

# Chapter Objectives

- Explain the conditions that will result in locational arbitrage and the realignments that will follow.
- Explain the conditions that will result in triangular arbitrage and the realignments that will follow.
- Explain the conditions that will result in covered interest arbitrage and the realignments that will follow.
- Explain the concept of interest rate parity.
- Explain the variation in forward rate premiums across maturities and over time.

# International Arbitrage (1 of 7)

Defined as capitalizing on a discrepancy in quoted prices by making a riskless profit.

Arbitrage will cause prices to realign

Three forms of arbitrage:

- Locational arbitrage
- Triangular arbitrage
- Covered interest arbitrage

# International Arbitrage (2 of 7)

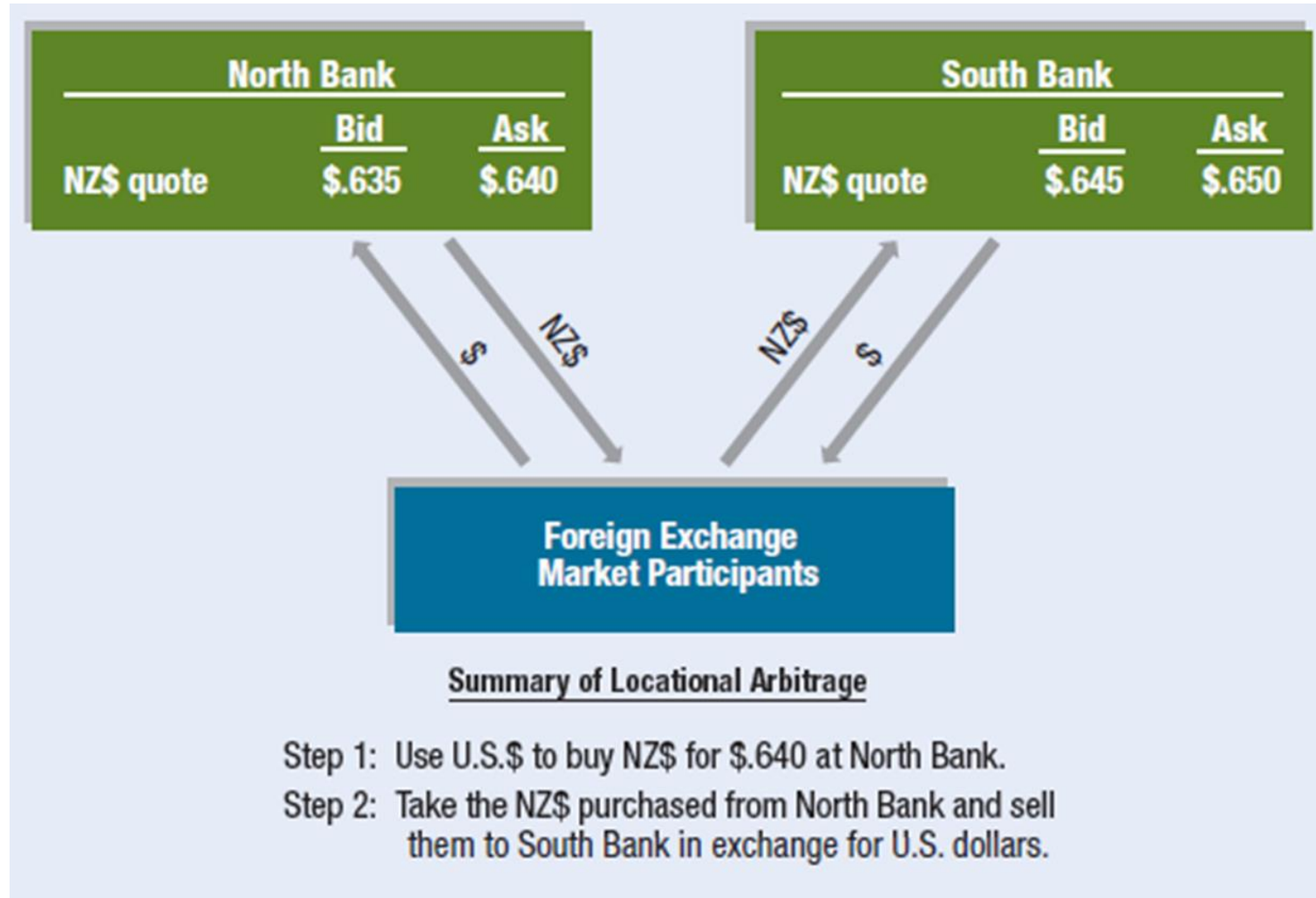
## Locational Arbitrage

- Defined as the process of buying a currency at the location where it is priced cheap and immediately selling it at another location where it is priced higher. (See Exhibit 7.1)
- **Gains from locational arbitrage** are based on the amount of money used and the size of the discrepancy. (See Exhibit 7.2)
- **Realignment due to locational arbitrage** drives prices to adjust in different locations so as to eliminate discrepancies.

# Exhibit 7.1 Currency Quotes for Locational Arbitrage Example

	<b>AKRON BANK in BID</b>	<b>AKRON BANK in ASK</b>		<b>ZYN BANK in BID</b>	<b>ZYN BANK in ASK</b>
British pound	\$1.60	\$1.61	British pound	\$1.61	\$1.62

# Exhibit 7.2 Locational Arbitrage

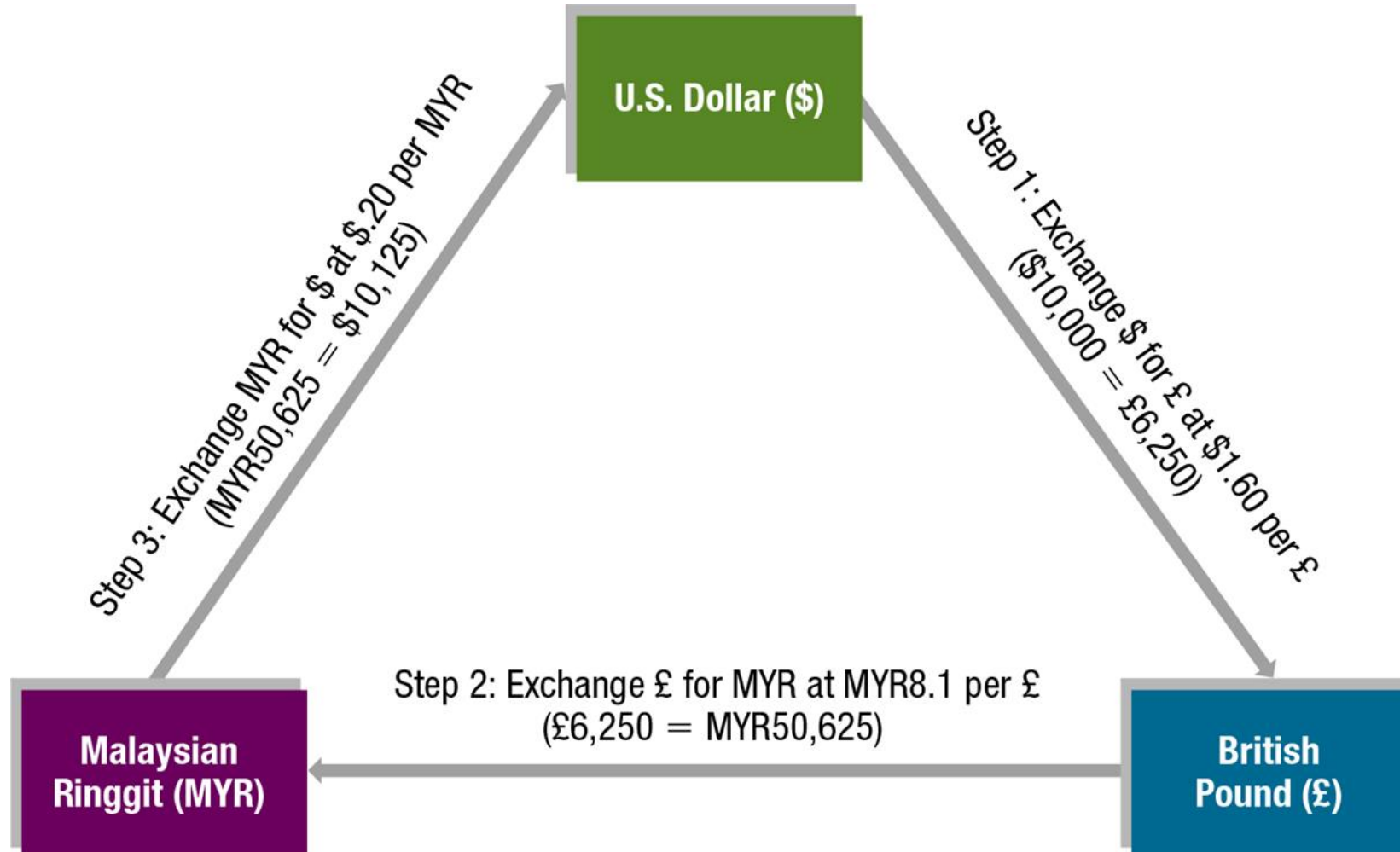


# International Arbitrage (3 of 7)

## Triangular Arbitrage

- Defined as currency transactions in the spot market to capitalize on discrepancies in the cross exchange rates between two currencies. (See Exhibits 7.3, 7.4, & 7.5)
- **Gains from triangular arbitrage:** Currency transactions are conducted in the spot market to capitalize on the discrepancy in the cross exchange rate between two countries.
- **Accounting for the Bid/Ask Spread:** Transaction costs (bid/ask spread) can reduce or even eliminate the gains from triangular arbitrage.
- **Realignment due to triangular arbitrage** forces exchange rates back into equilibrium. (See Exhibit 7.6)

# Exhibit 7.3 Example of Triangular Arbitrage

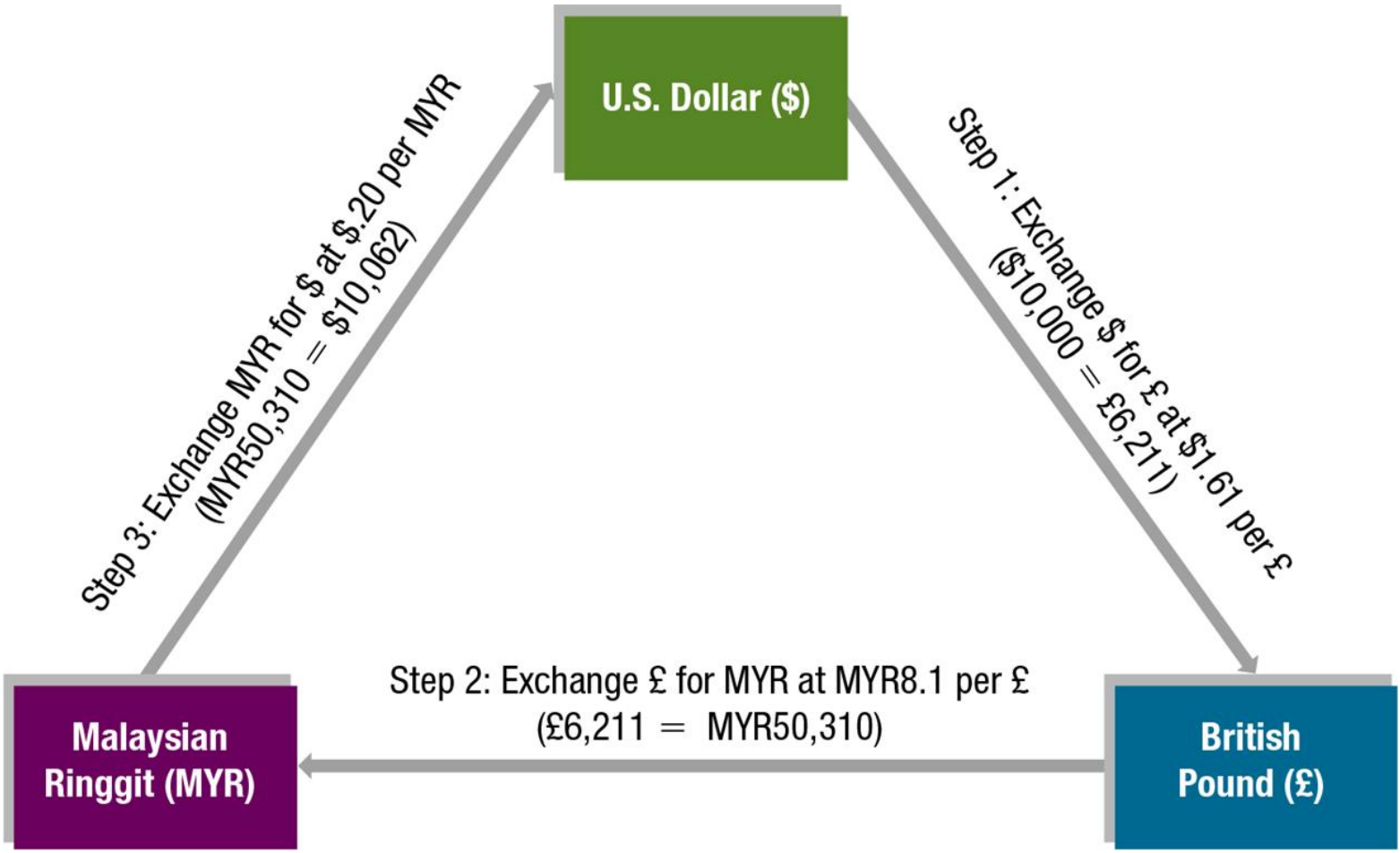


# Exhibit 7.4 Currency Quotes for a Triangular Arbitrage Example with Transaction Costs

	<b>QUOTED BID PRICE</b>	<b>QUOTED ASK PRICE</b>
Value of a British pound in U.S. dollars	\$1.60	\$1.61
Value of a Malaysian ringgit (MYR) in U.S. dollars	\$.200	\$.201
Value of a British pound in Malaysian ringgit (MYR)	MYR8.10	MYR8.20



# Exhibit 7.5 Example of Triangular Arbitrage Accounting for Bid/Ask Spreads



# Exhibit 7.6 Impact of Triangular Arbitrage

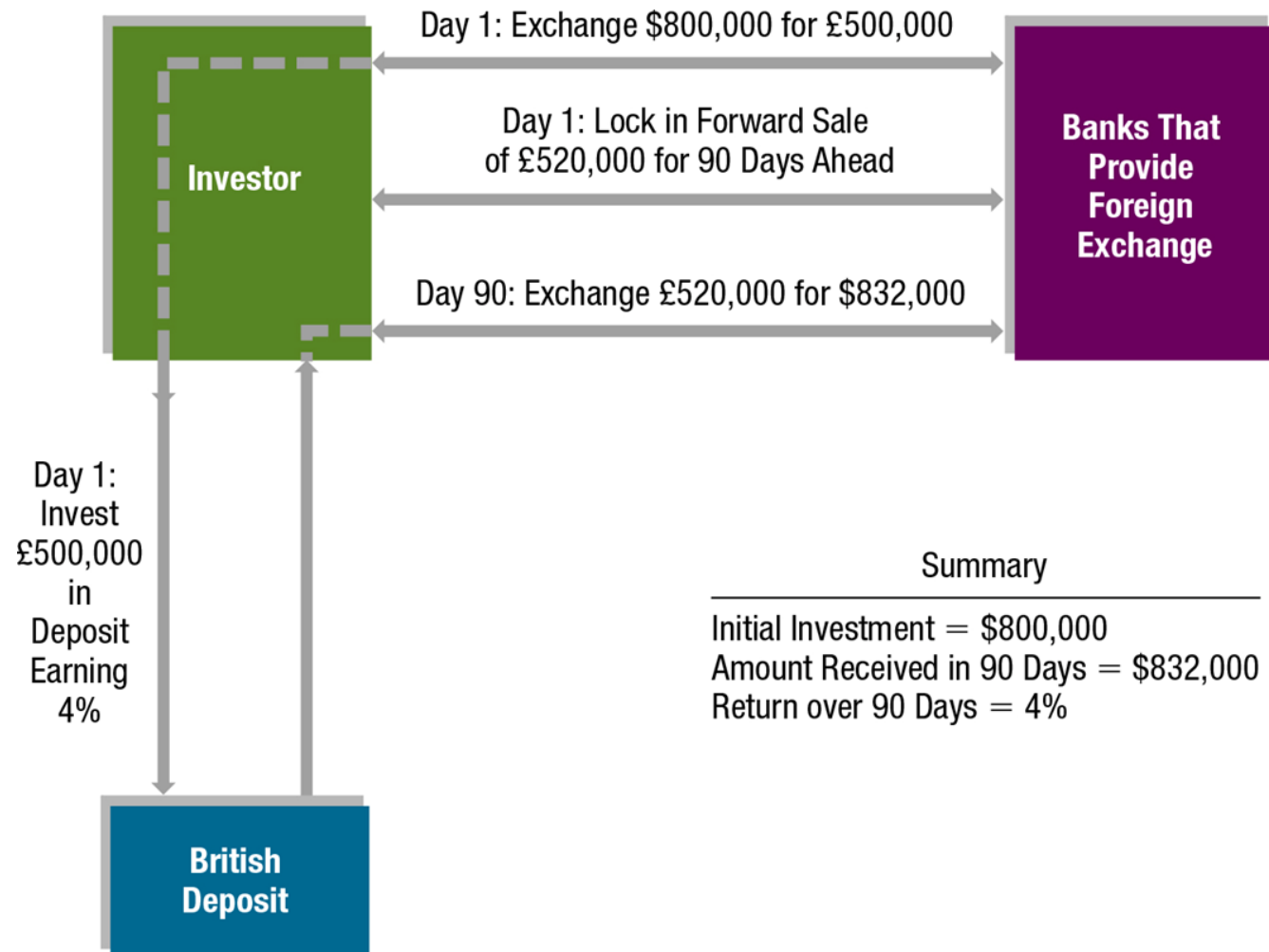
ACTIVITY	IMPACT
1. Participants use dollars to purchase pounds.	Bank increases its ask price of pounds with respect to the dollar.
2. Participants use pounds to purchase Malaysian ringgit.	Bank reduces its bid price of the British pound with respect to the ringgit; that is, it reduces the number of ringgit to be exchanged per pound received.
3. Participants use Malaysian ringgit to purchase U.S. dollars.	Bank reduces its bid price of ringgit with respect to the dollar.

# International Arbitrage (4 of 7)

## Covered Interest Arbitrage Process

- **Steps involved in covered interest arbitrage**
  - Defined as the process of capitalizing on the interest rate differential between two countries while covering your exchange rate risk with a forward contract.
  - Consists of two parts: (Exhibit 7.7)
    - Interest arbitrage: the process of capitalizing on the difference between interest rates between two countries.
    - Covered: hedging the position against interest rate risk.
- **Realignment due to covered interest arbitrage** causes market realignment.
- **Timing of realignment** may require several transactions before realignment is completed.

# Exhibit 7.7 Example of Covered Interest Arbitrage



# International Arbitrage (5 of 7)

## Covered Interest Arbitrage (continued)

### Realignment is focused on the forward rate

- the forward rate is likely to experience most if not all of the adjustment needed to achieve realignment.

### Arbitrage Example When Accounting for Spreads

- Investor must account for the effects of the spread between the bid and ask quotes and of the spread between deposit and loan rates.

### Covered interest arbitrage by Non-U.S. investors

- The concept of covered interest arbitrage applies to any two countries for which there is a spot rate and a forward rate between their currencies as well as risk-free interest rates quoted for both currencies.

# International Arbitrage (6 of 7)

## Comparison of Arbitrage Effects (Exhibit 7.8)

- The threat of locational arbitrage ensures that quoted exchange rates are similar across banks in different locations.
- The threat of triangular arbitrage ensures that cross exchange rates are properly set.
- The threat of covered interest arbitrage ensures that forward exchange rates are properly set. Any discrepancy will trigger arbitrage, which should eliminate the discrepancy.
- Thus, arbitrage tends to allow for a more orderly foreign exchange market.

# International Arbitrage (7 of 7)

## Comparison of Arbitrage Effects (continued)

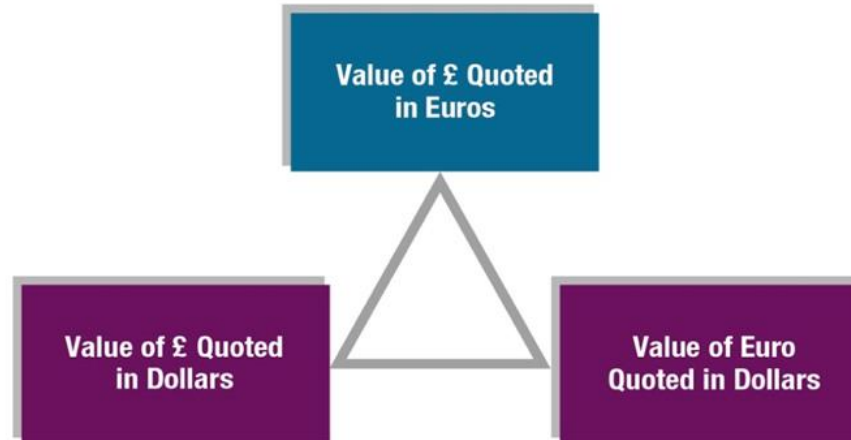
- **How arbitrage reduces transaction costs**
  - Locational arbitrage limits the differences in a spot exchange rate quotation across locations, while covered interest arbitrage ensures that the forward rate is properly priced. Thus, an MNC's managers should be able to avoid excessive transaction costs.

# Exhibit 7.8 Comparing Arbitrage Strategies

**Locational Arbitrage:** Capitalizes on discrepancies in exchange rates across locations.



**Triangular Arbitrage:** Capitalizes on discrepancies in cross exchange rates.



**Covered Interest Arbitrage:** Capitalizes on discrepancies between the forward rate and the interest rate differential.





# Interest Rate Parity (1 of 6)

In equilibrium, the forward rate differs from the spot rate by a sufficient amount to offset the interest rate differential between two currencies.

## Derivation of Interest Rate Parity

$$p = \frac{1 + i_h}{1 + i_f} - 1$$

where

$p$  = forward premium

$i_h$  = home interest rate

$i_f$  = foreign interest rate

# Interest Rate Parity (2 of 6)

## Derivation of Interest Rate Parity (continued)

The investor's return from using this strategy can be calculated from the following information:

- The amount of the home currency that is initially invested ( $A_h$ )
- The spot rate ( $S$ ) in dollars when the foreign currency is purchased
- The interest rate on the foreign deposit ( $i_f$ )
- The forward rate ( $F$ ) in dollars at which the foreign currency will be converted back to U.S. dollars

# Interest Rate Parity (3 of 6)

## Determining the Forward Premium

- **Effect of the interest rate differential:** The relationship between the forward premium (or discount) and the interest rate differential according to I RP is simplified in an approximated form:

where

$p$  = forward premium (or discount)

$F$  = forward rate in dollars

$S$  = spot rate in dollars

$i_h$  = home interest rate

$i_f$  = foreign interest rate

$$p = \frac{F - S}{S} \cong i_h - i_f$$

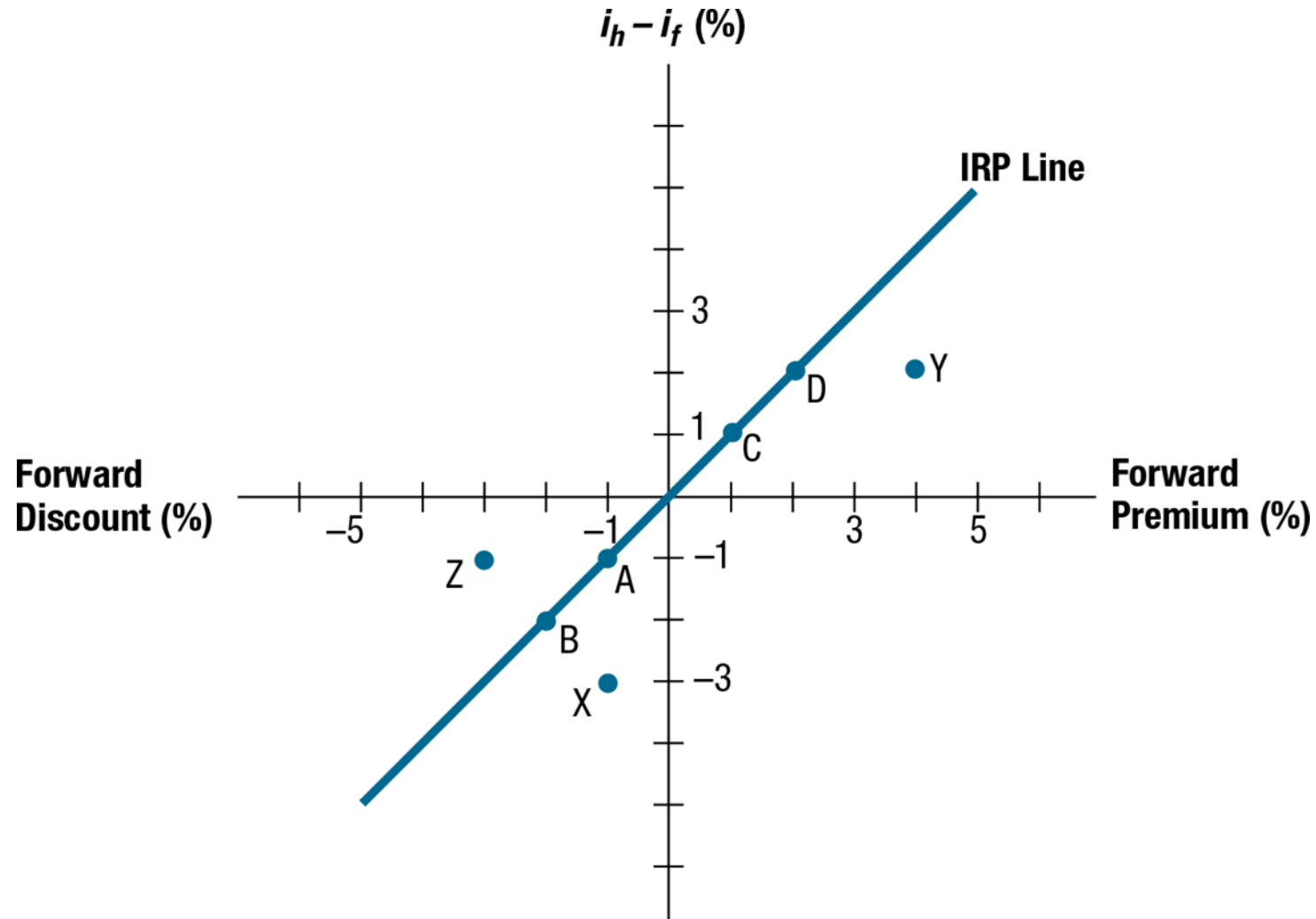
- **Implications:** If the forward premium is equal to the interest rate differential as just described, then covered interest arbitrage will not be feasible.

# Interest Rate Parity (4 of 6)

## Graphic Analysis of Interest Rate Parity (Exhibit 7.9)

- **Points representing a discount:** *points A and B*
- **Points representing a premium:** *points C and D*
- **Points representing IRP:** *points A, B, C, D*
- **Points below the IRP line:** *points X and Y*
  - Investors can engage in covered interest arbitrage and earn a higher return by investing in foreign currency after considering foreign interest rate and forward premium or discount.
- **Points above the IRP line:** *point Z*
  - U.S. investors would achieve a lower return on a foreign investment than on a domestic one.

# Exhibit 7.9 Illustration of Interest Rate Parity



# Interest Rate Parity (5 of 6)

## Does Interest Rate Parity Hold?

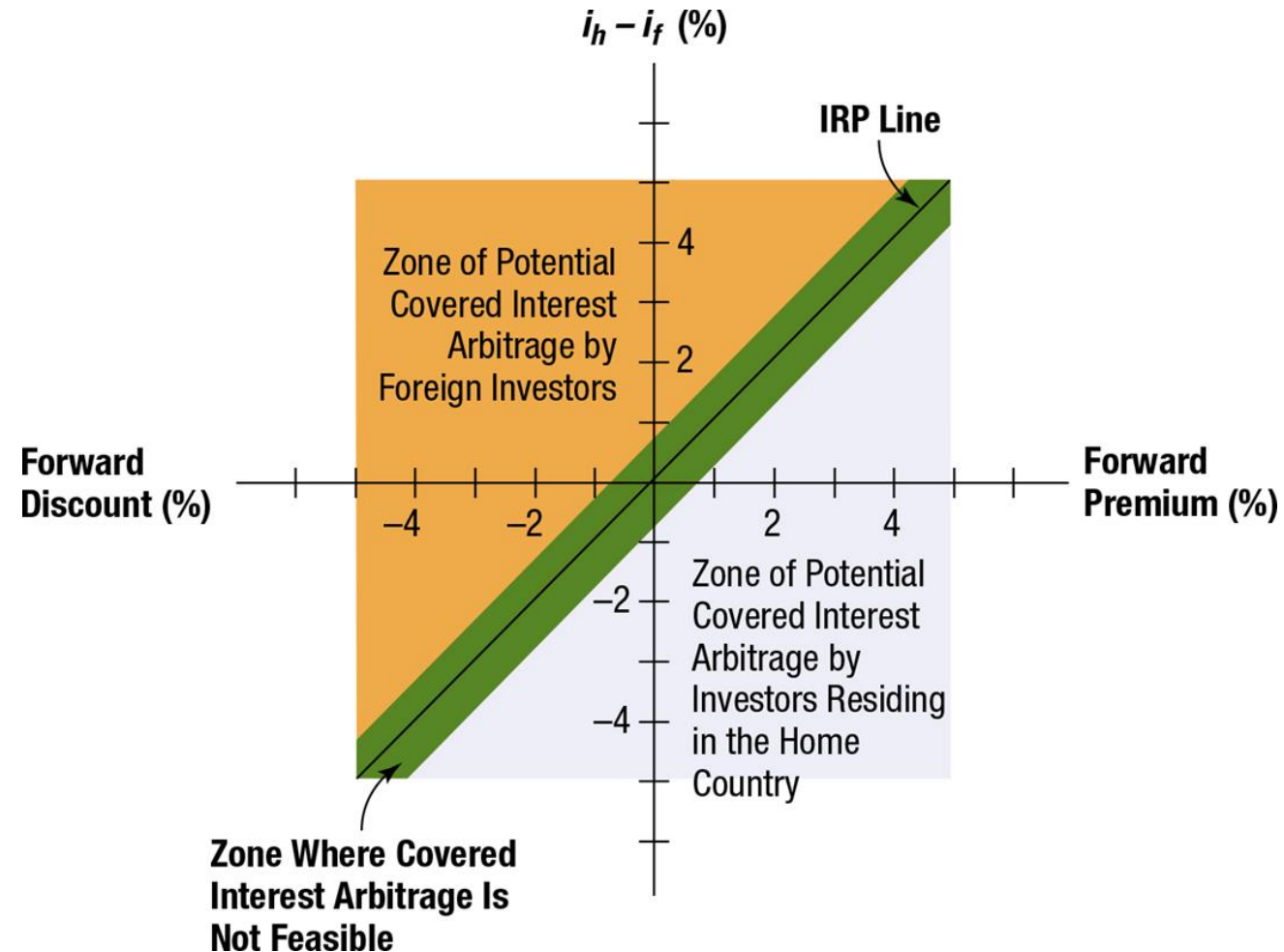
- Compare the forward rate (or discount) with interest rate quotations occurring at the same time. Due to limitations in access to data, it is difficult to obtain quotations that reflect the same point in time.

# Interest Rate Parity (6 of 6)

## Considerations When Assessing Interest Rate Parity

- **Transaction costs**
  - The actual point reflecting the interest rate differential and forward rate premium must be farther from the IRP line to make covered interest arbitrage worthwhile. (See Exhibit 7.10)
- **Political risk**
  - A crisis in the foreign country could cause its government to restrict any exchange of the local currency for other currencies.
- **Differential tax laws**
  - Covered interest arbitrage might be feasible when considering before-tax returns but not necessarily when considering after-tax returns.

# Exhibit 7.10 Potential for Covered Interest Arbitrage When Considering Transaction Costs





# Variation in Forward Premiums (1 of 2)

At any time, the forward premium varies among maturities for any particular currency. In addition, the forward premium of a particular currency with a particular maturity date varies over time.

## **Forward Premiums across Maturities (Exhibit 7.11)**

- The annualized interest rate differential between two countries can vary among debt maturities, and so will the annualized

# Variation in Forward Premiums (2 of 2)

## Changes in Forward Premiums over Time

- The formula forward rate is written as follows:

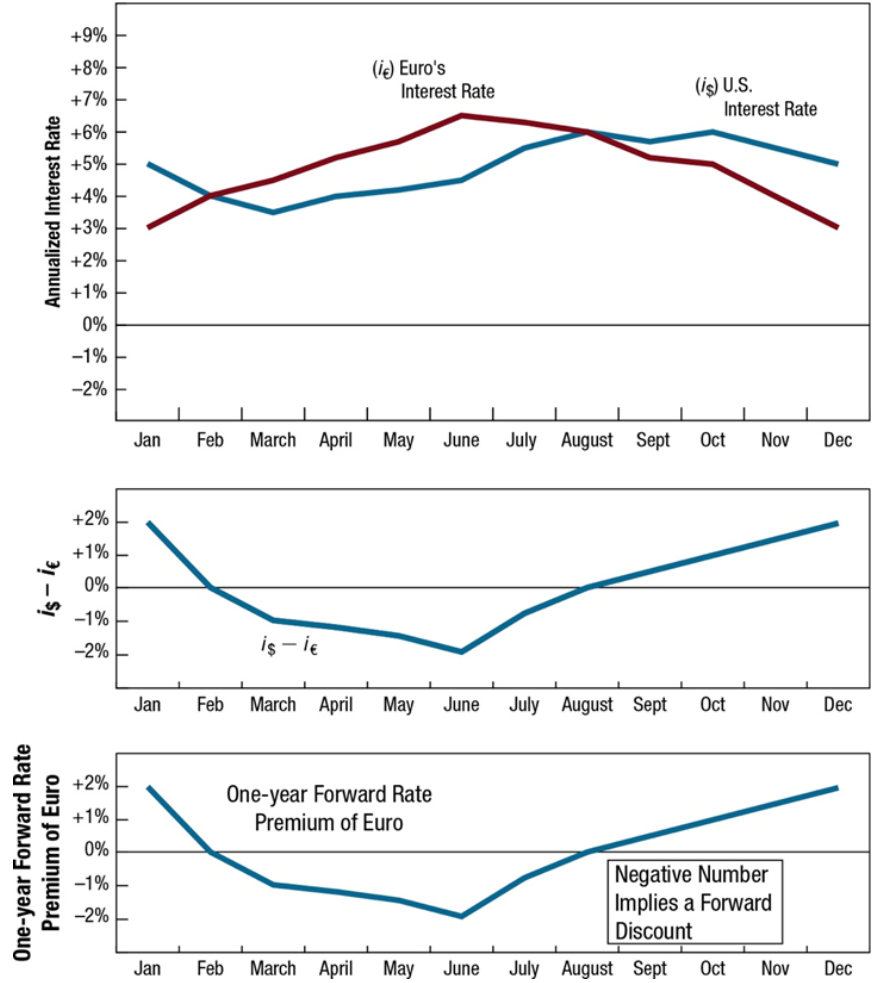
$$F = S(1 + p)$$

- Exhibit 7.12 illustrates the relationship between interest rate differentials and the forward premium over time, when interest rate parity holds. The forward premium must adjust to existing interest rate conditions if interest rate parity holds.
- The forward rate is indirectly affected by all the factors that can affect the spot rate ( $S$ ) over time, including inflation differentials, interest rate differentials, etc. The change in the forward rate can also be due to a change in the premium.

# Exhibit 7.11 Quoted Interest Rates for Various Times to Maturity

<b>TIME TO MATURITY</b>	<b>U.S. INTEREST (ANNUALIZED) QUOTED TODAY</b>	<b>EURO INTEREST (ANNUALIZED) QUOTED TODAY</b>	<b>INTEREST RATE DIFFERENTIAL (ANNUALIZED) BASED ON TODAY'S QUOTES</b>	<b>APPROXIMATE FORWARD RATE PREMIUM (ANNUALIZED) OF EURO AS OF TODAY IF IRP HOLDS</b>
30 days	4.0%	5.0%	-1.0%	-1.0%
90 days	4.5	5.0	-.5	-.5
180 days	5.0	5.0	.0	.0
1 year	5.5	5.0	+.5	+.5
2 years	6.0	5.0	+1.0	+1.0

# Exhibit 7.12 Relationship over Time between the Interest Rate Differential and the Forward Premium



# Summary (1 of 4)

- Locational arbitrage may occur if foreign exchange quotations differ among banks. The act of locational arbitrage should force the foreign exchange quotations of banks to become realigned, after which locational arbitrage will no longer be possible.
- Triangular arbitrage is related to cross exchange rates. A cross exchange rate between two currencies is determined by the values of these two currencies with respect to a third currency. If the actual cross exchange rate of these two currencies differs from the rate that should exist, triangular arbitrage is possible. The act of triangular arbitrage should force cross exchange rates to become realigned, at which time triangular arbitrage will no longer be possible.

# Summary (2 of 4)

- Covered interest arbitrage is based on the relationship between the forward rate premium and the interest rate differential. The size of the premium or discount exhibited by the forward rate of a currency should be about the same as the differential between the interest rates of the two countries of concern. In general terms, the forward rate of the foreign currency will contain a discount (premium) if its interest rate is higher (lower) than the U.S. interest rate.
- If the forward premium deviates substantially from the interest rate differential, then covered interest arbitrage is possible. In this type of arbitrage, a short-term investment in some foreign currency is covered by a forward sale of that foreign currency in the future. In this manner, the investor is not exposed to fluctuation in the foreign currency's value.

# Summary (3 of 4)

- According to the theory of interest rate parity (IRP), the size of the forward premium (or discount) should be equal to the interest rate differential between the two countries of concern. If IRP holds then covered interest arbitrage is not feasible, because any interest rate advantage in the foreign country will be offset by the discount on the forward rate. Thus, covered interest arbitrage would not generate higher returns than would be generated by a domestic investment.

# Summary (4 of 4)

- Since the forward premium of a currency (from a U.S. perspective) is influenced both by the interest rate of that currency and by the U.S. interest rate, and since those interest rates change over time, it follows that the forward premium changes over time. Thus, a forward premium that is large and positive in one period, when the interest rate of that currency is relatively low, could become negative (reflecting a discount) if its interest rate rises above the U.S. level.