

UNIT EC455, LEVEL 3

**CARTELS AND COLLUSIVE
BEHAVIOUR**

THE ECONOMICS OF EUROPEAN INDUSTRY

Semester 2 2000

Lecturer: K. Hinde

Room: 427 Northumberland Building

Tel: 0191 2273936

Email: kevin.hinde@unn.ac.uk

Web Page: <http://www.unn.ac.uk/~egkh1>



Aims

There are two aims of this session.

- ❑ To analyse the theories associated with collusive behaviour.
- ❑ To facilitate learning about cartels in Europe using web based methods and reading materials.

Learning Outcomes

By the end of this session you will have

- ❑ Identified different forms of collusive behaviour.
- ❑ Applied the dominant firm (price leadership) model.
- ❑ Critically examined the Prisoner's Dilemma model of collusion and the methods by which players resolve the paradox.
- ❑ Used the web to find examples of collusion in Europe.

Cartels and Collusive Behaviour

What is meant by collusion?

Whilst there may be interdependence in oligopolistic industries there may also be collusive activity.

Adam Smith's famous passage offers an insight.

“People of the same trade meet together, even for merriment and diversion, but the conversation ends in conspiracy against the public, or in some contrivance to raise prices.”

Collusion takes many forms

❑ **Controls**

Various professions – e.g., accounting, medicine, law - have entry restrictions of some kind. In the USA recently action was taken by the Department of Justice to stop the 'Ivy League' universities from offering identical scholarships to bright pupils.

❑ **Tacit collusion**

This is usually characterised by periods of **price stability**. There may not be any formal written agreements between

firms to keep prices at this level. Indeed, there may be price stability but vigorous non-price competition. Where, however, the differentiation of products appears minimal then competition authorities may be wary. So why do prices appear stable?

The **kinked demand curve model** shows that firms in an industry converge upon a stable price, above which they face dramatic falls in sales and below which the increase in sales is negligible. It also may be that **barometric pricing** occurs in an industry. This is where one firm acts as a price leader (barometer) for the industry and followers set their prices accordingly. The price rise may have been set off by some shock on the cost side, say because of a rise in the price of raw materials such as oil. However, this may not be enough to convince the authorities that the scale of the rise is in the public interest. Further, if one firm is constantly leading and others follow this may well be construed as collusive.

□ **Cartels.**

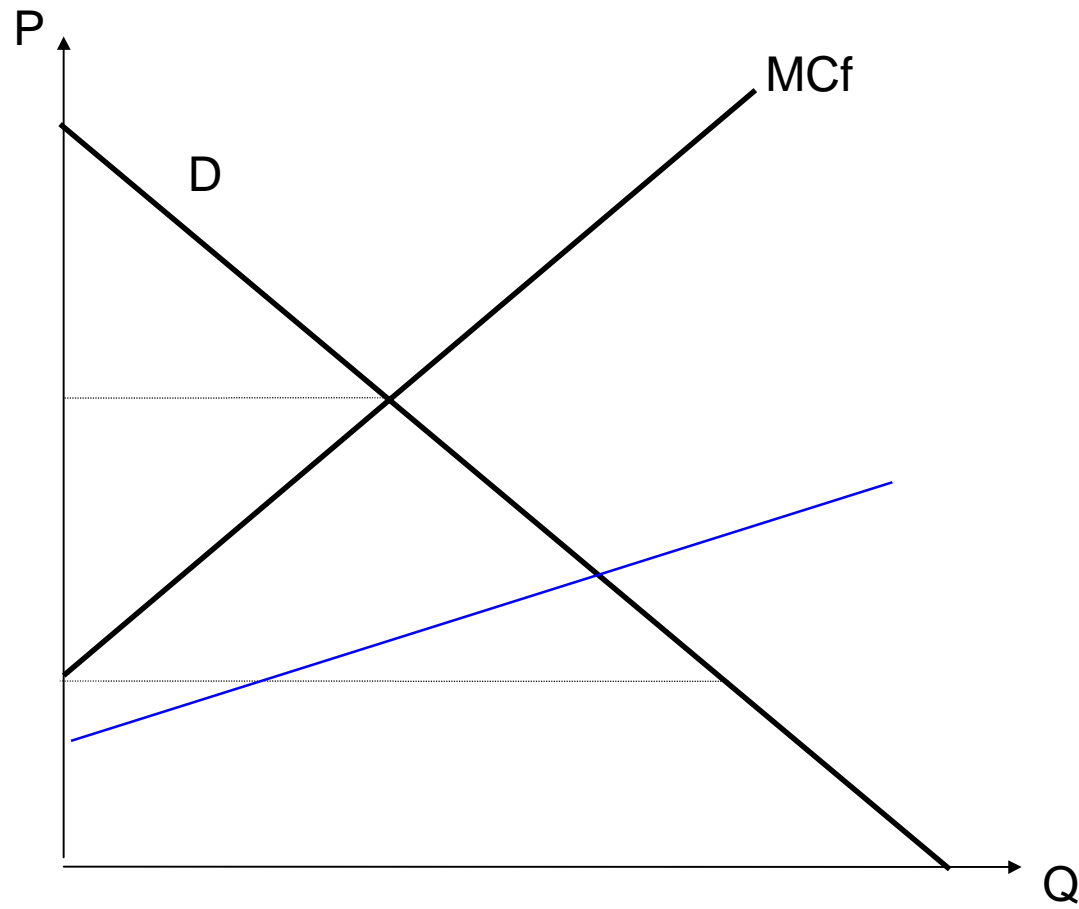
These come in various forms. Some have written agreements with regard to pricing, output, product mix, investment, and profit pooling, much as in a genuine monopoly.

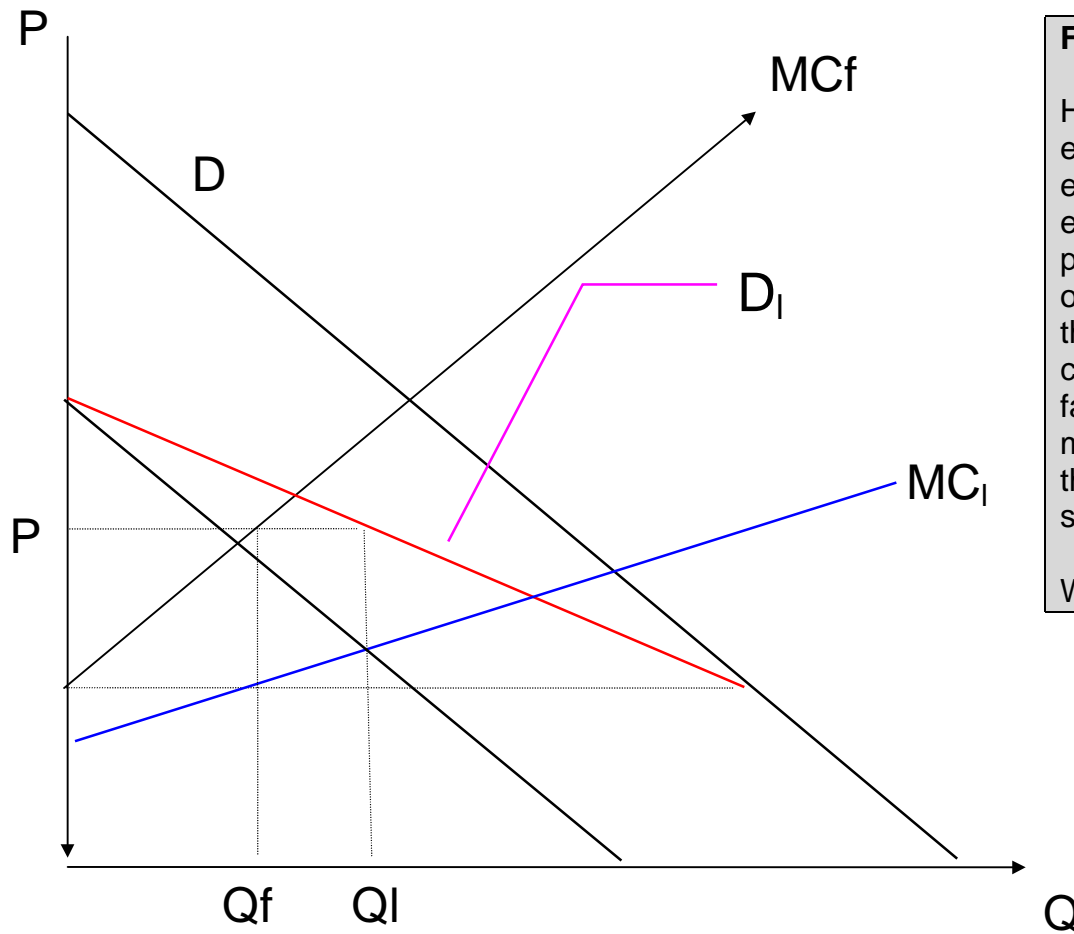
Some are less complete cartels, e.g. the marketing cartel which may handle members sales and manages revenues. They often argue that such bodies are required to manage dramatic volatility in demand.

There are, of course, some famous cartels such as OPEC and IATA.

(OPEC might be considered in the context of a dominant firm, or Dominant Group, model set out below)

Dominant Group (FIRM) Price Leadership Model





Food for thought

Here you might think about the impact on economic welfare created by demand and supply elasticity. For example, OPEC countries have an elastic supply relative to, say, North Sea oil producers and market demand is inelastic. On the other hand, CIPEC, the international copper cartel that supplies 1/3 of the world market (made up of countries such as Chile, Peru, Zambia, and Zaire) face very elastic demand and supply. Further you might want to consider what has happened within the OPEC nations and its relative cost advantage since the mid-1970s.

Why not visit the [OPEC web Site](#)?

Cartels and The Prisoner's Dilemma (Due to A.W. Tucker)

It would be wrong to think that cartels were the normal behavioural characteristic of modern industry, indeed competitive behaviour is much more likely. However, for the players involved competition offers lower payoffs than collusion. To see this dichotomy we can use game theory and the famous case of 'The Prisoner's Dilemma'.

In this game 2 prisoners have been brought in for questioning by the police about a serious crime. The police have some information and so can make some charges hold but they need to question the suspects if they are to get the whole picture. The police interview the suspects in separate rooms. The prisoners now find themselves in a dilemma. The game is shown in the matrix below. Both have two choices, to confess or not confess. The pay offs for prisoner 1 are shown in the right of the bracket and those for prisoner 2 on the left. They are negative to reflect years in prison.

Clearly, both prisoners have a **dominant strategy** of confessing; it does not matter what strategy the other prisoner chooses (we can thus say that not confessing is a **dominated strategy**). Both prisoners will get either 5 years or 6 months in prison for confessing and 10 years or 1 year if they keep quiet. Given the possibility of a 6 month sentence both players find themselves confessing.

Note

“there is complete but imperfect information. it is complete because both know the strategies and payoffs available to each other, yet imperfect because decisions have to be made before the other's choice has been revealed. all of this is common knowledge” (Lyons, *ibid.* p.98)

The implications of the PD are clear enough. Both players act sub-optimally. However, this sits uneasily with the concept of **instrumental rationality**; both players would be better off acting 'irrationally' and co-operating with each other. Both would then enjoy a higher pay off.

This is not just a parlour game, it has relevance to the world of big business. Figure 2a shows 2 firms competing on price. Again, we see that if the firms acted **co-operatively**, i.e. colluded, and raised price to a monopolistic level, they would obtain higher joint profits. However, as they are unsure about what the other might do a perfectly competitive equilibrium is arrived at both players **defect**. This is good for society but bad for the players.

Figure 2. The Prisoner's Dilemma

		PRISONER 2	
		Confession	No Confession
PRISONER 1	Confession	(-5, -5)	(-0.5, -10)
	No Confession	(-10, -0.5)	(-1, -1)

		Firm 2	
		High Price	Low Price
Firm 1	High Price	(100, 100)	(-10, 140)
	Low Price	(140, -10)	(0, 0)

Figure 2a: Bertrand Duopoly Game

Resolving the Prisoner's Dilemma Game

It is difficult for players to reach co-operative solutions given the powerful forces of competition apparent in this game and the watchful eye of authorities. However, we know that cartels are pervasive across the globe, so how is the dilemma resolved?

One method is for one player to punish defection by the other. Two methods are discussed in the literature; Trigger strategies and 'Tit for Tat' strategies.

Trigger Strategies

This is the most severe punishment strategy, and is sometimes given the name 'Grim Strategy' because of its severity. With a trigger strategy a player defects in the next period, $t+1$, if their opponent defects in period t . Thereafter they play defect strategies. (You might think of it as a player pulling a trigger with grim consequences for both players).

Tit for Tat Strategies

Robert Axelrod invited well-known game theorists to resolve the dilemma. In the tournament he devised he discovered that the most successful strategy was known as 'Tit for Tat', devised by Annatol Rappoport.

In the tournament each programme had to compete

- against another, head to head.
- against another, but the competitor was randomly selected by the computer.
- against itself

Tit for Tat entailed two components.

- It would engage in cooperation in the first round

- In subsequent rounds it would adopt its opponents strategy from the previous round (e.g. in round t a tit for tat player would adopt its opponents strategy from $t - 1$)

The 'tit for tat' strategy won Axelrod's tournament because it is

- Nice (a player starts out co-operatively and is not the first to defect)
- Provocable (a TFT player will punish defection quickly)
- Forgiving (a TFT player will act co-operatively again if their opponent signalled cooperation in $t - 1$)

To see why it was so successful we shall play the game over 10 rounds. We will be Firm 1 in Figure 2a and play TFT.

	Firm 1 Tit for Tat	Firm 2 Dominant Strategy
Round 1	C -10	D 140
Round 2	D 0	D 0
↓	↓	↓
Round 9	D 0	D 0
Round 10	D 0	D 0
Total Profits	- 10	140

In the next game we will play another TFT player (itself).

	Firm 1 Tit for Tat	Firm 3 Tit for Tat
Round 1	C 100	C 100
Round 2	C 100	C 100
↓	↓	↓
Round 9	C 100	C 100
Round 10	C 100	C 100
Total Profits	1000	1000

Now Firm 2 has to play itself

	Firm 2 Dominant Strategy	Firm 3 Dominant Strategy
Round 1	D 0	D 0
Round 2	D 0	D 0
↓	↓	↓
Round 9	D 0	D 0
Round 10	D 0	D 0
Total Profits	0	0

The cumulative profits for Firm 1 are 990 and for Firm 2 they are 140: Tit for Tat wins!

However, Tit for Tat is a suboptimal strategy in

- Head to head contests with a dominant strategy player.

- Situations where information is uncertain and incomplete.

To see the latter consider the case where a non-player, Nature, intervenes randomly in a game with two 'Tit for Tat' players. In such a situation Nature determines that a player plays a defect strategy even though they might wish to cooperate.

	Firm 1 Tit for Tat	Firm 2 Tit for Tat
Round 1	C 100	C 100
Round 2	C 100	C 100
Round 3	Nature D 140	C - 10
Round 4	C - 10	D 140
Round 5	D 140	C - 10
Round 6	C - 10	D 140
Round 7	D 0	Nature D 0
Round 8	D 0	D 0
Round 9	D 0	D 0
Round 10	D 0	D 0
Total Profits	460	460

Clearly they would have been better off recognising that mistakes due to outside forces do occur. Thus, if they had played Tit for 2 Tats the pay offs would have been greater.

	Firm 1 Tit for 2 Tats	Firm 2 Tit for 2 Tats
Round 1	C 100	C 100
Round 2	C 100	C 100
Round 3	Nature D 140	C - 10
Round 4	C 100	C 100
Round 5	C 100	C 100
Round 6	C 100	C 100
Round 7	C - 10	Nature D 140
Round 8	C 100	C 100
Round 9	C 100	C 100
Round 10	C 100	C 100
Total Profits	930	930

What factors facilitate (and thus limit the extent of) collusion?

- **Concentration and a small number of suppliers**

Chamberlin suggested that it is most likely to occur in industries which exhibit high concentration ratios. Empirical investigations have suggested that this might be when the 8 firm concentration ratio reached 70% and one study suggested that the move from competition to monopoly output occurs when the largest two firms reached a combined share of 25 to 35% (Kwoka, Rev of Econ. and Statistics, 1979).

However, collusion requires initial agreement between firms and adherence to the pact. A particular problem is that of **cheating** and that occurs where there may be a large number of sellers spread over a large geographical area.

Interestingly Stigler (1968, Organisation of Industry) predicts that where there are only a few firms (the HHI concentration ratio is high) then fluctuations in sales go down. Thus, declines in sales indicate that customers are going elsewhere and that cheating is taking place among a collusive oligopoly.

- **Costs**

Unless costs are similar then there is little incentive for a low cost firm to enter a collusive arrangement. Further, industries with high overheads have low marginal costs and thus the scope for price cutting increases.

- **Demand**

If demand is **heterogeneous and volatile** then discovering an optimal price will be difficult because of insufficient information. However, in capital goods industries, where demand is 'lumpy' there may be incentives to reduce the worst excesses of price wars.

In situations where **demand is elastic** then it will be difficult for a cartel to raise prices. In contrast where demand is inelastic prices may be raised with little reduction in output.

- **Technological advance**

If there is rapid technological change in an industry then demand curves will vary across firms making it unlikely that collusion will occur.

- **Non-price competition**

When a product is differentiated then members of a cartel must fix a whole schedule of prices if they are to succeed. However, it is usually the case that differentiation leads to differences in demand between firms making collusion improbable.

Collusion in the EC: A Web Based Exercise

Go to the following Website: [The EC Competition Newsletter](#)

Obtain a copy of the following articles

Joshua J (1999), Cartel Enforcement, Competition Policy Newsletter, no. 1. October, pp. 27 - 30

Dohms R and Visser M (1999) The Commission fines a cartel of British Sugar producers and merchants, Competition Policy Newsletter, no. 1. October, pp. 33 - 34.

Before the class I want you to have read the articles and considered the following questions.

1. How did these cartels develop?
2. What form did they take?
3. How long did they last?
4. Was there any evidence of cheating by the participants?
5. Are the punishments sufficient?

Try a search on the EU Competition website to find instances of permissible agreements, permissible as indicated by Article 81 section 3 of The Treaty of Amsterdam.

In the class you will have to discuss these questions with other members of the class and write down answers.

Additional material on the role of the EC in determining collusive behaviour can be found in Martin (1994) pp. 175 – 187.

A Conclusion

Collusive activity is quite natural as Adam Smith recognised over 200 years ago. However, it can be against the public interest. Legislation in the UK and the EU does allow some collusive practices, as long as the wider benefits to society outweigh the costs.

This is clearly a difficult area but one which regulators constantly monitor

Reading

Jensen D E and Waldman E J (1998) *Industrial Organisation. Teory and Practice*, Addison Wesley, Harlow England.

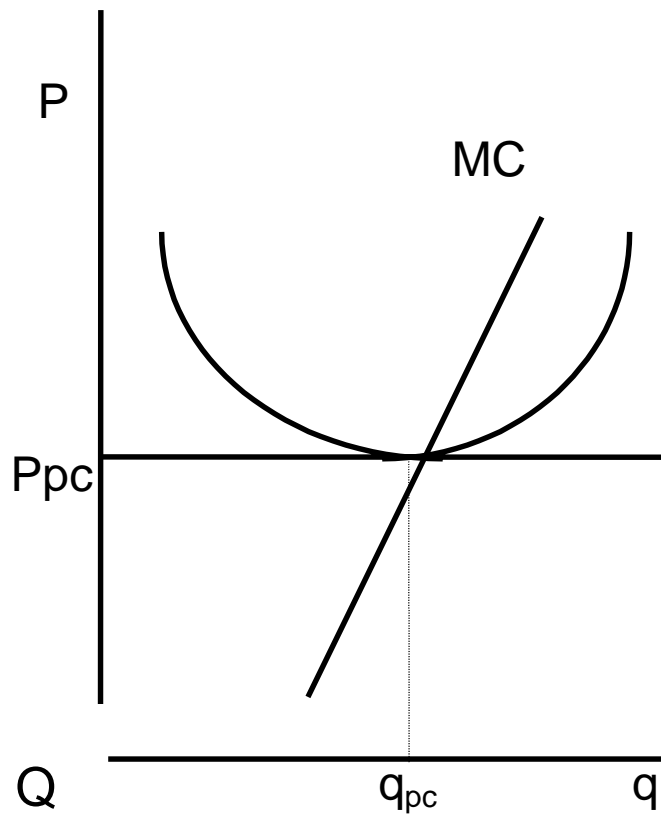
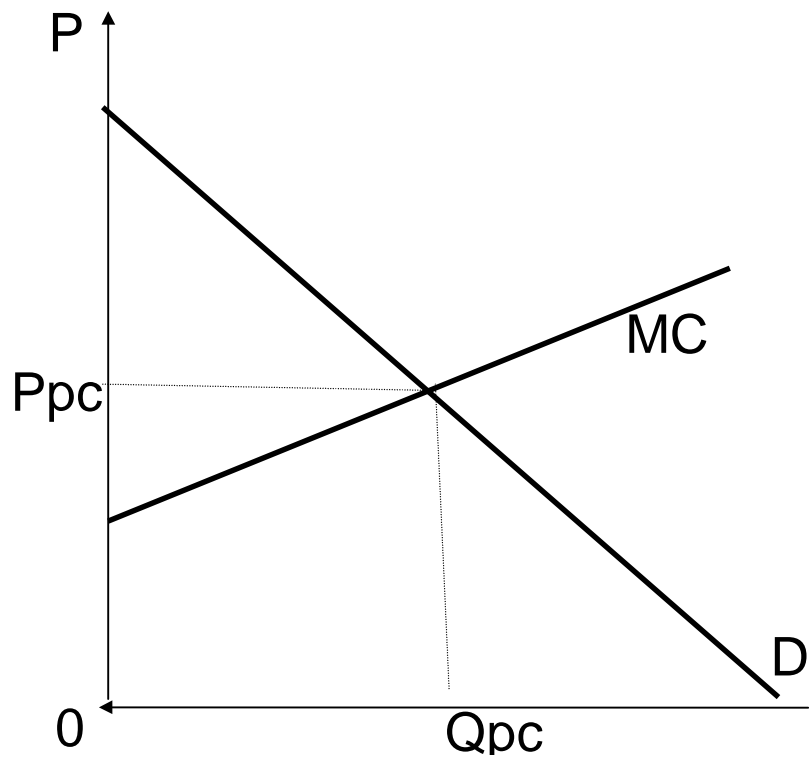
Martin S (1994) *Industrial Economics. Economic Analysis and Public Policy*, 2nd edition, Macmillan, London. Chapter 6.

Scherer, F.M. & Ross, D. (1990) *Industrial Market Structure and Economic Performance*, 3rd edition, Houghton Mifflin Co, Boston. Chapters 6 - 9.

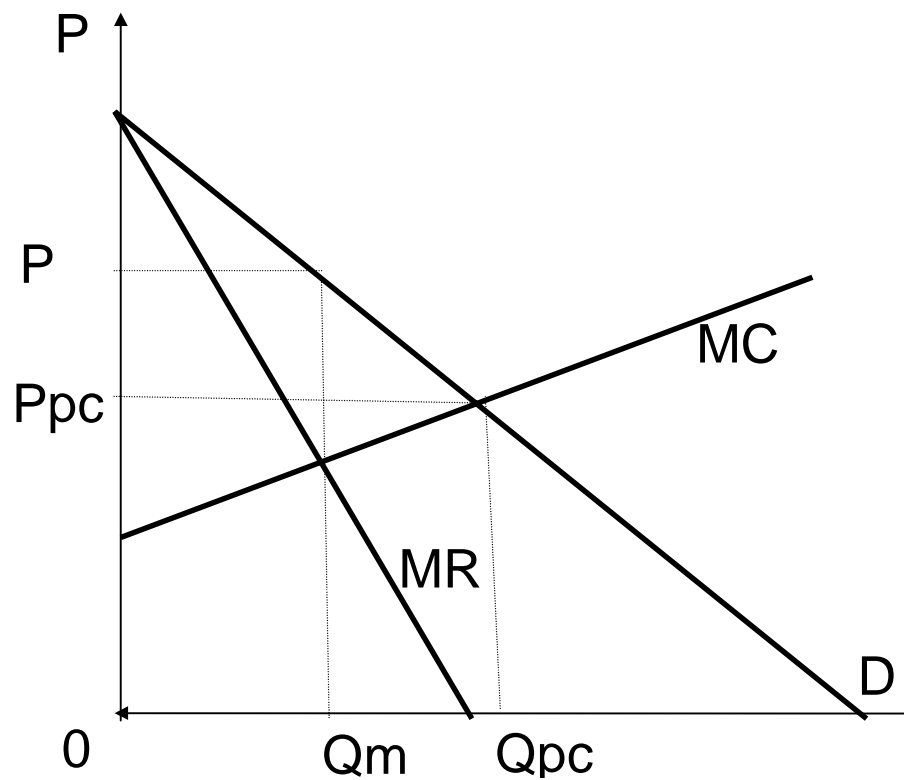
Shepherd, W.G. (1990) *The Economics of Industrial Organisation*, Prentice Hall International, London. Chapters 13 & 14.

The Incentive to cheat: A view from inside the firm

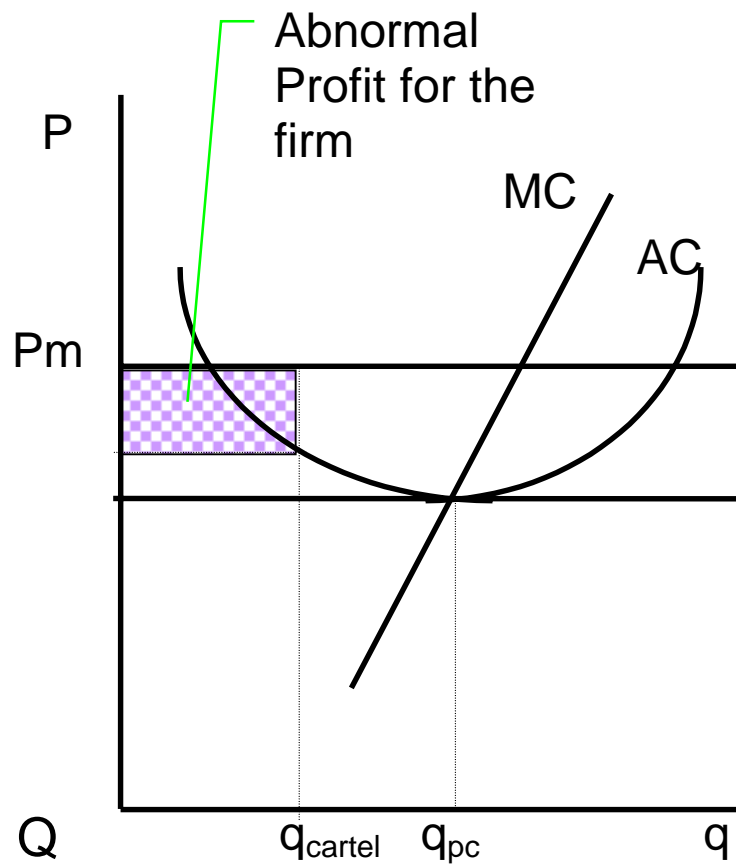
1. Perfect Competition



2. Collusion

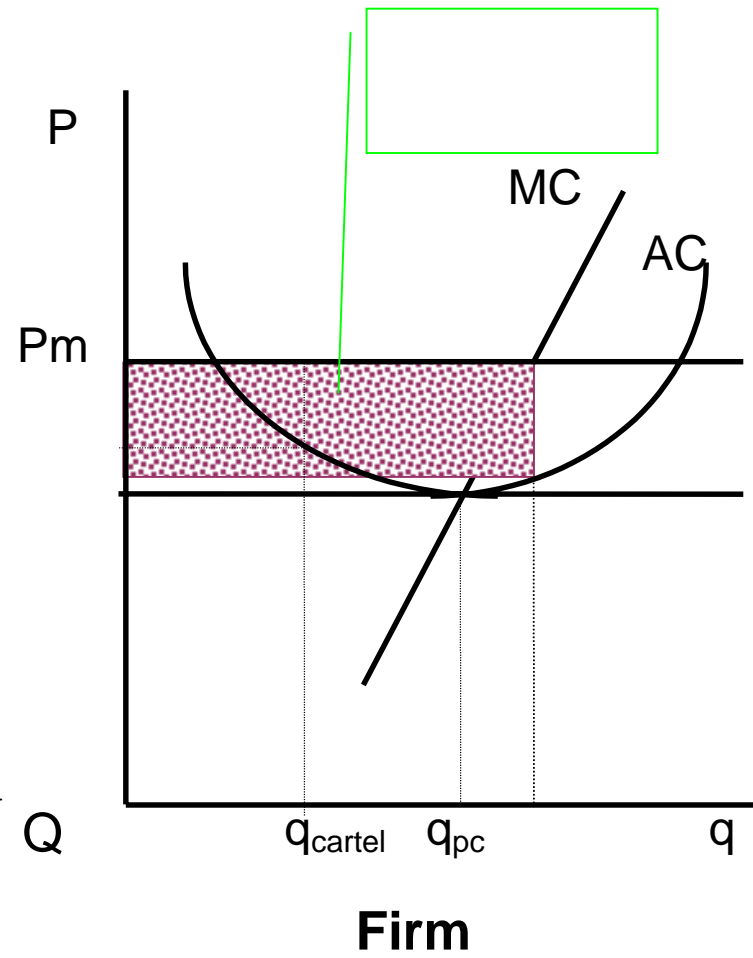
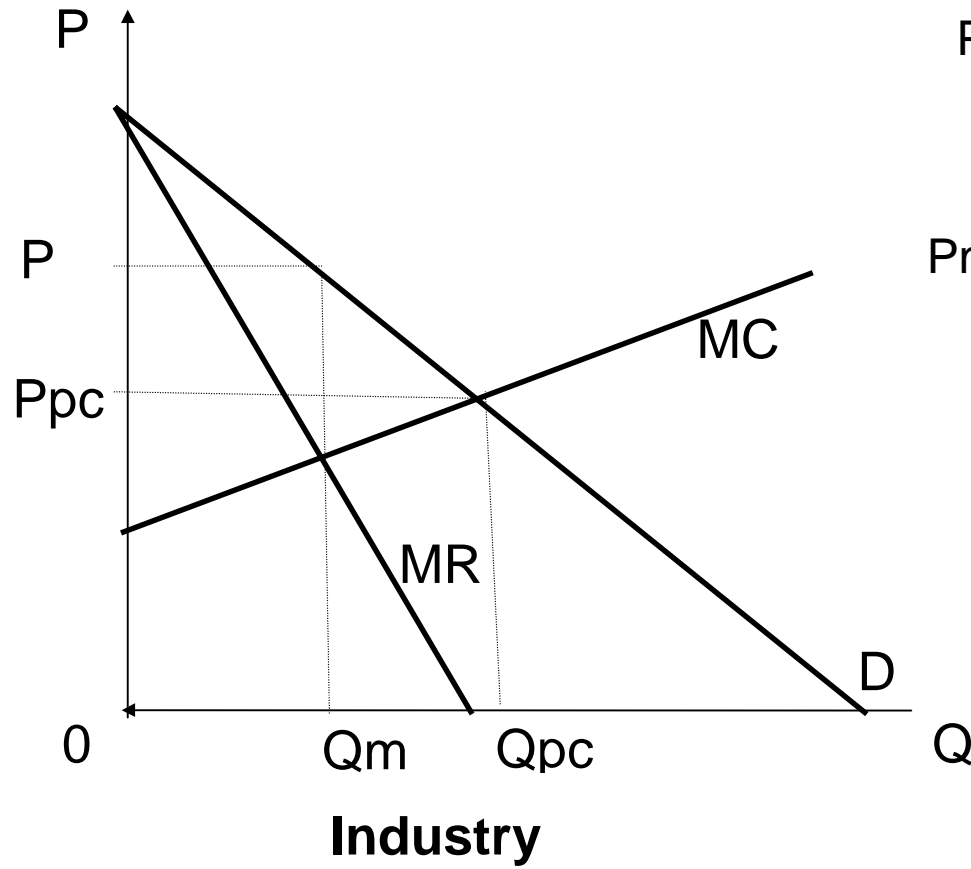


Industry



Firm

3. Cheating





Cartels and Collusive Behaviour

by

Kevin Hinde

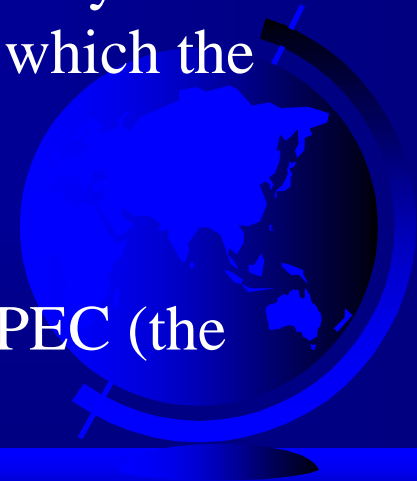
What is meant by collusion?

- ❖ Was Adam Smith right?
 - “People of the same trade meet together, even for merriment and diversion, but the conversation ends in conspiracy against the public, or in some contrivance to raise prices.”
- ❖ Today we see
- ❖ Cartels.
- ❖ Controls
- ❖ Tacit Collusion
- ❖ How can we explain such behaviour?



Tacit collusion

- ❖ There are a number of models
- ❖ Barometric Price
 - where one firm acts as a barometer for the industry and others follow.
- ❖ Kinked Demand
 - firms converge at a stable price above which they would face dramatic falls in sales and below which the increase in sales are negligible.
- ❖ Dominant Group
 - used to explain cartels such as OPEC and CIPEC (the copper cartel)

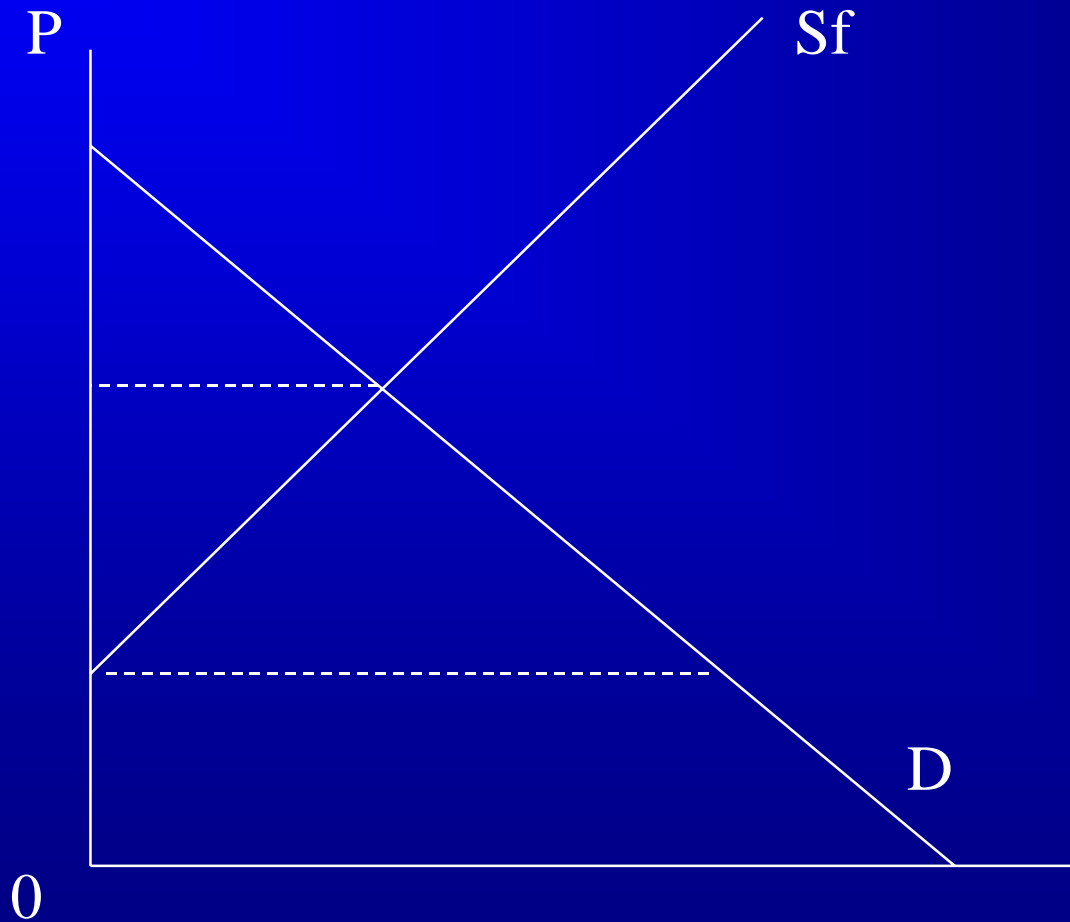


The Dominant Group - *Price* Leadership

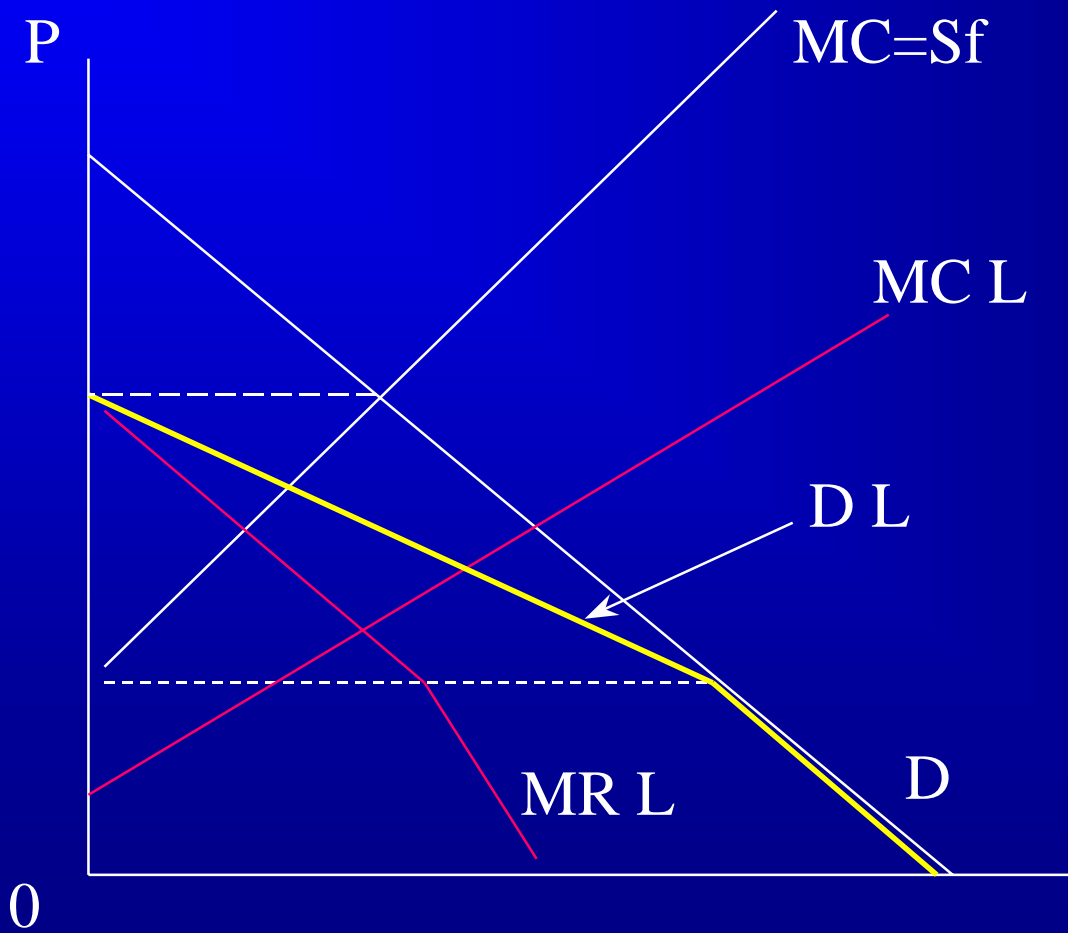
- ❖ A dominant firm or group has full information about market demand and industry costs can set prices so that it earns economic profit whilst the passive fringe earns a normal rate of return.



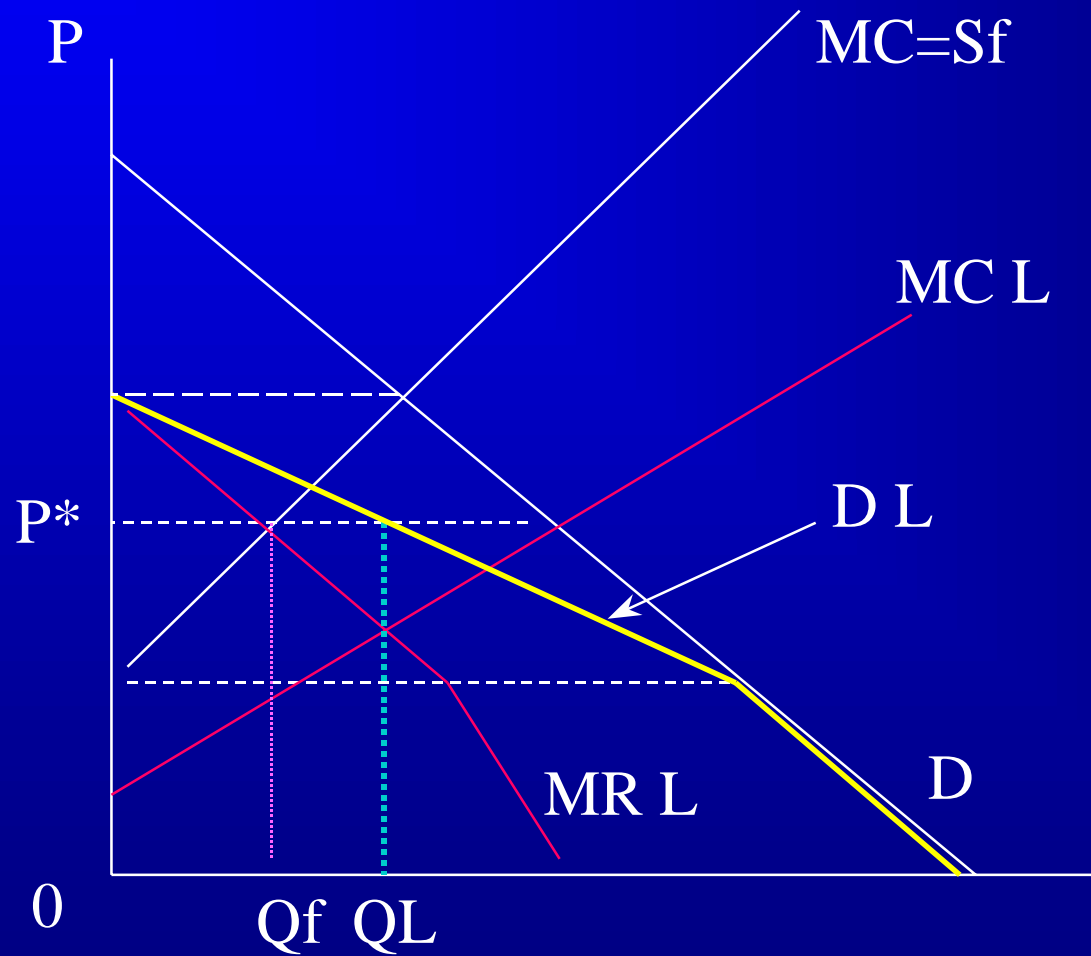
The Dominant Firm Model (1)



The Dominant Firm Model (2)

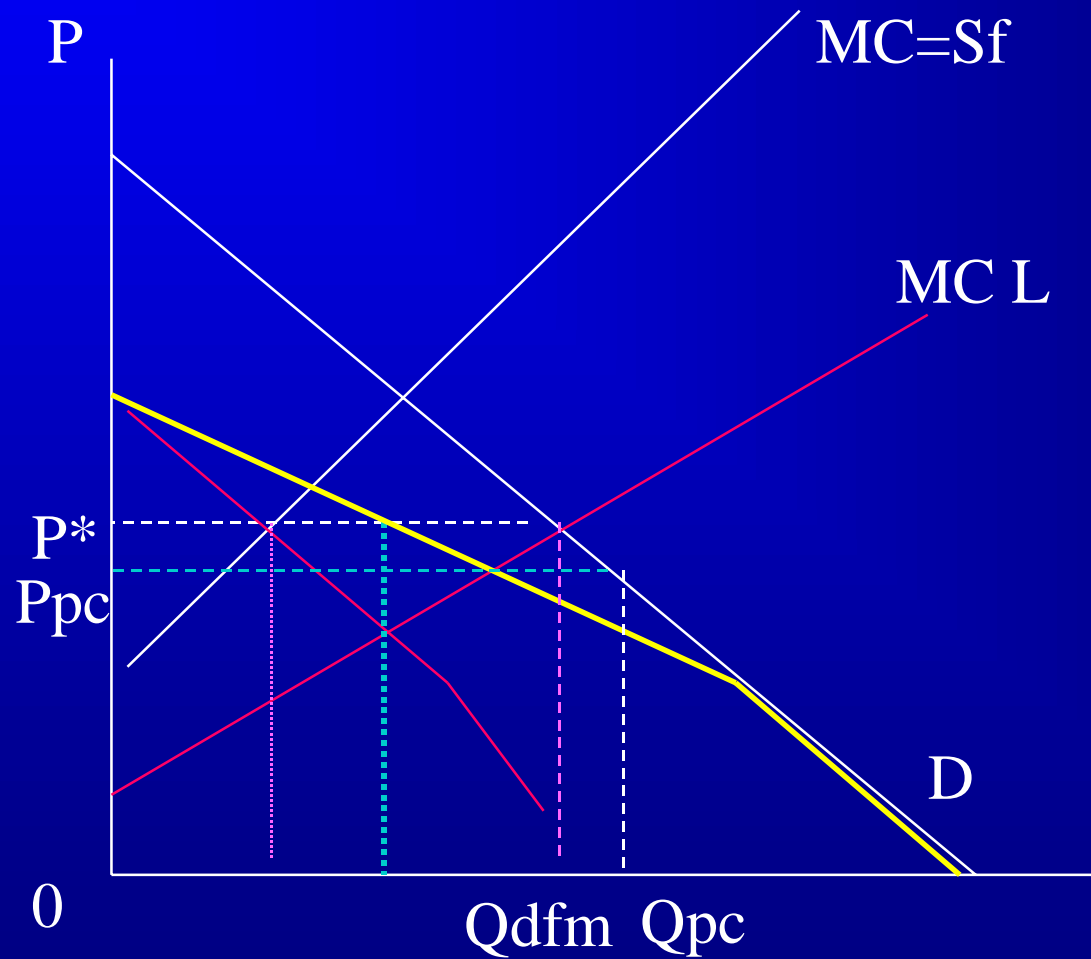


The Dominant Firm Model (3)



Comparing the dominant firm with perfect competition.

What if the demand and supply curves were more (in)elastic?



A numerical example

- ❖ Assume the supply curve of the competitive fringe is

$$S = 0.2P$$

- ❖ This is known to the dominant firm as is the market demand.

$$D = 50 - 0.3P$$

- ❖ The dominant firm derives its own demand curve as the difference

$$X = D - S \text{ at any one price}$$

$$X = 50 - 0.3P - 0.2P$$

$$\text{or } P = 100 - 2X$$



- ❖ Assume the dominant firm's costs are

$$C = 2X$$

- ❖ and it maximises its profits

$$\Pi = R - C = PX - 2X$$

$$\Pi = (100 - 2X)X - 2X = 98X - 2X^2$$

$$\frac{\partial \Pi}{\partial X} = 98 - 4X = 0$$

$$X = 24.5$$



- ❖ The leader will set price

$$P = 100 - 2X = 100 - 2(24.5) = 51$$

- ❖ At this price the market is in equilibrium when.

$$D = 50 - 0.3 P = 34.7$$

- ❖ As the leader produces 24.5 the fringe supplies

- ❖ $S = 0.2P = 0.2(51) = 10.2$



The Prisoner's Dilemma Game



RED

C

D

C

(3, 3)

(1, 4)

YELLOW

D

(4, 1)

(2, 2)



The Prisoner's Dilemma

		Prisoner 2	
		Confession	No Confession
Prisoner 1	Confession	$(-5, -5)$	$(-0.5, -10)$
	No Confession	$(-10, -0.5)$	$(-1, -1)$



Bertrand Duopoly Game

		Firm 2	
		High Price	Low Price
Firm 1	High Price	(100, 100)	(-10, 140)
	Low Price	(140, -10)	(0, 0)



Resolving the Prisoner's Dilemma Game



Tit for Tat Strategies

- ❖ Discovered in Robert Axelrod's tournament to be the most successful strategy.
- ❖ It entails
 - cooperation in the first round.
 - Every subsequent round adopt your opponents strategy (e.g. in round t adopt $t-1$)
- ❖ In the tournament each program competed
 - head to head against another
 - against another, but selected randomly by a computer
 - against itself.



Playing the Game

	Firm 1 Tit for Tat	Firm 2 Dominant Strategy
Round 1	C -10	D 140
Round 2	D 0	D 0
↓	↓	↓
Round 9	D 0	D 0
Round 10	D 0	D 0
Total Profits	- 10	140



Playing the Game (2)

	Firm 1 Tit for Tat		Firm 3 Tit for Tat	
Round 1	C	100	C	100
Round 2	C	100	C	100
↓				
		↓		↓
Round 9	C	100	C	100
Round 10	C	100	C	100
Total Profits		1000		1000



Playing the Game (3)

	Firm 2 Dominant Strategy	Firm 3 Dominant Strategy
Round 1	D 0	D 0
Round 2	D 0	D 0
↓	↓	↓
Round 9	D 0	D 0
Round 10	D 0	D 0
Total Profits	0	0



Problems for Tit for Tat

- ❖ Generally tit for tat works because it is
- ❖ nice
 - it starts out co-operatively and is not the first to defect.
- ❖ Provocable
 - it will punish defection quickly
- ❖ forgiving
 - it will act co-operatively again if the other player co-operated in $t-1$
- ❖ However it is suboptimal in
 - head to head contests with a dominant strategy player.
 - Situations where information is uncertain an incomplete



Tit for Tat and random effects

	Firm 1 Tit for Tat		Firm 2 Tit for Tat	
Round 1	C	100	C	100
Round 2	C	100	C	100
Round 3	Nature D	140	C	- 10
Round 4	C	- 10	D	140
Round 5	D	140	C	- 10
Round 6	C	- 10	D	140
Round 7	D	0	Nature D	0
Round 8	D	0	D	0
Round 9	D	0	D	0
Round 10	D	0	D	0
Total Profits		460		460



Tit for 2 Tats and random effects

	Firm 1 Tit for 2 Tats	Firm 2 Tit for 2 Tats
Round 1	C 100	C 100
Round 2	C 100	C 100
Round 3	Nature D 140	C - 10
Round 4	C 100	C 100
Round 5	C 100	C 100
Round 6	C 100	C 100
Round 7	C - 10	Nature D 140
Round 8	C 100	C 100
Round 9	C 100	C 100
Round 10	C 100	C 100
Total Profits	930	930



Tolerating Cheating in a Prisoner's Dilemma Game

		Kuwait Production	
		1 m barrels per day	2m barrels per day
Saudi Arabia Oil Production	4 m barrels per day	(64,16)	(48,24)
	5 m barrels per day	(60,12)	(40, 16)

Source: Dixit and Nalebuff (1991)



What factors facilitate (and thus limit the extent of) collusion?

- ❖ **Clearly, it is possible to resolve the Prisoner's Dilemma Game, although there are immense forces operating against it.**
- ❖ **Are there any clues as to when collusion may or may not occur?**
- ❖ **Concentration and a small number of industry participants.**
- ❖ **Costs**
- ❖ **Demand**
- ❖ **Rapid advances in Technology**
- ❖ **Non-price competition**

