

## Lecture 13(iii)

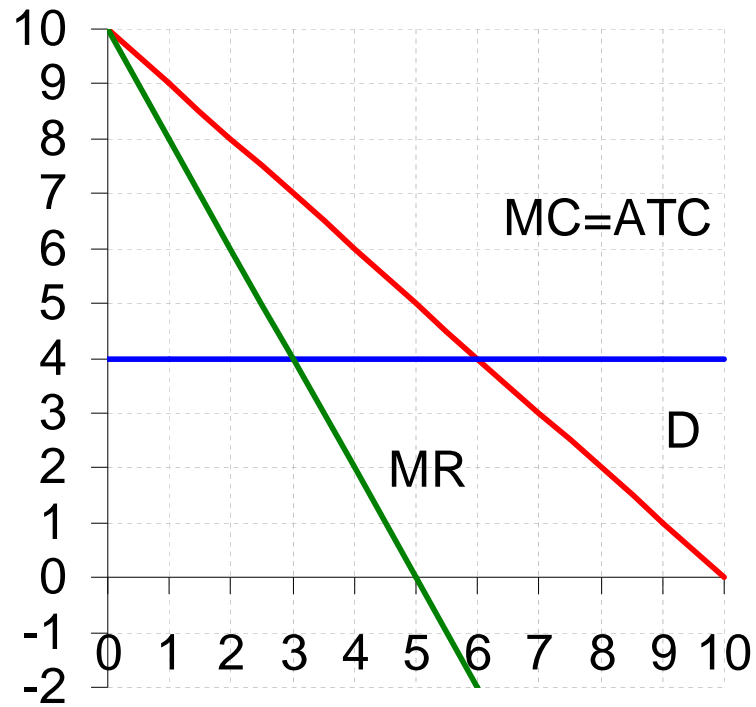
### Announcements

- Final Exam OneStop page (at the very bottom of Moodle at Week 15. Has links to practice midterms all in one place.

## Lecture on Oligopoly

1. Duopoly
2. When is cooperation likely?
3. Competition Policy in the U.S. and Europe
4. An Application of Game Theory: An Arms Race for Nuclear Weapons

Duopoly In Econland  
Goldy and Bucky have entered Widgeit  
business



1. Have to post prices, stay that way for the entire day.
2. Have to be a round number.
3. Buyers buy from the lowest price firm. If prices the same, then the sellers split the market.
4. For now, look at prices 6 and 5.

Payoff Matrix  
How Profit Depends Upon  
Both Actions

Goldy

P = 6

P = 5

P = 6  
Bucky

	P = 6	P = 5
P = 6 Bucky	G gets B gets	G gets B gets
P = 5	G gets B gets	G gets B gets

Other prices?

1. P = 7 is monopoly price.

But....

2. P = 4?

So Nash Equilibrium is....

What about if repeated every day forever?

Can sustain cooperation with threat to revert to price war.

Monopoly price:  $P = 7$ .

Market  $Q = 3$

Each sells  $q=1.5$ ,  
profit for each is  $(7-4)*1.5 = 4.5$

Threat: if every the other guy sets  $P < 7$ , then just set  $P=4$  after that.

Look at incentives:

Take as given other guy setting  $P=7$   
If match, then get 4.5 today.

If set  $p = 6$ , get whole market of  $Q=4$ .  
Make profit  $(6-4)*4 = 8$ .

Short term gain!  
But then its over...

So compare::

	Cooperate Forever	Cheat today
today	4.50	\$8.00
tomorrow	4.50	0.
next day	4.50	0.
day after that	4.50	0.
.....	4.50	0.

If care about the future, cooperation is sustainable.

(But if desperate for cash now, might see breakdown of cooperation)

What if there more bidders?

Suppose 3 sellers:

Goldy, Bucky, and Hawkeye.

Cooperate a monopoly forever, each sets price at \$7, divide  $Q=3$  three ways, profit is  $(7-3) \times 1 = \$3$ .

Returns to Cooperation and Cheating with 3 Firms

	Cooperate Forever	Cheat today
today	3	\$8.00
tomorrow	3	0.
next day	3	0.
day after that	3	0.
....	3	0.

Gain from cheating same as before.

But gain from cooperating is less.

So cheating on agreement is more likely.

Cartels more likely to work if:

(1) interaction is frequently repeated and participants have long horizons.

(2) The fewer players, the better

(3) If other players can more quickly react. (If information about what each other is doing goes back and forth quickly.)

(4): Cooperation more likely with a more favorable legal environment.

Current law is not favorable for cartels

U.S. Antitrust Law:

1890 Sherman Act outlaws price fixing  
If part of a conspiracy to fix price can go to jail.

Europe: Regulated by the European Commission.

Let's take a look at the web site of the European Commission concerned with competition policy.

[http://ec.europa.eu/competition/index\\_en.html](http://ec.europa.eu/competition/index_en.html) We can see some examples of cartel cases that have been prosecuted

[http://ec.europa.eu/competition/cartels/overview/index\\_en.html](http://ec.europa.eu/competition/cartels/overview/index_en.html)

Application of Game Theory: The Cold War and Mutually-Assured Destruction.

Potential Prisoner's Dilemma Situation for a first strike nuclear Attack.

		<b>Soviet Union</b>	
		First Strike	Don't Attack
U.S.	First Strike	USSR gets -100 U.S. gets -100	USSR. gets -1000 US. gets 200
	Don't Attack	USSR gets 200 U.S. gets -1000	USSR gets 0 U.S. gets 0

The unique Nash equilibrium is \_\_\_\_\_  
(Prisoner's dilemma again.)

Suppose instead, each party can **credibly** commit to launch a massive retaliatory attack on warning. So if one party launches a first strike, nuclear winter results. The payoffs now look like: (where  $-\infty$  means "minus infinity")

		<b>Soviet Union</b>	
		First Strike	Don't Attack
U.S.	First Strike	USSR gets $-\infty$ U.S. gets $-\infty$	USSR gets $-\infty$ US. gets $-\infty$
	Don't Attack	USSR gets $-\infty$ U.S. gets $-\infty$	USSR gets 0 U.S. gets 0

The unique Nash equilibrium is now

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This is the concept of mutually-assured destruction, (MAD) which results in a kind of stability.

- Requires both to keep up in an arms race (if one is more powerful than the other then MAD can break down).
- Requires rationality on both parts.

A useful theory for thinking about Soviet/U.S. Cold War interactions.

Not a useful theory for thinking about North Korea and Iran....

Lets use game theory to talk about Arms Control (See Ch 17 of Mankiw text, page 374.) Text presents the following model of an “Arms Race”

		Soviet Union	
		Arm	Disarm
U.S.	Arm	USSR at risk U.S. at risk	USSR at risk, weak US. safe, powerful
	Disarm	USSR safe, powerful U.S. at risk, weak	USSR safe U.S. safe



Again, we see the usual Prisoner's Dilemma, where unique equilibrium is both chose "Arm"

Again, if could cooperate, both would be better off if both disarm.

Try an arms control agreement. Both parties can be better off. **But it is crucial for both sides to be able to verify compliance of the other party.**

In the news: **New START Treaty** that the Obama administration has negotiated with Russia.

- Continued reduction in count of warheads
- Tweaking of the inspection regime.

Need 2/3 Senate Majority to ratify a treaty or 67 votes.

Two previous arm agreements passed 93-6 and 95-0 in Senate. This one got through the Senate Committee with a vote 14-4. In think most people think the bill is a good idea.

Now with the increase in Republicans in the Senate, is has changed the game. If it is voted on next session, need 14 Republicans, while 9 are needed if it is voted on by in a "lame duck" session.

It is interesting to think about game theory in terms of what the Republicans are up to here. In

principle, the bill could be delayed and still voted on and passed in the new session. It is worth noting that it isn't simply a matter of delaying the vote until the new Congress is sworn in because it has to go through committee hearings again.

The advantage of the Republicans of delaying is that with more seats, they have greater bargaining power. They know that Obama wants to get this thing passed, so they might expect to be able to extract more concessions out of him if the vote is delayed until the next session. Obama sees this endgame, so he wants to get it passed now.

If it isn't passed in the lame duck session, it might never be passed, as there is some chance that Republicans will just go for a "scorched earth" policy (no to everything) until 2012 presidential election is resolved.

Another interesting example of game theory and the interaction between Obama and Republicans in Congress. Currently, the Bush tax cuts will expire Dec. 31. Obama wants keep the cuts for people making less than \$250,000 and let the tax go back up for income over \$250,000.

Obama is proposing: permanently lower rates for those <\$250k, and a

temporary extension of cuts to people over 250. In this case, for 2011, everyone keeps the tax cuts.

You might think the Republicans would bite on this, because they get low taxes for 2011 and can fight about what to do in 2012 later. But they probably won't bite on this. Why?

They see the endgame. If the tax cuts for people < 250 are permanent, then when the tax cuts for people making more than 250 expire, the Republicans are put in the position of trying to get a new tax bill passed that only lowers taxes for people making more than 250. This will be awkward....