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Abstract

This lecture, PowerPoint slides, and movie provide a relatively non-technical introduction to cartels. After describing the characteristics of cartels predicted by economic theory, the instructor shows a movie of the "secret" meetings of the lysine cartel. This movie demonstrates that an actual cartel behaves as economic theories predict. Although the lecture is designed for undergraduates, graduate students normally enjoy this introduction as a break from more technical material. The lecture and the accompanying PowerPoint slides take up the first hour of a 90 minute class, and the movie (roughly 24 minutes) takes up the rest of the time. The lecture can be reduced to an hour by skipping the game theory section and going lightly over a few other areas.

KEYWORDS: cartels, oligopoly, antitrust, game theory

Author Notes: I am grateful to Dennis Carlton, John Connor, and Jim Dearden (who edited this submission).

Introduction

Today's lecture concerns cartels.¹ (Slide 1) Cartels are groups of firms that explicitly coordinate their pricing or output activities. Cartels are particularly common in oligopolistic markets where there are only a few firms.

We are going to cover six main topics. (Slide 2) First, cartels are harmful and common. Second, there are a number of conditions that usually must be met for a cartel to form. Third, cartels often fail because cartel members cheat on their agreement. Fourth, there are additional conditions that usually hold for cartels to prosper and last. Fifth, one of these conditions is that a cartel is more likely to succeed in markets that last for multiple periods. Sixth, many countries use anti-trust laws to try to prevent cartels. Seventh, a major recent cartel, the lysine cartel, illustrates most of these points. We will conclude the lecture by showing a tape, filmed secretly by the FBI, of actual meetings of the lysine cartel. This film demonstrates that economic theories about cartels are consistent with real-world events.

Cartels: Bad and Ubiquitous

As Adam Smith stated, whenever people in the same industry meet, they have a tendency to hatch plans to raise prices or take other actions that will increase their profits. (Slide 3) A truly successful cartel (from the firms' standpoint) achieves the same level of profit that a monopoly would—or, at least higher profits than the firms would make without coordinating activities.

The resulting higher prices harm consumers and society as a whole. Just as you learned in your introductory economics course, the extra profit for firms is less than the loss to consumers.

We know that cartels form frequently from a variety of pieces of evidence. Where cartels are not forbidden by law they have been common, as in the United States in the eighteenth century or Europe until recently. Where the laws of a single nation cannot affect international cartels involving countries, such as OPEC (the Organization of Petroleum Exporting Countries), cartels operate freely. We also know that even when cartels are prohibited by law, they frequently occur. The U.S. Department of Justice and the Federal Trade Commission frequently take legal actions against firms who they allege have colluded. We'll provide examples later in this lecture.

¹ This lecture draws heavily on material in Carlton and Perloff (2005) and Perloff (2007), for obvious reasons.

Why Cartels Form and Firms Cheat

Cartels form because a firm can make a higher profit by coordinating its actions with other firms than by acting independently. (Slide 4) Although firms that act independently try to maximize their profits, in doing so, they ignore the effects their actions have on other firms. For example, a firm will increase its output if it believes that its own profit will rise even though it knows that by so doing, it will lower the profit of other firms in the market. (Slide 5) The cartel will take these externalities into account in setting the optimal cartel output or price.

Luckily for consumers, many cartels fail even without government intervention. The reason is that members of the cartel cheat on their agreement by producing extra output or undercutting the cartel's price. (Slide 6)

Although most cartels are formed by oligopolistic firms, we can illustrate the basic reason why forming a cartel raises collective profits and why firms want to cheat by using a competitive market example. (Slide 7) Suppose that there are a large, fixed number of identical, price-taking firms in a market with cost curves as shown in panel a (the figure on the left). The competitive supply curve is the horizontal aggregation of the representative individual firm's supply curve: the marginal cost (MC) curve above the minimum of the average cost (AC) curve. In panel b, the supply curve (sum of the individual MC curves) is labeled S . It intersects the market demand curve at p_c , the competitive price, and Q_c , the competitive quantity. At that price, each of price-taking firm produces q_c , as panel a shows.

If the firms were to coordinate their actions, they would operate like a monopoly (thereby maximizing aggregate profit). If the monopoly's marginal cost curve is S (panel b), its profit is maximized where S intersects the aggregate quantity Q_m where S intersects its marginal revenue (MR) curve. That is, each of the individual firms would have to reduce their quantity from q_c to q_m (panel a) so that aggregate quantity falls from Q_c to Q_m (panel b). Question to the class: How do we know that firm and collective profits rise? [Point out that the cartel free to pick any output levels it wants including the original, pre-cartel ones. If it changes from the noncollusive level, it must believe that it is increasing its profit. One can also use the marginal revenue and marginal cost curves to present a more formal argument.]

Notice that, to raise the price, each firm has to restrict its output to q_m . {Segment 5 of the lysine movie shows the cartel members allocating output by firm.} As shown in the figure on the left, at that quantity, the typical firm is receiving a price that is above its marginal cost. Thus, a firm could increase its profit by cheating on the agreement and raising its output level. Assuming that the other firms do not change their behavior, one firm could cheat without greatly affecting the cartel price. (The most profitable outcome for any one firm is for all other firms to run a cartel and for it to act independently.) To maximize its profit,

it would increase its output to q^* . Of course, if it pays for one firm to cheat, then all have an incentive to cheat.

Conditions for Cartel Success

Economists have identified many conditions for cartels to form, last, and be profitable. (Slide 8) Here, we review some of the major ones. First, the cartel can significantly raise prices. Second, the cartel controls most of the market (makes most of the sales). Third, the organizational costs of forming and running a cartel are low. Fourth, buyers do not have monopsony power—they are at the mercy of the cartel. Fifth, the cartel can be maintained. The cartel has mechanisms that allow it to detect and prevent cheating, and it can avoid prosecution and punishment by the government.

It only pays to set up a cartel and risk government prosecution if the potential rewards are great. (Slide 9) That is, the cartel has to expect that it can raise prices substantially. It can do that if the demand facing the cartel is not very elastic. If it were, then even a monopoly cannot raise profit. Question to class: Why? [Remind them that monopoly price is $p_m = MC/(1 + 1/\epsilon)$, where MC is the marginal cost and ϵ is the market demand elasticity.] {Segment 4 of the lysine movie shows cartel members setting prices globally.}

The cartel cannot raise prices substantial unless the cartel makes most of the market sales. (Slide 10) Ideally for the cartel, all firms belong to the cartel, or, at least, all the big firms in the market. Moreover, recycling is not feasible. For example, a copper cartel sells “new” copper that competes with recycled copper (old copper products are melted down and the copper is reused). When the cartel raises its price and profit increases, other firms will want to enter.

For the cartel to succeed, there must be barriers to prevent such entry. (Slide 11) Limits to entry are important for cartel success because entrants cannot dissipate cartel profits.

Evidence to support this claim is that most cartels occur in markets with relatively few firms. (Slide 12) (One important exception is that cartels sometimes form in professional associations, often because they get help from governments through licensing laws or other means.)

According to a study of Department of Justice price-fixing cases (Hay and Kelley 1974) from 1963 to 1972, almost half of the cartels (48%) involved six or fewer firms. Only 6.5% consisted of 50 or more conspirators.

Of the global cartels from 1990 to 2003 studied by Connor (2003), over three-quarters (77%) involved six or fewer firms. The median number of corporations involved was five. Only 13% had 10 or more participants—and most of those were organized by quasi-official European trade associations.

Many cartels fail when entry occurs. When a third firm (country) entered the mercury market, that cartel failed.

Cartels are more likely to form and persist if organizational costs are low. (Slide 13) If there are few firms in the industry, secretly meeting is relatively easy. (Remember Adam Smith's comment. *Segment 3 of the lysine movie shows cartel members discussing using the trade association as a front for their secret meetings.*) If a few firms make most of the sales in the industry, then those few large firms may be able to collude among themselves. If output is identical across firms, then it is easier for firms to agree as to how to limit output or set prices. In contrast, if each firm produces many, differentiated products, agreeing how to run the cartel is relatively difficult. Industry organizations' legal meetings provide a cover for illicit meetings. These organizations may have data collecting or information sharing functions that help cartels enforce their agreements.

Obviously detecting and preventing cheating by cartel members is crucial for cartel longevity. (Slide 14) If there are relatively few firms in the cartel, it is relatively easier to determine which one cheated by producing too much output or selling at too low a price. If all firms produce identical, homogeneous products, then it is much easier to see if other cartel members have deviated from the agreement. Monitoring is easier if purchases are infrequent and large. Some cartels make monitoring easier by dividing customers between firms (other firms agree not to try to steal those customers) or by dividing the market geographically. In recent sophisticated cartels (lysine, vitamins), agreements require that firms adjust output at the end of the year if one firm sells more than it was allocated. {*In segment 7 of the lysine movie, a conspirator explains how this reallocation scheme works.*}

Many other monitoring techniques have been developed to enforce cartel agreements. (Slide 15) Some bold cartels have agreed to let other firms review their books. Some use most-favored national clauses in customer contracts in which they promise to adjust their prices if they later give a better deal to other customers, thus giving customers an incentive to monitor. Many government contracts are put out to bid, and government agencies report the winning bid and company.

Have you ever gone to an electronics or bed retailer and been offered a "low price" guarantee? For example, if you find a lower price within a month of purchasing there, they'll give you double the difference. That probably made you feel like you were getting a good deal. However, it might have been part of a cartel scheme. Such a guarantee gives consumers an incentive to monitor for the firm.

Cartels are likely to avoid government prosecution under antitrust laws if their actions are undetected (e.g., they meet in secret). (Slide 16) Cartels do not care substantially if they are caught if the punishments are small (which used to be the case in the United States).

Under most antitrust laws, the crime is not raising prices by meeting to do so. Thus, firms can avoid prosecution if they can agree tacitly (sometimes called conscious parallelism) but not explicitly. Before the Department of Justice objected, an airline might announce that it was raising fares in two weeks. If the other firms made similar announcements, it went ahead and raised fares. Otherwise it rescinded its announced increase.

Many international, government-run cartels such as OPEC are effectively immune to prosecution by authorities in any one country. In the past, the United States participated in such international agreements (e.g., concerning the price of international airline tickets).

Cartels over Time

{Optional Section} According to game theory, collusion is extremely difficult in a one-period game (a market that lasts only briefly). (Slide 17) It is easier in a multiperiod game.

We illustrate game theory and determine the Nash equilibrium for a real-world, single-period game involving a duopoly: an oligopoly with two (*duo*-) firms. (Slide 18) We examine how American Airlines and United Airlines actually compete for customers on flights between Chicago and Los Angeles.² (Slide 19)

The total number of passengers flown by these two firms, Q , is the sum of the number of passengers flown on American, q_A , and those flown on United, q_U . The airlines can set the number of flights and the number of seats per flight. However for simplicity, we assume that the airlines can pick only a relatively large quantity, 64 units (one unit being 1000 passengers) per quarter, or a relatively small quantity, 48 units per quarter.

The profit matrix or payoff matrix (Slide 20) shows the profits given the strategies that the firms choose. For example, if American chooses a large quantity, $q_A = 64$ units per quarter, and United chooses a small quantity, $q_U = 48$ units per quarter, the firms' profits are in the cell in the lower left-hand corner of the matrix. In that cell, American's profit (upper-right number) is \$5.1 million per quarter, and United's profit (bottom-left number) is \$3.8 million per quarter.

Because the firms choose their strategies simultaneously, each firm selects a strategy that maximizes its profit given what it believes the other firm will do. That is, the firms are playing a noncooperative game of imperfect information in which each firm must choose an action before observing the simultaneous action by its rival.

²This example is based on Brander and Zhang (1990). They reported data for economy and discount passengers taking direct flights between the two cities in the third quarter of 1985. In calculating the profits, we assume that Brander and Zhang's estimate of the firms' constant marginal cost is the same as the firms' relevant long-run average cost.

The firm must choose its best response to the other firm's strategy given that it doesn't know what the other firm will do. The firm rejects any strategy that is strictly dominated by another strategy. (Slide 21) Strategy 1 strictly dominates Strategy 2 if Strategy 1 produces at least a profit as high as Strategy 2 does regardless of the action taken by the rival firm. If one strategy strictly dominates all other strategies, regardless of the actions chosen by rival firms, the firm should choose this dominant strategy. Where a firm has a dominant strategy, its belief about its rival's behavior is irrelevant.

Although firms do not always have dominant strategies, they do have them in this game. To determine American's dominant strategy, American's managers can use the following reasoning: (return to Slide 20)

- *If United chooses the high-output strategy ($q_U = 64$), American's high-output strategy maximizes its profit:* Given United's strategy, American's profit is \$4.1 million (top-right number in the upper-left cell) with its high-output strategy ($q_A = 64$) and only \$3.8 million (top-right number in the upper-right cell) with its low-output strategy ($q_A = 48$). Thus American is better off using a high-output strategy if United chooses its high-output strategy.
- *If United chooses the low-output strategy ($q_U = 48$), American's high-output strategy maximizes its profit:* Given United's strategy, American's profit is \$5.1 million with its high-output strategy and only \$4.6 million with its low-output strategy.
- *Thus the high-output strategy is American's dominant strategy:* Whichever strategy United uses, American's profit is higher if it uses its high-output strategy.

By the same type of reasoning, United's high-output strategy is also a dominant strategy. (Slide 22) Because the high-output strategy is a dominant strategy for both firms, the pair of high-output strategies, $q_A = q_U = 64$, is a Nash equilibrium.³ In this Cournot-Nash equilibrium, each firm earns \$4.1 million. If the firms colluded, they would choose the "cartel" equilibrium ($q_A = q_U = 48$), where each firm would earn \$4.6 million. Thus the sum of the firms' profits is not maximized in this simultaneous-choice, one-period game.

Why don't the firms cooperate and use the individually and jointly more profitable low-output strategies, by which each earns a profit of \$4.6 million,

³ We can use the profit matrix to confirm that this pair of strategies is a Nash equilibrium by showing that neither firm wants to change its strategy if it is certain that the other firm will use its high-output strategy. If American knew that United would use its high-output strategy, it still would not switch to its low-output strategy because its profit would fall from \$4.1 million to \$3.8 million. Similarly, United would not switch if it knew American would use its high-output strategy. Because neither firm wants to change its strategy given that the other firm is playing its Nash equilibrium strategy, this pair of strategies ($q_A = q_U = 64$) is a Nash equilibrium.

instead of the \$4.1 million in the Nash equilibrium? (Slide 23) They don't cooperate due to a lack of trust: Each firm uses the low-output strategy only if the firms have an enforceable, binding agreement.

Suppose that the two firms meet in advance and agree to restrict their outputs to the lower quantity. If the firms are going to engage in this game only once, each has an incentive to cheat on their agreement. If American believes that United will stick to the agreement and produce $q_U = 48$, American can increase its profit from \$4.6 million to \$5.1 million by violating the agreement and producing $q_A = 64$. Moreover, if American thinks that United will also cheat on the agreement by producing $q_U = 64$, American wants to produce the high output (so that it will earn \$4.1 million rather than \$3.8 million). By this reasoning, each firm has a substantial profit incentive to cheat on the agreement. In this type of game—called a prisoners' dilemma game—all players have dominant strategies that lead to a profit (or other payoff) that is inferior to what they could achieve if they cooperated and pursued alternative strategies.

Collusion is more feasible in a repeated, multiperiod game. (Slide 24) In a single-period game, one firm cannot punish the other firm for cheating on a cartel agreement. But if the firms meet period after period, a wayward firm can be punished by the other.

In the single-period game, each firm takes its rival's strategy as given and assumes that it cannot affect its rival's strategy. However, if the same game is played repeatedly, firms engage in a supergame in which players may devise strategies for this period that depend on rivals' actions in previous periods.

In a repeated game, a firm can influence its rival's behavior by *signaling* and *threatening to punish*. One airline could use a low-quantity strategy for a couple of periods to signal to the other firm its desire that the two firms cooperate and produce that low quantity in the future. If the other firm does not respond by lowering its output in future periods, the first firm suffers lower profits for only a couple of periods. However, if the other firm responds to this signal and lowers its quantity, both firms can profitably produce at the low quantity thereafter.

In addition to or instead of signaling, a firm can punish a rival for not restricting output. We can illustrate how firms punish rivals to ensure collusion. (Slide 25) Suppose that American announces or somehow indicates to United that it will use the following two-part strategy:

- American will produce the smaller quantity each period as long as United does the same.
- If United produces the larger quantity in period t , American will produce the larger quantity in period $t + 1$ and all subsequent periods.

If United believes that American will follow this strategy, United knows that it will make \$4.6 million each period if it produces the lower quantity. Although United can make a higher profit, \$5.1 million, in period t by producing

the larger quantity, by doing so it lowers its potential profit to \$4.1 million in each following period. Thus United's best policy is to produce the lower quantity in each period unless it cares greatly about current profit and little about future profits. If United values future profits nearly as much as current ones, the one-period gain from deviating from the collusive output level does not compensate for the losses from reduced profits in future periods, which is the punishment American will impose. United may take this threat by American seriously because American's best response is to produce the larger quantity if it believes it cannot trust United to produce the smaller quantity.⁴ Thus if firms play the same game *indefinitely*, they should find it easier to collude.

Playing the same game many times, however, does not necessarily help the firms collude. (Slide 26) Suppose that the firms know that they are going to play the game for T periods. In the last period, they know that they are not going to play again, so they know they can cheat—produce a lot of output—without fear of punishment. As a result, the last period is like a single-period game, and all firms cheat. That makes the $T - 1$ period the last interesting period. By the same reasoning, they'll cheat in $T - 1$. Continuing this type of argument, we conclude that maintaining a cartel will be difficult if the game has a known stopping point. If the players know that the game will end but aren't sure when, cheating is less likely to occur. Collusion is therefore more likely in a game that will continue forever or that will end at an uncertain time.

Reasons for Antitrust Laws

Before cartels and price fixing were made illegal, cartels thrived. (Slide 27) Cartels (or "trusts" as they were called in the nineteenth century) existed in oil, steel, sugar, and many other markets. Eventually Congress acted and passed laws establishing the first antitrust law, the Sherman Act, in 1890. In 1914, it also passed the Federal Trade Commission Act, which also contained antitrust provisions.

These laws prohibit firms from explicitly agreeing to take actions that reduce competition, such as meeting to jointly setting price. (Slide 28) These anti-cartel laws are called "antitrust laws" in the United States and "competition policies" in most other countries.

At first, the antitrust laws were not enforced and appeared to be very weak. (Slide 29) However, starting in 1902, under pressure from President Teddy Roosevelt, the Department of Justice (DOJ) brought suits that eventually ended up

⁴ American does not have to punish United forever to induce it to cooperate. All it has to do is punish it for a long enough period that it does not pay for United to deviate from the low-quantity strategy in any period.

in the Supreme Court. (Slide 30) The resulting decisions established that the laws were potent and could be enforced.

Again, one of the most features of the U.S. antitrust law is that most people finding surprising is that it requires explicit agreement between firms. One interesting example comes from the airlines industry. (Slide 31) *{At this point, have two students read the exchange on (Slides 32 and 33). You can get some cheap laughs by having them substitute “horsefeathers” or some other antiquated phrase for the symbols used to indicate obscenities.}* No antitrust prosecution resulted in this case because there was a lack of a formal agreement. (Slide 34)

Until recently, Europe and other areas of the world had much weaker antitrust laws than did the United States. *{Segment 2 of the lysine movie is a telephone conversation in which an Asian co-conspirator is hesitant to meet in the United States because of the U.S. antitrust laws.}* Now their laws are much closer to those of the United States. (Slide 35)

Both the United States and Europe now use Corporate Leniency Programs to induce some cartel members to squeal on the others. (Slide 36)

Lysine

An important recent case that illustrates most of the properties of successful cartels that we have just addressed and involved the Corporate Leniency Program involved the international lysine industry (see Connor, 2003, and Eichenwald, 2001). (Slide 37) Lysine is an amino acid that is used as a nutritional supplement, in animal feed to promote growth, and for other purposes. At the time it was prosecuted, this cartel received the largest penalties to date. In 1996, Archer Daniels Midland and other firms pleaded guilty to price fixing in this industry.

The lysine and its market have many of the properties that lead to a successful cartel. (Slide 38) Lysine is a homogenous product. The lysine market is highly concentrated: the four largest firms control most of the U.S. and world markets. The four largest buyers purchase less than 30 percent of the total market. Buyers make infrequent, large purchases. Entry is difficult because new plants are expensive, take years to build, and require people with unusual skills to run them.

We know a lot about this conspiracy because one of the leading participants helped the FBI tape the colluders’ “secret” meetings. Their agreement was a typical one. (Slide 39) The cartel firms felt that they needed all the major firms to participate. *{Segment 1 of the lysine movie shows the conspirators discussing the various firms involved.}* They fixed prices and allocated quantities that could be sold to each firm. *{The cartel members discuss fixing prices in segment 4 and allocating output in segment 5.}* They used their industry organization to collect data and provide cover for their illicit meeting. *{See segment 3.}* They shared

sales data. {See segment 8. Segment 6 shows the largest firm threatening other smaller firms if they do not agree to the cartel and its allocation terms.} They had a punishment scheme in place to prevent firms from exceeding their quotas. {See segments 7 and 8.}

Prior to this case, government fines tended to be small relative to the benefits from the conspiracy. That changed with the lysine case. (Slide 40) Moreover, fairly serious individual penalties were assessed. (Slide 41) (Although, notice that the heads of the firms avoid jail time.) In the private cases that followed the government cases, consumers recouped some of their losses. (Slide 42)

Movie

Now show the movie. You can request a free copy of the VHS tape, a booklet containing transcripts of the tape segments, via mail or fax (202-616-4529) from the United States Department of Justice, Antitrust Division, Freedom of Information Act Unit, 325 Seventh Street, N.W., Suite 200, Washington, D.C., 20530. The electronic version posted here is of lower quality than the original film (to keep its size down).

It is a good idea to preview the movie first so that you can make comments before and during running the movie. It helps to explain what is about to happen in each segment and how that segment connects to the points in the lecture. Details on the various segments of the movie are available in a speech by James M. Griffin, Deputy Assistant Attorney General, Antitrust Division, U.S. Department of Justice, <http://www.usdoj.gov/atr/public/speeches/4489.htm>, provides. If you are familiar with the background (e.g., read Eichenwald's *The Informant*), you can tell your students about the bizarre behavior of Mark Whitacre and his role. You might want to skip the last segment, which is difficult to follow, and the first section, which mainly introduces the players and shows their contempt for customers and antitrust authorities. I've shown this film to both undergraduates and graduate students. It is a big hit with both groups. Students are happy to sit through the entire movie without squirming.

To make downloading easier and to allow you to show just a subset of the movie easily, the movie has been divided into sections:

Segment	Title, length
1	The DOJ title (28 seconds); “January 18, 1995, Cartel Meeting in Atlanta, Georgia, Cartel members show disdain for customers and antitrust enforcement” (2 minutes, 54 seconds)
2	“July 13, 1993, Telephone Call from ADM Headquarters, foreign co-conspirator expresses reluctance to meet in the United States” (1 minute, 54 seconds) [Taped phone conversation with text appearing on the screen.]
3	“March 10, 1994, Cartel Meeting in Maui, Hawaii, Cartel members use trade association as a cover for conspiracy meetings” (1 minute, 47 seconds)
4	“March 10, 1994, Cartel Meeting in Maui, Hawaii, Cartel members fix price on a global basis” (2 minute, 41 seconds)
5	“October 25, 1993, Cartel Meeting in Irvine, California, Cartel members allocate worldwide sales volumes” (3 minutes, 28 seconds)
6	“October 25, 1993, Cartel Meeting in Irvine, California, Co-conspirator threatens retaliation if others don’t agree to proposed market allocation scheme” (2 minutes, 48 seconds)
7	“March 10, 1994, Cartel Meeting in Maui, Hawaii, Co-conspirator explains how end-of-year compensation scheme eliminates the incentive to cheat on the cartel” (2 minutes, 31 seconds) [High point of the movie: One of ADM’s executives tells other firms that the customers are their enemies and that only the various firms are their friends.]
8	“January 18, 1995, Cartel Meeting in Atlanta, Georgia, Cartel members report end-of-year sales figures and find that sales volumes ‘were right on target’” (4 minutes, 49 seconds)

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