ECON 110, Prof. Hogendorn

Problem Set 7 Answers

1. *Water_a.*

   (a) Total revenue and marginal revenue are:

   $$\begin{aligned} TR(q) &= (1000 - 0.01q)q \\ MR(q) &= 1000 - 0.01q - 0.01q = 1000 - 0.02q \end{aligned}$$

   Total cost and marginal cost are:

   $$\begin{aligned} TC(q) &= 25,000,000 + 100q \\ MC(q) &= 100 \end{aligned}$$

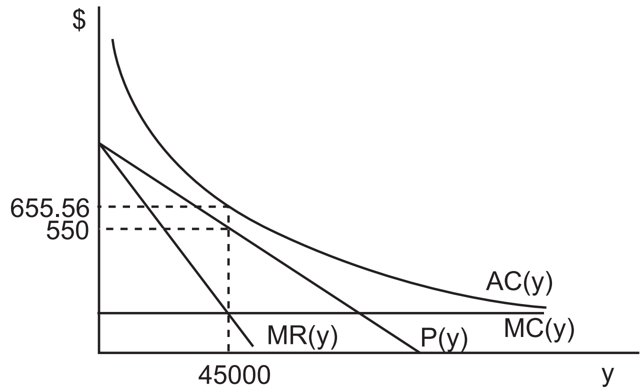
   (b) The optimal behavior is to set marginal revenue equal to marginal cost:

   $$\begin{aligned} 1000 - 0.02q &= 100 \\ q &= 45000 \end{aligned}$$

   The price at this output is $p(45,000) = 1000 - 0.01 \cdot 45,000 = 550$. The profit is:

   $$\begin{aligned} \Pi(45,000) &= (p(45,000) - AC(45,000))45,000 \\ &= (550 - 655.56)45,000 \\ &= -4,750,000 \end{aligned}$$

   (c) The key here is that the AC curve lies everywhere above the demand curve, so there's no way the monopoly can avoid a loss, even at the maximum "profit" level.



(d) If the government is only concerned with its own budget, the cheapest lump-sum subsidy needed is \$4,750,000, which is just enough to offset the monopoly lost. We know this is the smallest possible lump-sum subsidy that will induce you to provide water service, because the monopoly output maximizes profits, or, in this case, minimizes losses.

If the government is concerned with overall welfare, it should induce the monopoly to set price equal to marginal cost. At this price, the monopolist makes $p(q) = 100 \Rightarrow q = 90,000$ units and its profits are:

$$\begin{aligned} \Pi(90,000) &= (p(90,000) - AC(90,000))90,000 \\ &= (100 - 377.78)90,000 \\ &= -25,000,000 \end{aligned}$$

Thus the government would have to provide a \$25,000,000 subsidy on condition that the firm produces 90,000 units. This would be harder on the government budget, but it would maximize social welfare.

2. *OldGermans_a.*

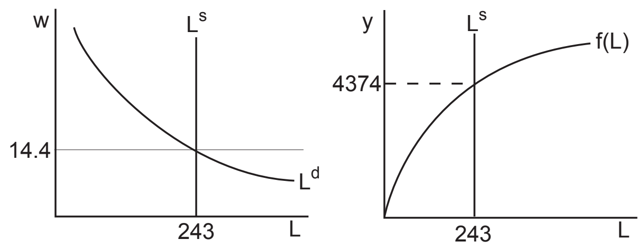
(a) We can find labor demand using $pMP_L = w$, so,

$$\frac{4}{5} \cdot \frac{54}{4} L^{-1/5} = w \Rightarrow L^d = \left(\frac{54 \cdot 4}{5w}\right)^5$$

Setting $L^d = L^s = 243$ gives an equilibrium real wage of $w = 14.4$.

(b) The total costs of the firm are $wL = 14.4 \cdot 243 = 3499.2$. The total revenues are $py = 1 \cdot f(243) = 4374$. Thus the profits, paid as dividends, are 874.8. The firm's output is 4374.

Workers earn total wages of $wL = 3499.2$ and total dividends of 874.8. Their total consumption of beer is thus 4374, so there is equilibrium. 80% of the workers' income is from wages, and 20% from dividends.



(c) L^d is the same as before, but now setting $L^d = L^s = 198$, gives an equilibrium real wage of $w = 15$. Firm output is $f(198) = 3713$, of which the total costs are $wL = 2970$ and the dividends are 743.

Workers' wages plus dividends sum to 3713, all of which they consume, so there is equilibrium in the goods market.

3. *Uchitelle_a.*

(a) The profit of one of the firms is $\pi(L) = p \cdot 25L^{1/4} - wL$. The first order condition for the optimal L to demand is

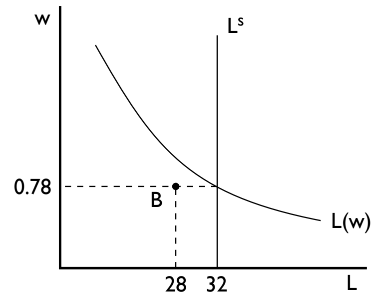
$$\frac{d\pi}{dL} = 6.25L^{-3/4} - w = 0$$

Solving for L, we find that the firm's labor demand is

$$L^D = 11.5w^{-4/3}$$

Setting labor supply equal to *market* labor demand gives us:

$$32 = 23w^{-4/3} \Rightarrow w^* = 0.78$$



(b) At this wage, each firm hires $L^D = 16$ workers and produces an output of $f(16) = 50$ hamburgers. Each firm makes a profit of $\pi(16) = 50 - 0.78 \cdot 16 = 37.52$. The income of the consumers is the total wage bill of $0.78 \cdot 32 = 25$ plus the dividends earned from owning the firms, for a total of $25 + 2 \cdot 37.5 = 100$. With nothing else to buy, this means consumers demand 100 hamburgers, which is the total output of the firms.

(c) Each firm now hires 14 workers, although this is not on their correctly-calculated labor demand curve as shown by point B in the diagram. Each firm's output is now $f(14) = 48.36$ hamburgers. The wage bill is only $0.78 \cdot 14 = 10.92$, so the profits of a firm are $\pi(14) = 48.36 - 10.92 = 37.44$. So firm profits fall slightly, which makes sense since they are no longer profit-maximizing. This implies that the dividend portion of household income also falls slightly.

The wage income portion of household income clearly falls, since fewer people are employed, although this reduction falls entirely on the 4 unemployed workers.