



Worksheet – Game theory, Oligopoly, Collusion

Related podcast: [The ice-cream conspiracy](#) (Planet Money: NPR, February 8, 2023)

Summary: This worksheet could be used for in-class or homework practice. Students will be asked to read an excerpt from the manuscript of a podcast about the producers of premium ice-cream Ben & Jerry’s and Haagen-Dazs, and the potential collusion they might be engaged in. Then, students will be asked to explain how collusion affects prices and consumers, and to distinguish between real-world examples of explicit and tacit collusion. Students will also have to analyze a simultaneous game of complete information to determine the dominant strategy (if any) of each player, and the Nash equilibrium/equilibria (if any) of the game. The podcast is long (24 min.) so the excerpt should be sufficient for the purposes of this worksheet, but students should be encouraged to listen to the podcast at home. **Answers are provided at the end of this document.**

Learning objectives:

At the end of this worksheet, students will be able to:

- o Analyze the implications of collusion for prices and consumer surplus;
- o Analyze a simultaneous game of complete information to determine whether a player has a dominant strategy, and if yes, what it is;
- o Analyze a simultaneous game of complete information to determine the Nash equilibrium/equilibria of the game (if any);
- o Recognize that a given situation provides an example of the Prisoner’s dilemma;
- o Distinguish between explicit and tacit collusion;
- o Recognize real-world examples of explicit and tacit collusion;
- o Evaluate given scenarios to recognize analogies.

Economics concepts: Collusion, Dominant strategy, Nash equilibrium, Competition, Tacit collusion

Suggested excerpts:

“...you've got Chunky Monkey, a classic. You need your teeth to chew a Ben & Jerry's ice cream.”

“They're in the freezer together. But they don't really compete. One makes chunky; the other makes smooth. Why?”

“... ask, is this a case of ice cream collusion?”

“...he [Christopher Sullivan, Professor of Economics] thinks to himself, if those flavors [chocolate, coffee, strawberry, butter pecan] are so popular, why would an ice cream company not make them? It seems like Ben & Jerry's must have the know-how. It would be easy to simply not put the big chunks in.”

“Ben & Jerry's clearly know how to make coffee-flavored ice cream without all the chunks. They even sell it in their stores. But usually, they do not sell it in the supermarket. And as we noticed in our supermarket, the other big player in the pint space, Haagen-Dazs, they make the opposite. Mostly, they just make smooth.”

“Is this just the result of natural competition between these firms, that they would specialize in one type of ice cream as a way to make as much money as possible? Or is there something potentially beyond that going on?”

“...are they potentially coordinating or tacitly colluding their choice of flavors?”

“Haagen-Dazs debuts in 1960 - made in New York, but named like it was from the Scandinavian fjords.”

“Haagen-Dazs is so thick and creamy, giving you a deliciously rich experience that lasts and lasts and lasts.”

“... Ben & Jerry's enter the market in 1978, eventually becoming famous for just how unsmooth their chunky flavors are.”

“And when it came to product types, the two companies mostly stayed out of each other's way. When this kind of thing is done explicitly, it's called market division.”

“...through the 1980s, ice cream sales are good for both companies. Together, they own 90% of what is known as the superpremium ice cream market.”

“The stalemate holds, that is, until 1992, when sales of superpremium ice cream start to slow and both companies are trying to figure out how to respond. And then, one competitor decides to cross that invisible border.”

“Haagen-Dazs releases a line of chunky flavors in supermarkets for the first time. And Ben & Jerry's immediately thereafter decides they're going to offer smooth flavors in the supermarket for the first time.”

“So after years of occupying separate turf, the two companies start going after each other's customers.”

“This is great news for ice cream fans - lots more choice in the supermarket. And according to documents at the time, Haagen-Dazs even discounted the price of its new flavors. That is what you would expect in a competitive environment.”

“In game theory, you think not just about what your choices are, but what your competitor's choices are and what are their best strategies and how should your strategies adapt to theirs.”

“Now the two companies have a choice. They could just stay in each other's territory, vigorously competing - and may the best ice cream win. Or they could start cooperating. Ben & Jerry's

could retreat back to Chunky Town; Haagen-Dazs would go back to Smooth Ville. And there would be peace once again in the ice cream freezer.”

“You game-theory nerds may recognize this as something called the prisoner's dilemma. If each ice cream company agrees not to compete, then they both win. They can charge much more for their individual products.”

“Cooperating is really hard.”

“Companies that are truly competing act in a certain way. If you study their products and prices over the years, the data should be responding largely to consumer demand. But if two companies are cooperating, then their actions and prices seem to move together.”

“...what Christopher finds is that this fancy ice cream is far more expensive than what you would expect in a perfectly competitive world.”

“In the median kind of supermarket and kind of the average supermarket, prices are 20- to 50% higher for pints of Ben & Jerry's and Haagen-Dazs than they would have been if the firms had not coordinated on products and prices.”

“The antitrust laws - they are rules that govern what businesses can and cannot do when it comes to competing fairly. And they're based on the Sherman Act of 1890.”

“If you meet with the neighboring supermarket in the parking lot at the dead of night and set the price for something - eggs, bananas, roast beef - that's illegal.”

“And indeed, this kind of parking lot price fixing really happens. A classic case was in the canned tuna industry - no joke. StarKist, Bumble Bee and Chicken of the Sea were accused of colluding to sell cans of tuna for the same price.”

“...the difference between illegal collusion and something we call tacit collusion.”

“This next type of collusion, tacit collusion, doesn't have a formal agreement between competitors. Tacit collusion is often made up of subtle signals.”

“We asked Fiona [an economist] where the ice cream case falls. Is it tacit collusion or the illegal kind?”

“I [Prof. Sullivan] haven't found any evidence that they actually explicitly, either through phone calls with wiretaps or through emails, actually communicated these strategies and their intent to monopolize the superpremium ice cream market.”

“I [Prof. Sullivan] don't believe that either Ben & Jerry's or Haagen-Dazs engaged in any behavior that's illegal in the United States.”

“They [Haagen-Dazs] denied that they colluded. They say that their focus is on making lots of different flavors. Quote, "some are appreciated by consumers. Some are not. In the end, the consumer decides," end quote.”

“In a robust market with a dozen companies, it is much harder to collude. But if there are only two or three big players, you can do the kind of tacit collusion that we've been talking about. You can watch, send signals, and punish each other for crossing the line.”

Questions

1. Consider two scenarios. First, Haagen-Dazs makes only smooth ice-cream, while Ben & Jerry's makes only chunky ice cream. Second, both ice-cream producers make both smooth and chunky ice-cream. In which of the two scenarios do the two companies compete more?
 - a. First scenario.
 - b. Second scenario.
 - c. The level of competition is the same regardless of the types of ice-cream the two companies make.
 - d. There is no competition between the two companies.

2. The article examines the following scenario: "Imagine if Ben & Jerry's and Haagen-Dazs were somehow working together - one takes the chunky market; one takes the traditional market - and actively choosing not to compete with each other." This implied that:
 - a. Ben & Jerry's and Haagen-Dazs might have colluded.
 - b. Ice-cream prices would be higher than they would be if the market was competitive.
 - c. Consumer surplus would be lower compared to what it would be if the two companies produced both kinds of ice-cream.
 - d. All of the above.

3. According to the suggested excerpt provided in this worksheet, which of the following statements about the history of Haagen-Dazs and Ben & Jerry's is true?
 - a. Ben & Jerry's entered the ice-cream market before Haagen-Dazs.
 - b. Through the 1980s, Ben & Jerry's specialized in the production of smooth ice-cream.
 - c. Until the 1980s, Ben & Jerry's and Haagen-Dazs controlled 90% of the super-premium ice-cream market.
 - d. All of the above.

4. True or False? When Haagen-Dazs and Ben & Jerry's started to offer both chunky and smooth kinds of ice-cream, the ice-cream market became less competitive.

5. In 1992, Haagen-Dazs and Ben & Jerry's started to offer both chunky and smooth kinds of ice-cream. The podcast explains that "the two companies have [had] a choice. They could just stay in each other's territory, vigorously competing - and may the best ice cream win. Or they could start cooperating." Additionally, "if each ice cream company agrees not to compete, then they both win. They can charge much more for their individual products." However, "there are

these short-run incentives to deviate,” “steal all your [competitor’s] customers, and earn more money.”

The following payoff matrix presents the payoffs given the four possible combinations of strategies of Haagen-Dazs and Ben & Jerry’s. The first payoff in each cell represents the annual revenue of Ben & Jerry’s, and the second payoff shows the annual revenue of Haagen-Dazs. What is the dominant strategy of Haagen-Dazs (if any)?

		Haagen-Dazs	
		Offer only smooth ice-cream (Cooperate)	Offer both chunky and smooth ice-cream (Compete)
Ben & Jerry’s	Offer only chunky ice-cream (Cooperate)	\$550 million; \$520 million	\$400 million; \$600 million
	Offer both chunky and smooth ice-cream (Compete)	\$600 million; \$400 million	\$450 million; \$420 million

- a. To cooperate.
 - b. To compete.
 - c. It does not have a dominant strategy.
 - d. It cannot be determined.
6. Given the payoff matrix in Question 5, what is the dominant strategy of Ben & Jerry’s (if any)?
- a. To cooperate.
 - b. To compete.
 - c. It does not have a dominant strategy.
 - d. It cannot be determined.
7. Given the payoff matrix in Question 5, what is/are the Nash equilibrium/equilibria (NE) of the game played by Haagen-Dazs and Ben & Jerry’s?
- a. (Ben & Jerry’s: Compete; Haagen-Dazs: Compete).
 - b. (Ben & Jerry’s: Cooperate; Haagen-Dazs: Cooperate).
 - c. (Ben & Jerry’s: Compete; Haagen-Dazs: Cooperate) and (Ben & Jerry’s: Cooperate; Haagen-Dazs: Compete).

- d. The game has no NE.
8. The game described in Question 5 provides an example of:
- a. A Bertrand game.
 - b. A cooperation game.
 - c. A Cournot game.
 - d. The Prisoner's dilemma.
9. Which of the following statements about tacit collusion is true?
- a. Competitors that engage in tacit collusion have a formal agreement to raise prices.
 - b. Tacit collusion is illegal in the United States.
 - c. Tacit collusion violates the Sherman Act.
 - d. Tacit collusion often involves subtle signals.
10. True or False? According to the podcast, the manufacturers of beer in the U.S. have been accused of explicit collusion, while those of canned tuna and drugs have engaged in tacit collusion.
11. The podcast describes the following situation: "Imagine three pizza places in your neighborhood. One of them raises the price for a whole pie. And the other two look at that and think, that looks pretty good to me. And they also raise their prices. Now, pizza place No. 1 looks at that and thinks, hey, we're kind of all in this together - wink - and raises the price again, and the two other joints follow.... Now, they're all watching each other. They're mimicking each other. But they're not talking to each other or communicating in any way." Which of the following scenarios resembles this situation the most?
- a. Microsoft makes it hard for users to install competing software.
 - b. Nike pays attention to what prices Adidas, Puma, Reebok and Under Armour are charging for their sports goods, and sets a price based on the actions of its competitors.
 - c. Two tech companies sign an agreement to not hire each other's workers.
 - d. Monsanto controls the market for agricultural biotechnology in the U.S.
12. True or False? According to the podcast, although the prices of the ice-cream made by Haagen-Dazs and Ben & Jerry's are higher than what they would be in the absence of collusion, there is no evidence that the two companies engaged in explicit collusion.
13. According to the podcast, there is a "suspicious lack of competition" in the markets for car rentals, candies and concert tickets in the U.S. Do you think that the companies in each of these three markets engage in collusion or not?

Answer Key

1. Consider two scenarios. First, Haagen-Dazs makes only smooth ice-cream, while Ben & Jerry's makes only chunky ice cream. Second, both ice-cream producers make both smooth and chunky ice-cream. In which of the two scenarios do the two companies compete more?
 - a. First scenario.
 - b. Second scenario.
 - c. The level of competition is the same regardless of the types of ice-cream the two companies make.
 - d. There is no competition between the two companies.

Answer: B.

2. The article examines the following scenario: "Imagine if Ben & Jerry's and Haagen-Dazs were somehow working together - one takes the chunky market; one takes the traditional market - and actively choosing not to compete with each other." This implied that:
 - a. Ben & Jerry's and Haagen-Dazs might have colluded.
 - b. Ice-cream prices would be higher than they would be if the market was competitive.
 - c. Consumer surplus would be lower compared to what it would be if the two companies produced both kinds of ice-cream.
 - d. All of the above.

Answer: D. There might be collusion in the ice-cream industry. Prices would be higher than the competitive ones, and consumers would be worse off.

3. According to the suggested excerpt provided in this worksheet, which of the following statements about the history of Haagen-Dazs and Ben & Jerry's is true?
 - a. Ben & Jerry's entered the ice-cream market before Haagen-Dazs.
 - b. Through the 1980s, Ben & Jerry's specialized in the production of smooth ice-cream.
 - c. Until the 1980s, Ben & Jerry's and Haagen-Dazs controlled 90% of the super-premium ice-cream market.
 - d. All of the above.

Answer: C. According to the podcast, Haagen-Dazs and Ben & Jerry's entered the market in 1960 and 1978, respectively. Through the 1980s, Haagen-Dazs specialized in the production of smooth ice-cream, while Ben & Jerry's specialized in chunky ice-cream. The podcast suggests

that "...through the 1980s, ice cream sales are [were] good for both companies. Together, they own [owned] 90% of what is [was] known as the superpremium ice cream market."

4. True or False? When Haagen-Dazs and Ben & Jerry's started to offer both chunky and smooth kinds of ice-cream, the ice-cream market became less competitive.

Answer: False. With more producers of each type of ice-cream, the market became more competitive.

5. In 1992, Haagen-Dazs and Ben & Jerry's started to offer both chunky and smooth kinds of ice-cream. The podcast explains that "the two companies have [had] a choice. They could just stay in each other's territory, vigorously competing - and may the best ice cream win. Or they could start cooperating." Additionally, "if each ice cream company agrees not to compete, then they both win. They can charge much more for their individual products." However, "there are these short-run incentives to deviate," "steal all your [competitor's] customers, and earn more money."

The following payoff matrix presents the payoffs given the four possible combinations of strategies of Haagen-Dazs and Ben & Jerry's. The first payoff in each cell represents the annual revenue of Ben & Jerry's, and the second payoff shows the annual revenue of Haagen-Dazs.

What is the dominant strategy of Haagen-Dazs (if any)?

		Haagen-Dazs	
		Offer only smooth ice-cream (Cooperate)	Offer both chunky and smooth ice-cream (Compete)
Ben & Jerry's	Offer only chunky ice-cream (Cooperate)	\$550 million; \$520 million	\$400 million; \$600 million
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- a. To cooperate.
- b. To compete.
- c. It does not have a dominant strategy.
- d. It cannot be determined.

Answer: B. If Ben and Jerry's cooperates, Haagen-Dazs's best response is to compete because \$600 million > \$520 million. If Ben and Jerry's competes, Haagen-Dazs's best response is to

compete because \$420 million > \$400 million. Therefore, regardless of the strategy chosen by Ben & Jerry's, Haagen-Dazs' best strategy is to compete, that is Haagen-Dazs's dominant strategy is to compete (i.e., offer both chunky and smooth kinds of ice-cream).

6. Given the payoff matrix in Question 5, what is the dominant strategy of Ben & Jerry's (if any)?
- To cooperate.
 - To compete.
 - It does not have a dominant strategy.
 - It cannot be determined.

Answer: B. If Haagen-Dazs cooperates, the best response of Ben & Jerry's is to compete because \$600 million > \$550 million. If Haagen-Dazs competes, the best response of Ben & Jerry's is to compete because \$450 million > \$400 million. Therefore, regardless of the strategy chosen by Haagen-Dazs, the best strategy of Ben & Jerry's is to compete, that is its dominant strategy is to compete (i.e., offer both chunky and smooth kinds of ice-cream).

7. Given the payoff matrix in Question 5, what is/are the Nash equilibrium/equilibria (NE) of the game played by Haagen-Dazs and Ben & Jerry's?
- (Ben & Jerry's: Compete; Haagen-Dazs: Compete).
 - (Ben & Jerry's: Cooperate; Haagen-Dazs: Cooperate).
 - (Ben & Jerry's: Compete; Haagen-Dazs: Cooperate) and (Ben & Jerry's: Cooperate; Haagen-Dazs: Compete).
 - The game has no NE.

Answer: A. If Ben & Jerry's competes, Haagen-Dazs' best response is to compete, and if Haagen-Dazs competes, the best response of Ben & Jerry's is to compete as well. Therefore, (Ben & Jerry's: Compete; Haagen-Dazs: Compete) is a NE of the game. This is the only NE of the game, because for each of the remaining three combinations of strategies of the two companies, at least one of the companies has an incentive to change its strategy.

8. The game described in Question 5 provides an example of:
- A Bertrand game.
 - A cooperation game.
 - A Cournot game.
 - The Prisoner's dilemma.

Answer: D. In a Bertrand game, the companies choose prices. In a Cournot game, they choose quantities. In the game described in Question 5, the NE is for both Ben & Jerry's and

Haagen-Dazs to compete although they could both be better off if they cooperated. This is not an example of a cooperation game.

Both companies (players in the game) have dominant strategies (to compete), follow them, and this leaves both of them worse off than they would be if they cooperated. Therefore, this game is an example of the Prisoner's dilemma.

9. Which of the following statements about tacit collusion is true?
- Competitors that engage in tacit collusion have a formal agreement to raise prices.
 - Tacit collusion is illegal in the United States.
 - Tacit collusion violates the Sherman Act.
 - Tacit collusion often involves subtle signals.

Answer: D. Companies that engage in tacit collusion do not have a formal agreement. This type of collusion is not illegal in the United States, and does not violate the Sherman Act.

10. True or False? According to the podcast, the manufacturers of beer in the U.S. have been accused of explicit collusion, while those of canned tuna and drugs have engaged in tacit collusion.

Answer: False. U.S. beer manufacturers have engaged in tacit collusion, while those of canned tuna and drugs have been accused of explicit collusion.

11. The podcast describes the following situation: "Imagine three pizza places in your neighborhood. One of them raises the price for a whole pie. And the other two look at that and think, that looks pretty good to me. And they also raise their prices. Now, pizza place No. 1 looks at that and thinks, hey, we're kind of all in this together - wink - and raises the price again, and the two other joints follow.... Now, they're all watching each other. They're mimicking each other. But they're not talking to each other or communicating in any way." Which of the following scenarios resembles this situation the most?

- Microsoft makes it hard for users to install competing software.
- Nike pays attention to what prices Adidas, Puma, Reebok and Under Armour are charging for their sports goods, and sets a price based on the actions of its competitors.
- Two tech companies sign an agreement to not hire each other's workers.
- Monsanto controls the market for agricultural biotechnology in the U.S.

Answer: B. The given scenario about the pizza places and the one described in (b) provide examples of tacit collusion.

12. True or False? According to the podcast, although the prices of the ice-cream made by Haagen-Dazs and Ben & Jerry's are higher than what they would be in the absence of collusion, there is no evidence that the two companies engaged in explicit collusion.

Answer: True.

13. According to the podcast, there is a "suspicious lack of competition" in the markets for car rentals, candies and concert tickets in the U.S. Do you think that the companies in each of these three markets engage in collusion or not?

Answer: Answers will vary.