

## Oligopoly

November 7, 2006

Reading: Chapter 15

Examine markets with a few sellers. There are many models of oligopoly: difficult to say which one is the best. We briefly discuss a few. We also examine game theory which is relevant in many spheres of life where strategic considerations are involved. Also discuss anti-trust policy in more detail.

## Oligopoly

- Oligopoly and its prevalence
- Understanding oligopoly
- Game theory
- Kinked demand and price rigidity
- Oligopoly in practice

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## Oligopoly and its prevalence

**Oligopoly** is an industry with a small number of producers. A producer in such an industry is known as an **oligopolist**.

When no one firm has a monopoly, but producers nonetheless realize that they can affect market prices, we say that an industry is characterized by **imperfect competition**. Two types: oligopoly and monopolistic competition. Oligopolies are very common.

Often oligopolists are **giant corporations**. But sometimes they may be **small firms** – eg: two grocery stores in a neighborhood.

The most important **explanation** of oligopolies is the existence of **economies of scale**. Not as strong as in the case of natural monopolies, but still strong enough to allow a few firms to satisfy market demand. Could also be due to **technological superiority**.

“Four-firm concentration ratios” (share of industry sales accounted for by four largest firms). Those industries with high ratios are oligopolies.

Industry	Concentration ratio	Largest firms
1. Cigarettes	98.9	Philip Morris, R. J. Reynolds, Lorillard, Brown and Williamson
2. Batteries	90.1	Duracell, Energizer, Rayovac
3. Breweries	89.7	Anheuser-Busch, Miller, Coors, Stroh's
4. Light bulbs	88.9	Westinghouse, General Electric
5. Breakfast cereals	82.9	Kellogg's, General Mills, Post, Quaker Oats
6. Automobiles	79.5	General Motors, Ford, DaimlerChrysler

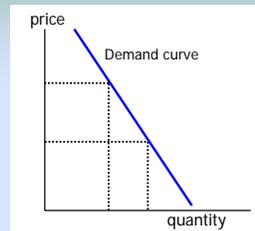
## Understanding Oligopoly

Some key issues regarding oligopoly can be understood by examining the simplest case, a **duopoly**, a market with two firms.

Each would realize that by producing more it would drive down the market price. So each firm would, like a monopolist, realize that profits could be higher if it limited its production.

So how much will the two firms produce? What prices will they charge?

It turns out that there is no simple answer to this question. There are many possibilities. This makes the analysis of oligopoly complicated.



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## Understanding Oligopoly Collusion

One possibility: two firms engage in **collusion**, that is, they cooperate to raise each others' profits.

By acting as if they were a single monopolist, oligopolists can maximize their combined profits. So there is an incentive to form a **cartel** (strongest form of collusion), agreement by several producers that increases their combined profits and determines how much each seller one will produce. (Ex: OPEC). But:

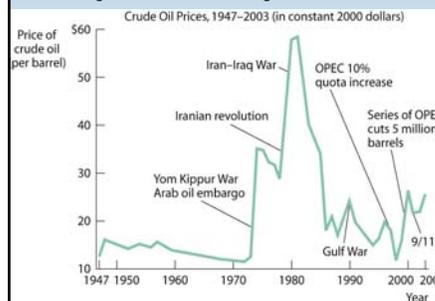
- In many countries (including the US) **illegal** to form cartel.
- Each firm has an **incentive to cheat** — to produce more than it is supposed to under the cartel agreement. If others stick to the agreement, each firm can increase its own profits by producing more. Producing more has a positive quantity effect on profits, but negative price effect on all producers. Each firm will ignore the price effect on others' profits. If legal contract not to break agreement cannot be enforced, cartels are unlikely collude successfully.

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## Understanding Oligopoly

**Collusion: Organization for Petroleum Exporting Countries (OPEC)**

Most oil exporting countries are members of OPEC, the international oil cartel. It is not illegal because it involves governments of different countries.



OPEC raised real crude oil prices in 1974. But since then they have not successfully kept the price high. Has responded to supply and demand shocks, mostly political events. But sometimes they have limited oil production and secured price increases.

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## Understanding Oligopoly

### Non-cooperative behavior

Firms may therefore engage in **non-cooperative behavior**, ignoring the effects of their actions on each others' profits.

Firms may decide to engage in:

- quantity competition:** this is more likely if competitors cannot expand their profits much by cutting prices, since they cannot increase their output much because of capacity constraints.
- price competition:** if they can change their output levels quickly they are more likely to engage in price competition. Take over the entire market if they produce homogenous products.

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## Understanding Oligopoly

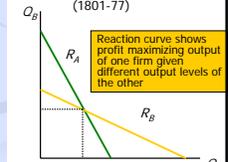
### Quantity competition and the Cournot model

The basic insight of the **quantity competition** is that when firms are restricted in how much they can produce, it is easier for them to avoid excessive competition and to "divvy up" the market, thereby pricing above marginal cost and earning profits. They achieve an outcome that looks like collusion without a formal agreement.



French economist Augustin Cournot (1801-77)

Shown by **Cournot model**, in which each firm producing homogeneous product takes other firm's output as given, and maximizes its own profit by choosing its output, taking into account the effect of its production and therefore industry production on the price level. This gives the reaction curve for each firm. Equilibrium where the two reaction curves intersect. At the equilibrium, each firm is maximizing profits given the other firm's output level. Total industry output,  $Q_A + Q_B$ , is more than monopoly output, and profits less than under joint profit maximization. This is because the firms do not take into account the fact that their decisions have adverse effects on the profits of the other firm.



## Understanding Oligopoly

### Price competition and the Bertrand model

The logic behind **price competition** is that when firms produce perfect substitutes and have sufficient capacity to satisfy demand when price is equal to marginal cost, then each firm will be compelled to engage in competition by undercutting its rival's price.



French economist Joseph Louis Bertrand (1922-1900)

In the **Bertrand model** this undercutting goes on, with each firm cutting its price and taking over the entire market, until the price reaches marginal cost (which we assume to be constant)—that is, the perfect competition outcome.

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## Game Theory

### Basic concepts

When the decisions of two or more firms significantly affect each others' profits, they are in a situation of **interdependence**. The study of behavior in situations of interdependence using optimizing behavior is known as **game theory**. It is used in a variety of contexts, for instance, to understand oligopoly, arms races between countries, union-firm bargaining, and military strategy in battles.

A game is often shown with a table. Games have **players**, each having possible **actions**, which yields **payoffs** to them depending on what action they take and the action taken by other players. Payoffs are shown with payoff matrices. Example with two players and two actions is shown here. Each box shows payoffs for the two players.

**Interdependence** is shown by the fact that each player's payoff depends not only on the action of the player, but the action of the other players.

Players choose actions, that is, adopts a **strategy**, to obtain the highest payoff taking into account the actions of others.

		Ajinomoto	
		Produce 30 million pounds	Produce 40 million pounds
ADM	Produce 30 million pounds	Ajinomoto makes \$180 million profit. ADM makes \$180 million profit.	Ajinomoto makes \$200 million profit. ADM makes \$150 million profit.
	Produce 40 million pounds	Ajinomoto makes \$150 million profit. ADM makes \$200 million profit.	Ajinomoto makes \$160 million profit. ADM makes \$160 million profit.

## Game Theory

### Solutions

What will be the outcome of a game? When there is a solution. How do we find a solution? Two standard methods.

- Dominance arguments.** A strategy dominates another if its payoffs to the player are higher whatever is the other player's action. If the player has a strategy that dominates all others, she will choose that strategy. When both players choose such strategies, we have a solution.

- Equilibrium.** Most common is Nash equilibrium idea. Equilibrium strategies are those at which no players has an incentive to deviate from that strategy, given the other player's action. Named after John Nash.

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Produce 40 dominates produce 30 for both. So solution is the bottom right cell. The cell is also a Nash equilibrium



American economist and mathematician John Nash, b. 1928

## Game Theory

### The Prisoners' Dilemma

The prisoner's dilemma is a game in which: (1) each player has an incentive to not cooperate (or cheat), regardless of what the other player does; (2) when both players do not cooperate (they cheat) their payoffs are lower than their payoffs when they cooperate (they do not cheat).

Two prisoners, held in separate cells, are each offered a deal by the police—a light sentence if she confesses and implicates her accomplice but her accomplice does not, and heavy sentence if she does not confess but her accomplice does, and so on.

It is in the **joint interest** of both prisoners **not to confess**

It is in each one's **individual interest** to **confess**.

		Louise	
		Don't confess	Confess
Thelma	Don't confess	Louise gets 5-year sentence. Thelma gets 5-year sentence.	Louise gets 2-year sentence. Thelma gets 20-year sentence.
	Confess	Louise gets 20-year sentence. Thelma gets 2-year sentence.	Louise gets 15-year sentence. Thelma gets 15-year sentence.

## Game Theory

### Repeated Interaction Can Support Collusion

Prisoner's dilemma suggests that players will not collude or cooperate. But cooperation may emerge if there are repeated interactions. This may be applicable to oligopolies, where firms interact with each other repeatedly. So some form of tacit collusion will emerge, implying market failure.

		Ajinomoto	
		Tit for tat	Always cheat
ADM	Tit for tat	Ajinomoto makes \$180 million profit each year. ADM makes \$180 million profit each year.	Ajinomoto makes \$200 million profit 1st year, \$160 million profit each later year. ADM makes \$150 million profit 1st year, \$160 million profit each later year.
	Always cheat	Ajinomoto makes \$150 million profit 1st year, \$160 million profit each later year. ADM makes \$200 million profit 1st year, \$160 million profit each later year.	Ajinomoto makes \$160 million profit each year. ADM makes \$160 million profit each year.

A strategy of "tit for tat" involves playing cooperatively at first, then following the other player's move. This rewards good behavior and punishes bad behavior. If the other player cheats, playing "tit for tat" will lead to only a short-term loss in comparison to playing "always cheat." But if the other player plays "tit for tat," also playing "tit for tat" leads to a long-term gain.

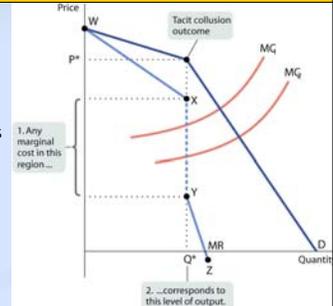
So, a firm that expects other firms to play "tit for tat" may well choose to do the same, leading to successful tacit collusion.

## Kinked Demand Curve and Price Rigidity

When firms achieve tacit collusion, they may have a tendency not to change their behavior even when there are changes in the environment, for instance, a change in costs unique to the firm.

The oligopolist's demand curve is very flat to the left of  $Q^*$ . The kink in the demand curve leads to the break  $XY$  in the marginal revenue curve.

Oligopolist believes (1) she will lose a substantial number of sales by reducing output and increasing price (because competitors won't reciprocate) but (2) will gain only a few additional sales if she increases output and lowers price (because competitors will reciprocate), away from the tacit collusion outcome. Seller faces a **kinked demand curve**. MR curve will have a break. So when MC shifts in range, no change in price and output.



## Oligopoly in Practice

### Legal Framework

As industrialization progressed in the US in the second half of the 19<sup>th</sup> century, partly due to the expansion of railroads, large companies emerged, including those in railroads, steel, oil, etc.

### Trusts

Large firms often tried to collude, sometimes forming **trusts**. Ex: Rockefeller's Standard Oil Company formed a trust, in which shareholders of major companies in industry placed their shares in hands of a board of trustees who controlled the companies and essentially created monopolies.

### Antitrust Policy

Public backlash due to economic effects and the rising power of the owners of trust led to changes in laws. The **Sherman Antitrust Act of 1890** aimed to break up monopolies. Ex: Standard Oil in 1911, Bell Telephone in 1980s. **Antitrust policy** used also against attempts to restrict competition and form monopolies. People sent to jail. Tacit agreements legal, not real agreements through meetings. Sometimes also looking at firm's practices and attempts to monopolize markets.

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## Oligopoly in Practice

### Tacit collusion and price wars

Although oligopolies operate under legal restrictions in the form of antitrust policy, many succeed in achieving **tacit collusion**. Firms in most oligopolistic industries keep prices above their noncooperative levels and certainly above marginal costs.

However, prices are not at monopoly levels either. **Tacit collusion is limited** by a number of factors, including

- **Large numbers of firms.** Reduces possibility of cooperation and increases chances of cheating
- **Complex products and pricing schemes.** Many different products, pricing methods, makes it difficult to ascertain whether firm is cheating on tacit agreement.
- **Differences of interest among firms.** Established firms versus new ones. Differences in costs.
- **Bargaining power of buyers.** Often oligopolists sell to not individual consumers but to large buyers like Wal-Mart who can keep prices low through their market power.

Because tacit collusion is hard to achieve, collusion sometimes breaks down, leading to **price wars** as in the Bertrand model. These can be very destructive for firms.

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## Oligopoly in Practice

### Efforts to limit price competition

To limit competition and price wars, firms resort to various techniques.

1. **Markup pricing.** Firms charge a fixed markup on their variable costs, ignoring demand factors about which information is scarce. Kalecki found this to be what firms often do. Size of markup depends on degree of industrial concentration. When costs of all firms change, say wages, they raise prices. But not when there are changes in demand. They just change level of production.
2. **Product differentiation and non-price competition.** Instead of competing on prices, they make different types of products and compete over quality, or through advertising.
3. **Price leadership.** When products are differentiated, it is sometimes possible for an industry to achieve tacit collusion through firms following the price set by the leading firm in the industry. Ex: GM and cars.



Polish economist, Michal Kalecki (1899-1970). Also very important in developing the theory of aggregate demand in macro, for which only J. M. Keynes is mostly credited.

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## Conclusion

Oligopoly is very important in reality. Then why use perfect competition model so much with only one small part on oligopoly. **Should we drop perfect competition and work only on oligopoly?** Some reasons for doing perfect competition:

1. In several markets **conditions approximate perfect competition**.
2. **Oligopoly is much harder to analyze**, since there is no unique model which takes interdependence into account which can be applied to all situations. General simple theories do not exist. Since the nature of interdependence depends on context, maybe no such theory can be developed, unlike perfect competition and monopoly.
3. Perfect competition provides a **benchmark case** which under some assumptions leads to efficiency (though not equity). By studying that we can see how other market forms create welfare losses which can be corrected by public policy.
4. Supply and demand issues are also relevant under conditions of oligopoly. Example of OPEC. Rise in demand due to growth in "emerging" nations can make collusion easier. Supply shocks due to wars can also restrict supply and make collusion easier. So **ideas relevant for perfect competition can be applied to oligopolistic markets**.

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