MANAGERIAL ECONOMICS CHAPTER 13

Price and Output Determination: Oligopoly

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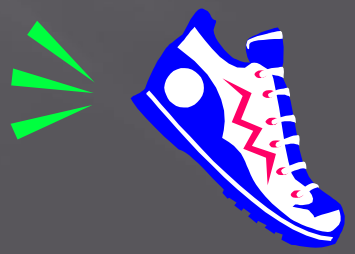
Chapter # 13

- **Oligopolistic Market Structures**
  - Few Firms
    - Consequently, must consider the **reaction** of rivals to price, production, or product decisions
    - Interrelated reactions
  - Heterogeneous or Homogeneous Products
- Example -- athletic shoe market
  - Nike has 47% of market
  - Reebok has 16% and Adidas has 7%



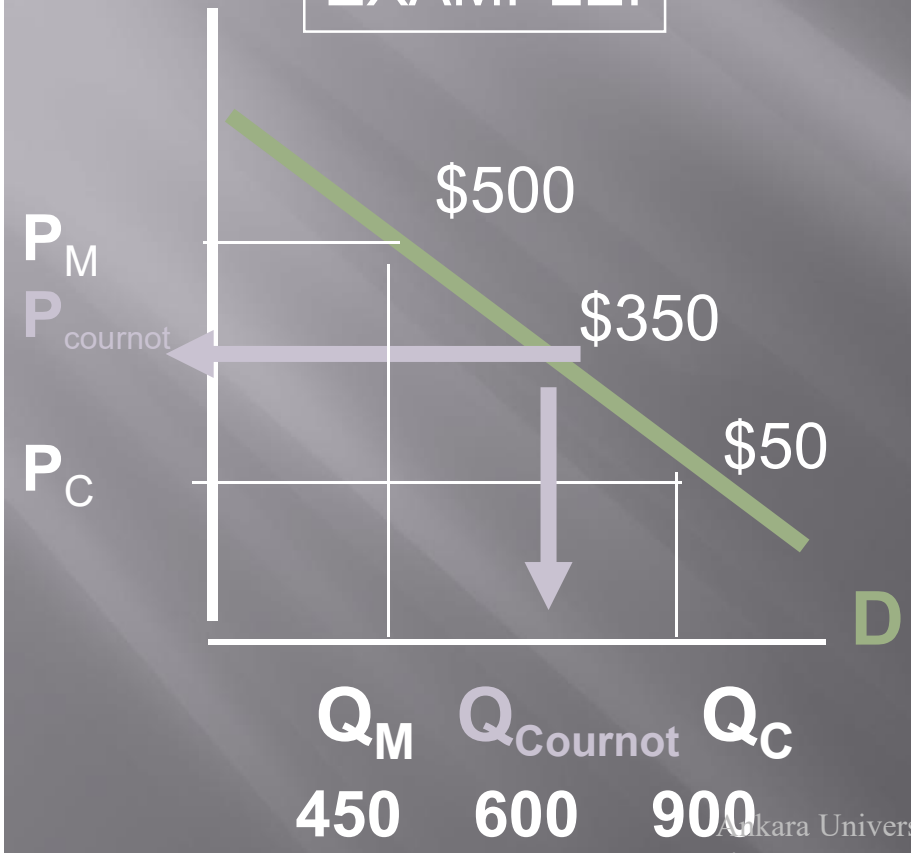
COURNOT OLIGOPOLY

- **Oligopoly** -- just a few firms
- Models vary depending on assumptions of actions of **rivals** to pricing and output decisions.
- Augustin **Cournot** (1838) created a model that is the basis of Anti-trust Policy in the US.
  - Relatively simple assumption: ignore the interdependency with rivals
  - This makes the math easy

A Model Between Monopoly & Competition

P = 950 - Q and MC =50

EXAMPLE:



- **IN COMPETITION**
  - P = MC, so 950 - Q = 50
  - P_C = \$50 and Q_M = 900
- **IN MONOPOLY**
  - MR = MC, so 950 -2Q = 50
  - Q_M = 450 so
  - P_M = 950 - 450 = \$500
- **IN DUOPOLY**
  - **Let $Q = q_1 + q_2$**

Cournot Solution:
Case of 2 Firms (Duopoly)

- Assume each firm maximizes profit
- Assume each firm believes the other will **NOT** change output as they change output.
  - The so-called: Cournot Assumption
- Find where each firm sets **MR = MC**

Let $Q = q_1 + q_2$

- $P = 950 - Q = 950 - q_1 - q_2$ and $MC = 50$

- $TR_1 = Pq_1 = (950 - q_1 - q_2)q_1 = 950q_1 - q_1^2 - q_1q_2$ and
- $TR_2 = Pq_2 = (950 - q_1 - q_2)q_2 = 950q_2 - q_2q_1 - q_2^2$

- Set $MR_1 = MC$ & $MR_2 = MC$

  $950 - 2q_1 - q_2 = 50$

  $950 - q_1 - 2q_2 = 50$

2 equations & 2 unknowns

With 2 Equations & 2 Unknowns:
Solve for Output

$$950 - 2q_1 - q_2 = 950 - q_1 - 2q_2$$

So, $q_2 = q_1$ Then plug this into the demand equation we find:

$$950 - 2q_1 - q_1 = 950 - 3q_1 = 50.$$

Therefore $q_1 = 300$ and $Q = \underline{600}$

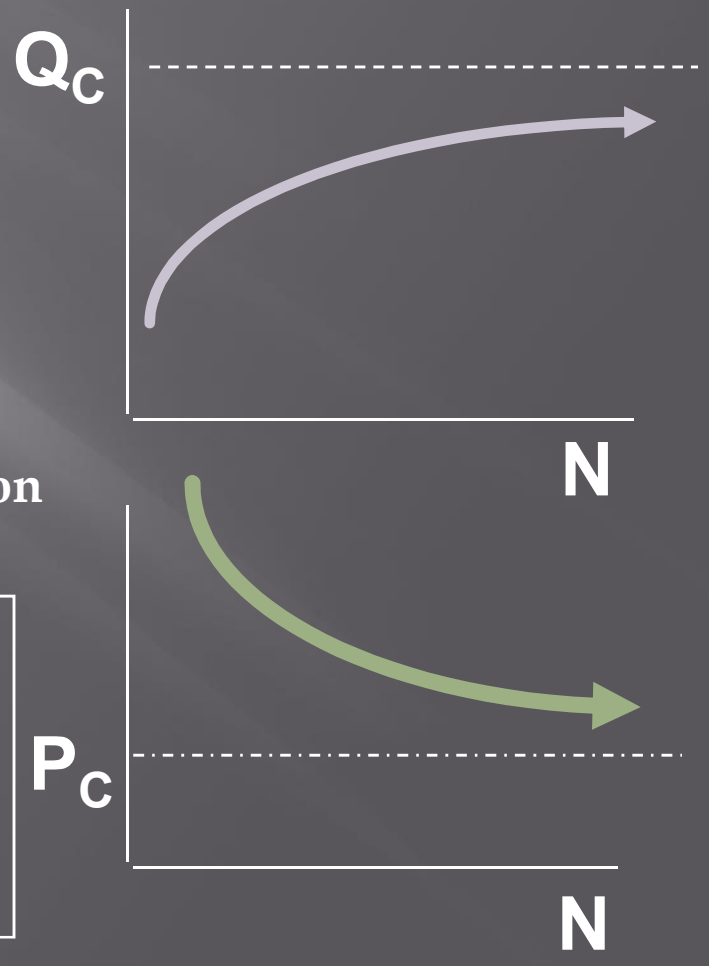
The price is: $P = 950 - 600 = \underline{\$350}$

	P	Q
Competition	50	900
Cournot	350	600
Monopoly	500	450

N-Firm Cournot Model

- For 3 firms with linear demand and cost functions:
  - $Q = q_1 + q_2 + q_3$
  - the solution is higher output and lower price

$Q_{Cournot} = \{ N/(N+1) \} Q_{Competition}$



THEREFORE, Increasing the Number of Firms Increases Competition. This is the historical basis for Anti-trust Policies

Example: Cournot as N Increases

N = 3

- If N = 3 Triopoly
- P = 950 - Q & MC=50
- Then, Q = (3/4)(900)
- Q = 675
- P =$275

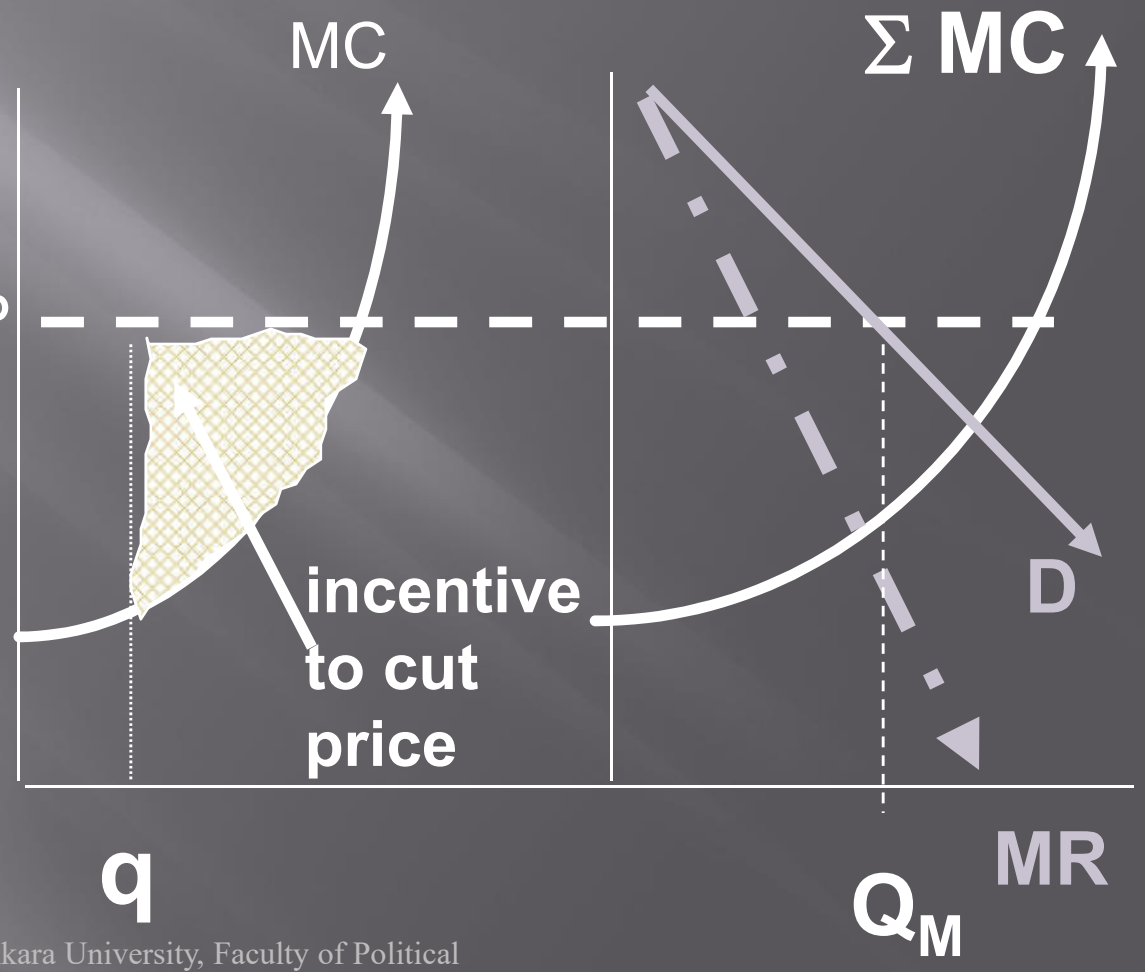
N = 5

- If N = 5
- P = 950 - Q and MC = 50
- Then Q = (5/6)(900)
- Q = 750
- P = $200

Oligopolies & Incentives to Collude

When there are just a few firms, profits are enhanced if all reduce output

But each firm has incentives to "cheat" by selling more



Collusion *vs* Competition

- Sometimes collusion will succeed
- Sometimes forces of competition win out over collective action
- When will Collusion tend to succeed?
  - Determinants of successful collusion, for industries with only

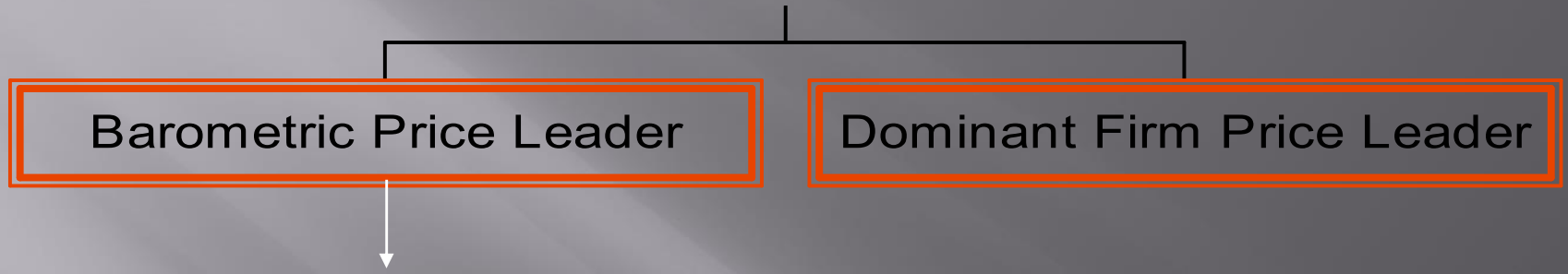
Factors Likely to Affect Collusion

1. ***Number and Size Distribution of Sellers***. Collusion is more successful with few firms or if there exists a dominant firm.
2. ***Product Heterogeneity***. Collusion is more successful with products that are standardized or homogeneous
3. ***Cost Structures***. Collusion is more successful when the costs are similar for all of the firms in the oligopoly.
4. ***Size and Frequency of Orders***. Collusion is more successful with small, frequent orders.
5. ***Secrecy and Retaliation***. Collusion is more successful when it is difficult to give secret price concessions.

Examples of Cartels

- **Ocean Shipping** -- maritime exemption from US Antitrust Laws
- **DeBeers** -- diamonds
- 1950's **Electrical Pricing Conspiracy** -- GE, Westinghouse, and Allis Chalmers
- **OPEC** - oil cartel, with Saudi Arabia making up 33% of the group's exports
- **Siemens and Thompson-CSF --** airport radar systems
- **NCAA** - intercollegiate sports

PRICE LEADERSHIP



- **Barometric:** One (or a few firms) sets the price
- One firm is unusually aware of changes in cost or demand conditions
- The barometer firm senses changes first, or is the first to ANNOUNCE changes in its price list
- Find barometric price leader when the conditions unsuitable to collusion & firm has good forecasting abilities or good management

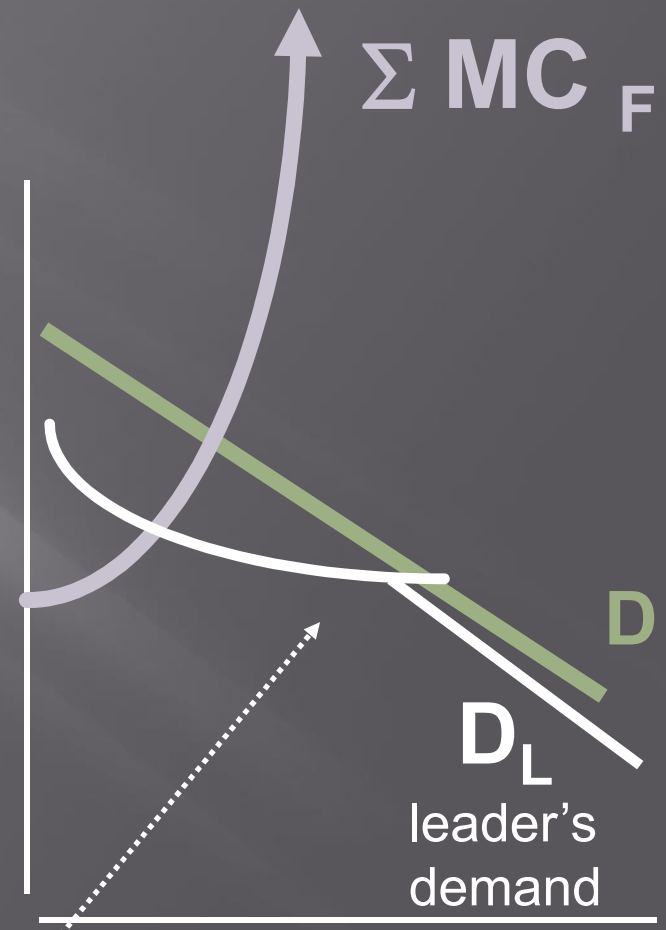
Barometric Price Leader Example: Citibank & Prime Rate Announcements

- Banking: 6,000 banks and falling, but still a lot.
- New York, center of Open Market activities of the Fed Reserve
- Citibank's announcement represents changes in interest rate conditions to other banks tolerably well.

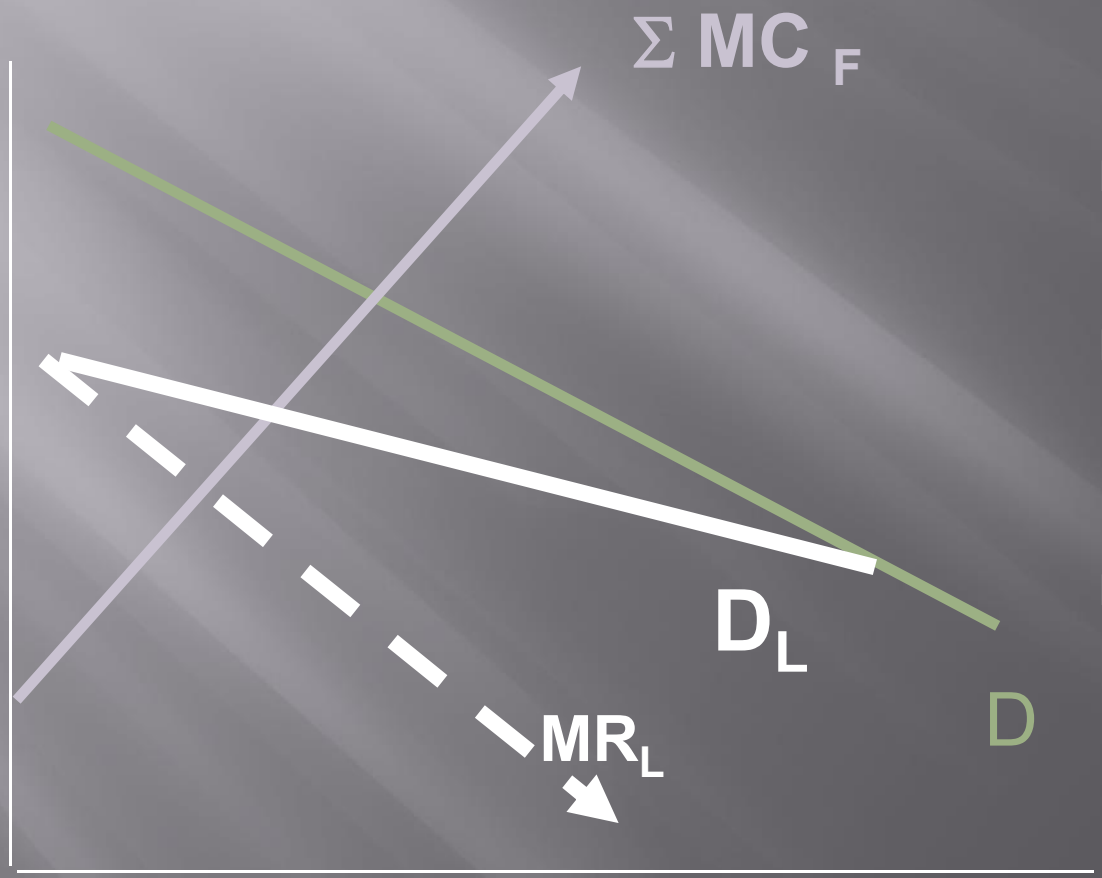
Dominant Price Leadership

- **Dominant Firm**: 40% share of market or more.
- No price or quantity collusion
- Dominant Firm **(L)** expects the other firms **(F)** to follow its price and produce where

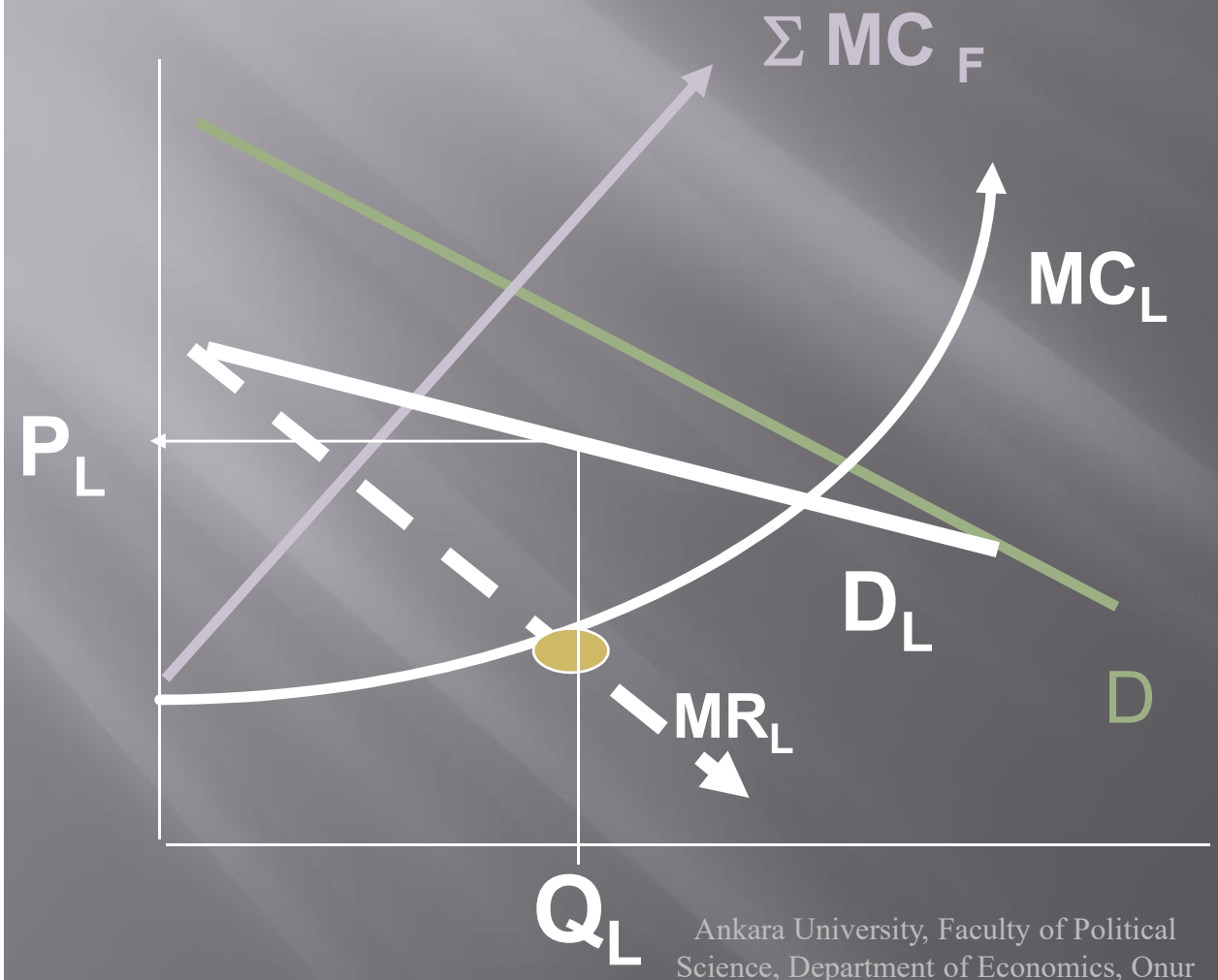
$$\Sigma MC_F = P_L$$



Net Demand Curve: $D_L = D - \Sigma MC_F$



- Find leader's demand curve, $D_L = (D - \Sigma MC_F)$
- Find where $MR_L = MC_L$
- At Q_L, find the leader's price, P_L
- Followers will supply the remainder of Demand: $(Q_T - Q_L) = Q_F$



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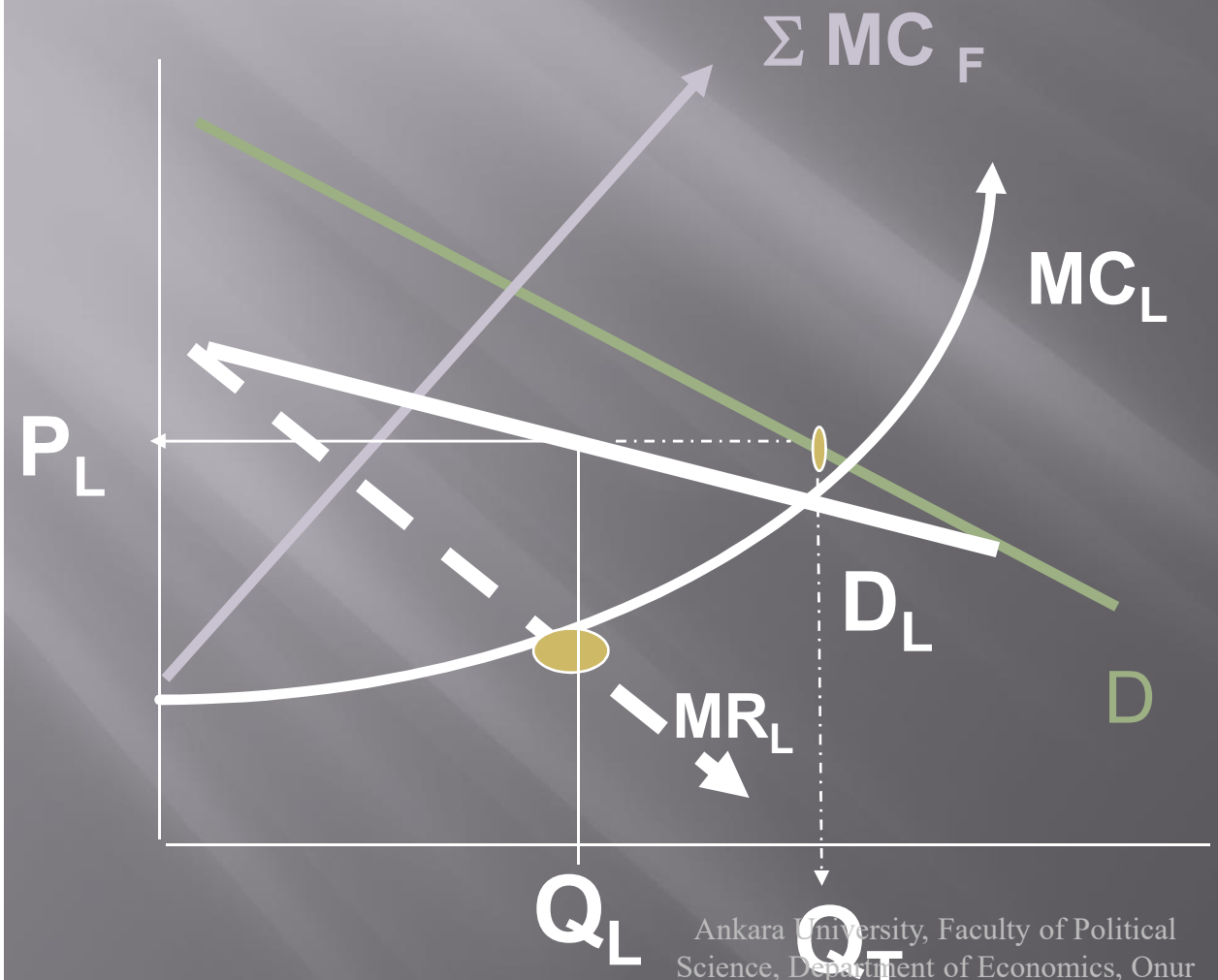

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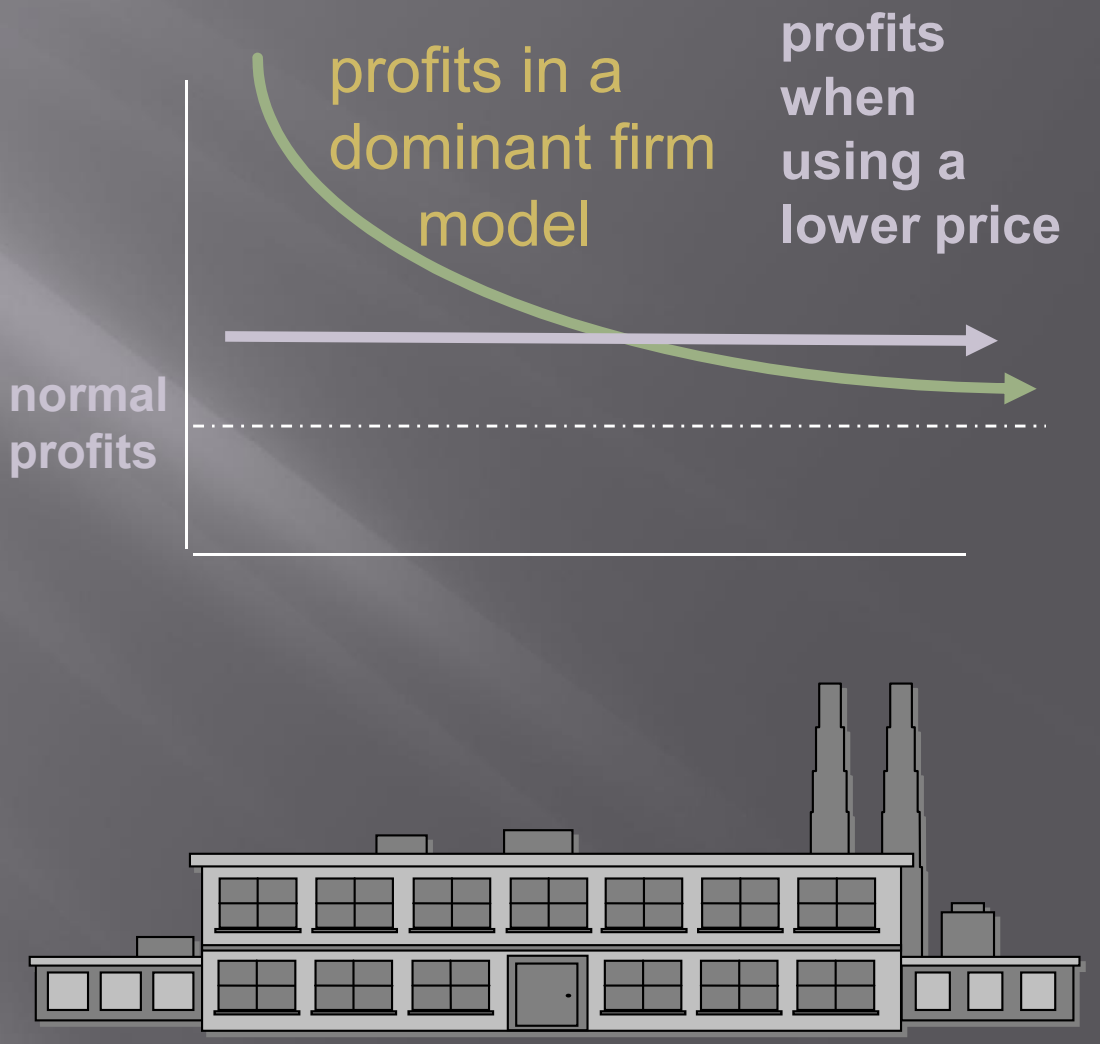
Implications of a Dominant Firm P.L.

- **Market Share** of the Dominant Firm **Declines** Over Time
  - Entry expands Σ MC_F, and Shrinks D_L and MR_L
- **Profitability** of the Dominant Firm **Declines** Over Time

- Market Share of the Dominant Firm is **PROCYCLICAL**
  - rises in booms, declines in recessions

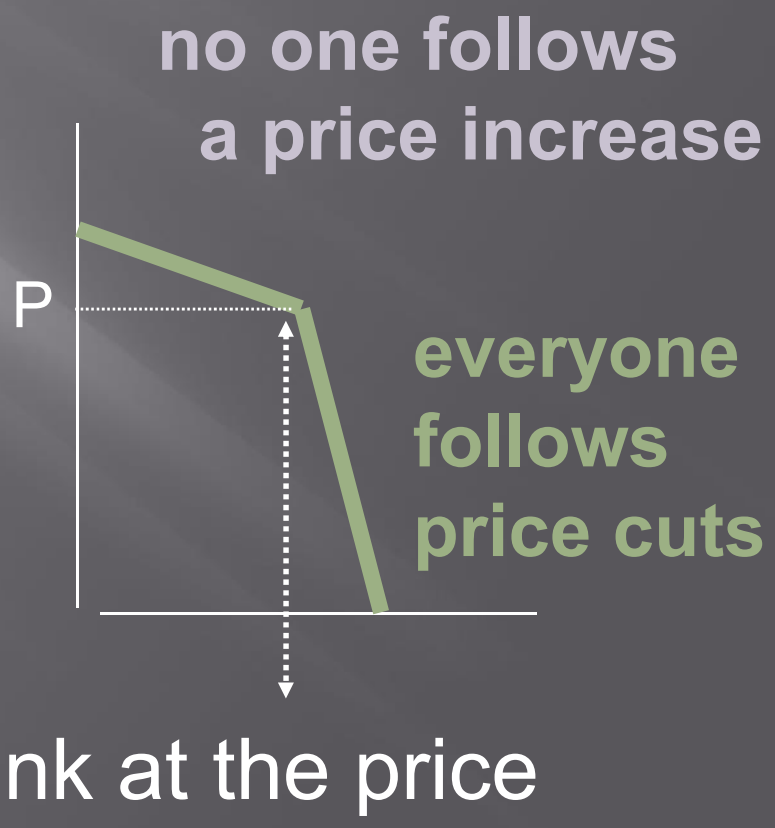
U.S. Steel (USX)

- Judge Gary
- Industrial "Cocktail Parties" to discuss pricing
- 1901 steel mergers led by J.P.Morgan
  - 66% market share
  - 46% market share by 1920
  - 42% share by 1925

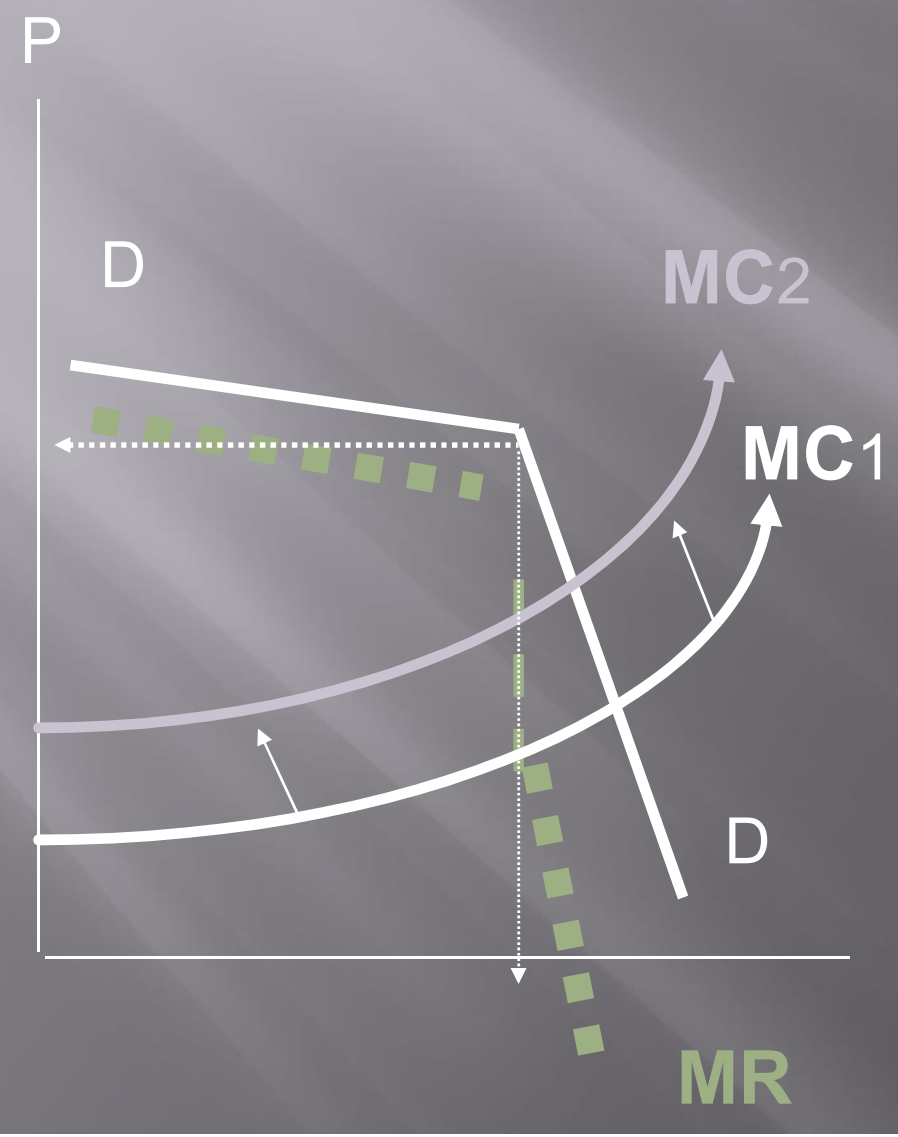


Kinked Oligopoly Demand Curve

- Belief in **price rigidity** founded on experience of the great depression
- Price **cuts** lead to everyone following
  - highly inelastic
- Price **increases**, no one follows
  - highly elastic



A Kink Leads to Breaks in the MR Curve

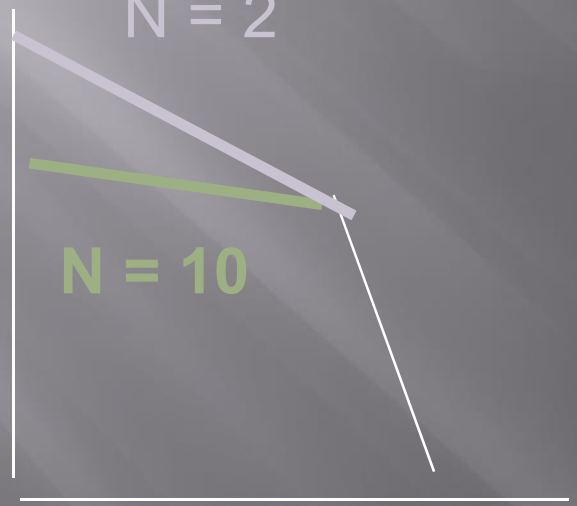


- Although MC rises, the optimal price remains constant
- Expect to find price rigidity in markets with kinked demand
- QUESTION:
  - Where would we more likely find KINKS and where NOT?

Which industries are likely to have kinks and which have no kinks?

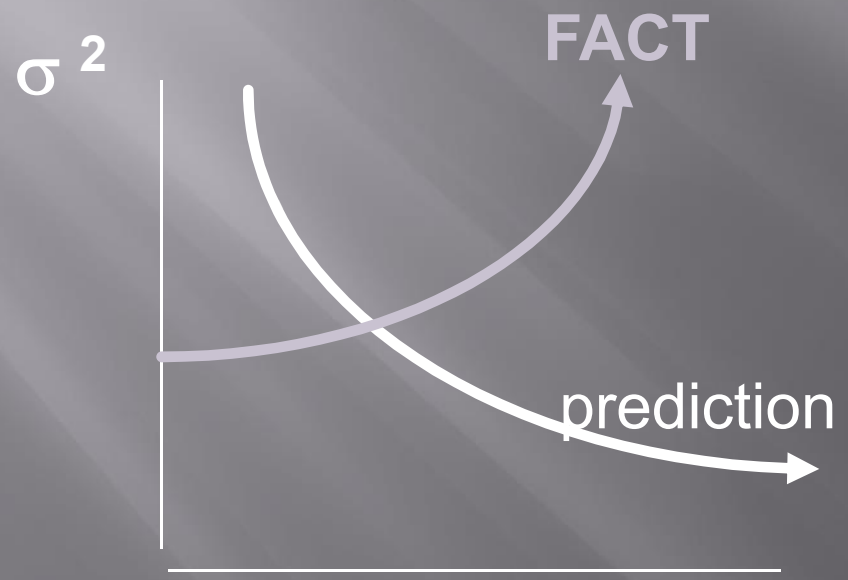
- The GREATER the number of firms, likely more kinked
- Prices Likely More Rigid

- The more HOMOGENEOUS, likely more kinked
- Prices More Rigid

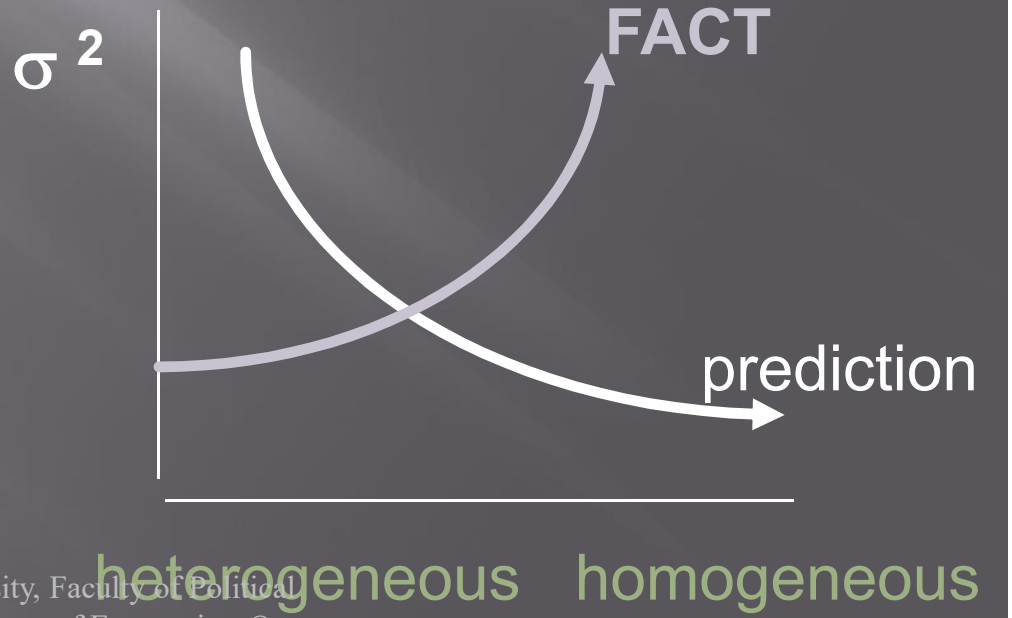


Empirical Evidence *vs.* Predictions of the Model

- Oligopolies with few firms were **more rigid** in FACT



- Oligopolies with homogeneous products were **MORE** rigid in FACT

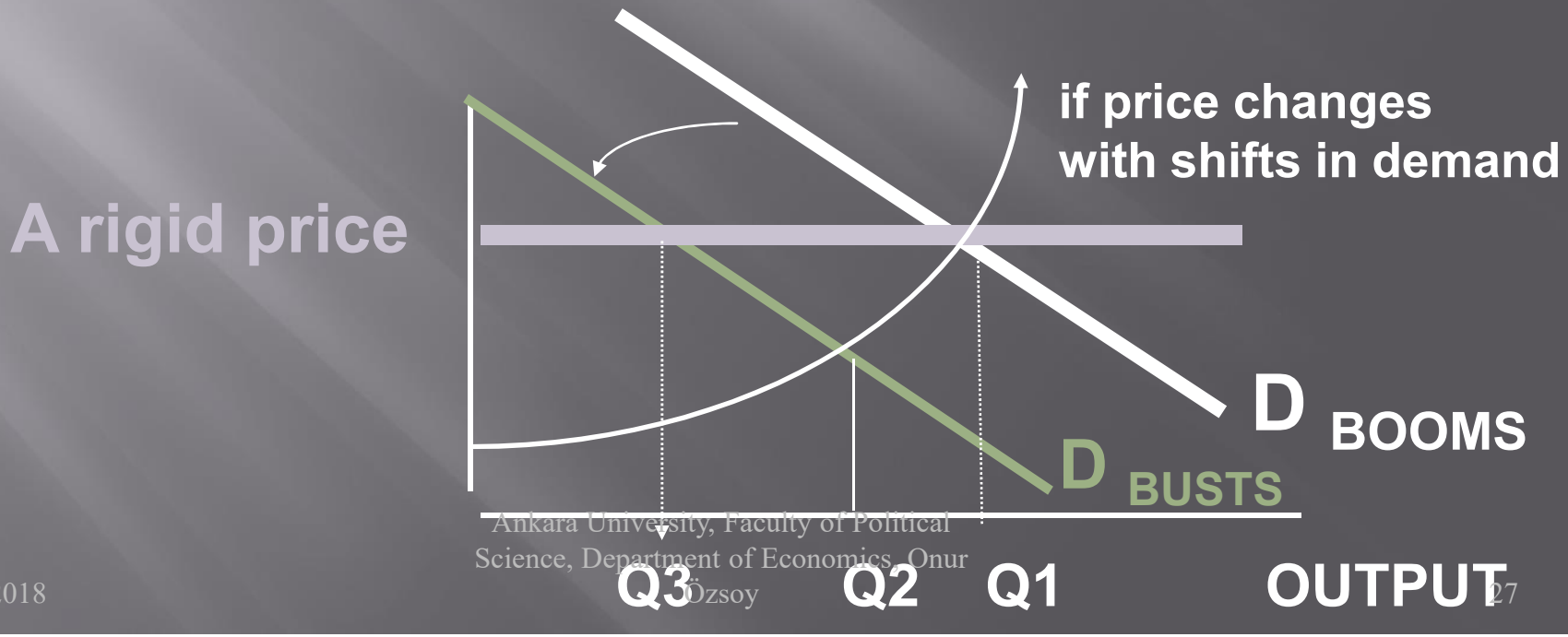


Are these Empirical Findings Surprising?

- A Kink is a **barrier to profitability**
- Firms are in business to make profits and avoid "barriers."
- **Simple Alternative Explanations Exist:**
  - More firms are more competitive
  - More homogenous products act more competitive
- Collusion leads firms to fix prices. The rigid prices seen in oligopolies are signs of collusion.

Price Rigidities and Employment Impacts

- Price rigidity will make business downturns worse
- Employment will be more volatile over the business cycle if there are price rigidities



Oligopolistic Rivalry & Game Theory

- John Von Neuman & Oskar Morgenstern--
  - Game Theory used to describe situations where individuals or organizations have conflicting objectives
  - **Examples:** Pricing of a few firms, Strategic Arms Race, Advertising plans for a few firms, Output decisions of an oligopoly
- **Strategy**--is a course of action
  - The **PAYOFF** is the outcome of the strategy.
  - Listing of PAYOFFS appear in a **payoff matrix**.

Two Person, Zero Sum Game

ASSUMPTIONS

- Each player knows his and opponent's alternatives
- Preferences of all players are known
- Single period game
- Sum of payoffs are zero
  - Like a Poker Game
- **An Equilibrium**--none of the participants can improve their payoff

PLAYER 2

PLAYER 1	c	d
a	1, -1	3, -3
b	-2, 2	0, 0

Player 1 is the first number in each pair. We will get to **{a,c}** which is an Equilibrium

Dominant Strategies & Maximin Strategy

- For Player 1, strategy (a) is a dominant strategy
  - best regardless of what others do
- Maximin Strategy
  - the choice that **MAX**IMIZES across the set of **MIN**IMUM possible

PLAYER 1	PLAYER 2: c	PLAYER 2: d
a	1, **-1**	3, **-3**
b	**-2**, 2	0, 0

Player 1 looks for the Max { Min}
as Max {1, -2} so picks Strategy-a
Player 2 looks for Max { Min } as
as Max {-1, -3} so picks Strategy-c

Find Maximin Strategies for Bob & Alice

- Alice's payoffs appears in upper triangle and Bob's appear in the bottom
- Find Maximin Solution
- Is it an Equilibrium?

Bob

Alice

	c	d	e
a	5 / -5	1 / -1	-1 / 1
b	3 / -3	7 / -7	-8 / 8

best

Worst for Alice with **a**-strategy is -1

Worst for Alice with **b**-strategy is -8

Worst for Bob with **c**-strategy is -5

Worst for Bob with **d**-strategy is -7

Worst for Bob with **e**-strategy is 1

best

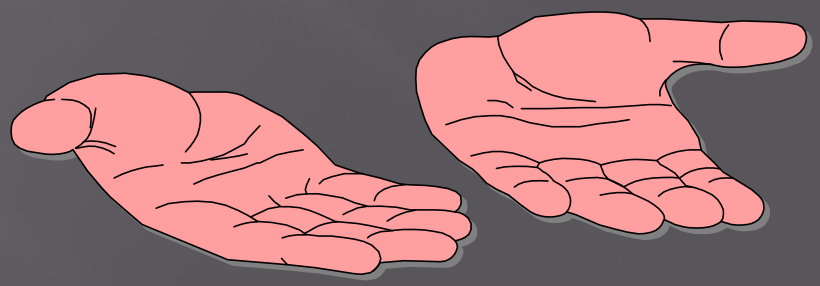
?

Unstable Games: No Equilibrium Is Found

- In the Alice-Bob Game here, Maximin Strategies lead to solution {b, c}
- But Alice has an incentive to switch to strategy-a
- Then Bob has an incentive to switch to strategy-d, *etc., etc*

Alice \ Bob	c	d
a	3, - 3	1, - 1
b	2, - 2	4, - 4

There is no, single stable equilibrium Each player may elect a random strategy

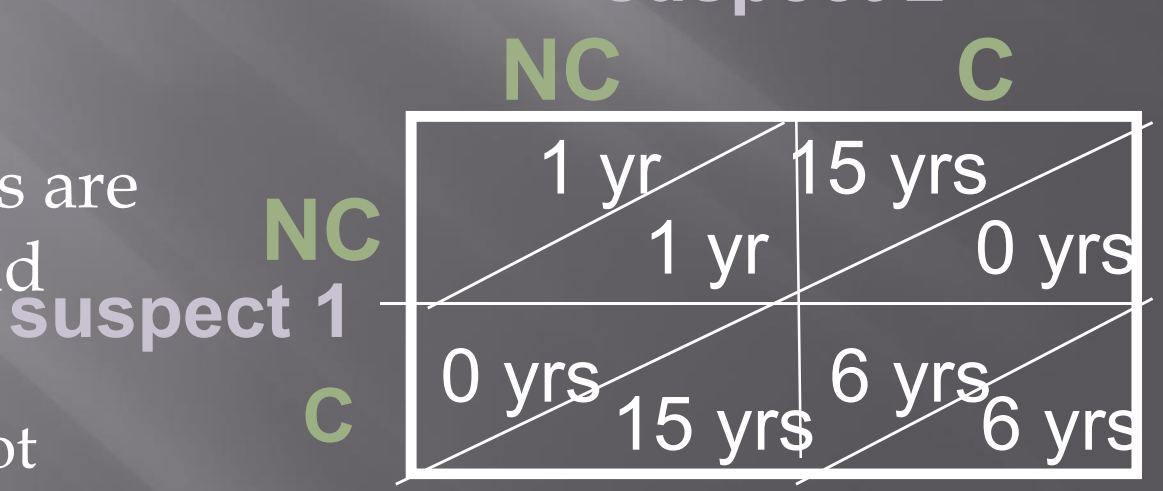


Two-Person, Non-Zero Sum Games

- Often the payoffs vary depending on the strategy choices
- *Famous Example:*

  The Prisoner's Dilemma

- Two suspects are caught & held separately
- Confess or Not Confess:
  - a one period game
- Noncooperative Solution
  - both confess: {C, C}
- Cooperative Solution
  - both do not confess {NC,NC}
- Off-diagonal represent a Double Cross

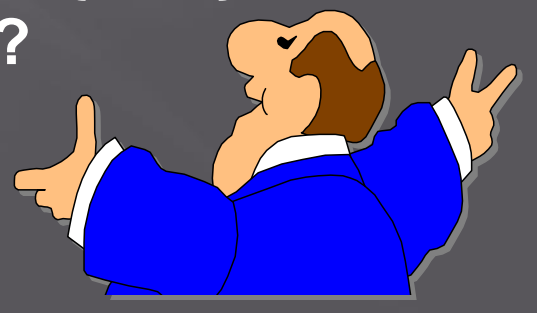


Duopoly as a Prisoner's Dilemma

- Even if both spies meet to agree on a cooperative solution, one may double cross.
- Two firms: Decision is the amount of output [S = small, or L = large]
- {L,L} represents normal profits

		FIRM 2 S	FIRM 2 L
FIRM 1	S	100, 100	10, 150
	L	150, 10	20, 20

MAXIMIN SOLUTION {L, L }
Is it an Equilibrium?



Duopoly as a Multiperiod Game

- The **single period game** predicts that there will be competition
  - But duopolists are likely to have many periods in which to compete
- **Multiple periods** allow for "Punishment" or retribution not found in single period games.
  - We would expect that collusion is More Likely to Succeed, the greater chance for more periods

N – Person Games

- Can extend also to more than 2 players
- Chief new complication:
  - Coalitions of players
  - Issues of cooperation & duplicity
- Solutions for N-person games can be difficult
  - It gives mangers a way to gain an insight into the nature of conflict, posturing, and resolution