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Oligopoly and Strategic Behavior

ECO 304K: Introduction to Microeconomics

Cell Phone companies are competitive

The cell phone industry has features of both competition and monopoly: competition is fierce, but smaller firms and potential entrants into the market find it difficult to enter and compete. This mixture of characteristics represents another form of market structure—**oligopoly**. In this chapter, we examine oligopoly by comparing it with other market structures already familiar; we then look at some of the strategic behaviors firms in an oligopoly employ, an examination that leads us into the fascinating topic of game theory.

Big Questions

- What is oligopoly?
 - Oligopoly is a type of market structure that exists when a small number of firms sell a differentiated product in a market with significant barriers to entry. An oligopolist is like a monopolistic competitor in that it sells differentiated products; it is like a monopolist in that it enjoys significant barriers to entry. The small number of sellers in oligopoly leads to mutual interdependence.
 - Oligopolists have a tendency to collude and to form cartels in the hope of achieving monopoly-like profits.
 - Oligopolistic markets are socially inefficient because price and marginal cost are not equal. The result under oligopoly falls somewhere between the competitive market and monopoly outcomes.
- How does game theory explain strategic behavior?
 - Game theory helps to determine when cooperation among oligopolists is most likely to occur; in many cases, cooperation fails to occur because decision-makers have dominant strategies that lead them to be uncooperative. As a result, firms compete with price or advertising when they could potentially earn more profit by curtailing these activities.

- Games become more complicated when they are played multiple times, so short-run dominant strategies often disappear. Whenever repeated interaction occurs, decision-makers fare better under tit-for-tat, an approach that maximizes the long-run profit.
- How do government policies affect oligopoly behavior?
 - Antitrust law is complex, and cases are hard to persecute; nevertheless, these laws are essential in providing oligopolistic firms an incentive to compete rather than collude.
 - Antitrust policy limits price discrimination, exclusive dealings, tying arrangements, mergers and acquisitions that limit competition, and predatory pricing.
- What are network externalities?
 - A network externality occurs when the number of customers who purchase or use a good influences the quantity demanded. The presence of significant positive network externalities can cause small firms to go out of business.

What is Oligopoly?

Oligopoly is a form of market structure that exists when a small number of firms sell a product in a market with significant barriers to entry. An oligopolist is like a monopolistic competitor in that it often sells a differentiated product; but like pure monopolists, oligopolists enjoy significant barriers to entry. **Table 13.1** compares the differences and similarities between the four market structures.

Table 13.1

Comparing Oligopoly to other market structures			
Competitive Market	Monopolistic competition	Oligopoly	Monopoly
Many sellers	Many sellers	A few sellers	One seller
Similar products	Differentiated product	Differentiated product (most of the time)	Unique product without close substitutes
Free entry and exit	Easy entry and exit	Barriers to entry	Significant barriers to entry

We have seen that firms monopolistically competitive markets usually have a limited amount of market power. As a result, buyers often find low prices (but not as low as competitive markets) and wide availability. In contrast, an oligopolist sells in a market with significant barriers to entry and fewer rivals. Thus, the oligopolist has more market

power than a firm operating under monopolistic competition. However, because an oligopolist has as much market power as a monopolist.

Our study of oligopoly begins with a look at how economists measure market power in an industry; we then work through a simplified model of oligopoly to explore the choice that oligopolists make.

Measuring the concentration of industries

In markets with only a few sellers, industry output is highly concentrated among a few large firms. Economists use **concentration ratios** as a measure of the oligopoly power present in an industry; the most common measure, known as the four-firm concentration ratio, expresses the sales of the four largest firms in an industry as a percentage of that industry's total sales. The ratio is determined by taking the output of the four largest firms in an industry and dividing that output by the total production in the entire industry.

Collusion and Cartels in a Simple Duopoly Example

In this section, we explore the two conflicting tendencies found in oligopoly: oligopolists would like to act like monopolists, but they often end up competing like monopolistic competitors. To help us understand oligopoly behavior, we start with a simplified example: an industry consisting of only two firms, known as a **duopoly**. Duopolies (such as Boeing and Airbus in the wide-body jet) are rare in national and international markets, but not that uncommon in small, local markets. With **Table 13.3** as our guide, we will examine the output in this market under three different scenarios: competition, monopoly, and duopoly.

Duopoly sits between the two extremes; competition still exists, but is not as extensive as you would see in competitive markets, which ruthlessly drive the price down to cost. Nor does the result always mirror that of monopoly, where competitive pressures are completely absent. In an oligopoly, a small number of firms feel competitive pressures and also enjoy some of the advantages of monopoly.

Competitive Outcome

Recall that competitive markets drive the prices down to the point at which marginal revenue is equal to the marginal cost; because these firms are in business to make money, they will not provide something for nothing.

Monopoly Outcome

At the other extreme of the market structure continuum, a monopolist faces no competition, and price decisions do not depend on the activity of other firms. A

monopolist can search for the price that brings in the most profit. Compared with a competitive market, the monopoly price is higher and the quantity sold is lower; the result is a loss of efficiency.

Duopoly Outcome

In a duopoly, the two firms can decide to cooperate—even though this practice is illegal in the United States, as we will discuss shortly. If the duopolist cooperate, we say that they collude. **Collusion** is an agreement between rival firms that specifies the price each firm charges and the quantity it produces; the firms that collude can act like a single monopolist to maximize their profits.

When two or more firms act in unison, economists refer to them as a **cartel**.

Many countries prohibit cartels; in the United States, **antitrust laws** prohibit collusion. However, even if collusion were legal, it would probably fail more often than not.

From what we know about competitive markets, we might expect the competition between the two firms to cause a price war in which price eventually falls to zero. Duopolists are unlikely to participate in an all-out price war because both firms would no longer be making any profit, but we cannot know to what extent competitive pressures will determine each firm's decision. We see that a market with a small number of sellers is characterized by **mutual interdependence**, which is a market situation in which the actions of one firm have an impact on the price and output of its competitors. As a result, a firm's market share is determined by the products it offers, the price it charges, and the actions of its rivals.

Oligopolists want to emulate the monopoly outcome, but the push to compete with their rivals often makes it difficult to maintain a cartel. Yet the idea that cartels are unstable is not guaranteed. When a stable cartel is not achieved, firms in oligopoly fall short of fully maximizing profits; but they also do not compete to the same degree as firms in competitive markets. Therefore, when a market is an oligopoly, output is likely to be higher than under a monopoly and lower than within a competitive market. As you would expect, the amount of output affects the prices; the higher output (compared with monopoly) makes oligopoly prices generally lower than monopoly prices, and lower output (compared with a competitive market) makes oligopoly prices higher than those found in competitive markets.

In many industries, smaller firms may take a cue from the decisions made by the price leader. **Price leadership** occurs when a single firm, known as the price leader, produces a larger share of the total output in the industry. The price leader sets the price and the output level that maximizes its own profits. Smaller firms then set their prices to match the price leader; because the impact on the price is small to begin with, it makes sense that smaller rivals tend to follow the price leader.

Price leadership is not illegal because it does not involve collusion; rather, it relies on an understanding that an effort to resist changes implemented by the price leader will lead to both increased price competition and lower profits for every firm in the industry; because the firms act in accordance with one another, this practice is commonly known as **tacit collusion**.

Oligopoly with more than two firms

We have seen how firms behave in a duopoly; what happens when more firms enter the market? The additional of a third firm complicates efforts to maintain a cartel and increases the possibility of a more competitive result.

This is a **price effect**, and it reflects how a change in price affects the firm's revenue. When the firm sells an additional unit, it generates additional revenues for the firm; this **output effect** occurs when a change in price affects the number of customers in a market.

The price effect and output effect make it difficult to maintain a cartel when there are more than two firms. Generally, as the number of firms grow, each individual firm becomes less concerned about its impact on the overall price, because any price above marginal cost creates a profit. Therefore, individual firms are more willing to lower prices because doing so creates a large output effect for the individual firm and only a small price effect in the market.

Of course, not all firms are the same size, therefore, smaller and larger firms in an oligopolistic market react differently to the price and output effects. Increased output at smaller firms will have a negligible impact on overall prices because smaller firms represent only a tiny fraction of the market supply; but the same is not true for firms with a large market share. Decisions at these firms will have a substantial impact on price and output because the overall amount supplied in the market will change appreciably...in other words, in an oligopoly, the decisions of one firm directly affect other firms.

How does Game Theory explain strategic behavior?

Decision-making under oligopoly can be complex; **game theory** is a branch of mathematics that economists use to analyze the strategic behavior of decision-makers who have to consider the behavior of others around them. In particular, game theory can help us determine what level of cooperation is most likely to occur; a game consists of a set of players, a set of strategies available to those players, and specification of the payoffs for each combination of strategies. The game is usually represented by a payoff matrix that shows the players, strategies, and payoffs; it is presumed that each player acts simultaneously or without knowing the actions of the other.

In this section, we will learn about the prisoner's dilemma, an example from game theory that helps us understand how dominant strategies often frame short-run decisions. (In its simplest form, the prisoner's dilemma is a game played just once, not

repeatedly over time.) We will use the idea of the dominant strategy to explain why oligopolists often choose to advertise. Finally, we will come full circle and argue that the dominant strategy in a game may be overcome in the long run, through repeated interactions.

Strategic Behavior and Dominant Strategy

We have seen that in oligopoly there is mutual interdependence: rival's business choices affect the earnings the other rivals can expect to make. To learn more about the decisions firms make, we will explore a fundamental problem in game theory known as **prisoner's dilemma**.

The scenario goes like this: two prisoners are being interrogated separately about a crime they both participated in, and each is offered a plea bargain to cooperate with the authorities by testifying against each other. If both suspects refuse to cooperate with the authorities, neither can be convicted of a more serious crime, though they will both have to spend more time in jail; but the police have offered full immunity if one cooperates and the other does not. This means that each suspect has an incentive to betray the other. The problem is that if they both confess, they will spend more time in jail than if they had both stayed quiet; when decision-makers face incentives that make it difficult to achieve mutually beneficial outcomes, we say they are in a **prisoner's dilemma**. This situation makes the payoff for cooperating with the authorities more attractive than the result of keeping quiet.

We can understand the outcomes of the prisoner's dilemma by looking at the payoff matrix in Figure 13.1.

When a player always prefers one strategy, regardless of what his opponent chooses, we say it is a **dominant strategy**. We can see a dominant strategy at work in the case of our two suspects; they know that if they both keep quiet, they will spend one year in jail. The dilemma occurs because both suspects are more likely to testify and get 10 years in jail. The choice to testify is obvious for two reasons; **first**, neither suspect can monitor the actions of the other after they are separated. **Second**, once each suspect understands that his partner will save jail time if he testifies, he realizes that the incentives are not in favor of keeping quiet.

The dominant strategy in our example is also a Nash equilibrium, named for mathematician John Nash. A **Nash equilibrium** occurs when all economic decision-makers have no incentive to change their current decision; if each

suspect reasons that the other will testify, the best response is also to testify. Each suspect may wish that he and his partner could coordinate their actions and agree to keep quiet. However, without possibility of coordination, neither has an incentive to withhold testimony; so they both think strategically and decide to testify.

Duopoly and the Prisoner's Dilemma

The prisoner's dilemma example suggests that cooperation can be difficult to achieve; what this means for oligopoly is that it is not natural or easy for firms to collude. This is the prisoner's dilemma: each firm has an incentive to lower its price to generate more revenue than if they had colluded and kept prices high, but acting on this incentive causes them both to earn less revenue than if they had kept prices high.

Advertising and Game Theory

We have seen that oligopolists function like monopolistic competitors in that they sell differentiated products. We know that advertising is commonplace in markets with a differentiated product; in the case of an oligopoly, mutual interdependence means that advertising can create a contest between firms trying to gain customers. The result may be skyrocketing advertising budgets and little, or no, net gain of customers. Therefore, oligopolists have an incentive to scale back advertising, but only if their rivals also agree to scale back. Like all cooperative action among competitors, this is easier said than done.

This dilemma is that each firm needs to advertise to market its product and retain its customer base, but most advertising expenditures end up canceling each other out and costing the companies millions of dollars.

Escaping the Prisoner's Dilemma in the long run

We have seen how game theory can be a useful tool for understanding strategic decision-making in noncooperative environments. However, the dominant strategy does not consider the possible long-run benefits of cooperation.

Game theorist Robert Axelrod decided to examine the choices participants make in the long-run setting; he ran a sophisticated computer simulation in which he invited scholars to submit strategies for securing points in a prisoner's dilemma tournament over many rounds. All the submission were collected and paired, and the results were scored; After each simulation, Axelrod eliminated the weakest strategy and reran the tournament with the remaining strategies.

This evolutionary approach continued until the best strategy remained; among all strategies, including those that were solely cooperative or noncooperative, tit-for-tat dominated. **Tit-for-tat** is a long-run strategy that promotes cooperation among participants by mimicking the opponent's more recent decision with repayment in kind. As the name implies, a tit-for-tat strategy is one in which you do whatever your opponent does. If your opponent breaks the agreement, you break the agreement, too. If the opponent behave properly, then you behave properly, too.

Because the joint payoffs for cooperation are high in a prisoner's dilemma, tit-for-tat begins with the players cooperating. In subsequent rounds, the tit-for-tat strategy mimics whatever the other player did in the previous round. The genius behind tit-for-tat is that it changes the incentives and encourages cooperation.

The prisoner's dilemma nicely captures why cooperation is so difficult in the short run, but most interactions in life occur over the long run. For example, scam artists and sketchy companies take advantage of short-run opportunities that cannot last because relationships in the long run—with businesses and with people—involve mutual trust. Cooperation is the default because you know that the other side is invested in the relationship; under these circumstances, the tit-for-tat strategy works well.

Sequential Games

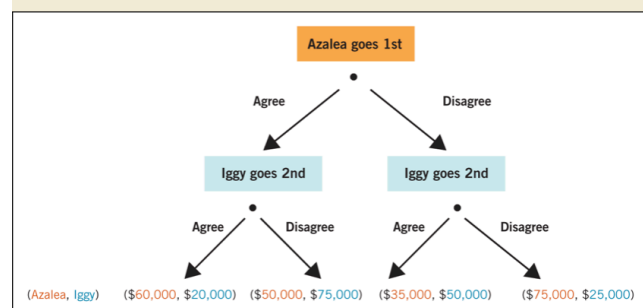
Not all games involve simultaneous decisions; sometimes one player must move first and then the other player responds to the first move. In this case it is possible for the first player to utilize **backward induction** to get the best possible result. Backward induction in game theory is the process of deducing backward from the end of a scenario to infer a sequence of optimal actions.

However, if we let one player go first, the game has a predictable conclusion; to see this process at work, look at Figure 13.5. This type of diagram is known as **decision tree**; it illustrates all of the possible outcomes.

FIGURE 13.5

Decision Tree for a Sequential Game

Azalea will agree, knowing that Iggy will disagree. This game guarantees Azalea \$50,000 and Iggy \$75,000.



There are many examples of sequential games in life; chess and checkers are two popular board games that utilize backward induction. Likewise, many businesses decisions are also sequential in nature, and once a particular path is taken, it becomes easier to predict how future decisions will unfold. For instance, when a firm decide to launch a new advertising campaign, it is easier for the firm to predict how a rival will react by examining the remaining choices along a decision tree.

A caution about game theory

Game theory is a decision-making tool, but not all games have dominant strategies that make players decisions easy to predict. The preferred choice is strictly a function of what the other player selects; winning at business in the long run often occurs because you are one step ahead of the competition, not because you deploy strategy that attempts to take advantage of a short-run opportunity.

How do government policies affect oligopoly behavior?

When oligopolists in an industry form a cooperative alliance, they function like a monopoly. Competition disappears, which is not good for society; one way to improve the social welfare of society is to restore competition and limit monopoly practice through policy legislation.

Antitrust policy

Efforts to curtail the adverse consequences of oligopolistic cooperation began in the **Sherman Antitrust Act of 1890**, the first federal law to place limits on cartels and monopolies. The Sherman Act was created in response to the increase in concentration ratios in many leading U.S industries, including steel, railroads, mining, textiles, and oil. Prior to the passage of the Sherman Act, firms were free to pursue contracts that created mutually beneficial outcomes; once the act took effect, however, certain cooperative actions became criminal. Section 2 of the Sherman Act reads, “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 felony.”

The **Clayton Act of 1914** targets corporate behaviors that reduce competition. Large corporations had been vilified during the presidential election of 1912, and

the Sherman Act was seen as largely ineffective in curbing monopoly power. To strengthen antitrust policy, the Clayton Act added to the list of activities deemed socially detrimental, including:

1. *Price discrimination*

1. If it lessens competition or creates monopoly

2. *Exclusive dealings*

1. That restrict a buyer's ability to deal with competitors

3. *Tying arrangements*

1. That requires the buyer to purchase an additional product in order to purchase it the first.

4. *Mergers and acquisitions*

1. That lessen competition, or situations in which a person serves as a director on more than one board in the same industry.

As the Clayton Act makes clear, there are many ways to reduce competition

Over the past hundred years, lawmakers have continued to refine antitrust policy; additional legislation along with court interpretations of existing antitrust law have made it difficult to determine whether a company has violated the law. The U.S Justice Department is charged with oversight, but it often lacks the resources to fully investigate every case; antitrust law is complex, and cases are hard to prosecute, but these laws are essential to maintaining a competitive business environment. Without effective restraints on excessive market power, firms would organize into cartels more often or would find other ways to restrict competition.

Predatory Pricing

While firms have a strong incentive to cooperate in order to keep prices high, they also want to keep potential rivals out of the market. **Predatory pricing** is the practice of setting prices deliberately below average variable costs with the intent of driving rivals out of the market; the short-run loss in order to prevent rivals from entering the market or to drive rival firms out of business in the long run. Once the rivals are gone, the firm should be able to act like a monopolist.

Predatory pricing is illegal, but difficult to prosecute; neither the court system or economists have a simple rule that helps to determine when a firm steps over the line; predatory pricing can look and feel like spirited competition. Moreover, the concern is not the competitive aspect or lower prices, but the effect on the market when all rivals fail. To prove that predatory pricing has occurred, the courts need evidence that firm's prices increased significantly after its rivals failed.

What are network externalities?

We end this chapter by considering a special kind of externality that often occurs in oligopoly. A **network externality** occurs when the number of customers who purchase or use a good influence the demand. When a network externality exists, firms with many customers often find it easier to attract new customers and to keep their regular customers from switching to other rivals.

Most network externalities involve the introduction of new technologies. For instance, some technologies need to reach a critical mass before consumers can effectively use them.

In addition to the advantages of forming a larger network, customers may face significant switching costs if they leave. **Switching costs** are the costs incurred when a consumer changes from one supplier to another. When consumers face switching costs, the demand for the existing product becomes more inelastic; as a result, oligopolists not only leverage the number of customers they maintain in their network, but also try to make switching to another network more difficult. For instance, firms promote customer loyalty through frequent flier benefits, hotel reward points, and credit card reward programs to create higher switching costs.

Oligopolists are keenly aware of the power of network externalities; as new markets develop, the first firm into an industry often gains a large customer base. When there are positive network externalities, the customer base enables the firm to grow quickly. In addition, consumers are often more comfortable purchasing from an established firm; these two factors favor the formation of large firms and make it difficult for smaller competitors to gain customers. As a result, the presence of significant positive network externalities causes small firms to be driven out of business or force them to merge with larger competitors.

Conclusion

Firms in oligopoly markets can compete or collude to create monopoly conditions; the result is often hard to predict. In many cases, the presence of a dominant short-run

strategy causes firms to compete on price and advertising even though doing so yields a lower economic profit. In contrast, the potential success for a tit-for-tat strategy suggests that oligopolistic firms are capable of cooperating to jointly maximize their long-run profits. Whether oligopoly mirrors the result found in monopolistic competition or monopoly matters a great deal because society's welfare is higher when more competition is present; because oligopoly is not a market structure with a predictable outcome, each oligopolistic industry must be assessed on a case-by-case basis by examining data and utilizing game theory. For these reasons, the study of oligopoly is one of the most fascinating parts of the theory of the firm.