ECON 110, Prof. Hogendorn

Problem Set 7

1. *Water.* The government has offered to give you a monopoly if you will provide water to a city. The inverse demand curve is $p(q) = 1000 - 0.01q$ and the average cost curve is $AC(q) = \frac{25,000,000}{q} + 100$.

   (a) What are the marginal revenue and marginal cost curves?

   (b) What is the optimal price you should charge and quantity you should produce? What is the profit of the monopolist?

   (c) Graph this situation carefully.

   (d) If the government were to give this firm a lump-sum subsidy, how big should it be if (1) the government is concerned only about its own budget or (2) it is concerned with overall welfare?

2. *OldGermans.* In Germany, the birth rate is low and the population is ageing. As a result, the working age population is falling at about 0.2% per year. It has been suggested that this population decline puts the German economy at risk. This question asks you to use our simple neo-classical model to evaluate that claim.

   Let there be $\mathcal{L} = 243$ German workers who inelastically supply labor and who spend all of their income on beer consumption. These workers own the German beer firms which have aggregate production function $f(L) = \frac{54}{4}L^{4/5}$. (Aggregate meaning we treat all the firms as if there were just 1.) Let $p = 1$.

   (a) Find the equilibrium real wage in the labor market and graph the labor market.

(b) Verify that there is also equilibrium in the beer market and graph the production function. What share of workers' income comes from wages and what share from dividends?

(c) Suppose that over 10 years, the German population falls and there are only $\mathcal{L}' = 198$ workers. Find the new general equilibrium.

3. *Uchitelle.* The following are quotes from an op-ed by Louis Uchitelle that appeared in the New York Times on August 25, 2002. It provides some food for thought, but we can evaluate the arguments a lot more clearly in a simple macroeconomic model. At the end of the article is a suggestion for trying to model Uchitelle's idea.

> In Alice in Wonderland fashion, we talk of expansion and ignore the contraction all around us. We convince ourselves that out of cost-cutting will come prosperity. But while cost-cutting can lift a single company or two, when practiced widely enough it can pull down an economy. And that is happening today.
>
> ... consider what happens in an imaginary country where Burger King and McDonald's are the entire business sector and the total national output 100 hamburgers a day, evenly divided between the companies matches the demand from this nation's consumers. Demand and sales revenue, however, stay flat. So Burger King lays off two workers and uses the saved wages partly to fatten profits and partly to discount prices by just enough to take sales and revenue away from McDonald's. And McDonald's responds in kind. But soon, the four laid-off workers, with little income, buy fewer hamburgers, and the nation's total consumption drops to 95 hamburgers a day. That sets off another round of cost-cutting and price discounting, and our imaginary nation sinks gradually into stagnation or deep recession not unlike America in the 1930's.

Let the entire population of the economy be 32 workers who inelastically supply labor and who spend all of their income on hamburgers. Let McDonald's and Burger King be identical firms that each have production function $f(L) = 25L^{0.25}$. Let them both behave as perfect competitors. Let $p = 1$.

(a) Find the equilibrium real wage in the labor market. Remember that there are TWO firms, so the total demand for labor is the sum of each firm's demand for labor. Illustrate with a graph.

(b) Verify that there is also equilibrium in the hamburger market and comment on the sources of the workers' total income.

(c) Suppose that the two firms each laid off 2 workers as Uchitelle wrote. Assume the laid-off workers get no income whatsoever. Also suppose that the remaining 28 workers receive the same wage as before. Show the situation on a labor market diagram. Are the firms' profits higher? What about the workers' incomes?

Review Problems only, not to turn in:

4. *ChinaMobile.* This problem is loosely based on reality: Every year, cellular phone equipment becomes cheaper, and China Mobile's costs fall. Specifically, assume that in year 1, the marginal cost per minute is 0.20 yuan and in year 2 it falls to 0.10 yuan. (Note, in both years, MC is constant, i.e. horizontal.)

(a) Let demand (in minutes per typical consumer) be given by $y(p) = 100 - 100p$. Treating China Mobile as a monopoly, what is the profit maximizing price and number of minutes in year 1? What about year 2? On the same graph, show the optima in both years.

(b) Suppose that China Mobile committed to the *quantities* from (a) in year 1 and year 2, but that the demand estimate turned out to be a mistake. Really demand is $y'(p) = 60 - 60p$. In terms of

foregone profits, are China Mobile's problems getting worse or better over time?

(c) From the point of view of China as a whole, was the mistake bad or good? In money terms, how much did China gain or lose in year 2? Illustrate on a graph.

(d) Just for fun: Who do you think China Mobile hired to do the initial demand estimate?

5. *Deflate.* Given the information below about the U.S. economy, how much did real GDP grow between 1980 and 1990? Between 1990 and 2000?

|	1980	1985	1990	1995	2000
Nominal GDP (trillions)	2.8	4.21	5.8	7.4	9.96
GDP deflator (1996=100)	57.0	73.7	86.5	98.1	106.9

6. *AGUnemployed.* Since his screw-up at the pharmaceutical consultancy, Amherst Guy has not been able to find another job. Is he frictionally unemployed, cyclically unemployed, or a discouraged worker?

Answer to Review Problems:

4. *ChinaMobile_a.*

(a) The inverse demand curve is $p(y) = 1 - 0.01y$. For a monopoly, profit is maximized when marginal revenue equals marginal cost. $TR = p(y)y = y - 0.01y^2$, so marginal revenue is $MR = 1 - 0.02y$. Then in year 1 the profit maximizing quantity is $1 - 0.02y = 0.2 \Rightarrow y = 40$. The price at this quantity is $p(40) = 0.60$.

In year 2, the same calculations with the new marginal cost give $1 - 0.02y = 0.1 \Rightarrow y = 45$ and $p(45) = 0.55$. The graph looks like this:
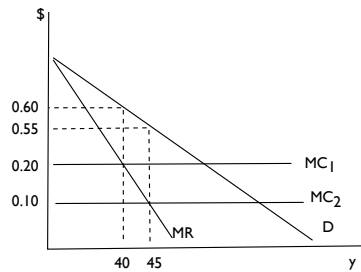
(b) The true inverse demand curve turns out to be $p'(y) = 1 - 0.017y$. In year 1, they mistakenly set $y = 40$. This gives them a price of $p'(40) = 0.32$. Their profit is $\pi = py - TC(y) = 0.32 \times 40 - 0.2 \times 40 = 4.8$.

Actually, marginal revenue was $1 - 0.034y$, so the correct monopoly quantity was $1 - 0.034y = 0.2 \Rightarrow y' = 23.5 \Rightarrow p'(23.5) = 0.6$. The profit would have been $\pi' = 0.6 \times 23.5 - 0.2 \times 23.5 = 9.4$. Thus, China Mobile forewent $\pi' - \pi = 9.4 - 4.8 = 4.6$ profit.

In year 2, they mistakenly set $y = 45$. The price is $p'(45) = 0.235$. Their profit is $\pi = py - TC(y) = 0.235 \times 45 - 0.1 \times 45 = 6.075$.

Actually, the correct monopoly quantity was $1 - 0.034y = 0.1 \Rightarrow y' = 26.47 \Rightarrow p'(26.47) = 0.55$. The profit would have been $\pi' = 0.55 \times 26.47 - 0.1 \times 26.47 = 11.91$. Thus, China Mobile forewent $\pi' - \pi = 11.91 - 6.075 = 5.835$ profit.

Thus, not only did they lose a lot in both years (about half of potential profits), but things were worse in year 2 than in year 1. The reason is that there is more to lose when the monopoly has lower costs it can take advantage of.

(c) Since monopolies inefficiently reduce quantities below the competitive level, and since price was still above marginal cost despite the mistake, we can be sure that China as a whole gained from the mistake. In year 2, 45 units were produced instead of 26.47.

The added value (reduced deadweight loss) of these units was the area between the demand curve and the marginal cost curve between 26.47 and 45 units, shaded on the graph below.
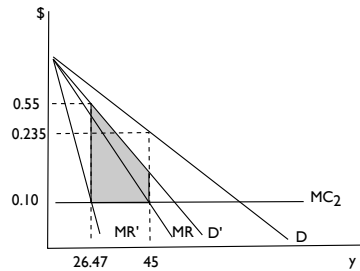
The numerical gain was:

$$\int_{26.47}^{45} 1 - 0.017y - 0.2 \, dy \quad = \quad \left| 0.8y - .0085y^2 \right|_{26.47}^{45}$$
$$= \quad 18.7875 - 15.22$$
$$= \quad 3.5675$$

(d) Amherst Guy!

5. *Deflate_a*. Total growth in real GDP between 1980 and 1990 was 36.5% and between 1990 and 2000 was 38.9%.

6. *AGUnemployed_a*. The joking answer is that he went to Amherst, so his skills are completely useless and therefore he is structurally unemployed. The realistic answer is that things like this happen all the time to workers, and they go find new jobs. This is just part of the labor market, and is just frictional unemployment. Finally, it is possible to answer that the U.S. economy has been experiencing cyclical unemployment due to a recession, which could be impacting this worker.