ECON 110, Professor Hogendorn

Problem Set 6

1. *FordToyota.* Let Ford and Toyota have two small factories, each with exactly the same production function for producing cars:

$$f(L) = 316L^{1/4}$$

Each company makes a single type of car that sells for a price of $p = \$25,000$. Each worker's annual salary is $\$62,500$. Each company makes 1000 cars per year at its factory.

   (a) What is the conditional factor demand for labor? What is the average variable cost and marginal cost of a car?

   (b) Toyota has a fixed cost of $\$15,000,000$ at its factory. What is its operating profit and its net profit? Show the profits on a graph of price, average cost and average variable cost.

   (c) Ford has the same $\$15,000,000$ fixed cost, plus additional fixed costs of $\$6,000,000$ due to pensions for retired employees. What is its operating profit and its net profit? Show the profits on a graph of price, average cost, and average variable cost.

   (d) Assume production is fixed at 1000 cars and does not change from year to year. Toyota's factory will last for 5 years. Car prices and workers' salaries are both projected to grow at 5% per year. The production function will not change, and the same $\$15$ million fixed cost occurs every year. The factory will have no value at all after 5 years. If the interest rate is 10%, how much is the factory worth today?

2. *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) (Extra, not to turn in.) 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 paying the smallest possible subsidy or (2) it is concerned with overall welfare?

3. *Campbell.* An article in *Business Week,* Nov. 24, 2010, describes how Campbell Soup works very hard to improve productivity at its factories.

   (a) The article says that "Productivity gains come when hundreds of nitpicky efforts combine to save time, money, and effort." Draw how these efforts change the production function $f(L)$.

   (b) Suppose that Campbell is able to change its production function from $f(L) = 75L^{1/2}$ to $f(L) = 85L^{1/2}$. What is its labor demand curve for both cases?

   (c) Suppose that Campbell has a near monopoly on the American soup market, with a demand curve of $p(q) = 5 - 0.011q$ Also suppose that Campbell must pay a wage of 10 and has the production function $f(L) = 85L^{1/2}$ mentioned above. What is the monopoly profit maximizing quantity and price?

   (d) Draw a diagram of the monopoly profit maximization problem. Add an average cost curve that shows Campbell making a *loss* at the monopoly profit maximum. How could this be? Should Campbell Soup shut down if this happens?

4. *NetAlone.* Suppose netalone.com is an Internet startup that specializes in e-business consulting. The following table summarizes the company's projected earnings in the next 5 years:

Year	Earnings
2009	100,000
2010	300,000
2011	500,000
2012	700,000
2013	1,000,000

The CEO of netalone.com announced that the company was going to issue 10,000,000 shares of common stock and the IPO (initial public offering) price was set at $1 per share. (A share of stock entitles you to a share of ownership of the company, and the company's value is based on its earnings.) Suppose the market discount rate is 10%. Based on the above earnings forecast, will you buy the stock? What do you think is a more reasonable price?

Review Problems only, not to turn in:

5. *NaturalGas.* One of the most important energy trends of the past year has been the decline in natural gas prices in the United States. Measured per MMBtu (million British thermal units), they have declined from $4 to $2 from 2011 to 2012.

   (a) Suppose there is a perfectly competitive, profit-maximizing electricity generating firm that uses natural gas to produce electricity. Suppose the price of the electricity was $90 per MWh (megawatt-hour) in both 2011 and 2012. If the firm can freely adjust its input of natural gas, what was the marginal product of an MMBtu of natural gas in 2011 and in 2012?

   (b) Explain the logic behind why the firm let the marginal product fall in part (a).

   (c) Graph the firm's demand curve (the price), the average cost curve (assume there are some fixed costs), and the marginal cost curve. Draw it so the firm had price equal to average cost

in 2011. Now show how the curves shift in 2012, and show whether the firm is making rents in 2012. (Think carefully how the AC curve shifts since the only change is in variable costs, not fixed costs.)

(d) In the long run, if nothing else changes, what will happen? Illustrate with a graph of the overall electricity market.

6. *MovieWindows.* The movie industry is struggling to adapt to technology change. Traditionally, a movie was released in cinemas for a 4-month "window," and then it became available on DVD. Now DVD sales have fallen because consumers have more alternatives available for watching movies. Some movie studios are thinking about shortening the window (and sending films direct to Netflix, iTunes, etc.) in order to increase sales.

(a) During the window, a movie studio has a monopoly on selling that particular movie to cinemas. Let the demand curve be

$$p = 1.64 - 0.034Q$$

and the marginal cost be a constant: $MC = AVC = 0.28$.

Write the profit function. Write out the first order condition, but do not solve for Q yet. Write in words the mathematical and the economic intuition behind the first order condition.

(b) The monopoly price they set is $p_m = 0.96$, which is to say that the studio takes 96% of the cinema's box office revenue. The movie sells $Q_m = 20$ (million) tickets. Verify mathematically that these are the optimal monopoly price and quantity, and illustrate on a diagram.

(c) Show in your diagram and calculate the amount of dead-weight loss caused by the monopoly. (Note that using the

"price" of 0.96, deadweight loss will be expressed as a percent of total ticket sales, not in dollars. To convert to dollars, just multiply by an average ticket price of $8.)

(d) True or false, and explain with a graph: since the monopoly price is well above the average variable cost, all movies make economic profits.

(e) If the cinema window were reduced, waiting for the movie to come out on DVD or online would be a better substitute for impatient consumers, increasing elasticity but also shifting demand. Let's say that demand would pivot like this:
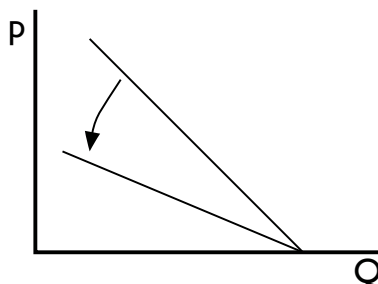

Show what happens on the monopoly diagram. Does monopoly price rise or fall? Monopoly operating profit? You don't have to find any of these mathematically, but you do need to show them graphically.

7. *Benetton.* Benetton has a stock market capitalization of $1.2 billion and trades at a price-earnings ratio of 6.5. Hennes & Mauritz, the parent of H&M, trades at a price-earnings ratio of 18.3.

   (a) What are Benetton's yearly earnings? Does the stock market expect them to rise faster or slower than H&M's?

   (b) Benetton's costs as a percentage of sales are 54%, while H&M's are 39%. Does this help to explain the difference in price-earnings ratios?

Answers to Review Problems:

5. *NaturalGas_a.*

   (a) A perfectly competitive, profit maximizing firm always sets price of output times marginal product of a factor equal to the price of the factor. For example, for labor it sets $pMP_L = w$. For gas the equation is $90MP_g = p_g$. In 2011, this gives $MP_g = 4/90$ and in 2012 it gives $MP_g = 2/90$.

   (b) Since the firm is profit maximizing, it keeps on using more gas until the value of the product of the marginal unit of gas equals the cost the the marginal unit of gas. With the gas price lower, the firm makes higher profits by using more gas even though diminishing returns set in and the marginal product of gas is lower.

   (c) Since the price of a factor of production has fallen, both marginal and average cost curves shift down. The AC curve shifts down less at low quantities and more at high quantities since the importance of variable costs becomes greater at larger quantities. Since the firm made zero profit before, it must now be making rents since its costs are lower. The rents are shown by the shaded box.
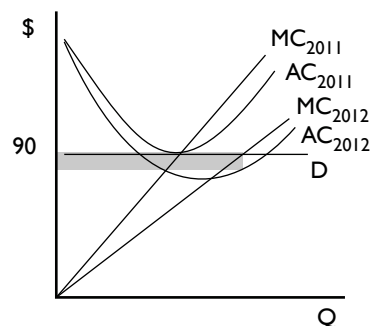
   (d) In the long run, the rents will attract more firms to enter the electricity market by using natural gas. The increased supply

will lower electricity prices, eventually pushing them down until a typical natural gas generator again earns zero profits.
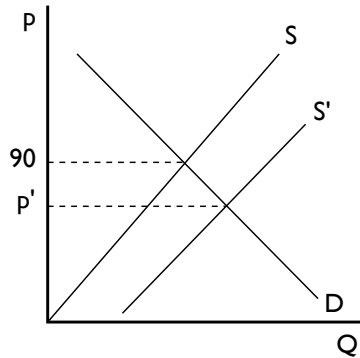
6. *MovieWindows.*

  (a) Profits are

$$\Pi(Q) = pQ - TC(Q) = (1.64 - 0.034Q)Q - 0.28Q$$

The first order condition is

$$\frac{d\Pi(Q)}{dQ} = 1.64 - 0.034Q - 0.034Q - 0.28 = 0$$

Mathematically, this finds the point of zero slope, the flat top of the "hill."

Economically, this finds where the marginal increase in revenue from selling one more unit equals the marginal increase in cost. After this, further production will reduce profits.

  (b) Solving the first order condition gives

$$1.64 - 0.068Q = 0.28 \Rightarrow Q = 20$$

The graph shows the downward-sloping MR curve hitting the MC curve:
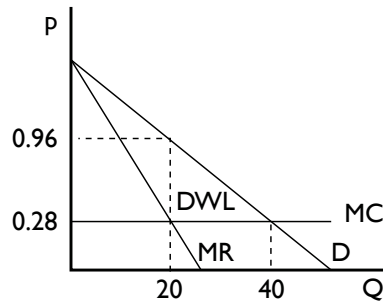
(c) If the studio behaved as a perfect competitor, it would rent the movie for 28% of ticket sales, and the quantity of tickets sold would be 40. So the deadweight loss is

$$\frac{1}{2}(0.96 - 0.28)(40 - 20) = 6.8$$

Multiplying by $8 suggests a deadweight loss of $54.4 million for the movie.

(d) This is false. The movie described above earns an operating profit of $(0.96 - 0.28)20 = 13.6$, or about $109 million when multiplied by the ticket price. But fixed costs might be higher than this, it depends on the movie. The movie shown in the following graph loses money on net.
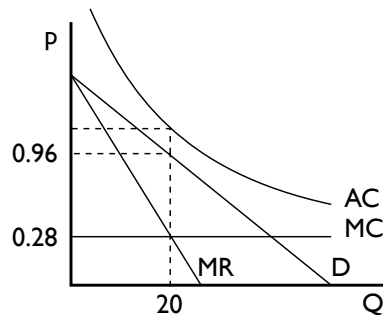
(e) The pivot shown in the graph will reduce both the monopoly price and the monopoly quantity, and therefore the monopoly operating profit.
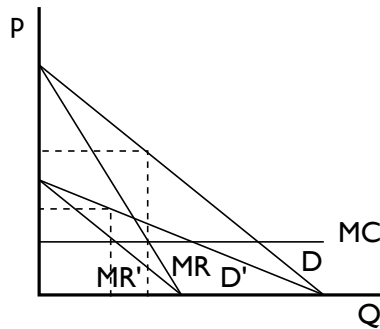
7. *Benetton_a*

(a) Since the price-earnings ratio is 6.5, that means that

$$\frac{\$1.2}{E} = 6.5 \Rightarrow E = \frac{\$1.2}{6.5} = \$0.18\,\text{billion}$$

The market allows you to buy \$1 of *current* Benetton earnings for about one-third of the price of \$1 of current H&M earnings. The only way that could be an equilibrium is if market participants expect H&M's future earnings to rise faster than Benetton's.

(b) Yes. This indicates that the total cost component of Benetton's profits is much higher than for H&M . So the implication is that any future growth in revenue will likely coincide with a much larger increase in costs for Benetton. Thus, even if the market expects both companies to have the same growth in sales (i.e. total revenue), it would still expect Benetton to have a lower increase in earnings.