

Non-cooperative oligopolies & Game Theory:

- A small and fixed number of firms meet (there is no entry and no repeated interactions)
 - Later in semester: repeated interactions
- All sell identical products (homogeneous)
 - Later in semester: differentiated products
- Each firm in an oligopoly thinks the following every time it decides its action: *“Since I know my competitors will respond to my action and since I know that they know that I will respond to their response rather than be passive, how should I act in the first place?”*
- Confused? It is easy to get confused without using **Game Theory** ...
- Game theory : *lets us go beyond this double guessing, formalizes the fundamental strategic aspects and allows us to get an equilibrium*

Game theory

- Game theory is the formal analysis of strategic behavior.
- Informal definition:

Seeing through the future. Decisions taken today may have an impact on both my own and my competitors' future decisions.

Seeing through your competitors' eyes. Outcomes depend not only on your decisions but also on your competitors' decisions.

Example: oil production by Russia and OPEC.

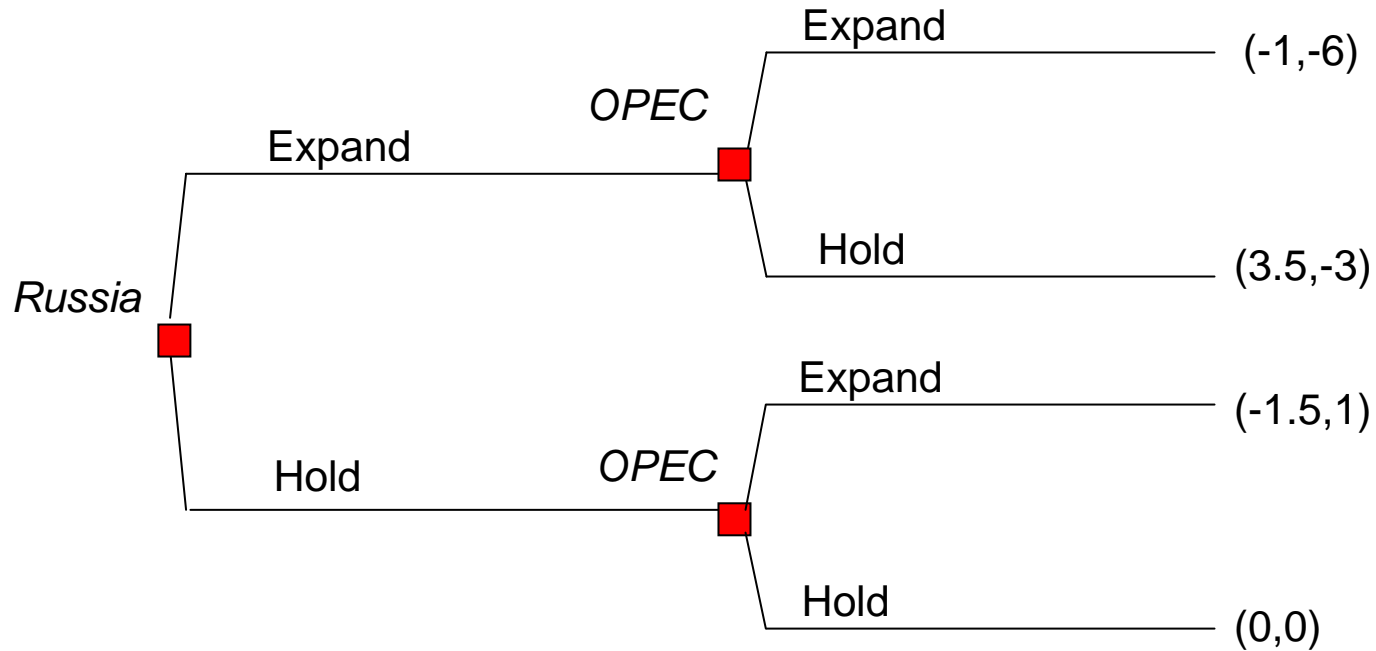
- Russia's oil output has surged this year by about 500,000 barrels a day, and is expected to rise by an additional 350,000 barrels next year.
- OPEC production meanwhile has dropped by about 3.5 million barrels a day, and OPEC is worried about losing market share to Russia.
- OPEC would like Russia to join other non-OPEC oil producing countries, like Norway and Mexico, that agree to scale back exports to keep prices above \$20/barrel.
- OPEC is threatening a price war if Russia doesn't scale back production.

OPEC's and Russia's decisions.

- Both OPEC and Russia are facing decisions about how much oil to export in the coming year.
- The payoffs from their decisions depend on what the other does:

Russia's Move	OPEC's Move	Russia's Payoff	OPEC's Payoff
Expand	Expand	-\$1 Billion	-\$6B
Expand	Hold steady	\$3.5B	-\$3B
Hold steady	Expand	-\$1.5B	\$1B
Hold steady	Hold steady	\$0B	\$0B

Game tree.



Basic concepts.

What is a game?

- Players (*e.g.*, Russia and OPEC).
- Rules (*e.g.*, sequentially choosing output).
- Strategies (*e.g.*, hold steady or expand).
- Payoffs (*e.g.*, revenue minus production costs).

What can I do with it?

- Determine how good each of my strategies is.
- Figure out what my rival is probably going to do.
- Think about ways to change the game to my advantage (*e.g.* by making a simultaneous game sequential).

How to represent a game.

Extensive or game-tree form:

- Decision trees with nodes for competitor's decisions.
- These are most useful when decisions are sequential.

Normal form:

- These are most useful when decisions are made simultaneously (or when firms don't observe their competitors' decisions).

Normal form: example.

		Player B		
		L	C	R
Player A	T	9 5	8 6	1 7
	M	1 3	2 5	0 6
	B	2 7	3 6	3 8

Dominant and dominated strategies.

In a *dominant strategy*, your payoff is greater than any other strategy regardless of your rival's choice.

Rule 1: Always choose a dominant strategy if there is one.

In a *dominated strategy*, your payoff is lower than some other strategy regardless of your rival's choice.

Rule 2: Never choose a dominated strategy.

Equilibrium.

- Sometimes a game can be solved simply by finding the dominant and dominated strategies (e.g., the example above).
- However, there are many games for which this does not work.

In a *Nash Equilibrium* no player wants to change his/her strategy unilaterally, given what the other players have chosen.

- Games can have no *pure strategy* equilibria, or
- Multiple equilibria.

The prisoner's dilemma.

		Prisoner 1	
		Lie	Confess
Prisoner 2	Lie	10	20
	Confess	20	0

Payoffs are listed in the top-right and bottom-left corners of each cell. Arrows indicate the direction of the payoff values.

War of attrition.

		Sky	
		Throw in Towel	Stay in
BSB	Throw in Towel	50	90
	Stay in	90	-10

movie

Some background

Corporate Leniency Program

in 1993, DOJ introduced new Corporate Leniency Program:
participant in a cartels that blows the whistle receives
immunity from federal prosecution

consequently, DOJ has caught, prosecuted, and fined
several gigantic cartels (e.g. vitamins)

on Valentine's Day, 2002, EC adopted a similar policy

Lysine cartel

1996: Archer Daniels Midland (ADM) pleaded guilty to price fixing

ADM admitted to price fixing in lysine (used in livestock feed) and citric acid (used in soft drinks and detergents)

sources: DOJ movie, Eichenwald (2000), Lieber (2000), Connor (2001, 2003)

Lysine market

perfectly homogeneous product

share of global production of 4 largest manufacturers of lysine in early 1990s

- > 97% in U.S.
- > 95% world

purchases of four largest buyers < 30%

large infrequent purchases

cost of a new plant \$150+ million (over 3 years to build)

Lysine agreement

felt they needed everyone's agreement

allocated sales quotas across firms

used industry organization to meet and collect data

shared cost data

had a punishment scheme in place

Lysine fines

5 corporate fines

- U.S. corporate fines: \$92.5 million
- EU: \$97.9 million
- Canada: \$11.5 million

lysine cartel U.S. fine was 7x previous highest fine

7 personal fines

in 1999, 3 people got prison sentences of 99 months total
(indiv. max 36 months)

Individual fines

Michael D. Andreas (U.S.), Vice Chairman, ADM, \$350,000 fine, 36 months of jail

Terrance Wilson (U.S.), Pres., Corn Products Div., ADM, \$350,000, 33 months

Mark Whitacre (U.S.), Pres., Bioproducts Div., ADM, \$350,000, 30 months

Kanji Mimoto (J), Div. Mgr., Ajinomoto, \$75,000

Hirozaku Ikeda (J), Div. Mgr., Ajinomoto \$0

Kaztoshi Yamada (J), Mng. Dir., Ajinomoto, Fugitive

Masaru Yamamoto (J), Div. Mgr., Kyowa, \$50,000

Jhom Su Kim (SK), Pres., Sewon America, \$75,000

Lysine buyers

individual U.S. buyers received compensation \approx
their losses — that is, they did not get treble
damages

total U.S. corporate settlements: about \$85 million