

Game Theory

The study of rational behavior among interdependent agents

Agents have a common interest to make the pie as large as possible, but

Agents have competing interests to maximize their own share of the pie.

An agent's rational decisions require anticipating rivals' responses

These expectations are not perfect, so uncertainty is a necessary feature of games

Prisoner's Dilemma

During the Stalinist Era

Russian Conductor studying Tchaikovsky score
on the train to Minsk

Arrested by the KGB

Thrown into prison

For three days, he is told nothing

.....Then.....

Prisoner's Dilemma

“We have your friend Tchaikovsky and he is starting to talk”

Should the conductor confess?

Prisoner's Dilemma

Tchaikovsky

Confess

Don't Confess

Conductor

Confess

(-8, -8)

(0, -15)

Don't Confess

(-15, 0)

(-1, -1)

	Confess	Don't Confess
Confess	(-8, -8)	(0, -15)
Don't Confess	(-15, 0)	(-1, -1)

Prisoner's Dilemma

		<u>Tchaikovsky</u>	
		Confess	Don't Confess
<u>Conductor</u>	<u>Confess</u> →	(-8, -8)	(0, -15)
	<u>Don't Confess</u> →	(-15, 0)	(-1, -1)

Prisoner's Dilemma

		<u>Tchaikovsky</u>	
		Confess	Don't Confess
<u>Conductor</u>	Confess →	(-8, -8)	(0, -15)
	Don't Confess →	(-15, 0)	(-1, -1)

Prisoner's Dilemma

Conclusion:

The Conductor will confess

And Tchaikovsky?

Prisoner's Dilemma

		<u>Tchaikovsky</u>	
		Confess	Don't Confess
<u>Conductor</u>	Confess	(-8, -8)	(0, -15)
	Don't Confess	(-15, 0)	(-1, -1)

Prisoner's Dilemma

		<u>Tchaikovsky</u>	
		Confess	Don't Confess
<u>Conductor</u>	Confess	(-8, -8)	(0, -15)
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Prisoner's Dilemma

Conclusion:

Tchaikovsky confesses also

Both get 8 years, even though if they cooperated, they could get off with one year each

For both, confession is a dominant strategy: a strategy that yields a better outcome regardless of the opponent's choice

Prisoner's Dilemma

What would the Conductor and Tchaikovsky decide if they could negotiate?

They could both become better off if they reached the cooperative solution....

which is why police interrogate suspects in separate rooms.

Equilibrium need not be efficient. Noncooperative equilibrium in the Prisoner's dilemma results in a solution that is not the best possible outcome for the parties.

Equilibrium

Nash Equilibrium: Neither player has an incentive to change strategy, given the other player's choice

Both confess is a Nash Equilibrium

Both don't confess is not a Nash Equilibrium, rival will always want to renege

Dominant Firm Game

Two firms, one large and one small

Either firm can announce an output level (lead) or else wait to see what the rival does and then produce an amount that does not saturate the market.

Dominant Firm Game

		<u>Dominant</u>	
		Lead	Follow
<u>Subordinate</u>	Lead	(0.5, 4)	(3, 2)
	Follow	(1, 8)	(0.5, 1)

Dominant Firm Game

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Dominant Firm Game

		<u>Dominant</u>	
		Lead	Follow
<u>Subordinate</u>	Lead	(0.5, 4)	(3, 2)
	Follow	(1, 8)	(0.5, 1)

Dominant Firm Game

Conclusion:

Dominant Firm will always lead.....

But what about the Subordinate firm?

Dominant Firm Game

		<u>Dominant</u>		
		Lead	Follow	↓
<u>Subordinate</u>	Lead →	(0.5, 4)	(3 , 2)	
	Follow	(1, 8)	(0.5 , 1)	

Dominant Firm Game

		<u>Dominant</u>	
		Lead	Follow
<u>Subordinate</u>	Lead	(0.5, 4)	(3, 2)
	Follow	(1, 8)	(0.5, 1)

Dominant Firm Game

Conclusion:

No dominant strategy for the Subordinate firm.

Does this mean we cannot predict what they will do?

Dominant Firm Game

		<u>Dominant</u>	
		Lead	Follow
<u>Subordinate</u>	Lead	(0.5, 4)	(3, 2)
	Follow	(1, 8)	(0.5, 1)

Dominant Firm Game

Conclusion:

Subordinate firm will always follow, because dominant firm will always lead.

Equilibrium

Nash Equilibrium: Neither player has an incentive to change strategy, given the other player's choice

Dominant: Lead & Subordinate Follow is a Nash Equilibrium

A player's best option may be dictated by anticipating the rival's best option

Timing and Ending

Two Stage Game between A and B who are dividing \$1.00

- 1) Player A moves first and proposes how to split the dollar. Player B either accepts the split in which case the game ends, or we move to round 2.
- 2) The pie drops to \$.90. Player B proposes a split. Player A accepts or the game ends and both get 0.

Timing and Ending

What should A do?

Timing and Ending

The timing of the end of the game can dictate the strategy employed. If the game went past round 2, A's strategy would change.

Go back to Prisoner's Dilemma:
Is there a way to generate the cooperative solution?

		<u>Tchaikovsky</u>		
		Confess	Don't Confess	↓
<u>Conductor</u>				
Confess		(-8, -8)	(0, -15)	
Don't Confess	→	(-15, 0)	(-1, -1)	

Go back to Prisoner's Dilemma: Is there a way to generate the cooperative solution?

Not a Nash Equilibrium

If Conductor commits to "Don't Confess", Tchaikovsky has an incentive to confess

If Tchaikovsky commits to "Don't Confess", Conductor has an incentive to confess

Role of a contract—to commit parties to actions they would not undertake voluntarily

Alternative: Implied contract

if there were a long relationship between the parties—(partners in crime) are more likely to back each other

Application to Collective Bargaining

Two agent game

Uncertainty

Each party has to anticipate what the other will do

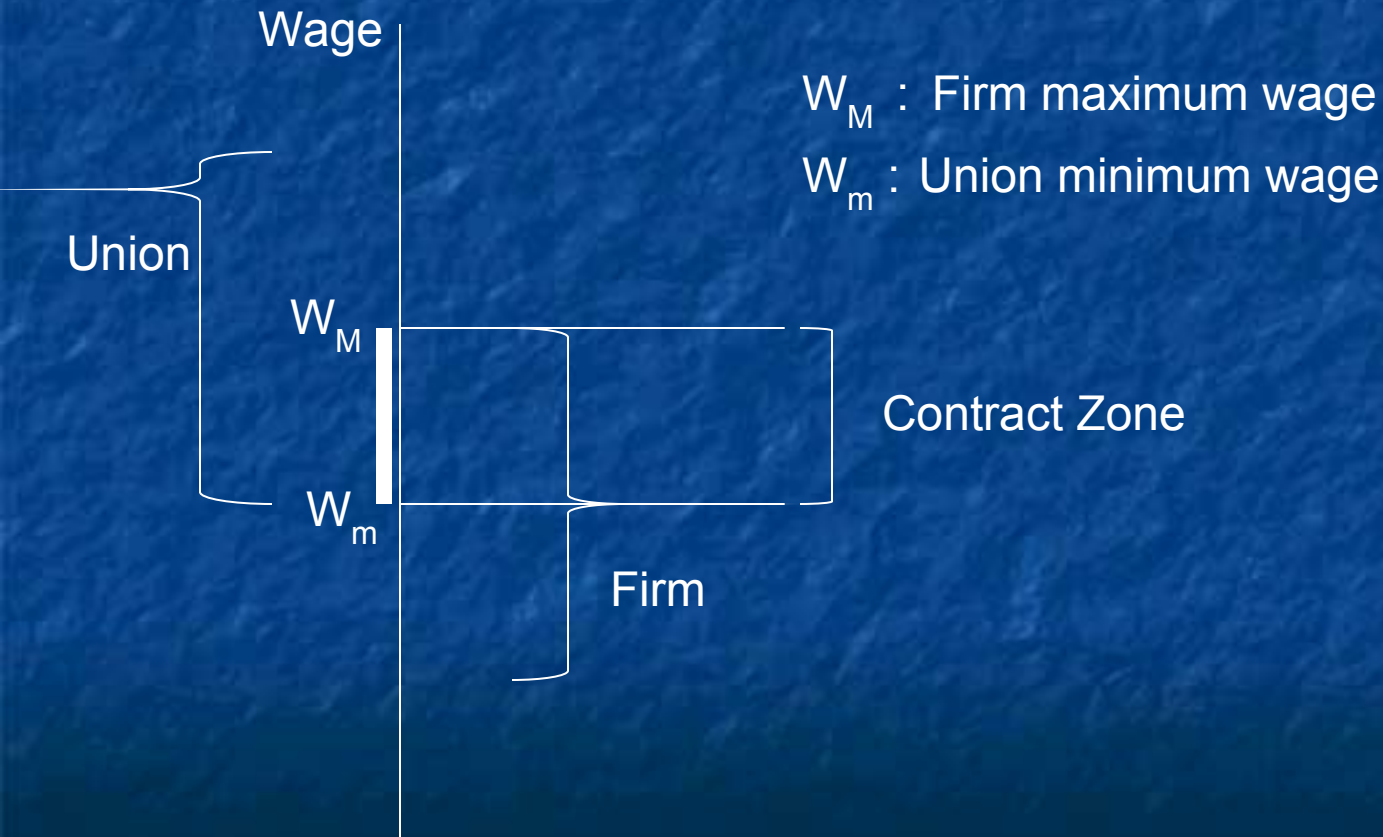
Time limit matters

Ability to contract affects outcome

A long, continuing relationship can enhance the efficiency of the outcome

Complicating the game

Suppose there is a range of outcomes



Where we end up in the contract zone depends on bargaining power

Bargaining power depends on

- Alternative opportunities if no bargain is reached (outside option)
 - Union: alternative employment
 - Firm: Substitute for union workers
- Relative cost of delay
 - Union: Strike fund
 - Firm: Inventory, strength of sales demand
- Commitment strategy
 - Extent to which you can make the other party believe you will not budge

Example of a more complicated Bargaining Simulation

Two teams: Union(U); Management (M)

Each team gets a suit of 13 cards

The cards correspond to wage thresholds:

<u>Wage</u>	<u>M</u>	<u>U</u>
■ 15	2	
■ 14	3-4	
■ 13	5-7	
■ 12	8-10	
■ 11	J-K	A
■ 10	A	J-K
■ 9		8-10
■ 8		5-7
■ 7		3-4
■ 6		2

- Each team draws one card that will set their reservation wage. This must not be shown to the other team except for the full information game.
- Through the remaining rounds, teams will reveal additional cards at random
- Teams can reveal other cards if they wish
- Teams can make statements about their bargaining objectives to the other team

Bargaining Techniques

- Distributive Bargaining: View bargaining as a zero sum game
 - —split of the pie: what one party gains, the other loses
 - Example—our game
 - Often accompanied by pressure tactics
 - Threats
 - Bluffs
 - Bullying/

Bargaining Techniques

- Interest-Based Bargaining
 - Attempt to arrive at efficient outcome
 - No relevant information privileged
 - Focus on solving mutual problem of making the firm as successful as possible
 - Requires long-standing bargaining relationship between parties

Bargaining Techniques

■ Principled Negotiations

- Both parties start with perceptions of the economic climate and their goals
- Alternative mechanisms to reach these goals are presented
- Options are evaluated against some objective criteria or by a third party expert
- No private information

Bargaining Techniques

- Collective Bargaining by Objectives
 - Each party lists its objectives
 - Objectives are prioritized
 - Areas of agreement are identified, while the remaining areas of disagreement are ranked by their importance to the parties
 - Parties can withhold information

Bargaining Techniques

- Note the similarity between these techniques and the games
 - Role of information
 - Role of history
 - Role of the other party's objectives, actions
 - Role of cooperative vs competitive bargaining environment