CHAPTER 10 Game Theory and Strategic Behavior

Strategic Behavior

- Decisions that take into account the predicted reactions of rival firms
  - Interdependence of outcomes
- Game Theory
  - Players
  - Strategies
  - Payoff matrix

Strategic Behavior

- Types of Games
  - Zero-sum games
  - Nonzero-sum games
- Nash Equilibrium
  - Each player chooses a strategy that is optimal given the strategy of the other player
  - A strategy is dominant if it is optimal regardless of what the other player does

TABLE 10-1 Payoff Matrix for an Advertising Game

		Firm B	
		Advertise	Don't Advertise
Firm A	Advertise	(4, 3)	(5, 1)
	Don't Advertise	(2, 5)	(3, 2)

Advertising Example 1

		Firm B	
		Advertise	Don't Advertise
Firm A	Advertise	(4, 3)	(5, 1)
	Don't Advertise	(2, 5)	(3, 2)

Advertising Example 1

What is the optimal strategy for Firm A if Firm B chooses to advertise?

		Firm B	
		Advertise	Don't Advertise
Firm A	Advertise	(4, 3)	(5, 1)
	Don't Advertise	(2, 5)	(3, 2)

Advertising Example 1

What is the optimal strategy for Firm A if Firm B chooses to advertise?

If Firm A chooses to advertise, the payoff is 4. Otherwise, the payoff is 2. The optimal strategy is to advertise.

		Firm B	
		Advertise	Don't Advertise
Firm A	Advertise	(4, 3)	(5, 1)
	Don't Advertise	(2, 5)	(3, 2)

Advertising Example 1

What is the optimal strategy for Firm A if Firm B chooses not to advertise?

		Firm B	
		Advertise	Don't Advertise
Firm A	Advertise	(4, 3)	(5, 1)
	Don't Advertise	(2, 5)	(3, 2)

Advertising Example 1

What is the optimal strategy for Firm A if Firm B chooses not to advertise?

If Firm A chooses to advertise, the payoff is 5. Otherwise, the payoff is 3. Again, the optimal strategy is to advertise.

		Firm B	
		Advertise	Don't Advertise
Firm A	Advertise	(4, 3)	(5, 1)
	Don't Advertise	(2, 5)	(3, 2)

Advertising Example 1

Regardless of what Firm B decides to do, the optimal strategy for Firm A is to advertise. The dominant strategy for Firm A is to advertise.

		Firm B	
		Advertise	Don't Advertise
Firm A	Advertise	(4, 3)	(5, 1)
	Don't Advertise	(2, 5)	(3, 2)

Advertising Example 1

What is the optimal strategy for Firm B if Firm A chooses to advertise?

		Firm B	
		Advertise	Don't Advertise
Firm A	Advertise	(4, 3)	(5, 1)
	Don't Advertise	(2, 5)	(3, 2)

Advertising Example 1

What is the optimal strategy for Firm B if Firm A chooses to advertise?

If Firm B chooses to advertise, the payoff is 3. Otherwise, the payoff is 1. The optimal strategy is to advertise.

		Firm B	
		Advertise	Don't Advertise
Firm A	Advertise	(4, 3)	(5, 1)
	Don't Advertise	(2, 5)	(3, 2)

Advertising Example 1

What is the optimal strategy for Firm B if Firm A chooses not to advertise?

		Firm B	
		Advertise	Don't Advertise
Firm A	Advertise	(4, 3)	(5, 1)
	Don't Advertise	(2, 5)	(3, 2)

Advertising Example 1

What is the optimal strategy for Firm B if Firm A chooses not to advertise?

If Firm B chooses to advertise, the payoff is 5. Otherwise, the payoff is 2. Again, the optimal strategy is to advertise.

		Firm B	
		Advertise	Don't Advertise
Firm A	Advertise	(4, 3)	(5, 1)
	Don't Advertise	(2, 5)	(3, 2)

Advertising Example 1

Regardless of what Firm A decides to do, the optimal strategy for Firm B is to advertise. The dominant strategy for Firm B is to advertise.

		Firm B	
		Advertise	Don't Advertise
Firm A	Advertise	(4, 3)	(5, 1)
	Don't Advertise	(2, 5)	(3, 2)

Advertising Example 1

The dominant strategy for Firm A is to advertise and the dominant strategy for Firm B is to advertise. The Nash equilibrium is for both firms to advertise.

		Firm B	
		Advertise	Don't Advertise
Firm A	Advertise	(4, 3)	(5, 1)
	Don't Advertise	(2, 5)	(3, 2)

TABLE 10-2 Payoff Matrix for the Advertising Game

		Firm B	
		Advertise	Don't Advertise
Firm A	Advertise	(4, 3)	(5, 1)
	Don't Advertise	(2, 5)	(6, 2)

Advertising Example 2

		Firm B	
		Advertise	Don't Advertise
Firm A	Advertise	(4, 3)	(5, 1)
	Don't Advertise	(2, 5)	(6, 2)

Advertising Example 2

What is the optimal strategy for Firm A if Firm B chooses to advertise?

		Firm B	
		Advertise	Don't Advertise
Firm A	Advertise	(4, 3)	(5, 1)
	Don't Advertise	(2, 5)	(6, 2)

Advertising Example 2

What is the optimal strategy for Firm A if Firm B chooses to advertise?

If Firm A chooses to advertise, the payoff is 4. Otherwise, the payoff is 2. The optimal strategy is to advertise.

		Firm B	
		Advertise	Don't Advertise
Firm A	Advertise	(4, 3)	(5, 1)
	Don't Advertise	(2, 5)	(6, 2)

Advertising Example 2

What is the optimal strategy for Firm A if Firm B chooses not to advertise?

		Firm B	
		Advertise	Don't Advertise
Firm A	Advertise	(4, 3)	(5, 1)
	Don't Advertise	(2, 5)	(6, 2)

Advertising Example 2

What is the optimal strategy for Firm A if Firm B chooses not to advertise?

If Firm A chooses to advertise, the payoff is 5. Otherwise, the payoff is 6. In this case, the optimal strategy is <u>not</u> to advertise.

		Firm B	
		Advertise	Don't Advertise
Firm A	Advertise	(4, 3)	(5, 1)
	Don't Advertise	(2, 5)	(6, 2)

Advertising Example 2

The optimal strategy for Firm A depends on which strategy is chosen by Firms B. Firm A does not have a dominant strategy.

		Firm B	
		Advertise	Don't Advertise
Firm A	Advertise	(4, 3)	(5, 1)
	Don't Advertise	(2, 5)	(6, 2)

Advertising Example 2

What is the optimal strategy for Firm B if Firm A chooses to advertise?

		Firm B	
		Advertise	Don't Advertise
Firm A	Advertise	(4, 3)	(5, 1)
	Don't Advertise	(2, 5)	(6, 2)

Advertising Example 2

What is the optimal strategy for Firm B if Firm A chooses to advertise?

If Firm B chooses to advertise, the payoff is 3. Otherwise, the payoff is 1. The optimal strategy is to advertise.

		Firm B	
		Advertise	Don't Advertise
Firm A	Advertise	(4, 3)	(5, 1)
	Don't Advertise	(2, 5)	(6, 2)

Advertising Example 2

What is the optimal strategy for Firm B if Firm A chooses not to advertise?

		Firm B	
		Advertise	Don't Advertise
Firm A	Advertise	(4, 3)	(5, 1)
	Don't Advertise	(2, 5)	(6, 2)

Advertising Example 2

What is the optimal strategy for Firm B if Firm A chooses not to advertise?

If Firm B chooses to advertise, the payoff is 5. Otherwise, the payoff is 2. Again, the optimal strategy is to advertise.

		Firm B	
		Advertise	Don't Advertise
Firm A	Advertise	(4, 3)	(5, 1)
	Don't Advertise	(2, 5)	(6, 2)

Advertising Example 2

Regardless of what Firm A decides to do, the optimal strategy for Firm B is to advertise. The dominant strategy for Firm B is to advertise.

		Firm B	
		Advertise	Don't Advertise
Firm A	Advertise	(4, 3)	(5, 1)
	Don't Advertise	(2, 5)	(6, 2)

Advertising Example 2

The dominant strategy for Firm B is to advertise. If Firm B chooses to advertise, then the optimal strategy for Firm A is to advertise. The Nash equilibrium is for both firms to advertise.

		Firm B	
		Advertise	Don't Advertise
Firm A	Advertise	(4, 3)	(5, 1)
	Don't Advertise	(2, 5)	(3, 2)

Prisoners' Dilemma

Two suspects are arrested for armed robbery. They are immediately separated. If convicted, they will get a term of 10 years in prison. However, the evidence is not sufficient to convict them of more than the crime of possessing stolen goods, which carries a sentence of only 1 year.

The suspects are told the following: If you confess and your accomplice does not, you will go free. If you do not confess and your accomplice does, you will get 10 years in prison. If you both confess, you will both get 5 years in prison.

TABLE 10-3 **Negative Payoff Matrix (Years of Detention) for Suspect A and Suspect B**

		Individual B	
		Confess	Don't Confess
Individual A	Confess	(5, 5)	(0, 10)
	Don't Confess	(10, 0)	(1, 1)

Prisoners' Dilemma

Payoff Matrix (negative values)

		Individual B	
		Confess	Don't Confess
Individual A	Confess	(5, 5)	(0, 10)
	Don't Confess	(10, 0)	(1, 1)

Prisoners' Dilemma

Dominant Strategy
Both Individuals Confess

(Nash Equilibrium)

		Individual B	
		Confess	Don't Confess
Individual A	Confess	(5, 5)	(0, 10)
	Don't Confess	(10, 0)	(1, 1)

TABLE 10-4 Payoff Matrix for a Pricing Game

		Firm B	
		Low Price	High Price
Firm A	Low Price	(2, 2)	(5, 1)
	High Price	(1, 5)	(3, 3)

Prisoners' Dilemma

Application: Price Competition

		Firm B	
		Low Price	High Price
Firm A	Low Price	(2, 2)	(5, 1)
	High Price	(1, 5)	(3, 3)

Prisoners' Dilemma

Application: Price Competition

Dominant Strategy: Low Price

		Firm B	
		Low Price	High Price
Firm A	Low Price	(2, 2)	(5, 1)
	High Price	(1, 5)	(3, 3)

Prisoners' Dilemma

Application: Nonprice Competition

		Firm B	
		Advertise	Don't Advertise
Firm A	Advertise	(2, 2)	(5, 1)
	Don't Advertise	(1, 5)	(3, 3)

Prisoners' Dilemma

Application: Nonprice Competition

Dominant Strategy: Advertise

		Firm B	
		Advertise	Don't Advertise
Firm A	Advertise	(2, 2)	(5, 1)
	Don't Advertise	(1, 5)	(3, 3)

Prisoners' Dilemma

Application: Cartel Cheating

		Firm B	
		Cheat	Don't Cheat
Firm A	Cheat	(2, 2)	(5, 1)
	Don't Cheat	(1, 5)	(3, 3)

Prisoners' Dilemma

Application: Cartel Cheating

Dominant Strategy: Cheat

		Firm B	
		Cheat	Don't Cheat
Firm A	Cheat	(2, 2)	(5, 1)
	Don't Cheat	(1, 5)	(3, 3)

Extensions of Game Theory

- Repeated Games
  - Many consecutive moves and countermoves by each player
- Tit-for-Tat Strategy
  - Do to your opponent what your opponent has just done to you

Extensions of Game Theory

- Tit-for-Tat Strategy
  - Stable set of players
  - Small number of players
  - Easy detection of cheating
  - Stable demand and cost conditions
  - Game repeated a large and uncertain number of times

Extensions of Game Theory

- Threat Strategies
  - Credibility
  - Reputation
  - Commitment
  - Example: Entry deterrence

TABLE 10-5 Payoff Matrix for Pricing Game with a Threat

		Firm B	
		Low Price	High Price
Firm A	Low Price	(2, 2)	(2, 1)
	High Price	(3, 4)	(5, 3)

TABLE 10-6 Payoff Matrix without Credible Entry Deterrence

		Firm B	
		Enter	Do Not Enter
Firm A	Low Price	(4, –2)	(6, 0)
	High Price	(7, 2)	(10, 0)

TABLE 10-7 Payoff Matrix with Credible Entry Deterrence

		Firm B	
		Enter	Do Not Enter
Firm A	Low Price	(4, –2)	(6, 0)
	High Price	(3, 2)	(8, 0)

Entry Deterrence

No Credible Entry Deterrence

		Firm B	
		Enter	Do Not Enter
Firm A	Low Price	(4, -2)	(6, 0)
	High Price	(7, 2)	(10, 0)

Credible Entry Deterrence

		Firm B	
		Enter	Do Not Enter
Firm A	Low Price	(4, -2)	(6, 0)
	High Price	(3, 2)	(8, 0)

Entry Deterrence

No Credible Entry Deterrence

		Firm B	
		Enter	Do Not Enter
Firm A	Low Price	(4, -2)	(6, 0)
	High Price	(7, 2)	(10, 0)

Credible Entry Deterrence

		Firm B	
		Enter	Do Not Enter
Firm A	Low Price	(4, -2)	(6, 0)
	High Price	(3, 2)	(8, 0)

TABLE 10-8 Two-Firm Competition and Strategic Trade Policy

		Airbus	
		Produce	Don't Produce
Boeing	Produce	(−10, −10)	(100, 0)
	Don't Produce	(0, 100)	(0, 0)

International Competition

Boeing Versus Airbus Industrie

		Airbus	
		Produce	Don't Product
Boeing	Produce	(-10, -10)	(100, 0)
	Don't Produce	(0, 100)	(0, 0)

Sequential Games

- Sequence of moves by rivals
- Payoffs depend on entire sequence
- Decision trees
  - Decision nodes
  - Branches (alternatives)
- Solution by reverse induction
  - From final decision to first decision

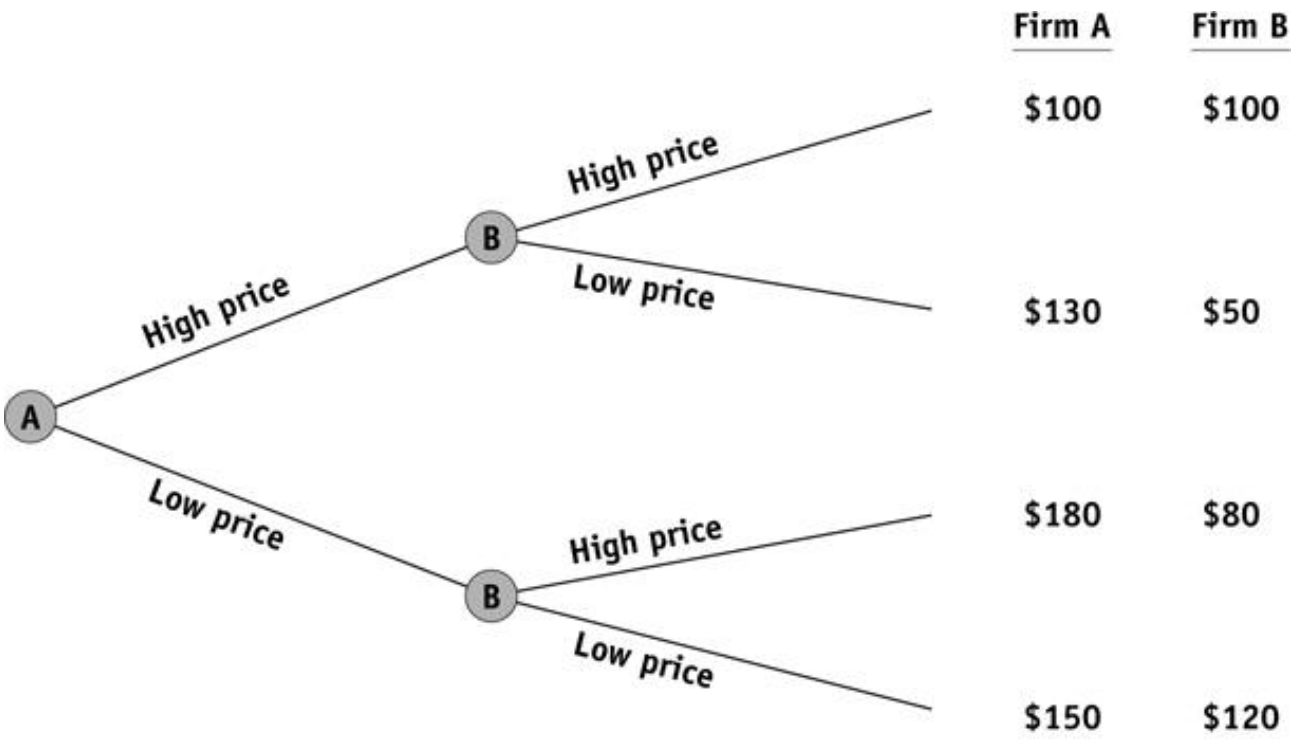
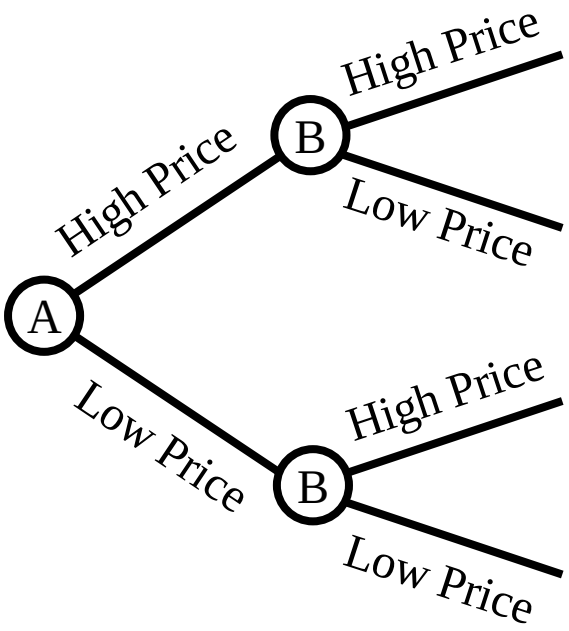


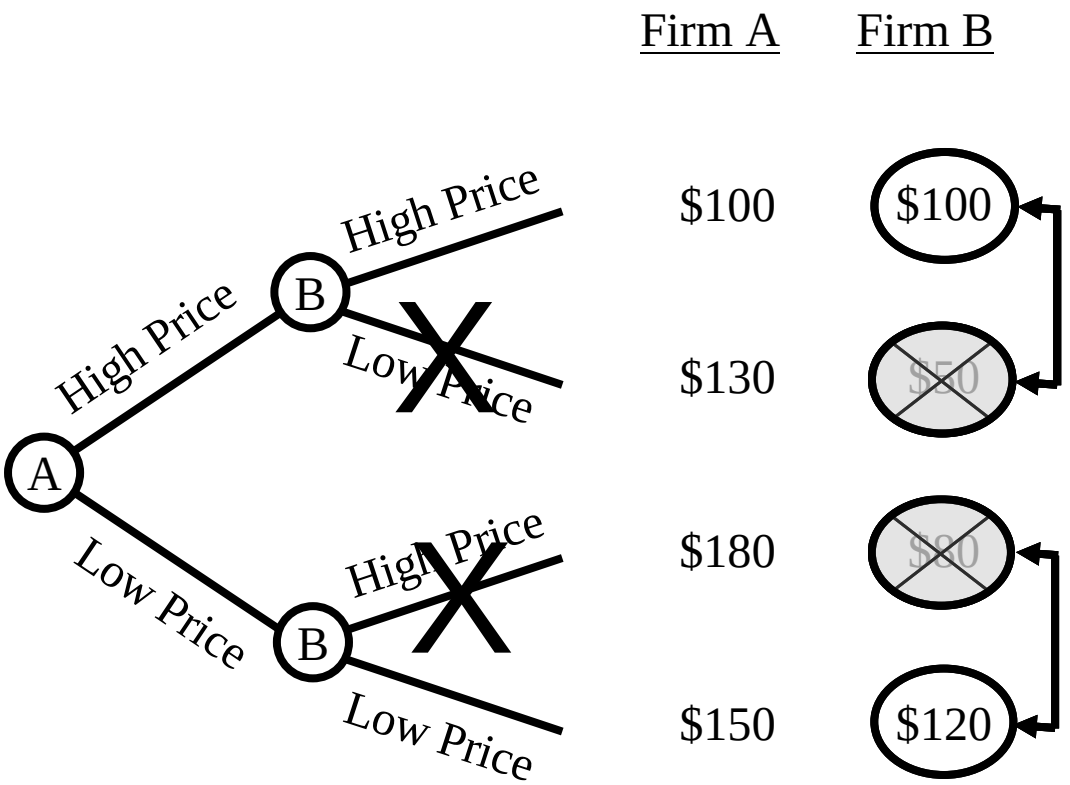
FIGURE 10-1 High-Price, Low-Price Strategy Game The strategy or highest payoff for firm A is to adopt a low-price strategy (the bottom branch node) rather than a high-price strategy (the top branch node). Given firm A's decision, firm B's best payoff is to also adopt a low-price strategy.

High-Price, Low-Price Strategy Game

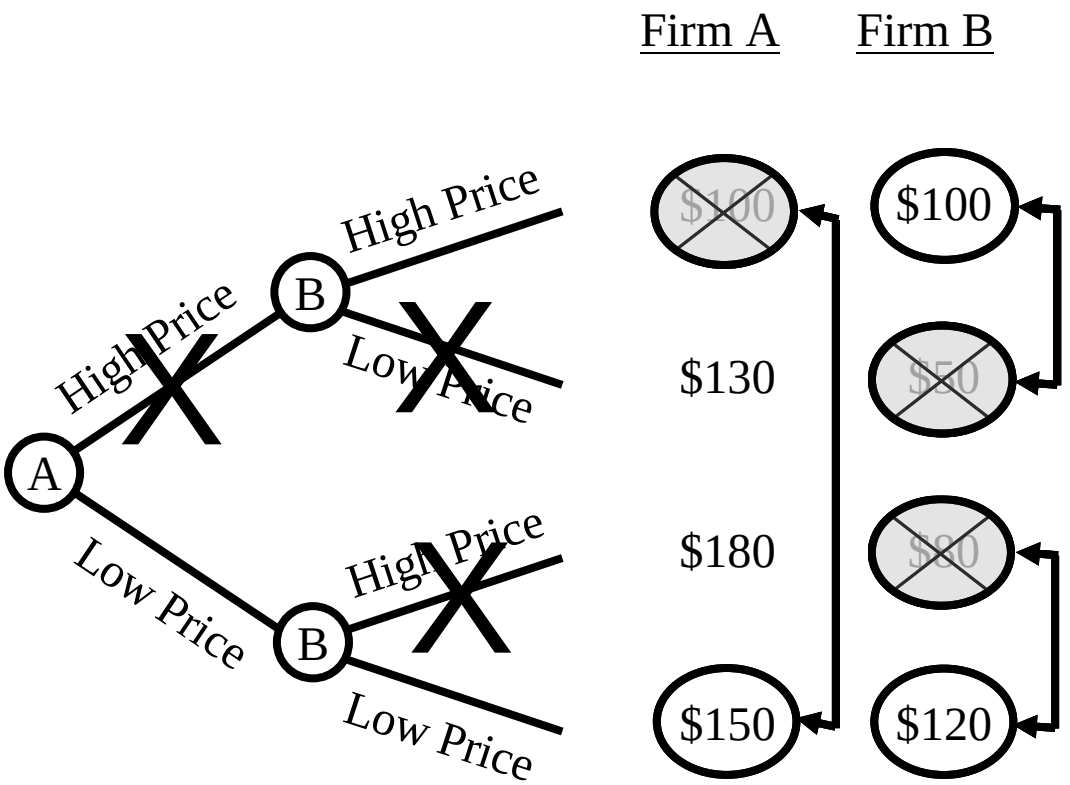


	Firm A	Firm B
High Price, High Price	$100	$100
High Price, Low Price	$130	$50
Low Price, High Price	$180	$80
Low Price, Low Price	$150	$120

High-Price, Low-Price Strategy Game



High-Price, Low-Price Strategy Game



Solution: Both firms choose low price.

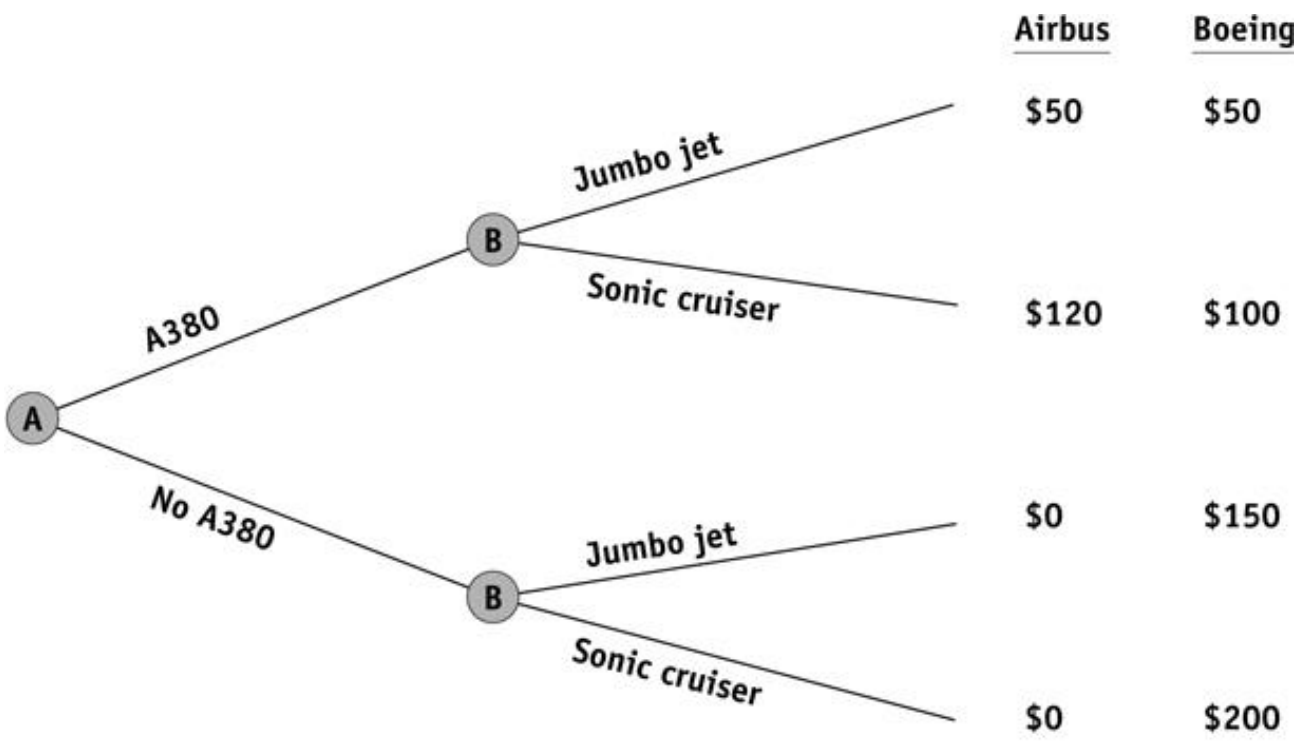


FIGURE 10-2 Airbus's Strategic Decision to Build the A380 and Boeing's Sonic Cruiser Response The best payoff for Airbus is to build the A380 (the top branch node) rather than not to build it (the bottom branch node). Given Airbus's decision, Boeing's best payoff is to build the sonic cruiser.

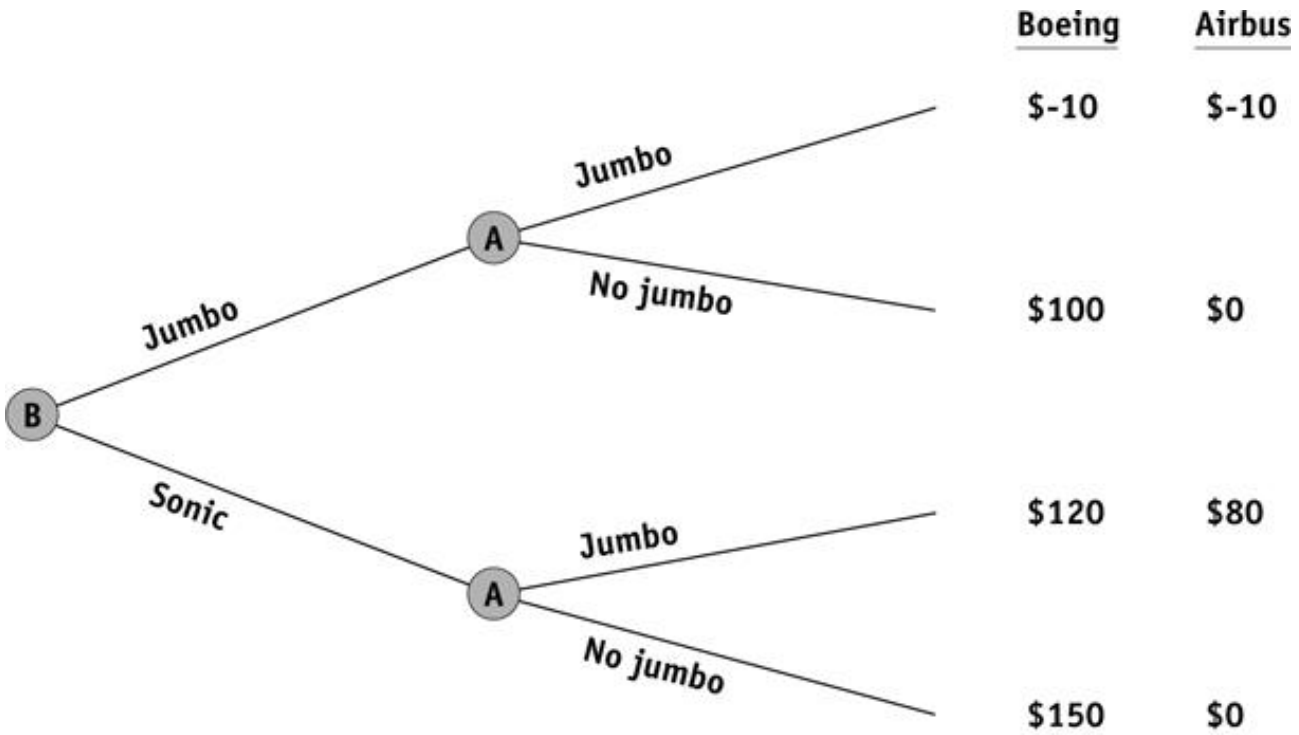
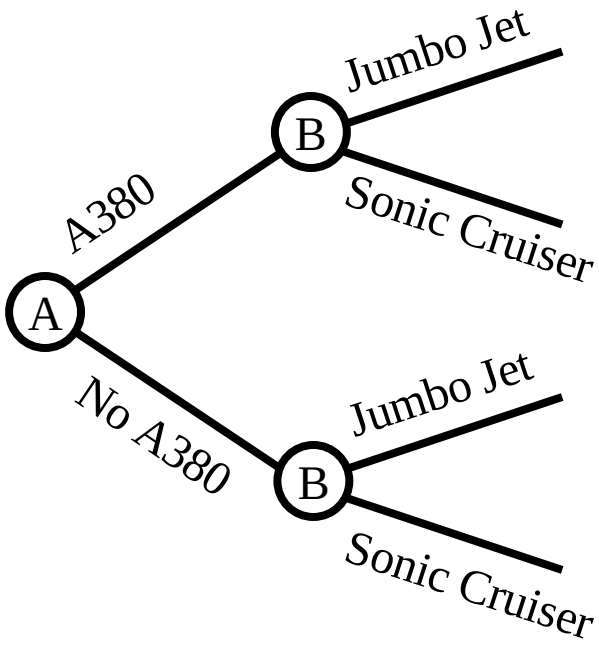


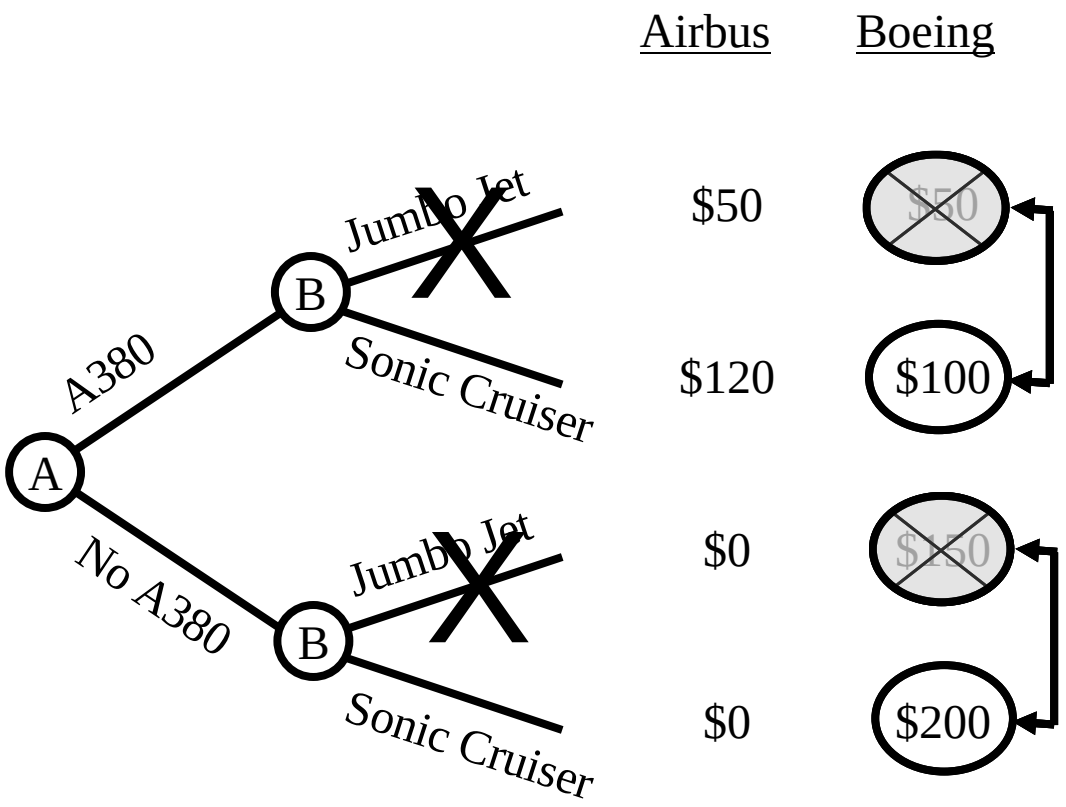
FIGURE 10-3

Airbus and Boeing

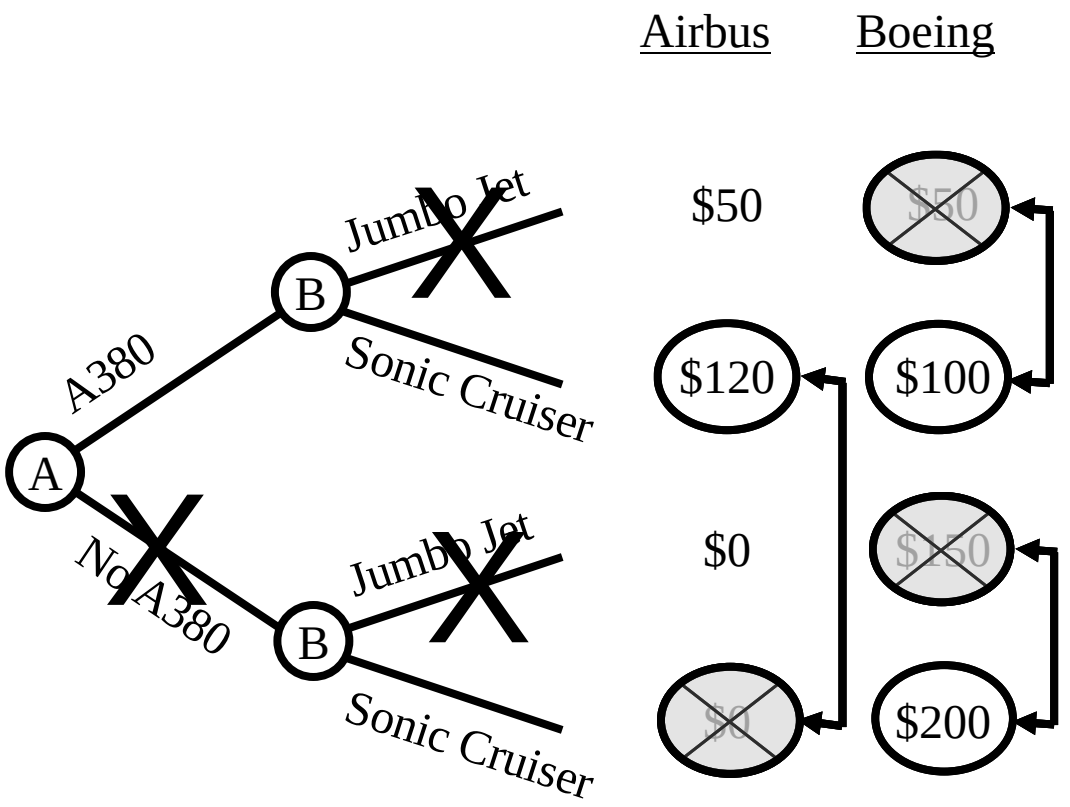


	Airbus	Boeing
Jumbo Jet	$50	$50
Sonic Cruiser	$120	$100
Jumbo Jet	$0	$150
Sonic Cruiser	$0	$200

Airbus and Boeing



Airbus and Boeing



Solution: Airbus builds A380 and Boeing builds Sonic Cruiser.

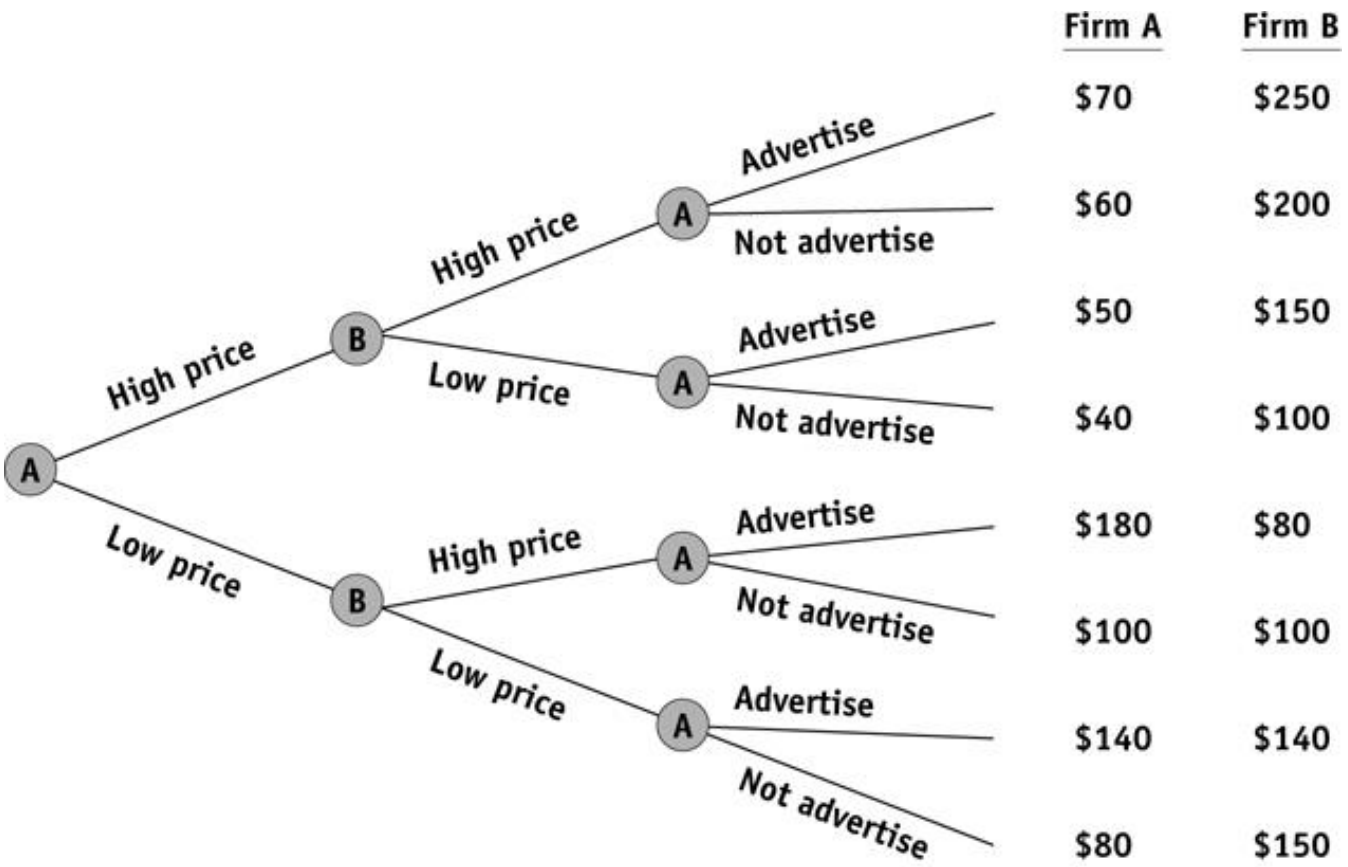


FIGURE 10-4