OLIGOPOLY & CARTELS

On the spectrum between Competition where we usually imagine there are a large number of firms and Monopoly which is defined as a single firm, we have *Oligopoly*. Oligopoly is a few firms serving the market. When there are two firms, we call it a *duopoly*.

Oligopoly creates a special problem for economic models and theories. When there are a small number of players in a business situation, it is hard to figure out what they will do. They are said to be in a "game" where they may employ a wide variety of strategies against one another. They may act as dyed-in-the-wool rivals and drive the market price "ruinously" low, or they may act as one and perfectly monopolize the market. There are a myriad of possibilities in between.

THEORIES

The oldest and simplest theory of oligopoly behavior is called the *Cournot Model*.[1] The Cournot model is based on the simplistic assumption that the market participants assume that the other market participants will not change their quantity of production. Start with a monopoly, where the single firm is producing half way up the demand curve between a flat supply curve and the exclusion price. Enter a second firm. The second firm assumes that the first firm will continue to produce at its current level. This leaves the demand curve between the monopolist's price and the supply for the second firm. It then produces half way down that "remnant" demand. The first firm then readjusts (exactly contrary to the what the second firm anticipated); the second firm readjusts; etc., etc. The ultimate solution has the following characterization:

Number of Firms	% of Competitive Output
2	2 / 3
3	3 / 4
4	4 / 5
...	...
n	n / (n+1)

While the behavioral assumption is naive, the solution is conveniently straightforward. Moreover, there is some experimental evidence supporting the hypothesis that this model characterizes the way people actually behave.

The Cournot model is part of what is called *game theory*. Game theory tries to predict how people will behave when they are faced with a one-on-one situation. A simple game theory that demonstrate the issues involved is the Prisoners' Dilemma. Assume two murder suspects are arrested. The prosecutor interrogates them separately. He offers the following choice to each: "If you confess and your partner doesn't, you will get 5 years and he will get life. If he confesses and you don't, you will get life. If you both confess, you both get 10 years."

The model can be characterized by the following payoff matrix:

[1] Antoine Augustin Cournot. French mathematician and economist. Born: 28 Aug 1801 in Gray, France Died: 31 March 1877 in Paris, France. We will ignore the other oligopoly models such as the Stackleburg and Kinky Demand models.

		Prisoner Boudreaux	
		confess	*stonewall*
Prisoner Hebert	*confess*	Both get 10 years	Hebert gets 5 yrs. Boudreaux gets life.
	stonewall	Boudreaux gets 5 yrs. Hebert gets life.	Both walk

The payoffs, 5 years, 10 years, and life, can be adjusted by the prosecutor in order to maximize the probability of the total sentence that can be levied against the two men. The greater is the difference between confession and stonewalling, the greater the probability of confession.

This simple Prisoners' Dilemma is a one period game. We could imagine a game like the prisoners' dilemma that was replayed an infinite number of times. Mathematicians and economists have studied this at length. In fact, a computer game has been run where anyone can submit a strategy. The winning strategy has been found to be *Tit-for-Tat*. Tit-for-Tat means that you play a cooperative game until the other player acts opportunistically. Then you retaliate.

In the context of Boudreaux and Hebert, this means that Boudreaux will stonewall until Hebert confesses. Then, in the next round, Boudreaux confesses. Boudreaux continues to confess until Hebert stonewalls. Then Boudreaux goes back to stonewalling.[i]

The interesting implication of the Tit-for-Tat winning strategy is that in a real market situation, it implies that monopolizing cooperation among the oligopoly may be a dominant pattern. This monopolizing cooperation may take the form of Cournot behavior or it may come closer to perfect monopoly. Monopolizing cooperation is called a cartel.

CARTELS

What?: A cartel is an agreement among firms to act in concert, that is, like a team. In a perfect cartel the firms act as if they were a single firm with multiple plants or facilities.

Why?: In acting as a single firm, the cartel can monopolize the market, raise price, lower quantity and substantially increase profits. In rare cases, cartels seem to perform other functions such as effective marketing such as the DeBeers diamond cartel or the Cali drug cartel. But even here we expect that the cartel acts to restrict quantity. Cartels in sports, which includes the professional sports leagues as well as the National Collegiate Athletic Association, organize the interaction of the firms on the field. These cartel define play in the sport. Even so, there is ample evidence that they act to monopoly the market on both the output side as well as the input side.

When?: Firms will cartelize when it is cheap to do so. Most importantly, firms cartelize when there are no government restrictions on doing so.

The Sherman Antitrust Act of 1890 prohibited price fixing or cartelization. Until that time, there was no legal restraint on firms acting as a cartel. As a consequence, nearly every industry in the country in the last half of the 19th century had attempted some form of cartel. The fact that cartels in the US are so uncommon as to be considered rare birds is a testimony to the efficiency of the Sherman Act. The benefits that we derive from this feat of government regulation cause the Sherman Act to rank as one of the most important pieces of legislation to ever have been enacted.

However, government sanction is not the only obstacle to forming an effective cartel. Firms must be able to organize themselves and to stop the entry of new firms. Typically organization costs are low when there are only a few firms in the industry and when for some reason, production is *concentrated* in one or two of these. Effective cartels are usually associated with natural resource markets where the entry of new firms can be thwarted by restricting the distribution of the raw materials necessary for production. Aluminum is the common example.

The natural resource bauxite is concentrated in ownership. Oil and the Arab OPEC cartel is another example.

How?: The effectiveness of a cartel depends on its ability to enforce the rules of the cartel on its members. Each member of the cartel has an incentive to cheat because, if all the other members hold the line on price and quantity, any one firm can substantially increase profits by increasing its own output and selling at the now high, monopoly price. Since an individual firm in the cartel does not substantially lower price because its contribution to market output is relatively small, it gets to enjoy the high price and produce at full capacity. Thus, its profits are really big. Even so, since every firm wants to do this, the cartel is always in jeopardy of breaking down. This is what happened to OPEC in the mid 1980s.

The cartel must prevent cheating on the cartel agreement. Cheating is most easily detected when there are only a few firms, where prices don't fluctuate much because of market conditions, where prices are known to all members and where everyone sells the same product to similar buyers. In one of the most famous illegal cartels of all time, several electric equipment manufacturers led by Westinghouse and GE conspired to fix prices especially on government contracts. They were kind of silly in that they agreed to share the market by allowing one firm and then another to win bids. The losers all submitted identical higher bids. Even so, the ability of the cartel to enforce its agreement was enhanced by the fact that they were submitting sealed bids to government who was bound to reveal the amounts of all bids publicly and bound to accept the lowest. Thus, the cartel members could know exactly what everyone else bid and could know who if anyone cheated on the cartel agreement.

The gain to the cartel members is the excess profits created by monopolizing or restricting the quantity supplied to the market. The cartel must decide how these profits are to be shared among the members. One way is for everyone to pay their profits into a pool and then have the cartel manager pay dividends out of the pool. Professional sporting leagues sometimes do this, for instance, in sharing the revenues from television broadcasts of member games. In this instance, the pooling procedure is efficient because the cartel manager (the league office) is the central contracting agent in arranging the television agreement. Generally, however, the cartel members agree on the distribution of the profits based on an allocation of the market. The market is allocated among the cartel members in some way. The members receive shares. Generally speaking it is necessary to divide the market in some way other than just setting a target price. When only a target price is set, cheating will generally become the order of the day and the cartel will fail.

In the Philadelphia electric case mentioned above (so called because the Phil. antitrust office brought the case) the cartel members allocated percentage shares of the contracts that each would be allowed to win. Sometimes cartels allocate the market geographically. In the NCAA case, the right to be shown on TV was allocated by the association. The NCAA said that a team could only be on TV something like four times in two years (not counting bowl games). Ultimately, it was this sharing rule that broke the NCAA cartel.

In the early part of this century, GE and Westinghouse cartelized the light bulb market. GE used a licensing agreement to police cartel cheating by W. GE required that light bulbs only be sold at licensed dealers and the contract that both it and W. signed with these dealers required that they maintain a minimum retail price. This provision is called “resale price maintenance.” By policing the retail price, GE could control the market share allocated to W.

Other cartel control devices include the unlikely candidates of contracts that include “meet the competition’s price,” and most favored nation agreement.

[i] The prisoner's dilemma [quoted from <http://www.abc.net.au/science/slab/tittat/story.htm#tittat>]

The prisoner's dilemma refers to an imaginary situation in which two individuals are imprisoned and are accused of having co-operated to perform some crime. The two prisoners are held separately, and attempts are made to induce each one to implicate the other. If neither one does, both are set free. This is the co-operative strategy available to both prisoners. In order to tempt one or both to defect, each is told that a confession implicating the other will lead to his or her release and, as an added incentive, to a small reward. If both confess, each one is imprisoned. But if one individual implicated the other and not vice versa, then the implicated partner receives a harsher sentence than if each had implicated the other.

The prisoner's dilemma is that if they both think rationally then each one will decide that the best course of action is to implicate the other even although they would both be better off trusting each other. Consider how one prisoner thinks. If his partner fails to implicate him then he should implicate his partner and get the best possible pay-off. If his partner has implicated him he should still 'cheat' - since he suffers less than if he trusts his partner. However, the situation is more complicated than this analysis suggests. It is fairly obvious that the players' strategic decisions will also depend upon their likelihood of future encounters. If they know that they are destined never to meet again, defection is the only rational choice. Both individuals will cheat and both will end up relatively badly-off. But if the prisoner's dilemma is repeated a number of times, then it may be advantageous to co-operate on the early moves and cheat only towards the end of the game. When people know the total number of games of prisoner's dilemma, they do indeed cheat more often in the final games.

Robert Axelrod was interested in finding a winning strategy for repeated prisoner's dilemmas games. He conducted a computer tournament where people were invited to submit strategies for playing 200 games of prisoner's dilemma (Axlerod and Hamilton, 1981). Fourteen game theorists in disciplines such as economics and mathematics submitted entries. These 14, and a totally random strategy, were paired with each other in a round robin tournament. Some of these strategies were highly intricate. But the result of the tournament was that the simplest of all strategies submitted attained the highest average score. This strategy, called TIT FOR TAT by its submitter Anatol Rapoport, had only two rules. On the first move co-operate. ON each succeeding move do what your opponent did the previous move. Thus, TIT FOR TAT was a strategy of co-operation based on reciprocity. By conceptualising reciprocal altruism as a series of prisoner's dilemmas we can see that TIT FOR TAT might be the Evolutionary Stable Strategy for our reciprocal altruism adaptation. It might even help to explain the evolution of co-operation in a more general way than Trivers' theory of reciprocal altruism.

TIT FOR TAT

The results of Axelrod's tournament were published and people were invited to submit programs for a second tournament. This was identical in form to the first, except that matches were not of exactly 200 games, but were of a random length with median 200; this avoided the complication of programs that might have special cheating rules for the last game. This time there were 62 entries from six countries. Most of the contestants were computer hobbyists but also present were professors of evolutionary biology, physics and computer science as well as the disciplines represented earlier. Rapoport again submitted TIT FOR TAT and again it won with a leg in the air. Ultimately it displaced all other strategies and became the equivalent of an ESS for prisoner's dilemma.

From an analysis of the 3-million choices made in the second competition, four features of TIT FOR TAT emerged:

1. Never be the first to defect
2. Retaliate only after your partner has defected
3. Be prepared to forgive after carrying out just one act of retaliation
4. Adopt this strategy only if the probability of meeting the same player again exceeds 2/3.

These results provide a model for the evolution of co-operative behaviour. At first sight it might seem that the model is relevant only to higher animals which can distinguish between their various opponents. If so, TIT FOR TAT would simply be Trivers' theory of reciprocal altruism restated. But TIT FOR TAT is more than this and can be applied to animals that cannot recognise each other - as long as each individual starts co-operative encounters with very minor, low cost moves and gradually escalates as reciprocation occurs.

Axelrod and Hamilton emphasise that a formal theory for the evolution of co-operation needs to answer three questions.

1. How can a co-operative strategy get an initial foothold in an environment which is predominantly non-co-operative?
2. What type of strategy can thrive in a varied environment composed of other individuals using a wide diversity of more or less sophisticated strategies?
3. Under what conditions can such a strategy, once fully established, resist invasion by mutant strategies (such as cheating)?

The studies of TIT FOR TAT answer these questions about initial viability, robustness and stability. Provided that the probability of future interaction between two individuals is sufficiently great, co-operation based on reciprocity can indeed get started in an asocial world, can flourish in a variegated environment and can defend itself once fully established.

According to Axelrod, TIT FOR TAT is a successful ESS because it is 'nice', 'provokable' and 'forgiving'. A nice strategy is one which is never first to defect. In a match between two nice strategies, both do well. A provokable strategy responds by defecting at once in response to defection. A forgiving strategy is one which readily returns to co-operation if its opponent does so; unforgiving strategies are likely to produce isolation and end co-operative encounters.

Since the appearance of TIT FOR TAT as a model for the evolution of co-operation, there have been many strategies derived from it: TIT FOR TWO TATS, SUSPICIOUS TIT FOR TAT and ALWAYS DEFECT to name just three. Under varying conditions all achieve some success but none demonstrate the robustness of TIT FOR TAT. However the real proof of this theory is in nature where TIT FOR TAT is beginning to be identified.

[See <http://www-personal.umich.edu/~axe> for references.]