is the economic intuition behind this result?

Intuitively, we should expect the adjustments in employment to be large (and therefore slow) when the labor supply curve is elastic, because by definition when the labor supply curve is elastic (i.e., responsive), changes in employment will be large (large and positive for small positive wage changes; large and negative for small negative wage changes).



4-12. A monopsonist's demand for labor can be written as $VMP_E = 40 - 0.005E_D$. Labor is supplied to the firm according to $w = 5 + 0.01E_S$. Thus, the firm's marginal cost of hiring workers when it hires off of this supply schedule is $MC_E = 5 + 0.02E_S$.

(a) How much labor does the monopsony firm hire and at what wage when there is no minimum wage?

The monopsonist sets MC_E equal to VMP_E and solves. In this case, $5 + 0.02E = 40 - 0.005E$ solves as $E^* = 1{,}400$. At this employment level, the firm pays a wage off of the supply curve, which is $5 + 0.01 \times 1{,}400 = \$19$.

(b) How much labor does the monopsony firm hire and at what wage when it must pay a minimum wage of $25?

When the minimum wage is $25, the firm's marginal cost curve also equals $25 until this wage hits the supply curve. When it does, the firm then faces the original marginal cost curve. To check: at a wage of $25, solve $25 = 5 + 0.01E \rightarrow E = 2{,}000$ units of labor are supplied. At 2,000 units of labor, $VMP_E = 40 - 0.005 \times 2{,}000 = \$30$. Therefore, we know that the minimum wage of $25 hits the supply curve before it hits the demand curve.

With the firm facing a marginal cost of $25, set marginal cost equal to the supply curve (see Figure 4-22). In this case, this requires $25 = 5 + 0.01E$, which solves as $E^* = 2{,}000$. Therefore, when facing a wage of $25, the firm pays a wage of $25 and hires 2,000 workers.

The lesson here is that, compared to part (a), a minimum wage can cause a monopsony firm to respond by hiring more workers.

4-13. Suppose the economy's labor market is competitive and that labor demand can be written as $w = 50 - 0.3E$ while labor supply can be written as $w = 8 + 0.2E$ where E is the total amount of employment in millions. What is the market clearing wage? How many people are employed? What is the total value of producer surplus? What is the total amount of worker surplus?

The picture of market clearing equilibrium is given in Figure 4–1. To find E^*, set labor demand equal to labor supply and solve:

$$8 + 0.2E = 50 - 0.3E$$
$$0.5E = 42$$
$$E^* = 84 \text{ million workers}$$

Use E^* and either equation to then solve for the market equilibrium wage:

$$w^* = 50 - 0.3(84) = \$24.80$$

or

$$w^* = 8 + 0.2(84) = \$24.80$$

Therefore, the market equilibrium is that 84 million workers are hired at an hourly wage of $24.80.

Looking at Figure 4–1, producer surplus is the area designate by triangle P. Thus:

$$P = (\tfrac{1}{2}) \times (\$50 - \$24.80) \times 84 \text{ million} = \$1{,}058.4 \text{ million}.$$

Looking at Figure 4–1 again, worker surplus is the area designate by triangle *Q*. Thus:

$$Q = (\tfrac{1}{2}) \times (\$24.80 - \$8) \times 84 \text{ million} = \$705.6 \text{ million}.$$

4-14. Suppose the Cobb-Douglas production function given in equation 4-1 applies to a developing country. Instead of thinking of immigration from a developing to a developed country, suppose a developed country invests large amounts of capital (foreign direct investment, or FDI) in a developing country.

(a) How does an increase in FDI affect labor productivity in the developing country? How will wages respond in the short-run?

FDI is an increase in capital, *K*. As equation 4-5 shows, the marginal product of labor increases as *K* increases. Thus, wages (which equal the marginal product of labor in a competitive market) will increase in the developing nation in response to FDI inflows.

(b) What are the long-run implications of FDI, especially in terms of potential future immigration from the developing country?

Intuitively, there will be less migration out of the developing country in the long run due to FDI inflows because the domestic wage (and standards of living) will have increased. Thought of differently, as *r* is constant in the long run, the capital to labor ratio is also constant in the long run (see the text). Thus, FDI $\uparrow \rightarrow K \uparrow \rightarrow L \uparrow$in the long run. There are several ways to increase *L* in the long run, but an obvious candidate is to have less migration out of the developing country.

4-15. Empirical work suggests that labor demand is very elastic while labor supply is very inelastic. Assume too that payroll taxes are about 15% and legislated to be paid half by the employee and half by the employer.

(a) What would happen to worker wages if payroll taxes were eliminated?

Because labor supply is relatively inelastic while labor demand is relatively elastic, workers bear most of the tax burden of payroll taxes, regardless of who is legislated to pay the tax. Therefore, a good estimate might be that workers bear 12 percentage points of the tax while firms bear 3 percentage points of the tax. If so, average wages would increase by 12 percentage points if payroll taxes were eliminated.

(b) What would happen to employment costs paid by firms if payroll taxes were eliminated?

Using the description from part A, it is likely that employer wage costs would fall by only 3 percentage points if payroll taxes were eliminated.

(c) What would happen to producer and worker surplus if payroll taxes were eliminated? Which measure is relatively more sensitive to payroll taxes? Why?

Both producer surplus and worker surplus would increase if payroll taxes were eliminated, but in terms of a percent change, the change would be much greater (maybe as much as 4 times greater) for workers than for firms.

(d) Why might workers not want payroll taxes eliminated?

Despite the increase in worker surplus that would accrue from an elimination of payroll taxes, workers may still not want them to be eliminated if workers value the programs these taxes fund – in particular payroll taxes fund social security, Medicare, and Medicaid.