

# Homework 3

## Solutions

ECON 380  
UNC Chapel Hill

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This homework is due on **February 22** by **12:05PM**. You must turn in your work on a printed copy of this document in order for it to be graded. Your assignment must be stapled and in the correct order. Non-stapled assignments will automatically receive a 10 point deduction. There are a total of 50 available points.

### Labor Market Equilibrium

1. Suppose demand for low-skilled workers in the United States is given by  $E_D = 300 - 10w$  and supply of low skilled workers is given by  $E_S = 30w - 300$ , where  $E$  represents the number of workers (in millions) and  $w$  is the daily wage rate.
  - (a) Solve for the equilibrium wage rate and employment level of low-skilled workers. [2 pts]

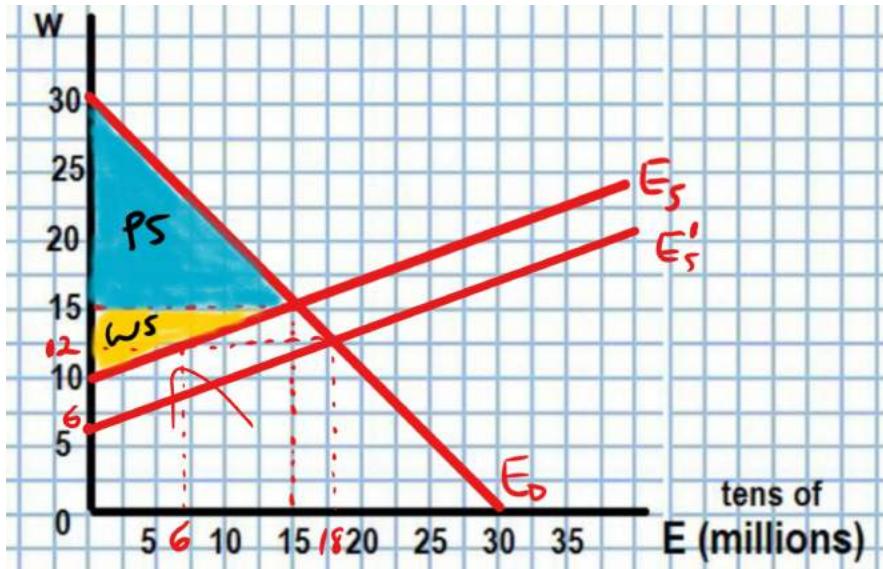
**Solution:** Set  $E_D = E_S$  to find the equilibrium wage rate:

$$300 - 10w = 30w - 300 \Rightarrow 40w = 600 \Rightarrow w^* = \$15.$$

Plug into either  $E_D$  or  $E_S$  to find equilibrium level of employment:

$$E^* = 30(15) - 300 = 300 - 10(15) = 150 \text{ million}$$

- (b) Plot the labor demand and labor supply functions on the graph below, labeling each as [2 pts] $E_D$  and  $E_S$ , respectively.



- (c) On your plot above, label (i) worker surplus and (ii) firm (producer) surplus. Compute [4 pts] their values here.

**Solution:**

$$PS = \text{Area between } E_D \text{ and } w^* \text{ up to } E^* = (1/2)(15)(150,000,000) = \$1.125 \text{ billion}$$

$$WS = \text{Area between } E_S \text{ and } w^* \text{ up to } E^* = (1/2)(5)(150,000,000) = \$375 \text{ million}$$

- (d) What is total surplus in the US market for low-skilled labor? [2 pts]

**Solution:**

$$TS = PS + WS = \$1.5 \text{ billion}$$

- (e) If the government imposes a \$20 minimum wage in this market, what will be the change [3 pts] in worker, firm, and total surplus as a result? Note: Assume that the workers with the lowest reservation wages are those that end up employed. This ensures we are calculating the maximum potential surplus as a result of this law.

**Solution:** The minimum wage is above the equilibrium market wage, so it would be binding. With the \$20 minimum wage,  $E_D = 300 - 10(20) = 100$ , so only 100 million workers will be employed ( $\bar{E} = 100$  million). Plug in 100 into  $E_S$  to find reservation wage of the 100 millionth worker:  $100 = 30w - 300 \Rightarrow w = 13.3$

$$PS' = \text{Area between } E_D \text{ and } \bar{w} \text{ up to } \bar{E} = (1/2)(10)(100,000,000) = \$500 \text{ million}$$

$$WS' = \text{Area between } E_S \text{ and } \bar{w} \text{ up to } \bar{E} \approx \frac{6.7 + 10}{2} \times 10 = \$835 \text{ million}$$

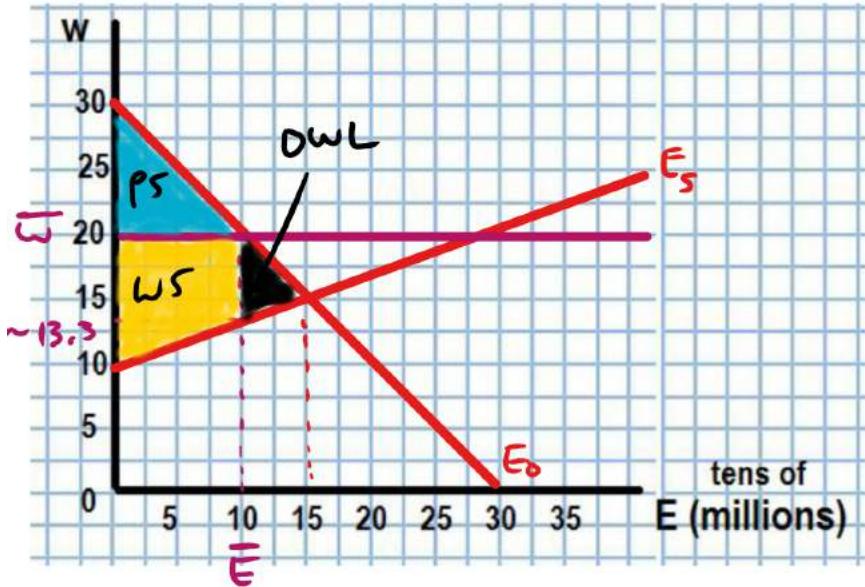
$$TS' = PS' + WS' \approx \$1.335 \text{ billion}$$

$$\Delta PS = -\$625 \text{ million}$$

$$\Delta WS \approx +\$460 \text{ million}$$

$$\Delta TS \approx -\$165 \text{ million}$$

Note: The area of  $WS'$  is a trapezoid. My calculation of  $WS'$  is not exact (I'm overstating it by rounding, which means I'm understating  $\Delta TS$ ), but is approximately what it should be. Here is a picture showing the effect of the minimum wage:



## Immigration Impacts

- Suppose that after an influx of immigrants, labor supply in the market for low-skilled workers is now given by  $E_S = 30w - 180$ . Labor demand is still  $E_D = 300 - 10w$ . The government decided against imposing a minimum wage and the market wage is freely determined by labor supply and demand.

- (a) Are the immigrants perfect substitutes or complements for native low-skill labor? [2 pts]
- Solution:** Since the migrants increased the supply of labor in the market for low-skilled labor, they are perfect substitutes. If they were complements, then the supply of labor in the unskilled labor market would be unchanged.

- (b) Plot the new labor supply curve on your plot above, labeling it  $E_S^1$ . [2 pts]
- (c) What is the equilibrium wage rate and employment level in the market for low-skilled labor after the influx of immigrants? [2 pts]

**Solution:** Again, set  $E_S = E_D$  to find  $w^*$  and plug in to either to find  $E^*$ .  $(w^*, E^*) = (\$12, 180 \text{ million})$ .

- (d) How many native workers are employed now? [2 pts]

**Solution:** For native workers,  $E_S = 30w - 300$ . At the new wage rate of \$12, the number of natives employed would be  $E_N = 30(12) - 300 = 60 \text{ million}$ .

- (e) What is the change in total surplus as a result of this immigration wave? [2 pts]

**Solution:**

$$TS' = \text{Area between } E_D \text{ and the new supply curve} = (1/2)(24)(180,000,000) = \$2.16 \text{ billion}$$

$$\Delta TS = \$660 \text{ million}$$

## Non-Competitive Labor Markets

1. Wrigley is a company town, and the only purchaser of labor in the region is the Wrigley Gum Company (WGC), who produce chewing gum to sell in the market for wholesale gum. WGC employs only labor, and labor is their only expenditure. Because they are a monopsony, they may either choose to pay low wages and hire just a few workers, or pay higher wages to induce more workers to produce gum. Note that the market for wholesale gum is competitive, so WGC must accept the market price of \$35 for each box of gum they produce. Table 1 shows the number of labor hours WGC can hire at different wages and how much output is produced by those labor hours.

Table 1: WGC Costs and Production

Wage	Labor Hours	Total Cost	Marginal Cost	Output	Total Revenue	Marginal Revenue
\$10	5	\$50	—	100	\$3,500	—
\$12	6	\$72	\$22	101	\$3,535	\$35
\$14	7	\$98	\$26	102	\$3,570	\$35
\$16	8	\$128	\$30	103	\$3,605	\$35
\$18	9	\$162	\$34	104	\$3,640	\$35
\$20	10	\$200	\$38	105	\$3,675	\$35
\$22	11	\$242	\$42	106	\$3,710	\$35
\$24	12	\$288	\$46	107	\$3,745	\$35
\$26	13	\$338	\$50	108	\$3,780	\$35

- (a) Fill in the blank columns in Table 1. [4 pts]  
 (b) Assuming WGC is a profit maximizing firm, how many hours of labor should they hire? [2 pts]

**Solution:** The firm should hire the next hour of labor as long as  $VMP_E \geq MC$ . In this example,  $MP_E = 1$ , so  $VMP_E = \$35 \times 1 = \$35 = MR$ . The firm should hire 9 hours of labor.

- (c) What is the profit earned by WGC if they employ the profit-maximizing number of labor hours? [2 pts]

**Solution:**

$$\Pi = TR - TC = \$3,640 - \$162 = \$3,478$$

- (d) Compare the wage rate to the value of the marginal product of labor. Which is greater (or are they equivalent)? [2 pts]

**Solution:**  $VMP_E = \$35 > w = \$18$ . Workers are paid less than the value they bring to the firm.

- (e) Now, suppose that the town of Wrigley imposes a minimum wage of \$22. In Table 2 below, fill in WGC's total cost, marginal cost, and profit. Assume prices and revenues are the same as before. [3 pts]

Table 2: WGC Costs and Production

Wage	Labor Hours	Total Cost	Marginal Cost	Profit
\$22	5	\$110	—	\$3,390
\$22	6	\$132	\$22	\$3,403
\$22	7	\$154	\$22	\$3,416
\$22	8	\$176	\$22	\$3,429
\$22	9	\$198	\$22	\$3,442
\$22	10	\$220	\$22	\$3,455
\$22	11	\$242	\$22	\$3,468
\$24	12	\$288	\$46	\$3,457
\$26	13	\$338	\$50	\$3,442

- (f) What happens to the quantity of labor employed after the minimum wage is imposed? [2 pts]  
How does this compare to the effect of a binding minimum wage in a competitive market?

**Solution:** The quantity of labor will increase to 11 hours of labor after the imposition of the minimum wage since this is the profit maximizing number of hours to employ. In a competitive market, an increase in the wage rate due to a binding minimum wage would decrease employment.

- (g) What happens to worker surplus as a result of the minimum wage? Explain why. You [2 pts] don't have to calculate the change in worker surplus here, just explain why it changes in the direction it does.

**Solution:** Worker surplus will increase as a result of the minimum wage. Both the number of labor hours employed and the wage rate increased, which will result in an unambiguous increase in worker surplus.

- (h) What happens to total surplus as a result of the minimum wage (relative to the total surplus without the minimum wage)? Explain why. You don't have to calculate the change in total surplus here, just explain why it changes in the direction it does. [2 pts]

**Solution:** Earlier labor employment was low due to the firm's monopsony power. After the minimum wage is put in place, the firm expands production. The firm's profits fall, but the gains of the workers make up for it. Under a monopsony, increasing employment will increase total surplus as we will be closer to the optimal employment level where  $E_S = VMP_E$ .

## LMDCs

Directions: Type your answers to the following questions and attach them to the back of this packet.

1. Read the introduction of Jayachandran (2006). In 3-5 sentences, briefly summarize the paper's results in regards to how the wage responded differently to productivity shocks depending on the availability of "smoothing mechanisms." [4 pts]

**Solution:** Jayachandran finds that agricultural wages in rural India are less sensitive to productivity shocks (instrumented by local rainfall changes over time) if

1. an area has a more developed banking sector

2. workers are able to migrate away from an area
3. workers are landless

You didn't have to mention this, but these results support the theoretical prediction that labor supply should be more inelastic if workers cannot save/borrow in order to smooth consumption (i.e., the income effect should be large if you cannot "weather" negative wage shocks). Additionally, if workers are "stuck" in areas, we again should only see a small change in labor supply if access to other regions is limited or if individuals own land and cannot readily move. These issues are exacerbated further if workers are near subsistence, as is the case in many developing countries, since the marginal utility of income for these workers is high.

2. Read the introduction to Jensen (2012). In 3-5 sentences, briefly summarize the paper's results [4 pts] in regards to how increased labor market opportunities affected young women's labor market participation as well as other outcomes beyond the labor market.

**Solution:** Jensen finds that the recruiting service provided to rural treatment villages in India (a proxy for increasing labor market opportunities) lead to

1. women in treatment villages to be 4.6% more likely to work in a BPO job than women in control villages and 2.4% more likely to participate in any work outside the home
2. women in treatment villages expressing a greater interest in labor force participation throughout their life
3. increased investments for women in treatment villages (e.g., higher enrollment in private classes, greater enrollment for younger females and higher BMI)
4. women in treatment villages to be 5-6% less likely to be married or give birth during the treatment period and reporting a desire to have fewer children