ECON 110, Prof. Hogendorn

Problem Set 7

1. US Airways. In fall 2006, US Airways announced a hostile takeover bid for Delta Air Lines. The investment community and the airline industry responded very positively. Everyone thought that a merger like this would reduce competition and raise profits for all airlines, not just the two merging firms.

   (a) With reference to the formula for pricing a stock, did airline stocks rise or fall after the announcement?

   (b) With reference to the formula for pricing a bond, did airline bond yields rise or fall? Did airline bond prices rise or fall? Why?

   (c) Did the news change the coupon payments on airline bonds with a $100 face value issued in August 2006? Is it likely to have changed the coupon payments on airline bonds with a $100 face value issued in December 2006 (i.e., bonds not yet issued at the time of the announcement)? Why?

2. Small Country. Remember that a country’s supply of loanable funds is the net supply after households that borrow are subtracted from those who save. Suppose there is a small country with 1000 households. 700 of these have a savings function \( s = 50r \), where \( r \) is the rate of return on capital. The remaining 300 households have savings function \( s = -1 + 10r \). (You can imagine that both the number of households and the amount of savings are in thousands.)

   (a) Graph the individual and aggregate savings functions. Describe in words what happens to both types of household and the whole country when the interest rate rises from 3% to 11%.
(b) There are 100 firms, and each firm has an investment demand function \( i(r) = 10/r \). Find and graph the aggregate investment function for the whole country.

(c) Show that the equilibrium interest rate in this country is 16.6% (rounded to one decimal).

(d) In most countries, a real interest rate of 7% would be more typical. Do you think this country will have higher or lower economic growth than the typical country? Explain.

3. **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?

<table>
<thead>
<tr>
<th>Year</th>
<th>Nominal GDP (trillions)</th>
<th>GDP deflator (1996=100)</th>
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<tbody>
<tr>
<td>1980</td>
<td>2.8</td>
<td>57.0</td>
</tr>
<tr>
<td>1985</td>
<td>4.21</td>
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<td>5.8</td>
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<tr>
<td>1995</td>
<td>7.4</td>
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<tr>
<td>2000</td>
<td>9.96</td>
<td>106.9</td>
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Review Problems only, not to turn in:

5. *Lula.* Suppose there is a Brazilian government bond with a face value of R$100 (i.e. 100 reals, the currency of Brazil). The bond has a coupon of R$5 and matures in 1 year.

(a) If the bond’s current price is R$80, what is its yield?

(b) Many investors thought that if Lula da Silva were elected president of Brazil, Brazilian debt would become more risky. Explain what probably happened to the price of Brazilian government bonds when Lula won.

6. *UncleKarl.* Your Uncle Karl gives you 20,000 dollars of capital.

(a) For $1000, you can buy a risk-free government bond with a coupon of $50 (payable at the end of the year), a face value of $1050, and a maturity of one year. What is the yield on this bond?

(b) Alternatively, you can invest some of the capital in a business venture producing downloadable music. For each dollar of capital invested over the course of one year, do you think it is more reasonable to let your cost of that capital be $0.05, $0.10, or $0.15? Discuss your answer with reference to part (a), assuming you can buy fractional amounts of the bonds.
(c) To simplify, assume no labor is involved in this business; the only factor is capital. Your production function is $q(K) = 100K^{9/10}$, where output is measured in the number of downloads. You must also use $5,000 more of capital to pay a fixed cost to get started. What are the equations for your total, average, and marginal cost curves, using your answer to (b)? Graph the AC and MC curves.

(d) If each download brings you revenue of $0.04, how much capital should you invest in this business? Show this on your graph. Do you earn a competitive rate of return on your capital, or do you receive rents?

7. Jetta. Suppose you were thinking about buying (with a car loan) or leasing a Volkswagen Jetta.

Buying with loan: To make this simple, let’s assume that each year you pay your entire car payment at the end of the year. Based on Volkswagen’s current financing offer, you would pay $6,186 at the end of year 1, 2, and 3, and then you would own the car. According to the web site, the car will be worth $10,739 at that point.

Leasing: Volkswagen has an offer where you can lease the car with no up-front costs. Again let’s make the entire lease payment due at the end of the year, in which case the lease payments are $3,237 at the end of year 1, 2, and 3. After that you just have to give the car back to Volkswagen.

Let’s use 5% as the interest rate for this problem.

(a) Write down the formula for the present value of the lease offer, and then find the present value.

(b) Write down the formula for the present value of the buy with loan offer, and then find the present value.

(c) Suppose that you take the buy offer, but then at the end of year 1, right after you make the $6,186 payment, you decide to sell
the car. The person you sell to will have to pay the remaining two payments. That person gets a value equal to $3,237 in each of the two years from having a car to drive. How much will the buyer pay?

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

(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?

9. 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:

5. Lula.

(a) The formula to use here is

\[
P = \frac{A}{1 + i} \quad R$80 = \frac{R$5 + R$100}{1 + i} \quad \Rightarrow 1 + i = 1.3125 \Rightarrow i = 31.25\%
\]

(b) Investors perceived Lula as risky, and they demanded a higher risk premium on Brazilian government bonds. For an existing bond, the coupon and face value have already been set, so the only way for the yield to rise was for the present value to fall, as shown in the formula above.
6. UncleKarl_a.

(a) Assuming you get paid the coupon at the end of the year, the present value equation is:

\[ 1000 = \frac{50}{1 + i} + \frac{1050}{1 + i} \Rightarrow 1000(1 + i) = 1100 \Rightarrow i = 10\% \]

(b) We know that you can buy a risk-free bond and get a yield of 10%. Therefore any risk-free investment should have a cost of capital of $0.10 per dollar invested. Presumably the online music business is very risky, so a cost of capital of $0.15 would be more appropriate. (Indeed, a cost of capital of more like $0.40 might be reasonable.)

(c) Since \( q(K) = 10K^{q/10} \), you need \( K(q) = \frac{q}{10} \) units of capital to produce output \( q \). Since capital costs $0.15, and you have an additional fixed cost of $5000 that also comes out of capital, the cost curves are:

\[
TC(q) = 0.15 \left( 5000 + \frac{q}{10}^{10/9} \right) = 750 + 0.0116q^{10/9}
\]

\[
AC(q) = \frac{TC(q)}{q} = \frac{750}{q} + 0.0116q^{1/9}
\]

\[
MC(q) = \frac{dTC(q)}{dq} = 0.0129q^{1/9}
\]

If you draw the graph exactly, it is a little strange because marginal cost is concave:

![Graph](image)

(d) Your profit maximizing quantity is where marginal cost equals price:

\[
MC(q) = p \Rightarrow 0.0129q^{1/9} = 0.04 \Rightarrow q^* = 26,418
\]
At that quantity, you need to invest $K(26, 418) = 6,340$ dollars of capital plus the 5,000 dollar startup cost. Given that your cost of capital is 0.15, your total costs are 1,701. Your total revenue is $pq^* = 0.04 \times 26, 418 = 1,056.72$. Thus you actually lose money on this investment, since your revenues are lower than your costs, including the proper cost of capital. You should buy the bond instead!


(a) This formula is quite simple:

$$\frac{-3237}{1.05} + \frac{-3237}{1.05^2} + \frac{-3237}{1.05^3} = -8815$$

(b) Here the formula is a little more complex because you have the residual value of the car after the loan is paid off:

$$\frac{-6186}{1.05} + \frac{-6186}{1.05^2} + \frac{-6186}{1.05^3} + \frac{10739}{1.05^3} = -7569$$

(c) Here there are several interesting issues. First, we are talking about a sale that will take place at the end of year 1. Although that is 1 year in the future, the question asks for the amount that will be paid at the time of the sale, so the amount should not be discounted back to the present.

Second, the buyer will not end up paying very much for the car because they are also assuming the loan.

Third, the buyer ends up with the residual value of the car after the loan is paid off. The formula is thus:

$$\frac{-6186 + 3272}{1.05} + \frac{-6186 + 3272}{1.05^2} + \frac{10739}{1.05^3} = 4322$$

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

7
(a) Total revenue and marginal revenue are:

\[ TR(y) = (1000 - 0.01y)y \]
\[ MR(y) = 1000 - 0.01y - 0.01y = 1000 - 0.02y \]

Total cost and marginal cost are:

\[ TC(y) = 25,000,000 + 100y \]
\[ MC(y) = 100 \]

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

\[ 1000 - 0.02y = 100 \]
\[ y = 45000 \]

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

\[ \Pi(45,000) = (P(45,000) - AC(45,000))45,000 \]
\[ = (550 - 655.56)45,000 \]
\[ = -4,750,000 \]

(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 $P(y) = 100 \Rightarrow y = 90,000$ units and its profits are:

\[
\Pi(90,000) = (P(90,000) - AC(90,000))90,000 \\
= (100 - 377.78)90,000 \\
= -25,000,000
\]

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.

9. **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.