Game Theory and Oligopolies


   In response to Holman Jenkins’s broadside at the Federal Trade Commission’s decision to challenge the merger of Staples and Office Depot (Business World, April 8): His principal argument on why the FTC action is not “intellectually coherent” and the staff cannot suppress its “bumptiousness” is to note that “the two retailers account for a mere 4% of the market for office supplies-hardly a monopoly as the FTC readily admits.”

   Here is the fallacy of his argument: Although Staples and Office Depot operate or have plans to operate in many markets, there are thousands of cities and towns where neither are present, which leads to a relatively low national market share for the two chains. But the competitive market for office supplies is local. For example, Staples and Office Depot compete with each other in Washington, D.C. If the merger results in higher prices to customers there, what difference does it make that neither company is present in Amarillo or Boise? If prices go up in Washington, customers will not travel to Amarillo to buy file folders or paper clips. The proper question is the market share of Staples and Office Depot in those cities where competition between the two would be eliminated. We will show in court that in those local markets Staples and Office Depot are dominant.

   The bottom line for Mr. Jenkins seems to be that shareholders interests should rule the day even if consumers will experience significantly higher prices. He may not care that a box of file folders costs $1.72 in Orlando, Fla. (where there is competition between Staples and Office Depot) and $4.17 in nearby Leesberg (where Office Depot has a monopoly). But it is our job to care. And that is why we are challenging the merger.

   William J. Baer
   Director
   Bureau of Competition
   Federal Trade Commission

   For simplicity, assume Staples and Office Depot have no fixed costs. Assume that the marginal cost, average variable cost and average total cost for staplers are constant at $0.50. The market demand for staplers in Washington D.C. is depicted on the graph below.

   ![Graph showing market demand for staplers in Washington D.C.]

   Suppose Staples and Office Depot in Washington D.C. are each charging the same price for staplers and each making profits of $90. Also assume that they are the only two stores that sell office supplies in Washington D.C. How much will the price of a stapler increase if the merger occurs? EXPLAIN.

   If the merger of Staples and Office Depot did occur, how is it likely to affect Bob’s Office Supply, an office supply retail store in Arlington, Virginia? Be precise in your explanation. (Arlington is a town just outside of Washington, D.C.)
2. Software Developers Inc. and AMC Applications Inc. are two companies developing statistical software programs. These companies must simultaneously decide whether to develop software that operates on the Unix operating system, Microsoft’s Windows operating system or an object-orientated operating system. The table below indicates Software Developers Inc. and AMC Applications Inc. profits depending on the operating system they develop their statistical software for.

<table>
<thead>
<tr>
<th>Software Developers Inc.</th>
<th>AMC Applications Inc.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unix</td>
</tr>
<tr>
<td>Unix</td>
<td>40 , 50</td>
</tr>
<tr>
<td>Windows</td>
<td>45 , 40</td>
</tr>
<tr>
<td>Object-Orientated</td>
<td>25 , 60</td>
</tr>
</tbody>
</table>

a) Does Software Developers Inc. or AMC Applications Inc. have a dominant strategy? Explain.

b) Identify all Pure Strategy Nash Equilibria. Explain.

c) Can you explain why profits may be greater for both firms when they develop software for the same operating system?
Here is a story you may have heard- urban legend.

There are two friends taking MBA814 this semester. Both had done pretty well on all of the homeworks and the midterm, so that going into the final they had a solid 4.0. They were so confident the weekend before the final that they decided to go to a party in Chicago. The party was so good that they overslept all day Sunday, and got back too late to study for the final that was scheduled for Monday morning. Rather than take the final unprepared, they went to Prof. Conlin with a sob story. They said they had gone to Chicago and had planned to come back in plenty of time to study for the final but had had a flat tire on the way back. Because they did not have a spare, they had spent most of the night looking for help. Now they were really tired, so could they please have a makeup final the next day? Prof. Conlin thought it over and agreed. The two studied all of Monday evening and came well prepared on Tuesday morning. Prof. Conlin placed them in separate rooms and handed the test to each. The first question on the first page, worth 10 points, was very easy. Each of them wrote a good answer, and greatly relieved, turned the page. It had just one question, worth 90 points. It was: “Which tire?”

Suppose that each student’s “payoff” is 100 (because they receive an 4.0 in the class) if they answer the second question the same and each student’s “payoff” is 30 (because they receive a 2.0 in the class) if they answer the second question differently.

a) Depict the above situation as a normal form game.

b) Does either student have a dominant strategy? If so, please identify the dominant strategy.

c) Identify all pure strategy Nash Equilibria.

d) Identify one mixed strategy Nash Equilibrium.

Holiday Inn and Choice Hotels must select how many hotels to build on South Padre Island. Suppose they select the number of hotels at the same time. The following table provides Holiday Inn’s and Choice’s profits based on the number of hotels they decide to build. Suppose both Holiday Inn and Choice are deciding between 0, 1 or 2 hotels. Let M denote millions of dollars.

<table>
<thead>
<tr>
<th>Choice Hotels</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 Hotels</td>
</tr>
<tr>
<td>0 Hotels</td>
</tr>
<tr>
<td>Holiday Inn</td>
</tr>
<tr>
<td>2 Hotels</td>
</tr>
</tbody>
</table>

a) Does either Holiday Inn or Choice Hotels have a dominant strategy? If so, please identify the dominant strategy. In either case, please provide an EXPLANATION.

b) Identify the Pure Strategy Nash Equilibrium (ia).
5. East Lansing and Lansing are two cities located right next to each other. Each city is deciding whether to allow casinos in their city. If both cities allow casinos, each city’s payoff will be –30. (The reason for the negative payoff is that the casinos will compete against each other and, therefore, will not be very profitable. The city’s payoff will be a function of the casinos’ profitability because it will affect the tax revenue the city collects. In addition, the more casinos that exist, the busier are local law enforcement personnel.) If East Lansing allows casinos and Lansing does not allow casinos, then East Lansing’s payoff is 60 and Lansing’s payoff is –10. If East Lansing does not allow casinos and Lansing allows casinos, then East Lansing’s payoff is -20 and Lansing’s payoff is 50. If neither city allows casinos, each city’s payoff is 0. Suppose East Lansing and Lansing make their decision of whether to allow casinos at the same time. (Hint: It may be useful to depict the normal form game (i.e., the table with payoffs and strategies).)

a) Does either East Lansing or Lansing have a dominant strategy? EXPLAIN IN DETAIL.

b) Identify all Pure Strategy Nash Equilibria.

6. Mr. Clemens and Mr. McNamee are partners in a drug company (called Hall of Fame Results Inc.) that produces B-12 vitamin supplements (wink-wink). Mr. Clemens is going on vacation the second week of January and Mr. McNamee is going on vacation the first week of January. At the end of the second week in January, Hall of Fame Results Inc. is going to introduce a new “supplement” targeting high school and college athletes. The likely success of the new supplement will depend on how hard Mr. Clemens and Mr. McNamee work prior to its introduction. While their payoffs increase with the likelihood of success (holding the amount they work constant), their payoffs decrease with the amount they work (holding the likelihood of success constant). Mr. Clemens and Mr. McNamee will not change their vacation plans but must decide whether to work hard or not work hard during the week they are in the office. Because Mr. Clemens is in the office the first week of January and Mr. McNamee is in the office the second week of January, Mr. McNamee observes whether Mr. The extensive form of the game is depicted below.

![Game Tree](image)

What is (are) the Subgame Perfect Equilibrium (ia) of the above game?
7. Suppose Gang and Gang B sell drugs in the same area, but their customers can choose to buy drugs in other areas the gangs don’t operate in. If there are conflicts between the two gangs, people will be less likely to come buy drugs from them so they will have to lower their prices to sell their drugs, hurting their profitability. The gangs’ profits are represented by their payoffs in the extensive form game below.

<table>
<thead>
<tr>
<th></th>
<th>Gang A</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Gang B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Retaliate</td>
<td>-50</td>
<td>70</td>
</tr>
<tr>
<td>Don’t Retaliate</td>
<td>20</td>
<td>65</td>
</tr>
<tr>
<td>Attack</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Don’t Attack</td>
<td>-40</td>
<td>-30</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>50</td>
</tr>
</tbody>
</table>

What is the Subgame Perfect Equilibrium of the above game? Explain.

---

8. Lafollete Kitchen and Design is providing Stacy Dickert-Conlin a quote (i.e., specify a price) for a kitchen renovation. For simplicity, assume Lafollete can either quote a high price of $30,000 or a low price of $20,000. After Lafollete quotes a price, Stacy Dickert-Conlin decides whether to have Lafollete renovate the kitchen or not to have the kitchen renovated. (Assume there is no negotiating over the quoted price.) If Stacy Dickert-Conlin decides to have Lafollete renovate the kitchen, Lafollete then decides whether to do a high quality job or a low quality job. Note that Lafollete decides on the quality of the job after Stacy makes her decision. The maximum Stacy Dickert-Conlin is willing to pay for a high quality job is $35,000 and the maximum she is willing to pay for a low quality job is $29,000. It costs Lafollete $18,000 to do a high quality job and $17,000 to do a low quality job.

a) Depict the extensive form of the “game” described above (i.e., the game tree).

b) What is the Subgame Perfect Equilibrium of the game? BE PRECISE AND MAKE SURE YOU IDENTIFY A STRATEGY FOR EACH PLAYER.
Both Magic Johnson and Lou Anna Simon are interested in opening separate Chester’s in East Lansing. Chester’s, a quick service chicken sandwich restaurant, is a fast growing franchise restaurant. For simplicity, suppose Chester’s (the franchisor) charges a fixed monthly fee and does not obtain a percent of total revenue. As for the fixed monthly fee, Chester’s is willing to charge different franchisees different fixed fees. If Magic Johnson has the only Chester’s in East Lansing, his monthly demand for chicken sandwiches would be as depicted below. Assume Magic Johnson cannot price discriminate.

Assume Magic Johnson and Lou Anna Simon cannot price discriminate.

Suppose the marginal cost of each chicken sandwich is $2 and Magic’s monthly fixed costs are $10 (not including the franchisor’s fixed monthly fee).

If both Magic Johnson and Lou Anna Simon become Chester’s franchisees, they open up separate Chester’s restaurants in East Lansing. In this case, Magic’s monthly profits (prior to the franchisor’s fixed fee) would be $70 and Lou Anna Simon’s profits (prior to the franchisor’s fixed fee) would be $60. Note that these profits do not include the franchisor’s monthly fixed fee.

Suppose Chester’s decides to first offer a franchise to Magic Johnson by making a “take-it-or-leave-it” fixed monthly fee offer. Magic Johnson then decides whether or not to accept this fixed monthly fee offer. Whether or not Magic Johnson accepts the offer, Chester’s then makes a “take-it-or-leave-it” offer to Lou Anna Simon. Chester’s take-it-or-leave-it offer to Lou Anna Simon can be different than the offer to Magic Johnson. Lou Anna Simon then accepts or rejects this offer.

a) Depict the extensive form game and identify the subgame perfect equilibrium.

b) Would Chester’s be better off if, when making the offer to Magic Johnson, Chester’s could commit not to offer a franchisee to Lou Anna Simon? Explain.
10. Bill owns a warehouse in Lansing that Jane operates her exporting business from. Suppose Jane is leasing the warehouse and the lease agreement stipulates that, if Bill decides to sell the warehouse, Jane would be allowed to submit a bid on the warehouse before other potential buyers. Let Fred be the only other potential buyer and assume Bill is thinking about selling the warehouse. The minimum Bill is willing to accept is $3 million ($3M). If Bill decides to sell, Jane would make a bid (denote as $B_J$) which Bill would either accept or initially reject. If Bill accepts, then the warehouse would be sold to Jane for $B_J$. The warehouse is worth $6M to Jane. If Bill initially rejects Jane’s bid, Fred then decides whether or not to bid on the warehouse. Fred incurs a cost of $500,000 when putting together a bid. If Fred decides to put together a bid, Fred must then decide exactly what to bid (denote as $B_F$). The warehouse is worth $5M to Fred. If Fred does not put together a bid, Bill then decides whether or not to accept Jane’s bid ($B_J$). If Fred does put together a bid, Bill then decides whether to reject both bids, accept Jane’s bid ($B_J$) or accept Fred’s bid ($B_F$).

a) Depict the extensive form of the game (i.e., draw the game tree).

b) What is the subgame perfect equilibrium of this game? (I suspect this would be the likely outcome to this game.)

c) How would the outcome of the above game change if Jane could make a second offer (perhaps a matching offer) after Fred makes an offer? In other words, what would you expect to happen if Jane had a Right of First Refusal? (This is very similar to the example done in lecture when I discussed the Right of First Refusal in the context of the NBA. Based on the discussion in class, provide the intuition on how a Right of First Refusal would change the outcome. You do not have to draw the corresponding game tree but you can if it helps.)

d) How would the outcome of the game change if Jane’s offer was “taken off the table” if Bill rejected it? What this means is, what would happen if Bill could not accept Jane’s offer after Fred decides whether not to make an offer or make an offer of $B_F$? (You do not have to draw the corresponding game tree but you need to explain the intuition.)
11. Suppose it is 2008 and American International Group (AIG) executives are deciding whether to make a very risky investment. They can either choose to make this risky investment or choose not make this risky investment. If they choose not to make the risky investment, AIG’s expected 2008 payoff is $14B ($14 Billion) and the United States government’s 2008 payoff is 0. If they make this risky investment and the economy takes a dive, they have a chance of becoming insolvent. AIG realizes that if this occurs, the United States government would then decide whether or not to bailout AIG. Suppose AIG’s expected 2008 payoff is $12B if they make the risky investment thinking that the government would not bail them out and $15B if they make the risky investment thinking that the government would bail them out. The United States government’s expected 2008 payoff from choosing a bailout if AIG becomes insolvent is minus $8B and the United States government’s expected 2008 payoff from choosing no bailout if AIG becomes insolvent is minus $9B.

Suppose this is the “game” the United States government and AIG play in 2008 and it is the exact same game that is played in 2009 irrespective of what happens in 2008. Suppose the annual interest rate is 10% for AIG as well as the United States government.

a) Depict below the extensive form of the above game (include both the 2008 and 2009 decisions along with the payoffs).

b) What is the subgame perfect equilibrium of this game? Depict on the graph above. (You can also obtain partial credit by describing the subgame perfect equilibrium.)

c) Now suppose the United States government could credibly commit to either a bailout or no bailout prior to AIG’s investment decision. Would the outcome of this game change and would this outcome be preferred by the United States government? Explain. (A game tree is not necessary.)