



CHAPTER 17

Oligopoly

If you go to a store to buy tennis balls, you will probably come home with one of four brands: Wilson, Penn, Dunlop, or Spalding. These four companies make almost all the tennis balls sold in the United States. Together these firms determine the quantity of tennis balls produced and, given the market demand curve, the price at which tennis balls are sold.

The market for tennis balls is an example of an **oligopoly**. The essence of an oligopolistic market is that there are only a few sellers. As a result, the actions of any one seller in the market can have a large impact on the profits of all the other sellers. Oligopolistic firms are interdependent in a way that competitive firms are not. Our goal in this chapter is to see how this interdependence shapes the firms' behavior and what problems it raises for public policy.

oligopoly
a market structure in which only a few sellers offer similar or identical products



game theory

*the study of how people
behave in strategic
situations*

The analysis of oligopoly offers an opportunity to introduce **game theory**, the study of how people behave in strategic situations. By “strategic” we mean a situation in which a person, when choosing among alternative courses of action, must consider how others might respond to the action she takes. Strategic thinking is crucial not only in checkers, chess, and tic-tac-toe but also in many business decisions. Because oligopolistic markets have only a small number of firms, each firm must act strategically. Each firm knows that its profit depends not only on how much it produces but also on how much the other firms produce. In making its production decision, each firm in an oligopoly should consider how its decision might affect the production decisions of all the other firms in the market.

Game theory is not necessary for understanding competitive or monopoly markets. In a market that is either perfectly competitive or monopolistically competitive, each firm is so small compared to the market that strategic interactions with other firms are not important. In a monopolized market, strategic interactions are absent because the market has only one firm. But, as we will see, game theory is useful for understanding oligopolies and many other situations in which a small number of players interact with one another. Game theory helps explain the strategies that people choose, whether they are playing tennis or selling tennis balls.

17-1 Markets with Only a Few Sellers

Because an oligopolistic market has only a small group of sellers, a key feature of oligopoly is the tension between cooperation and self-interest. The oligopolists are best off when they cooperate and act like a monopolist—producing a small quantity of output and charging a price above marginal cost. Yet because each oligopolist cares only about its own profit, there are powerful incentives at work that hinder a group of firms from maintaining the cooperative outcome.

17-1a A Duopoly Example

To understand the behavior of oligopolies, let’s consider an oligopoly with only two members, called a *duopoly*. Duopoly is the simplest type of oligopoly. Oligopolies with three or more members face the same problems as duopolies, so we do not lose much by starting with the simpler case.

Imagine a town in which only two residents—Jack and Jill—own wells that produce water safe for drinking. Each Saturday, Jack and Jill decide how many gallons of water to pump, bring the water to town, and sell it for whatever price the market will bear. To keep things simple, suppose that Jack and Jill can pump as much water as they want without cost. That is, the marginal cost of water equals zero.

Table 1 shows the town’s demand schedule for water. The first column shows the total quantity demanded, and the second column shows the price. If the two well owners sell a total of 10 gallons of water, water goes for \$110 a gallon. If they sell a total of 20 gallons, the price falls to \$100 a gallon. And so on. If you graphed these two columns of numbers, you would get a standard downward-sloping demand curve.

The last column in Table 1 shows the total revenue from the sale of water. It equals the quantity sold times the price. Because there is no cost to pumping water, the total revenue of the two producers equals their total profit.

TABLE 1

The Demand Schedule for Water

Quantity	Price	Total Revenue (and total profit)
0 gallons	\$120	\$ 0
10	110	1,100
20	100	2,000
30	90	2,700
40	80	3,200
50	70	3,500
60	60	3,600
70	50	3,500
80	40	3,200
90	30	2,700
100	20	2,000
110	10	1,100
120	0	0

Let's now consider how the organization of the town's water industry affects the price of water and the quantity of water sold.

17-1b Competition, Monopolies, and Cartels

Before considering the price and quantity of water that would result from the duopoly of Jack and Jill, let's discuss briefly what the outcome would be if the water market were either perfectly competitive or monopolistic. These two polar cases are natural benchmarks.

If the market for water were perfectly competitive, the production decisions of each firm would drive price equal to marginal cost. Because we have assumed that the marginal cost of pumping additional water is zero, the equilibrium price of water under perfect competition would be zero as well. The equilibrium quantity would be 120 gallons. The price of water would reflect the cost of producing it, and the efficient quantity of water would be produced and consumed.

Now consider how a monopoly would behave. Table 1 shows that total profit is maximized at a quantity of 60 gallons and a price of \$60 a gallon. A profit-maximizing monopolist, therefore, would produce this quantity and charge this price. As is standard for monopolies, price would exceed marginal cost. The result would be inefficient, because the quantity of water produced and consumed would fall short of the socially efficient level of 120 gallons.

What outcome should we expect from our duopolists? One possibility is that Jack and Jill get together and agree on the quantity of water to produce and the price to charge for it. Such an agreement among firms over production and price is called **collusion**, and the group of firms acting in unison is called a **cartel**. Once a cartel is formed, the market is in effect served by a monopoly and we can apply our analysis from Chapter 15. That is, if Jack and Jill were to collude, they would agree on the monopoly outcome because that outcome maximizes the total profit that they can get from the market. Our two producers would produce

collusion

an agreement among firms in a market about quantities to produce or prices to charge

cartel

a group of firms acting in unison

a total of 60 gallons, which would be sold at a price of \$60 a gallon. Once again, price exceeds marginal cost, and the outcome is socially inefficient.

A cartel must agree not only on the total level of production but also on the amount produced by each member. In our case, Jack and Jill must agree on how to split the monopoly production of 60 gallons. Each member of the cartel will want a larger share of the market because a larger market share means larger profit. If Jack and Jill agreed to split the market equally, each would produce 30 gallons, the price would be \$60 a gallon, and each would get a profit of \$1,800.

IN THE NEWS

Public Price Fixing

If a group of producers coordinates their prices in secret meetings, they can be sent to jail for criminal violations of antitrust laws. But what if they discuss the same topic in public?

Market Talk

By Alistair Lindsay

Most companies have antitrust compliance policies. They typically—and quite rightly—identify a number of things that officers and employees should not do, on pain of criminal liability, eye-watering fines and unlimited damages actions. All make clear that companies must not agree with their competitors to fix prices. This is a bright-line rule. But it raises an important question: Can companies coordinate price increases without infringing the cartel rules?

In markets where competitors need to publish their prices to win business—for example, many retail markets—it is perfectly lawful to shadow a rival's increases, so long as each seller acts entirely independently in setting its charges. The very definition of an oligopoly is a market involving a small number of suppliers that set their own commercial strategies but take account of their competitors. One competitor may emerge as a leader, with others taking their cue on when to raise prices and by how much.

When prices are privately negotiated—as in many industrial markets—it is common

for a customer to volunteer information about a rival's prices to obtain leverage: “You’ve quoted £100 per ton, but X is offering £95 and I’m going to them unless you can do better.” A company that receives this information obtains valuable intelligence about what its rivals are charging, but it does not infringe cartel rules. . . .

Companies also sometimes signal to one another in their communications with investors, whether deliberately or not. A competitor which informs the markets, say, that it expects a price war to end in February is providing relevant information to actual and potential owners of its stock. But of course its rivals read the same reports and can change their strategies accordingly. So a statement to the market can serve as just as much of a signal to competitors as a statement made during a cartel meeting. . . .

Signaling through investor communications raises difficult questions for cartel enforcement. The enforcers want to protect consumers from the adverse effects of blatant signaling, but not at the price of losing transparency in financial markets. For example, it is highly relevant to an investor to know an airline’s predicted growth of per-mile passenger revenue for the next quarter. But a



rival airline might use the announced figure as a benchmark when setting its own fares for the next quarter.

As things stand, cartel authorities have focused their efforts in such situations on blocking mergers in markets where signaling is prevalent, arguing that consolidation in such markets can further dampen competition by making coordination easier or more successful. However, they have not taken high-profile action alleging cartel infringements against companies for announcements made to investors.

If there is no justification for a particular announcement other than to signal to competitors, cartel authorities should seek to intervene. For in this case the public announcement is analytically the same as a private discussion directly with the rivals, and there is scope for consumers to be seriously harmed. But most announcements do serve legitimate purposes, such as keeping investors informed. In these cases, intervention by the cartel authorities seems too complex, given the disparate policy objectives in play. ▲

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17-1c The Equilibrium for an Oligopoly

Oligopolists would like to form cartels and earn monopoly profits, but that is often impossible. Squabbling among cartel members over how to divide the profit in the market can make agreement among members difficult. In addition, anti-trust laws prohibit explicit agreements among oligopolists as a matter of public policy. Even talking about pricing and production restrictions with competitors can be a criminal offense. Let's therefore consider what happens if Jack and Jill decide separately how much water to produce.

At first, one might expect Jack and Jill to reach the monopoly outcome on their own, because this outcome maximizes their joint profit. In the absence of a binding agreement, however, the monopoly outcome is unlikely. To see why, imagine that Jack expects Jill to produce only 30 gallons (half of the monopoly quantity). Jack would reason as follows:

"I could produce 30 gallons as well. In this case, a total of 60 gallons of water would be sold at a price of \$60 a gallon. My profit would be \$1,800 (30 gallons \times \$60 a gallon). Alternatively, I could produce 40 gallons. In this case, a total of 70 gallons of water would be sold at a price of \$50 a gallon. My profit would be \$2,000 (40 gallons \times \$50 a gallon). Even though total profit in the market would fall, my profit would be higher, because I would have a larger share of the market."

Of course, Jill might reason the same way. If so, Jack and Jill would each bring 40 gallons to town. Total sales would be 80 gallons, and the price would fall to \$40. Thus, if the duopolists individually pursue their own self-interest when deciding how much to produce, they produce a total quantity greater than the monopoly quantity, charge a price lower than the monopoly price, and earn total profit less than the monopoly profit.

Although the logic of self-interest increases the duopoly's output above the monopoly level, it does not push the duopolists all the way to the competitive allocation. Consider what happens when each duopolist produces 40 gallons. The price is \$40, and each duopolist makes a profit of \$1,600. In this case, Jack's self-interested logic leads to a different conclusion:

"Right now, my profit is \$1,600. Suppose I increase my production to 50 gallons. In this case, a total of 90 gallons of water would be sold, and the price would be \$30 a gallon. Then my profit would be only \$1,500. Rather than increasing production and driving down the price, I am better off keeping my production at 40 gallons."

The outcome in which Jack and Jill each produce 40 gallons looks like some sort of equilibrium. In fact, this outcome is called a Nash equilibrium. (It is named after economic theorist John Nash, whose life was portrayed in the book and movie *A Beautiful Mind*.) A **Nash equilibrium** is a situation in which economic actors interacting with one another each choose their best strategy given the strategies the others have chosen. In this case, given that Jill is producing 40 gallons, the best strategy for Jack is to produce 40 gallons. Similarly, given that Jack is producing 40 gallons, the best strategy for Jill is to produce 40 gallons. Once they reach this Nash equilibrium, neither Jack nor Jill has an incentive to make a different decision.

This example illustrates the tension between cooperation and self-interest. Oligopolists would be better off cooperating and reaching the monopoly outcome. Yet because they pursue their own self-interest, they do not end up reaching the monopoly outcome and maximizing their joint profit. Each oligopolist is tempted to raise production and capture a larger share of the market. As each of them tries to do this, total production rises, and the price falls.

Nash equilibrium

a situation in which economic actors interacting with one another each choose their best strategy given the strategies that all the other actors have chosen

At the same time, self-interest does not drive the market all the way to the competitive outcome. Like monopolists, oligopolists are aware that increasing the amount they produce reduces the price of their product, which in turn affects profits. Therefore, they stop short of following the competitive firm's rule of producing up to the point where price equals marginal cost.

In summary, *when firms in an oligopoly individually choose production to maximize profit, they produce a quantity of output greater than the level produced by monopoly and less than the level produced by perfect competition. The oligopoly price is less than the monopoly price but greater than the competitive price (which equals marginal cost).*

17-1d How the Size of an Oligopoly Affects the Market Outcome

We can use the insights from this analysis of duopoly to discuss how the size of an oligopoly is likely to affect the outcome in a market. Suppose, for instance, that John and Joan suddenly discover water sources on their property and join Jack and Jill in the water oligopoly. The demand schedule in Table 1 remains the same, but now more producers are available to satisfy this demand. How would an increase in the number of sellers from two to four affect the price and quantity of water in the town?

If the sellers of water could form a cartel, they would once again try to maximize total profit by producing the monopoly quantity and charging the monopoly price. Just as when there were only two sellers, the members of the cartel would need to agree on production levels for each member and find some way to enforce the agreement. As the cartel grows larger, however, this outcome is less likely. Reaching and enforcing an agreement becomes more difficult as the size of the group increases.

If the oligopolists do not form a cartel—perhaps because the antitrust laws prohibit it—they must each decide on their own how much water to produce. To see how the increase in the number of sellers affects the outcome, consider the decision facing each seller. At any time, each well owner has the option to raise production by one gallon. In making this decision, the well owner weighs the following two effects:

- *The output effect:* Because price is above marginal cost, selling one more gallon of water at the going price will raise profit.
- *The price effect:* Raising production will increase the total amount sold, which will lower the price of water and lower the profit on all the other gallons sold.

If the output effect is larger than the price effect, the well owner will increase production. If the price effect is larger than the output effect, the owner will not raise production. (In fact, in this case, it is profitable to reduce production.) Each oligopolist continues to increase production until these two marginal effects exactly balance, taking the other firms' production as given.

Now consider how the number of firms in the industry affects the marginal analysis of each oligopolist. The larger the number of sellers, the less each seller is concerned about her own impact on the market price. That is, as the oligopoly grows in size, the magnitude of the price effect falls. When the oligopoly grows very large, the price effect disappears altogether. That is, the production decision of an individual firm no longer affects the market price. In this extreme case, each firm takes the market price as given when deciding how much to produce. It increases production as long as price is above marginal cost.

We can now see that a large oligopoly is essentially a group of competitive firms. A competitive firm considers only the output effect when deciding how much to produce: Because a competitive firm is a price taker, the price effect is absent. Thus, *as the number of sellers in an oligopoly grows larger, an oligopolistic market looks more and more like a competitive market. The price approaches marginal cost, and the quantity produced approaches the socially efficient level.*

This analysis of oligopoly offers a new perspective on the effects of international trade. Imagine that Toyota and Honda are the only automakers in Japan, Volkswagen and BMW are the only automakers in Germany, and Ford and General Motors are the only automakers in the United States. If these nations prohibited international trade in autos, each would have an auto oligopoly with only two members, and the market outcome would likely depart substantially from the competitive ideal. With international trade, however, the car market is a world market, and the oligopoly in this example has six members. Allowing free trade increases the number of producers from which each consumer can choose, and this increased competition keeps prices closer to marginal cost. Thus, the theory of oligopoly provides another reason, in addition to the theory of comparative advantage discussed in Chapter 3, why all countries can benefit from free trade.

Quick Quiz *If the members of an oligopoly could agree on a total quantity to produce, what quantity would they choose? • If the oligopolists do not act together but instead make production decisions individually, do they produce a total quantity more or less than in your answer to the previous question? Why?*

17-2 The Economics of Cooperation

As we have seen, oligopolies would like to reach the monopoly outcome. Doing so, however, requires cooperation, which at times is difficult to establish and maintain. In this section we look more closely at the problems that arise when cooperation among actors is desirable but difficult. To analyze the economics of cooperation, we need to learn a little about game theory.

In particular, we focus on a “game” called the **prisoners’ dilemma**, which provides insight into why cooperation is difficult. Many times in life, people fail to cooperate with one another even when cooperation would make them all better off. An oligopoly is just one example. The story of the prisoners’ dilemma contains a general lesson that applies to any group trying to maintain cooperation among its members.

17-2a The Prisoners’ Dilemma

The prisoners’ dilemma is a story about two criminals who have been captured by the police. Let’s call them Bonnie and Clyde. The police have enough evidence to convict Bonnie and Clyde of the minor crime of carrying an unregistered gun, so that each would spend a year in jail. The police also suspect that the two criminals have committed a bank robbery together, but they lack hard evidence to convict them of this major crime. The police question Bonnie and Clyde in separate rooms and offer each of them the following deal:

“Right now, we can lock you up for 1 year. If you confess to the bank robbery and implicate your partner, however, we’ll give you immunity and you can go free. Your partner will get 20 years in jail. But if you both confess to the crime, we

prisoners’ dilemma
a particular “game”
between two captured
prisoners that illustrates
why cooperation is
difficult to maintain
even when it is mutually
beneficial

won't need your testimony and we can avoid the cost of a trial, so you will each get an intermediate sentence of 8 years."

If Bonnie and Clyde, heartless bank robbers that they are, care only about their own sentences, what would you expect them to do? Figure 1 shows their choices. Each prisoner has two strategies: confess or remain silent. The sentence each prisoner gets depends on the strategy he or she chooses and the strategy chosen by his or her partner in crime.

Consider first Bonnie's decision. She reasons as follows: "I don't know what Clyde is going to do. If he remains silent, my best strategy is to confess, since then I'll go free rather than spending a year in jail. If he confesses, my best strategy is still to confess, since then I'll spend 8 years in jail rather than 20. So, regardless of what Clyde does, I am better off confessing."

In the language of game theory, a strategy is called a **dominant strategy** if it is the best strategy for a player to follow regardless of the strategies pursued by other players. In this case, confessing is a dominant strategy for Bonnie. She spends less time in jail if she confesses, regardless of whether Clyde confesses or remains silent.

Now consider Clyde's decision. He faces the same choices as Bonnie, and he reasons in much the same way. Regardless of what Bonnie does, Clyde can reduce his jail time by confessing. In other words, confessing is also a dominant strategy for Clyde.

In the end, both Bonnie and Clyde confess, and both spend 8 years in jail. This outcome is a Nash equilibrium: Each criminal is choosing the best strategy available, given the strategy the other is following. Yet, from their standpoint, the outcome is terrible. If they had *both* remained silent, both of them would have been better off, spending only 1 year in jail on the gun charge. Because each pursues his or her own interests, the two prisoners together reach an outcome that is worse for each of them.

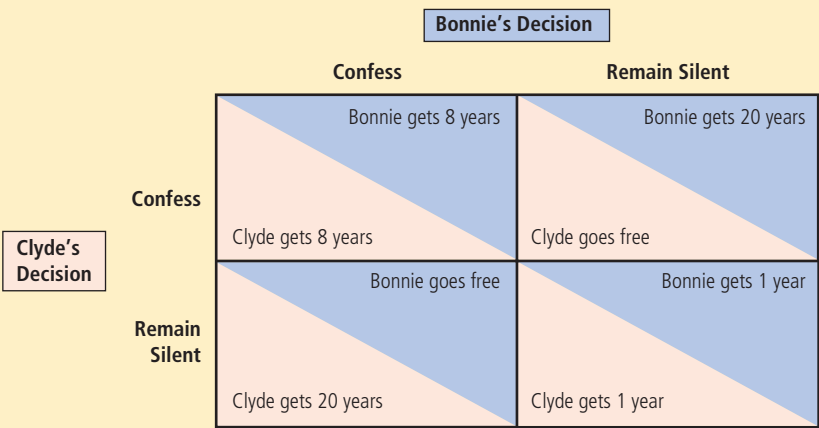
You might have thought that Bonnie and Clyde would have foreseen this situation and planned ahead. But even with advanced planning, they would still run into problems. Imagine that, before the police captured Bonnie and Clyde, the two criminals had made a pact not to confess. Clearly, this agreement would make them both better off *if* they both lived up to it, because they would each spend only 1 year in jail. But would the two criminals in fact remain silent, simply

dominant strategy
a strategy that is best for a player in a game regardless of the strategies chosen by the other players

FIGURE 1

The Prisoners' Dilemma

In this game between two criminals suspected of committing a crime, the sentence that each receives depends both on his or her decision whether to confess or remain silent and on the decision made by the other.



because they had agreed to? Once they are being questioned separately, the logic of self-interest takes over and leads them to confess. Cooperation between the two prisoners is difficult to maintain, because cooperation is individually irrational.

17-2b Oligopolies as a Prisoners' Dilemma

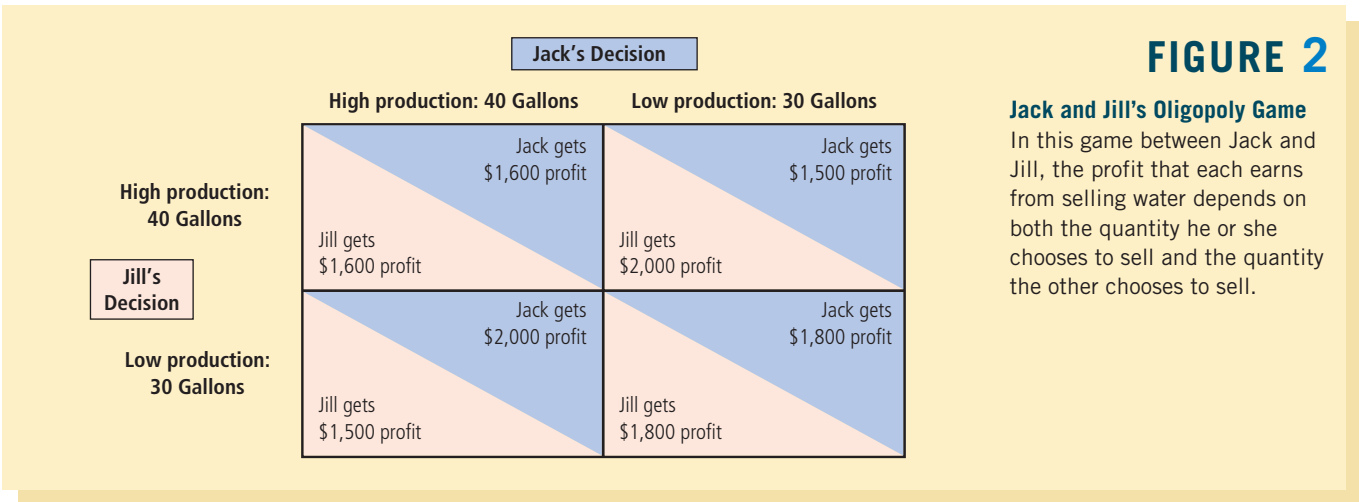
What does the prisoners' dilemma have to do with markets and imperfect competition? It turns out that the game oligopolists play in trying to reach the monopoly outcome is similar to the game that the two prisoners play in the prisoners' dilemma.

Consider again the choices facing Jack and Jill. After prolonged negotiation, the two suppliers of water agree to keep production at 30 gallons so that the price will be kept high and together they will earn the maximum profit. After they agree on production levels, however, each of them must decide whether to cooperate and live up to this agreement or to ignore it and produce at a higher level. Figure 2 shows how the profits of the two producers depend on the strategies they choose.

Suppose you are Jack. You might reason as follows: "I could keep production at 30 gallons as we agreed, or I could raise my production and sell 40 gallons. If Jill lives up to the agreement and keeps her production at 30 gallons, then I earn profit of \$2,000 by selling 40 gallons and \$1,800 by selling 30 gallons. In this case, I am better off with the higher-level production. If Jill fails to live up to the agreement and produces 40 gallons, then I earn \$1,600 by selling 40 gallons and \$1,500 by selling 30 gallons. Once again, I am better off with higher production. So, regardless of what Jill chooses to do, I am better off reneging on our agreement and producing at the higher level."

Producing 40 gallons is a dominant strategy for Jack. Of course, Jill reasons in exactly the same way, and so both produce at the higher level of 40 gallons. The result is the inferior outcome (from Jack and Jill's standpoint) with low profits for each of the two producers.

This example illustrates why oligopolies have trouble maintaining monopoly profits. The monopoly outcome is jointly rational, but each oligopolist has an incentive to cheat. Just as self-interest drives the prisoners in the prisoners' dilemma to confess, self-interest makes it difficult for the oligopolists to maintain the cooperative outcome with low production, high prices, and monopoly profits.



case study**OPEC and the World Oil Market**

Our story about the town's market for water is fictional, but if we change water to crude oil, and Jack and Jill to Iran and Iraq, the story is close to being true. Much of the world's oil is produced by a few countries, mostly in the Middle East. These countries together make up an oligopoly. Their decisions about how much oil to pump are much the same as Jack and Jill's decisions about how much water to pump.

The countries that produce most of the world's oil have formed a cartel, called the Organization of Petroleum Exporting Countries (OPEC). As originally formed in 1960, OPEC included Iran, Iraq, Kuwait, Saudi Arabia, and Venezuela. By 1973, eight other nations had joined: Qatar, Indonesia, Libya, the United Arab Emirates, Algeria, Nigeria, Ecuador, and Gabon. These countries control about three-fourths of the world's oil reserves. Like any cartel, OPEC tries to raise the price of its product through a coordinated reduction in quantity produced. OPEC tries to set production levels for each of the member countries.

The problem that OPEC faces is much the same as the problem that Jack and Jill face in our story. The OPEC countries would like to maintain a high price for oil. But each member of the cartel is tempted to increase its production to get a larger share of the total profit. OPEC members frequently agree to reduce production but then cheat on their agreements.

OPEC was most successful at maintaining cooperation and high prices in the period from 1973 to 1985. The price of crude oil rose from \$3 a barrel in 1972 to \$11 in 1974 and then to \$35 in 1981. But in the mid-1980s, member countries began arguing about production levels, and OPEC became ineffective at maintaining cooperation. By 1986 the price of crude oil had fallen back to \$13 a barrel.

In recent years, the members of OPEC have continued to meet regularly, but they have been less successful at reaching and enforcing agreements. As a result, fluctuations in oil prices have been driven more by the natural forces of supply and demand than by the cartel's artificial restrictions on production. While this lack of cooperation among OPEC nations has reduced the profits of the oil-producing nations below what they might have been, it has benefited consumers around the world. ▲

17-2c Other Examples of the Prisoners' Dilemma

We have seen how the prisoners' dilemma can be used to understand the problem facing oligopolies. The same logic applies to many other situations as well. Here we consider two examples in which self-interest prevents cooperation and leads to an inferior outcome for the parties involved.

Arms Races In the decades after World War II, the world's two superpowers—the United States and the Soviet Union—were engaged in a prolonged competition over military power. This topic motivated some of the early work on game theory. The game theorists pointed out that an arms race is much like the prisoners' dilemma.

To see why, consider the decisions of the United States and the Soviet Union about whether to build new weapons or to disarm. Each country prefers to have more arms than the other because a larger arsenal would give it more influence in world affairs. But each country also prefers to live in a world safe from the other country's weapons.

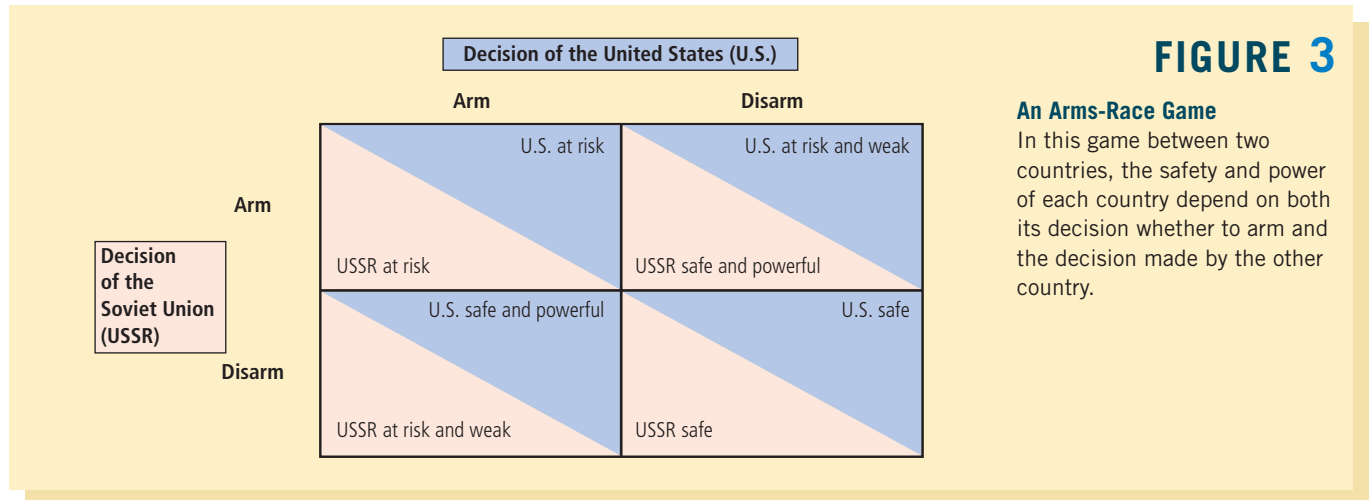


Figure 3 shows the deadly game. If the Soviet Union chooses to arm, the United States is better off doing the same to prevent the loss of power. If the Soviet Union chooses to disarm, the United States is better off arming because doing so would make it more powerful. For each country, arming is a dominant strategy. Thus, each country chooses to continue the arms race, resulting in the inferior outcome with both countries at risk.

Throughout the Cold War era from about 1945 to 1991, the United States and the Soviet Union attempted to solve this problem through negotiation and agreements over arms control. The problems that the two countries faced were similar to those that oligopolists encounter in trying to maintain a cartel. Just as oligopolists argue over production levels, the United States and the Soviet Union argued over the amount of arms that each country would be allowed. And just as cartels have trouble enforcing production levels, the United States and the Soviet Union each feared that the other country would cheat on any agreement. In both arms races and oligopolies, the relentless logic of self-interest drives the participants toward the noncooperative outcome, which is worse for both parties.

Common Resources In Chapter 11 we saw that people tend to overuse common resources. One can view this problem as an example of the prisoners' dilemma.

Imagine that two oil companies—Exxon and Texaco—own adjacent oil fields. Under the fields is a common pool of oil worth \$12 million. Drilling a well to recover the oil costs \$1 million. If each company drills one well, each will get half of the oil and earn a \$5 million profit (\$6 million in revenue minus \$1 million in costs).

Because the pool of oil is a common resource, the companies will not use it efficiently. Suppose that either company could drill a second well. If one company has two of the three wells, that company gets two-thirds of the oil, which yields a profit of \$6 million. The other company gets one-third of the oil, for a profit of \$3 million. Yet if each company drills a second well, the two companies again split the oil. In this case, each bears the cost of a second well, so profit is only \$4 million for each company.

FIGURE 4

A Common-Resources Game

In this game between firms pumping oil from a common pool, the profit that each earns depends on both the number of wells it drills and the number of wells drilled by the other firm.

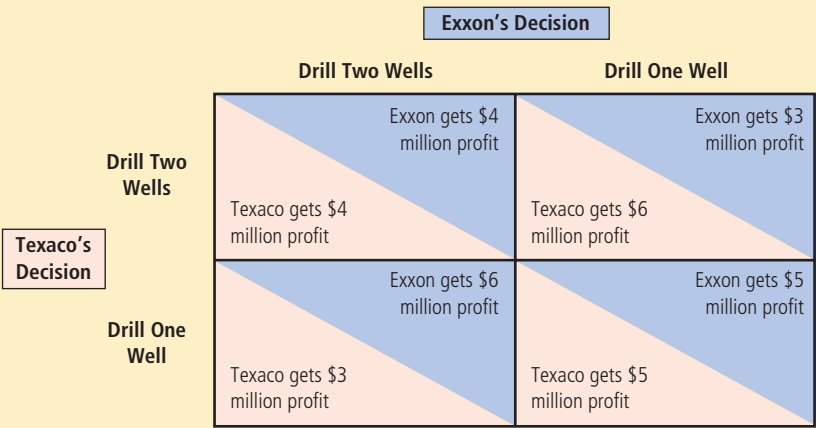


Figure 4 shows the game. Drilling two wells is a dominant strategy for each company. Once again, the self-interest of the two players leads them to an inferior outcome.

17-2d The Prisoners' Dilemma and the Welfare of Society

The prisoners' dilemma describes many of life's situations, and it shows that cooperation can be difficult to maintain, even when cooperation would make both players in the game better off. Clearly, this lack of cooperation is a problem for those involved in these situations. But is lack of cooperation a problem from the standpoint of society as a whole? The answer depends on the circumstances.

In some cases, the noncooperative equilibrium is bad for society as well as the players. In the arms-race game in Figure 3, both the United States and the Soviet Union end up at risk. In the common-resources game in Figure 4, the extra wells dug by Texaco and Exxon are pure waste. In both cases, society would be better off if the two players could reach the cooperative outcome.

By contrast, in the case of oligopolists trying to maintain monopoly profits, lack of cooperation is desirable from the standpoint of society as a whole. The monopoly outcome is good for the oligopolists, but it is bad for the consumers of the product. As we first saw in Chapter 7, the competitive outcome is best for society because it maximizes total surplus. When oligopolists fail to cooperate, the quantity they produce is closer to this optimal level. Put differently, the invisible hand guides markets to allocate resources efficiently only when markets are competitive, and markets are competitive only when firms in the market fail to cooperate with one another.

Similarly, consider the case of the police questioning two suspects. Lack of cooperation between the suspects is desirable, for it allows the police to convict more criminals. The prisoners' dilemma is a dilemma for the prisoners, but it can be a boon to everyone else.

17-2e Why People Sometimes Cooperate

The prisoners' dilemma shows that cooperation is difficult. But is it impossible? Not all prisoners, when questioned by the police, decide to turn in their partners in crime. Cartels sometimes manage to maintain collusive arrangements, despite

the incentive for individual members to defect. Very often, players can solve the prisoners' dilemma because they play the game not once but many times.

To see why cooperation is easier to enforce in repeated games, let's return to our duopolists, Jack and Jill, whose choices were given in Figure 2. Jack and Jill would like to agree to maintain the monopoly outcome in which each produces 30 gallons. Yet, if Jack and Jill are to play this game only once, neither has any incentive to live up to this agreement. Self-interest drives each of them to renege and choose the dominant strategy of 40 gallons.

Now suppose that Jack and Jill know that they will play the same game every week. When they make their initial agreement to keep production low, they can also specify what happens if one party reneges. They might agree, for instance, that once one of them reneges and produces 40 gallons, both of them will produce 40 gallons forever after. This penalty is easy to enforce, for if one party is producing at a high level, the other has every reason to do the same.

The threat of this penalty may be all that is needed to maintain cooperation. Each person knows that defecting would raise his or her profit from \$1,800 to \$2,000. But this benefit would last for only one week. Thereafter, profit would fall to \$1,600 and stay there. As long as the players care enough about future profits, they will choose to forgo the one-time gain from defection. Thus, in a game of repeated prisoners' dilemma, the two players may well be able to reach the cooperative outcome.

case study

The Prisoners' Dilemma Tournament

Imagine that you are playing a game of prisoners' dilemma with a person being "questioned" in a separate room. Moreover, imagine that you are going to play not once but many times. Your score at the end of the game is the total number of years in jail. You would like to make this score as small as possible. What strategy would you play? Would you begin by confessing or remaining silent? How would the other player's actions affect your subsequent decisions about confessing?

Repeated prisoners' dilemma is a complicated game. To encourage cooperation, players must penalize each other for not cooperating. Yet the strategy described earlier for Jack and Jill's water cartel—defect forever as soon as the other player defects—is not very forgiving. In a game repeated many times, a strategy that allows players to return to the cooperative outcome after a period of noncooperation may be preferable.

To see what strategies work best, political scientist Robert Axelrod held a tournament. People entered by sending computer programs designed to play repeated prisoners' dilemma. Each program then played the game against all the other programs. The "winner" was the program that received the fewest total years in jail.

The winner turned out to be a simple strategy called *tit-for-tat*. According to tit-for-tat, a player should start by cooperating and then do whatever the other player did last time. Thus, a tit-for-tat player cooperates until the other player defects; then she defects until the other player cooperates again. In other words, this strategy starts out friendly, penalizes unfriendly players, and forgives them if warranted. To Axelrod's surprise, this simple strategy did better than all the more complicated strategies that people had sent in.

The tit-for-tat strategy has a long history. It is essentially the biblical strategy of "an eye for an eye, a tooth for a tooth." The prisoners' dilemma tournament suggests that this may be a good rule of thumb for playing some of the games of life. ■

Quick Quiz *Tell the story of the prisoners' dilemma. Write down a table showing the prisoners' choices and explain what outcome is likely.* • *What does the prisoners' dilemma teach us about oligopolies?*

17-3 Public Policy toward Oligopolies

One of the *Ten Principles of Economics* in Chapter 1 is that governments can sometimes improve market outcomes. This principle applies directly to oligopolistic markets. As we have seen, cooperation among oligopolists is undesirable from the standpoint of society as a whole because it leads to production that is too low and prices that are too high. To move the allocation of resources closer to the social optimum, policymakers should try to induce firms in an oligopoly to compete rather than cooperate. Let's consider how policymakers do this and then examine the controversies that arise in this area of public policy.

17-3a Restraint of Trade and the Antitrust Laws

One way that policy discourages cooperation is through the common law. Normally, freedom of contract is an essential part of a market economy. Businesses and households use contracts to arrange mutually advantageous trades. In doing this, they rely on the court system to enforce contracts. Yet, for many centuries, judges in England and the United States have deemed agreements among competitors to reduce quantities and raise prices to be contrary to the public good. They have therefore refused to enforce such agreements.

The Sherman Antitrust Act of 1890 codified and reinforced this policy:

Every contract, combination in the form of trust or otherwise, or conspiracy, in restraint of trade or commerce among the several States, or with foreign nations, is declared to be illegal. . . . Every person who shall monopolize, or attempt to monopolize, or combine or conspire with any person or persons to monopolize any part of the trade or commerce among the several States, or with foreign nations, shall be deemed guilty of a misdemeanor, and on conviction thereof, shall be punished by fine not exceeding fifty thousand dollars, or by imprisonment not exceeding one year, or by both said punishments, in the discretion of the court.

The Sherman Act elevated agreements among oligopolists from unenforceable contracts to criminal conspiracies.

The Clayton Act of 1914 further strengthened the antitrust laws. According to this law, if a person could prove that she was damaged by an illegal arrangement to restrain trade, that person could sue and recover three times the damages she sustained. The purpose of this unusual rule of triple damages is to encourage private lawsuits against conspiring oligopolists.

Today, both the U.S. Justice Department and private parties have the authority to bring legal suits to enforce the antitrust laws. As we discussed in Chapter 15, these laws are used to prevent mergers that would lead to excessive market power in any single firm. In addition, these laws are used to prevent oligopolists from acting together in ways that would make their markets less competitive.

case study

An Illegal Phone Call

Firms in oligopolies have a strong incentive to collude in order to reduce production, raise price, and increase profit. The great 18th-century economist Adam Smith was well aware of this potential market failure. In *The Wealth of Nations* he wrote, “People of the same trade seldom meet together, but the conversation ends in a conspiracy against the public, or in some diversion to raise prices.”

To see a modern example of Smith’s observation, consider the following excerpt of a phone conversation between two airline executives in the early 1980s. The call was reported in the *New York Times* on February 24, 1983. Robert Crandall was president of American Airlines, and Howard Putnam was president of Braniff Airways, a major airline at the time.

CRANDALL: I think it’s dumb as hell . . . to sit here and pound the @#\$\$ out of each other and neither one of us making a #\$\$& dime.

PUTNAM: Do you have a suggestion for me?

CRANDALL: Yes, I have a suggestion for you. Raise your \$%*& fares 20 percent. I’ll raise mine the next morning.

PUTNAM: Robert, we . . .

CRANDALL: You’ll make more money, and I will, too.

PUTNAM: We can’t talk about pricing!

CRANDALL: Oh @#\$\$, Howard. We can talk about any &*#@ thing we want to talk about.

Putnam was right: The Sherman Antitrust Act prohibits competing executives from even talking about fixing prices. When Putnam gave a tape of this conversation to the Justice Department, the Justice Department filed suit against Crandall.

Two years later, Crandall and the Justice Department reached a settlement in which Crandall agreed to various restrictions on his business activities, including his contacts with officials at other airlines. The Justice Department said that the terms of settlement would “protect competition in the airline industry, by preventing American and Crandall from any further attempts to monopolize passenger airline service on any route through discussions with competitors about the prices of airline services.” ▲

17-3b Controversies over Antitrust Policy

Over time, much controversy has centered on what kinds of behavior the antitrust laws should prohibit. Most commentators agree that price-fixing agreements among competing firms should be illegal. Yet the antitrust laws have been used to condemn some business practices whose effects are not obvious. Here we consider three examples.

Resale Price Maintenance One example of a controversial business practice is *resale price maintenance*. Imagine that Superduper Electronics sells Blu-ray disc players to retail stores for \$100. If Superduper requires the retailers to charge customers \$150, it is said to engage in resale price maintenance. Any retailer that charged less than \$150 would violate its contract with Superduper.

At first, resale price maintenance might seem anticompetitive and, therefore, detrimental to society. Like an agreement among members of a cartel, it prevents the retailers from competing on price. For this reason, the courts have at times viewed resale price maintenance as a violation of the antitrust laws.

Yet some economists defend resale price maintenance on two grounds. First, they deny that it is aimed at reducing competition. To the extent that Superduper Electronics has any market power, it can exert that power through the wholesale price, rather than through resale price maintenance. Moreover, Superduper has no incentive to discourage competition among its retailers. Indeed, because a cartel of retailers sells less than a group of competitive retailers, Superduper would be worse off if its retailers were a cartel.

Second, economists believe that resale price maintenance has a legitimate goal. Superduper may want its retailers to provide customers a pleasant showroom and a knowledgeable sales force. Yet, without resale price maintenance, some customers would take advantage of one store's service to learn about the Blu-ray player's special features and then buy the item at a discount retailer that does not provide this service. To some extent, good service is a public good among the retailers that sell Superduper products. As we discussed in Chapter 11, when one person provides a public good, others are able to enjoy it without paying for it. In this case, discount retailers would free ride on the service provided by other retailers, leading to less service than is desirable. Resale price maintenance is one way for Superduper to solve this free-rider problem.

The example of resale price maintenance illustrates an important principle: *Business practices that appear to reduce competition may in fact have legitimate purposes.* This principle makes the application of the antitrust laws all the more difficult. The economists, lawyers, and judges in charge of enforcing these laws must determine what kinds of behavior public policy should prohibit as impeding competition and reducing economic well-being. Often that job is not easy.

Predatory Pricing Firms with market power normally use that power to raise prices above the competitive level. But should policymakers ever be concerned that firms with market power might charge prices that are too low? This question is at the heart of a second debate over antitrust policy.

Imagine that a large airline, call it Coyote Air, has a monopoly on some route. Then Roadrunner Express enters and takes 20 percent of the market, leaving Coyote with 80 percent. In response to this competition, Coyote starts slashing its fares. Some antitrust analysts argue that Coyote's move could be anticompetitive: The price cuts may be intended to drive Roadrunner out of the market so Coyote can recapture its monopoly and raise prices again. Such behavior is called *predatory pricing*.

Although predatory pricing is a common claim in antitrust suits, some economists are skeptical of this argument and believe that predatory pricing is rarely, if ever, a profitable business strategy. Why? For a price war to drive out a rival, prices have to be driven below cost. Yet if Coyote starts selling cheap tickets at a loss, it had better be ready to fly more planes, because low fares will attract more customers. Roadrunner, meanwhile, can respond to Coyote's predatory move by cutting back on flights. As a result, Coyote ends up bearing more than 80 percent of the losses, putting Roadrunner in a good position to survive the price war. As in the old Roadrunner–Coyote cartoons, the predator suffers more than the prey.

Economists continue to debate whether predatory pricing should be a concern for antitrust policymakers. Various questions remain unresolved. Is predatory pricing ever a profitable business strategy? If so, when? Are the courts capable of telling which price cuts are competitive and thus good for consumers and which are predatory? There are no simple answers.

Tying A third example of a controversial business practice is *tying*. Suppose that Makemoney Movies produces two new films—*The Avengers* and *Hamlet*. If Makemoney offers theaters the two films together at a single price, rather than separately, the studio is said to be tying its two products.

When the practice of tying movies was challenged, the Supreme Court banned it. The court reasoned as follows: Imagine that *The Avengers* is a blockbuster, whereas *Hamlet* is an unprofitable art film. Then the studio could use the high demand for *The Avengers* to force theaters to buy *Hamlet*. It seemed that the studio could use tying as a mechanism for expanding its market power.

Many economists are skeptical of this argument. Imagine that theaters are willing to pay \$20,000 for *The Avengers* and nothing for *Hamlet*. Then the most that a theater would pay for the two movies together is \$20,000—the same as it would pay for *The Avengers* by itself. Forcing the theater to accept a worthless movie as part of the deal does not increase the theater's willingness to pay. Makemoney cannot increase its market power simply by bundling the two movies together.

Why, then, does tying exist? One possibility is that it is a form of price discrimination. Suppose there are two theaters. City Theater is willing to pay \$15,000 for *The Avengers* and \$5,000 for *Hamlet*. Country Theater is just the opposite: It is willing to pay \$5,000 for *The Avengers* and \$15,000 for *Hamlet*. If Makemoney charges separate prices for the two films, its best strategy is to charge \$15,000 for each film, and each theater chooses to show only one film. Yet if Makemoney offers the two movies as a bundle, it can charge each theater \$20,000 for the movies. Thus, if different theaters value the films differently, tying may allow the studio to increase profit by charging a combined price closer to the buyers' total willingness to pay.

Tying remains a controversial business practice. The Supreme Court's argument that tying allows a firm to extend its market power to other goods is not well founded, at least in its simplest form. Yet economists have proposed more elaborate theories for how tying can impede competition. Given our current economic knowledge, it is unclear whether tying has adverse effects for society as a whole.

case study

The Microsoft Case

The most important and controversial antitrust case in recent years has been the U.S. government's suit against the Microsoft Corporation, filed in 1998. Certainly, the case did not lack drama. It pitted one of the world's richest men (Bill Gates) against one of the world's most powerful regulatory agencies (the U.S. Justice Department). Testifying for the government was a prominent economist (MIT professor Franklin Fisher). Testifying for Microsoft was an equally prominent economist (MIT professor Richard Schmalensee). At stake was the future of one of the world's most valuable companies (Microsoft) in one of the economy's fastest-growing industries (computer software).

A central issue in the Microsoft case involved tying—in particular, whether Microsoft should be allowed to integrate its Internet browser into its Windows

operating system. The government claimed that Microsoft was bundling these two products together to expand its market power in computer operating systems into the unrelated market of Internet browsers. Allowing Microsoft to incorporate such products into its operating system, the government argued, would deter other software companies from entering the market and offering new products.

Microsoft responded by pointing out that putting new features into old products is a natural part of technological progress. Cars today include CD players and air conditioners, which were once sold separately, and cameras come with built-in flashes. The same is true with operating systems. Over time, Microsoft has added many features to Windows that were previously stand-alone products. This has made computers more reliable and easier to use because consumers can be confident that the pieces work together. The integration of Internet technology, Microsoft argued, was the natural next step.

One point of disagreement concerned the extent of Microsoft's market power. Noting that more than 80 percent of new personal computers used a Microsoft operating system, the government argued that the company had substantial monopoly power, which it was trying to expand. Microsoft replied that the software market is always changing and that Microsoft's Windows was constantly being challenged by competitors, such as the Apple Mac and Linux operating systems. It also argued that the low price it charged for Windows—about \$50, or only 3 percent of the price of a typical computer—was evidence that its market power was severely limited.

Like many large antitrust suits, the Microsoft case became a legal morass. In November 1999, after a long trial, Judge Penfield Jackson ruled that Microsoft had great monopoly power and that it had illegally abused that power. In June 2000, after hearings on possible remedies, he ordered that Microsoft be broken up into two companies—one that sold the operating system and one that sold applications software. A year later, an appeals court overturned Jackson's breakup order and handed the case to a new judge. In September 2001, the Justice Department announced that it no longer sought a breakup of the company and wanted to settle the case quickly.

A settlement was finally reached in November 2002. Microsoft accepted some restrictions on its business practices, and the government accepted that a browser would remain part of the Windows operating system. But the settlement did not end Microsoft's antitrust troubles. In recent years, the company has contended with several private antitrust suits, as well as suits brought by the European Union alleging a variety of anticompetitive behaviors. ▲



AP Photo/Laura Rauch

"Me? A monopolist? Now just wait a minute . . ."

Quick Quiz What kind of agreement is illegal for businesses to make? * Why are the antitrust laws controversial?

17-4 Conclusion

Oligopolies would like to act like monopolies, but self-interest drives them toward competition. Where oligopolies end up on this spectrum depends on the number of firms in the oligopoly and how cooperative the firms are. The story of the prisoners' dilemma shows why oligopolies can fail to maintain cooperation, even when cooperation is in their best interest.

IN THE NEWS

Should the N.C.A.A.
Be Taken to Court?

Colleges and universities regularly meet to discuss the deals they offer student athletes. This op-ed questions whether this coordination might violate the antitrust laws.

The College Sports
Cartel

By Joe Nocera

Twice a year in Vienna, the members of the Organization of Petroleum Exporting Countries gather to decide on the short-term direction of oil prices. Sometimes, O.P.E.C. agrees to cut back on oil production, pushing up the price of oil. Other times, it decides to boost production. Always, the goal is to fix the price of oil, rather than allow it to be set by the competitive marketplace. Indeed, collusion and price-fixing are the main reasons cartels exist—and why they are illegal in America.

Yet, in Indianapolis a few weeks from now, a home-grown cartel will hold its annual meeting, where it, too, will be working to collude and fix prices. This cartel is the National Collegiate Athletic Association. The N.C.A.A. would have you believe that it is the great protector of amateur athletics, preventing college athletes from being tainted by the river of money pouring over college sports.

In fact, the N.C.A.A.'s real role is to oversee the collusion of university athletic departments, whose goal is to maximize revenue and suppress the wages of its captive labor force, aka the players. . . .

Sports leagues can't exist without at least some collusion. As Andy Schwarz, an economist and litigation consultant, puts it, "If steel companies got together to decide when and where to produce steel, that would violate the antitrust laws. But if sports teams in a league get together to decide when and where to play games, that's generally allowed." Major League Baseball has long had an antitrust exemption; other professional leagues have salary caps, which are legal because they have been agreed to by the players.

The N.C.A.A. has neither an antitrust exemption nor a player's union to negotiate with. In other words, it lacks some of the legal protections that shield professional sports from antitrust suits. What it has, instead, is a work force full of young adults dreaming of becoming pros and willing to sign any document, no matter how onerous, if it will help them reach that goal. The document the N.C.A.A. forces them to

sign completely stacks the deck against them.

Recently, Mark Emmert, the president of the N.C.A.A., tried to make the rules a tad less onerous. He got the N.C.A.A. board of directors to approve an optional \$2,000 stipend

as well as a four-year scholarship instead of the current one-year deal for players.

And how did the cartel react to these modest changes? It rose up in revolt. Enough universities signed an override petition to temporarily ice the new stipend. The same thing happened with the four-year scholarship.

A lawyer in Fort Worth, Christian Dennie, who specializes in sports law, got ahold of an internal N.C.A.A. document outlining some of the objections. One is especially worth repeating: "The new coach may have a completely different style of offense/defense that the student athlete no longer fits into," wrote Indiana State. Four-year scholarships might mean that the school would be stuck with "someone that is of no 'athletic' usefulness to the program." Thus does at least one school show how it truly views its "student athletes." . . .

How can it be that the N.C.A.A. can define amateurism in one moment as allowing a \$2,000 stipend and in the next moment as forbidding such a stipend? How can it justify rolling back a change that would truly help student athletes, such as the four-year scholarship, simply because coaches want to continue to have life-or-death power over their charges? How can the labor force that generates so much money for everyone else be kept in shackles by the N.C.A.A.?

The N.C.A.A. claims it has the legal right to do all the above and more. And maybe it does. But it certainly would be worthwhile to see someone challenge its cartel behavior in court. The inevitable rollback of the \$2,000 stipend and the four-year scholarship would be an awfully good place to start. ▲

Source: *New York Times*, December 31, 2011.



Getty Images

Victims of a cartel?

Policymakers regulate the behavior of oligopolists through the antitrust laws. The proper scope of these laws is the subject of ongoing controversy. Although price fixing among competing firms clearly reduces economic welfare and should be illegal, some business practices that appear to reduce competition may have legitimate if subtle purposes. As a result, policymakers need to be careful when they use the substantial powers of the antitrust laws to place limits on firm behavior.

Summary

- Oligopolists maximize their total profits by forming a cartel and acting like a monopolist. Yet, if oligopolists make decisions about production levels individually, the result is a greater quantity and a lower price than under the monopoly outcome. The larger the number of firms in the oligopoly, the closer the quantity and price will be to the levels that would prevail under perfect competition.
- The prisoners' dilemma shows that self-interest can prevent people from maintaining cooperation, even when cooperation is in their mutual interest. The logic of the prisoners' dilemma applies in many situations, including arms races, common-resource problems, and oligopolies.
- Policymakers use the antitrust laws to prevent oligopolies from engaging in behavior that reduces competition. The application of these laws can be controversial, because some behavior that can appear to reduce competition may in fact have legitimate business purposes.

Key Concepts

oligopoly, <i>p.</i> 347	cartel, <i>p.</i> 349	dominant strategy, <i>p.</i> 354
game theory, <i>p.</i> 348	Nash equilibrium, <i>p.</i> 351	
collusion, <i>p.</i> 349	prisoners' dilemma, <i>p.</i> 353	

Questions for Review

1. If a group of sellers could form a cartel, what quantity and price would they try to set?
2. Compare the quantity and price of an oligopoly to those of a monopoly.
3. Compare the quantity and price of an oligopoly to those of a competitive market.
4. How does the number of firms in an oligopoly affect the outcome in its market?
5. What is the prisoners' dilemma, and what does it have to do with oligopoly?
6. Give two examples other than oligopoly that show how the prisoners' dilemma helps to explain behavior.
7. What kinds of behavior do the antitrust laws prohibit?

Quick Check Multiple Choice

1. The key feature of an oligopolistic market is that
 - a. each firm produces a different product from other firms.
 - b. a single firm chooses a point on the market demand curve.
 - c. each firm takes the market price as given.
 - d. a small number of firms are acting strategically.
2. If an oligopolistic industry organizes itself as a cooperative cartel, it will produce a quantity of output that is _____ the competitive level and _____ the monopoly level.
 - a. less than, more than
 - b. more than, less than
 - c. less than, equal to
 - d. equal to, more than

3. If an oligopoly does not cooperate and each firm chooses its own quantity, the industry will produce a quantity of output that is _____ the competitive level and _____ the monopoly level.
 - a. less than, more than
 - b. more than, less than
 - c. less than, equal to
 - d. equal to, more than
4. As the number of firms in an oligopoly grows large, the industry approaches a level of output that is _____ the competitive level and _____ the monopoly level.
 - a. less than, more than
 - b. more than, less than
 - c. less than, equal to
 - d. equal to, more than
5. The prisoners' dilemma is a two-person game illustrating that
 - a. the cooperative outcome could be worse for both people than the Nash equilibrium.
 - b. even if the cooperative outcome is better than the Nash equilibrium for one person, it might be worse for the other.
 - c. even if cooperation is better than the Nash equilibrium, each person might have an incentive not to cooperate.
 - d. rational, self-interested individuals will naturally avoid the Nash equilibrium because it is worse for both of them.
6. The antitrust laws aim to
 - a. facilitate cooperation among firms in oligopolistic industries.
 - b. encourage mergers to take advantage of economies of scale.
 - c. discourage firms from moving production facilities overseas.
 - d. prevent firms from acting in ways that reduce competition.

Problems and Applications

1. A large share of the world supply of diamonds comes from Russia and South Africa. Suppose that the marginal cost of mining diamonds is constant at \$1,000 per diamond and the demand for diamonds is described by the following schedule:

Price	Quantity
\$8,000	5,000 diamonds
7,000	6,000
6,000	7,000
5,000	8,000
4,000	9,000
3,000	10,000
2,000	11,000
1,000	12,000

 - a. If there were many suppliers of diamonds, what would be the price and quantity?
 - b. If there were only one supplier of diamonds, what would be the price and quantity?
 - c. If Russia and South Africa formed a cartel, what would be the price and quantity? If the countries split the market evenly, what would be South Africa's production and profit? What would happen to South Africa's profit if it increased its production by \$1,000 while Russia stuck to the cartel agreement?
 - d. Use your answers to part (c) to explain why cartel agreements are often not successful.
2. The *New York Times* (Nov. 30, 1993) reported that "the inability of OPEC to agree last week to cut production has sent the oil market into turmoil . . . [leading to] the lowest price for domestic crude oil since June 1990."
 - a. Why were the members of OPEC trying to agree to cut production?
 - b. Why do you suppose OPEC was unable to agree on cutting production? Why did the oil market go into "turmoil" as a result?
 - c. The newspaper also noted OPEC's view "that producing nations outside the organization, like Norway and Britain, should do their share and cut production." What does the phrase "do their share" suggest about OPEC's desired relationship with Norway and Britain?
3. This chapter discusses companies that are oligopolists in the market for the goods they sell. Many of the same ideas apply to companies that are oligopolists in the market for the inputs they buy.
 - a. If sellers who are oligopolists try to increase the price of goods they sell, what is the goal of buyers who are oligopolists?
 - b. Major league baseball team owners have an oligopoly in the market for baseball players. What is the owners' goal regarding players' salaries? Why is this goal difficult to achieve?
 - c. Baseball players went on strike in 1994 because they would not accept the salary cap that the owners wanted to impose. If the owners were already colluding over salaries, why did they feel the need for a salary cap?

4. Consider trade relations between the United States and Mexico. Assume that the leaders of the two countries believe the payoffs to alternative trade policies are as follows:

		United States' Decision	
		Low Tariffs	High Tariffs
Mexico's Decision	Low Tariffs	U.S. gains \$25 billion Mexico gains \$25 billion	U.S. gains \$30 billion Mexico gains \$10 billion
	High Tariffs	U.S. gains \$10 billion Mexico gains \$30 billion	U.S. gains \$20 billion Mexico gains \$20 billion

- What is the dominant strategy for the United States? For Mexico? Explain.
 - Define *Nash equilibrium*. What is the Nash equilibrium for trade policy?
 - In 1993, the U.S. Congress ratified the North American Free Trade Agreement, in which the United States and Mexico agreed to reduce trade barriers simultaneously. Do the perceived payoffs shown here justify this approach to trade policy? Explain.
 - Based on your understanding of the gains from trade (discussed in Chapters 3 and 9), do you think that these payoffs actually reflect a nation's welfare under the four possible outcomes?
5. Synergy and Dynaco are the only two firms in a specific high-tech industry. They face the following payoff matrix as they decide upon the size of their research budget:

		Synergy's Decision	
		Large Budget	Small Budget
Dynaco's Decision	Large Budget	Synergy gains \$20 million Dynaco gains \$30 million	Synergy gains zero Dynaco gains \$70 million
	Small Budget	Synergy gains \$30 million Dynaco gains zero	Synergy gains \$40 million Dynaco gains \$50 million

- Does Synergy have a dominant strategy? Explain.
 - Does Dynaco have a dominant strategy? Explain.
 - Is there a Nash equilibrium for this scenario? Explain. (*Hint*: Look closely at the definition of Nash equilibrium.)
6. You and a classmate are assigned a project on which you will receive one combined grade. You each want to receive a good grade, but you also want to avoid hard work. In particular, here is the situation:
- If both of you work hard, you both get an A, which gives each of you 40 units of happiness.

- If only one of you works hard, you both get a B, which gives each of you 30 units of happiness.
 - If neither of you works hard, you both get a D, which gives each of you 10 units of happiness.
 - Working hard costs 25 units of happiness.
- a. Fill in the payoffs in the following decision box:

		Your Decision	
		Work	Shirk
Classmate's Decision	Work	You: Classmate:	You: Classmate:
	Shirk	You: Classmate:	You: Classmate:

- What is the likely outcome? Explain your answer.
 - If you get this classmate as your partner on a series of projects throughout the year, rather than only once, how might that change the outcome you predicted in part (b)?
 - Another classmate cares more about good grades: She gets 50 units of happiness for a B, and 80 units of happiness for an A. If this classmate were your partner (but your preferences were unchanged), how would your answers to parts (a) and (b) change? Which of the two classmates would you prefer as a partner? Would she also want you as a partner?
7. A case study in the chapter describes a phone conversation between the presidents of American Airlines and Braniff Airways. Let's analyze the game between the two companies. Suppose that each company can charge either a high price for tickets or a low price. If one company charges \$300, it earns low profit if the other company also charges \$300 and high profit if the other company charges \$600. On the other hand, if the company charges \$600, it earns very low profit if the other company charges \$300 and medium profit if the other company also charges \$600.
- Draw the decision box for this game.
 - What is the Nash equilibrium in this game? Explain.
 - Is there an outcome that would be better than the Nash equilibrium for both airlines? How could it be achieved? Who would lose if it were achieved?
8. Two athletes of equal ability are competing for a prize of \$10,000. Each is deciding whether to take a dangerous performance-enhancing drug. If one athlete takes the drug, and the other does not, the one who takes the drug wins the prize. If both or neither take the drug, they tie and split the prize. Taking the drug imposes health risks that are equivalent to a loss of X dollars.
- Draw a 2×2 payoff matrix describing the decisions the athletes face.

- b. For what X is taking the drug the Nash equilibrium?
 - c. Does making the drug safer (that is, lowering X) make the athletes better or worse off? Explain.
9. Little Kona is a small coffee company that is considering entering a market dominated by Big Brew. Each company's profit depends on whether Little Kona enters and whether Big Brew sets a high price or a low price:

		Big Brew	
		High Price	Low Price
Little Kona	Enter	Brew makes \$3 million Kona makes \$2 million	Brew makes \$1 million Kona loses \$1 million
	Don't Enter	Brew makes \$7 million Kona makes zero	Brew makes \$2 million Kona makes zero

- a. Does either player in this game have a dominant strategy?
- b. Does your answer to part (a) help you figure out what the other player should do? What is the Nash equilibrium? Is there only one?
- c. Big Brew threatens Little Kona by saying, "If you enter, we're going to set a low price, so you had better stay out." Do you think Little Kona should believe the threat? Why or why not?
- d. If the two firms could collude and agree on how to split the total profits, what outcome would they pick?

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