EconS 425 - Horizontal Mergers

Eric Dunaway

Washington State University

eric.dunaway@wsu.edu

Industrial Organization
Let's continue our discussion of horizontal mergers today.

Last time, we discussed the horizontal merger paradox, where under normal circumstances, there are no incentives for two firms to merge unless there are some cost savings or market advantages to merging.
Horizontal Mergers

- Let's look at another way to overcome the horizontal merger paradox: sequential mergers.
- In this situation, we must have at least $N \geq 4$ firms. Half of which are low cost firms and half of which are high cost firms.
  - To make the math easy, we’ll assume that low cost firms have a constant marginal cost of 0 while high cost firms have a constant marginal cost of $c$.
- Now, one low and one high cost firm have the opportunity to merge, and upon observing the first mover’s merge, another set of low and high cost firms can decide to merge, and so on.
  - Does the ability to observe another merge in advance make later merges more likely to happen?
Horizontal Mergers

- Let’s build our model. We’ll say that there are $N = 4$ firms, where firms 1 and 2 have low costs ($MC = 0$) and firms 3 and 4 have high costs ($MC = c$). All of the firms face the market demand curve

$$p = a - q_1 - q_2 - q_3 - q_4$$

- Before we consider mergers, let’s calculate some equilibrium values if no firms merge. Starting with firm 1, their profit maximization problem is

$$\max_{q_1} \left( a - q_1 - q_2 - q_3 - q_4 \right) q_1$$

with first-order condition

$$\frac{\partial \pi_1}{\partial q_1} = a - 2q_1 - q_2 - q_3 - q_4 = 0$$

- Solving this expression for $q_1$, we can obtain firm 1’s best response function to all of the other firms’ quantities.

$$q_1 = \frac{a}{2} - \frac{q_2}{2} - \frac{q_3}{2} - \frac{q_4}{2}$$
Now let’s look at firm 3 (a high cost firm). Their profit maximization problem is

$$\max_{q_3} \left( a - q_1 - q_2 - q_3 - q_4 \right) q_3 - cq_3$$

with first-order condition

$$\frac{\partial \pi_3}{\partial q_3} = a - q_1 - q_2 - 2q_3 - q_4 - c = 0$$

Again, solving this expression for $q_3$ gives us firm 3’s best response function to all of the other firms.

$$q_3 = \frac{a - c}{2} - \frac{q_1}{2} - \frac{q_2}{2} - \frac{q_4}{2}$$
Horizontal Mergers

\[
q_1 = \frac{a}{2} - \frac{q_2}{2} - \frac{q_3}{2} - \frac{q_4}{2}
\]

\[
q_3 = \frac{a - c}{2} - \frac{q_1}{2} - \frac{q_2}{2} - \frac{q_4}{2}
\]

Rather than deal with 4 equations and 4 unknowns, we can invoke some symmetry here.

- Firms 1 and 2 are identical (the low cost firms) and firms 3 and 4 are identical (the high cost firms).
- Let \( q_1 = q_2 = q_L \) and \( q_3 = q_4 = q_H \).

Our best response functions become

\[
q_L = \frac{a}{2} - \frac{q_L}{2} - q_H
\]

\[
q_H = \frac{a - c}{2} - q_L - \frac{q_H}{2}
\]

and rearranging terms,
Horizontal Mergers

\[
q_L = \frac{a}{3} - \frac{2q_H}{3}
\]

\[
q_H = \frac{a - c}{3} - \frac{2q_L}{3}
\]

- From here, this is just two equations and two unknowns. We can solve them to obtain

\[
q_L^* = \frac{a + 2c}{5}
\]

\[
q_H^* = \frac{a - 3c}{5}
\]

- Plugging this back into our inverse demand function gives us the market price

\[
p^* = a - q_1^* - q_2^* - q_3^* - q_4^*
\]

\[
= a - \frac{2(a + 2c)}{5} - \frac{2(a - 3c)}{5} = \frac{a + 2c}{5}
\]
Lastly, we can calculate profits for the low and high type firms,

\[
\pi^*_L = p^* q^*_L = \left( \frac{a + 2c}{5} \right) \left( \frac{a + 2c}{5} \right) = \frac{(a + 2c)^2}{25}
\]

\[
\pi^*_H = (p^* - c) q^*_H = \left( \frac{a + 2c}{5} - c \right) \left( \frac{a - 3c}{5} \right) = \frac{(a - 3c)^2}{25}
\]

As expected, the low cost firms have higher profit levels than the high cost firms.
Now suppose that firms 1 and 3 decide to merge. The resulting firm gets to take advantage of firm 1’s low costs. Our market now has two low cost firms and 1 high cost firm.

We can use the same method as before to calculate our equilibrium values which I’ll just provide

\[
q_L^* = \frac{a + c}{4} \quad q_H^* = \frac{a - 3c}{4} \\
p^* = \frac{a + c}{4} \\
\pi_L^* = \frac{(a + c)^2}{16} \quad \pi_H^* = \frac{(a - 3c)^2}{16}
\]

Again, we still have that the low cost firms make more in profit, but firm 2, the low cost firm that didn’t merge, was able to take advantage of those profits without having to merge, themselves.
Lastly, what if firms 2 and 4 also decided to merge? This would leave us with just two low cost firms. Updating our equilibrium values,

$$q^*_L = \frac{a}{3} \quad p^* = \frac{a}{3} \quad \pi^*_L = \frac{a^2}{9}$$

Now, we have all of our situations depending on who decides to merge. Let’s see what happens when firms move simultaneously.

- Firms 1 and 3 represent player 1, and they choose whether to merge or to not merge.
- Firms 2 and 4 represent player 2, and make the same choice.

For simplicity, the payoffs are denoted as $\pi^*_L$ in the case where 0 firms merge and the firm has low costs.
### Horizontal Mergers

<table>
<thead>
<tr>
<th>Player 1</th>
<th>Player 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Merge</strong></td>
<td><strong>Merge</strong></td>
</tr>
<tr>
<td>$\pi^2_L, \pi^2_L$</td>
<td>$\pi^1_L, \pi^1_L + \pi^1_H$</td>
</tr>
<tr>
<td><strong>Not Merge</strong></td>
<td><strong>Not Merge</strong></td>
</tr>
<tr>
<td>$\pi^1_L + \pi^1_H, \pi^1_L$</td>
<td>$\pi^0_L + \pi^0_H, \pi^0_L + \pi^0_H$</td>
</tr>
</tbody>
</table>
Horizontal Mergers

- To figure out the best responses for each player, we need to condition it on some values of \( a \) and \( c \).
  - First of all, we need \( a > 3c \) in order for the high cost firm to even produce.
- If player 2 decides to not merge, player 1 will merge if the profit of the merged firm is greater than the individual profits of the two unmerged firms, i.e.,
\[
\frac{\pi^1_L}{16} > \frac{\pi^0_L + \pi^0_H}{25} + \frac{(a - 3c)^2}{25}
\]
- This is a pain to solve, but this relationship holds as long as
\[
\frac{7a}{61} < c < \frac{a}{3}
\]
- Thus, if costs are relatively high for the high cost firm, it’s better for firms 1 and 3 to merge even if firms 2 and 4 do not.
Horizontal Mergers

- If player 2 decides to merge, player 1 will merge under the same conditions: the profit of the merged firm is higher than the profits of the two unmerged firms,

\[ \pi_2^L > \pi_1^L + \pi_1^H \]

\[ \frac{a^2}{9} > \frac{(a + c)^2}{16} + \frac{(a - 3c)^2}{16} \]

- This relationship holds as long as

\[ \frac{a}{15} < c < \frac{a}{3} \]

- It’s harder to make a merger happen in this situation.

- Firms 1 and 3 can free ride on the merger between firms 2 and 4 and have their profits increase by doing nothing; making a merger less lucrative.
Case 1: \( \frac{7a}{61} < c < \frac{a}{3} \)

<table>
<thead>
<tr>
<th>Player 1</th>
<th>Player 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Merge</td>
</tr>
<tr>
<td>Merge</td>
<td>( \pi^2_L, \pi^2_L )</td>
</tr>
<tr>
<td>Not Merge</td>
<td>( \pi^1_L + \pi^1_H, \pi^1_L )</td>
</tr>
</tbody>
</table>
### Case 2: \( \frac{a}{15} < c < \frac{7a}{61} \)

<table>
<thead>
<tr>
<th>Player 1</th>
<th>Player 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Merge</td>
<td>Merge</td>
</tr>
<tr>
<td></td>
<td>( \pi^2_L, \pi^2_L )</td>
</tr>
<tr>
<td>Not Merge</td>
<td>Not Merge</td>
</tr>
<tr>
<td></td>
<td>( \pi^1_L + \pi^1_H, \pi^1_L )</td>
</tr>
</tbody>
</table>
**Case 3:** $c < \frac{a}{15}$

<table>
<thead>
<tr>
<th>Player 1</th>
<th>Player 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Merge</strong></td>
<td><strong>Merge</strong></td>
</tr>
<tr>
<td>$\pi_L^2, \pi_L^2$</td>
<td>$\pi_L^1, \pi_L^1 + \pi_H^1$</td>
</tr>
<tr>
<td><strong>Not Merge</strong></td>
<td><strong>Not Merge</strong></td>
</tr>
<tr>
<td>$\pi_L^1 + \pi_H^1, \pi_L^1$</td>
<td>$\pi_L^0 + \pi_H^0, \pi_L^0 + \pi_H^0$</td>
</tr>
</tbody>
</table>
Horizontal Mergers

- In cases 1 and 3, the outcome is clear:
  - When costs are high, it’s always better to merge. This is similar to what we saw last time.
  - When costs are low, it’s always better to not merge.

- What about case 2?
  - We have two Nash equilibria, one where both merge and one where neither merge.
  - Both firms merging is always better than neither firm merging, but firms only want to merge if the other firm merges, too.

- Can we fix this?
Of course we can!

What if we let the firms move sequentially?
Now, firms 1 and 3 get to decide whether to merge first, and upon observing their decision, firms 2 and 4 decide whether to merge or not.

Remember when we talked about sequential games, when there is more than one Nash equilibrium, the first mover will choose the strategy that leads to their best possible outcome that is a Nash equilibrium.

And in this case, the best outcome for either player is when both sets of firms merge.
Horizontal Mergers

- For a simultaneous move merger, both firms merging was only guaranteed as long as $\frac{7a}{61} < c < \frac{a}{3}$. Now, with a sequential merger allowed, both firms merge as long as $\frac{a}{15} < c < \frac{a}{3}$
  - That basically doubles the range of costs for which mergers are profitable.

- As usual, however, consumers suffer under this kind of arrangement, as prices rise sharply.
  - The regulators may not be happy.
Moving along, suppose we had differentiated products, similar to what we saw in horizontal differentiation.

- Previously, we saw the Hotelling line, where firms position themselves along a line from 0 to 1 and market their product to uniformly distributed consumers.

- This time, however, I want to introduce the Salop circle, which is similar to the Hotelling line, but has no endpoints.
  - Intuitively, think about airline flights. You may have a preferred time that your flight departs. Would a line make sense for this? No.
Horizontal Mergers
Suppose that we had 5 firms and they were equally spaced along our Salop circle.

We’ll assume that the consumers are distributed uniformly along the Salop circle and they purchase from the firm that gives them the highest payoff, taking into consideration the transportation cost that they must pay to purchase from the firm.
Horizontal Mergers
Horizontal Mergers
Horizontal Mergers

- The consumer located exactly between each firm is indifferent between purchasing from the firm on either side.
  - We would find our equilibrium prices and quantities by looking at this consumer.
- Suppose now that two of the firms in this market decided to merge.
  - They get to keep both of their "stores" at their current locations, but now they price together (i.e., collude legally).
Horizontal Mergers

- If firms 2 and 3 decide to merge, competition for the consumers located between firm 2 and firm 3 softens severely.
  - These consumers prefer either firm 2 or firm 3, and the merged firm does not care which firm they purchase from, as long as they retain those consumers.
- Thus, it is likely that we will see both firm 2 and firm 3 raise their prices when they merge.
  - They lose some of their consumers to firms 1 and 4, but at the same time, can extract much more surplus out of their remaining consumers; especially those located between the two firms.
  - In response, we’ll find that firms 1 and 4 also raise their prices, as firms 2 and 3 are competing less against them. We still end up with the merger free riding problem.
Horizontal Mergers

- In the end, this is a profitable merger for all firms in the market.
  - Less competition works out great for the firms, but bad for the consumers.
- One thing to note: This only works when the firms are next to each other.
  - If firms 1 and 3 decided to merge, they wouldn’t be able to exploit the consumers between them, as firm 2 could poach them all. This wouldn’t be a profitable merger.
This reveals an important tool for regulators.

Most firms claim that cost savings from merging are passed on to the consumer. These claims are usually met with a certain level of skepticism, especially in a market that behaves like a Salop circle.

For example, consider the newspaper market. Suppose 2 firms wanted to merge, but they are also the only two firms in a local market.

We would expect the merged firm to take advantage of those consumers.
Horizontal Mergers

- A frequent tool that regulators use is to force the merged firm to sell one of their firms in that local market to a new competitor.
  - This gives the local consumers an alternative, should the merged firm try to exploit them. It basically prevents firms that are next to each other in the Salop context from merging.
  - If the cost savings are legitimate, it will still be profitable for the firm (and possibly good for the consumers).
- Another tool that regulators use is price capping newly merged firms.
  - Force them to charge a negotiated price that is better for consumers.
  - Monitoring is fairly cheap, as their competitors would be happy to expose them if they are pricing anticompetitively.
Horizontal Mergers

- In the real world, regulators have a tough task figuring out which mergers are good for the economy, and which are bad.
  - Previous to game theory’s development, the $CR_4$ index was primarily used. Mergers were only allowed in markets with a $CR_4$ of less than 75 and each merging firm had less than 4 percent of the market share.
  - Now, we are more interested in the $HH$ index, where mergers are allowed when the value is less than 1,000 and the merger will not increase that value by more than 100.
Horizontal Mergers

- For the most part, regulators are concerned with consumer surplus, which may not be optimal.
  - A merger could cause a small decrease in consumer surplus, but a larger increase in producer surplus, which would increase the value of total surplus.
  - Several mergers have been blocked even though the evidence supported this.

- The idea is that since firms do not care about consumer surplus, it makes sense that their regulator agency (and the voters that support them) do care about them.
We can continue to correct for the horizontal merger paradox by allowing firms to merge sequentially.

Mergers are also very lucrative in markets with product differentiation.

Regulation of mergers is challenging, and not perfect.
Next Time

- Vertical Mergers
  - What happens when firms merge with their suppliers or distributors?
- Reading: Chapter 12
Practice Problem

- Look at that Salop circle I presented in class, and calculate the equilibrium prices and quantities without the presence of any mergers. Assume linear transportation costs.
  - The book can guide you through this.