ECON 224, Prof. Hogendorn

Problem Set 1

1. *OilWells.* Suppose a small county in West Texas has 28 oil wells with cost curves subscripted “1” in the graph below and 4 oil wells with cost curves subscripted “2.” The price of oil is determined outside this market, and is shown by the horizontal demand curve.

![Graph of OilWells with curves SRMC1, SRMC2, SRAC1, SRAC2, and demand curve D]

(a) Show in the graph what quantity a type-2 well produces. How much profit does it make?

(b) If the type-2 wells are earning Ricardian rents, what does this imply for the long-run number of each type of well and the price?

(c) If the type-2 wells have recently adopted a new technology which is available to all oil wells worldwide, what does this
imply for the long-run number of each type of oil well and the price?

2. ProfitMax. A monopoly firm produces quantity $\hat{q}$ at price $\hat{p}$ as shown in this diagram:

(a) Does this firm maximize profit? Explain.
(b) Is there any deadweight loss? How much?
(c) If this firm is under threat of government regulation, does that help explain the firm's decision to produce $\hat{q}$?
(d) Harder. Without drawing any additional curves on the diagram, show how much operating profit this firm makes.

3. LongRun. Currently, the industry shown in the following diagram is in a long-run, perfectly competitive equilibrium with many firms all using technology 1.
(a) What quantity does a type-1 firm produce? How much profit does it make?

(b) Suppose technology 2 becomes available. Nevertheless, there are some firms that would like to stay with technology 1 because they believe that the type of work involved in technology 1 is more creative and personally fulfilling. Can these firms stay with technology 1 in the long run?

4. IMOpen. Underlying Instant Messaging (IM) is a database called the Names and Presence Directory (NPD) which shows who is available and whether or not they are online (present). Several leading IM services, including AOL, Yahoo!, Microsoft, and Skype, use proprietary NPDs that are not open to other systems. There may be positive externalities in production of IM because the NPD, if open, could be used to produce other value-added products based on whether or not people are online.

Here is a diagram of the situation for AOL Instant Messenger (AIM)
(a) Without any intervention in the market, AIM would produce quantity $Q^*$. Which area (A, B, or C) would be deadweight loss? Explain in words who would suffer this loss?

(b) If the government employed a Pigouvian subsidy to get AOL to produce $Q^*$, the cost of the subsidy would be what?

5. Are the services of Middletown’s snow plows rival or nonrival? Excludable or nonexcludable?

6. Rural Broadband. One part of the Obama administration’s stimulus package funds broadband Internet service for rural and other underserved areas. This problem consider why government funding might be justified.

Suppose that the cost and demand curves for broadband Internet in a rural area are given by the following graph:
(a) Explain concisely what could shift the AC curve up so far.

(b) Show on the diagram the smallest loss a monopoly could make serving this market.

(c) Could the government increase total welfare by subsidizing the monopoly loss? Explain with reference to the graph.

(d) Is it possible for the government to raise total welfare beyond what you showed in part (c). Again, explain with reference to the graph.

(e) The Smith family buys the broadband service and the family members get pleasure and productivity from using World of Warcraft and Skype. Are these examples of positive externalities from the government’s broadband Internet initiative? Explain why or why not.

7. *GreenClean.* Suppose that your research indicates the following Cournot reaction functions for quantities of two cleaning products, Clorox Green Works (denoted $q_C$) and Seventh Generation (denoted $q_{7G}$). (Assume there are no other green cleaning products.)
(a) Describe in words the meanings of the points \( a, b, c, \) and \( d \).

(b) What is special about point \( e \)?

(c) Suppose the US Department of Justice found that the firms were producing quantities given by point \( f \). Could any antitrust action be taken? Explain.

(d) Which of the following HHIs is most plausible if the firms are at point \( f \), 1400, 5000, or 8200? Explain.

(e) Suppose that in a Congressional hearing, the CEO of Clorox states that there is substantial competition for Clorox’s green cleaning products from its own and others’ non-green cleaning products. How does this relate to the “Cellophane fallacy” that “a monopoly creates its own competition?”

Answers:

1. \( \text{OilWells}_a \).
(a) A type-2 firm produces quantity $q_2$, determined from setting its marginal cost equal to its price. Its profits are

$$(p - SRAC_2(q_2))q_2$$

which is shaded on the graph.

(b) Since the rents are Ricardian, they cannot be reproduced. No other oil wells can become type-2 wells. Therefore, the type-2 wells will continue to earn these rents in the long run, and the type 1 rents will remain in business and continue to earn zero economic profit.

(c) Since there are large rents to using the type-2 technology, the type 1 wells and/or new entrant wells will want to adopt it. As they do adopt it, this will push the industry supply curve to the right, lowering the price. Eventually, the price will fall to $D'$, at which point there will be many more type-2 wells, all earning zero economic profit. No type-1 wells will be able to remain in business.

2. ProfitMax_a.
(a) No, this firm does not maximize profits because the marginal cost of \( \hat{q} \) is greater than the marginal revenue. Profits would therefore rise if the firm cut output. The profit-maximizing output is where \( MR + MC \), labeled \( q_m \), on the diagram.

(b) Yes, there is a deadweight loss, labeled \( D \) in the diagram. It is obviously larger than the zero deadweight loss that would occur if the firm behaved like a perfect competitor, but it is smaller than the deadweight loss of a profit-maximizing monopoly.

(c) Yes, if there is some chance the government will regulate the firm, it might want to avoid the image of being an inefficient monopoly. Increasing output, and thereby decreasing price and deadweight loss, is a way of making the firm less costly to society. Of course, this comes at the expense of reduced profits, but those profits might still be higher than what would be earned under regulation.
(d) The operating profit is the revenue minus the variable cost. In this case, total revenue is equal to the area $\hat{p}\hat{q}$. Total variable cost is the area under the marginal cost curve between $q = 0$ and $q = \hat{q}$. The difference between these is operating profit, the shaded trapezoid in the figure.

3. *LongRun_a.* Currently, the industry shown in the following diagram is in a long-run, perfectly competitive equilibrium with many firms all using technology 1.

![Diagram](image)

(a) Each type 1 firm maximizes its profit by setting marginal cost equal to price, producing output $q_1$. Since the firms are in long-run equilibrium, price also equals average cost at that point. As a result, the firms do not make any economic profit.

(b) Initially, a small number of type 2 firms could enter the industry and produce output $q_2$. They would earn large profits since price is well above $SRAC_2$, while the type-1 firms would continue to earn zero profit.
However, the large profits available to type-2 firms would attract entry into the industry. Even if none of the type-1 firms changed technology, capital would move into the industry from other sectors of the economy. Eventually, the entry of type-2 firms would increase market supply and thus decrease equilibrium price. The new demand curve facing a single firm would shift to $D'$ in the diagram. At this price, type-2 firms would make zero economic profit, but type-1 firms would incur a heavy loss. Eventually, all type-1 firms would have to leave the industry.

Note that all of this is based on the homogeneous-good demand curve which is given in the problem. If, somehow, the type-1 firms could differentiate their product, they could command a higher price, and perhaps then they could stay in business.

4. IMOOpen_a.

(a) The deadweight loss is $B$. This is the area that has a lower social cost than it does social benefit. It is suffered by those who demand the NPD service, in this case both end-consumers and the hypothetical producers of the add-on products.

(b) A Pigouvian subsidy would push AOL to lower its price to the level given by the MSC curve. The problem for AOL is that it would be lowering the price on every unit, not just the units between $\hat{Q}$ and $Q^*$. Thus, it would incur a loss equal to the vertical distance between MSC and MPC on every unit. The subsidy would therefore cost $A+B+C$.

This shows how difficult Pigouvian subsidies can be. In order to produce benefit $B$, the government needs to spend a great deal more on subsidy. The subsidy is just a transfer within society, from the taxpayers to AOL, so it does not reduce so-
cial welfare, but it is not very plausible that Congress would approve such a large redistribution of resources for such a small social gain. In the real life case of the AOL / Time-Warner merger, a condition of merger approval was to open the NPD, which in this case is a simpler strategy, especially since the marginal cost in this example is close to zero.

5. Plowed streets are both nonrival and nonexcludable. They are nonrival because one car driving on a plowed street does not somehow “unplow” the street. And they are nonexcludable because there is no way to prevent cars from using the plowed streets.

On the other hand plowed driveways are rival and excludable. They are rival because if one driveway is plowed, then the time and energy taken to plow it was not used on another driveway. And they are excludable because normal property laws prevent drivers from using driveways without permission (note that the fact that most driveways are dead-end is important to enforcing these laws – through driveways are more difficult to exclude and are often used as illegal shortcuts).

If you define snowplow services somewhere in between these two extremes, such as comparing plowed and unplowed sections of town, then the services are partially rival and excludable.

6. RuralBroadband_a.

(a) Given that the MC is upward sloping, AC will be U-shaped and cross MC at its lowest point. But it can shift anywhere up or down along the MC curve depending on how large the fixed costs are. In this case, fixed costs are very high relative to demand, which makes sense since infrastructure industries usually have high fixed costs.

(b) The monopoly would maximize profits by setting MR=MC. In this case, that still causes a loss equal to C+D+E.
(c) Without a subsidy, the market will simply not exist since even a monopoly makes a loss. With a subsidy equal to C+D+E, the market will exist and it will generate consumer surplus of A+B+C+D. Area E represents some additional costs not justified by demand, but it is much smaller than A+B so there is a welfare gain.

(d) For clarity, there is a second graph below. At the monopoly solution from (c), there is deadweight loss shown by the shaded area. If the government increased the subsidy to C+D+E+F and combined it with a mandate that the firm produce the competitive quantity \( q^* \) and charge the competitive price \( p^* \), this deadweight loss would be eliminated. The consumer surplus is now a quite large area A+B+C+ D+E (plus the tiny tiny triangle above E), which again needs to be weighed against some added costs F. But since F is smaller than A+B, this again increases total welfare.

It should be noted that if the government cannot perfectly measure \( q^* \), there may be a difficult regulatory principal-agent problem here, and it may take some additional and unwelcome costs to solve it.
(e) Two answers are possible here. The first is to say that since the Smith family buys the Internet service, any consumer surplus they receive is internal to the transaction and thus does not qualify as an externality. The second is to say that Skype and WOW are networked goods, so there may be a positive direct network externality by adding the Smiths to the user base. This would accrue to other users, not to the Smiths.


(a) At point a, Seventh Generation’s quantity is so high that Clorox does not produce anything. At point b, Clorox is producing 0 so Seventh Generation optimally responds with the monopoly quantity. We know it must be this way round and not the other because the monopoly quantity is smaller and more restrictive, whereas the quantity that pushes the other firm out of the market is much bigger.

By the same reasoning, point d is where Clorox drives Seventh Generation’s quantity to 0, and point c is where Seventh Generation has produced 0 so Clorox responds with the monopoly quantity.
(b) Point \( e \) is the one point which is on both reaction functions as the same time. Each company is doing the best it can given what the other company is doing. No company wants to change quantities. This is called the Cournot equilibrium.

(c) Point \( f \) is not on the reaction functions, it involves smaller-than-Cournot quantities for both firms, and thus probably higher profits. This may be cause for concern. However, this could be the result of tacit collusion, which is legal, instead of explicit collusion which is illegal. If Clorox is not considered a “monopoly,” and if only tacit collusion is observed, the only antitrust remedy would be to prevent mergers (or to put conditions on them). But with its large market share, it is possible that Clorox will be deemed a monopoly, in which case the tougher remedies under the Sherman Act might come into force. In the most extreme case, Clorox might be split into separate companies.

(d) At point \( f \), the quantity for Clorox is very high while the quantity for Seventh Generation is much lower. This means the market is heavily skewed toward Clorox, and the HHI will be indicative of a near monopoly. This is most consistent with the HHI of 8200.

(e) If Clorox really does have such a huge market share, it is likely that its high prices are forcing marginal consumers to buy non-green cleaners even though they would have wanted green cleaners at lower prices. Thus, the Cellophane fallacy may very well apply: the only reason the non-green cleaners are substitutes is the high prices being charged.