# Practice Problems: Labor [Key]

1. As background to a consulting assignment, you have been asked to work through an analytical example to illustrate the impact of minimum wage legislation and payroll taxes on employment and unemployment. You decide to adapt the framework of your *Global Economy* class notes. The labor demand function is $L^D(w) = \left(\frac{3}{2}w\right)^{-3}$. The supply of labor rises with the wage, w: $L^s(w) = w^2$.

   a. Describe, first, how the labor market might work in this economy if the market is unregulated. What is the wage? How much labor is employed? What is the unemployment rate? In a supply and demand diagram, sketch the labor supply and demand curves and label the equilibrium wage and level of employment with the values you computed. (20 points)

Setting labor demand equal to labor supply $\left(2/(3w)\right)^3 = w^2$ Solving this for the wage yields

$w = 0.784$. After we substitute the value of the wage into either the supply or the demand equation we find that total employment is 0.61. (The units don't mean anything in this example.) There is no unemployment in this economy, as labor demanded at this wage is equal to labor supplied, so the unemployment rate is 0%.
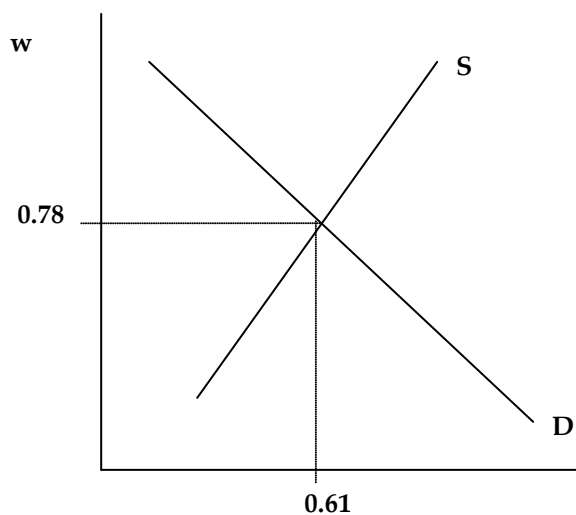
Now consider the effect of introducing a minimum wage, w_m.

b. Suppose $w_m = 1$. How much labor is employed? What is the unemployment rate? On your graph from part a., label the minimum wage, the amount of labor supplied at the minimum wage and the amount of labor demand at the minimum wage. (10 points)

Labor demand: $L^D (w = 1) = \left(\frac{2}{3}\right)^3 = 0.296$ and labor supply is $L^s (w = 1) = 1^2 = 1$, so the amount of labor employed is 0.296. The unemployed are 1-0.296=0.704, so the unemployment rate is 70.4%.
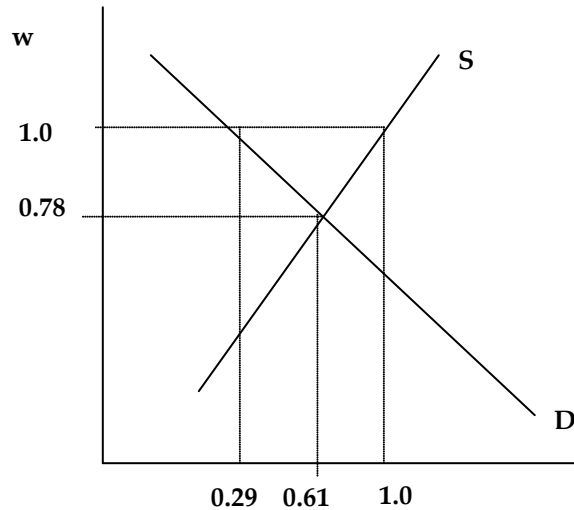
c. Suppose $w_m = 0.5$. How much labor is employed? What is the unemployment rate? (3 points)

A minimum wage of 0.5 is lower than the equilibrium wage, so the minimum wage is nonbinding. 0.61 units of labor are employed and the unemployment rate is 0%.

Finally, consider the impact of introducing a 5% payroll tax (a tax on labor levied on employers).

    d. Compute employment and unemployment. Hint: if w is the wage earned by an employee, the unit labor cost to her employer is $w \times 1.05$. (10 points)

Equating labor supply and demand:

$$\left(\frac{2}{3}\frac{1}{w*1.05}\right)^3 = w^2$$

$$w = 0.761$$

In this situation, the labor supply is equal to the labor demand. There is no unemployment, but there is a lower amount of employment, 0.579. Notice that the total cost of hiring a worker is now $w*1.05 = 0.799$

    e. In a new supply and demand diagram, sketch the labor supply curve, the labor demand curve without the tax, and the demand curve with the tax. Label the equilibrium wage and level of employment with the values you computed in part d. (5 points)
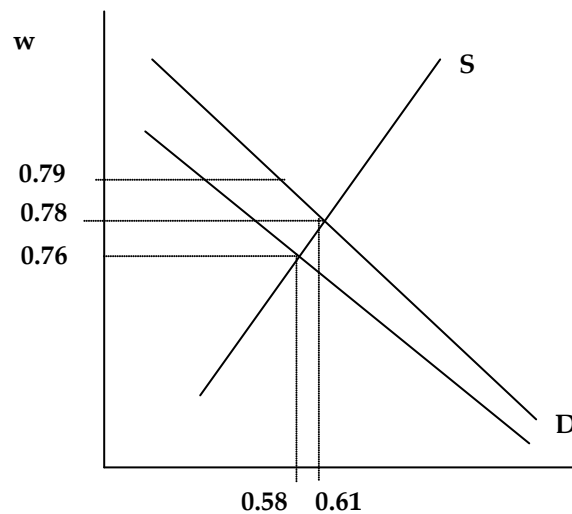
2. With the supply and demand analysis settled, you are asked consider the dynamic effects of labor market regulations on unemployment. As derived in the class notes, the change in the unemployment rate can be written as

$$\Delta u_{t+1} = s(1-u_t) - au_t$$

where s is the constant separation rate and a is the constant accession rate.

    a. If $a = 0.28$ and $s = 0.013$, what is the steady state level of unemployment in this economy? (4 points)

$$u_{ss} = \frac{s}{a+s} = 0.044$$

A large spike in gasoline prices has severely decreased the demand for SUVs. This, in turn, has cost many people in the auto industry their jobs, raising the unemployment rate at time "zero" to $u_0 = 0.089$.

    b. Compute the unemployment rate for the next 4 periods, u_1, u_2, u_3, u_4. It might be more efficient to compute these in Excel and report a neat table of numbers. (6 points)

The following table comes from the repeated application of $\Delta u_{t+1} = s(1-u_t) - au_t$, or equivalently,

$u_{t+1} = u_t + s(1-u_t) - au_t$, which is, after substituting the values for s and a,

$$u_{t+1} = u_t + 0.013 * (1-u_t) - 0.28 * u_t$$

Time	Unemployment Rate
0	0.089
1	0.076
2	0.067
3	0.060
4	0.055

    c. Compute the growth rate (it will be negative) between the unemployment rate in period 4 and period 0. (3 points)

$$\ln\left(\frac{0.055}{0.089}\right)\frac{1}{4} * 100 = -12.03\%$$

3. Suppose that in a different country, $a = 0.15$ and $s = 0.025$, what is the steady state level of unemployment in this economy? (4 points)

$$u_{ss} = \frac{s}{a+s} = 0.14$$

The health risks associated with foods high in fat have severely decreased the demand for cheese. This, in turn, has cost many people in the cheese industry their jobs, raising the unemployment rate at time "zero" to $u_0 = 0.286$.

    a. Compute the unemployment rate for the next 4 periods, u_1, u_2, u_3, u_4. It might be more efficient to compute these in Excel and report a neat table of numbers. (6 points)

Using the same methods as in 2b, but with the different parameters.

Time	Unemployment Rate
0	0.286
1	0.261
2	0.240
3	0.223
4	0.209

b. Compute the growth rate (it will be negative) between the unemployment rate in period 4 and period 0. (3 points)

$$\ln\left(\frac{0.209}{0.286}\right)\frac{1}{4}*100 = -7.84\%$$

4. In your analysis of labor markets in questions 2 and 3, the key factors were the separation and accession rates. Give two examples of policies that would affect the separation and/or the accession rates. For each example explain in a sentence or two how they affect the separation and/or accession rates. (20 points)

Any of the examples we talked about in class would work here, laws restricting work week length, firing costs, laws that give unions more power, unemployment benefits, or minimum wages to name a few.

5. There are 8,731,784 employed people in the New York City metro area and 404,291 unemployed people. The working age population is approximately 13 million. What is the labor force? What is the unemployment rate? What is the participation rate? (6 points)

$$labor force = 8,731,784 + 404,291 = 9,136,075$$

$$unemployment\,rate = \frac{404291}{9136075}*100 = 4.425\%$$

$$participation\,rate = \frac{9136075}{13000000}*100 = 70.3\%$$