EE481: Industrial Economics

Game Theory (Dynamic Game)

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Game Theory

- In many circumstances, there are more than 1 player.
- The decision of 1 player can affect the payoffs to other players.
- Game theory analyzes how each player makes strategic decisions

Strategic decisions = **decisions that take into account other players' actions and responses.**

Static Game = One-shot game. No player can observe the others' decisions.

Dynamic vs. Static

- Static Game = One-shot game. No player can observe the others' decisions.
- Dynamic Game = More realistic, players meet and compete more than 1 time
  - Repeated Game
    - Finitely repeated
    - Infinitely repeated
  - Sequential Game

Noncooperative vs. Cooperative Games

- Cooperative game = Participants can negotiate binding contracts that allow them to make joint-strategies.

Example:

- Noncooperative game = Negotiation and enforcement of binding contracts between players is not possible.

Example:

Nash Equilibrium

Nash Equilibrium = A solution concept for a game proposed by Prof.John Nash.

- Dominant Strategies: I'm doing the best I can *no matter what another person do.* You're doing the best you can *no matter what I do*.
- Nash Equilibrium: I'm doing the best I can *given what you are doing.* You're doing the best you can *given what I am doing.*
  - At the Nash Equilibrium, no player has an incentive to unilaterally change their decision.

Finitely Repeated Games

- Actions are taken and payoffs are received over and over again.
- Increase a possibility to enforce an agreement (firms compete in more than 1 period).

Example: Price-fixing Game

		Firm 2: Cooperate	Firm 2: Defect
Firm 1	Cooperate		
	Defect		

Payoff (Firm 1, Firm 2)

- Suppose this game is played repeatedly for 20 periods.
- What now would be each player's strategy?

Finitely Repeated Games

- Finite number of repetitions
  - Game theory predicts that coorperation will never happen.
- Suppose firm1 and firm2 successfully cooperate until period 19, what would happen in period 20 (last period)?
  - Nash Equilibrium solution suggests that both defect.
- If both would defect in the last period, what benefit there would be to cooperate in the next-to-last period?
  - None. So in period 19, both would defect again.
- Use the same rational back to the first period.
  - Both defect from the beginning.
  - Cooperate would never be choosen!

Infinitely Repeated Games (T = ∞)

- In the real world, we see that firms sometimes cooperate, sometimes defect.
  - Needs to find a better model to explain the situation.
- Infinitely repeated game
  - There is no end period
- Infinitely repeated game allows us to predict that firms would cooperate.

Infinitely Repeated Games (Strategies)

Grim Strategy

1. Start by choosing "cooperate".
2. Continue to choose "cooperate" unless some player has chosen "defect", in which case choose "defect" forever.

Tit-for-Tat

1. Start by choosing "cooperate".
2. Thereafter, in period n choose the action that the other player choose in period $(n-1)$.

Infinitely Repeated Games (In Practice)

Grim Strategy and Tit-for-Tat in Practice

- Could work in practice, although firms don't compete infinitely (there is an end at some point)
- This is because

1. There is uncertainty about when the game would end
2. Firms may not be 100% rational. So, would not be able to work out that if they compete for a finite number of periods, it is rational to just cheat from the first period.

- But if there are too many firms, Grim Strategy and Tit-for-Tat would be difficult to enforce.

Infinitely Repeated Games (In Practice)

When do firms defect??

- Rotemberg and Saloner (1986) - during boom.

- Green and Porter (1984) - during recession.

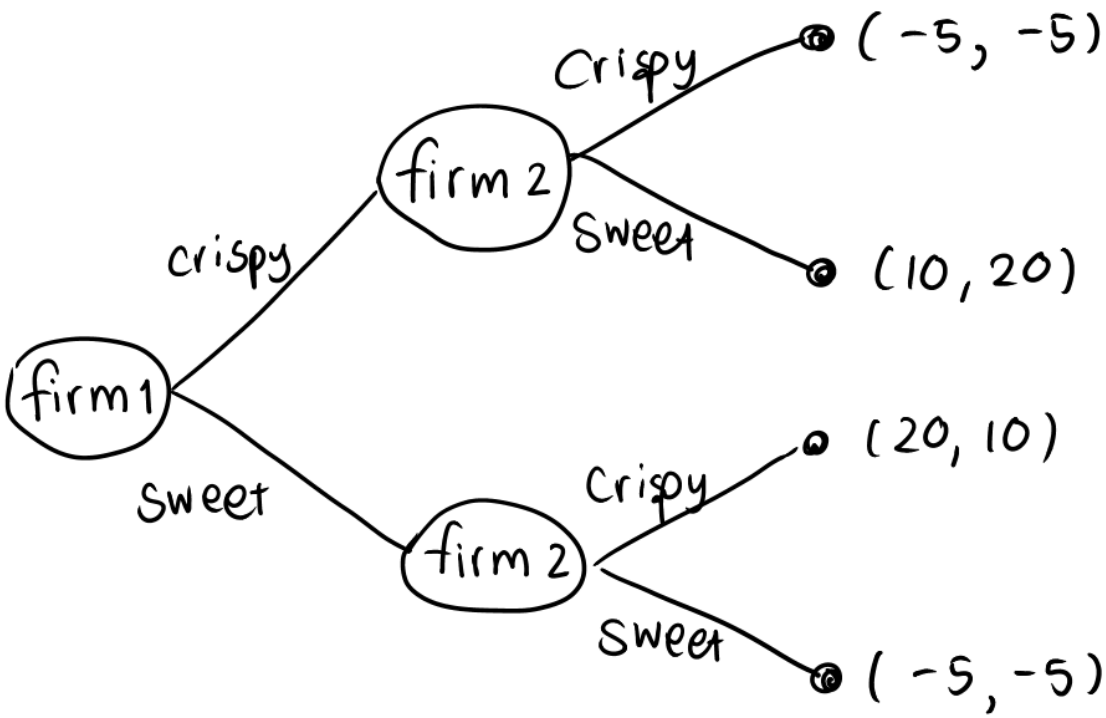
Sequential Games

- Sequential games = game in which players move in turn, responding to each other's actions and reactions.

The **extensive form** representation of a sequential game identifies:

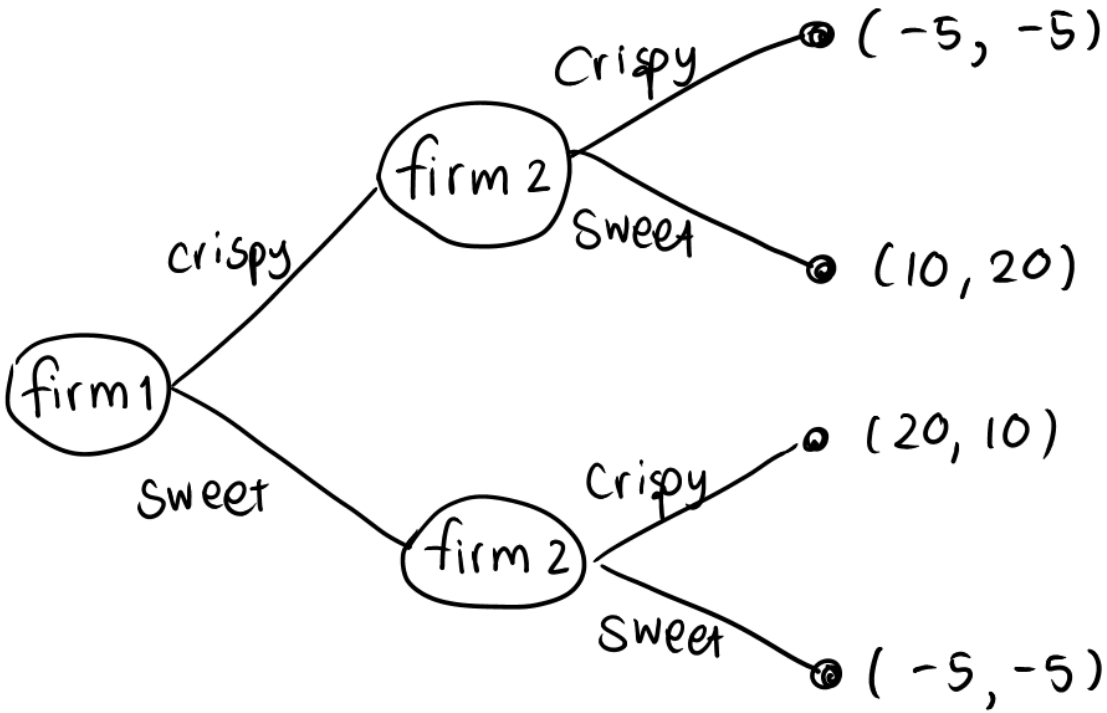
1. Identity of each player
2. Timing of move
3. Choices and actions available to each player
4. Information (history of the game)
5. Payoffs (all possible outcomes)

A Simple Sequential Game



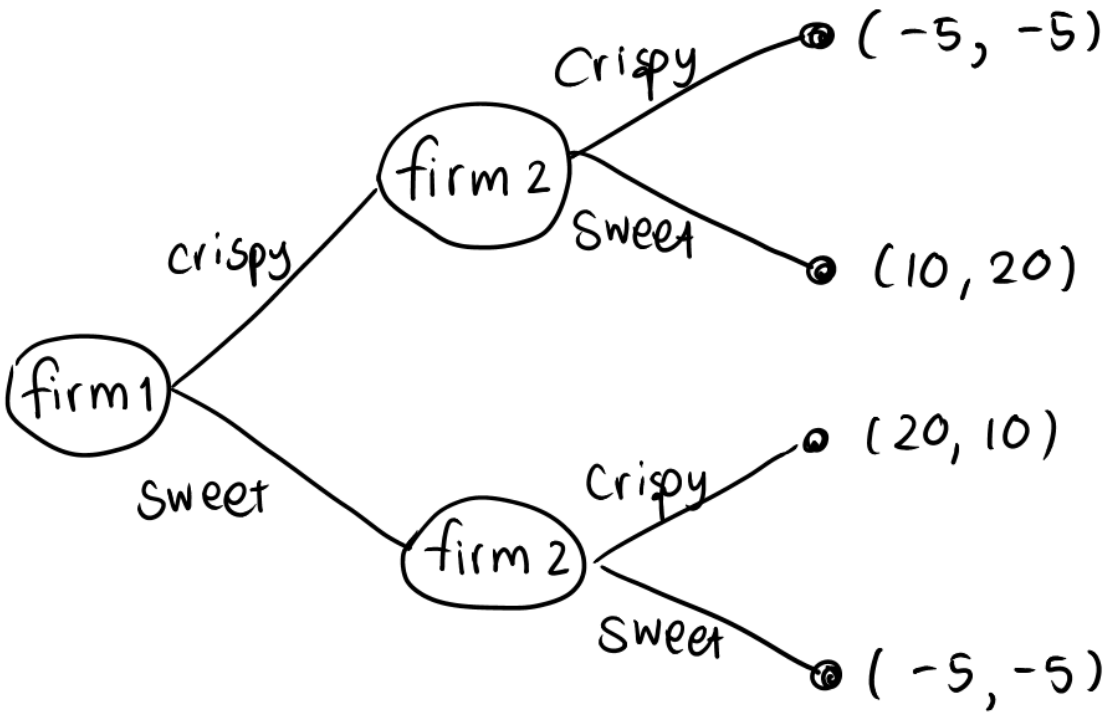
Non-Credible Threats (Empty Threats)

- A non-credible threat is a threat that would never happen if the firm is rational.



Backward Induction and SPNE

- We can use "backward induction" to find the equilibrium of the game.
- The equilibrium found would be called a Subgame Perfect Nash Equilibrium (SPNE). For SPNE, the solution to every subgame is a Nash Equilibrium.



Entry Deterrence Example

Reference and Further Reading I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