Economics 121: PROBLEM SET 2
Due: Thursday, October 7, 2004, 12:30 PM (in lecture)

1. True/False/Uncertain: Decide whether the following statements are true, false or uncertain, and then explain the reasoning behind your answer.
   a) The Bertrand Paradox will arise for a duopoly on the Hotelling line as transportation costs go to zero.
      UNCERTAIN. - Recall that price in the model is $P + tx$. If $t = 0$, then each consumer will only pay the price regardless of its position on the Hotelling line.
      - If $t=0$, we can assume that consumers view the products as perfect substitutes. In this case, the price will converge to the marginal cost.
      - However, if marginal costs differ across firms, then firms will compete on price. If we assume two firms with different costs, say $MC_1 > MC_2$. Then, when the firms compete on price, firm 2 will be able to price just below $MC_1$

   b) If production exhibits learning by doing, then a scope economy arises between the product produced at different points in time.
      TRUE. Assume there are two periods and define $q_1$ and $q_2$ as output in the first and second periods, respectively. The cost of producing either output alone without the other would be the same, but when some of $q_1$ has been produced in the first period, then the cost of producing $q_2$ in the second period is lower than when $q_2$ is produced stand alone. Note that the source of the scope economy here is not a shared input since production in the second period does not affect cost in the first, but rather a cost complementarity: more produced in the first period, the less the cost in the second.

   c) When firms in an industry act as price takers, their index of scale economies, $s$, will be less than 1 when the industry reaches equilibrium.
      FALSE: $s = AC/MC$. When firms act as price takers (i.e. a competitive industry), when $s < 1$ then $AC < MC$ and firms are making a profit. In equilibrium, however, profits will be zero, since firms enter until profits are zero. Profits are just zero when $AC = MC$, or when $s = 1$.

2. Engineering economists have found that the cost of producing small cars (S) and trucks (T) can be expressed as follows:
   * $C(S, T) = 10 + S + 2T + ST$ if $S > 0$ and $T > 0$
   * $C(S, T) = 8 + 2T$ if $S = 0$ and $T > 0$
   * $C(S, T) = 4 + S$ if $S > 0$ and $T = 0$

   Both S and T are measured in thousands of vehicles per year.

   a) Find the incremental cost function of producing trucks when a positive amount of small cars are produced: $S > 0$.
      $IC_T(S,T) = C(S,T) - C(S,0) = 10 + S + 2T + ST - (4 + S) = 6 + 2T + ST$

   b) Evaluate incremental cost of trucks at $T = 10$ when $S = 10$ and then again when $S = 20$.
      $IC_T(10;10) = 6 + 2*10 + 10*10 = 126$; $IC_T(20;10) = 6 + 2*10 + 10*20 = 226$

   c) Are there scope economies? Demonstrate how you came to this conclusion.
      There are scope economies if and only if
\[ C(S, T) < C(S, 0) + C(0, T) \]
\[ \iff 10 + S + 2T + ST < 4 + S + 8 + 2T \]
\[ \iff ST < 2 \]

The difference between the fixed costs when the two products are produced together (10) and the sum of the fixed costs when they are produced separately (4 + 8 = 12) constitutes a public input.

d) List three potential sources of scope economies in the production of these two products using your knowledge of the industry.

1. If produced in the same plant, trucks and cars probably share many inputs along the assembly line, for example the painting process. 2. Assuming large volumes of production, workers are expected to be highly specialized. 3. Most of the plant machinery is a common fixed cost for both cars and trucks.

e) Are there multi-product increasing or decreasing returns to scale? Demonstrate your answer.

There are multi-product economies of scale iff the following condition holds:

\[ \frac{C(S, T)}{MC_S S + MC_T T} > 1 \iff 10 + S + 2T + ST \rightleftharpoons (1 + T)S + (2 + S)T > 10 > ST \]

So for a certain range of production there are multi-product economies of scale.

f) Are there product-specific scale economies for either product?

There will be product-specific scale economies if:

\[ PS_S = \frac{AIC_S}{MC_S} = \frac{IC_S / S}{MC_S} = \frac{(2 + S + ST) / S}{1 + T} > 1 \iff 2 + S + ST > S(1 + T) \iff 2 > 0 \]

So there are product-specific scale economies for cars (S). Turning to trucks:

\[ PS_T = \frac{AIC_T}{MC_T} = \frac{IC_T / T}{MC_T} = \frac{(6 + 2T + ST) / T}{2 + S} > 1 \iff 6 + 2T + ST > T(2 + S) \iff 6 > 0 \]

So there are also product-specific scale economies for trucks (T).

g) Suggest a source of product-specific scale economies again using your knowledge of the production of automobiles.

Any machine that is unique to automobiles not used in the making of trucks would represent product specific economies to scale for automobiles as this product specific cost would be spread out over more automobiles the more of them were introduced. Perhaps a machine that makes trunk lids, as trucks lack trunks for instance, or there may be safety features unique to cars and trucks. Efficiencies gained through specialization and large-scale organization for cars specifically would also yield product specific economies of scale.

3. DVD Palace is located in Springfield, where each year 100 people are willing to buy a DVD player at up to $150. There are also 100 people in Shelbyville, who are willing to pay $150 for a DVD player but must incur a $50 transportation cost of getting to and from the DVD Palace. DVD Palace has marginal costs of $20 per player and pays a rent of F per year.
a) What is the highest price DVD Palace can set such that both residents of Springfield and Shelbyville will purchase a DVD player? Show that this gives them a higher profit than if they set a price of $150 and sold to Springfield residents only.

At $P = $99.99, residents of Shelbyville will purchase the DVD player since they pay $99.99 plus $50 in transportation costs. Total costs are $149.99 which is less than what they would be willing to pay ($150).

At this price (say $100) the store makes a profit of $(P - c)Q - F = ($100 - 20) x 200 - F = 16,000 - F$

If they sold only to Springfield residents, they could set a price of $P = 150$. Profits would be $(P - c)Q - F = (150 - 20) x 100$ units $- F = 13,000 - F$. Clearly, this will be less than if they set a price in order sell to both towns.

b) Suppose that $F = $7,000. Calculate: - stores profits - consumer welfare - total welfare.

Profits: $16,000 - 7,000 = $9,000$

CS:
- Springfield: $V - P - t(x^* - x) = 150 - 100 - 0 = 50$
- Shelbyville: $V - P - t(x^* - x) = 150 - 100 - 50 = 0$

Total: $50 x 100 = 5,000$

Total Welfare for 1 store setting a price of $100$ is 14,000.

c) Show that opening another store in Shelbyville (where the residents would no longer have to pay transportation costs) is more profitable than having one store in Springfield only.

If they open another store, they get to charge $150 in each town.

Profits are: $(P - c)Q - 2F = (150 - 20)200 - 2(7,000) = 26,000 - 14,000 = $12,000$

Which is greater than the profits from 1 store (part b).

d) Is opening a second store optimal from a social welfare perspective?

Note that residents of both towns now get 0 consumer surplus. Therefore, total surplus = profits = $12,000, which is lower than the total welfare in part b.

4. The following table gives the profits of the only two manufacturers of Widgets – Widget Corp. and Tegdiw Inc. The two firms set prices simultaneously and (for simplicity) must choose a high or low price.

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<tr>
<th></th>
<th>High</th>
<th>Low</th>
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</thead>
<tbody>
<tr>
<td><strong>High</strong></td>
<td>500</td>
<td>0</td>
</tr>
<tr>
<td><strong>Low</strong></td>
<td>400</td>
<td>100</td>
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The profits for Tegdiw Inc are given in the lower left of each box (in bold). The profits for Widget Corp are in the upper right.

a) Does either firm have a dominant strategy?

Yes, Widget Corp has a dominant strategy of the low price. If Tegdiw is setting a high price Widget gets higher profits from setting the low than the high price (200 > 100), and similarly if Tegdiw sets the low price, Widget Corp still wishes to set the low price (100 > 0). Tegdiw does not have a dominant strategy, but rather wants a high price if Widget has a high price and a low price if Widget has a low price.
b) What are all the possible Nash Equilibria for this game?

No matter what Tegdiw is doing, Widget’s best response involves setting the low price. So we know in any equilibrium, Widget is setting the low price. If Widget is setting the low price, then Tegdiw must also be setting the low price to be best responding. Thus the unique Nash Equilibrium for this game is that both firms set the low price.

c) Give an intuition for the payoffs in this game (i.e. suggest a market structure that could yield this situation).

This situation could be describing one in which Tegdiw has the superior product (or brand image) over Widget Corp. If Tegdiw has a lower price than Widget Corp, Widget Corp is making zero profits, which might be caused by Tegdiw capturing the entire market. If Widget Corp has a lower price than Tegdiw, Tegdiw loses profits and Widget Corp gains them, but Widget Corp cannot eliminate Tegdiw’s profits. It would seem then that this game could be describing an interaction between a dominant brand and some sort of generic or less respected brand.

5. Consider the Ready to Eat (RTE) Breakfast Cereal industry:

a) Explain why continuing product differentiation in this industry makes it less and less profitable to enter the market with a new cereal.

As each new product fills a new niche in the market, there are fewer niches and less demand available for other products. Each new product puts pressure on the products around it in the spectrum, and also makes it less profitable to introduce a new cereal into one of the spaces near it.

b) What advantages might the larger cereal companies (e.g. Kelloggs, General Mills) have over the smaller firms in the industry when it comes to introducing new cereal types?

They control greater shelf space and can thus allocate a small portion of it to a new product without diminishing the space for any one of their other products by very much. A larger company with more brands already may already have all the components to a new cereal in production (imagine a cereal, which is simply a combination of corn and bran flakes for instance). The large companies can also choose to advertise and promote their products as an entire portfolio (an economy of scale). There are many other possible explanations.

c) Can you give an explanation for why the big three all have a similar Raisin Bran product (Post Raisin Bran, Kellogg’s Raisin Bran, Total Raisin Bran), but there is only one Froot Loops (a Kellogg product)?

One explanation could be historical. Products created early in the industry were subject to less marketing and less brand imaging, as such people may see little difference between different raisin bran cereals. Products introduced later were subject to massive advertising campaigns by the larger brands creating brand identities, which may have made it harder to be the second producer of a very similar product. A second reason could be the distribution of tastes. In the Hotelling model we have assumed an even distribution of tastes, however if people are clustered at different parts of the various product spectrums, we will tend to see more bunching of products in those areas as well. Those areas of the spectrum with less demand will have less ability to profitably support more than one product.